

Substorms During Prolonged Northward Interplanetary Magnetic Field

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We have studied substorm events under a condition of prolonged northward interplanetary magnetic field (IMF). On 19 January 1998, a series of substorm expansion onsets and intensifications were observed by Polar UVI, after northward IMF persisted for more than 19 hours, except for several very short and small southward excursions. These substorms were weak, with a typical magnitude of the westward auroral electrojet of \sim 150-200 nT. During this period, ionospheric convection was very weak; the Kp index was 0+ or 1-. Geotail observed total pressure increases in the magnetotail at -25>X>-30 Re, caused by the enhancement in the solar wind dynamic pressure and the large IMF By component. At the substorm onsets, Geotail observed plasmoids and total pressure decreases at X~-30 Re, indicating that magnetic reconnection occurred earthward of Geotail. The GOES satellites observed dipolarizations at geosynchronous orbit. These signatures suggest that the mechanism for substorm expansion onset is the same as usual substorms, even under prolonged northward IMF conditions. The IMF By effect can be important for energy accumulation in the magnetotail. Also, fast tailward flows were observed before the first substorm onset, but they did not correspond to any auroral activity. These observations suggest that some condition of the near-Earth magnetotail and the ionosphere is necessary for the substorm initiation in addition to the occurrence of magnetic reconnection in the midtail.