Variations of the polar ionosphere, thermosphere, and mesosphere caused by energy inputs from the magnetosphere

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The Earth's atmospheric system has been maintained under the energy inputs from the Sun. In particular, the polar upper atmosphere has been affected significantly by the solar radiation and solar wind energy inputs. In order to understand the energy dissipation processes in the polar upper atmosphere, we should understand behaviours of both the plasmas and neutrals. The European Incoherent Scatter (EISCAT) radar system, which covers from the auroral oval to polar cap region, has been one of unique and powerful tools to monitor the solar wind energy input and its resultant plasma and neutral phenomena. Recently, the upgrade of the EISCAT radar system (EISCAT_3D) is planed to capture the 3D structures of the polar ionosphere, thermosphere, and mesosphere. The new EISCAT system will enable us to understand fine and 3D structures of plasma and neutral motions. In addition to the observations, we have performed numerical simulations using a global model which covers all the atmospheric regions and ionosphere. A model of the chemical processes in the mesosphere and thermosphere are under development for the global model.
In the present study, we will show some observational and simulation results obtained from the EISCAT observations and the global simulations. Then, we will discuss the outstanding issues which should be challenged after the progresses of observational and modelling techniques.

Keywords: ionosphere, thermosphere, mesosphere, EISCAT, simulation, polar region