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

Anonymous Referee #1

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This is interesting and important study of ion precipitations in the magnetotail. Authors use quite developed simulation tool to check the effect of fast plasma flows on formation of precipitating ion fluxes. The brief comparison of simulation results and published observational data shows a reasonable agreement. I believe this paper should be published in Angeo after Authors address several (quite minor) questions.

Introduction: there are several important references related to proton aurora investigations that may be included: 10.1029/2008JA013099, 10.1134/S001679321805016X, 10.1134/S0016793218040114

Page 7, eq. (8): this equations assume that ion energy is conversed along the bounce

trajectory, i.e. there is no field-aligned electric fields in the system. It would be useful to show 2D plot with the parallel electric field distribution and quickly discuss the weakness of this electric field effect on ion dynamics.

Page 8, Line 17: <1o of the loss-cone is an estimate based on nondisturbed magnetic field models. It would be useful to provide also a loss-cone estimate for magnetic field enhancements at the dipolarization front accompanied fast flows (where Bz is significantly larger than the magnetotial Bz)

Page 17, Lines 1-5: Previous models of pitch-angle scattering (e.g., Sergeev and Tsyganenko, 1982) were developed for the quiet time magnetotail current sheet, whereas in this paper Authors consider ion precipitation from the acceleration (fast plasma flow) region, what is closer to simulation results shown in 10.1029/2012JA018171, 10.1029/2012JA017677. Any relations to pitch-angle scattering on the magnetic field line curvature should be confirmed by corresponding estimates of the kappa parameter, e.g. kappa dependence on x and time would support Authors' conclusions.

There are two model features that require some explanations/discussions: Figure 3: what is a local temperature minimum around S1 position? Temperatures earthward and tailward from S1 are higher than in the S1 location. Is there any analogy of such temperature minimum in the statistical spacecraft observations? As I know, the temperature profile along the magnetotail is generally monotonous (see, e.g., 10.1029/2008JA013849, 10.1002/2016JA023710.)

Figure 4: some of shown distributions are definitely unstable (they contain ion beams with positive slobs along the parallel velocity direction). Thus, some discussion is needed to explain if these instabilities are too slow to influence ion distributions or they are simply suppressed in the numerical calculations.

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