

DSCOV^R – Status Update and Comparing Data from L1

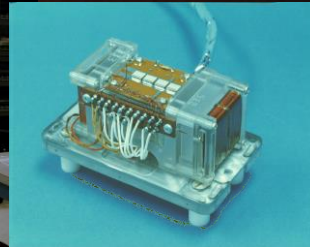
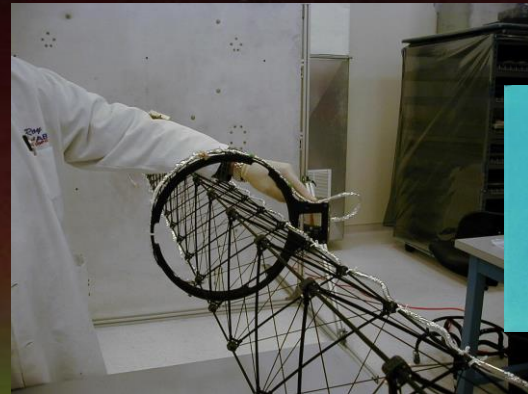
Doug Biesecker¹ and Jeff Johnson^{1,2}

¹NOAA/SWPC

²CU/CIRES

Outline

- Let's take a trip back in time to Solar Cycle 23
- DSCOVR Status
 - Instruments
 - MAG is great
 - I'll say no more
 - Faraday Cup
 - The good news; the bad news; there's still hope
 - Spacecraft
- Comparing L1 Data
 - ACE, DSCOVR, & Wind



October 2003

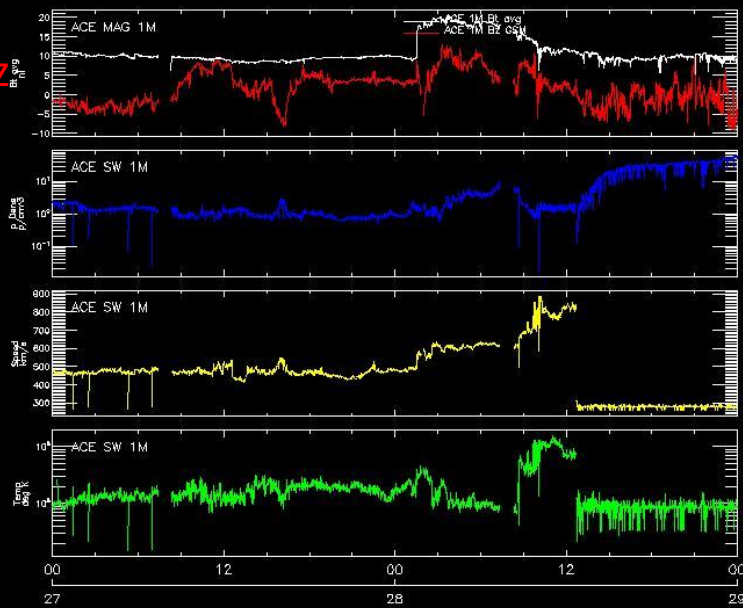
2003 Oct 27 00:00:00

B, Bz

n

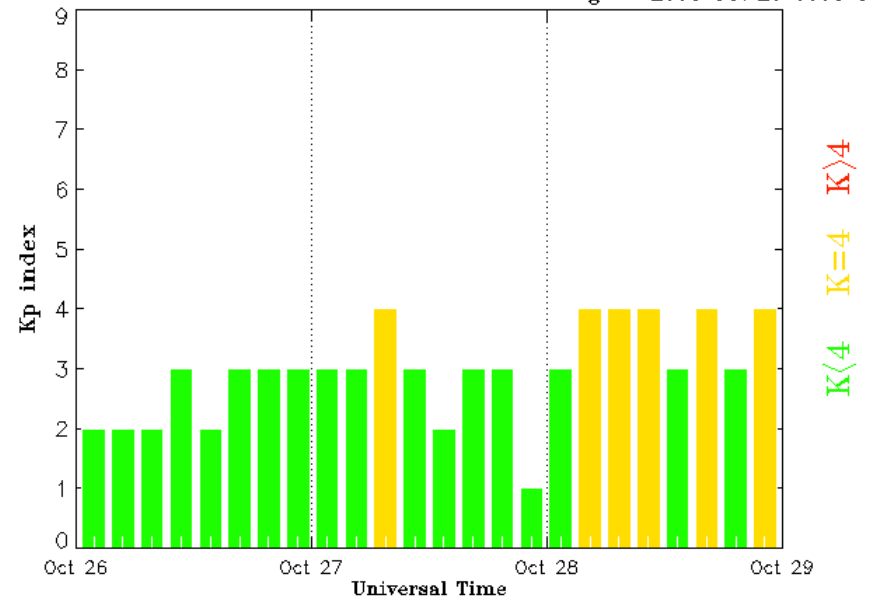
V

T



UTC (Hour/Day)
Created: Wed Apr 18 02:43:59 2018 UTC

Estimated Planetary K index (3 hour data) Begin: 2003 Oct 26 0000 UTC



Updated 2003 Oct 29 02:45:04 UTC

NOAA/SEC Boulder, CO USA

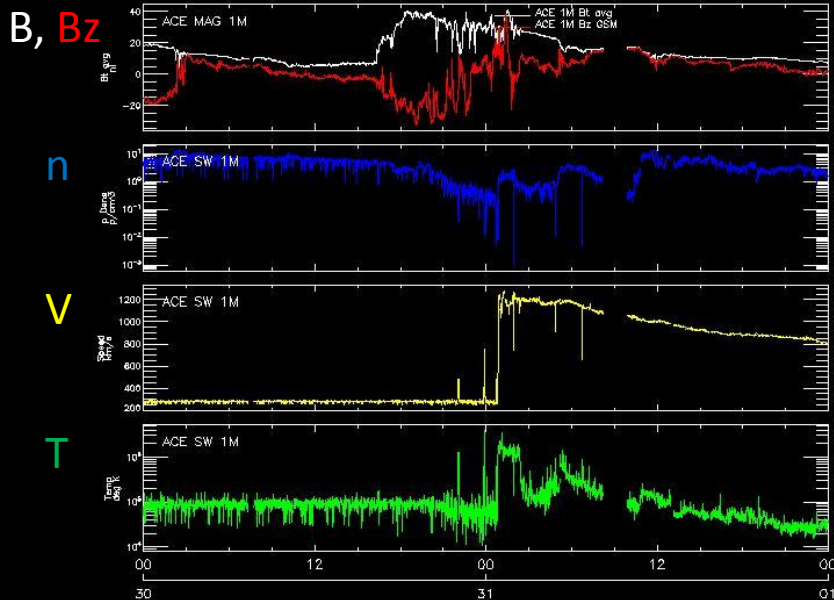
October 2003



October 2003



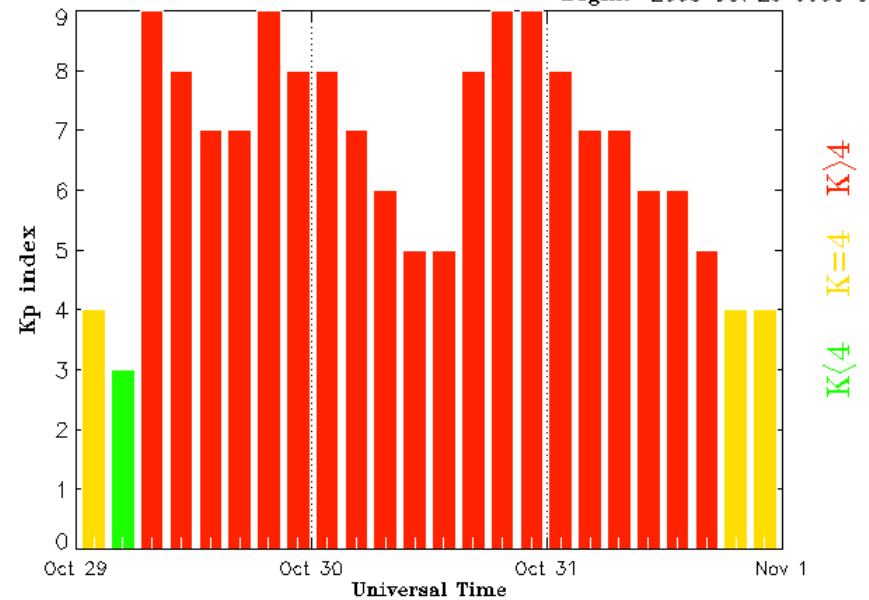
2003 Oct 30 00:00:00



Created: Wed Apr 18 02:45:34 2018 UTC

Estimated Planetary K index (3 hour data)

Begin: 2003 Oct 29 0000 UTC

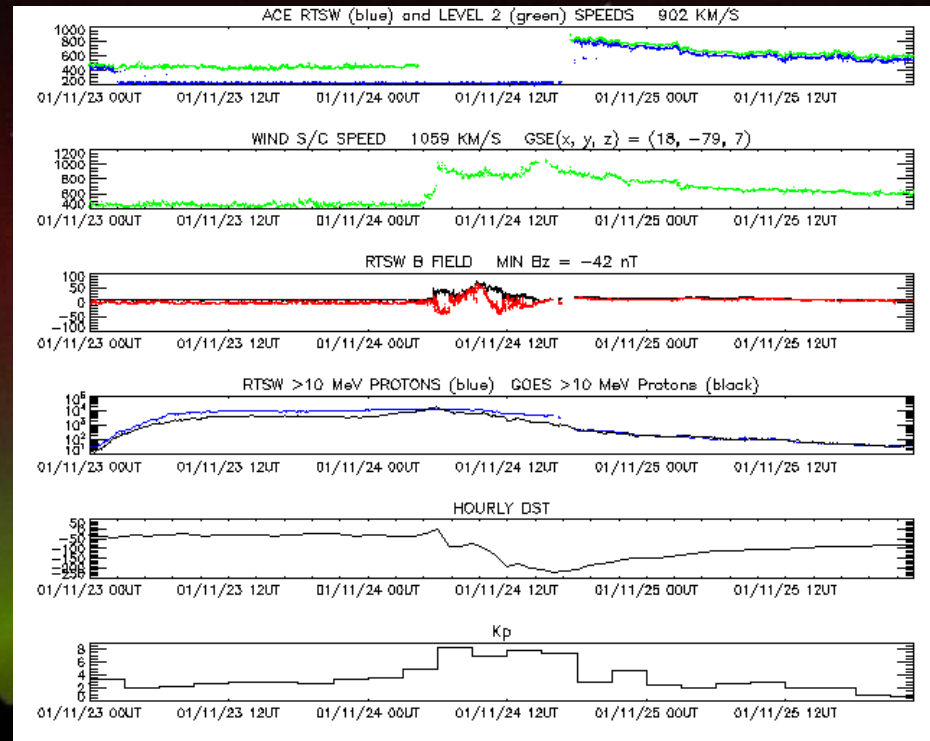


Updated 2003 Nov 1 02:45:03 UTC

NOAA/SEC Boulder, CO USA

ACE in Solar Cycle 23

- 1998-2012
- 44 events reaching
 - Severe
 - $K_p \geq 8$; $A_p \geq 100$; $Dst \leq -150$ nT
 - Extreme
 - $K_p = 9$
- 23% of the events and all 3 extreme events had no valid solar wind data in real-time
- Why?
 - Proton Contamination
- This is only applicable to the real-time data, not science data



2001/11/23-25

Let's move on to Cycle 24

- DSCOVR Launch
 - Feb 11, 2015
- Orbit Insertion
 - June 8, 2015
- SWPC Operational Date
 - July 27, 2016
 - Why did it take so long?



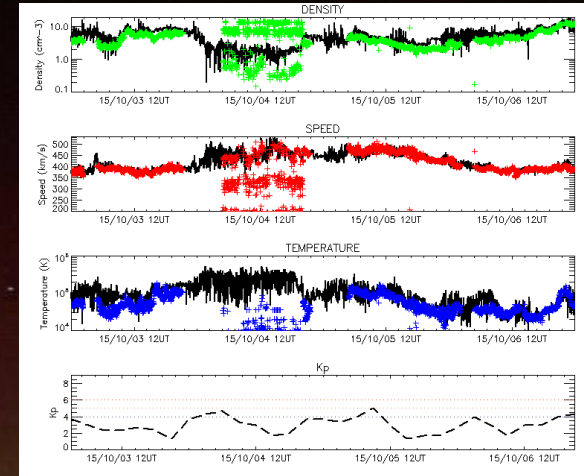
The Story in Late 2015

Oct 4, 2015

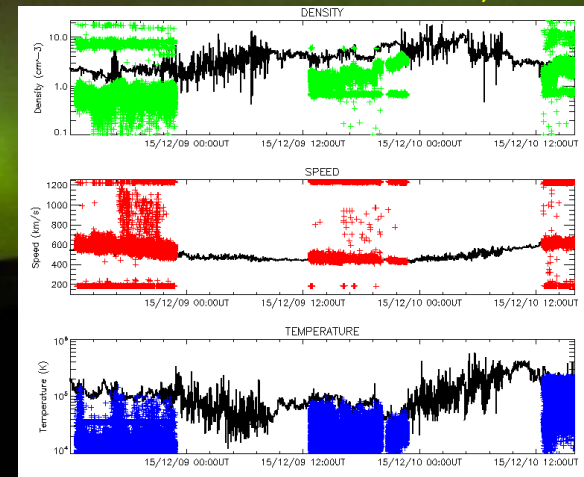
Faraday Cup

- Does not meet requirements during periods of low density
- Mitigation strategy for initial commissioning calibration is ongoing
- Mission science density data to be processed in data processing phase.

!!!WRONG!!!

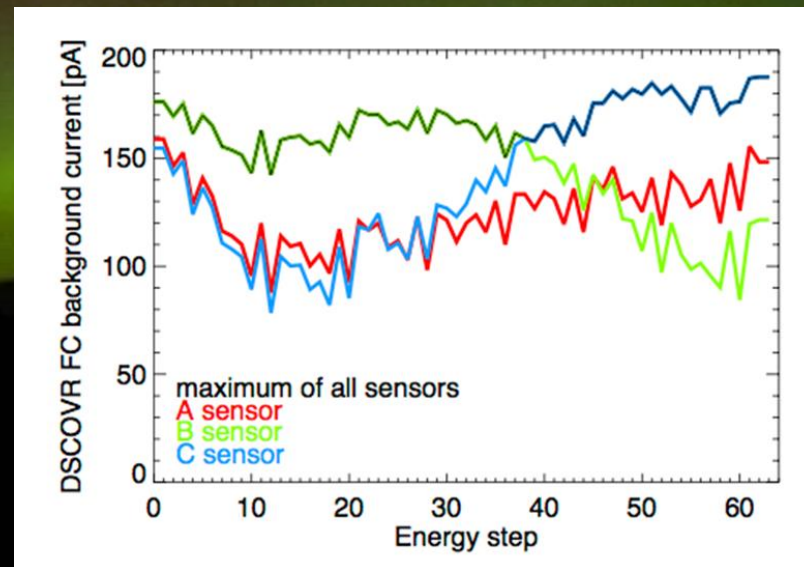
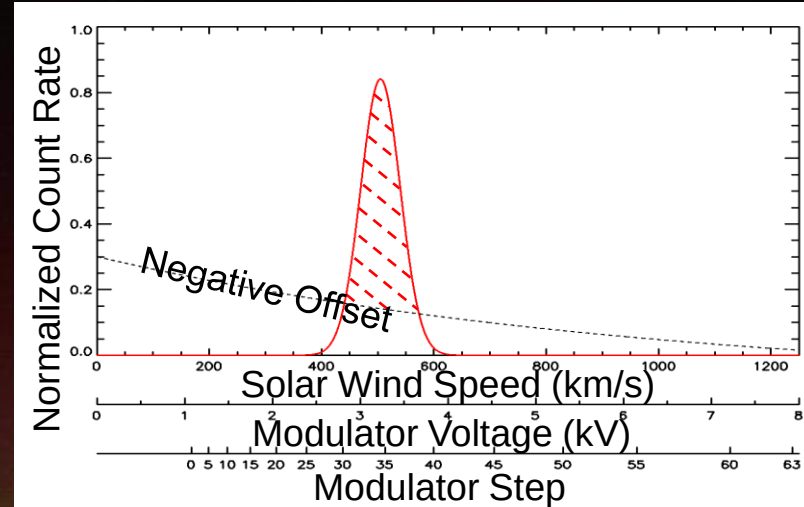


Dec 8-10, 2015



Why?

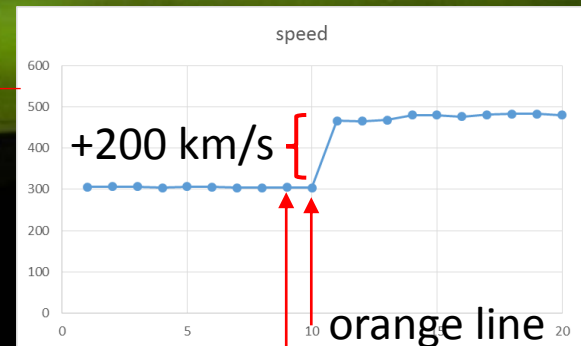
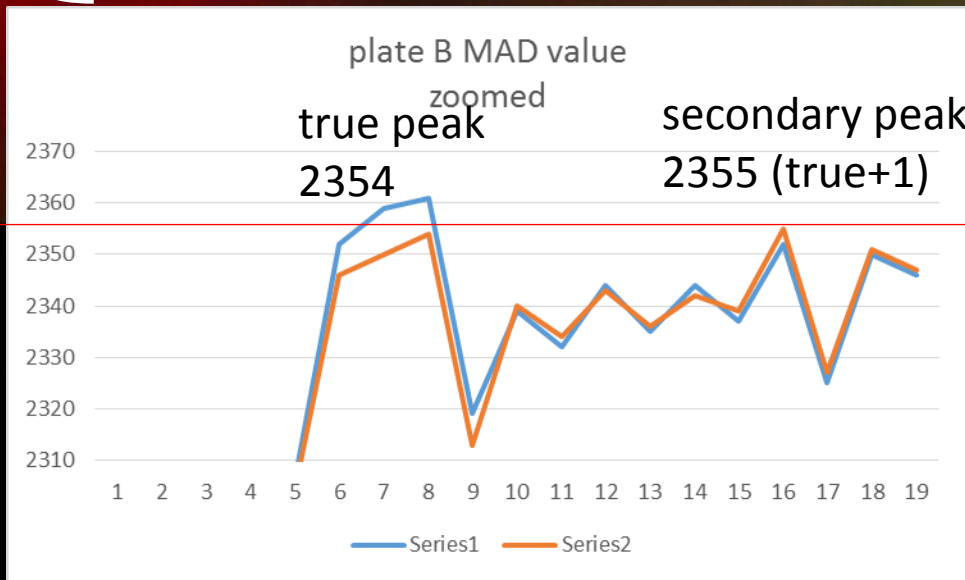
- FC hardware issues
 - HV power supply not grounded
 - Plate signal cables not torqued down
- Background noise caused by the hardware issues
 - Varies by voltage differently for each FC plate



Relevant FSW patches

- The FC flight software 3 peak detection software patches
 - 1) **Range extension (11/28/16)**
 - Most noise is at the highest energy levels
 - 2) **Retrace interval (9/7/17 + 9/20/17)**
 - Bug in the FSW caused the last AD values to be used as the first interval of the next cycle
 - 3) **First duplicate peak chosen (10/2/17)**
 - Original design was that if peak value occurs more than once in a cycle, the last one is used as the peak
 - This was assuming that the later peak value would be caused by a shock hitting in the middle of the cycle
 - This happens a lot due flat curves when the density is low, not because of shocks

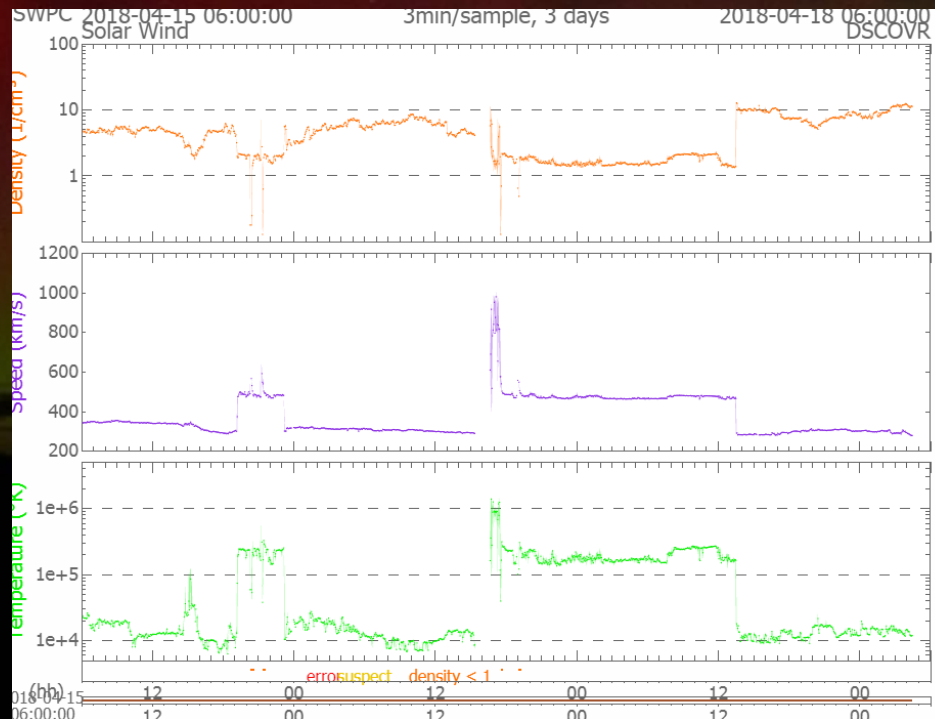
Fixed
spiking
> 800



blue line

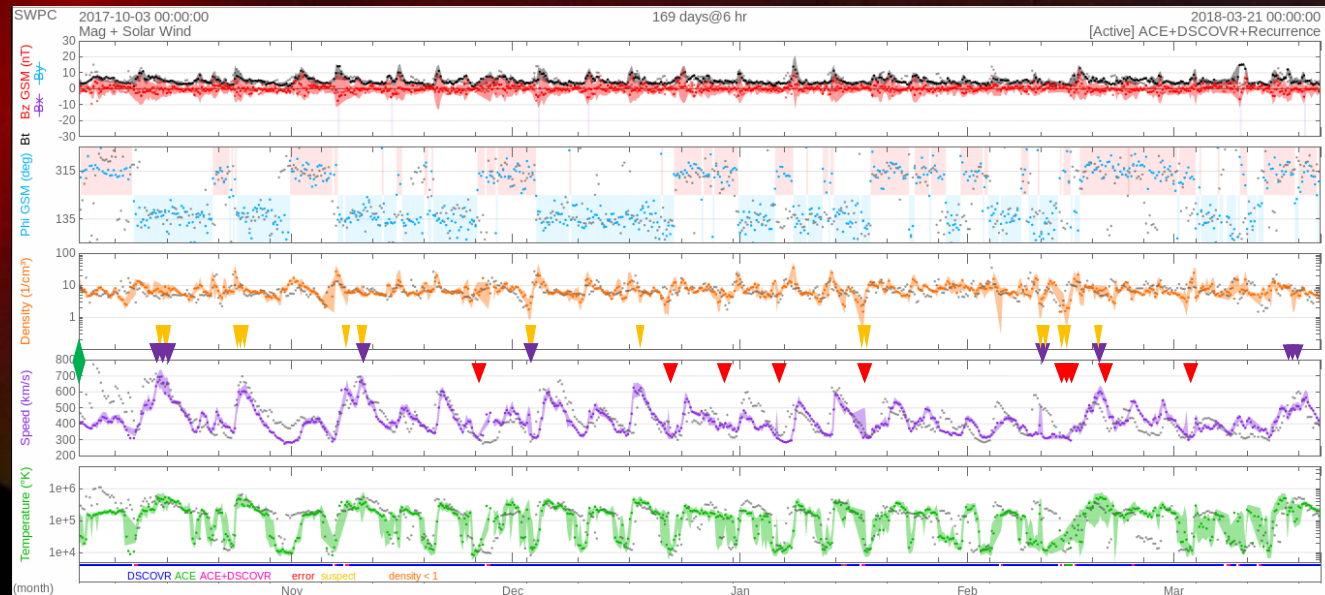
It happened this week

- Speed jumps up by ~ 200 km/s, remains there for a while, then drops back down
 - Density drops and temperature rises when the speed spikes
- April 15-16, 2018



Analysis period

- Analysis starts after all of the patches: 10/3/17 to 3/20/18



- spike
- thrashing
- bad jump
- FSW patch

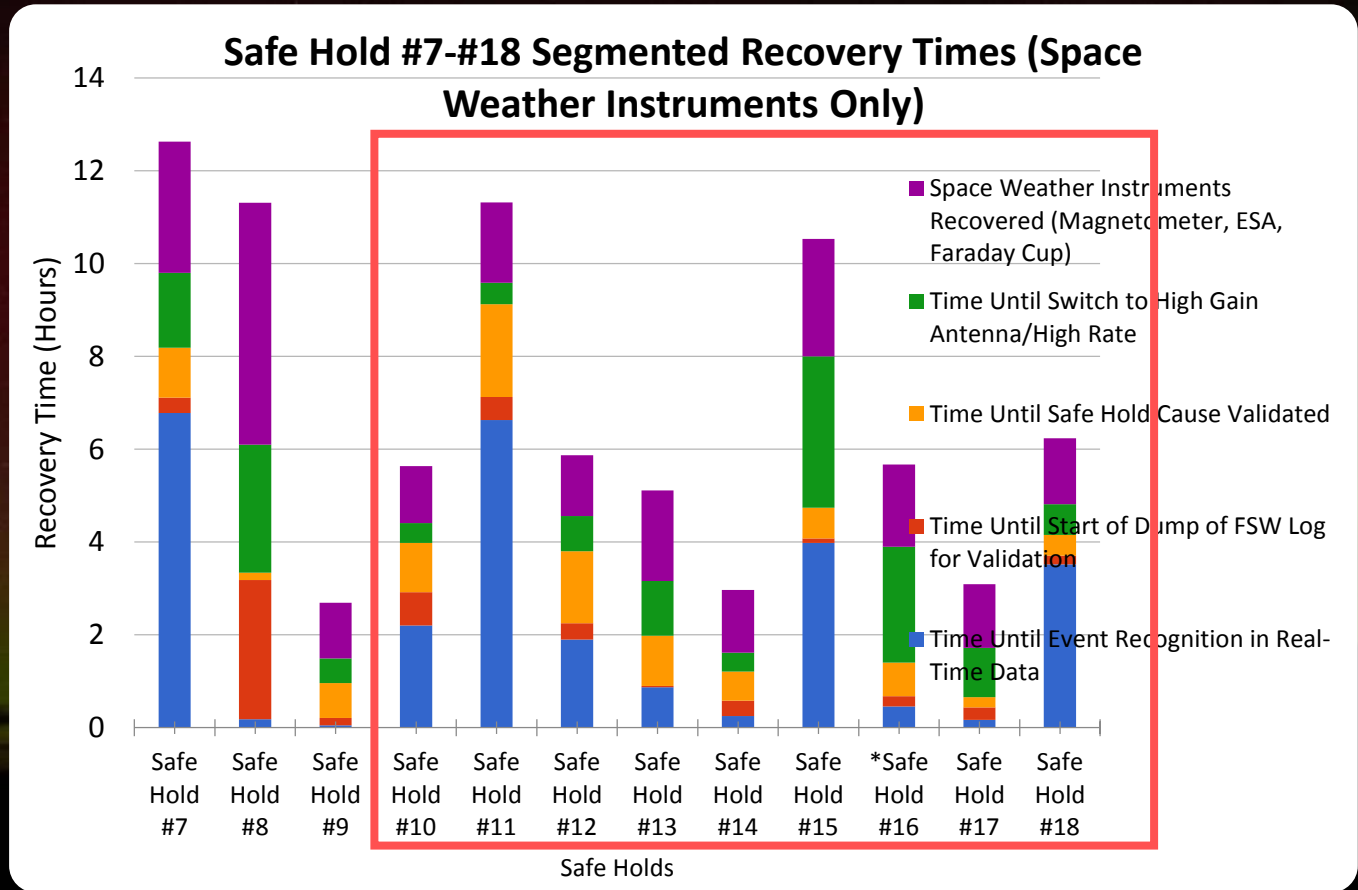
We have a potential fix

- Can be improved by modifying the flight software to:
 - Perform full background subtraction and some de-emphasis
 - The bottom line is the issues we are seeing are addressable

	# triggering cycles	# fixed via deemphasis	# early recovery via deemphasis	# fixed via bkgd subtraction	# early recovery via bkgd subtraction	# fixed via bkgd subtraction and deemphasis	# early recovery via bkgd subtraction and deemphasis
11/26/2017	1	1	2	1	1	1	1
12/22/2017	2	2	6	2	0	2	16
1/6/2018	1	1	20	1	0	1	52
1/17/2018	32	31	16	23	12	32	51
1/18/2018	2	1	2	1	0	2	6
2/13/2018	13	8	468	10	21	13	698
2/14/2018	9	8	1372	8	10	9	1996
2/15/2018	0	0	266	0	0	0	364
3/2/2018	8	8	2	6	0	8	5
	68	60	2154	52	44	68	3189
	success rate	88%		76%		100%	

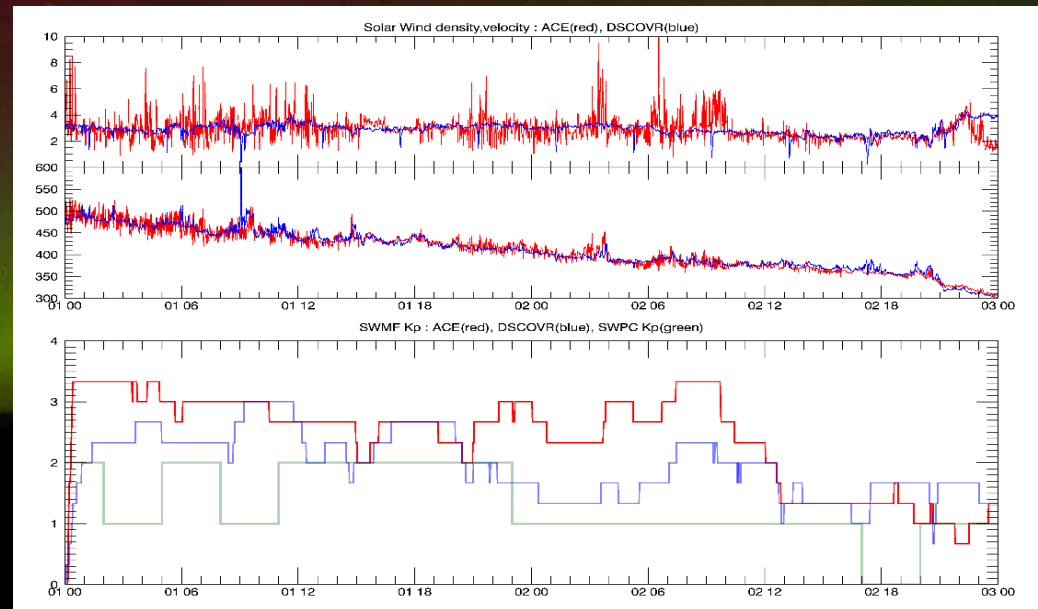
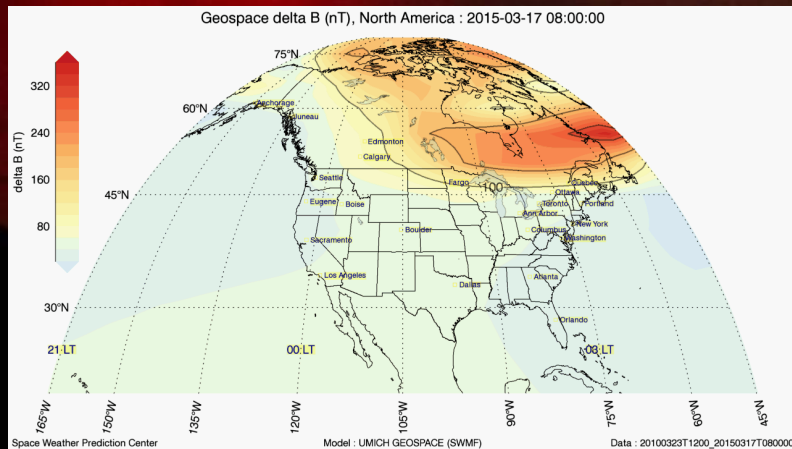
DSCOVN Safeholds and Recovery From

Safehold 1	6/23/2015
Safehold 2	6/27/2015
Safehold 3	7/15/2015
Safehold 4	8/4/2015
Safehold 5	9/29/2015
Safehold 6	10/8/2015
Safehold 7	1/6/2016
Safehold 8	1/14/2016
Safehold 9	5/24/2016
Safehold 10	9/17/2016
Safehold 11	10/11/2016
Safehold 12	10/30/2016
Safehold 13	8/24/2017
Safehold 14	10/10/2017
Safehold 15	1/14/2018
Safehold 16	3/7/2018
Safehold 17	3/9/2018
Safehold 18	3/22/2018



Models need good data

- Not only do models need data, they need good quality data.
- We recognized early on that when DSCOVR data was good, it was very good – *c.f.* Geospace

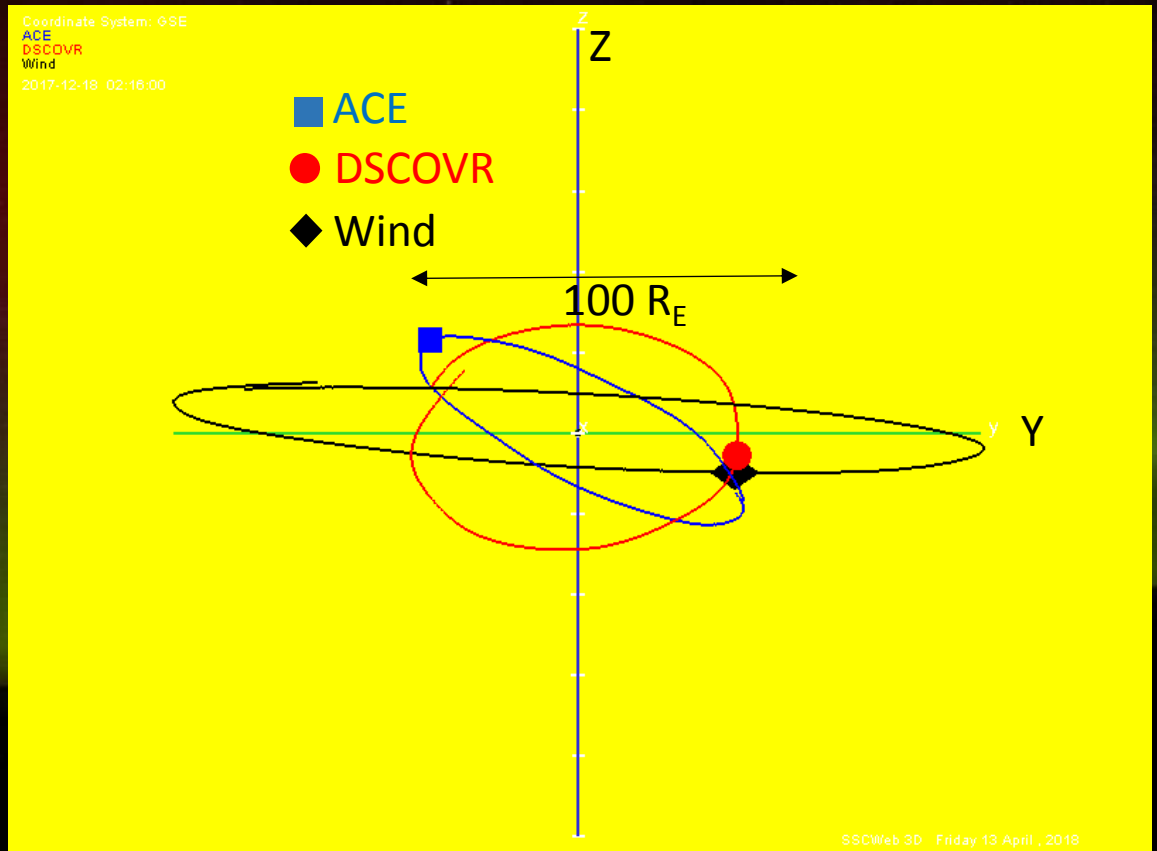


Comparing Solar Wind Data at L1

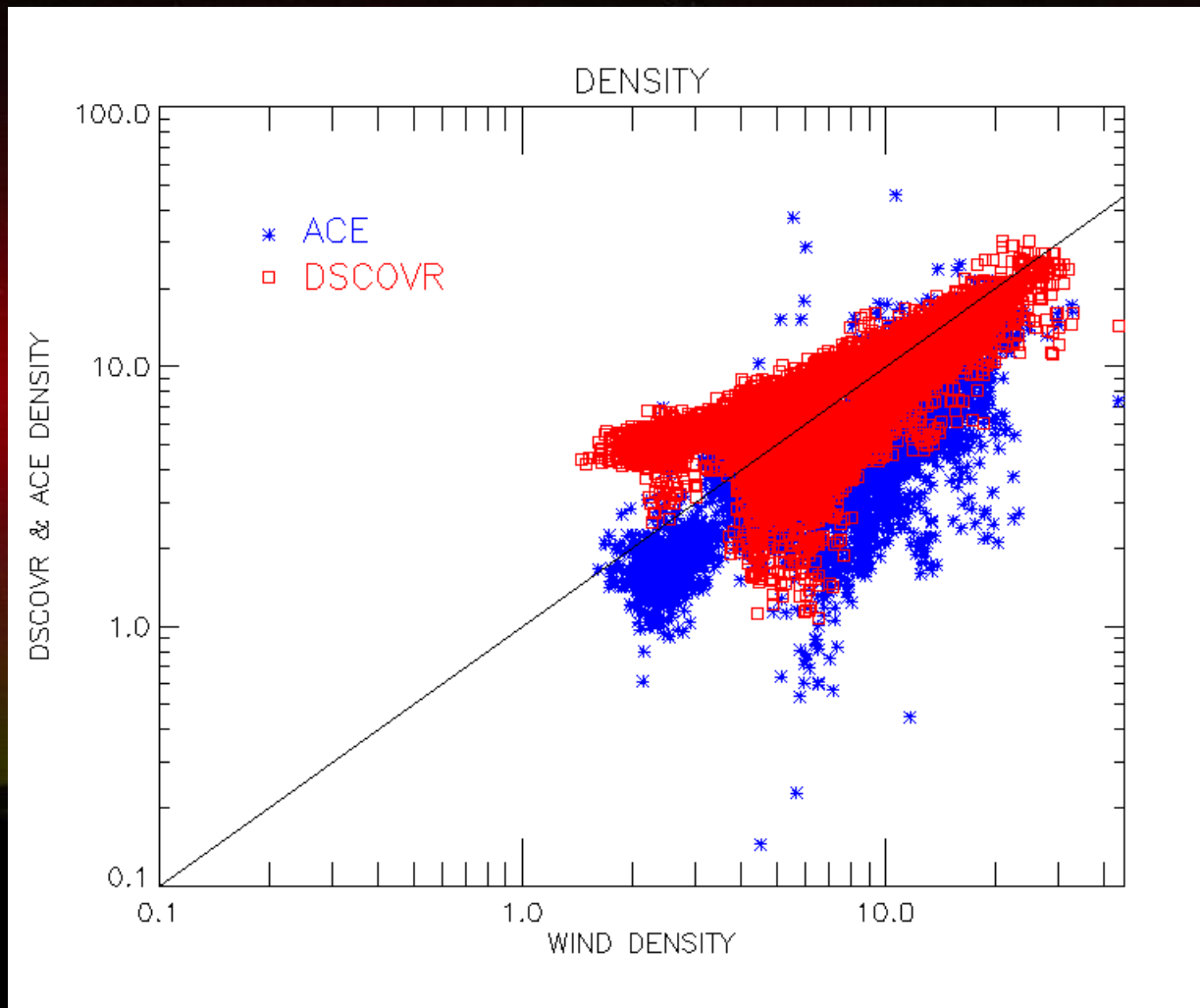
- Three observatories, one must be correct, right?
- NASA/Wind will be the reference
- Compare NASA/ACE and NOAA/DSCOVR to Wind
 - Note, this is ACE SWEFAM real-time data

December 18, 2017

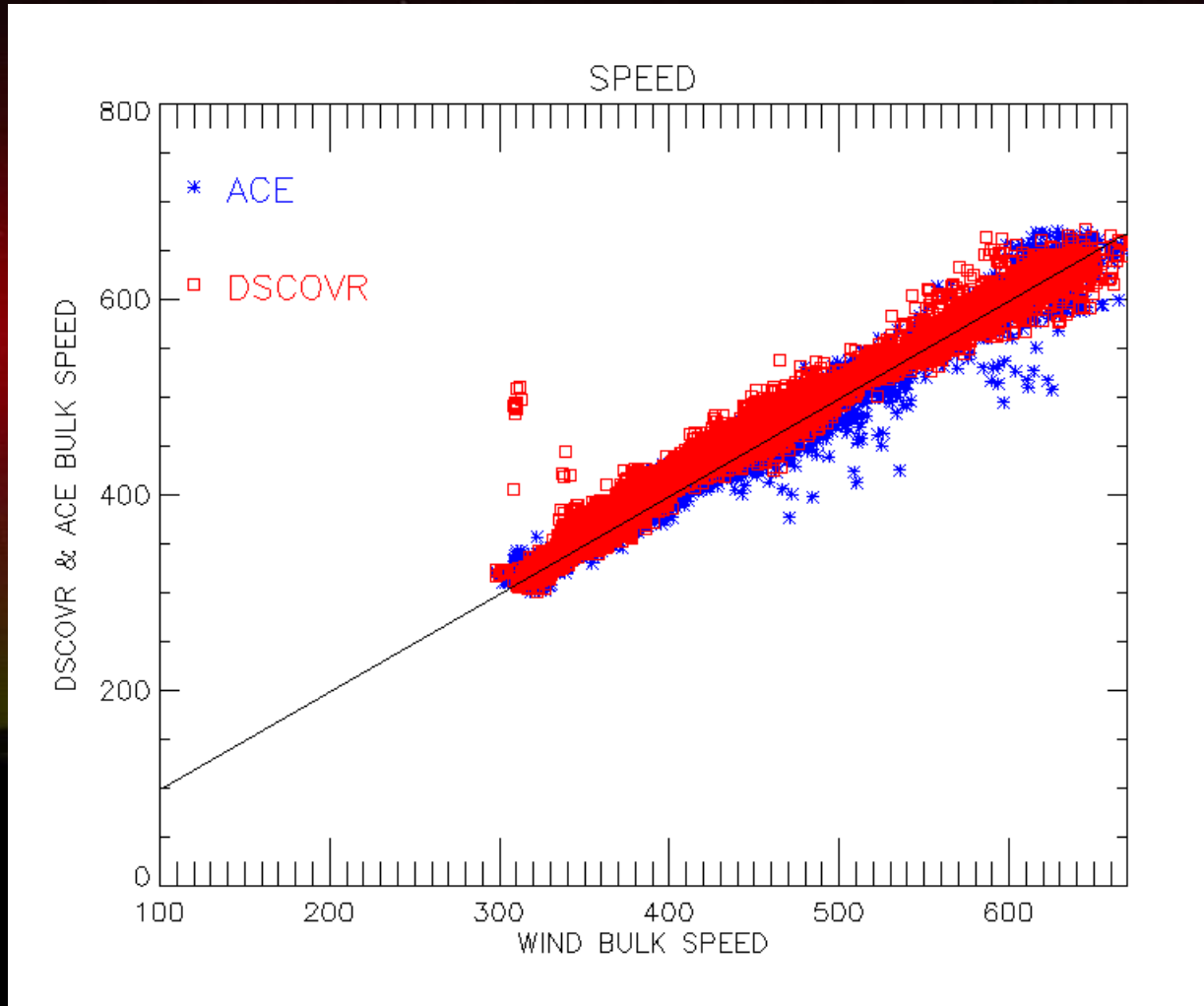
- DSCOVR and WIND in line
- ACE $\sim 100 R_E$ away



Density (Dec 11-25, 2017)

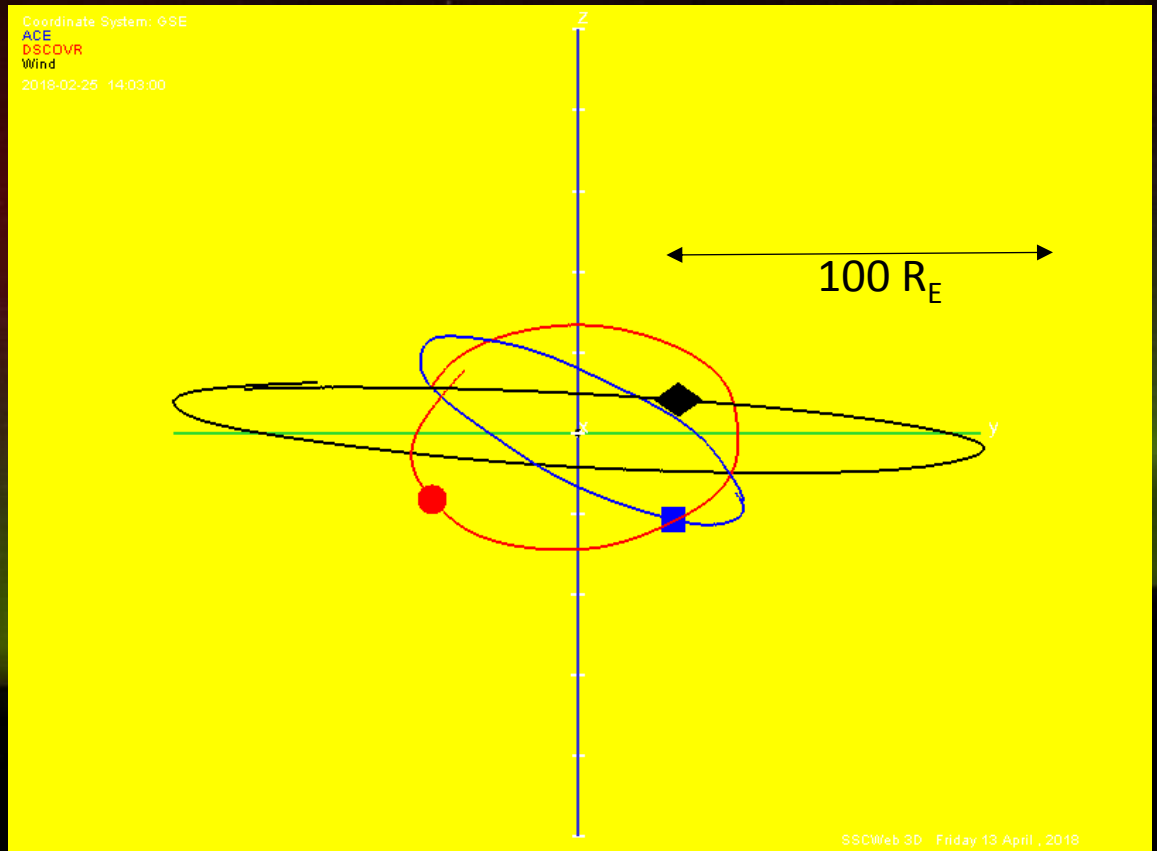


Speed (Dec 11-25, 2017)

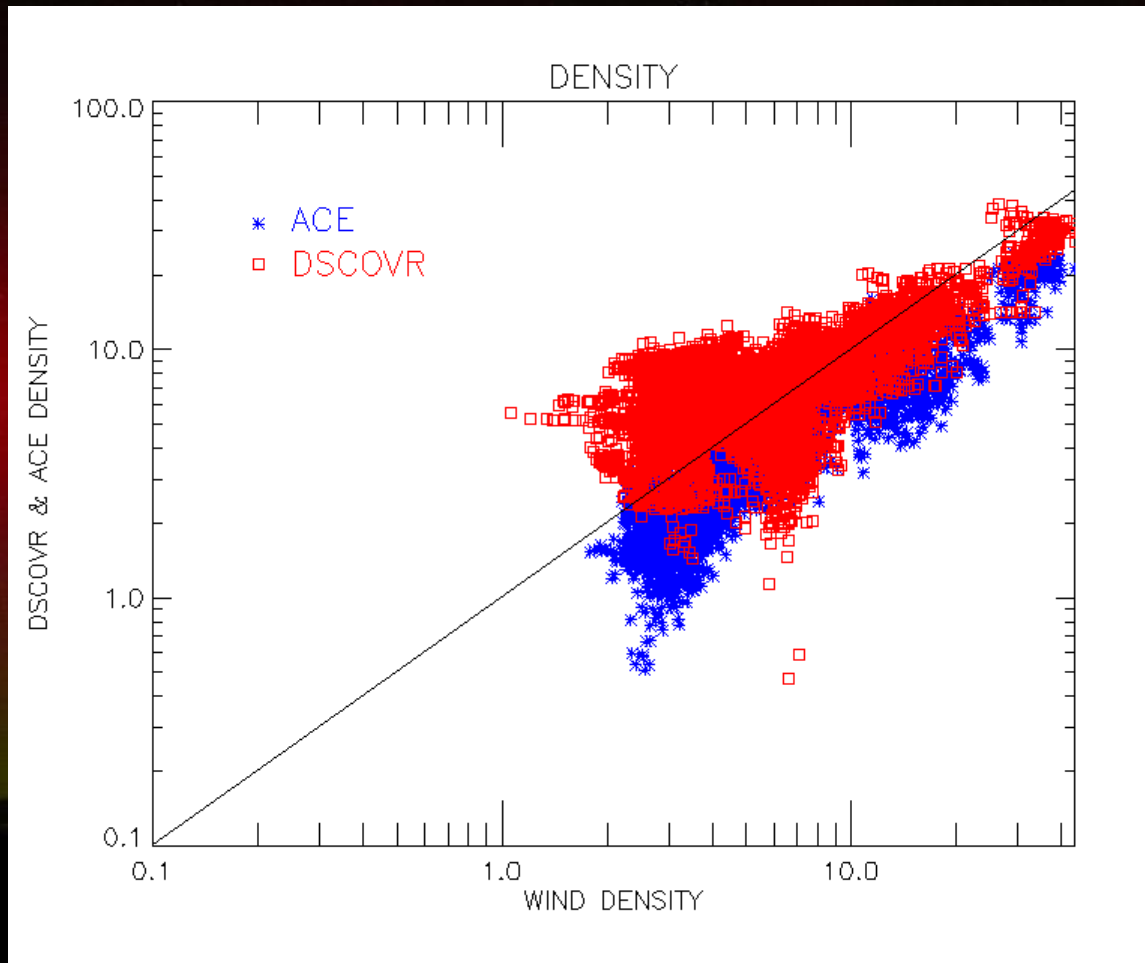


February 25, 2018

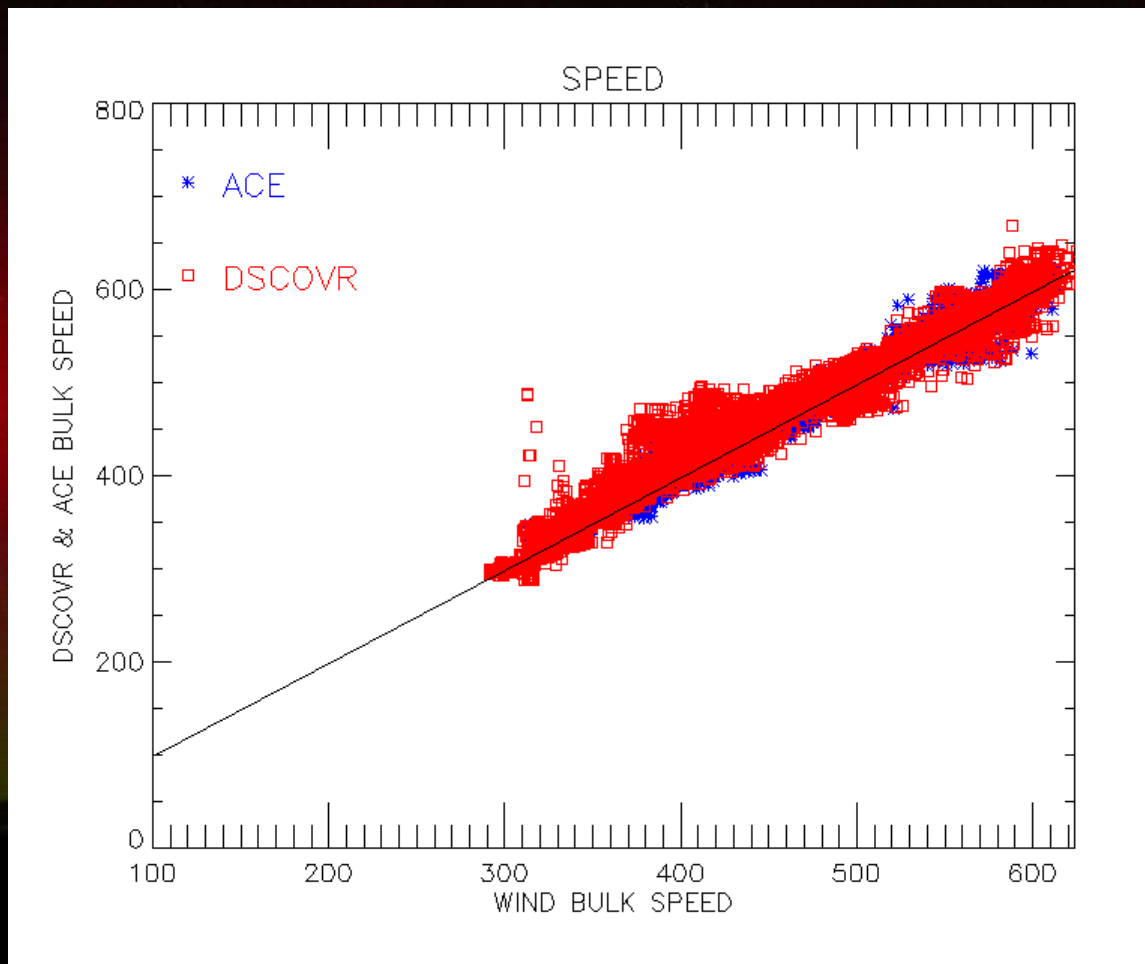
- WIND and ACE closer
- DSCOVR further away



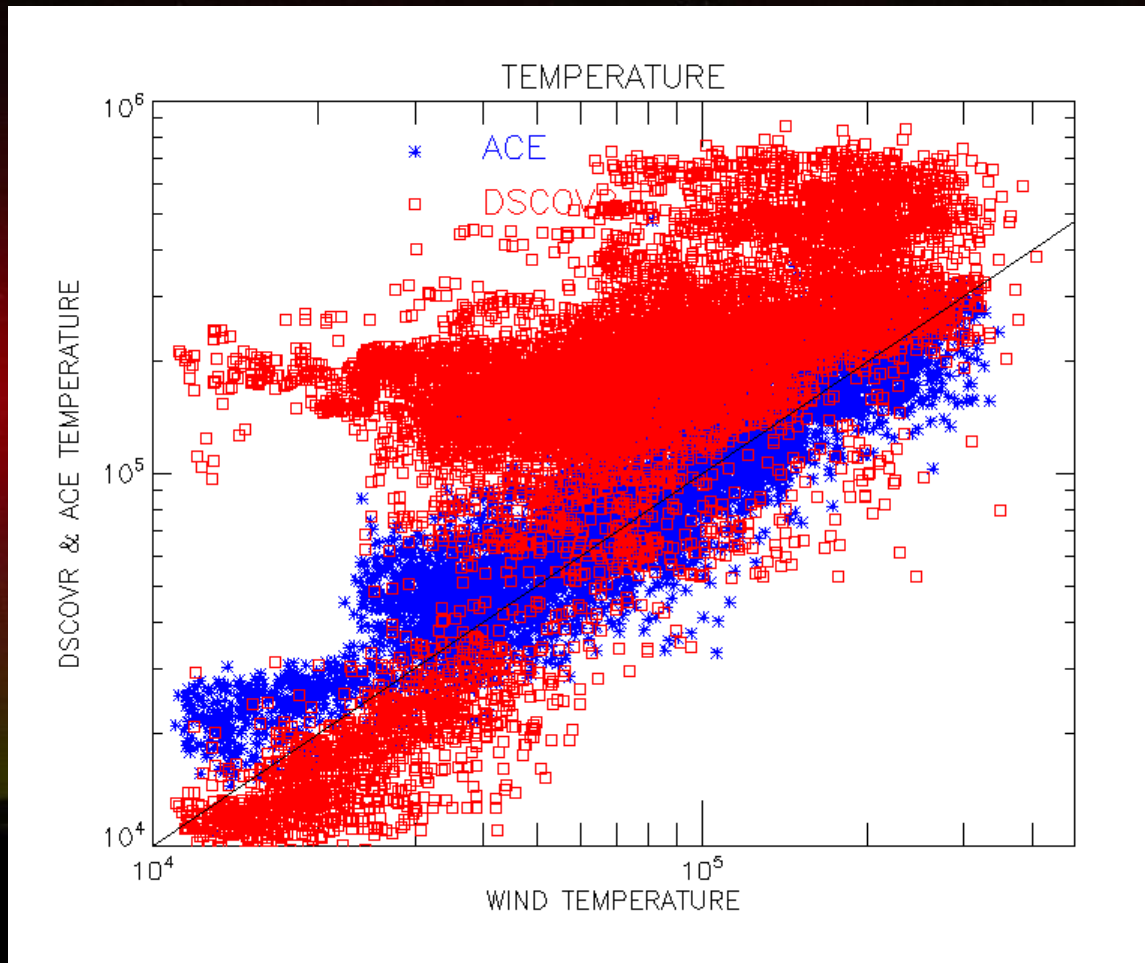
Density (Feb 18-Mar 4, 2018)



Speed (Feb 18-Mar 4, 2018)



Temperature (Feb 18-Mar 4, 2018)



Summary

- DSCOVR, except for the safeholds, can be better than what we had before.
 - In fact, most of the time, it is better.
 - I admit I didn't show plasma temperature...
- You tell me which spacecraft is returning accurate solar wind values at any instant in time
 - That said, it looks to me like ACE is seeing a recurrence of its low density problem.