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Reply on RC1

James H. Lane et al.

Author comment on "Dynamics of variable dusk–dawn flow associated with magnetotail current sheet flapping" by James H. Lane et al., Ann. Geophys. Discuss., https://doi.org/10.5194/angeo-2021-32-AC1, 2021

We would like to thank the reviewer for their careful consideration of the manuscript and their valuable comments. The reviewer raises only two concerns which we believe are easily addressed. Our responses are provided below.

Comment 1: *First, the case locates at the dusk side of magnetotail where magnetic fields have strong positive/negative Y component. So that is not good place to estimate the little IMF By effect on the process at the magnetotail*

Response 1: We agree with the reviewer that the effect of magnetotail flaring towards the dusk-dawn flanks is apparent (Fig. 5 in the manuscript, and the C2-C4 data during the flapping interval). We haven't purposely chosen this location to try and estimate any IMF B_y effects. We are investigating an interval of current sheet flapping (occurring at this location) and have considered that there might be an IMF B_y effect. Previous studies such as Pitkänen et al. (2013, 2017) have investigated IMF B_y control of magnetotail flows at up to ~ 7 R_E towards the dusk-dawn flanks which revealed a clear dependence of the flows on IMF B_y. Based on this, it was clear that we should consider the possible effects of IMF B_y on the

convection observed at the location of Cluster in our study. According to the model data we

present (Fig. 5), there is definite evidence of IMF $B_y > 0$ penetration (locally), highlighted by

the fact that the SC observed $B_y = 0$ when $B_x = 0$ prior to the flapping interval (lines 520-532).

Whether this is governing the nature of the convection (locally), however, is another matter

(discussed below in response to comment 2).

Comment 2: *Second, the IMF penetration and the polar convection are the process in global*

scale, while the dusk- dawn flow associated with current sheet in this case is at much less

scale. So the analysis of IMF and polar convection can not support inconsistency between the

expected By in current sheet and the observed By during the crossing of current sheet.

Response 2: In our study, the flows observed by C1 during the flapping would have been

consistent with IMF B_y control if we had a situation where IMF $B_y < 0$ penetration had

occurred (lines 351-355). This motivates our reasoning for needing to look on a global scale,

so we use the IMF and SuperDARN data to demonstrate what the sense of the large-scale

magnetospheric asymmetry is. This data tells us what (if any) sense of IMF B_y has

penetrated into the magnetosphere, and conveys that it is definitely not IMF $B_y < 0$; in-fact,

it is consistent with IMF $B_y > 0$. This is a critical detail, because it means that the observed

dusk-dawn flow associated with the current sheet flapping is therefore definitely not IMF B_y

controlled. It is an important distinction that we do not use the IMF and polar convection

data to interpret the dynamic behaviour of the plasma and magnetic field that is occurring

in the current sheet. Instead, we separately examine whether the current sheet flapping

might be responsible for driving the variable dusk-dawn flow. The negative B_y perturbations

observed by C1 during the flapping are consistent with perturbations in the dusk-dawn flow

(lines 280-281), and are clearly unrelated to any IMF B_y-effect.