Format of solar wind data plots (produced by Ian Richardson, GSFC, ian.richardson@gsfc.nasa.gov) Revised February 28, 2007.

The majority of the plots show 64s resolution "level 2" (verified) magnetic field and plasma data from the ACE MAG and SWEPAM experiments. The data are obtained from the ACE Science Center (http://www.srl.caltech.edu/ACE/ASC/). For events in 1996-1997, prior to the launch of ACE, the magnetic field and plasma data are from the 1 minute OMNI database (http://omniweb.gsfc.nasa.gov/); these have "OMNI" in the file name. Plots using OMNI data are also provided for a few other events, for example, where there are important gaps in the ACE data.

For each event, a 2-day interval is generally shown, centered on the time of peak Dst as noted in the CDAW event table. The parameters shown are:

- The magnetic field intensity, polar (90 deg = northward) and azimuthal (90 deg = directed to the west) angles (GSE);
- Proton temperature (black line). The red line is the "expected temperature" for normally expanding solar wind (Richardson and Cane, 1995). This is derived from the solar wind speed (panel 6) using the results of Lopez (1987) based on OMNI data. See Neugebauer et al. (2003) for a similar formula derived from ACE data. In normal (non-ICME) solar wind, T_{exp} typically tracks T_p. In ICMEs, typically $T_p << T_{exp}$. Black shaded regions indicate when $T_p < 0.5 T_{exp}$, a frequent indicator of possible ICMEs (Richardson and Cane, 1995), as well as other structures such as heliospheric current/plasma sheet crossings. For a recent review of the in-situ signatures of ICMEs, see Zurbuchen and Richardson (2006), and references therein.
- Solar wind proton density;
- Solar wind speed;
- Solar wind helium/proton ratio. Elevated values above 0.06 are typically associated with ICMEs. However, not all ICMEs have elevated He/p. This ratio also varies during the solar cycle (see Richardson and Cane, 2004, and references therein). He/p is not provided in the OMNI dataset;
- Ratio of solar wind oxygen ions with charges 7 and 6, from the ACE/SWICS instrument (Level 2 data from the ACE Science Center). O^7/O^6 is believed to provide a measure of the coronal electron freezing-in-temperature. The red line is an estimate of the expected value of O^7/O^6 for ambient, non-ICME solar wind, inferred from the solar wind speed (Richardson and Cane, 2004, and references therein). ICMEs typically have $O^7/O^6 >>$ the expected value;
- (1998 – 2000 events) Fraction of solar wind iron ions with charge states ≥16, from ACE/SWICS. High values (>0.1) are typically associated with ICMEs (e.g., Lepri et al., 2001). Red line indicates "expected value" based on the solar wind speed (Richardson & Cane, 2004). (Data supplied by Sue Lepri, U. of Michigan);
- Bz in GSM coordinates. Negative values indicate southward-directed magnetic fields;
- The Dst geomagnetic index;
- The Kp geomagnetic index, shown as Kp*10;
- An ICME index (1 = probable ICME), based on the ICME identifications of Cane and Richardson (2003), with updates. Note that these identifications did not use

composition/charge state data, thus some adjustments to the event boundaries may be made in the light of these data. In addition, it is possible that an occasional event may have been missed or mis-identified.

Vertical green lines indicate times of *geomagnetic storm sudden commencements* with at least one "A" report in the NGDC list. These typically are associated with shocks observed at ACE, with a delay due to the upstream location of ACE at the L1 libration point. Other shocks may be evident in the plasma/field data - see the ACE shock list at http://www-ssg.sr.unh.edu/mag/ace/ACElists/obs_list.html#shocks.

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