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Review of GEM Radiation Belt Dropout and Buildup Challenges

Weichao Tu (1), Wen Li (2), Steve Morley (3), and Jay Albert (4)

(1) West Virginia University, United States (wetu@mail.wvu.edu), (2) Boston University, United States (wenli77@bu.edu), (3) Los Alamos National Laboratory, United States (smorley@lanl.gov), (4) Air Force Research Laboratory, United States (jay.albert@us.af.mil)

In Summer 2015 the US NSF GEM (Geospace Environment Modeling) focus group named “Quantitative Assessment of Radiation Belt Modeling” started the “RB dropout” and “RB buildup” challenges, focused on quantitative modeling of the radiation belt buildups and dropouts. This is a community effort which includes selecting challenge events, gathering model inputs that are required to model the radiation belt dynamics during these events (e.g., various magnetospheric waves, plasmapause and density models, electron phase space density data), simulating the challenge events using different types of radiation belt models, and validating the model results by comparison to in situ observations of radiation belt electrons (from Van Allen Probes, THEMIS, GOES, LANL/GEO, etc). The goal is to quantitatively assess the relative importance of various acceleration, transport, and loss processes in the observed radiation belt dropouts and buildups. Since 2015, the community has selected four "challenge" events under four different categories: “storm-time enhancements”, “non-storm enhancements”, “storm-time dropouts”, and “non-storm dropouts”. Model inputs and data for each selected event have been coordinated and shared within the community to establish a common basis for simulations and testing. Modelers within and outside US with different types of radiation belt models (diffusion-type, diffusion-convection-type, test particle codes, etc.) have participated in our challenge and shared their simulation results and comparison with spacecraft measurements. Significant progress has been made in quantitative modeling of the radiation belt buildups and dropouts as well as accessing the modeling with new measures of model performance. In this presentation, I will review the activities from our “RB dropout” and “RB buildup” challenges and the progresses achieved in understanding radiation belt physics and improving model validation and verification.