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Candle in the Wind: Probing the Solar Wind Structure Using Interplanetary Scintillation Data

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Overview

Due to variation in density of the solar wind plasma, radio waves from distant astronomical sources are scattered as they propagate through the interplanetary space. The resulting fluctuation in the intensity of observed radio sources, which is called interplanetary scintillation (IPS), can be used to estimate solar wind properties, such as density and velocity. Using the IPS data from 2000 to 2008, I have plotted two-dimensional distributions of solar wind velocity and density on the 5 AU sphere at two different times, which provide a simple, but interesting view of the spatial and temporal variations of the solar wind structure.

Impact

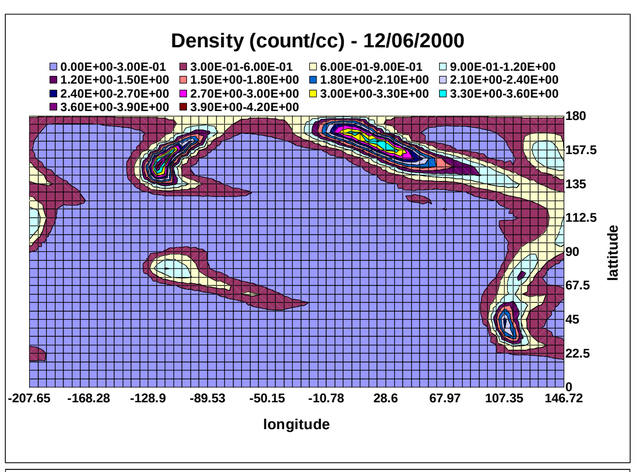
Space weather forecasting largely depends on computer modeling of the heliosphere. Used as boundary conditions in the time-dependent 3D modeling of the heliosphere, the IPS data along with in-situ measurements by spacecrafts can help to enhance the accuracy of the forecast model, which will benefit not only the space industry, but the entire modern society.

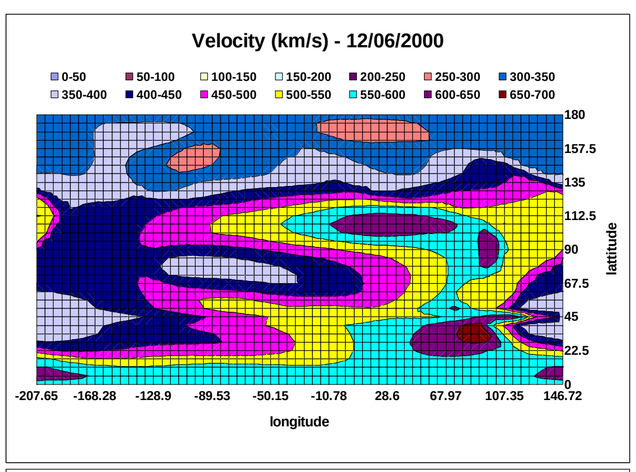
Explanation

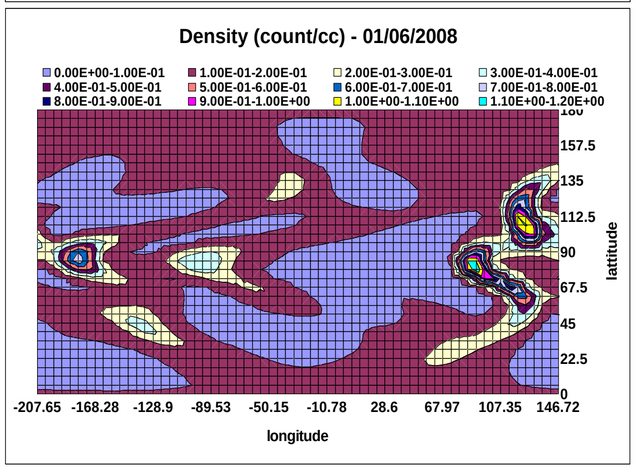
Accurate modeling of the heliosphere is critical to the advancement of space science and exploration, which is the primary objective of the AAS.

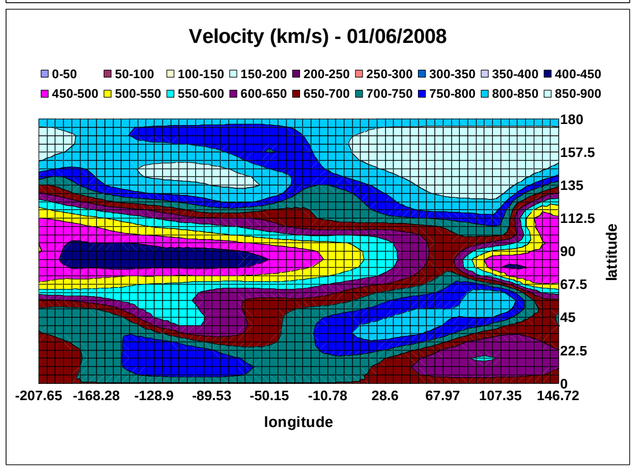
Results

The IPS data consists of one complete set of measurements covering the entire 5 AU sphere per each day. Since there are large number of data sets, I have arbitrarily chosen measurements from two different days, roughly 7 years apart, and plotted the density and velocity distributions below.

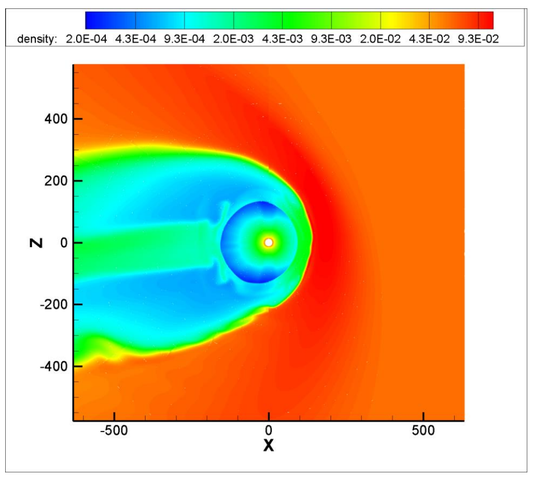


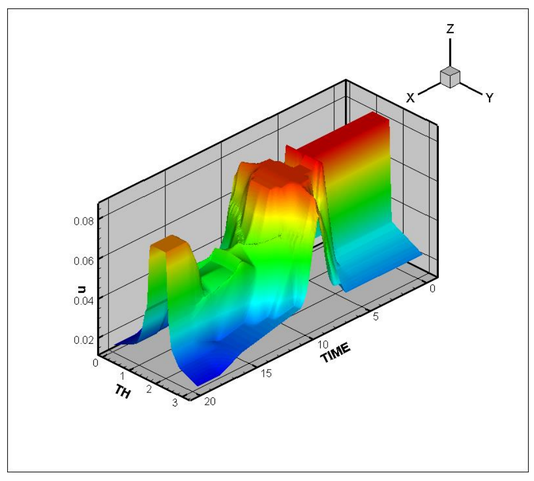


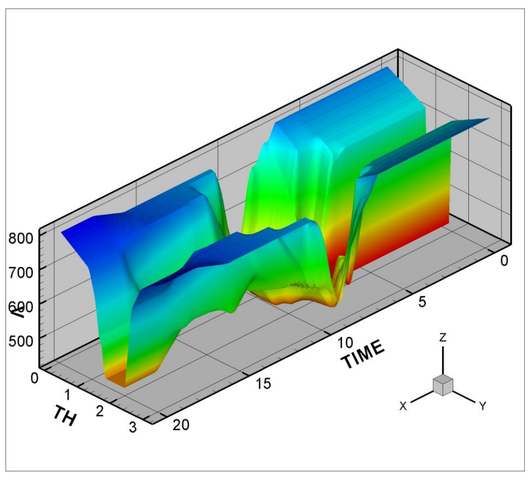




I have also included some figures below as examples of what can be done further by using the IPS measurements as boundary conditions in computer modeling of the heliosphere. The first figure shows numerically obtained density distribution in the meridional plane, while the other two figures show time variations of density and velocity.







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