Modeling the Convection Zone-to-Corona System over Global Spatial Scales

Abbett, William P. (1), abbett@ssl.berkeley; David J. Bercik (2); and George H. Fisher (1).
(1) Space Science Laboratory, University of California, Berkeley, CA, USA
(2) Dept. of Physics and Astronomy, Michigan State University, East. Lansing, MI, USA

How magnetic energy and flux emerges from the turbulent convective interior of the Sun into the solar atmosphere is of great importance to a number of challenging problems in Heliophysics. With the wealth of data from missions such as SDO, Hinode, and IRIS, it is evident that the dynamic interaction of magnetic structures at the photosphere and in the solar atmosphere occurs over a vast range of spatial and temporal scales. Emerging active regions often develop magnetic connections to other regions of activity some distance away on the solar disk, and always emerge into a global coronal field whose structural complexity is a function of the solar cycle. Yet even small-scale dynamic interactions (e.g., processes at granular or supergranular scales in the photosphere) can trigger rapid changes in the large-scale coronal field sufficient to power eruptive events such as coronal mass ejections, or solar flares. The challenge of modeling this system in its entirety is that the magnetic field not only spans multiple scales, but also regions whose physical conditions vary dramatically. In this overview, we will summarize recent progress in the effort to dynamically model the upper convection zone-to-corona system over large spatial scales, and will present the latest results from a new, global radiative-MHD model of the upper convection zone-to-corona system, RADMHD2S. We will characterize the flux of electromagnetic energy into the solar atmosphere as flux systems of different scales dynamically interact, and discuss how physics-based models of the convection zone-to-corona system can be used to guide the development and testing of data-driven models of CME initiation and propagation.