Activities of space weather forecast operation and research in Japan

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Japanese space weather forecast information is provided every day including holidays and weekend by National Institute of Information and Communications Technology. These information is used by operational radio users e.g., telecommunication, broadcast and satellite positioning, national and local governments, and huge number of amateur radio operators.

NICT has been undertaking ionospheric observations in Japan and Antarctica since the IGY at five stations located in Wakkanai (45.16N, 141,75E), Kokubunji (35.71N, 139.49E), Yamagawa (31.20N, 130.62E), Okinawa (26.68N, 128.15E), and Syowa (69.00S, 39.58E) as of 2013. NICT has been one of the ground stations (35.71N, 139.49E) of the Real-Time Solar Wind network (RTSWnet) since 1997 and has been tracking two satellites, ACE and STEREO, which retrieve real-time information on solar winds and images on the basis of international cooperation. NICT will contribute to data reception from DSCOVR satellite, which was launched in 2015. Concerning solar observation, NICT has a long history of measuring solar radio waves at the Hiraiso observatory since 1952. In 2014, NICT built a new solar radio telescope in Yamagawa observatory and started solar observation.

As a research project mainly studying the dynamics and characteristics of plasma bubbles and geospace disturbances related to radiation belt dynamics, NICT has network observations of the ionosphere in Southeast Asia, a ground-based magnetometer network in the Siberian region, and an HF radar in Alaska in cooperation with universities and academic institutes.

NICT has been developing the model and simulation code of ionosphere and magnetosphere to improve the precision of space weather forecast. NICT is providing some information with empirical models and developing numerical models. NICT created several empirical models to satisfy current user needs Such models can provide practical information in near real time. NICT has developed a Kalman filter based on a multivariate autoregressive model to predict relativistic electron flux at geostationary orbit [Sakaguchi et al., 2013].

We have been developing a global magnetospheric MHD simulation for understanding the physical processed of space weather [Tanaka, 1995] The next-generation of the real-time simulation system is now under development.

Plasma bubbles are known to affect satellite positioning, and it is still difficult to forecast their occurrence numerically. NICT is now developing an empirical model of the occurrence of plasma bubbles using a neural net. At present, NICT can provide the TEC distribution in the vicinity of Japan every hour and also provide a forecast 24 hours in advance.

The behaviour of the lower atmosphere also influences ionospheric and thermospheric variations. NICT's Ground-to-Topside Model of Atmosphere and Ionosphere for Aeronomy (GAIA) [Jin et al., 2011] is being developed to solve ionosphere-thermosphere, including electrodynamics, in a self-consistent manner.