3-D Global Hybrid Simulation of Dayside Dynamics Associated With the Quasi-Parallel Bow Shock

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A 3-D global-scale hybrid simulation is carried out for dynamics of the dayside bow shock-magnetosphere system associated with the quasi-parallel bow shock. A case with IMF along the Sun-Earth line is examined in detail. First, the foreshock waves and the associated shock reformation process are investigated. In particular, the generation and structure of diamagnetic cavities, with a decrease in the magnetic field and density, in the foreshock of the quasi-parallel shock are discussed. Second, the interaction of the foreshock-originated pressure pulses with the dayside magnetosphere is simulated. The diamagnetic cavities that are generated in the turbulent foreshock due to the ion beam plasma interaction are found to lead to strong surface perturbations at the magnetopause. Third, the coupling between the pressure pulses and the magnetosphere is studied. The compressional waves are found to mode convert to shear Alfvén waves and kinetic Alfvén waves (KAWs) through the Alfvén resonance process in nonuniform plasmas. The shear Alfvén waves lead to field line resonance, which corresponds to the fundamental odd resonance wave number, and produce field-aligned currents in the dipole magnetospheric field.