

***Interactive comment on* “Statistical survey of day-side magnetospheric current flow using Cluster observations: Bow shock” by Evelyn Liebert et al.**

Anonymous Referee #1

Received and published: 19 March 2018

I thank the Editor for choosing me to review this manuscript titled “Statistical survey of day-side magnetospheric current flow using Cluster Observations: Bow Shock”. In this manuscript the authors estimated bowshock currents using curlometer method and compared with theoretical understanding of bowshock currents. To my knowledge this seems to be one of the early statistical studies which tried to verify our understanding of Bowshock current. Hamrin et al. (2017, <https://doi.org/10.1002/2017JA024826>) presented a statistical study on bowshock current closure using MMS data which is limited to low latitudes. However, this study verifies our theoretical understanding of bowshock currents from Cluster data which has highlatitude coverage aswell. I suggest the authors also comment on their view on bowshock current closure based on their dataset.

This will improve the manuscript's scientific quality. The authors in current manuscript presented the topic in a simple and logical manner. However, I have one general comment – Figure captions do not describe the figure properly. This makes the reader to expect more information in the text but I find the authors' description of figures in the manuscript text is brief. Below are some comments and suggestions which I think will improve the quality of this manuscript. 1) I suggest the authors add a figure on location of Cluster spacecraft during the events presented in this manuscript. Such a figure can be one similar to Figure 4 (top panel) with representative location of Cluster tetrahedra. It is important for the reader to understand the spatial coverage of results presented in this study. 2) Page 4, lines 1&2: The authors mention rotating GSE coordinate system to align with IMF yz components. I suggest explaining why the authors choose to do this and what is the advantage of such a rotation in the text. Also, in page 5, line 2, authors mentioned IMF-aligned coordinate system first time in this study. I guess they are referring to the coordinate rotation mentioned in page 4 but I suggest defining IMF-aligned system in page 4. 3) Description of Figure 6 in section 4.2 is not clear. The authors seem to say that a linear relation between bow shock current and IMF z-component is seen in Fig 6 which is in line with Tang et al. (2012). Looking at figure 6, I do not agree with this conclusion. I suggest the authors describe the text for figure 6 clearer. 4) Figure 7 presents a schematic of bowshock currents but did not describe the distance ranges that this schematic is valid. I suggest the authors describe how Cluster results presented in this paper support this schematic. Adding a figure of Cluster position as suggested in point 1 above would help understand Figure 7. 5) In description of Figure 5 (Page 5), the authors compared current magnitudes obtained in this study with those presented in Lopez et al. (2011) but they did not comment on current directions or the current closure. But the schematic in Figure 7 seems to suggest the bow-shock currents do close on themselves, is that right? If yes, explain how the results presented support your conclusion. Lopez et al. (2011) suggested that in MHD simulations, bowshock currents closed with magnetospheric currents. A recent study by Hamrin et al. (2017, <https://doi.org/10.1002/2017JA024826>) presented statis-

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tical study on bow-shock current closure using MMS data but this study limited by the lack of high latitude bowshock crossings. I would suggest that the authors present their view of bowshock current closure based on their dataset as this Cluster dataset has wider latitudinal coverage than MMS study by Hamrin et al. (2017). Again, adding a figure with Cluster locations for events used in this study will help clarify this manuscript better. 6) I suggest the authors discuss Hamrin et al. (2017) in their introduction and where possible compare results presented in this study with those of Hamrin et al. (2017).

Some minor language issues: Page3, lines 1-2: This sentence seems to be a bit complicated. Suggest rewriting to make it simpler. Page 3, line 11: add “to” between approach and solving. Page 4, line 13 and elsewhere throughout: suggest using “deviates” or something similar instead of “diverts”. Page 5, line 4: The current’s → The current Page 5, line 4 and elsewhere throughout: Use some other word like “described” instead of “prescribed”

Please also note the supplement to this comment:

<https://www.ann-geophys-discuss.net/angeo-2018-9/angeo-2018-9-RC1-supplement.zip>

Interactive comment on Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2018-9>, 2018.

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