

Farside Imaging of the Sun

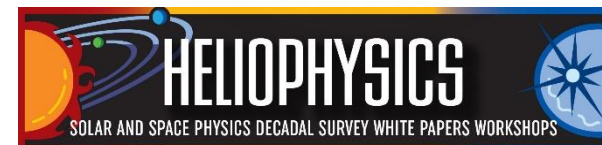
A Crucial Component in Future Space Weather Forecasting

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The Statement of Task

Improving the detectability of active regions in the far hemisphere, quantifying the probability of their emergence on the Earth-facing side of the Sun, and finally incorporating the farside information in magnetic field models for better characterization of EUV irradiance and flaring potential of active regions.

Category and Relevant Topics

Category:	Space Weather Applications
Primary Topic:	Solar Physics
Secondary Topic:	Space Weather Pipeline from Research to Application to Operations



Current Status: Farside Monitoring

Direct imaging from the space

STEREO

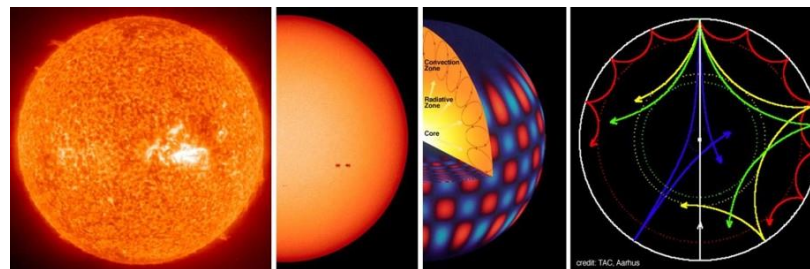


Solar Orbiter



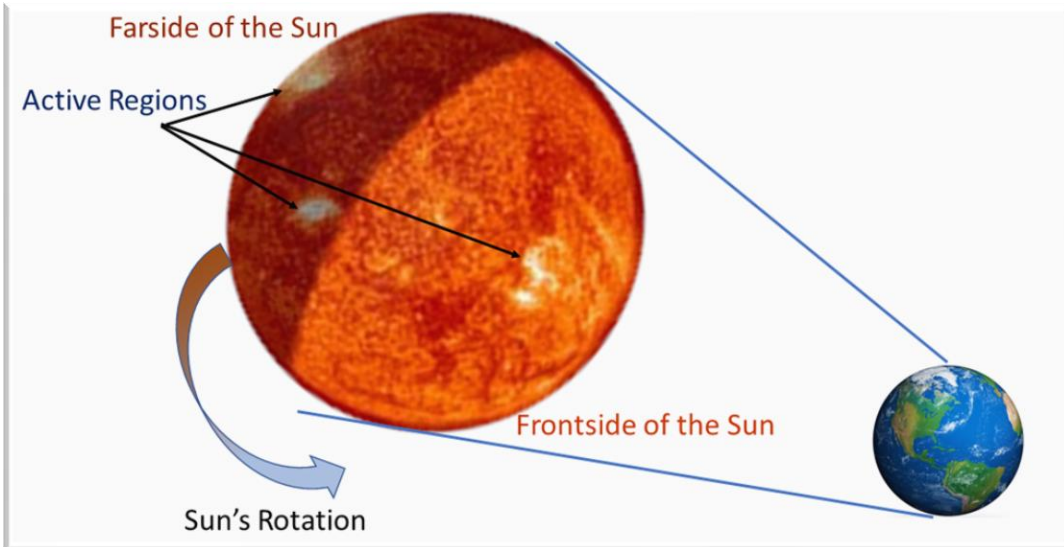
Indirect method using continuous, high-cadence full-disk Doppler observations from both ground-based **GONG** and space-borne **SDO/HMI**

Helioseismic Mapping



Thus, only helioseismic mapping provides the continuous monitoring of the full far hemisphere.

Why the Farside Monitoring of the Sun is important



Tracking solar activity on the invisible side of solar disk, e.g., emergence of active regions.

Important component in space weather prediction, e.g., solar storms.

Forecasting solar flares near the limb.

Forecasting solar irradiance for ionospheric modeling.

Studying global magnetic field and improving magnetic field models by tracking evolution of active regions in 360° Sun.



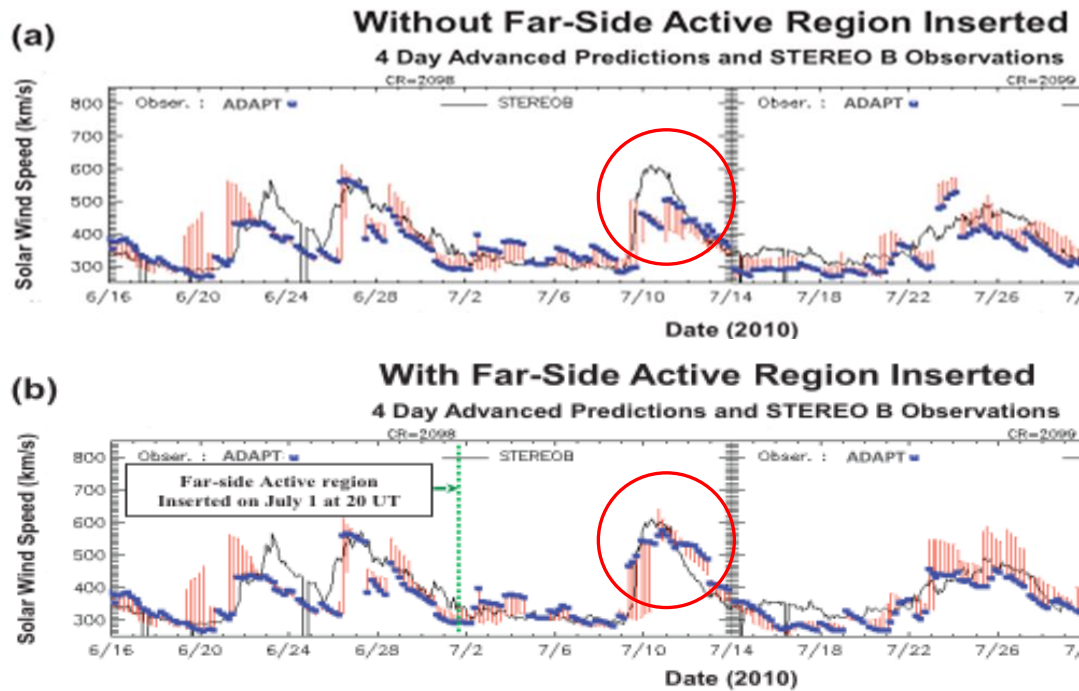
Space Weather Prediction: Solar Wind and Coronal Holes

Examples based on magnetic field from ADAPT model

Model: Wang-Sheeley-Arge (WSA)

Input: Solar global magnetic field

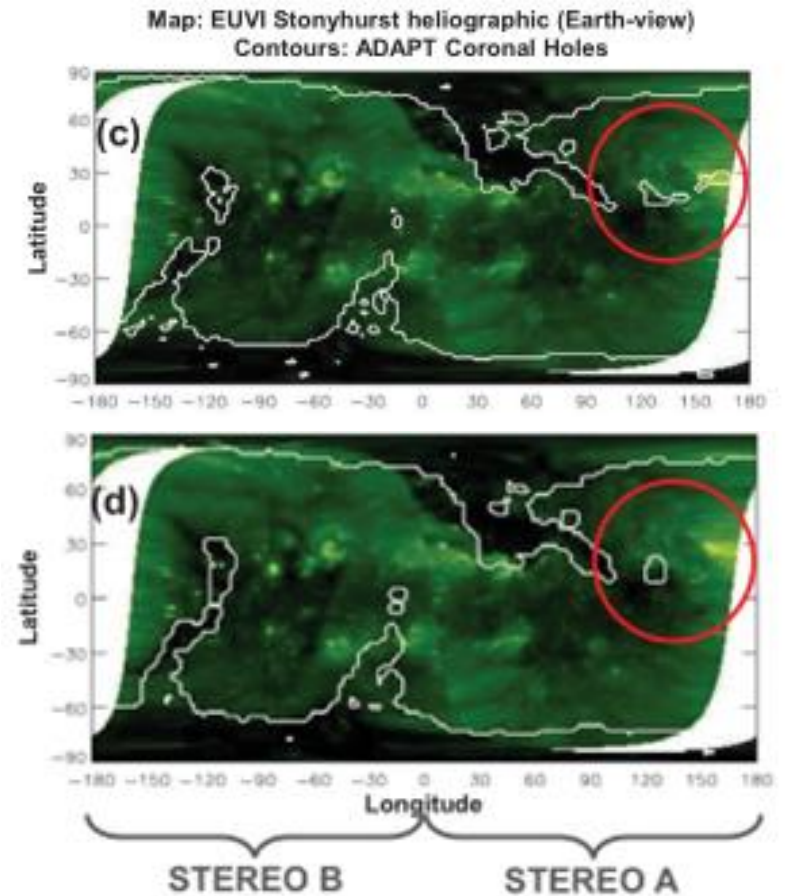
Solar Wind



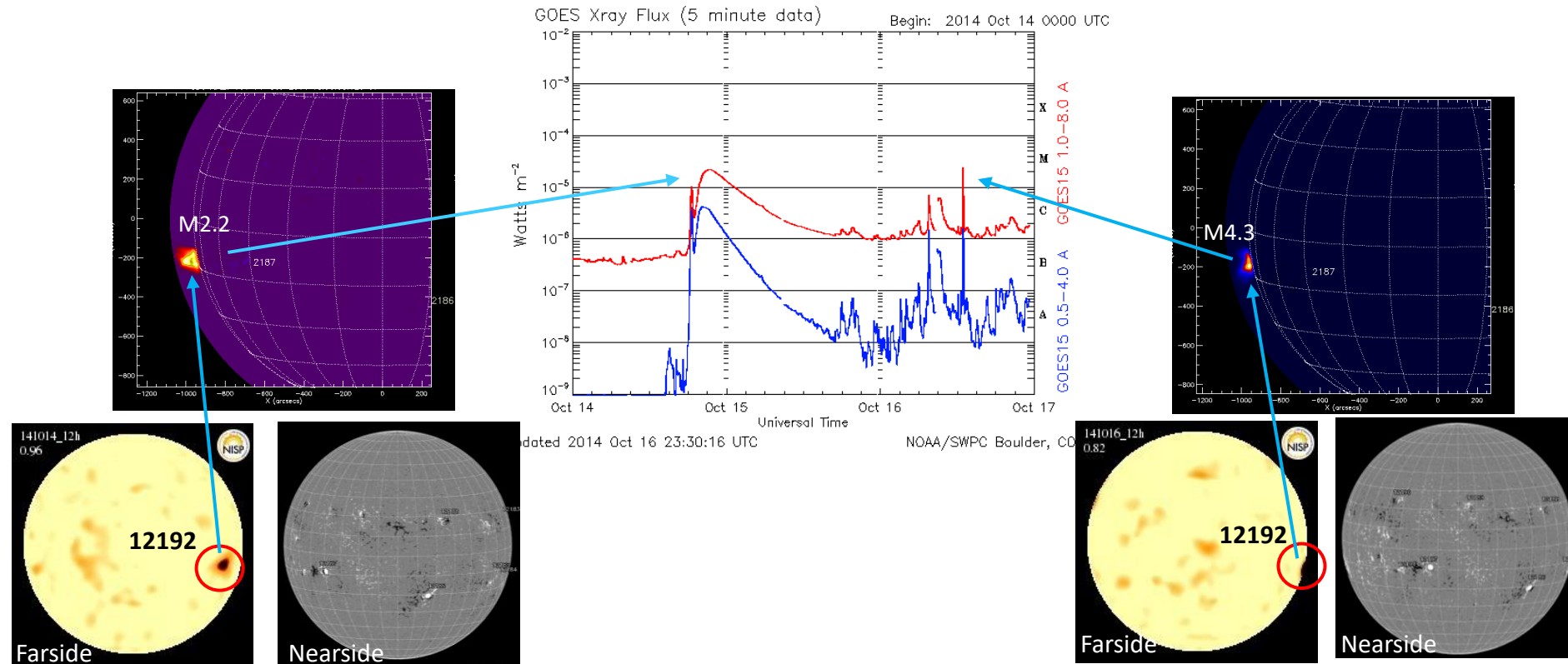
Without farside
active regions
included

With farside
active regions
included

Coronal Holes



Space Weather Prediction: Limb Flares and EUV Irradiance



- ✓ Nearside magnetograms coupled with farside active regions in the Flux transport model can be used to improve flare forecast near the limb...work in progress by Leka et al.
- ✓ Similarly, farside active regions near the limb can be used to improve EUV irradiance forecasting.
 - Preliminary work carried out by Fontenla et al. (2009, *Adv. Space Res.* 44, 457) shows significant improvement in Ly- α irradiance forecasting.
 - He II irradiance forecast by using farside information alongwith TIMED/SEE measurements (Lindsey et al.)



Key Points

Several examples demonstrate that incorporating farside active regions in magnetic field models improves the prediction, however more work is required to implement it in the routine predictions of solar wind, flares, irradiance etc.

Though farside helioseismic mapping has come a long way since its inception and the maps are routinely produced, there are still several hidden aspects that need to be explored, e.g., detection of small active regions and polarity assignment and tilt in active regions (crucial in ADAPT model)

GONG has been reliably producing farside maps since 2006, however it needs to be upgraded with improved capabilities due to its aging instrumentation.

It should be noted that SDO was launched in February 2010, and it has already been in orbit for more than 12 years. There is no other mission planned by NASA and/or ESA for replacing HMI in future, thus ngGONG becomes critical for continuous monitoring of the Sun's far hemisphere.

Comprehensive ranked research strategy

- Continue to obtain high-cadence full-disk Dopplergrams,
- produce high-quality farside maps,
- ingest data into models
- Pass on requirements to ngGONG

