

Interactive comment on “Hybrid-Vlasov modelling of nightside auroral proton precipitation during southward interplanetary magnetic field conditions” by Maxime Grandin et al.

Anonymous Referee #2

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The manuscript deals with the nightside proton precipitation, focusing on the perspective of the magnetosphere, by using Vlasiator, a global kinetic hybrid simulation of the near-Earth environment. The authors found a good agreement in terms of differential number fluxes and energies, compared to the empirical Hardy model. The proton precipitations are observed as burst events and, in some cases, they can be traced back to the current sheet in the magnetotail and associated with depolarising flux bundles.

The paper brings interesting results and can be acceptable for publication after some clarifications.

1. In my opinion, the authors should justify the resolutions chosen for the simulation

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in terms of characteristic plasma quantities. In particular, in order to comment on the physical space resolution, what is the value for the ion inertial length? or Larmor radius? Since the proton precipitation is produced by the magnetic reconnection in the magnetotail, how thin is the current sheet? And, in a similar way, the authors should comment on the velocity space resolution. In this respect, what is the value for the Alfvén speed?

2. In the inner boundary, protons are described with a static Maxwellian VDF. This means that here kinetic effects are neglected. However, the observed VDFs close to the inner boundary, for example in S2 (Fig.3), are strongly non Maxwellian during the precipitation. I am wondering if the imposed sharp change in the VDF could influence the results. Could the authors comment on this point?

3. One of the hypotheses used to evaluate the directional differential particle flux is that 'protons remain attached to a given magnetic flux tube'. However, during a magnetic reconnection event this is not exactly true. Although the locations in the magnetosphere are chosen far from the X-point, I am wondering if the change in the magnetic topology can have effects also at these points for the analysis.

4. During the phase 2, the orbit of the NASA-MMS mission was chosen to spend time on the night side of the Earth's magnetosphere. Did the authors check if there are any datasets able to support their results?

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