STRONG MAGNETIC FLUX SPOTS AND THE CORE FLOW NEAR THE CORE-MANTLE BOUNDARY

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Observations over the past 400 years show strong magnetic flux spots near the equatorial regions at the core-mantle boundary (CMB) that have not been clearly identified in numerical dynamo simulation. To understand the mechanisms responsible for the observed equatorial flux spots, we employ a sequential data assimilation algorithm to integrate surface geomagnetic observations over the past 400 years with our MoSST core dynamics model with two different lower mantle: a weak electrically conducting D"-layer at the top of the core-mantle boundary (CMB), and an electrically s]insulating mantle. The assimilated results with a conducting D"-layer show significant changes in the toroidal field near the top of the outer core: strong radial electrical current densities appear in the region of the equatorial magnetic flux spots across the CMB. Consequently, the Lorentz force associated with these features is very strong, with a magnitude nearly 50% of the Coriolis force near the CMB. These results suggest that the strong equatorial magnetic flux spots may arise from strong electrical currents across the CMB. In addition, appropriate inversion of the core flow in these regions may need new approaches different from the tangential geostrophic approximation.

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