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First direct observation of the F region dynamo currents by CHAMP

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The satellite CHAMP in its low-altitude polar orbit, and with its high-resolution magnetic field measurements, provides the opportunity to investigate ionospheric currents in great detail. In this study we focus on average features of equatorial current systems during day time. Considering quiet time observations from the period Aug. 2000 to Oct. 2004 we determined the average characteristics of the F region dynamo. Although having been predicted long ago (Rishbeth, 1971), these currents are observed now for the first time at all local times. The only comparable observations have been obtained by Magsat (Takeda and Maeda, 1983), but they were limited to the1800 local time sector. Thermospheric zonal winds blowing away from the thermally driven pressure peak in the afternoon set up vertical electric fields over the equator. The resulting meridional current system, driven by the westward thermospheric wind, becomes strongest around noon. Similar meridional currents, but flowing in the opposite direction, are caused by eastward winds. This kind of system is observed from the early evening hours until midnight. It peaks shortly after sunset. At CHAMP altitudes (about 420km) in the F region over the dip equator we find vertical sheet currents. During the first part of the day they are oriented downward attaining average current densities of 6 mA/m at noon. We observe upward currents densities of 4 mA/ after sunset. From these deduced current densities other key parameters like vertical E-field or flux tube conductance can be estimated.