

Variations of thermospheric mass density probed from satellite orbit change

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The kinetic energy of LEO satellites is generally decreased by atmospheric drag in the thermosphere. The drag is dependent on atmospheric mass density especially near the perigee. The mass density has been investigated through the decrease of kinetic energy of LEO satellites. The mass density in the thermosphere is controlled by the temperature, and solar EUV radiation and geomagnetic activity cause large variation of the temperature. This leads to variation of satellite drag with progress of 11 year cycle of sun spots. In the last solar minimum, record-low thermospheric density was reported, which may not be simply attributed to low solar activity. Increased concentration of CO₂ in the lower thermosphere is expected to produce a cooler, more contracted thermosphere. It is, therefore, of interest how low the thermospheric density is in the current solar minimum. The Geospace Exploration Satellite Arase launched on December 20, 2016. The initial apogee and perigee are 32,000 km and 440 km, respectively. Its low perigee enables us to investigate the mass density in the thermosphere. We have so far found long-term decrease of the kinetic energy of the satellite, which can be interpreted in terms of the atmospheric drag. From the change in the satellite orbit, we will discuss how the atmospheric density of the thermosphere changes in the current solar minimum.

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