Geophysical Research Abstracts,
Vol. 10, EGU2008-A-07097, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-07097
EGU General Assembly 2008

Influence of plasma sheet density, temperature and local time distribution on the proton ring current strength and morphology

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The ring current strongly depends upon the properties of the plasma injected from the magnetotail. The present work is motivated by the knowledge that this typically hot and tenuous plasma can, at times, (1) be substantially colder and denser, and (2) be injected at varying local times, with recent observations suggesting a cold-dense plasma source at dawn of geosynchronous orbit during storms. We have run a kinetic model of the ring current with different plasma sheet boundary conditions to test the systematic influence of these varying conditions on the ring current strength and morphology. We show in particular that a cold-dense plasma sheet is more geo-effective than a hot-tenuous one, as has been suggested by observations, and that the local time distribution of the injected plasma is of prime importance, in particular for its morphology. While cold and dense plasma may convect deep inside the ring current region, hotter plasma is more subject to magnetic drifts and quickly drifts toward dusk with lower energization. These modeling results illustrate how both the presence and location of a cold-dense plasma sources in the magnetotail influence the ring current during an ensuing storm.