Improvements of the Swarm Accelerometer Data Processing

The Swarm satellites were launched on 22 November 2013 and carry accelerometers and GPS receivers as part of their scientific payload. The GPS receivers are not only used for locating the position and time of the magnetic measurements, but also 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 and potentially winds 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. These disturbances have caused a significant delay of the accelerometer data release.

In this presentation, we describe the new, improved four-stage processing that is required 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 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 describe the methods used in each stage, highlight the difficulties encountered, and comment on the quality of the thermospheric neutral density data set.