Project Details

ROSES ID: NNH08ZDA001N
Selection Year: 2009
Program Element: Data, Tools, & Methods

Topic: Measure the properties of the solar dynamo that affect solar irradiance and active region generation.

Project Title:
Tools for Local Helioseismology

PI Name: Aaron Birch
PI Email: aaronb@cora.nwra.com
Affiliation: Colorado Research Associates, NWRA, Inc.
Project Member(s):
- Crouch, Ashley D; Co-I; NorthWest Research Associates
- Braun, Douglas C; Co-I; NorthWest Research Associates, Inc.
- Werne, Joseph ; Co-I; NorthWest Research Associates, Inc.

Summary:
We propose to develop and refine tools for the modeling and interpretation of local helioseismic measurements, in particular for time-distance, holography, and ring-diagram analysis. We will focus on tools for: (1) obtaining approximate solutions of forward problems, and (2) solving inverse problems. We will use numerical simulations of wave propagation and comparisons between different methods using MDI/SOHO and HMI/SDO data to validate these tools. The forward problem is to determine the helioseismic measurements that would be expected to result from known models of physical conditions in the solar interior (e.g., flows or local changes in sound speed). We propose to develop and deliver a code for efficient computation of forward problems in plane-parallel and spherical geometries, following Gizon & Birch (2002) and Birch and Gizon (2007). The inverse problem is to use helioseismic measurements to infer conditions in the solar interior. We will develop and deliver tools for: (1) optimally localized averaging (OLA) inversions of two-point travel times for studying small spatial scales, (2) joint inversions of multiple data types, and (3) inversions in spherical geometry. After validation, these codes will be delivered to the community by making them available in the HMI/SDO pipeline. In order to maximize the benefits of HMI/SDO to the LWS program it is crucial to advance our ability to interpret local helioseismic measurements. Some of the key problems of relevance to LWS which could be addressed using the tools proposed here are: (1) the detection of flows in the deep convection zone, this is centrally important to Focused Science Topic A: ``Measure the properties of the solar dynamo that affect solar irradiance and active region generation'' and (2) the detection of subsurface flows or sound-speed variations which may be precursors to active region emergence or evolution.

Publication References:

Summary: no summary

Reference: Gizon, Laurent; Birch, Aaron C.; Spruit, Henk C.; (2010), Local Helioseismology: Three-Dimensional Imaging of the Solar Interior, Annual Review of Astronomy and Astrophysics, vol. 48, p.289-338, doi: 10.1146/annurev-astro-082708-101722