A Next-Generation Model of the Solar Corona & Solar Wind
PI: Jon Linker, Predictive Science Inc. (PSI)
Co-I’s: R. Lionello, Z. Mikic, P. Riley (PSI), N. Arge (AFRL), K. Schrijver (LMSAL), J. Harvey (NSO), T. Hoeksema & P. Scherrer (Stanford)

• Overall project goals:
  • Provide models in different approximations
  • Improve use of input data
  • Improve the fidelity of the models by enhancing the physics and comparing with observations
  • Deliver a state-of-the-art coronal and solar wind model to the community

• Project has ~1.5 years until completion
• Primary deliverable is a suite of models and tools: CORHEL (CORona-HELiosphere)
• CORHEL has been delivered to AFRL, CCMC, and CISM
CORHEL: Present Status

Magnetic Maps: MDI, MWO, NSO/KP, NSO/GONG, NSO/SOLIS, WSO

Smoothing, Flux balance, Pole Fitting

Coronal Model Choices:
- WSA
- MHD (MAS) (Polytropic)
- MHD (MAS) (Thermodynamic)

Coronal Solution

Vr, Br, open/closed
Empirical prescription

Radiative Outputs (EUV, X-Rays)
White Light

Observational Validation (Coronal Holes)

Heliospheric Model Choices:
- Cone Model
  CME
- Enlil
- MAS

Observational Validation (In Situ Measurements, STEREO Heliospheric Imaging)

Input Models
Output Validation
Examples of CORHEL Solutions

Mikic et al. SH42A-09: July 11

July 11, 2010 Total Solar Eclipse
STEREO A EUVI 195Å: CR 2097+2098
Simulated EUVI 195Å
Longitude
Latitude
0° 90°N
-90°S
60° 30° -30°
180° 60° 0° 240° 300° 360°
120°
Jun 11
Jun 16
Jun 21
Jun 25
Jun 30
Jul 4
Jul 10
Jul 14
Jul 18
Jul 22
Jul 26
Jun 17
Jun 21
Jun 25
Jun 29
Jun 30
Jun 16
Jun 30
1
0
2
3

MHD Model

Eclipse Image (F. Diego)

CR2097
CR2098

[Log 10 DN/s]

STEREO A EUVI 195Å: CR 2097+2098

Riley et al. SH31B-1799: Comparison with Solar Wind Observations

Cone Model CME (MAS-Enlil)

Enlil predicts Solar Wind at Messenger
Baker et al. SH 42A-06

WSA Model in CORHEL

WSA Solar Wind Speed: CR2030

2008-10-06T00:00

Mercury
Venus
Earth
Mars
Messenger
Stereo A
Stereo B

Cone Lot Plane

IMF polarity

0°

45°

90°

Ulysses

Predictive Science, Inc.
Summary and Lessons Learned

• The Strategic Capabilities program has facilitated major progress in modeling.
• Comprehensive modeling projects need this type of funding to be successful.
• Creating near-bullet proof versions for automatic runs from state-of-the-art models is challenging.
• In solar modeling, use of the input magnetic data crucially affects the solutions - this is an ongoing challenge.
  • See SH31B & SH41D: Magnetic Data as Drivers for Coronal Models
  • Especially Riley et al, SH31B-1799 and Linker et al, SH41D-03
• Fundamental problems in coronal physics require time-dependent modeling at high resolution - (calculations on 10,000-100,000 cores)
• Community models at CCMC will require allocation of additional resources.