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MODELING
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Using Solar-Helio Models at CCMC

Christina O. Lee

Space Sciences Lab, UC Berkeley

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“I requested the 1000th run at CCMC[!]”



Thanks for cool t-shirt!
😊

Overview

- Provide personal feedback using MAS/ENLIL and WSA/ENLIL solar-helio (CISM) models

See talks tomorrow by N. Arge, P. Riley, and D. Odstrcil regarding models...

- Present my latest CCMC results

Using CCMC Solar-Helio Models: “Pros”

Good user interface

CCMC User Interface

(top) Select preferences in the run request interface:

- desired Carrington Rotation (CR)
- input solar coronal model
- solar magnetograms (WSA)
- maximum radial distance of run

(bottom) Various output data in different formats (color contour plots, 1D line plots, etc.) and plotting parameters (e.g., plot variables, plot axes range, etc.)

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Step 5: Select the model (MAS or WSA) and choose Carrington Rotation

Selected model will provide the output to be used as time-independent inner boundary condition for this ENLIL run.

MAS. Choose a Carrington Rotation from ones available for MAS model:
1625

WSA. Choose a Carrington Rotation from ones available for WSA model:
1986

Mount Wilson Observatory
 Kitt Peak Observatory
 both of the above

WSA Note: We currently have magnetogram data available for Carrington Rotations 1986 through 2039 from Kitt Peak Observatory. We check the magnetograms before requested runs to make sure the data is good. We select above if you have an observatory preference or if you wish us to run the model for both data sources.

We are expecting an upgrade to the WSA model in the immediate future which will enable us to extend our list of Carrington Rotations to include their polar fields corrected by Nick Arge who uses a temporal interpolation over a number of Carrington Rotations.

Step 6: Select the outer radial boundary

Select the outer radial boundary. This will influence the size of grid in radial dimension available to you. For this run, the outer radial boundary is set to 10AU.

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3D Simulation Results: Model: ENLIL Run: Christina_Lee_120306_SH_1 CR=1633

This is the web interface for the visualization of results of a three-dimensional simulation of the Sun's environment.

Please review the [default selections](#) below and make your changes.

To start the graphics program click the *Update Plot* button. The resulting image will be displayed at this location of the page.

Should the result be a black image, then the graphics program encountered a programming error. Please report the set of input parameters used.

Update Plot will update (generate) the plot with the chosen time and plot parameters below. This will take some time (typically 10-30s) as data is read in and processed.

Plot Options:

Exclude region around the Sun up to 0 AU

Choose data time:
Date: 1975/10/22 Time: 11:26:54

Change time by moving
-1 output steps

Allow variable plot image size
(all 2D plots: aspect ratio dx/dy between 0.3 and 4)

Show simulation grid (disabled with 3D-Surface)

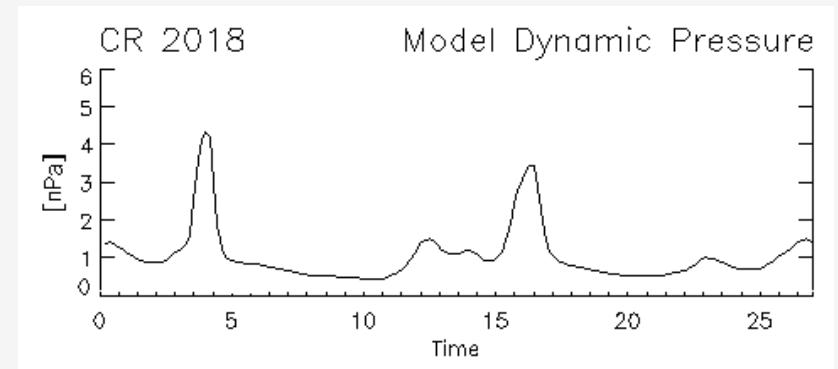
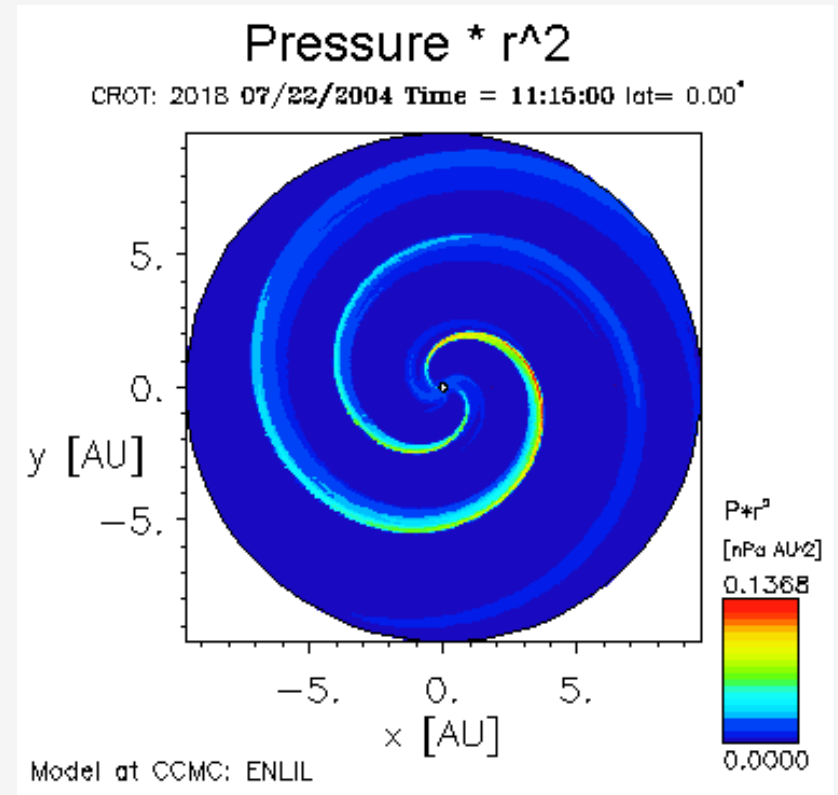
Interpolate data onto equidistant grid
(available with 3D-Surface and Vector, recommended for plots with Vector)

Choose **Plot Mode**: Line (1D) Choose **quantity** to be displayed (some Plot Modes require up to three choices):
Q 1: N Q 2: V Q 3: P_ram

Illustration from model results of how solar wind dynamic pressure evolves for one Carrington Rotation

(top) CCMC-generated output of a 2-D color contour plot for the variation in pressure with radial distance.

(bottom) Time series for dynamic pressure generated from the CCMC-generated ASCII text data output file.



Using CCMC Solar-Helio Models: “Pros”

Good user interface

Ability to request many runs/day

Quick turn-around time of result output

Fast response time to resolve issues
regarding output results

Modelers are very accommodating to special requests
(to within limits of the model capabilities)

Useful “quick view” plots are provided with
each run submission result output page

Using CCMC Solar-Helio Models: “Cons”

Output figures need additional labels
(version of model, Carrington Rotation, observatory)

Limited information about models on the website
(model grid sizes, boundaries, versions being used)

References for the models not always provided

Obtaining ASCII files of run results not automatic

Slower turn-around time of result output
during “busy” season or “bug” in system

“Limitations” of Models at CCMC

MAS/ENLIL

- Currently utilizes solar magnetograms from NSO only
Plans to use other magnetograms are underway, I think...

WSA/ENLIL

- Existing list of CRs no earlier than 1986 (Feb. 3, 2002)
MAS/ENLIL goes back to CR 1625 (Feb. 19. 1975)

Some general questions:

- Clarification on existing models at CCMC – versions?
- Magnetograms – other sources besides NSO & MWO?
- Documentation – references? Posting of sample results?
- Carrington Rotations – plans to extend existing list?

For the novice CCMC user...

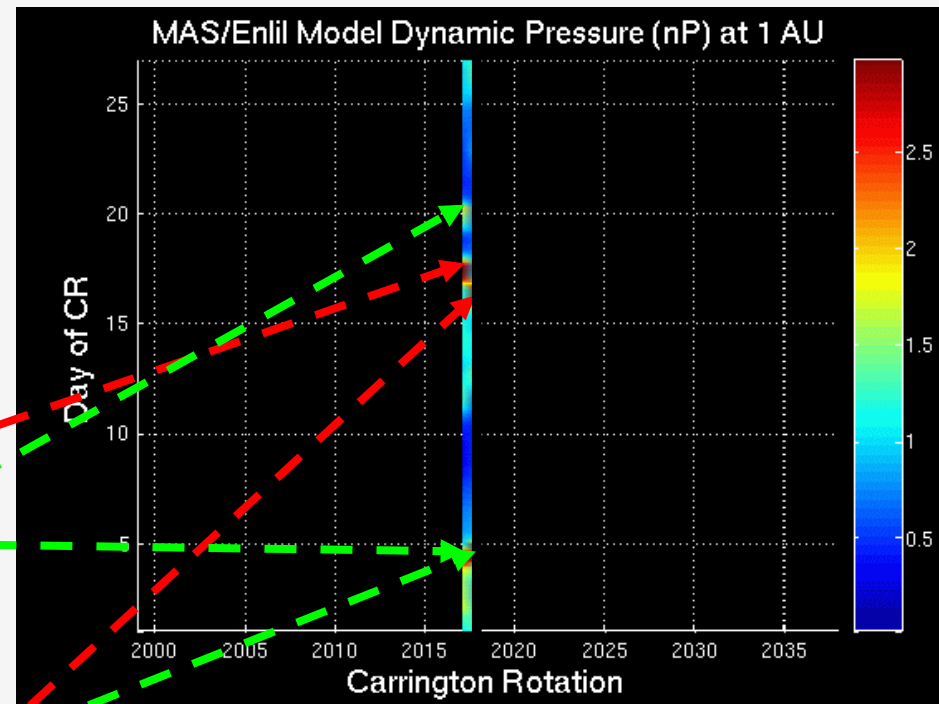
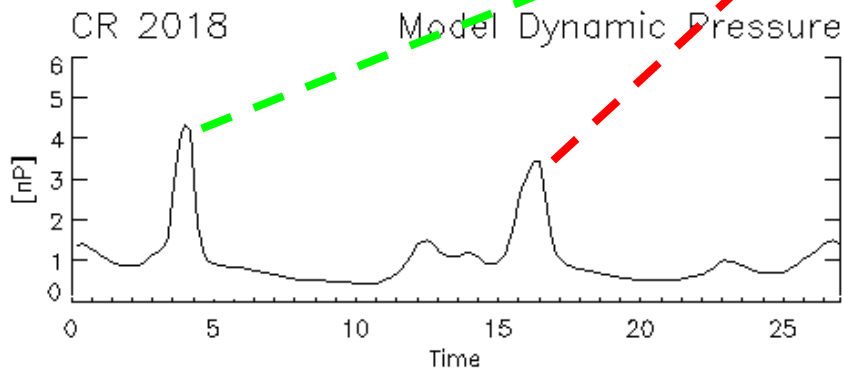
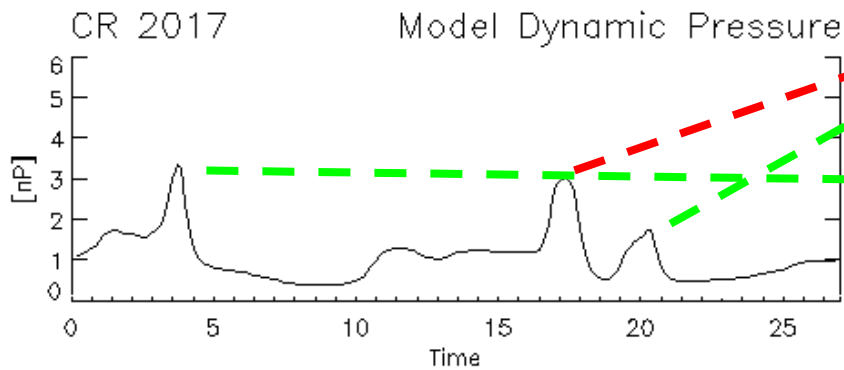


Errors can occur
in run results
so beware!

e.g., results not for CR
requested, corrupted
magnetogram → weird
results, etc...

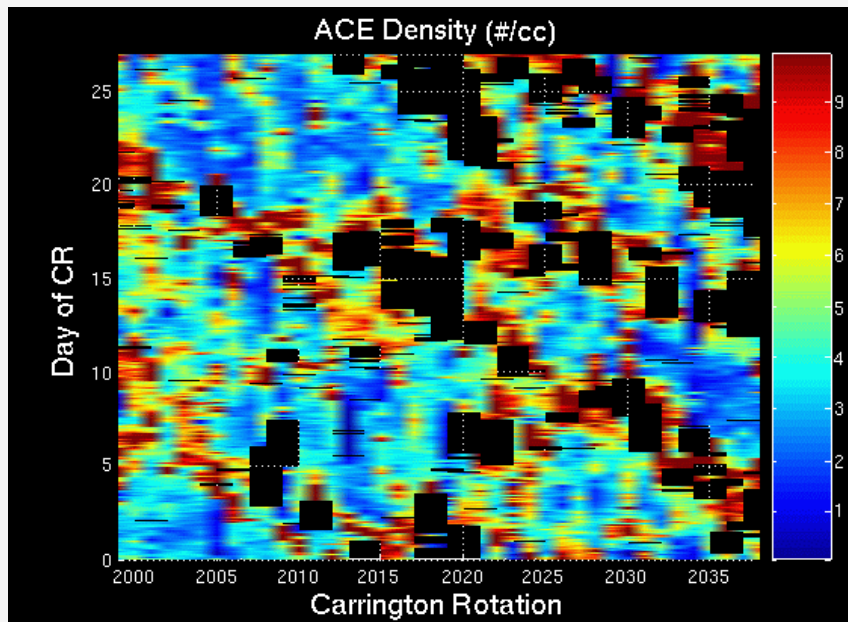
My CCMC results!

Adopted plot style for displaying solar wind parameters

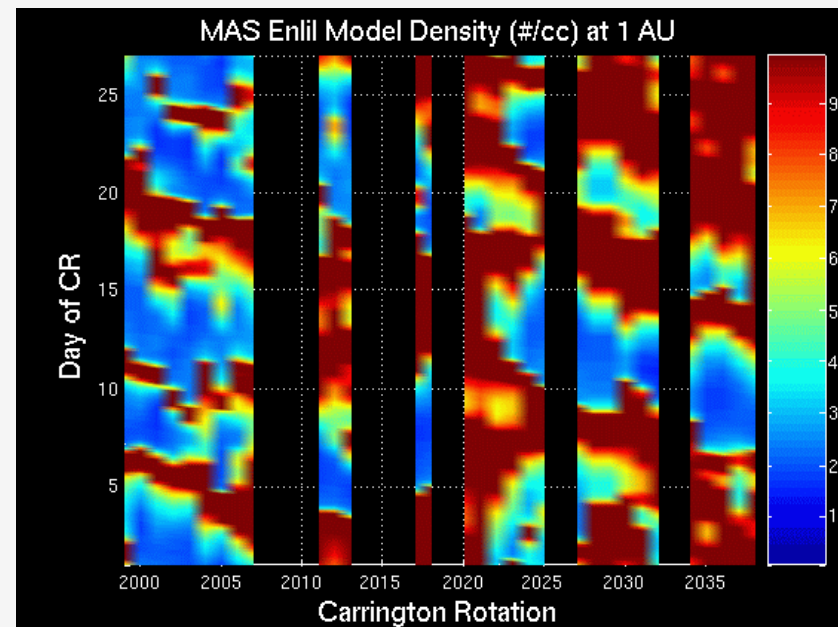
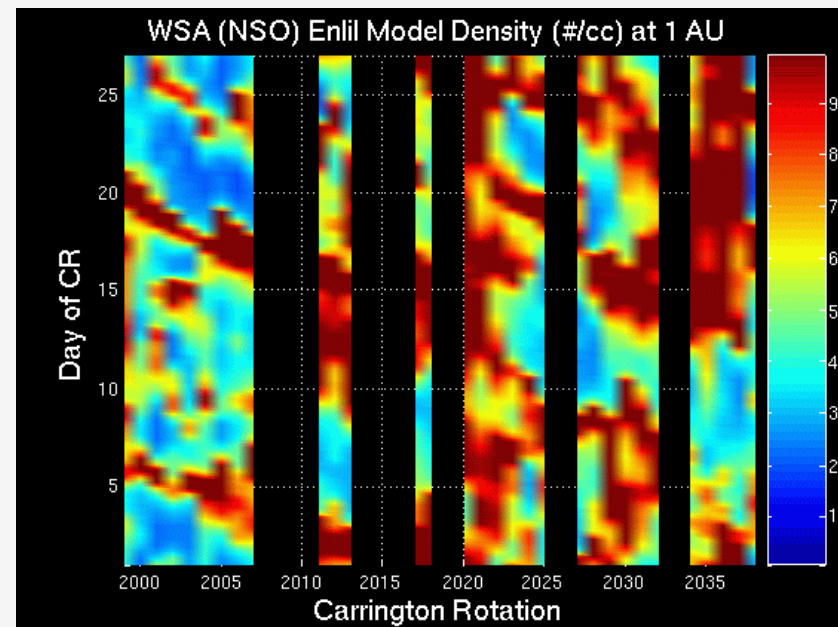


Time series of dynamic pressure (left) modeled at 1 AU for CR 2017 and 2018. The time series can be stacked against each other, where the magnitude of the dynamic pressure is now represented in color.

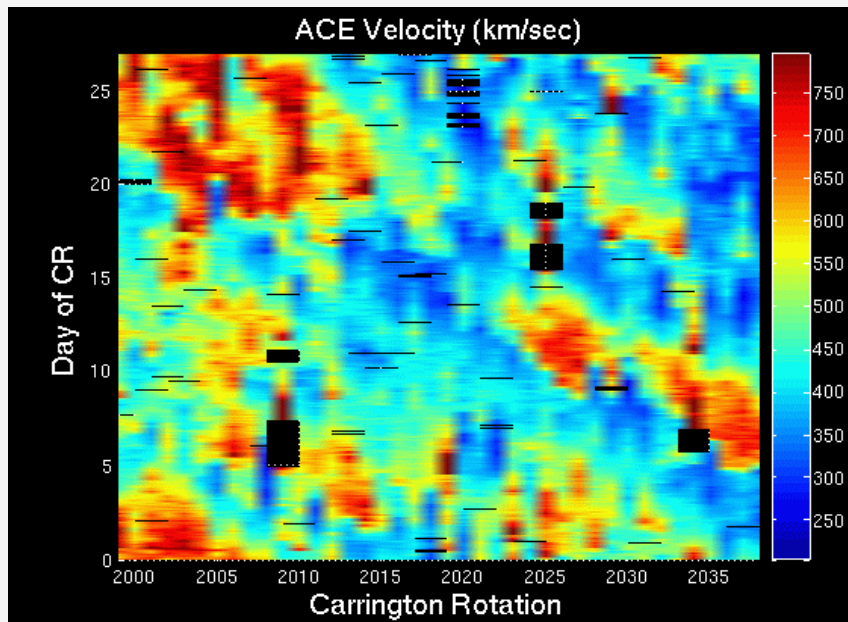
Comparison of MAS/Enlil and WSA/Enlil w/ ACE Density at 1 AU



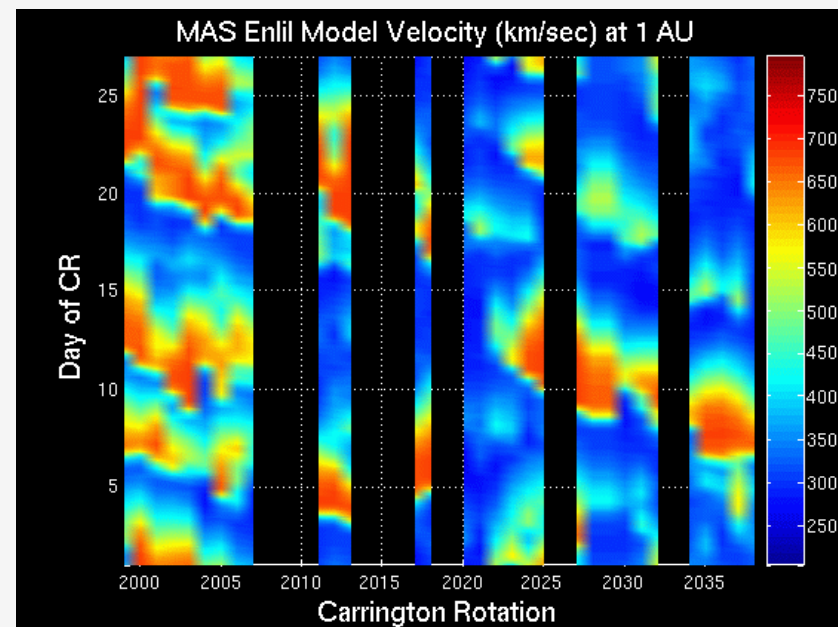
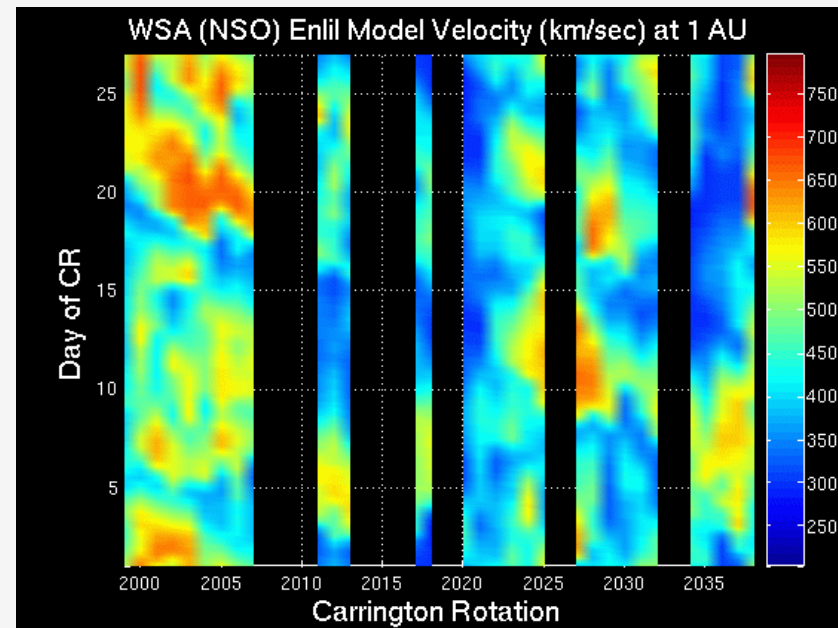
For CRs 1999-2020 where the stream interaction regions are a 2-sector structure, there are 2 corresponding high-density ridges (reds). For CRs 2020 to 2038, there are 4 high-density ridges corresponding with a 4-sector structure.



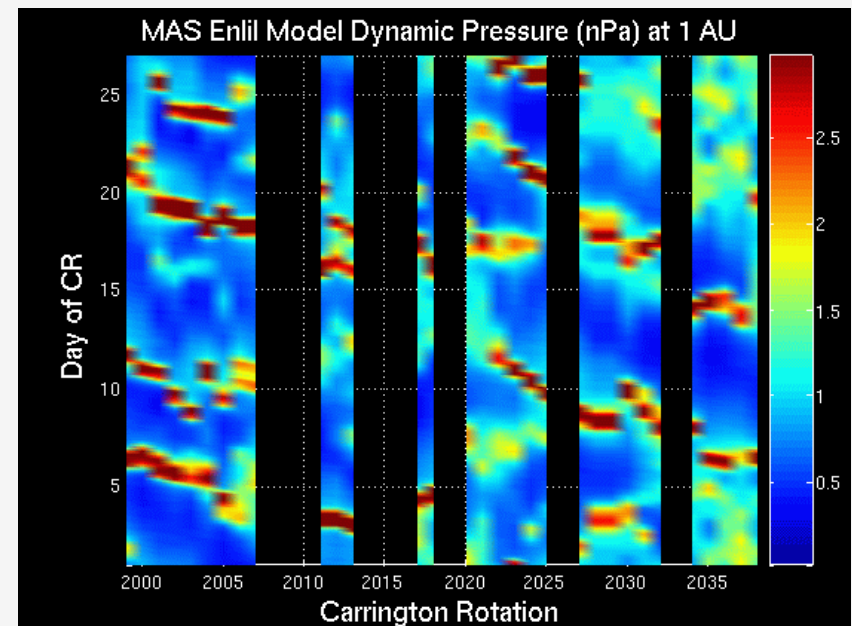
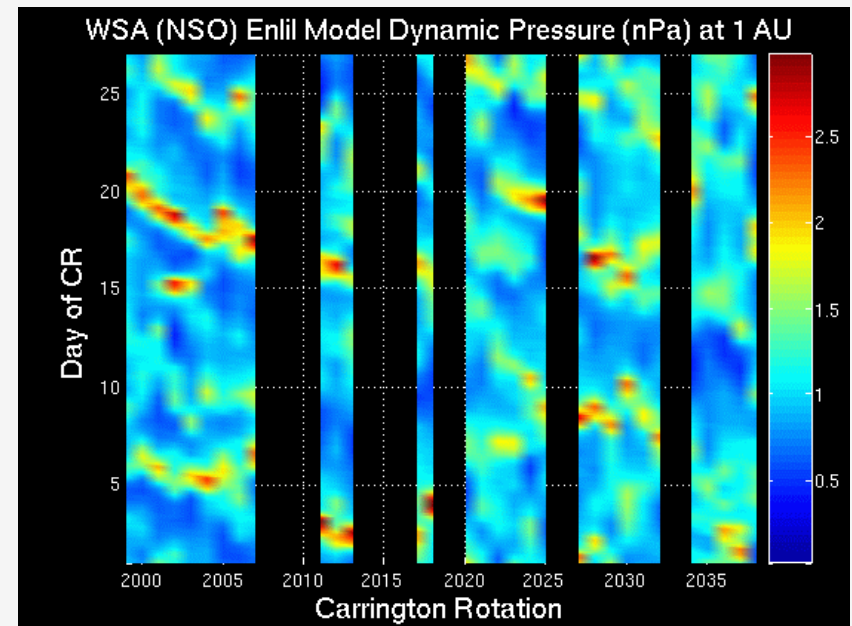
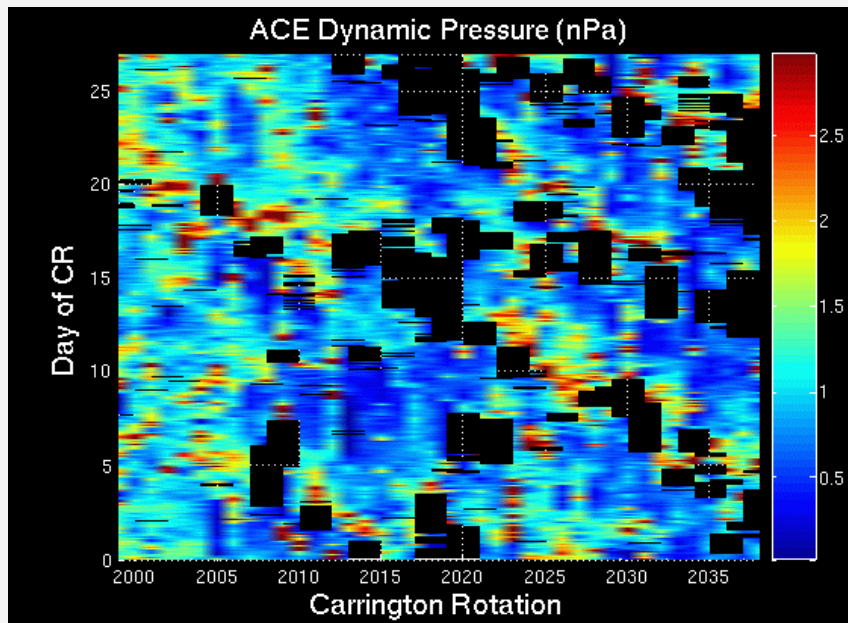
Comparison of MAS/Enlil and WSA/Enlil w/ ACE Velocity at 1 AU



In the modeled velocity (right), it can be seen that the pattern of high velocity values (orange-red) match fairly well with those from the ACE observations (above).



Comparison of MAS/Enlil and WSA/Enlil with ACE Dynamic Pressure at 1 AU



Compared to ACE observations (above), the models do a good job of replicating the high dynamic pressure ridges. It is noticeable that the MAS/ENLIL results have less mid-range values (aqua) compared to the WSA/ENLIL results.



CCMC results will be presented
in a paper for publication!

*The Solar Wind At 1 AU During Solar Minimum:
Comparison Of 3D Numerical Model Results
With Observations*

C. Lee, J. G. Luhmann, D. Odstrcil, P. MacNeice,
I. de Pater, P. Riley, and C. N. Arge

Special thanks to...



Anna Chulaki and Peter MacNeice