Project Details

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Project Title:
Developing Rapid Helioseismic Mapping of Evolving Solar Subsurface Weather and Magnetic Structures for SDO

PI Name: Bradley W. Hindman
PI Email: hindman@solarz.colorado.edu
Affiliation: University of Colorado, Boulder
Summary:
The high spatial and temporal resolution data to be provided by the Solar Dynamics Observatory (SDO) will lead to a new era of discovery about local dynamics and structure within the highly turbulent solar convection zone. Recently, local helioseismology applied to data from SOI-MDI on SOHO has revealed large-scale flow fields within the upper convection zone that are spatially intricate and evolve on a variety of time scales, changing from day-to-day as well as more gradually with advancing solar cycle. These weather-like flow patterns, now referred to as Solar Subsurface Weather (SSW), are crucial elements in the establishment of the sun's differential rotation and in the distribution and evolution of magnetic fields that emerge at the surface. The helioseismic imager aboard SDO will likely have fourfold better resolution than the full-disk field of SOI-MDI. This increased resolution coupled with uninterrupted observing will result in massive data sets (about 1 TB/day) and will present major challenges to measure SSW in a timely and continuous fashion. We propose to develop rapid ring-diagram analysis techniques capable of keeping pace with the data rate while mapping the flows over most of the solar disk and much of the near-surface rotational shear layer. We have identified three tasks necessary to achieve these objectives. The first is to characterize the flow properties at the high spatial and temporal resolution available with SDO. Using the high-resolution field of SOI-MDI as a proxy for SDO data, we will apply ring-diagram methods to a dense mosaic of tiles to study the spatial and temporal variability of SSW and to assess how these large-scale flows are modulated by the presence of magnetic structures. The second task is to develop new 3-D inversion procedures which take advantage of both small and large analysis tiles in order to observe SSW with the highest spatial resolution possible while simultaneously sampling deeply below the surface. The third task is to coordinate comparisons between ring-diagram, time distance, and correlation tracking methods. These tests will help establish the sensitivity and robustness of these complementary procedures to probe local dynamics. These efforts must start soon in order to develop, test, and implement the programs before SDO becomes operational.

Publication References:

Summary: ''

Reference: Developing Rapid Helioseismic Mapping of Evolving Solar Subsurface Weather and Magnetic Structures for SDO - Hindman, Bradley W. U. CO