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An Insight into Auroral Electrojet Development: Identification and Decoupling of DP1 and DP2 Current Systems

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Recent studies have shown that severe controversy about the storm-substorm relationship still exists. This is not only because the complexity of the phenomenon, but also the limitation of measurements from the ground and space. For example, at the high latitude region of the northern hemisphere, magnetometers distributed along the auroral oval are used to create AU, AL and AE indices. Changes in the indices are the manifestation of the electrojet variation contributed by both near midnight substorm current wedge (also called DP1 current) and the ionospheric Hall current (also called DP2 current). The two current systems have completely different physics of responding to the solar wind and magnetosphere/ionosphere conditions. By only studying these indices, one is unable to depict when the DP1 current system is developed and dominant, as well as unable to elucidate which portion of the electrojet, the DP1 or DP2, is more important to the ring current intensification. To clarify this situation, in this study, we develop and improve the method of natural orthogonal components (MNOC), at the first time, to distinguish and decouple DP1 and DP2 current. MNOC is an algorithmic technique that can decouple DP1 and DP2 currents by calculating the current function on the basis of ground-based magnetograms.