R006-05
Zoom meeting B ：11/1 AM2 (10:45-12:30)
10:45〜11:00

Diagnosis of solar-wind effects on the AE indices based on an echo state network model

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The AE indices consist of the AU and AL indices. The former represents the strength of the eastward auroral electrojet and the latter represents the strength of the westward auroral electrojet. Although the AE indices are widely used for monitoring geomagnetic activity, it is not easy to model the behavior of the AE indices because of the complicated physical processes of the auroral electrojets.

In this study, we employ an echo state network for modeling the relationship of the AE indices to solar wind parameters. The echo state network is a kind of recurrent neural networks where the connections and weights between hidden state variables are fixed, and it can be easily implemented for modelling dynamical systems and time series data. Our echo state network model successfully reproduces temporal variations of the AU and AL indices with comparable accuracy to other existing modelling studies.

Using this echo state network model, we can obtain synthetic AE indices under artificial input conditions. In order to assess the impact of the solar-wind speed and density on the AE indices, we derived synthetic AE indices under some artificial solar wind conditions: a high speed solar wind, a high density solar wind, and a low density solar wind. The results show the followings.

1. The solar wind speed has significant effects on the AE indices. In particular, many events of the AL enhancements are related with high-speed solar wind streams.

2. The solar wind density also makes effects on both the AU and AL indices. However, the AL index is influenced by the solar wind density only under high-speed solar wind conditions, while the density effect on the AU index is observed even under low-speed solar wind conditions.

The latter result is consistent with a simulation result by Ebihara et al. (JGR, 2019). However, it is likely to be relatively rare that solar wind density actually contributes to the AL index because high solar wind density is mostly concurrent with a low-speed region in the front of a high-speed stream of the solar wind.