Comparing HELCATS CIR catalogues derived from white-light images and in-situ measurements

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In-situ view of a CIR

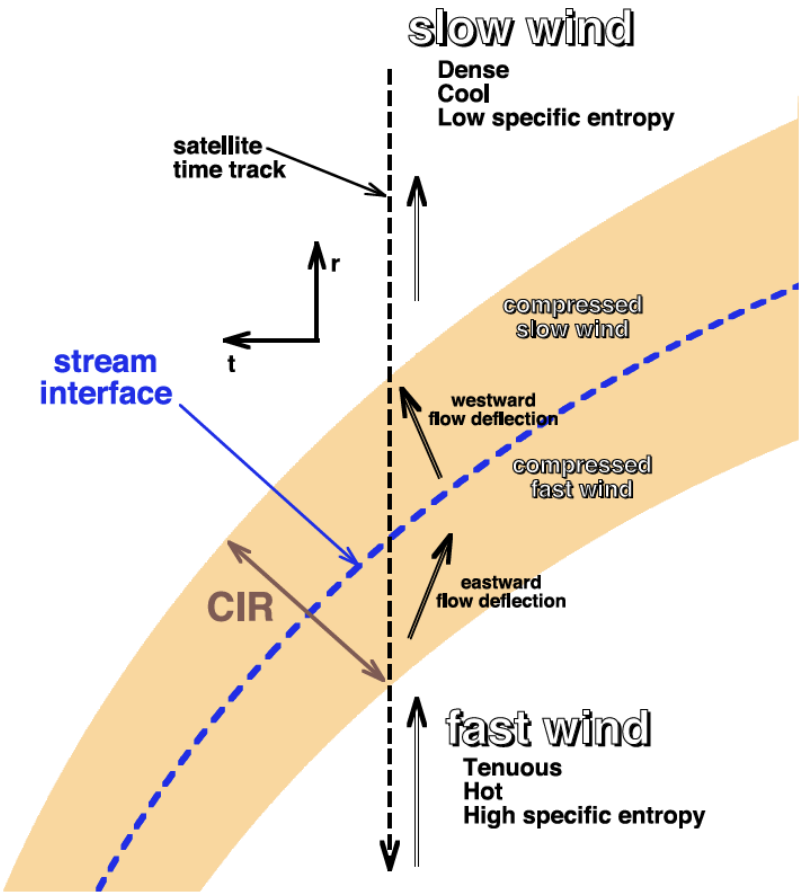
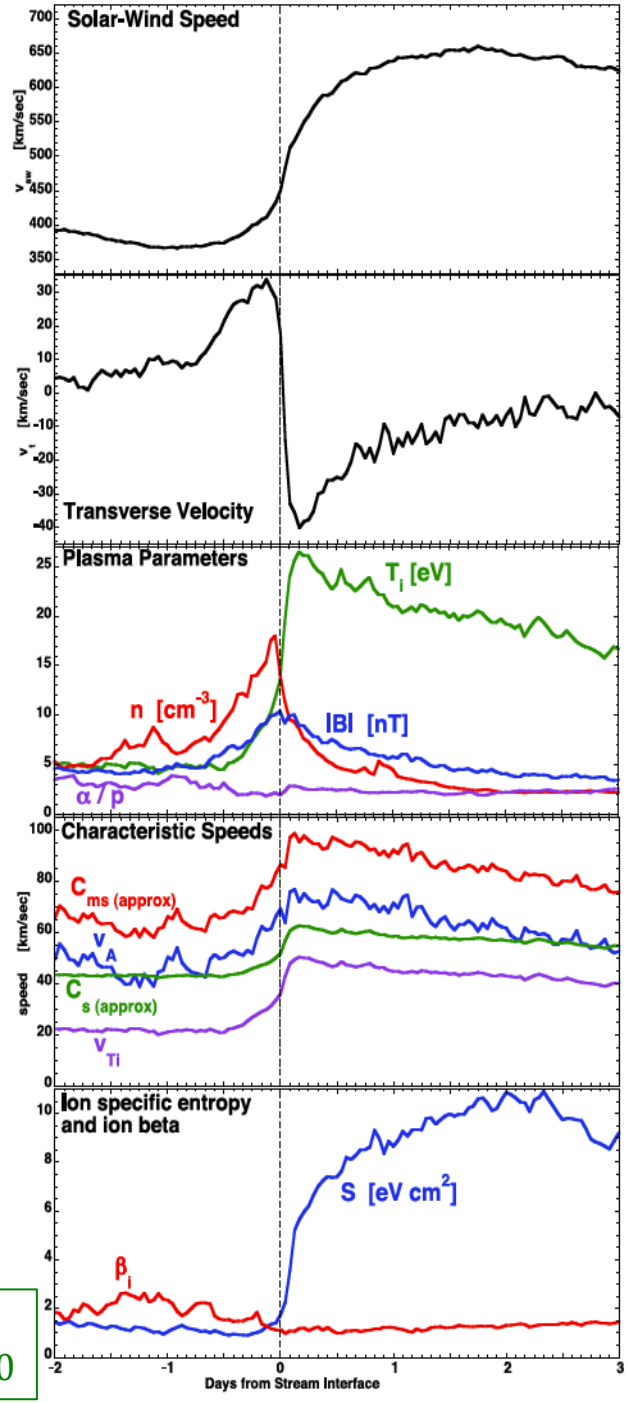
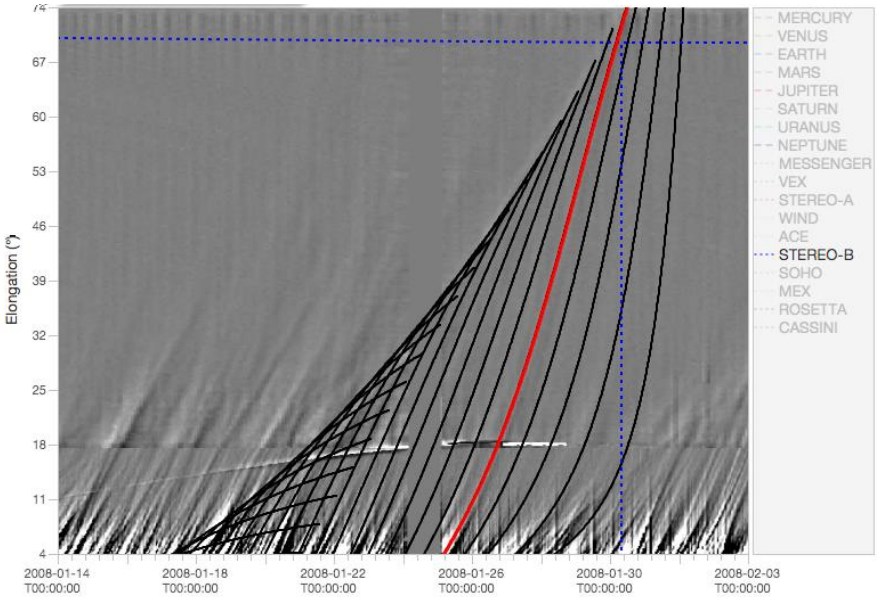


Figure 5. A sketch of a CIR in the vicinity of 1 AU. Standard view in the reference frame of the Sun in RTN coordinates. The reference frame emphasizes the westward-eastward flow deflection (arrows) in the CIR (brown shading).



Borovsky & Denton
JGR, 115, A10101, 2010

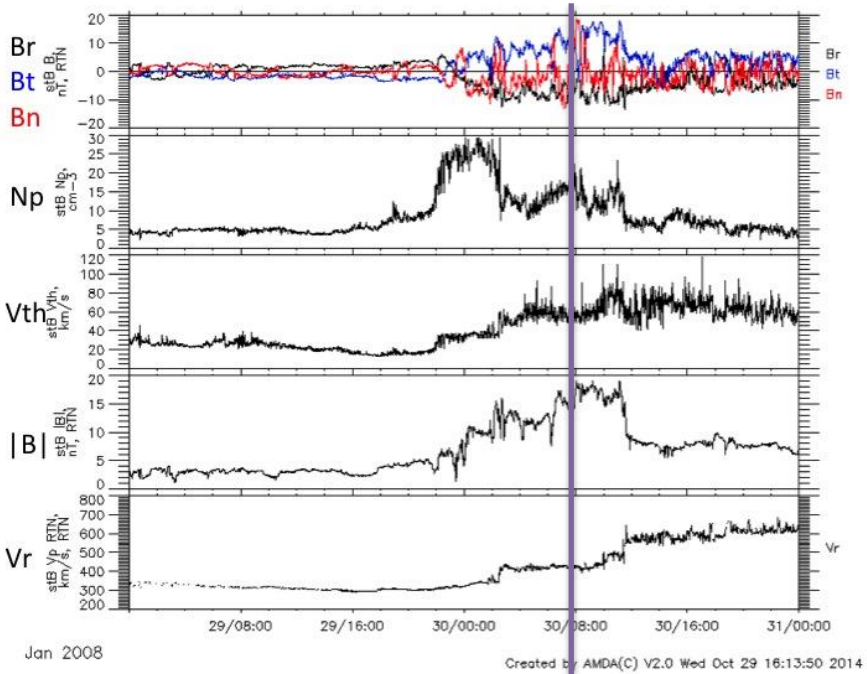
From J-map trace fit to in-situ observations



- Fit of the one density enhancement tblob.
- Reconstruct all traces and the envelope (locus of the enhanced visibility)
- Backproagate to the Sun (CH in proximity?)
- Propagate to different probes (Stereo A-B, ACE, Wind…)

- On 2008-01-24
- Fitted speed: 291 km/s
- No Coronal Hole seen at the footprint of the event.
- Predicted arrival time in the middle of the CIR.

AMDA Stereo B in situ data



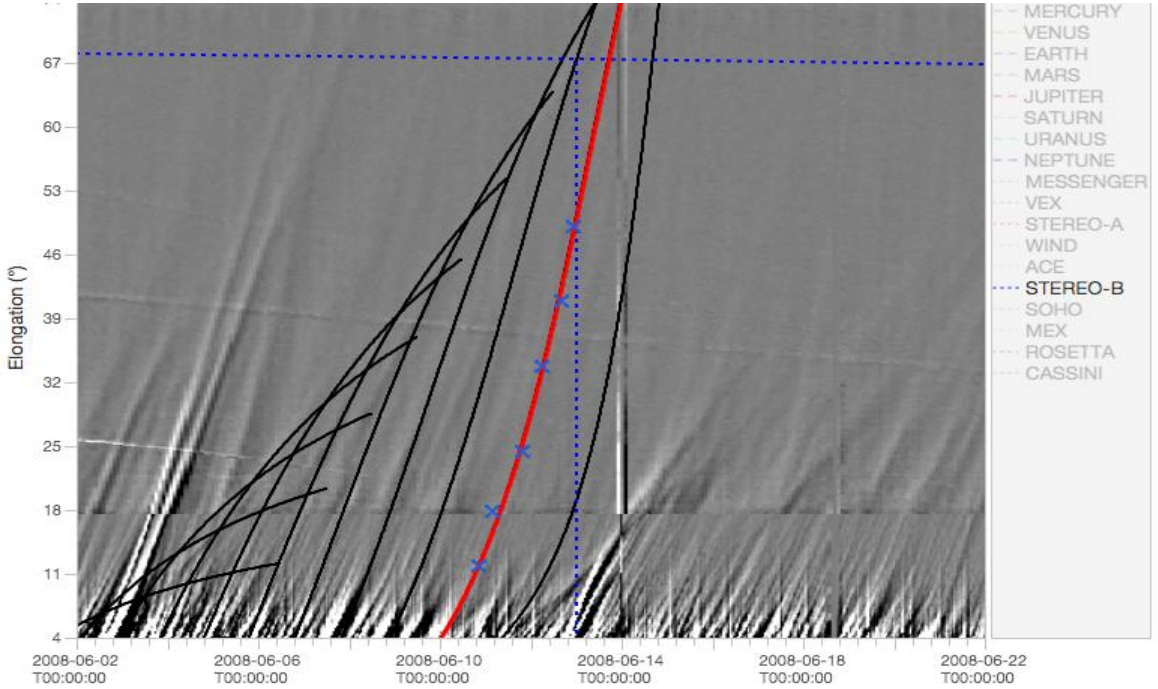
SIR events arrival prediction (subset)

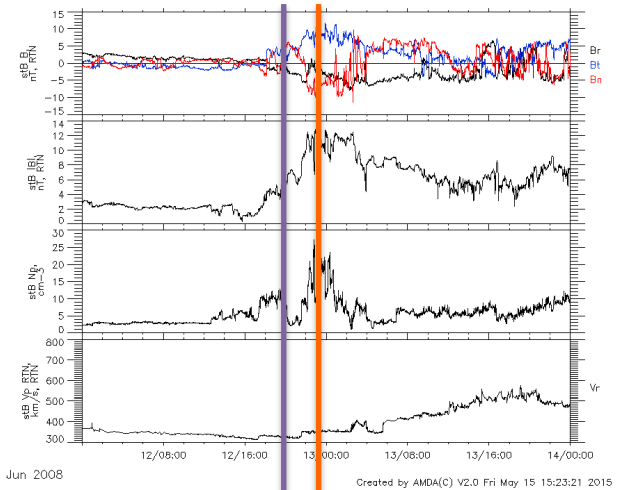
- Question: relevence of the heliospheric imagers to predict SIR (CIRs) arrival time at distant sources?
- A subset of 61 events selected (april 2007 – december 2008)
- Predicted arrival times and speeds at Stereo A-B, Ace, Wind, Rosetta etc. are recorded for every event.
- The incertitude on the velocity is typically about 10%.

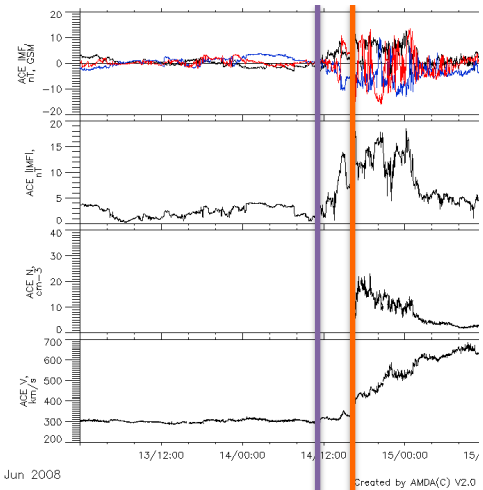
One event case

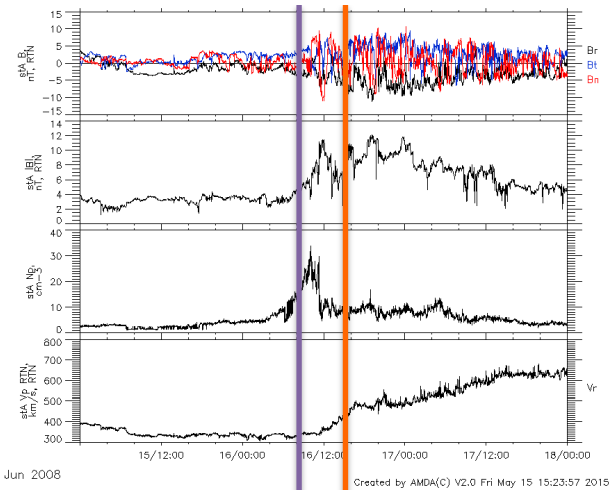
Start time: 2008-06-08T21:10:30. Speed: 335 ± 12 km/s

- Stereo B: impact at 2008-06-12T18:58:18
- Ace: impact at 2008-06-14T10:47:00 (Borovsky & Denton 2010: stream interface at 2008-06-14T16:27:00)
- Stereo A: impact at 2008-06-16T10:36:0
- New fit in better agreement with ace data. Close to the stream interface.



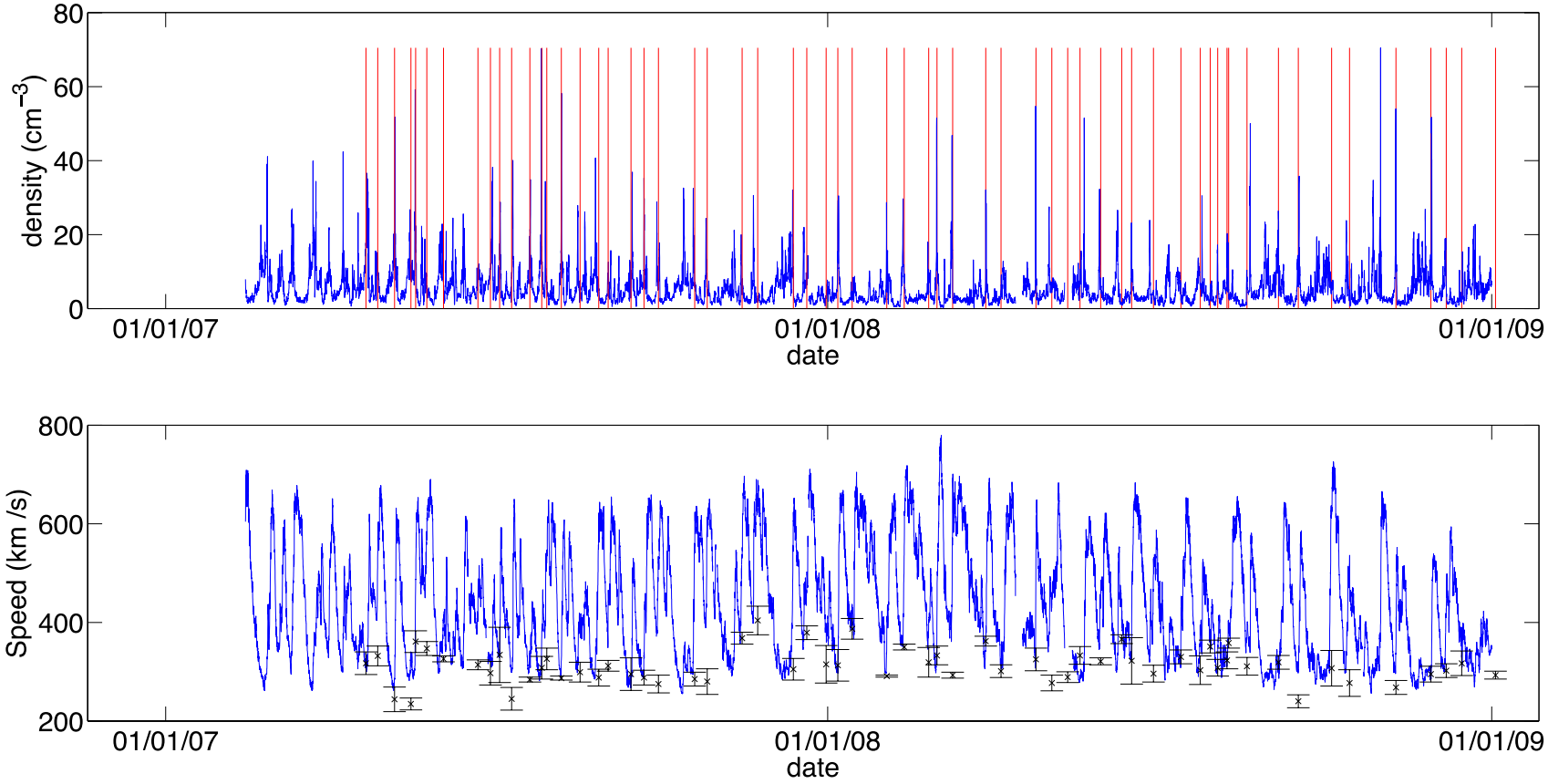






General trend

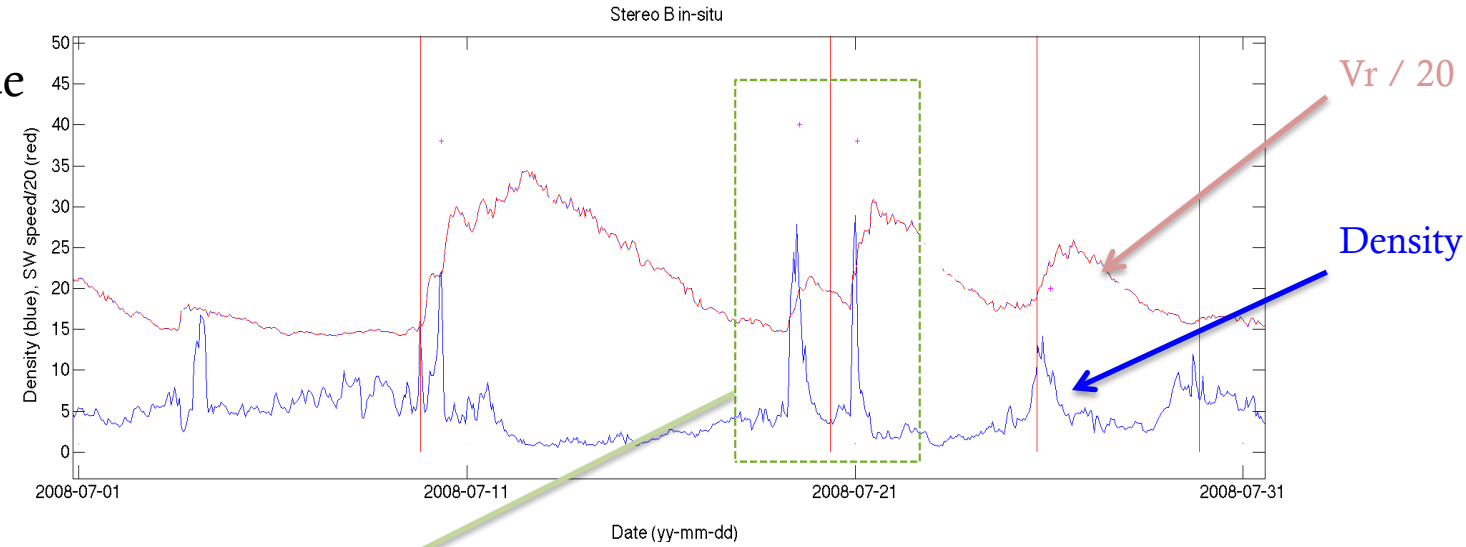
In-situ Stereo A density and radial speed with predicted arrival times (red vertical lines) and speeds (black symbols).

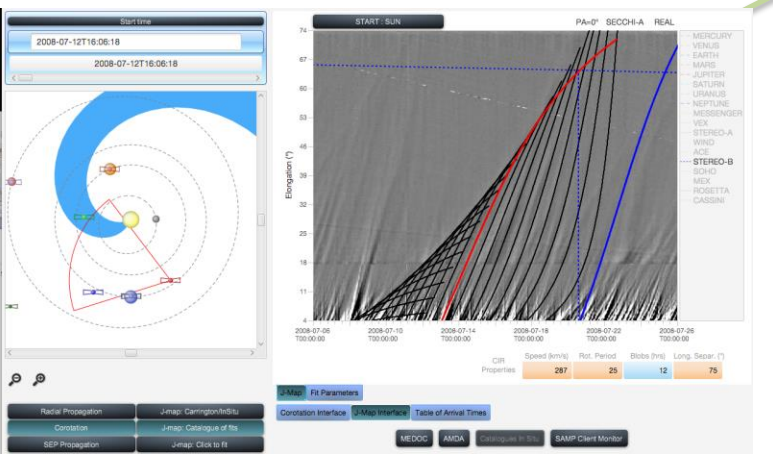


Good correletion with the slow SW but underestimeted. Predicted arrivals are generally after the denisty pics (up to 2 days difference).

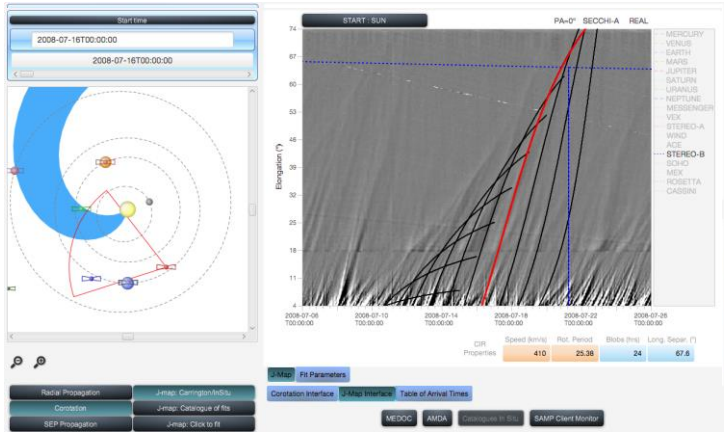
Special cases: very close SIRs

Identified as unique SIR in the first J-map run



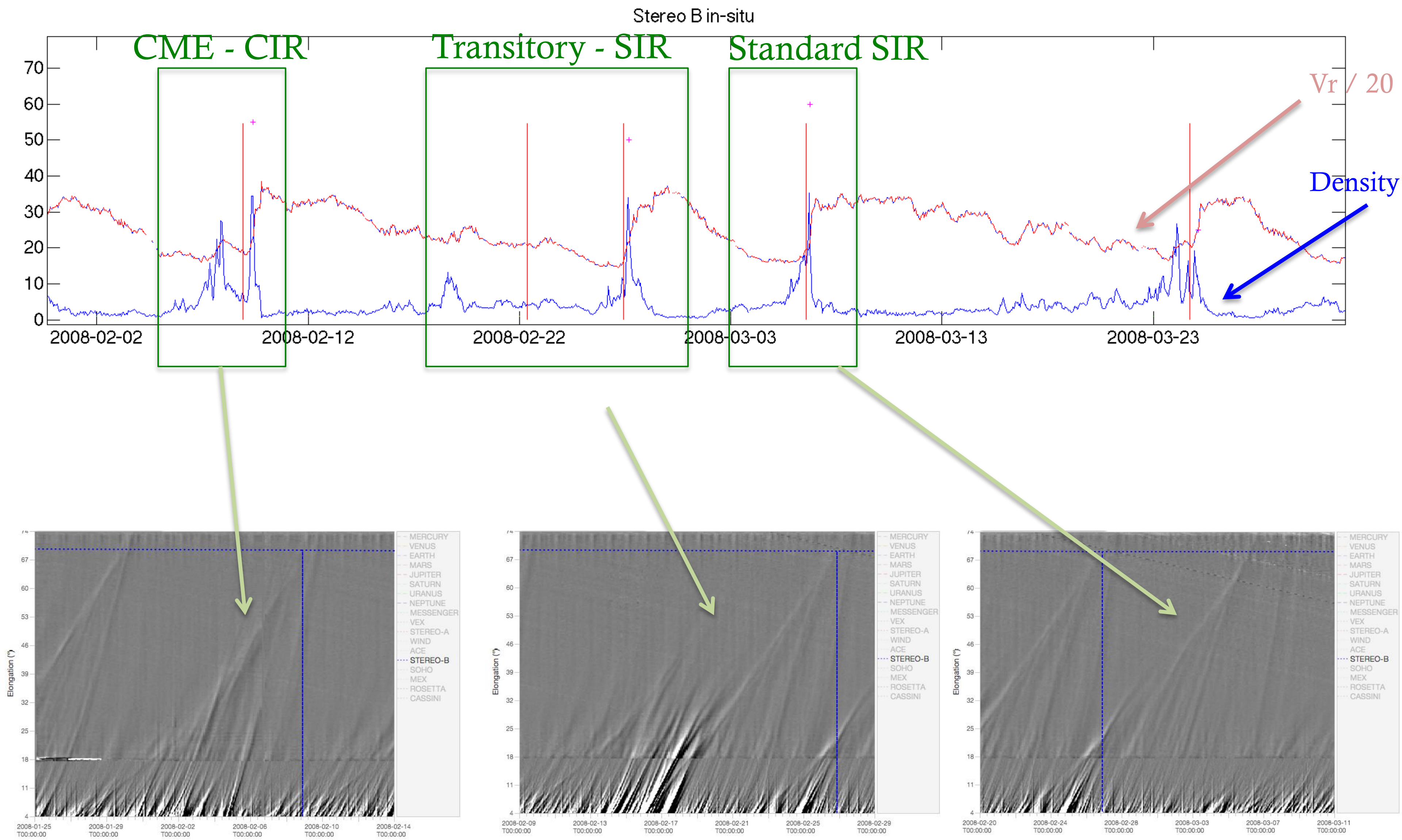


Rectify CH and speed



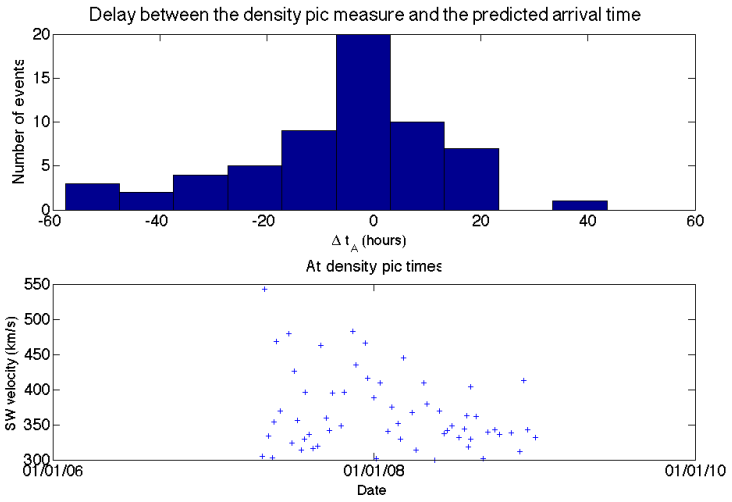
Special cases: CME-SIR, transitory stuff…

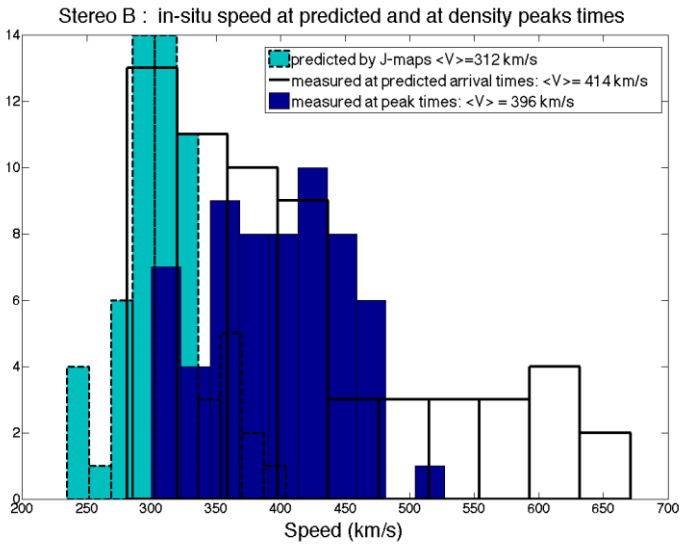
February-march 2008 Stereo B data.



Statistics: Stereo A

- One by one correlation from predicted arrival times to the closest density pics in the in-situ data for Stereo-A and B.

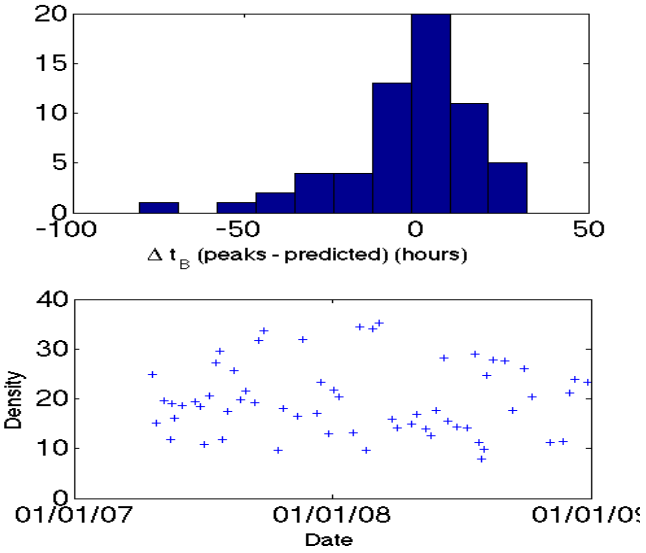


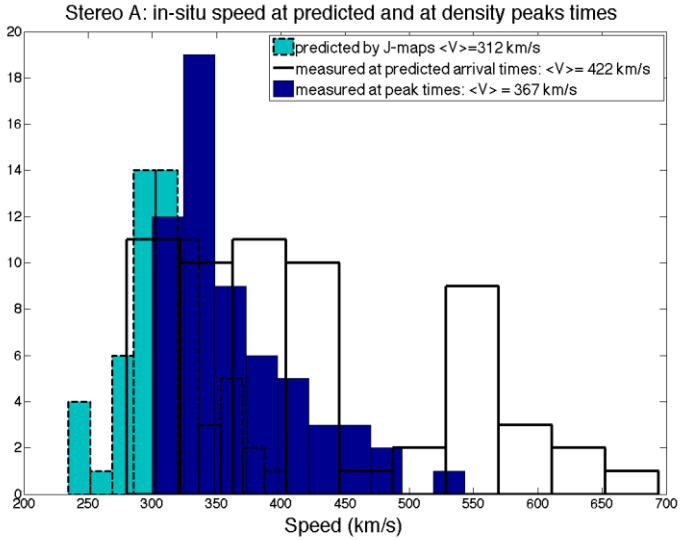


- Trend to predict after the actual SIR arrival
  (max difference = 2 days, mean = 14.4 hours, median=9.3 hours)
- Slow wind speed seems to be underestimated by J-map fits.
  Track are followed clearly for alphas< 45 deg.
  The speed might be lower at these distances
- Density peaks are not so relevant for slow wind (stream interface).
  Need to measure 1-2 days before. (see comparison to L. Jian results).

Statistics: Stereo B

- One by one correlation from predicted arrival times to the closest density pics in the in-situ data for Stereo-A and B.





- Quite similar to Stereo A.
- SIR arrival: max difference = 2.6 days, mean = 14.0 hours, median=11.0 hours
- Slow wind speed seems to be underestimated by J-map fits…
- …but density peaks are not so relevant for slow wind (stream interface). Need to measure 1-2 days before. (see comparison to L. Jian results).

Summary and ongoing

- J-map running difference images track mostly the stream interface.
- Several classes of events (CMEs, transitory overdensities…) can mask or mimic a SIR. Need the in-situ diagnostic.
- When well identified SIR the arrival time is about 12 hours precise on Stereo A and B.
- The SIR speed seems to be underestimated, but not so much if compare to the pre-stream interface in-situ SW speed.

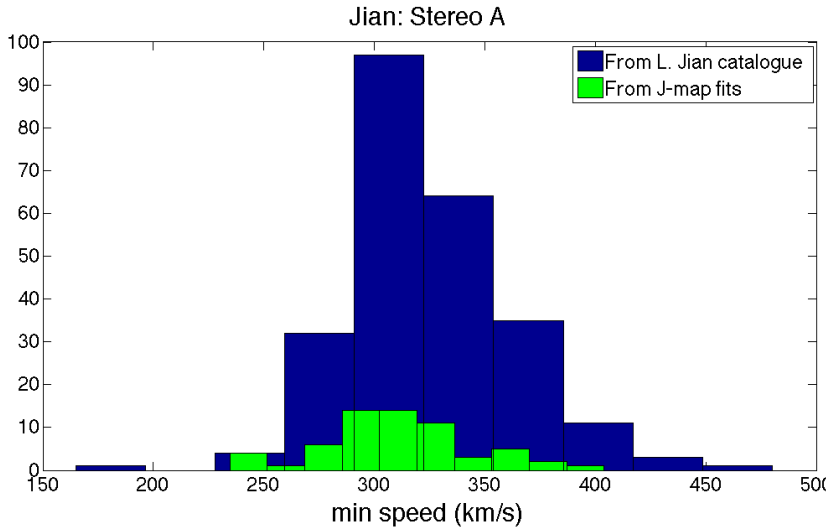
- Complete non-seen SIR in J-maps.
- 2009-2014 to be done. Going to the Solar maximum…
- Specific study on transitory events impact ?

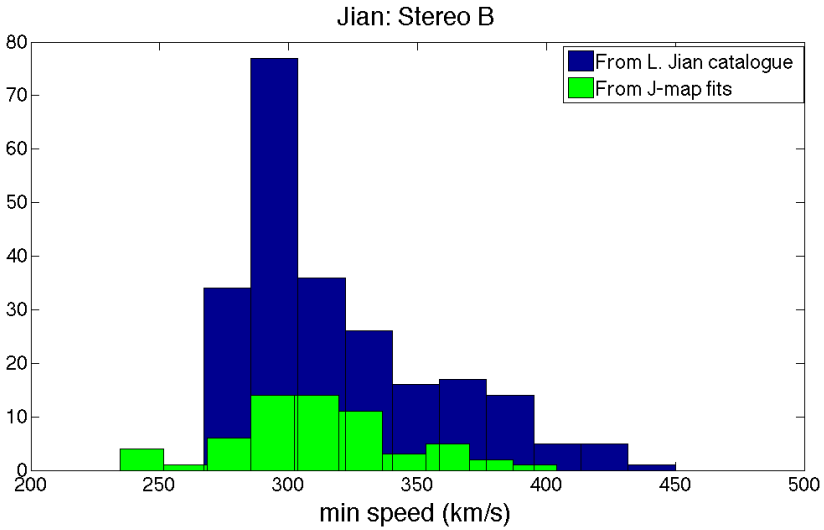
Extras

Comparison to Lan Jian's catalogue

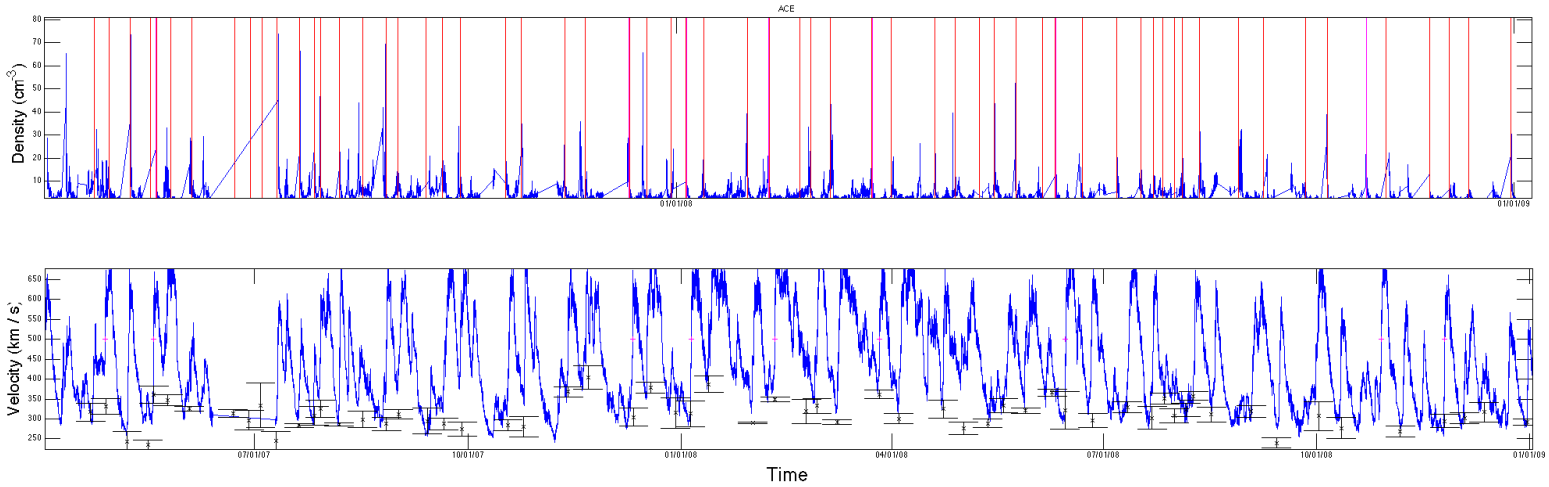
L.K. Jian, C.T. Russell, J.G. Luhmann, A.B. Galvin, K.D.C. Simunac,
Solar Wind Observations at STEREO: 2007 – 2011,
Amer. Inst. Phys. Proceedings of Solar Wind 13, 1539, 191-194, doi: 10.1063/1.4811020, 2013
http://www-ssc.igpp.ucla.edu/forms/stereo/stereo_level_3.html

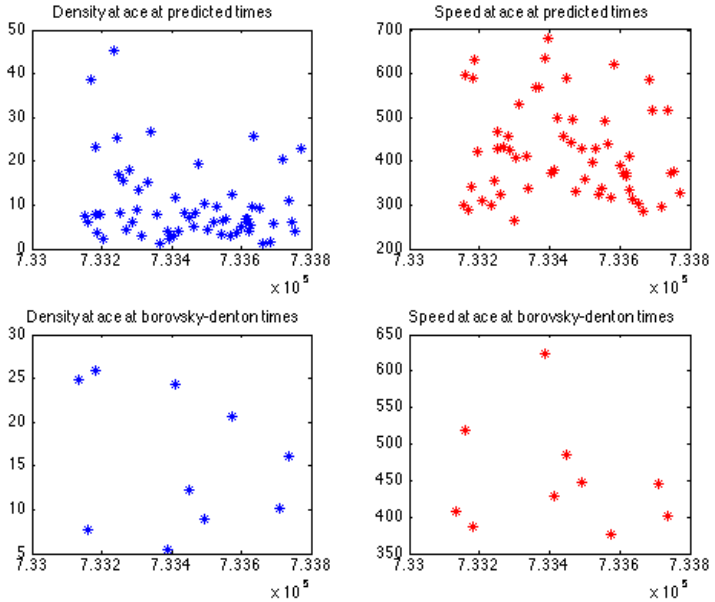
- 248 events on StA and 231 events on StB in the perion 2007-2014. ~30/year
- Minimal speed: <Vmin> = 320 km/s (312 from J-maps up to end of 2008)
- Maximal speed: <Vmax>=570 km/s





ACE measurements





- -> Compare to the Borovsky & Denton CIRs (2007-2008 avialable)