Global Boundary Magnetic Field Optimization for Coronal and Solar Wind Models

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Motivation

- Coronal and solar wind models are ultimately driven by knowledge of (at least) the radial component of the magnetic field at a lower boundary.
- Simple Potential Field Source Surface (PFSS) type models have been remarkably successful at recovering the large-scale coronal magnetic field.
  - The radial component alone can be useful for operational models.
- Modeling of Coronal Mass Ejections (CMEs) typically relies on knowledge of the background solar wind through which the eruption propagates.

A good representation of the radial field is necessary to successfully model the solar wind and CMEs.

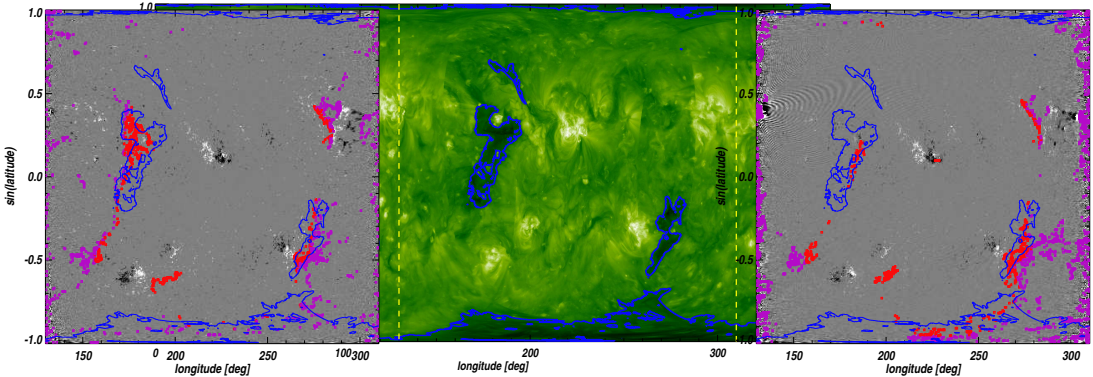
Overview

Multiple ways to generate the radial magnetic field boundary condition:

- Radial magnetic field observations are available
  - typically noisier than line of sight magnetic field observations, particularly in critical areas like the polar regionsn
  - there is presently no operational data source for vector magnetogramsn
- Line of sight observations + some assumption
  - Assume field is radial $\rightarrow$ μ-correction (B_l/μ)
  - Assume field is potential and use radial component of potential field B_r^{pot}
- Best choice likely depends on the structure being observed
  - We are working to create hybrid maps
- Validate results using solar wind and coronal field predictions from Wang-Sheely-Arge (WSA) model by way of the Air Force Data Assimilative Photospheric Flux Transport (ADAPT) model

Importance (2011 Sept 6)

Synchronic EUV map of the Sun generated by Predictive Science. Automatically identified coronal hole boundaries are shown in blue.



Radial component of the magnetic field as constructed using
left: the radial component of the observed vector magnetic field
right: the line of sight component of the magnetic field with a μ-correction.
The footpoints of open field lines from a PFSS model are shown in red.

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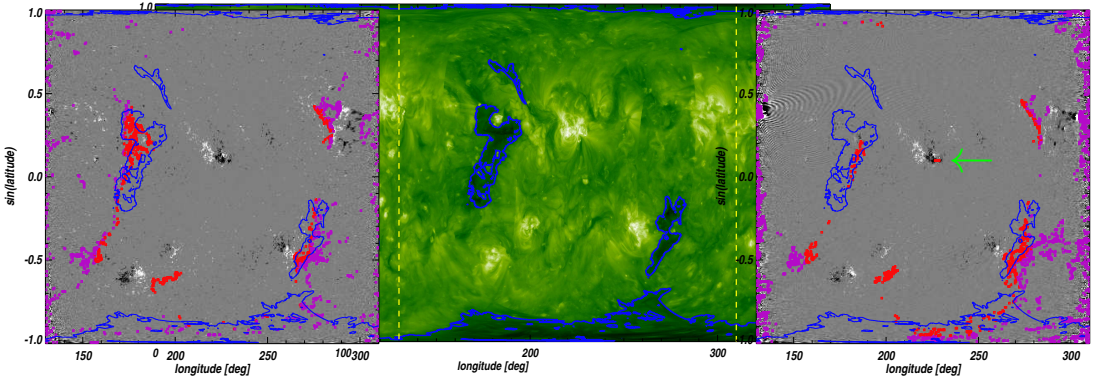

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Summary

- Coronal and heliospheric models rely on the radial component of the magnetic field.
- Different ways of determining B_r can lead to substantially different coronal models.
- We are working on determining the optimal way to combine different estimates of B_r.