

#高橋 直子¹⁾, 西塚 直人¹⁾⁽¹⁾NICT**Forecast of CIR-driven geomagnetic storms using the deep neural networks**#Naoko Takahashi¹⁾, Naoto Nishizuka¹⁾⁽¹⁾National Institute of Information and Communications Technology

The magnetospheric disturbances is one of the essential indicators for the space weather forecast. The condition in the Earth's magnetosphere strongly depends on the solar wind variation associated with, for example, coronal mass ejection (CME) and/or co-rotating interaction region (CIR). Here, we focus on CIR-driven geomagnetic storms, which are originated from high-speed plasma flow from coronal holes.

We have developed a regression prediction model of solar wind that have been applied from the solar flare prediction model using deep neural networks (DeFN). First, the database of coronal holes (location coordinates, area) and solar wind (speed (V_{SW}), plasma density (N_{SW}), IMF B_Z , IMF magnitude (IMF B_T), clock angle ($\phi = \tan^{-1}(B_Y/B_Z)$) is constructed from the observation data in 2017-2021 for learning, with a temporal resolution of 1 day. The parameters for coronal holes are derived from by SDO spacecraft data. The solar wind parameters are obtained from DSCOVR spacecraft with a temporal resolution of 1 hour. For each day, the maximum absolute value of the solar wind parameter is selected. In addition, we make the database without CME-driven storm events to forecast pure CIR-driven storm events. The magnetic storm list is provided from Kakioka Magnetic Observatory. Based on the magnetic storm list, CME-driven storm events are defined as that CME is observed by SOHO/LASCO at a few days before the onset of magnetic storm. We exclude the data from 1-day before to 3-days after the onset from the database.

We perform the 1-day, 2-days, and 3-days forecasts for the solar wind variations and geomagnetic indices in 2022. The model can forecast V_{SW} , N_{SW} , and IMF B_T , with the root-mean-square errors (RMSEs) for 1-day forecast of ~ 60 km/s, ~ 8 /cc, and ~ 3.5 nT, respectively. The accuracy for 2-days and 3-days forecasts is ~ 25 -60 % worse than 1-day forecast. On the other hand, IMF B_Z cannot be forecasted because the related parameters of coronal holes (i.e., magnetic field of solar surface) are not included in the current database. We also find that the forecast accuracy using the database without CME events is almost the same as that using the database with CME events, which is due to a small number of relatively large-scale CME events in 2022. In addition, we forecast two geomagnetic indices: the Dst index and the Kp index. The Kp index is relatively well predicted due to its strong relationship with V_{SW} . In contrast, the prediction of the Dst index is less accurate, as the forecast of IMF B_Z is not reliable. Improving the forecast accuracy of IMF B_Z and ultimately enabling the prediction of Kakioka K index will be important tasks for future work.