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Studies of coupling processes between upper and lower atmospheres in the arctic region from observations and simulations

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The polar upper atmosphere shows significant variations due to the energy inputs from the solar X-ray and EUV radiation and from the magnetosphere. In addition, recent observational and simulation studies have revealed spatial-temporal variations in the upper atmosphere caused by the lower atmospheric variability. For example, decrease and increase in temperature were observed in the mesosphere and lower-thermosphere, respectively, during the sudden stratospheric warming (SSW) event in 2009. Moreover, the peak height of warming region descends with time, and the coupling process between the troposphere and stratosphere is seen after the 2009 SSW.

The problem of the global warming is one of the main interests in the 21st century. The temperature in the middle and upper atmosphere seems to show decreasing trend during several decades, suggesting the global cooling in the region. For example, some people reported visually-apparent noctilucent clouds in the mid-latitude region for several years. Some observational and theoretical studies suggest that this global cooling in the middle and upper atmosphere affects the general circulation of the lower atmosphere through the coupling process between upper and lower atmospheres. The sciences of the coupling process will enable us to open up the area for the atmospheric science and to take a broad view of the Earth's environment.

We present an overview of our research activities in the arctic region. Some research projects using radars and optical instruments, which have been developed for several decades, and numerical models are shown in this presentation. Moreover, studies of the coupling process between upper and lower atmospheres in the arctic region are discussed.

Keywords: atmospheric coupling process, observations in the arctic region, numerical modeling, climate change