Project Details

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Project Title:
Assessing Interactions Between Solar Subsurface Weather and Magnetism

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Summary:
The Helioseismic and Magnetic Imager (HMI) instrument to be flown on the Solar Dynamics Observatory (SDO) will enable continuous mapping of the vector magnetic fields in the atmosphere coupled with seismic measurement of complex large-scale flows over a range of depths below the solar surface using local helioseismic ring-diagram and time-distance methods. Such remarkable weather-like horizontal flows, now called Solar Subsurface Weather (SSW), were first revealed using SOI--MDI data from SOHO. SSW involves intricate flow patterns that can change from one day to the next, accompanied by more gradually evolving features such as banded zonal flows and meridional circulation cells. The SSW flows are of particular significance since they appear to interact and influence the magnetic fields visible at the surface, with active regions appearing as zones of convergent flow and possible subduction. Such subsurface flows can mechanically twist and displace field lines, possibly leading to unstable magnetic configurations that may flare or erupt as coronal mass ejections (CMEs). Preliminary helioseismic probing has revealed that at least one recent active region complex possessed strong inflowing streams just below the surface and prominent diverging flows at greater depths during an extended interval of flaring and CMEs. It is highly likely that such flows and magnetic fields are broadly linked in their evolution. In getting ready for the major data streams from HMI on SDO, we propose to investigate interactions between SSW and magnetism through two major tasks: (A) characterization of the flows associated with SSW in the vicinity of active regions using ring-diagram analyses applied to existing and future SOI--MDI data, (B) verification of these ring-diagram flow deductions through careful testing and detailed comparison with inferences drawn using time-distance analyses. These elements should provide the means to design optimal helioseismic analysis strategies for studying SSW in near real time in the vicinity of active complexes. Upon completion of these tasks, the HMI project should be able to implement these strategies into the data analysis pipelines in the two years prior to launch. This would ensure that the interaction of SSW flows with magnetic complexes can be studied in detail from the outset of the SDO mission.

Publication References:

Summary: "

Reference: Toomre, Juri U CO - Assessing Interactions Between Solar Subsurface Weather and Magnetism