IONOSPHERIC ELECTRODYNAMICS WITH THE SWARM SATELLITE MISSION: A NEW ANALYSIS METHOD

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The European Space Agency (ESA) Swarm spacecraft mission is the first multisatellite ionospheric mission with two low-orbiting spacecraft that are flying in parallel at a distance of about 100-140 km, thus allowing derivation of spatial gradients of ionospheric parameters not only along the orbits but also in the direction perpendicular to them. A third satellite with a higher orbit regularly crosses the paths of the lower spacecraft. Using the Swarm magnetic and electric field instruments, we present a novel technique that allows derivation of two-dimensional (2D) maps of ionospheric conductances, currents, and electric field in the area between the trajectories of the two lower spacecraft, and even to some extent outside of it. This technique is based on Spherical Elementary Current Systems (SECS).

We present synthetic test cases of realistic situations, from which we calculate virtual Swarm data and show that the technique is able to reconstruct the ionospheric electric field, horizontal currents, and conductances with a very good accuracy. Larger errors arise for the reconstruction of the 2D field-aligned currents (FAC), especially in the area outside of the spacecraft orbits. However, even in this case the general pattern of FAC is recovered, and the magnitudes are valid in an integrated sense.

We also present some initial results obtained from Swarm measurements during 2014-2015, including comparisons with simultaneous ground based measurements done by the MIRACLE array of magnetometers and all-sky cameras in Finland and Scandinavia. These comparisons are however limited to ionospheric currents and FAC, due to limited availability of Swarm electric field measurements.

[1] Amm O., H. Vanhamäki, K. Kauristie, C. Stolle, F. Christiansen, R. Haagmans, A. Masson, M. G. G. T. Taylor, R. Floberghagen, and C. P. Escoubet (2015), A method to derive maps of ionospheric conductances, currents, and convection from the Swarm multisatellite mission, *J. Geophys. Res.*, **120**, doi:10.1002/2014JA020154.