Geophysical Research Abstracts
Vol. 20, EGU2018-8401, 2018
EGU General Assembly 2018

Increasing the contribution of satellite gravity field missions to the investigation of the thermosphere-ionosphere

Eelco Doornbos (1), Claudia Stolle (2), Martin Rother (2), Gang Lu (3), Brian Anderson (4), Tim Visser (1), Jose van den IJssel (1), Pieter Visser (1), Bjorn Frommknecht (5), and Fabrice Cipriani (6)

(1) Delft University of Technology, Faculty of Aerospace Engineering, Space Engineering, Delft, Netherlands (e.n.doornbos@tudelft.nl), (2) Faculty of Aerospace Engineering, TU Delft, Delft, The Netherlands (e.n.doornbos@tudelft.nl), (3) High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado, USA, (4) The Johns Hopkins University Applied Physics Laboratory, Laurel, Maryland, USA, (5) ESA/ESRIN, Frascati, Italy, (6) ESA/ESTEC Noordwijk, The Netherlands

Satellite gravity field missions, such as CHAMP, GRACE, GOCE and GRACE-FO, are designed to make extremely accurate measurements in low Earth orbit of the (relative) motion of satellites, and proof masses inside these satellites, in order to infer information on the Earth's gravity field. There are several mechanisms through which the thermosphere and ionosphere influence the way in which this motion is measured. The accelerometers, drag-free control system, dual-frequency radio-tracking systems, star cameras and magnetometers that are part of the payloads and platforms of the satellites, are to some extent also devices for active space weather monitoring. The space weather observations, which are considered an error source to be mitigated for the primary goal of gravity field determination, are a valuable source of information for studies of the thermosphere-ionosphere.

For nearly two decades now, data from the accelerometers on board these gravity field missions have had a very large impact on studies of the thermosphere density and horizontal neutral wind. Accurate information on ionospheric electron content has been derived from dual-frequency satellite-to-satellite tracking systems as well. More recent developments are the derivation of vertical neutral wind from GOCE acceleration data and the calibration of platform magnetometer data, converted into ionospheric field-aligned current densities. Using these processing techniques, GOCE, GRACE and GRACE-FO can be turned into sources of valuable thermosphere-ionosphere data, that supplement dedicated missions such as Swarm, in terms of temporal and spatial coverage.

To demonstrate the value of this data in the space weather and space physics domains, we provide comparisons of these data with other data sources, such as AMPERE, as well as with output of a global thermosphere-ionosphere general circulation model. It is noteworthy that satellite mission concepts for investigations of thermosphere-ionosphere coupling, that are currently under study, would carry similar devices and benefit from similar satellite platform designs and orbits as the current gravity field missions. It is clear that there is a large potential to increase this synergy today, and opportunity for dual-purpose missions in the future. We therefore conclude by providing recommendations in terms of instrumentation and data handling for present and future missions.