

Stream interface slope near 1 AU and the configuration of the heliospheric current sheet at 2.5 solar radii

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Introduction

“... stream interfaces are offset from, but are aligned roughly parallel to, the heliospheric current sheet...because both arise from basically the same geometry back at the Sun”

Gosling and Pizzo, Formation and Evolution of Corotating Interaction Regions and Their Three Dimensional Structure, Space Science Reviews 89: 21 - 52, 1999.

Stream Interfaces: Quick Review

- The boundary marking a transition from slow to fast solar wind
- Speed increases
- Density drops
- Temperature increases
- Flow shears observed

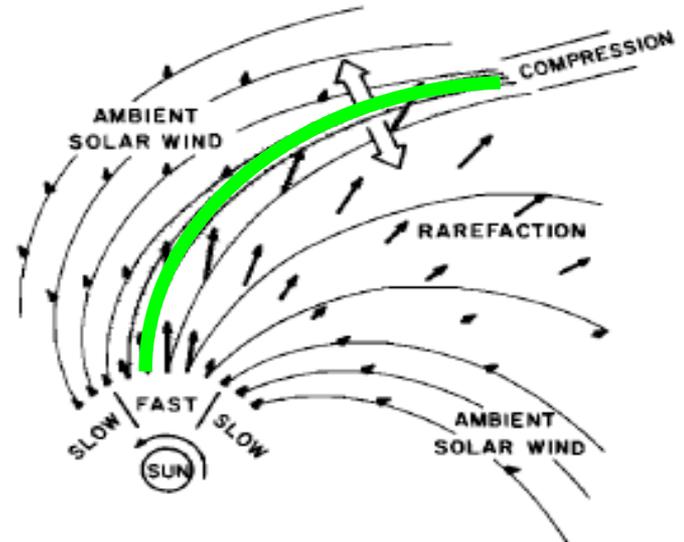


Figure 1 from Pizzo 1978.

Stream Interface: Example 1

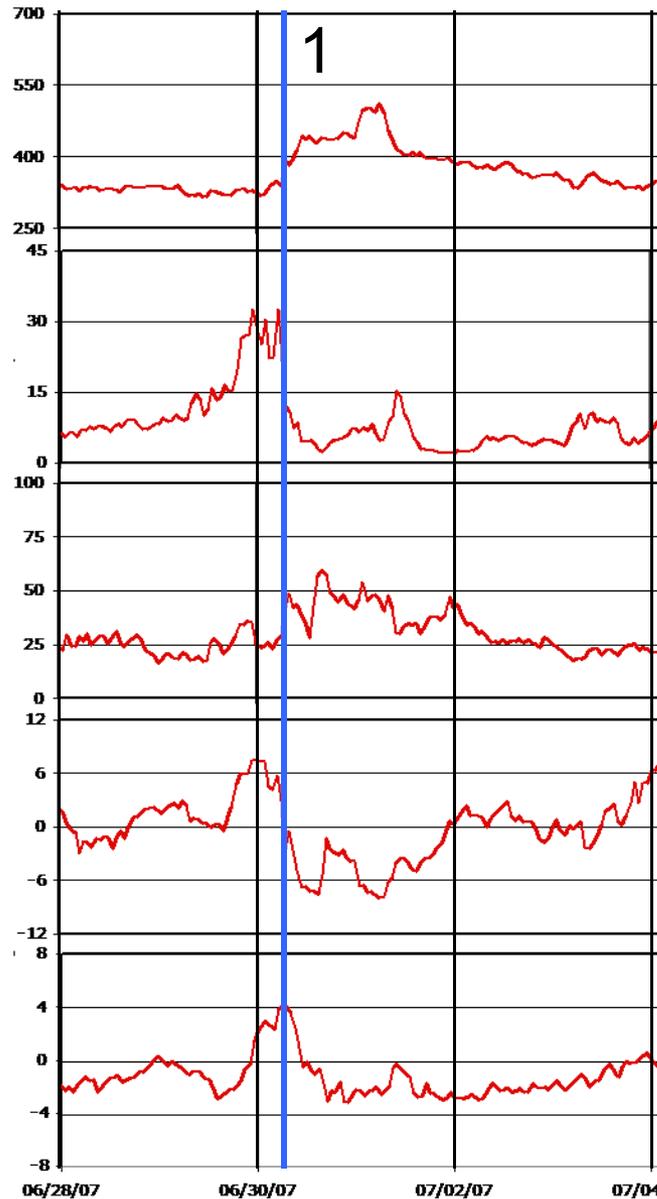
Bulk
Speed
[km/s]

Proton
Density
[cm⁻³]

Thermal
Speed
[km/s]

East/West
Flow
[degrees]

North/South
Flow
[degrees]



1 hour averaged data
from STEREO-A/
PLASTIC

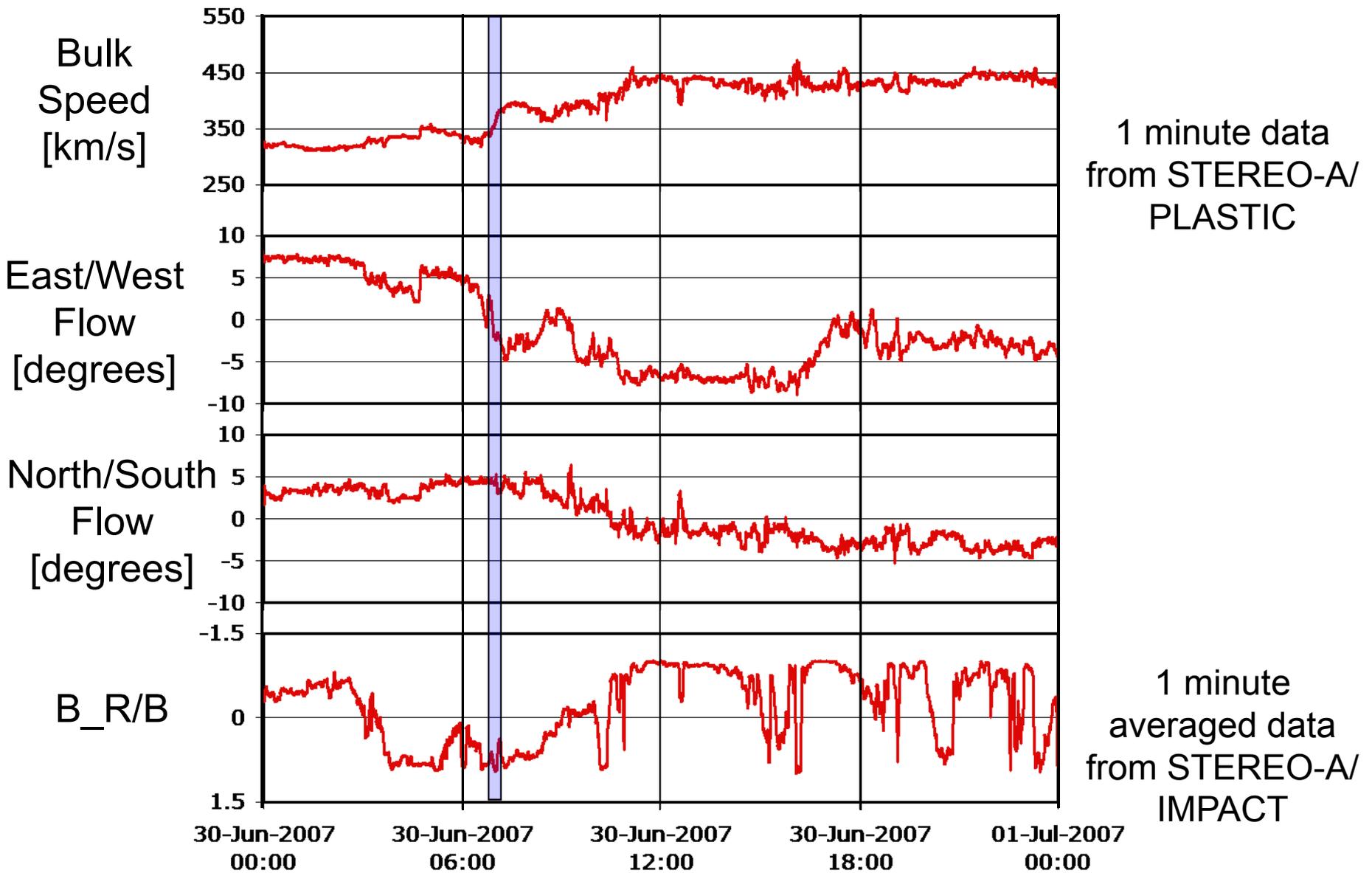
28 June - 4 July, 2007

Lee 2000: Stream Interface Slope

“... the ratio of the N-S component to the E-W component of the transverse flow is $-(\mathbf{e}_\theta \cdot \mathbf{n})/(\mathbf{e}_\phi \cdot \mathbf{n})$.”

Stream Interface 1

30 June 2007 06:48 to 07:09 UT



Example 1

$$\Delta\text{East/West} = -2.3^\circ - 2.5^\circ = -4.8^\circ$$

$$\Delta\text{North/South} = 3.1^\circ - 4.3^\circ = -1.2^\circ$$

$$\text{slope} = 0.25$$

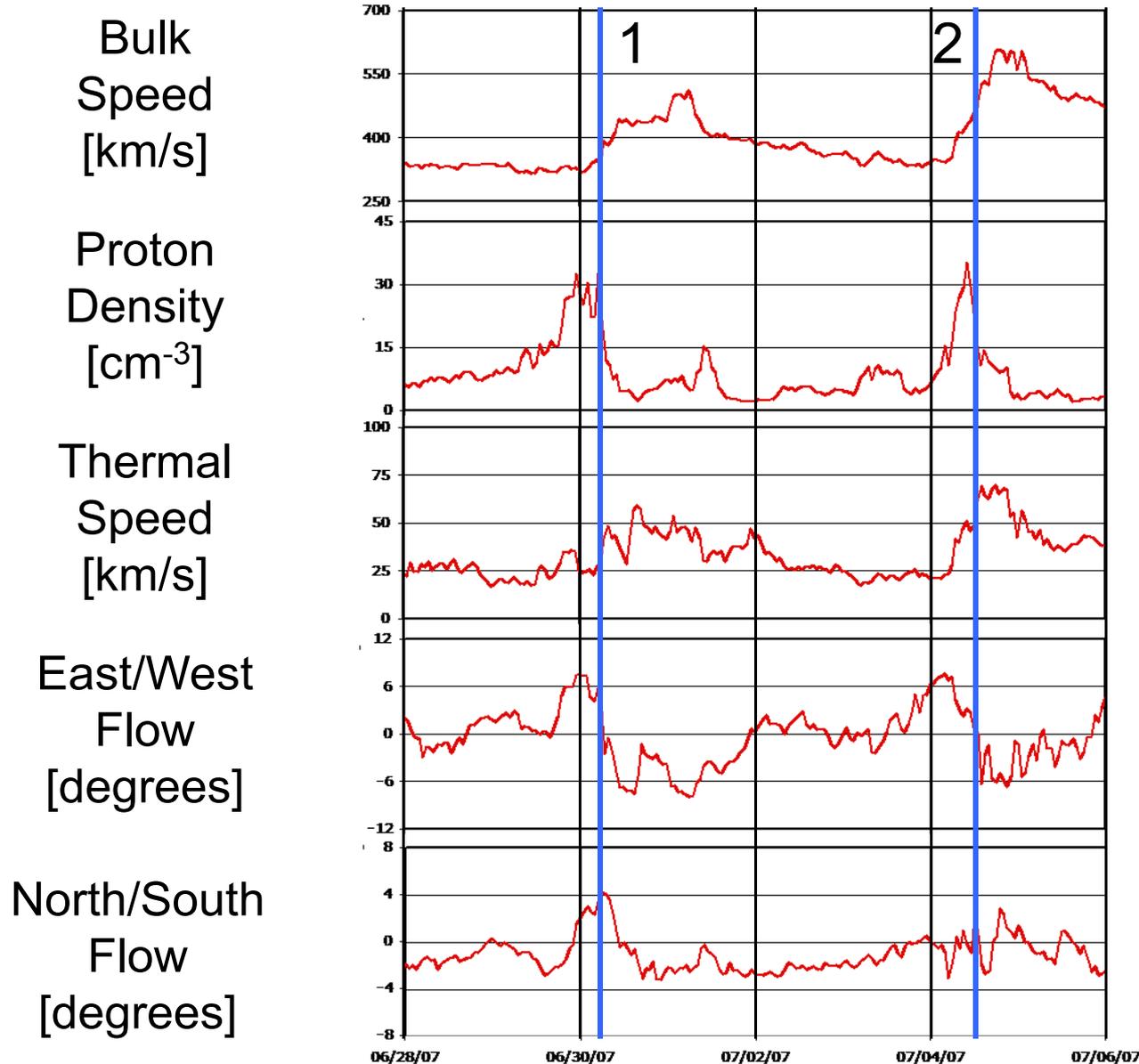
Red: $B_R < 0$

~~QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.~~

Green: $B_R > 0$

GONG line-of-sight ecliptic plane field model

Stream Interface 2

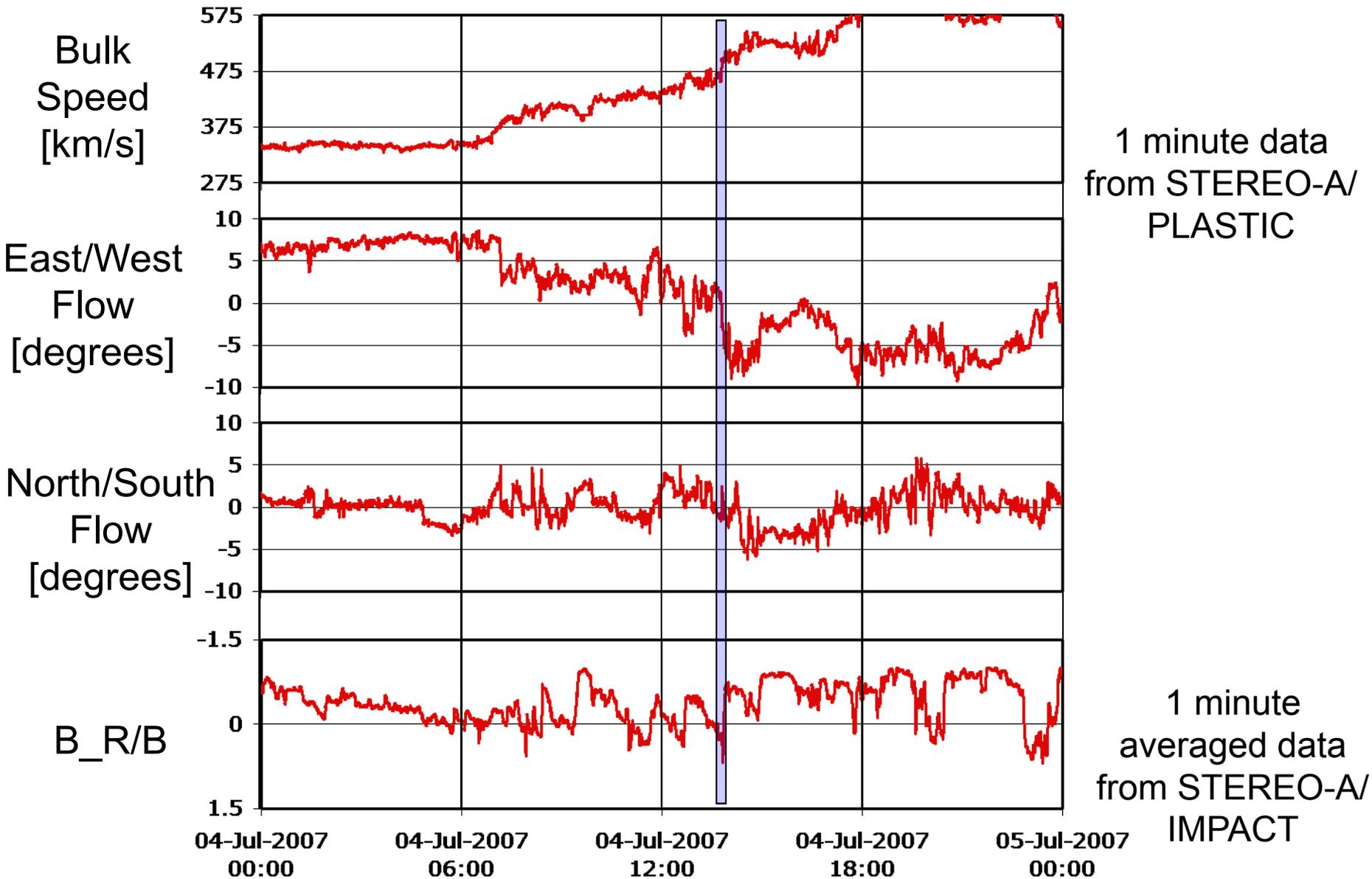


1 hour
averaged
data from
STEREO-A/
PLASTIC

28 June - 6
July, 2007

Stream Interface 2

4 July 2007 13:45 to 13:53 UT



Example 2

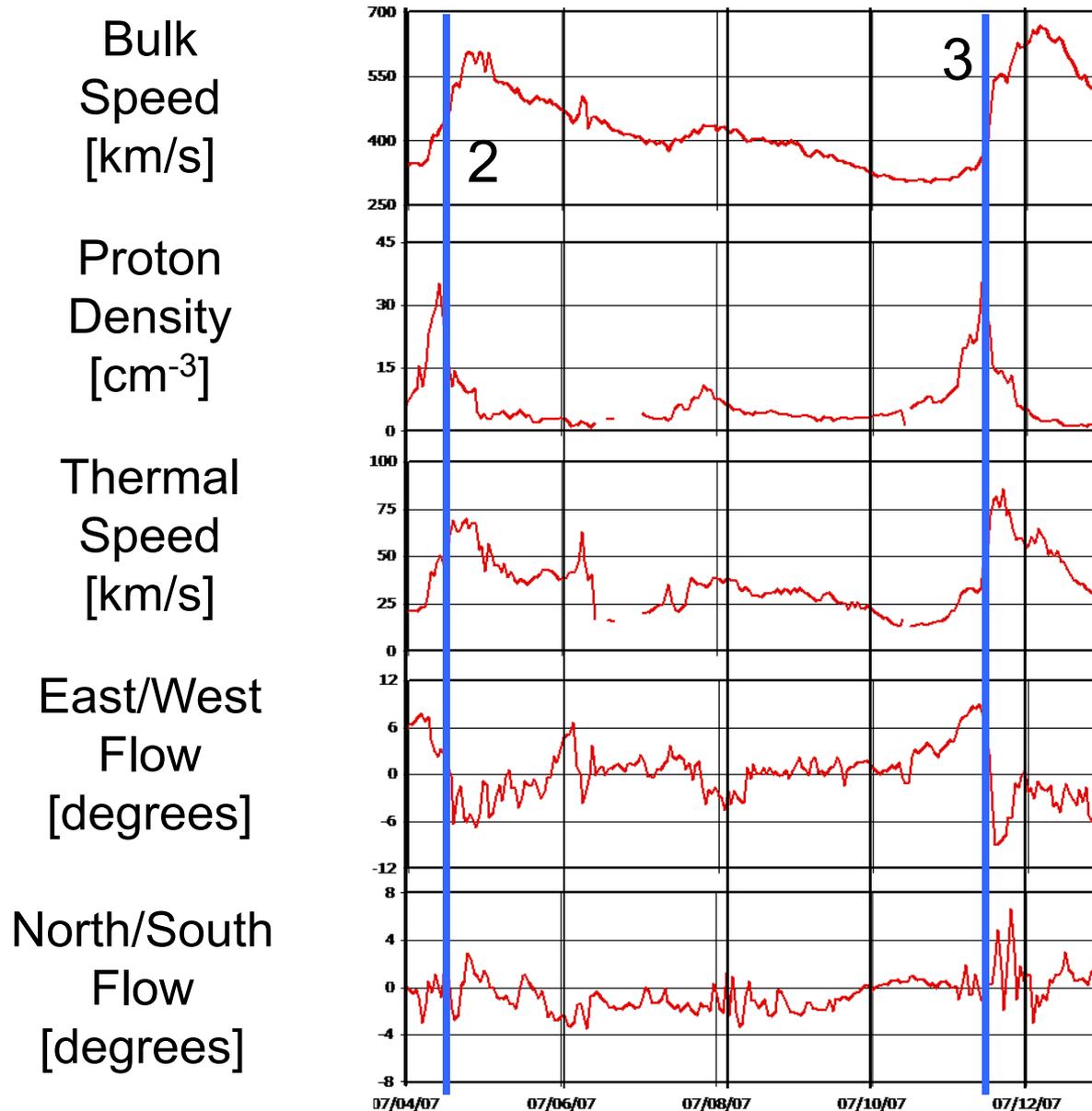
$$\Delta\text{East/West} = -5.2^\circ - 1.4^\circ = -6.6^\circ$$

$$\Delta\text{North/South} = -1.3^\circ - (-0.7^\circ) = -0.6$$

$$\text{slope} = 0.09$$

~~QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.~~

Example 3

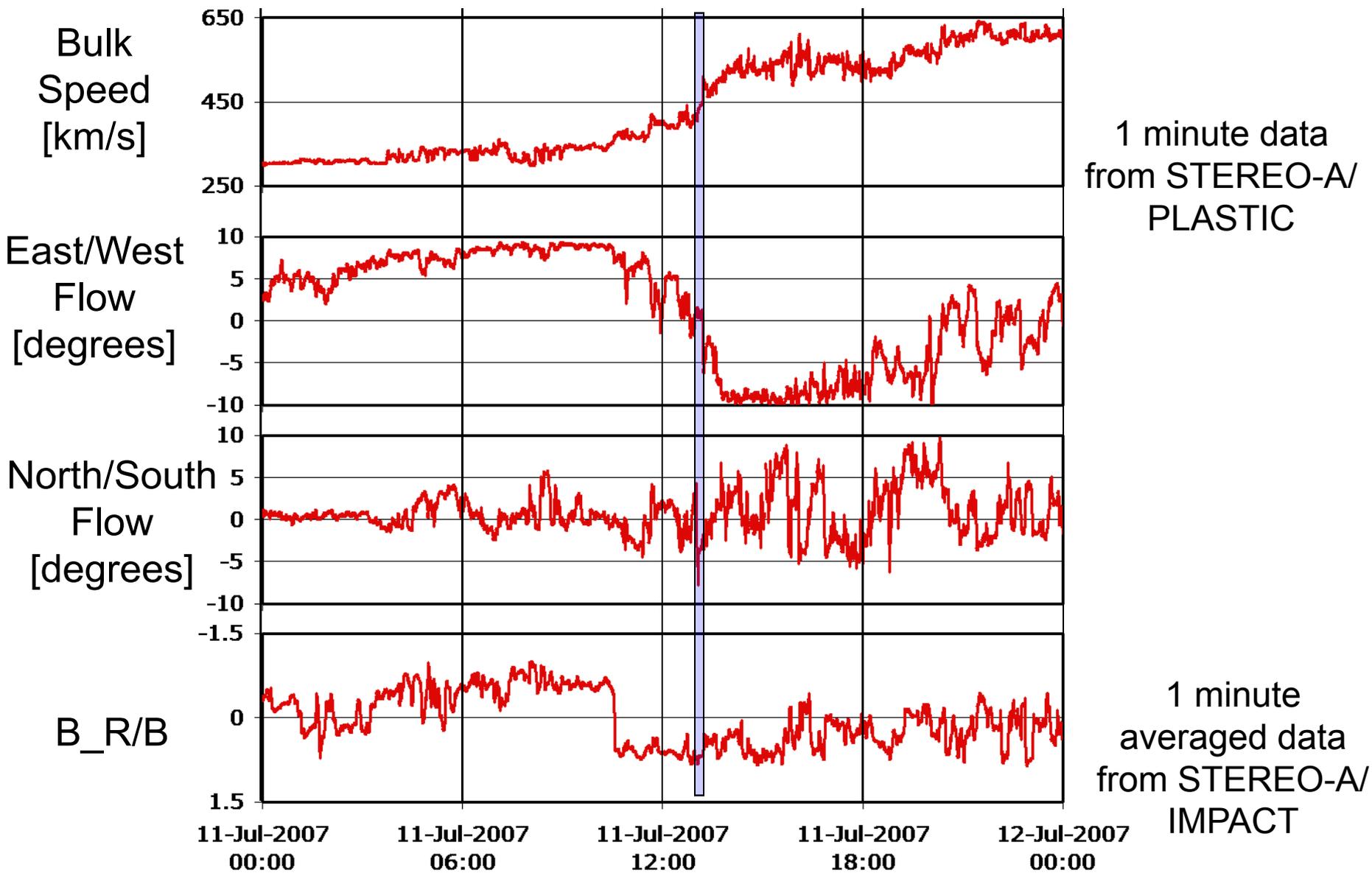


1 hour
averaged
data from
STEREO-A/
PLASTIC

4 - 13 July,
2007

Stream Interface 3

11 July 2007 13:03 to 13:13 UT



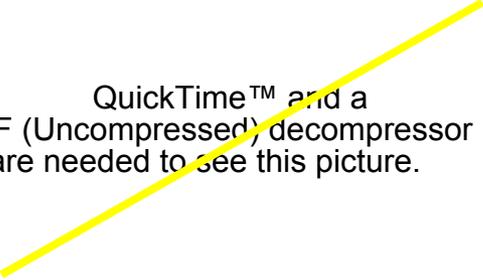
Example 3

$$\Delta\text{East/West} = -6.2^\circ - 1.3^\circ = -7.5^\circ$$

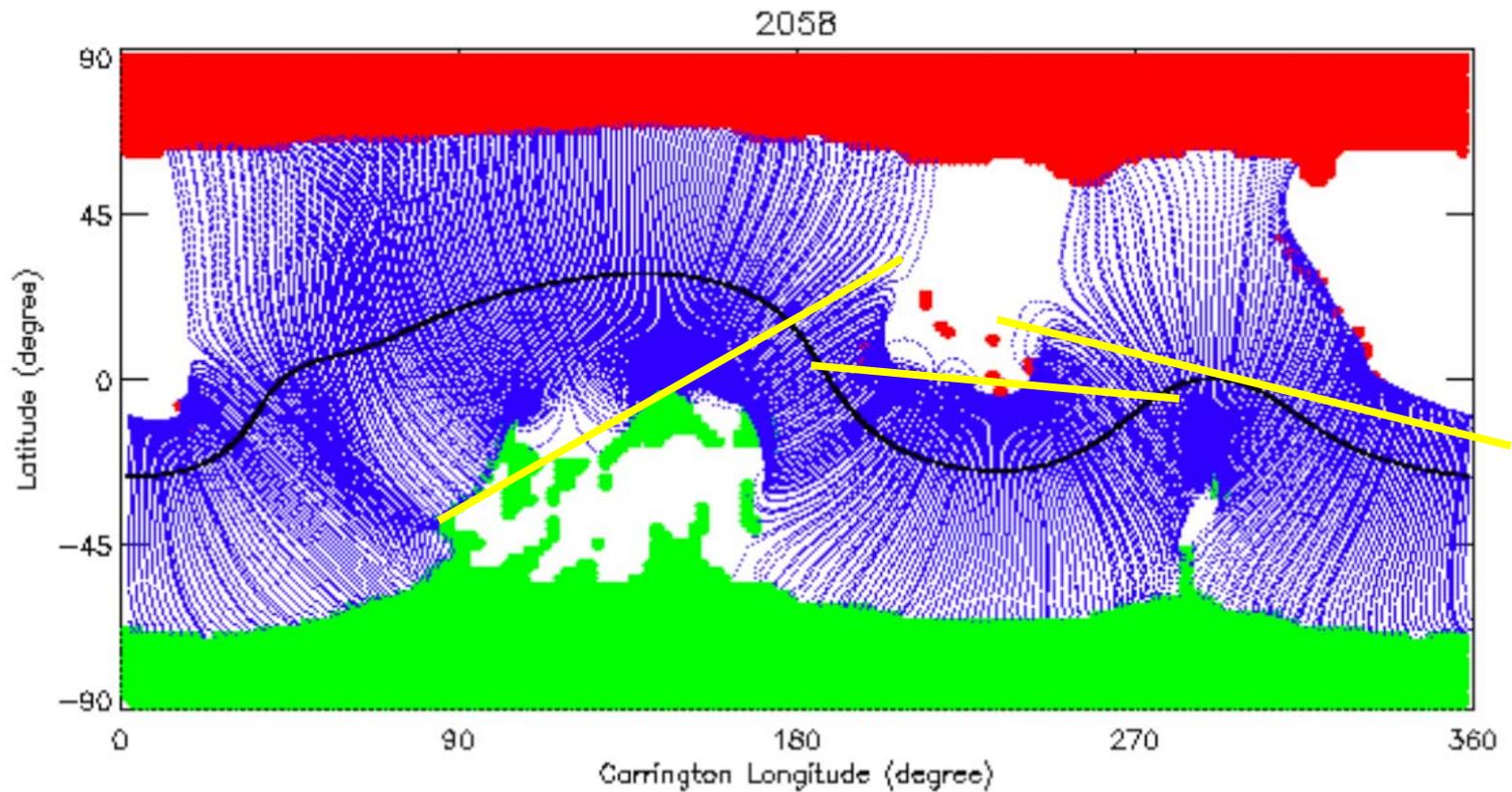
$$\Delta\text{North/South} = -3.5^\circ - (-7.8^\circ) = 4.3$$

$$\text{slope} = -0.57$$

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

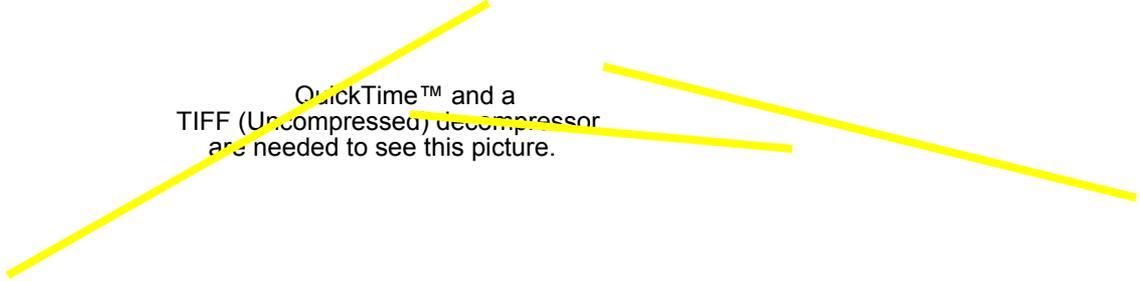


All 3 Examples and GONG Model



All 3 Examples and WSO Model

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.



WSO Radial 2.5 R_Sun model

All 3 Examples and ENLIL Model

ENLIL model 0.1 AU

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

All 3 Examples and ENLIL Model

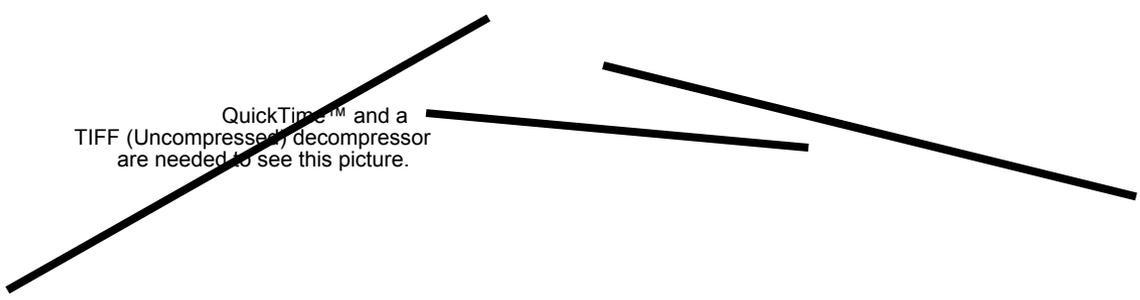
ENLIL model 0.1 AU

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

ENLIL model 0.1 AU

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

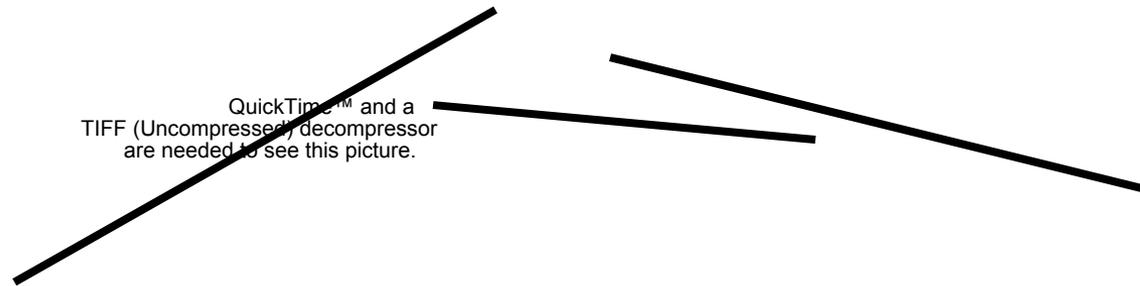
All 3 Examples and Predictive Science Model



QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

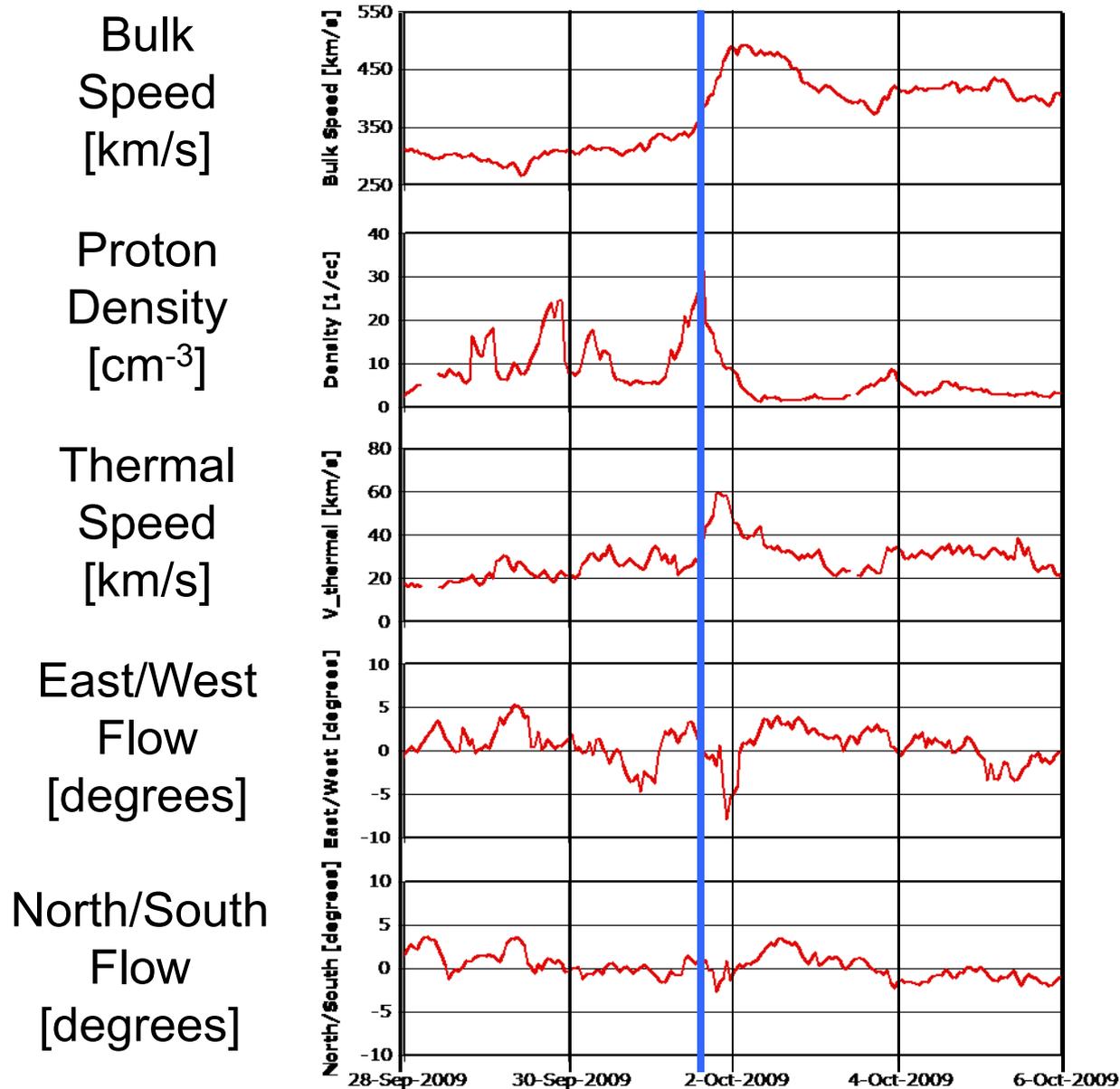
Predictive Science B_R at 2.5 Solar Radii

All 3 Examples and Predictive Science Model for 1 AU



Predictive Science B_R at 215 Solar Radii

Example 4 -- More Recent

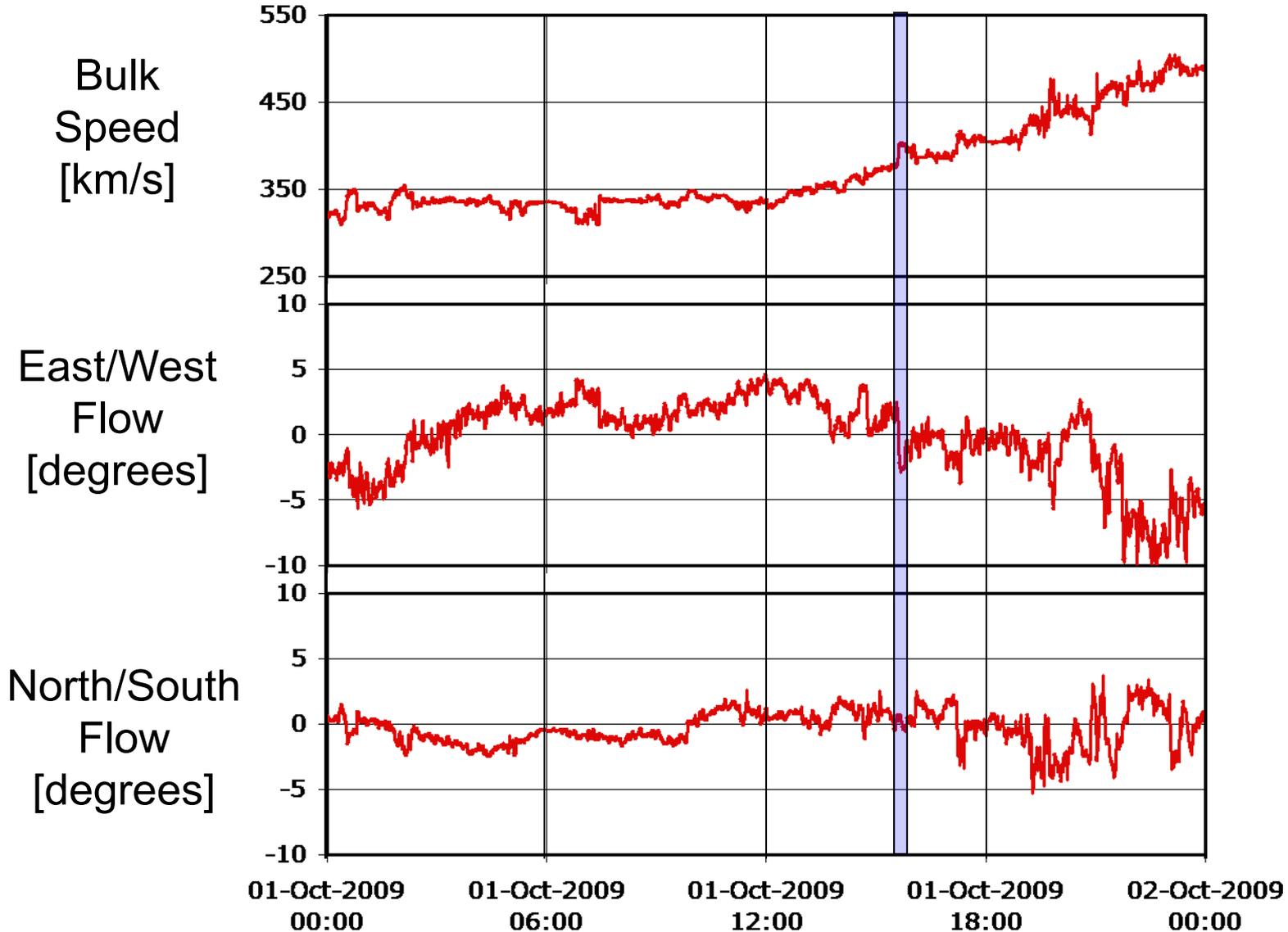


1 hour
averaged
data from
STEREO-A/
PLASTIC

28 Sept. - 6
Oct., 2009

Stream Interface 4

1 October 2009 15:34 to 15:40 UT



Example 4

$$\Delta\text{East/West} = -2.9^\circ - 1.7^\circ = -4.6^\circ$$

$$\Delta\text{North/South} = 0.3^\circ - 0.7^\circ = -0.4^\circ$$

$$\text{slope} = 0.09$$

~~QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.~~

Summary and Questions

After looking at about 30 cases with 1 hour time resolution, I conclude that the interfaces observed in connection with current sheet crossings do seem to be roughly parallel to the current sheet...somewhere.

I have looked at just a few interfaces with the 1 minute resolution data, but results are so far consistent with 1 hour averaged data.

In some cases the north/south and east/west flow shears are not exactly cotemporaneous -- what does this mean? How should I deal with it?

When the stream interface does not closely follow a current sheet crossing, what should we expect?

Thank you.

- PLASTIC team
- IMPACT team
- GONG consortium
- WSO
- Predictive Science
- CCMC