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Determining shock velocities for inputs to Sun-to-Earth models from radio and coronagraph data

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The speed of a shock that precedes ejecta from a solar energetic eruption is one of the key parameters used for input by many numerical modeling codes that predict the arrival of interplanetary shocks at Earth. These shocks are likely to be followed by significant geomagnetic activity. Near-real-time forecasts of shock arrival times at the L1 libration point have been made for several years with the Hakamada-Akasofu-Fry (version 2) model and distributed by e-mail to interested subscribers ("fearless forecasts"$*$). The model uses, for input speed near the Sun, the speeds obtained from observations of metric type II radio bursts that are signatures of a shock propagating out through the solar corona. More recently, speeds of the halo/partial halo coronal mass ejections (CMEs) were also considered in these models as another measure of shock speeds close to the Sun. During the period of high solar activity in Oct.-Nov. 2003, the data required for input into the models was often available in near real time from a number of observing stations. Therefore in a number of cases the *fearless forecasts* were issued with alternative inputs. These forecasts provided a basis on which to compare the success of the predictions (in terms of how close each prediction of the shock arrival time was to the observed time). The results of the analysis of this data set are presented in the form of guidelines to the selection of the speed for use as input to shock propagation models. Both CME and metric type II radio burst measurements are shown to be useful and complimentary. This demonstrates the desirability of having coronagraph data available for operational use.

*http://gse.gi.Alaska.edu/recent/vdp.html and http://gse.gi.Alaska.edu/recent/vdbs.html.