

## ***Interactive comment on “Strong Southward and Northward Currents Observed in the Inner Plasma Sheet” by Yanyan Yang et al.***

**Yanyan Yang et al.**

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We appreciate all comments from the reviewer, which help to further improve the quality of our manuscript. In this round of revision, we have considered all comments seriously. The point-by-point revisions have been made and tracked in the change-noted manuscript. We hope that the new version of manuscript has met the requirements from the referee and ANGEO. In the following, each comment is followed by our responses.

This is an interesting paper for investigating the currents at low and middle latitudes during intense geomagnetic storms. The results showed that there exist also southward/northward currents in the inner plasma sheet, but they are neither the ring cur-

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rents nor field aligned currents. The authors suggest that such horizontal currents at low and middle latitudes are caused by the curvature drift of energetic particles during magnetic storms. In general, the paper is well written, and the observational results support their conclusion. However, before it is accepted by Annales Geophysicae, some comments listed below may need to be taken into account.

Major comments: 1. The authors focus only the northern middle latitudes in their study. One interesting question would be to check the southern low and middle latitudes, to see if similar currents can also be observed. If yes, it might indicate that such currents are field-aligned. If not, the authors could provide some explanation or suggestions. Response: Thank you for your good suggestion. Actually, the southward and northward current also can be observed in the southern low and middle latitudes. Figure 1 and Figure 2 show the geometry of the magnetic field and the current distribution in the southern hemisphere for the two events concerned in this work. We can see similar fluctuations with what we observed in the manuscript. So, the reported southward and northward current can be observed both in north and south hemisphere. However, they are not the field-aligned currents. Actually, we have also given field-aligned current component in last panel of the figure. The observed southward and northward current is the component perpendicular to  $\mathbf{B}$ . Anyway, it is a good suggestion to mention result from south hemisphere. We have added a short discussion in ‘Discussion’ part, see lines 4-6 in page 13 of the change-noted manuscript.

2. It seems there is no real summary in the end of the study. The author may think to add a typical summary. Response: Thank you for your suggestion, we have added the summary section in the manuscript, see lines 4-18 in page 14 and lines 1-2 in page 15 of the change-noted manuscript.

Some minor comments Abstract: 1. during large storm events  $\rightarrow$  during intense geomagnetic storms Response: Changed. See line 11 in page 1 of the change-noted manuscript.

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2. which cannot be FACs -> which should not be FACs Response: Modified. See line 12 in page 1 of the change-noted manuscript.

3. highly fluctuate -> high dynamic Response: Revised. See line 14 in page 1 of the change-noted manuscript.

Introduction 4. Page 1, line 20: "Recently, through simulations and observations, numerous studies have shown that the inner magnetosphere currents have a more complicated structure and distribution than originally thought". The author are suggested to provide more detailed description of "more complicated structure and distribution than originally though", not just added references there. Response: Thank you, we have provided more detailed description in the new version of manuscript. See lines 21-25 in page 1 of the change-noted manuscript.

5. Page 1, line 26: respectively, from high latitude and low latitude -> from high and low latitudes, respectively. Response: Modified. See lines 2-3 in page 2 of the change-noted manuscript.

6. Page 2, line 6: in the latitude regions from 10°N to 50°N In the abstract, the authors claimed that they focus on the latitude range between 10-30° N. Response: Thanks to point out our mistake, it should be from 10-30° N. We have made a modification. See line 11 in page 2 of the change-noted manuscript.

3. Event analysis 7. Page 7, line 7: (The event was once reported by Shen et al. (2014), but they only concentrated on the interval from ~07:00 to 7:25 UT). -> The event was once reported by Shen et al. (2014), but they only concentrated on the interval from ~07:00 to 7:25 UT. Response: Changed. See lines 7-8 in page 7 of the change-noted manuscript.

8. Page 7, lines 11-12: It can be seen that these parameters behave as same as that of the first event, but with stronger magnetic field strength. Response: Modified. See lines 11-12 in page 7 of the change-noted manuscript.

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9. page 7, line 14: And the largest rotation rate (Figure 3g) oscillates significantly and exhibits. . . Response: Revised. See lines 14-15 in page 7 of the change-noted manuscript.

4. Summary and Discussion It should be Discussion and Summary Response: Since we have added a summary in the last part, we modified this part as 'Discussion'. See line 4 in page 8 of the change-noted manuscript.

10. Page 10, line 12:  $\varepsilon$  and  $\alpha$  are the particle energy and pitch angle, respectively. Response: Modified. See line 12-13 in page 10 of the change-noted manuscript.

11. Page 11, line 11: During the strong storm time, turbulences, e.g., the ULF waves, result in the fluctuation of the MFLs, . . . Response: Modified. See line 2 in page 11 of the change-noted manuscript.

12. Provide a typical summary of this work at the end of the study. Response: Provided. See lines 4-18 in page 14 and lines 1-2 in page 15 of the change-noted manuscript.

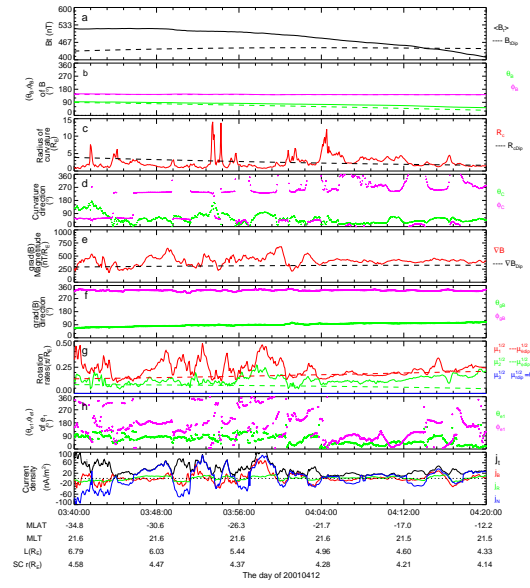
Please also note the supplement to this comment:

<https://www.ann-geophys-discuss.net/angeo-2019-56/angeo-2019-56-AC1-supplement.pdf>

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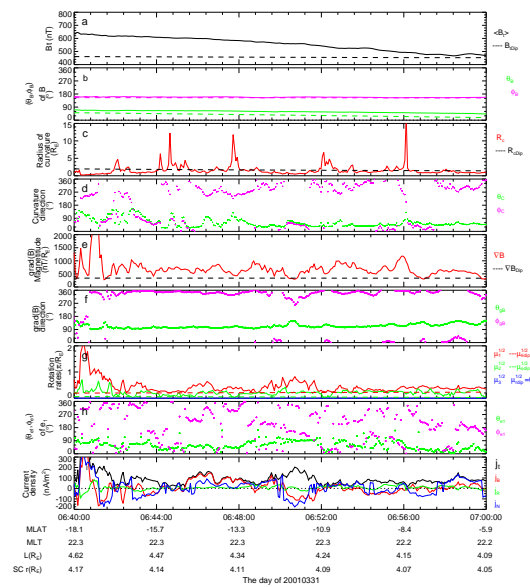
Interactive comment on Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2019-56>, 2019.

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**Fig. 1.** Geometry of the magnetic field and the current distribution in the south hemisphere on 12 April 2001

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**Fig. 2.** Geometry of the magnetic field and the current distribution in the south hemisphere on 31 March 2001

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