



Major results of the MAARBLE project

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The goal of the MAARBLE (Monitoring, Analyzing and Assessing Radiation Belt Loss and Energization) project was to shed light on the ways the dynamic evolution of the Van Allen belts is influenced by low-frequency electromagnetic waves. MAARBLE was implemented by a consortium of seven institutions (five European, one Canadian and one US) with support from the European Community's Seventh Framework Programme. The MAARBLE project employed multi-spacecraft monitoring of the geospace environment, complemented by ground-based monitoring, in order to analyze and assess the physical mechanisms leading to radiation belt particle energisation and loss. Particular attention was paid to the role of ULF/VLF waves. Within MAARBLE we created a database containing properties of ULF and VLF waves, based on measurements from the Cluster, THEMIS and CHAMP missions and from the CARISMA and IMAGE ground magnetometer networks. The database is now available to the scientific community through the Cluster Science Archive as auxiliary content. Based on the wave database, a statistical model of the wave activity dependent on the level of geomagnetic activity, solar wind forcing, and magnetospheric region has been developed. Multi-spacecraft particle measurements have been incorporated into data assimilation tools, leading to a more accurate estimate of the state of the radiation belts. The synergy of wave and particle observations is in the core of MAARBLE research studies of radiation belt dynamics. Results and conclusions from these studies will be presented in this paper. The MAARBLE (Monitoring, Analyzing and Assessing Radiation Belt Energization and Loss) collaborative research project has received funding from the European Unions Seventh Framework Programme (FP7-SPACE 2011-1) under grant agreement no. 284520.

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