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Studies on the ionospheric-thermospheric coupling mechanisms using SLR

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Several Low Earth Orbiters (LEOs) have been used by different research groups to model the thermospheric neutral density distribution at various altitudes performing Precise Orbit Determination (POD) in combination with satellite accelerometry. This approach is, in principle, based on satellite drag analysis, driven by the fact that the drag force is one of the major perturbing forces acting on LEOs. The satellite drag itself is physically related to the thermospheric density.

The present contribution investigates the possibility to compute the thermospheric density from Satellite Laser Ranging (SLR) observations. SLR is commonly used to compute very accurate satellite orbits. As a prerequisite, a very high precise modelling of gravitational and non-gravitational accelerations is necessary. For this investigation, a sensitivity study of SLR observations to thermospheric density variations is performed using the DGFI Orbit and Geodetic parameter estimation Software (DOGS). SLR data from satellites at altitudes lower than 500 km are processed adopting different thermospheric models. The drag coefficients which describe the interaction of the satellite surfaces with the atmosphere are analytically computed in order to obtain scaling factors purely related to the thermospheric density.

The results are reported and discussed in terms of estimates of scaling coefficients of the thermospheric density. Besides, further extensions and improvements in thermospheric density modelling obtained by combining a physics-based approach with ionospheric observations are investigated. For this purpose, the coupling mechanisms between the thermosphere and ionosphere are studied.