

## Seismic ionospheric disturbances in Papua – New Guinea region observed by Swarm satellites during two tsunamis in December of 2016.

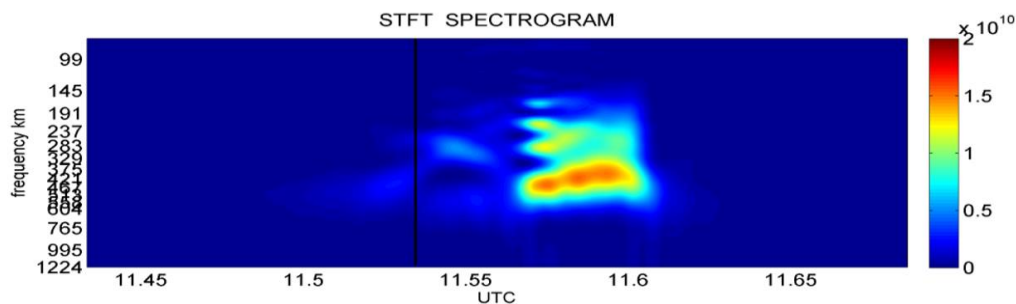
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Dense networks of ground GNSS stations have heterogeneous distribution worldwide, and only a few seismically active places are rich in dense ground GNSS networks. A very interesting seismically active region investigated in this study does not belong to these “privileged” locations. The region of Papua New-Guinea (PNG) is located at the connection of four main tectonic plates: Australian, Pacific, Eurasian and Philippines. There are also a number of smaller plates, which makes this region particularly seismically active. The time period selected for the analysis covers November and December of 2016. November is relatively seismologically quiet, whereas December 2016 is very active seismologically with two EQ having magnitudes 7.8 and 7.9, both triggering tsunamis. Deficiency of dense ground GNSS stations in PNG significantly impedes the identification of SIDs, and limits studies on their correlation in a wider range. Low-Earth orbit (LEO) satellite data like Swarm, in turn, are globally distributed, which can provide interesting along-track observations of large number of seismic events occurring often on the Earth [1]. The orbits of Swarm satellites, which have the inclination around 87°, pass the edge of two subducting tectonic plates (Australian and Pacific) at a quite large angle, which is an observational advantage. The short-time Fourier transform (STFT) has been applied for the first time to Swarm in-situ electron density (ED) data from Langmuir Probes (LP) (Fig. 1).



**Figure 1.** Spectrogram of residual ED from Swarm A LP. PNG region on 17.12.2016, 40 min. after PNG EQ=7.9. The perturbation occupies various frequencies, but the predominant signal can be found around 400 km.

The analysis of ED and TEC signals onboard Swarm satellites detects many ED disturbances, which are significantly correlated with persisting seismic activity in December 2016 in PNG and Solomon Islands regions. The power spectrum of signal samples at selected frequencies shows the coincidence of large spectral peaks with critical seismic activity, and low spectral responses with the relaxation time, respectively. The analyses of Swarm data provide interesting observations of SIDs not only directly related with the largest EQs and tsunamis, but also occurring during entire periods of enhanced seismic activity. The results of this research are promising for the future spectral recognition of different disturbing ionospheric signals in along-track LEO data.

## References

- [1] A. De Santis, D. Marchetti, L. Spogli, et al. , “Magnetic Field and Electron Density Data Analysis from Swarm Satellites Searching for Ionospheric Effects by Great Earthquakes: 12 Case Studies from 2014 to 2016”. *Atmosphere* **10**, 371, 2019, doi.org/10.3390/atmos10070371.