

Interactive comment on “AMPERE Polar Cap Boundaries” by Angeline G. Burrell et al.

Anonymous Referee #1

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This study proposes to use data on field-aligned currents (FACs) inferred from magnetometer measurements on the IRIDIUM satellites to monitor the location of the open-closed boundary (OCB) of the Earth's magnetic field. Traditionally, the OCB has been determined from satellite measurements of precipitating electron fluxes. The authors relate the location of the area separating the so called Region 1 and Region 2 FAC currents (R1/R2) with the OCB location inferred from DMSP satellite measurements. The offset between these areas is assessed statistically for both hemispheres and in various MLT sectors, and the authors create a general equation to optimally describe it. To validate the technique, the authors compare OCBs inferred from R1/R2 data with the convection reversal boundary (CRB) inferred from DMSP ion drift measurements and with IMAGE optical data. All the data sets agree reasonably well at dawn and dusk. It is believed that the new boundaries based on R1/R2 data would allow researchers “to improve high latitude statistical studies and climatological models.”

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The paper is certainly a contribution to the field and I would recommend it for publication. However, the presentation requires significant improvement. It is important for the paper to be understandable to an un-prepared reader. The present version is not up to this expectation. My concerns are that the Introduction is too patchy to understand the justification for the study and there is no discussion of the significance of the work done in terms of future applications.

Generally, one can expect that the offset between the OCB and the R1/R2 separation line depends on the IMF intensity and orientation. In various parts of the manuscript, the explanations assume that there is the Dungey cycle going on, which is OK when the IMF $B_z < 0$. However, some (unspecified) comparisons were done when the IMF $B_z > 0$ (page 4, line 3). Thus, there is a sort of inconsistency in the explanations and conditions for which the comparison was actually done. Ideally, in my view, it would be important to establish that the offsets are IMF independent. Discussion of this aspect would be beneficial.

The paper needs further discussion the relationship between OCB and CRB. The latter was introduced without any explanations/comments at all. While OCBs and CRBs collocate well at dawn and dusk, they are quite off in closer to midnight sectors, see Fig. 4. What does this mean? Would this result “validate” the newly-introduced way of finding the OCB from R1/R2 data? This kind of little details urges the question on the value of the work done. One would expect these issues to be addressed in the Discussion section of the paper.

Below I list technical comments that I recommend the authors to think about.

1) p2: The first statement is supposed to be with respect to the ionosphere, not atmosphere. Then atmospheric motions and their effects can be introduced. In fact, abstract has more proper words than Introduction.

2) p.2: I am concerned about the usage of words: . . . plasma drifts . . .travel. . .

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- 3) p.2: In lines 13-15, Joule heating is mentioned without connection to the previous narration on the plasma driven by the Dungey reconnection processes.
- 4) p.2: In lines 16-17 you state: “Due to the differences in ionospheric and thermospheric behavior in the auroral oval and the polar cap”. It is not clear what it meant here, what kind of differences, they have not been introduced earlier.
- 5) p.2: In line 19 you mention “improved statistical and climatological results”. Specifics need to be given here.
- 6) p.2: In line 20, the statement about OCB comes suddenly into the play, disconnected from the previous narration.
- 7) p.2, lines 26-27: Because the location of the Birkeland current system is tied to the OCB A reference or explanation is required here.
- 8) p.2, line 29: I would replace “measured by” by “inferred from”
- 9) p.2, line 34: Convection reversal boundary (CRB) is mentioned for the first time, but how it is related to the OCB and R1/R2 currents has never been mentioned.
- 10) p.3, line 21: “state of the magnetic field lines” – what is this?
- 11) p.3, lines 22-23: this statement should be in Introduction
- 12) p.9, line 3: Remove “R.H.”
- 13) p.9, line 11: Remove dash
- 14) p.9, line 23: revise the statement
- 15) p.9: Fig 4 caption: . . .data show
- 16) p.15, line 35. . . .Borovsky J.A. and Young T.D.
- 17) p.16, line 31: remove two “and”
- 18) p.16: Is reference on Jones correct?

19) p.16: Please, correct reference for Spiro

20) p.16: Reference on Zhu is incomplete

21) p.16: Many citations are not consistent with Ann. Geo. requirements in terms of style.

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