CORHEL 3.0: A Global Model of the Solar Corona and Inner Heliosphere, Including Ambient Solar Wind and Simple Transients*

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Summary

CORHEL 3.0 has greatly simplified the process of running the coupled coronal (MAS) and heliospheric (ENLIL) MHD codes by providing two sophisticated interfaces from which to set up and initiate runs. Both interfaces provide exactly the same level of user options, such as the choice of observatory (Kitt Peak/SOLIS or Wilcox), the desired resolution of the run, or a myriad of optionally adjustable parameters. One however, is a graphical, web-based Javascript interface (see the example to the left), while the other is a command-line driven interface. The former is ideal for exploring the effects of various inputs visually before submitting the run, while the latter allows the user to submit either batch jobs or jobs at remote locations where web-based connectivity is not possible. Both approaches have been assembled, compiled, and tested on both Mac OS X and Linux (Debian and Redhat). The package (with some optional benchmark runs) fits onto a single CD that can be distributed to users, and includes a user guide as well as installation instructions. In this release, we have added the ability to simulate simple transients, such as "cone model" CMEs. Also new to this release is the ability to run either the coronal model or the heliospheric model separately. Of course the latter requires that a suitable coronal solution is available. Its primary use is to explore the effects of different transient profiles. This release also includes many minor improvements, such as improved error checking. Finally, CORHEL 3.0 now merges the magnetic field data from the coronal and heliospheric solutions into a single dataset to simplify visualization and analysis of the results, and for use in other applications, such as modeling SEPs. The output from CORHEL can be visualized using the standard CISM-DX package. CORHEL 3.0 can be run interactively from: http://aeolus.adnc.net:8080/corhel/

This same version was made available to the CCMC. Future developments of CORHEL include: (1) adding visualization and analysis tools to help explore the simulation results (see panel to the right); (2) Adding additional observatories to drive the inner boundary conditions; and (3) Replacing the current serial codes with parallel versions.

(Above) Here are two examples of the types of studies that can be undertaken using CORHEL results. The top panel summarizes the evolution of the heliospheric current sheet over an entire solar cycle. The bottom panel displays several interim products of the CORHEL package, including the smoothed photospheric magnetic field, the computed location of the coronal holes, and the velocity map at 30 Rs used to drive the heliospheric solution. The blue Isosurface in the center is computed from the magnetic field solution. In this application, we are using the simulation results to understand the global context of Ulysses observations.

(Right) Here is an example of showing the evolution of a simple transient ("cone model" CME) through the ambient solar wind computed using CORHEL. All of the parameters for the ambient solar wind, as well as the properties of the transient can be specified on the first few web pages of the CORHEL interface. Parametric studies can be performed by launching different CME profiles into the same ambient solution, without having to repeat the ambient solar wind calculation.

(Left) A selection of pages showing how the user sets up a typical ambient solar wind run in CORHEL.

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