Automatically Plotting and Identifying Interplanetary Coronal Mass Ejection and Stream Interaction Region in In Situ Observations

Heather Elliott[1], Maher Dayeh, Mihir Desai, Craig Deforest, Raphael Attie, Curt DeKoning, Sarah Gibson, David Webb

[1]Southwest Research Institute, San Antonio, United States

The PUNCH mission tracks high density solar wind structures such as fast Coronal Mass Ejections (ICMEs) and Stream Interaction Regions (SIRs) as they propagate towards Earth. We develop a set of plots and criteria to automatically identify ICMEs and SIRs using in situ observations to aid PUNCH collaborations other missions having the common goal to understand how also CMEs and SIRs evolve en route from the Sun to Earth and impact Earth's space environment. We use the OMNI solar wind dataset because OMNI 1) combines observations from a variety of spacecraft producing a nearly complete coverage of the solar wind near Earth/L1, 2) is a widely used data set by the broader heliophysics community, and 3) uses certified solar wind observations. We flag and color-code time intervals where given solar wind and interplanetary magnetic field quantities satisfy given criteria that indicative of an ICME or an SIR. No one criterion is usually enough to make firm identifications of SIRs and CMEs; therefore, we test what combination of criteria can be used to automatically make a list of ICMEs and SIRs start and stop times that could be verified by a scientist or validated against prior lists. We know from prior experience that even with a few criteria, we can get an automated list that will likely only slightly differ from lists developed by eye. The differences tend to be limited to slight differences in start and stop times, and to identifying small and/or slow ICMEs because many criteria are not distinct for these. Since the density enhancements for the SIRs are not as dramatic as those of the fast ICMEs, it will be more challenging to identify and track SIRs in the PUNCH images. By calculating the magnetic field polarity of the solar wind structures, we can identify series of SIRs that are long-lived called Corotating Interaction Regions (CIRs). Having the timing of when a set of SIRs reach Earth/L1 can be used to verify and improve SIR tracking in PUNCH observations.