Project Details

ROSES ID: NNH16ZDA001N
Selection Year: 2016
Program Element: Focused Science Topic

Topic: Advances Toward a Near Real Time Description of the Solar Atmosphere and Inner Heliosphere

Project Title:
FRAN: Fluxon Rapid Assimilative Nowcasting

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Summary:
Advances Toward a Near Real time Description of the Solar Atmosphere and Inner Heliosphere

We propose to adapt three current demonstrated analysis methods into a nowcasting facility for the solar wind near the Sun. The methods are:

- Fluxon modeling of global magnetic field evolution in the vicinity of the Sun

- Magnetic tracking of magnetic footpoints in photospheric magnetograms

- Direct, automated measurement of wind flow speed via Fourier speed filtering in coronagraph and heliospheric imager data

These three techniques, combined, have the potential to replace WSA with a more physics-based, integrative and assimilative model of the solar wind at the base of the heliosphere.

The fluxon model, FLUX, was developed at SwRI and treats the solar magnetic field as a skeleton of magnetic field lines, each of which supports a 1-D plasma model; this greatly reduces the computational load required to develop 3-D reduced-MHD coronal models, by eliminating numerical resistivity; the cost is that only discrete, and not continuous, reconnection can be modeled. The code is currently undergoing development, internally funded by SwRI, to produce quasi-smooth reconnection and enable global integrative simulation.

SWAMIS is a pioneering magnetic tracking code, that has been used for numerous applications but was originally developed specifically to drive global fluxon models.

Direct, measurement of wind speed via image speed-spectrum analysis was recently pioneered and demonstrated by the PI. We now propose to use it to integrate wind speed data into the suite of 1-D wind models embodied in a global fluxon simulation of the Sun. By evolving the model with input from SWAMIS and from routine coronagraph images, we will produce an improved nowcasting model that can be used to drive a heliospheric predictive simulation such as ENLIL.

We will disseminate the model to the community via CCMC and direct code distibution.

Relevance:

Our effort works directly to attack the problem of improved nowcasting of space weather, by: (1) producing a low-computational-cost physics based model of the corona that is intermediate in complexity between semi-analytic extrapolation (CSSS; WSA) and full 3-D simulation; (2) producing a new data product   wind speed extracted maps   from existing synoptic coronagraph data; (3) integrating those two elements; and (4) sharing both our integrated work and its components with the selected Focus Team.

Proposed Contributions to the Focus Team Effort:

We will work closely with the focus team, by:

- identifying further applications for the tracked magnetic data input;

- working to adapt and cross-compare our 1-D simulations with 3-D solutions used by the rest of the team

- sharing our ongoing wind-speed data for integration by other simulations to produce the best teamwide-integrated tool.

Publication References:

no references