## Simulation of Events in the Solar Interior

### Science Mission Directorate

The Sun is by far the strongest external influence on Earth's climate, but its output varies over time in complex and poorly understood ways. Understanding the mechanisms that affect solar variation is critical to developing reliable, long-term predictions of climatic conditions and their effects on humanity. Solar variation is also important for assessing spaceflight risks due to space weather phenomena and for studying the evolution of planetary systems throughout the universe. To provide insight into these influential solar variation mechanisms, we are performing large-scale simulations of events in the solar interior, with results validated against space- and ground-based observations.

Fully nonlinear, radiative magnetohydrodynamic (MHD) simulations provide a means to investigate relatively small-scale but important solar phenomena, such as sunspots and other active regions. We have performed simulations of turbulent MHD processes in the Sun's upper connective boundary layer and lower atmosphere, which reveal an intense magnetic field concentration mechanism that may explain sunspot formation. Additionally, our simulations of magnetoacoustic wave propagation provide crucial validation and calibration for inferring conditions and events in the solar interior from helioseismology observations of solar oscillations.

Solar simulations such as these must be able to analyze long spans of time at very high spatial resolution, which requires substantial computing and data storage resources. NASA's state-of-the-art supercomputers provide the computational power, speed, and storage capacity needed to support these intensive solar simulation projects.

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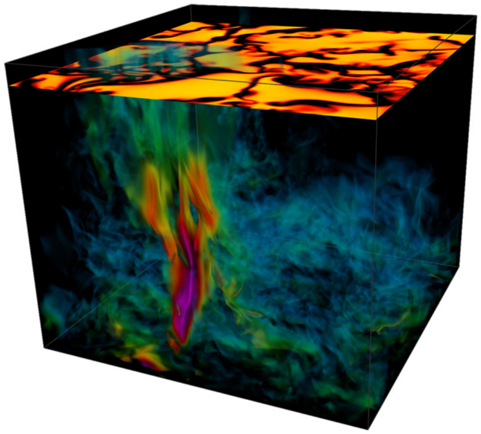

Realistic magnetohydrodynamic (MHD) simulation showing formation of a compact magnetic structure in the Sun's upper convective boundary layer. The image shows magnetic field strength, from 1,000 gauss (black) to 6,000 gauss (magenta), and solar surface temperatures above, from 4,000 Kelvin (black) to 8,000 Kelvin (yellow). *Irina Kitiashvili, Stanford University; Alan Wray, Timothy Sandstrom, NASA/Ames*