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Modeling Space Weather in the thermosphere

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The accelerometers on the CHAMP and GRACE satellites have made it possible to accumulate near-continuous records of thermosphere density between about 300 and 490 km since May 2001, and September 2002, respectively. In particular, the response to virtually every significant geomagnetic storm has been observed with an in-track resolution of 80 km or better. CHAMP (decayed in September 2010) and GRACE data cover (nearly) all latitudes and sample 24 hr local time approximately every 4 and 5 months, respectively. The temporal and latitudinal responses of the thermosphere to geomagnetic disturbances, i.e. space weather, have been extensively studied over the last decade by several authors using these exceptional datasets.
Semi-empirical thermosphere density models (NRLMSISE-00, JB2008, DTM) are used in satellite orbit determination to compute the atmospheric drag force, as well as in upper atmosphere studies. They reproduce mean temperature and density as a function of altitude, latitude, local solar time, day of year, and solar and geomagnetic proxies. The climatology of the thermosphere is better represented by semi-empirical than first-principle models. However, the former models are purely statistic and cannot reproduce space weather events. First-principles models on the other hand can with some success, and in this study the CTIPE model is evaluated.
This presentation aims at giving an overview of observed (with accelerometers) and modeled (statistical and first-principle models) space weather effects.