Geophysical Research Abstracts, Vol. 8, 06518, 2006
SRef-ID: 1607-7962/gra/EGU06-A-06518

Thermospheric preconditioning of the ionosphere and response to geomagnetic activity

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The thermosphere is usually seen as a passive medium within which the dynamic ionosphere responds to magnetospheric forcing. However, there would be no daily nor seasonal variation in the Earth's upper atmosphere without the thermospheric contribution. The Sun provides only a solar cycle variation, and it is the rotation, orbit and inclination of the Earth's axis that provide the rest. These latter modulate the temperature and chemical composition of the atmosphere, which then modify the effects of the influx of solar radiation and particle precipitation. In addition, thermospheric winds carry energy and particles across electromagnetic field boundaries that would otherwise trap the charged particles of the ionosphere. The thermosphere can therefore act to precondition the response of the ionosphere to magnetospheric forcing. In particular, the large-scale response of the upper atmosphere to magnetospheric forcing via ion-neutral collisions has embedded in it a history of the previous 6-12 hours of geomagnetic activity. This is due to the inertia of the thermosphere on scales of thousands of kilometres and hours. On meso-scales, (i.e., tens of kilometres and tens of minutes) the thermosphere can show a rapid localised response in winds and temperatures which affects ionospheric composition, and energy and momentum transfer, thus altering the redistribution of magnetospheric energy between Joule heating and acceleration of the neutral gas. These issues will be discussed using Coupled Thermosphere Ionosphere Plasmasphere (CTIP) model simulations and thermospheric and ionospheric measurements from co-located Fabry-Perot Interferometers and the EISCAT radars in Northern Scandinavia.