Auxiliary material for Paper 2014JA020401

The effect of magnetopause motion of fast mode resonance

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Introduction:

The auxiliary material contains three figures demonstrating the effects of grid resolution, the Boris correction, and numerical dissipation on the results of this study.

1. Auxiliary_Material_fs01.pdf - Auxiliary material, Figure 1: From left to right, SM xy plane grid resolution is indicated using color for three different grids.

2. Auxiliary_Material_fs02.pdf - Auxiliary material, Figure 2: Left) A comparison between the power spectral density of the east-west electric field perturbation at r=(6,0,0) Re in the simulation for the three different grids shown in Figure 1 (grid 1 is on the left, grid 2 in the middle, grid 3 on the right) and an additional grid identical to grid 1 except all regions with cell dimensions of 1/8 Re are replaced with 1/4 Re cells. Identical driving conditions and Boris correction=0.02 are used in all cases. Frequencies below roughly 20 mHz are relatively unaffected by the grid resolution, but higher frequencies are substantially attenuated in grids 1 (both 1/4 and 1/8 Re) and 2 compared to grid 3. This is caused by the attenuation of small spatial structures/high frequency variations in the solar wind density as they propagate from the outer boundary to the bow shock, as we show in Figure 3 of the auxiliary material. The fact that PSD below 20 mHz is not substantially different between these cases indicates that grid 3 can be used for this study without concern that the simulated FMR wave properties would change substantially if a higher resolution grid were used. Right) The same as on the left, but for three different values of the Boris correction (but identical driving conditions and all using grid 3). Compared to the grid resolution effects, the Boris correction has very little effect on wave properties observed in the magnetosphere. Note that this may only be true for the FMR waves that are the focus of this study – waves that are more strongly coupled to the ionosphere than FMR, such as standing Alfven waves, would likely be more strongly affected by this correction factor (since the Alfven speed is much larger at the inner boundary).

3. Auxiliary_material_fs03.pdf - Auxiliary material, Figure 3: This figure explores the reason for the attenuation of higher frequency perturbations (>20 mHz) shown in Figure 2 of the auxiliary material (and Figure 2B in the manuscript) for the lower resolution grids. Left) The power spectral density of solar wind density fluctuations is shown versus frequency at the outer boundary (black line), r=(30,0,0) Re (blue line), r=(25,0,0) Re (green line), and r=(20,0,0) Re (red line). The high frequency power spectral density is smaller at larger distances from the outer boundary. This is because high frequencies correspond to small spatial structures in the solar wind rest frame; these smaller structures are not completely resolved by the 1/8 Re grid cells. Right) The power spectral density of solar wind density fluctuations is shown versus frequency at the outer boundary (black line), and at r=(20,0,0) Re for grid 2 (blue line) and grid 3 (red line). Grid 3 has smaller grid cells near the outer boundary, enabling it to better resolve the smaller scale density structures in the solar wind and thus leading to higher power spectral densities (relative to grid 2) at higher frequencies.