Numerical simulation of magnetic field variation associated with equatorial plasma bubble

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Equatorial plasma bubble (EPB) is a well-known phenomenon in the equatorial ionospheric F region. As it causes severe scintillation in the amplitude and phase of radio signals, it is important to understand and forecast the occurrence of EPB from a space weather point of view. The development of EPB is known as a evolution of the generalized Rayleigh-Taylor instability. We have developed a new 3D high-resolution bubble (HIRB) model for EPB and presented nonlinear growth of EPB which shows very turbulent internal structures such as bifurcation and pinching. Recently, it has been reported that high-resolution magnetometer onboard low Earth orbit satellites such as CHAMP and Swarm can detect small-scale magnetic field perturbation associated with EPBs. It is interpreted as the diamagnetic effect produced by pressure gradient-driven current, and field-aligned current flowing along the walls of EPBs. We have upgraded the 3D numerical simulation model by removing the equipotential magnetic field assumption so that 3D current distribution can be calculated. The magnetic field variations produced by the current associated with EPBs are consistent with the in situ observations and expected physical models. It is also important for internal magnetic field modeling because such magnetic field variations are comparable to that of the lithospheric contribution.

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