Acceleration and loss of relativistic electrons in the outer radiation belt: “recent scientific insights and modelling efforts”

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The dynamics of the outer radiation belt are driven by a complex interplay between acceleration and loss mechanisms leading to a broad energy range of energetic electrons. In addition, these physical mechanisms depend on the electron energy, the timescale, and the various types of geospace disturbances. Electric fields and plasma waves are the main factors regulating the electron transport, acceleration and loss, yet both of them are driven directly or indirectly by disturbances originating in the Sun, propagating through interplanetary space and impacting the Earth. Here we will discuss the current understanding of the response of the outer Van Allen belt electrons to various types of solar wind and internal magnetospheric forcing, to geospace magnetic storms of different intensities and to intense magnetospheric substorms using electron phase space density calculations as well as concurrent Pc5 and chorus wave activity observations during the Van Allen Probes era. Furthermore, we will discuss recent efforts for the nowcasting/forecasting of the response of the outer belt electron population using physics-based or data-driven model and we emphasize the importance of Machine Learning methods in improving the current models.