On-Line Visualization

Quiet Magnetosphere
Heliophysics Laboratory Primer

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This primer has been created to help you to:

1. use the CCMC tools designed to interrogate Heliophysics models at CCMC, and
2. obtain a top level view of the connectivity and naming of regions and parameters that comprise the heliophysics system.

The highest level picture of the Heliophysics system shows three components - the Sun, the solar wind, and the magnetosphere while buried inside the magnetosphere is the ionosphere and thermosphere. Click for the specific primer:

- Heliosphere
- Magnetosphere
- Ionosphere/Thermosphere
On-line Visualization
Quite Magnetosphere (Equinox)

| Run Number         | Keyword           | Model   | Model Version | Event date     | V_x  | N  | |B|  | IMF Clock Angle | B_x | B_y | B_z | Conductance Model |
|--------------------|-------------------|---------|---------------|----------------|------|----|-----|-----------------|-----|-----|-----|------------------|
| HSS2011_SWMF_051111_2 | HS2010, equinox, quiet | BATSRUS | v8.01         | March 21 2007  | -400.0 | 5.0 | 5.0 | 180.0           | 0.0 | 0.0 | -5.0 | uniform p=5,h=0  |

Run output in CDF format: HSS2011_SWMF_051111_2_T200.out.cdf

Magnetosphere Tutorial

Space Weather Explorer Tutorial
On-Line Visualization: Quiet Magnetosphere

HSS2011_SWMF_051111_2

Title/Introduction:
Key Word: HSS2010, equinox, quiet

3D MHD Model: BATSRUS
Simulation With Modeled Conditions
Inflow Boundary Conditions: Fixed
Start Time: 2000/01/01 00:00
End Time: 2000/01/01 02:00
Dipole Tilt at Start in X-Z Plane: 0.0 deg.
Dipole Tilt in Y-Z GSE Plane: 0.0 deg.
Dipole Update With Time: no
Ionospheric Conductance: unifomp5,ho
No Corotation Velocity is Applied at The Inner Boundary.
Radio Flux 10.7 cm: 150.
Coordinate System for the Output: GSM
Initial Solar Wind (SW) Parameters in GSM Coordinates:

- SW Density: 5.00 n/cc
- SW Temperature [Kelvin]: 232100.00 Kelvin
- X Component of SW Velocity: -400.00 km/sec
- Y Component of SW Velocity: 0.00 km/sec
- Z Component of SW Velocity: 0.00 km/sec
- IMF Bx: 0.00 nT
- IMF By: 0.00 nT
- IMF Bz: -5.00 nT
- IMF |B|: 5.00 nT
- IMF Clock Angle: 180.0 deg.

- View solar wind input data
- List solar wind input data in ASCII format (see format description here).
- View Magnetosphere

- Create Timeseries in Magnetosphere
- View Ionosphere
- View Northern hemisphere polar cap flux and area
- View Southern hemisphere polar cap flux and area
- View Magnetopause standoff and closest approach within 30 deg. of Sun-Earth line (local noon)
- View Polar cap boundary at 24 magnetic local times
- View Ionospheric dissipation Ring Current data:
- View Ring Current H+ ion data
- View Ring Current electron data
Make a First Plot with Default Selections

3D Simulation Results: Model: BATSRUS
Run: HSS2011_SWMF_051111_2

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

Go back to web page of run

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.
Magnetosphere Overview Plot: Color Contour
Number density in noon-midnight meridional plane (Y=0)

Default date for runs with model conditions

01/01/2000 Time = 02:00:00 UT y = 0.00R_E

Sunward (inflow) boundary at X=33 R_E: Solar wind parameters are applied here

Magnetotail
Inner boundary at R=3 R_E
Earth
Solar wind

Number density
N [cm^-3]
27.2
0.1

Model at CCMC: BATSRS

Earth radius
Select time step

Choose time step from the pull-down menu

Click “Update Plot” to make a plot with default selections

OR

Scroll down to modify default selections such as “Physical Variables”, “Plot Mode”, “Plot Area”, “Plot Options”, etc.
Select **Plot Mode** and **Physical Variables** to be Displayed from Pull-Down Menus

Click here for Plot Modes description

Click here for the complete list of physical variables written by global MHD models

**Plot Mode Example:**
**ColorContour** – Contour plot in 2D slice (2D Plot Area) using color-filled levels. Physical Variable (e.g., J – current density magnitude) is selected in Q1 pull-down menu

Scroll down to choose “Plot Area”
Choose Plot Area

Choose Plot Area:

- **All Plot Modes** except Line Plot and Vertical Plot: Select lower left corner of plot area on the left, and the upper right corner on the right.
- **Line Plot**: Select start point of line on the left, the end point on the right.
- **Vertical Plot**: Select X and Y position on the left.

**Choose Cut Plane:**

- **X=constant**: -15
- **Y=constant**: 0
- **Z=constant**: 0

Choose Cut Plane, e.g.,

- **Y = 0** – noon-midnight meridional plane
- **Z = 0** – equatorial plane
- **X = -15 \(R_E\)** – cross-tail cut

Choose Plot Area: **Zoom-in to the area of interest**

Click “Update Plot”
Color Contour Plots of Current Density ($J$) in Different Cut Planes

- **Meridional cut $Y=0$**
- **Equatorial cut $Z=0$**
- **Cross-tail cut $X=-15 R_E$**

- **Magnetotail current sheet**
- **Magnetopause**
- **Bow shock**
Example: **Color+Vector+Flowlines** Plot Mode

Plasma Pressure, Velocity Vectors, Magnetic Field Lines

Choose Plot Mode: **Color+Vector+Flowlines**
Choose Physical Variable for Color (Q1 menu): **P (pressure)**
Choose Physical Variable for Vector (Q2 menu): **any component of the velocity vector (V_x, V_y or V_z)**
Choose Physical Variable for Flowlines (Q3 menu): **any component of the magnetic field vector (B_x, B_y or B_z)**
Choose Cut Plane: **Y=constant=0**
Choose Plot Area: **X_1=-25, X_2=15, Z_1=-15, Z_2=15**

**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.

**Modify Plot Options**
Set flow lines thickness to **3**

**Plot Options:**
- Exclude region around the Earth up to **3 R_E**
- Image magnification **1** (all images; use >=1.25 for 3D Flowlines)
- **Line thickness 3** (flow lines, arrows)

Click “Update Plot”
Example: **Color+Vector+Flowlines** Plot Mode (Results)  
**Plasma Pressure, Velocity Vectors, Magnetic Field Lines,**

- **Red lines** (closed): Magnetic field (MF) lines with both ends connected to the Earth
- **Black lines** (open): MF lines with only one end at the Earth
- **Blue lines** (interplanetary): MF lines with both ends in the interplanetary space
Example: **Color+Vector+Flowlines** Plot Mode

**V_x Velocity Component, Velocity Vectors, Velocity Flowlines**

Choose Plot Mode: **Color+Vector+Flowlines**
Choose Physical Variable for Color (Q1 menu): **V_x (X-component of velocity)**
Choose Physical Variable for Vector (Q2 menu): any component of the velocity vector (V_x, V_y or V_z)
Choose Physical Variable for Flowlines (Q3 menu): any component of the velocity vector (V_x, V_y or V_z)
Choose Cut Plane: **Z=0**
Choose Plot Area:
X_1=-25, X_2=15, Y_1=-21, Y_2=21

Click “Update Plot”
Example: **Line (1D) Plot Mode**

**Velocity, Current Density, and Number Density**

Choose Plot Mode: **Line (1D)**

Choose 1\(^{st}\) Physical Variable (Q1 menu): **V** (velocity)

Choose 2\(^{nd}\) Physical Variable (Q2 menu): **J** (current density)

Choose 3\(^{rd}\) Physical Variable (Q3 menu): **N** (number density)

Choose **quantity** to be displayed (some Plot Modes require up to three choices):

- **Q 1:** V
- **Q 2:** J
- **Q 3:** N

Note: divergences, gradients and curls are not yet available with SWX plot modes.

**Choose Cut Plane:** Z=0

Choose start point of line: \(X_1=7, \ Y_1=0, \ Z_1=0\)

Choose start point of line: \(X_2=14, \ Y_2=0, \ Z_2=0\)

Click “Update Plot”
Example: **Line (1D) Plot Mode (Results)**

**Velocity, Current Density, Number Density**

Choose Plot Mode: **Line (1D)**
Choose 1\(^{st}\) Physical Variable (Q1 menu): \( V \) (velocity)
Choose 2\(^{nd}\) Physical Variable (Q2 menu): \( J \) (current density)
Choose 3\(^{rd}\) Physical Variable (Q3 menu): \( N \) (number density)
Model: BATSRUS
Run: HSS2011_SWMF_051111_2

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Go back to web page of run
Field-aligned currents from the inner boundary of the magnetosphere domain (at about $R = 3 R_E$) are mapped along the magnetic field lines to the ionosphere (at about $R=110$ km). Ionosphere electrodynamics solver derives electrostatic potential at the $R=110$ km sphere and map it back to the magnetosphere.
Make a Plot of Ionospheric Potential with Polar Cap (Default Selections)

2D Ionosphere output
Model: BATSRUS
Run: HSS2011_SWMF_051111_2

This is the web interface for the visualization of: Ionosphere of simulation of solar wind flow around the Earth.

Go back to web page of run
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 5-10s) as data is read in and processed.

Choose data time:
- Date: 2000/01/01 Time: 02:00:00

- or -

- Change time by moving
- output steps

- or -

- Create GIF movie with current plot settings

Note: This is a queue submission system requiring the following three additional inputs:

Start Time:
- Date: 2000/01/01 Time: 00:00:00

Plot Options:
View angles (latitude, longitude from local midnight for EarthView only):
- AX [.90, .90]: [0.60] 
- AZ [0.360]: [0.0]

- Plot in geographic coordinates with continents
- Show Grid (in contour plots):
  - latitude-MLT/LT grid (10° in Theta, 30° in MLT)
  - simulation grid

Image magnification [100] (all images)
Line thickness [1] (flow lines, arrows)
Character thickness [1] (all annotations)

☐ Plot Polar Cap Boundary (only runs where polar cap had been requested)
Ionospheric Potential with Polar Cap
(Results)

Closed: Magnetic field (MF) lines with both ends connected to the ionosphere
Open: MF lines with one end connected to the ionosphere and another end to the interplanetary space