Physical Parameters to be Passed Between the Solar Interior and the Solar Atmosphere

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Results from the Community Survey Indicate Two Different Parameter Requirements.

- Parameters that can be used in an operational mode at the solar surface to drive space weather forecasting models.
- Parameters that can be passed between models of the solar interior and the Corona in order to understand the relationship between the two regions.

Space Weather Forecasting (Data Driven)

- Desire vector magnetogram observations over the whole Sun.
- Density and temperature at the solar surface.
- High cadence data for time evolution.

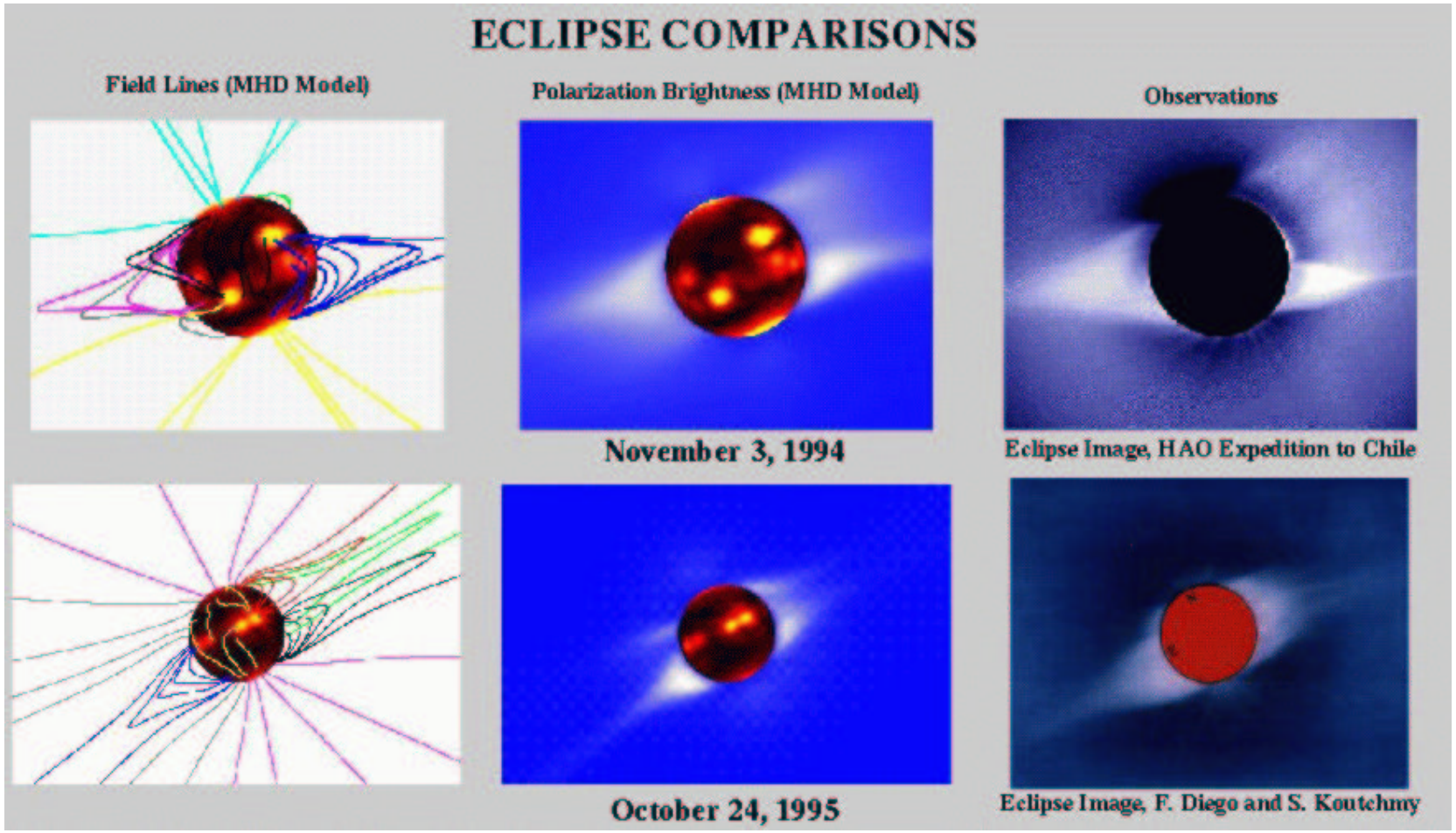


Figure 1: Calculations performed by Jon Linker, Zoran Mikic, Roberto Linello and Pete Riley, SAIC

Problems with the Data Driven Approach

Data

1. Transverse vector magnetic field measurements are noisy.

2. It is hard to resolve the 180° ambiguity in the vector field data.

3. Coverage of each physical parameter ($\mathbf{v}$, $\mathbf{B}$, ρ and T) is often incomplete in time and space (note information is not available for the back side of the Sun).

Data Driven Models

1. The physics at the photosphere is not understood very well.

2. Models often require information about the gradients of the physical parameters. This information is not available by the observations

3. MHD models require $\mathbf{v}$ and $\mathbf{B}$ on the lower boundary, but observations don't generally give enough information to specifies all components of $\mathbf{v}$.

The issue of driving coronal MHD models with data will be addressed at a Solar MURI workshop April 29-May 1, hosted at SSL. Contact George Fisher (510) 642 - 8896 for additional information.

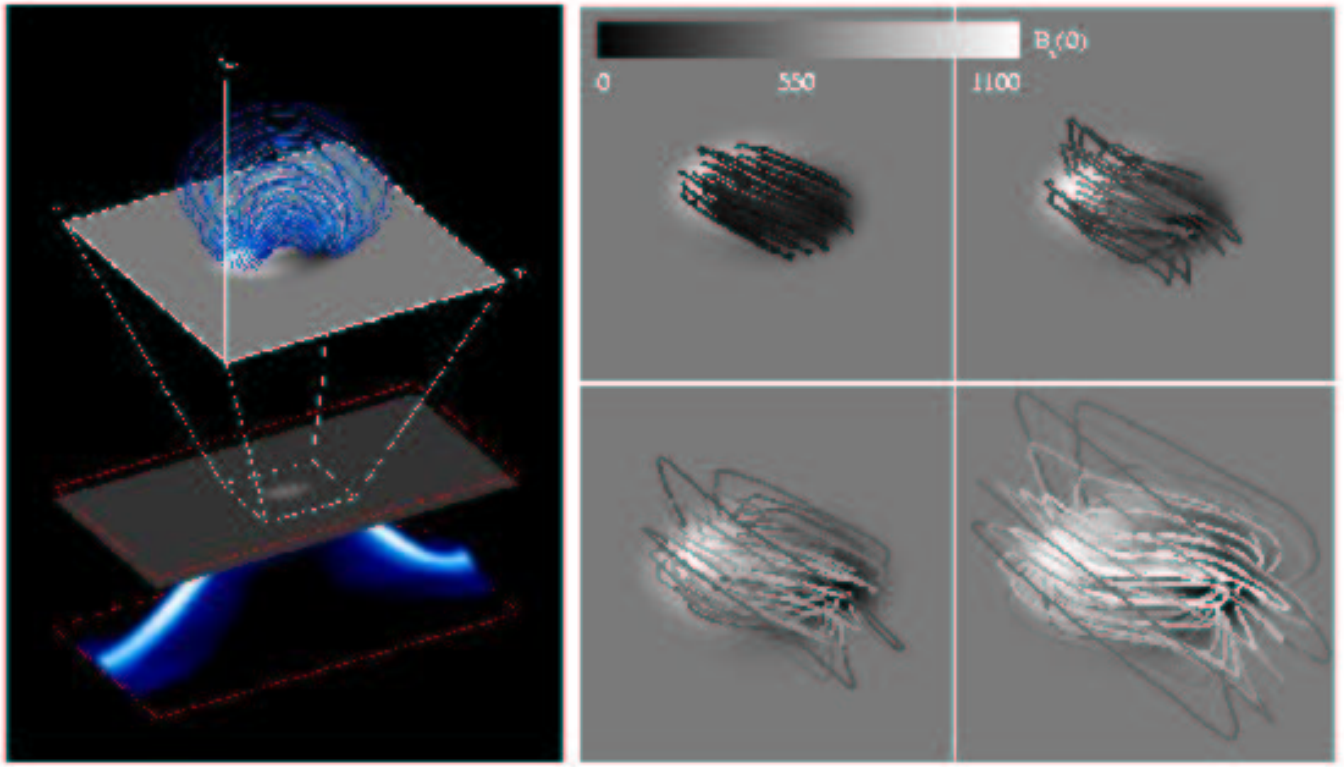
Model Coupling (Physical Understanding)

Combine models of the solar interior with models of the solar corona

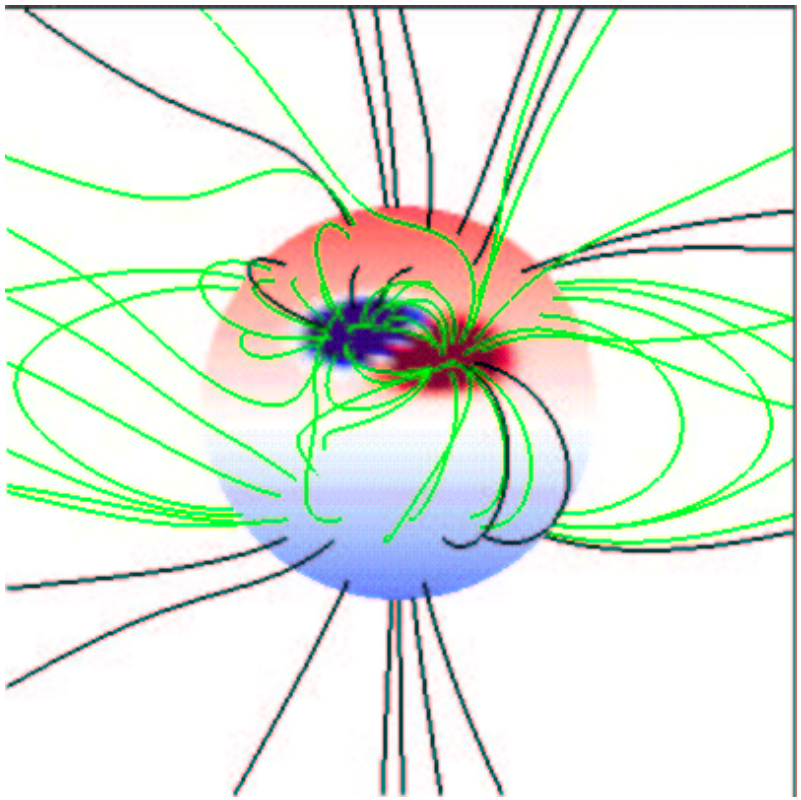
- Evolution of the solar corona is influenced by magnetic fields and mass flows at and below the photosphere.
- The corona can affect the deeper layers (Longcope & Welsch, 2000).
- Conditions at the base of the corona are subsonic and subAlfvénic and are strongly influenced by backward propagating waves.

To date interior models have only been used to ***drive*** coronal codes (no feedback from the corona into the interior simulation).

ANMHD simulation of emerging magnetic flux used to drive a MHD simulation of the coronal response (from Abbett et al., 2001):



ANMHD simulation of emerging magnetic flux used to examine the effect on the global coronal field configuration (from Li et al., 2001):



Survey Results

Survey respondents indicate that the following physical parameters need to be passed between models of the solar interior and atmosphere:

- **Scalar variables:** Density and Temperature
- **Vector variables:** Magnetic field and Velocity
- **Gradient information:** For the above scalar and vector parameters

In addition since the models must be truly coupled:

- Time step information