Study of the Coupled Solar-Earth System with Large Atmospheric Radars, Ground-based Observation Network and Satellite Data: Project Overview

*Toshitaka Tsuda[1], Mamoru Yamamoto[1], Hiroyuki Hashiguchi[1], Hiroshi Miyaoka[2], Yasunobu Ogawa[2], Kazuo Shiokawa[3], Satonori Nozawa[3], Akimasa Yoshikawa[4]

1. Research Institute for Sustainable Humanosphere (RISH), Kyoto University, 2. National Institute of Polar Research (NIPR), 3. ISEE, Nagoya University , 4. ICSWSE, Kyushu University

The solar energy can mainly be divided into two categories: the solar radiation and the solar wind. The former maximizes at the equator, generating various disturbances over a wide height range and causing vertical coupling processes of the atmosphere between the troposphere and middle and upper atmospheres by upward propagating atmospheric waves. The energy and material flows that occur in all height regions of the equatorial atmosphere are named as “Equatorial Fountain.” These processes from the bottom also cause various space weather effects, such as satellite communication and GNSS positioning. While, the electromagnetic energy and high-energy plasma particles in the solar wind converge into the polar region through geomagnetic fields. These energy/particle inflow results in auroral Joule heating and ion drag of the atmosphere particularly during geomagnetic storms and substorms. The ion outflow from the polar ionosphere controls ambient plasma constituents in the magnetosphere and may cause long-term variation of the atmosphere.
We promote to clarify these coupling processes in the solar-terrestrial system from the bottom and from above through high-resolution observations at key latitudes in the equator and in the polar region. We propose to establish a large radar with active phased array antenna, called the Equatorial Middle and Upper atmosphere radar, in west Sumatra, Indonesia. We will also participate in construction of the EISCAT_3D radar in northern Scandinavia. These radars will enhance the existing international radar network. We will also employ a data collected with a global observation network of ground-based radio and optical remote sensing measurements as well as novel satellite measurements.

Keywords: Atmospheric radar , Solar-terrestrial coupling processes , ground-based observation network , IUGONET

