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Response of Saturn's thermosphere and ionosphere to forcing from the magnetosphere

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Saturn - like all other gas giants in our solar system - is known to have an upper neutral atmosphere (thermosphere/exosphere) far hotter than expected on the basis of solar EUV heating alone. Measured low to mid latitude exospheric temperatures on Saturn range from 320–530 K, while solar heating alone produces values of below 180 K. For the case of Jupiter, where the solar driven temperature shortfall is even more extreme, the discovery of waves by the Galileo probe prompted the idea of thermospheric heating by dissipating gravity wave. This process, which would effectively act to transport energy from the interior to the outer atmosphere, is still under debate since the altitude of energy deposition by waves is highly sensitive to the background atmosphere, which is largely unconstrained. While still remaining a possibility, the uncertainty in the wave heating theory justifies a closer look at alternative energy sources. The other main energy source on Saturn is magnetospheric currents which flow primarily in the auroral (polar) regions and can deposit globally more than 50 times the absorbed solar EUV value as thermal energy, primarily via Joule heating.

This study will be revisiting the energy problem on Saturn, adding more recent observations by the Cassini spacecraft and reanalyses of Voyager/UVS observations to the constraints and providing a new set of model calculations with the Saturn Thermosphere Ionosphere Model (STIM) which for the first time consider full ion-neutral drag as well as self-consistent calculation of auroral ionisation by precipitating energetic electrons. We present calculations illustrating the response of Saturn's global thermosphere and ionosphere, including dynamics, composition and energy redistribution, to magnetospheric energy input.