New Views of the Solar Atmosphere

Science Mission Directorate

Our research uses advanced, multi-dimensional, radiative magnetohydrodynamic (MHD) simulations to help advance our understanding of how the solar atmosphere is energized and how the solar wind is accelerated. Our work also helps explain the solar drivers of so-called space weather, which can affect the functioning and orbits of satellites and cause damage to electrical grids.

The chromosphere forms a violently dynamic interface between the Sun's surface and outer atmosphere. It is powered by the magnetoconvective energy that drives solar activity and space weather. Our understanding of this crucial region has been severely hampered by the challenging non-local and dynamic nature of the radiative environment.

We use MHD simulations to understand: the role of chromospheric heating and dynamics in the solar atmosphere; mass and energy transfer from the convection zone into the solar corona and solar wind; and the complex interaction of magnetic fields, hydrodynamics and radiation fields. Our results have highlighted the importance of Alfven waves and chromospheric spicules in energy and mass transfer in the solar atmosphere.

This work is part of the science investigation of NASA's Interface Region Imaging Spectrograph (IRIS) small explorer, due for launch in December 2012. Numerical modeling for this work demands supercomputing resources due to the complex radiative transfer and physical processes, and the enormous contrasts of density, temperature, and magnetic field within the interface region. As the physical complexity of simulations increases, so do the processor requirements—ranging from 1–5 million processor-hours per hour of solar time.

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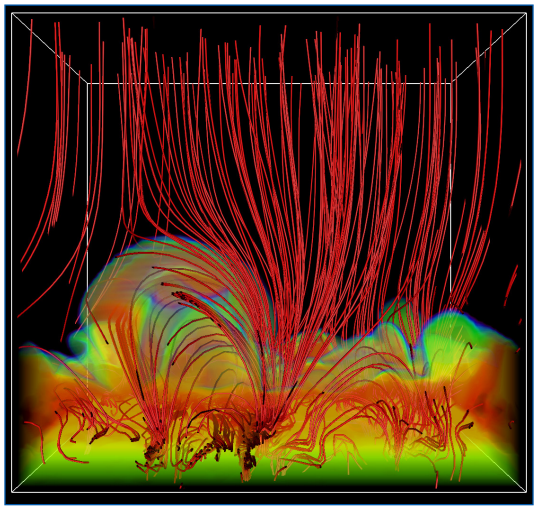

Magnetohydrodynamic (MHD) simulation from the convection zone (bottom), through the transition region (yellow-blue), to the corona. The atmosphere is permeated by magnetic fields (red lines) that sway, carrying enough energy from the convection engine to accelerate the solar wind. *Mats Carlsson, University of Oslo*