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Interactive comment on "Asymmetries in the Earth's dayside magnetosheath: results from global hybrid-Vlasov simulations" *by* Lucile Turc et al.

Anonymous Referee #2

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Referee report on the "Asymmetries in the Earth's dayside magnetosheath: results from global hybrid-Vlasov simulations", by L. Turc et al.

This manuscript describes 2D simulations of the dayside magnetosheath using the hybrid Vlasiator code, for three different upstream conditions (one in the noon-midnight plane, and two in the GSE equatorial plane). The authors appropriately describe the capabilities as well as the issues and shortcomings pertaining to this hybrid model. The detailed description of the challenges of magnetosheath studies using spacecraft observations is also highly appropriate. The explanations provided regarding the numerical results of magnetosheath asymmetries of parameters (B, density, and velocity)

downstream of the Qpara and Qperp bow shock regions as a function of angle from the Sun-Earth line are plausible, though perhaps not the only possible explanations. Comparing the numerical simulation results with magnetosheath observations by the THEMIS spacecraft is also highly appropriate.

There are two significant concerns with the manner in which the study results are presented. These ought to be fairly easily addressed, but are important because they directly affect most of the figures and results presented in this study:

1) Magnetosheath parameters determined from the numerical simulations within each spatial bin and for the time interval used are presented as averages; whereas the magnetosheath parameters determined from spacecraft observations are presented as medians. In order to ensure that the comparisons between simulations and observations are meaningful, the same statistical measure should be used for both (ideally medians, to avoid outlier kinetic effects due to processes at the bow shock convected into specific magnetosheath bins from unduly influencing the overall average value). An alternative is to demonstrate that within the magnetosheath bins, the distribution of values used to determine the spatial and temporal average is Gaussian, so that the average and median values are the same.

2) It is difficult to judge the robustness of the results, because there are no estimates of the statistical spread (uncertainties) associated with the averages (or medians). From the simulations, sampling in appropriately sized sub-spatial and sub-temporal bins to provide e.g., standard deviations (or quartiles) used in the estimate of the asymmetry would instill considerable confidence that the percentage of asymmetry results are robust. Similarly for the THEMIS observations, it would be more appropriate if statistical estimates representing the range of values within each bin are determined and then used to estimate the range of values (measure of uncertainty) for the percentages of asymmetry for the various plasma parameters.

Minor issues:

Line 268: considerable -> considerably

Figure 4: Should label which side of the plot corresponds to Qpara, and which side corresponds to Qperp.

Line 341: magnetosheah -> magnetosheath

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