Forecast of energetic electron flux variations of the outer belt using the machine learning

*Satoshi Fukuoka[1], Yoshizumi Miyoshi[1], Daikou Shiota[2], Shinji Saito[4], Takefumi Mitani[3], Tomoaki Hori[1], Nana Higashio[3], Shun Imajo[1], Iku Shinohara[3]

1. Institute for Space-Earth Environmental Research, Nagoya University, 2. National Institute of Information and Communications Technology (NICT), 3. Japan Aerospace Exploration Agency, Institute of Space and Astronautical Science, 4. National Institute of Information and Communications Technology

The relativistic/sub-relativistic electron flux variations of the outer radiation belt often cause serious damage on the satellite operations through the dielectric charging. In order to forecast flux variations of these electrons, various forecast methods based on the physics-based simulation and empirical modeling have been developed. For the physics-based simulation, we have operated the SUSANOO system that is simulating a code-coupling simulation of heliosphere and radiation belt provides MeV electron flux variations for the next couple of days. For the empirical modeling, the linear prediction filter and the auto-regressive moving average are popular methods, which have been used for the forecast of MeV electrons. Recently, the machine learning techniques have widely been used for the space weather forecast, for example, ionospheric variations, the flare prediction, etc. In this study, we have developed the forecast system of relativistic/sub-relativistic electron flux variations based on long short-term memory recurrent neural network (LSTM-RNN). As the training data, we use the solar wind data and energetic electron data observed by Arase/HEP, XEP instruments at different L-shells of the outer belt. Our developed network provides time variations of the energetic electron flux around L=4,5,6 using the solar wind data as an input parameter. In this presentation, we will report the forecast performance, focusing on how forecast skills depend on the lead-time and energy ranges.

Keywords: Forecast of energetic electron flux

