

A New Prediction Model for Solar Wind-Triggered Magnetospheric Disturbances Based on Potential Learning (Neural Network)

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Nowadays, it becomes so important in saving our economic activity, and preventing the disasters caused by terrestrial electromagnetic effects to predict a scale and the duration of the geomagnetic disturbances based on in-situ solar wind observations. Recently, one of the notable techniques for the predictions of the magnetospheric disturbances is Neural Network (NN). However, most of these studies are focused on the reproduction of the behaviors of the index values, which represent the geomagnetic disturbances (e.g, D_{st} and AE), by inputting the solar wind parameters measured by the satellites. In our study, we apply a novel neural network model of ‘Potential Learning (PL)’.

Basically, Neural Networks (NNs) are models which imitate the information processing in the nervous system of brain. The nerve is made of cells as referred to as “neurons”, which specializes the information processing. NNs consist of “artificial” neurons, and can process information by learning. Therefore, using NNs, we can obtain some characteristics of the data inputted. The PL is a new kind of the NNs. A feature of the PL is to make a network that can understand the input variables based on learning by “input potentialities”, which are indices as calculated with the variances derived from the input variables. If using this PL, we can specify what input variable(s) is (are) potentially important and influential for a phenomenon.

In this study, introducing the PL technique, we try to specify which solar wind parameter plays an essential role in causing the geomagnetic disturbances. Although the conventional PL, where we used, had automatically selected the variables of interest, we develop a “improved” PL in this study so that the variables can manually be selected. We benchmark this new algorithm using the 4 polar magnetic storm cases occurred under the southward Interplanetary Magnetic Field (IMF)- B_z conditions, and advisedly set the maximum potentiality for the IMF- B_z , so that the IMF- B_z component is the most possible solar wind parameter to cause the geomagnetic disturbances. We note “second” solar wind parameter(s) to possibly cause the magnetospheric disturbances, following the IMF- B_z component. After testing our new technique to actual storm events, we might distinguish the magnetospheric disturbances into two different types, that is, the geomagnetic disturbances driven by “IMF-dominant” and “combination of IMF with solar wind plasma (dynamic pressure)”. The advantages to adopt this new algorithm to space weather, and more detailed results will be discussed in this presentation.

Keywords: Predictions of Geomagnetic Activity, Neural Network Considered Potential Learning, Development of Space Weather