

Exploring the Solar Wind Structure Using the Enlil 3D Dashboard

Introduction

- Got to this link <http://dashboard-enlil.ensemblespacehub.com>
- You should see a sphere in the middle of the screen with field lines radiating out from it.
- Navigation
 - Rotate by clicking and dragging with the mouse.
 - Zoom using the scroll wheel or two finger gesture on the trackpad.
- Note the CR value in the file name at the top of the screen. Does this represent a Carrington rotation from Solar Minimum or Solar Maximum?
- The distance scale on this image is 1 AU.
 - Estimate the size of the sphere in the middle (not the r value on the slider above).
 - How would the sun be in this image?
 - Note that the inner radius of the simulation should not be less than 20 or 30 solar radii. How many AU is that? (feel free to ask <https://www.wolframalpha.com>)
- Notice the color scale on the left. That is in kg/m^3 . How many protons per cubic centimeter does that represent?
- Note the latitude of the high density and low density regions.

- Use the “r” slider to increase the radius of the 1 AU.
- Note the range of densities. How many protons per cubic centimeter does this represent?
- Note the latitude of the high density and low density regions.
- Check other “r” values to see if this pattern holds for all radii.

Explore Different Variables

- The second drop down menu allows the view of different variables
 - “rho” is density
 - “u” is velocity with the subscript indicating the components
 - “b” is the magnetic field with the subscript indicating the components

Exploring the Velocity structure at Solar Minimum and Solar Maximum

- Return to 1 AU and compare the components of the solar wind speed. (Note that the units are in meters per second)
 - Which component dominates?
 - What direction is the solar wind velocity?
 - Do the same comparison at various distances from the Sun. Does your response change?
 - How does the magnitude of the major component vary with latitude

Switch to a Carrington Rotation from a time near Solar Maximum (say CR 2150)

- How does the velocity vary with longitude for solar maximum?
- What general conclusions can you draw about the velocity at solar minimum and the velocity at solar maximum?

Review Co-Rotating Interaction regions

Change the cut-plane to “r-phi” (from “theta-phi”) and look at the radial velocity component.

- Do you see co-rotating interaction regions?
- What other variables might show this?

Exploring the Magnetic Field structure at Solar Minimum and Solar Maximum

Switch back to the solar minimum case and plot the radial component of the magnetic field (b_r).

- At small radii, how does the strength of the radial component of the magnetic field vary with latitude?
- Where does the magnetic field go to zero and what can you say about that region? Is there evidence for a current?
- Compare the radial component compare to the azimuthal component (b_ϕ)
 - How do these results change with radii? Look at different components at 1 AU
- How would you describe the shape of the current sheet at solar minimum

Switch back to the solar solar maximum case and explore the above.

- What is the shape of the current sheet at solar maximum?