

# ***Interactive comment on “ICME impact at Earth with low and typical Mach number plasma characteristics” by Antti Lakka et al.***

**Anonymous Referee #2**

Received and published: 13 September 2018

## **1 General Comments**

This paper studies the effect of two ICMEs of different characteristics on the Earth's magnetosphere, focussing on the saturation of the cross polar cap potential (CPCP). The majority of the abstract talks about the properties of the ICMEs, and is lacking in actual results, or the motivation of the paper. The introduction has a good overview of the relevant literature. However, like the abstract, it is missing the aims and motivation of the paper.

Whilst the results are interesting, I have concerns about their validity. The validation performed in the paper is minimal, only comparing simulation to spacecraft magnetic field data and the position of the magnetopause with the Shue model. The comparison

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with spacecraft data is missing a key aspect, the plasma data, and there is little explanation for why GUMICS-4 underestimates the magnetic field strength. The comparison of the Shue model with the simulation magnetopause is also missing key details, such as the definition of the “dayside magnetopause” and whether errors include the full 3D simulation magnetopause. A two or three dimensional comparison would be more appropriate.

This leads to the other issue with the paper, the calculation of the total energy into the magnetosphere. The Shue model is an axisymmetric model, and does not include features such as the cusps, hence using the Shue model for this calculation is potentially incorrect, capturing the sheath or magnetosphere.

The overall quality of the writing in the paper is adequate with a few spelling, grammatical and citation style errors. These have been pointed out in the specific and technical comments, though the authors should thoroughly proof read.

Though the results are interesting, I would not recommend the paper for publication in its current form. However, with a little more analysis and responding to the questions posed in this review, it has the potential for publication.

## 2 Specific Comments

- Pg 3, Section 2.1: Do you consider a dipole tilt or rotation? This should be stated
- Pg 4, Ln 14: You should be specific in why it’s not feasible. Does it run too slowly, or are there memory issues?
- Pg 4, Ln 11: Should list the solar wind values you’re referencing to make it easier to understand
- Pg 6, Ln 26: Why do you use the Shue magnetopause for this calculation, not the

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simulation magnetopause? I would have thought this would be a more consistent calculation with the simulation. The general 3D structure of the Shue magnetopause likely not in the correct position, especially near the cusps. Does this mean you'd be capturing energy flux through an arbitrary surface either in the sheath or inside the magnetopause? Also, does this use the 3D magnetopause surface and how far does the dayside region extend to? The details of this calculation should be more clearly stated in the paper (or cited).

- Pg 7, Lns 1-5: Continuing on from the previous comment, are these percentages over the whole 3D dayside surface of the magnetopause? If they aren't then they probably aren't a good metric as they don't account for the full shape of the magnetopause.
- Pg 7, Ln 10: The author mentions both runs are consistent; this should be shown with a figure of the GUMICS magnetosphere data (e.g. cuts through the noon-midnight and ecliptic planes).
- Fig 4c: What is the strange artefact in the position of Geotail? It seems to jump to a different position?
- Fig. 5: More odd artefacts: (c) position of geotail jumps throughout dataset; (b) jumps in the magnetic field strength of Cluster at approx. April 30 (06:00) and April 30 (09:00)

### 3 Technical corrections

- Pg 4, Ln 10: Need brackets around Lakka et al. (2017)
- Pg 5 Ln 6: "rotate", not "rotated"

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- Pg 5, Ln 30: Citation should have parentheses
- Pg 6, Ln 11: replace “proper” with “properly”
- Fig 8. Ln 4: replace “are showing” with “show”
- Pg 10: Ln 2: unnecessary hyphen in front of “line”
- Pg 10, Ln 8: Citation should not have parentheses
- Pg 10, Ln 20: Citation should have parentheses
- Pg 11, Ln 14: Citation should have parentheses

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Interactive comment on Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2018-81>, 2018.

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