Slow Solar Wind and the Heliospheric Current Sheet

B. Bala

Visiting Scientist
High Altitude Observatory
National Center for Atmospheric Research
Boulder, CO 80305

Background

Heliospheric Current Sheet (HCS) separates the heliospheric magnetic field (HMF) into two opposite dominant polarities. The solar wind velocity in the heliosphere is found to be minimum on the HCS and increases with distance from it. However, it has been shown by various authors that there exists a discrepancy between the latitudinal extensions of the slow solar wind and the HCS (Kojima and Kakinuma 1987; Crooker et al., , 1997). In an earlier study, Suess and his collaborators have shown the existence of an azimuthal gradient on the HCS and the distortion of the HCS caused by it (Suess and Hildner 1985; Suess et al., 1986).

Azimuthal distribution of slow solar wind

V-map: Velocities estimated from the technique of interplanetary scintillation (IPS) within a distance of 0.3–0.9 AU in the heliosphere are projected back to the source surface kinematically to make synoptic maps (V–maps) of solar wind in heliographic latitude and Carrington longitude (Kojima et al., 1987; 1998).
Figure 1: The V-mapfor Carrington rotations CRs 1925–1928 in 1997. The thin white contours are the slow speed solar wind; velocities less than 500 km s^{-1}. The thick solid line is the HCS, taken as the neutral line of the coronal magnetic field obtained using potential field model of Hoeksema for the same period.
Figure 2: The azimuthal distribution of slow solar wind for rotations CRs 1925–1928.

Compact structures in slow solar wind

Small, localized regions of very slow solar wind has been detected within the low speed belt of solar wind velocity. The origin and cause of such very low sloar wind would be useful to be studied in detail. Such a work is currently underway.

Figure 3 shows the V-map prepared by superposing the IPS data for three Carrington rotations CRs 1894-1896, in 1995. The thin white contours are the slow solar wind (450 km $s^{-1}$and lower). The thick white line is the HCS for CR 1894. Here, the smallest contours at (a) longitude 0–15° and latitude 0–15° N, (b) at longitude 15–30° and latitude 0–15° S, (c) longitude 60–105° and latitude 0–15° S, (d) longitude 180–240° and latitude 10–20° N,

(e) longitude 255–285° and latitude 15–25° S and (f) longitude 340–360° and latitude 0–15° N, are the compact structures within the low–speed belt. The velocity at these regions are less than 300 km s^{-1}. Such compact structures are seen in Figure 1 also.

Acknowledgement: I thank Prof M. Kojima for kindly making available all the data necessary for this work.

Literature Cited

Crooker, N. U., A. J. Lazarus, J. L. Phillips, J. T. Steinberg, A. Szabo, R. P. Lepping, and E. J. Smith 1997: *Journal Geophys. Res.* , **102**, 4673.

Kojima, M. and T. Kakinuma, 1987: *Journal Geophys. Res.* , bf 92, 7269.

Suess, S. T. and E. Hildner, 1985: *Journal Geophys. Res.* , **90**, 9461.

Suess, S. T., P. H. Scherrer and J. T. Hoeksema, 1986: The Sun and the Heliosphere in Three Dimensions, edited by R. Marsden, D. Reidel, 275.

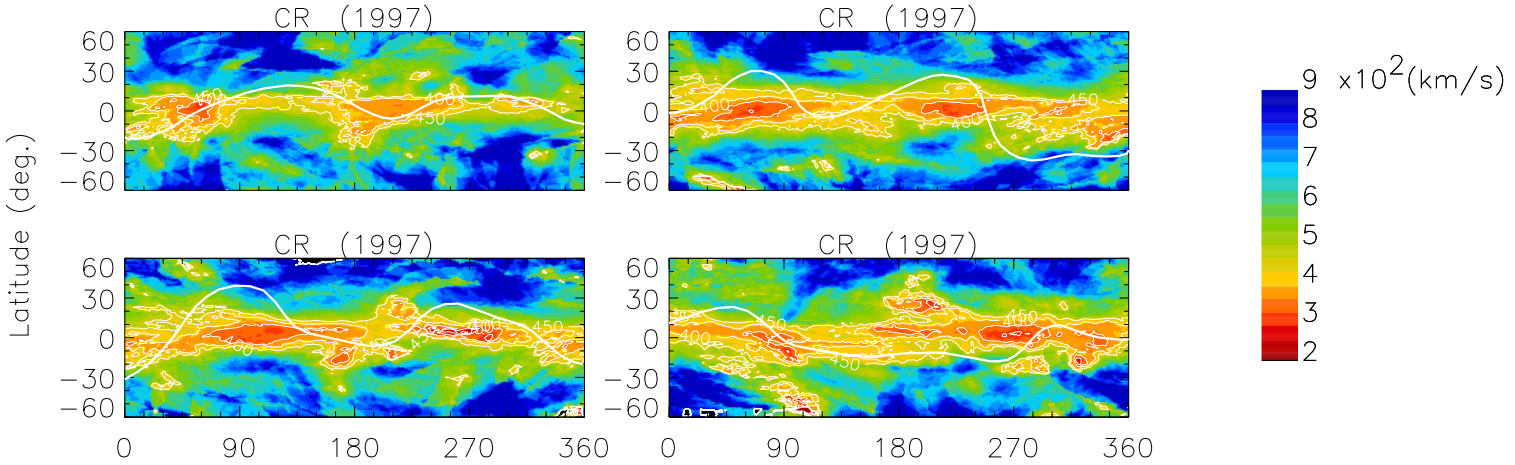

Figure 1: The V-maps for CRs 1925, 1926, 1927 and 1928. The thick solid line represents the magnetic neutral line (HCS) for the respective rotations and the contours are for solar wind speed ≤ 450 km s^{-1}.

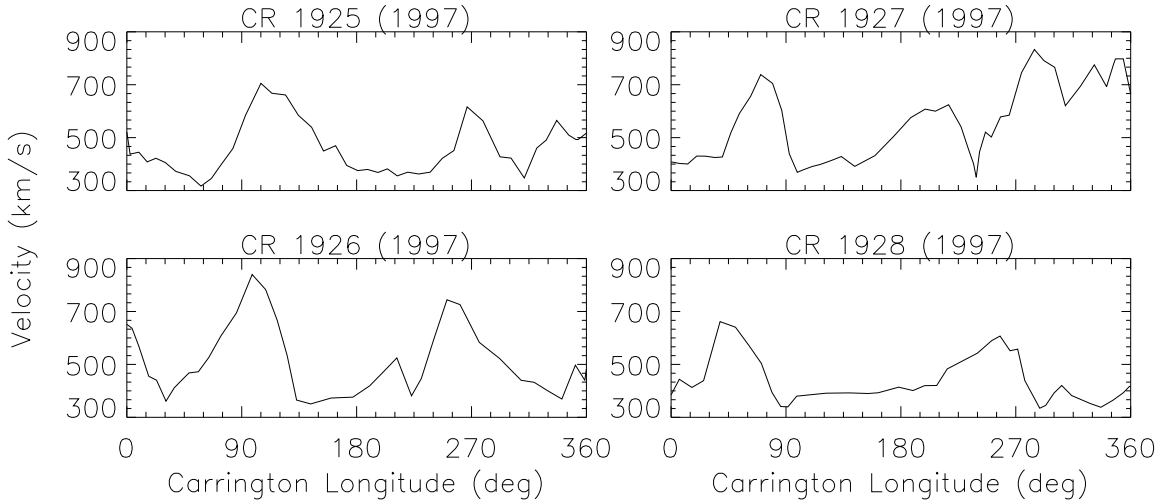

Figure 2: The azimuthal variation of solar wind speed within the low speed belt for CRs 1925, 1926, 1927 and 1928 in 1997.

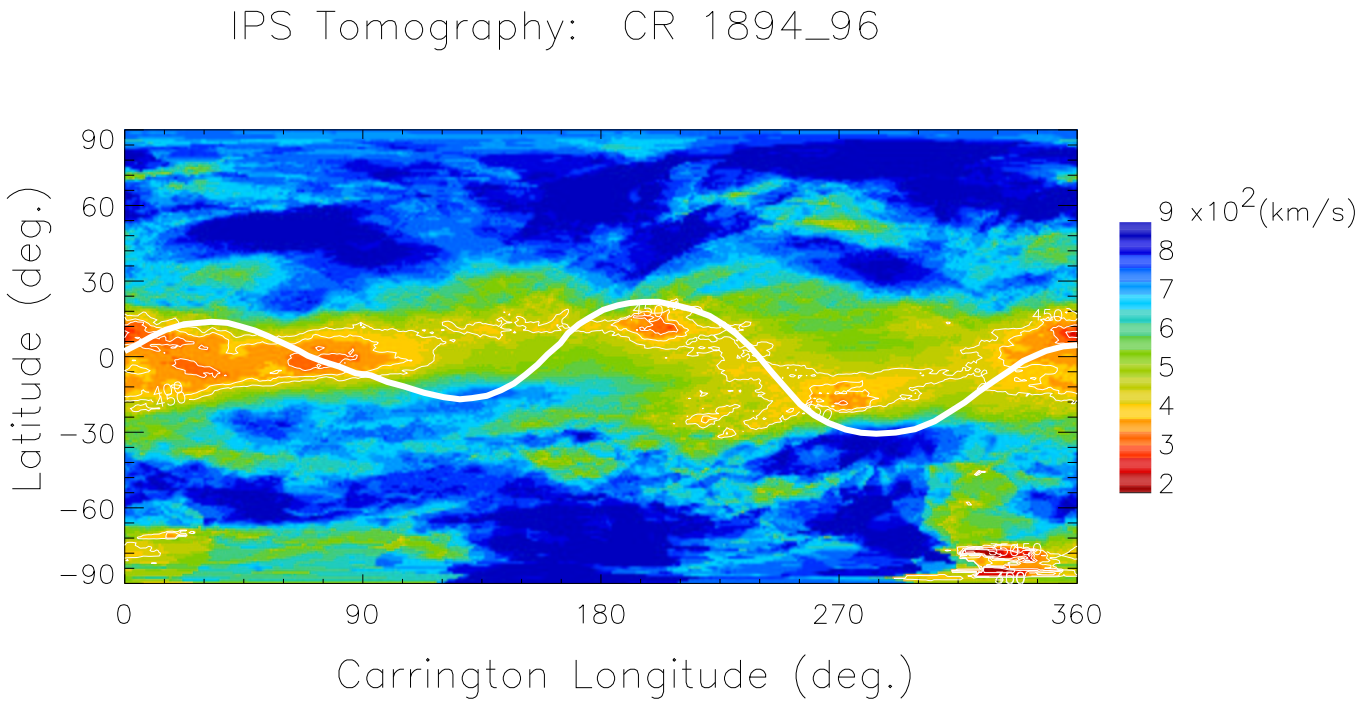

Figure 3: The variation of solar wind speed within the low speed belt.