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Simulation of the global ocean-induced magnetic field for a spherically symmetric model of electrical conductivity

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Numerical model simulations are performed for better understanding the influence of ocean dynamics on the Earth's magnetic field and therefore, may help to identify and interpret the magnetic field observed by the Swarm satellites. The finite-thickness ocean layer with realistic ocean dynamics is used as a source of volumetric electric currents for inducing the magnetic field. The ocean and Earth's mantle electrical conductivity is modelled by a realistic radial profile. We compute the primary poloidal magnetic field component generated by horizontal electric currents in oceans, but also the toroidal component induced by vertical electric currents with the possibility including vertical gradient of the horizontal ocean flow. Although this primary toroidal magnetic field can not be observed outside the ocean, it couples with the strong conductivity contrast between the oceans and continents and generates a secondary poloidal magnetic field. The particular magnetic field components induced by M2 tidal ocean dynamics are calculated independently by the matrix-propagator technique and spectral-finite element approach and shows a good agreement.