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Equatorial magnetic Rossby waves — evidence for a thin, strongly-buoyant stratified layer in earth's core

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A low density stratified layer at the top of Earth's core has been proposed by many authors on the basis of chemical and thermodynamic arguments and has implications for Earth's thermal history, core energetics, and core-mantle interactions. Past studies claiming to detect a layer using perturbations in seismic wave speeds are contentious due to the extremely small magnitude of the detected signal. Recently, several studies have instead argued for the existence of a stratified layer by hypothesizing that oscillations in the observed geomagnetic field arise from waves propagating in the layer. In particular, $\sim$60 year oscillations in dipole strength have been attributed to global MAC waves, and $\sim$8 year oscillations of secular acceleration have been attributed to equatorially-trapped waves. We use a new hybrid finite-volume and Fourier numerical method we developed to model magnetohydrodynamic waves in a thin layer and show that a thin, strongly buoyant layer can produce equatorially-trapped waves with similar structures and periods to the observed $\sim$8 year signal. Using these simulated wave structures, we provide additional evidence for the existence of several propagating wave modes and place constraints on estimates for the wave periods, stratified layer thickness, and strength of buoyancy within the layer.