Analysis of Modeled Magnetospheric Current Systems of Mercury for Low Internal Dipole Fields and Various Solar Wind Pressures

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Mercury is embedded in the most dynamic heliospheric space environment of all planets. The solar wind and IMF conditions do not only permeate the magnetosphere but also control the magnetospheric current systems, resulting in highly-variable magnetic fields within the magnetosphere. The determination of Mercury's intrinsic magnetic field is thus a challenging endeavor even for planetary orbiters such as the MESSENGER spacecraft, en-route to Mercury, and the upcoming BepiColombo spacecrafts. Magnetospheric magnetic field models and global simulations represent a guide for the analysis of the external field, but they have to be employed with caution. The adaptation of terrestrial models to Mercury's magnetosphere is problematic since the solar wind and IMF conditions at Mercury are fundamentally different from those at Earth so that the models are frequently operated at the limit or beyond their validated parameters space. Furthermore, due to the small size of the magnetosphere, one cannot exclusively rely on MHDsimulations but has to employ full-particle or at least hybrid simulation techniques. The internal dipole field strength constitutes an important input parameter to models and simulations. Since the magnetospheric currents extend throughout the magnetosphere and to low altitudes, the classical separation of the magnetic field into internal and external contributions could be difficult to achieve. We compare different adapted magnetospheric models and hybrid simulations and present how well they capture the current systems for various strengths of the planetary dipole moment and a range of solar wind pressures. From the simulation results we infer the respective contributions of the magnetospheric current systems to the external magnetic field spectrum at the planetary surface.