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Optimal Solar Inputs for use in Upper Atmosphere Density Models

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The European 7th framework programme ATMOP (Advanced Thermosphere Modelling for Orbit Prediction) aims at building a new thermosphere model, including an operational version. It will enable precise air drag computation, which is mandatory for improved survey and precise tracking of space objects in Low Earth Orbit and the initiation of appropriate measures to minimise risks to satellites (track loss, collisions) and ground assets (re-entry zone).
The solar spectral irradiance in the UV/EUV range is essential to characterize the amount of solar energy the upper atmosphere receives, and this is important in particular for the determination of satellite drag through the use of thermosphere models such as DTM or MSIS. Because of the lack of long-term and continuous observations, the F10.7 proxy for solar activity is used in all upper atmosphere models. More appropriate solar inputs are crucial and the SEM and MgII indices are more representative of short-term variability in particular.
Using almost 17 years of mean densities derived from orbit perturbation analysis from the French geodetic satellite STELLA at about 820 km altitude and a selection of solar activity proxies, we provide a quantitative assessment of the performance of each proxy. We do this on different time scales as the performance of the proxies is found to be quite different for short (days) and long (months) time scales, as well as for low and high solar activity. This study shows which solar inputs are most appropriate at each time scale and provides guidance on the choice of a better set of inputs for operational density models.