National/International joint studies with the Tromsø OMTI for studying the polar upper atmosphere

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Institute for Space-Earth Environmental Research (ISEE) has been operating various kinds of optical instruments for more than 15 years at the Tromsø European Incoherent Scatter (EISCAT) radar site in Norway (Geographic: 69.6N, 19.2E, Geomagnetic: 66.7N, 102.2E, L=6.4), which is one of the state-of-art observatories at high latitudes. In January 2009, we began operation of a Fabry-Perot interferometer (FPI) and an all-sky type cooled CCD camera (ASC) at dark nights of the winter months (from middle of September to early April in most years). The FPI (#01 of the Optical Mesosphere Thermosphere Imagers (OMTIs)) measures airglow and aurora by rotationally changing optical wavelengths of 557.7 and 630.0 nm for most of the nights in order to derive the thermospheric wind and temperature. Four cardinal points with zenith angle of 45 or 15 and the geographic vertical (i.e. five directions) are measured sequentially. The combination of data from the four cardinal positions provides the horizontal components of the neutral wind velocity. The all-sky camera (camera #12 of OMTIs) includes a filter wheel used to select one of the six optical filters (channel 1: 557.7 nm, channel 2: 630.0 nm, channel 3: OH band (720 ~1000 nm), channel 4: 589.3 nm, channel 5: 572.5 nm, and channel 6: 732.0 nm). While the exposure time for FPI and ASC measurements is tuned as good for individual scientific objectives, in the case of FPI typical values are 1 minute or 15 seconds for airglow and auroral measurements, respectively, and in the case of ASC those are about 30 and 10 seconds for the individual targets, respectively. However, shorter exposure times have been applied for measuring fine structures of aurora. Other optical instruments such as photometer, digital camera, and all-sky camera (486.1 nm) are collocated with the OMTI FPI and ASC. Data from these instruments have been provided to national and international researching activities. For example, the FPI was operated together with the EISCAT radars as a key diagnostic instrument for providing thermospheric parameters during periods of geomagnetic disturbances. Integrated studies of the FPI-measured wind and the EISCAT-measured ionospheric parameters (including full vector of the electric field) improve our understanding of the energy dissipation and momentum transfer processes and of polar ionospheric/thermospheric responses to the solar-wind change. Effects of energetic electron precipitation (EEP) on the atmosphere are also analyzed using data from our optical instruments and EISCAT radars. This topic is proceeded under collaboration with Chemical Aeronomy in the Mesosphere and Ozone in the Stratosphere (CHAMOS) group. Sodankylä Ion Chemistry (SIC) model, which is used in the group, is a powerful tool for estimating atmospheric responses to EEP, in particular variations in the atmospheric minor components such as NO_x, HO_x, and O_3. Ionospheric and atmospheric variations associated with EEP will be one of the important scientific objectives in the ERG project. This presentation will make a brief introduction of a few results from the national/international join studies.

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