Geophysical Research Abstracts
Vol. 20, EGU2018-7023, 2018
EGU General Assembly 2018

Imaging the topside ionosphere and the plasmasphere using Swarm GPS observations

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ESA‘s Satellite Mission Swarm provides GPS data from near polar orbits at initial altitudes of about 460km (Swarm A/C) and 530km (Swarm B). In addition, since 15 July 2014, it provides GPS data with a 1Hz sampling, which leads to a very good spatial sampling. This makes Swarm a good candidate to attempt an in situ reconstruction of the topside ionosphere using single LEO satellites.

We are using a simple and straightforward method to reconstruct the topside ionosphere based on GPS data from the Swarm POD antennas. The reconstruction maps the estimated electron density onto a 2D grid defined by the along track direction and the altitude and has the potential to provide snapshots of the low and mid latitude ionosphere based on only 20 minutes of data. In contrast, most of the currently realized ionospheric reconstruction algorithms rely on large arrays of ground based GPS receivers, a priori models for the altitude profile, and long, averaging observation time spans of more than 1 hour. Our approach will be completely independent of any a priori models and could therefore offer new opportunities.

It has been shown by several authors that the quality of the Swarm GPS data is degraded in regions with a high ionospheric activity. This is mainly visible in GPS-derived products such as Swarm precise orbit solutions and thereof derived gravity fields. To improve the quality of the derived products, screening and weighting strategies have been developed to mitigate ionosphere artefacts to the extent possible. It has to be assumed that without dedicated mitigation strategies the quality of the derived slant-TEC will also be degraded. In this contribution we therefore assess the quality and robustness of our reconstruction approach with respect to the problematic Swarm GPS data. We will investigate which type of preprocessing and additional data screening is necessary to obtain reliable results and if the remaining data amount after screening is still dense enough for the proposed reconstruction algorithm. In addition we will test two methods to calibrate the density profile using GPS code observations or boundary conditions.