

## Studies of the polar upper atmosphere from observations and GCM simulations

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Various types of ionospheric and thermospheric variations, which would result from the solar phenomena, e.g. the solar flare/CME, have been found from various ground-based and satellite observations. However, details of the variations of the polar cap ionosphere, thermospheric wind and density variations are still unknown because we have little understanding of energy inputs into the polar thermosphere/ionosphere. Recent satellite observations, e.g., CHAMP observations, have revealed thermospheric density variations caused by significant solar energy injection into the polar thermosphere and ionosphere. Some IS radar observations also have revealed ionospheric signatures of energy inputs into the polar region due to changes in the solar wind. Comprehensive studies by observations from space, ground-based ones, and numerical simulations will enable us to understand the polar thermosphere and ionosphere quantitatively. In order to understand variations of the polar ionosphere from the solar minimum to maximum periods, we have made EISCAT experiments in January 2011, March, 2012, and March 2013. For example, ionospheric variations were observed during solar flare and CME events on March 12, 2012. These EISCAT data clearly show an example of the solar wind, magnetosphere, and ionosphere coupling. In addition to the EISCAT observations, we will also investigate variations of the polar thermosphere during periods of significant solar activities from GCM simulations.

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