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Comment on angeo-2022-20

Anonymous Referee #3

Referee comment on "Width of plasmaspheric plumes related to the level of geomagnetic storm intensity" by Zhanrong Yang et al., Ann. Geophys. Discuss., https://doi.org/10.5194/angeo-2022-20-RC3, 2022

The paper "Width of Plasmaspheric Plumes Related to the Intensity of Geomagnetic Storm" investigates the relationship between the minimum value of dst indice and the plasmaspheric plume width. The dst indice is assumed to be connected to geomagnetic storm intensity. The analysis relies on Van Allen Probes data and it is illustrated with simulations of two plume events. The paper is logically organized, the figures are generally correctly described and the reasoning is clearly explained. However, I have several concerns about the methodology that I would recommend to address before publication.

- The Dst is the single proxy for geomagnetic storm intensity considered in the study. Looking back at Gonzales 1994, based on magnetic storms, only min(Dst) lower than -30nT are related to magnetic storms (weak:[-50,-30] and moderate [-50,-100] nT). Intense magnetic storms are not part of this study and conversely the large number of events with min(Dst) larger than -30nT might not be considered as magnetic storms. Your work seems to analyze the relationship between plume width and Dst dip (rather than magnetic storm intensity). This point needs to be clarified (for example, you could either replace the wording "magnetic storm intensity" or exclude the >-30nT events from the study).
- You claim that you find a relationship a dependence between the plume width only when excluding the events with most negative min(Dst) values. To my opinion it is not fully proven, as you also excluded events that are too large (in MLT and/or R). I would suggest to also try to find a relationship between the plume width and all the dst values when the large plumes are excluded.
- I have some concern about your statistical analysis (l204). I do not see any very significant linear relationship in Figure 6, as stated L204. Is it a problem of data distribution, of Spearman correlation understanding, or something else?

Minor comments:

- It is striking from your simulation figures that the plume width is smaller at larger R values. How does this affect your analysis?
- In the first paragraph a reference to a paper of early explanation/observation of the plasmaspheric plume is missing.
- L63 (1): this is true for outbound crossing only. I guess you identify the plasmapause during inbounds as well.
- L83-84: Need some clarification. How did you proceed? Did you search the plumes for the whole rbsp dataset or are you looking for plumes only after Dst minima?
- L134: how do you define the main phase? How many plumes are not related to any storm?
- L209: describe in few words how the two processes differ.
- L223: one can suppose that Maynard and Chen discovered the solar wind electric field. Is that correct?
- L223: "IMF" azimuthal angle