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THERMOSPHERIC DENSITIES FROM SWARM MISSION OBSERVATIONS AND THE NRLMSISE-00 MODEL

Abstract

The technique for deriving thermospheric density from accelerometers were established many decades ago by Marcos et al. (1977) and Marcos and Forbes (1985). The initial algorithms have now been significantly enhanced and accurate accelerometers are on board satellites missions such the CHAllenging Minisatellite Payload (CHAMP), Gravity Recovery And Climate Experiment (GRACE) and more recently the Earth's Magnetic Field and Environment Explorers (more commonly known as the Swarm satellites). Previous studies confirmed that the Swarm accelerometers have a resolution comparable to the CHAMP accelerometer of better than 3 nm/s2and a noise level below 10 nm/s2. In this study we investigate the density variations using measurements from the accelerometer on-board the Swarm satellites. Temporal variations include diurnal variation, multi-day variation, solar-rotational variation, annual/semi-annual variation, solar-cycle variation, and long-term trends with a time scale of decades and spatial variations include latitudinal and longitudinal variations, as well as variation with altitude. The result shows density is varying due to multi-day recurrent geomagnetic force, presence and absence of solar irradiance during day and night, appearance and disappearance of sun's active region, sun-earth distance, large scale circulation, thermosphere and ionosphere coupling, joule and auroral heating. Empirical models have also been used to calculate atmospheric density. The NRLMSISE-00 model is an empirical model calculating the neutral mass density in the atmosphere. In this paper, Swarm observations are compared with modelling results from NRLMSISE-00 model.