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The role of magnetospheric energy sources on Titan and Venus: A comparative evaluation

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The atmospheres of Venus and Titan on one level share many similarities, but at the same time host interesting differences which motivate a more comprehensive comparison. As a result of highly successful missions like Pioneer Venus and Venus Express, the atmosphere of Venus is the most extensively observed planetary atmosphere apart from the Earth's. The ongoing tour of Cassini-Huygens has led to a vast increase in our knowledge and understanding of Titan's atmosphere, but important information gaps remain. How much can we learn from Venus when attempting to understand the upper atmosphere of Titan? One fundamental question to address is that of the global energy balance in the atmosphere of Titan, and in particular in the upper atmosphere (thermosphere/ionosphere region), which in turns drives the global dynamics and affects the neutral and ion species distribution. One potentially important energy source on Titan derives from magnetosphere-atmosphere coupling by a combination of energetic particle precipitation and the closing of magnetospheric currents in the ionosphere. As a result of weaker solar forcing at Titan, these magnetospheric energy sources may play a comparatively stronger factor in driving the global energy balance and thereby dynamics on Titan than they do on Venus. This paper will evaluate the energy balance on Venus and Titan by assessing the ease at which numerical models driven by solar heating reproduce observed thermosphere densities. We will discuss the relative roles of solar and magnetospheric energy sources on Venus and Titan and outline the wider consequences of their differences.