Impact of Variability on the Thermosphere Ionosphere System: from Flare to Solar Cycle Timescales

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Variability in the thermosphere-ionosphere comes from a number of sources. Unlike the lower atmosphere there appears to be little internal stochastic variability, so that for a given external forcing the equilibrium response is apparently the same. The variability in the response therefore arises from variation in solar XUV, EUV, and UV radiation, magnetospheric electrodynamic and particle sources, and the wave fields propagating from below. Their relative importance varies with solar and geomagnetic activity, and is difficult to separate purely from observations. Solar variability ranges from flare timescales, through day-to-day and solar rotation, to the larger variations over the solar cycle. Magnetospheric sources, predominantly the convection electric field and auroral precipitation at high altitudes, are just as variable and force changes on periods as short as minutes. During geomagnetic storms some of the most dramatic changes occur in the global thermosphere-ionosphere system. Tides propagating from the lower atmosphere have clear and important consequences in the region, particularly their impact on electrodynamics and plasma redistribution from the dynamo action of the neutral winds. There are apparent signatures of the day-to-day variability in tidal forcing, possibly as a consequence of planetary and gravity wave modulation. The partitioning of the mechanisms and sources of variability remain a challenge and are being address by the latest generation of physical models.