



Scale Height variations with solar cycle in the ionosphere of Mars

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The Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS) on board the Mars Express spacecraft has been probing the topside of the ionosphere of Mars since June 2005, covering currently almost one solar cycle. A good knowledge of the behaviour of the ionospheric variability for a whole solar period is essential since the ionosphere is strongly dependent on solar activity. Using part of this dataset, covering the years 2005 – 2012, differences in the shape of the topside electron density profiles have been observed. These variations seem to be linked to changes in the ionospheric temperature due to the solar cycle variation. In particular, Mars' ionospheric response to the extreme solar minimum between end-2007 and end-2009 followed a similar pattern to the response observed in the Earth's ionosphere, despite the large differences related to internal origin of the magnetic field between both planets.

Plasma parameters such as the scale height as a function of altitude, the main peak characteristics (altitude, density), the total electron content (TEC), the temperatures, and the ionospheric thermal pressures show variations related to the solar cycle. The main changes in the topside ionosphere are detected during the period of very low solar minimum, when ionospheric cooling occurs. The effect on the scale height is analysed in detail. In contrast, a clear increase of the scale height is observed during the high solar activity period due to enhanced ionospheric heating.

The scale height variation during the solar cycle has been empirically modelled. The results have been compared with other datasets such as radio-occultation and retarding potential analyser data from old missions, especially in low solar activity periods (e.g. Mariner 4, Viking 1 and 2 landers), as well as with numerical modelling.