ABSTRACT BOOK

2021

VIII SBGEA

Simpósio Brasileiro de Geofísica Espacial e Aeronomia

& VIII SIMFAST

Simpósio de Física e Astronomia do Vale do Paraíba

22 a 26

de março | 2021

UNIVAP - São José dos Campos/SP - Brasil

VIII SBGEA & VIII SIMFAST

Simpósio Brasileiro de Geofísica Espacial e Aeronomia

Simpósio de Física e Astronomia do Vale do Paraíba

O Simpósio Brasileiro de Geofísica Espacial e Aeronomia (SBGEA) é um evento científico promovido pela Associação Brasileira de Geofísica Espacial e Aeronomia, e que acontece desde 2006. A oitava edição (VIII SBGEA) do simpósio será realizada em conjunto com a oitava edição do Simpósio de Física e Astronomia do Vale Paraíba (VIII SimFAST), um evento organizado anualmente pelos discentes do Programa de Pós-Graduação em Física e Astronomia da Universidade do Vale do Paraíba (UNIVAP).

O evento será uma oportunidade única para que a comunidade científica da área de Geofísica Espacial e Aeronomia, bem como das diferentes áreas de pesquisa da Física e Astronomia, possam divulgar e discutir seus trabalhos diante de uma plateia multidisciplinar.

Um objetivo importante da reunião da SBGEA & SimFAST é facilitar a comunicação entre estudantes e professores/pesquisadores, promovendo um intercâmbio frutífero de ideias e experiências.

http://www.univap.br/sbgea-simfast

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Scientific Sessions

Ionosphere: Earth and Other Planets

Chairs: Paulo A.B. Nogueira(IFSP), Fabiano S. Rodrigues(The University of Texas at Dallas), Laysa C.A. Resende(CAS/INPE)

Physics and Chemistry of the Neutral Atmosphere

Chairs: José V. Bageston(CRS/INPE), Pierre-Dominique Pautet(Utah State University), Mauricio J.A. Bolzam(UFG)

Space Weather and Sun-Earth Connections

Chairs: Alisson D. Lago(INPE), José H. Fernandez(UFRN), Clezio M. De Nardin(INPE)

Physics of Plasmas

Chairs: Rodrigo A.M. Cerda(UNB), Pablo R.M. Gutberlet(Universidad de La Serena), Marco A.R. Ramos(UNIVAP)

Solar Physics, Interplanetary Medium and Planetary Magnetospheres

Chairs: Jean-Pierre Raulin(UPM), Jean C. Santos(UTFPR), Marcos V.D. Silveira(GSFC/NASA; CUA)

Astronomy and Astrophysics

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Special Sessions

Women in Geosciences and Astronomy

Chairs: Alessandra A. Pacini(NWRA), Vânia F.A.N. Silva(CAS/INPE)

INCT GNSS NavAer: Integrating Space Weather, Geodesy and Air Navigation

Chairs: João F.G. Monico(UNESP), Eurico de Paula(INPE)

Preface

The Brazilian Symposium on Space Geophysics and Aeronomy (SBGEA) is a scientific event that has taken place since 2006. The SBGEA in our biennial series is organized by the Brazilian Association of Space Geophysics and Aeronomy. This year the eighth edition (VIII SBGEA) of the symposium will be held in conjunction with the 8th Symposium on Physics and Astronomy (VIII SimFAST), an event organized annually by the Graduate Program in Physics and Astronomy at University of Vale do Paraíba (UNIVAP).

Due to the COVID-19 pandemic, these events primarily scheduled to occur in May of 2020, was postponed for this year of 2021 (22-26 March), and will take place in a virtual (online) format. The headquarter of the VIII SBGEA & VIII SimFAST Joint Virtual Symposium is situated in the city of São José dos Campos (SP), Brazil.

We are aware that now the most important is the health and well-being of all participants. And for those of you that decided to attend this virtual symposium, thank you for the support and the scientific endeavors. For those participating for the first time in SBGEA & SimFAST, we are confident that you will enjoy and learn much over the coming week. Although in online format, we strongly believe that the event will be a unique opportunity for the scientific community of Space Geophysics and Aeronomy, as well as from different research areas of Physics and Astronomy, to disseminate and discuss their work with a multidisciplinary audience, which will include experts from Brazil and foreign institutions.

One important objective of the SBGEA & SimFAST meeting is to facilitate students' interactions with researchers and professors, by promoting a fruitful interchange of ideas and experiences. We hope that in this present edition of SBGEA & SimFAST, professionals working in the different areas involved in the event will be able to establish and strengthen cooperation and academic interchange.

Finally, we would like to acknowledge the chairs of the scientific sessions and to the members of the scientific committee for the enormous contribution given to the evaluation of the works and to the quality of the symposium. We are also grateful to São Paulo Research Foundation-FAPESP for the financial support (Proc. nº 2019/19225-9), Coordenação de Aperfeiçoamento de Pessoal de Nível Superior-CAPES (Proc. nº 23038.010900/2019-51) and

Fundação Valeparaibana de Ensino (FVE). This joint symposium is also being co-sponsored by the Committee on Space Research (COSPAR) and the International Association of Geomagnetism and Aeronomy (IAGA).

On behalf of all members of the Local Organizing Committee (LOC),
Marcio Tadeu de Assis Honorato Muella
Chair of the VIII SBGEA & VIII SimFAST

VIII SBGEA & SIMFAST

Simpósio Brasileiro de Geofísica Espacial e Aeronomia

Simpósio de Física e Astronomia do Vale do Paraíba - Univap

SCIENTIFIC PROGRAM

Presentation Language: English Portuguese

22 MARCH Monday

09:00 - 09:20	**Opening of the VIII SBGEA & VIII SimFAST Joint Symposium (ZOOM MEETING #01A)** Academic Head from UNIVAP - President of the SBGEA - General Chair - UNIVAP's Students Representative	
	Special Session (E1) – Women in Geosciences and Astronomy (ZOOM MEETING #01A) Chairs: Alessandra Pacini (NWRC, USA) and Vânia Andrioli (CAS/INPE, China/Brazil)	
09:20 - 09:50	**Honored Speaker - Inez Staciarini Batista (INPE, Brazil)** My scientific trajectory I. S. Batista	ENG
	Session 1 – Ionosphere: Earth and Other Planets (ZOOM MEETING #01A) Chairs: Paulo Nogueira (IFSP, Brazil), Fabiano Rodrigues (UTD, USA), Laysa Resende (CAS/INPE, China/Brazil)	
09:50 - 10:30	**Invited Speaker - Christina Arras (Helmholtz Postdam German Research Centre for Geosciences-GFZ, Germany)** Investigating the Earth's lower ionosphere from space: How GPS radio occultation profiles provide a global overview on sporadic E layer occurrence C. Arras, L. C. A. Resende, and J. Wickert	ENG
10:30 - 10:45	**Ligia A. da Silva (CAS/INPE, China/Brazil):** *Energetic particle dynamic on the Earth's radiation belts and the generation of the sporadic E layer (Esa) on the SHMA* *L. A. Da Silva, J. Shi, L. C. A. Resende, L. R. Alves, I. S. Batista, D. Sibeck, L. E. A. Vieira, J. Moro, C. Wang, V. M. Souza, P. R. Jauer, J. P. Marchezi, C. Medeiros, C. M. Denardini, S. Y. Zhang, and Z. Liu*	ENG
10:45 - 11:00	**Laysa C. A. Resende (CAS/INPE, China/Brazil):** Disturbance dynamo electric field in the formation of strong sporadic E-layers over Boa Vista, a low latitude station in American sector L. C. A. Resende, J. Shi, C. M. Denardini, I. S. Batista, P. A. B. Nogueira, C. Arras, V. F. Andrioli, J. Moro, L. A. Da Silva, A. J. Carrasco, P. F. Barbosa, C. Wang, and L. Zhengkuan	ENG
11:00 - 11:15	*Break*	
11:15 - 11:30	**Hisao Takahashi (INPE, Brazil):** Equatorial plasma bubble observation campaign H. Takahashi, I. Paulino, C. M. Wrasse, F. Rodrigues, R. A. Buriti, P. R. Fagundes, E. Correa, J. Souza, C. Nardin, E. R. de Paula, P. P. Batista, M. Bolzan, and M. A. Milla	ENG
11:30 - 11:45	**Rafael A. M. Lopes (ITA, Brazil):** Assessment of GNSS tracking loop structures for retrieval of phase variations induced by ionospheric scintillations R. A. M. Lopes and F. D. Antreich	ENG
11:45 - 12:00	**Paulo R. Fagundes (UNIVAP, Brazil):** Estudo da Anomalia de Ionização equatorial no setor Brasileiro Paulo R. Fagundes P. R., Maukers A. L. Dias	ENG
12:00 - 12:20	**Fábio Vargas (University of Illinois at Urbana-Champaign, USA):** Vertical scales of gravity-wave origin TIDs detectable by imagery of the redline nightglow | F. Vargas, G. Swenson, P. Terra, and C. Brum	ENG
12:20 - 14:00	*Lunch Break*	
	Special Session (E1) – Women in Geosciences and Astronomy (ZOOM MEETING #01B) Chairs: Alessandra Pacini (NWRC, USA) and Vânia Andrioli (CAS/INPE, China/Brazil)	
14:00 - 14:20	**Honored Speaker - Maria Virginia Alves (INPE/Brazil)** Minha trajetória científica M. V. Alves	PORT
	Session 2 – Physics of Plasmas (ZOOM MEETING #01B) Chairs: Rodrigo Cerda (UNB, Brazil), Pablo Gutberlet (Univ. La Serena, Chile), Marco Ramos (UNIVAP, Brazil)	
14:20 - 15:00	**Invited Speaker - Vladimir Jesus Trava Airoldi (INPE, Brazil)** Recent studies on plasma discharge used for studies and production of DLC (Diamond-like Carbon) Films V. J. Trava-Airoldi	ENG
15:00 - 15:20	**Nahuel Andrés (CONICET-UBA/Sorbonne University, Argentina/France):** The energy cascade rate in compressible Hall-MHD turbulence: theory vs. MMS observations N. Andres, F. Sahraoui, S. Galtier, L. Z. Hadid, R. Ferrand, and S. Y. Huang	ENG
15:20 - 15:40	**Rodrigo A. M. Cerda (UNB, Brazil):** Multifractality and cross-scale coupling in interplanetary magnetic field turbulence during a rope-rope magnetic reconnection event R. A. Miranda, A. C.-L. Chian, Q. Hu, and P. R. Muñoz	ENG
15:40 - 16:00	**Rodrigo A. F. Alves (UNB, Brazil):** Numerical simulations of the electron drift instability in a closed-drift plasma device R. A. F. Alves and R. A. Miranda	PORT
16:00 - 16:20	*Break*	
16:20 - 16:40	**Marco A. R. Ramos (UNIVAP, Brazil):** Tribological evaluation and behavior of DLC coatings on steel in PECVD system with TiO_2 over layer using ALD plasma technique M. A. Ramirez, M. Stefany, C. Velasquez, and L. Vieira	ENG
16:40 - 17:00	**Luz S. Murcia Correa (UNIVAP, Brazil):** Optical emission spectroscopy for Ar and compressed air plasma characterization L. S. Murcia-Correa and M. A. R. Ramirez	PORT

23 MARCH **Tuesday**

	Session 1 – Ionosphere: Earth and Other Planets (ZOOM MEETING #02A) Chairs: Paulo Nogueira (IFSP, Brazil), Fabiano Rodrigues (UTD, USA), Laysa Resende (CAS/INPE, China/Brazil)
09:00 - 09:40	**Invited Speaker - Lucilla Alfonsi (Istituto Nazionale di Geofisica e Vulcanologia-INGV, Italy)** The study of the ionospheric irregularities on a global scale | L. Alfonsi **ENG**
09:40 - 10:00	**Liliana Macotela (Sodankylä Geophysical Observatory, University of Oulu, Sodankylä, Finland):** Spring-autumn Asymmetry in the Propagation of VLF Waves in the Northern Hemisphere E. L. Macotela, M. Clilverd, J. Chau, J. Manninen, and D. Banys **ENG**
10:00 - 10:15	**Lucilla Alfonsi (Istituto Nazionale di Geofisica e Vulcanologia, Italy):** INGV contribution to international Space Weather initiatives | L. Alfonsi **ENG**
10:15 - 10:30	**Paulo Alexandre B. Nogueira (IFSP, Brazil):** Latitudinal dependence of the ionospheric response to solar flare P. A. B. Nogueira, G. A. S. Picanço, P. F. B. Neto, and C. M. Denardini **ENG**
10:30 - 10:45	**Mauricio J. A. Bolzam (UFJ, Brazil):** Study of the main periodicities from F-layer ionosphere of the mid-west of Brazil, 2017 | M. J. A. Bolzan, P. R. Fagundes, V. G. Pillat, and A. Tardelli **ENG**
10:45 - 11:00	*Break*
11:00 - 11:40	**Invited Speaker - Mangalathayil Ali Abdu (ITA, Brazil)** Investigations of the nighttime equatorial and low latitude ionospheric irregularities over Brazil M. A. Abdu , E. A. Kherani, J. Sousasantos and P. A. B. Nogueira **ENG**
11:40 - 11:55	**Pedrina Terra (UCF/Arecibo Observatory, USA):** Geomagnetic and solar dependency of MSTIDs occurrence rate: A climatology based on airglow observations from ROF P. Terra, F. Vargas, C. Brum and E. Miller **ENG**
11:55 - 12:10	**Saúl A. S. Juarez (INPE, Brazil):** Geomagnetic and ionospheric disturbances generated by earthquakes S. A. Sanchez, E. A. Kherani, E. R. de Paula, and V. Klausner **PORT**
12:10 - 14:00	*Lunch Break*
	Special Session (E1) – Women in Geosciences and Astronomy (ZOOM MEETING #02B) Chairs: Alessandra Pacini (NWRC, USA) and Vânia Andrioli (CAS/INPE, China/Brazil)
14:00 - 14:20	**Honored Speaker - Ana Roberta da Silva Paulino (UEPB, Brazil)** Pesquisa sobre a maré atmosférica lunar desenvolvida no Brasil A. R. S. Paulino **PORT**
	Session 3 – Physics and Chemistry of the Neutral Atmosphere (ZOOM MEETING #02B) Chairs: José V. Bageston (CRS/INPE, Brazil), Pierre-Dominique Pautet (Utah State University, USA), Mauricio J. A. Bolzam (UFJ, Brazil)
14:20 - 15:00	**Invited Speaker - Yang Guotao (NSSC, China)** The development of the comprehensive lidar station in Yanqing and upper atmospheric study with lidar data Y. Guotao **ENG**
15:00 - 15:20	**Fábio Vargas (University of Illinois at Urbana Champaign, USA):** O(1S) and OH(6,2) intensity variations and wave activity over the Andes Lidar Observatory (ALO) (30.3°S, 70.7°W) F. Vargas, Y. Amaro-Rivera, T-Y. Huang, and J. Urbina **ENG**
15:20 - 15:35	**Nyassor P. Kwamla (INPE, Brazil):** Concentric gravity waves observed by OH airglow over São João do Cariri P. K. Nyassor, C. M. Wrasse, D. Gobbi, I. Paulino, H. Takahashi, J. V. Bageston, P. N. Kleber, P. P. Batista, D. Barros, C. A. O. B. Figueiredo, and R. A. Buriti **ENG**
15:35 - 15:50	*Break*
15:50 - 17:50	**Online Poster Session P1: Contributions of Session 1 (Ionosphere: Earth and Other Planets) and Session 2 (Physics of Plasmas) - (ZOOM MEETING #02B)** Chair: Valdir G. Pillat (UNIVAP, Brazil); Arian O. Gonzalez (UNIVAP, Brazil)

24 MARCH Wednesday

	Special Session (E1) – Women in Geosciences and Astronomy (ZOOM MEETING #03A) Chairs: Alessandra Pacini (NWRC, USA) and Vânia Andrioli (CAS/INPE, China/Brazil)	
09:00 - 09:20	**Honored Speaker - Adriana Benetti Marques Valio (CRAAM-Mackenzie, Brazil)** Minha Trajetória Científica A. B. M. Valio	ENG
	Session 4 – Solar Physics, Interplanetary Medium and Planetary Magnetospheres (ZOOM MEETING #03A) Chairs: Jean-Pierre Raulin (Mackenzie, Brazil), Jean C. Santos (UTFPR, Brazil), Marcos V. D. Silveira (Catholic University of America / GSFC-NASA, USA)	
09:20 - 10:00	**Invited Speaker – Maria Hebe Cremades (CONICET/Universidad Tecnológica Nacional, Argentina)** Expansion of coronal mass ejections from the low to the outer corona M. H. Cremades	ENG
10:00 - 10:15	**Maria V. Sieyra (Universidad Tecnológica Nacional/CONICET, Argentina):** Understanding CME deflections during the rising phase of solar cycle 24 M. V. Sieyra, M. Cecere, H. Cremades, F. A. Iglesias, A. Sahade, M. Mierla, G. Stenborg, A. Costa, M. West, and E. D'Huys	ENG
10:15 - 10:30	**Ligia A. Da Silva (CAS/INPE, China/Brazil):** Contribution of the pitch angle scattering on the relativistic electron flux dropout in the outer radiation belt after the Coronal Mass Ejection L. A. Da Silva, J. Shi, L. R. Alves, D. Sibeck, V. M. Souza, J. P. Marchezi, C. Medeiros, L. E. A. Vieira, O. Agapitov, P. R. Jauer, M. E. S. Alves, C. Wang, H. Li, Z. Liu, W. Gonzalez, A. D. Lago, M. V. Alves, M. Rockenbach, D. N. Baker, S. Y. Zhang, and S. G. Kanekal	ENG
10:30 - 10:50	*Break*	
10:50 - 11:10	**Livia R. Alves (INPE, Brazil):** How does relativistic outer radiation belt electron flux change under recurrent solar wind structures? L. R. Alves, G. B. D. da Silva, L. A. da Silva, P. R. Jauer, V. M. Souza, C. Medeiros, D. G. Sibeck, S. G. Kanekal, J. B. Blake, C. Kletzing, and D. Baker	ENG
11:10 - 11:25	**Arian O. Gonzalez (UNIVAP, Brazil):** Apresentação de um método para identificar intervalos longos de alta alfvenicidade no vento solar do ano de 1999 a 2018 A. O. González, M. V. C. Cardoso, and M. G. A. de Souza	PORT
11:25 - 11:40	**Marcos W. S. Oliveira (IFSP, Brazil):** Application for correction of the variance analysis in the magnetic clouds study M. W. S. Oliveira, R. A. R. Oliveira, A. O. González, and V. G. Pillat	PORT
11:40 - 14:00	*Break*	
	Session 3 – Physics and Chemistry of the Neutral Atmosphere (ZOOM MEETING #03B) Chairs: José V. Bageston (CRS-INPE, Brazil), Pierre-Dominique Pautet (Utah State University, USA), Mauricio J. A. Bolzam (UFJ, Brazil)	
14:00 - 14:40	**Invited Speaker - Paulo Prado Batista (INPE, Brazil)** Middle atmosphere research at INPE: History, present situation, and future | P. P. Batista	ENG
14:40 - 15:00	**Pierre-Dominique Pautet (Utah State University, USA):** Mesospheric mountain waves observations and characteristics in the lee of the Southern Andes during the austral winter 2018 P-D. Pautet, M. J. Taylor, D. Janches, and D. C. Fritts	ENG
15:00 - 15:15	**Igo Paulino (UFCG, Brazil):** Oscilações semi-mensais observadas na deriva zonal de bolhas de plasma ionosféricas I. Paulino, A. R. Paulino, A. F. de Medeiros, R. A. Buriti, C. M. Wrasse, and H. Takahashi	PORT
15:15 - 15:30	**Rennan G. Rocha (UFCG, Brazil):** Determinação de vento horizontal a partir da observação de ondas de gravidade de média escala na mesosfera e baixa termosfera R. G. Rocha, I. Paulino, A. V. Bilibio, A. R. Paulino, C. M. Wrasse, and A. F. de Medeiros	PORT
15:30 - 15:45	**Jorge F. V. Silva (CRAAM/Mackenzie, Brazil):** Atmospheric absorption at 45 and 90 GHz in CASLEO J. F. V. Silva, C. G. G. de Castro, C. Passarelli, D. C. Espinoza, M. M. Cassiano, J-P. Raulin, and A. Valio	PORT
15:45 - 16:00	*Break*	
16:00 - 18:00	**Online Poster Session P2: Contributions of Session 3 (Physics and Chemistry of the Neutral Atmosphere), Session 4 (Solar Physics, Interplanetary Medium and Planetary Magnetospheres) and Session 5 (Space Weather and Sun-Earth Connections) - (ZOOM MEETING #03B)** Chair: Marcio T. A. H. Muella (UNIVAP, Brazil); Valdir G. Pillat (UNIVAP, Brazil)	

25 MARCH THURSDAY

Special Session (E1) – Women in Geosciences and Astronomy (ZOOM MEETING #04A)
Chairs: Alessandra Pacini (NWRC, USA) and Vânia Andrioli (CAS/INPE, China/Brazil)

09:00 - 09:20 **Honored Speaker - Alicia Luisa Clúa de Gonzalez Alarcon (INPE, Brazil)**
My scientific trajectory
A. L. C. G. Alarcon
PORT

Session 5 – Space Weather and Sun-Earth Connections (ZOOM MEETING #04A)
Chairs: Alisson Dal Lago (INPE, Brazil), José H. Fernandez (UFRN, Brazil), Clezio M. De Nardin (INPE, Brazil)

09:20 - 10:00 **Invited Speaker – Sergio Dasso (FCEN/UBA-CONICET, Argentina)**
Dynamical evolution of solar ejecta in the interplanetary medium: Consequences on geo-effectiveness and cosmic rays
S. Dasso
ENG

10:00 - 10:15 **José R. Cecatto (INPE, Brazil):** Solar phenomena, the possibility to predict their occurrence, and what to expect for next years
J. R. Cecatto, M. V. Martins, J. M. S. C. Mota, A. E. A. da Silva, M. X. Ribeiro, M. T. P. Santos, A. L. S. Gradvohl, G. P. Coelho, and M. M. Fernandes
ENG

10:15 - 10:30 **Luis E. A. Vieira (INPE, Brazil):** Status of the Galileo Solar Space Telescope mission (GSST)
L. Vieira, A. Dal Lago, M. Rockenbach, F. Guarnieri, L. A. da Silva, F. Carlesso, L. Alves, V. Moura, and P. Jauer
ENG

10:30 - 10:50 *Break*

10:50 - 11:30 **Invited Speaker - Walter Demetrio Gonzalez Alarcon (INPE, Brazil) - (ZOOM MEETING #04B)**
A multi-scale satellites mission to study magnetic reconnection at the Earth's magnetosphere
W. D. G. Alarcon
ENG

11:30 - 11:45 **Denny Oliveira (University of Maryland / NASA Goddard Space Flight Center, USA):** Estimating satellite orbital drag during historical magnetic superstorms (Dst < -500 nT)
D. M. Oliveira, E. Zesta, H. Hayakawa, and A. Bhaskar
ENG

11:45 - 12:00 **Marlos Rockenbach (INPE, Brazil):** Estudo de dois casos de ICMEs: origem solar e consequências no espaço próximo da terra | M. Rockenbach, A. Dal Lago, O. Mendes, L. A. Vieira, V. Deggeroni, A. A. X. Barbosa, L. A. Da Silva
PORT

12:00 - 14:00 *Lunch Break*

14:00 - 14:40 **Invited Speaker – Norbert Jakowski (Institute for Solar-Terrestrial Physics, German Aerospace Center, Germany)**
GNSS based indices for studying and characterizing the ionosphere
N. Jakowski and M. M. Hoque
ENG

14:40 - 14:55 **Clezio M. De Nardin (INPE, Brazil):** Recent advances for developing ionospheric scale index map based on TEC data for South America | C. M. Denardini, G. A. S. Picanço, P. F. B. Neto, P. A. B. Nogueira, C. S. Carmo, L. C. A. Resende, J. Moro, S. S. Chen, E. Romero-Hernandez, R. P. Silva, and C. M. Wrasse
ENG

14:55 - 15:10 **Fabiano S. Rodrigues (The University of Texas at Dallas, USA):** AMISR-14 studies of low-latitude ionospheric F-region irregularities | F. S. Rodrigues and M. A. Milla
ENG

15:10 - 15:25 **Dinibel P. Bello (CONICET/University of La Plata, Argentina):** Comparison of two artificial neural networks for vertical total electron content forecasting in Argentina
D. Pérez-Bello, Ma. P. Natali, and A. Meza
ENG

15:25 - 15:40 *Break*

15h40-17h40 **Online Poster Session P3: Contributions of Session 6 (Astronomy and Astrophysics) and Special Session E2 (INCT GNSS NavAer: Integrating Space Weather, Geodesy and Air Navigation) - (ZOOM MEETING #04B)**
Chair: Arian O. Gonzalez (UNIVAP, Brasil); Marcio T. A. H. Muella (UNIVAP, Brazil)

26 MARCH FRIDAY

Special Session (E2) – INCT GNSS NavAer: Integrating Space Weather, Geodesy and Air Navigation - (ZOOM MEETING #05A) | Chairs: João F. G. Monico (UNESP, Brazil), Eurico R. de Paula (INPE, Brazil)

08:30 - 08:50	**João F. G. Monico (UNESP, Brazil):** Space Weather and ionosphere activities by the Space Geodesy Research Group of Unesp/Brazil J. F. G. Monico, B. Vani, P. O. Camargo, I. Tsuchiya, and R. S. Santos	ENG
08:50 - 09:10	**Paulo S. de Oliveira Jr (UFPR, Brazil):** Assessment of unbiased SSR ionospheric corrections derived from PPP with ambiguity resolution P. S. de Oliveira Jr and J. F. G. Monico	ENG
09:10 - 09:30	**Bruno C. Vani (IFSP, Brazil):** Ionospheric scintillation and Precise Point Positioning (PPP): Characterization and modeling B. C. Vani, J. F. G. Monico, M. H. Shimabukuro, B. Forte, and A. O. Moraes	PORT
09:30 - 09:50	**Teddy M. S. Espejo (PUC-RJ, Brazil):** Simulating ionospheric effects on a Ground Based Augmentation System T. M. S. Espejo, E. Costa, A. O. Moraes, E. R. de Paula, and J. F. G. Monico	PORT
09:50 - 10:30	**Invited Speaker – Natali Caccioppoli (Eurocontrol, France)** GBAS (GAST-F) ionosphere impact using GBAS Messenger with latest updates | N. Caccioppoli	ENG
10:30 - 10:50	*Break*	
10:50 - 11:10	**Claudinei R. Aguiar (UTFPR, Brazil):** Real-time TEC estimation from GNSS NTRIP Network C. R. Aguiar and J. F. G. Monico	PORT
11:10 - 11:25	**Kátia M. dos Santos (IACIT Soluções Tecnológicas, Brazil):** New approach for a Ground Based Augmentation System implementation in Brazil | C. A. M. Herrera, E. G. Silva, F. M. R. Carvalho, M. Tortolio Jr, R. M. Andrade, K. M. dos Santos, M. L. V. Oliveira, and M. R. Silva	ENG
11:25 - 11:40	**Kátia M. dos Santos (IACIT Soluções Tecnológicas, Brazil):** Operational analysis of a Ground Based Augmentation System | C. A. M. Herrera, E. G. Silva, F. M. R. Carvalho, M. Tortolio Jr, R. M. Andrade, K. M. dos Santos, M. L. V. Oliveira, and M. R. Silva	ENG
11:40 - 12:20	**Invited Speaker – Samuel Phillip Pullen (Stanford University, USA)** Lessons learned from the development of ionospheric monitoring for ground-based and satellite-based augmentation of GNSS | S. M. Pullen	ENG
12:20 - 14:00	*Lunch Break*	

Session 6 – Astronomy and Astrophysics - (ZOOM MEETING #05B)
Chairs: Alexandre S. Oliveira (UNIVAP, Brazil), Ângela C. Krabbe (UNIVAP, Brazil), Irapuan R. O. Filho (UNIVAP, Brazil)

14:00 - 14:40	**Invited Speaker – Raimundo Lopes de Oliveira Filho (UFS, Brazil)** Opportunities from the X-ray Astronomy | R. L. O. Filho	ENG
14:40 -15:00	**Sergio Pilling (UNIVAP, Brazil):** Photochemistry and desorption induced by X-rays in water rich astrophysical ice analogs: Implications for Enceladus moon and other frozen space S. Pilling, W. R. M. Rocha, F. M. Freitas, and P. A. da Silva	ENG
15:00 - 15:20	**Adriana R. da Silva (UNIVAP, Brazil):** Signature of polycyclic aromatic hydrocarbons in regions of starbursts galaxies | A. R. da Silva, A. C. Krabbe, and D. P. Andrade	PORT
15:20 - 15:40	**Irapuan R. O. Filho (UNIVAP, Brazil):** Simulando o sistema de galáxias em interação AM 2229-735 e a formação de sua estrutura polar | I. Rodrigues, L. F. Quiroga, J. C. Muñoz-Cuartas, and N. I. Libeskind	PORT
15:40 - 16:00	**Diego V. Enríquez (Corporación Universitaria Autónoma de Nariño, Colombia):** Orbital classification on a N-body bar galactic model | D. Valencia-Enríquez and I. Puerari	ENG
16:00 - 16:15	*Break*	
16:15 -16:35	**Angela C. Krabbe (UNIVAP, Brazil):** The chemical abundance of the LINER galaxy UGC 4805 A. C. Krabbe, C. B. Oliveira Jr., I. A. Zinchenko, J. A. Hernandez-Jimenez, O. L. Dors Jr., G. F. Hagele, M. V. Cardaci, and N. R. Telles	PORT
16:35 - 16:55	**Jurandi L. Santos (INPE, Brazil):** Study and characterization of the spectral states of 1E 1740.7-2942 in hard X-rays J. Leão, P. Stecchini, M. Castro, and F. D'Amico	PORT
16:55 – 17:15	**Alexandre S. de Oliveira (UNIVAP, Brazil):** Spectroscopic search for new Magnetic Cataclysmic Variables with SOAR Telescope | A. S. Oliveira, C. V. Rodrigues, M. Martins, M. S. Palhares, K. M. G. Silva, I. J. Lima, and F. J. Jablonski	PORT
17:15 – 17:40	Closing of the VIII SBGEA & VIII SimFAST Joint Symposium - (ZOOM MEETING #05B) Student Video Poster Competition Winners Announcement General Chair - President of the SBGEA	

Realização:

SBGEA · Observatório de Astronomia e Física Espacial Univap · IP&D Instituto de Pesquisa e Desenvolvimento · UniVap Universidade do Vale do Paraíba

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Scientific Program QR Code
March 22 - 26, 2021

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WOMEN IN GEOSCIENCES AND ASTRONOMY
Invited Speakers

Dra. Adriana Benetti Marques Valio
Universidade Presbiteriana Mackenzie (UPM), CRAAM, Brasil

Honored speaker of the special session Women in Geosciences and Astronomy: Wednesday, March 24, 2021, 09h00-09h20 a.m.

Minha Trajetória Científica

ABSTRACT

Nesta apresentação compartilharei um breve histórico de minha carreira, para que meus desafios, conquistas e legado científico inspirem as próximas gerações da SBGEA & SimFAST.

Short bio: Dra. Adriana B. M. Valio possui graduação em Bacharelado em Física pela Universidade Estadual de Campinas (1986), mestrado em Astronomy - University of California at Berkeley (1992), mestrado em Astronomia pela Universidade de São Paulo (1989) e Phd In Astronomy - University of California at Berkeley (1995). Realizou pós-doutorados no California Instittute of Technology (Caltech - 1995-1997) e na UNICAMP (1997-1999). É livre-docente pela Universidade de São Paulo (2008). Foi presidente da Sociedade Astronômica Brasileira (SAB) no biênio 2012-2014, e tesoureira da SAB (2015-2017). Professora adjunto e coordenadora do curso de pós-graduação em Ciências e Aplicações Geoespaciais da Universidade Presbiteriana Mackenzie. Coordenadora da área de Astronomia da FAPESP desde 2016. Membro do Comitê Assessor do CNPq na área de Física e Astronomia (2018-2021). Tem experiência na área de Astronomia, com ênfase em atividade Solar e Estelar, atuando principalmente nos seguintes temas: explosões solares e estelares, manchas solares e estelares, atmosferas solar e estelar, planetas extrassolares e a interação com suas estrelas, habitabilidade planetária, além de radioastronomia (Fonte: Currículo Lattes)

Dra. Alicia Luisa Clúa de Gonzalez Alarcon
Instituto Nacional de Pesquisas Espaciais (INPE), DGE, Brasil

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Honored speaker of the special session Women in Geosciences and Astronomy: Thursday, March 25, 2021, 09h00-09h20 a.m.

Minha Trajetória Científica

ABSTRACT

Sou pesquisadora aposentada e colaboradora voluntária do Instituto de Pesquisas Espaciais, em São José dos Campos, SP. Neste instituto trabalhei na área de Geofísica Espacial e desempenhei-me como docente no curso de pós-graduação GES, associado às divisões de Geofísica Espacial e de Aeronomia, durante 30 anos. A minha formação foi em Física, na Universidade Nacional de La Plata, Argentina, na área de Espectrospia Ótica. Obtive uma bolsa para fazer um pós-doutorado na Universidade de Berkeley, Califórnia, onde permaneci por quase três anos. No interim, contrai matrimônio com o Dr. Walter Gonzalez, que se encontrava na mesma Universidade com uma bolsa de doutorado pelo INPE. Dali viemos para o INPE, onde ele já tinha uma posição como pesquisador e fui também contratada depois de alguns meses, na gestão do Dr. Fernando de Mendonça como diretor do instituto. Trabalhando na área de Geofísica Espacial, concentrei-me principalmente em análise de dados interplanetários e geomagnéticos, e na aplicação de técnicas estatísticas para os mesmos.

Short bio: Alicia Luisa C. G. Alarcon is currently a retired researcher and volunteer collaborator at the National Institute for Space Research (INPE). She earned the master degree (1967) and the Ph.D (1970) degree in physics from Universidad Nacional de La Plata. She works in the field of Geosciences, with an emphasis on Space Geophysics, mainly on topics such as geomagnetic activity, geomagnetic storms, solar-magnetosphere interaction, geomagnetic indices and the origin of geomagnetic storms. (Source: Curriculo Lattes)

Dra. Ana Roberta da Silva Paulino
Universidade Estadual da Paraíba (UEPB), CCT, Brasil

Honored speaker of the special session Women in Geosciences and Astronomy: Tuesday, March 23, 2021, 02h00-02h20 p.m.

Pesquisa Sobre a Maré Atmosférica Lunar Desenvolvida no Brasil

ABSTRACT

A maré lunar desempenha um papel importante na atmosfera e devido ser uma oscilação sempre presente, contribui para a variabilidade de curto período dos campos atmosféricos. Além disso, possui uma forçante bem conhecida e previsível. Como consequência, sua variabilidade observada indica mudanças nas condições básicas da atmosfera. No Brasil, medidas contínuas e simultâneas do vento neutro fornecidas por três radares meteóricos instalados em São João do Cariri (7,4º S; 36,5º W), Cachoeira Paulista (22,7º S; 45,0º W) e Santa Maria (29,7º S; 53,7º W) permitiram a determinação da maré semidiurna lunar na região da mesosfera e baixa termosfera brasileira. Combinando com um longo período de observações em Cachoeira Paulista (1999 a 2008), foi possível observar que a maré lunar apresenta variações latitudinais, variação ano-a-ano e que sua amplitude é intensificada durante eventos de aquecimento súbito da estratosfera polar. Esta intensificação da maré lunar desempenha um papel importante na geração de perturbações na ionosfera, que foram confirmadas com medidas de conteúdo eletrônico total sobre o território brasileiro. Medidas de temperatura cinética fornecidas pelo instrumento SABER/TIMED permitiram o estudo global da maré lunar e mostraram a importância das componentes não migrantes dessa oscilação nas variações longitudinais observadas.

Short bio: Ana Roberta S. Paulino has a MS and Ph.D. in Space Geophysics from the National Institute for Space Research (INPE). She is currently professor in the Department of Physics at the State University of Paraíba. Ana

Roberta Paulino was the winner of the 2014 CAPES award in the field of Geosciences. She has experience in the field of Geosciences, with an emphasis on Aeronomy, mainly in the study of the dynamics of the Mesosphere-Thermosphere-Ionosphere using ground-based and space-based instruments. (Source: Curriculo Lattes)

Dra. Inez Staciarini Batista
Instituto Nacional de Pesquisas Espaciais (INPE), DAE, Brasil

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Honored speaker of the special session Women in Geosciences and Astronomy: Monday, March 22, 2021, 09h20-09h50 a.m.

Minha Trajetória Científica

ABSTRACT

Sinto-me extremamente honrada com o convite para fazer uma apresentação na sessão especial "Mulheres nas Geociências e Astronomia" do VIII Simpósio Brasileiro de Geofísica Espacial e Aeronomia & VIII Simpósio de Física e Astronomia do Vale do Paraíba. Nessa palestra farei um breve relato dos obstáculos enfrentados, das dificuldades que as mulheres enfrentam para conciliar maternidade e carreira, mas falarei também sobre a alegria de se ver os desafios superados e os objetivos atingidos. Discorrerei brevemente sobre os temas de pesquisa que desenvolvi ao longo de minha carreira: Camada E-esporádica, Eletrodinâmica da ionosfera equatorial e de baixas latitudes, Camada F3, Irregularidades de plasma e bolhas ionosféricas, entre outros. São todos temas que continuam atuais em face da grande influência que a ionosfera exerce sobre a propagação de ondas eletromagnéticas, podendo afetar os modernos sistemas tecnológicos que utilizam sinais de satélites que atravessam a ionosfera. Finalmente, espero conseguir mostrar que ainda há muito a ser feito nessa área de pesquisa tão fascinante, e que contamos com as novas gerações para dar continuidade a esse trabalho.

Short bio: Inez S. Batista is senior researcher of Aeronomy Division at the National Institute for Space Research (INPE). She earned the Ph.D. degree from INPE in 1985 in Atmospheric and Space Sciences and developed post-doctoral research in Boston University, USA, in 1987-1988. She works in ionospheric research where the main interest fields are the ionospheric electrodynamical processes, the equatorial ionosphere plasma irregularities and bubbles, as well as the effects of space weather on the ionopshere (Source: Curriculo Lattes)

Dra. Maria Virginia Alves
Instituto Nacional de Pesquisas Espaciais (INPE), Brasil

Honored speaker of the special session Women in Geosciences and Astronomy: Monday, March 22, 2021, 02h00-02h20 p.m.

Minha Trajetória Científica

ABSTRACT

Ao consultar a página do CNPq que traz os CVs de pesquisadores, ao pesquisar meu nome, pode-se descobrir que me graduei em Matemática Aplicada pela (USP) em 1978, recebi os graus de Mestre em Astrofísica e de Doutor em Ciência Espacial, ambos pelo INPE, em 1981 e 1990, respectivamente. Minha trajetória profissional foi construída no INPE, onde trabalho desde 1982, a partir de várias mudanças, como se pode já notar a partir da formação apresentada acima. Comecei na Coordenação de Ciências Espaciais e Atmosféricas, mas em 1986 me transferi para o Laboratório Associado de Plasmas (LAP). Algumas experiências me foram marcantes, destacando aqui o doutorado sanduíche realizado no Grupo de Teoria e Simulações do EECS, UC Berkeley, nos Estados Unidos, entre fevereiro de 1989 e junho de 1990. Voltei de lá com a tese praticamente pronta, a qual foi defendida em setembro de 1990. Ao voltar ao Brasil, dei continuidade ao meu trabalho junto ao LAP e passei a integrar o corpo docente do curso de Pós-Graduação em Geofísica Espacial, no qual atuei como Coordenadora Acadêmica de 1999 a 2001 e de novembro de 2013 a março de 2017. Também exerci a Chefia do LAP de janeiro de 2005 a fevereiro de 2008 e de janeiro de 2007 a fevereiro de 2008 atuei como Coordenadora Substituta da Coordenação de Laboratórios Associados (CTE). As atividades de gestão me atraíram bastante, e em novembro de 2010 conclui o curso de PósGraduação em Gestão Estratégica da Ciência e Tecnologia em IPP's pela FGV. O INPE para mim sempre foi motivo de orgulho e colaborar com sua gestão no cargo de Chefe de Gabinete, de março de 2008 a agosto de 2012, e de setembro de 2016 até o momento, me permite ver o INPE como um todo, em suas diversas áreas de atividade. As atividades

de gestão não me impediram de dar continuidade às minhas pesquisas, sempre realizadas com alunos de mestrado e doutorado e outros pesquisadores, do INPE e de outras instituições. Meus interesses são a modelagem numérica e maior entendimento das relações Sol-Terra. Nesta apresentação pretendo detalhar um pouco mais as várias fases desta trajetória e mostrar que as mudanças ao longo da carreira podem trazer crescimento e construção de novas habilidades e competências.

Short bio: Maria Virginia Alves has a BS in Applied Mathematics from the University of São Paulo (USP) in 1978. She earned a MS degree in Astrophysics and a Ph.D. in Space Science, both from the National Institute for Space Research (INPE), in 1981 and 1990, respectively. She works at INPE since 1982. The main interest fields of studies are modeling and numerical simulation of plasmas. (Source: Curriculo Lattes)

IONOSPHERE: EARTH AND OTHER PLANETS
Invited Speakers

Dra. Christina Arras
Helmholtz Potsdam German Research Centre for Geosciences (GFZ), Germany

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Invited speaker of the session Ionosphere Earth and Other Planets:
Monday, March 22, 2021, 09h50-10h30 a.m.

Investigating the Earth's lower ionosphere from space: How GPS radio occultation profiles provide a global overview on sporadic E layer occurrence

C. Arras[1] , L. C. A. Resende[2,3], J. Wickert[1,4]
[1] German Research Center for Geosciences GFZ
[2] INPE, Sao Jose dos Campos, Brazil
[3] State Key Laboratory of Space Weather, Beijing, China
[4] Technische Universität Berlin, Germany

ABSTRACT

The GPS radio occultation (RO) technique established successfully during the last two decades and evolved into a valuable application for precise atmospheric and ionospheric profiling. GPS RO signals are very sensitive to vertical changes in the electron density in the Earth's ionosphere. This issue becomes visible as strong fluctuations in e.g. signal-to-noise ratio recordings, which allow detecting sporadic E layers in the lower ionosphere. Due to the geometry of the GPS RO technique, it enables for the first time receiving a global and comprehensive picture of sporadic E layer occurrence and properties in a high spatial resolution. Sporadic E (Es) layers are thin sheets of enhanced electron density occurring in the lower ionospheric E region, preferably between 95 and 120 km. It is widely accepted that Es formation at low- and midlatitudes is due to the wind shear mechanism when the

ionized metallic particles of meteoric origin interact with the lower thermospheric neutral wind field. In polar and equatorial electric fields play and additional important role in the Es layer formation process. In this presentation, we like to give an overview on global sporadic E characteristics. We will demonstrate the varying behavior of this phenomenon at different latitudinal regions and we will illustrate that the Es formation results from complex coupling processes in the thermosphere-ionosphere-magnetosphere system. We will discuss several geophysical parameters such as tidal winds in the upper atmosphere, the presence of metallic ions and the Earth's magnetic field influencing the Es formation.

Short bio: Christina Arras earned the Ph.D. degree (2010) in Meteorology from University of Leipzig, Germany. Since 2010 she has been working as a project scientist at the GFZ Potsdam institution, Germany. The research interests are GNSS atmosphere/ionosphere sounding, sporadic E phenomenon in Earth's lower ionosphere and ionosphere/thermosphere coupling processes.

Dra. Lucilla Alfonsi
Istituto Nazionale di Geofisica e Vulcanologia (INGV), Italy

Invited speaker of the session Ionosphere Earth and Other Planets:
Tuesday, March 23, 2021, 09h00-09h40 a.m.

The study of the ionospheric irregularities on a global scale

ABSTRACT

The Istituto Nazionale di Geofisica e Vulcanologia (INGV) has a long tradition of probing the ionosphere via HF sounding, inherited by its founder Guglielmo Marconi. Thanks to that legacy, INGV matured a consolidated experience in the monitoring of the upper atmosphere and in the comprehension of the physics ruling the Sun-Earth relationship. Besides the traditional observation by the ionosondes started in the '30s, INGV performs measurement of the ionosphere through GNSS ground-based receivers since 2003. The stations are located in the Mediterranean area, at high and low latitudes all over the world, allowing a global description of the ionospheric plasma reconstructed through a regional assessment. Furthermore, thanks to its international collaborations with academic entities from European and extraEuropean Countries, such as Brazil, South Africa, USA, Canada and South-East Asia, INGV has access to additional groundbased and satellite data. The measurements are analysed by means of different approaches to derive information on the effects of the solar windmagnetosphereionosphere interplay in terms of formation and evolution of ionospheric irregularities. The ionosphere is considered irregular when its electron density is unevenly distributed, presenting regions of depleted or enhanced density, termed irregularities. The study of the irregularities is necessarily based on a multi-instruments and multi-disciplinary approach, leveraging on in-situ (from satellites and rockets) and ground-based data providing information on the Sun, the solar wind, the magnetosphere, the ionosphere. Where the data are scarce, or completely missing, the use of theoretical and semiempirical models can support the investigation. INGV developed good skills

in this framework, contributing to advance the understanding of physical mechanisms triggering the electron density gradients, the scintillations, the ionospheric absorption, the positive/negative ionospheric storms, the travelling ionospheric disturbances. This presentation will give an overview of the capabilities recently reached in probing, modelling and investigating the ionospheric irregularities at global scale as a matter of discussion and further collaboration with the audience.

Short bio: Lucilla Alfonsi is MS in Physics (2000) from University of Rome, Italy, and Ph.D. in Geophysics (2003) from University of Bologna, Italy. She is Researcher at INGV Upper Atmosphere Physics Unit, where she takes part, often with a leading role, to the scientific studies on the upper atmosphere monitoring and study related to space weather applications, particularly about the investigation of ionospheric irregularities from ground based as well as from in situ measurements. She is also expert on the investigation of the long-term changes of the upper atmosphere on a planetary scale in the frame of Global Change studies and on the design and development of ionospheric scintillations models.

Dr. Mangalathayil Ali Abdu
Instituto Tecnológico de Aeronáutica (ITA), Brazil

Invited speaker of the session Ionosphere Earth and Other Planets:
Tuesday, March 23, 11h00-11h40 a.m.

Investigations of the nighttime equatorial and low latitude ionospheric irregularities over Brazil

ABSTRACT

The post sunset equatorial ionosphere becomes unstable to perturbations in density and polarization electric field, when the layer is subjected to upward displacement due to vertical plasma drift. The instability process results in the structuring of ionosphere into plasma irregularities of wide ranging scale sizes. These irregularities are of two types: those confined to the F layer bottom-side, and those that develop upward to dominate also the topside ionosphere. We investigate the relative importance of the different ionospheric parameters driving the generation of rising bubble type and bottom type spread F (ESF) irregularities. Digisonde data from the equatorial and low latitude locations in Brazil for the complete month of October 2001, a solar maximum epoch (F10.7=210), and October 2008, an extended solar minimum period (F10.7=70), are analyzed to examine the spread F intensity and occurrence rate as a function of the evening prereversal vertical drift velocity, and the corresponding F layer heights and the bottom-side density gradient. While the ESF observed at an equatorial site is indicative of both the bottom-side irregularities and rising bubbles, the ESF at low latitude represents exclusively the latter. Comparison of the results, from the two epochs, reveals large decrease in the intensity and occurrence rate of plasma bubbles, with decrease in solar flux. But notable increase in these characteristics is observed in the case of bottom-side spread F. It is found that a larger (steeper) density gradient of the F layer bottom-side that is present under low solar flux condition is responsible for an enhanced Raleigh-Taylor (R-T) instability growth, counter-balancing a reduction in this rate that may

arise from a smaller prereversal vertical drift and lower layer height that also characterize the low solar flux condition. Thus the role of the bottom-side density gradient in the ESF instability growth has been identified for the first time in terms of its ability to explain the contrasting irregularity features as observed during solar flux maximum and minimum years.

Short bio: Mangalathayil A. Abdu is currently senior research at Technological Institute of Aeronautics (ITA), Brazil. He earned the Ph.D. degree in Ionospheric Physics from University of Gujarat, India, in 1967. The main interest fields are Solar-terrestrial Physics, Space Geophysics with an emphasis on Space and Atmospheric Sciences and in Physics of Ionosphere and Aeronomy. He was responsible for the establishment of several ionospheric observatories in Brazil, when served as a researcher at INPE from 1973 to 2015.(Source: Curriculo Lattes)

PHYSICS AND CHEMISTRY OF THE NEUTRAL ATMOSPHERE
Invited Speakers

Dr. Paulo Prado Batista
National Space Research Institute, INPE, Brazil

Invited speaker of the session Physics and Chemistry of the Neutral Atmosphere: Wednesday, March 24, 2021, 02h00-02h40 p.m.

Middle Atmosphere research at INPE: History, present situation, and future

ABSTRACT

The National Institute for space research (INPE) develops since it was created in 1961, researches in the neutral and ionized atmosphere from ground to space limits. The region between $\sim$ 20 and 110 km of altitude, called "Middle Atmosphere", and especially the part between $\sim$ 80 and 110 km called "Upper Mesosphere and lower Thermosphere (MLT)" displays a wide variety of chemical and physical phenomena. This region of the atmosphere is not easily accessible by conventional in situ measurements for being too high, or by satellites for being too low. However, there are several ways to measure remotely their chemical and physical properties. This facility for measurements arises from properties and natural phenomena that occur on it. The electromagnetic wave scattering, on several spectral bands, by neutral and ionized molecules and atoms can be measured from ground-based radars. In the MLT region occurs the ablation of a number of meteors coming from space, and these meteors deposit many metal elements (Fe, Mg, Na, K, etc.) that modify the region chemistry and act as local movement tracers. Passive methods can also be used by measuring the light emitted by exited atoms and molecules (Airglow) that concentrate into layers in this region. INPE has started neutral atmosphere research by using a Light detection and Ranging (Lidar) in 1968, initially measuring the aerosol load present in the atmosphere at around 20 km altitude. After 1972 the same Lidar started to measure the Sodium density in the MLT with all the instrumental devices developed at INPE. After 1999 the research on the MLT dynamics had a great impulse with the installation of a Meteor Radar at Cachoeira Paulista, SP. Radars in

the equatorial region (São João do Cariri, PB), and in middle-low latitude (Santa Maria, RS) were deployed in 2004. With the two instruments and added by Airglow measurements many works were published aiming the understanding of the Atmospheric Waves (Planetary Waves, Tides and Internal Gravity Waves) and its role in the coupling among several atmospheric layers. The original Lidar, which was used also to measure the mesopause temperature, went broken on October 2016, but another Lidar with two channels aimed to measure simultaneously the Sodium and Potassium started to work on November 2016 due to a cooperation with China/NSSC/CAS through the China-Brazil Joint laboratory for Space Weather. In this presentation, I will talk about the history of the instruments and, will give the main scientific results obtained in the past and nowadays. We will present the future possibilities, mainly those that will come from the collaboration with China, including the deployment of an Advanced Lidar able to measure density, temperature, and winds from the ground to the thermosphere. These systems, the present and the future have great capacity to aggregate researchers and generate research opportunities to new Master and Doctors for many years ahead.

Short bio: Dr. Paulo P. Batista é bacharel em Física pela Universidade Federal de Goiás (1972), mestre em Geofísica Espacial pelo Instituto Nacional de Pesquisas Espaciais (1976), doutor em Geofísica Espacial pelo Instituto Nacional de Pesquisas Espaciais (1983) e Pós-Doutorado pela Boston University (USA) em 1987. Atualmente é pesquisador titular do Instituto Nacional de Pesquisas Espaciais. Tem larga experiência na área de Geociências, com ênfase em Geofísica da Alta Atmosfera, atuando principalmente nos seguintes temas: Dinâmica da região da Mesosfera e Baixa Termosfera, Marés Atmosféricas, Ondas Planetárias e ondas de Gravidade com a utilização de técnicas de Aeroluminescência Atmosférica, Radar de Laser (Lidar), Radares Meteóricos e Satélites. (Fonte: Curriculo Lattes)

Dr. Yang Guotao
State Key Lab. of Space Weather, NSSC, China
China-Brazil Joint Laboratory for Space Weather

Invited speaker of the session Physics and Chemistry of the Neutral Atmosphere: Tuesday, March 23, 2021, 02h20-03h00 p.m.

The development of the comprehensive lidar station in Yanqing and upper atmospheric study with lidar data

ABSTRACT

A lidar station was constructed in 2009 in Yanqing (40.5°N, 116.0°E), under the support of Chinese Meridian Project. This lidar is a dual -wavelength lidar, mainly for sodium and atmospheric density observations. The signal noise ratio of this lidar is so high, and then the observations with high spatial or temporal resolutions have been done. Later, based on this lidar, we successfully get the daytime sodium atom layer measurements, as well as the potassium layer detection. Otherwise, under the support of NSFC of China and the State Key Lab, an all solid sodium temperature/wind lidar and a Doppler wind lidar were also developed in recent years. And now we are working on the Ni, Ca+ and Ca layers detection with a new telescope and lasers. Thus a comprehensive lidar station has been developed in Yanqing. Very large amounts data have been obtained by the above lidars, and upper atmospheric study was done with these data. The study mainly includes the properties of mental layers study and gravity wave study: A series of low-thermospheric sodium layer cases were detected by Yanqing lidar and it aroused people's interest worldwide to study sodium layers at high altitudes; The maximum of the seasonal variation of potassium layer density is in winter, different with other potassium lidar observations; The gravity wave activity above Yanqing was obtained and was compared with other lidar results in China. Until now, based upon Yanqing lidar data, more than 30 papers has been published.

SPACE WEATHER AND SUN-EARTH CONNECTIONS
Invited Speakers

Dr. Norbert Jakowski
Institute for Solar-Terrestrial Physics, German Aerospace Center, Kalkhorstweg 53, 17235 Neustrelitz, Germany

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Invited speaker of the session Space Weather and Sun-Earth Connections: Thursday, March 25, 02h00-02h40 p.m.

GNSS based indices for studying and characterizing the ionosphere

N. Jakowski[1] and M. M. Hoque[1]
[1] Institute for Solar-Terrestrial Physics, German Aerospace Center, Kalkhorstweg 53, 17235 Neustrelitz, German

ABSTRACT

The Earth's ionosphere is impacted by space weather processes and simultaneously contributes also to space weather effects on technical systems. Thus, terrestrial and trans-ionospheric radio signals used in telecommunication, navigation or radar systems may be adversely affected by space weather effects of ionospheric origin. In particular, safety of life and precision applications of Global Navigation Satellite Systems (GNSS) require key information on space weather conditions to warn users if certain protection or accuracy levels are violated due to severe ionospheric perturbations. To fulfill customer needs, the complex interaction of geospheres such as magnetosphere, thermosphere and ionosphere in particular during solar radiation and solar wind driven space weather events has to be monitored and investigated in a systematical way. Taking into account that ionospheric perturbations may seriously degrade the performance of GNSS and other trans-ionospheric radio systems like remote sensing radars, current efforts to characterize the perturbation degree of the ionosphere appropriately will be discussed. The use of geomagnetic indices for characterizing ionospheric perturbations as often

practiced is not sufficient to fulfill challenging customer needs when considering quite different spatial and temporal scales of ionospheric behavior. In order to provide the required ionospheric information, numerous attempts have been made to use GNSS based ionospheric variables for estimating type and strength of ionospheric perturbations.

Dr. Sergio Dasso
IAFE (UBA-CONICET), Buenos Aires, Argentina
DCAO-DF (FCEN/UBA), Buenos Aires, Argentina

Invited speaker of the session Space Weather and Sun-Earth Connections: Thursday, March 25, 2021, 09h20-10h00 a.m.

Dynamical evolution of solar ejecta in the interplanetary medium. Consequences on geo-effectiveness and cosmic rays

ABSTRACT

Interplanetary manifestation of Coronal Mass Ejections (ICMEs) are consequence of coronal magnetic instabilities. When these solar ejecta travel in the heliosphere, they transport huge amounts of mass, energy, magnetic flux, and helicity. They also affect the flux of energetic particles in the solar wind. ICMEs contain different plasma and magnetic field properties, compared with those of the ambient solar wind, which can strongly perturb the geo-space. These transients are the most geo-effective heliospheric objects, with major consequences on new technologies and on live in space. Different physical mechanisms occur during their evolution, and thus determine their impact on the space environment of Earth. These mechanisms include expansion, erosion, dynamics of fluctuations and turbulence, accretion of magnetic field, and drag. The identification of the composing sub-structures, their global 3D shape, as well as how the plasma and magnetic field are typically distributed inside them, are crucial to understand these interplanetary objects. In the present talk I will present a general review of these aspects of ICMEs. In particular, I will focus on the recent observations and models, and will also present some results of the Space Weather laboratory recently deployed by our LAMP (Laboratorio Argentino de Meteorología del esPacio) group in Antarctic, where a cosmic rays detector was installed. The results presented here will help to better understand the interaction of ICMEs with planetary magnetic environments, and in particular to improve the forecast of the solar-terrestrial coupling.

Dr. Walter Demetrio Gonzalez Alarcon
Laboratório Conjunto Brasil-China em Clima Espacial (CBJLSW), China/Brazil

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Invited speaker of the session Space Weather and Sun-Earth Connections: Thursday, March 25, 2021, 10h50-11h30 a.m.

A multi-scale satellites mission to study magnetic reconnection at the Earth's magnetosphere

ABSTRACT

This paper presents a review on multi-scale satellites mission to study magnetic reconnection at the Earth's magnetosphere.

Short bio: Walter Demetrio Gonzalez Alarcon possui graduação em Fisica - Universidad Nacional de Ingenieria (1967), mestrado em Geofísica Espacial pelo Instituto Nacional de Pesquisas Espaciais (1969) e doutorado em Física - University of California - Berkeley(1973). Trabalhou na Universidade de Stanford, Universidade de Caltech e no laboratório JPL da NASA. Atualmente é pesquisador titular nível III do Instituto Nacional de Pesquisas Espaciais. Tem experiência na área de Geociências, com ênfase em Geofísica, atuando principalmente nos seguintes temas: reconexão magnética, tempestades geomagnéticas, atividade solar e física do meio interplanetário, magnetosferas planetárias e interação do vento solar com a magnetosfera terrestre. (Fonte: Curriculo Lattes)

PHYSICS OF PLASMAS
Invited Speaker

Dr. Vladimir Jesus Trava Airoldi
Instituto Nacional de Pesquisas Espaciais (INPE), Laboratório Associado de Sensores e Materiais (LABAS), Brazil

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Invited speaker of the session Physics of Plasmas: Monday, March 22, 2021, 02h20-03h00 p.m.

Recent studies on plasma discharge used for studies and production of DLC (diamond-like carbon) films

ABSTRACT

Deposition systems of thin carbon films, for example, DLC (Diamond-like Carbon) have diversified quite a lot. The unique properties of these types of coatings and the numerous areas of applications have led many studies beyond the techniques used for its creation, IBAD (Ion Beam Assisted Deposition) and the most used in commercial system, PVD (Physical Vapor Deposition). In this work will be shown the advances with the technique PECVD (Plasma Enhanced Chemical Vapor Deposition), evidencing a new concept that involves a process of confinement of charges (electrons and ions). This confinement process will provide a greater control of the DLC deposition process as a function of the inner parameters that influence the properties of the respective coating, including a structure with controlled hydrogen density, as named by amorphous hydrogenated carbon DLC films (a-C:H). These studies have been supported by the advantages of new applications and scientific appeals of strong impact. Superior properties such as: lower coefficient of friction, higher chemical inertness, higher hardness, higher wear resistance, biocompatibility, bactericide action, higher adhesion on different substrates materials, etc.. However, a very big challenge concerning scientific and technological affairs need to be overcome, especially concerning with residual stress, improvement of adhesion for huge applications and thickness. So, in this presentation a Pulsed DC PECVD technique that was modified with the confinement of electrons and of ions inside of an additional cathode, in cold plasma discharge will be discussed, including some properties of the plasma

at very low pressure (collision less process) and some data from Langmuir probe. Some superior DLC properties, as some examples, will be presented and discussed in details. Also, low cost, easy operation, scalable for big volume was, also, shown to be feasible and some remark will be presented too.

Short bio: Dr. Vladimir Jesus Trava Airoldi possui graduação em Física pelo Instituto de Física da Universidade de São Paulo (1978), mestrado em Física pelo Instituto Tecnológico de Aeronáutica (1981), doutorado em Física pelo Instituto Tecnológico de Aeronáutica (1986) e pós-doutorado no Jet Propulsion Laboratory - NASA/USA e California Institute of Technology - CALTECH/USA (1989-1990). Atualmente é pesquisador sênior do Instituto Nacional de Pesquisas Espaciais - INPE, professor e orientador no curso Pós-Graduação em Engenharia e Tecnologia Espaciais do INPE e orientador no curos de Pós-Graduação em Engenharia e Ciências de Materiais, Coordenador de projetos em Pesquisa, Desenvolvimento e Inovação (P & D &I) no INPE e coordenador de projetos de inovação em Ciência e Tecnologia em Pequenas Empresas. Tem foco de pesquisa e desenvolvimento na área de Engenharia de Materiais e Metalúrgica, com ênfase em Diamante CVD e DLC, filmes finos, descargas em plasma, expansão de gases, física de moléculas, tecnologia de vácuo e criogenia, nanoestruturas, estruturas monocristalinas e estruturas monocristalinas. Atua, principalmente nos seguintes temas: estudos de crescimento e caracterização de filmes finos e espessos, especialmente de diamante-CVD e DLC nano estruturados, poli cristalinos e monocristalinos, estudos de modificação de superfícies e adequação de interfaces para estudos de aderência entre filmes de Diamante-CVD e de DLC com substratos metálicos e não metálicos, alívio de tensões destes filmes, Diamante-CVD com estruturas monocristalina, estudos em tribologia e desenvolvimento e concretização de aplicações espaciais e industriais. Participa do aperfeiçoamento de processos de empreendedorismo em inovação, com busca de dados, informações de demanda e com pesquisas específicas. Participa de atividades de transferências de tecnologias, e estudos de escalonamentos industriais. Sócio fundador de empresa de Inovação na área de Diamante-CVD e seus Materiais Relacionados. (FONTE: Currículo Lattes)

Dr. Evaldo Jose Corat
Instituto Nacional de Pesquisas Espaciais (INPE), Brazil

Invited speaker of the session Physics of Plasmas: Monday, March 22, 2021, 02h20-03h00 p.m.

Title

ABSTRACT

Short bio: Dr. Evaldo Jose Corat possui graduação em Física pelo Instituto de Física Gleb Wataghin (1982), mestrado em Física pelo Instituto Tecnológico de Aeronáutica (1986) e doutorado em Física pelo Instituto Tecnológico de Aeronáutica (1993). Atualmente é pesquisador titular - Laboratório Associado de Sensores e Materiais do Instituto Nacional de Pesquisas Espaciais. Tem experiência na área de Materiais de Carbono produzidos por CVD, atuando principalmente nos seguintes temas: diamante cvd, filmes finos, filmes espessos, aderência e interfaces, nanodiamante, diamond-like carbon (DLC), nanotubos de carbono e grafenos. (FONTE: Currículo Lattes)

SOLAR PHYSICS, INTERPLANETARY MEDIUM AND PLANETARY MAGNETOSPHERES

Invited Speaker

Dra. Maria Hebe Cremades
CONICET, Mendoza, Argentina

Invited speaker of the session Solar Physics, Interplanetary Medium and Planetary Magnetospheres: Wednesday, March 24, 2021, 09h20-10h00

Expansion of coronal mass ejections from the low to the outer corona

ABSTRACT

Coronal mass ejections (CMEs) constitute the most spectacular dynamic events in the solar system, and are key players in determining space weather conditions. So far, it has been impossible to predict when a CME will erupt from the Sun, thus the best attempt at forecasting is to assess if and how they will impact Earth once erupted. Understanding how magnetic fields are organized within CMEs and how they evolve from the low corona into the heliosphere, is crucial. The stereoscopic-view images provided by the STEREO/SECCHI instrument suite in combination with images from Earth's perspective recorded by SDO/AIA and SOHO/LASCO provide a unique opportunity to study the morphological evolution of CMEs. The set of CMEs under study arises from an appropriate combination of spacecraft vantage points and CME propagation direction, which is helpful to reduce uncertainties in their forward modeling. These events are carefully analyzed as they originate low in the corona by means of simultaneous multi-viewpoint observations in the extreme UV, and followed up to the outer fi elds of view of the STEREO and SOHO coronagraphs. In particular, we examine how CMEs expand along their main symmetry axis and orthogonal to it, as well as the evolution of their global configuration.

ASTRONOMY AND ASTROPHYSICS
Invited Speaker

Dr. Raimundo Lopes de Oliveira Filho
Universidade Federal de Sergipe (UFS), Brasil

Invited speaker of the session Astronomy and Astrophysics: Friday, March 26, 2021, 02h00-02h40 p.m.

Opportunities from the X-ray Astronomy

ABSTRACT

X-ray Astronomy deals with many of the most extreme physical conditions in the Universe including very low or high densities, unusually hot plasma, and strong magnetic fields. In fact, being produced by more than half of the baryons in the Universe, X-rays are associated with almost all kind of astrophysical systems such as hot gas permeating galaxy clusters and galaxies, active galactic nuclei, stars and their remnants, and bodies in planetary systems as planets, moons and comets. The atmosphere is opaque to X-rays so X-ray Astronomy is only carried out from above atmosphere by lifting scientific payloads aboard rockets, balloons, and satellites. Thus, as a branch of the space exploration that makes it possible only in the past 60 years, X-ray Astronomy is a recent field when compared to the modern optical Astronomy which was born with the first telescopes in the early 1600s. In spite of this, its rapid growth and remarkable contributions have opened new horizons in science. While involving state-of-the-art technology and demanding substantial funding to support it, X-ray Astronomy is marked by open access with every researcher being able to ask for observations in the vast majority of X-ray satellites and also explore their public rich, archival observations. This is important not only to maximize the results of the missions but, in another perspective, also to promote the development of research in developing countries. In this talk, I will contextualize the reasoning above and present some examples and paths that can be followed to explore X-ray Astronomy and its potential to contribute to the Brazilian Astronomy at low cost.

Short bio: Raimundo L. de Oliveira Filho é atualmente professor associado no Departamento de Física da UFS. Graduou-se bacharel em Física (UFBA), mestre e doutor em Ciências (USP) e Doutor em Astrofísica (Université de Strasbourg, França). Pós-doutoramentos em Astrofísica (USP e NASA). Encontra-se envolvido em pesquisa científica, formação de graduandos e de pós-graduandos na UFS e no Observatório Nacional (RJ), e interação sociedade-ciência. Coordena o grupo AstrALe de estudos e iniciação à pesquisa em Astrofísica de Altas Energias na UFS. (Fonte: Currículo Lattes)

INCT GNSS NavAer: INTEGRATING SPACE WEATHER, GEODESY AND AIR NAVIGATION
Invited Speakers

Dr. Samuel Phillip Pullen
GNSS Laboratory at Stanford University, USA

Invited speaker of the special session INCT GNSS NavAer: Integrating Space Weather, Geodesy and Air Navigation: Friday, March 26, 2021, 11h40-12h20 a.m.

Lessons learned from the development of ionospheric monitoring for ground-based and satellite-based augmentation of GNSS

ABSTRACT

Ground-based and Satellite-based Augmentation Systems (GBAS and SBAS) provide differential corrections and integrity information that allow GNSS satellite range measurements to be used for aviation applications with demanding accuracy and safetyof-life requirements, such as not having unsafe and undetected errors occur more than once per ten million flight operations. Unusual variations in ionospheric delays that affect GNSS range measurements are one of the most challenging error sources that must be monitored by these systems. In mid-latitude regions where most GBAS and SBAS users reside, the ionosphere is almost always well-behaved spatially and temporally; thus almost all of the ionospheric delay is removed by applying differential corrections. The limited ionospheric data available in the late 1990's made it appear that anomalous ionospheric conditions driven by ionospheric storms or solar CMEs would create larger but manageable errors. However, early results from SBAS and CORS ground networks in the early 2000's discovered spatial gradients exceeding 300 mm/km during ionospheric anomalies caused by a powerful CME in October 2003. Gradients of this magnitude severely violated the "smoothness" assumptions of SBAS ionospheric fitting and created the potential for unsafe errors even for GBAS corrections generated a few kilometers from users. As a result, both systems had to be significantly modified to include real-time monitoring of ionospheric behavior and methods to calculate and verify bounds on anomalous ionospheric residual errors (after corrections and monitoring) that satisfy the integrity

requirements mentioned above. This presentation describes how these GBAS and SBAS ionospheric monitors and error bounds were developed and the performance and availability that they provide in the Conterminous United States (CONUS). The focus is on “lessons learned” from this process regarding (1) creating data-driven models representing anomalous ionospheric behavior; (2) adapting to constraints on what can be observed in real time; and (3) managing the development of safety-critical systems when surprising new threats are discovered. The implications of these lessons on newer systems that are affected by ionospheric behavior and safety-critical systems in general are also discussed.

Short bio: Sam Pullen is a senior researcher within the GNSS Laboratory at Stanford University, where he received his Ph.D. in Aeronautics and Astronautics in 1996. He has supported the FAA and other service providers in developing system concepts, technical requirements, integrity algorithms, and performance models for GBAS, SBAS, and other augmentations and applications of GNSS. He has also performed GNSS system design, application development, risk assessment, and legal support through his consultancy, Sam Pullen Consulting. He was awarded the ION Early Achievement Award in 1999 and became an ION Fellow in 2017.

Dr. Natali Caccioppoli
Eurocontrol, France

Invited speaker of the special session INCT GNSS NavAer: Integrating Space Weather, Geodesy and Air Navigation: Friday, March 26, 2021, 09h50-10h30 a.m.

GBAS (GAST-F) ionosphere impact using GBASMessenger with latest updates

ABSTRACT

The presentation will provide some short fundamental on GBAS, considering the GAST-F developments, and discuss about the ionosphere impact during the use of the module GBASMessenger of PEGASUS. The data included in the analysis present high level of ionosphere scintillation.

Short bio: Natali Caccioppoli studied radio-electronic navigation, and telecommunication engineering, at "Universitá degli Studi di Napoli Parthenope", Italy, holding two laurea degrees (cum laude). In 2003, he was appointed as Fellow Researcher at the "G. Latmiral" Engineering School granted by the Italian aerospace research centre (CIRA) working on GNSS Signal Processing. In 2007, he joined the EUROCONTROL HQ (Belgium) as internship, and then, since October 2008, he has been working as GNSS Operational Validation Expert Consultant at EUROCONTROL Experimental Centre (France) in the domain of GNSS aviation applications (EGNOS, GBAS using GPS and GALILEO). To date, he contributes to the development and validation of PEGASUS Tool, assisting the EUROCONTROL project stakeholders (SESAR 2020) to evaluate the technical feasibility of systems prototypes, for both mainline and business aircraft, providing the first level of technical validation (performance and functional), and contributing to the standardization and rulemaking EUROCONTROL's activities. Since June 2017, he earns the IATA AvMP Designation issued by Stanford University (USA) and IATA, demonstrating his commitment to the aviation profession, and expertise, by validating his education, and competency. Thanks to his past academia working experience and to the experience gained during PEGASUS training courses for EUROCONTROL IANS, as well as to international public and private research institutions, he demonstrated ability to summarise information, explaining the aims, results and conclusion tailoring the communication to the needs and knowledge level of the audience.

Oral Presentations - Ionosphere: Earth and Other Planets

Differences of the northern equatorial ionization anomaly between the eastern Asian and American sectors

D. Zhang[1]

[1] Peking University, China.

ABSTRACT

The morphological difference of the northern Equatorial Ionization Anomaly (EIA) between the eastern Asian and American sectors is statistically studied with total electron content (TEC) from 2000 to 2011. The intensity (Ic), latitudinal location (Lc),

and occurrence time (Tc) of the daytime EIA crest are derived from daytime peak TEC in time- latitude plots. The main results are as follows. Lc in the two sectors exhibits an apparent

difference, especially in solar minimum, during which Lc in the American sector shows an annual variation that is more poleward in northern summer and more equatorward in northern winter,

while Lc in the eastern Asian sector shows a semi-annual variation that is more poleward around equinoxes and more equatorward around solstices. Ic tends to be stronger in the eastern Asian sector than in the American sector in all seasons, and this difference increases with the increase of the solar flux index. Tc tends to be earlier in northern winter and later in northern summer in both sectors and shows dependence on solar activity. We demonstrate that the seasonal variation of Lc in the American sector is not dominated by the ionospheric equatorial zonal electric field, and suggest that the difference of Lc between the two sectors is probably related to different meridional wind effects due to the displacement of geographic and magnetic equators. The Ic difference is probably related to the longitudinal wave number−3 and −4 structures driven by tidal forcing from the lower atmosphere.

Vertical scales of gravity-wave origin TIDs detectable by imagery of the redline nightglow

F. Vargas[1], G. Swenson[1], P. Terra[2], C. Brum[2]

[1] University of Illinois at Urbana- Champaign, USA

[2] Arecibo Observatory, Puerto Rico.

ABSTRACT

We report here simulations of the volume emission rate (VER) of the O(1D) redline nightglow perturbed by TIDs of gravity wave origin traveling across the thermosphere at around 250 km altitude. These TIDs perturb the electronic and neutral background densities and temperatures in the region and modify the O(1D) layer intensity as it is captured by ground-based nightglow instruments. The changes in the integrated volume emission rate are calculated for various vertical wavelengths of the perturbations. We demonstrate that, as the solar activity intensifies, the vertical scales of most likely observable TID waves become

larger. For high solar activity, we demonstrate that only waves presenting vertical wavelengths larger than 360 km are likely to be observed. The variation of the range of likely observable vertical wavelengths with the solar cycle offers a plausible explanation for the low occurrence rate of TID in measurements of the redline nightglow during high solar activity periods. In comparison with observation, we verify that observed vertical wavelengths distribute around 140- 210 km, in good correspondence with our predicted threshold wavelength $\approx$ 160 km for very low solar cycle period.

Ionosphere response to the partial solar eclipse of 11/08/2018 according to oblique sounding of the ionosphere in the Eurasian region

V. P. Uryadov[1], F. I. Vybornov[1], V. I. Kurkin[2], Alexander V. Pershin[1], Olga A. Sheiner[1]

[1] Radiophysical Research Institute Nizhny Novgorod State University, Russia;

[2] Institute of Solar Terrestrial Physics SB RAS, Irkutsk, Russia.

ABSTRACT

This work is devoted to study the solar eclipse effect to ionosphere parameters. To study the ionosphere response to the partial solar eclipse (on August 11, 2018), the method of oblique sounding of ionosphere by the chirp signals was applied, and paths of various lengths and orientations were used. Chirp transmitters are located at the following points: Lovozero, Murmansk reg. (68N; 35.02E), Norilsk (69.36N; 88.36E), Irkutsk (51.8N; 104E), and Khabarovsk (47.5N; 134.5E). The receiving of chirp signals was carried out in Vasilsursk, Nizhny Novgorod Region (56.1N; 46.1E) and Nizhny Novgorod City (56.1N; 44.1E). The influence of the solar eclipse was manifested: a) a decrease by 8-10% in the maximum observed frequency (MOF) in all paths when reflected from the F layer of the ionosphere, b) an increase in MOF by 15% when reflected from the Es layer of the ionosphere on the Lovozero-Vasilsursk path. The results of oblique sounding were used to detect acoustic-gravitational waves (AGW) during a partial solar eclipse.

Assessment of GNSS tracking loop structures for retrieval of phase variations induced by ionospheric scintillations

R. A. M. Lopes[1], F. D. Antreich[2]

[1] Instituto Nacional de Pesquisa Espacial (INPE), Brazil

[2] Instituto Tecnológico de Aeronáutica (ITA), Brazil.

ABSTRACT

Transient fluctuations of electron content inside regions of the ionosphere interact with propagating radio waves, resulting in scintillations. For global navigation satellite systems (GNSS) in particular, ionospheric scintillations can have a significant impact, since the induced distortions of the satellites emitted signals can reduce the level of availability, accuracy, continuity, and integrity of such systems. The signal processing channels in a GNSS receiver perform Doppler dynamics and code delay tracking of acquired GNSS satellite signals. The ionospheric scintillation manifests in the receiver as one source of amplitude and phase variation adding up to the Doppler and phase dynamics, introducing disturbance to the tracking algorithms in the receiver that may imply in the reduction of precision in the downstream positioning computations and eventually in the loss of lock of the respective satellite signal. In this work we investigate the effects of phase variations in the receiver's Doppler tracking loops via computer simulations of a receiver model. We consider a traditional coherent phase-lock loop (PLL), a traditional noncoherent phase-lock loop/frequency-lock loop (PLL/FLL) and a noncoherent PLL/FLL Kalman filter, while code delay tracking is performed by a traditional delay-lock loop (DLL) with a noncoherent early-late discriminator. We compare the responses to low and high frequency phase variations and to synthetic scintillation phase variations generated by Cornell scintillation model (CSM), evaluating the capability of phase variations retrieval in each structure. The simulation results underpin the frequency separation inherently imposed by the traditional PLL-FLL structure, where Doppler dynamics are tracked at low frequency while phase variations can be recovered with a lead-lag effect induced by the band-pass loop response. Exploiting a linear approximation of the traditional PLL permits recovery

of phase variations in a wider frequency interval, but limited to a region for which this approximation is valid. The Kalman PLL/FLL structure can provide advanced Doppler dynamics tracking and phase variation estimates for subsequent scintillation monitoring purposes.

Evidence of interaction between Equatorial Plasma Bubble, Medium-scale Traveling Ionospheric Disturbances, and Midnight Brightness Wave

C. A. O. B. Figueiredo[1], C. Wrasse[1], H. Takahashi[1], Y. Otsuka[2], K. Shiokawa[2], R. Buriti[3], I. Paulino[3], D. Silva[1]

[1] Instituto Nacional de Pesquisas Espaciais

[2]Institute for Space-Earth Environmental Research, Nagoya University

[3]Universidade Federal de Campina Grande, Brazil

ABSTRACT

Observation of equatorial plasma bubbles (EPBs), mediumscale traveling ionospheric disturbance (MSTID), and midnight brightness wave (MBW) were made using the OI 630 nm emission by an All-Sky imager located at Cachoeira Paulista, Brazil (22.7°S, 45.0°W, magnetic dip latitude ∼20°S, referring to 2015) on the night of September 17-18, 2015. The EPBs were observed moving eastward while the MSTID propagated northwestward with the wavefront aligned to southwest-northeast. On the other side, the MBW was observed moving to south-southwest. After the interaction between the MSTIDS and the EPBs, the latter became tilted, grew and narrowed. This effect could be associated to the ExB drift and also to changes in the neutral wind. Furthermore, an MBW also interacts with EPB and fills the EPB edge with plasma transforming it into a bright structure.

Equatorial plasma bubble observation campaign

H. Takahashi[1], I. Paulino[2], C. M. Wrasse[3], F. Rodrigues[3], R. A. Buriti[2], P. R. Fagundes[2], E. Correa[5], J. Souza[1], C. Nardin[1], E. Paula[1], P. P. Batista[1], M. Bolzan[6], M. A. Milla[7]

[1] Instituto Nacional de Pesquisas Espaciais, INPE, Brazil
[2] Universidade Federal de Campina Grande, Brazil
[3] University of Texas at Dallas, UTD, USA
[4] Universidade do Vale do Paraiba, UNIVAP, Brazil
[5] Instituto Presbiteriano Mackenzie, CRAAM, Brazil
[6] Universidade federal de Jatai, Brazil
[7] Radio Observatorio de Jicamarca, Instituto Geofísico del Peru, Peru

ABSTRACT

As a part of the SBGEA activity, observational campaign of Equatorial Plasma Bubbles (EPBs) over South American equatorial and low latitude region was planned to carry out in 2020-2023. Scientific goal of the campaign is to study on seeding process of the Equatorial Plasma Bubbles, contribution of atmospheric gravity waves and traveling ionospheric disturbances. First workshop on the campaign was held at INPE, São José dos Campos, 25-26 September, 2019, where discussed in the observation sites, possible instrumentations, and the campaign period. The results of the workshop will be summarized and presented proposed a campaign scheme.

Spectral modelling for tec map reconstruction using F10.7 index

K. T. P. Ruppenthal[1,2], A. Petry[1], E. Mattos[1], Telmo S. Klipp[1], Victor D. Bento[1]

[1]Instituto Nacional de Pesquisas Espaciais, INPE, Brazil

[2]Federal University of Santa Maria (UFSM), Brazil

ABSTRACT

In the ionosphere, the variations of Total Electron Content (TEC) are strongly related to the solar activity, which can be evaluated using F10.7 index. In this context, we developed a method to reconstruct the TEC maps daily variation for any given F10.7 value. The method is based on the analysis of a three-years period (2014-2016) of TEC data provided by The International GNSS Service (IGS), and the correspondent daily F10.7 index values in the period, produced by the Solar Irradiance Platform. Each geographic location in IGS TEC maps was evaluated individually, and the set of TEC values for a given day is first transformed to the frequency domain by applying the Discreet Fourier Transform (DFT) and then associated to the correspondent F10.7 value. The process is repeated for every day in the period evaluated, and individual plots of each one of the DFT coefficients versus F10.7 values were generated. After that, a linear regression technique was used to estimate the best fit to the data, using the Least Squares Method and Cramer's Rule. The resulting linear curves (one for every DFT coefficient, in every geographic location) were able to model the TEC variability for any F10.7 value by just reversing the process, i.e. the curves are used to estimate the correspondent DFT coefficients, and the inverse DFT of these coefficients provides TEC variability in a day. Comparisons for the year 2017, not used in the modelling process, between IGS data and the reconstructed TEC maps using the proposed approach showed good agreement with daily and seasonal TEC variations. We observed daily Root Mean Squared Error (RMSE) close to 5 TECU in the whole period, except in three occasions, with duration of 2-8 days each, possibly related to unusual fast F10.7 peak events due to geomagnetic perturbations. Geographic distribution of error showed slight increase near magnetic Equator.

Disturbance dynamo electric field in the formation of strong sporadic E-layers over Boa Vista, a low latitude station in american sector

L. C. A. Resende[1,2], J. Shi[1], C. M. Denardini[2], I. S. Batista[2], P. A. B. Nogueira[3], C. Arras[4], V. F. Andrioli[1,2], J. Moro[1,6], L. A. Silva[1,2], A. J. Carrasco[5], P. F. Barbosa[2,7], C. Wang[1], L. Zhengkuan[1]

[1] State Key Laboratory of Space Weather, Beijing, China,

[2] Instituto Nacional de Pesquisas Espaciais, INPE, Brazil

[3] Federal Institute of Education, Science and Technology of São Paulo, Brazil

[4] Helmholtz Centre Potsdam, German Research Centre for Geosciences (GFZ), Germany,

[5] University of Los Andes, Mérida, Venezuela

[6] Southern Regional Space Research Center CRS/COCRE/INPE, Brazil,

[7] Salesian University Center São Paulo, Campus São Joaquim, Brazil

ABSTRACT

The formation of strong sporadic E-layers (Es) is frequently observed during the recovery phase of the magnetic storms over Boa Vista (BV, 2.8°N, 60.7°W, dip = 18°), a low latitude region over the Brazilian sector. To provide some explanation for this behavior, we investigated in detail the ionospheric response to the disturbed electric fields in these atypical Es layers appearance during the magnetic storm of 21-22 January 2016. The analysis was based on F region and Es layers ionospheric parameters obtained from digisonde, as well as on the Total Electron Content (TEC) obtained from Global Navigation Satellite System (GNSS). Furthermore, a theoretical model for the E region named MIRE (Portuguese acronym for E Region Ionospheric) is used to simulate the Es layers development. Such simulation takes into account the E region winds and electric fields. The results show that the storm time electric field is enough to drive the strong Es layers development. Moreover, it is seen that the intensification of the Es layers is related to the inhibition of the F-region pre-reversal enhancement of the vertical drift due to a westward electric field during the disturbance dynamo effect. Finally, the combined results from the model and observational data seemed to contribute significantly to advance our understanding of the role of the electric fields in the Es layer formation.

Energetic particle dynamic on the radiation belts and the generation of the sporadic E- layer (Esa) on the SHMA

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ABSTRACT

The energetic particle population in the radiation belts can be affected through the coupling between the solar wind structures and the Earth's magnetosphere. When such particles precipitate into the upper atmosphere they may also affect both the ionosphere and the neutral atmosphere, especially at high-latitudes and the Southern Hemisphere Magnetic Anomaly (SHMA). Presently, the impact of the energetic particle precipitation into the high-latitude ionosphere is well understood. On the other hand, the direct impact into the SHMA ionosphere is still lacking in more information. Therefore, a case study (May 28, 2017) is selected during the strong geomagnetic-storm (Dst: -125 nT) associated with an Interplanetary Coronal Mass Ejection. The Van Allen Probes recorded a significant reduction on the radiation belts electron fluxes concomitant with a shock detected by ACE-satellite in the Interplanetary Medium. Particles in a wide range of energy levels were lost to the atmosphere. POES satellite data and FengYun series spacecraft 3C confirm a strong increase of the energetic particle flux in the SHMA region during this storm. Data from a digisonde installed near the center of the SHMA (29.68°S, 53.81°W) show the type sporadic E-layer (Esa), unusual in low-latitudes, during several hours. The increase of charged particles in this region can be related to the generation of the Esa layers, which occurrence is associated with particle precipitation. We conclude that the radiation belt dynamics, as well as the particle precipitation on the SHMA region during this storm, are the main components responsible for the generation of the Esa layers over the Brazilian region.

2021 VIII SBGEA Simpósio Brasileiro de Geofísica Espacial e Aeronomia & VIII SIMFAST Simpósio de Física e Astronomia do Vale do Paraíba
22 a 26 de março | 2021
Univap | Campus Urbanova
Av. Shishima Hifumi, nº2911 | SJC - SP

Spring-autumn Asymmetry in the Propagation of VLF Waves in the Northern Hemisphere

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ABSTRACT

The variation of the daytime lower ionosphere, monitored using the propagation of Very Low Frequency (VLF) radio waves, exhibits distinct seasonal characteristics with high variability in winter and low variability in summer. However, the spring and autumn transition period shows a comparative asymmetry that is not well understood. In this study, we investigate the possible phenomena behind this asymmetry. We use VLF data from the AARDDVARK network focusing on the VLF signals transmitted from USA (NAA, f = 24 kHz), UK (GQD, f =19.6 kHz) and Iceland (NRK, f = 37.5 kHz) recorded in Northern Finland since 2011 to 2019. The annual variation of daily average values around noon were computed, and the seasonal influence of solar radiation removed. The spring transition can be explained by the seasonal variation in solar illumination, whereas the autumn behaviour cannot and exhibits anomalous amplitude increases. A similar procedure was then applied to temperature data from the Solar Occultation For Ice Experiment (SOFIE) instrument on the Aeronomy of Ice in the Mesosphere satellite. Both, mesospheric temperature and VLF amplitude variations show a spring-autumn asymmetry that correlate in time. In addition, and as expected from previous studies, the autumnal increase in the VLF amplitude anomaly is associated with a decrease in mesospheric temperature. To interpret the autumn transition conditions, we evaluate the influence of mesospheric wind dynamics using Specular Meteor Radar (SMR) data recorded in Germany and Norway. We find that the autumn asymmetry may be related to changes in the amplitude of the mesospheric semidiurnal tide.

INGV contribution to international Space Weather initiatives

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ABSTRACT

The Istituto Nazionale di Geofisica e Vulcanologia (INGV) owns a well established expertise in the monitoring and in the study of the upper atmosphere phenomena. Thanks to these capabilities, INGV is significantly contributing to the international efforts to design, realize and release Space Weather products. Among the others in this framework, it is worth highlighting two main initiatives: the Ionosphere Prediction Service (IPS) and the Pan-European Consortium for Aviation Space Weather User Services (PECASUS). IPS is a project funded by the European Commission, concluded in February 2019 with the opening to the users of the IPS service prototype. The project has been led by TELESPAZIO (Italy) in collaboration with INGV, the University of Nottingham (UNOTT, UK), the University of Rome Tor Vergata (UTOV-Italy), the Nottingham Scientific Ltd (NSL, UK) and TELESPAZIO VEGA (DE). The scope of IPS was to design and develop a service prototype capable of providing in realtime nowcasting and prediction products at local, regional and global scales to assist different GNSS users communities to cope with the potential degradation of GNSS performance. It offers to GNSS users and service providers early warnings, nowcasting and forecasts related to flare and coronal mass ejection, ionosphere total electron content (TEC) and ionospheric scintillation, as well as their impact at GNSS user level. The core scientific contribution of the project is represented by the research activities carried out by the project's research partners (i.e. INGV, UNOTT and UTOV) aiming to go beyond the state of the art in understanding the impact of significant ionospheric-related geophysical events on present day technology-based society. The outputs of the research activities are nowcasting and forecasting tools, dealing with different topics: Solar activity related products (UTOV), Ionospheric activity related products (INGV), GNSS user receiver (UNOTT) and Service related products (TELESPAZIO) addressed to aviation. TELESPAZIO implemented the IPS prototype as a chain of

processors capable of describing the Space Weather phenomena affecting the GNSS service provider and users community. The pecularity of IPS service is the possibility for the single user to create a page in which it can view the products of interest setting customized alarm for product. The prototype will remain active for the users and it is now deployed at the Joint Research Center premises in Italy, in order to continue to test the platform capability and its further potential. This presentation will provide a survey of the INGV contribution to Space Weather, with particular reference to the aforementioned initiatives, to stimulate open discussions and envisage collaborations with Brazilian academic and industrial stakeholders.

Characteristics of ionospheric signatures after lithospheric phenomena

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ABSTRACT

It is well known that earthquakes and volcanic eruptions are quite frequent on the west coast of South-America, which belongs to the so-called. Sometimes, a few minutes after these phenomena on the lithosphere, an ionospheric response is observed as concentric disturbances above the epicenter. The ionospheric responses to earthquake (>6.7 Mw) and volcanic eruptions during the 2013-2019 interval are analyzed in this work. Maps of Total Electron Content from South-American networks of GNSS receivers are obtained for each event. Moreover, available ionosonde data are used. Out of 26 earthquakes, there are clear ionospheric responses in 6 cases, not so clear responses in 5 and no response at all in the other 15 cases. The clear responses are not related to the earthquakes magnitude, but seem to correlate with the earthquake depth and development of tsunamis. Clear ionospheric response starts about 7-10 min after the shock, with amplitudes from 0.15 to 1 TECu and propagation speeds between 950 and 1160 m/s. This velocity range corresponds to Rayleigh waves and is not related to a tsunami propagation speed (≈250 m/s). Out of the 3 volcanic eruptions studied, in 2 cases there are ionospheric responses. The ionospheric responses begin 30 and 57 min after the volcanic pulse, with amplitudes of 1.0 and 1.5 TECu and propagation speeds of 1100 and 1200 m/s, respectively. In general, the ionospheric responses significantly differ according to the direction of propagation. The ionosonde data available allows the disturbances height dependence determination.

Study of the main periodicities from F-layer ionosphere of the mid-west of Brazil, 2017

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ABSTRACT

In this study of the interaction of the coronal mass ejection over the geomagnetic field was performed to understand the energy transfer between scales such as kolmorogovian cascade. The geomagnetic storm occurred at 5–6 September, 2017, was analyzed through using the Cross Wavelet Transform (XWT) in order to study temporal variability of the energy from equatorial electro jet (EEJ) over the main scales observed. Furthermore, this study proposes a new methodology to obtain the EEJ through of the coherence wavelet transform. The results are discussion in terms of the comparison between traditional method and the new one through of the main periodicities found in the time series.

Latitudinal dependence of the ionspheric response to solar flare

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ABSTRACT

In the present we study the ionospheric response for four X2- class intense solar flares that occurred in between 2014-2015, indeed we have used the GNSS receivers operating in South America to calculated a Total Electron Content Map (TECmap). By using the TECmap a disturbance ionospheric index (DIX) was developed, allowing the analyzes of the latitudinal dependence of the ionospheric disturbances. Preliminary results are indicating a local time and latitudinal dependence in the ionospheric response, showing that the largest disturbances occur nearby noon and at the locations of the Equatorial Ionization Anomaly crest. Finally, we compare the DIX response to solar flare and magnetic storms of different magnitudes. Both events, magnetic storms and solar flares, can have serious consequences to technological systems of public and private agencies around Brazilian sector. We believe this study can help to better understand the effects of solar flares in the ionosphere.

Estudo da Anomalia de Ionização equatorial no setor Brasileiro

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ABSTRACT

Durante o dia a ionosfera na região equatorial apresenta uma deriva para cima, dada por $\vec{E} \times \vec{B}$, ou seja perpendicular aos campos magnético terrestre e elétrico zonal ($\vec{E}_{leste}$). Assim, devido ao efeito fonte o plasma ionosférico é removido da região próxima ao equador magnético, difunde-se ao longo das linhas de campo magnético, sob influência da gravidade e gradiente de pressão. Este plasma é depositado em baixas latitudes ($\pm 15° - 17°$) em ambos hemisférios. Consequentemente o efeito fonte da origem a anomalia ionosférica equatorial (EIA). A EIA se caracteriza por formar uma diminuição na densidade eletrônica na região do equador magnético e dois picos de densidade eletrônica em baixas latitudes (um em cada hemisfério). Este processo eletrodinâmico é global, mas no setor Latino Americano apresenta uma complexidade extra devido uma configuração geométrica única entre os equadores geográfico e magnético. No setor leste brasileiro ambos os equadores estão relativamente próximos ($\sim 100km$), mas no setor oeste a distância entre os equadores é maior do que 1000 km. Assim, a eletrodinâmica da canada-F setor brasileiro apresenta uma variação longitudinal a ser considerada e, portanto, difere dos outros setores da Terra. Neste trabalho pela primeira vez será investigado as diferenças na variação dia-a-dia da EIA durante períodos calmos e perturbados em 3 diferentes setores brasileiros (leste, central e oeste brasileiro).

Geomagnetic and solar dependency of MSTIDs occurrence rate: A climatology based on airglow observations from ROF

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ABSTRACT

We employ in this work the first O(1D) 630.0-nm airglow dataset registered at the Remote Optical Facility (ROF) in Culebra, Puerto Rico, during the descending phase of the solar cycle 24. From November 4, 2015, to September 26, 2019, observations were carried out during 633 nights at ROF using a small all-sky imager, while MSTID events were identified in 225 of 499 nights classified as clear. A quantitative analysis of these MSTIDs and their dependency by geophysical parameters (solar and geomagnetic activities) are the main focus of this study. We introduce an original statistical methodology that examines the unique features of the dataset and minimizes the cross-contamination of individual modulators onto one another, avoiding bias in the results. Our findings include a primary peak of MSTIDs occurrence in the December solstice and a secondary peak in the June solstice. We observed a remarkable correlation in the occurrence rate of the MSTIDs with the geomagnetic activity. A notable modulation of the MSTIDs occurrence rate with the solar activity is also found, which includes periods of correlation and anti-correlation depending on the season. This modulation has an annual component that is $\sim 33\%$ and $\sim 83\%$ stronger than the semi-annual and terannual components, respectively. We discuss these findings based on the behavior of the thermospheric neutral winds derived from 30 years of Fabry-Perot interferometer observations. Our results, which are valid for low to moderate solar activity, point out circumstances that might explain differences in previous climatological studies of nighttime MSTIDs.

Geomagnetic and ionospheric disturbances generated by earthquakes

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ABSTRACT

Events on solid earth, such as earthquakes, volcanoes and tsunamis, can generate atmospheric and ionospheric disturbances that cause ionospheric disturbances co-seismic (CIDs), due to the small vertical oscillations of the Earth's surface sending pressure waves into the neutral atmosphere. Those oscillations grow in amplitude 3 to 4 orders of magnitude as they reach ionospheric heights. The increase is because the atmospheric density decreases exponentially in relation to the earth's surface and atmosphere. The CIDs most often measured in the form of disturbances of the total ionospheric electron content (TEC) data measured by the Global Navigation Satellite System (GNSS), however, the CIDs can be calculated with other data such as magnetometers, barometers, and Doppler ionospheric sounders. In this work, we used to calculate CIDs, GNSS and magnetometers data. The preliminary results obtained are that the CIDs have two large periods of resonance at 3.8 and 5.1-5.3 mHz, and they also depend on the geometry and terrestrial magnetic field. For the moderate earthquake using data from the GNSS receiver, we detected ionospheric disturbances associated with acoustic waves with speeds of (0.3 and 0.2 km/s).

Oral Presentations - Physics and Chemistry of the Neutral Atmosphere

O(1S) and OH(6,2) intensity variations and wave activity over the Andes Lidar Observatory (ALO) $(30.3°S, 70.7°W)$

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ABSTRACT

Airglow offers valuable information regarding the chemistry and dynamics of the mesosphere and lower thermosphere (MLT) region. Moreover, airglow intensity variations in multi-layer observations provide crucial information on the gravity waves (GWs) propagating in that region. O(1S) and OH(6,2) airglow observations obtained from all-sky airglow imagers located at the Andes Lidar Observatory (ALO) on Cerro Pachón, Chile are used in the present study in order to better understand gravity wave activity and sources of unusual O(1S) and OH(6,2) intensity variations over the Andes region. The wave characteristics and seasonal occurrence of the unusual O(1S) and OH(6,2) intensity variation events during the 2011 to 2017 period are presented. We perform a 1D Fast Fourier transform to identify the gravity wave spectra in the airglow intensity time-series observations. The spectral analysis provides insight as to whether or not these gravity waves play a role in the observed intensity variations. Other causative processes responsible for these unusual events are also explored and discussed.

Oscilações semi-mensais observadas na deriva zonal de bolhas de plasma ionosféricas

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ABSTRACT

A variabilidade dia-a-dia das características de bolhas de plasma ionosféricas continua sendo um dos temas mais desafiadores para as ciências atmosféricas. Tanto a previsão de ocorrência, quanto o desenvolvimento dinâmico das bolhas de plasma ionosféricas são de difícil previsão, principalmente, devido a grande quantidade de fenômenos físicos envolvidos nesses processos. Neste trabalho Neste trabalho, é investigado uma oscilação semimensal que aparece com frequência na deriva zonal de bolhas de plasma. Notou-se que esta oscilação é estatisticamente significante e persistência em um período de aproximadamente sete anos (2000 a 2007) de observações ópticas da deriva zonal de bolhas de plasma extraídas de imagens de aeroluminescência da emissão do OI6000 sobre são João do Cariri $(7,4°S; 36,5°W)$. Uma vez realizada a conversão da hora de ocorrência das bolhas para o tempo lunar, calculou-se amplitude da oscilação em aproximadamente 4 m/s, o que representa 6% do valor médio das derivas das bolhas em períodos magneticamente calmos, com máximo em torno das 20h00min (tempo lunar). Esses resultados sugerem que a maré semidiurna lunar deve ser o principal agente que controla essa oscilação semi-mensal em latitudes equatoriais.

Atmospheric absorption at 45 and 90 GHz in CASLEO

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ABSTRACT

The total atmospheric absorption at 45 and 90 GHz have been obtained from calibration data of two solar radio telescopes located in El Leoncito Astronomical Complex during the period 2012-2013. The results show time fluctuations of opacity from hourly variations associated with diurnal changes in temperature to seasonal patterns. It was found a good correlation of opacity in both frequencies, with the precipitable water vapor content obtained with a Sun-photometer for aerosols measurements. Using the water vapor content and data from a meteorological station, the atmosphere over the site was modeled using an atmospheric model. The predictions of the model allows to evaluate the dynamic range of opacity measurements and to predict separately the contributions from H_2O and O_2 , the main components of total atmospheric absorption at these frequencies. An empirical relation is established between the water vapor contribution to the zenith opacity in function to the observed frequency.

Desenvolvimento de metodologia para o estudo de perturbações no TEC ocasionadas por ciclone extratropical atuante na região Sul e Sudeste do Brasil

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ABSTRACT

Nos últimos anos, vários trabalhos vêm mostrando evidências de perturbação do Conteúdo Eletrônico Total (TEC) Ionosférico devido a sistemas meteorológicos de mesoescala e de escala sinótica originados na troposfera. Entre os principais sistemas convectivos atuantes no Brasil estão os ciclones extratropicais, distúrbios que podem acarretar essa perturbação na ionosfera. Com o objetivo de descrever o impacto dos ciclones extratropicais no TEC, apresentamos neste trabalho o desenvolvimento de uma metodologia para identificar e quantificar esse efeito. Para tal fim, foi selecionado um caso de ciclone extratropical ocorrido entre 24 e 26 de Setembro de 2013 (período magneticamente calmo), que se formou próximo ao litoral entre o estado do Rio Grande do Sul e Espírito Santo. A metodologia consiste em utilizar um algoritmo de identificação e rastreio da região de baixa pressão atmosférica característica do ciclone extratropical e também analisar dados de TEC de várias estações receptoras de sinais GNSS localizadas sobre toda a região de influência do ciclone. Os dados de TEC resultantes serão comparados com a média dos três dias mais calmos no período próximo ao evento meteorológico. Espera-se assim, observar anomalias no TEC devido ao efeito das ondas de gravidades geradas pelo intenso sistema de baixa pressão.

Concentric Gravity waves observed by OH airglow over São João do Cariri

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ABSTRACT

Observation of concentric/circular gravity waves (CGWs) in the OH airglow emission over the Brazilian equatorial region. An all-sky imager located at São João do Cariri [7.39°S, 36.53°W] was used in the acquisition of the images. Using 20 years of observational data (between 1998 and 2018), 1052 nights of airglow observations were taken. However, only 5 CGW(s) cases were found with small-scale wave characteristics. The CGW(s) events showed horizontal wavelengths between 25 and 31km, horizontal phase speed between 42 and 75m/s and periods ranging from 7 to 11 minutes. Most of the CGW structures were well defined with coherent wave patterns expanding concentrically with all observed cases having semi-circle or arc-like shapes. The occurrence of CGWs was found to coincide mostly with the seasons of strong tropospheric convective activity as well as low background winds. This suggested a low level of wave breaking or critical level absorption/filtering/reflection, allowing the CGWs to propagate up to the mesosphere and lower thermosphere (MLT) region.

Mesospheric mountain waves observations and characteristics in the lee of the Southern Andes during the austral winter 2018

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ABSTRACT

Gravity waves (GWs) are one of the main drivers of the atmosphere as they vertically couple energy and momentum throughout its successive layers. Orographic forcing caused by the wind flowing over a mountain range is a major source for these waves. Such perturbations are known to impact the troposphere, the stratosphere (Eckermann and Preusse, 1999) where they interact with the background atmosphere, and even the mesosphere lower thermosphere (e.g., Smith et al., 2009; Pautet et al., 2016; Taylor et al., 2019), where they finally dissipate, possibly generating secondary gravity waves. In November 2017, Utah State University (USU) has deployed an Advanced Mesospheric Temperature Mapper imager (AMTM) alongside a DLR Rayleigh lidar, an existing Boston University all-sky imager and the SAAMER meteor radar, in Rio Grande, Argentina ($53.8°S, 67.8°W$). This site is in the lee of the Southern Andes Mountain Range and corresponds to the largest gravity wave hotspot on Earth. Unprecedented measurements taken during the Austral winter 2018 (March to September) have revealed the wealth of mountain waves reaching the mesosphere ($\sim$ 100 events during a 6-month period). This talk will describe these recent mountain wave observations and present their characteristics. Their occurrence, correlated with semidiurnal tides, and their possible effects on the upper atmosphere through momentum transport will also be discussed.

Determinação de vento horizontal a partir da observação de ondas de gravidade de média escala na mesosfera e baixa termosfera

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ABSTRACT

O conhecimento do vento em vários níveis de altura na atmosfera terrestre contribui, em grande parte, para entender processos dinâmicos de várias escalas temporais e espaciais que nela existem. Por isso, a longo prazo, observações de vento foram feitas em diversos lugares do mundo e estudos foram realizados fazendo-se uso de várias técnicas e equipamentos. Esses equipamentos, em geral, possuem alta complexidade de operação, processamento e valores econômicos elevados. Visando uma possibilidade alternativa para a estimativa do vento na mesosfera e baixa termosfera, o presente trabalho traz detalhes de uma metodologia para estimação do vento considerando sua interação com as ondas de gravidade. Para tal, foram utilizadas nesta pesquisa medidas experimentais de um banco de dados consolidado de imagens de aeroluminescência e ventos meteóricos coletados em Cachoeira Paulista (22,67ºS; 45ºW), bem como medidas de perfis de temperatura do radar de laser de São José dos Campos (23,15ºS; 45,85ºW). Foram analisadas 27 noites, dentre os anos de 2007 e 2008, que apresentavam medidas simultâneas desses instrumentos. As análises mostraram as noites de 14/09/2007 e 10/10/2007 interessantes, pois, foi possível caracterizar mais de uma onda de gravidade de média escala simultânea em mais de uma emissão da aeroluminescência. O vento horizontal foi estimado a partir da relação de dispersão de ondas de gravidade e comparações foram feitas com as medidas realizadas pelo radar meteórico. Detalhes sobre a precisão da metodologia, como influência de parâmetros atmosféricos são discutidos neste trabalho.

Oral Presentations - Space Weather and Sun-Earth Connections

On the impact of CME- and CIR/HSSs-driven geomagnetic storms on the ionospheric processes during the descending phase of solar cycle 24. A space weather approach.

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ABSTRACT

In this work we present a study of the low latitude ionospheric response to two distinct kinds of geomagnetic storms, associated with a Corotating interaction region, CIR, and High-Speed Streams, HSSs, and Coronal Ejection Mass, CME during the descending phase of solar cycle 24. For this aim we analyze ionospheric parameters such as GNSS TEC, as well as the F-layer bottom height, h'F. We observe remarkable features in the ionization over the equatorial region and the crests of the Equatorial ionization anomaly, EIA, in Brazil, as compared to the average quietest days. The results showed a clear intensification of the TEC during the main phase of the CME-storm as well as the development of plasma irregularities. On the other hand, during the moderate CIR/HSS- driven storm, the TEC deviation was higher than 100 percent in comparison to the 5 quietest days for several days. We discuss the causes of this ionospheric response.

Estimating satellite orbital drag during historical magnetic superstorms ($Dst < -500nT$)

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ABSTRACT

Understanding extreme space weather events is of paramount importance in efforts to protect technological systems in space and on the ground. Particularly in the thermosphere, the subsequent extreme magnetic storms can pose serious threats to low-Earth orbit (LEO) spacecraft by intensifying errors in orbit predictions. Extreme magnetic storms (minimum $Dst \leqslant -250nT$) are extremely rare: only 7 events occurred during the era of spacecraft with high-level accelerometers such as CHAMP (CHAllenge Mini-satellite Payload) and GRACE (Gravity Recovery And Climate experiment), and none with minimum $Dst \leqslant -500nT$, here termed magnetic superstorms. Therefore, current knowledge of thermospheric mass density response to magnetic superstorms is very limited. Thus, in order to advance this knowledge, 4 historical magnetic superstorms, i.e., events occurring before CHAMP's and GRACE's commission times, are used to empirically estimate density enhancements and subsequent orbital drag. The November 2003 magnetic storm (minimum $Dst = -422nT$), the most extreme event observed by both satellites, is used as the benchmark event. Results show that, as expected, orbital degradation is more severe for the most intense storms. Additionally, results clearly point out that the time duration of the storm is strongly associated with storm-time orbital drag effects, being as important as or even more important than storm intensity itself. The most extreme storm-time decays during CHAMP/GRACE-like sample satellite orbits estimated for the March 1989 magnetic superstorm show that long-lasting superstorms can have highly detrimental consequences for the orbital dynamics of satellites in LEO.

Recent advances for developing ionospheric scale index map based on TEC data for South America

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ABSTRACT

The present work shows a summary of our recent advances for developing an ionospheric scales index map based on the Disturbance Ionospheric Index (DIX) that covers the whole South America. This index aims to target all the different user groups affected by ionospheric disturbances, e.g. the navigation, positioning, and satellite communication users, in a simple and straightforward approach. Therefore, we used the Vertical TEC (VTEC) over South America to calculate the Total Electron Content Maps covering latitudes from 60 S to 20 N and longitudes from 90 to 30 W, with 0.5x0.5 degrees resolution. Afterward, the DIX Maps are obtained to reveal the variation of the TEC over an average quiet ionosphere background. In order to illustrate the use of the map index, the ionospheric disturbances after and during the December 17-23, 2015 intense geomagnetic storm and the 2015 Saint Patrick magnetic storm are presented as an example of the disturbances in the DIX at different latitudinal ranges and under different magnetic conditions. The results are compared to the traces of the ionograms obtained at three different ionospheric stations (Fortaleza, Campo Grande, and Cachoeira Paulista) in Brazil acquired in the same period and at the same time rate. Among the results, the DIX Map revealed some patches of "Disturbed" and "Weakly Disturbed" ionospheric conditions during the magnetically quiet time prior to the storm, which were associated with range and frequency Spread-F over

the same area as observed in ionograms. Also, the information from the southern portion of the dip equator showed a transition from occurrences of Spread-F prior to sunrise to a condition favorable enough to develop a F3 layer after sunrise.

Comparison of two Artificial Neural Networks for vertical Total Electron Content Forecasting in Argentina

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ABSTRACT

Accurate prediction of Total Electron Content (TEC) is important for monitoring the behavior of the ionosphere and indeed a magnitude of interest to understand the properties and behavior of the Sun-Earth System. The conditions of this medium, have a direct impact on a growing variety of critical technological infrastructure. This work presents a comparison between two different Artificial Neural Networks (ANNs): an adaptive neuro fuzzy inference system (ANFIS) and Nonlinear Autoregressive Neural Network (NAR-NN) applied to TEC. Both ANNs where tested on 4 different geomagnetic locations on 4 one-week periods having a variety of geomagnetic disturbance levels. The effect of using different training period lengths and the system response for 60 and 30 minutes sampling rate TEC time series were investigated. NAR-NN show a slightly better performance, being the higher difference during the greater perturbations. There is also a better response when sampling rates of 30 minutes are used.

AMISR-14 studies of low-latitude ionospheric F-region irregularities

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ABSTRACT

ESF is the general name given to signatures of temporal and spatial variations in the electron density of the ionospherc F-region at low magnetic latitudes. The study of ESF is motivated by a better understanding of fundamental physical processes associated with the Earth's thermosphere-ionosphere (IT) system. It is also motivated by the impact of ESF irregularities on the propagation of radio waves and, therefore, on the performance of radio-based technological systems used for navigation, remote sensing and communications. The Advanced Modular Incoherent Scatter Radar (AMISR) is a modular, transportable phased-array radar system developed for atmospheric and ionospheric studies. Full AMISR systems (128 panels) have been deployed in Alaska, USA and Resolute Bay, Canada, and have been successfully used for incoherent scatter radar studies of the high-latitude ionosphere. A smaller version (14 panels) of an AMISR system was also deployed at the Jicamarca Radio Observatory, a magnetic equatorial site in Peru. We will show that while this 14-panel version of the system (AMISR-14) is not capable of producing useable incoherent scatter observations, it can still be used for coherent scatter radar studies of ionospheric irregularities. In this presentation, we introduce the system and a radar experiment for F-region observations. In this mode, we have set AMISR-14 operations in an east-west scanning mode (10 beam directions) to determine the temporal evolution of the spatial distribution of ionospheric irregularities within the field of view of the system. Snapshots of irregularity distribution over about 400 km zonal distance and every $\sim$30 seconds can be obtained with this mode. The low angular resolution of the observations (about 8 deg.) is dictated by the antenna beam width. In this talk, we will introduce and discuss the results of AMISR-14 observations of ESF events. Examples of pre- and post-midnight ESF events will be presented. The conditions leading to the observed events will also

be presented and discussed in light of current theories of ESF generation. AMISR-14 observations will also be compared with irregularity measurements made by other types of instruments, including VHF radars, that are collocated at Jicamarca. The implications for studies of ionospheric turblu-ence and space weather at low latitudes will be highlighted.

Observational and modeling efforts to quantify the role played by radial diffusion during relativistic electron dropouts of the Van Allen Probes mission era

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ABSTRACT

Since the launch in recent decades of space missions dedicated to the study of the Earth's radiation belts populations, it has been accepted by the space physics community that the mechanisms of magnetopause shadowing (related to the high compression of the magnetopause following the passage of a transient solar wind) and pitch angle scattering (driven by electromagnetic waves during wave-particle interactions) can both explain most of the massive losses of relativistic electrons (called dropouts) to the magnetopause and atmosphere, respectively. Additionally, radial diffusion can account for further losses to the magnetopause, causing the formation of internal peaks in the radial profile of electron distributions. In order to evaluate the role played by this mechanism in such loss scenarios, two case studies were developed in this work. For this, MHD simulations through BATS-R-US runs were performed so that we can obtain realistic radial diffusion coefficients (DLL) for the events. The results of this analysis show that the maximum total DLL rates calculated at $L = 6.6$ for dropouts on 27 March 2017 and 20-21 November 2017 are roughly the same ($\sim$ 1 day-1). For instance, DLL values of this order of magnitude represent a change (inward or outward) of $\sim$ 1.4 Earth radii, over the course of one day, for electron populations with $\mu = 2083 MeV/G$. On the other hand, analyses of the PSD radial profiles show a more pronounced internal peak formed in the first event, which means that the outward radial diffusion mechanism was more operational in this event than in the other for the additional losses observed at high L regions. We found that underestimations in the modeled magnetic and electric fields are the possible explanations for the low differences reported in the DLL rates of the two events, although the PSD radial profiles suggest that important dissimilarities between them existed.

A low-cost geomagnetic station for engaging students in geosciences

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ABSTRACT

Recruiting students of all academic levels in geosciences is a challenging task, especially in developing countries. Since Paraguay is immersed in the South Atlantic Anomaly (SAA), monitoring the geomagnetic field it's an important step to develop space weather monitoring capabilities. Low-cost geomagnetic stations can engage Paraguayan students and researchers in space physics. COTS (commercial off-the-shelf) sensor packages, embedded systems (e.g. Arduino, Raspberry pi, etc) and open source projects such as AuroraWatch UK magnetometer are opportunities to spread the involved educational institutions (High School and Universities). A magnetometer network calibrated with a more accurate geomagnetic network like Embrace MagNet can be useful to have an alert system. This work presents measurements and preliminary measurements of a low-cost geomagnetic station based on three fluxgate magnetometers capable of measuring variations in the magnetic field strength in the three orthogonal directions at a resolution of 1 nT (in the $\pm$ 50000nT range). The system has a frequency counter, a GPS receiver (for timing reference), a battery (5000mAh) and an Arduino board to collect and save the data. This work is part of the Faculty of Exact and Natural Sciences project and it has three phases: the first one consists in the selection of low-cost sensors and components to build a geomagnetic station prototype, the second part includes the laboratory testing and a critical design review to improve the station, the last part will require the calibration of its measurements taking it near an EmbraceMagnet station. This work presents the station scheme, component cost, preliminary measurements, and comparisons done during the first and second phases. The station would help to define an optimal location for the EmbraceMagnet station which its planed to be installing this year at the Engineering Faculty Campus. The entire magnetometer design is open-source to encourage engineering and physics students to build their low-cost network in high schools around the country.

Solar phenomena, the possibility to predict their occurrence, and what to expect for next years

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ABSTRACT

Space Weather deals mainly with solar phenomena, their generation, interaction with the Earth environment, the way affect technological services / systems as well as methods to mitigate the disturbances, damages and risks to human. Depending on the solar phenomenon and respective characteristics, there is a proper previous time to take decision and realize mitigating actions or not. For example, the solar wind velocity typically varies in the range 250-900 km/s. In this case, assuming a constant velocity since the departure from the Sun up to its arrival at the Earth, there exists a lapse of 2 to 7 days. So, it is possible to predict the wind arrival at the Earth with a due anticipation. This allows mitigating actions be taken. By the other side, a solar flare takes just about 8 minutes to arrive to the Earth. And the registering occurs when the detectors orbiting the Earth measure its electromagnetic radiation. Therefore, in this extreme case the recording is simultaneous with the arrival. Here, we present and discuss about the occurrence, and detection of solar phenomena. Also, we discuss about the recent research and current status on solar flare forecasting.

INGV contribution to international Space Weather initiatives

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ABSTRACT

The Galileo Solar Space Telescope (GSST) is a cornerstone mission to provide accurate measurements of the magnetic field in the photosphere and outer layers of the solar atmosphere to be proposed to the Brazilian Space Agency (AEB) within the international effort to understand of the evolution of the Heliosphere. The solar electromagnetic and corpuscular emissions are strongly modulated by the evolution of the magnetic structure of the solar atmosphere. The solar magnetism is driven by the energy transport from the inner layers of the Sun to its atmosphere. Although systematic observations since the invention of the telescope have revealed several features related to the evolution of solar activity, there is not a complete explanation of the physical processes that lead to solar activity cyclic variability and its long-term changes. Here we describe the status of mission's Phase 0/A. The underlying basic questions to be addressed by the GSST mission are: What are the fundamental physical/plasma processes at work in the Sun? How does the solar dynamo work? What is the relative contribution of different physical processes that lead to the heating of the outer layers (Chromosphere to Corona)? What are the effects of the magnetic structure of the outer layers of the Sun on the evolution of the Earth's highly coupled atmosphere-ocean system? What is the response of the magnetic field and energetic particles in the vicinity of our planet, i.e. the Earth's inner magnetosphere region, due to different solar wind structures? Taking into account these open scientific questions, the Galileo Solar Space Telescope proposed mission is to perform solar observations in high spatial and temporal resolution to characterize the evolution of the magnetic structure of the photosphere, chromosphere, transition region, and corona and its impact on the Geospace. Specifically, the mission has three main objectives: (1) Contribute to the understanding of

the evolution of the magnetic structure of the Sun; (2) Contribute to the understanding of the Sun's influence on Earth's Climate; and, (3) Contribute to the understanding of the Sun's impact on the Geospace. This contribution is an update of the previous version presented at the AGU Fall Meeting 2019.

Estudo de dois casos de ICMES: Origem e consequências no espaço próximo da Terra

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ABSTRACT

A partir do monitoramento feito pelo Programa de Estudo e Monitoramento Brasileiro do Clima Espacial - Embrace - que descreve a evolução das estruturas solares, desde sua origem no Sol até as suas consequências no espaço próximo da Terra, foi feito um estudo de duas "Interplanetary Coronal Mass Ejections - ICMEs" ocorridas nos dias 17 de março de 2013 ed 19 de fevereiro de 2014, desde a identificação de sua origem solar e suas consequências no campo geomagnético, na ionosfera terrestre e na alta atmosfera. Esse estudo é importante no contexto de que a variabilidade do plasma interplanetário traz consequências importantes, principalmente nas tecnologias que dependem de sistemas embarcados em satélites. O monitoramento das condições do ambiente espacial no entorno da Terra tem sido solicitado por setores estratégicos, tais como a aviação civil, telecomunicações, geolocalização, defesa, entre outros, com consequências diretas à sociedade. Desta forma, esse estudo faz parte da organização das informações necessárias para atender ao público em geral, na forma de relatórios técnicos, que possam embasar as ações e/ou políticas referentes a mitigação das possíveis consequências que a atividade solar pode impor às tecnologias atuais.

Mid-latitude Ionospheric trough using global IGS vTEC maps during 2008

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ABSTRACT

The aim of this work was to analyze the mid-latitude ionospheric trough (MIT), in both hemispheres, using the IGS Global Ionospheric Maps (GIM) during the solar minimum (2008). This study was carried out for different local hours, 22, 00, 02 and 04 LT in the northern and southern hemisphere simultaneously. MIT shows an asymmetric pattern in both hemispheres. The high latitude troughs are clearly distinguished in autumn and winter. In addition, MIT in the northern hemisphere has a longitudinal westward development of the geomagnetic pole that covers a wider area. Five empirical reference models were compared with the minimum position of the MIT obtained from the GIM at different local times for both hemispheres. The results show a better agreement with the observations for the northern hemisphere, especially with the Köehnlein & Raitt model. In both hemispheres, there are fluctuations of 9 days and 27 days of the minimum position of the MIT, which could be related to the solar wind oscillations, especially for 00 and 02 LT.

Oral Presentations - Physics of Plasmas

Tribological evaluation and behavior of DLC coatings on steel in PECVD system with TiO2 over layer using ALD plasma technique

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ABSTRACT

Diamond-Like Carbon (DLC) coatings have attracted significant attention due to low friction, high hardness and high wear resistance. These films meet conditions that can be used in some mechanical applications in aerospace, medical and automotive industries. The major disadvantage of these coatings is a low adhesion on metallic substrates, caused by elevated compressive residual stresses after deposition. Some plasma conventional methods require a high consumption of energy that are used to grow DLC films, resulting in a high level of temperature and pressure during the deposition, which affects the adhesion of the film to the substrate. DLC coatings were deposited employing an asymmetrical bipolar pulsed-DC PECVD system, in a very low temperature and pressure (about 87° C and 0.1 Pa) which allowed lower level of collisions and a higher plasma density. Methane gas was used as a precursor. In order to overcome low adhesion of DLC films on steel substrate, a thin amorphous silicon interlayer was deposited at the interface, and to the last process was to deposit a thin TiO2 film over DLC using ALD Technique. Resulting coatings were observed with SEM and Raman spectroscopy to analyze atomic arrangement. The total residual stress was evaluated by the curvature method. The tribological behavior (friction and wear) was analyzed by lubricated reciprocating wear tests at room temperature. The elevated coating hardness (higher than 25 GPa) promoted good wear resistance. These results suggest that the PECVD-DC Pulsed with additional cathode and methane as a precursor gas to grow DLC films on metallic substrates may represent a new alternative to improve the mechanical behavior in some applications.

The energy cascade rate in compressible Hall-MHD turbulence: theory vs. MMS observations

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ABSTRACT

Energy cascade rate derived from Incompressible MHD theory (IMHD) has been widely used to study inertial range solar wind (SW) turbulence in view of better understanding the longstanding problem of SW heating. In recent years, the IMHD theory was extended to compressible flows described within the isothermal approximation [1] and applied to investigate the role of density fluctuations in inertial range SW and magnetosheath turbulence. Here we discuss the extension of those theoretical and observational models to describe sub-ion scale cascade using new incompressible and compressible Hall-MHD models (IHMHD and CHMHD, respectively) [2]. We will discuss the application of these new models to the Magnetospheric MultiScale (MMS) in-situ observations in the magnetosheath and the SW [3,4]. Comparing the results obtained from IHMHD and CHMHD highlights the importance of density fluctuations at the sub-ion scale, even when the inertial range is nearly incompressible, in agreement with theoretical expectation. We will discuss other features such as the link between the fluid sub-ion cascade and kinetic features like plasma instabilities and kinetic damping processes. [1] N. Andrés, and F. Sahraoui. Phys. Rev. E 96, 053205 (2017). [2] N. Andrés, S. Galtier, and F. Sahraoui. Phys. Rev. E 97, 013204 (2018). [3] N. Andrés et al. Phys. Rev. Lett. 123, 245101, 2009. [4] L.Z. Hadid, F. Sahraoui, S. Galtier, and S. Y. Huang. Phys. Rev. Lett. 120, 055102 (2018).

Optical emission spectroscopy for Ar and compressed air plasma characterization

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ABSTRACT

Optical emission spectroscopy (OES) is one of the plasma diagnostics tool been discussed among the scientific community. Moreover, OES measurement has been recognized for many years as one of the suitable plasma diagnostics techniques due to its simplicity and low cost. Subsequently, the benefit of using OES diagnostics ables to acquire the data without perturbing the plasma during the diagnostics process. For this research, we will use OES to describe and understand the physical and chemical aspects occurring in an argon and compressed air plasma. Besides that, we will investigate the ion excitation mechanism in the plasma using the emission lines from the OES measurement. The optical characterization of a plasma is a useful tool for technological applications as materials treatment, thin-film growth systems, microelectronics, nanotechnology and others.

Numerical simulations of the electron drift instability in a closed-drift plasma device

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ABSTRACT

The Hall thruster is a closed-drift plasma device with important applications in space propulsion technologies such as station-keeping purposes in satellites and deep-space missions. This device generates thrust from the interaction between plasma charged particles and electromagnetic fields. Several nonlinear processes occur in the Hall thruster plasma and are poorly understood. For example, the electron cross-field mobility is several orders of magnitude higher than that expected from electron-neutral collisions. Recently, numerical simulations and experimental measurements have shown the occurence of a high-frequency, low-wavenumber instability known as the ExB electron drift instability. This instability is the most plausible candidate to explain the observed electron anomalous diffusion. We perform numerical simulations of a SPT-100 Hall thruster using the particle-in-cell method. We describe a two-dimensional model in cylindrical coordinates in which the axial and azimuthal directions are represented, neglecting variations in the radial direction. Our numerical simulations show the growth of a large-amplitude wave in the azimuthal electric field and the ion density due to the electron drift instability. We characterize the frequency and wavenumber of this instability by applying a spectral analysis, and compute power-laws in the resulting power spectra. Our results demonstrate that the plasma in a Hall thruster displays a turbulent behavior with an energy cascade induced by the ExB electron drift instability. We also show that the microturbulence is characterized by an inertial subrange which extends to scales smaller than 1 mm.

Multifractality and cross-scale coupling in interplanetary magnetic field turbulence during a rope-rope magnetic reconnection event

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ABSTRACT

We analyze the multifractal scaling of the modulus of the magnetic field $|B|$ during a rope-rope magnetic reconnection event measured by ACE and Cluster on 1 February 2002. This event is characterized by three interplanetary magnetic flux ropes (IMFR), a bifurcated current sheet, and evidence of rope-rope magnetic reconnection. The time series of $|B|$ is divided into five intervals corresponding to interior regions and boundary layers of the three IMFRs. We quantify the degree of intermittency by computing the scaling exponents of the structure functions at each interval, and show that the magnetic reconnection occurring in the interface between two flux ropes can act as a source of intermittent magnetic field turbulence. We also analyze the relation between the skewness and the kurtosis, and demonstrate that the parabolic relation displays scale dependence and is enhanced during magnetic reconnection. These results indicate that a direct coupling between the scales of magnetic flux ropes and the scales within the inertial subrange occurs in the solar wind.

Oral Presentations - Solar Physics, Interplanetary Medium and Planetary Magnetospheres

Apresentação de um método para identificar intervalos longos de alta alfvenicidade no vento solar

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ABSTRACT

As caraterísticas físicas das ondas de Alfvén são conhecidas desde o trabalho teórico apresentado pelo físico Hannes Alfvén na revista Nature no ano de 1942. Estas ondas se caracterizam por um movimento ondulatório transversal das linhas de campo magnético que se deslocam com uma velocidade igual à raiz quadrada da divisão entre a tensão da linha e a densidade do fluido. Com o inicio da corrida espacial, após o lançamento do satélite Sputnik em 1957, foi possível identificar estas ondas em um fluido compressível e condutor imerso em um campo magnético. Como exemplos podem-se mencionar o meio interplanetário e a magnetosfera. Neste trabalho começamos sabendo que estas ondas são mais frequentes de serem identificadas na fase decrescente do ciclo solar associadas aos feixes de vento solar rápido provenientes de buracos coronais, além do mais, elas apresentam baixa amplitude e muitas flutuações nas medidas do campo magnético interplanetário. O objetivo desta pesquisa é propor um método que possibilite fazer uma procura de períodos contínuos de no mínimo 48 h de alta Alfvenicidade, do ano de 1999 a 2018, utilizando somente dados do satélite ACE. Utiliza-se a entropia de Shannon inserida num método de análise de séries temporais como ferramenta auxiliar de estudo. A entropia é utilizada para caracterizar estes eventos. Apresenta-se um catálogo com esses eventos o que nos permite fazer uma caraterização estatística relacionada com a atividade solar e os efeitos na atividade geomagnética. Agradecimento à Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) , Processo 16/25563-6. Conselho Nacional de Desenvolvimento Cientifica e Tecnológico (CNPq) processo 431396/2018-3. Projeto vinculado ao Grupo de Pesquisa do CNPq “Matemática Aplicada à Física Espacial”

The solar radius at 37 GHz through cycles 22 to 24

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ABSTRACT

To better understand the influence of the activity cycle on the solar atmosphere, we report the time variation of the radius observed at 37 GHz ($\lambda = 8.1mm$) obtained by the Metsähovi Radio Observatory (MRO) through Solar Cycles 22 to 24. Almost 5800 maps were analyzed, however, due to instrumental setups changes the data set showed four distinct behaviors, which requested a normalization process to allow the whole interval analyses. When the whole period was considered, the results showed a positive correlation index of 0.17 between the monthly means of the solar radius at 37 GHz and solar flux obtained at 10.7 cm (F10.7). This correlation index increased to 0.44, when only the data obtained during the last period without instrumental changes were considered. The solar radius correlation with the solar cycle agrees with the previous results obtained at mm/cm wavelengths (17 and 48 GHz), nevertheless, this result is the opposite with the reported at submillimeter wavelengths (212 and 405 GHz).

Numerical modelling of filaments winking

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ABSTRACT

Large-scale coronal waves can perturb distant quiescent filaments, even in some extreme cases these perturbations may give rise to a filament to erupt. E.g., after the occurrence of a Moreton event, some observations have reported oscillatory dynamics and emission by faraway quiescent filaments. This kind of oscillations are known as winking filament; also, observations have pointed out that the activation time of a winking filament coincides with the passage through it of a large-scale wavefront, which is not generally detected at coronal heights. By numerical experiments our aim is to study whether winking filaments are compatible with perturbations exerted by a large-scale coronal wave, and whether their oscillating emissions are a consequence of these perturbations. The FLASH code was used to carry out ideal 2D MHD simulations: the filament was modelled by a current-currying wire floating in the corona at a certain height; the background environment is a gravitational stratified corona in hydrostatic equilibrium, also including the chromosphere and a thin transition region; the background plasma and the magnetic field configuration are in quasiequilibrium; and the coronal large-scale wave was modelled by a blast wave. Therefore, the filament interaction with a large-scale wave results in an attenuating oscillatory movement, where the restitutive forces are the magnetic tension and magnetic field lines tied at the base of the chromosphere. Kinematic quantities such as amplitude of oscillations, periods and velocities were analysed and will be presented. Comparing the emission line FWHM used to observe the winking filaments with the (red/blue) shifts obtained in the simulations due to the filament oscillatory movement, indicate that coronal large-scale waves may be responsible for winking filaments. Moreover, the kinematic results obtained are of the same order of observed values.

HATS: a ground-based telescope to explore the THz domain

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ABSTRACT

The almost unexplored frequency window from submillimeter to mid-infrared (mid-IR) may bring new clues about the particle acceleration and transport processes and the atmospheric thermal response during solar flares. Because of its technical complexity and the special atmospheric environment needed, observations at these frequencies are very sparse. The High Altitude THz Solar photometers (HATS) is a full sun ground-based telescope designed to observe the continuum from the submillimeter to the mid-IR. It has a 457-mm spherical mirror with the sensor in its primary focus. The sensor is a Golay cell with high sensitivity in a very wide frequency range. The telescope has a polar mount, and a custom-build data acquisition system based on a 32 ksamples per second, 24 bits (72 dB dynamic range), 8 channels analog-to-digital board. Changing only the composition of the low- and band-pass filters in front of the Golay cell, the telescope can be setup to detect very different frequency bands; making the instrument very versatile. In this paper we describe the telescope characteristics and its development status. Moreover, we give estimates of the expected fluxes during flares.

Contribution of the pitch angle scattering on the relativistic electron flux dropout in the outer radiation belt after the Coronal Mass Ejection

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ABSTRACT

The decrease of relativistic electron flux in the outer radiation belt is observed after an Interplanetary Coronal Mass Ejection (ICME) reaches the magnetosphere on July 19, 2016. Several dynamic mechanisms may be involved with this variability; however, we are interested to identify the pitch angle scattering mechanism because we would like to understand the dynamics related to violation of the first and/or second adiabatic invariant. Pitch angle scattering mechanisms may occur through wave-particle interactions. Here, we investigate the electromagnetic ion cyclotron (EMIC) waves (0.3 Hz up to 3 Hz) and whistler-mode chorus waves (from hundreds of Hz up to about 10 kHz) activities, and the possible wave-particle interactions. Pitch angle scattering mechanism may cause dropout in the outer radiation belt, consequently can lead the particle precipitation to the atmosphere and cause influences in a neutral/ionized atmosphere. Different techniques are used to confirm the contribution of the pitch angle scattering during the relativistic electron flux dropout in the outer radiation belt observed in the study, as such characterization of the sub-elements and obliquity of the chorus waves, minimum resonant energy for electrons interacting with EMIC waves and pitch angle distribution.

The magnetic structure and EUV emission associated to active region NOAA 12673

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ABSTRACT

Active region NOAA 12673 entered the solar disk on August 29th 2017. During its passage it has produced many flares and between September 9-10 this active region launched a series of three coronal mass ejections, the last one associated with an X8.2 flare. The first CME was launched at 23:46UT on September 9 and reached a velocity of 500km/s. A second faster CME (1000km/s) was launched on September 10 at 02:16UT. The fastest CME (2600 km/s) was launched at 16:54 UT and catch up with the slower CME, merging into a single CME. In this work we use data from HMI and AIA instruments, onboard the SDO satellite, to analyze the structure of the LOS photospheric magnetic field associated to active region NOAA 12673 and the EUV emissions associated to flares. We estimate different parameters like spectral index, image entropy and fractal dimension, which help to characterize the complexity of NOAA 12673 magnetic field. Also, we analyze the 3D strucuture of the magnetic field and, at the end, investigate the temporal and spatial evolution of EUV emissions associated to the X8.2 flare. This conjugated study of EUV emissions and magnetic structure may help to understand the cause of the violent release of magnetic energy during strong (M and X class) flares.

How Does Relativistic Outer Radiation Belt Electron Flux Change Under Recurrent Solar Wind Structures?

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ABSTRACT

The key question on the Earth's radiation belts trapped particles lies in the understanding of how solar wind drives the magnetospheric physical mechanisms changing the trapped particle populations. Corotating Interaction Regions (CIR) from Coronal Holes (CH) are predominant structures through the descending phase of the solar cycle. Some of the solar wind conditions related to CIRs are also recurrent in each rotation, so these structures may also cause a recurrent magnetospheric response to the solar wind coupling, including the inner magnetospheric parameters, in particular at the outer radiation belt dynamics. Throughout the descending phase of the solar cycle 24, we identified 46 CIRs in the period from 2016-2019. All the CIRs are isolated solar wind structures, i.e. complex solar wind structures are out of the scope of this paper. By following seven recurrences of CH 838, we identified recurrent magnetospheric auroral disturbances, besides inner magnetosphere seed population particle injection, and as a consequence, whistler-mode chorus waves are observed in a wide frequency range and in several L-shells and Magnetic Local Time. The unprecedented Van Allen Probes observation of very low frequency (VLF) waves show that for two subsequent orbits, whistler-mode chorus waves frequency bands alternates from one satellite passage to the other, being observed in several frequency ranges during the same solar wind event.. As a result, the relativistic outer radiation belt electron fluxes can be lost and enhance each time, as a function of the chorus waves power spectral density, thus the survey of outer radiation belt particle flux from several CIR events results that dropout, enhancement or no change may occur with the same likelihood ($\sim 25\%$) each.

Application for correction of the variance analysis in the magnetic clouds study

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ABSTRACT

Magnetic clouds (MC) are observed by different satellites in the solar wind and are generally associated with Interplanetary Coronal Mass Ejections (ICME). Properties related to the magnetic field, such as smooth vector rotation and greater intensity than the environment average, are used in its identification. The MCs can be ideally characterized by the force-free model and thus approximated by the geometry of infinite cylinders or flow tubes. In the real case, the Minimum Variance Method (MVA) is applied to adjust the data obtained via satellite to the force-free model and to identify the type and orientation of the flow tube. For this purpose, several works use the visual inspection of maximum and minimum variance plans to carry out this adjustment. This work presents an application proposal that processes MVA and presents two options of maximum and minimum variance plans and respective components of the rotated field ($|B|$, B_x, B_y, B_z, B_{lat}, B_{lon}) for visual inspection and possible correction of the axes obtained in the MVA. In addition, the application presents an interactive model in three dimensions for the event and has a tool that helps to identify the extremes of the event based on plasma beta graphs, speed, temperature and proton density. Applied and computational mathematics techniques in the areas of signal analysis and pattern recognition support the proposal. The tool is under development in the Python language and the preliminary results demonstrate the potential to assist future research, both for characterizing complex events and for training human resource beginners.

Understanding CME deflections during the rising phase of solar cycle 24

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ABSTRACT

To better understand the governing conditions under CME deflections, we performed a careful analysis of several events showing large deflections along a one-year time interval. We used telescopes imaging the solar corona at different heights and wavelengths on board the Project for Onboard Autonomy 2 (PROBA2), Solar Dynamics Observatory (SDO), Solar TErrestrial RElations Observatory (STEREO) and Solar and Heliospheric Observatory (SOHO) spacecraft. Taking advantage of the quadrature position of spacecraft from October 2010 until September 2011 we inspected the 3D trajectory of CMEs and the associated filament with respect to their solar sources by means of a forward model and a tie-pointing tool, respectively. The trajectory of both filament and CME is investigated and analyzed in the context of the coronal magnetic field, obtained at different heights from PFSS extrapolation. We determine the angle between the trajectory and the gradient of the magnetic energy density. In agreement with previous reports, we found that for most of the events the trajectory is against the direction of the magnetic energy density gradient for altitudes greater than 2.5 solar radii and for lower heights this behavior is not clearly defined.

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Signature of Polycyclic Aromatic Hydrocarbons in regions of Starbursts Galaxies

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ABSTRACT

This work presents a study on the identification of polycyclic aromatic hydrocarbons (PAH) signatures in 07 Seyfert galaxies and 04 starbursts galaxies, which were selected from Spitzer/IRS ATLAS. The Spitzer /IRS data used comprise low-resolution spectra ($R \sim 100$) in the wavelength range of $5 - 15\mu m$. The spectral decomposition tool PAHFIT was used to determine the best model continuum, which was subtracted from the observed spectra. The PAH IR Spectroscopic Database (PAHdb), which contains an extensive collection of theoretical and experimental infrared (IR) spectra of PAHs, was used to identify possible PAHforming molecules by comparing the observed spectra of the sample galaxies with the theoretical and experimental spectra of PAHdb. The results indicate that there is an order of contribution to emission among the species C36H16, C34, C10H9N, C15H9N+, C42H16 e C54H18 in the group of galaxies under study, showing a predominance of neutral species with a maximum of 50 carbon atoms, indicating a region favorable to the effects of fragmentation, a phenomenon that plays an important role in the physical chemistry properties of these regions. Nowadays, the physical conditions of the ionized gas are being determined through photoionization models in conjunction with the observed spectra, and the next step is to perform laboratory experiments irradiation with fast electrons with molecules of identified PAH to verify the possible chemical behavior of the PAHs in the galaxies under study. keyword: Signature – PAH – Galaxy –Seyfert– Starburst – PAHdb – Astrochemistry.

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Spectroscopic search for new magnetic cataclysmic variables with SOAR telescope

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ABSTRACT

The increasing number of synoptic surveys carried out by small robotic telescopes, such as the Catalina Real-Time Transient Survey (CRTS), represents a unique opportunity for the discovery of variable sources, increasing the samples and improving the statistics of these classes of objects. Among these transient sources, our goal is the discovery of Magnetic Cataclysmic Variables (mVCs), which include Polars and Intermediate Polars. These are relatively rare objects, useful for investigating scenarios of matter accretion controlled by the white dwarf's magnetic field. We will present our results in this search for new mVCs, using spectra obtained in the SOAR Telescope of 90 targets selected by variability criteria in the CRTS catalog.

The chemical abundance of the LINER galaxy UGC 4805.

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ABSTRACT

The low-ionisation nuclear emission line region (LINER) class of galaxies are interesting objects as they might appear in about one third of the galaxies of the near universe (Ho et al. (1997). The nature of their excitation is still not well understood and there are no reliable methods to estimate abundances in the central regions of these galaxies. One method, calibrated for active galaxies, was derived by Storchi-Bergmann et al. (1998). This is valid for Seyfert nuclei, but is not accurate for LINERs. In this work, we present preliminary results on the determination of the chemical abundance of the LINER galaxy UGC 4805, using the MaNGA (Mapping Nearby Galaxies at the Apache Point Observatory) data, that comprises integral field spectroscopy in a wavelength range of 3,600-10,300 A, with a resolution of $R \sim 2000$. The BPT diagram (Baldwin, Phillips & Terlevich 1981), which is based on line ratios between high and low ionization potential species, was used in order to separate the LINER regions from the star forming regions and 'normal' Active Galactic Nuclei. Also, the diagnostic diagram which makes use of the equivalent width of Hα (EWHα) - the so-called WHAN diagram (Cid Fernandes et al. 2010) was used to discriminate between a genuine LINER and emission-line galaxies, whose ionizing photons are produced in the atmospheres of evolved low-mass stars (the so-called postAGB stars). The underlying stellar population was subtracted using the stellar population synthesis method STARLIGHT (Cid Fernandes et al. 2005). The abundance of oxygen was determined using the calibrations R23 (Edmunds & Pagel, 1984); O3N2 (Pettini & Pagel, 2004) and the one derived by Pilyugin & Grebel (2016). We found an abundance of oxygen ranging from

$8.2 < 12 + \log(O/H) < 8.8$. This value is close to that found by Castro et. al (2017) for a sample of Seyfert galaxies. We estimate the abundance of oxygen by three calibration methods. The resulting abundances vary up to 0.8 dex from one calibration to another.

Orbital classification on a N-body bar galactic model

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ABSTRACT

The dynamics and evolution of a galactic structure are strongly influenced by the properties of the orbits that constitute it. This work shows a comparison between the morphological classification created in Valencia-Enríquez et al. (2017) and the orbital classification created by Šidlichovský & Nesvorný (1996), which is based on the analysis of fundamental frequencies using Fourier Transform methods. These methods are applied to the barred model of Valencia-Enríquez et al. (2019). It is found that a good percentage of orbits that support the bar in the morphological classification is around the 2:1 resonance, while those that are ridding around the Lagrangian points are around the 1:1 resonance.

Accretion discs in supermassive black hole binaries and future observations for the LISA detector

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ABSTRACT

A circumprimary gas disc is pushed into the primary supermassive black hole (SMBH) by the tidal force of the decaying secondary during a SMBH merger. When the binary system is inclined can occur misaligned snowplough effect producing an increase in luminosity prior to merger. In this work, we estimate the accretion rates and we suggest a possible eletromagnetic counterpart produced by SMBHs. Using the 3D Smoothed Particle Hydrodynamics (SPH) code PHANTOM, we extend previous investigations of co-planar discs and the disc-binary orbital planes misaligned for the most sensitive mass range of SMBHs ($10^7 M\odot$) for the LISA gravitational waves detector. We consider a geometrically thin disc planar a nd with inclination angles varying from 1 to 180 degrees and a binary with mass ratio $q = 10^{-3}$. We also consider different numbers of SPH particles for each simulation, 5×10^5, 7×10^5, 1×10^6 and 2×10^6. We find that aligned discs at high resolution ($1 - 2 \times 10^6$ particles) produce an increase in luminosity exceeding the Eddington rate. By contrast, discs with inclinations between 1 and 30 degrees show a less pronounced rise in the accretion rate. Whilst thicker discs with disc aspect ratio $H/R = 0.02; 0.05$, show no peak in the mass accretion rate. The rise in the accretion rate produced by discs inclined with angles < 30 degrees to the binary orbit can produce an electromagnetic counterpart to the gravitational wave signal emitted from final stages of the binary orbital decay.

Simulando o sistema de galáxias em interação AM 2229-735 e a formação de sua estrutura polar

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ABSTRACT

Investigamos a formação de galáxias com anéis polares através de minor-mergers. Usamos simulações de N-corpos + hidrodinâmica para reproduzir a dinâmica do sistema observado AM2229-735, cujos sinais de interação indicam ser o progenitor de uma galáxia com anel polar. A partir da informação observacional do sistema obtivemos as condições iniciais para realizações numéricas das galáxias e das possíveis órbita para simulações. Nossas simulações reproduzem as características globais de interação observadas no sistema, tais como braços e ponte de material que liga as galáxias. Como um remanescente de fusão, encontramos uma corrente de maré plana quase-estável e auto gravitante, com matéria escura, estrelas e gás orbitando em um plano aproximadamente perpendicular ao disco principal da galáxia levando no futuro à formação de uma galáxia de anel polar. As condições dinâmicas da estrutura polar sugerem que este tipo de remanescente de fusão pode levar à formação de uma estrutura semelhante a um disco com suporte isotérmico, fornecendo evidências inspiradoras sobre o processo de formação de discos galácticos e um potencial cenário independente para estudar a presença de matéria escura neste tipo de galáxias.

Study and characterization of the spectral states of 1E 1740.7-2942 in hard X-rays

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ABSTRACT

The source 1E 1740.7-2942 (1E), located near the Galactic Center, is an X-ray binary whose compact object is classified as a black hole candidate due to its spectral similarities to Cygnus X-1. The hard X-ray spectra of 1E ($20 < E < 200keV$) can be understood by the sombrero model, in which thermal photons from the accretion disk are comptonized in a hot electron corona. In this model, the X-ray spectra are well adjusted by a power-law, whose index, Gamma, is used to characterize the source's spectral state. Values in the literature for this index, however, are quoted over a wide range (e.g., between 1.2 and 2.5). In this work, we analyzed the public database of 1E from ISGRI telescope on-board the INTEGRAL satellite. Data were reduced to obtain spectra in the 20-200 keV range, as well as light curves in six different bands. We use the XSPEC environment to perform spectral analysis. Both these tasks (reduction and spectral analysis) were automated. The data allowed us to verify that 1E is mostly in the hard (canonical) state and is one of the most brilliant sources in the region where it is observed, corroborating previous results. We present a Gamma indexes distribution, which allow us to distinguish four spectral states for 1E in hard X-rays. In addition, it was possible to recover the degeneracy between kT and tau and, also, the correlation between the parameters E_cut and kT. Another fundamental result was to conclude that, in 1E, the hot electron corona is most likely static and, therefore, the spectral states of the source are the consequence of the truncation of the disk radius, as canonically described by the sombrero model.

Carbono, 12C/13C e nitrogênio em estrelas gêmeas solares.

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ABSTRACT

The abundance of light elements in dwarf stars of different ages is an important parameter for stellar yields, galactic chemical evolution models and exoplanet compositions. We measured the isotopic ratio 12C/13C and nitrogen abundance in solar twins for the first time. These results were obtained under a self-consistent, homogeneous and automated procedure, together with the carbon determination by means of high precision spectral synthesis of molecular lines/features selected in $\lambda\lambda$4180-4400 A, using high-resolution and high-quality HARPS spectra (ESO Observatory La Silla). Our analysis of the 55 stars of the thin disc confirmed the dependence on carbon and nitrogen with respect to metallicity. [N/Fe] was analyzed for the first time for this sample of solar twins as a function of metallicity and isochrone stellar age. KPMFITS was used in our analysis to obtain the linear fits, since this takes into account the errors in the X and Y scales. Our derived correlation [C/Fe]-age agrees with previous works for solar-type stars and solar twins. The linear fits of [C/Fe] and [N/Fe] as a function of [Fe/H] and isochrone stellar age for the solar twins lay under-solar for both whole scales in [Fe/H] and age (also confirming that the Sun is slightly enhanced in both volatiles C and N relative to the refractory Fe in comparison with solar twins).12C/13C appears to have decreased a little in time along the evolution of nearby Galaxy's thin disc. The Sun also appears above the C isotope ratio with respect to the other solar twins. We estimate that 12C/13C is around 81 +/- 1.5 in the current epoch.

Photochemistry and desorption induced by X-rays in water rich astrophysical ice analogs: Implications for Enceladus moon and other frozen space

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ABSTRACT

In an attempt to simulates the photochemical processing and photodesorption processes induced by X-rays in frozen surfaces at space environments we present an experimental study on the photolysis of water-rich ices (containing also CO2, CH4 and NH3) in the presence of soft X-rays. The simulated scenario includes for example, the surfaces of Enceladus moon, outer solar system frozen bodies and icy grains in the interstellar medium and in the vicinity of young stellar objects that are highly exposed to x-rays. The experiments were performed at the Brazilian synchrotron facility LNLS/CNPEN employing broadband radiation (from 6 to 2000 eV), mainly soft X-rays and small fraction of VUV) in the solid samples at temperatures of 20 an 80 K, and the icy sample were monitored by infrared spectroscopy. We determined the effective destruction cross section (in the order 10-18) as well the formation cross section for the new species produce by radiation such as OCN-, CO, CO3, CH3OH, H2OH, HCOO-, NH4+, HCONH3 and CH3COH (mostly of them were only detected in the ice at 80 K). The compaction induced by x-rays ion porous ices at 20 K was characterized with a determined value for its cross section of 1.8E-17 cm-2. The chemical equilibrium stage was characterized and molecular abundances were quantified (we also included a methodology for estimated the amount of unknown species in the ice produced by photolysis). The samples reach chemical equilibrium at fluences around 2- 3 1018 cm-2. Timescale for reaching chemical equilibrium in space environments illuminated by X-rays were given, as well as, some desorption yield induced by X-rays. Implication on the chemistry and desorption processes of Enceladus moons are provided. Se details at [1,2 and 3].

This work was financed by FAPESP (JP 2009/18304-0, DR 2013/07657-5; PUB 2015/20132-4), CAPES and CNPq.

The population of clusters originating by fission failure inside collisional asteroid families

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ABSTRACT

Asteroid families are groups of objects that share similar orbits. They are mostly the product of collisions between two bodies. Asteroid clusters can be created by the rotational failure of a parent body, and they tend to be more compact in proper elements domains than asteroid families. Recently, using family recognition methods based on time-reversal dynamical simulations, machine-learning clustering algorithms, and the exceptional orbit accuracy obtained from Gaia observations of Solar System Objects, we identify several sub-clusters within at least nine extremely young collisional families. We find that collisional asteroid families younger than 100 Myr have a higher fraction of young detectable spin sub-clusters with respect to older groups. The collisional events that form asteroid families may trigger a subsequent cascade of spin-induced formations of clusters by producing fragments on fast rotating states. Bibliography Carruba V., Spoto F., Barletta W., Aljbaae S., Fazenda Á., Martins B., (2020) The population of rotational fission clusters inside collisional families, Nature Astronomy, in press. Carruba V., Ribeiro J. V. (2020) The Zelima asteroid family, resonant configuration and rotationa fission clusters, Planetary and Space Science, in press.

Oral Presentations - INCT GNSS NavAer: INTEGRATING SPACE WEATHER, GEODESY AND AIR NAVIGATION

Ionospheric scintillation and Precise Point Positioning (PPP): characterization and modeling

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ABSTRACT

GNSS signals propagating through small-scale plasma irregularities in the ionosphere may experience fluctuations in amplitude and/or phase, the so-called ionospheric scintillations. The scintillations affect the performance of GNSS based services, such as Precise Point Positioning (PPP) relying on GPS dual-frequency data. This work presents the main results of a research that focused on establishing a link between ionospheric conditions driving scintillations and its effects on the GNSS observables. Several aspects such as effects on data availability (losses of lock), fading depth and their relations to the mai scintillation indices were investigated. Data from a monitoring station located in São José dos Campos at UNIVAP premises were applied. The main results are the basis of a novel approach for modeling the scintillation effects on the least squares adjustment. This novel approach presented promising results, including cases of accuracy recovery of the PPP service under strong scintillation. This research was conducted in the context of National Institute of Science and Technology for GNSS in Support of Air Navigation (INCT GNSS-NavAer), funded by CNPq (465648/2014-2), FAPESP (2017/50115-0), and CAPES (88887.137186/2017-00).

On the impact of CME- and CIR/HSSs-driven geomagnetic storms on the ionospheric processes during the descending phase of solar cycle 24. A Ionospheric Forecasting Approach.

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ABSTRACT

We present a study of the low latitude ionospheric response to a Corotating interaction region, CIR, and High-Speed Streams, HSSs, and to Coronal Ejection Mass, CME, during the descending phase of solar cycle 24. For this aim we analyze ionospheric parameters such as GNSS TEC, and scintillation index, S4, as well as other ionospheric parameters. We observe remarkable differences in the development of plasma irregularities and scintillations processes especially over the equatorial region and the crests of the Equatorial ionization anomaly, EIA, in Brazil. The results showed a clear intensification of the TEC and the development of plasma bubbles in the main phase of CME-storm. On the other hand, during the moderate CIR/HSS- driven storm, the TEC intensification extended to the recovery phase of the storm for several days which can be influenced the scintillation processes. We discuss the remarkable differences on the ionospheric scintillations processes during the two distinct storms.

Real-time TEC estimation from GNSS NTRIP network

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ABSTRACT

In recent years, the GNSS (Global Navigation Satellite System) has become an important tool for monitoring the Earth's atmospheric parameters, particularly the ionosphere. This layer is the major error source on signals broadcasted by GNSS satellites, affecting positioning and navigation results. Because of this interference, signals traveling through the ionosphere layer provide information about this layer. Therefore, the code delay and the carrier phase advance suffered by GNSS signals reflect the ionosphere behavior as a function of TEC (Total Electron Content). In this context, there are two aspects to using active GNSS networks. One involves the development of ionospheric models to improve positioning and navigation results for GNSS users. The second involves the application of active networks as an important infrastructure for remote sensing of the ionosphere, allowing its monitoring and studies of the behavior of this dynamic layer. In both aspects, real-time data processing has become an increasingly important requirement, especially for applications requiring real-time or low latency modeling, such as air navigation involving SBAS (Satellite Augmentation System (Satellite Augmentation System) or GBAS (Ground Augmentation System) concepts. In this context, in recent years, the Geomatic Studies and Research Group (GEPG) at UTFPR-Apucarana has been developing research for the estimation of TEC and ionospheric modeling in real-time, using GNSS data disseminated via NTRIP (Networked Transport of RTCM Internet Protocol), such as RBMC-IP. Currently, in collaboration with researchers from the Space Geodesy Study Group (GEGE) at FCT/Unesp, research has been conducted to improve the real-time TEC estimation algorithm as well as the structure for data availability to users.

Space Weather and Ionosphere activities by the Space Geodesy Research Group of Unesp/Brazil

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ABSTRACT

In this presentation a brief description of Unesp (São Paulo State University) will presented together with few researches carried out by the Geodetic Research Group (GEGE) including the infrastructure of research and data set available. These researches are related with Geodetic Remote Sensing and Positioning, including Navigation. For this presentation, the concentration will be on those ones related with Ionosphere, including DCB (Delay Code Bais) and TEC (Totla Electron Contents) estimation, mitigation of scintillation effects in the Navigation and Positioning, as well as a few words about ionosphere scintillation prediction. Special attention will be given for the INCT project, called GNSS NavAer, which is related with ionosphere and air navigation and is leaded by Unesp, with participation of several other universities and institutes in Brazil. The web page under construction can be found at http://inct-gnss-navaer.fct.unesp.br.

Operational analysis of a ground based augmentation system

C. A. M. Herrera[1], E. G. Silva[1], F. M. R. Carvalho[1], M. Tortolio Junior[1], R. M. Andrade[1], K. M. Santos[1], M. L. V. Oliveira[1], M. R. Silva[1]

[1]IACIT Soluções Tecnológicas

ABSTRACT

Global Navigation Satellite Systems (GNSS) is a technology that has the potential to provide a guidance with global coverage. However, this system fails to grant integrity that civil aviation operations requires. Therefore, a system like the Ground Based Augmentation System (GBAS) is required. The GBAS ground subsystem consists in at least three Reference Receivers (RR) located at known positions, that receives the signals from the satellites that are in-view and provide the pseudoranges, a VHF Data Broadcast Station (VDB), that broadcasts the GBAS messages to the aircraft that are operating inside its coverage and an Integrity Monitoring Station (IMS), which main function includes monitoring the operational state and the integrity of the GBAS ground subsystem elements. Along with that, there is a Processing Base Station (PBS), that processes data and estimates the pseudorange errors and broadcasts pseudorange correction messages to the aircraft through the VDB subsystem. This way, the objective of this work is to make an operational evaluation of the GBAS system, analyzing and comparing Vertical and Horizontal Protection Level (VPL, HPL) and Vertical and Horizontal Position Error (VPE, HPE) in two locations and analyze its behavior in different periods of time. There are three types of data collected and analyzed in this work, two using the PolaRx5S, a multi-frequency multi-constellation receiver, one in IACIT headquarters and one in Santa Helena Farm, and data from the RR installed in Santa Helena farm, both in São Paulo state. These, along with data from the VDB in Santa Helena, are used as input in the PEGASUS software, which allows the GNSS data analysis. Then, a report is generated comparing VPL and VPE, HPL and HPE and Number of Satellite Vehicles (NSV) from the PolaRx5S data and from the RR. This analysis may provide a better understanding of the behavior of the data GBAS system in different periods.

2021 VIII SBGEA Simpósio Brasileiro de Geofísica Espacial e Aeronomia & VIII SIMFAST Simpósio de Física e Astronomia do Vale do Paraíba
22 a 26 de março | 2021
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New approach for a ground based augmentation system implementation in Brazil

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[1]IACIT Soluções Tecnológicas

ABSTRACT

Global Navigation Satellite Systems (GNSS) is a technology that has the potential to provide a guidance with global coverage. However, this system fails to grant integrity that civil aviation operations requires. Therefore, a system like the Ground Based Augmentation System (GBAS) is required. The GBAS ground subsystem consists in at least three Reference Receivers (RR) located at known positions, that receives the signals from the satellites that are in-view and provide the pseudoranges, a VHF Data Broadcast Station (VDB), that broadcasts the GBAS messages to the aircraft that are operating inside its coverage and an Integrity Monitoring Station (IMS), which main function includes monitoring the operational state and the integrity of the GBAS ground subsystem elements. Along with that, there is a Processing Base Station (PBS), that processes data and estimates the pseudorange errors and broadcasts pseudorange correction messages to the aircraft through the VDB subsystem. In Brazil the implementation of this system faces ionospheric challenges. Because of the South Atlantic Magnetic Anomaly (SAMA) and the formation of plasma bubbles in the equatorial region, the communication among the receivers, airplanes and satellites is affected and sometimes it can transmit wrong or incomplete messages. Therefore, the IACIT company came with a new solution to work around this problem that includes the installation of receivers. This new approach avoids the plasma anomaly issue because both the receivers position given by the GPS and their real position are known. Thus, it's possible to estimate the error between these positions and apply the corrections needed. This work is currently being developed, but when the system is fully completed, it may work anywhere around the globe, without being affected by the ionospheric anomaly problem.

Assessment of unbiased SSR ionospheric corrections derived from PPP with ambiguity resolution

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ABSTRACT

PPP (Precise Point Positioning) is a GNSS (Global Navigation Satellite Systems) positioning method that requires SSR (State Space Representation) corrections in order to provide solutions with high accuracy (cm level). RT-PPP (Real-time PPP) is possible thanks to real-time precise SSR corrections, for orbits and clocks, provided by IGS (International GNSS Service) as well as the associated analysis centers such as CNES (Centre National d'Etudes Spatiales). CNES SSR products enable RT-PPP with integer ambiguity resolution. PPP with ambiguity resolution (PPP-AR) in real-time is often referred as PPP-RTK (PPP - Real Time Kinematic) and PPP-WIZARD software is capable of performing PPP-RTK. Ionospheric effects are spatially correlated by GNSS data from active networks, so it is possible to model and provide ionospheric delays for any position in the network coverage area. The prior knowledge ionospheric delays improve positioning convergence for PPP-RTK users. In this study, we demonstrate that ionospheric delays obtained throughout PPP-AR estimation are actually ionospheric observables. These ionospheric observables are biased by receiver hardware. These biases prohibit the use of PPP-WIZARD derived ionospheric delays to produce ionospheric models. Receiver biases correction is essential to provide ionospheric delays while using PPP-AR based ionospheric observables. In this research, a method was implemented to estimate and mitigate receiver hardware biases influence on slant ionospheric observables from PPP-AR. The assessment of unbiased SSR ionospheric corrections derived from PPP with ambiguity resolution was performed. The proposed solution is promising and could produce high quality 1-2 TECU ($\sim$ 16-32cm in $L1$). slant ionospheric delays. This product can be used in a large variety of modeling approaches, since ionospheric delays after correction are unbiased. Besides, preliminary results on the use of unbiased ionospheric corrections in PPP-RTK are also presented.

Simulating ionospheric Eeffects on a ground based augmentation system

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ABSTRACT

The ionosphere affects the propagation of GPS signals in the equatorial and low-latitude regions. Even auxiliary systems such as the Ground Based Augmentation System (GBAS), are affected by ionospheric effects, which are the focus of the present contribution. For all active channels between GPS satellites and receivers, models for the pseudorange, carrier phase, and received power of the GPS L1 signal will be described, considering the geometric range; receiver and satellite clock errors, ionospheric and tropospheric delays; multipath; phase and amplitude scintillation; and system parameters. To simulate ionospheric delays, the vertical Total Electron Content is characterized through a statistical analysis of dual-frequency GPS data from the Rede Brasileira de Monitoramento Contínuo and their residuals relative to those provided by the International Reference Ionosphere (IRI 2016). This study considers different combinations of five geophysical parameters. The $\alpha - \mu$ probability distribution model is used to represent amplitude scintillation. To define the parameters of this distribution, a random value for the S_4 index (the standard deviation of the received power, normalized by its average value) and the associated value for α and μ are selected, according to data from the CIGALA/CALIBRA network. Successive samples for the phase scintillation term are generated similarly, according to empirical relationships between S_4 and σ_ϕ (the standard deviation of phase fluctuations) values, combined with zero-mean Gaussian probability distributions. Next, the functions of a GBAS (Signal-in-Space Receive and Decode; Signal Quality Receiver; Signal, Measurement, and Data Quality Monitoring; Multiple Reference Consistency Check) will be described. The functional blocks are integrated by the Executive Monitor to test, smooth, correct, and average

signals, as well as to estimate protection levels and to generate correction messages that will be transmitted to aircrafts via a Very High Frequency Data Broadcast link. Finally, this contribution will present and discuss results from the above formulation for different combinations of geophysical parameters and configurations of interest.

Poster Presentations - Ionosphere: Earth and Other Planets

Solar flares effects on the ionosphere monitores by the ground-basead GPS-TEC receivers and radio waves over brazilian sector

A. J. de Abreu[1,2], E. Correia[1,3], M. Roberto[2], M. A. Alves[2], J. R. Abalde[2], P. A. Nogueira[4], K. Venkatesh[5], P. R. Fagundes[6], R. de Jesus[1], M. Gende[7], I. M. Martin[2]

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ABSTRACT

In this investigation, we present and discuss the effects of 6 X2-class solar flare events in the ionospheric F region over Brazilian sector that occurred during 2013 to 2015. For this investigation, we present the vertical total electron content (VTEC) observations from nearly 120 Global Positioning System (GPS) receivers all over the Brazilian sector for each event. The stations belong to the "Rede Brasileira de Monitoramento Contínuo", operated by the "Instituto Brasileiro de Geografia e Estatística"(IBGE). Also, ionospheric sounding observations obtained in São José dos Campos (23.2°S, 45.9°W), under the southern crest of the equatorial ionospheric anomaly (EIA), Brazil, are presented. The observations show that the greatest TEC impact occurs with the EUV fluxes increases lasting for more than one hour and when the solar active region is located close to the solar disc center. The largest increase of ΔTEC occurs below the magnetic equator line, covering mainly the central, northeast, southeast and south regions, which includes the equatorial ionospheric anomaly (EIA) region. The ionograms show partial or total fade out in the echoes traces observed causing blackouts of radio signals of up to 60 minutes, which can have serious consequences to technological systems of public and private agencies around Brazilian sector.

Why do equatorial plasma bubbles bifurcate?

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ABSTRACT

Plasma bubbles observations using all-sky imagers show bifurcations with complex patterns. Bifurcation is the division of one channel of the plasma bubbles into two that grows vertically in the magnetic equator. Several theories have been suggested to explain the bifurcation mechanism. In this work we use a plasma bubble simulation code to examine these theories. A result of the model is that the height where the bifurcation occurs is conditioned by the electric polarization fields inside the bubble. The numerical results obtained show plasma bubbles with complex ramifications which agree with the observations taken at São Joao do Cariri (7.4°S, 36.5°W).

Comportamento ionosférico diurno em Jataí (Dip-latitude 12,5ºS) e São José dos Campos (Dip-latitude 19,9ºS), ambas as localidades próximas à crista da Anomalia Equatorial (EIA)

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ABSTRACT

Nesta investigação apresentamos os primeiros resultados do comportamento ionosférico diurno em Jataí (JAT-17,9ºS, 51,7ºO; dip latitude 12,5ºS), os ionogramas foram obtidos através de um sistema de ionossonda digital do tipo CADI recentemente instalado (abril de 2016). Além disso, apresentamos uma comparação entre os parâmetros ionosféricos h'F e foF2 observados em JAT e São José dos Campos (SJC-23,2ºS, 46,0ºO; Dip latitude 19,9ºS) para o período de outono/inverno (abril, maio e junho de 2016) e período de primavera/verão (outubro, novembro e dezembro de 2016), visto que ambas as localidades estão próximas da crista da Anomalia Equatorial de Ionização (EIA). Os resultados mostraram que a ionosfera em ambas as localidades apresenta diferenças notáveis, embora esses locais estejam separados por 6º de longitude. Observamos que a formação da camada F3 é muito mais frequente em JAT se comparada à SJC e nos meses de abril, maio e junho não foram observadas a formação da camada F3 simultaneamente, contudo, no período de primavera/verão, foram observados diversos casos de formação da camada F3 de forma simultânea em ambas as localidades. Provavelmente, a geração da camada F3 está relacionada à propagação das ondas de gravidade e/ou MSTID. Outro aspecto observado é que a camada F1 no JAT é mais evidente se comparada à SJC.

Analysis of internal gravitational waves structure from observations of noctilucent clouds on high latitudes

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ABSTRACT

Investigations of atmospheric gravitational waves on the observations of noctilucent clouds in Yakutsk in the summer seasons of 2018-2019 was carried out. The observations were made using a permanently installed Samsung Galaxy S4/ mini phone using the free program Time Lapse Creator. The shooting was carried out with an exposure of 2 seconds, every 2 minutes in the direction above the northern horizon. The rare case of observing such a wave structure of noctilucent clouds on July 26, 2018, when several waves of different lengths and intersecting directions of propagation are simultaneously observed, is analyzed. The main characteristics of the analysis of these gravitaty waves are given. The work is aimed at developing a study of the wave properties of the middle atmosphere from images of noctilucent clouds according to a low-base network of cameras and a set of optical instruments for measuring the temperature profile of the atmosphere (lidar, infrared OH spectrograph). The study of the wave structure, especially in the range of internal gravitational waves, is important for understanding the processes of energy exchange in the middle atmosphere and the formation of its dynamics.

Estudo das camadas intermediárias descendentes sobre a região brasileira.

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ABSTRACT

O presente trabalho tem por objetivo estudar a climatologia das camadas intermediárias descendentes (CI's) sobre a região equatorial e de baixas latitudes brasileiras durante diferentes períodos de atividade solar. Na região conhecida como vale ionosférico, localizada entre o topo da região E e a base da região F, encontra-se uma camada de fraca ionização denominada por camada intermediária descendente (CI). Dentre suas principais características podemos ressaltar o movimento descendente característico apresentado por ela, o qual pode perdurar de minutos a horas. Este movimento descendente faz com que as camadas intermediárias acabem por atingir as alturas da região E ionosféricas e assim acabem se fundindo com as camadas esporádicas-E (Es). Embora as camadas intermediárias já venham sendo estudadas há muitos anos, algumas características sobre esse fenômeno ainda não são bem conhecidas e precisam ser melhores investigadas, tais como, o mecanismo de sua formação, sua composição, qual a influência da atividade solar e magnética, dentre outras. Neste contexto, um estudo sobre o comportamento das camadas intermediárias descendentes sobre o setor brasileiro de São José dos Campos - SP durante o período de agosto/2008 a julho/2009 representando o mínimo solar, e durante o período de maio/2013 a abril/2014, representando um ano de máxima atividade solar vem sendo realizado. Os resultados preliminares indicam que a presença dessas camadas em baixa latitude e durante o mínimo solar pode ser elevada, visto que o primeiro mês de dados analisados em São José dos Campos (outubro de 2008) revelou uma ocorrência mensal de 98%.

Assessment of global ionospheric maps considering TEC uncertainties

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ABSTRACT

The Earth's ionosphere can influence GNSS (Global Navigation Satellite System) signals in many ways, affecting the positioning performance. Ionospheric influence varies in time and space, according to the differences in the distribution of electrons. Those differences can be related to many factors, such as the position on the surface of the Earth, the geomagnetic field activity, season of the year, solar ionization flow and sunspot cycles. Several researches are being developed in order to understand the ionosphere and to mitigate its effects on GNSS positioning. In this context, some products were developed in order to represent the ionospheric behavior and irregularities. There are networks composed by receivers specifically for ionospheric monitoring and, besides that, the GNSS networks can also be useful for this purpose. Among the ionospheric products, nowadays available, ionospheric information can be provided on a global scale in IONEX (IONosphere map EXchange) format. Global ionospheric maps developed by IGS (International GNSS Service) data centers provide total electron content (TEC) values and its root mean square errors, in grids with 2.5º x 5º (latitude x longitude) and two-hour resolution. Many studies have been performed using IONEX information as a representation of the ionospheric behavior as well as to assess the quality of those products. Considering the information provided by IONEX files, in this work we aimed to explore ways of visualization of VTEC values, considering the respective VTEC uncertainties. We also present some ways of using VTEC values with weighting, based on the corresponding uncertainties. In this case, VTEC interpolation takes into account, not only the distances from the grid (with VTEC information), but also the RMSE of those values. Some experiments were also performed considering the possibility of using products of different IGS centers. The assessment of VTEC estimated was performed considering data from other sources, such as altimeters and observed in independent GNSS ground reference stations.

Climatology of intermediate descending layers over the equatorial and low latitude regions of Brazil during a solar minimum period

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ABSTRACT

this work, we discuss the climatology of the intermediate descending layers (ILs) over Brazilian equatorial and low latitudes regions during the extreme solar minimum period of 2009. The results shows that the occurrence frequency of the ILs is very high, being $> 60\%$ over São Luís (2° S; 44° W, I: -5.7°) and $> 90\%$ in Cachoeira Paulista (22.42° S; 45° W, I: -34.4°). In most cases the ILs occur during the day at altitudes varying from 130 to 180 km and they may descend to lower altitudes ($\sim$ 100 km) in a time interval of a few minutes to hours. The main driving force for the ILs at the low latitude region may be considered to be the diurnal tide (24 h) followed in smaller dominance by the semidiurnal (12 h), terdiurnal (8 h) and quarter-diurnal (6 h) components. The semidiurnal tide, however, does not appear to influence the ILs dynamics except in summer. Additionlly, the ILs mean descent velocities over São Luís and Cachoeira Paulista show a day-to-day variability that may be associated to a wave like perturbation with a periodicity of some days. Some peculiarities in the ILs dynamics were observed e will be discussed in this work.

Analysis of ionospheric disturbances during the intense geomagnetic storm of June 2015 using GPS-TEC and ionosonde observations in Brazil

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ABSTRACT

The F-region response during the intense geomagnetic storm of June 21-24, 2015 is investigated using multisite and multi-instrument in the Brazilian sector. A network of 116 GPS-TEC receivers and 1 CADI ionosonde are used. To study the ionospheric response during the geomagnetic storm, the geomagnetic indices (Dst and Kp) and solar wind interplanetary parameters (Np, Vp and Bz) were used. During this intense storm, the disturbance storm time index (Dst) reached a minimum value of -204 nT on June 23, 2015 at 0500 UT and Kp index reached a maximum of 8. The interplanetary solar wind velocity increased from 270 km/s to $\sim 790 km/s$ and the proton density reached a maximum value of $\sim$ 70 particles per cm3. The interplanetary magnetic field (Bz) reversed to the south and then reversed to the north showing an oscillatory behavior during the main phase and the initial recovery phase. The total vertical electron content (VTEC) showed a positive ionospheric disturbance during the main phase at stations located at the magnetic equator region and low latitude regions, while during the recovery phase a negative storm effect was observed. However, beyond the crest of the equatorial ionization anomaly (EIA) region, the VTEC presented a positive ionospheric effect both during the main and recovery phases. This ionospheric disturbance was probably caused by the prompt penetration electric field (PPEF). The EIA variations during the storm are analyzed using a network of GPS-TEC receivers, located perpendicular to the geomagnetic equator. It is observed that, during the main phase there was an intensification of the EIA which was probably due to the enhanced fountain effect. Later, in the recovery phase, a significant decrease in the intensity of the EIA was noticed. However, from the second day of the recovery phase (06/24/2015), the EIA began to show quiet time behavior.

A step-to-step plan to recognize the occurrence of plasma irregularities using Digisonde capabilities and other instruments.

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ABSTRACT

The complex electrodynamics of the E and F regions are important in providing conditions for the generation of plasma irregularities at the equatorial region which can reach higher latitudes, such as the crests of the equatorial ionization anomaly, EIA, or further, where they are associated to strong scintillation processes and spread-F in ionograms. There are distinct patterns and signatures of plasma irregularities, which depend on many factors. In this way, there are many techniques to identify and classify them, depending on the instrumental sensitivity and its characteristics. In this talk we present a summary of techniques to primary identify plasma irregularities using Digisonde data and capabilities and how to validate it with other experimental methods.

Analysis of multipath index time series using data from Brazilian GNSS stations under different ionospheric conditions

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ABSTRACT

GNSS (Global Navigation Satellite Systems) transmitted signals can be affected by several error sources. The atmosphere has an important influence on GNSS signals propagation, in particular the ionosphere. The ionospheric influence can vary in time and space and is related to several factors, e.g. the position on the Earth's surface, season, solar ionization flow, geomagnetic activity and sunspot cycles. Equatorial region presents high electron density, this characteristic combined with irregularities and anomalies such as EIA (Equatorial Ionization Anomaly) puts the Brazilian territory in an interesting position for investigations related to ionosphere due to its location and extension, with different ionospheric conditions. Another error related to GNSS propagation occurs when the transmitted signal arrives to the receiver by a direct and an indirect path, due to reflections in the surrounding surfaces, this error is known as multipath. In order to evaluate the influence of multipath in a station some indexes (MP1 and MP2) can be estimated using GNSS observation. MP1 and MP2 consider the carrier phase, therefore, cycle slips and other interferences may directly affect the indexes estimation. It means that ionospheric disturbances can also influence multipath indexes. Previous studies analyzed multipath indexes behavior in order to identify possible seasonality and its causes. In this research, we aim to investigate the multipath index behavior using data from two GNSS stations in regions with distinct ionospheric influence. Data from 2003 to 2018 were used to estimate the indexes. The time series cover solar cycle 23 decrease (2003-2008) and almost the whole solar cycle 24, including its peak (2013-2014). Results show the regional and seasonal influence of ionosphere on multipath index estimation, which reflects the ionospheric behavior. Indexes obtained with data from the station in the region with low ionospheric activity presented more regular behavior than those from the region more affected by the

ionosphere. Seasonal behavior could also be noticed, with higher and more variable values between October and March, mainly when the solar cycle 24 peak is considered.

Perturbações no Conteúdo Eletrônico Total (TEC) gerada por atividade vulcânica na América do Sul

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ABSTRACT

Variações no Conteúdo Eletrônico Total (TEC) Ionosférico provocado tanto por eventos externos quanto internos a Terra são as principais fontes de perturbação nos sinais de GNSS. O número de trabalhos visando identificar e/ou mensurar o impactos dos eventos internos capazes de perturbar o TEC vem crescendo ao longo do tempo, entretanto, alguns ainda necessitam de maior detalhamento, como é o caso das erupções vulcânicas. Com esse objetivo, apresentamos neste trabalho o desenvolvimento de uma metodologia de estudo para identificar e quantificar o impacto no TEC provocado por atividade vulcânica. Para isso, foi escolhida uma atividade vulcânica ocorrida em junho de 2011 pelo Vulcão Puyehue (Chile). A metodologia consiste em utilizar dados de TEC de várias estações de GNSS localizadas próximo ao vulcão, aplicando o método de interpolação de Krigem nos dados, além de filtrar o comportamento de dia calmo. Esse método permite observar que as perturbações no TEC já estavam ocorrendo mesmo antes erupção principal, provavelmente, devido a grande atividade sísmica.

EQUARS Science

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ABSTRACT

The Equatorial Atmosphere Research Satellite, or EQUARS, improves the knowledge in Equatorial Aeronomy, with an emphasis on investigating the connections between the neutral atmosphere and the ionosphere in the equatorial region. In this context, three fundamentals issues that contribute to elucidate the effects of this coupling shall be addressed: 1) How the electrodynamic conditions of the ionospheric plasma and its response to momentum and energy inflows from the lower atmosphere regulate the formation of plasma bubbles? (2) Does planetary wave activity play a relevant role as a component of the day-to-day variability observed in the occurrence of plasma bubbles? (3) Is E-layer ionization enhancement due to particle precipitation in the South America Magnetic Anomaly (SAMA) a competitive factor in the dynamics of plasma bubbles? The observational approach of the EQUARS satellite is carried out employing five instruments that use different techniques to achieve the goals of the mission successfully. The observational data provide: (1) in situ conditions (density and temperature) of the ionized plasma as diagnosis of ionospheric irregularities; (2) ionospheric airglow as indicator of plasma bubbles dynamics; (3) mesospheric airglow as tracer of large-scale atmospheric waves dynamics; (4) fluxes of low-energy electron precipitation responsible to the enhancement of E-layer dynamo; (5) refractivity of lower atmosphere to infer the thermodynamic state (pressure, temperature, etc.) of the neutral atmospheric layers; (6) refractivity of the upper atmosphere to estimate the electron density and the ionospheric scintillations; (7) fluxes of energetic particles in the inner radiation belts which affect the electrodynamic state of the ionosphere. The unpredicted variations due to plasma bubble phenomenon are one of the most potentially significant threats for satellite positioning systems (GNSS). Hence, the expected

outcomes of the investigation proposed by the EQUARS mission, within the scope of applications in Space Weather, should benefit, especially, the sectors that make use of communication sensors that require direct georeferencing (3D position), including aviation safety, geophysical survey and precision agriculture.

Estimating the daytime vertical ExB drift velocities in the F-region of the equatorial ionosphere using the IEEY and AMBER magnetic data in West Africa

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ABSTRACT

In this paper the daytime vertical ExB drift velocity in the F-region of the equatorial ionosphere was estimated from the magnetic effect of the Equatorial Electrojet (EEJ) in West African sector for September equinoxes in 1993 during solar cycle 22 and in 2013 during solar cycle 24. Geomagnetic data recorded during the International Equatorial Electrojet Year (IEEY) from 1993 to 1994 and the ongoing AMBER (African Meridian B-field Education and Research) program since 2008 were used. The vertical drift velocity was inferred from the EEJ contribution (ΔH) in the geomagnetic field horizontal component. The IEEY data were used to examine the seasonal variations of the daytime vertical drift velocity. The noontime seasonal averages are Vd=10.95m/s and Vd=9.46 m/s respectively for March and September equinoxes, and Vd= 8.75 m/s and Vd=8.27 m/s for December and June solstices. The daytime vertical drift velocity was found to be larger in equinoxes than in solstices. The dependence of the daytime vertical drift velocity on solar cycle was also shown by comparing the results of September equinox in 1993 and 2013. The drift velocity of 9.5m/s in 1993 is significantly weaker than that of 24.5m/s in 2013. This strong difference in Vd reflects the level of solar cycle between 1993 when the mean F10.7=109.86 sfu and 2013 when the mean F10.7=122.55 sfu.

Characterization of the diurnal effects of Total Electron Content on radio waves.

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ABSTRACT

The ionosphere is a component of the Earth's atmosphere that comprises of free electrons and positive ions. The ionosphere is found at about 50 km altitude and extends beyond 1000 km. Total Electron Content (TEC) is the measure of the magnitude of electron density in the path of a radio signal between satellite and receiver. Radio signals transmitted from satellites are affected by this electron density. These effects in turn sabotage the accuracy and effectiveness of trans-ionospheric radio systems. The data used in this study was collected from the Ghana Geological Survey Authority, Accra (GGSA). The Global Navigation Satellite System (GNSS) data were processed using software such as Convert to RINEX, GPS RINEX to TEC. TEC data was analyzed for January 24th, February 5th, February 6th, February 7th, February 15th, March 26th and March 27th. TEC was observed to increase steadily from morning hours to midday (1200hrs UT) maximum of about 40 TECU. The lowest peak value recorded was 15 TECU which occurred at 1200hrs UT. The results obtained in this project predicts that: trans-ionospheric radio signals would suffer the greatest ionospheric effect at midday (1200hrs UT). Also, ionospheric effects would be least during early morning hours. Ionospheric effects can be estimated and corrected. Ionospheric corrections help to reduce ionospheric error and signal degradation.

Ground and satellite-based observations of ionospheric plasma bubbles and blobs at 5.65° latitude in the brazilian sector

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ABSTRACT

In this study, we use an all-sky imager (ASI) collocated with an ionosonde at Araguatins (5.65° S, 48.07° W and dip-latitude of 4.17° S) a near-equatorial station in Brazil, and plasma density measurements from Swarm satellites, to investigate the occurrence of plasma bubbles and blobs and their association with atypical Spread-F features observed in ionograms. Plasma bubbles and blobs are respectively regions of plasma density depletions and enhancements compared to the ambient plasma density in the ionosphere occurring after sunset in the equatorial and low latitude F region ionosphere. The majority of investigations carried out over the years have been done to link plasma bubbles observed in airglow images and Spread-Fs shown on ionograms with very little work done on the relationship between plasma bubbles/blobs and the “atypical” Spread-F. Cases of airglow images and ionograms in 2017 were obtained and analyzed. The results show the atypical Spread-F in ionograms corresponding with bubbles and blobs observed in the airglow images These atypical Spread-F structures were observed in the ionograms beyond the background critical frequency (foF2) of the F layer mostly around midnight - local time (LT) and were located at or above the virtual height (h’F) of the F region base.

Characterization of gravity waves in the lower ionosphere using VLF observations at Comandante Ferraz Brazilian Antarctic Station

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ABSTRACT

The goal of this work is to investigate the gravity waves (GWs) characteristics in the low ionosphere using very low frequency (VLF) radio signals. The spatial modulations produced by the GWs affect the conditions of the electron density at reflection height of the VLF signals, which produce fluctuations of the electrical conductivity in the D-region that can be detected as variations in the amplitude and phase of VLF narrowband signals. The analysis considered the VLF signal transmitted from the US Cutler/Marine (NAA) station that was received at Comandante Ferraz Brazilian Antarctic Station (EACF, 62.1o S, 58.4o W), which is a great circle path crossing longitudinally the Drake Passage. The wave periods of the GWs detected in the low ionosphere are obtained using the wavelet analysis applied to the VLF amplitude. The use of the VLF technique was validated comparing the wave period and duration properties of one GW event observed simultaneously with a co-located airglow all-sky imager both operating at EACF. The statistical analysis of the wave periods detected using VLF technique for 2007 showed that the GW events occur almost all nights, with a higher frequency per month from March to October. The predominant wave periods are more frequent between 10 and 15 min occurring preferentially during the equinoxes, but there are some events with periods higher than 60 min appearing only in the solstices (January and July). These results show that VLF technique is a powerful tool to obtain the wave period and duration of GW events in the low ionosphere, with the advantage to be independent of sky conditions, and can be used during daytime and year-round.

Study of TEC variations over the Latin American region during moderate and high solar activity

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ABSTRACT

The ionospheric plasma is a scattering medium that can affect the trajectory of ground-based Global Navigation Satellite System (GNSS) signals, introducing positioning errors. When the solar activity is lower, the ionosphere is almost transparent to the radio waves. However, when it is disturbed, satellite signals are refracted (higher electronic density). Thus, the ionosphere is a region highly relevant for Space Weather studies, from which it is possible to know the solar activity state. The present work is a comprehensive study of the ionospheric Total Electron Content (TEC) variations based on data obtained from (GNSS) receivers (networks) available in Latin America. Annual TEC trends at daytime and nighttime are studied for different solar activity conditions: 2011 (ascending phase) and 2014 (maximum phase). The present analysis was focused on: (1) response to the solar flux variation; (2) seasonal variations in different latitudes and longitudes; and (3) interhemispheric asymmetry. The daytime-nighttime comparison was performed to analyze the ionosphere dynamics in this period. The results showed that: in the daytime there were equinoctial asymmetries with an opposite configuration in high and moderate solar activity, and some hemispherical asymmetries

were observed which seems to be attributed to the meridional winds; while in the nighttime a strong latitudinal dependence of nighttime vTEC variation was observed, and the Midlatitude Summer Nighttime Anomaly (MSNA) in the Southern hemisphere was identified during January, February, and December of 2011. Also, the neutral wind approximations suggest that MSNA was associated with the presence of equatorward winds.

Variação na amplitude da maré lunar no conteúdo eletrônico total sobre o Brasil durante eventos distintos de SSW

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ABSTRACT

Usando dados de Conteúdo Eletrônico Total (Total Electron Content - TEC) para os anos de 2010 a 2014, fornecidos pelo programa de clima espacial, EMBRACE (Estudo e Monitoramento Brasileiro do Clima Espacial), foi possível investigar a dinâmica da alta atmosfera mais especificamente a ionosfera. Os dados de TEC usados para confecção dos resultados são medições realizadas com uma resolução temporal de 10 minutos, permitindo estudar a Maré Atmosférica Lunar com boa precisão. Com o intuito de entender a influência da Maré Lunar na ionosfera brasileira, este trabalho utiliza medidas de TEC para investigar a modulação da amplitude da Maré Lunar por ondas de escala planetária e o efeito dos eventos de aquecimento abrupto da estratosfera polar (Sudden Stratospheric Warming SSW). A partir das análises foi possível caracterizar a variabilidade da Maré Lunar na ionosfera e os efeitos dos eventos de SSW.

Estudo dos distúrbios ionosféricos no setor americano durante os fortes eventes de aquecimento estratosférico súbito (SSWs) de 2017-2018 e 2018-2019

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ABSTRACT

Os eventos de aquecimentos estratosféricos súbitos (SSWs) se caracterizam por um forte aumento na temperatura estratosférica polar durante o inverno nos Hemisférios Norte ou no Sul. O presente estudo investiga as perturbações ocorridas no conteúdo eletrônico total-TEC e nos parâmetros ionosféricos da região F ionosférica (foF2 e h'F) devido aos SSWs de 2017-2018 e 2018-2019, ocorridos no Hemisfério Norte. Os dados analisados de GPS-TEC e Ionossonda referem-se aos seguintes dias do ano (DOY) de 335 a 365 (dezembro de 2017 e 2018) e de 01 a 90 (janeiro a março de 2018 e 2019. Os dados de GPS-TEC foram obtidos utilizando 75 receptores das redes do IBGE e UNAVCO, setor americano. Estes 75 receptores abrangem uma ampla faixa latitudinal (52,2ºN a 53,8ºS) e longitudinal (35,2ºW a 104,1ºW). Os parâmetros ionosféricos foF2 e h'F utilizados nesta investigação são de três Ionossondas, localizadas nas cidades Araguatins (5,7ºS e 48,1ºW), Jataí (17,9ºS e 51,7ºW) e S.J.Campos (23,2ºS e 46,0ºW), do grupo de pesquisa do IP&D-Univap. Nota-se que, os distúrbios ionosféricos desde o equador até médias latitudes causados pelos eventos de SSWs (forte) produz uma diminuição dos valores de TEC. O TEC em todas as estações GPS mostram variações significativas durante os dias do pico de temperatura para os eventos de SSWs. Os parâmetros h'F e foF2 das três Ionossondas, também mostram fortes variações durante o período de ocorrência dos SSWs. Além disso, os parâmetros h'F e foF2 mostram semelhanças em resposta aos SSWs antes e após o seu período de ocorrências para as três estações de Ionossondas. Portanto, é possível notar que, mesmo em períodos em que os índices solar e magnético são bastante calmos e próximos de seus valores mínimos, a variabilidade ionosférica é atribuída aos eventos de SSWs.

Occurrence and modeling examination of sporadic-E layers in the region of the South America (Atlantic) Magnetic Anomaly

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ABSTRACT

In this work, the occurrence of different types of sporadic-E layers (Es) was described for two stations located in the region of the South America Magnetic Anomaly: Jataí and São José dos Campos. The results show the hourly and monthly values of the Es occurrences and presented five types of layers (cusp, high, flat, low, and slant), with the flat/low types (Esf/l) being the most frequent over both stations. We also analyzed the Es layer parameters of blanketing frequency (fbEs) and top frequency (ftEs) obtained from ionosonde data during storm-time periods, in order to investigate possible evidences of energetic particle-induced E-layer ionization. The results revealed increases in the values of the nighttime ftEs and fbEs, which can be related to the particle precipitation in the South America Magnetic Anomaly region. Additionally, we investigated the roles of the wind shear mechanism in the formation of the Es types by using a modified form of the Ionospheric E-Region Model (MIRE), which incorporates tidal winds obtained from meteor radar data. Furthermore, the electron densities deduced from fbEs parameter were compared with the maximum electron densities obtained from MIRE simulations. Depending on local time and season, the initial results revealed for both stations some discrepancies between modeled and measured electron densities. However, a better fitting was obtained when the amplitudes of the zonal/meridional wind components were adjusted by some factor, which may be attributed to the possible effects of day-to-day tidal wind variability and their interaction with gravity and planetary waves.

Análise de regressão para obtenção de modelos ionosféricos

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ABSTRACT

A análise de regressão tem por objetivo determinar, de forma otimizada, a relação entre uma ou mais variáveis que a princípio apresentam uma relação não determinística, ou seja, que não possuem uma expressão analítica que as relacionem. Ela possui diversas formas, sendo que a mais comum é a regressão linear, que estabelece uma equação linear relacionando as variáveis em questão. Especificamente, uma das variáveis, chamada de variável dependente, é escrita como combinação linear das outras variáveis que são chamadas de independentes. Os coeficientes dessa combinação indicam a importância de cada uma delas na descrição da variável dependente. Dessa forma, nota-se que esse tipo de análise é bastante recorrente no contexto da Física, pois frequentemente é necessário desenvolver um modelo que relacione as variáveis associadas a um fenômeno físico, permitindo determinar quais delas têm maior relevância no fenômeno sendo estudado, além de aumentar a compreensão sobre o seu funcionamento. Assim sendo, o objetivo do presente trabalho é descrever matematicamente a regressão linear múltipla e mostrar como ela pode ser utilizada para estabelecer modelos ionosféricos.

Electron temperature adiabatic transport during Equatorial Plasma Bubble events: Comparison between satellite probe data and numerical simulation

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ABSTRACT

The ionospheric plasma density during early nighttime may present huge depletions over low-latitude regions named Equatorial Plasma Bubbles. Equatorial plasma bubbles exhibit large upward velocity as a result of the intense zonal component of the electrostatic potential gradient inside the depleted region. Meanwhile, the increased plasma transport will in turn alter the pattern of the temperature distribution in the altitudes of the F region. These features are usually registered through probes boarded in rockets, satellites and cubesats, and exhibit several aspects of interest over equatorial region. This work presents an evaluation of this transport using data from Lagmuir probe boarded in the C/NOFS satellite and simulation from ionospheric and plasma instability models. Profiles describing the spatiotemporal distribution of the plasma density and electron temperature during equatorial plasma bubble events are assessed in terms of spatial width and level of electron temperature amplitude variation in the depletion region. The results indicate that simulation is capable to reproduce/forecast these events and that during plasma bubble events the electron temperature may vary by hundreds of kelvins depending highly on the ionospheric onset conditions, electron temperature initial profile and level of plasma depletion.

Optical Imaging of the Spatiotemporal Dynamics of Ionospheric Intermittent Turbulence

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ABSTRACT

Ionospheric plasma bubbles have significant impact on radio wave propagation in the upper atmosphere, causing rapid fluctuations in the power of radio signals used in telecommunication and GPS navigation. These convective ionospheric storms play a crucial role in space weather. Complex structuring and self-organization of depleted flux tubes involving bifurcation, pinching-off, merging, and broad plasma depletions is the signature of nonlinear evolution of interchange instability, responsible for the generation of coherent structures and turbulence in the ionosphere. The aim of this paper is two-fold: 1) report the first optical imaging of multiple bubble-bubble reconnections in the South Atlantic Magnetic Anomaly, 2) report the first optical imaging of equatorial ionospheric intermittent turbulence. We show that the degree of spatiotemporal complexity (intermittency, non-Gaussianity, multifractality) of ionospheric intermittent turbulence can be quantified by nonlinear studies of optical images, confirming the duality of amplitude-phase synchronization in multiscale interactions. By decomposing the analyses into North-South and East-West directions, we show that the degree of complexity is stronger in the North-South direction, confirming the anisotropic nature of the convective instability.

Study of the ionospheric variability in the South American Magnetic Anomaly (SAMA) during solar minimum (2017-2018)

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ABSTRACT

We investigate for the first time the variability of the F2 layer critical frequency (foF2), its peak height (hmF2), the thickness parameter B0, and the E-region critical frequency (foE) over Santa Maria (29.7oS, 53.7oW, dip= -38o), a station located in the central region of the South American Magnetic Anomaly (SAMA). The selected ionospheric parameters were obtained from ionograms recorded by a recent Digisonde Portable Sounder (DPS-4D). The time period covers 309 days from 1st September 2017 to 30th August 2018. The diurnal analyses revealed a large day-to-day ionospheric variability, with some peculiarities as a strong semi-annual pattern superimposed to expected ionospheric behavior. Furthermore, the results show significant differences between the averaged foF2 in December and June solstices, revealing a possible presence of the annual asymmetry. The coefficient of variation (CV) is used as a quantitative description of the variability of each parameter versus time and season. Considering low solar flux and geomagnetically quiet days only, we note that CV is smaller during the daytime, and larger during nighttime for all parameters. The least variable ionospheric parameter in our study is foE, while the most variable one is B0. Regarding the F2-layer parameters, we observe that foF2 is much more variable than hmF2. We attribute the observed CV to the neutral atmosphere source over Santa Maria. The ionospheric variability is in general enhanced during geomagnetically disturbed periods. The estimated CV is higher over Santa Maria than Wuhan (30.5oN, 114.4oE, dip= 46o), China, a station with no influence of the SAMA.

Study of the main periodicities from F-layer ionosphere of the mid-west of Brazil, 2017

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ABSTRACT

The annual time series of the ionospheric parameter, h'F, obtained at Jataí (17^o 52' 33"S; 51^o 43' 17"W), 2017, through at CADI Ionossonde from UNIVAP, we used to investigate the main periodicities present. The Wavelet Transform (WT) was used due to be able to analyze the non-stationary time series and give us the temporal variability of the energy from each periodicity found it. We applied the WT for each month of the 2017 year and were observed the presence of the following periods ~ 0.5, ~ 1.0, ~ 1.4 and ~ 4.0 days. The first analyses indicate that the last period ($\sim 4d$) are associated with the Spread-F presence observed on ionograms. Furthermore, the results are discussion in terms of the seasonal variability over other ionospheric parameters in order to improve our analyses.

Observações de ondas de gravidade tipo “ripples” sobre a região equatorial brasileira

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ABSTRACT

Ondas de gravidade desempenham um papel importante nos processos dinâmicos atmosféricos e podem alterar, inclusive, as condições de estabilidade atmosférica. Durante a quebra de ondas de gravidade, é possível ocorrer processos de instabilidades na atmosfera, que podem gerar ondas menores, denominadas ripples. Utilizando um imageador de aeroluminescência instalado em São João do Cariri (7,4°S; 36,5°W), foi observada e registrada a ocorrência destes ripples no céu do nordeste na região da mesosfera e baixa termosfera. Foram catalogados ripples noturnos para os anos de 2015 a 2019. Neste trabalho são mostrados a evolução temporal da ocorrência dos ripples e destacados a sazonalidade e variação interanual dos eventos. Outros aspectos como relações da ocorrência e duração dos ripples com a atividade solar também foram investigados nesse trabalho.

Determinação de parâmetros de ondas de gravidade usando medidas de temperatura de interferômetros Fabry-Perot

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ABSTRACT

Ondas de gravidade atmosféricas são essenciais na transferência de energia e momentum da média para a alta atmosfera. Essas são capazes de desestabilizar o equilíbrio hidrostático do fluido atmosférico, tendo como principal força restauradora a gravidade. Neste trabalho são utilizados dados de temperatura, coletados por dois interferômetros Fabry-Perot (FPI) que realizam medições de emissões da linha vermelha do oxigênio atômico - OI630,0 nm durante o período noturno, um localizado em São João do Cariri (7,4°S; 36,5°W) e outro em Cajazeiras (6,8°S; 38,5°W) durante o ano 2013. Foram estimados parâmetros de ondas de gravidade, tais como, amplitude período observado, comprimento de onda horizontal e direção de propagação de fase horizontal na região da termosfera-ionosfera em uma altitude em torno de 250 km. Periodograma de Lomb-Scargle e a análise de ondeletas foram utilizados na determinação dos parâmetros das ondas observadas. Para a obtenção das amplitudes e a fases foram feitos ajustes de curvas com os métodos de mínimos quadrados. Após a análise de 340 noites para Cajazeiras e 346 para São João do Cariri, observou um total de 14 e 27 eventos, respectivamente, com comprimentos de ondas variando de 18 a 938 km, período observados entre 35,4 min a 155,4 min, amplitude médias variando de 3,84 K até 130,6 K. Notou-se ainda que as ondas observadas propagaram-se preferencialmente entre 0,21° e 180° de azimute.

Ionospheric scintillations associated to E-region irregularities

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ABSTRACT

The occurrence of daytime ionospheric scintillations at equatorial and low-latitude regions has been attributed to the presence of sporadic layers (Es) and irregularities at E region heights. At latitudes closer to the magnetic equator, the most intense amplitude scintillations on satellite radio wave signals have been associated to the presence of q-type of sporadic E-layers (Esq). The Esq is known to be formed by plasma instabilities in the equatorial electrojet (EEJ). Otherwise, at low-latitudes the daytime scintillations are mainly associated to blanketing sporadic E-layers (Esb). The Esb is primarily generated by shearing mechanism in the horizontal neutral wind, thus causing an intensification of the ionization at Es heights. The Esq and Esb layers can be manifested in the vertical ionogram traces recorded by digital ionosondes. In this work we investigate for the Brazilian sector the possible effects of these two types of Es layers on GNSS signals. Simultaneous observations of Es layers from digital ionosondes and amplitude scintillations from ground-based GPS receivers, conducted in the Brazilian sector since 2000, are used in the analysis. The presence of the daytime scintillations will be investigated in detail in order to find the possible relation with the E-region irregularities. The results attained in this work is important for a better understanding of the ionospheric effects on the operation of satellite navigation and communication systems.

UTECDA: Novas funcionalidades para análise da distribuição do conteúdo total em períodos calmos e perturbados

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ABSTRACT

A investigação da eletrodinâmica da ionosfera pode ser realizada utilizando equipamentos ópticos e de radiossondagem, atualmente estão à disposição redes de receptores GPS que são amplamente utilizadas neste estudo. Os dados utilizados estão disponíveis nas seguintes redes: Rede Brasileira de Monitoramento Contínuo - RBMC (IBGE), International GNSS Service - IGS e University NAVSTAR Consortium - UNAVCO. Os dados obtidos a partir destas redes estão no formato Receiver Independent Exchange Format - RINEX. Esse arquivo combinado com os arquivos Differential Code Biases (DCB) são processados pelo programa GPS-TEC desenvolvido por Gopi Krishna Seemala e assim obtendo o Conteúdo Total Eletrônico - TEC médio em arquivos STD e o TEC calculado para cada satélite em arquivos CMN. Para visualizar a distribuição do TEC foi desenvolvida a ferramenta denominada Univap Total Eletronic Content Data Analysis - UTECDA na qual nos permite visualizar a variação da distribuição do TEC em diferentes formatos. No UTECDA é disponibilizada interfaces que possibilitam realizar análises da variação da distribuição do TEC de forma local e regional. Neste trabalho são apresentadas as novas interfaces implementadas para auxiliar no estudo da presença de irregularidades ionosféricas utilizando o Rate of TEC-ROT, o estudo da Anomalia Equatorial de Ionização-EIA através de mapas de contorno e a variação da distribuição do TEC sobre todo território terrestre.

Space-time variations of the Equatorial Ionization Anomaly (EIA) over the Brazilian sector using GPS-TEC network and IRI model d ata

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ABSTRACT

Recently it was noticed that the EIA in the Brazilian eastern and western sectors present different intensities, lifetime and morphologies during geomagnetic storm and sudden stratospheric warming (SSW) events by Fagundes et al. (2016) and Vieira et al., (2017), respectively. Therefore, then main motivation of this study is to investigate month-to-month characteristics of the equatorial ionization anomaly (EIA) in 3 different sectors over the Brazilian Region, where the geomagnetic equator presents the largest declination. Four this study, the observation from 3 latitudinal networks with 35 GPS-VTEC stations spanning from the equator to low-latitudes are analyzed. The longitudinal variations of the EIA during the descending phase of the solar activity, year of 2016 are investigated. As expected, the EIA showed a semiannual variation all sectors with maximum during the summer and spring and minimum during the winter. Is is observed from this study that, in the Brazilian sector the EIA variability (crest and trough) is the result of the combination of solar zenith angle and the geometry of the geographic and geomagnetic equators. A comparison between the EIA from measurements using GPS-VTEC and IRI-2016 model derived from TEC data showed differences in the EIA crest and trough shape and life time.

Study of the troposphere- ionosphere coupling in the brazilian sector by means of gravity waves during minimum and maximum solar cycle 24

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ABSTRACT

The study of equatorial ionospheric irregularities and plasma bubbles is a topic of active research due to its key role in the dynamic processes in the upper atmosphere. Studies of equatorial ionospheric irregularities are motivated by the need of reliable space weather forecasting models for aeronautics and aerospace activities, which may be substantially affected by ionospheric instabilities. In the equatorial and low latitude regions in the Brazilian sector, strong ionospheric irregularities occur frequently. They are caused by a mechanism of plasma instability known as collisional interchange instability (CII). The CII is seeded by some initial disturbance in the base of the F layer in the sunset, where high vertical drift velocities may occur due to an effect known as pre-reversal enhancement (PRE). The initial disturbances are generally associated with atmospheric waves, called acoustic gravity waves (AGW's), which are generated by tropospheric convection and depend on meteorological conditions. The AGW's can occur due to tropospheric convection at altitudes ranging from 10 to 20 km and propagating upwards. As the density of the atmosphere decreases with altitude, the gravity wave amplitudes increase exponentially and become maximum in the F region. The objective of this study is to establish a correlation between the data obtained by meteorological stations (aerodromes - commonly used by the Air Force Command) and by Global Positioning System (GPS), from which the total electron content (TEC) was calculated. Altitude and surface data were obtained from 32 meteorological stations prepared by the "Sessão de Meteorologia Aeronáutica" of the "Instituto de Controle do Espaço Aéreo" and data from approximately 120 GPS stations, which belong to the "Rede Brasileira de Monitoramento Contínuo" in 2009 and 2014. The analysis of tropospheric parameters showed the existence of oscillations compatible with those responsible for the generation of gravity waves.

Studies of the onset conditions that generate equatorial plasma bubbles/spread-F using COSMIC-2/FORMOSAT-7 satellites data.

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ABSTRACT

The recent launched COSMIC-2/FORMOSAT-7 6-satellite constellation provide in-situ ionospheric ion density and using the RFB (Radio Frequency Beacon) instrument on board provide UHF, L-band and S-band signals for ground-based receivers. Onset conditions that generate equatorial plasma bubbles (EPB)/spread-F can be analyzed using the São João do Cariri airglow imager, São Luís ionosonde, and in-situ ion density data and scintillation data on UHF, L-band and S-band data. This work presents initial results of this study at São Luís - MA region.

Efeitos do aquecimento estratosférico súbito, que ocorreu entre 01 de janeiro e 08 de fevereiro de 2006, na camada F ionosférica equatoria e de baixa latitude no setor brasileiro

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ABSTRACT

Este estudo apresenta as investigações relacionadas aos efeitos do aquecimento estratosférico súbito (sudden stratospheric warming - SSW), que ocorreu entre o dia 01 de janeiro e 08 de fevereiro de 2006, na camada F ionosférica equatorial e de baixa latitude no setor brasileiro. Neste trabalho são apresentados os resultados do conteúdo eletrônico total na vertical (vertical total electron content - VTEC), ΔVTEC, ROT (rate of TEC), e análise espectral (continuous wavelet transform - CWT) do ΔVTEC obtidos de sete receptores GPS sobre o Brasil. Os resultados mostram um forte descréscimo nos valores do VTEC e ΔVTEC no período da tarde sobre baixas-latitudes após o primeiro pico de temperatura durante o evento SSW de 2006. Os valores do ΔVTEC indicam periodicidades diurnas e semidiurnas durante o evento SSW. As variações do ΔVTEC também mostram periodicidades de aproximadamente 02-08 dias durante o SSW. O evento SSW não afetou a geração de irregularidades ionosféricas equatoriais.

Langmuir probe in CubeSat for low earth orbit ionosphere plasma characterization

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ABSTRACT

CubeSats are revolutionary for space exploration and upper atmospheric characteristics due to its low cost and short manufacturing period. CubeSat with a Langmuir probe as a scientific payload allows the in-situ observation of lower atmospheric waves and characteristics. The in-situ measured data are more reliable and can be used as a validation for the other equatorial measurement methods and broadcasting. In this research, the feasibility testing for possible implementation of the Cylindrical Langmuir Probe in CubeSat for the upper atmosphere plasma characterization is analytically studied. The attitude of the CubeSat can be controlled by using different attitude control methods. Therefore, by sending the command through the ground station, we can get access to the particular atmospheric environment. Which improved the resolution in the reconstruction of E-region ion layers and densities, moreover desire spatial coverage can be provided by CubeSats. Thus, we equipped our newly designed Langmuir probe for electrons, ion density, and temperature variations. Moreover, the receiver antenna receives the information from the ground-based radar and after refining, it will send all the information on that atmosphere. The scientific objective of the proposed Langmuir probe is the in-suit study of low ionosphere-plasma sphere coupling, aurora structures, and multi-scale behaviour of the plasma turbulence. The design effectiveness and structural safety of the proposed mechanisms were successfully verified under launch severe environments through sine and random vibration tests at qualification level.

2021 VIII SBGEA Simpósio Brasileiro de Geofísica Espacial e Aeronomia & VIII SIMFAST Simpósio de Física e Astronomia do Vale do Paraíba
22 a 26 de março | 2021
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Investigation of Multi-Needle Langmuir Probe in CubeSat Platform for Low Earth Orbit Ionosphere Characterization

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ABSTRACT

CubeSats are miniature satellites that have been used exclusively in low Earth orbit for low-cost educational and scientific missions. CubeSat with a Langmuir probe as a science payload allows the in-situ measurement of lower atmospheric waves and plasma characteristics. The results obtained in-situ are more accurate and can be used as evidence for the other methods of equatorial measurement and broadcasting. The feasibility test for possible implementation of the Cylindrical Langmuir Probe in CubeSat for the plasma characterization of the upper atmosphere is analytically analysed in this work. The CubeSat attitude can be controlled by using various methods of attitude control, therefore, we can get access to the specific atmospheric environment by sending the command through the ground station. Thus, we have investigated the feasibility of the newly designed multi-needle cylindrical Langmuir probe to determine the variations in electrons, ion density, and temperature. In addition, the effectiveness of the proposed design in terms of structural safety during the launch phase is also investigated through the sine and random vibration tests.

Study of internal structures in plasma bubbles: Numerical simulations and experimental data

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ABSTRACT

All-Sky imager observations at off-equatorial region have evidenced striations-like structures within the dark regions (plasma bubbles) observed in the imager's field of view. Using a 3D extension of a numerical simulation model of Collisional Interchange Instability (CII-3D) the observational data are compared with the numerical model results. Conclusions about the possible origin of these minor scale irregularities inside large-scale irregularities or plasma bubbles are presented.

An Improved DCB algorithm for NAVIC TEC Observations

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ABSTRACT

India's regional satellite system known as Navigation with Indian Constellation (NavIC) system providing position, velocity, time in all weather conditions. NavIC is also a powerful tool for monitoring low latitude ionosphere using L5 and S-band signals over the Indian subcontinent. The termination of differential code biases (DCB) for NavIC satellites and receivers is crucial for determining the ionosphere remote sensing and navigation applications. Most of the DCB and TEC estimation algorithm is assumed that the ionosphere thin shell height is either 350km or 450km for Global Navigation Satellite System observations. A fixed ionospheric thin shell height is not valid for low and equatorial regions. Variable ionospheric thin shell height information (hmf2) can be obtained from Ionosonde observations effectively to improve TEC and DCB estimations. The NavIC DCB estimation algorithm is implemented by (Siva Krishna & Ratnam .2020). Siva Krishna & Ratnam (2020) proposed that NavIC DCB estimation with aided modeling of GPS TEC Observations is recorded at the same location by NavIC and GPS receiver (KL University, Guntur, India, (16.470 N, 80.610 E). Ionosonde data is obtained from the Tata Institute of Fundamental Research (TIFR) at Hyderabad, India. As part of modeling on ionospheric TEC values, the modified planar fit model is implemented. In this ionospheric model, the fixed height and variable heights(hmF2) information are implemented for estimating TEC and DCB values. Three months (June to August-2016) data was analyzed. It is found that DCB estimations are improved using variable ionospheric shell height as compared to fixed ionospheric thin shell height. The demonstrated technique is capable to derive TEC, in turn, would be useful for motoring the ionosphere in real-time and to mitigate ionospheric effects on radio-based communication and navigation systems.

Temporal and longitudinal variabilities of the equatorial ionization anomaly observed by ground based GNSS receiver networks over south America

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ABSTRACT

Equatorial Ionization Anomaly (EIA) was mapped, every 10 minutes interval, over the south American continent using total electron content (TEC) data obtained from GNSS ground-based receiver networks. Temporal (day to day and seasonal) and longitudinal variations of the peak location and intensity of EIA were studied. In this work, the peak intensity (TEC level at EIA crest) were determined by picking the TEC along different magnetic longitudes at an altitude of 300 km. From the analysis, we found that monthly averaged EIA peak intensities showed significant seasonal and annual variations from 2013 to 2019. Also, a significant time delay of the peak intensity, almost 20 to 30 days, for the different magnetic longitudes were observed in summer and Spring. In addition, the time occurrences of the peak intensity were found between 14 UT to 24UT, having latitudinal position ranging from 0o to 35oS. Salient features of variability of the EIA map are presented.

Imaging the Solar Wind-Magnetosphere-Ionosphere Interaction from the Ground

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ABSTRACT

Ground-based all-sky imaging techniques have been used in many research and science applications. Rapid advances in sensor technology result in high frame rates, high pixel numbers, much lower noise, lower power consumption, strong dynamic performance, improved quantum efficiency and sensitivity, and better performance/cost ratios. These improvements now allow ground-based imagers to capture very weak nightglow and auroral emissions at high spatial and temporal resolution. The imagers are not only major research tools but can also partner with many space-based missions to provide complementary measurements. They have been used in many auroral and airglow studies and space weather applications. Many space missions have been launched to investigate geospace phenomena from micro- to globalscales. Geomagnetic storms and substorms, phenomena which control the flow of solar wind mass, energy, and momentum through the magnetospheric system, represent two of the most important scientific topics. We will discuss how ground imaging techniques complement spacebased missions and together answer fundamental science questions. In this presentation, we will present the multi-wavelength observations of substorm phenomena and results from JHU/APL's ground-based all-sky imaging array installed at Poker Flat Research Range and HAARP in Alaska that have been operating since October 2018. We will also introduce our groundimaging facility in Hawaii for studies of the low-latitude ionosphere.

Estudo de uma forte perturbação ionosférica sobre o setor brasileiro associada a moderada tempestade geomagnética de 27-30 de setembro de 2017

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ABSTRACT

Para realizar o estudo da forte perturbação ionosférica ocorrida no período de 27 a 30 de setembro de 2017 (baixa atividade solar) devido a uma tempestade geomagnética foram utilizados três tipos de equipamentos: a rede de 130 estações GPS-TEC distribuídas no setor brasileiro, 3 ionossondas (Araguatins, Jataí e São José dos Campos) e 4 imageadores All Sky (Manaus, Araguatins, Jataí e São José dos Campos). Durante este evento o Dst atingiu um mínimo de -55 nT, o Kp atingiu um máximo de 7, a velocidade do vento solar (Vp) foi de aproximadamente 300 km/s antes da tempestade atingindo o valor máximo de aproximadamente 720 km/s durante a fase principal, e a densidade de prótons (Np) atingiu aproximadamente 60 #/cm3 durante a fase principal. O IMF Bz durante a fase principal teve reversões múltiplas, revertendo 3 vezes para sul e duas vezes para o norte. No conteúdo vertical total (VTEC) foi observada uma fase positiva durante as fases principais e de recuperação da tempestade. Também foi observado que as regiões equatoriais e baixas latitudes foram mais perturbadas do que as regiões além do pico da anomalia equatorial de ionização (EIA). As perturbações ocorreram quase ao mesmo tempo em ambas as regiões, indicando a penetração imediata do campo elétrico (PPEF). A EIA também foi perturbada severamente devido a este PPEF. O parâmetro foF2 mostrou o comportamento semelhante a do VTEC. As imagens obtidas pelos imageadores utilizando o filtro (OI 630 nm) mostram a ocorrência de bolhas de plasma durante todas as noites da fase principal. Este estudo mostra que a ionosfera pode ser perturbada por tempestades geomagnéticas durante condições de baixa atividade solar (F10,7=80 sfu). Durante a realização deste estudo foi desenvolvida uma nova ferramenta computacional para auxiliar a análise e interpretação do TEC, denominada Univap Total Eletronic Contend Data Analysis (UTECDA).

Geomagnetic field variations due to Solar and Lunar tides in the Brazilian Sector

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ABSTRACT

Geomagnetic field variations in 2018 due to solar and lunar tides in the Brazilian sector were studied using data provided by magnetometers installed at São José dos Campos (23.21°S, 0345.97°W; Dip latitude 20.9°S), Eusébio, Ceará (3.89°S, 38.46°W) and São Luís, Maranhão (2.53°S, 44.30°W). Variations associated with these tides were identified using the horizontal component of the geomagnetic field, H(nT). Least square fit method was employed in determining the monthly amplitudes and phases of the diurnal, semidiurnal and ter-diurnal solar tides. The monthly amplitudes and phases of the lunar tide were then calculated using the residual measurements (obtained after subtracting the solar tidal components from each day), converting the solar local time to lunar time and subjecting the residuals to harmonic analysis. The maximum solar tide amplitude recorded was 23.96nT(diurnal) in March, at Eusébio whereas the minimum amplitude was 0.45nT(terdiurnal) recorded in December at São José dos Campos. The lunar tide recorded a maximum amplitude of 4.33nT(semidiurnal) in February, at São Luís and a minimum amplitude of 0.13nT(diurnal) in August, at Eusébio.

Hilbert-Huang transform filter applied in ahead of tsunami magnetic disturbance detection

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ABSTRACT

We document magnetic disturbances using Hilbert-Huang Transform (HHT) filter, first of its kind, derived from the network of ground-based magnetometers, during the Tohoku-Oki tsunami of March 11, 2011. The disturbances obtained by filtering the magnetic field data using the first intrinsic mode function (1IMF) of HHT appear 30 minutes to 2 hours earlier than the tsunami arrival at near/far-field magnetic stations. We refer to those disturbances as Ahead-of-Tsunami-Magnetic-Disturbances (ATMDs). The comparison with seismometer data shows them arriving within 30 minutes from the arrival of Rayleigh waves. Their association with both seismogenic and tsunamigenic processes is discussed and it is argued that the tsunamigenic process can well explain the magnetic disturbance propagation characteristics at far-field. At near-field, the ATMDs can be explained due to the vertical crustal movement. Here, we present the first report of geomagnetic disturbances triggered by shock- acoustic waves propagating at supersonic speed. The monitoring of these ATMDs can be extremely useful for the early warning of the tsunami.

The equatorial electrojet and Cowling conductivity response to Earth's magnetic field variation

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ABSTRACT

The equatorial ionospheric E-region is controlled mainly by solar ionizing radiation and neutral-charged particles interaction embedded in the Earth's magnetic field. Due to this field is horizontal at the dip equator, and to the existence of an east-west electric field, there is an enhancement of the Cowling conductivity, which results in an enhanced eastward current that is the equatorial electrojet (EEJ) flowing along the dip equator. Time and spatial variation of both, Cowling conductivity and the EEJ, are thus sensitive to the Earth's field, which has been decaying at a rate of ~5% per century from at least 1840. A plausible field decaying scenario would be a decrease of its dipolar component with an increase in its overall complexity due to increasing importance of multipolar components. Cowling conductivity and the EEJ spatial and time variation are analyzed under the secular variation of the geomagnetic field since 1900 and under an increasing role of multipolar field components. The EEJ induced magnetic daily variation increase relative to the main geomagnetic field is also analyzed.

Poster Presentations - Physics and Chemistry of the Neutral Atmosphere

Ondas de gravidade de média escala observadas via as emissões de luminescência atmosférica de OH e OI 557.7nm sobre Cachoeira Paulista

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ABSTRACT

Ondas de Gravidade de Média Escala (OGME) foram observadas entre 1998 e 2013 na região Sudeste do Brasil, utilizando as emissões da OH (Hidroxila) e do OI 5577 nm (Oxigênio atômico, linha verde). As medidas foram realizadas utilizando um imageador do tipo *all-sky* instalado no Observatório de Luminescência Atmosférica em Cachoeira Paulista/SP (22,4ºS; 45,0ºO). Neste período foi possível caracterizar 142 eventos de OGME, e os parâmetros característicos das OGME foram obtidos por meio da análise espectral de *keogramas*. As principais características das OGME foram: 1) comprimento de onda horizontal entre 50 e 500 km; 2) velocidade de fase entre 40 e 100 m/s; 3) período observado entre 20 e 80 minutos e 4) direção de propagação que muda de acordo com a estação do ano: verão (nordeste e sudeste), outono (noroeste), inverno (quase isotrópica) e primavera (nordeste e sudeste). Comparando as direções preferenciais de propagação das OGME com as Ondas de Gravidade de Pequena Escala (OGPE), pode-se sugerir que as possíveis fontes que geram estas ondas podem estar relacionadas e/ou serem as mesmas, devido sua marcante semelhança entre suas direções de propagação. As fontes geradoras das OGME podem estar associadas a sistemas do tipo frontal e convectivo.

EMBRACE All-Sky Imager Network over Brazil

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ABSTRACT

INPE Space Weather Program is expanding the all-sky imager network over Brazil. Two airglow observation sites were establish at Cachoeira Paulista (22.7°S,45.0°W) and at São João do Cariri (7.4°S,36.5°W) since the earlies of 2000. In the last year two new observation sites have been joined to the EMBRACE network. The first one is situated at Bom Jesus da Lapa (13.25°S,43.54°W) and the second one, at São Martinho da Serra (29.5°S,53.5°W). In the present work we will disclose the new results found at this observation sites, including gravity wave propagation data and plasma bubble events. The increment of EMBRACE imager network for this year and the followings will also be presented.

Observation of mesospheric fronts over Cachoeira Paulista

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ABSTRACT

Six mesospheric fronts were studied between 2007 and 2008 using simultaneous data from an all-sky imager (images), meteor radar (wind) and Na Lidar (temperature). The wave events were observed in the following nights: 14-15 September 2007; 5 October 2007; 5 March 2008; 31 March 2008; 3 September 2008; 10 October 2007, over Cachoeira Paulista (23°S, 45°W). Images of OH, O_2 (0,1) and OI 557.7 nm airglow emissions were used to identify the waves. The horizontal wind and temperature data were used to correctly describe the atmospheric background conditions in the mesosphere and lower thermosphere regions. The waves were classified as mesospheric bore front (four events), and mesospheric wall front (one event). This is the first simultaneous observation of a mesospheric front in Brazil using the all-sky imager, meteor radar, and Na lidar instrument. The analysis using the square of vertical wave-number profile revealed the duct regions and their primary cause (Doppler or Thermal). The bore fronts observed were undular and non-undular with dark fronts in some airglow emission layers and bright fronts in others. Most of the observed wave fronts were in agreement with the complementary effect predicted in the literature.

Stratospheric gravity waves in the Brazilian equatorial regio: case study

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ABSTRACT

Gravity waves can be defined as undulating and almost periodic perturbations that propagate horizontally and vertically in the atmosphere. The mechanisms of gravity wave generation in regions near to the magnetic equator are little known, making it difficult to study their characteristics especially in the stratosphere. These studies are based on the signature of gravity waves in temperature profile data obtained from radiosondes installed in weather balloons launched from the Center of Launch Barreira do Inferno (CLBI), located in Natal/RN. The experimental data were compared with the theoretical data generated from the semiempirical model MSIS that doesn't take into account the presence of these waves in the atmosphere, and thus it was possible to determine the Brunt-Väisälä frequency. This work is based on sounding carried out on February 12 of 2011, started at 11:33 am (UT). It was possible to show the temperature profile oscillating between 16.5 km and 19.5 km in altitude. From the measurements of the fundamental frequency, it was possible to determine the periods of the disturbances. According to the Monitoring and Climate Analysis Bulletin - vol. 26, nº 02 of February of 2011 - the Intertropical Convergence Zone (ITCZ) fluctuated between 3°S and 5°N, during February, making ITCZ a possible responsible for the generation of the gravity wave observed on probing day. Keywords: Gravity waves; meteorological balloons; Zone of Intertropical Convergence (ITCZ).

2021 VIII SBGEA Simpósio Brasileiro de Geofísica Espacial e Aeronomia & VIII SIMFAST Simpósio de Física e Astronomia do Vale do Paraíba
22 a 26 de março | 2021
Univap | Campus Urbanova
Av. Shishima Hifumi, nº2911 | SJC - SP

Estudo da atividade da onda planetária de quase 10 dias nas medidas de vento neutro da região MLT em épocas de aquecimento estratosférico súbito (SSW)

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ABSTRACT

Estudar a dinâmica da atmosfera terrestre é de extrema importância, pois ajuda a compreender os processos dinâmicos nela presentes. A atmosfera terrestre comporta diversos movimentos ondulatórios em diversas escalas espacial e temporal, que podem ser gerados por diversos mecanismos. Oscilações de escala planetária vem sendo alvo de diversos estudos ao longo dos tempos, principalmente soluções de modos normais (NM). Neste trabalho foram utilizadas medidas de vento neutro da alta mesosfera e baixa termosfera (MLT), com o objetivo de estudar a onda planetária de quase 10 dias (Q10DW), nas componentes do vento neutro. Foram utilizadas medidas do vento neutro para as altitudes de 81, 84, 87, 90, 93, 96 e 99 km fornecidas por dois radares meteóricos situados em Cachoeira Paulista-SP (22,7° S; 45,0°O) e São João do Cariri-PB (7,4° S; 36,5° O). Neste trabalho, investigou-se a variabilidade diária do vento para os anos 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2012, 2013, 2014, 2015, 2016, 2017, 2018 e 2019. A partir da análise de wavelet e filtros FFT, foram constatados assinaturas de oscilações com períodos próximos a 10 dias em certas estações do ano nas componente do vento zonal e meridional. Indicando a presença da oscilação de quase 10 dias nesta campo atmosférico. Além disso, foi possível investigar e caracterizar sua resposta aos eventos de aquecimento estratosférico súbito (SSW).

Longitudinal variability of the nonlinear interaction between ultrafast Kelvin waves and diurnal tides

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ABSTRACT

The nonlinear interaction between tides and planetary scale waves contributes to the short-term variability of the MLT dynamics and is a pathway for the coupling between the neutral atmosphere and the ionosphere-thermosphere (I-T) system. By using MLT wind measurements carried out at Cariri (7.4ºS, 36.5ºW) and at Ascension Island (7.9ºS, 14.4ºW) we have investigated the nonlinear interaction between an ultrafast Kelvin wave (UFKW) and the diurnal tide. Along with the signature of an UFKW (∼0.25 cycle/day), we observed periodic oscillations in the zonal wind, at both Cariri and Ascension Island, consistent with the secondary waves generated via the nonlinear interaction between the UFKW and the diurnal tide (1 cycle/day). In addition, we observed the modulation of the diurnal tide amplitude in the zonal wind at the period of the UFKW. At Cariri only the 0.75 cycle/day secondary wave related to the difference between the frequencies of the diurnal tide (1 cycle/day) and the UFKW was observed. On the other hand, at Ascension, both secondary waves related to the sum (1.25 cycle/day) and difference (0.75 cycle/day) between the diurnal tide and UFKW frequencies were observed. The vertical structure of these periodic oscillations also exhibited distinct behavior. At Cariri, the 0.75 cycle/day secondary wave exhibited a well-defined vertical structure with downward phase progression, indicating upward propagation with vertical wavelength of 44 km. On the other hand, at Ascension, while the 0.75 cycle/day secondary wave did not exhibit clear phase progression, either downward or upward, the 1.25 cycle/day secondary wave exhibited downward phase progression, and then upward propagation, with vertical wavelength of approximately 20 km. In this paper we will present and discuss in more details the characteristics and possible impacts of the nonlinear interaction in the mesosphere-thermosphere-ionosphere system.

Uncertainties on gravity wave parameters inferred from nightglow imagery

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ABSTRACT

Gravity wave observable parameters are commonly obtained from spatial-temporal variations of the nightglow radiance recorded in all-sky images. With those parameters, key atmospheric quantities associated with wave energy dissipation, like energy/momentum flux and flux divergence, are estimated. While these wave field derivables are obtained routinely from the observables, the accuracy of such estimations has been poorly considered in gravity wave climatology studies. In this work, we model the primary errors/biases in each assessed wave parameter and show that relatively small deviations in these observables quantities translate into enormous uncertainties in derivable quantities. In addition, we show that primary errors in the observables have different magnitudes and depend essentially on the technique used to monitor the nightglow.

Atmospheric electric field variability at Brazilian Northeastern locations of Campina Grande and Lagoa Seca

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ABSTRACT

The global electrical circuit consists of a complex system of electric fields and electric currents that flow through the Earth's atmosphere. Part of the global energy balance occurs through the global electric circuit, responsible for electrodynamic coupling of the atmospheric layers. In this work, we present studies and discuss interesting results about the intensity variability of the fair weather atmospheric electric field. We use measurements recorded by atmospheric electric field sensors located at Campina Grande and Lagoa Seca, State of Paraíba, which are part of the electric field sensor network called Atmospheric Electric FIeld Network in South America (AFINSA). Curves of monthly averages calculated for the months of April to September of the years 2017 to 2019 allow to observe their behavior in periods of equinox and winter and differences from year to year, as well as to characterize monthly average variation of the atmospheric electric field.

Vertical propagation analysis of small scale gravity waves in year 2017 at Comandant Ferraz Artartic station

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ABSTRACT

This work presents blocking diagrams analysis for the vertical propagation of small scale gravity waves observed over Commandant Ferraz Antarctic Station during the winter of 2017. The wave blocking diagrams are constructed by using the neutral winds obtained at several distinct atmospheric layers, from troposphere to the upper mesosphere, which absorbs the momentum of the waves when wind speeds are higher than the wave phase speed in the waves propagation direction. The waves were visualized from an all-sky imager, in the airglow hydroxyl near infrared emission (OH-NIR), from ∼700 nm to 900 nm, at altitude near 87 km. The physical parameters of the waves are obtained from applying a twodimensional Fast Fourier Transform (FFT) in a selected region of a given set of images where a wave event is clearly identified. The vertical propagation analysis of the small scale gravity waves is conducted by using a blocking diagram, which is the superposition of the wind components from all atmospheric layers comprising the mesosphere, stratosphere and troposphere. The wind utilized for preparing the blocking diagrams is an average wind calculated with nocturnal wind profiles. This average is taken with only a few nights (where there were observed waves) centered on the new moon day, and such average corresponds to the observed month. The wind database used in the averages was obtained by ERA-5 reanalysis from the ECMWF. In this work it will be presented the blocking diagrams for the months of April, May, June and July in the year 2017. The blocking diagrams well represent the wave filtering, showing the preferential propagation direction of the waves observed in the mesosphere, that is, the waves that reach the mesospheric height propagates in a different horizontal direction from the average wind in all altitudes levels below the observed layer.

Study of gravity waves and their relationship with the ozone concentration in the tropopause over Natal/RN

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ABSTRACT

This paper presents a case study on the correlation between the variation in the concentration of ozone in the tropopause, throughout 2015, and the appearance of gravity waves, over Natal/RN, investigating a possible relationship. It presents the analysis of radiosonde data from meteorological balloons, where, for which it was possible to compare the behavior of ozone concentration between different seasons and to verify in which season there was a greater change in the concentration of ozone, and so, seek relationship with atmospheric disturbances in the upper troposphere. Thus, from data fromobtained from previous studies about the daily occurrence of gravity waves in the city of Natal in 2015,it was possible to verify that the greatest variation in ozone concentration and the greatest amount of disturbance associated with gravitational waves occur during the austral summer months, in agreement with previous results, which were obtained during the same period, that verified a greater number of occurrences of gravity waves related to the presence of the Intertropical Convergence Zone in the South Hemisphere. The results obtained are of great importance for studies in Climate Sciences, also, Physics and Chemistry of the neutral atmosphere, since they can serve as a basis for possible changes in climate models, making possible new updates.

Mesospheric temperature over Comandante Ferraz Antarctic Station from 2005 to 2007

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ABSTRACT

The mesospheric temperature around the peak of the OH emission layer (~87 km height) is very changeable and, as it is located at altitudes where the atmospheric density is very low, this temperature is more sensitive to the global changes then the temperatures in the lower atmosphere (troposphere). An airglow spectral imager with a filter for the OH (6-2) emission band (8362 to 8470 Å) was installed at Comandante Ferraz Station (62.1°S, 58.4°W) on May of 2005, and operated successfully until late winter 2007. Until now these data have not been analyzed yet and neither compared to other temperature methods for the upper mesosphere. The present work investigates these observations, including some examples of nocturnal time series of OH rotational temperature, and comparisons of coincident measurements of the ground-based technique (analyses of relative intensities of airglow lines) with satellite data around Ferraz station (radius<600 km). Two satellite instruments have been used, which are the SABER and MLS. The temperature averaged between 3 km below and 3 km above the OH peak. The standard deviation of the mean temperature profiles, considering the radius around the station and the time of each pass during the night, will be considered, and the ground-based instrument error and an hourly mean standard deviation will be used to check how close are the temperatures, and also verify whether the time series of consecutive days are consistent in terms of temperature trends (day-to-day variability). Preliminary results have shown that the temperatures are quite distinct in terms of absolute values, probably due to the distances of the satellite measurement points from the observatory and other factors (such as methodologies). The error bars of both measurements cross one another several times, and the day-to-day variability is consistent between the ground-based instrument and the satellite instruments.

Study by on the seasonal behavior of the tropopause temperature over Natal/RN

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ABSTRACT

The terrestrial equatorial tropopause is generally treated as a region of modest temperature variations and seen only as an interface between the troposphere and the stratosphere. However, recent works have suggested that the tropopause may be a source of disturbances capable of locally affecting the tropospheric climate. In this context, the present work describes an investigation of the equatorial tropopause cold point over Natal- RN, from data of radiosondes of weather balloons launched from the Center of Launch Barreira do Inferno (CLBI) during the years from 2010 to 2014. The main results showed the seasonal minimum temperature of the tropopause presents lower values during the autumn while the higher ones occur during the winter. The hypothesis accepted by the authors is the Intertropical Convergence Zone drives instabilities on the seasonal behavior due to the release of energy to the upper troposphere.

Análise da variação temporal de tempestades elétricas e sua relação com a variação do campo elétrico atmosférico de tempo bom utilizando a rede WWLLN

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ABSTRACT

Estudos realizados pelo navio do Instituto Carnegie de Washington mostraram que as medidas de variação média do campo elétrico atmosférico de tempo bom (curva de Carnegie) era semelhante e independente do local de medição. A curva de Carnegie apresenta 3 picos máximos as 8, 14 e 19 UT, que são os horários de máxima convecção local na Ásia, Europa e América, ou seja, são os horários dos picos de máximo das tempestades elétricas nessas regiões, respectivamente. Devido a essa comparação as tempestades elétricas foram propostas como um dos principais geradores do circuito elétrico atmosférico global (CEAG). Neste trabalho, analisamos dados da rede WWLLN, para os anos de 2012 e 2013, que nos fornece o tempo de ocorrência e a posição de relâmpagos detectados de forma global. A partir desses dados, foram geradas curvas médias de variação diária do número de tempestades elétricas para 2012 e 2013. As curvas obtidas (anual) também foram comparadas com a curva de Carnegie (curva padrão) para observar a relação entre as variações do campo elétrico de tempo bom e as variações das tempestades elétricas. A metodologia consistiu em definir as tempestades elétricas, utilizando um agrupamento dos relâmpagos detectados em cada hora numa matriz de densidade espacial de 0,5 x 0,5 graus. Os resultados mostram uma boa correlação entre a curva de Carnegie e a curva de tempestades elétricas (R=0.9414 , R2= 0.8862).

Mesospheric Winds and Planetary Waves over Cariri (7.4°S) and Cachueira Paulista (23°S) During Arctic Sudden Stratospheric Warming

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ABSTRACT

During Sudden Stratospheric Warming (SSW) at high latitude on northern hemisphere, planetary waves show upward as well as equatorward propagation originating from winter mid-high latitudes, which can produce significant forcing and to influence the mesosphere and lower thermosphere (MLT) tropical dynamics being able to reach low latitudes in the southern hemisphere. In this study, we have investigated the meteor winds and planetary waves behavior at São João do Cariri (7.4°S, 36.5°W) and Cachoeira Paulista (22.7°S, 45.0°W), Brazil, during Arctic SSW events. The behavior of MLT winds over both sites is characterized by a westward change rate in mid-January, but this change rate is increased during a SSW major in the winter hemisphere, mainly at São João do Cariri. These results point out a possible relationship between meteor zonal wind at low latitudes and zonal wind and temperature at 10 hPa in the northern polar region. These relationships have been interpreted as due to planetary waves breaking, which showed upward as well as equatorward propagation originated from mid-high latitudes. It can produce significant forcing and can also change the tropical MLT dynamics in lower latitudes of the southern hemisphere.

Impacts of Land Use Change (LUC) and CO2 atmospheric on vegetation structure and evapotranspiration in Amazon and Cerrado biomes

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ABSTRACT

The Amazon is currently suffering two major impacts: global change and deforestation, with Land Use Change (LUC) in Brazil subject to and susceptible to global climate change, and at the same time driving climate change at the local and regional scales. The Cerrado biome (Brazilian tropical savannah), of great biodiversity and rich in endemic species, represents the second largest Brazilian biome, covering 23% (two million square kilometers) of the national territory. The Cerrado is also suffering from deforestation due to the advance of soy cultivation. Dynamic Global Vegetation Models (DGVMs) simulate surface processes, such as energy transfer, water and moment between the Earth's surface and the atmosphere, biogeochemical cycles, carbon assimilation by vegetation, phenology and changes in land use in scenarios of atmospheric variation and CO2 concentrations. In this work, four DGVMs were used: INLAND; LPJmFit, LPJ-GUESS and ORCHIDEE, and having four data sets as climatic forcing: GLDAS, GSWP3 and WATCH + WFDEI, in order to analyze changes in the structure of vegetation (carbon assimilation) and evapotranspiration in regions in the Amazon and Cerrado biomes that are under anthropic pressure. The results show a gradual decrease in evapotranspiration and productivity over the years, reinforcing that the impacts of these changes bring strong concerns to the planet's environmental and climate issue.

Effect of radon gas on measurements neutron and gamma radiation in the dry and rainy weather in São José dos Campos, SP, Brazil

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ABSTRACT

Observations of ground-level variability of thermal neutrons, gamma rays, Radon gas and rainfall were carried out in 2018/2019 and included simultaneous measurements accumulated over intervals of one hour. The monitoring was made during both dry meteorological conditions and in rainy weather using facilities of the Department of Physics of the Technological Aeronautics Institute, São José dos Campos, SP, Brazil. Measurement of gamma radiation was performed using a portable radiation detection system based on a sodium iodide scintillator doped with Thallium. Detection of neutron radiation was carried out by a He-3 tube gas and utilizing the same power electronics and digital data acquisition as that of the gamma detector system. Rainfall measurements were performed through a pluviometer placed in the area just outside the physics department. For monitoring the abundance of the radon gas, a RadonEye RD-200 portable detector is used. Our measurements show, that in the dry period there was typically present a 24 hour periodic radiation oscillation. But in the rainy season there was a significant radiation variation with the rainfall, over the background, in the measurements of these ionizing radiations. This appears due to rain interfering with the local exhalation of radon gas, and the washing out of this ambient Radon gas in the lower atmosphere. The Rn-222 is an important source in the production of gamma rays and neutrons, because when it decays, it emits gamma radiation and alpha particles. These particles, when interacting with nearby metals produce neutrons which are rapidly thermalized by the ambient water molecules.

Análise de variações na radiação gama natural e influência do campo elétrico atmosférico e efeitos meteorológicos

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ABSTRACT

O estudo das relações entre radiação gama e campo elétrico atmosférico vem ganhando cada vez mais destaque devido as necessidades de compreensão de processos atmosféricos e até mesmo de processos geológicos como eventos sísmicos. Atualmente sabe-se que o campo elétrico atmosférico é fortemente influenciado por eventos de ionização. A ionização atmosférica é gerada por raios cósmicos e radiação, onde esta última é produzida por elementos radioativos como o radônio e em eventos de descargas elétricas via Bremsstrahlung. O objetivo deste trabalho consiste em obter as médias diárias de tempo bom para o campo elétrico atmosférico, observar suas relações com a radiação gama natural e verificar possíveis variações em decorrência de condições meteorológicas, raios cósmicos e eventos sísmicos. Os dados foram observados no Observatório El Leoncito na Argentina no período de abril/2018 a fevereiro/2019. Nas médias de tempo bom foi possível obter uma boa correlação entre a curva de campo elétrico atmosférico local e a curva de Carnegie. Similarmente obtivemos a média diária padrão para a emissão gama. Nos dias em que houve variações anormais no indicador da radiação gama, foram analisadas as condições meteorológicas e em todos notamos a ocorrência de precipitação de chuva e/ou descargas elétricas antes do aumento na contagem de fótons, com valor máximo observado de 35%. A análise espectral desses aumentos, permitiu caracterizá-los com fótons na banda de energia entre 674 e 714 keV. Não observou-se correlação entre atividade sísmica e raios cósmicos nem com campo elétrico nem na contagem de fótons.

Development of a low-cost system to observe Noctilucent Clouds

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ABSTRACT

Nowadays, there is a need and consequently a great demand for automation processes associated with low-cost systems reliable to be implemented on relatively simple scientific experiments. In this work, a proposal work in this direction is implemented for future observations of atmospheric phenomena such as noctilucent clouds, at high latitudes, or to monitor tropospheric clouds. During the observation period, it will be possible to enable experiment monitoring in order to check the sky conditions and to monitor the experiment status. A system with a low-cost camera (typical photographic camera) was set up and it is controlled by a Raspberry PI3 (low-cost computer platform). A software (in Python language) was developed to control the camera and store the obtained data in an external hard disc or stick memory card. Besides the sky images, this system will also obtain and save temperature and humidity parameters from small low-cost sensors. This system will be housed in a box with thermal insulation and heated by resistors. The heating system is divided into two parts: a) the first part, controlled by a thermostat, directly drives a resistor; and the second one, controlled by a microcontroller and by means of switching transistors with the PWM technique, power the resistors. After the system is assembled and tested with the heaters, it will be used to observe polar mesospheric clouds (noctilucent clouds) that are tracer clouds, typically used to identify gravity waves in the upper mesosphere (∼84 km height) during the summer period in the Southern Hemisphere (November-February). This presentation will present a low-cost system for observing noctilucent clouds, including image acquisition software (with test data) and future improvements to be implemented. At this point, the system is able to capture images and store them on an external hard disk. In the next steps, future improvements will be made in the software layout and user interface that will allow easy configuration of the camera settings directly on the graphic interface.

Remote sensing of the neutral atmosphere using GNSS data

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ABSTRACT

The positioning technique based on the use of artificial satellites is one of the most used today, being widely used in navigation, positioning, etc. However, GNSS observations are subject to several sources of errors, one of the main ones being the neutral atmosphere delays (Zenital Total Delay-ZTD). The ZTD can be separated into two components, a delay due to the dry gases in the neutral atmosphere (Hydrostatic Zenith Delay - ZHD), and the non-dipole component of water vapor refractivity (Wet Zenith Delay - ZWD). This effect occurs since the signal is sensitive to the neutral atmosphere refractive index, which is dependent on the pressure, temperature and moisture contents [1]. Because of this correlation, the GNSS system has recently emerged as a powerful tool in atmospheric studies. In fact, the geodetic and atmospheric applications of the GNSS cannot be separated; to get the precise location of the receiver, the delay suffered by the GNSS signal while traversing the atmosphere must be accurately known. The main meteorological product based on GNSS is the estimate of Precipitable Water Vapor (PWV). Using ancillary measurements of surface pressure and temperature, PWV is inferred from values of ZWD which are directly estimated from the GNSS data. Its high spatial and temporal resolution, proven all-weather high accuracy and low cost, make ground-based GNSS a uniquely powerful system for the observation of water vapor. Based on this, the present work seeks to evaluate the behavior of the PWV calculated from the ZWD. In addition, an analysis of the neutral atmosphere conditions from meteorological parameters (pressure, temperature and humidity) measured with radiosondes, from which the ZTD is calculated, allows to verify the climatic variations. The analyzes were carried out for two Brazilian stations located in Porto Velho and Curitiba, from December/2017 to February/2018, a period characterized by greater rainfall variation between the two regions.

Study on Atmospheric gravity wave propagations in the Troposphere, Stratosphere and Mesosphere using GNSS Satellite Radio Occultation measurements

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ABSTRACT

Atmospheric gravity waves (AGWs) are an essential mechanism in the transport of energy and momentum flux from the low to the upper atmosphere. In the last decades satellite observations have become an important part in the analysis of AGWs due to their global and frequent coverage. Global Positioning Satellite (GPS) radio occultation (RO) is a well-established technique for obtaining AGWs information. Temperature profiles are derived with high vertical resolution and provide a global coverage under any weather conditions, offering the possibility of global and regional monitoring of the vertical temperature structure and atmospheric wave parameters. In this study, temperature profiles from RO measurements over South American sector were employed to study the atmospheric coupling of the troposphere, stratosphere, and mesosphere through the dynamic process of AGWs in the range of 20 km and 50 km in altitude. The results of the specific potential energy (Ep), vertical wavenumber, the horizontal and vertical wavelengths, and the vertical flux of horizontal momentum (MF) are calculated. Their temporal (day-to-day) and spatial variations over South America will be presented.

Características das ondas de Kelvin ultra-rápidas na aeroluminescência simulada pelo Kyushu GCM

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ABSTRACT

A aeroluminescência atmosférica tem sido amplamente utilizada para estudar a dinâmica e a composição da atmosfera terrestre, e também de outras atmosferas planetárias. Nesse trabalho será utilizado o modelo de circulação geral da atmosfera da Universidade de Kyushu para simular a aeroluminescência proveniente da região mesosfera e baixa termosfera e investigar a presença e a estrutura das ondas de Kelvin ultra-rápidas na região equatorial. As ondas de Kelvin ultra-rápidas são caracterizadas por perturbações nos campos atmosféricos, com períodos entre 3 e 4 dias, que se propagam para leste, primordialmente com número zonal 1, 2 ou 3. Neste estudo simulou-se as taxas de emissão da linha verde do oxigênio atômico (OI557.7nm) e da banda O_2(0-1) do oxigênio molecular ao longo de um ano. Aplicando a análise espectral de wavelets foram identificadas variações periódicas intermitentes nas emissões com períodos entre 3 e 4 dias, associadas às ondas de Kelvin ultra-rápidas. Analisando individualmente a estrutura longitudinal dessas periodicidades, observou-se que a maioria delas apresenta estrutura longitudinal compatível com a estrutura teórica prevista para as ondas de Kelvin ultrarápidas. Neste trabalho, serão apresentados e discutidos os detalhes desses resultados.

K Sporadic layers over São José dos Campos

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ABSTRACT

Sodium (Na) and Potassium (K) layers have been simultaneously observed by a dual beam LIDAR at São José dos Campos (23.1°S, 45.9°W) since November 2016. The sporadic incidence of layers of enhanced concentration of these meteoric metals in the MLT region has been observed by LIDAR at many locations. These layers are much thinner than the background layer, last between a few minutes and many hours, and appear to be related to ionospheric sporadic E. Sporadic Na layers (Nas) over São José dos Campos are well analyzed since Clemesha et al. (1978) reported them for the first time. However, Ks layers are not yet investigated over this region. Hence, we present in this work Ks seasonal variation, characteristics and how it compares to Nas over the same location.

Modelo semiempírico médio longitudinal de ventos termosféricos a 250 km para períodos de baixa atividade solar e geomagnética

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ABSTRACT

Neste trabalho é apresentado um modelo semi-empírico de ventos neutros termosféricos médios longitudinais para períodos de baixas atividades solar e geomagnética com dependência em hora local, dia do ano e latitude geográfica para 250 km de altitude. O modelo é denominado de SEATWIM (sigla em inglês para Semi Empirical Averaged Thermospheric Wind Model) válido para períodos de baixa atividade solar e geomagnética. O foi construído a partir de uma análise estatística dos dados observados in situ obtidos pelo satélite UARS (Upper Atmosphere Research Satllite) por meio da carga útil WINDII (Wind Imaging Interferometer), onde os valores representativos para 250 km são obtidos pela média integrada em altitude entre 205 km e 275 km, e, a partir de uma análise estatístico-espectral, foi extraído comportamento diário e sazonal distribuídos em latitude geográfica. O modelo proposto exibe uma boa concordância em relação à climatologia dos dados observados pelo satélite para as componentes zonal e meridional dos ventos neutros termosférico em distintos períodos. Quando comparado ao comportamento dos dados observados, os índices estatísticos exibiram bons resultados, sendo os melhores resultados obtidos nos períodos de equinócio em ambas as componentes do vento termosférico. A validação estatística também exibiu melhores resultados para a componente zonal em comparação a componente meridional, para todos os períodos do ano. Os testes estatísticos utilizados indicam que o modelo SEATWIM assemelha-se ao modelo HWM14 (Horizontal Wind Model, versão 2014) principalmente em relação a componente zonal.

Poster Presentations - Space Weather and Sun-Earth Connections

Influência dos oceanos Atlântico e Pacífico no sudeste do Paraná (BR) estudada por meio de anéis de crescimento de árvores

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ABSTRACT

As árvores, durante sua vida, armazenam informações de variáveis climatológicas e geofísicas que atuaram durante seu crescimento. Anomalias das Temperaturas da Superfície do Mar (ATSM) influenciam o clima de todas as regiões do planeta, podendo estas variações ser marcadas nos anéis de crescimento, e estes podendo ser utilizados como *proxy* dessas variações. Para estudar a relação dessas forçantes climáticas com as séries temporais de anéis de crescimento nas árvores da espécie imbuia (Ocotea porosa (Nees & Mart.) Barroso), coletadas no município de General Carneiro, localizado na região Sudeste do Estado do Paraná, foram utilizados as ATSM do setor equatorial do Oceano Atlântico representado pelo Índice do Atlântico Sul (IATLS) e do Pacífico representado pela região do Nino 3.4, o Índice de Oscilação Sul (SOI), Precipitação e Temperatura do ar. A série dendrocronológica de imbuia foi obtida pela análise de agrupamento, um processo hierárquico aglomerativo, utilizando a medida de dissimilaridade entre os elementos pela distância Euclidiana Quadrática e o agrupamento feito pelo método de variância de Ward, sendo os grupos formados representados por dendrogramas. Foi empregado a análise de cross-wavelet no estudo das relações entre a série dendrocronológica e as séries geofísicas e climáticas. A relação entre a ATSM dos oceanos e a precipitação na região apresenta um sinal intermitente de 2 a 7 anos ao longo de todo o período considerado, sendo mais intensa com o Pacífico. Já entre ATSM e temperatura há relação em torno de 22 anos. A relação da precipitação e temperatura do ar com os anéis de crescimento mostra períodos significativos de 2 a 7 anos, com menor intensidade para a temperatura do ar. A ação dos oceanos sobre os anéis possui períodos significativos de 2 a 4 anos para o Atlântico e de 2 a 7 anos para o Pacífico.

Briefings at the Brazilian Study and Monitoring of Space Weather (Embrace) Program

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ABSTRACT

The Space Weather Program at the National Institute for Space Research (INPE) is active since 2008. The main objective of the "Brazilian Study and Monitoring of Space Weather (Embrace) Program" is to proceed with data collection and maintenance of Space Weather observation, modeling processes of the Sun-Earth on a global and regional scale, provide information in real time and make Space Weather forecast, and provide diagnostics of their effects on different technology systems through the collection of satellite data, surface and computational modeling. Since 2012, weekly briefings are held where scientists discuss and evaluate in a comprehensive manner all the chains of events from the sun, interplanetary space, earth magnetosphere, radiation belts, ionosphere and upper atmosphere. Over the years, a variety of indices were put to test in these briefings, in order to evaluate their ability to reflect the severity of the space weather impacts in the different areas of interest. Some of the indices are available at the EMBRACE portal and can be openly used by the community.

Length of Day and Solar Activity Influence

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ABSTRACT

The Earth's rotation period, also called the duration of the Day (LOD), can be influenced by any mechanism that change angular moment between the nucleus, the mantle, the oceans and the Earth's atmosphere. Different studies have analyzed LOD time series and their variation (ΔLOD) allowing correlating their periodicity or orbital periods of the Moon and Earth, climatic phenomena, such as El Niño and seismic activities. However, recent work has shown that geomagnetic activity is affected by periods of maximum solar activity and, therefore, the phenomenon of LOD variation can also be understood by interactions between the magnetic field of the Sun and the Earth (VUKCEVIC, 2014). To understand the influence of solar activity in LOD, a time series made available by the International Earth Rotation Service (IERS) was adopted, between data from 01/01/1962 to 12/17/2019, which are the averages observed by VLBI (Very long baseline). On these data, a Fast Fourier Transform was applied to decompose the LOD signal into components of different frequencies, in which tidal and seasonal effects were used. Observing the influence of solar activity in these changes, the data of Polar Magnetic Field, Average Magnetic Field, index of F10.7 cm, Number of Solar Sunspot and secondary cosmic rays were also analyzed.

Comparative study of different methods of calculating the ROTI index

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ABSTRACT

We have detected and characterized ionospheric irregularities in the Brazilian region, using the ROTI index based on the variation of the Total Electron Content (TEC). The current work presents a comparative study of five methods of calculating ROTI for three stations, São Luis (SALU), Cachoeira Paulista (CHPI) and Santa Maria (SMAR), during 17, 18 and 20 January 2015 and 25 December 2015. To support our results, we contrast them to the available data from TEC maps, ionograms (at the Fortaleza (FZA0M), SALU and CHPI stations), and All Sky imagers (at the São João do Cariri and Cachoeira Paulista). The results show that the technique proposed by Cherniak et al. (2018, GPS Solutions) presented the best procedure for GNSS analysis in the Brazilian region. Plasma bubbles were also observed in the ROTI index and contrasted with the equipment used.

Dayside magnetopause reconnection: Its influence on geomagnetic activities

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ABSTRACT

In the previous study we investigated a dependence of dayside magnetopause reconnection on solar wind and magnetosheath conditions (Koga et al., 2019). Our next interest is how the Earth's magnetosphere responds to magnetic reconnection (MRX) at the dayside magnetopause. Although there have been many studies on magnetospheric responses for southward interplanetary magnetic fields (IMF Bs), interplanetary coronal mass ejections (ICMEs), and corotating interaction regions (CIRs), there is a few detailed studies of magnetospheric responses when MRX is in fact identified at the dayside magnetopause. Among the dayside reconnection events in Koga et al. (2019) we selected 8 MRX events which showed geomagnetically quiet conditions during 1 hour preceding the MRX observation time at the magnetopause. In the present study we investigate magnetospheric responses on the dayside magnetic reconnection events, using the cross polar cap potential and SuperMAG geomagnetic indices (SMR, SME, SMU, and SML, http://supermag.jhuapl.edu/). It is shown that substorm main phase (SML index) starts and substorm current wedge/partial ring current (SMR local time index) develops at midnight sector within 1.5 hour succeeding the MRX observation time at the magnetopause. Furthermore SME index peak values are high when the solar wind Alfvén speed is high which is associated with reconnection outflow jet speed (Koga et al., 2019). A possible extent of the reconnection X line at the magnetopause also will be discussed. Koga, D., Gonzalez, W. D., Souza, V. M., Cardoso, F. R., Wang, C., & Liu, Z. K. (2019). Dayside magnetopause reconnection: Its dependence on solar wind and magnetosheath conditions. Journal of Geophysical Research: Space Physics, 124. https://doi.org/10.1029/2019JA026889

Ionospheric plasma bubble detection

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ABSTRACT

Ionospheric irregularities and Equatorial Plasma Bubbles (EPBs) were detected and monitored by using detrended total electron contents (dTEC) calculated by data from ground based GNSS satellite signal receiver network over the equatorial and low latitude region of Brazil. The present EPB monitoring technique will provide near realtime map-ping of EPBs. Some relevant results of the EPB mapping will be presented and discussed.

Spread-F occurrence during moderate geomagnetic storms near the southern crest of the EIA in Argentina

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ABSTRACT

This work presents the analysis of the occurrence of ionospheric irregularities during geomagnetic storms at a low latitude station in the Southern American longitudinal sector (Tucuman - Argentina, 26.9ºS, 294.6ºE; magnetic latitude 15.5ºS), near the southern crest of the equatorial ionization anomaly (EIA). Three moderate geomagnetic storms May 27, 2017 (a month of low occurrence rates of spread-F), October 12, 2016 (a month of transition from low to high occurrence rates of spread-F) and November 7, 2017 (a month of high occurrence rates of spread-F) are analyzed using Global Positioning System (GPS) receivers and ionosondes. The Total electron content (TEC) estimated with a GPS-TEC calibration technique, GPS Ionospheric L-band scintillation, the virtual height of the F-layer bottom side (h'F) and the critical frequency of the F2 layer (foF2) scaled from ionograms, are considered. Furthermore, each ionogram is manually examined for the presence of spread-F signatures. In the cases studied, spread-F development due to eastward over- shielding prompt penetration electric field (PPEF) and disturbance dynamo electric fields (DDEF) is observed, even during low spread-F occurrence season. What is more, during October and November, strong GPS L band scintillation is observed associated with strong range spread-F (SSF), that is, irregularities extending from the bottom-side to the top side of the F region.

Measurements of gamma, neutrons, rainfalls, in São José dos Campos tropical region of Brazil

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ABSTRACT

The months of October 2019 until the end of January 2020 were very rainy in São Jose dos Campos (23012'S, 45052'W) tropical Brazilian region. In the period from 10/14/2019 to 01/27/2020, the counting of gamma rays, neutrons and rainfall intensity in a tower at 25 meters high was monitored at every one-minute interval. This tower is located in a free area without electromagnetic interference from man on the site. The average rate of gamma radiation count between (0.2-10.0) MeV was 39000 counts / min. The average neutron count observed was 2 neutrons / min, between 25 eV to 10.0 MeV. The amount of net rainfall in the period was 461 (mm) with variations in dry weather, fine, moderate and heavy rainfall throughout the monitored interval time. It can be seen in these measurements that the intense rains correlate very well with variations in the gamma rays and delayed of 4 to 5 days with the measured neutron intensities. This work gives possible explanations about this correlation based in in same site of rainfalls, gamma and neutron observations.

Environmental low energy gamma ray spectrum measurements in São José dos Campos, Brazil region.

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ABSTRACT

The city of São Jose dos Campos is in the state of São Paulo in Brazil. It is a region where are the main industries in Brazil. The Technological Institute of Aeronautics - ITA promotes quality higher education teaching and research especially in aeronautics and space science. Given this relevance, in 2011 to 2019 measurements were made of the low energy gamma ray environmental spectra (0.2 - 10.0) MeV in this region. The main factor influencing this spectrum was local rainfall. Through the increase of radon gas in the intense rainfall that occurred at the site, the increase of gamma radiation in this time interval is detected. Also cold-front passages from the Antarctic and Andean mountain regions have shown variations in the low-energy gamma radiation intensities in the region. Other influences become less important.

Muon detection using deep learning

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ABSTRACT

Cosmic-ray flux variations may be due to different causes of galactic, solar and atmospheric conditions. The data collected during the CONNIE experiment (Coherent Neutrino-Nucleus Interaction Experiment) can be used to search for time variations of periodic and stochastic nature. This experiment uses 12 high resistivity CCDs (charge-coupled devices) placed in the vicinity of the Angra dos Reis nuclear reactor (Planta Almirante Alvaro Alberto, Rio de Janeiro, Brazil), with the purpose of detecting the antineutrinos generated in the reactor. The sensors have recorded images of particles during the last 2 years, in 3 hour expositions, where the majority of the images are muons produced by the impact of cosmic rays with the atmosphere. To count the muons flux from those images a classification algorithm is needed. This work uses a deep learning approach to classify events and detect the muons. Two different types of convolutional neural networks (CNN) are implemented, those based on one class and the conventional ones (differentiated by the datasets necessary for their training). However, the first step involves the creation of two datasets for training: one based on synthetic images generated by a simulation(using Geant4) to feed the one class CNN, and another consisting of images of muons and non-muons classified by specialized researchers to train the conventional CNN. the efficiency of both classifiers will be analyzed to select the most suitable. This work will help to build the time series of the muons count and study the correlation with space weather events.

Measurement of the angular distribution of muons on the earth's surface

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ABSTRACT

In this work we show the measurements of the muon flux and its angular distribution made at National University of Asuncion, located at 140 m above sea level. The detector consists of three 10 x 30 cm scintillator plastic read with Silicon Photo Multipliers detectors (SiPM). We verified that the system worked as expected through the angular distribution, and also through the energy deposition in thin plastics as predicted by Landau's theory. The flux value found was in agreement with previous measurements made at Campinas, showing that the flux in the South Atlantic Magnetic Anomaly (SAMA) is much higher than other locations outside the anomaly. A comparison with the values measured by the same type of detector made at Chiapas showed a value of around 2.7 times more muons in the SAMA region.

Variabilidade da opacidade submilimétrica em escalas de minutos

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ABSTRACT

O vapor de agua é a causa principal da atenuação atmosférica em altas frequências. A medição da opacidade atmosférica (τ) é importante porque nos permite obter a verdadeira temperatura de brilho de um objeto astrofisico. Melo et al. (2005), apresentaram o método da brilhância do Sol para determinar a opacidade atmosférica em ondas sub-milimétricas. Despois, usando el mismo método Cornejo et al. (2017) estimou a opacidade em 212 (τ 212) e 405 (τ 405) GHz para o periodo de 2006 e 2014. As medidas foram realizadas com o Telescópio Sub-milimétricas Solar (SST), no sitio de "El Leoncito". Neste trabalho vamos usar um novo método para calcular a variação da opacidade em escalas temporais de minutos a horas. Usaremos como parâmetros de entrada as opacidades determinadas por meio do método da brilhância, em dias em que o Sol não apresente nenhuma região ativa. O método pressupõe que toda variação de intensidade observada é debido então a variações de τ no direção de observação.

Open Source Development of TEC-MAP using Kriging interpolation technique to study Ionospheric perturbation over Brazilian sector

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ABSTRACT

Ionospheric Total Electron Content (TEC) obtained from Global Navigation Satellite System (GNSS) data is an important tool to study ionospheric perturbations. Since the ionosphere over the Brazilian region is unique due to the amount of large scale plasma disturbances, a map tool has many uses. This work presents the development of the regional post-processed TEC map over the Brazilian region obtained by using a geostatistical interpolation method called Ordinary Kriging method. This technique was applied on vertical TEC derived to GNSS stations distributed over all Brazilian region. To validate the method, the interpolated TEC values have been compared, in every time step, with a random sample of experimental TEC values not use in interpolation processing until the mean square error to be smallest possible, allowing the process to be self-consistent. The TEC-map has been applied to three situations: a quiet day; an Equatorial Plasma Bubble; and a magnetic storm. The main results showed the technique based on kriging interpolation is consistent with the TEC behavior known in the literature.

Observation of the 27-day periodicity in albedo measurements of polar mesospheric clouds.

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ABSTRACT

Data collected by the Aeronomy of Ice in the Mesosphere (AIM) mission and its Cloud Imaging and Particle Instrument (CIPS) were assessed to determine the existence of periodicities in albedo measurements and particularly the 27-day solar periodicity. The analysis of twelve years of daily data collected over the south and north poles using time series and least-squares spectral techniques revealed that this periodicity is present and also correlated with the solar cycle and variations in cosmic rays. The periodicity is clearly present during periods of maximum solar activity and it was not observed during periods of minimum solar activity.

Sun-Moon-Earth Interactions with Larger Earthquakes Worldwide connections.

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ABSTRACT

The aim of this paper is to investigate the effects on Moon- Earth gravitational variations and Moon phases during three Solar Cycles (SC22, SC23, SC24) . The first part defines gravitational forces as a force that creates an oscillation when the moon is reaching the Perigee, the smallest distance between the Moon and Earth during its rotational movement around Earth. It has a small amplitude and large period. Unlikely other authors, we do not find a direct connection between the Moon phases and big earthquakes worldwide. The study is performed through the three Solar Cycles, which refer to the variation in the Sun's magnetic field. However, a strong indication appeared that almost the totality of largest quakes studied happened preferentially at the subduction zones, in the Southern Hemisphere. In this research we apply experimental data to find the tide force, and the Perigee position is an experimental value. Other parameters are experimental, such as the length of Solar Cycles, the Moon's phases connected to each earthquake where M$\geqslant$ 7.5. The calculations use regression in time to find the results. Our model considers in the regression the period 1986- 2018.

Modulations and long-term calibrated observations of the operative cosmic rays observatory for space weather studies at Marambio base, Antartic

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ABSTRACT

During 2019 an Antarctic Space Weather Laboratory was deployed by the LAMP group (Laboratorio Argentino de Meteorología del esPacio) at the Marambio base, Antartic. The main instrument installed was a cosmic ray detector based on water Cherenkov radiation. This detector is the first permanent Antarctic node of the LAGO Collaboration (Latin American Giant Observatory). The laboratory and the LAGO node are located at 64.24S-56.62W and 200 m a.s.l. The LAGO Project is an extended Astroparticle Observatory at global scale. It is mainly oriented to basic research in three branches of Astroparticle physics: the Extreme Universe, Space Weather phenomena, and Atmospheric Radiation at ground level. We will present long term (continuous and uninterrupted annual measurements) calibrated observations from the cosmic ray detector. The first long-term calibrated observation of the flux, on a one hour (real time) base is presented for operative Space Weather studies and it is provided on a public web site. We will study the long-term modulations of the flux as the daily modulation using superposed epoch analysis. Fluxes observed will be compared with fluxes observed by neutron monitor stations located in places having similar rigidity cut-off to the one at Marambio.

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Evaluation of the potential geo efficiency of coronal mass ejections using data of microwave solar emission

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ABSTRACT

This work is devoted to the study of the features of sporadic solar microwave emission preceding the registration of geoeffective coronal mass ejections (CMEs) on coronographs. The study is based on broadband patrol observations of the Sun in the radio range, which cover the centimeter, decimeter and meter wave ranges in some periods of the XXI-XXIII cycles of solar activity. It was shown that sporadic radio emission, which can be defined as radio precursors of coronal mass emissions, is observed in the two-hour interval before recording a significant number of coronal mass emissions on coronographs. Coronal mass ejections are considered geoeffective if their effect on near-Earth space is accompanied by changes in geomagnetic indices (Kp and Dst). The following regular features of radio precursors of such CMEs have been established on the basis of statistical consideration: a) the presence of the broadband radio emission of radio precursors of coronal ejections at least in one wavelength range, centimeter or decimeter; b) radio-precursor duration exceeds 10 min; c) coronal ejections which have broadband radio precursors and the greatest potential geoeffectiveness are referred to the loop-like, halo, and partial halo classes according to the classification used in various coronagraphs. In conclusion, it should be emphasized that the analysis of microwave emission effects at the stage of formation and initial propagation of the CMEs seems to be a necessary step in an integrated approach to considering the geoefficiency of CMEs and their influence on the parameters of near-Earth space.

Preliminary results using the DIXMAP over South America during the St Patrick's Geomagnetic Storm

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ABSTRACT

In the present work, we aim to analyze the intense magnetic storm of March 2015 using the DIXMAP over South America during the. The DIXMAP provides the ionospheric response to magnetic disturbances and covers the latitudinal range between 10 N and 60 S, and the longitudinal range between 90 and 30 W, with 5° of range resolution in both coordinates. It is built at the rate of one map every 10 minutes based on TEC data over the same area, which in turn is derived from 180 GPS receivers from 4 different networks (RBMC - Brazilian GNSS, RAMSAC, LISN, and IGS). The preliminary results show that the ionospheric disturbance occurs from equatorial to low latitudes regions. It is interesting to highlight that the main disturbances are occurring during the recovery phase, mainly around the Equatorial Ionization Anomaly. Moreover, the maps were compared to the ionograms set, recorded during the same period of magnetic storm occurrence, in order to discuss the performance of the proposed index.

Ionospheric TEC responses to HILDCAAs intervals

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ABSTRACT

The High-Intensity Long-Duration and Continuous AE Activities (HILDCAA) intervals are capable of causing a global disturbance in the terrestrial ionosphere. However, the ionospheric storms' behavior due to these intervals is still not widely understood. In the current study, we seek to comprise the HILDCAAs disturbance time effects in the Total Electron Content (TEC) values with respect to the quiet days' pattern analyzing local time and seasonal dependences, and the influences of the solar wind velocity to a sample of ten intervals occurred in 2015 and 2016 years. The main results showed that the hourly distribution of the disturbance TEC may vary substantially between one HILDCAA interval and another. It was found an equinoctial anomaly since the equinoxes represent more ionospheric TEC responses than the solstices. Regarding the solar wind velocities, although HILDCAA intervals are associated with High-Speed Streams, this association does not present a direct relation to TEC disturbances magnitudes in low and equatorial latitudes.

Analysis of Pc3 and Pc4 magnetic pulsations under the influence of equatorial electrojet in the Amazon region

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ABSTRACT

In this work we analyzed pulse signals ranging from Pc3 to Pc4 types from Tatuoca, Araguatins, São Luiz and Kouru stations, located in legal Amazon, in order to understand the signal amplitudes behavior due to the ionospherical effects of Equatorial Electrojet (EJE). We decomposed the geomagnetic field signal in different frequencies bands that characterized the Pc3 and Pc4 pulses through the short time fourier transform. We used data from magnetic storms of 2018 and we verified that amplitudes of Pc3 and Pc4 were amplified during these storms due mechanisms of increasing of Cowling conductivity in equatorial ionosphere.

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Detection of cosmic radiation through a low cost device for aerospace use

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ABSTRACT

Cosmic rays, produced by different physical processes in outer space, reach our planet continuously. When these particles enter our atmosphere, through an extensive atmospheric shower (CAE), they produce a cascade of lighter particles. Among the particles generated by the interaction and decay processes is the muon, a secondary component of the CAE. Traveling at relativistic speeds (about 0.9997c), more than 10,000 muons per square meter reach the Earth's surface. Its detection is carried out by different methods, including the scintillation method. The objective of this work is to present the construction of a low cost muon detector, using scintillators for the use of the study of cosmic radiation at ground level. This detector is already in operation and after three weeks of collection, the results showed that the detector is functional and its data can be used for monitoring and muon counts. In addition to the detector, a meteorological station was also built for the correction of pressure in muon data and correlations with climatic phenomena.

Poster Presentations - Physics of Plasmas

Simulating the interaction of a non-magnetized planet with the stellar wind produced by a sun-like star using the FLASH Code

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ABSTRACT

The study of the interaction between solid objects and magnetohydrodynamic (MHD) fluids is of great importance in physics as consequence of the significant phenomena generated, such as planets interacting with stellar wind produced by their host stars. There are several computational tools created to simulate hydrodynamic and MHD fluids, such as the FLASH code. In this code there is a feature which permits the placement of rigid bodies in the domain to be simulated. However, it is available and tested for pure hydrodynamic cases only. Our aim here is to adapt the existing resources of FLASH to enable the placement of a rigid body in MHD scenarios and, with such a scheme, to produce the simulation of a non-magnetized planet interacting with the stellar wind produced by a sun-like star. Besides, we consider that the planet has no significant atmosphere. We focus our studies on the patterns of the density, magnetic field and velocity around the planet, as well as the influence of the viscosity on such patterns.

Gravitational instability of damping MHD waves in anisotropic plasma

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ABSTRACT

The instability of gravitating anisotropic plasma in a magnetic field under viscous medium for a different mode of propagation with respect to the magnetic field has been studied. Heat flux, pressure, density and velocity profiles of plasma for different mode of propagation have been derived. It is also shown that the viscosity does not influence the transverse mode of propagation and maintains the Jeans condition unchanged while the parallel anisotropic pressure is shown to affect the Jeans instability condition. Further, it is also shown the firehose instability condition is satisfied for visco-gravitating anisotropic plasma. For the case of transversal perturbation, the velocity is found to decrease more rapidly due to gravitating damped plasma than due to the effects of viscosity. On the contrary, the longitudinal velocity perturbation undergoes fast propagation in the direction of the magnetic field. For the mode of propagation where the perpendicular and parallel wavenumber are equal, the Jeans instability is dependent on viscosity, frequency and density of plasma.

Coherent structures in a global model of accretion disks

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ABSTRACT

Protoplanetary accretion disks are disks of gas and dust around young stars in which planets are believed to form. Accretion disks can be modelled using a simplified local representation called the shearing-box model, which can display intermittent behavior induced by the magnetorotational instability. However, local models are not able to represent the global characteristics of accretion disks, and their comparison with observations can be difficult. We present results of a realistic global model that represents an accretion disk by a Keplerian flow on a two-dimensional Cartesian grid. Numerical simulations are performed using the PENCIL code, and show the formation of large-scale vortices. These vortices are responsible for the accumulation of solids and formation of protoplanets. We perform an objective detection of accretion disk vortices using a Lagrangian approach, and discuss the role of Lagrangian coherent structures in the formation of protoplanets.

The study of the outer and the inner magnetosphere during high speed streams

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ABSTRACT

High speed streams may reach the Earth and affect the outer and the inner magnetosphere. The compression of the dayside magnetosphere caused by the high dynamic pressure of the high speed streams and the magnetic reconnection onset depending on the solar wind conditions may be important to the processes occurring in the outer magnetosphere. The Van Allen radiation belts are formed by trapped particles in the inner magnetosphere. The electrons in the outer radiation belt can be lost during their drift around the Earth in crossing the magnetopause which is known as magnetopause shadowing. The wave- particles interaction may be responsible for the rapid electron flux variability in the outer belt. Our aim is to study the processes occurring in the inner and in the outer magnetosphere during events of high speed streams. We identify the events of high speed streams using the data from the ACE (Advanced Composition Explorer) mission. The outer magnetosphere processes are studied using THEMIS (Time History of Events and Macroscale Interactions during Substorms) data at the dayside magnetopause during a magnetopause crossing. The electron flux in the radiation belts is analyzed using the Van Allen Probes data. Our data analyses may indicate the magnetopause processes associated with the electron flux variability in the Van Allen radiation belts during a high speed streams event.

Cross-scale coupling in interplanetary magnetic field turbulence during a rope-rope magnetic reconnection event

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ABSTRACT

We analyze cross-scale coupling in the interplanetary magnetic field during a rope-rope magnetic reconnection event measured by Cluster on 1 February 2002. This event is characterized by three interplanetary magnetic flux ropes (IMFR), a bifurcated current sheet, and evidence of rope-rope magnetic reconnection. The time series of the modulus of the magnetic field $|B|$ is divided into five intervals corresponding to interior regions and boundary layers of the three IMFRs. We analyze the relation between the skewness and the kurtosis at each interval, and demonstrate that the parabolic relation displays scale dependence and is enhanced during magnetic reconnection. These results indicate that a direct coupling between the scales of magnetic flux ropes and the scales within the inertial subrange occurs in the solar wind.

Equação Específica de Grad-Shafranov: Uma nova Solução obtida dos Modelos de Yoon-Lui-2 e Yoon-Lui-3

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ABSTRACT

Uma forma específica da equação de Grad-Shafranov (GS) pode-se obter a partir do sistema de equações de Vlasov-Maxwell. Esta equação de GS é o Laplaciano bidimensional do potencial vetor normalizado (Ψ) igualado ao exponencial de Ψ. A equação de GS foi resolvida por Walker no ano de 1915, também pode aparecer na literatura como solução de Liouville, mas nós preferimos chamá-la de Fórmula de Walker. Ele propôs uma solução geral dependente de uma função analítica complexa chamada de função geradora $g(\zeta)$. Este pôster pretende mostrar uma solução analítica da Equação Específica de Grad-Shafranov (GS) usando a Fórmula de Walker, e fazendo uma fusão dos modelos de Yoon-Lui-2 e Yoon-Lui-3. Posteriormente plota-se os gráficos e se discuti as características físicas da solução.

Analysis of the magnetic field effects on a Helicon Plasma Thruster (HPT)

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ABSTRACT

This paper describes a numerical investigation of the magnetic field effect on a Helicon Plasma Thruster (HPT). The HPT is an electric propulsion device in which the plasma is generated through a radio frequency antenna. The plasma is contained in a tubular medium with a dielectric material, usually made of glass or quartz. A set of coils generates a magnetic field which is mainly aligned in the axial direction at the center of the tube, and creates a magnetic nozzle configuration at the exit region of the tube. We conduct a numerical and experimental analysis of the magnetic field in the HPT experiment currently under development at the Laboratory of Plasmas of the University of Brasilia (LP-UnB). Numerical simulations are performed using a two-dimensional model that represents the device using a cylindrical geometry. The magnetic field profile is obtained using the finite element method, whereas the plasma is simulated by solving the electrostatic equations and the equations of motion of charged particles using the particle-in-cell approach. We simulate several different magnetic field profiles and compare to experimental measurements. Our results can be useful to enhance the performance of the experimental device under development at the LP-UnB.

Poster Presentations - Solar Physics, Interplanetary Medium and Planetary Magnetospheres

A statistical study of ULF wave penetration into the Martian Ionosphere

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ABSTRACT

Ultra-Low frequency (ULF) waves are considered an essential factor for planetary magnetospheres, once they can transfer energy and momentum from the solar wind to the inner magnetospheric cavity. In Mars, the magnetosphere is induced, and the low energy ions escape is related to the extreme ultra violet solar radiation and to the solar wind pressure. The solar wind pressure increases the wave production in the magnetosheath, since magnetic shielding is unable to prevent that ULF waves generated in the sheath to penetrate into the ionosphere. Thus, ULF waves can provide enough energy to accelerate ionospheric ions, so that they reach escape speed, contributing to the atmosphere erosion. Knowing the important role of waves produced in the magnetosheath in the loss processes of the Martian atmosphere, search for evidences that ULF waves can penetrate in the ionosphere is of great value, since that proves that waves produced upstream of the bow shock can propagate through the ionospouse. The present study aims to perform a statistical study of potential cases of wave propagation into the ionosphere of Mars using 13 years of Mars Express (MEX) observations. Data of electron density from the Analyzer of Space Plasma and Energetic Atoms (ASPERA-3) and the Mars Advanced Radar for Subsurface and Ionosphere Sounding (MARSIS) instruments have been used. The kurtosis and the wavelet analyses techniques have been employed in the data. The kurtosis was applied in order to characterize how intermittent phenomena contribute to the energy exchange among scales within the Martian magnetospheric environment. The wavelet analysis was used with the goal of searching whether the oscillation in the magnetosheath (ASPERA-3 data) can be also observed in the ionosphere region. The wavelet analysis was also conducted in the MARSIS data, in order to observe in which frequencies the oscillations in the ionosphere have more

power and compare with ASPERA-3 results. Besides these techniques, the cross-correlation between the solar wind electron density (ASPERA-3) data and the ionospheric electron density (MARSIS) data have been computed. The influence of the solar cycle, solar wind dynamic pressure and Mars orbit on the occurrence of these cases was also analyzed.

Estudo do movimento de partículas carregadas, com velocidades relativísticas, sob ação de campo geomagnético perturbado

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ABSTRACT

As ondas de chorus são um tipo de ondas whistler com polarização RCP (ondas polarizadas circularmente à direita) que se propaga em uma direção paralela ou antiparalela ao campo magnético da Terra com frequências entre centenas de Hz e alguns kHz. A medida que se propagam, podem interagir com partículas energéticas relativísticas no cinturão de radiação de Van Allen, causando perdas de partículas. Neste trabalho se utiliza a teoria de centro de guia para calcular numericamente a equação de movimento de partículas relativísticas em dois casos; o primeiro para um campo magnético dipolar sem perturbação e o segundo para um campo magnético dipolar perturbado pela ocorrência de ondas de chorus. A solução da equação de movimento foi obtida numericamente utilizando Python. Como resultado se apresenta o estudo da interação onda-partícula ocorrida em um evento de perda de elétrons em 12 de setembro de 2014. Os dados dos campos eletromagnéticos da onda foram obtidos das sondas de Van Allen para elétrons na faixa de energia de 2 a 5 MeV na zona equatorial e L$\geqslant$ 5,5. A partir dos resultados obtidos, pode-se concluir que a variação da velocidade das partículas está relacionada ao ângulo de incidência da onda e à energia inicial da partícula.

Influence of solar activity on the Lenght of the Day

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ABSTRACT

The Earth's rotation period, also called the length of the Day (LOD), can be influenced by any mechanism that changes angular moment between the nucleus, the mantle, the oceans, and the Earth's atmosphere. Different studies have analyzed the LOD time series and their variation (ΔLOD) allowing correlating their periodicity or orbital periods of the Moon and Earth, climatic phenomena, such as El Niño and seismic activities. However, recent work has shown that geomagnetic activity is affected by periods of maximum solar activity and, therefore, the phenomenon of LOD variation can also be understood by interactions between the magnetic field of the Sun and the Earth. To understand the influence of solar activity in LOD, a time series made available by the International Earth Rotation Service (IERS) was adopted, between data from 01/01/1962 to 12/17/2019, which are the averages observed by VLBI (Very long baseline). On these data, a Fast Fourier Transform was applied to decompose the LOD signal into components of different frequencies, in which tidal and seasonal effects were used. Observing the influence of solar activity in these changes, the data of Polar Magnetic Field, Average Magnetic Field, index of F10.7 cm, Number of Solar Sunspot and secondary cosmic rays were also analyzed. The results indicated a high correlation between solar activity and the LOD.

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Slow magneto-acoustic-gravity cut-off periods in a flux tube

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ABSTRACT

Slow waves are commonly observed on the entire solar atmosphere. Assuming a thin flux tube approximation, cut-off periods of slow-mode magneto-acoustic-gravity waves that travel from the photosphere to the corona are studied (Costa et al. 2018). Due to the abrupt temperature change in the transition region, a change of the mean atomic weight (by a factor of approximately two) also occurs, but is often overlooked in analytical models for simplicity purposes. Here we present a calculation of these cut-off periods considering a flux tube in hydrostatic equilibrium with a temperature profile and with the inclusion of the variation of the mean atomic weight (Zurbriggen et al. 2020, submitted). Finally, the cut-off periods analytically obtained are compared with observed periods measured in a particular active region. We show that they are consistent.

A study of interplanetary shock parameters variation with heliospheric distance

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ABSTRACT

In this work, interplanetary shocks are studied near the orbits of Earth, Júpiter and Saturn. Their occurrence and parameters: shock normal angle, Mach number and compression ratio, are determined. The variation of these shock parameters with heliospheric radial distance, from 1 to 10 Astronomical Units, is studied.

Simulação da configuração ótica para espectropolarímetro solar baseado em filtro holográfico de banda curta.

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ABSTRACT

A presença de um campo magnético intenso em certas regiões acima da fotosfera solar altera o espectro de emissão e o estado de polarização da luz emitida. Essas anomalias, conduzidas pelo desdobramento de níveis energéticos por efeito Zeeman ou Hanlee, se expressam em diferentes elementos a certas temperaturas. Estimar o campo magnético através desses dados não é tarefa fácil. A primeira dificuldade aparece no método de coleta, onde são necessários a aquisição simultânea (ou o mais próximo disso) de imagens solares em diferentes comprimentos de onda na faixa de interesse. Além disso, para cada imagem tem-se que estimar o estado de polarização. Filtros óticos dedicados a um determinado comprimento de onda e uma orientação, geralmente são usados para a seleção espectral e de polarização. Desse modo, o aspecto de simultaneidade torna-se impraticável dado a necessidade de alteração dos elementos óticos para as características desejadas de seleção. Em instrumentos usuais o processo de imageamento completo dura em média alguns minutos, o que impede o estudo detalhado de fenômenos magnéticos rápidos, como os flares. Nesse sentido, apresentamos neste trabalho uma discussão sobre elementos óticos necessários para permitir o uso de filtros holográficos multiespectrais na espectrometria solar, onde a aquisição de imagens poderia ser realizada de forma paralela. O filtro estudado é baseado no cristal fotorefrativo niobato de lítio dopado com ferro. Em sua estrutura cristalina são gravados previamente padrões de refração volumétrico, que obedecem à condição de De Brag, e que permitem a transmissão ou reflexão apenas de determinados comprimentos de onda definidos na gravação. Possíveis configurações ótica conceituais são propostas para adequação do uso de filtro espectral holográfico de niobato de lítio dopado com Ferro em espectopolarimetros comuns. Os esquemas propostos são verificados através

de simulações pelo software Zeemax, onde parâmetros preliminares do instrumento são ser estimados, como dimensões espaciais, quantidade de elementos óticos (lentes, espelhos, e afins), disposição dos elementos e especificações da câmera de aquisição.

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Mid-IR emission observed during a GOES C2 class flare

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ABSTRACT

The event SOL2019-05-15 occurred in the active region (AR) 12741 and was classified as C2.0 in soft X-rays. However, at 30 THz (10 micro-meters) produced enough emission to be detected by a 20-cm ground based telescope, with a mid-infrared camera in its focus. We compare the 30 THz flux and source evolution with micro-waves, Halpha, UV and Soft- Xrays. We also investigate the AR magnetic topology and evolution. With all this information we discuss the physical scenario which originated the flare and the consequent mid-infrared emission.

Metric type III bursts recorded by CALLISTO-BR between 2010 and 2014

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ABSTRACT

We present the results of the analysis of type III solar emissions registered by CALLISTO-BR spectrograph, in the metric wave range (between 45 and 870 MHz) for the years from 2010 to 2014. Type III bursts generally occur in groups (tens or hundreds of individual emissions) with total duration of the order of few minutes. They are directly associated with the beam of energetic electrons accelerated during solar flares that propagate along the magnetic loops. During this period analyzed, 1007 groups of type III explosions were recorded. From dynamic spectra recorded, the following observational parameters were measured in the spectral and temporal domains: the average bandwidth of 93.8 MHz, average duration of 3.4 s and frequency drift rate between -1484.4 MHz/s (reverse slope) and 596.4 MHz/s. The average physical parameters for the type III emission group were also determined. For the emitting source of type III bursts in the solar corona, the preliminary values obtained for 2010 are: electronic density of 5.0 x 107 cm-3, average heliocentric distance of the emitting source of the order of 1.4 solar rays, emitting region temperature of 2 x 106 K, average magnetic field strength of approximately 2 G. For the emitting beam, the values obtained were: upper speed limit of 1.4 x 105 km/s, beam density of 2.3 x 105 cm-3 and total number of electrons in the beam of 1.7 x 1033 electrons. The association of those type III bursts with the occurrence of X-ray solar flares recorded by GOES-SXR and with coronal mass ejection (CME) will be presented and discussed.

Observações de choques interplanetários não-colisionais na heliosfera

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ABSTRACT

Choques interplanetários podem ser detectados por medidas in-situ com instrumentos sensores de plasma e campo magnético operando em espaçonaves no espaço profundo (alem da fronteira da magnetosfeChoques não-colisionais ocorrem no meio interplanetário quando a velocidade de propagação da perturbação excede a velocidade magnetossônica local do plasma do vento solar. Os principais indutores de choques são os remanescentes interplanetários de ejeções coronais de massa (ICME) e regiões de interação corrotantes (CIRs). ra terrestre). Choques podem ser identificados como variações abruptas e grande amplitude na densidade, velocidade e temperatura do vento solar bem como na magnitude do campo magnético interplanetário (IMF). O espaço próximo a Terra tem maior cobertura de dados do vento solar, com observações desde o início da era espacial. Por outro lado, outras regiões da heliosfera são menos exploradas, com observações quando há passagem de alguma espaçonave ou sonda planetária. Uma oportunidade ótima de estudar a evolução dos choques é com observações de várias espaçonaves que estejam momentaneamente radialmente alinhadas. Neste estudo, selecionamos o intervalo de tempo entre 2000 e 2004, quanto a sonda Cassini estava no espaço interplanetário passando por Júpiter (2000) e chegando em Saturno (2004). Procurou-se os periodos de melhor alinhamento entre a Cassini e as espaçonaves próximo a Terra, com separação azimutal máxima de 15 graus. Quatro conjunções foram calculadas neste período, cada uma tendo duração de aproximadamente um mês. Em três foram observadas perturbações no IMF, tanto na Terra quanto na Cassini, indicando um possível CME. Na quarta conjunção, foi observado um pequeno evento na espaçonave, porém na Terra nada foi encontrado, podendo ser uma CIR. Através desses estudos, é possível entender um pouco mais sobre como funcionam as CIRs e as CMEs no meio interplanetário e saber diferenciá-las interpretando gráficos IMF cujos dados foram gerados em diferentes partes do sistema solar.

Observational and numerical characterization of a wave-like front propagating along pseudo-open field lines above an active region

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ABSTRACT

Early on the day, on July 6, 2011, high spatial resolution images of the solar corona recorded in the extreme ultraviolet (EUV) channels of the Atmospheric Imaging Assembly (AIA) instrument onboard the Solar Dynamics Observatory (SDO) detected a recurrent, arc-shaped intensity disturbance over a sunspot in NOAA AR 1243. The intensity fronts were observed to propagate along a coronal loop bundle rooted in a small area of the dark umbra of the sunspot. Neither signatures of flare activity nor of a coronal mass ejection event were observed in association with the phenomenon. A preliminary analysis suggests that the fronts 1) propagate with a projected, average phase velocity of about 50 km/s, the exact value depending upon the EUV channel analyzed; 2) exhibit a pseudo-periodic recurrence with a period of about 3 minutes; and 3) appear to be rooted in an umbral dot. To shed light into the physical nature of the event, we performed numerical simulations based on a simple potential magnetic field configuration embedded in a gravitationally stratified atmosphere. In this presentation, we 1) report on the kinematical properties and frequency characterization of the event as observed at the different temperature regimes covered by the SDO/AIA images, and 2) compare them with the results from the numerical simulations carried out. The speed values obtained from numerical simulations are similar to those estimated from observations and we reproduce the periods observed in the corona. In brief, the analysis suggests that the wave-like, recurrent fronts are a signature of a propagating slow-mode magnetoacoustic wave.

Simplified method for solar rotation calculation

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ABSTRACT

Using the Geogebra mathematical software, measurements of the displacement of sunspots were made in images obtained by the Solar and Heliospheric Observatory, in the visible range of the electromagnetic spectrum. These images were collected in the years 2010, 2016 and 2017. In order to obtain the measurements, projections of the displacement of the sunspots were made, the images obtained have a two-dimensional character, but it is known that they are moving on a spherical surface. Analyzing the obtained data, to calculate the sunspot's displacement speed in several different latitudes, the smallest being 06°06'N and the largest being 26°28'N. Starting from the speed of displacement of sunspots, the synodic period was obtained and from it the sidereal period, this process was done for several latitudes within the range mentioned above, showing that the rotation period is not the same to all of them, but that it is shorter at the solar equator and increases as we approach the poles. In the article "A comparison of differential rotation measurements" published in 2000 at the Solar physics by John G. Back, it is shown an equation to calculate the angular velocity of the sunspot as a function of its latitude. When comparing the data we found with those of the article cited above, we can see that, using a simple method, it is possible to achieve a satisfactory result being compared with results obtained with more sophisticated techniques.

Global MHD simulation study of the amplification of both magnetic field and convection electric field perturbations in the inner magnetosphere due to the interaction of a magnetic cloud coupled to solar wind Alfvenic fluctuations

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ABSTRACT

The Sun, source of energy for the geospace, provides and affects cyclically the energy content of different regions including the environment closer to Earth. The energy content can significantly impact the physical processes that control the space weather, and can directly affect technological systems and even interfere with human life. A type of interplanetary structure typically associated with maximum solar activity, and which significantly modulates the magnetosphere's energy content are the so-called magnetic clouds. These interplanetary magnetic structures are characterized by both intense magnetic fields that undergo a smooth rotation and a low plasma beta. When this class of interplanetary magnetic structure is coupled with the geomagnetic field, it can transfer a significant amount of mass, momentum and energy to the Earth's magnetosphere causing serious and intense disturbances in the geomagnetic field, and in the energy level of the particle population surrounding the Earth, thus characterizing magnetic storms and sub-storms. However, magnetic clouds can coexist coupled with another type of physical process, which are fluctuations in the magnetic field components also known as Alfvénic fluctuations. In this way, these structures become complex, both from a physical point of view, and in relation to their effects on the terrestrial magnetosphere. The objective of this work is to carry out a detailed study of this type of complex structure using global magnetohydrodynamic simulations performed with the SWMF/BATSRUS code. In a controlled way, we try to separate the effects of each component and to estimate the level of

intensification of the power spectral density of the ultra-low frequency ULF waves, as well as of the AE, Dst, and Cross Polar Cap indices in the equatorial magnetosphere, and also correlate modeled magnetic and electric fields fluctuations with satellite observations.

Detecção automática de explosões solares utilizando curvas de luz da emissão milimétrica solar e *machine learning*

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ABSTRACT

Atualmente o desenvolvimento de observatórios espaciais e terrestres gerou uma grande quantidade de dados. O estudo da atividade do Sol é muito importante devido aos seus efeitos sobre a Terra. Os POEMAS (Polarização de Emissão Milimétrica da Atividade Solar) são um sistema de dois telescópios, instalados em CASLEO (Complexo Astronômico El Leoncito) na Argentina, que monitoram o Sol em dois comprimentos de onda milimétrica (45 e 90 GHz) com medidas de polarização. O objetivo principal desse trabalho é detectar automaticamente explosões solares observadas no comprimento de onda milimétrica observado pelo POEMAS utilizando *machine learning*. Para tal análise das explosões solares, antes faz-se necessário eliminar o *background*, causado por problemas instrumentais, das curvas de luz da emissão solar milimétrica. As curvas de luz são primeiramente tratadas com a aplicação de um filtro de Kalman (método matemático que produz estimativas dos valores reais das grandezas medidas e valores relativos predizendo um valor). O *background* é modelado como uma combinação das curvas de luz do dia anterior e posterior considerando um período de 3 horas. Este *background* é então subtraído das curvas de luz. A aplicação de técnicas *machine learning* possibilitarão identificar um maior número de explosões solares nas curvas de luz.

Case study: the influence of whistler-mode chorus waves in the relativistic electron flux variability on the outer radiation belt

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ABSTRACT

The dynamic of Earth's magnetosphere can be disturbed by solar wind structures, such as Coronal Mass Ejections - CMEs and changes the dynamic of the outer and inner magnetosphere. Those perturbations can generate waves in a wide frequency range, such as whistler-mode chorus waves (from hundreds of Hz up to tens kHz), can be detected almost at the same time with the arrival of solar wind structures in the magnetosphere. The dynamics of the trapped particles in the outer radiation belt can be violated, and it may have a direct impact on the particular population of the radiation belts, which is primarily formed by electrons. This impact may occur from different dynamic mechanisms, such as radial diffusion, pitch-angle scattering, magnetopause shadowing, and others. The main goal of this case study that occurred on March 7, 2016, focuses on the identification of the pitch-angle scattering mechanism from the resonance between chorus and relativistic electrons. The characterization of the wave packets (sub-elements) is performed to estimate the opening angle of the loss cone, and thus understand the role of the chorus waves during the dropout (flux decrease) observed in the outer radiation belt. The sub-elements can also provide information about the possibility of enhancement (flux increase) of the outer radiation belt that was detected by the Van Allen Probes. Data from the REPT (Relativistic Electron-Proton Telescope) and EMFISIS (Electric and Magnetic Field Instrument Suite and Integrated Science) instruments onboard the Van Allen Probes and data from the PLASMAG (Plasma-Magnetometer) instrument onboard the DSCOVR (Depp Space Climate Observatory) satellite are used to understand the dynamic mechanisms related to relativistic electron flux variability in the outer radiation belt during the occurrence of a CME.

Poster Presentations - Astronomy and Astrophysics

Chemical abundance of LINER galaxy with SDSS-IV MaNGA

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ABSTRACT

The determination of chemical abundace in galaxies is very important for estudies of chemical evolution of Universe. To determine the chemical abundance in galaxies LINER (Low Ionization Nuclear Emission-Line Region) is especially complex, once the ionization source of these objectics are uncertain. Papers claim the ionization LINERs is produce by AGN. However, anothers one claim the ionization in LINER occurs by star p-AGB or shock waves. In this paper, we present a study about the determination os chemical abundance in the LINER galaxy UGC 4805 The datas of this object was found on survey MaNGA. MaNGA is a survey using the Sloan Foundation Telescope and has a spectral resolution approximately by 2000. The datas cover the spectrum range of 3600A to 10300A, resulting in a field of view of 30" x 30" . The galaxy UGC 4805 was selected from the BPT diagrams through Kewley et al. And Kauffman et al. lines and it present LINER-type emission only in center region. The star population was subtract using the program STARLIGHT and the oxygen abundance has beem calculated using nine calibrations available in the literature. The results were compared with photoionization model grids. Our results predict a mean metallicity in agreement with the solar value but a larger sample of galaxies is required for relevant statistical results.

Spectroscopic analysis of the mCV candidate CSS0357+10 with SOAR Telescope data.

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ABSTRACT

Cataclysmic variables are binary systems where the primary component is a white dwarf star and the secondary is a main sequence star, usually a red dwarf. Due to the proximity of the system components the secondary star fills its Roche lobe causing a flow of ionized gas expelled by the internal Lagrange point forming an accretion disk around the primary. Some of these white dwarfs may have a magnetic field strong enough to change the path of the gas causing it to follow the lines of its field to form an accretion column that collides with the white dwarf near its magnetic pole instead of form a disc. In others the disk is partially formed with its internal part following the magnetic field. The first is known as polar and the second as intermediate polar (IPs), both are types of magnetic cataclysmic variables (mCVs). In our project to search and characterize new mCVs several candidates are selected from the Catalina Real Time Transient photometric survey (CRTS) to confirm whether the system belongs to this class. Several systems have already been confirmed as mCV. Among them CSS 0357+10 which had also been identified as an x-ray source was chosen for a more detailed study. In this work the analysis of the spectrum of this system obtained in the SOAR telescope was performed. The spectrum is dominated by hydrogen emission lines in the Balmer series and He II ionization characteristic, properties of a mCV spectrum.

Desorption processes induced by X-ray radiation: Implications for the radiation effects of compact objects towards astrophysical ices

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ABSTRACT

The photolysis of acetone ices triggered by soft X-rays were experimentally studied here. The Brazilian synchrotron facility (LNLS/CNPEN) was used in performing the experiment. In this study we employed broadband X-rays (6ev-2keV) to irradiate the frozen acetone CH3COCH3 at temperature of 12 K and with different photon fluences. Mid-infrared spectroscopy was used to follow the destruction of acetone molecules by ionizing radiation. We then determined the effective destruction cross-section of the father molecule and the effective formation cross-section for daughter species formed within the ice. Identified radiation products were: C2H4, C2H6, CH4, CO, CO2 and H2O. We study also chemical equilibrium and molecular abundances, including the abundance of unknown molecules. The quantification of molecular desorption induced by X-rays for the studied samples after reach chemical equilibrium and its implication in selected space environments was performed. We selected several objects from ordinary to compact objects, such as the Sun, white dwarfs and pulsars, as the source of X-ray radiation.

Orbital analysis of the Southern Delta Aquariids (SDA) meteor shower, recorded by EXOSS stations in 2017, 2018 and 2019

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ABSTRACT

When a meteoroid, a special rocky or metallic small body formed from collisions of asteroids or comet debris, penetrates the Earth's atmosphere with extreme speed, the ablation of that object makes it shine, and this luminous phenomenon is called a meteor. When several meteors appear for a certain period at a single point in the sky, also called radiant, the so-called meteor shower is characterized. The rains are usually named according to the constellation where the radiant is located. The Southern Delta Aquariids (SDA) is one of the meteor shower with the highest number of recorded meteors. The radiant is located, as its name suggests, in the constellation Aquarius, close to the star Delta-Aquarii (Skat star). SDAs are characterized as low intensity bright meteors. However, bright SDA meteors can also occur, especially in the southern hemisphere, as the radiant is located high enough in the sky, allowing their observation. The peak of activity for SDA shower occurs between July 29 and 30. The parental body for SDA meteors is suggested to be the Comet 96P/Machholz. The EXOSS is a non-profit institution with the participation of Professional and Amateur astronomers. The Project's mission is to record and analyze meteors, including meteor showers. Actually, EXOSS network consists of more than 50 Meteor Monitoring Stations, with more than 50 monitoring cameras in operation in Brazil, including two cameras operating regularly at UNIVAP (University of Vale do Paraíba, São Paulo). The stations of EXOSS network recorded a total of 805, 373 and 451 SDA meteors in the years 2017, 2018 and 2019, respectively. Using the

UFO ANALYZER software, the main observational and physical parameters (apparent magnitude, duration, speed) of the recorded meteors were determined. From the paired meteors (meteors registered by two or more stations), the orbits can be obtained using the UFO ORBIT software and a comparison with the orbital parameters of the Comet 96P/Machholz can be investigated.

Flutuações de densidade eletrônica em galáxias em interação com o SDSS-IV MaNGA

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ABSTRACT

Este trabalho constitui o estudo observacional sobres os efeitos das interações na densidade eletrônica do gás ionizado em uma amostra significativa de galáxias em interação. Para isso utilizou-se dados do survey do MaNGA (Mapping Nearby Galaxies at Apache Observatory), que compreendem espectroscopia de campo integral em um intervalo de comprimento de onda de 3.600A a 10.000A, com uma resolução de R$\sim$2000. Uma amostra de mais de 100 objetos foi selecionado do arquivo público do MaNGA. A densidade eletrônica foi estimada a partir da razão de intensidades de linhas [S II] λ6716/λ6731. Uma investigação sobre a origem dos altos valores de Ne, que provavelmente serão encontrados, também, será realizada.

A study on the physics of some solutions of Einstein Field Equations: black holes, wormholes and warp drives

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ABSTRACT

The present project studied some solutions of Einstein's Equations and their physical implications; the black hole solutions: Schwarschild, Kerr, Kerr-Newman and Reissner-Nordström, and their causal structure. Also, the present project studied two exotic solutions with respect the energy conditions of General Relativity. The present work obtained as a result the analysis of Newtonian gravity physics in comparison with black hole physics, in relation to the orbital dynamics of particles in these spacetimes. Also, the causal character of these spacetimes by the Carter-Penrose diagrams has been studied resulting in a better understanding of the interior of these solutions. The study of exotic solutions has resulted in a better understanding of what are the possible limits of General Relativity with respect to the type of energy-matter needed to generate such exotic geometries. Further, the one project could understood precisely how the General Relativity allows mathematically certain solutions, but how crucial it is to demarcate reasonable conditions for the energy-momentum tensor. In the case of Warp Drive, the need for a negative local energy density is required to support the "curvature bubble"; For the Wormhole, the "throat" stability that connects two portions of spacetime infers the need for exotic matter that violates energy conditions. For the next stage of the project, we intend to use quasar light curves to determine periods and then create an analogy of these periods with particle orbits around black holes.

2021 VIII SBGEA Simpósio Brasileiro de Geofísica Espacial e Aeronomia & VIII SIMFAST Simpósio de Física e Astronomia do Vale do Paraíba
22 a 26 de março | 2021
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Galáxias em interação: o Sistema AM 2203-281

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ABSTRACT

Encontros entre galáxias ocorrem com grande frequência desde o início do universo graças à força da gravidade, que além de causar eventos como planetas que permanecem em órbitas fixas e encontros entre diversos corpos celestes é a responsável pela força de maré, fenômeno que é determinante quando duas galáxias colidem. Colisões deste tipo, na escala de evolução do Universo, ocorrem o tempo todo, e nós as estudamos porque são peças essenciais para conhecermos o universo como é, já que galáxias são grandes blocos constituintes do Universo. Este trabalho teve como objetivo estudar o conjunto de galáxias AM2203-281, com dados coletados no âmbito do projeto de longa duração *Modellying star formation in galaxies: Characterization of star formation recipes*, aprovado e realizado no Observatório Pico dos Dias (OPD) - LNA/MCTI. Estes dados foram processados com o software IRAF (Image Reduction and Analysis Facility), largamente utilizado por astrônomos do mundo todo, que possibilitou o tratamento com calibração das imagens dos objetos em fluxo, calibração dos espectros em comprimento de onda e remoção de ruídos, tanto das imagens dos objetos, quanto das fendas espectrais e análises detalhada dos dados (as imagens foram captadas nas bandas U, B e I e os espectros em duas diferentes posições de fenda). Com informações retiradas de plataformas Astronômicas e das curvas de rotação obtidas da análise dos espectros de fenda longa, observou-se que uma das galáxias do grupo, WISEA J 220621.76-275743.6, não faz parte do plano de interação em questão, e por isto foi descartada. A partir das imagens do sistema, foram feitos mapas de cor, (B-U) e (B-I), que mostraram os locais de população estelar jovem na galáxia principal, comprovando nossa suspeita inicial de que houve uma colisão entre os corpos desse sistema. Deste modo, constatou-se que a galáxia espiral ESO 467-G 005 colidiu com a galáxia ESO 467-G 003 no passado e que possivelmente colidirá com a galáxia MCG -05 -52 -024 no futuro.

Optical observations and cyclops post-shock region modelling of the polar 1RXS J174320.1-042953

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ABSTRACT

Cataclysmic variables (CVs) are stellar binary systems composed of a white dwarf star (WD) that accretes matter from a late-type main sequence companion via an accretion disc. The magnetic Cataclysmic Variables (mCVs) harbours WDs with strong magnetic fields and are classified either as polars, whose $B > 10^7 G$ prevents the formation of the disc, or as intermediate polars (IPs) with $B \sim 10^7 G$, where an internally truncated disc may exist. In this work, we present the analysis of extensive, time-resolved spectroscopic, photometric and polarimetric data of the polar 1RXSJ174320.1-042953 (=RXJ1743) obtained at the SOAR and OPD telescopes. This object was selected as a candidate in a project to identify new mCVs from the Catalina Real-Time Transient Survey - CRTS - and from previously known X-ray sources. We also present a modelling of the photometric and polarimetric data with the CYCLOPS code, in order to investigate the geometry and physics of the accretion structure close to the WD. Our photometric data yield a non-eclipsing lightcurve and an orbital period of 0.08659 days consistent, within the uncertainties, with the period found in the literature. No stable periodicity related the spin of an unsynchronized WD primary is present in the data, which would otherwise indicate an IP nature for this system. The polarimetric data reveal strong and modulated circular polarization at the 45% level, besides less intense linear polarization. The optical spectrum is typical of polars, with no lines from the secondary component. The He II 4686 Å and Balmer emission-line radial velocities are modulated with the orbital period. In conclusion, our observational follow-up establishes RXJ1743 as a polar, with an orbital period close to the lower edge of the CV's period gap.

Possible electromagnetic interactions in the earth - moon system through metal layers originated by meteors and ionized by solar wind

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ABSTRACT

It is estimated that meteoric activity deposits about 50 tons of comet material on Earth each day. In bodies without an atmosphere, like the Moon or Mercury planet, these debris directly deposit their components on the ground since sublimation does not occur through friction with an atmosphere. In 1999 it was observed for the first time that metallic atoms, mainly sodium (Na) ionized by solar radiation escapes from the lunar surface and move at a certain speed. In the Earth-Moon system on new moon periods, our planet is within what is known in the literature as "lunar sodium tail", and it is possible to observe the concentration of these free atoms in the antisolar point in the visible spectrum of 589nm during these nights. In this work, we explain the first attempts to observe these interactions with the terrestrial ionosphere and/or the Earth's natural Na layer, in a hypothesis that these interactions may generate electromagnetic disturbances that would be detectable in radars/ion probes. Also are presented spectral analysis from different rains obtained in recent years at observation stations installed in Jataí / GO and other Brazilian observation sites through a collaborative network, thus obtaining the spectrum of comet samples that can carry different concentrations of metals in their compositions. Finally, possible reflections were observed at specific times on expected dates (most of them) in direct relation to the months of more intense meteor showers based on historical data, forecasts and local database. As this is a preliminary study, more indepth discussions are needed, which is the main objective of this presentation at this symposium.

Formation of astrophysic ice nanostructures using classical molecular dynamics

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ABSTRACT

Astrophysical ices, found in molecular clouds, are formed from a catalyst substrate, carbon or silicate, wrapped in different molecules such as H_2O, CO_2, NH_3 and CH_4. Astrophysical ices were detected with the aid of a space telescope and studied from laboratory simulations, which made it possible to prove the formation of more complex molecules when they were subjected to different types of irradiation. Thus, the following work aims to understand the formation of astrophysical ices on a manometric scale using the computational technique called Molecular Dynamics (MD). The procedure uses the laws of Newtonian mechanics to analyze the nuclear behavior of atoms from a total parameterized potential that describes connected and unconnected interactions. Different models of astrophysical ice have been created from carbonaceous surfaces. The first model was created from a graphene substrate, the second model was built from a single organic fullerene molecule and the third model was created from a structure consisting of 27 fullerenes. All models were simulated with the substrate electrically neutral and charged, under conditions of temperature and pressure that refer to the interstellar medium (IM). During the adsorption process, we obtained astrophysical ices formed at a final temperature of 10 K consisting only of H_2O and others consisting of H_2O and CO_2. The substrate loading provided a greater cohesion of the adsorbed molecules during the simulation. This study made it possible to develop a simulation protocol to model specific conditions, such as pressure and temperature, of a region of the molecular cloud capable of forming astrophysical ices on different carbonaceous substrates. In this sense, MD technique can be considered a promising tool in the study of IM astrophysics and astrochemistry.

Poster Presentations - INCT GNSS NavAer: INTEGRATING SPACE WEATHER, GEODESY AND AIR NAVIGATION

Contributions on the Statistical Modeling of Ionospheric Scintillation in the Brazilian Region

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ABSTRACT

Ionospheric scintillation is the term used to indicate amplitude and phase variations of radio signals that propagate through regions of low electronic density in the ionosphere (plasma bubbles, populated by irregularities with a wide range of scale sizes). This phenomenon occurs daily, especially in the years of high solar activity, around the geomagnetic equator and low latitude regions, during the summer solstice and after sunset, affecting radio signal users. In particular, ionospheric scintillation presents great liability to the performance of GPS receivers. It is responsible for significant degradation in the accuracy of position estimation. Rapid phase variations may be interpreted as a Doppler shift in the GPS signal, resulting in a loss of phase lock in severe cases. Furthermore, amplitude fades can cause the signal-to-noise ratio to drop below the threshold required for receiver operation. Under extremes scintillation scenarios, the receiver may lose lock of multiple channels and, depending on its severity, a full interruption of the receiver operation may occur. Because availability and integrity of GNSS services may be drastically affected by scintillation, this work analyzes GPS scintillation data recorded during the solar maximum of cycle 24 in the Brazilian cities of Fortaleza, Presidente Prudente, São José dos Campos and Porto Alegre. All these stations are located near or around the southern crest of the Equatorial Ionization Anomaly. The analysis has been performed aiming

at generating a series of models and approximations to better characterize the occurrence of scintillation in Brazil. The goal is to identify situations and understand the scenarios where the worst scintillation cases occur. This assessment is intended to support research regarding mitigation techniques and strategies for augmentation systems operation under equatorial and low latitude regions.

Evaluation of amplitude and phase scintillation impact on GPS and Galileo frequencies

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ABSTRACT

GNSS has been widely used in aviation applications, nonetheless its accuracy and reliability are degraded under ionospheric scintillation. This effect on the radio wave signals are rapid fluctuation on both amplitude and phase of the signals, which may even lead to loss of lock in the worst case. The GBAS based on GNSS signals is used for positioning improvement of the aircraft landing. However, ionospheric scintillation degrades GBAS performance and availability. For safety-of-life applications, such as aircraft operations, augmentation systems are necessary for aviation applications, once reliability under all conditions is of great importance. The evaluation of GNSS performance under amplitude and phase ionospheric scintillation is an important task when introducing a new safety-of-life technology such as GBAS. In this context, we present a quantitative analysis of the ionospheric amplitude and phase scintillation impact on same GPS and GALILEO frequencies. The analysis considered S4 and $\sigma_{\varphi 60}$ behavior for the same frequency between both systems (L1 = E1 and L5 = E5a signals). The data used in this study were measured by SJCU (23.1°S, 45.8°W), a station located in a region characterized by the occurrence of strong scintillations. The analyzed data were collected from November 12 to December 12, 2014, a period with moderated to strong solar activity. S4 and $\sigma_{\varphi 60}$ indices were estimated for satellites with elevation angle higher than 20° and indices values classified above 0.2 and 0.08, respectively. Considering GPS, amplitude and phase scintillation, the L5 signal had the greatest ionospheric impact in 91.7% and 98.4% of the epochs, respectively. Considering GALILEO, for amplitude and phase scintillation, E5a signal had the greatest ionospheric impact in 96.4% and 99.4% of the epochs, respectively. Those results indicate that lower frequencies are most affected under ionospheric scintillation. Furthermore, considering the same frequencies between GPS and GALILEO, the same behavior was

expected between the signals. However, the similarity was observed when phase scintillation was took into account, where L5 and E5 frequencies had a similar impact.

Challenges in real time amplitude scintillation index map generation

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ABSTRACT

In this work, it will be presented the challenges found in the various stages necessary for making ionospheric scintillation maps available for the Brazilian territory. The S4 amplitude scintillation index is typically obtained at 1-minute intervals using samples of signal strength collected at 50 Hz. From these 3000 samples, the S4 value is calculated using standard deviation normalized by the mean. The GNSS receiver calculates the S4 index for each visible satellite. With the various constellations currently available (GPS, GLONASS, GALILEO, BEIDOU, SBAS) the number of satellites can reach close to 40 for each monitoring station. The network of monitoring stations has 16 stations from the CIGALA/CALIBRA network and 14 stations from the LISN network distributed over Brazil. These stations can provide up to 800 S4 values per minute. The amplitude scintillation maps are obtained by interpolating the S4 values projected in the IPP (Ionospheric Pierce Point) in a grid that extends over the Brazilian territory. The necessary steps for making scintillation maps include data acquisition, data storage in a database, data retrieval from the database, generating and making the plots available on the WEB. For real time scintillation maps, all these steps must take place in the shortest possible time. Therefore, the challenges and solutions adopted at each stage of this process will be presented. It is expected that the availability of ionospheric scintillation maps in real time will contribute to several geodesic applications, including precision agriculture and positioning of offshore oil prospecting platforms. They can also be assimilated by ionospheric models and used in several scientific studies. There is the possibility, in the near future, to incorporate the scintillation maps into a service provided by the Brazilian Airspace Control System (SISCEAB).

Avaliação comparativa de dados e modelos descritivos do atraso ionosférico (TEC) na região brasileira

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ABSTRACT

Uma das principais fontes erro no sistema GNSS é a ionosfera, sobretudo em regiões de baixas latitudes próximas ao equador como é o caso do território brasileiro. Nestas regiões, durante a noite, a ionosfera apresenta perturbações que afetam os sinais de rádio nas frequências da banda L. O primeiro problema causado pela ionosfera é o atraso na propagação do sinal que afeta a determinação da pseudodistância, e o segundo é o efeito da cintilação que causa perda do rastreamento da portadora do sinal de radiofrequência. Este estudo visa avaliar modelos empíricos e teóricos que geram perfis de conteúdo eletrônico total (TEC) quanto a sua capacidade de representação da distribuição espaço temporal deste plasma ionosférico. Para tal, os dados de TEC calculados a partir de medidas obtidas por receptores da Rede Brasileira de Monitoramento Contínuo dos Sistemas GNSS (RBMC) foram comparados com modelos ionosféricos que fornecem os valores de TEC. Os modelos adotados foram o modelo Klobuchar, o modelo empírico IRI-2016, que tem o modelo NeQuick integrado em seus cálculos e o modelo teórico SAMI2. A razão para a escolha destes modelos é o fato do modelo de Klobuchar ser o padrão adotado por receptores GPS de frequência única, enquanto que o NeQuick é o modelo adotado pelo sistema de navegação europeu (Galileo). Por outro lado, durante este estudo foi também incluído um modelo teórico, para avaliação mais robusta dos resultados empregando as abordagens disponíveis para tal. As avaliações realizadas entre os valores TEC obtidos com os modelos e os dados reais calculados mostraram que os

modelos apresentam alguns desvios, necessitando, portanto, de futuras atualizações. Ao que os resultados indicam, estes desvios presentes tanto em abordagens empíricas quanto teóricas parecem ser provenientes das peculiaridades físicas do ambiente espacial sobre a região brasileira.

Introdução à caracterização e analise de previsibilidade de ocorrência de perdas de sincronismo em sinais GNSS associadas à ocorrência de cintilação ionosférica

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ABSTRACT

Os sistemas globais de navegação por satélite (Global Navigation Satellite System - GNSS), ao decorrer dos anos, apresentam inúmeras vantagens sobre os métodos convencionais de posicionamento. Entretanto, tal tecnologia está sujeita à influência de alguns efeitos. No contexto da propagação dos sinais GNSS na ionosfera, destacam-se os efeitos causados por variações no TEC (Total Electron Content - Conteúdo Total de Elétrons), que varia em função do fluxo de ionização solar, atividade magnética, ciclo de manchas solares, estações do ano, localização do usuário e direção do vetor entre o satélite e o receptor. Adicionalmente, destacam-se também as anomalias e irregularidades que afetam a propagação do sinal, como a ocorrência de bolhas e a cintilação ionosférica. Neste âmbito, o presente trabalho visa à apresentação de um estudo em andamento que aborda a previsibilidade de eventos de perdas de lock (perdas de sincronismo) entre satélite e receptor associados à ocorrência de cintilação ionosférica na região brasileira. São utilizados dados de monitoramento da intensidade e da fase do sinal GNSS, os quais foram amostrados em taxas de 50 Hz até 100 Hz, bem como dados de índices de cintilação comercialmente utilizados, como o índice S4, com taxa de 60 segundos. Os dados de monitoramento foram obtidos por meio da rede CIGALA/CALIBRA e processados no software MatLab®, sendo investigadas diferentes abordagens para a caracterização do sinal associada às diferentes ocorrências de perdas de sincronismo. Também está em curso de investigação o uso de parâmetros adicionais com o objetivo de desenvolver um algoritmo para prever tais ocorrências, bem como realizar a caracterização de desvanecimentos (fadings) que acarretam em perdas de sincronismo.

Multi-GNSS ambiguity resolution in Brazil under ionospheric disturbance periods

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ABSTRACT

The Global Navigation Satellite System (GNSS) Real-Time Kinematic (RTK) positioning has been widely used in geodesy, surveying, and navigation fields. The ambiguity resolution (AR) can benefit from the use of combined GNSS systems. In this work, we develop an integrated GPS + Galileo RTK positioning software, which performs instantaneous or multi-epoch AR in Brazil, using the LAMBDA (Least-Squares AMBiguity Decorrelation Adjustment) method. In this contribution, two GNSS systems will be used, GPS and Galileo. Located in the geomagnetic equatorial region, GNSS receivers in the city of Presidente Prudente (magnetic latitude of around -13o) will be used in the experiments. The objective is to show that our strategy can achieve good performance for AR and RTK positioning. To execute the experiments, GNSS data will be obtained from INCT GNSS NavAer (GNSS Technology in Support of Air Navigation) Network during periods of ionospheric disturbances from low to high levels. The AR performance with GPS + Galileo, GPS-only, and Galileo-only will be compared in terms of the Ambiguity Dilution of Precision (ADOP), the positioning accuracy and the ambiguity success rate. It will be demonstrated that when ionospheric delays residuals increase, ambiguity success rate decreases for GPS + Galileo or isolated systems. As expected results, it will be shown an improvement in positioning accuracy with GPS + Galileo compared to GPS-only and Galileo-only, even with the worst ionospheric disturbance level.

Solar flare effects on the GNSS positioning during September 2017

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ABSTRACT

Daylight GNSS, magnetometer and Digisonde data over Brazilian longitudinal sector were analyzed during the September 2017 X9.3 and X1.3 class solar flares. The solar flares frequently cause increases in the X ray and EUV fluxes as well as solar radio bursts (SRB). The SRBs, with duration of few tens of seconds to few hours, cover a large range of frequencies including L band, and they can give rise to signal fades in the GNSS carrier- to-noise (C/No) and fluctuations in its amplitude and phase. The X ray and EUV flux increases the ionospheric D and E region densities given origin to Sudden Increase in the Total Electron Content (SITEC). During these September 2017 events GNSS signal fades of 5 dBs and 10 dBs in the L1 and L2/L5 frequencies, respectively, as well as TEC increases with the rates of 2.5 to 5.0 TECU/minute for different PRNs were observed. In this contribution the aim is to analyze the effects of these solar flares on the quality of precise point positioning (PPP) in several stations over Brazil. GNSS data from several stations were processed using the kinematic PPP approach. Preliminary results using the RTKLib software provided evidence that the effects in the positioning were very clear. However, with two scientific softwares, such deterioration was not so evident. An analysis will be presented considering details about the residuals and position accuracy.

Charts describing the ionospheric condition: a simplified approach for non-scientific purposes

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ABSTRACT

The use of GNSS for air navigation has various benefits, but its real capabilities for high precision applications depend strongly on our knowledge about the surrounding conditions of the ionosphere. When such systems are used, the reliability degree of the obtained data must be considered with the help of as much additional information as possible. One way to address this problem is to probe the disturbance level of the ionosphere considering the development of the ROT (Rate of Total Electron Content) and the S4 scintillation index in the vicinity of the regarded sites. At equatorial and low-latitude regions, the proximity of the geomagnetic equator, with its recurrent ionospheric irregularities, and the influence of the equatorial ionization anomaly (EIA), with its large TEC gradients, can decrease the reliability of GNSS data significantly. Some case studies were analyzed to create situational maps and to follow the disturbances time evolution in sites near the geomagnetic equator and the crest of the EIA. The objective is to find the probable development of the ionospheric irregularities position in the subsequent minutes or hours, based on its initial geographic distribution and considering the current space weather conditions in a more direct way. This procedure could be developed to be continuously distributed as ionospheric warnings by space weather centers. Pilots or air traffic control facilities could employ this simplified ionospheric disturbance maps to help their decisions. The maps would serve as an additional tool to better evaluate what to expect ahead in individual flights considering the integrity of GNSS-derived solutions for navigation. In this work, we consider an approach to deliver straightforward ionospheric information using distribution maps of disturbances in the locations under observation.

Occurrences of plasma bubbles aligned with the path of GPS signals: Criteria and analyzes

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ABSTRACT

A presença de um campo magnético intenso em certas regiões acima da fotosfera solar altera o espectro de emissão e o estado de polarização da luz emitida. Essas anomalias, conduzidas pelo desdobramento de níveis energéticos por efeito Zeeman ou Hanlee, se expressam em diferentes elementos a certas temperaturas. Estimar o campo magnético através desses dados não é tarefa fácil. A primeira dificuldade aparece no método de coleta, onde são necessários a aquisição simultânea (ou o mais próximo disso) de imagens solares em diferentes comprimentos de onda na faixa de interesse. Além disso, para cada imagem tem-se que estimar o estado de polarização. Filtros óticos dedicados a um determinado comprimento de onda e uma orientação, geralmente são usados para a seleção espectral e de polarização. Desse modo, o aspecto de simultaneidade torna-se impraticável dado a necessidade de alteração dos elementos óticos para as características desejadas de seleção. Em instrumentos usuais o processo de imageamento completo dura em média alguns minutos, o que impede o estudo detalhado de fenômenos magnéticos rápidos, como os flares. Nesse sentido, apresentamos neste trabalho uma discussão sobre elementos óticos necessários para permitir o uso de filtros holográficos multiespectrais na espectrometria solar, onde a aquisição de imagens poderia ser realizada de forma paralela. O filtro estudado é baseado no cristal fotorefrativo niobato de lítio dopado com ferro. Em sua estrutura cristalina são gravados previamente padrões de refração volumétrico, que obedecem à condição de De Brag, e que permitem a transmissão ou reflexão apenas de determinados comprimentos de onda definidos na gravação. Possíveis configurações ótica conceituais são propostas para adequação do uso de filtro espectral holográfico de niobato de lítio dopado com Ferro em espectopolarimetros comuns. Os esquemas propostos são verificados através

de simulações pelo software Zeemax, onde parâmetros preliminares do instrumento são ser estimados, como dimensões espaciais, quantidade de elementos óticos (lentes, espelhos, e afins), disposição dos elementos e especificações da câmera de aquisição.

A Study on the latitudinal variation of radio wave scintillation over the brazilian sector during geomagnetic storms

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ABSTRACT

The ionosphere is a medium which has significant effects on the propagation of radio waves. Total Electron Content (TEC), is defined as the integral of the free electrons along the path from the satellite to the receiver. The magnitude of the TEC varies with the time of the day, latitude, season of the year, solar activity and geomagnetic activity. This is due to the exchange of energy from the solar wind, interplanetary magnetic field and the Earthâ's magnetosphere. TEC thus gives us a measure of the density of the ionosphere electron density. Scintillation in GPS signals is due to the presence of irregularities in the low latitude ionosphere. This can have significant impact on Air Navigation systems, Agriculture, Petroleum well as other industries which depends on GPS for their operations. The intensity of the scintillation is measured using the S4, ROT and ROTi indices. The intensity depends on the background electron density as indicated by the Total Electron Content. Thus these parameters can together be used to study the behavior of the ionosphere at different latitudes. This can be achieved by comparing the intensity of scintillation at sites located near the magnetic equator with sites located in the Equatorial Ionisation Anomaly region.

Climatology of ionospheric scintillation over Brazil: recent update

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ABSTRACT

The amplitude scintillation indices S4 from 1997 up to 2017 for different sites over the Brazilian territory are used to study and model the intensity of the ionospheric irregularities using spline cubic, least square and Fourier as data fitting techniques. The one minute average S4 data, measured by 3 arrays of GNSS receivers were classified according to different solar activities, seasons, Kp levels, local time and spatial dependency. Our analyze is for geomagnetically quiet conditions and the results confirm the main irregularity characteristics such as maximum (minimum) S4 values during December solstice (June solstice) inside the equatorial ionization anomaly crest (trough). The dependency of S4 index with the solar activity shows a linear increase from low to moderate solar flux levels and a saturation tendency for higher levels. The model was validated for different geophysical conditions presenting good performance.

Temporal fading characteristics at low latitude regions for GPS triple frequency users

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ABSTRACT

The ionospheric scintillation phenomenon has serious consequences on the communication systems. In particular, special attention has been given to GNSS systems with an emphasis on aeronautical applications. Scintillation causes attenuation in the amplitude and signal phase shifts, hence, its occurrence threaten the system operability, by causing loss of lock in the receiver, incorrect measurements that decreases the navigation performance and, in more severe cases, total loss of positioning. In the last decade, the GPS constellation has been modernized with the introduction of new codes/frequencies for more accurate operation through the L2C and L5 frequencies. The motivation for this modernization is the use of GPS for critical applications involving civil aviation and defense systems. The aim of this study is to perform a comparative analysis of the effects of ionospheric scintillation on GPS signals in order to characterize the fading effects on the received signal amplitude at the three frequencies, L1, L2C and L5. Data used in this analysis was collected by 50Hz scintillation monitors in four cities along the Brazilian territory: Fortaleza, Presidente Prudente, São José dos Campos and Porto Alegre. The analysis period was between November 2014 and March 2015, during the maximum solar activity of cycle 24. In the analysis, a particular focus was given to measure the frequency of occurrence and the typical duration of the fading events in the L2C and L5 signals in comparison to the L1 (legacy signal). Three fading threshold were chosen

-9 dB, -12 dB, and -15 dB. The number of fading events in all locations increased substantially, reaching up to 200% more occurrences in some cases. The results confirm previous works in the literature showing that L2C and L5 signals are more vulnerable to availability issues due to the occurrence of scintillation.

Ionospheric Maps to Support Early Warning of Anomalies Affecting Ground-Based Augmentation Systems

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ABSTRACT

The Ground-Based Augmentation System (GBAS) is a safety critical navigation aid designed to provide precision approach service by broadcasting corrections and integrity information for GNSS signals to nearby aircraft. GBAS has several advantages over the traditional radio navigation aids used for precision landings and brings direct operational and financial benefits for the service provider as well as for users. Since this system is based on transionospheric radio signals, it is influenced by the ionospheric environment, which is one of the most significant disturbances on GNSS signals, particularly in equatorial regions. This work explores an effective strategy to monitor the ionosphere affecting GBAS installations by generating Total Electron Content (TEC) maps of the ionosphere using data from a large network of ground stations within Brazilian territory: the Brazilian Network for Continuous Monitoring (RBMC). The process developed to generate the TEC maps is completely novel. First, ionospheric measurements are grouped by specific time intervals and stacked in bins corresponding to the closest integer coordinates. For each group of measurements, the resulting ionospheric delays are estimated considering by weighting each measurement by the satellite elevation angle that generated it. From these TEC measurements, a Delaunay triangulation is performed for the covered area using linear interpolation. The results are then smoothed by a low-pass filter on the map. This process has been validated in qualitative terms, meaning that the resulting TEC maps are clearly able to show patterns of equatorial plasma bubbles when they occur. The quality of the maps obtained by the proposed methodology

shows a considerable potential to support GBAS in low-latitudes by alerting GBAS stations in real time to plasma bubbles and other ionospheric anomalies that will soon affect satellites tracked by GBAS users. GBAS stations would then know when they are subject to ionospheric disturbances and when they are not. Exploitation of this knowledge by GBAS would significantly improve the integrity and availability of the system.

Low-cost platform for monitoring ionospheric irregularities with mobile access features

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ABSTRACT

The Earth's ionosphere is a region of the upper atmosphere located between 80 and 1,000 km altitude that can be described as a weakly ionized plasma. At low latitudes, perturbations in the ionospheric density commonly referred to as "bubbles" are generated after dusk as a result of plasma instabilities. Large variations in the index of refraction of the ionospheric channel associated with these plasma bubbles affect the amplitude and phase of radio signals used for communication, remote sensing and navigation. A better understanding of these ionospheric irregularities and their impact on various technological systems has been the topic of an extensive number of studies. However, systems for monitoring these irregularities in real (or near-real) time have been limited. One of the main reasons is the relatively high-cost of observing instrumentation. In this work we present and discuss a platform for real-time monitoring of ionospheric irregularities, the Ionik2, based on ScintPi monitors. ScintPi is a low-cost, easy-to-build ionospheric scintillation monitor based on Raspberry Pi single-board computers. The Ionik2 is a platform under development, which is based on a native mobile smartphone application for Android operating systems. Ionik2 plots scintillation indices (S4) for the satellites tracked at all available stations. The app also accesses the Google Maps service to show the location of the ScintPi receivers and the respective ionospheric piercing points (IPPs) along with the S4 values. At the back-end of Ionik2 is Google Firebase real-time database. Currently, the system is being tested with monitors deployed in a few universities over the Brazilian territory. Efforts have been devoted to correct acquisition of the ScintPi data and to comparison of these values against those obtained by collocated commercial monitors. The challenge now focuses on finding

strategies to identify the occurrence of irregularities in real time for users of our application. Another aspect that will be discussed in this work is the benefit of using this network in undergraduate education.

Start of the STSH station of the INCT GNSS-NavAer network in Santa Helena/PR and monitoring of ionospheric irregularities in the region

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ABSTRACT

The INCT GNSS-NavAer (http://inct-gnss-navaer.fct.unesp.br/en/index.php), started in January 2017 and sponsored by CNPq, CAPES and FAPESP, is currently the most important national project for understanding actions of the ionosphere over GNSS signals, aiming at the evaluation and safe application of satellite positioning in air navigation. Different institutions participate in this project: UNESP (Presidente Prudente campus) that coordinates it, INPE, ITA, IAE, PUC-Rio, UFRGS and IFSP (Presidente Epitácio campus), as well as other collaborating institutions, such as UFPR and UTFPR (St. Helena campus). Among the various fronts of INCT's activities, one consists of the implantation of receivers in strategic locations in the national territory, in order to compose a network for monitoring ionospheric activities. Comprised of 16 stations (February 2020), the network is equipped with Septentrio PolaRxS-PRO and PolaRx5S receivers, which provide specific parameters of the ionosphere. The most recent of these stations is the STSH (24º50'49.18379"S; 54º20'39.70810"W; geometric altitude 251.572 m), located on the roof of the building of the Agronomy course at UTFPR Santa Helena campus, which started operating on December 6, 2019. The extreme west of Parana state is characterized by being in transition between the regions of low and medium latitudes, a suitable place for the occurrence of ionospheric irregularities and, consequently, ionospheric scintillation. This fact could be noted in the values of the ROTI index, estimated with the Ion_Index program, which showed moderate irregularities during the period 22-4h UT (19-1h local time) of January 13, 14, 15 and 16, 2020. The possibility of identifying the times of occurrence of irregularities allows the application of techniques to obtain more precise coordinates. One technique is to exclude signals from satellites during the occurrence of irregularities. Experiment verified an improvement of up to 6% in planimetric precision and up to 42% in altimetric precision, which will be presented in this work.

Poster Competition - Ionosphere: Earth and Other Planets

Statistical Analyses of the Plasma Bubbles Observed in Jataí (17.9ºS, dip latitude 12.8ºS), Brasil

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ABSTRACT

Images of the OI630 nm from All-Sky imager obtained during four years (2016, 2017, 2018 and 2019) were used in order to characterize the equatorial plasma bubbles observed at (17.9ºS, 51.7ºW; dip latitude 12.8ºS). Preliminary results shown seasonality behavior for the period analyzed. Furthermore, the results were comparison with the Total Electronic Content (TEC) maps in order to study the temporal and space dynamics The use of the statistical tools were used in order to characterize the phenomenological aspects such as intermittence from Magnetohydrodinamic (MHD) turbulence. These results are compared with other studies did in Brazilian sector.

2021
VIII SBGEA Simpósio Brasileiro de Geofísica Espacial e Aeronomia & VIII SIMFAST Simpósio de Física e Astronomia do Vale do Paraíba
22 a 26 de março | 2021
Univap | Campus Urbanova
Av. Shishima Hifumi, nº2911 | SJC - SP

Ionospheric irregularities during the last solar cycle in the South American sector

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ABSTRACT

Ionospheric irregularities can affect trans-ionospheric radio signals from Global Navigation Satellite Systems (GNSS), High Frequency (HF) communication, and the satellites control system. One way to understand and predict such irregularities is to compare the amplitude scintillation index during solar maximum and minimum in different regions. The aim of this study is to performs S4 comparison in the Equatorial Ionospheric Anomaly (EIA) and South Atlantic Magnetic Anomaly (SAMA) regions. The results show important increases in the spring and summer of southern hemisphere of these regions, especially during the solar maximum. This understanding intends to contribute in the forecast of radio signals obstruction of receivers located on the Earth's surface in order to improve communication and navigation accuracy.

On the role of tidal winds in the descending of the high type of sporadic layer (Esh)

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ABSTRACT

As the prevailing tidal winds in the E region are generated by heating mechanisms, the dynamics of Es layers impacted by solar tides is a relevant theme in the space weather studies. This paper aims to identify the tidal wind component involved in the mechanism of formation and descending of the high type of sporadic layer (Esh). The Esh layers observed at altitudes between around 120 and 150 km in the Brazilian low latitude stations of Jataí and São José dos Campos during the months of April, June, September and December of 2016 are used in this analysis. The height variability and altitude descent of the Esh layers are analyzed from the h'Es parameter obtained by ionosonde data. In this study, the observational data are compared with the simulations generated by an extended version of the Ionospheric E- Region Model (MIRE). At higher altitudes in the E region, the results show that the prevailing tidal pattern and wind direction controlling the Esh layer formation and descent are different depending on month: (a) in April and June the zonal wind component and the associated semidiurnal tidal oscillations prevail, with some differences in terms of time of occurrence and descending speeds, and (b) in September and December the diurnal tidal periodicities become dominant, and both the meridional and zonal wind components seem to control the descending of the Esh layers. Since the role of the tidal periodicities and wind directions changed depending on the month, the results suggest a possible seasonal tidal wind pattern, which is not well understood from the present study but requires further investigation.

Assessment of global ionospheric maps considering TEC uncertainties

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ABSTRACT

The Earth's ionosphere can influence GNSS (Global Navigation Satellite System) signals in many ways, affecting the positioning performance. Ionospheric influence varies in time and space, according to the differences in the distribution of electrons. Those differences can be related to many factors, such as the position on the surface of the Earth, the geomagnetic field activity, season of the year, solar ionization flow and sunspot cycles. Several researches are being developed in order to understand the ionosphere and to mitigate its effects on GNSS positioning. In this context, some products were developed in order to represent the ionospheric behavior and irregularities. There are networks composed by receivers specifically for ionospheric monitoring and, besides that, the GNSS networks can also be useful for this purpose. Among the ionospheric products, nowadays available, ionospheric information can be provided on a global scale in IONEX (IONosphere map EXchange) format. Global ionospheric maps developed by IGS (International GNSS Service) data centers provide total electron content (TEC) values and its root mean square errors, in grids with 2.5º X 5º (latitude x longitude) and two-hour resolution. Many studies have been performed using IONEX information as a representation of the ionospheric behavior as well as to assess the quality of those products. Considering the information provided by IONEX files, in this work we aimed to explore ways of visualization of VTEC values, considering the respective VTEC uncertainties. We also present some ways of using VTEC values with weighting, based on the corresponding uncertainties. In this case, VTEC interpolation takes into account, not only the distances from the grid (with VTEC information), but also the RMSE of those values. Some experiments were also performed considering the possibility of using products of different IGS centers. The assessment of VTEC estimated was performed considering data from other sources, such as altimeters and observed in independent GNSS ground reference stations.

Transformada Wavelet Discreta na análise de variações geomagnéticas durante o Tsunami de Maule (2010)

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ABSTRACT

O projeto desenvolvido possui o objetivo de aprimorar a análise de eventos geofísicos utilizando ferramentas matemáticas computacionais desenvolvidas e implementadas de acordo com a necessidade de visualização do evento desejado. Abalos sísmicos geram ondas que podem se propagar até a alta atmosfera, como ondas de gravidade e de gravidade acústica que possuem duração de minutos ou horas. Estas oscilações se propagam na atmosfera e podem gerar TIDs (do inglês Travelling Ionospheric Disturbances). Para o desenvolvimento deste estudo, utilizamos o tsunami ocorrido em 27 de Fevereiro de 2010 com Magnitude de 8.8 Mw na escala Richter de origem tsunamigênica para estudar o acoplamento tsunami-atmosfera-ionosfera (TAI). O evento ocorreu na costeira de Maule - Chile. Devido a ocorrência de outros fenômenos na atmosfera é necessário processar o sinal obtido. Deste modo processamos o dado bruto de cada estação geomagnética no programa MAGNAMI desenvolvido pelos autores. Logo após, com os dados filtrados, realizamos a Transformada Wavelet Discreta para que o sinal de entrada seja decomposto no eixo de tempo-frequência. Com os dados filtrados, realizamos gráficos para diferentes estações geomagnéticas e analisamos as componente-H e componente-Z do campo magnético. Para as estações continentais, identificouse uma melhor assinatura na componente-H e para as estações de ilha, na componente-Z.

Statistical analysis of Medium-Scale Traveling Ionospheric Disturbances over the South American Equatorial Region during Solar Cycle 24

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ABSTRACT

Total electron content (TEC) perturbation maps from GNSS (GPS and GLONASS) dual frequency receiver networks were generated to identify the presence of MSTIDs over the South American equatorial region during the maximum, descending and minimum phase of solar cycle 24 (2014 to 2019). The MSTIDs were predominantly observed in winter solstices and equinoxes during daytime. The number of MSTIDs observed decreased with the solar cycle phase from maximum, descending and minimum phase. The horizontal wavelengths of the MSTIDs were concentrated between 300 and 1400 km, with the mean value of 654 $\pm$ 123 km. The observed periods were ranging from 20 to 60 min with the mean value of 35 $\pm$ 7 min. The observed horizontal phase speeds were distributed around 100 to 700 m/s, with the corresponding mean of 298 $\pm$ 69 m/s. The MSTIDs in winter solstice and equinoctial months predominantly tend to propagate northeastward and northwestward. Meanwhile, during summer solstice they propagated in all directions. Atmospheric gravity waves from strong convective sources could be a precursor of the northeastward and northwestward propagating MSTIDs during summer solstice and equinoxes. On the other hand, strong cold front emanating from mid/low latitude could be a prime trigger of the northeastward and northwestward propagated MSTIDs during winter solstice. In all the seasons, we noted that some oscillations of MSTIDs propagated toward southeast, which could be associated with the Intertropical Convergence Zone (ITCZ) activity.

Efeito das chuvas de meteoros na formação das Es em baixa latitude nos solstícios de verão de 2009 e 2013

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ABSTRACT

O plano eclíptico terrestre varia entre 10° e 15° no inverno e pode alcançar 60º no verão durante os meses de janeiro, fevereiro e março no Hemisfério Sul. Nesse período, a Terra é atingida por intensas poeiras de meteoros que se desprendem de cometas ao passarem pela órbita solar. Porém, esse fenômeno é minimizado no final do verão e no outono. A poeira ao entrar na atmosfera terrestre é abalada, dando origem às chuvas de meteoros que são nomeadas de acordo com o período de ocorrência. Durante a ablação meteórica na ionosfera terrestre são depositados íons metálicos como o magnésio (Mg+), o ferro (Fe+), o cálcio (Ca+), o sódio (Na+) e o silício (Si+). Desta maneira pode ocorrer reações fotoquímicas com os principais íons primários da região E, tais como N_2^+, O_2^+ e $O+$, e os íons mais numerosos, $NO+$ e O_2^+, e contribuir para a formação das camadas E-esporádicas (Es) entre uma altitude de 90 a 140 km. Esse trabalho objetivou investigar a relação das chuvas de meteoros com a intensidade das Es em baixa latitude durante os solstícios de verão de 2009 e 2013. Os dados sobre as chuvas de meteoros foram coletados nas plataformas internacionais Radio Meteor Observing Bulletin (RMOB) e International Meteor Organization (IMO), além das nacionais Brazilian Meteor Observation Network (BRAMON) e EXOSS, uma organização colaborativa citizen science. Por outro lado, os dados das Es foram coletados com uma ionossonda localizada em Palmas - TO, setor norte brasileiro. Para a redução dos dados das Es utilizou-se o programa Digital Ionosonde Data Analysis (UDIDA). Mostra-se como resultado uma comparação entre as chuvas de meteoros e a intensidade das Es destacando-se suas características como tipo, frequência de bloqueio (fbEs), frequência de topo (ftEs) e altura virtual (h'Es), no período do solstício de verão de 2009 e 2013, respectivamente, no máximo e mínimo de atividade solar do ciclo 24. Palavras Chave: Chuvas de Meteoros, E-esporádicas, Ciclo Solar.

Atividade das cintilações ionosféricas antes do amanhecer durante períodos geomagneticamente calmos e perturbados

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ABSTRACT

Neste trabalho a proposta foi analisar os registros das irregularidades ionosféricas (cintilações ionosféricas) obtidas por meio das suas assinaturas nos dados coletados pelos receptores do GNSS. As irregularidades de maior interesse nas observações foram aquelas tipicamente noturnas, geralmente denominadas bolhas de plasma. No entanto, as irregularidades que afetam os sinais dos satélites do GNSS são da ordem de centenas de metros e que na ionosfera coexistem com as bolhas de plasma. Para analisar o ambiente de cintilação ionosférica, amostras da amplitude da potência do sinal recebido na frequência L1 (1575,42 MHz) do GPS são gravadas por monitores de cintilação. Utilizando um software de pós processamento, esses monitores computam o desvio RMS normalizado da intensidade da potência do sinal recebido, conhecido como índice S4. Neste índice são registradas as estatísticas das flutuações na amplitude do sinal para cada intervalo de 1 minuto. Neste estudo foram empregados dados de cintilação em amplitude obtidos de dois observatórios: uma estação de baixa latitude localizada em São José dos Campos/SP (23,1S; 45,8O), e uma estação próxima ao equador magnético localizada em São Luís/MA (2,3S; 44,2O). Os dados foram coletados entre os anos de 2000-2014. O objetivo principal do estudo foi o de investigar a ocorrência e a atividade das cintilações ionosféricas durante os horários próximos ao amanhecer, entre 4h e 6h local. O critério utilizado para que o evento seja considerado um caso de cintilação ionosférica está relacionado ao valor atingido pelo índice S4, que deve se manter acima de 0,2 por pelo menos 5 minutos quando um ou mais satélites esteja acima de 40 graus de ângulo de elevação. No total foram identificados 502 casos de cintilações, sendo que 34 ocorreram em dias geomagneticamente perturbados e 468 em dias geomagneticamente calmos. Em relação as estações 373 casos foram identificados em São José dos Campos e 129 em São Luís.

Poster Competition - Physics of Plasmas

Caracterização de plasmas elétricos relacionadas com a variação de pressões de alto vácuo

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ABSTRACT

Na natureza, existem muitos fenômenos naturais relevantes para a investigação e compreensão de alguns conceitos físicos ou químicos, entre eles estão os fenômenos associados aos plasmas elétricos, pois estes ocorrem em uma escala diferente em tudo o que é conhecido no universo (estrelas, raios, aurora boreal e astral, etc.), por isso é importante reproduzir experimentos ao nível do laboratório que se assemelhem às condições desses fenômenos, já que atualmente não é possível obter dados in situ dos fenômenos mencionados acima. Uma maneira simples é usar uma câmara de vácuo com algum gás precursor a diferentes pressões, introduzir uma sonda de Langmuir na câmara muito próxima do fenômeno do plasma que é gerado dentro a partir dos efeitos das colisões das partículas, para obter valores de íons plasmáticos e de corrente de elétrons em medidas claras para diferenciá-los, deve-se esclarecer que, como a pressão na câmara é menor, os valores obtidos no osciloscópio das correntes de íons e elétrons serão menores, devido a ao fato de haver um tamanho médio de caminho livre médio maior das partículas internas na câmara de vácuo, com isso, a energia fornecida às partículas não permite que a velocidade delas não conduza a colisões internas entre as partículas, produzindo um campo de plasma maior. Finalmente, este trabalho serve de referência para tentar entender os fenômenos do plasma em diferentes pressões de vácuo e, assim, realizar uma extrapolação em diferentes escalas do universo.

The role of kinetic helicity in a magnetohydrodynamic dynamo

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ABSTRACT

The dynamics of the solar magnetic field can be studied using the mean-field dynamo theory, which is based on the approximation of two scales, which suggests that the magnetic field consists of a large-scale field with small-scale fluctuations. The large-scale field can be generated by the α^2 effect, related to the fluid's kinetic helicity. In the dynamo model, the α^2 effect is responsible for the regeneration of both the poloidal and toroidal components of the field. In this work, we investigate the role of kinetic helicity in α^2 dynamo through three-dimensional simulations of magnetohydrodynamic equations. This is done by varying the parameter that controls the injection of kinetic helicity into the domain and comparing the time series of magnetic energy and entropy, as well as the energy spectra. It is observed that kinetic helicity influences the organization of field lines and the establishment of dynamo action through a sudden transition preceded by long chaotic transients.

Particle-in-cell numerical simulations of a Pulsed Plasma Thruster (PPT)

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ABSTRACT

We present results from numerical simulations of a pulsed plasma thruster (PPT). The PPT is an electric space propulsion device mainly used in the maintenance of orbit and attitude control of space vehicles. Such a device has a solid propellant known as poly-tetra fluor ethylene instead of a gas system with a low cost and simple configuration prevailing. A prototype of the PPT is being developed at the Aerospace Systems Laboratory at the University of Brasília. We use the FEMM software to obtain the magnetic field generated, and the particle-in-cell approach implemented in XOOPIC to simulate the plasma dynamics in the PPT. Both FEMM and XOOPIC are available under a free software license. Our model can be used to obtain an optimal configuration of the PPT. We also discuss strategies to enhance the efficiency of the laboratory device based on our numerical simulations.

Poster Competition - Physics and Chemistry of the Neutral Atmosphere

Análise da disponibilidade e distribuição de perfis atmosféricos de missões de rádio ocultação para a região da América do Sul

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ABSTRACT

A técnica de Rádio Ocultação (RO) foi desenvolvida e pode ser aplicada para sondagem atmosférica de planetas do sistema solar a partir da recuperação da refração sofrida pelos sinais de rádio ao atravessarem essas regiões. Essa refração gera atrasos no sinal propagado e é utilizada para obtenção de perfis de densidade de elétrons, temperatura, pressão e umidade. Com o desenvolvimento tecnológico, sistemas com satélites de média órbita foram lançados, como o GPS (Global Positioning System), além de missões espaciais com satélites de baixa órbita (LEO-Low Earth Orbit) com receptores GNSS (Global Navigation Satellite System) embarcados, a exemplo da missão COSMIC (Constellation Observing System for Meteorology, Ionosphere and Climate). Deste modo, a aplicação dos conceitos de RO para investigação da atmosfera terrestre se tornou viável a partir da utilização dos sinais GNSS. Esta técnica apresenta uniformidade na sua ocorrência espacial e temporal, sendo possível recuperar perfis em regiões inacessíveis por técnicas convencionais, como estações GNSS e meteorológicas, bem como radiossondas. Sendo assim, a RO constitui uma fonte de dados alternativa e complementar das informações atmosféricas. Neste contexto, o presente trabalho tem como objetivo, analisar a disponibilidade e distribuição de perfis atmosféricos provenientes de missões de RO para a América do Sul. Os dados de RO GNSS são registrados desde 1995 até os dias atuais, com 13.196.946 ocultações já observadas apenas para atmosfera neutra, principalmente em regiões com latitudes médias, com dados de diferentes missões espaciais. Em algumas dessas verificam-se até 3 mil ocultações diárias, como a missão COSMIC nos primeiros anos de operação. Apenas no continente sul-americano são verificadas 633.128 ocultações, sendo promissoras na obtenção de informações atmosféricas e que, atualmente, não são consideradas em todas modelagens

atmosféricas. Esses dados podem contribuir para solução de inconsistências ou falhas em regiões com defasagem de dados provenientes de técnicas convencionais, com possibilidade de melhoria no desempenho de modelos atuais, como os de Previsão Numérica do Tempo, em regiões como a da Amazônia.

Variações semi-mensais observadas no pico de concentração de meteoros

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ABSTRACT

A Atmosfera terrestre funciona como uma camada protetora e a todo momento é bombardeada por meteoróides. Quando esses meteoróides adentram a Atmosfera começam a colidir com as moléculas gasosas e passam a se desintegrar. Em meio a esse processo de colisão, os meteoroides e as moléculas encontradas em seu caminho produzem vaporização, ao qual se formam trilhas ionizadas chamadas de meteoros. Estas trilhas aquecidas ionizadas são bastantes importantes, pois tem a propriedade de refletir ondas de rádio, se tornando assim uma ferramenta fundamental nos estudos da dinâmica da atmosfera na região da Mesosfera e da baixa Termosfera. Neste trabalho, foram utilizados dados do radar meteórico SKiYMET instalado em São João do Cariri-PB (7,4°S; 36,5°O). Este sistema opera automática e ininterruptamente 24 horas por dia, coletando pulsos eletromagnéticos que são enviados para o espaço e refletidos pelas trilhas meteóricas. O presente trabalho tem o objetivo de analisar o fluxo de meteoros e seu comportamento durante os anos de 2005 e 2006. Para minimizar incertezas, considerou-se apenas ecos meteóricos sem ambiguidade e um ângulo de elevação entre 10 e 70 graus. Para determinação da altitude média da concentração de meteoros, utilizouse uma janela móvel horária com três horas de espessura. Distribui-se então a ocorrência de meteoros em relação a altitude, notando que o fluxo obedece a uma distribuição gaussiana com um pico máximo variando em torno de 90 km de altitude. Notou-se uma forte variação diária no pico de concentração dos meteoros com um máximo em torno de 96 km de altitude às 03h00min (tempo universal) e um mínimo em torno de 68 km 12 horas depois. Esses máximos e mínimos também apresentaram uma periodicidade de aproximadamente 15 dias ao longo do período observado. Essa forte variação semi-mensal pode está relacionada a maré semidiurna lunar.

Poster Competition - Space Weather and Sun-Earth Connections

Dendroclimatic Analysis for General Carneiro, Southern Brazil

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ABSTRACT

The importance of studying the climate of the past decades is due to the need to understand and estimate the environmental changes that have already occurred or will occur. There is little information from past climatic records, to make up for this lack of information, and as dendrochronological studies demonstrate high efficiency, tree growth rings are used to obtain records of environmental conditions at the time of each ring formation. Dendrochronology is divided into sub-areas, one being Dendroclimatology, in which it relates tree rings to climatic conditions, which makes it possible to reconstruct the climate of the analyzed place. The regional climate can suffer unexpected changes during the year, such as the occurrence of geophysical/climatic phenomena, which could alter the common patterns of temperature and or precipitation for a given region, creating what we know as *climatic anomalies*. The southern region of Brazil is susceptible to occurrences of El Niño and La Niña, which during their months of occurrence modify the rain patterns. From 37 samples of the species Imbuia (Ocotea Porosa Barroso), an average dendrochronological series of 565 years was obtained, representing the trees of this species in the region of General Carneiro. Climatic series (temperature and precipitation) of the region were obtained by reanalysis. Pearson's correlation and significance values were performed for these correlations between the climatic series and the average dendrochronological series; thus, results were obtained that prove that precipitation during the spring-summer seasons has great influence on development of the trees analyzed. Based on this evidence, General Carneiro's precipitation patterns were reconstructed using the average dendrochronological series and the measured precipitation series, resulting in a 565-year precipitation series where it is possible to evaluate periods of higher and lower precipitation values, where they may possibly be related to the El Niño and La Niña events.

Multi-step-ahead Prediction of regional vertical total electron content using dynamic recurrent neural network

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ABSTRACT

This work presents the description and subsequent application of a multi-step-ahead (MS) forecasting network. The predicted vTEC value is based on a continuous learning process, allowing to have a predicted value every 1 hour, one-day-ahead. The MS forecasting network is applied for the prediction of vTEC maps over two different years, low and high solar activity, and also differencing the four seasons of the year, taking into account different geomagnetic scenarios. The final vTEC maps produced by Center for Orbit Determination in Europe (CODE), were used as input data to investigate the performance of the forecasting vTEC maps. Then, a comparison is performed between MS vTEC maps proposed in this work and the one day ahead forecast produced by CODE, i. e. C1PG product which is based on the extrapolation of Spherical Harmonic coefficient using Least-squares collocation. C1PG maps were implemented since 2009 and are free available. Finally, the comparison between both kinds of vTEC maps- one obtained from neuronal network and the other from stochastic model- is analyzed using three statistical indices: mean forecast error (MFE), mean squared error(MSE), or its variant such as root mean squared error(RMSE), and mean absolute percentage error (MAPE).

Details on a New TEC-based Index for Monitoring Ionospheric Effects of Geomagnetic Storms

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ABSTRACT

The Disturbance Ionosphere Index (DIX) is an index originally designed to express the response of the ionosphere to magnetic disturbances. The DIX values are calculated from the deviation of TEC data from a non-perturbed reference baseline, such as a monthly average of TEC values. In this work we present some details on the development of a new index, named DIXSA (Disturbance Ionosphere Index for South America). In order to make a more dynamic and sensitive index, the DIXSA was developed by applying different methods to represent the non-perturbed ionosphere reference, and including new mathematical terms into the original DIX equation. Consequently, different approaches to estimate the ionospheric state can emphasize certain physical phenomena mainly observed during day or nighttime. In this way, additional terms were included to level the contribution of different sources of ionospheric disturbances. Therefore, we calculated the DIXSA for some selected magnetic storm periods. The results are presented and discussed in terms of a performance comparison between DIXSA and DIX during magnetically disturbed periods, selected based on the Dst index.

Quiet daily variation model of the geomagnetic field over Cachoeira Paulista

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ABSTRACT

In the present work, we perform an empirical model of the geomagnetic field quiet daily variation from the years 2010 to 2019 in Cachoeira Paulista (22.7ºS, 45.0ºW). We obtained the magnetic field data from the Brazilian Space Weather Program, called Embrace MagNet. Thus, we constructed a model to calculate the quiet daily variations of the geomagnetic field for each month in terms of the solar cycle, day of the year, and local time. The simulations have been compared with the observational data to validate this model in a low latitude station. The results show some discrepancies in some hours, but in most hours, we have a good agreement with the simulations and observational data. The model represents a high accuracy of the daily variation of the geomagnetic field, in which the correlation was 0.96. Thus, this model could be a potential tool for monitoring the geomagnetic field for space weather predictions.

A statistical study of the influence of Corotating Interaction Region-High Speed Streams-driven geomagnetic storms on the low latitude ionosphere

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ABSTRACT

In this work we present a statistical study of the GNSS-TEC variations in the Brazilian low latitudes under the influence of the High-speed solar wind streams during the descending phase of the solar cycle 24. The CIR/HSSs-driven geomagnetic storms are weak to moderate, have no sudden commencement and present an extended recovery phase for several days. The continuous negative (southward) Bz excursions and the auroral activity during the storms can provide the necessary conditions to the increasing of the ionization and the development of plasma irregularities in unusual periods. The statistical study can be useful for Space Weather programs and ionospheric forecasting.

Mid-latitude ionospheric trough using Global Maps IGS vTEC during Solar Cycle 24

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ABSTRACT

In this work, the Global Ionospheric Maps (GIM) were used to analyze the behavior of the mid-latitude ionospheric trough (MIT) during the solar cycle 24. This analysis was performed for the Northern and Southern Hemispheres at different local times: 00, 02 and 04 LT. The position of the MIT shows very different behaviors between both Hemispheres. The northern MIT has strong annual variations during low solar activity and a combination of annual and semi-annual variation during high solar activity. The variations of the southern MIT are more complex and would be linked to its interaction with two ionospheric anomalies: the Weddell Sea Anomaly (WSA) and the South Atlantic Magnetic Anomaly (SAMA). In addition, the periodicity of the variability of the MIT position for both hemispheres and the solar wind speed were analyzed using the wavelet transform. Based on power spectrum analysis of both parameters, it may be concluded that they have a good agreement during the descending and minimum phase for both troughs.

Estudos a respeito de variações da região E associadas a fenômenos de origem atmosférica

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ABSTRACT

Neste trabalho, mostramos alguns resultados obtidos a partir de dados coletados durante a Campanha "Conjugate Point Equatorial Experiment" (COPEX), a qual foi conduzida nos meses de outubro a dezembro de 2002 e liderada por pesquisadores do Instituto Nacional de Pesquisas Espaciais (INPE). Nessa Campanha, diversos equipamentos baseados em diferentes princípios de funcionamento foram colocados em três localidades brasileiras distintas, alinhadas aproximadamente a um mesmo meridiano geomagnético. Utilizando-se ionogramas registrados por ionossondas digitais, modelo Digissonda DPS-4, estudamos variações de parâmetros ionosféricos referentes à região E. Procuramos por variações que estivessem possivelmente associadas a modulações causadas por fenômenos de origem atmosférica. Na ocasião do evento, apresentar-se-ão os resultados e discussões derivados desses estudos com dados obtidos na base de cooperação científica, visando trazer avanços no conhecimento do comportamento e das respostas do sistema ionosfera-mesosfera para a área de clima espacial.

Poster Competition - Solar Physics, Interplanetary Medium and Planetary Magnetospheres

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Multi- Wavelength Analysis of an X2.1 Solar Flare

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ABSTRACT

A solar flare happens when the magnetic energy accumulated in the solar atmosphere is suddenly released by magnetic reconnection, accelerating charged particles (mainly electrons), that interact with the plasma emitting radiation along the entire electromagnetic spectrum, from radio waves to gamma-rays. However, there still have not been many studies combining data of flares on both the nanometric (EUV) and decimetric (UHF) wavelengths. The literature describes several methods and applications for analyzing EUV emissions from the Sun, captured by different instruments, but there's a lack of tools for analyzing data from solar radio spectrometers. To be able to compare data of the two different wavelengths, we developed computational tools in Python, namely PyCallisto, which allows for easy visualization and analysis of radio emissions acquired by the e-Callisto international network of solar radio spectrometers. We have aggregated observations made by the EUV Imaging Spectrometer (EIS) aboard the Hinode spacecraft with UHF radio data from a Phoenix 4 ground-based spectrograph of the e-Callisto network, located at Bleien, Switzerland, for a solar flare class X2.1 X-ray (GOES) that occurred on October 25th, 2013. The flare started and ended at 14:51UT and 15:12UT, respectively, with a peak at 15:03UT, and it was associated with the Active Region 11882. From the EIS data, we were able to generate line profiles that illustrate the changes in energy in the active region during the flare. Furthermore, from the e- Callisto radio data, considering the expansion of a chromospheric evaporation front represented in the obtained spectra by a slow drift-rate towards lower frequencies during the flare, we extracted up-flow velocities of 139.7 km/s from the RHCP antenna (right polarized emission), and 133.2 km/s from the LHCP counterpart (left polarized emission). This multi-wavelength approach to the analysis of solar flares is helpful because, by yielding parameters from different observations, it provides a broader understanding of events selected to be studied.

Europa control of the Jovian Decametric Radio Emissions observed on the Nançay Decametric Array's data catalog

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ABSTRACT

The longest available observed data of Jupiter's magnetosphere are the non-thermal Decametric (DAM) radio emissions, first detected in 1955. It is thought that the mechanism originating those emissions is associated to the Cyclotron-maser instability (CMI) at high magnetic latitudes of Jupiter's magnetosphere. The satellite Io creates, through its volcanic activity, a plasma torus around Jupiter and, consequently, a strong electrodynamic interaction occurs between Io and Jupiter. This was inferred after the detection of the control of part of the Jovian DAM by Io, in 1964. The interaction results from the satellite acting as an obstacle to the magnetospheric plasma flow, and, therefore, it is also expected to occur between Jupiter and each one of the other Galilean satellites, but with intensity weaker than for Io.The extense digital catalog from the Nançay Decameter Array (NDA) has enabled the identification of the control of Ganymede (Ga) and possibly Europa (Eu), and also the selection and characterization of the emissions possibly induced by those satellites. Currently, the catalog assembles 29 year of daily observations of the Jovian DAM emission, from 1990 to 2018. In this work the NDA's catalog is studied in order to identify Eu-DAM emissions and their main parameters: intensity, maximum frequency and duration.

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A study on ULF waves in the magnetosheath of Venus

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ABSTRACT

The presence of ultra-low frequency waves (ULF) was first observed in Venus induced magnetosphere by the Mariner-10 spacecraft. Subsequently, ULF waves were observed in diverse regions of Venus's space environment by other space probes. It is believed that ULF waves are generated upstream of a planetary bow shock by energized ions and electrons, that are reflected on the boundary and transported to regions below the bow shock.. In the magnetosheath, ULF waves are more intense, since there are several sources that can nourish them, such as waves generated at the bow shock and local instabilities. In order to identify the main frequencies of ULF waves in the Venus's magnetosheath, the plasma boundaries of the Venusian magnetosphere were identified using plasma and magnetic field data provided by the ASPERA-4 (Analyzer of Space Plasmas and Energetic Atoms) and MAG (Magnetometer) instruments, respectively, from the Venus Express (VEX) mission. The identification was made using the CCATI software, which allows us to select the instant when VEX crosses each magnetosphere boundary. In this work we, focus on the bow shock and magnetic barrier (MB), boundaries that limit the magnetosheath. A catalog of plasma boundaries is being updated compiled for the VEX mission period. Then, with this catalog, the magnetosheath interval is selected and the Wavelet transform is applied to the electron density data (ELS/ASPERA-4) to identify the main frequencies in the ULF waves in the Venus's magnetosheath.

Interplanetary events related to change in the outer radiation belt electron flux during the Van Allen Probes mission era: A Superposed Epoch Analysis

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ABSTRACT

All the planets and spacecraft inside the heliosphere can be affected by disturbed solar wind conditions. Interplanetary Coronal Mass Ejections (ICME) and Solar wind High-Speed Streams (HSS) cause disturbances in the Earth's magnetosphere, including the Van Allen Radiation Belts. We statistically investigated how the changes on the outer radiation belt electron flux respond to perturbations related to HSS and ICME events that hit the Earth's magnetosphere. We use electron flux density measurements from Van Allen's Relativistic Electron Proton Telescope (REPT) instrument at 2.10 MeV as well as ULF waves at the frequency range of geomagnetic pulsations Pc5, together with solar wind parameters during the Van Allen Probes era, from October 2012 up to December 2017. We selected 140 HSS events and 49 ICME events, and we were able to compare 51 (36%) enhancements and 28 (20%) reduction events related to HSS with 17 (33%) enhancements, and 16 (31%) reduction events related to ICME events. The results show that ULF Pc5 waves are present in all the cases and can play a role in the diffusion of those particles. In the cases of electron enhancements, the predominant southward average of the Interplanetary Magnetic Field (IMF) at z-component, and the substorms with waves signal can help replenish the losses on the outer radiation belt.

Estudo estatístico das variações de entropia do campo magnético interplanetário no ponto de lagrange L1 nos anos de 1999 a 2001

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ABSTRACT

O presente trabalho tem como foco principal o cálculo dos valores de entropia no vento solar para melhor caracterização dos distúrbios no meio interplanetário. Tais distúrbios como: Ejeção de Massa Coronal no meio Interplanetário (ICME), Nuvens Magnéticas (MCs), Regiões de Interação Corrotante (CIR), Choques, Lâminas de corrente Heliosférica (HCs) e intervalos de alta Alvenicidade, podem na interação com a magnetosfera gerar tempestades e subtempestades geomagnéticas. Os dados do Campo Magnético Interplanetário (IMF) foram obtidos do satélite ACE situado no ponto de lagranje L1. No tratamento das componentes do IMF foram utilizados vários métodos para o cálculo da entropia de Shannon em séries temporais. Os quatro métodos de entropia utilizados neste trabalho são: Entropia Espaço-Temporal (STE); Entropia Espectral (SE); Densidade de Entropia em Período de recorrência (RPDE); Entropia de Shannon na Análise de Quantificação de Recorrência (ENT). Os resultados obtidos estão de acordo com a teoria de modo que nas MCs foram encontrados baixos valores de entropia. Por outro lado, para intervalos Alfvènicos encontramos altos valores de entropia. O método da RPDE teve uma distribuição ruim dos dados, portanto de difícil análise dos mesmos. Quanto aos outros métodos citados apresentaram boa distribuição e boa relação com as nossas hipóteses iniciais.

New Metric for Minimum Variance Analysis Validation in the Study of Interplanetary Magnetic Clouds

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ABSTRACT

Magnetic Clouds (MCs) constitute a subset of Interplanetary Coronal Mass Ejections (ICME), are observed by different satellites in the solar wind and have peculiar properties used in their identification. One approximation for the magnetic field line topology of a magnetic cloud is given by the force-free equilibrium model, characterizing the clouds as a cylindrical body. In this context, a technique commonly used to determine the direction of the cloud axis is the method of minimum variance (MVA). The MVA method is na eigenvalue problem and the reliability of the solution is linked to the separation of eigenvalues. The objective of this work is study the separation of eigenvalues in the minimum variance analysis based on solution geometry. We propose a mathematical metric to evaluate the eigenvalues separation. In the MVA method, a space of variance is obtained geometrically using an ellipsoid where the axes are equal to the square root of the eigenvalues of the covariance matrix. The metric is defined as the product between the geometric flattening of the ellipsoid with respect to the three axes. In this work, we present a statistical analysis applied to eigenvalues ratio distribution and mathematical metric focused in the study of several interplanetary coronal mass ejections with and without MCs. The experiment is carried out on ICME catalog of Richardson and Cane (2010) and MC Wind list (Lepping, Burlaga, and Jones, 1990). The results shows the non-applicability of the ratio between the intermediate and minimum eigenvalues, as well as that around 90range for the defined metric. Our metric is compared with others and showed robustness in indicating the MVA method to identify magnetic cloud axes. Therefore, it is recommended to apply the proposed metric for MVA validation in the study of magnetic clouds.

EUV emissions of a X8.2 Flare

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ABSTRACT

Solar flares are defined observationally as an increase of electromagnetic emission in different wavelengths. On September 10th 2017 an intense (X8.2 class) flare occurred at the Sun's limb, associated to active region NOAA 12673. The GOES x-ray flux sensors pointed that the peak of the flare was at 16:54 UT. In this work we used AIA measurements, on board the SDO satellite, to investigate the temporal and spatial variations of seven EUV bands (94, 131, 171, 193, 211, 304 e 335). Our research consist in using the AIA images to build temporal series of total emission and vertical profiles for a period of 6 hours around the peak of the flare, in order to understand how the energy is released and transported in the solar atmosphere. The results obtained are compared with the CSHKP standard flare model. This work will help us to understand how the energy release and the plasma heating processes affect the energy distribution in the solar atmosphere and if the processes is in accordance with the standard model.

Poster Competition - Astronomy and Astrophysics

Properties of spherical trigonometry for position Astronomy

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ABSTRACT

Position Astronomy is one of the oldest branches of Astronomy, which is fundamentally concerned with the directions in which the celestial bodies are seen, without worrying about their distances. There are records, since prehistory, of humanity's interest in the position and motion of the stars and the first studies and observations on this subject culminated in the Position Astronomy that we know today. In this branch of Astronomy, an abstract concept called celestial sphere is considered, where the observer is in the center of a sphere and the celestial bodies are positioned on the surface of this intangible sphere. As one can suppose, the study of the positioning and motion of stars in the celestial sphere requires a lot of skill in Spherical Geometry, particularly in Spherical Trigonometry. For this reason it is important to understand well this branch of Mathematics. In this context, the purpose of this work will be to demonstrate some theorems of Spherical Trigonometry for later application in Position Astronomy. We have chosen three important theorems of Spherical Trigonometry to demonstrate: The Sines Law, The Cosines Law and The Sailors Formulas. The results presented are part of the Master's dissertation in Mathematics entitled "Fundamentos de Geometria e Astronomia Esférica", which is being written by the first author of this work.

Laboratory Investigation of X-Ray Photolysis of Ethanol Ice and its Implication on Astrophysical Enviroments

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ABSTRACT

This work deals with ethanol ice and its behavior when bombarded by soft X-rays. Ethanol (CH_3CH_2OH or C_2H_6O) is a nine-atom molecule already detected in the solid phase and the gas phase in the interstellar medium. We perform your in-situ analysis using infrared (IR) spectra on laboratory simulated astrophysical ices. From the data, was carried out an experimental and theoretical investigation on the formation of the molecules of CO_2, CO, H_2O, CH_4, C_3H_6O, and $C_2H_4O_2$ during the photolysis of the material. Also, through this work, it was possible to estimate the chemical equilibrium fluency (EF). We use this fluency for comparisons of Chemical Equilibration Time with some positions in the interstellar medium and Saturn's orbit.

Gravitomagnetism: approach and applications

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ABSTRACT

The expansion of both sides of the Einstein's field equations in the weak field scheme up to the $1/c^4$ is derived and we named this expansion as 'Extended Gravitomagentism'. The Extended Gravitomagnetism formalism is then applied to the Mercury's perihelion advance orbit and for deflection of light. This formalism can provide the correct value for both problems, i.e., 43 arcsec/cy for Mercury perihelion advance and 1.75 secarc for the deflection of light, showing the feasibility of this approach.

TESS lightcurves as a new chronometer through solar twins

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ABSTRACT

We investigate the impact of the chromospheric activity on precise 2 minutes-cadence NASA/TESS lightcurves of a selected sample of young solar twins. These stars were also monitored by benchmark planet hunter ESO/HARPS spectrograph over the course of, at least, one rotation period. We estimate photometric variability of lightcurves due to rotational modulations and explore its correlations with classical spectroscopic indicators of chromospheric activity (such as Ca II lines), ages, and rotational periods. This valuable dataset will help us to understand the implications of magnetic activity variability in exoplanetary searches and the concept of habitability. This work is a part of a larger effort aimed at characterizing comprehensively (photometrically and spectroscopically) magnetic fields in young suns.

Chemical abundance of AGNs based on infrared emission lines

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ABSTRACT

The most reliable method to determine the chemical abundances in gaseous nebulae is the Te-method which is based on the measurements of auroral emission lines (e.g. [O III]4363). However, this method yields unreal subsolar abundances for AGNs. This problem is called temperature-problem and its origin is an open problem in nebular astrophysics. Comparison between optical and infrared abundances can be used to obtain the level of electron temperature fluctuations in AGNs, generally attributed to the origin of the temperature problem. In this work, optical and infrared emission-line intensities of neon were compiled from the literature and used to calculate the ionic abundance of this element twice ionized (Ne++). This methodology makes it possible to obtain the level of electron temperature fluctuation necessary to conciliate the optical and infrared abundance values. It was possible to apply this procedure to 7 AGNs and the preliminary results show optical and infrared discrepancies in order of 0.2 to 1.8 dex, a factor of 9 higher (i.e., 2 times higher) than the one derived in H II region studies. We conclude that, if electron temperature fluctuations are present in AGNs, it is more predominant than in H II regions.

Poster Competition - INCT GNSS NavAer: INTEGRATING SPACE WEATHER, GEODESY AND AIR NAVIGATION

Geração e análise de mapas regionais ionosféricos empregando o software científico Bernese 5.2

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ABSTRACT

Uma das principais fontes de erro sistemático no posicionamento pelo GNSS (Global Navigation Satellite System) é a ionosfera, a qual está relacionada ao conteúdo total de elétrons (TEC - Total Electron Content). O TEC por sua vez é influenciado por diversas variáveis, entre estas os ciclos solares, época do ano, hora local, localização geográfica, atividade geomagnética, além de irregularidades. Com o intuito de minimizar os efeitos causados pela ionosfera vários modelos têm sido desenvolvidos. Os GIMs (Global Ionospheric Maps) são um exemplo, disponibilizados por diversos centros, como por exemplo o CODE (Center for Orbit Determination in Europe), sendo que sua precisão varia de acordo com o número de estações, a região do globo, o período dos dados, entre outros fatores. Em regiões onde a atividade ionosférica é intensa pode haver deficiência no uso de mapas globais, já que os mesmos não levam em consideração os aspectos particulares de cada região. Uma solução para esse problema é a geração de mapas regionais da ionosfera. Nesse trabalho, foram utilizados dados GNSS da RBMC (Rede Brasileira de Monitoramento Contínuo dos Sistemas GNSS), do IGS e da RAMSAC (Rede Argentina de Monitoramento Contínuo por Satélite) durante o período de baixa e de alta densidade de elétrons, no ciclo solar 24, para gerar mapas ionosféricos por meio do software científico Bernese 5.2, o qual é um software de alta performance utilizado mundialmente por diversos centros. A fim de analisar os mapas regionais gerados, calculou-se a diferença entre os mesmos e os disponibilizados pelo CODE pelo fato de que, esse centro também utiliza o Bernese para obter os valores de VTEC. A diferença média encontrada entre os mapas foi de aproximadamente 32 TECU e de 72 TECU, no período de baixa e alta atividade ionosférica, respectivamente.

List of Presenting Authors

Invited Speakers - Women in Geosciences and Astronomy

1. Adriana Benetti Marques Valio, adrivalio@gmail.com, Mackenzie.
2. Alicia Luisa Clúa de Gonzalez Alarcon, alicia.gonzalez@inpe.br, INPE.
3. Ana Roberta da Silva Paulino, arspaulino@gmail.com, UEPB.
4. Inez Staciarini Batista, inez.batista@inpe.br, INPE.
5. Maria Virginia Alves, mvirginia.alves@inpe.br, INPE.

Invited Speakers - Ionosphere: Earth and Other Planets

1. Christina Arras, arras@gfz-potsdam.de, Helmholtz Postdam German Research Centre for Geosciences-GFZ, Germany.
2. Lucilla Alfonsi, lucilla.alfonsi@ingv.it, Istituto Nazionale di Geofisica e Vulcanologia-INGV, Italy.
3. Mangalathayil Ali Abdu, abdu.manga@gmail.com, Instituto Tecnológico de Aeronáutica.

Invited Speakers - Physics and Chemistry of the Neutral Atmosphere

1. Paulo Prado Batista, paulo.batista@inpe.br, Instituto Nacional de Pesquisas Espaciais.
2. Yang Guotao, gtyang@swl.ac.cn, State Key Lab. of Space Weather, NSSC, China; China-Brazil Joint Laboratory for Space Weather.

Invited Speakers - Space Weather and Sun-Earth Connections

1. Norbert Jakowski, norbert.jakowski@dlr.de, Institute for Solar-Terrestrial Physics, German Aerospace Center, Neustrelitz, Germany.

2. Sergio Dasso, sergio.dasso@gmail.com, FCEN/UBA-CONICET, Argentina.

3. Walter Demetrio Gonzalez Alarcon, walter.gonzalez@inpe.br, Instituto Nacional de Pesquisas Espaciais, Brasil.

Invited Speakers - Physics of Plasmas

1. Vladimir Jesus Trava-Airoldi, vladimir.airoldi@inpe.br, Instituto Nacional de Pesquisas Espaciais.

2. Evaldo Jose Corat, Instituto Nacional de Pesquisas Espaciais.

Invited Speakers - Solar Physics, Interplanetary Medium and Planetary Magnetospheres

1. Maria Hebe Cremades, hebe.cremades@gmail.com, CONICET/Universidad Tecnológica Nacional, Argentina.

Invited Speakers - Astronomy and Astrophysics

1. Raimundo Lopes de Oliveira Filho, rlopes@ufs.br, Universidade Federal de Sergipe.

Invited Speakers - INCT GNSS NavAer: Integrating Space Weather, Geodesy and Air Navigation

1. Samuel Phillip Pullen, spullen@stanford.edu, GNSS Laboratory at Stanford University, EUA.

2. Natali Caccioppoli, Eucocontrol

Oral Presentations - Ionosphere: Earth and Other Planets

1. Donghe Zhang, zhangdh@pku.edu.cn, Peking University.
2. Fabio Vargas, fvargas@illinois.edu, University of Illinois at Urbana-Champaign, USA.
3. Fedor Vybornov, vybornov@nirfi.unn.ru, Radiophysical Research Institute Nizhny Novgorod State University, Russia.
4. Rafael A. M. Lopes, antreich@ieee.org, Instituto Tecnológico de Aeronáutica.
5. Cosme A. O. B. Figueiredo, anagetinga@gmail.com, Instituto Nacional de Pesquisas Espaciais.
6. Hisao Takahashi, hisao.takahashi@inpe.br, Instituto Nacional de Pesquisas Espaciais, INPE, Brazil.
7. Keli Tauana Prass Ruppenthal, kelitauana@gmail.com, National Institute for Space Research (INPE), Federal University of Santa Maria (UFSM).
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Poster Competition - Physics and Chemistry of the Neutral Atmosphere

1. Victor Vinicius Silva de Moraes, victor.v.moraes@unesp.br, Programa de Pós Graduação em Ciências Cartográficas - FCT UNESP, Brasil
2. Wellington Benevenuto de Lima, wellingtonbenevenuto@gmail.com, Universidade federal de Campina Grande

Poster Competition - Space Weather and Sun-Earth Connections

1. Daniela Oliveira da Silva, fys.dani@gmail.com, Universidade do Vale do Paraíba, Brasil
2. Dinibel Pérez Bello, dinibel@gmail.com, National Council of Scientific and Technological Research (CONICET), Argentina; Laboratory of Space Meteorology, Earth Atmosphere, Geodesy, Geodynamics, Instrumental Design and Astrometry (MAGGIA), National University of La Plata, Argentina.
3. Giorgio Arlan da Silva Picanço, giorgio.picanco@inpe.br, National Institute for Space Research, INPE, Brazil
4. Sony Su Chen, sonysuchen@gmail.com, National Institute for Space Research (INPE), São José dos Campos-SP, Brazil

5. Stella Pires Moraes dos Santos, stella.santos@inpe.br, National Institute for Space Research

6. Juan Manuel Castaño, jmcastano88@gmail.com, National University of La Plata, CONICET

7. Wedson Philippe V. de Brito, wedsonphilippe@gmail.com, Universidade Estadual da Paraíba

Poster Competition - Solar Physics, Interplanetary Medium and Planetary Magnetospheres

1. Andre Rossi Korol, anrobits@yahoo.com.br, Universidade do Vale do Paraiba.

2. Hadassa Raquel Peixoto Jácome, hadassajacome@gmail.com, National Institute for Space Research, Brazil.

3. João Carlos de Moura Castro Neto, jc.neto963@gmail.com, Federal University of Goias, Jatai, Brazil.

4. Jose Paulo Marchezi, jpmarchezi@gmail.com, National Institute for Space Research.

5. Marcus Vinicius Chemello Cardoso, vina_fei@yahoo.com.br, Universidade do Vale do Paraiba.

6. Rosemeire Aparecida Rosa Oliveira, meirematematica@gmail.com, University of Vale do Paraíba, Brazil.

7. Tallyta Layanne de Almeida Santos, tallyta.asantos@outlook.com, Universidade Tecnológica Federal do Paraná UTFPR.

Poster Competition - Astronomy and Astrophysics

1. Carla Patrícia Ferreira dos Santos, carlapatriciafs@hotmail.com, Universidade Estadual Paulista "Júlio de Mesquita Filho", Brazil

2. Fabricio Moreira Freitas, fmfreitas@gmail.com, Universidade do Vale do Paraíba, Brasil

3. Flavia Pereira da Rocha, rocha.pereira.flavia@gmail.com, Instituto Tecnológico de Aeronáutica

4. Geisa Ponte, geisaponte.astro@gmail.com, Centro de Radioastronomia e Astrofísica Mackenzie, Universidade Presbiteriana Mackenzie

5. Mark Armah, karmah89@rocketmail.com, Universidade do Vale do Paraíba

Poster Competition - INCT GNSS NavAer: Integrating Space Weather, Geodesy and Air Navigation

1. Viviane Aparecida dos Santos, vivian_edos_santos@hotmail.com, São Paulo State University

VIII SBGEA & VIII SIMFAST

Simpósio Brasileiro de Geofísica Espacial e Aeronomia

Simpósio de Física e Astronomia do Vale do Paraíba

O Simpósio Brasileiro de Geofísica Espacial e Aeronomia (SBGEA) é um evento científico promovido pela Associação Brasileira de Geofísica Espacial e Aeronomia, e que acontece desde 2006. A oitava edição (VIII SBGEA) do simpósio será realizada em conjunto com a oitava edição do Simpósio de Física e Astronomia do Vale Paraíba (VIII SimFAST), um evento organizado anualmente pelos discentes do Programa de Pós-Graduação em Física e Astronomia da Universidade do Vale do Paraíba (UNIVAP).

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