Update on Solar Wind Sources

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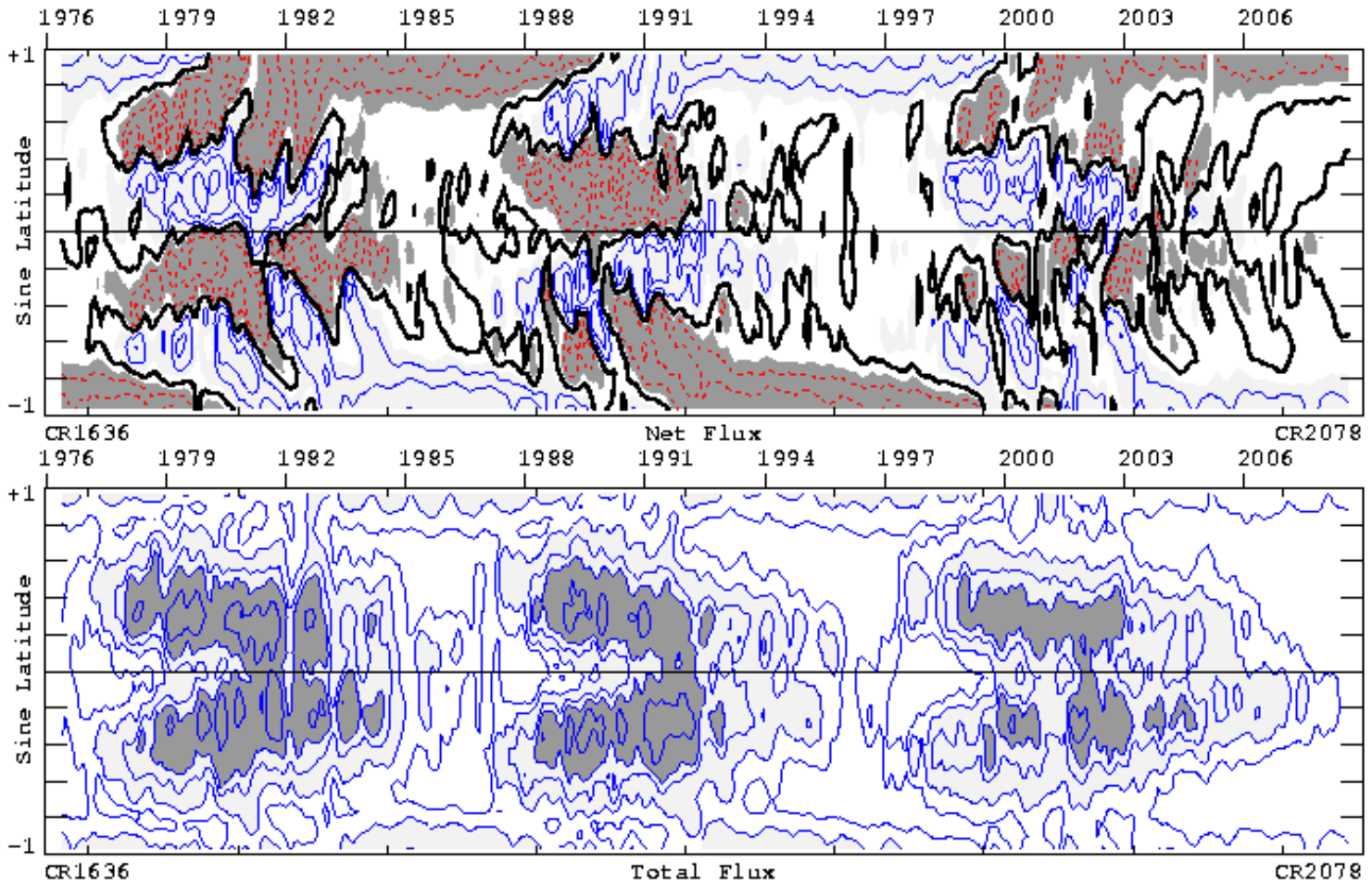
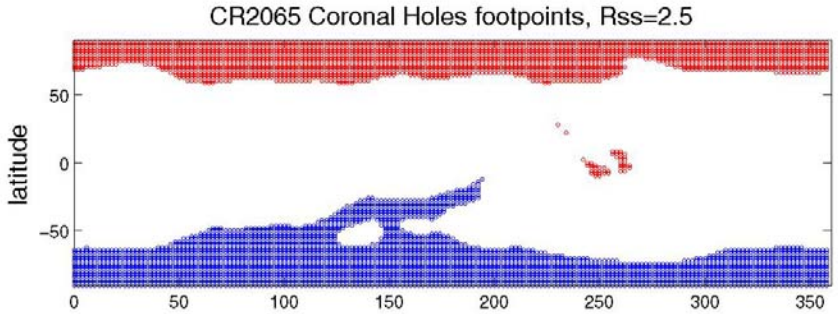
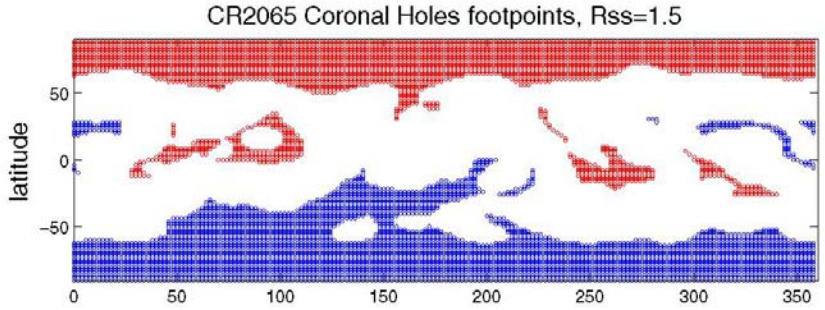


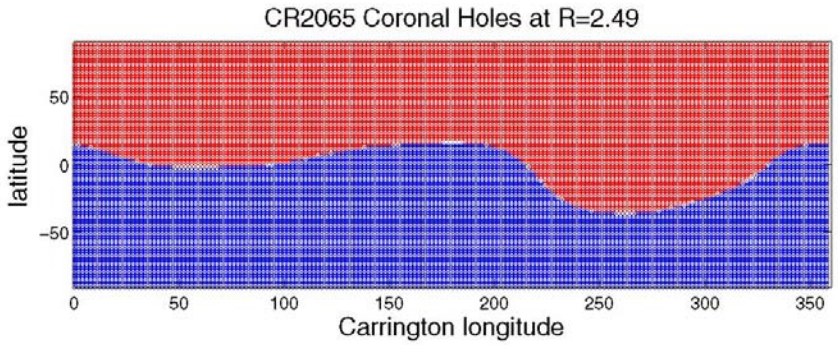
Low photospheric field appears to characterize this entire cycle (data from WSO website)-not just low polar field. However the spherical harmonic content favors higher order moments more than in earlier late declining phases.

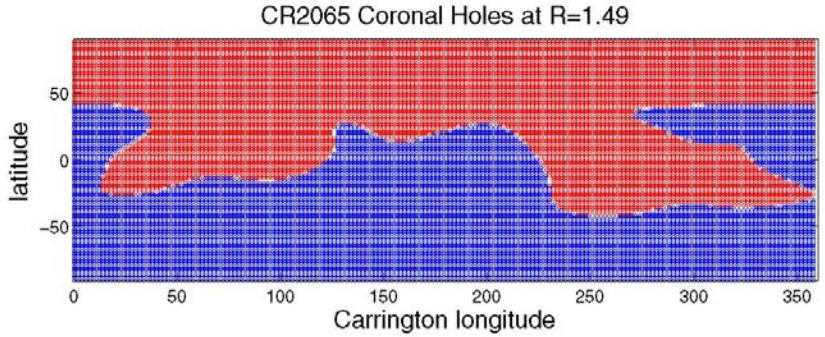
Solar Wind Source Regions Consequence: Ubiquity of Low Latitude Coronal Holes

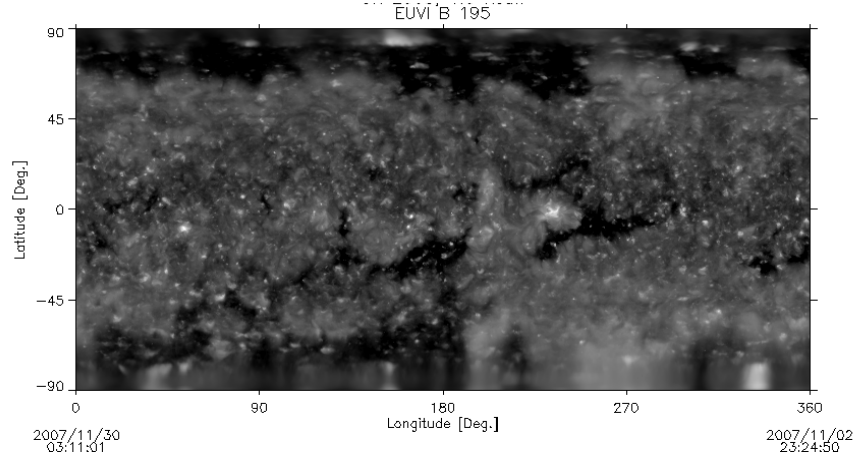
CR2065: A smaller effective source surface may exist at this time, producing more low latitude open fields

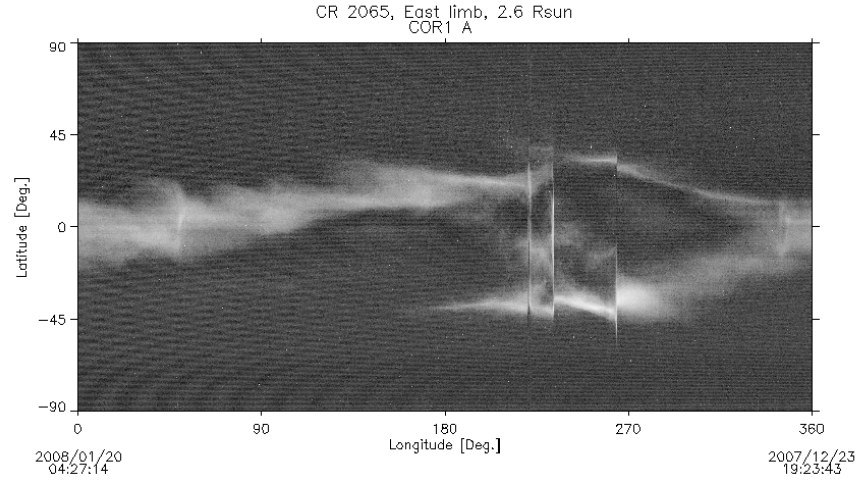






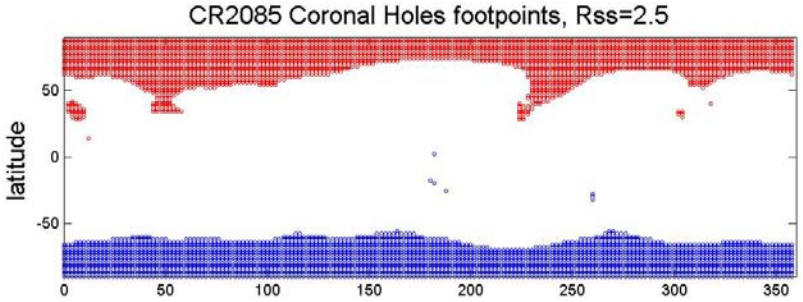


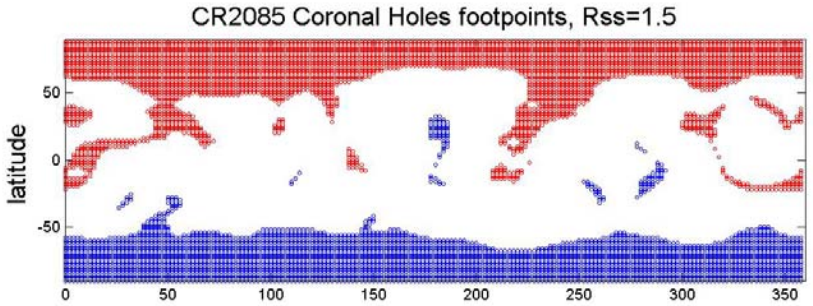


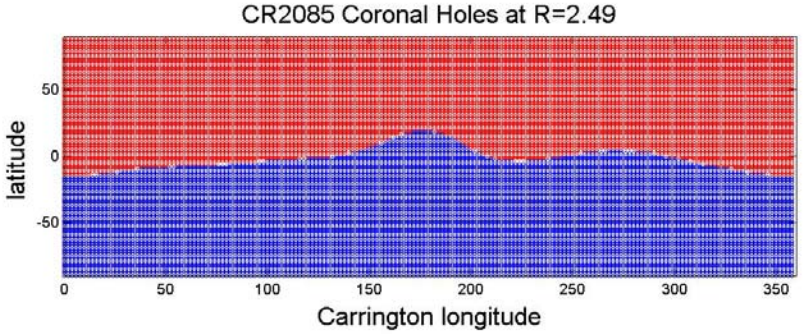


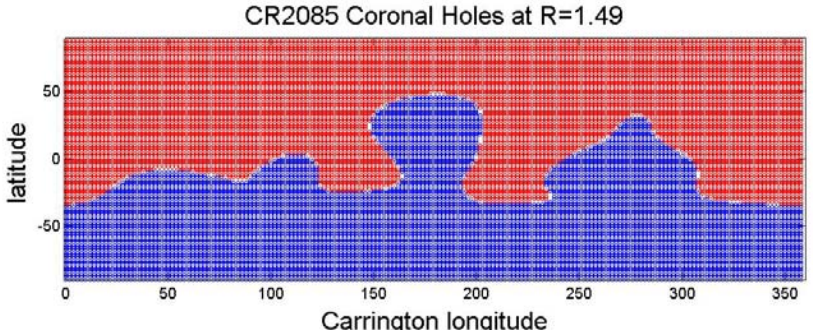
Top: MWO-based PFSS models; Bottom: STEREO SECCHI EUVI and COR data

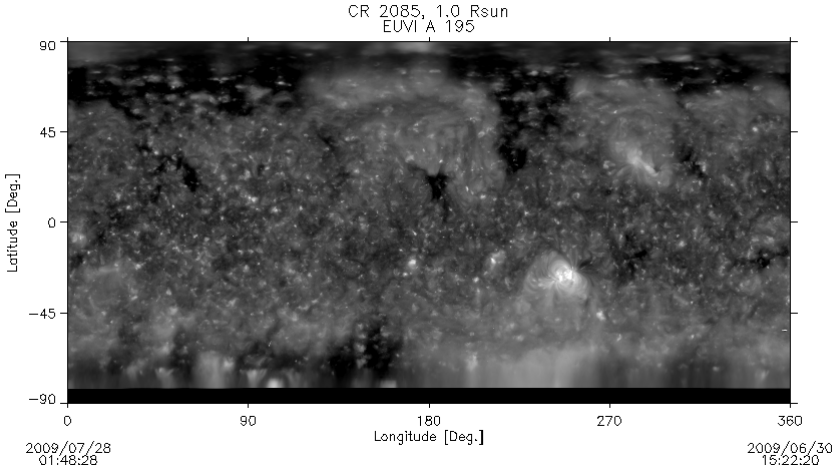
CR2085: A smaller effective source surface may exist at this time, producing more low latitude open fields

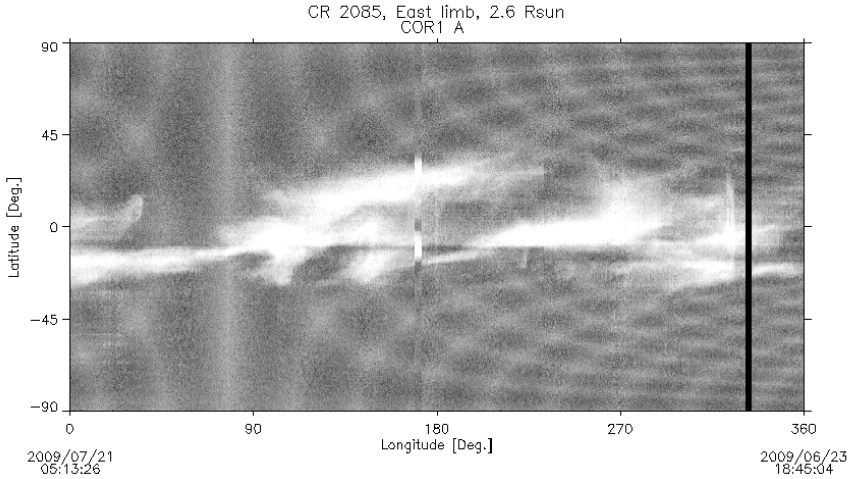






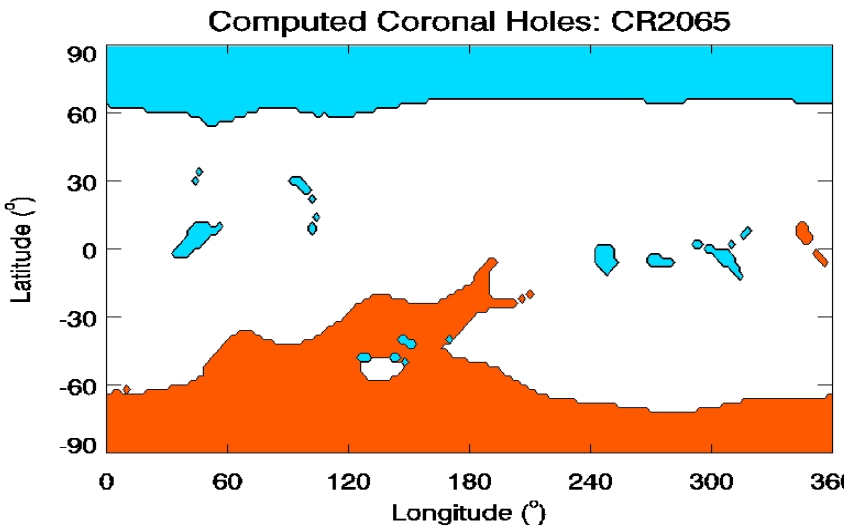


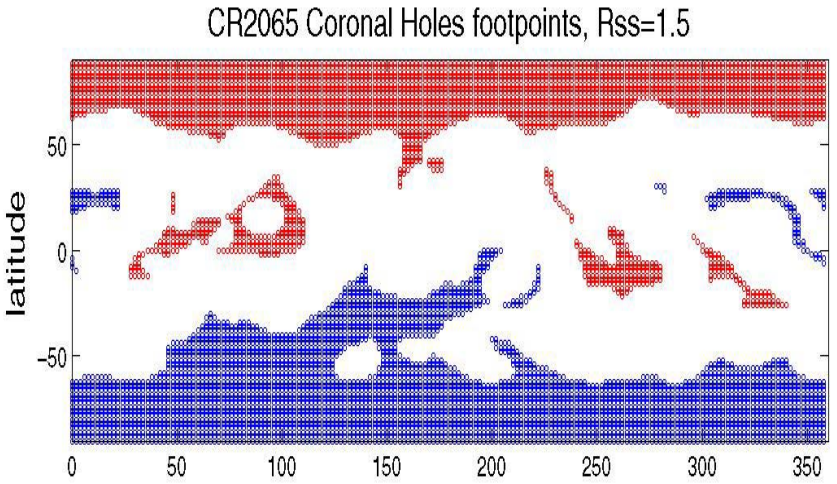


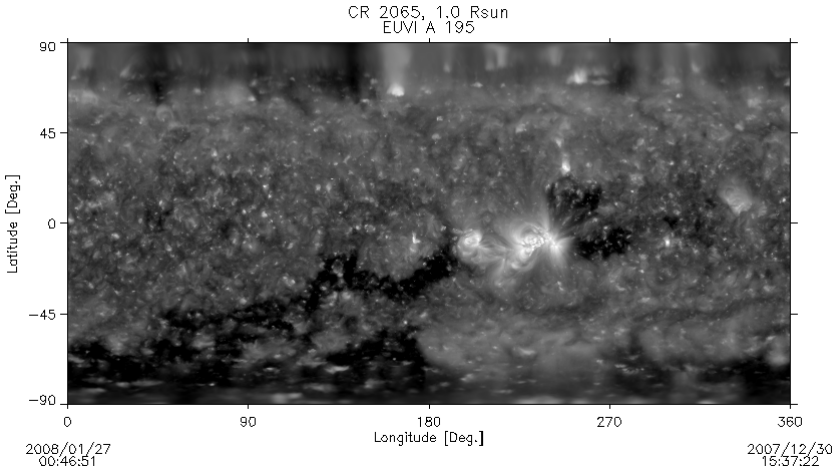


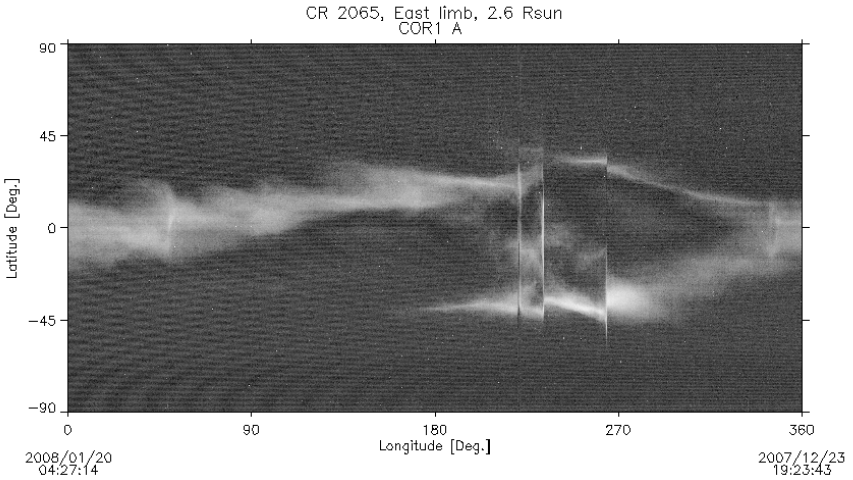
Top: MWO-based PFSS models; Bottom: STEREO SECCHI EUVI and COR data

The MAS MHD model (polytropic version) naturally captures the more open configuration (www.predsci.com): e.g. CR2065



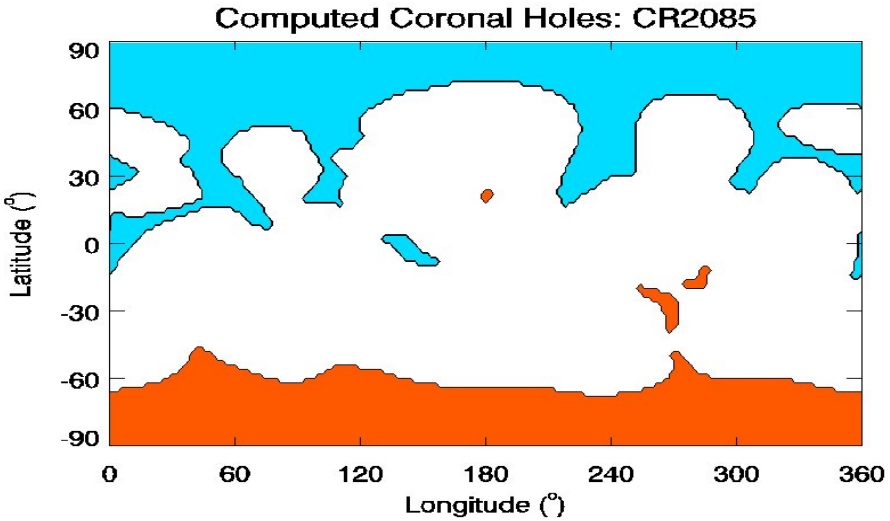


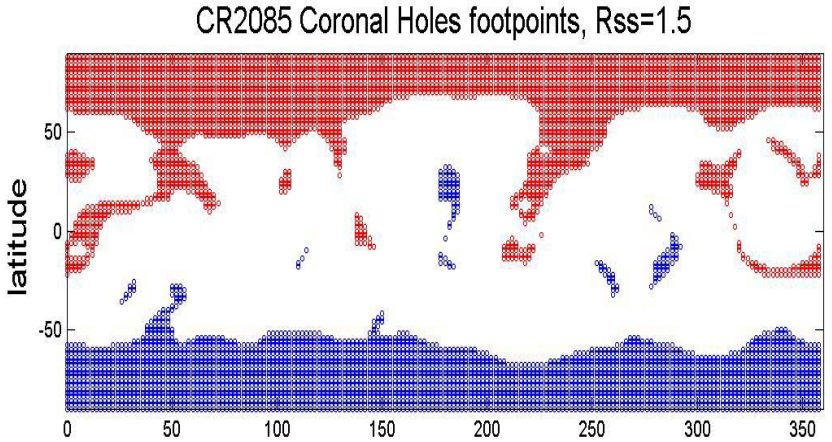


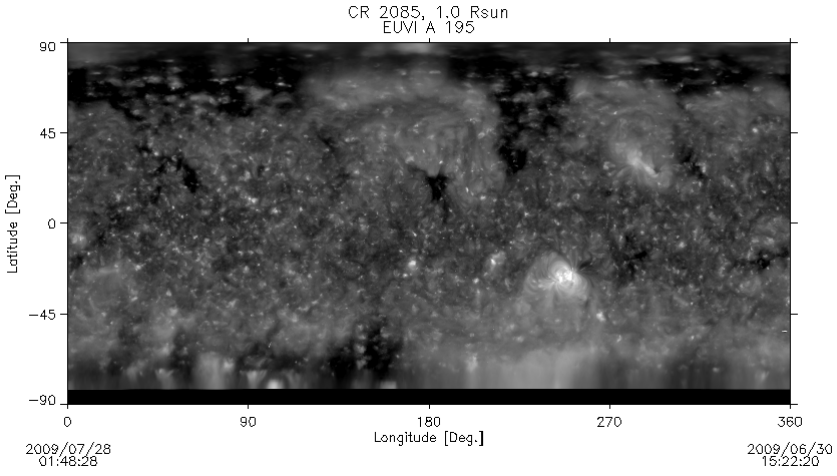


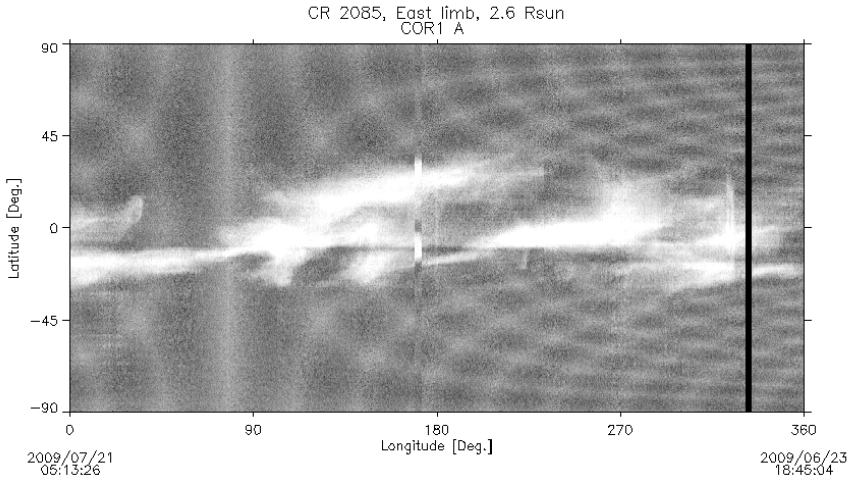
Top: MWO-based PFSS and MHD models; Bottom: STEREO SECCHI EUVI and COR

The MAS MHD model (polytropic version) naturally captures the more open configuration (www.predsci.com): e.g. CR2085





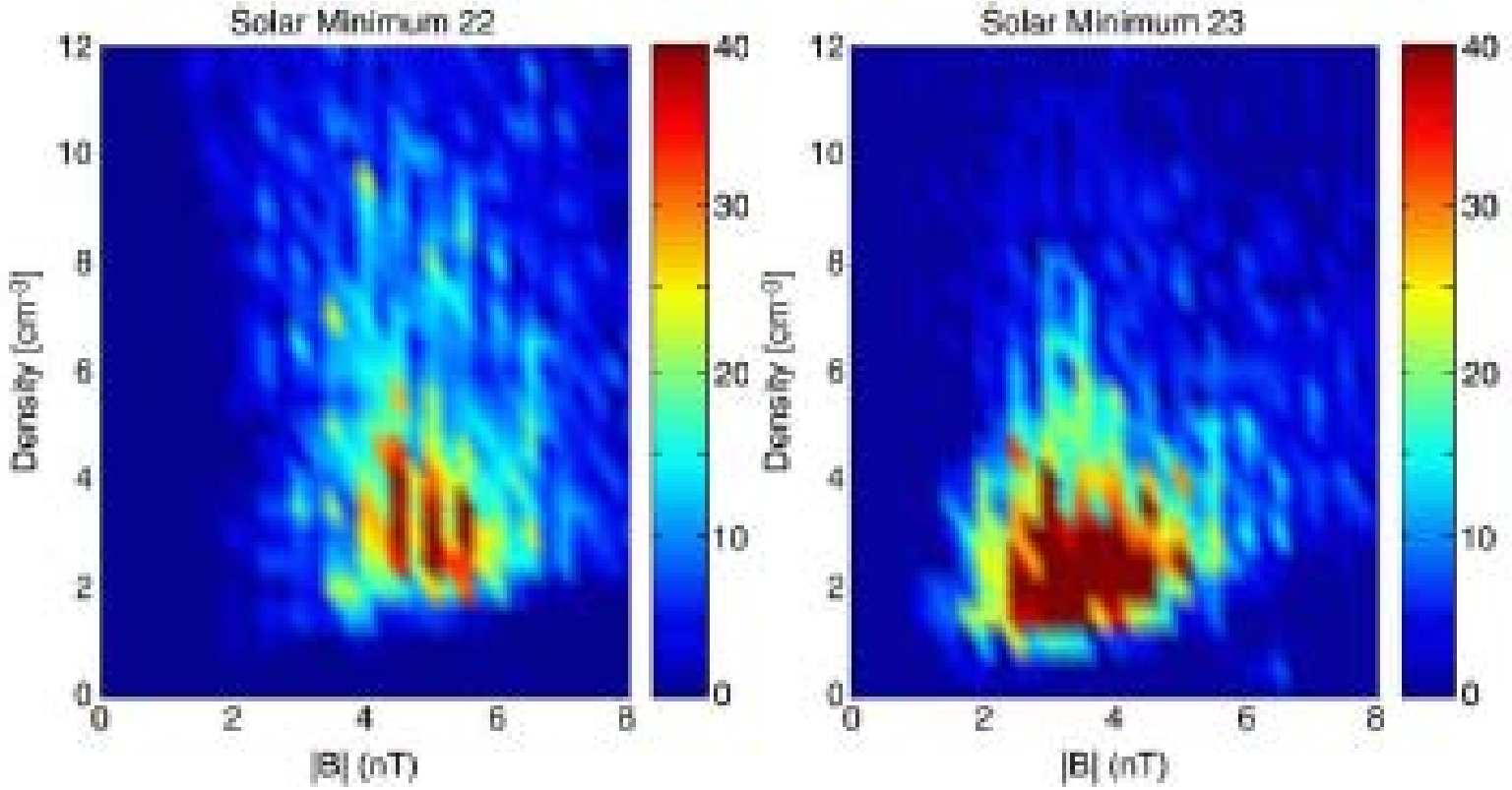




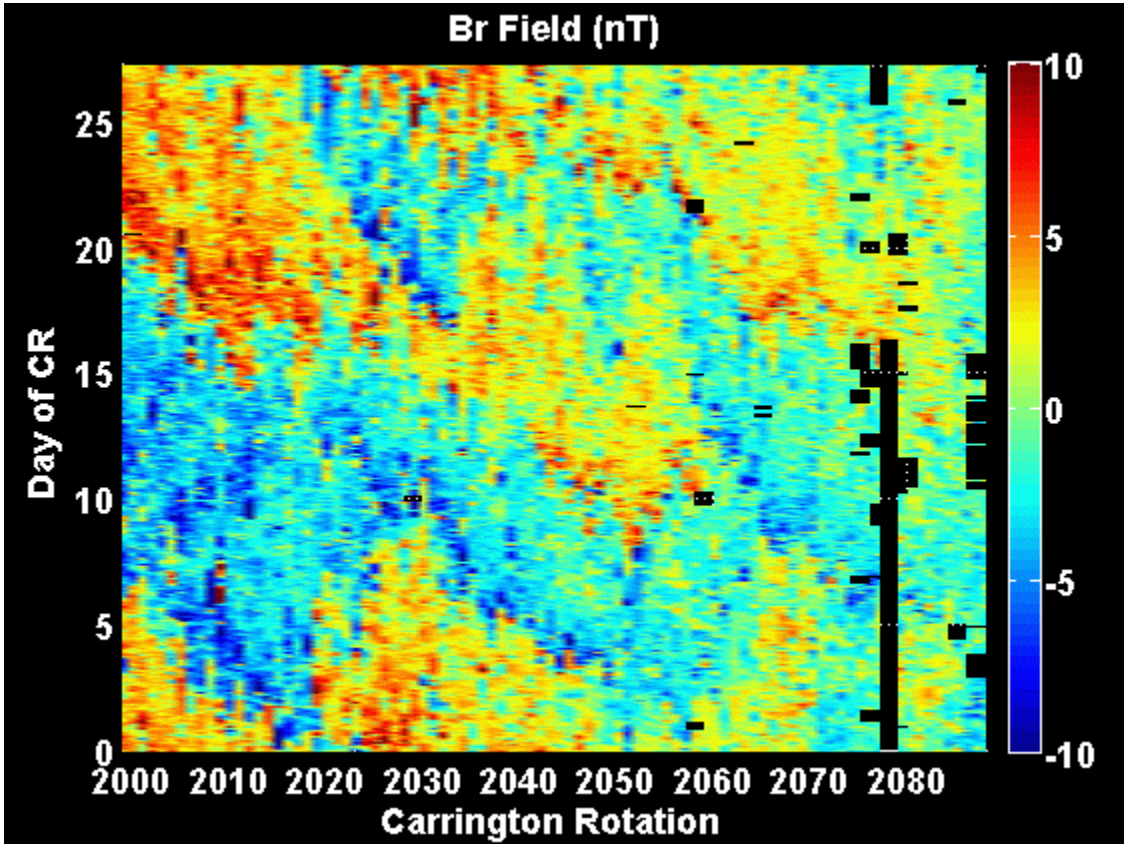
Top: MWO-based PFSS and MHD models; Bottom: STEREO SECCHI EUVI and COI

IMF and Solar Wind Properties
Consequences:
Low field magnitudes and densities/dynamic pressures compared to previous cycle minimum

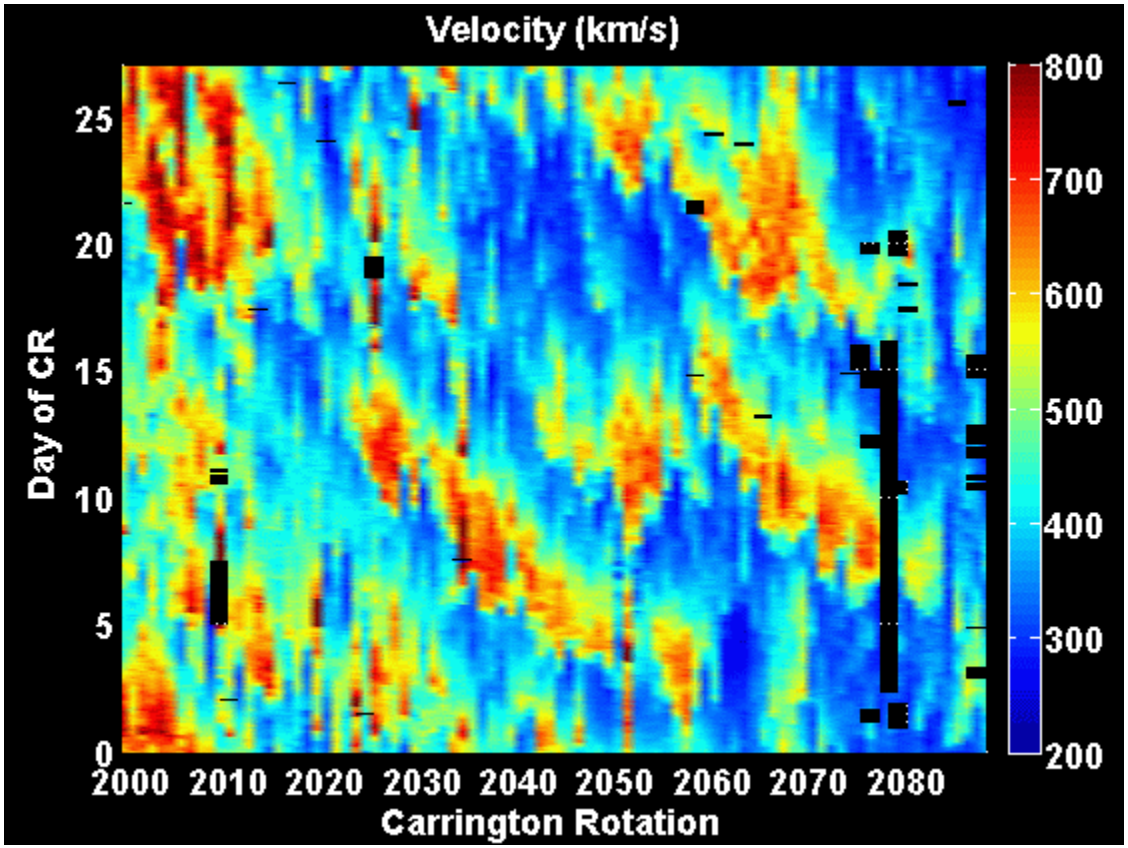
OMNI IMF and density



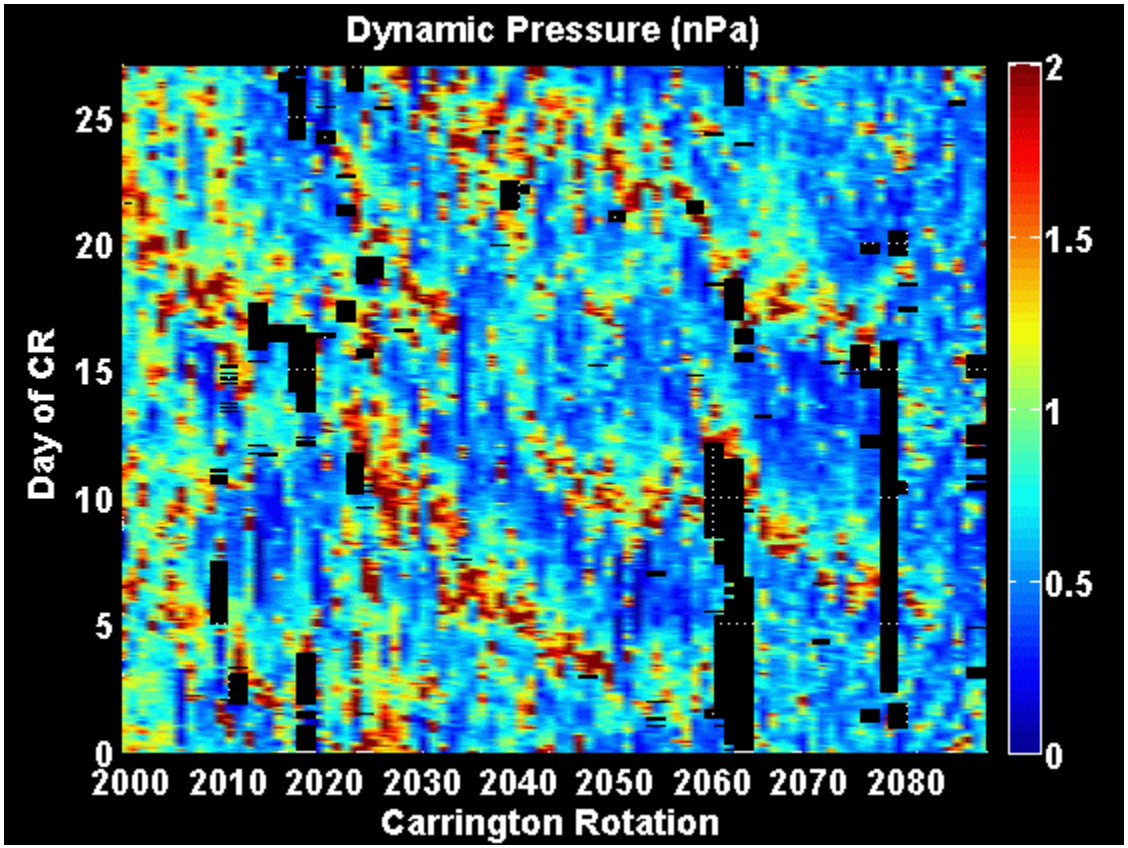
OMNI Radial Field at 1 AU
CRs 1999 to 2088
(January 2003 – October 2009)



OMNI High speed solar wind at 1 AU
CRs 1999 to 2088
(January 2003 – October 2009)



OMNI Dynamic Pressure at 1 AU
CRs 1999 to 2088
(January 2003 – October 2009)

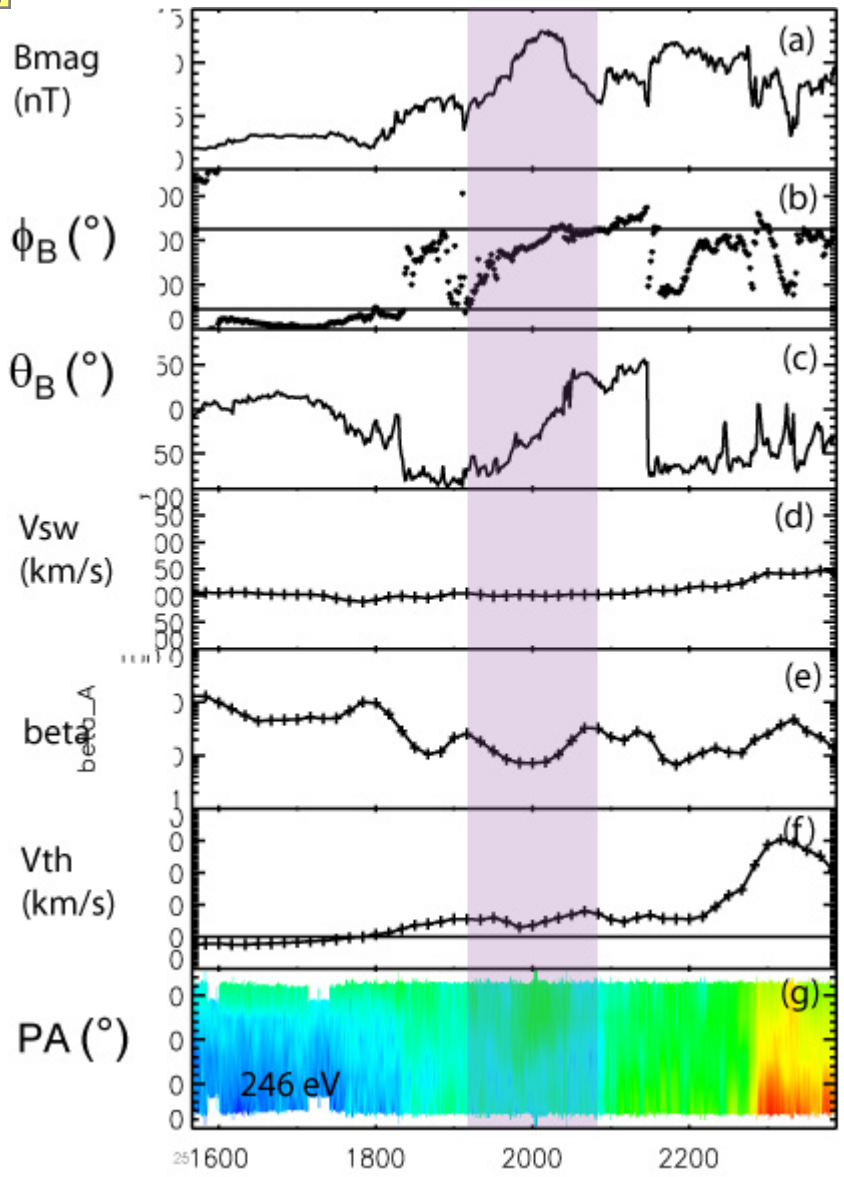


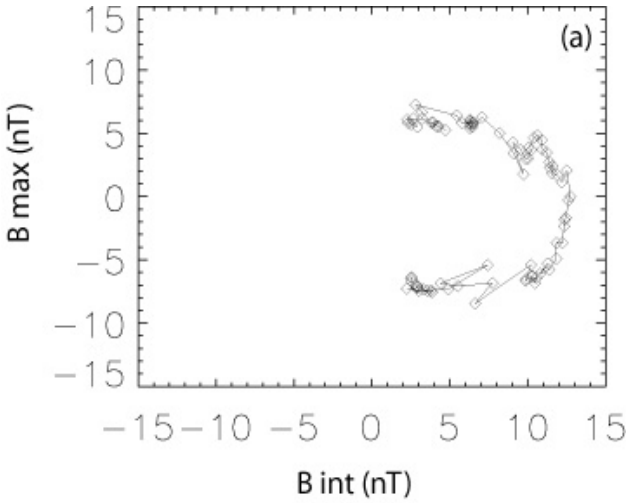
Small "ICME-like structures" in the slow solar wind

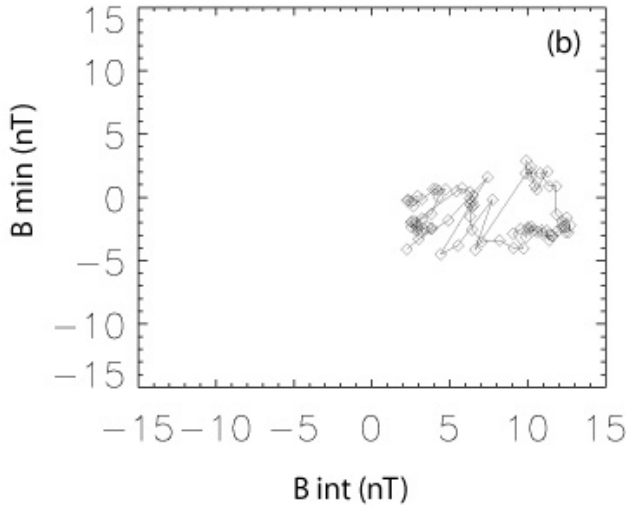
- STEREO A and B measurements
- 14 Carrington rotations investigated: 2057-2070
  (May 24, 2007 – June 9, 2008)
- solar activity minimal → ideal time to study the structure of slow solar wind

Motivation

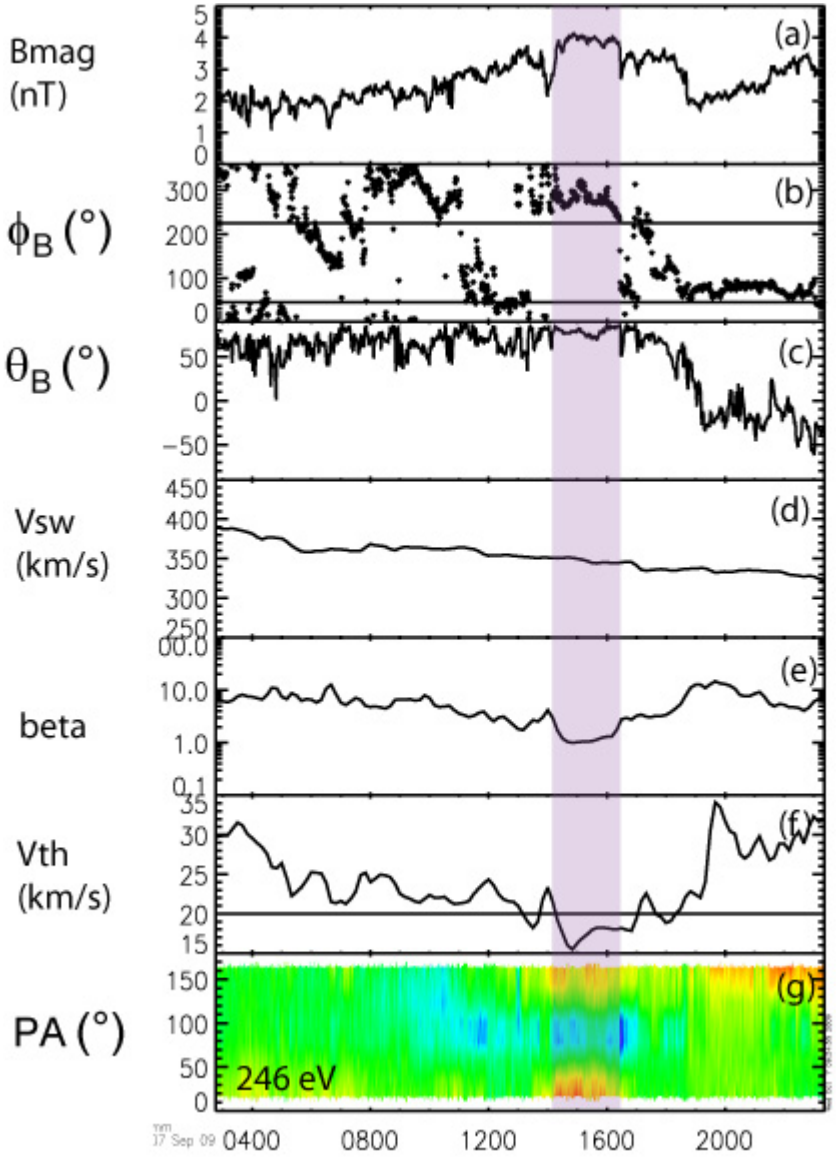
- the occurrence of ICME-like structures plus HI images
- distribution in time and with respect to the large scale HCS
- size distribution: bimodal or continuous?

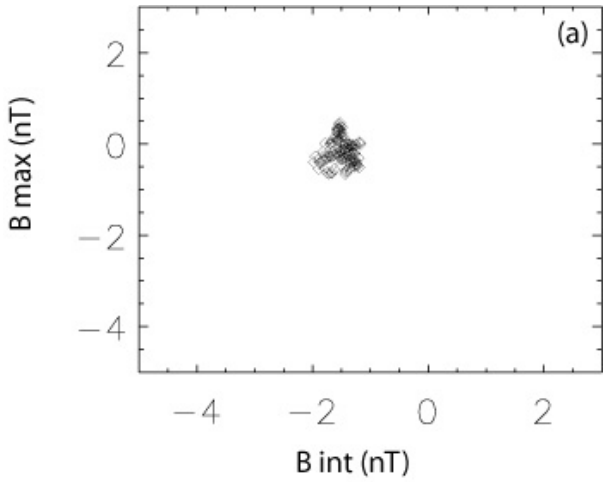


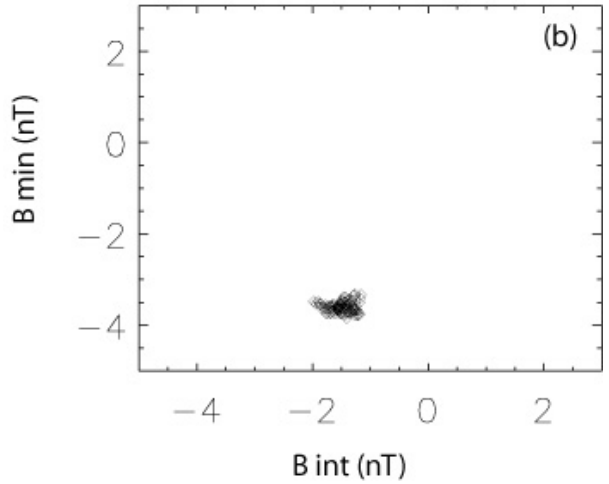




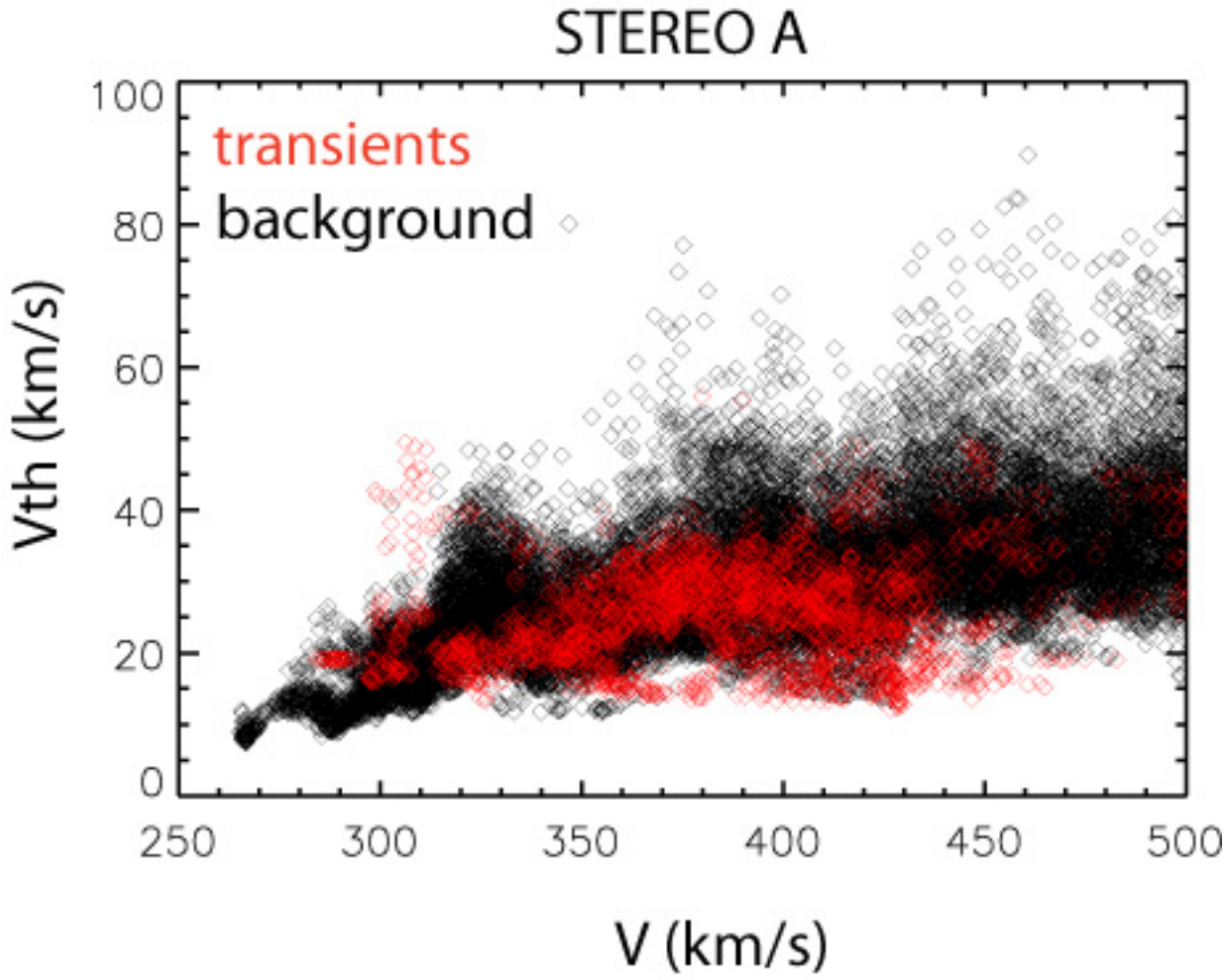
Example 1
only criterion of IMFrotation fulfilled

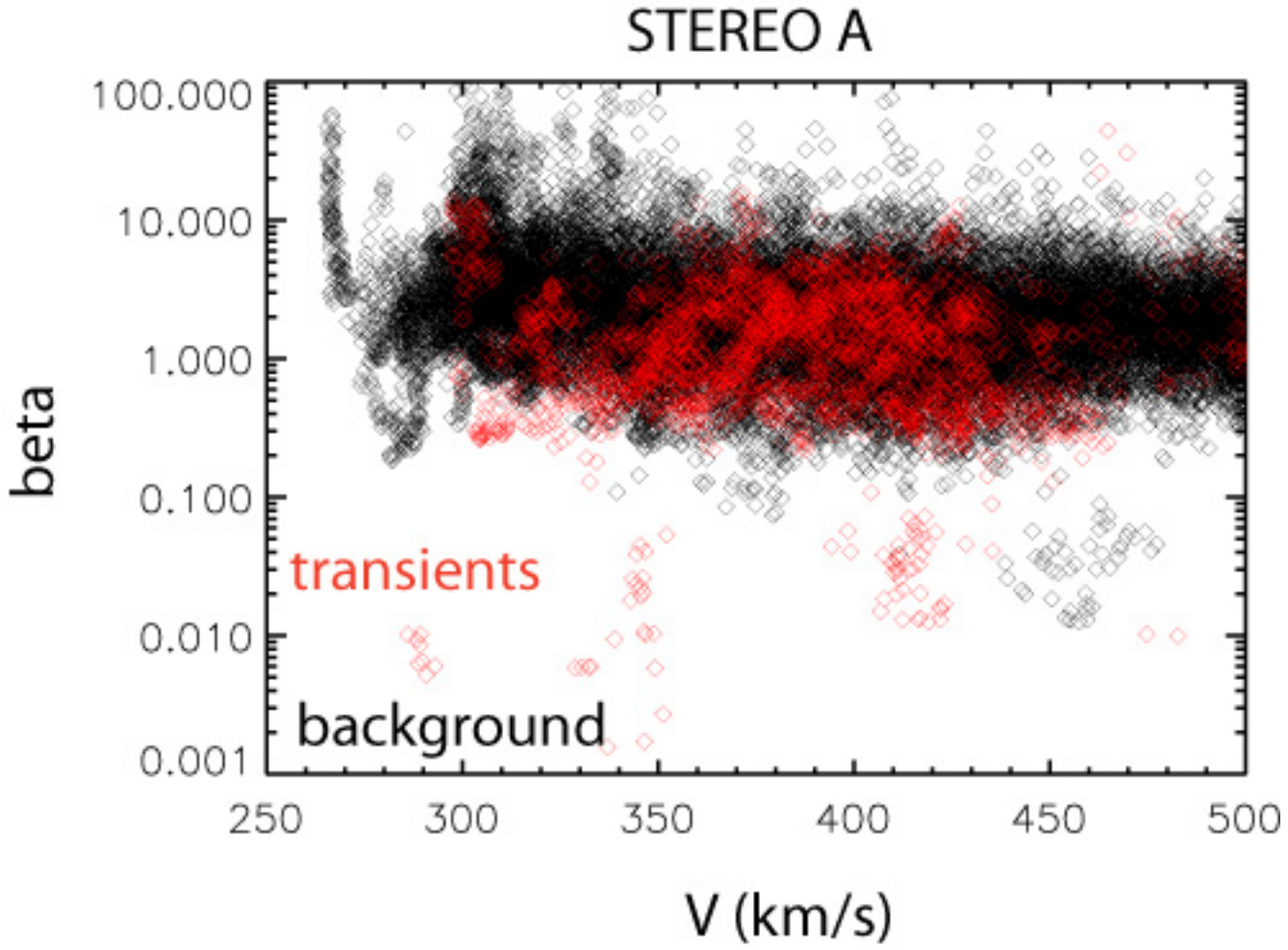


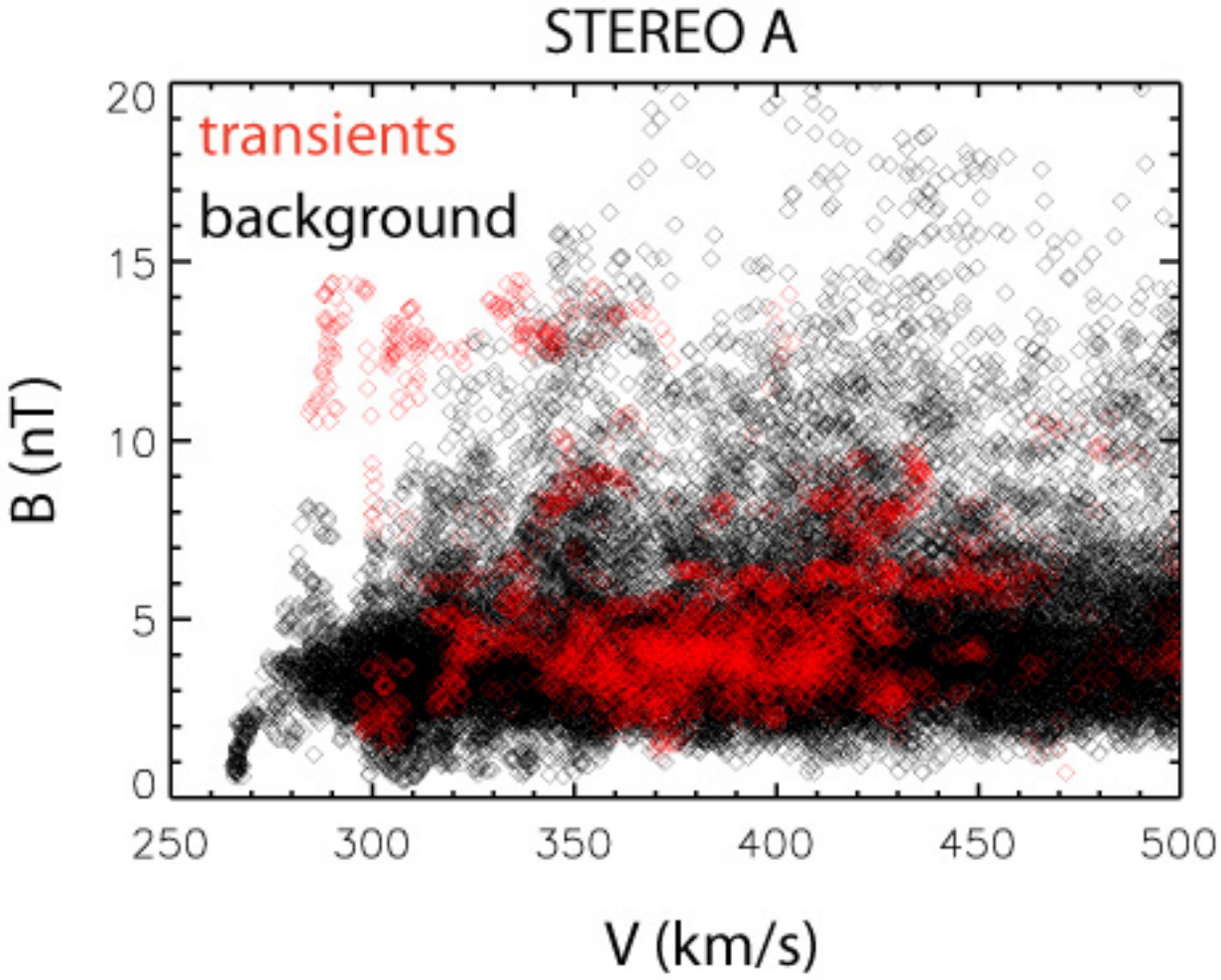




Example 3
Only criterion of counterstreaming electrons fulfilled


STEREO A
transients
background
Vth (km/s)
V (km/s)
0
20
40
60
80
100
250
300
350
400
450
500


STEREO A
100.000
10.000
1.000
0.100
0.010
0.001
beta
transients
background
250
300
350
400
450
500
V (km/s)


STEREO A
transients
background
B (nT)
V (km/s)
0
5
10
15
20
250
300
350
400
450
500

- even at the time of very low solar activity ICME-like structures found frequently in the slow solar wind
- magnetic field values clearly lower and radial diameters clearly smaller than for typical large-scale ICMEs
- occur ‘everywhere’, not just near the coronal sector boundaries
- continuous size distribution identified, but peaks toward the small scale sizes

..

- Do all ICME-like structures have solar origin or is there a population produced by the reconnection across the heliospheric current sheet?

Bottom lines on solar wind sources analyses (study leads in parentheses):

Study 1: Source surface looks smaller this solar minimum (consistent with some theoretical work indicating last closed field line location is sensitive to coronal temperature, which current integrated XUV fluxes indicate is low) (Luhmann et al.)

Study 2: Weak IMF and low density persist. (C.O. Lee et al.)

Study 3: Small transient-like phenomena in slow solar wind are ubiquitous, but their origins still unclear (Kilpua et al.)