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Characterisation of auroral current systems in Saturn's magnetosphere: High-latitude Cassini observations

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We present observations from the high-latitude phases of the Cassini mission during which the azimuthal field component exhibits the signature of field aligned currents flowing between the magnetosphere and ionosphere. For the high-latitude orbits between mid-2006 and mid-2007, we have identified field aligned currents from seven periapsis passes. We will compare the observations of the mainly dayside field aligned currents from 2006/2007 with those observed during the high-latitude orbits in 2008, where the encounters with the northern and southern hemisphere field-aligned currents occurred at nightside local times. For the 2006/2007 orbits in the southern hemisphere, it is found that an intense layer of upward-directed field aligned current occurs on closed field lines in the dawn and pre noon sector immediately adjacent to the open-closed field line boundary as the strongly 'lagging' field consistently observed on southern open field lines first declines, and then (usually) reverses to a 'leading' configuration. 'Lagging' and 'leading' fields are generally indicative of plasma sub- and super-corotation, respectively. These 'leading' fields then decline sharply to smaller values further inside the boundary, indicative of intense downward field aligned currents as the plasma reverts to near-corotational flow, the magnitude of the field change being dependent on the phase of the planetary-period oscillation in the interior region. We show that the region of upward current is co-located with the statistical UV auroral oval, while the downward current immediately equatorward maps to the outer ring current in the equatorial magnetosphere. Continuing with the observations from 2006/2007 in the northern hemisphere at dusk and pre-midnight local times, only weak azimuthal fields are observed on open field lines, while stronger 'lagging' fields are observed immediately equatorward in the closed field region, indicative of downward current just inside the open-closed field line boundary, and upward current in the interior region where this layer interfaces with the region containing the planetary-period oscillations.