Analysis and modeling of tropical convection observed by CYGNSS

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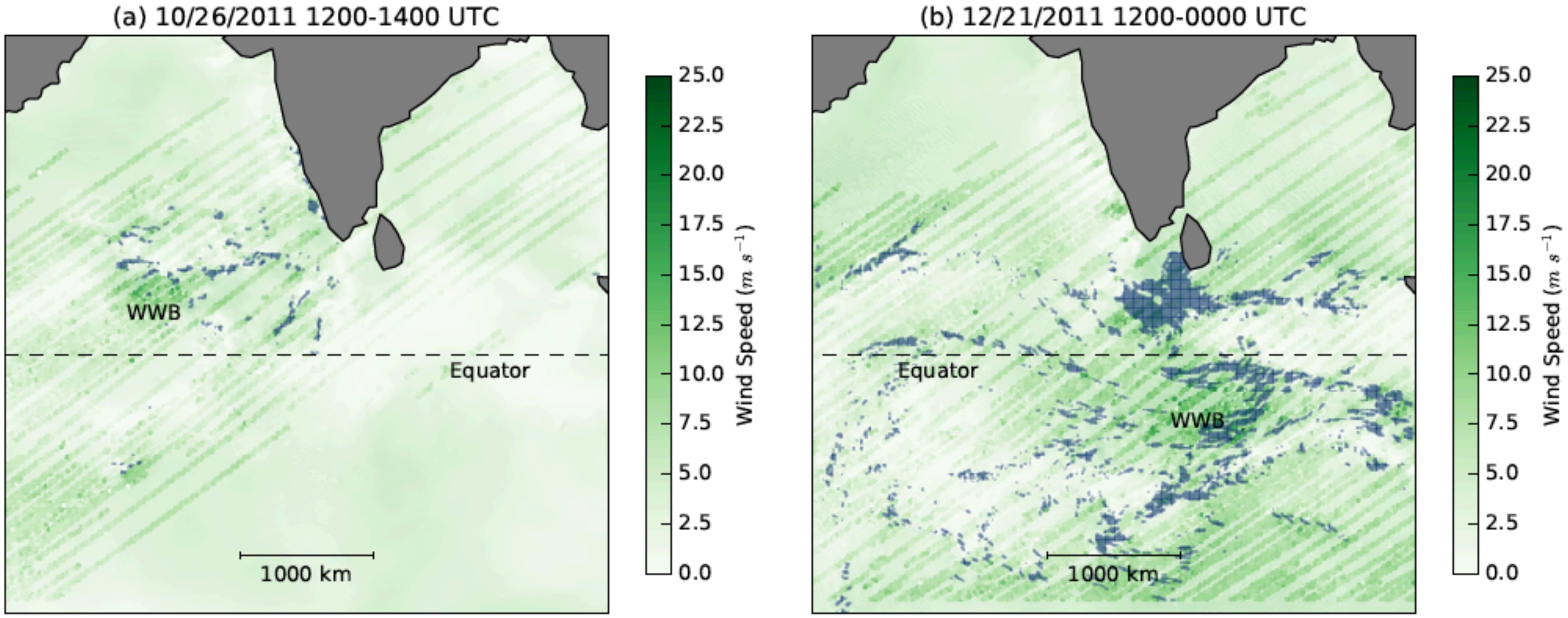
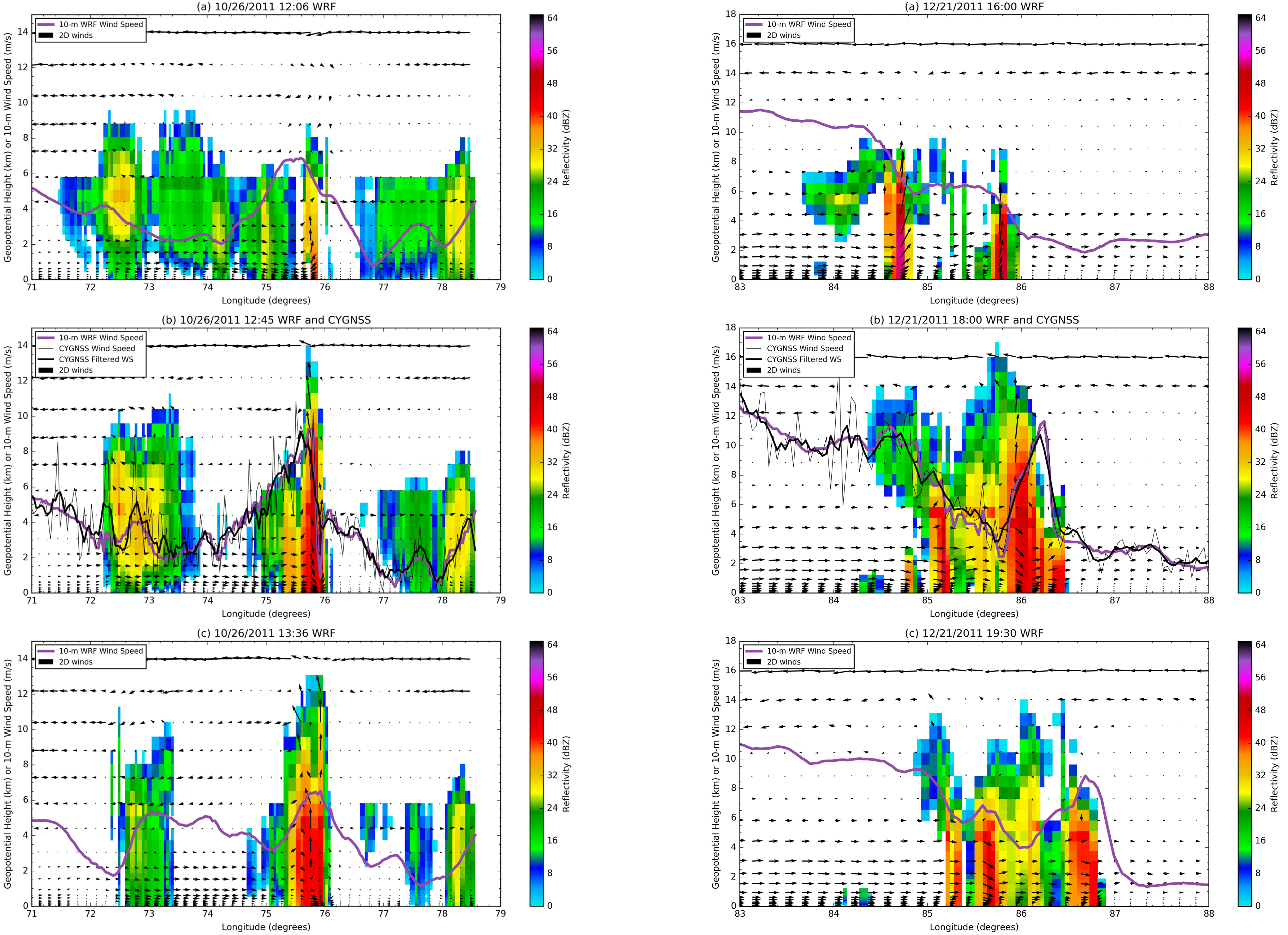
Looking for convective feature in CYGNSS data …



CYGNSS E2ES analysis; Hoover et al. (2017)

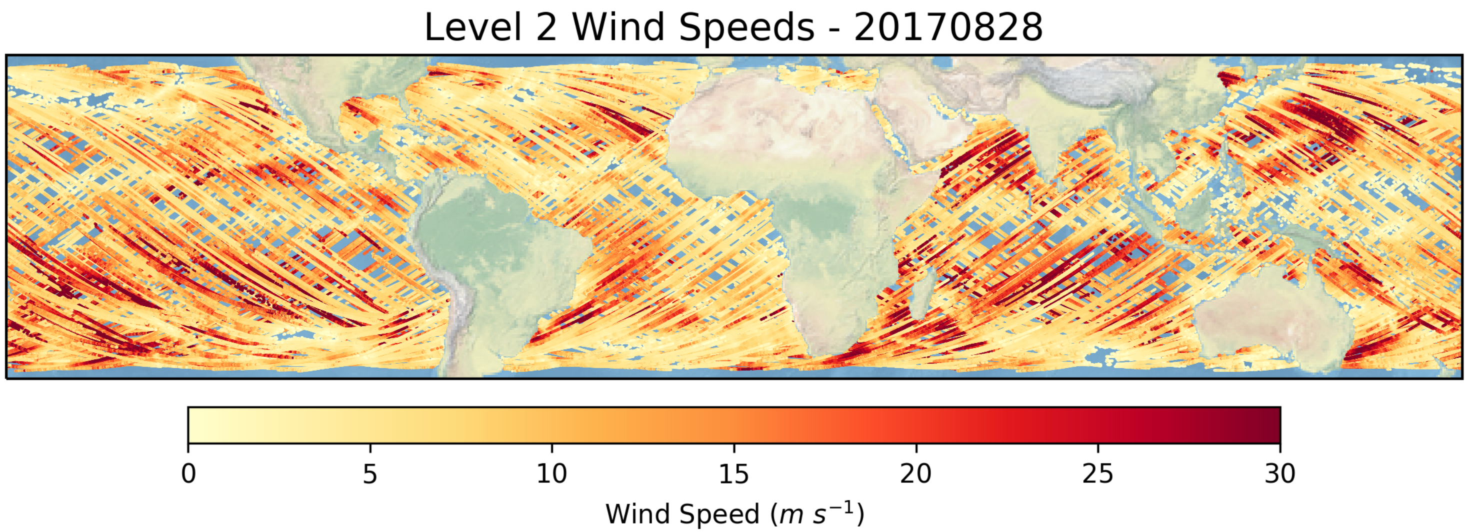
October 2011

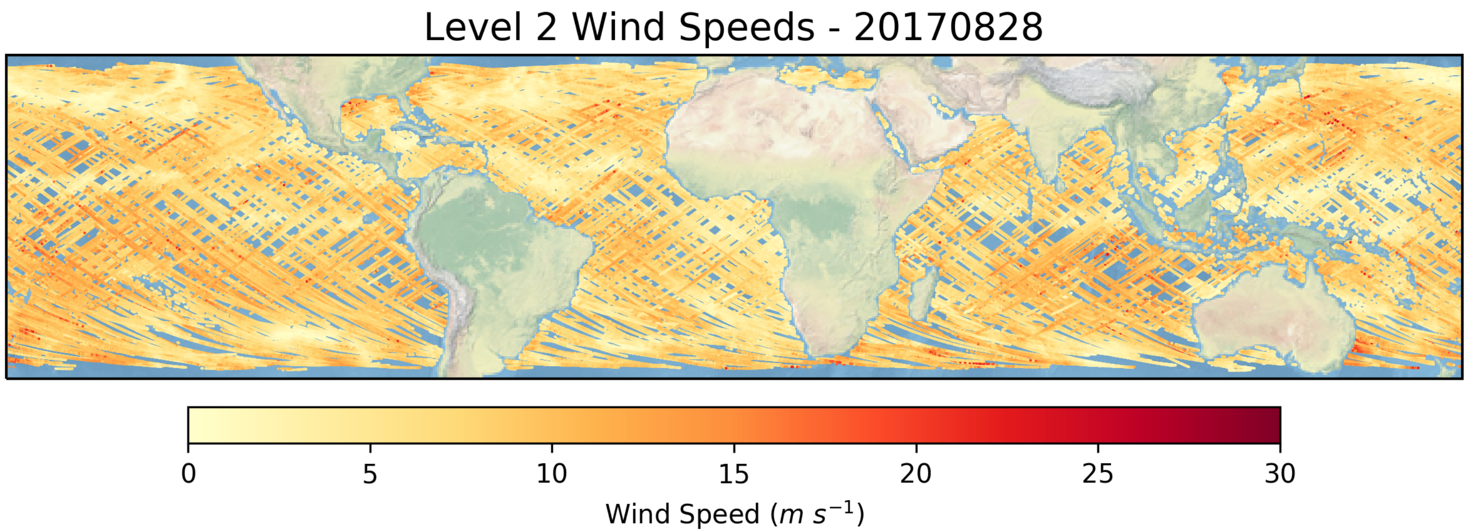


December 2011

CYGNSS E2ES analysis; Hoover et al. (2017)

Version 1

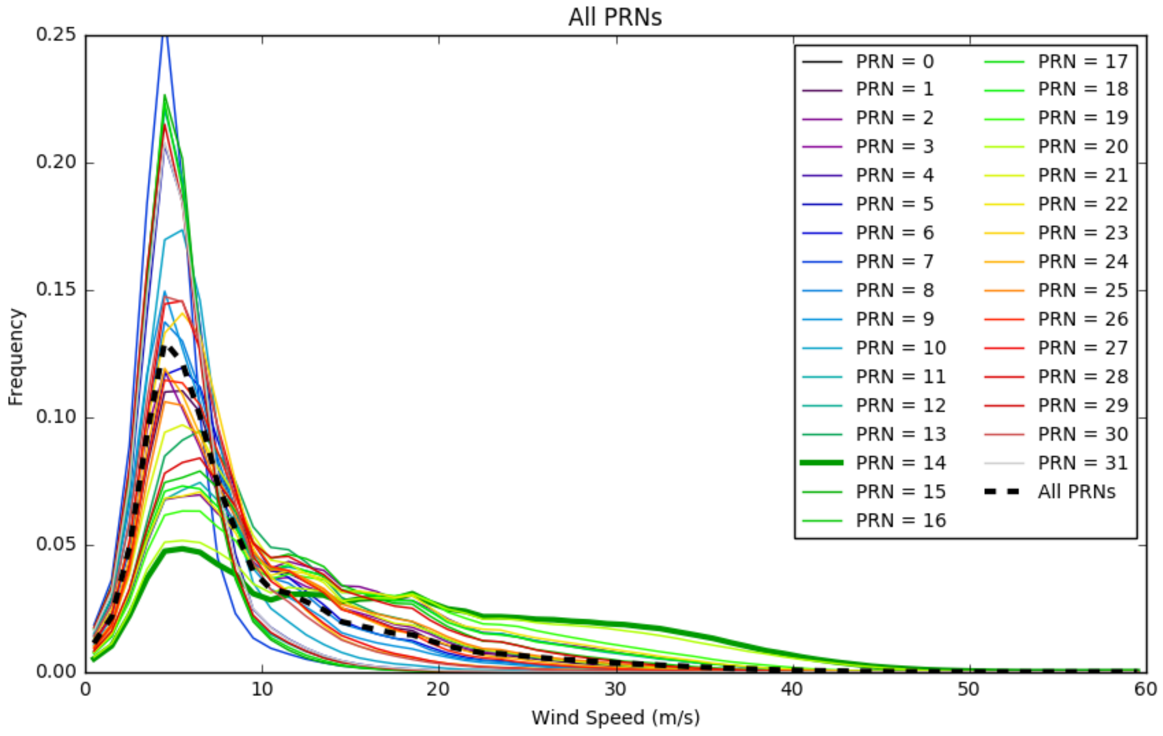




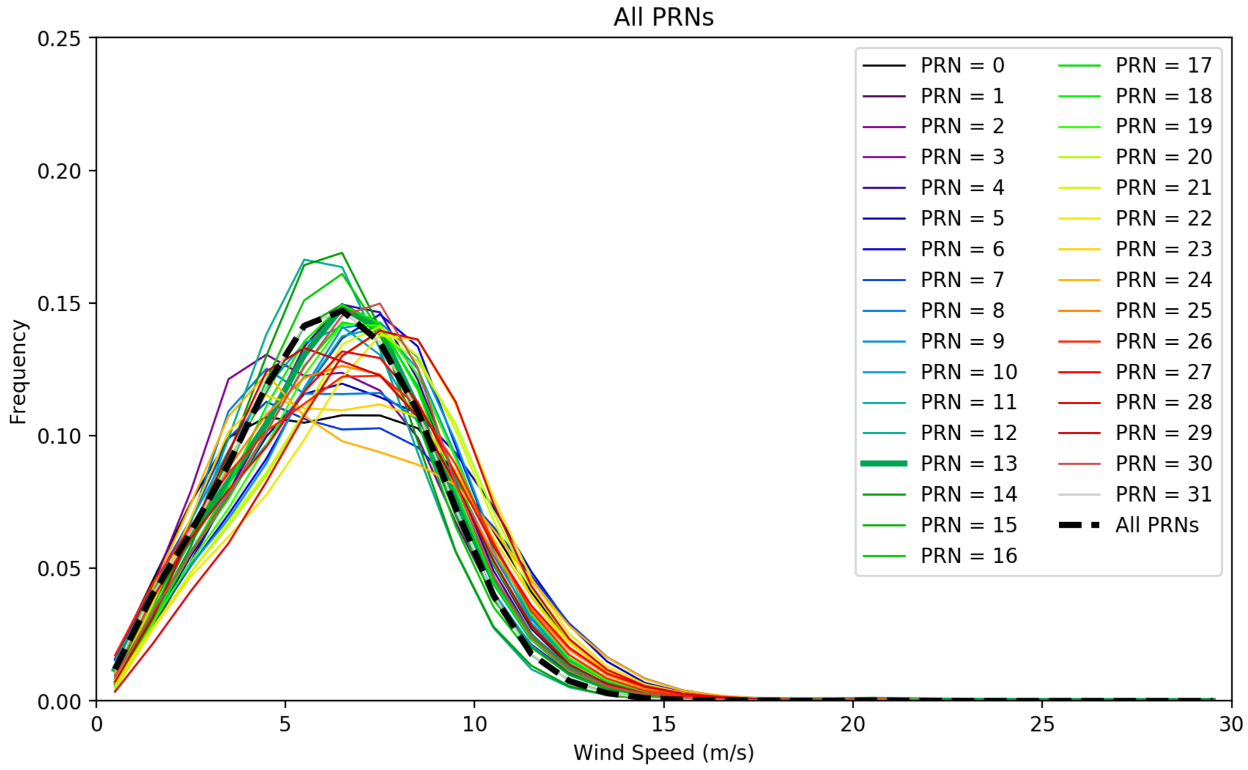
Version 2 beta FD

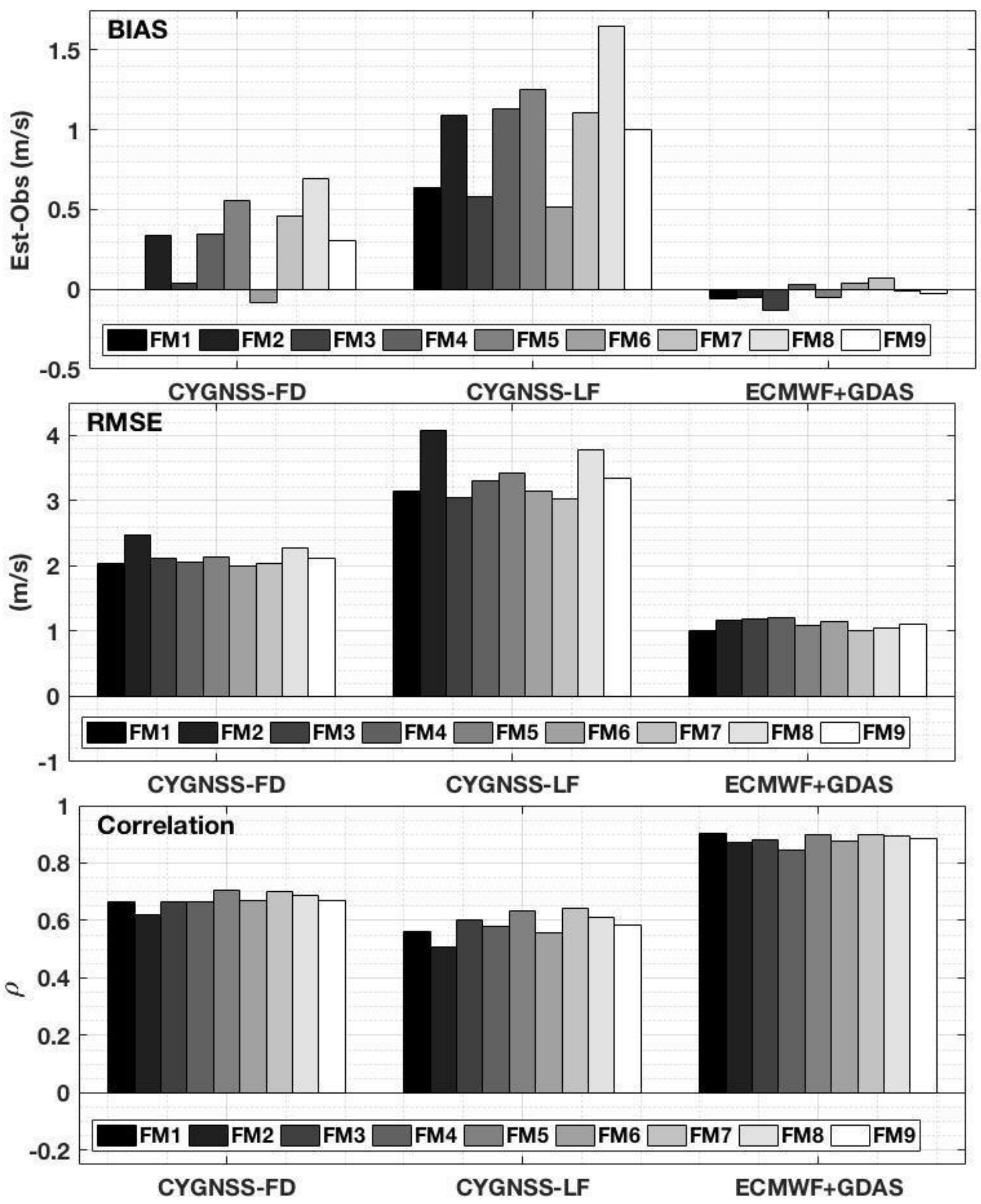
Version 1

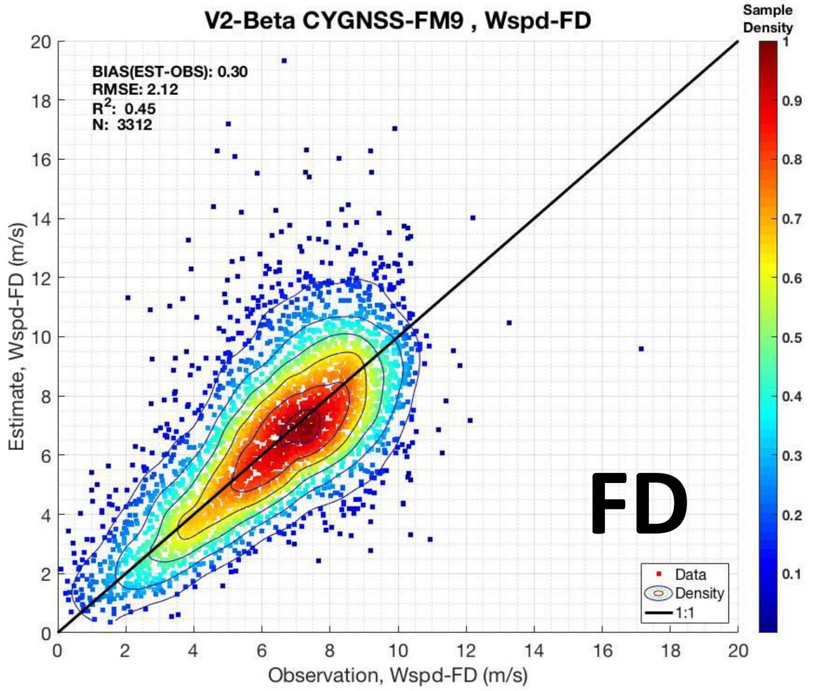
CYGNSS
by PRN Code

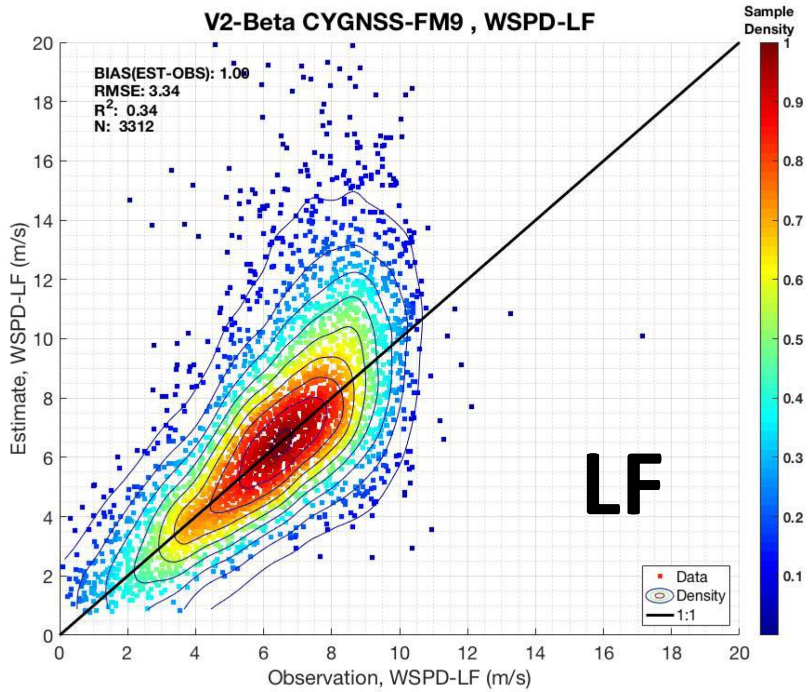


Version 2 beta FD

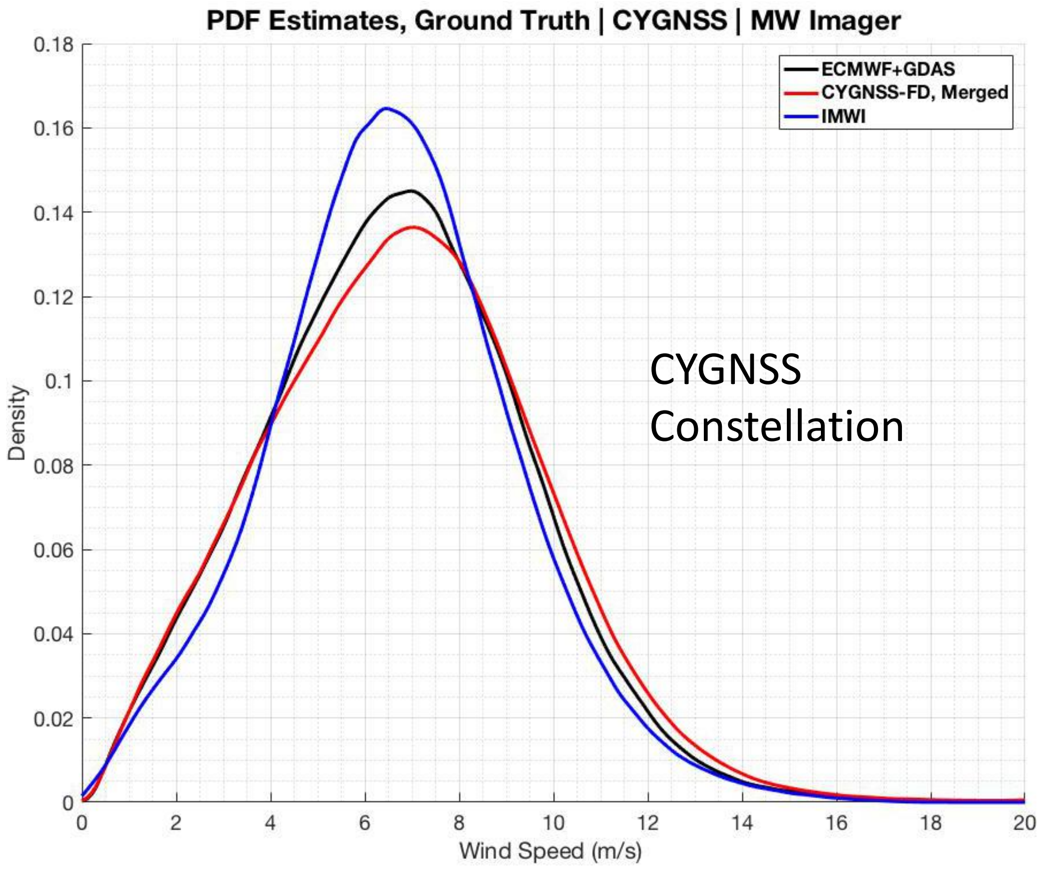


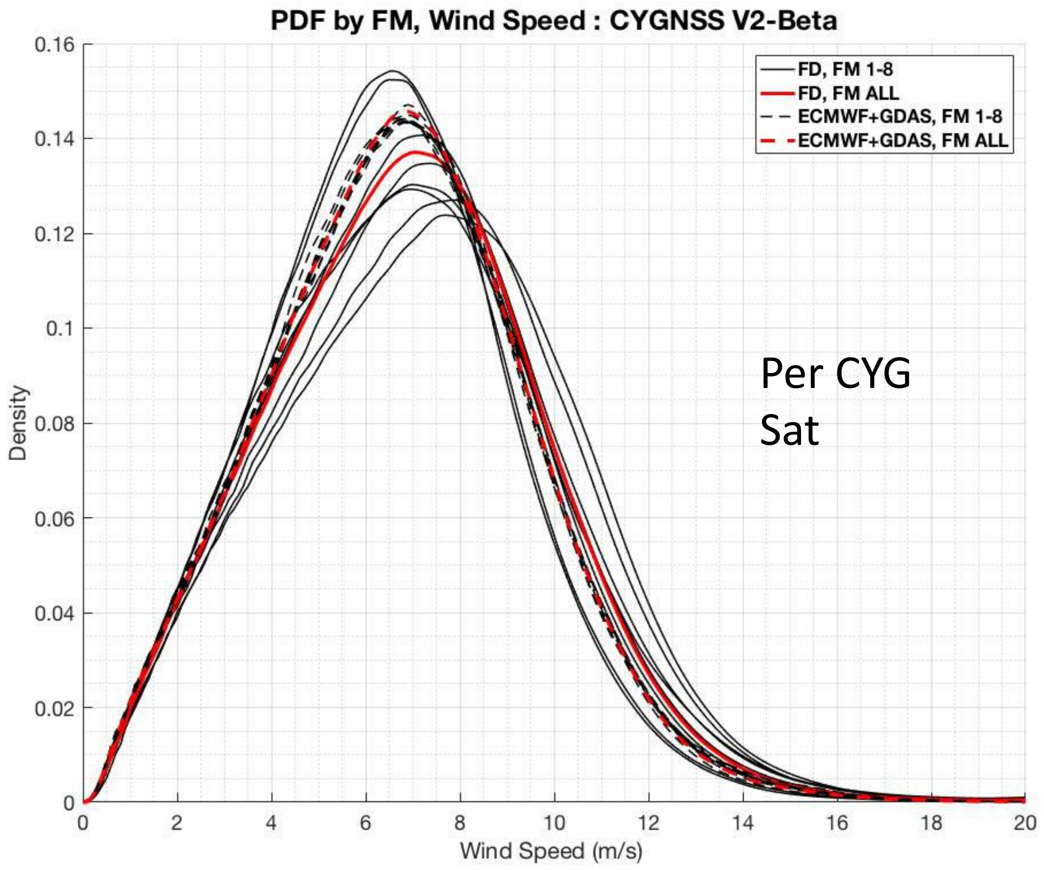

BIAS
Est-Obs (m/s)
FM1 FM2 FM3 FM4 FM5 FM6 FM7 FM8 FM9
CYGNSS-FD
CYGNSS-LF
ECMWF+GDAS
RMSE
(m/s)
Correlation
ρ


V2-Beta CYGNSS-FM9 , Wspd-FD
BIAS(EST-OBS): 0.30
RMSE: 2.12
R2: 0.45
N: 3312
Sample Density
Estimate, Wspd-FD (m/s)
Observation, Wspd-FD (m/s)
Data
Density
1:1
FD

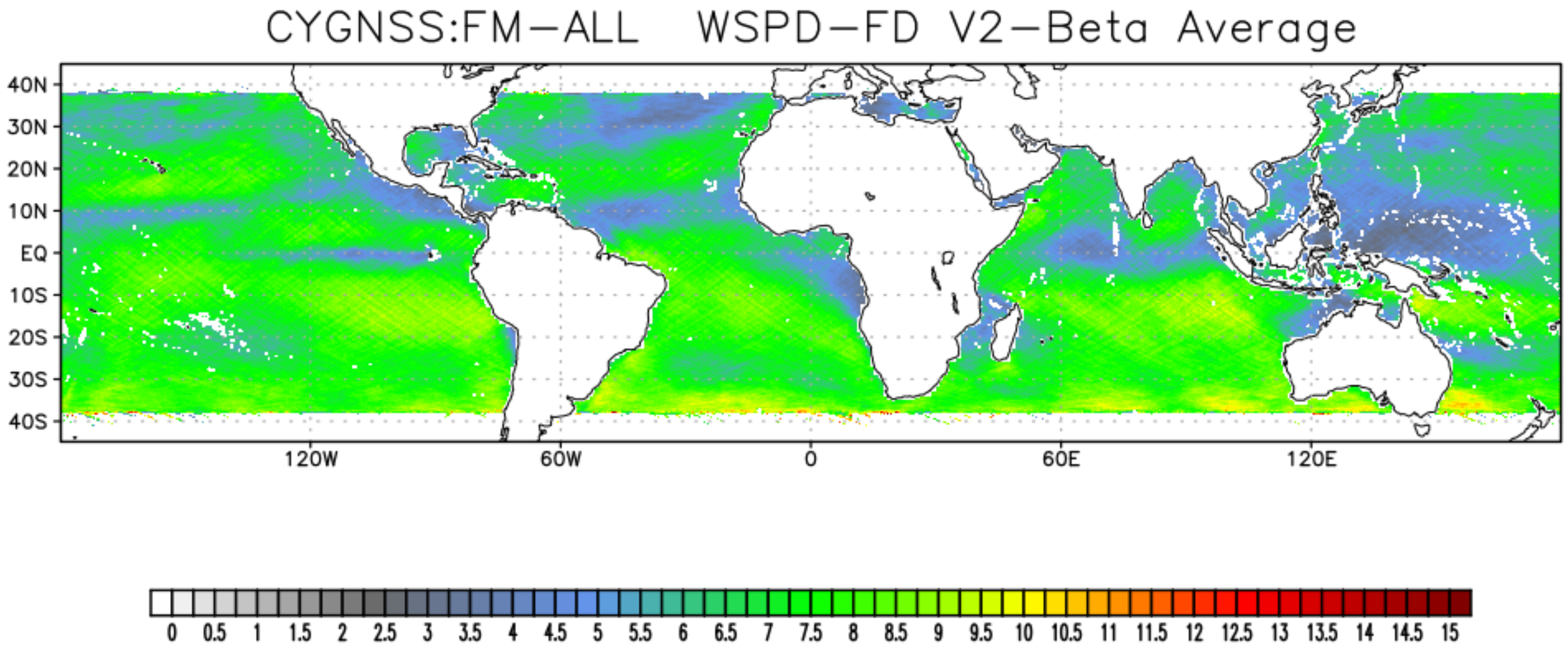

V2-Beta CYGNSS-FM9 , WSPD-LF
BIAS(EST-OBS): 1.00
RMSE: 3.34
R2: 0.34
N: 3312
Sample Density
Estimate, WSPD-LF (m/s)
Observation, WSPD-LF (m/s)
Data
Density
1:1
LF

Comparison to ECMWF+GDAS and Microwave Imager

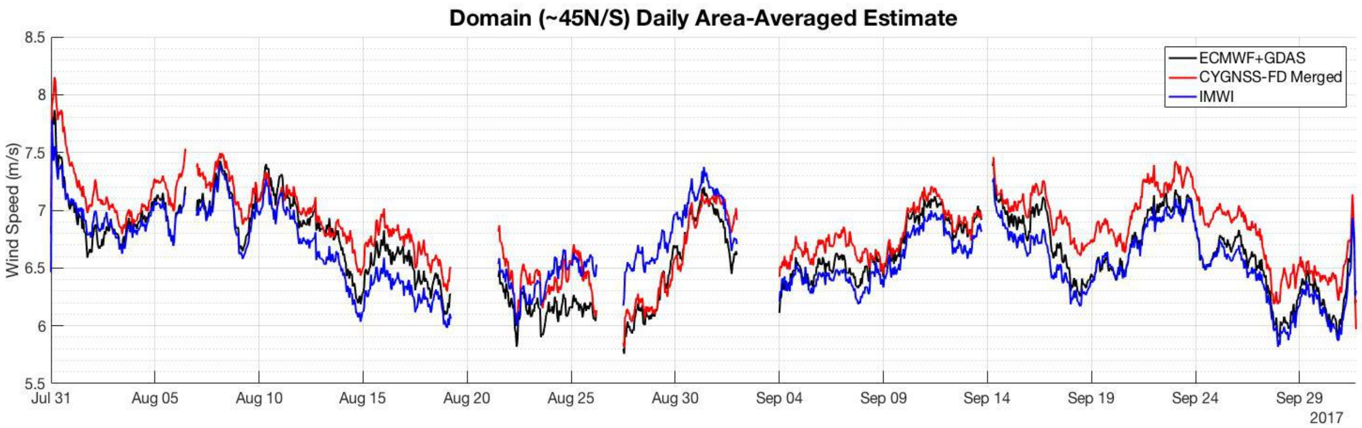




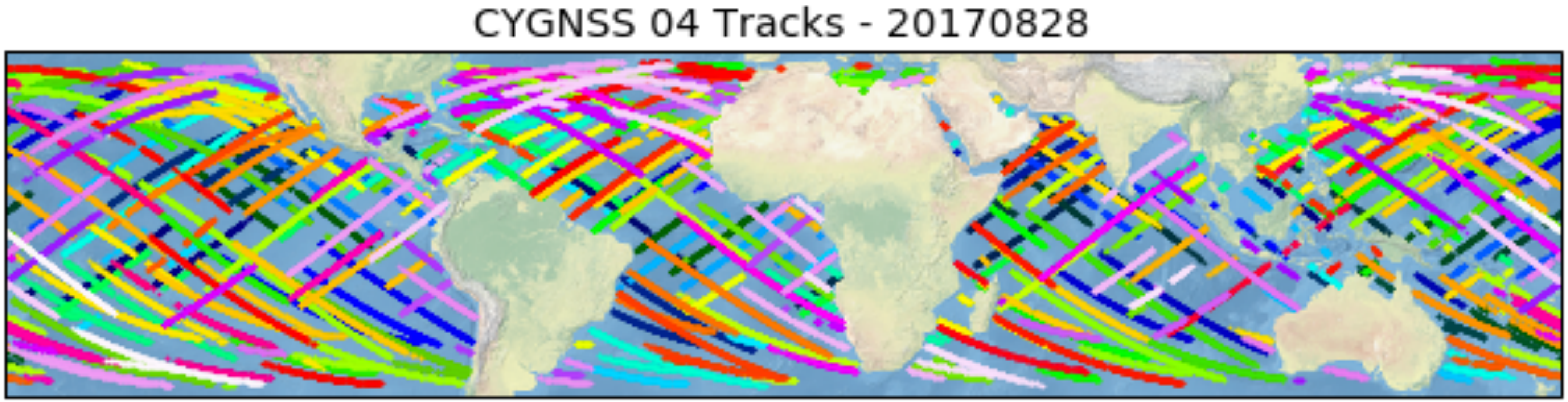
~2-Month Average



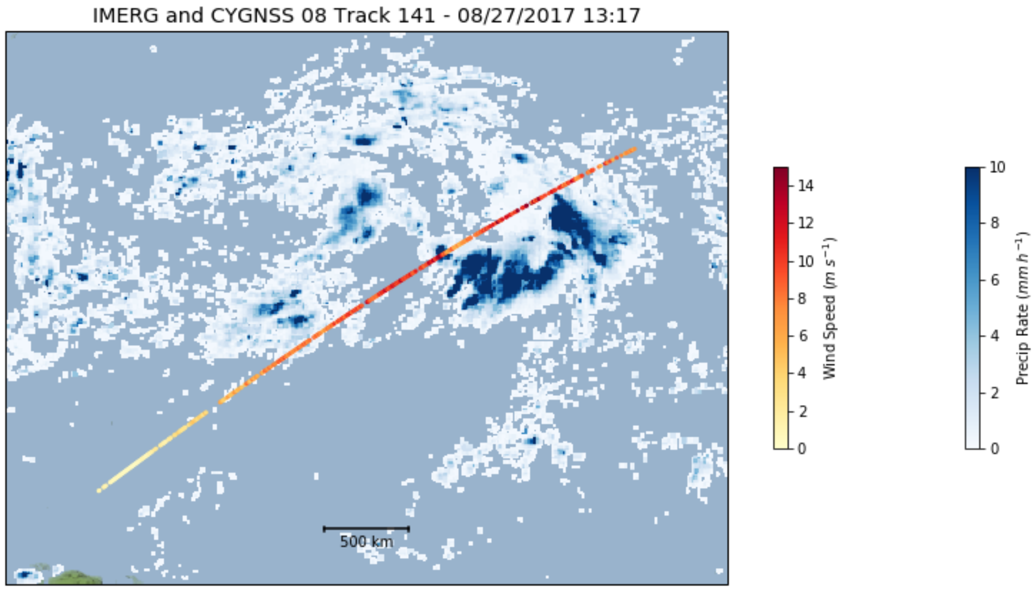
~2-Month Time Series

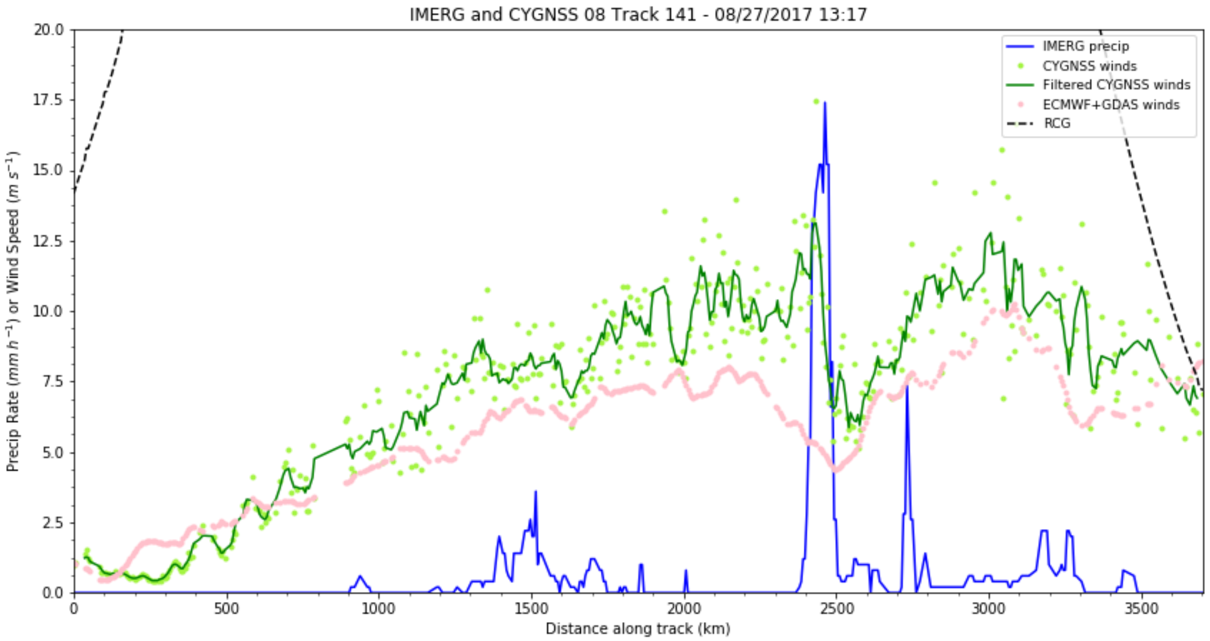


Track Identification

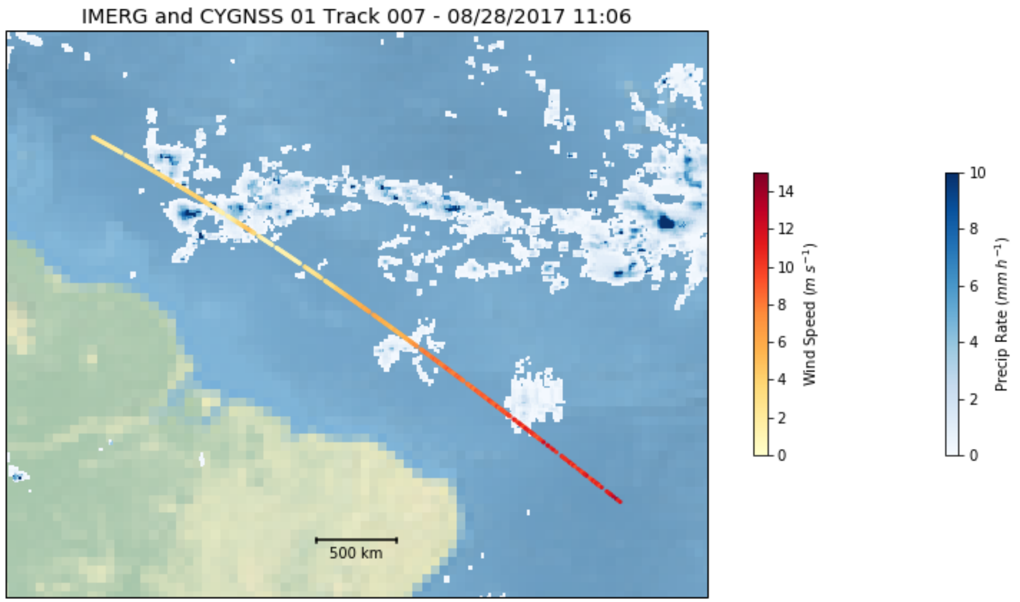


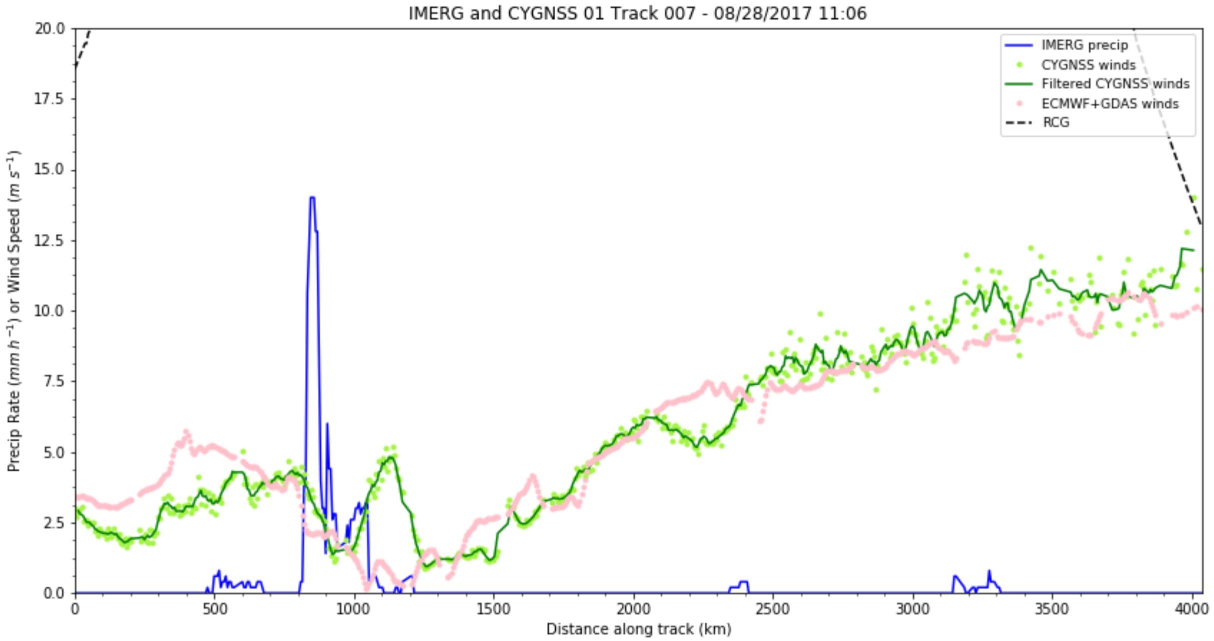
Track Example





Track Example





CYGNSS vs. ECMWF+GDAS

8/26/17-8/30/17	RMSE ($m\ s^{-1}$)	Bias ($m\ s^{-1}$)
FD_{rain}	2.7	+0.0
FD_{norain}	2.0	-0.1
LF_{rain}	3.6	+0.7
LF_{norain}	2.8	+0.3

CYGNSS V2 beta winds were tested in a simple Data Assimilation (DA) experiment focusing on Hurricane Harvey landfall. LF winds had greater impact.

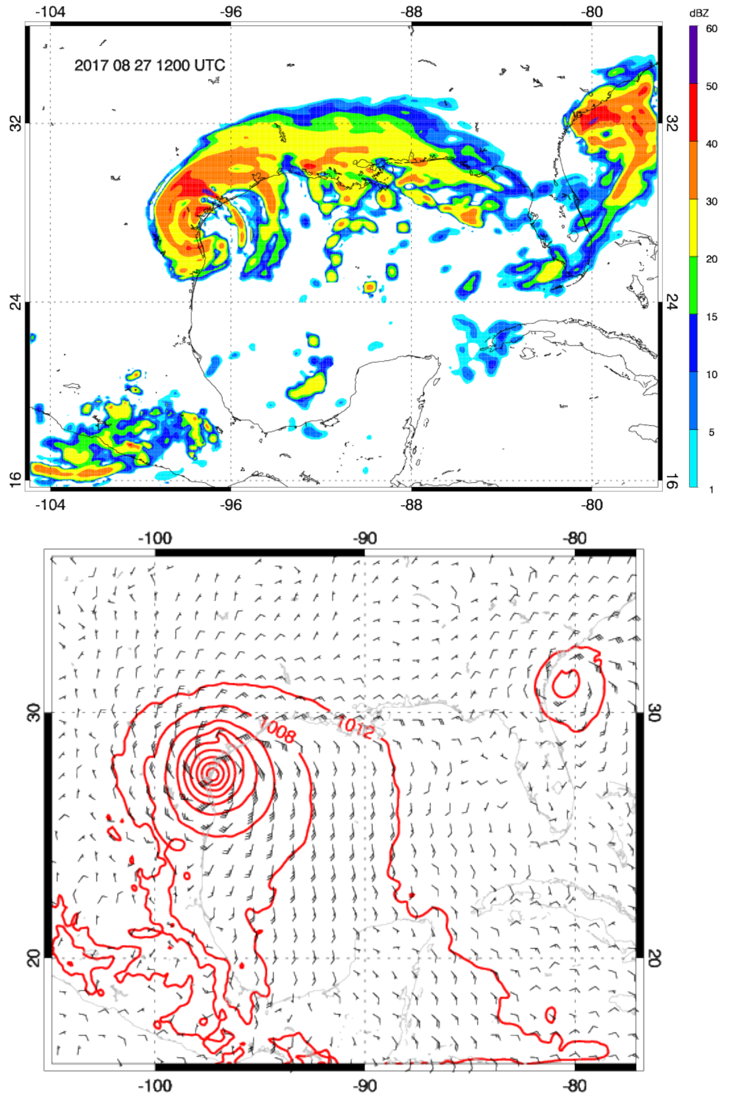
WRF Domain: 9 km resolution (300x250x40)

WRF Control Run: 06 UTC 24 August 2017 – 00 UTC 29 August 2017

DA: 5 cycles – 06 & 12 UTC August 25, 12 UTC August 27,
06 & 12 UTC August 28

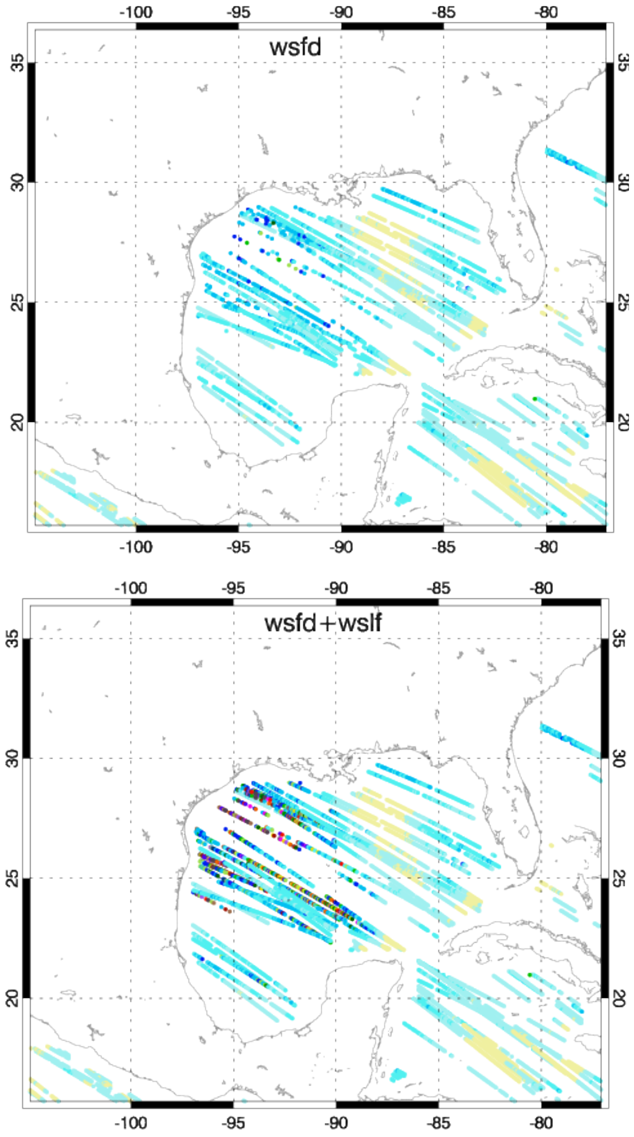
DA_wsfd: Assimilate FD wind speed; **DA_hur_wslf**: Assimilate FD + LF around Harvey

Control



12 UTC 2017-08-27

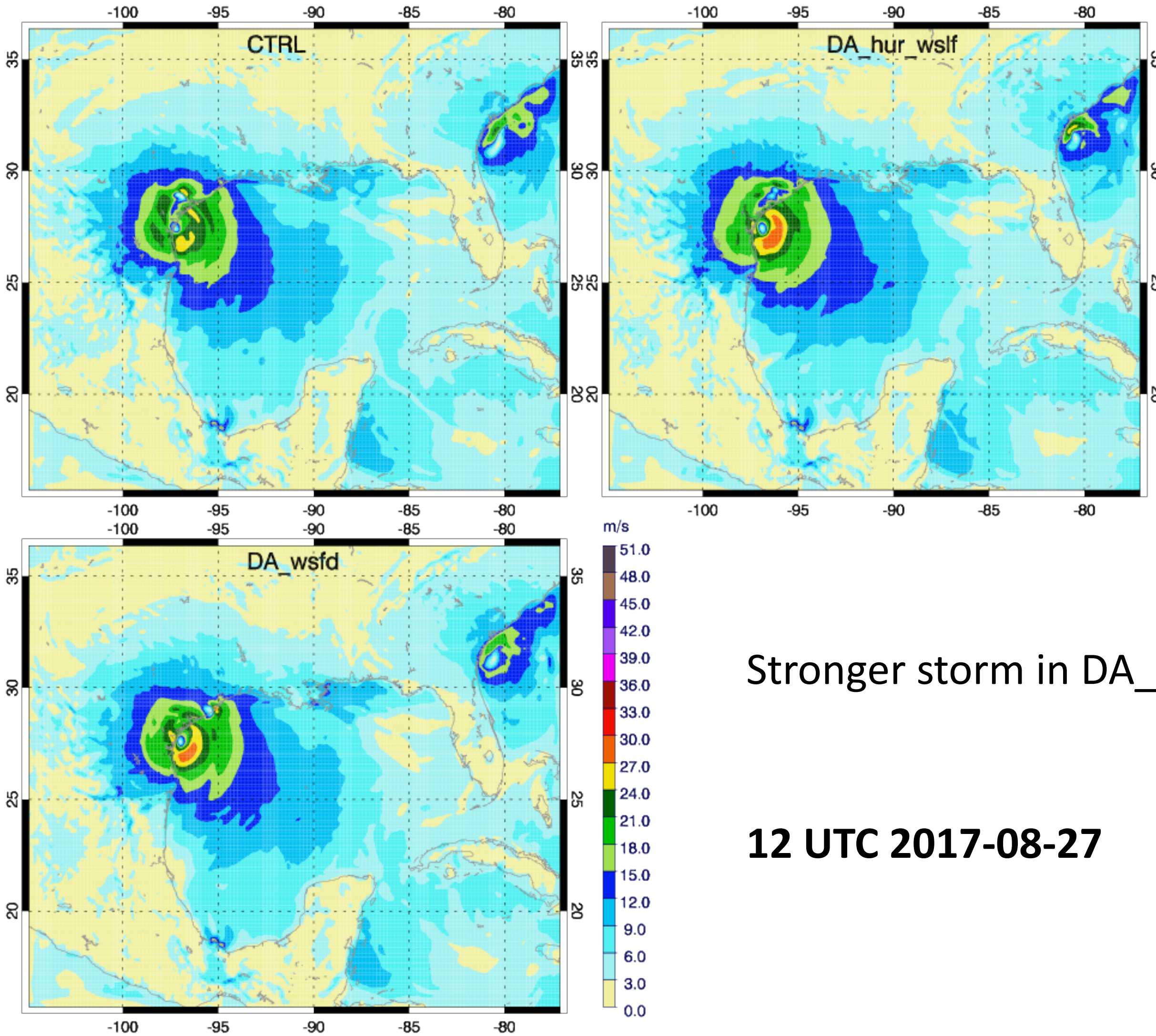
Storm slower and weaker than truth



12 UTC 2017-08-27
FD & FD+LF winds

LF applied within 800 km of storm center

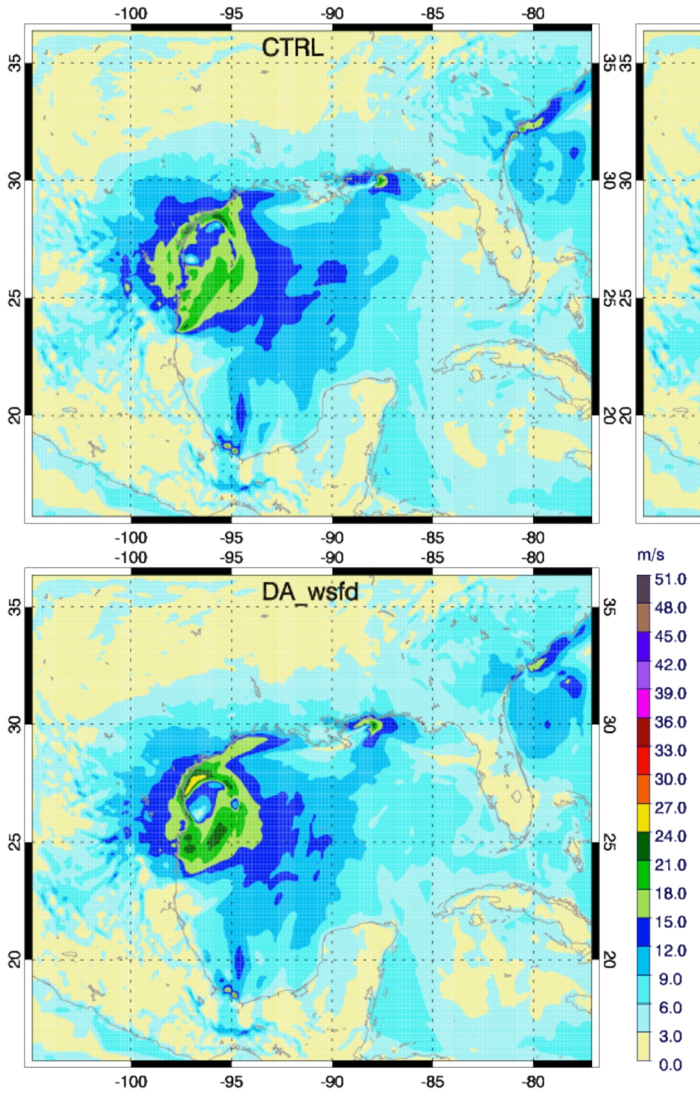
10-m wind speed after the 3rd DA cycle



Stronger storm in DA_hur_wslf

12 UTC 2017-08-27

10-m wind speed after all DA cycles



Stronger wind in DA_hur_wslf

12 UTC 2017-08-28

Conclusions

- V2 beta is a major improvement over V1. FD winds close to +/-2 m s^{-1} mission requirement for non-TC winds. Good agreement with microwave imagers as well.

- Tracked-based analysis approach supported by real CYGNSS data. Evidence that convectively driven wind/sea differences may account for increased disagreement w/ ECMWF+GDAS in rainy areas.

- FD + LF wind assimilation for Harvey landfall leads to strongest storm, supporting the splitting of GMFs.