

ASTR 101 - Fall 2013 - T. Bensky - Solar Wind Extra Credit Assignment

The “rules”

- This assignment is for 10 points of extra credit. It will help your grade if you do it, but will not hurt your grade if you do not do it.
- Due date: Nov 8, at the beginning of class.
- What to turn in:
 - A screenshot of your web browser showing the two NASA simulations linked to below.
 - Detailed answers to all questions you find below.

Introduction

As discussed in class last week in class (and in Sect 9-4 of your book), the Earth’s magnetic field protects us from the deadly solar wind. The solar wind is studied very intensely by NASA scientists, in particular CMEs (also discussed last week). To help along with their studies, NASA has developed a computer program that simulates the solar wind, so it can be investigated and studied using the convenience (and safety) of a computer. This extra credit assignment is about using a (free) NASA simulation to study the solar wind. Hey neat! You get to use a NASA simulation! In particular, you will investigate the speed and direction of the solar wind through our solar system.

The Questions

The question you’ll answer for this extra credit is:

- What is the dominant direction the SW travels?
- Does the speed of the SW change as it travels through the Solar System?"
- What is the average speed of the solar wind?

Warm-up Solar Wind Tutorial

We’ll use software developed at NASA called "Integrated Space Weather Analysis" or iSWA to get a feeling for the SW (SW=Solar Wind). Go to this link: <http://goo.gl/Isdfl>. When it loads, close the “Available Cygnets” window at the top (to avoid confusion).

Next, look at the circular graph to the left. To familiarize yourself with the graph, consider these points:

1. Locate the Sun and Earth. How many AUs from the Sun does the plot represent?
2. What SW variables are available to you?
3. What are the "spikes" coming out of the Sun?
4. Why do the spikes rotate like a lawn sprinkler?
5. What is the "big burp" you see? (hint: the Sun is a violent, dangerous place.)

Research

Now let's get on with answering the questions. We'll use more NASA software called the "Community Coordinated Modeling Center" (CCMC). Go to <http://goo.gl/gyRpj> to access it. The interface is a bit rough, but make these settings:

1. Set "Plot Mode" to Line (1D).
2. Under "Choose quantity to be displayed" set all select boxes to "V_r."
3. Under "Choose Plot Area," set Lon1, Lon2, Lat1, Lat2, and Lon=, Lat= all to zero.
4. Click the "Update Plot" button.

Study the plot that comes up carefully. Be clear on what is represented on both axes. Note here that "V_r"

stands for "radial velocity," or the part of the SW's velocity that is heading away from the Sun along a line that directly connects the center's of the Earth and Sun.

Follow up questions

- How long does it take the SW to reach the edge of the Solar System, which is about 100 AUs?
- If astronauts were on the moon and a CME occurred, how long would the astronauts have to somehow protect themselves?
- What issues can you think of involving traveling to Mars (hint: Mars is outside of the Earth's magnetic field).