

# IUGONET data analysis system for a study of coupling processes in the solar-terrestrial system

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The earth's atmosphere in a height range of more than 80 km is called the upper atmosphere, and this region is influenced by both the solar activity and the atmospheric waves propagating from the lower atmosphere. Therefore, in order to understand the physical mechanism of the short-term and long-term variations in the upper atmosphere and atmosphere-plasma interaction in this region, we need to perform an integrated analysis of various kinds of ground-based and satellite observation data taken by different techniques. Since these observation data were separately being managed by each institute, it was difficult for users to effectively find and analyze them for promotion of an interdisciplinary study. To solve this problem, the Inter-university Upper atmosphere Global Observation NETwork (IUGONET) project [Hayashi et al., 2013] has been initiated in 2009, consisting of five institutes (Tohoku University, National Institute of Polar Research, Nagoya University, Kyoto University, and Kyushu University). In this project, we have added data information (metadata) for various kinds of ground-based observation data in the solar-terrestrial physics and built a practical database (IUGONET Type-A) to share them on the Internet. We have also developed several integrated data analysis tools (IUGONET Data Analysis Software: UDAS and UDAS egg: UDAS Easy Guide to Generate your load routines) as one of the functions of Space Physics Environment Data Analysis Software (SPEDAS) [Angelopoulos et al., 2019] to analyze and visualize various kinds of ground-based and satellite observation data. In the IUGONET Type-A, users can easily learn characteristics of observation data through the quick look images/plots and how to use several basic commands to visualize the data. Recently, we have added a new function of UDAS Web (ASCII Downloader) to convert CDF into ASCII files on this website so that users can easily read and analysis the observational data with their own tools. We have further started to develop the SPEDAS MATLAB software. In order to enhance an international use of these IUGONET products and to promote an interdisciplinary study of coupling processes on the sun-earth system, we have held tutorial seminars and workshops several times in Japan and foreign countries (India, Indonesia, Nigeria, Malaysia etc.). As a result, many scientific papers [e.g., Dao et al., 2017; Batubara et al., 2018; Koushik et al., 2018] and Master/Doctor theses become published by preparing an analysis environment, and the IUGONET products effectively works as an international platform. This fact suggests that the IUGONET project is in the position enough to serve the subjects of a large research project: Study of coupling processes in the solar-terrestrial system (Master Plan 2014/2017/2020, Load Map 2014) through a collaboration with other ground-based and satellite observation plans and international programs. Judging from the above situations, the common data analysis platform developed by the IUGONET project leads to new scientific results of coupling process in the solar-terrestrial system, human development and strong international cooperation to a whole equatorial region (South America, Africa) in addition to India and Indonesia in future. Therefore, it can be concluded that the IUGONET activity plays an important role in promoting the equatorial and polar atmospheric observations, international collaboration and data science (data assimilation), which are three main subjects of Master Plan (2014/2017/2020).

Keywords: Inter-university Upper atmosphere Global Observation NETwork (IUGONET), human development, International cooperation, Promotion of new scientific results of coupling

process of the solar-terrestrial system, Integrated analysis, Database