Toward real forecast of aurora electrojet index using the data assimilation

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The auroral electrojet indices (AU, AL, AE) are a proxy of substorm as well as auroral activity, so that the forecast of these indices is important for the space weather forecast. In this study, we develop a data assimilation code to estimate the AU index based on Goertz et al. [1993] model. In the data assimilation, the state space model consists of the system model and the observation model. The model of Goertz et al.[1993] is used as the system model, which calculates time variation of the AU index using the electric fields of the solar wind. The state vector includes the AU index and coupling parameters for solar-wind, magnetosphere and ionosphere. The AU index provided from World Data Center for Geomagnetism, Kyoto is used as the observation vector. The sequential data assimilation includes the following three steps; prediction, filtering, and smoothing. We use the particle filter that can apply for non-linear/non-gaussian problems. Furthermore, we use the particle smoother as the smoothing scheme. To apply the real-time forecast of the AU-index, we develop a system that includes hindcast and forecast. The hindcast investigates probable past state using the data assimilation, while the forecast investigates propable future state. Using the estimated coupling parameters at the hindcast, the AU index is predicted by the Goertz model. The test calculation shows that the forecast performance is improved by estimating the coupling parameters with the data assimilation at the hindcast. This system has been coupled with the SUSANOO-SW that simulates the solar wind and IMF at 1 AU for the next 7 days based on the MHD model, and the electric fields of the solar wind provided from the SUSANOO-SW is used as an input for both hindcast and forecast. Our developed system has been operated and provided weekly variations of the AU index.

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