Thermospheric space weather modeling

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Abstract: We review impacts of satellite drag and describe past, current and future capabilities designed to meet evolving operational requirements. Historically, thermospheric research has been data starved. Thus, from the early space age to the end of the 20th century little progress was made in satellite-drag modeling. This condition improved greatly with the development of empirical assimilative models and recent availability of comprehensive drag measurements. The resurgence in orbital drag analyses to specify thermospheric densities has been particularly useful for addressing input requirements of assimilation models as well as their development and validation. With the new Jacchia-Bowman 2006 model the status of empirical modeling improved significantly. It builds on the expanded satellite drag database and incorporates improved estimates of solar flux changes as well as semiannual and local time variations of the thermosphere. However, magnetic storm representations of Jacchia-Bowman 2006 are similar to those used in other current models. Satellite-borne accelerometers and optical sensors now provide complementary spatial and temporal capabilities that permit monitoring the thermosphere over a wide range of altitudes under most solar and geomagnetic conditions. Long-standing shortfalls during periods of high geomagnetic activity are now being attacked with these data and through new analyses of solar wind and IMF measurements, correlations with magnetosphere-based magnetic indices and emerging theoretical tools. These advances in understanding thermospheric coupling during magnetic storms will be incorporated into empirical model upgrades. The analyses of new data sets joined with on-going research on physical thermosphere-ionospheremagnetosphere coupling processes support the pursuit of our ultimate goal, an assimilative and predictive operational model of thermospheric neutral densities.

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