Swarm accelerometer data processing from raw accelerations to thermospheric neutral densities - DTU Orbit (23/04/2019)

The Swarm satellites were launched on November 22, 2013, and carry accelerometers and GPS receivers as part of their scientific payload. The GPS receivers do not only provide the position and time for the magnetic field measurements, but are also used for determining non-gravitational forces like drag and radiation pressure acting on the spacecraft. The accelerometers measure these forces directly, at much finer resolution than the GPS receivers, from which thermospheric neutral densities can be derived. Unfortunately, the acceleration measurements suffer from a variety of disturbances, the most prominent being slow temperature-induced bias variations and sudden bias changes. In this paper, we describe the new, improved four-stage processing that is applied for transforming the disturbed acceleration measurements into scientifically valuable thermospheric neutral densities. In the first stage, the sudden bias changes in the acceleration measurements are manually removed using a dedicated software tool. The second stage is the calibration of the accelerometer measurements against the non-gravitational accelerations derived from the GPS receiver, which includes the correction for the slow temperature-induced bias variations. The identification of validity periods for calibration and correction parameters is part of the second stage. In the third stage, the calibrated and corrected accelerations are merged with the non-gravitational accelerations derived from the observations of the GPS receiver by a weighted average in the spectral domain, where the weights depend on the frequency. The fourth stage consists of transforming the corrected and calibrated accelerations into thermospheric neutral densities. We present the first results of the processing of Swarm C acceleration measurements from June 2014 to May 2015. We started with Swarm C because its acceleration measurements contain much less disturbances than those of Swarm A and have a higher signal-to-noise ratio than those of Swarm B. The latter is caused by the higher altitude of Swarm B as well as larger noise in the acceleration measurements of Swarm B. We show the results of each processing stage, highlight the difficulties encountered, and comment on the quality of the thermospheric neutral density data set.

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