New perspectives on coupling processes in solar-terrestrial system obtained by comprehensive data analysis

*Yoshimasa Tanaka[1], Norio Umemura[2], Shuji Abe[3], Satoru UeNo[4], Masahito Nose[2], Yumi Nakagawa[5]

1. National Institute of Polar Research, 2. Institute for Space-Earth Environmental Research, Nagoya University, 3. International Center for Space Weather Science and Education, 4. Kwasan & Hida Observatories, School of Science, Kyoto University, 5. Ibaraki University

In the Earth’ s upper atmosphere above 60 km, including magnetosphere and ionosphere, various phenomena are generated by energy inputs from solar radiation (including solar wind) and atmospheric waves propagating from the lower atmosphere. Thus, comprehensive analysis of various kinds of satellite and ground-based observational data using advanced methods is required to understand physical mechanism of the phenomena. For such interdisciplinary studies, it is important to share data distributed across many universities and institutes and use advanced tools, such as metadata database for cross-searching a variety of datasets and analysis software for analyzing various types of data in an integrated fashion. In fact, many scientific papers on the upper atmosphere have recently been obtained by comprehensive analysis of various data with such analysis tools.
We present some examples of scientific results achieved by comprehensively analyzing data from multiple regions. These examples include the effect of solar coronal holes on the Earth’ s geomagnetic activity and the interaction between solar wind, magnetosphere, ionosphere and neutral atmosphere. The former study investigated long-term trends of coronal boles, solar wind parameters, and Earth’ s geomagnetic indices during two solar cycles. It showed the possibility that the solar wind speed and geomagnetic activities may be controlled by the size and latitudinal distribution of coronal holes. The latter analyzed multi-instrument data simultaneously obtained from interplanetary space, magnetosphere, and ionosphere and mesosphere in both northern and southern hemispheres. They newly found that the polar mesosphere is affected by relativistic electron precipitation caused by the interaction with magnetospheric plasma waves during the high-speed solar wind stream. These studies demonstrate that sharing and comprehensive analysis of long-term, multiple-sphere, and multi-instrument data using sophisticated tools are very effective to produce scientific outcomes. At present there are data gap areas in the Asia and African regions. Therefore, we believe that filling in the data gap by international collaborations could be a breakthrough for unsolved issues in the upper atmosphere.

Keywords: upper atmosphere, coupling between multiple regions, comprehensive analysis, long-term observational data

