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Investigation of temporal change of thermosphere density scale factors derived from SLR observations to LEO satellites

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Precise knowledge on the density of the neutral thermosphere and exosphere is important for precise orbit determination, especially for predicting the motion of satellites orbiting the Earth at altitudes below 1000 km. A series of empirical thermosphere models has been derived using mass spectrometer, incoherent scatter radar, orbit and accelerometer data since 1961 until now. Such space missions, as CHAMP, GRACE, GOCE and Swarm provide data that can be used for the generation of thermosphere models. Precise Satellite Laser Ranging (SLR) observations to spherical satellites at the altitude of 350 to 425 km can be used to scale the neutral thermosphere density provided by various thermosphere density models.
In this study, we use SLR observations to five low Earth orbiting (LEO) satellites, namely ANDE-RR Active and ANDE-RR Passive (2007-2008), ANDE Castor and ANDE Pollux (2009-2010) as well as Spinsat (2015-2016) to derive scale factors related to the thermosphere density provided by the following five empirical models: CIRA86, NRLMSISE00, JB2008, DTM2013 and the new CH-Therm-2017 model developed at GFZ using CHAMP data (2001-2009). We compare the scale factors derived from the analysis of observations to different satellites at different time intervals and altitude and investigate their temporal evolution.