GP43B-0803 - Complex wave decomposition of geomagnetic secular acceleration in the equatorial region of Earth's core.

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Recent satellite missions have detected short pulses of magnetic secular acceleration in the equatorial region of Earth's core (Chulliat et al., 2010; Finlay et al., 2016). The new data provide an opportunity to detect dynamics in the Earth's core on short timescales. To interpret these signals, we require a technique to separate distinct wave motions. The standard method, called Empirical Orthogonal Function (EOF), applies only to standing waves. An extension to deal with traveling waves (known as complex - EOF) relies on a Hilbert transform of the dataset before applying the EOF methodology (Horel, 1984; Susalito, 1994). This technique allows us to extract the period (T), the angular wave number (m) and the phase velocity (v), based solely on information in the CHAOS-6 model. We focused on two equatorial regions; one centered on Southeast Asia and the other on the Caribbean. The first two complex - EOFs in both regions account for over 90% of the signal. We find two eastward traveling waves in the Southeast Asia region (T_{mode1}=16.2 years, T_{mode2}=9.1 years, v_{mode1} = 3.5 ± 0.7 degrees/year, v_{mode2} = 7.1± 1.8 degrees/year and m_{mode1}=m_{mode2}=6). In the Caribbean region, the first mode represents a westward traveling wave (T_{mode1} =6.7 years, v_{mode1} = -7.0 ±0.4 degrees/year and m_{mode1} = 6). The second mode appears to be a standing wave with a complicated spatial pattern. Extending our analysis beyond ±20º latitude causes a gradual loss of coherence, suggesting that the waves are confined to the equator, consistent with predictions for equatorially trapped MAC waves. In fact, both of the eastward waves in Southeast Asia are compatible with a thin layer of strongly stratified fluid in the outer 28 km of the Earth's core. Confirmation of this result will require forward models to predict the magnetic secular acceleration expected from equatorially trapped MAC waves. As future work, we propose to use these forward models to reconstruct the CHAOS-6 model in the two equatorial windows.