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Quasi-static modeling of the magnetosphere: first three-dimensional results from a coupled model

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In the absence of strong flows, the magnetic (Lorentz) forces are almost balanced by plasma pressure gradient forces in the magnetosphere, leading to a "quasi-static" equilibrium situation. The very evolution of the magnetosphere (excluding explosive events such as substorms) can then be portrayed as a time sequence of equilibrium "snapshots." In order to globally model such equilibria, we have started to develop a comprehensive magnetospheric equilibrium model, by coupling a 3-D numerical equilibrium code in flux coordinates *[Cheng, 1995, Zaharia et al., 2004]* covering the inner/middle magnetosphere with an asymptotic "tail equilibrium" approach *[Birn, 1987]*. In both models the magnetic field is represented in terms of Euler potentials (i.e. explicit field line representation), facilitating the coupling via a "line-tying" approach. In the work presented here we extend the two-dimensional coupling previously achieved by line tying to the full three-dimensional case (with still some limitations on the total pressure function in the tail region, which will be discussed). In particular, we present the solutions obtained by solving a boundary value problem, in which the shape of an outer magnetic flux boundary (from an empirical magnetic field model) is specified, along with realistic plasma pressure distributions. We compare the resulting global equilibrium configurations with observations, as well as with previously obtained results in the interior region and the magnetotail.