Validation of CYGNSS V2 Level 2 Winds

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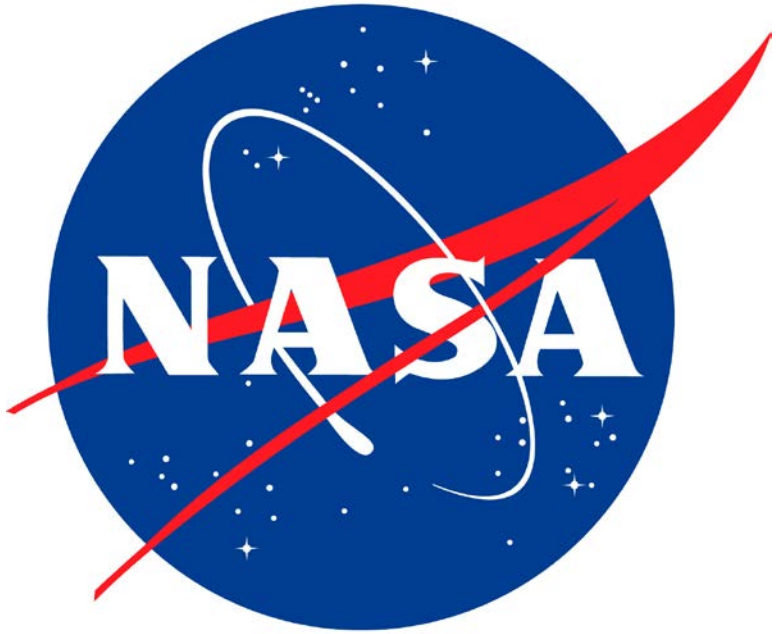


Background

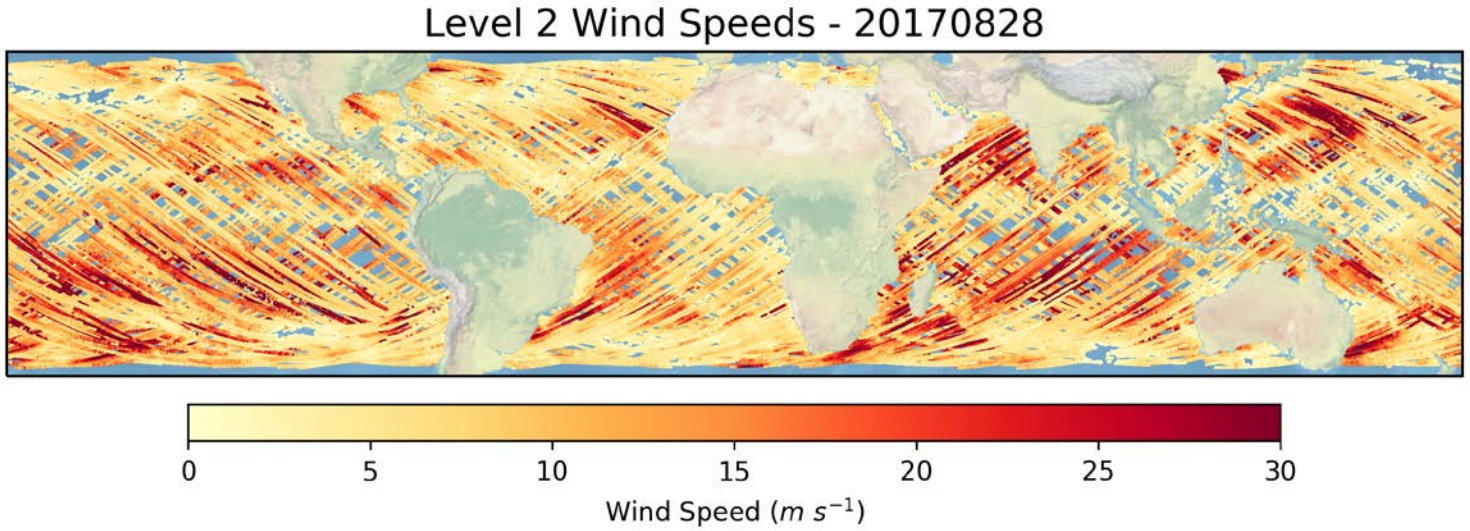
- CYGNSS Version 2 Level 2 wind products are a major overhaul from V1, and include improvements in the Level 1 dataset as well as updated geophysical model functions (GMFs)

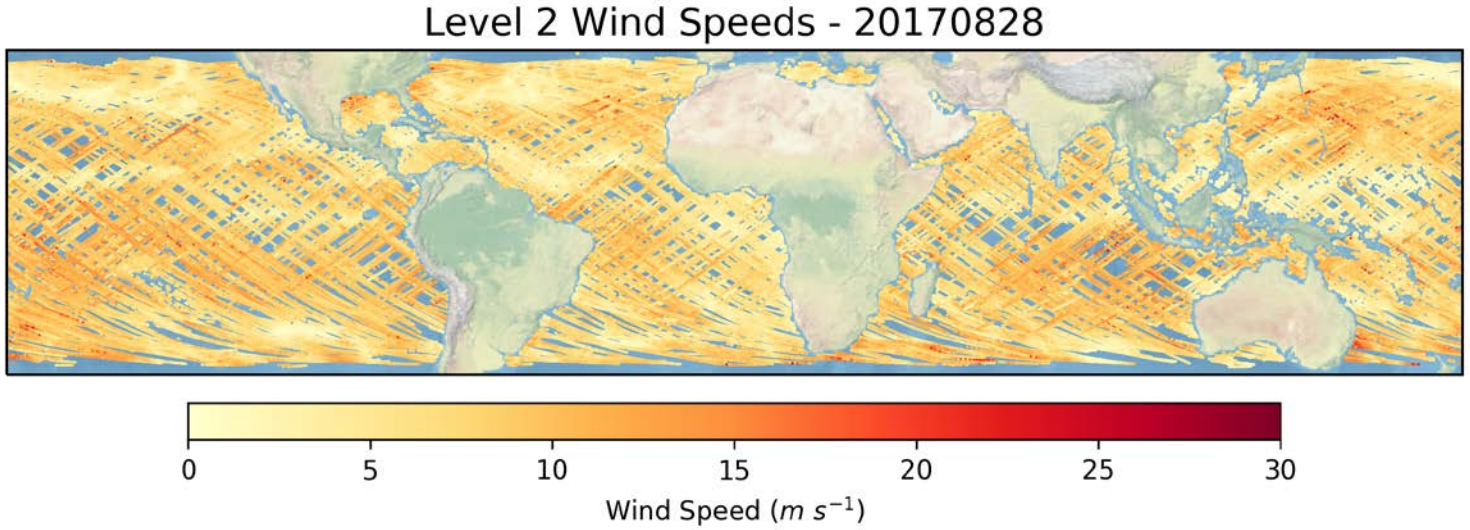
- Now two GMFs in CYGNSS L2 data:
  - Limited Fetch (LF) appropriate for tropical cyclones
  - Fully Developed Seas (FD) appropriate everywhere else

- Validation was performed for August-September 2017 data against a subset of available buoys and volunteer observing ships

Daily Summary Example

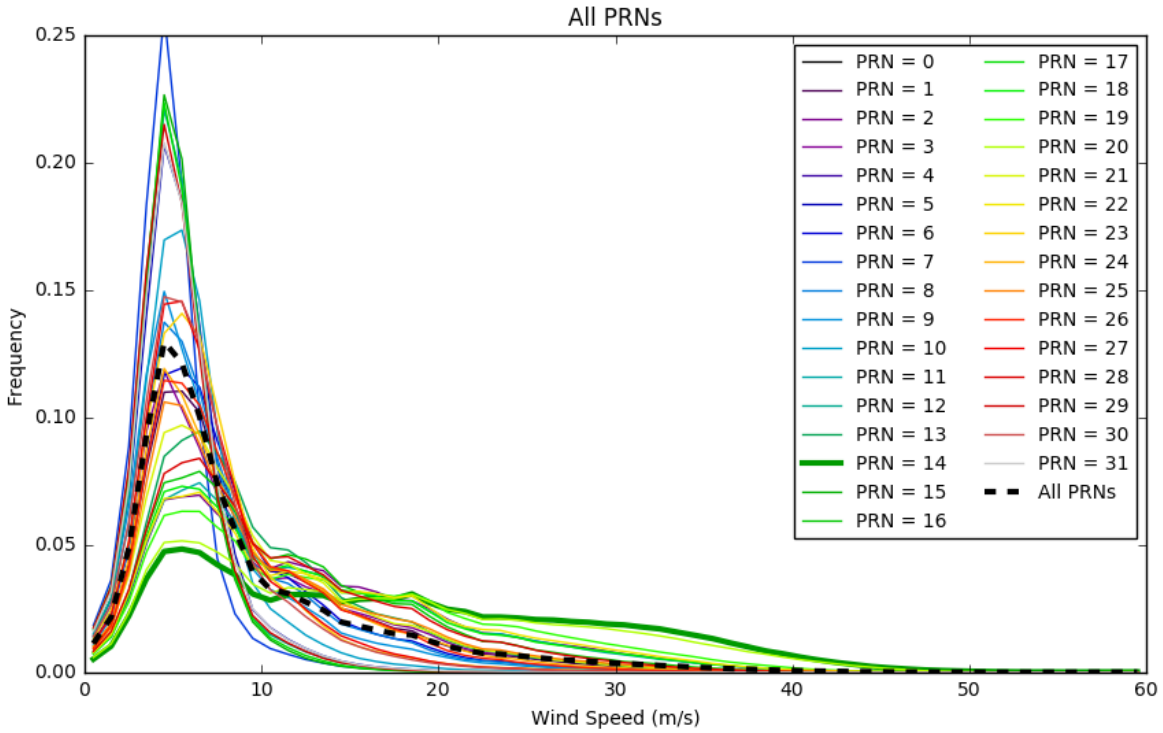
Version 1





Spurious high winds in V1 have been removed in V2

Version 2 FD

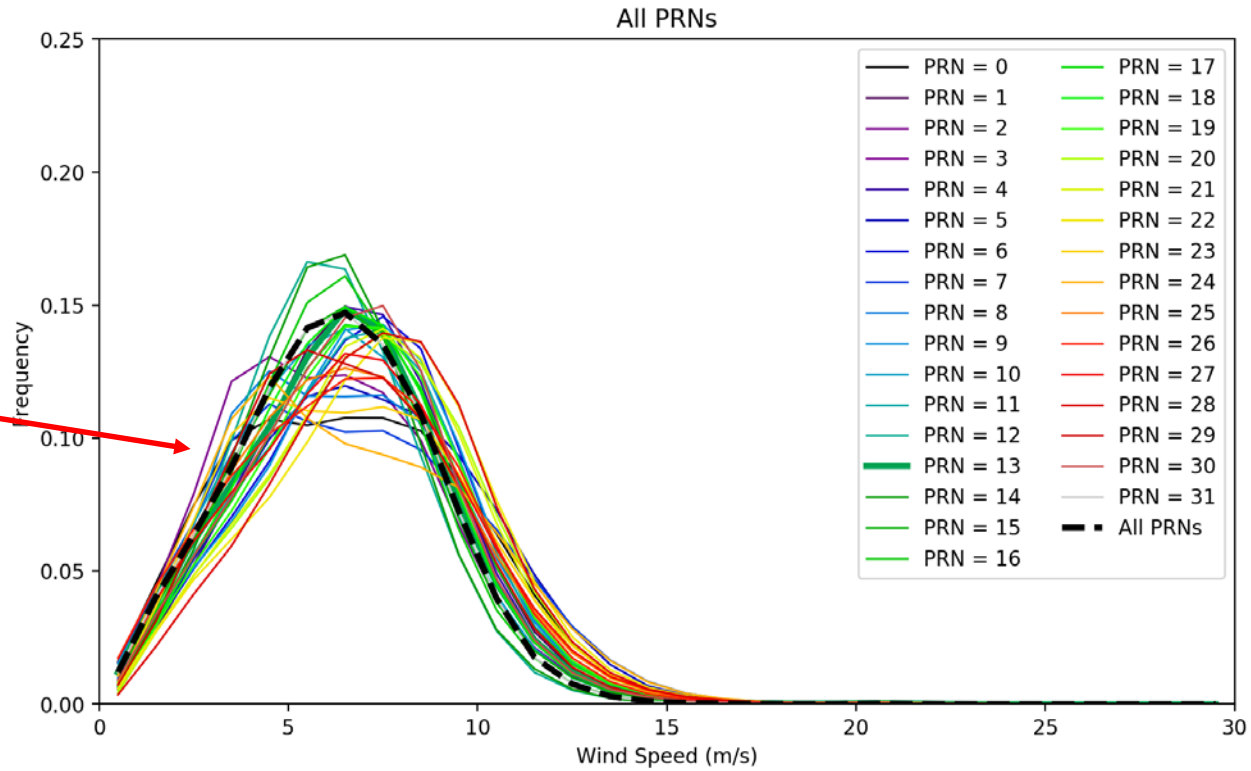


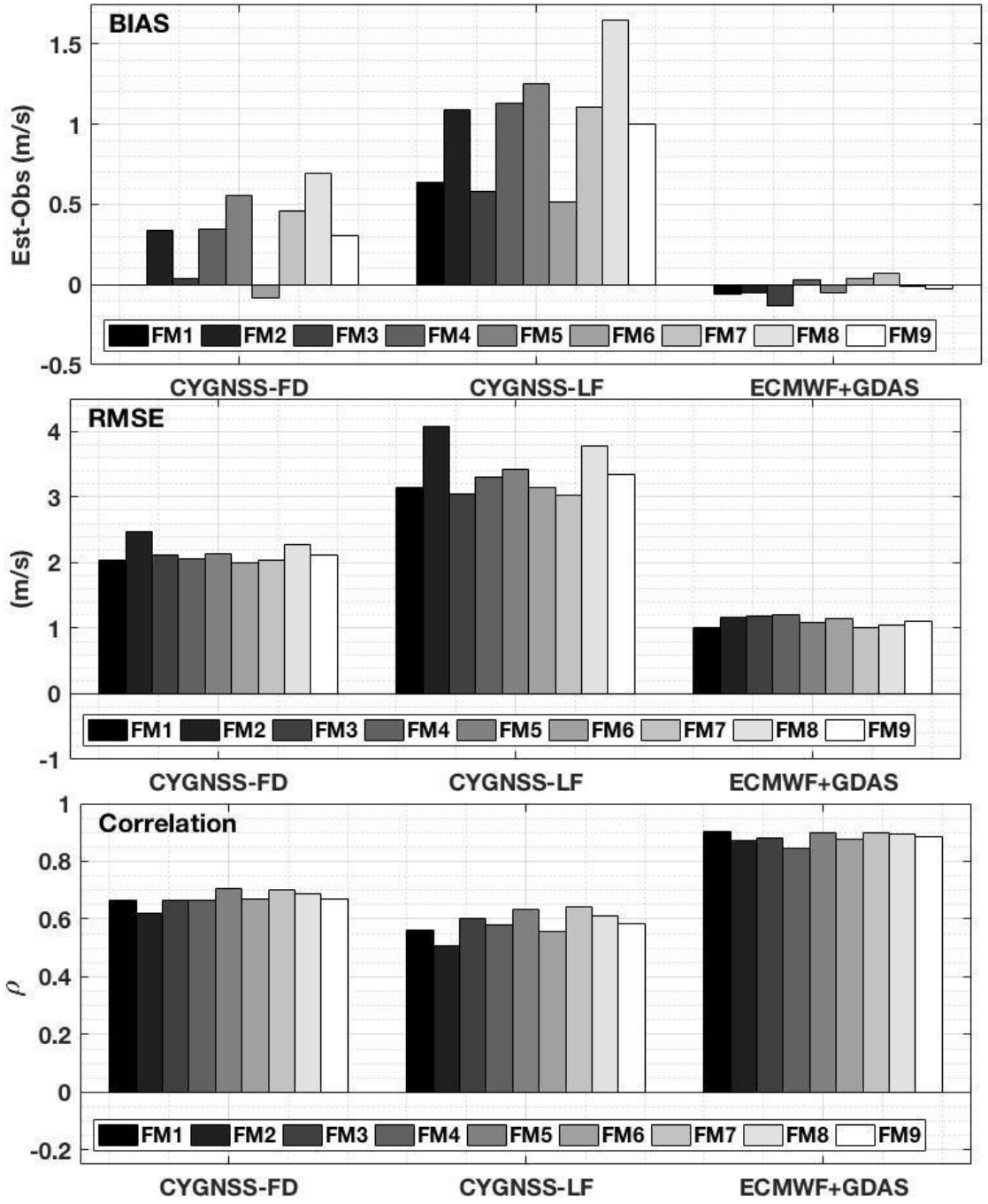
Version 1

CYGNSS by PRN Code (i.e., individual GPS satellites)

V2 has major reductions in differences between different GPS satellites, suggesting better information on transmitter characteristics (e.g., power)

Version 2 FD





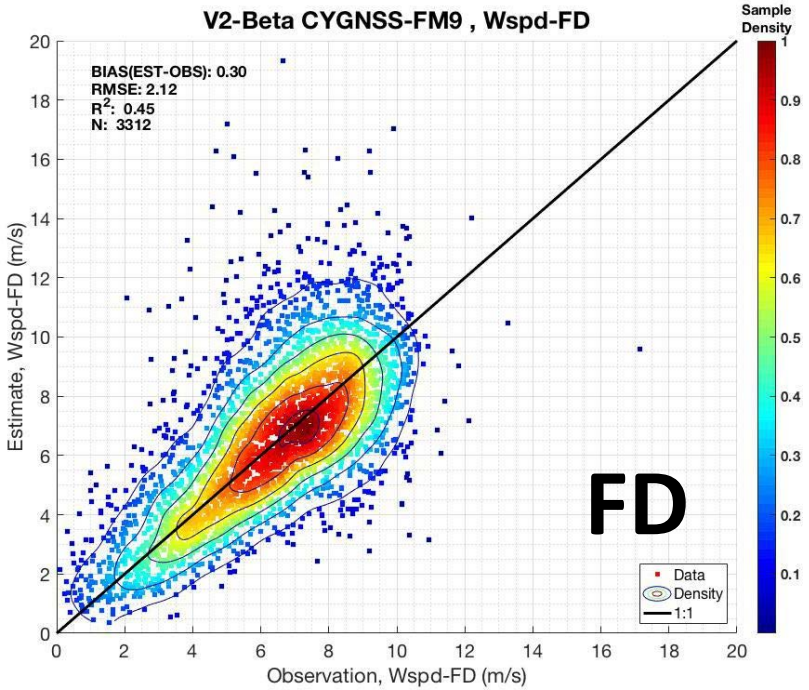
CYGNSS vs. Buoys/Ships

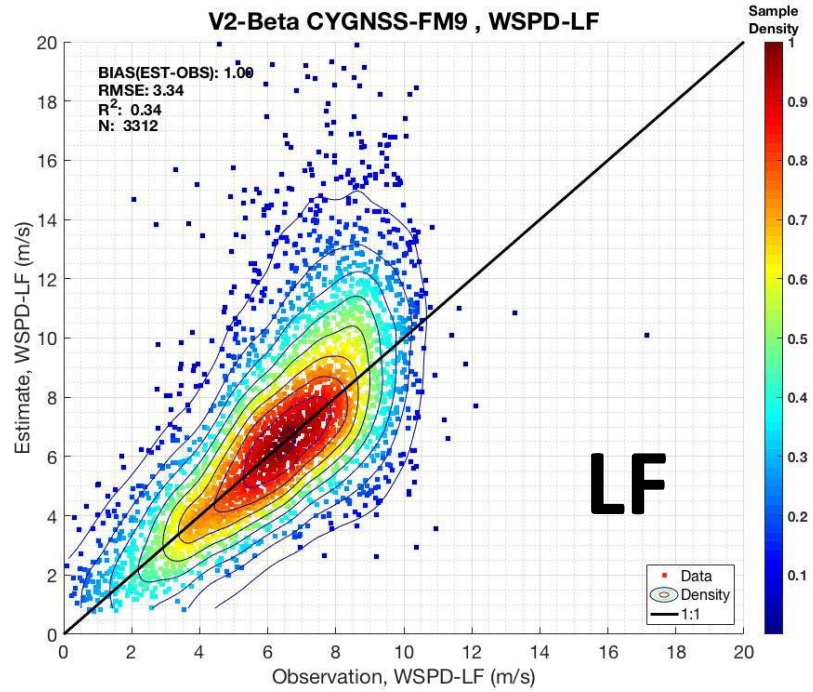
FM = CYGNSS satellite
(FM9 = constellation average)

- Root mean square error (RMSE) about 2 m s^{-1} on average for FD winds
- High bias for CYGNSS, but usually less than +0.5 m s^{-1}; some variability across observatories
- LF winds worse, but not enough tropical cyclone measurements to judge
- ECMWF+GDAS model analysis winds perform best against buoys/ships

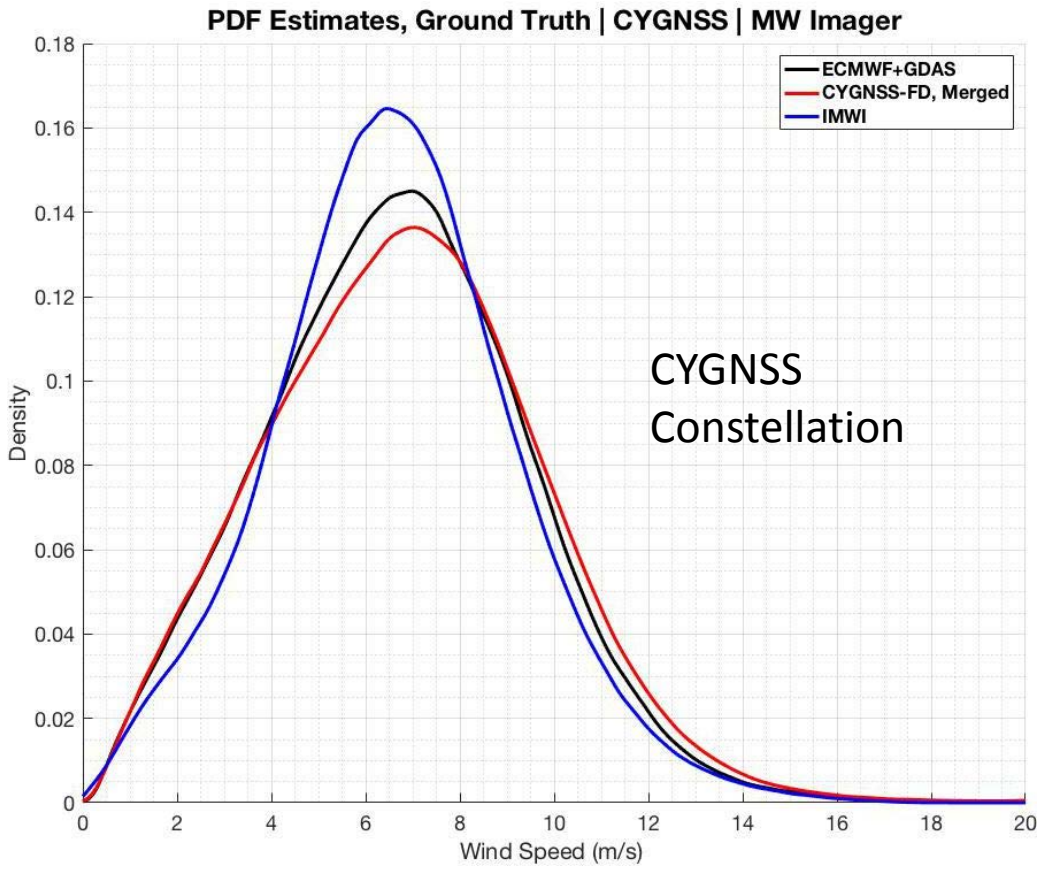
CYGNSS vs. Buoys/Ships (scatterplots)

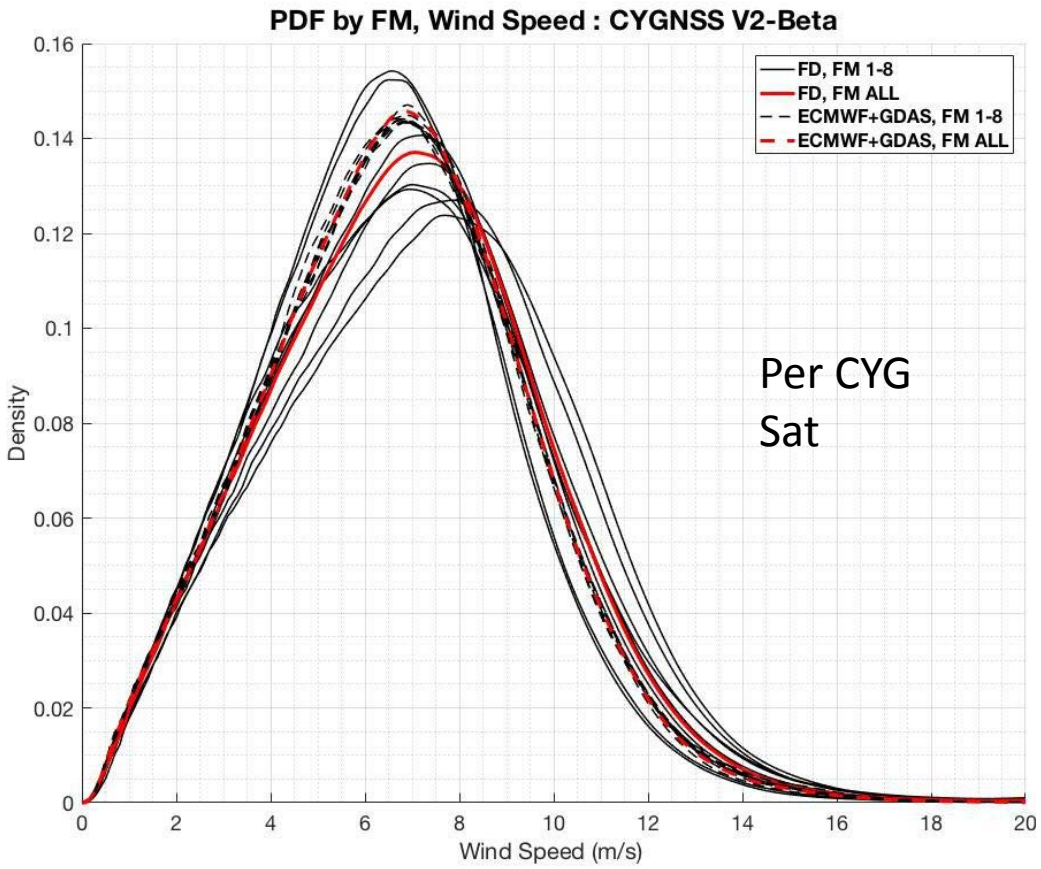
- Good correlation between FD winds and observations
- CYGNSS high bias appears to be related to influence of outliers
- LF winds are biased high due to lack of tropical cyclones in the validation dataset





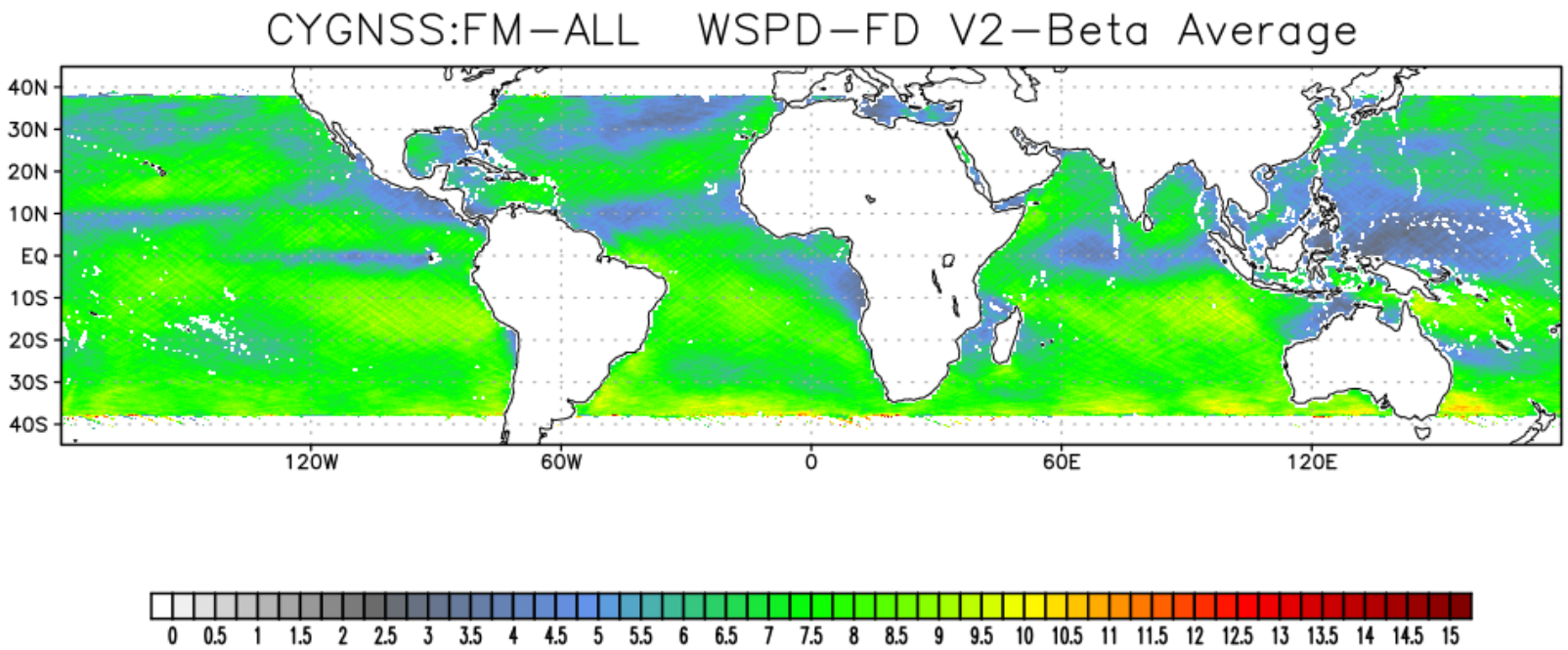
Comparison to ECMWF+GDAS and Microwave Imager





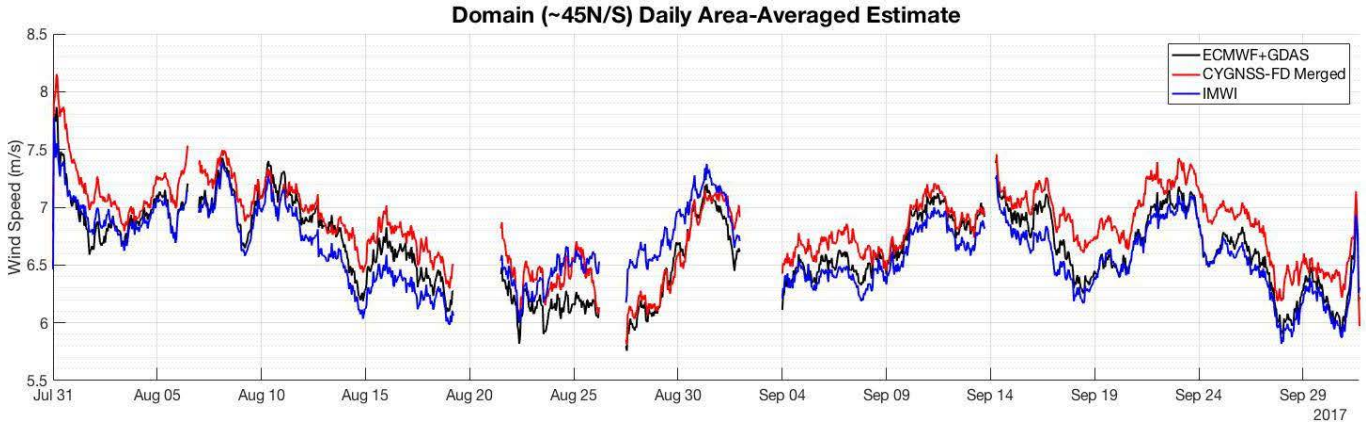
- Microwave imager winds (derived from GPM constellation L1C dataset) close to CYGNSS, but slightly weaker.
- Some wind variability between different CYGNSS satellites.

~2-Month Average



CYGNSS temporal averages in V2 look relatively smooth and realistic

~2-Month Time Series



CYGNSS domain average time series shows variable offset; typically < 0.5 m s^{-1}

Conclusions

- CYGNSS V2 Level 2 wind product is a major improvement over V1.
- FD winds close to +/-2 m s^{-1} mission requirement for low winds. LF winds difficult to validate with such a short dataset with few tropical cyclones.
- Some remaining differences between individual GPS and CYGNSS satellites, suggesting additional work needed to make dataset fully self-consistent.
- Good agreement with microwave imagers, although CYGNSS tends to see somewhat stronger winds.