Ann. Geophys. Discuss.,
https://doi.org/10.5194/angeo-2018-128-RC1, 2018

Annales Geophysicae Discussions

Interactive comment on "Magnetic dipolarizations inside geosynchronous orbit with tailward ions flow" *by* Xiaoying Sun et al.

Anonymous Referee #1

Received and published: 31 December 2018

The present paper studied two successive dipolarizations that were observed by the two THEMIS spacecraft located earthward and tailward of the geosynchronous orbit near midnight. These dipolarizations were accompanied by tailward flows. The authors concluded that the tailward flow propagates tailward in a speed of dipolarization region expansion, carrying energy. Before making decision for publication, however, I have a couple of major concerns which require additional data analysis and more detailed discussions.

The authors describe that THEMIS D observed the two successive dipolarizations at ∼0930 and ∼0936 UT, while THEMIS E observed only one dipolarization at ∼0936 UT. The authors associate the two dipolarizations with only one substorm that began at ∼0930 UT, and they link the dipolarization at THEMIS D at ∼0930 UT to the dipolariza-

Printer-friendly version

Discussion paper

tion at THEMIS E at ~0936 UT that propagated tailward from the THEMIS D location at a speed of -47 km/s.

I, however, have a couple of concerns in the above interpretations. First, I am wondering whether the two successive dipolarizations are associated with a substorm or associated with a pseudosubstorm (pseudobreakup) and the following substorm. The authors state that THEMIS D observed the two dipolarizations, but THEMIS E observed only one dipolarization. Ohtani et al. (JGR, p. 19,355, 1993) showed that dipolarization associated with a pseudosubstorm is localized, while that associated with a substorm expands to a wide region. Hence there is a possibility that the ~0930 UT dipolarization of the present event is localized at and near THEMIS D, associated with a pseudosubstorm, while the ~0936 UT dipolarization expanded to both THEMIS D and E, associated with the following substorm. To verify the interpretation, the authors need to check ground substorm signatures, such as bay-type magnetic field changes, Pi2 and Pi1 pulsations, and auroral activity, at each ground station near the footprints of THEMIS D and E.

Second, I am wondering whether dipolarization at THEMIS D really occurred in two steps at ~0930 and ~0936 UT. In Figure 3, it seems that Bz continuously increased from ~0930 or ~0932 UT through ~0937 UT and did not increase stepwise at ~0936 UT. Furthermore, THEMIS E observed one dipolarization at ~0937 UT. If dipolarization at THEMIS D occurred in two steps and if the dipolarization at THEMIS E is linked to the ~0930 UT dipolarization at THEMIS D, how do the authors explain the lack of the second dipolarization at THEMIS E that could be linked to the ~0936 UT dipolarization at THEMIS D? The ground signatures mentioned above may be helpful for this question.

After the additional analysis and discussions mentioned above, the dipolarizations at the two spacecraft can be linked, and hence the tailward propagation speed of the dipolarization region can be obtained in a more convincing way.

Printer-friendly version

Discussion paper

Other specific comments:

Lines 62-67: The maximum AE value of the substorm examined in the present study was ∼500 nT at ∼1010 UT, not 1273 nT at a later time. Hence this substorm should be moderate, not intense. After the present substorm, a lot of substorms or steady magnetospheric convection occurred during the storm main phase, and AE reached a peak of 1273 nT during one of these activities.

Line 90: The ion temperature was decreased, not increased, during the weak dipolarization at 0930 UT, while the ion density, the electron density, and the electron temperature were increased. This sentence is confusing, so please reword it.

Lines 108-109: It should be noted that these low beta values and its increase indicate that the spacecraft was in the lobe and moved to the plasma sheet boundary layer and then the plasma sheet. The parallel flow should have observed in the plasma sheet boundary layer.

Lines 128-129: The negative (tailward) Ex with the positive (northward) Bz corresponds to the duskward perpendicular flow, not the dawnward perpendicular flow. In the present event, the measured Ex is opposite to Ecx calculated from VxB. The measured electric field may need some caution, since it may include an offset and the contributions other than VxB.

Lines 143-148: In this paragraph, the authors discuss only the azimuthal speed of the dipolarization region expansion and do not discuss the tailward speed. Since the tailward speed is related to the main conclusion of the present study, it should be discussed as well.

Discussion: The current disruption model for substorm triggering proposed that current disruption and dipolarization launches a tailward propagating rarefaction wave, which should be accompanied by a fast earthward flow (e.g., Lui, JGR, p. 1849, 1991; Chao et al., PSS, p. 703, 1977). This is possibly in contrast to the present results. Hence it might be good to discuss this discrepancy or how different the rarefaction wave proposed by the current disruption model and the tailward propagation of the tailward flow and dipolarization region discussed in the present paper.

Minor corrections:

Line 33: NESP –> NEPS

Line 35: Liang et al., 2008 –> 2009 ?

Line 42: Liang et al. (2008) should be deleted here because Liang et al. (2008) did not show magnetotail observations.

Lines 60-61: Dst –> Sym-H

Line 61: Figure 1e –> Figure 1f

There is no space between words in many places throughout the text. Put space between the words throughout the text.

Interactive comment on Ann. Geophys. Discuss., https://doi.org/10.5194/angeo-2018-128, 2018.