Automated bow shock and radiation belt edge identification methods and their application for Cluster, THEMIS/ARTEMIS and Van Allen Probes data

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The bow shock and the outer rim of the outer radiation belt are detected automatically by our algorithm developed as a part of the Boundary Layer Identification Code Cluster Active Archive project. The radiation belt positions are determined from energized electron measurements working properly onboard all Cluster spacecraft. For bow shock identification we use magnetometer data and, when available, ion plasma instrument data. In addition, electrostatic wave instrument electron density, spacecraft potential measurements and wake indicator auxiliary data are also used so the events can be identified by all Cluster probes in highly redundant way, as the magnetometer and these instruments are still operational in all spacecraft. The capability and performance of the bow shock identification algorithm were tested using known bow shock crossing determined manually from January 29, 2002 to February 3,. The verification enabled 70% of the bow shock crossings to be identified automatically. The method shows high flexibility and it can be applied to observations from various spacecraft.

Now these tools have been applied to Time History of Events and Macroscale Interactions during Substorms (THEMIS)/Acceleration, Reconnection, Turbulence, and Electrodynamics of the Moon's Interaction with the Sun (ARTEMIS) magnetic field, plasma and spacecraft potential observations to identify bow shock crossings; and to Van Allen Probes supra-thermal electron observations to identify the edges of the radiation belt. The outcomes of the algorithms are checked manually and the parameters used to search for bow shock identification are refined.