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Links between the plasmopause and the radiation belts boundaries as observed by Cluster instruments

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The Cluster mission offers the exceptional opportunity to study the relations between the position of the plasmopause and the position of the radiation belt boundaries with identical sensors on multiple spacecraft. We compare the positions of the radiation belt edges deduced from CIS observations (electrons with energy larger than 2 MeV) with the positions of the plasmopause derived from WHISPER data (electron plasma frequency). In addition, we compare those results with the boundary positions determined from RAPID observations (electrons with energy between 244.1 and 406.5 keV).

The period of 1 April 2007 to 31 March 2009 has been chosen for the analysis because at that time Cluster's perigee was located at lower radial distances than during the earlier part of the mission (as close as 2 Re, deep inside the plasmasphere and the radiation belts). This time period corresponds to a long solar activity minimum.

Differences are observed between the radiation belt boundary positions obtained from the two different instruments: The radiation belt positions are related to the energy bands. The plasmopause position is more variable than the radiation belt boundary positions, especially during small geomagnetic activity enhancements. A correspondence is observed between the plasmopause position determined by WHISPER and the outer edge of the outer radiation belt of energetic electrons (> 2 MeV) observed by CIS. There may be an apparent contradiction with previous studies that indicated a correlation between the inner edge of the outer radiation belt and the plasmopause. Radiation belt losses through plasmaspheric waves, however, occur on a longer time scale and are longitudinally averaged because of energetic particle drift motion, so the radiation belt boundaries should not necessarily reflect the instantaneous plasmopause position at one particular local time. Moreover, during higher geomagnetic activity time periods, the plasmopause is located closer to the inner boundary of the outer radiation belt.