Far-side Seismic Imaging of Active Regions: Progress Report

Irene González Hernández and the GONG and HMI far-side teams

National Solar Observatory, Tucson, AZ
Northwest Research Associates (CORA), Boulder, CO
Stanford University, Stanford, CA
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Helioseismic Imaging of the Farside


Helioseismic Imaging of the Farside

Phase of the Correlation

\[ C(r, z, \tau) = \int dt H_+(r, z, t) H_-(r, z, t + \tau) \]
Prediction capability

Active Region NOAA-10808

Aug 29 → Sep 9 2005 (GONG)

Carrington Longitude

Source: MLSO K-coronameter
Improving the far-side monitor

Users able to subscribe to alerts > %
The current far-side monitor

✓ Detecting medium size active regions ➔ Reducing the noise by combining consecutive, non-overlapping maps

✓ Calibrating in terms of magnetic field ➔ Comparison of seismic signature of active regions in the far-side with their front-side passage characteristics

✓ Removing the Solar Cycle variation

✓ Confidence Level

✓ Adding extra info on date of return and NOAA previous number if existed
Calibrating the far-side signal

Solar cycle variation of the “quiet Sun” in the far-side maps

Confidence Level

González Hernández, Hill, Scherrer, Lindsey, and Braun 2010 Space Weather Journal
New Calibrated Far-side maps

C. Long, Latitude Phase-shift Prob. Effective-Area Date-of-return Front-side-number
203.039993 -19.876875 -0.159418 87 84.239998 20100911 NOAA 11100
New Calibrated Far-side maps

Helioseismic far-side maps on the left and simultaneous STEREO behind observations of AR NOAA 11026 before it appeared on the front side of the Sun on September 21 2009

STEREO images from (http://stereo-ssc.nascom.nasa.gov)
On-going work

- Proper Area estimation
  - Front side study
- Detecting small active region
  - Combining maps from different instruments and calculated with different heliseismic methods
  - Combining maps calculated using different techniques
  - Improving the “greens functions”
- Integrated far-side index
“far-side” imaging of the near side

1 x 3 skip method actually extends well onto the near side!
Combining maps from different Instruments

GONG

060902

060903

MDI

060902

060903
Far-side maps from time-distance

GONG

MDI

September 03 2005

Seismic holography

NOAA 10308

Courtesy of Junwei Zhao
Can we improve the Green’s Functions?

- More realistic model
- Calibration of the dispersion
- Dispersion for several bounces
- Integrate signal from the full front side of the Sun

In collaboration with K. Jain, W. K. Tobiska and F. Hill

The Farside Magnetic Index (FSMI)

Comparison with front-side indexes: The graphic below shows simultaneous observations of Ly-\(\alpha\) (lasp.colorado.edu), \(F_{10}\) (www.ngdc.noaa.gov), the calculated Mount Wilson Sunspot Index (www.astro.ucla.edu) and the Far Side Magnetic Index. The sequence spans from October 2002 to December 2006. The different indexes have been scaled and shifted to aid the comparison.

In collaboration with K. Jain, W. K. Tobiska and F. Hill
Summary and Future Work

- **Current far-side maps:**
  - Detection of medium size AR
  - Automatic highlighting of candidates
  - Associated confidence level

- **Ongoing work:**
  - Area estimation
  - Detection of smaller AR (HMI+GONG)
  - Integrated index (FSMI)

- **Future work:**
  - Correcting sensitivity variation with location
  - Error estimation
  - Polarity