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Themens, D. R., P. T. Jayachandran, and R. B. Langley (2015), The nature of GPS differential receiver bias variability: An examination in the polar cap region, *J. Geophys. Res. Space Physics*, 120, 8155–8175, doi:10.1002/2015JA021639

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Correia, E., L. Spogli, L. Alfonsi, C. Cesaroni, A. Gulisano, E. Thomas, R. Ramirez, and Alexandre Rodel. Ionospheric Response to the 26 September 2011 Geomagnetic Storm in Antarctica. *Annales Geophysicae*. 2017 Submitted

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Selected GRAPE papers:

2018

Three most notable papers

1. Alfonsi, L., Cilliers, P. J., Romano, V., Hunstad, I., Correia, E., Linty, N., ... & Riley, P. (2016). First observations of GNSS ionospheric scintillations from DemoGRAPE project. *Space Weather*, *14*(10), 704-709, doi:10.1002/2016SW001488

   This work provides the outcomes of the DemoGRAPE project concerning new solutions on Software-Hardware infrastructures tested in different Antarctic Stations in the frame of GRAPE.

2. M. Negusini, B. H. Petkov, P. Sarti and C. Tomasi, (May 2016) "Ground-Based Water Vapor Retrieval in Antarctica: An Assessment," in *IEEE Transactions on Geoscience and Remote Sensing*, vol. 54, no. 5, pp. 2935-2948. doi: 10.1109/TGRS.2015.2509059.

   This work provides a contribution to GRAPE neutral atmosphere topic and the advancement on the capability to retrieve Water Vapor.

3. Correia, E., Spogli, L., Alfonsi, L., Cesaroni, C., Gulisano, A. M., Thomas, E. G., ... & Rodel, A. A. (2017, October). Ionospheric F-region response to the 26 September 2011 geomagnetic storm in the Antarctica American and Australian sectors. In *Annales Geophysicae* (Vol. 35, pp. 1113-1129), doi: 10.5194/angeo- 35-1113-2017

   This work provides a detailed investigation on the ionized atmosphere reaction to a geomagnetic storm in different longitudinal sectors over Antarctica and comes from a strong collaboration among scientists of different Countries supporting GRAPE.

2020

Five most notable papers

1. Correia, E., Raunheitte, L. T. M., Bageston, J. V., & D'Amico, D. E. (2020, March). Characterization of gravity waves in the lower ionosphere using very low frequency observations at Comandante Ferraz Brazilian Antarctic Station. In *Annales Geophysicae* (Vol. 38, No. 2, pp. 385-394).

   They investigated the gravity wave (GW) characteristics in the lower ionosphere using very low frequency (VLF) radio signals. The analysis considered the VLF signal transmitted from the US Cutler, Maine (NAA) station that was received at Comandante Ferraz Brazilian Antarctic Station (EACF), with its great circle path crossing the Drake Passage longitudinally. The wave periods of the GWs detected in the low ionosphere are obtained using the wavelet analysis applied to the VLF amplitude. These results show that VLF technique is a powerful tool to obtain the wave period and duration of GW events in the lower ionosphere, with the advantage of being independent of sky conditions, and it can be used during the whole day and year-round.

2. Themens, D. R., Jayachandran, P. T., Reid, B., & McCaffrey, A. M. (2020). The limits of empirical electron density modeling: Examining the capacity of E-CHAIM and the IRI for modeling intermediate (1- to 30-day) timescales at high latitudes. *Radio Science*, 54. https://doi.org/10.1029/2018RS006763.

   E-CHAIM (Empirical Canadian High Arctic Ionospheric Model model outperforms the IRI (International Reference Ionosphere) at 1- to 30-day timescales within the polar cap. E-CHAIM is capable of explaining 4–25% of the foF2 (the frequency of the F2 ionospheric layer) variance at storm timescales at high latitudes. Storm models are capable of improving overall model performance beyond the best monthly median representation.

Selected GRAPE papers:

3. Wang, Y., Zhang, Q.-H., Ma, Y.-Z., Jayachandran, P. T., Xing, Z.-Y., Balan, N., & Zhang, S.-R. (2020). Polar ionospheric large-scale structures and dynamics revealed by TEC keogram extracted from TEC maps. *Journal of Geophysical Research: Space Physics*, 125, e2019JA027020. https://doi.org/ 10.1029/2019JA027020

   A tool named TEC (Total Electron Content) keogram is introduced for continuously monitoring the dynamics of large-scale structures in the polar region. Inspired by auroral keogram, the TEC keogram is developed from a time series of TEC lines obtained from long-term TEC maps. With this tool, case and statistical studies are carried out to infer the average moving speed and formation mechanism of polar patches.

4. De Franceschi, G., Spogli, L., Alfonsi, L., Romano, V., Cesaroni, C. Hunstad, I. (2019). The ionospheric irregularities climatology over Svalbard from solar cycle 23. *Scientific Reports, Nature Publishing Group*, https://doi.org/10.1038/s41598-019-44829-5

   This work provides an unprecedented description of the climatology of ionospheric irregularities over the Arctic derived from the longest GNSS data series ever collected for this specific aim. The results offer realistic features of the high latitude ionosphere that can substantially contribute to the necessary improvements of forecasting models, providing a broad spectrum of ionospheric reactions to different space weather conditions.

5. Prikryl, P., Nikitina, L., and Rusin, V. (2019), Rapid intensification of tropical cyclones in the context of the solar wind-magnetosphere-ionosphere-atmosphere coupling, *Journal of Atmospheric and Solar-Terrestrial Physics*, 183, 36-60. https://doi.org/10.1016/j.jastp.2018.12.009

   This work highlights the interaction between lower and upper atmosphere and the influence of the polar/high latitude on the tropical cyclones. Rapid intensification of tropical storms tends to follow arrivals of high-speed solar wind. Atmospheric gravity waves launched from high latitudes can reach tropical cyclones, can trigger moist instabilities leading to convective bursts, linked to rapid intensification of tropical cyclones.

2022

Notable paper

Alfonsi, Lucilla et al., Review of environmental monitoring by means of radio waves in the (Ant)Arctic: from atmosphere to geospace, submitted to Surveys in Geophysics March 2022, accepted for publication with minor revisions June 2022.

This review paper focuses on the observing capabilities and scientific knowledge gained in the last two decades by the international community that studies the atmosphere and the geospace using observations acquired at and over the polar regions by means of radio probing supported by auxiliary methods. The review on ionospheric weather describes some examples of what we learnt and suggests what we do not know yet. Moreover, the overview of long-term investigations and space weather events testifies how, despite the remoteness and harsh conditions of the polar environment, the scientific community is improving significantly its capacity to monitor the atmosphere at high latitudes. A lot more should be done and specific actions are proposed. Finally, the survey points out the urgent need to reinforce the existing international coordination to overcome the current gaps in the observing systems, from ground-based and satellite equipment, and to stimulate and facilitate the adoption of a multidisciplinary approach as the preferred method to significantly advance the state of the art in the knowledge of global change and the geospace environment.