Wave Propagation and Global Implications of Magnetopause Surface Eigenmodes

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Using global magnetohydrodynamic simulations we investigate the recently discovered eigenmode of the magnetopause surface – the natural response of the boundary to impulsive solar wind transients. We show that following the directly driven motion of the magnetopause by a pressure pulse, decaying oscillations of the boundary follow in agreement with theoretical predications and previous simulations of the magnetopause surface eigenmode. Across the equatorial magnetosphere these oscillations originate at the subsolar point and maintain a near-constant frequency through all local times, though into the flanks a secondary higher-frequency signal emerges consistent with the expectations of Kelvin-Helmholtz generated surface waves. Focusing only on the eigenmode shows its amplitude grows with local time away from the subsolar point, with the waves showing no azimuthal propagation in the region 9-15h MLT – surprising given the convecting effect downtail of the magnetosheath flow. In the noon-midnight meridian the eigenmode is confined to the dayside magnetosphere. Comparing these results to MHD theory, we propose how the structure of the magnetopause surface eigenmode is determined by the properties of the magnetospheric system and how it may influence global dynamics during impulsive events.