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Data-driven Three-Dimensional (3D) Global Magnetohydrodynamic (MHD) Model with Radiation to Study the Solar Atmospheric Dynamics[1]

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In this presentation, we describe a self-consistent, three-dimensional, global compressible, and resistive magnetohydrodynamic (MHD) model together with time-dependent boundary conditions based on the projected method of characteristics at the source surface (photosphere) to accommodate the observations. The additional physics included in this model are differential rotation, meridional flow, effective diffusion, and cyclonic turbulence effects in which the complex magnetic field structure can be generated through the nonlinear interactions between the plasma flows and magnetic field. To illustrate the capability of this model, we selected GONG's global transverse velocity measurements of synoptic chart CR2009 near the photosphere and SOLIS full-resolution LOS magnetic field maps of synoptic chart CR2009 on the photosphere as the inputs to drive the model to simulate the equilibrium state and compute the energy transport across the photosphere. To show the advantage of using both measured magnetic field and transverse velocity data, we have investigated two cases: (1) with the inputs of the LOS magnetic field and transverse velocity measurements, and (2) with the input of only the LOS magnetic field. For these two cases, the simulation results presented here are a three-dimensional coronal magnetic field configuration, density distribution on the photosphere and 1.5 solar radii, and the solar wind in the corona. The deduced physical characteristics are the total current helicity and the synthetic emission.

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