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Time development of the Dipolarization Front and its interactions with the dipole-field region obtained by 2-1/2 dimensi

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Bursty bulk flows with increasing B_z (northward component of the magnetic field), which are caused by magnetic reconnections in the magnetotail, are called Dipolarization Front (DF). Under the picture of the Near Earth Neutral Line model, which is one of the models explaining the triggering of substorms, the compression of the dipole region by DF and the pileup of DF itself around the near-Earth plasma sheet boundary cause a wide increase of B_z in the night magnetosphere. Although there are many observational studies of DFs by spacecraft, there are no full-particle simulations that examine the case in which the DF approaches to the dipole region.

In this context, we have performed two-dimensional full-particle simulations for the initial magnetic configuration which is akin to Earth's dipole magnetic field together with a stretched magnetic field by the thin current sheet. We have generated the magnetic reconnection and earthward plasma flows accompanied by B_z, and examined the time development of the flows and the interactions with Earth's dipole-field.

In our simulations, a minimal region of the northward magnetic field where B_z does not increase have been formed between the dipole region and flux pileup region, different from the common picture of Dipolarization. The reason of this can be considered as follows; (1) the earthward flows transport and accumulate the plasmas of the current sheet around the near-Earth plasma sheet boundary, (2) the pressure of the accumulated plasmas decelerate the flow, (3) B_z piles up in the tailward of the boundary. This result is different from the common effect of the DF that it broadly increases B_z in the night side of the magnetosphere. Because of the two-dimensionality in our simulations, the accumulated plasmas cannot leave in the Y-direction (eastward), producing such characteristic region. We also discuss on the structure of the particle flow velocity and particle density distributions near the DF by comparing with observational results.

Keywords: Substorm, Dipolarization Front, Dipolarization