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Multi-point Observations of the Plasmasphere, Radiation Belts and Other Regions of the Magnetosphere

Viviane Pierrard* [(1,2)], Alexandre Winant[(1,2)], Edith Botek[(1)], and Jean-François Ripoll[(3,4)]
(1) Royal Belgian Institute for Space Aeronomy (BIRA-IASB), Space Physics and Solar-Terrestrial Center of Excellence, Brussels, Belgium; e-mail: viviane.pierrard@aeronomie.be; alexandre.winant@aeronomie.be; edith.botek@aeronomie.be
(2) Université Catholique de Louvain, Center for Space Radiations, Earth and Life Institute ELI-C, Louvain-La-Neuve, Belgium
(3) CEA, DAM, DIF, F-91297 Arpajon, France
(4) UPS, CEA, LMCE, 91680 Bruyères-le-Châtel, France

Comparisons of the observations from the NASA Van Allen Probes at Medium Earth Orbit (MEO) with those of different spacecraft like GOES at geostationary orbit, and ESA PROBA-V/EPT at Low Earth Orbit (LEO) allow us to study the inner magnetosphere, and especially the radiation belts and the plasmasphere, as well as their links with the ionosphere and auroral regions [1]. Combined with ground-based observations and the results of models, they give a global 3D-view of the magnetosphere and its dynamics during geomagnetic storms and substorms. We find that loss mechanisms of trapped electrons can be very different depending on the geomagnetic activity. Dropouts are visible at all energy during each storm from the different satellites. The Dst (Disturbance storm time) effect during the main phase of a geomagnetic storm results in an outward radial drift and a deceleration of the electrons. This outward drift motion is energy independent, but pitch angle dependent. At fixed L-shell, this causes a sharp decay of the LEO precipitating flux. The Dst effect, associated with magnetopause shadowing and radial diffusion can explain the main characteristics of outer radiation belt electron dropouts appearing at the beginning of storms. These instantaneous dropouts have to be distinguished from the gradual scattering that depopulates the slot region and the outer belt during the recovery period after a storm. Fokker-Planck simulations with event-driven diffusion coefficients of plasmaspheric waves at high temporal resolution can reproduce the slot formation and the gradual loss in the outer belt. The typical energy-dependence of these losses leads to the absence of scattering for relativistic and ultra-relativistic electrons in the outer belt, oppositely to dropouts.
Protons trapped in the inner belt are also observed by PROBA-V/EPT, as well as injections at high latitudes during Solar Energetic Particle events [2], as illustrated in Figure 1. In the South Atlantic Anomaly, some protons are lost at the edges of the proton belt due to geomagnetic storms and solar activity.

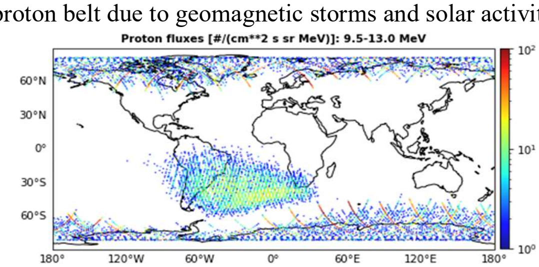

Figure 1. South Atlantic Anomaly and injection of protons at high latitude observed by PROBA-V/EPT from 20 to 30 June 2015 during a Solar Energetic Particle event.

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