

Latest cal/val assessment of v2.1 L1/L2 data

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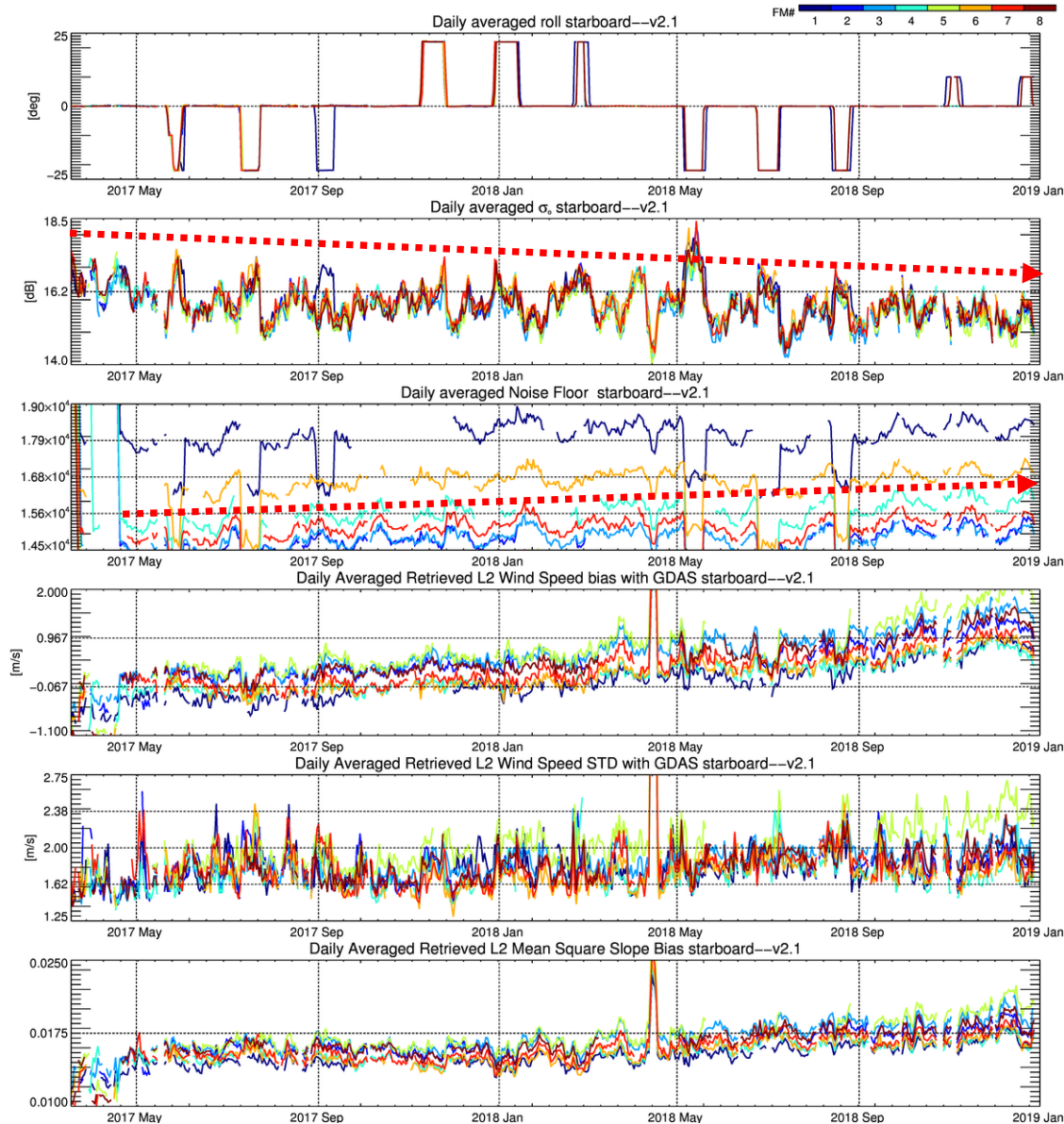
³UCAR

Outline

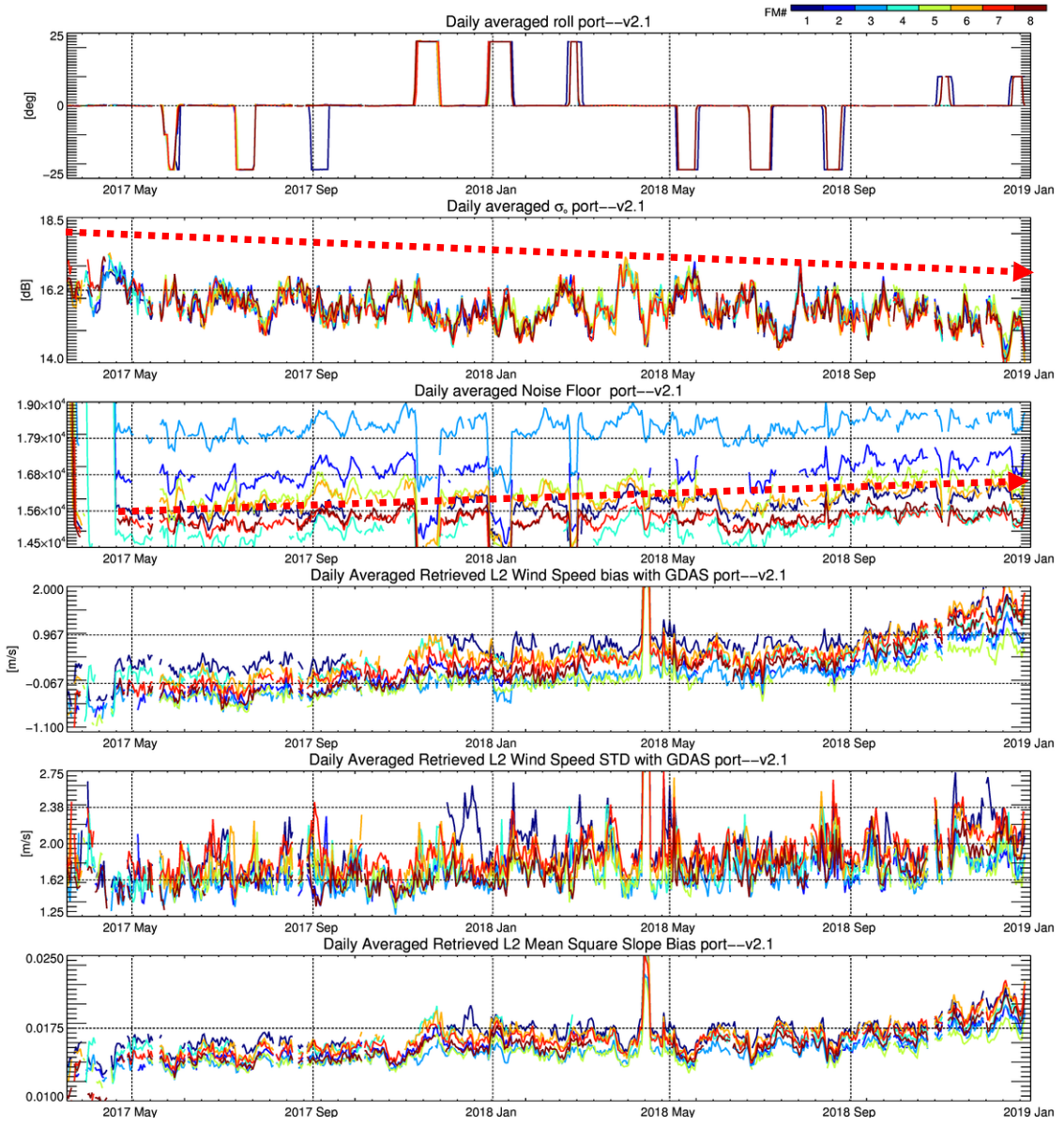
- Revisiting
 - v2.1 L1/L2 timeseries plots
 - v2.1 NBRCS vs incidence angle relationship
- A look at v2.1 L2 wind performance
- Summary and Observations

(L1) Roll, NBRCS, Noise Floor,
(L2) Wind speed bias, std, MSS
timeseries
per observatory per antenna

Note: data from block IIF sp. excluded (to be consistent with latest L2)



STARBOARD V.2.1



PORT V.2.1

Bin averaged Sigma0/les/wind_speed/mss vs incidence angle **separated by antenna and observatory** for a fixed ecmwf wind speed bin (6-6.5 m/s)

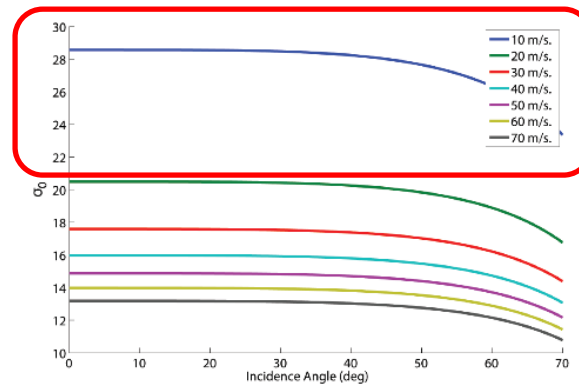


Figure 9.14. Curves of $\sigma_0(\bar{\epsilon}_{gr})$ versus incidence angle, for different wind speed values.

May-Dec 2017

σ^0

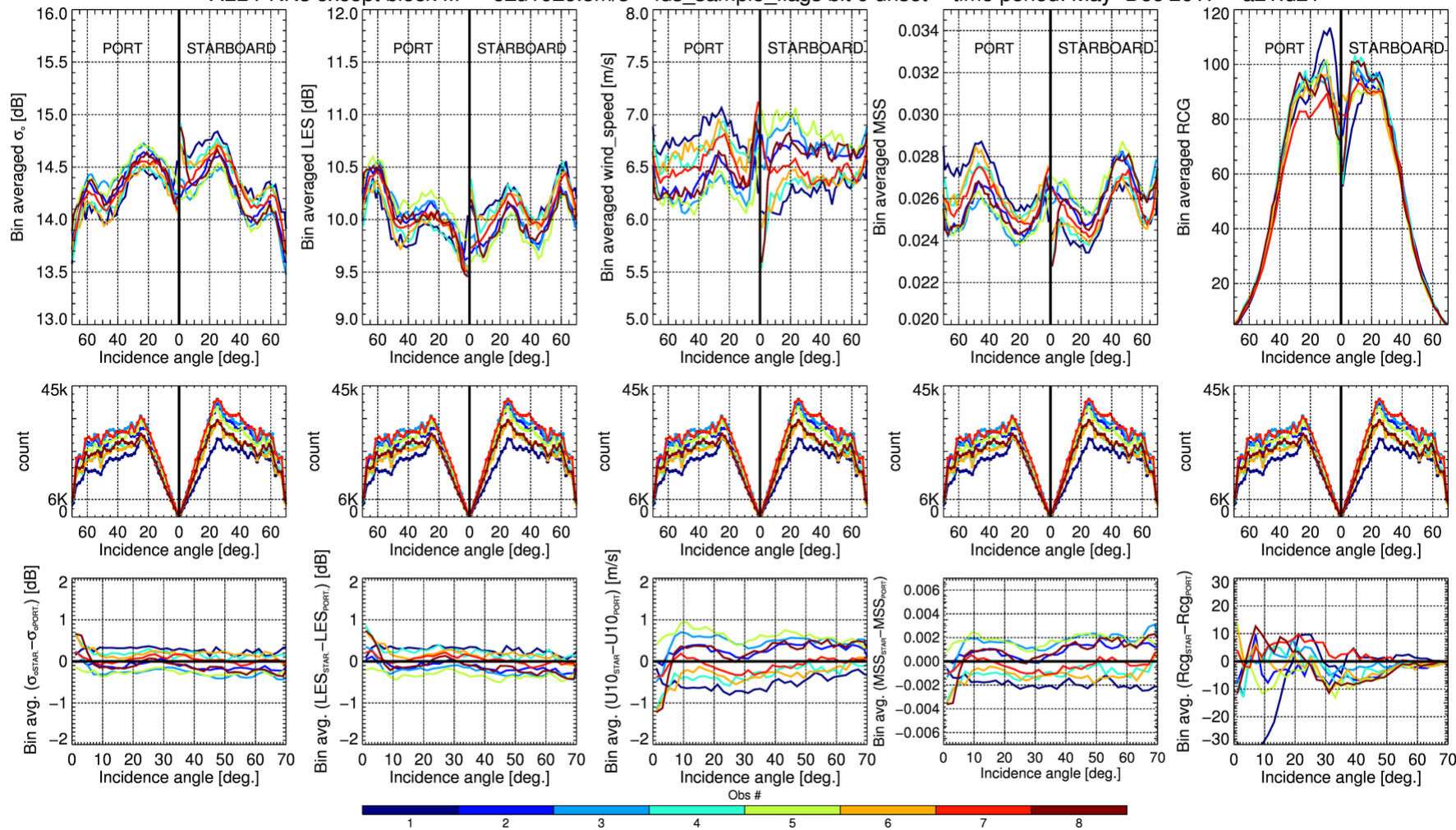
LES

U_{10}

mss

Rx Gain

ALL PRNs except block IIF— $6 \leq u_{10} \leq 6.5 \text{ m/s}$ —fds_sample_flags bit 0 unset—time period: May-Dec 2017—a21.d21



Jan-Apr 2018

σ^0

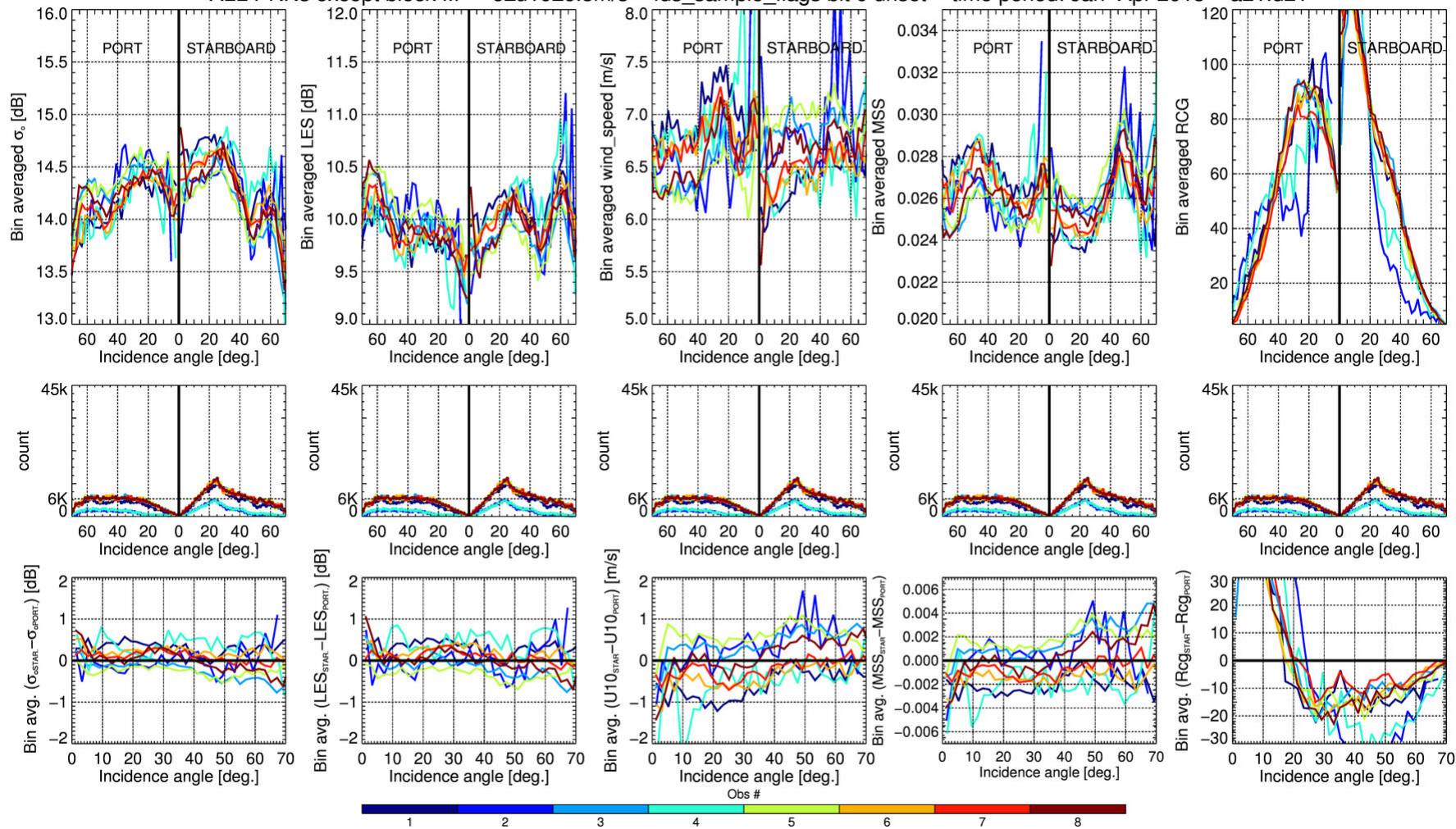
LES

U_{10}

mss

Rx Gain

ALL PRNs except block IIF— $6 \leq u_{10} \leq 6.5 \text{ m/s}$ —fds_sample_flags bit 0 unset—time period: Jan-Apr 2018—a21.d21



May-Aug 2018

σ^0

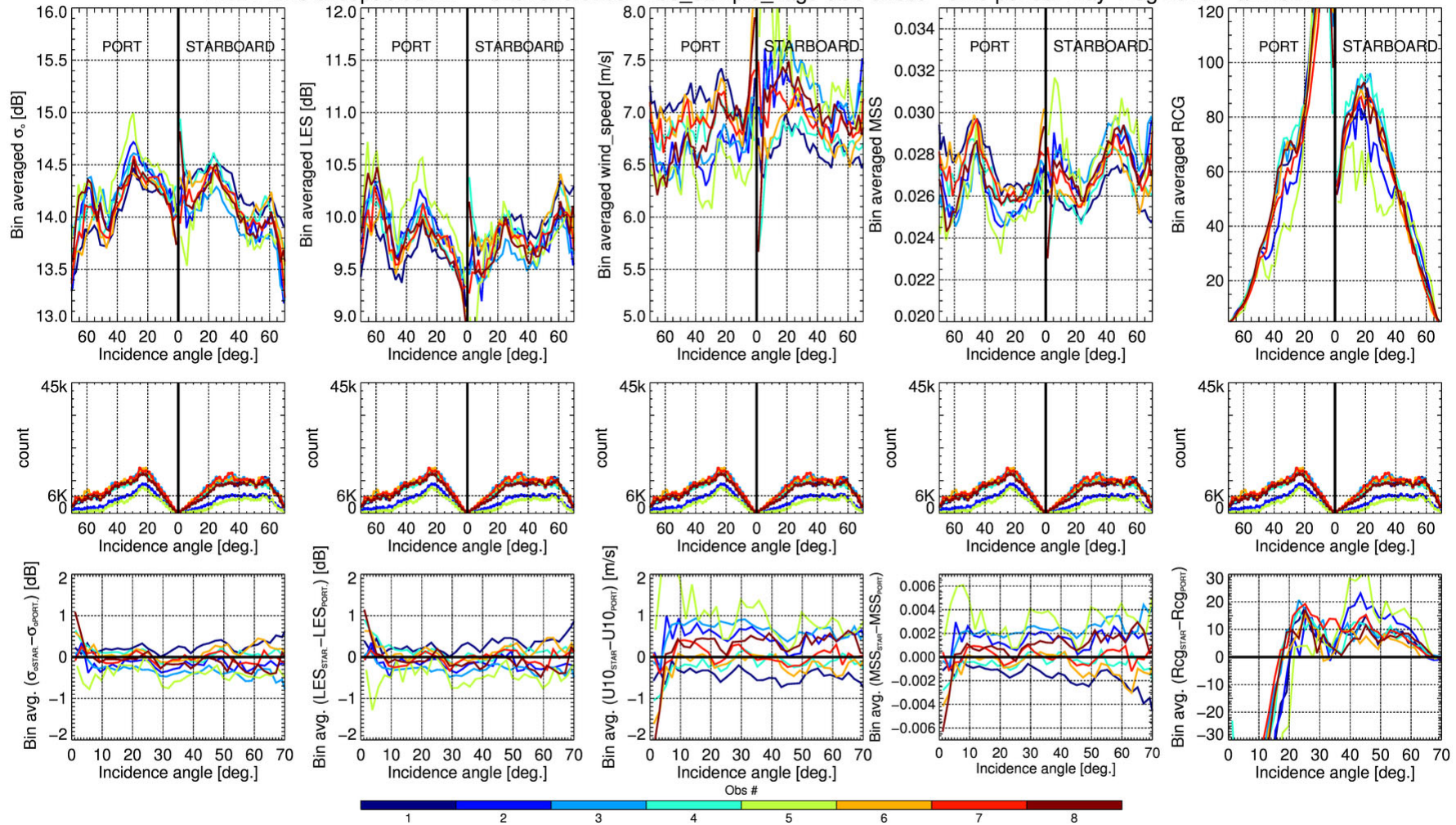
LES

U_{10}

mss

Rx Gain

ALL PRNs except block IIF— $6 \leq u_{10} \leq 6.5 \text{ m/s}$ —fds_sample_flags bit 0 unset—time period: May-Aug 2018—a21.d21



Sep-Nov 2018

σ^0

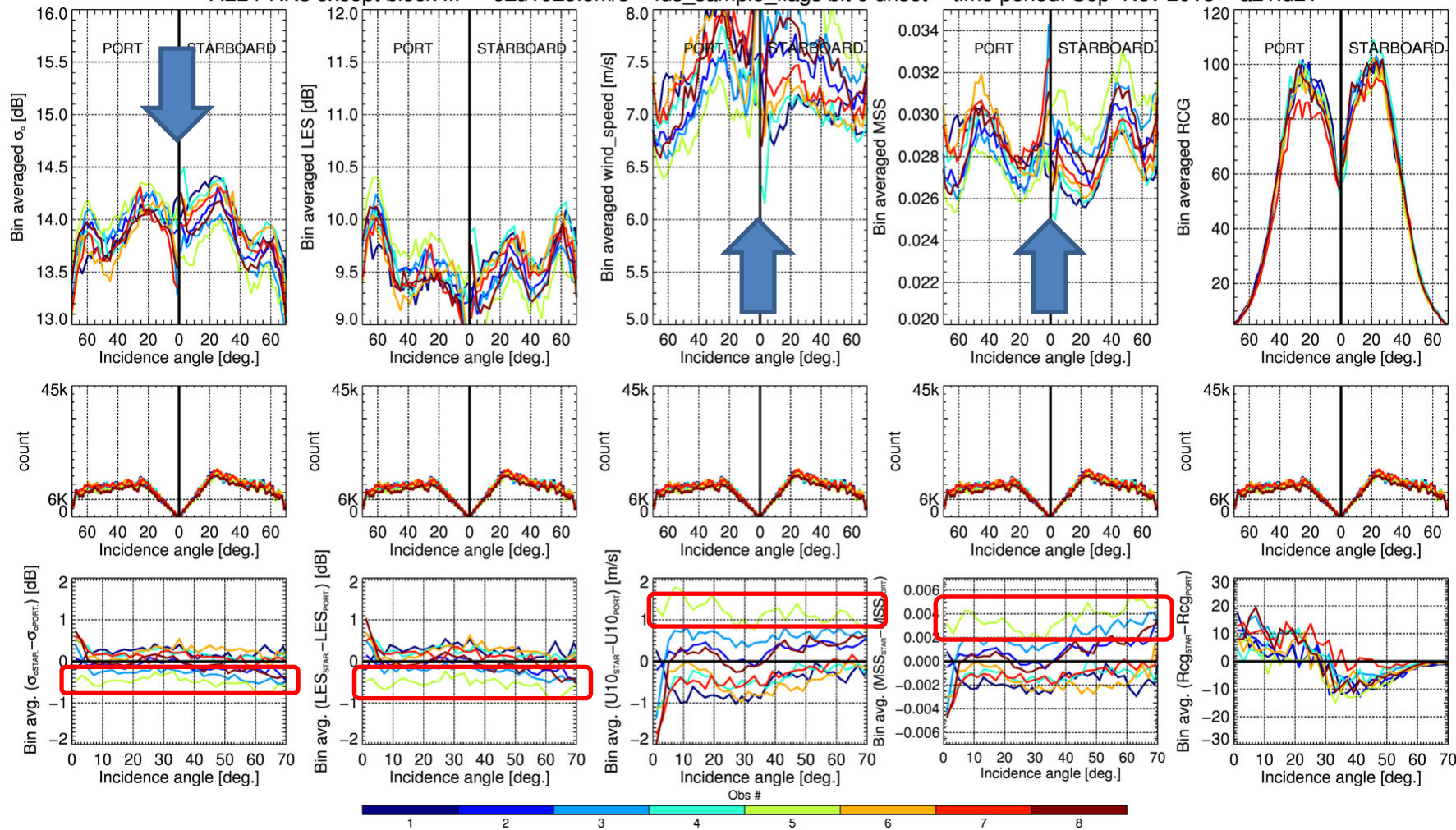
LES

U_{10}

mss

Rx Gain

ALL PRNs except block IIF— $6 \leq u_{10} \leq 6.5 \text{ m/s}$ —fds_sample_flags bit 0 unset—time period: Sep-Nov 2018—a21.d21



A look at v2.1 L2 performance compared to ECMWF, HWRF, and *preliminary* NOAA L2 winds⁽¹⁾

Two periods selected for analysis:



Aug 1 - Sep 30 2017

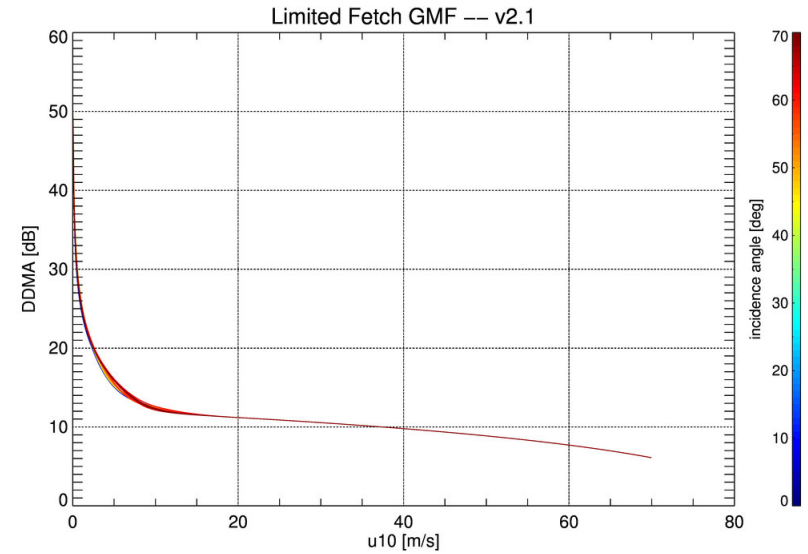
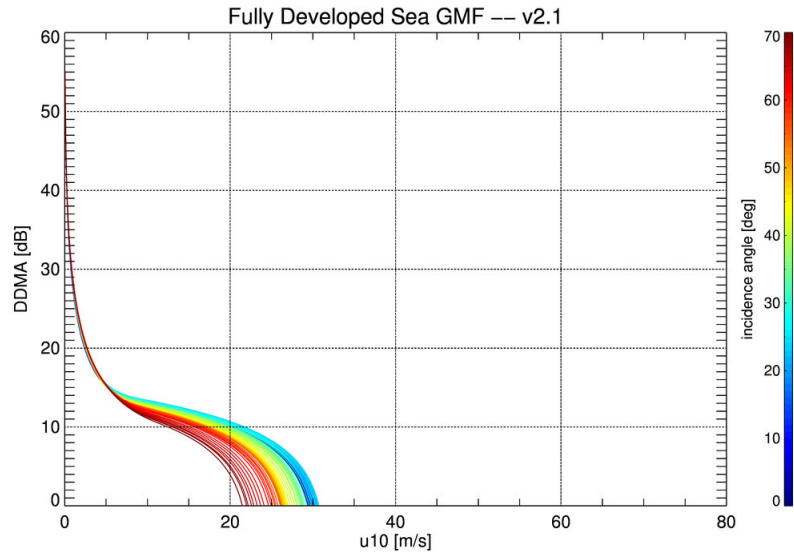


Aug 1 - Oct 15 2018

(1)

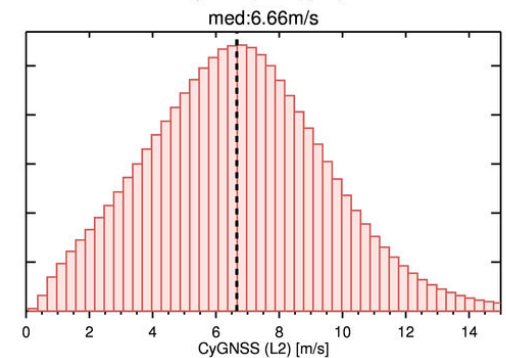
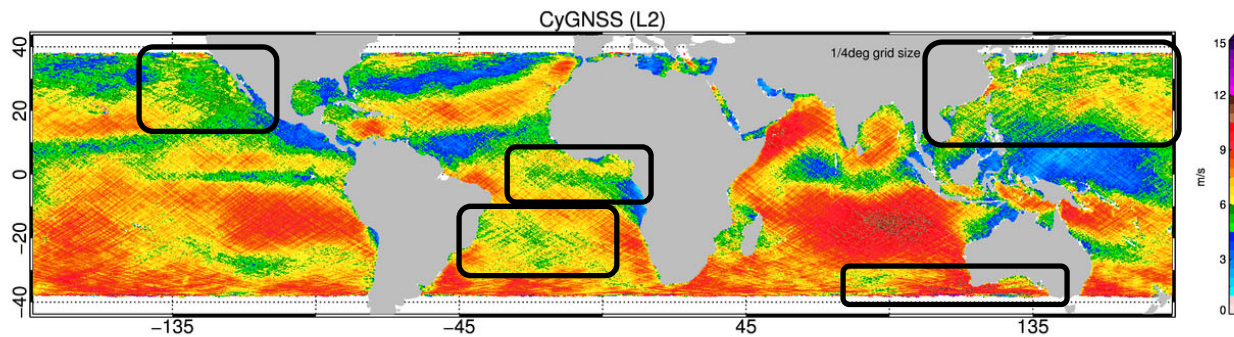
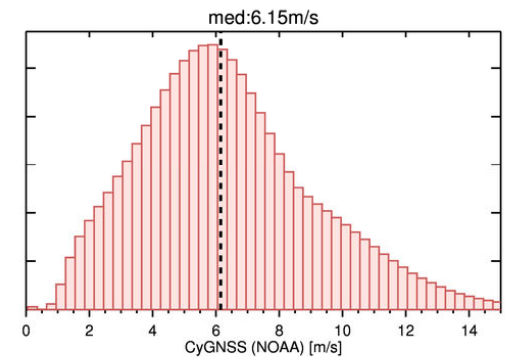
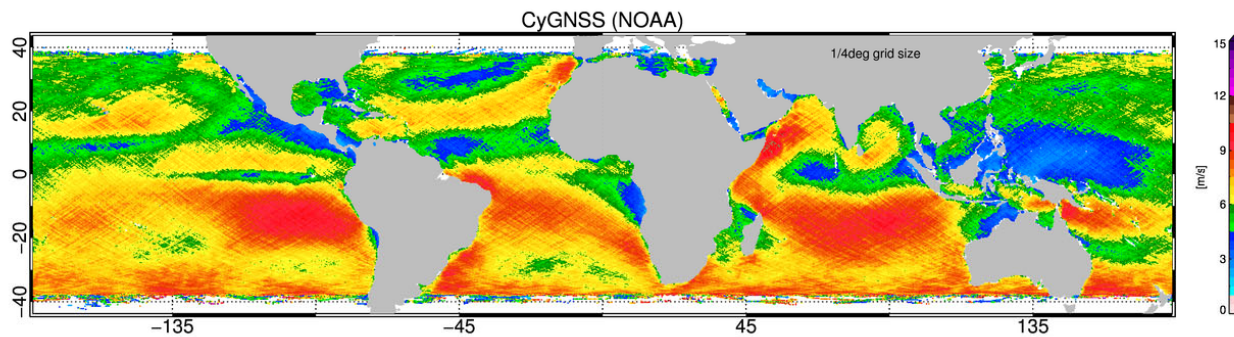
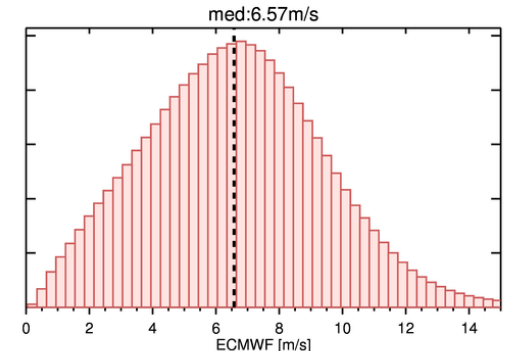
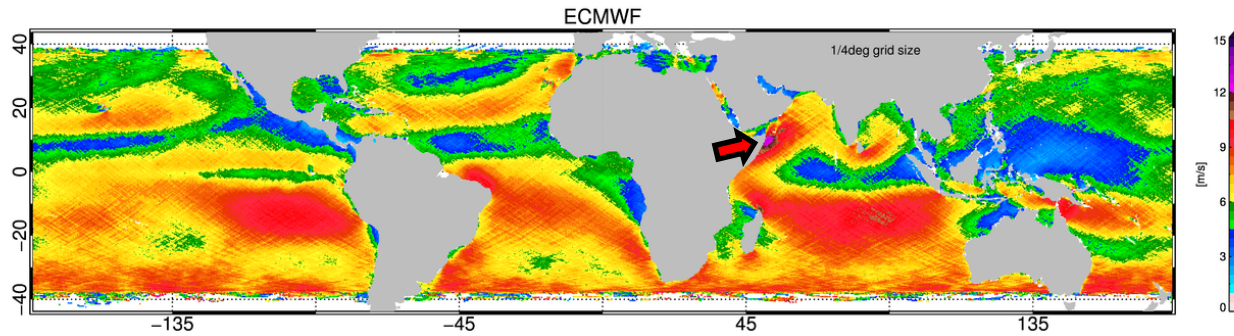
- 'track-wise' wind retrieval method (more details provided at either upcoming GNSS+R or IGARSS conference)
- **ALL** PRNs included
- using fds GMF (for global wind analysis)
- using yslf GMF (for tropical cyclone wind analysis)
- no statistical correction applied

Currently used L2 GMFs (v2.1)



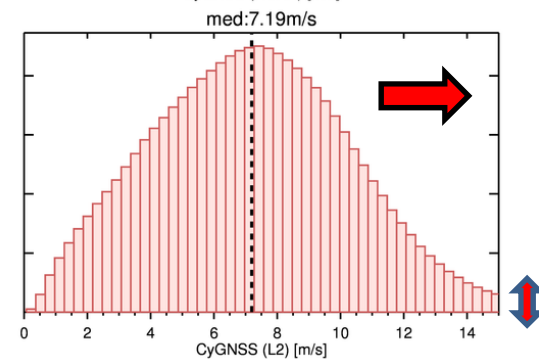
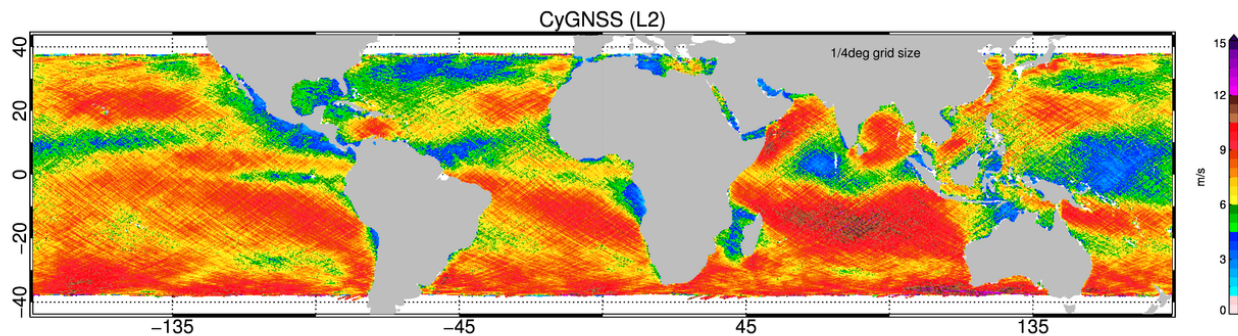
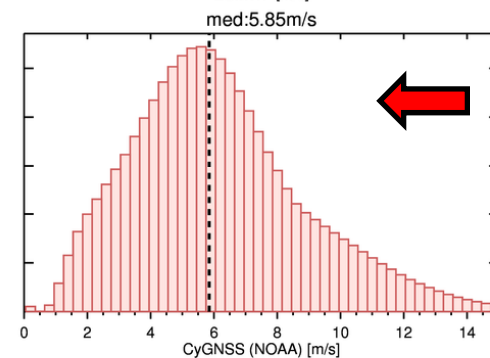
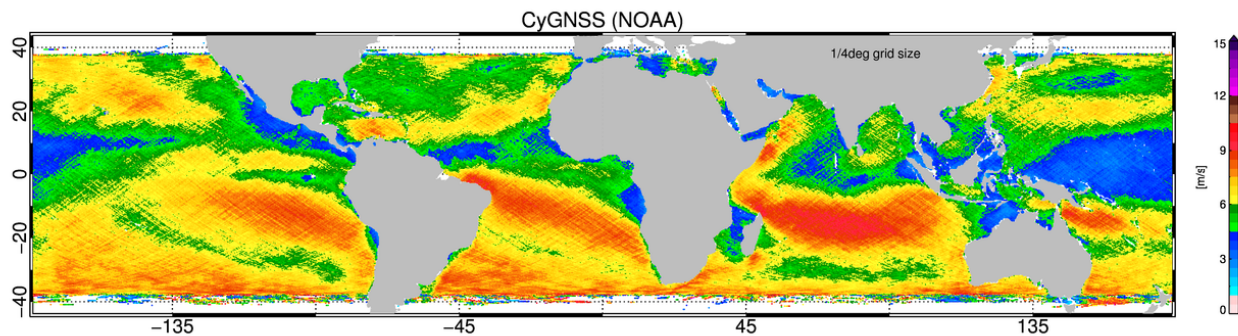
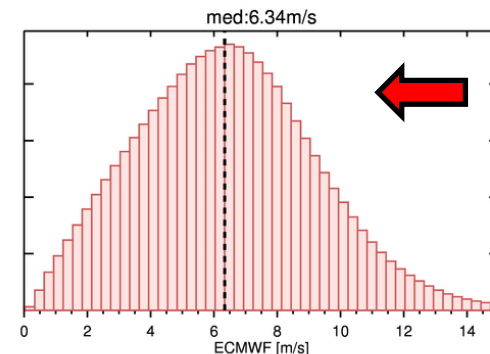
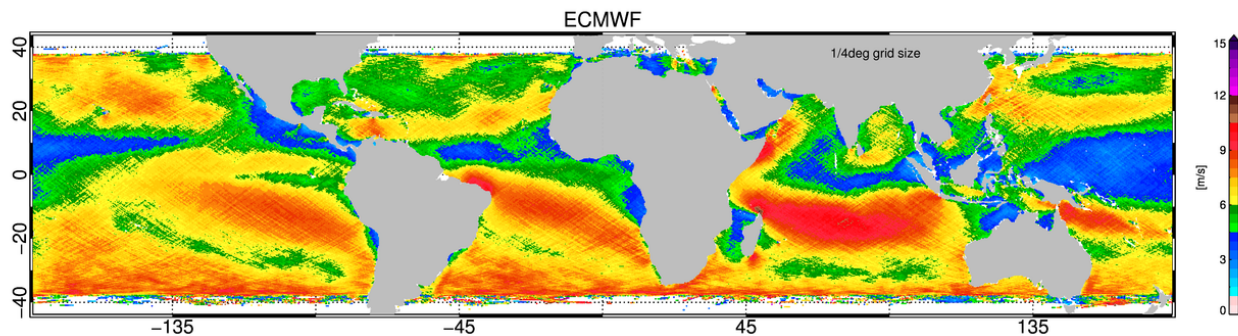
ECMWF vs. CyGNSS (2017)

all FMs | All blocks | Time period: Aug 1–Sep 30 2017



ECMWF vs. CyGNSS (2018)

all FMs | All blocks | Time period: Aug 1–Oct 15 2018

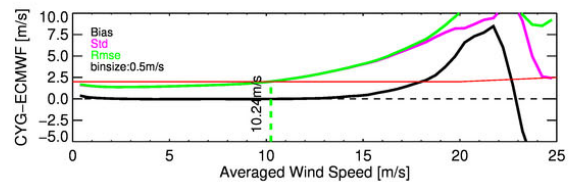
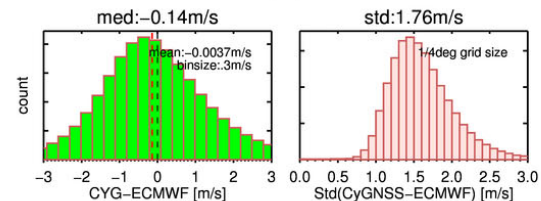
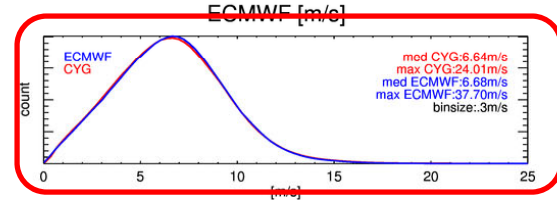
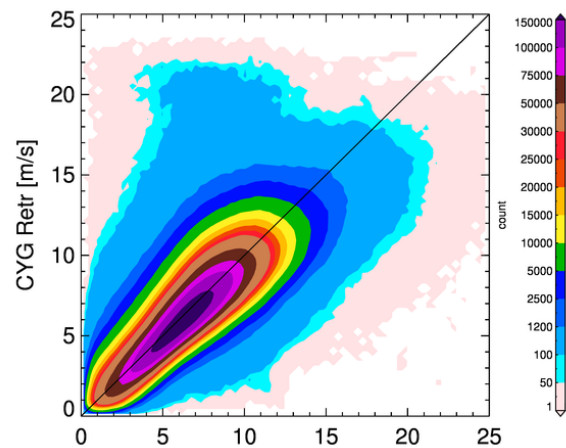
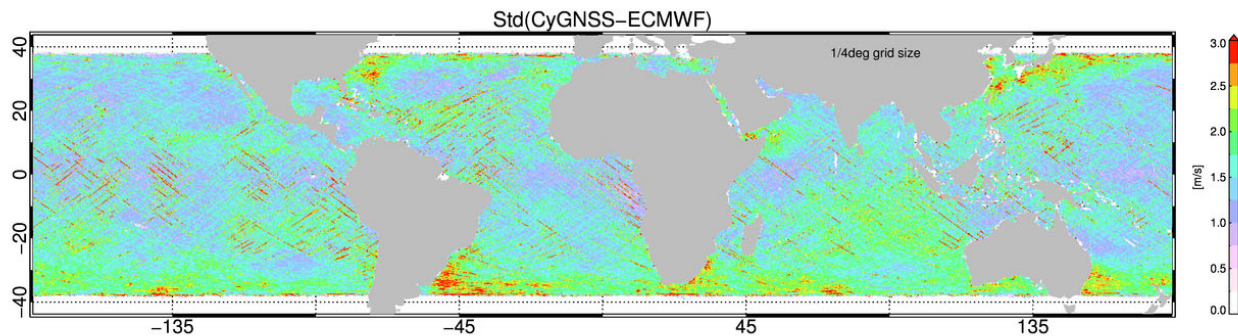
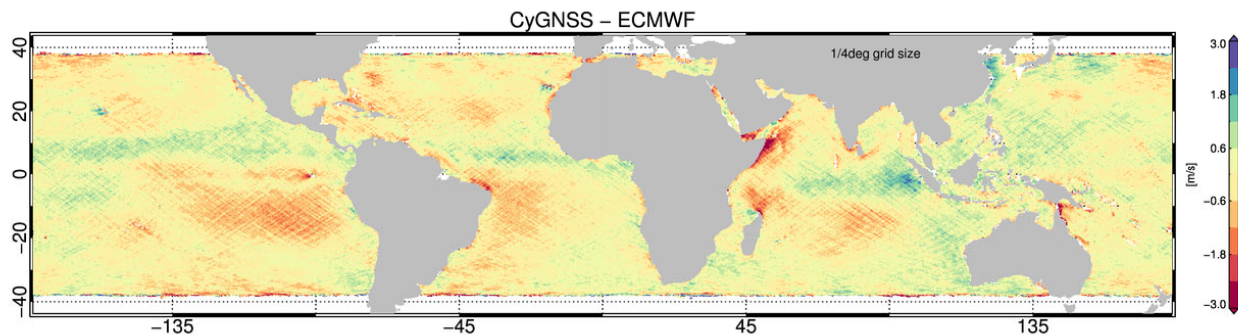
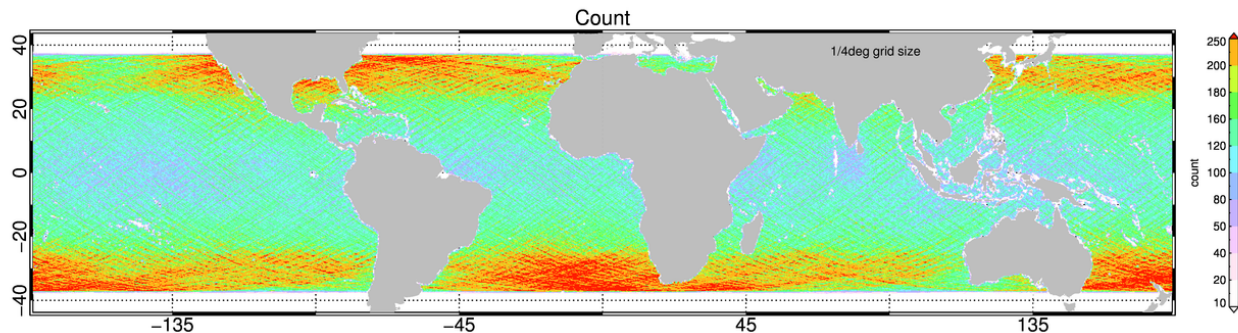


Bias/Std with ECMWF L2 vs. NOAA 2017/2018

CyGNSS L2 - 2017



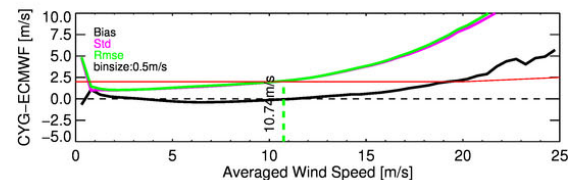
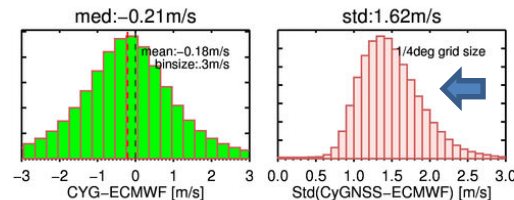
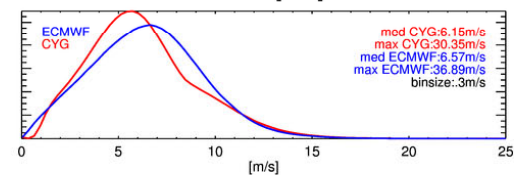
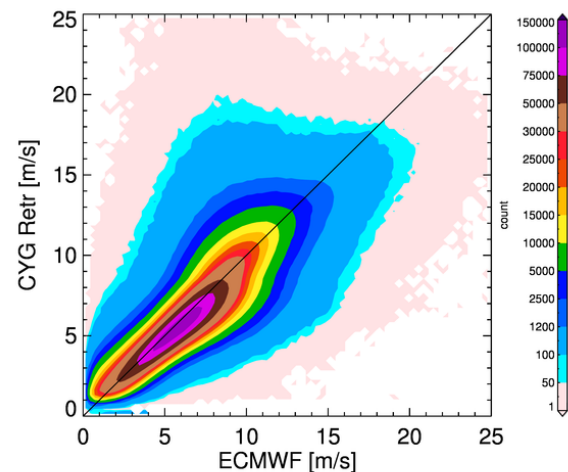
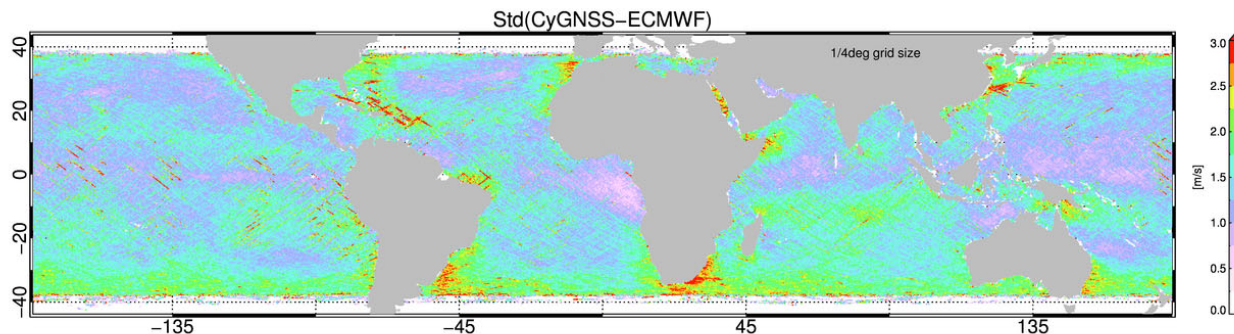
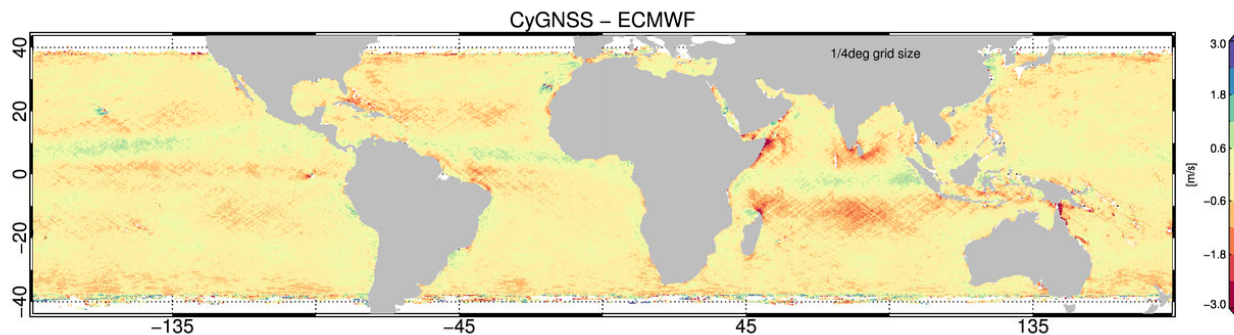
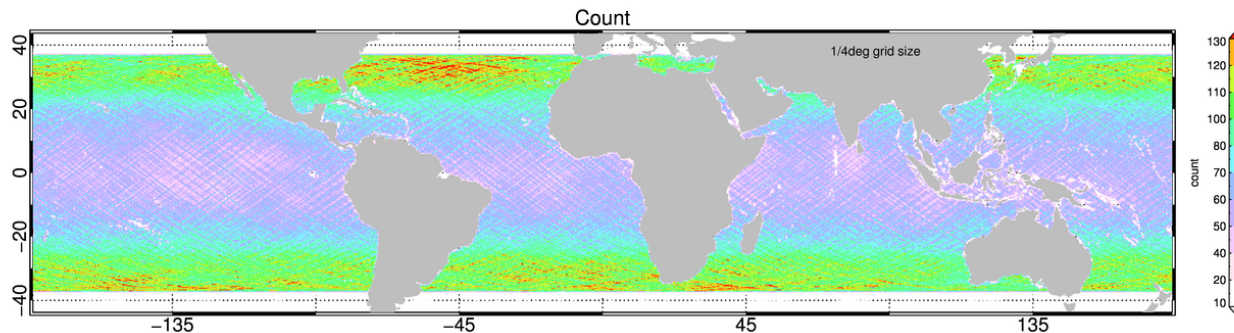
all FMs | All blocks | Time period: Aug 1–Sep 30 2017 | L2 dataset | Applied flag: fds_sample_flags bit 0 unset and range_corr_gain > 3



CyGNSS NOAA - 2017



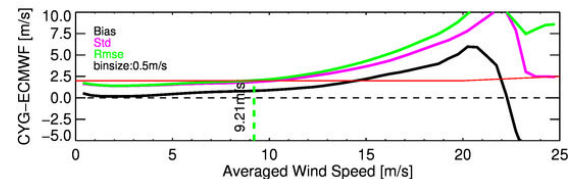
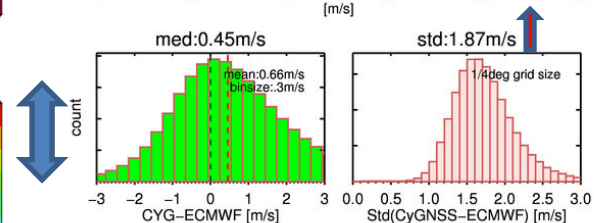
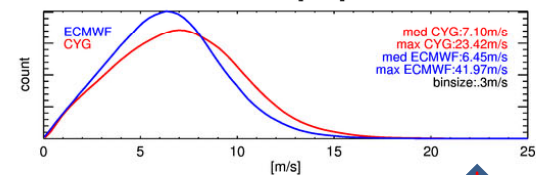
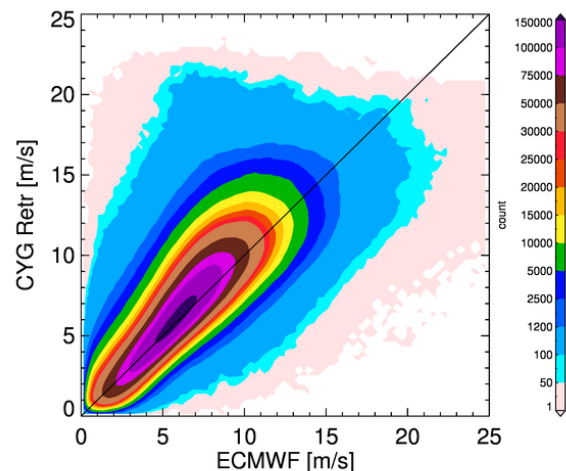
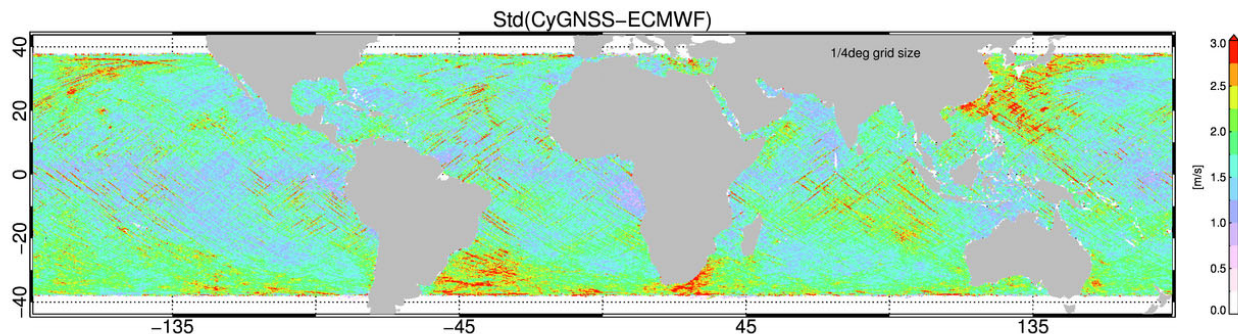
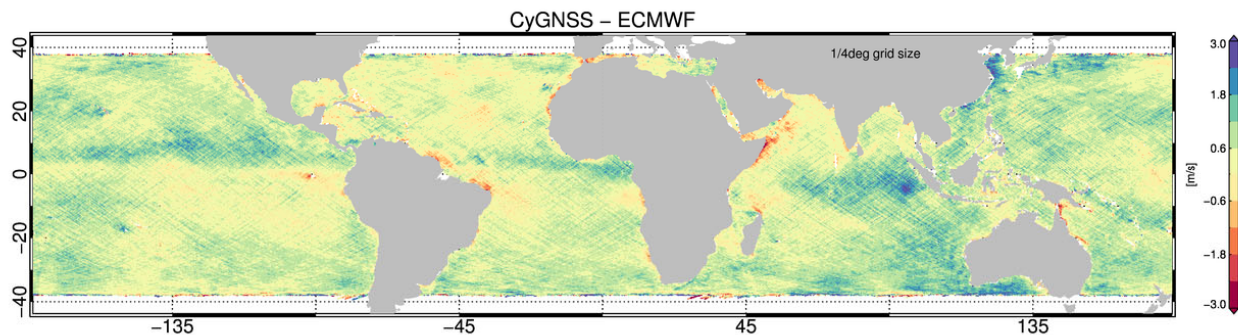
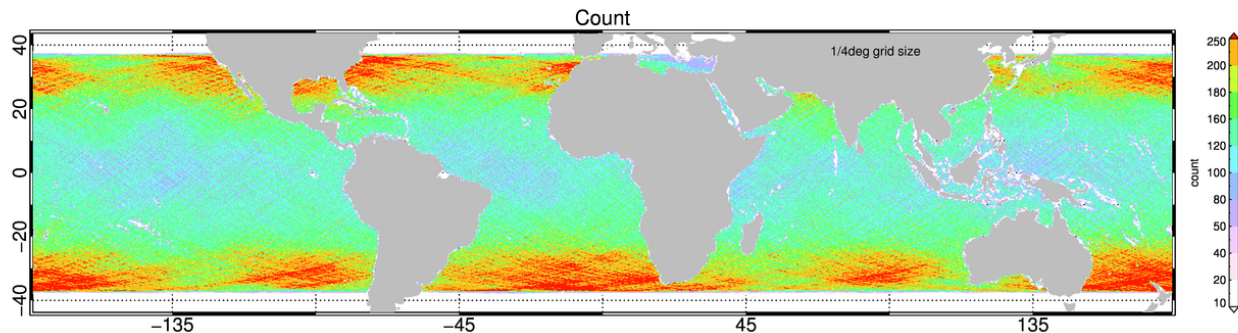
all FMs | All blocks | Time period: Aug 1–Sep 30 2017 | NOAA dataset | Applied flag:snr > 1 dB and $-2 < \text{roll} < 2$ deg



CyGNSS L2 - 2018



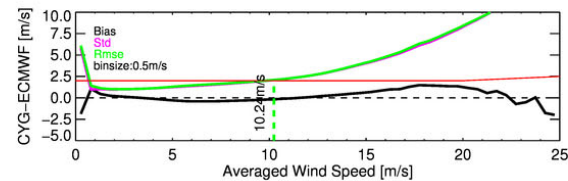
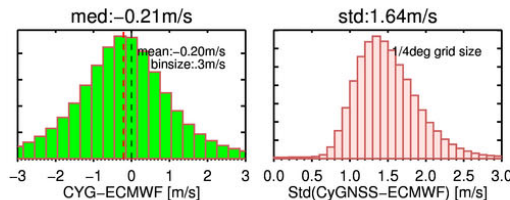
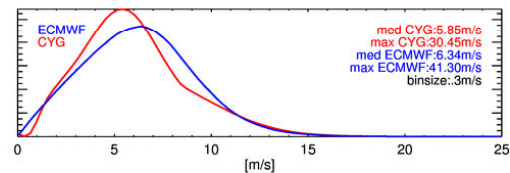
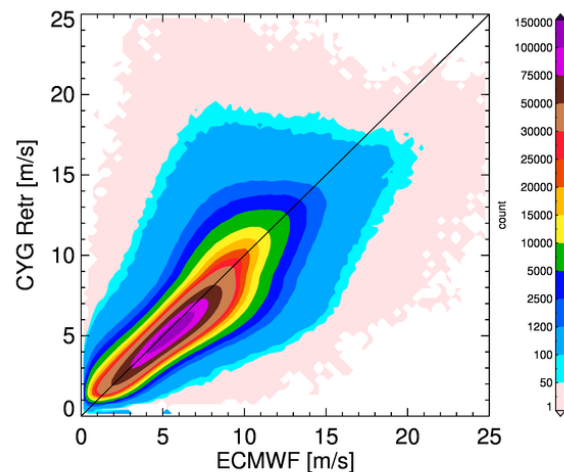
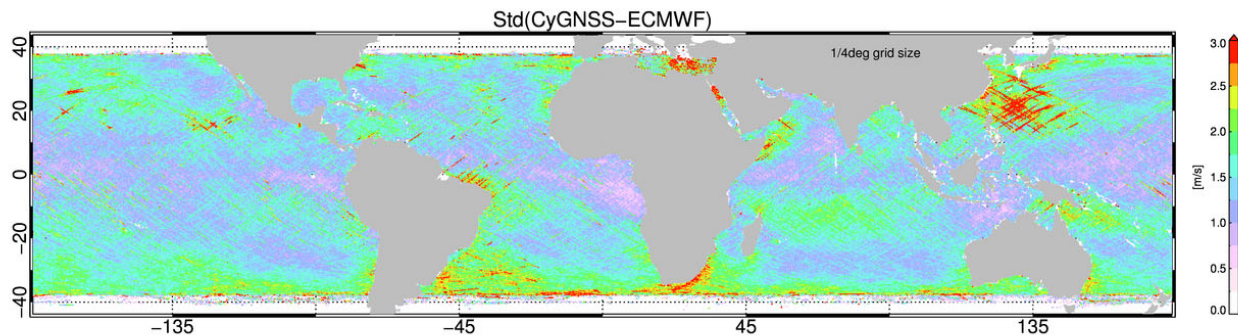
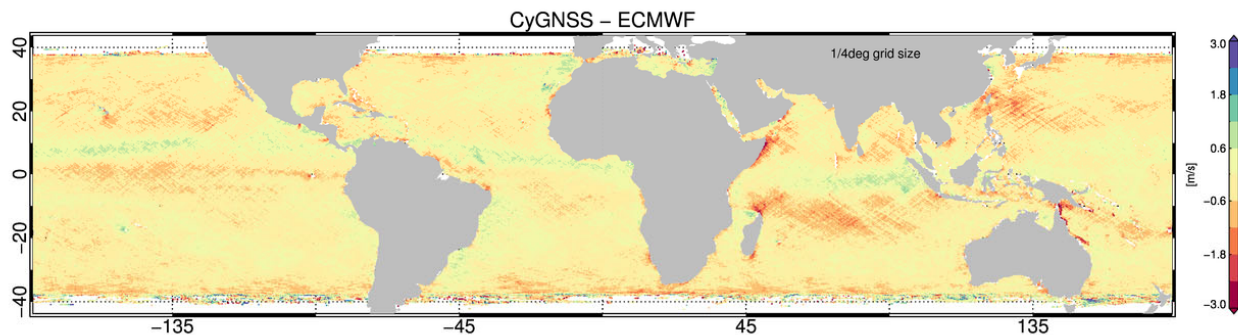
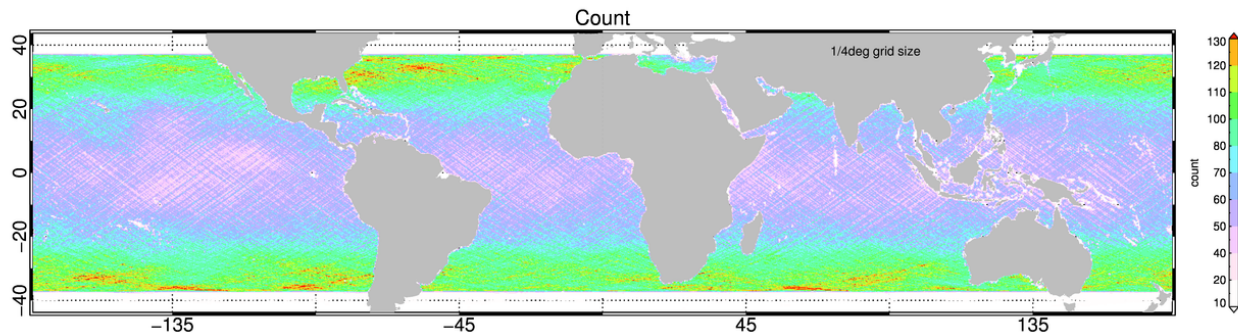
all FMs | All blocks | Time period: Aug 1–Oct 15 2018 | L2 dataset | Applied flag: fds_sample_flags bit 0 unset and range_corr_gain > 3



CyGNSS NOAA - 2018



all FMs | All blocks | Time period: Aug 1–Oct 15 2018 | NOAA dataset | Applied flag:snr > 1 dB and $-2 < \text{roll} < 2$ deg

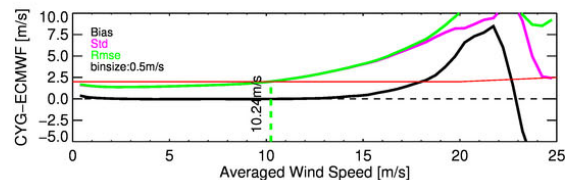
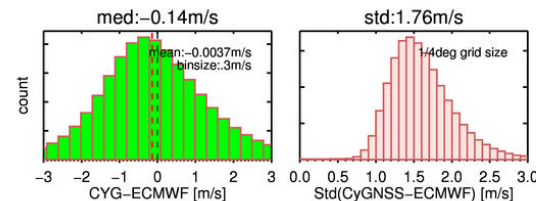
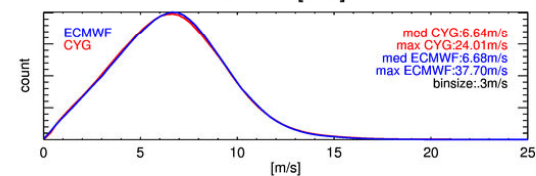
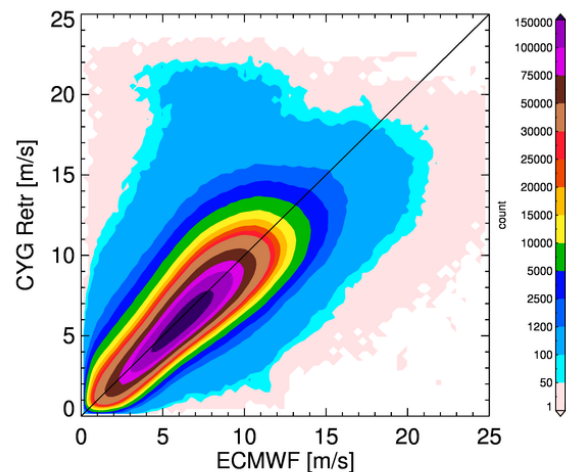
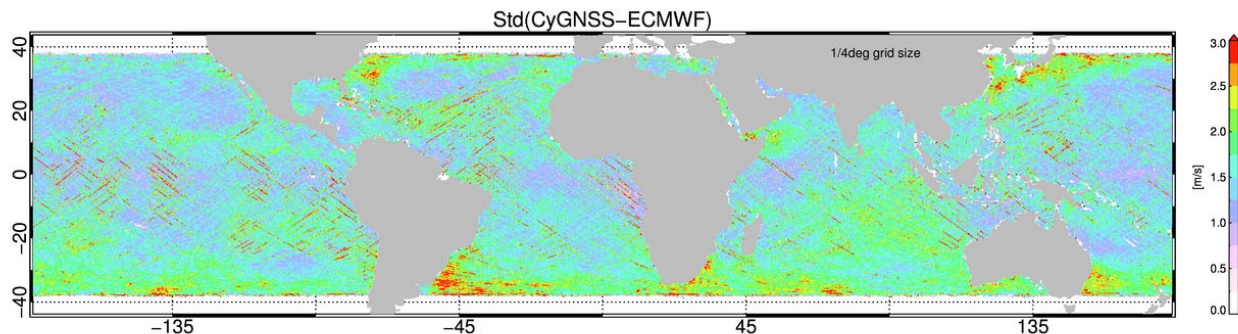
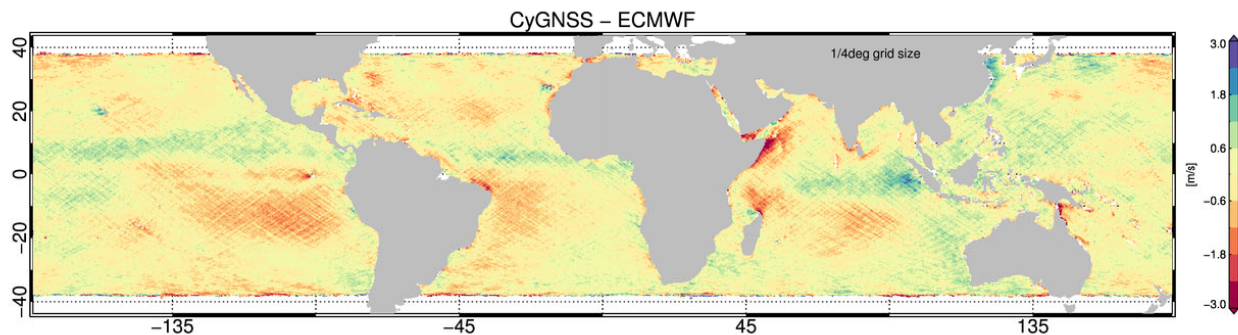
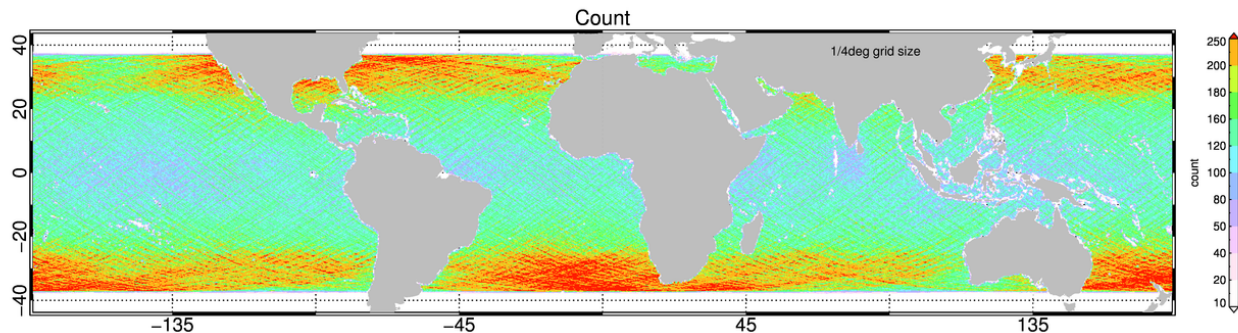


2017 vs. 2018

CyGNSS L2 - 2017



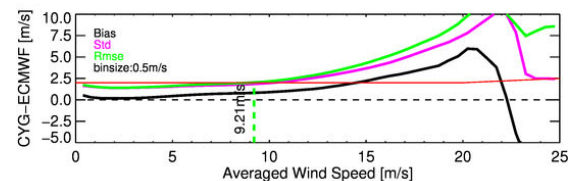
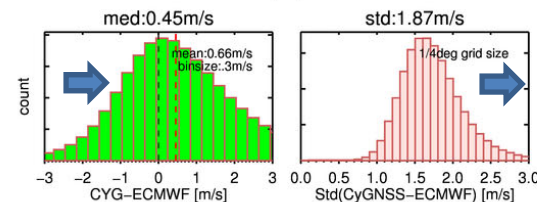
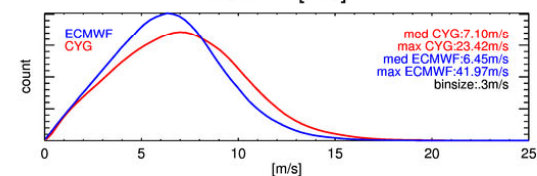
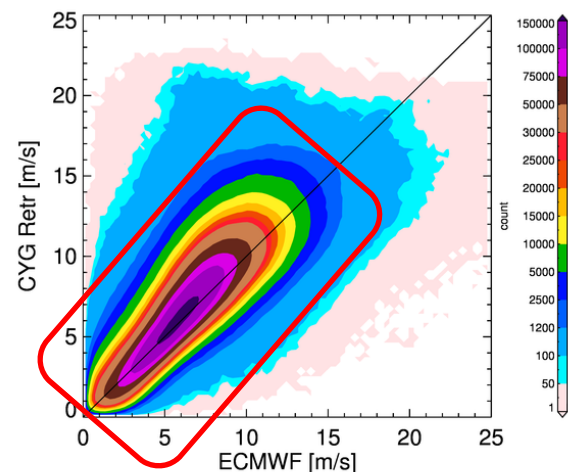
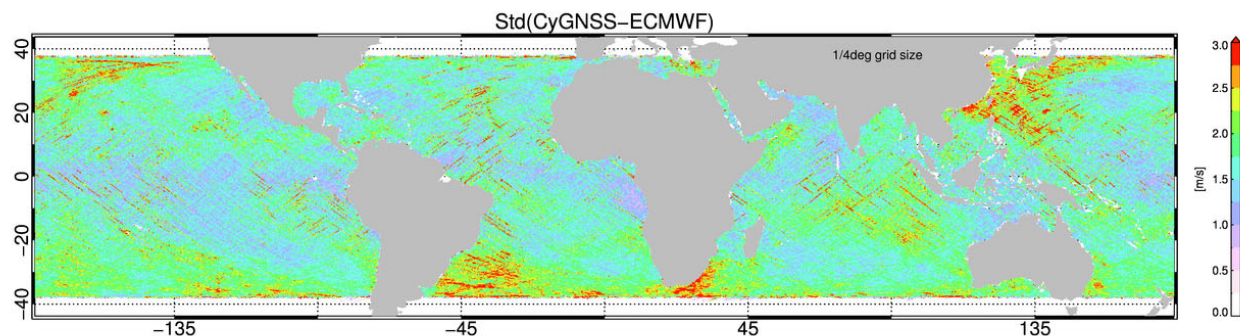
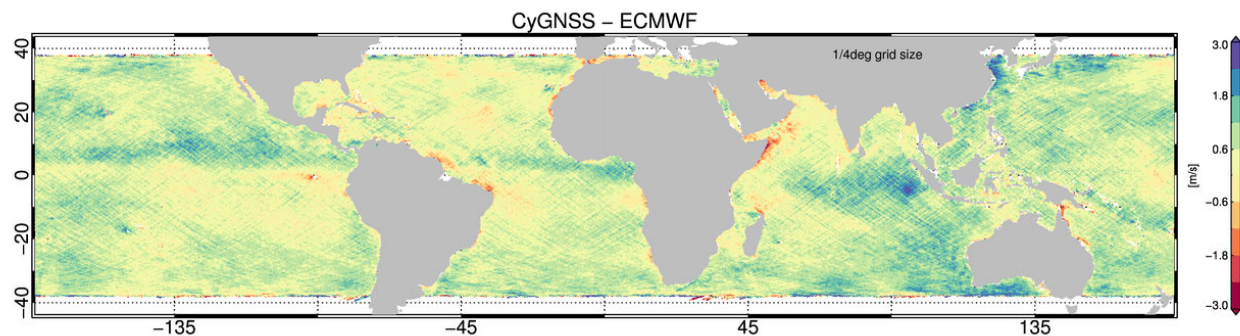
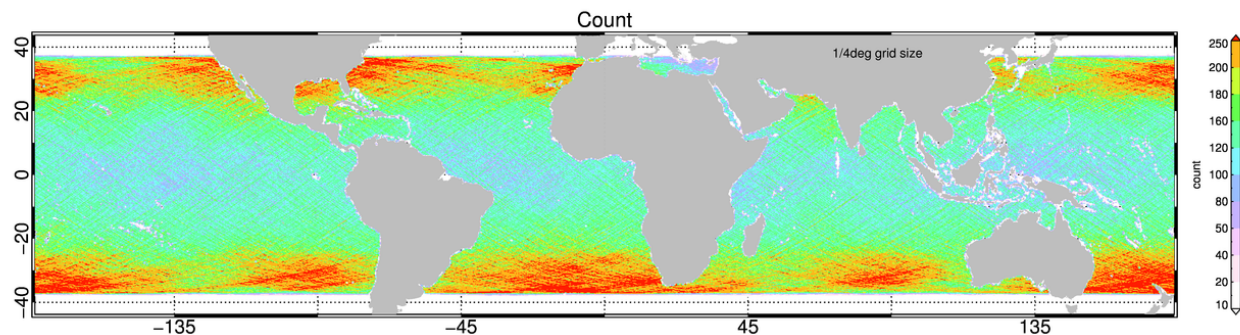
all FMs | All blocks | Time period: Aug 1–Sep 30 2017 | L2 dataset | Applied flag: fds_sample_flags bit 0 unset and range_corr_gain > 3



CyGNSS L2 - 2018



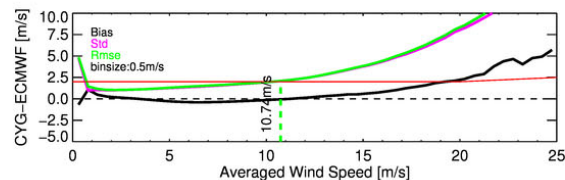
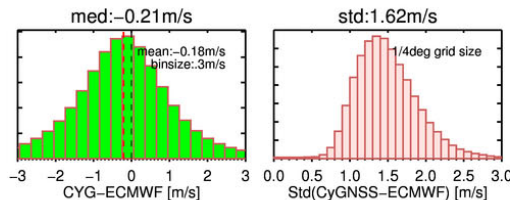
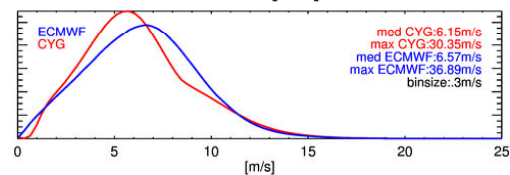
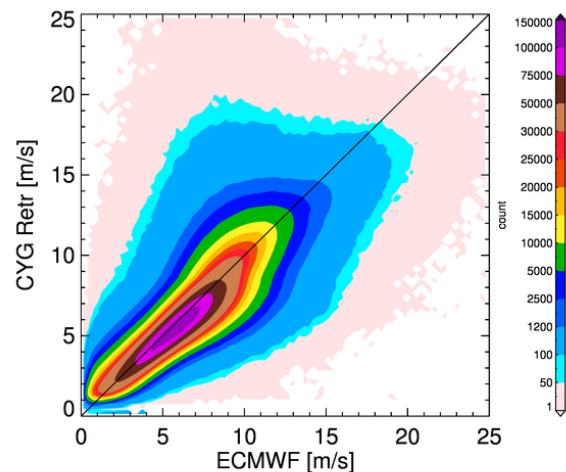
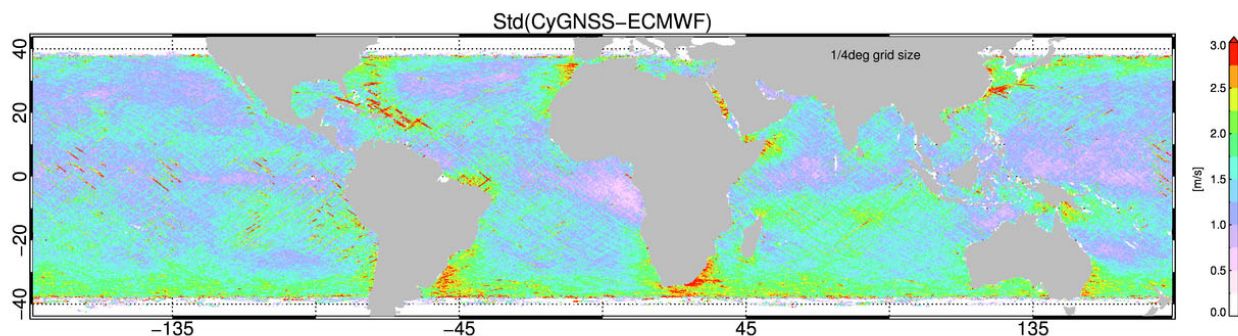
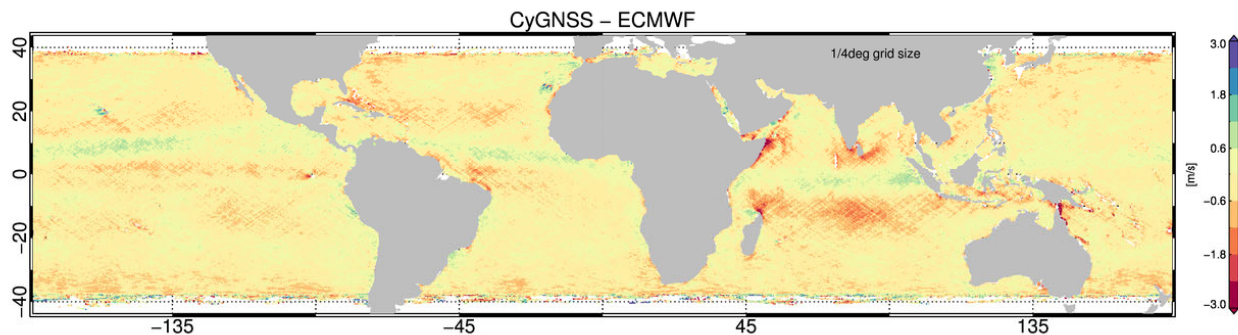
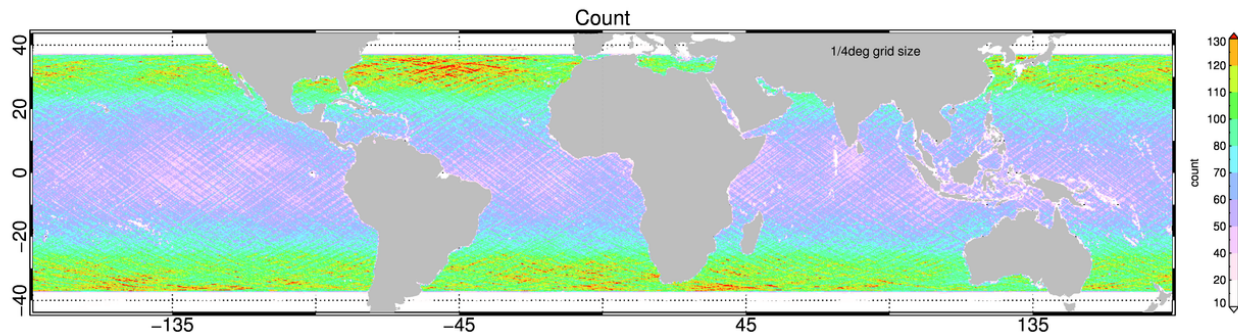
all FMs | All blocks | Time period: Aug 1–Oct 15 2018 | L2 dataset | Applied flag: fds_sample_flags bit 0 unset and range_corr_gain > 3



CyGNSS NOAA - 2017



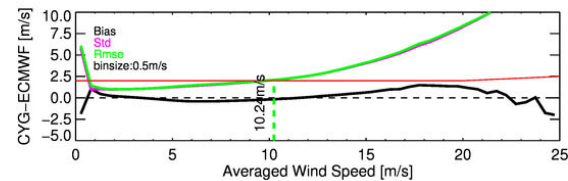
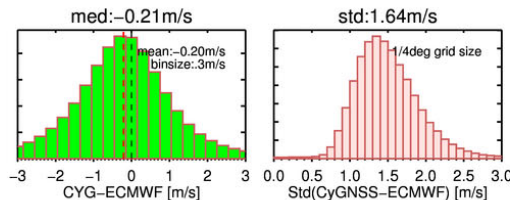
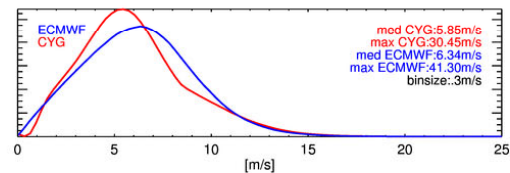
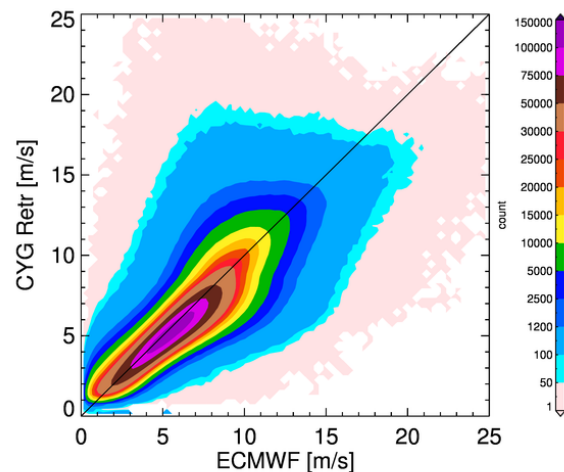
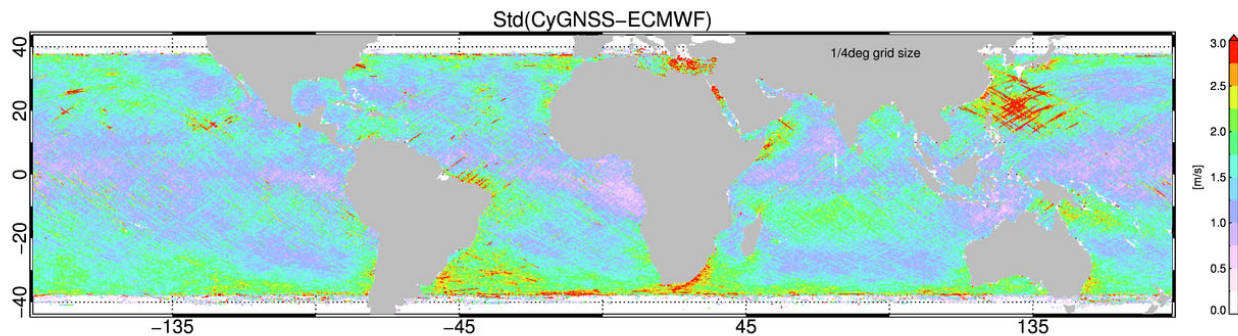
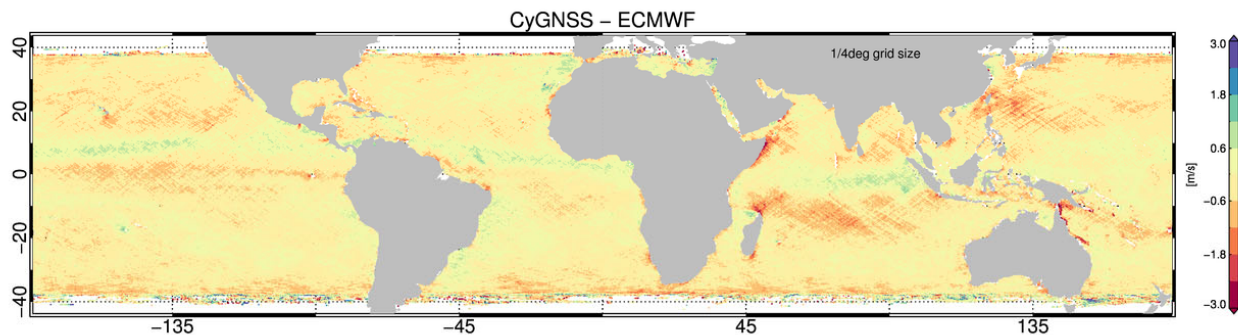
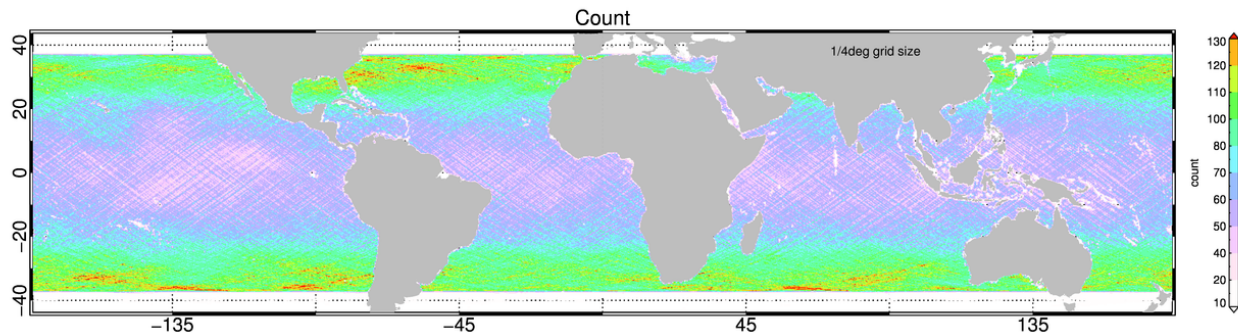
all FMs | All blocks | Time period: Aug 1–Sep 30 2017 | NOAA dataset | Applied flag:snr > 1 dB and $-2 < \text{roll} < 2$ deg



CyGNSS NOAA - 2018



all FMs | All blocks | Time period: Aug 1–Oct 15 2018 | NOAA dataset | Applied flag:snr > 1 dB and $-2 < \text{roll} < 2$ deg

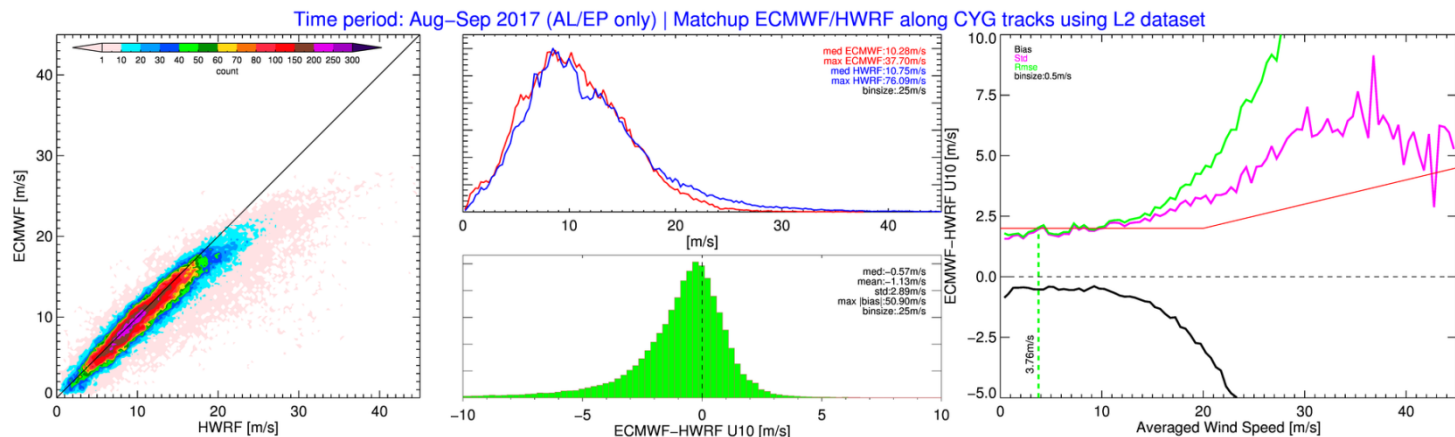


Bias/Std with HWRF

L2 vs. NOAA

AL/EP basins (2017)

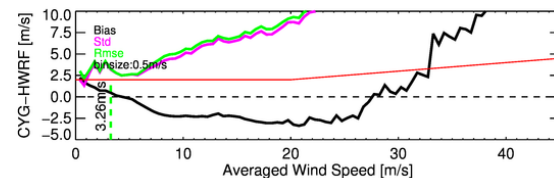
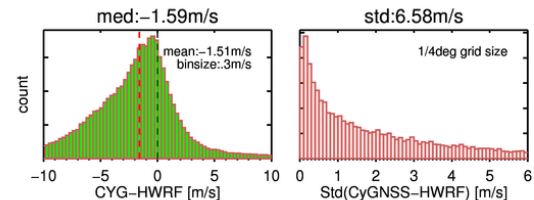
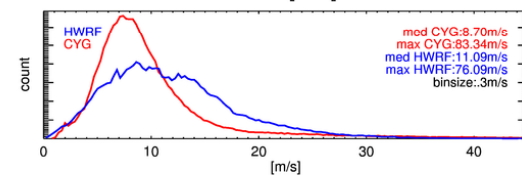
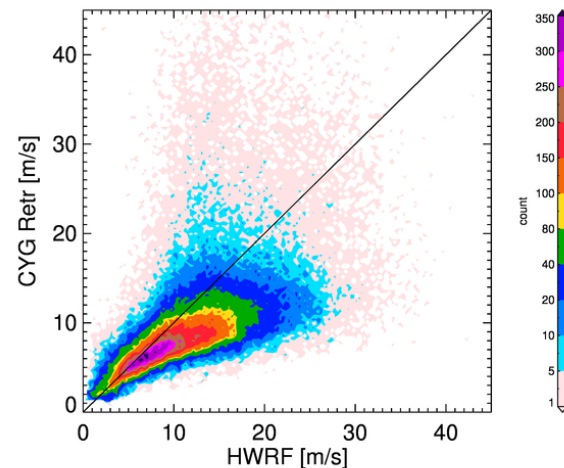
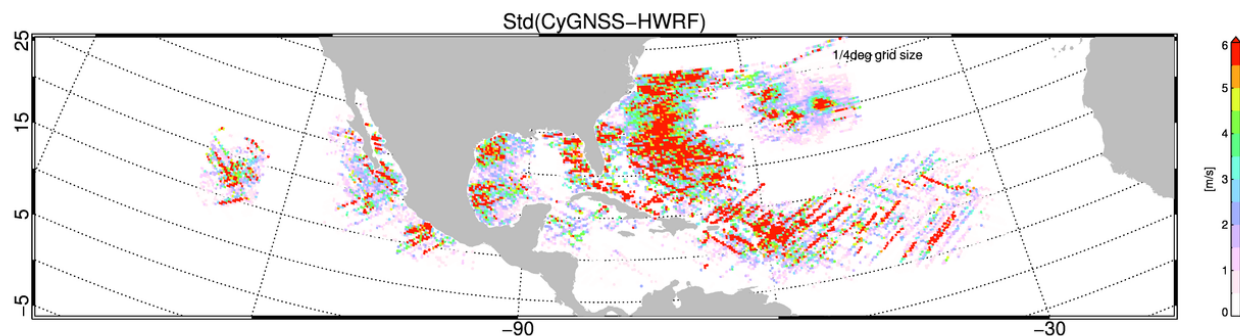
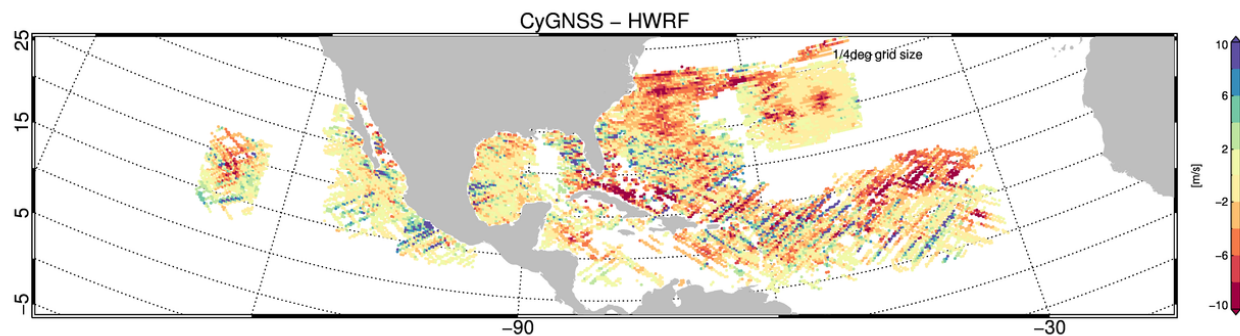
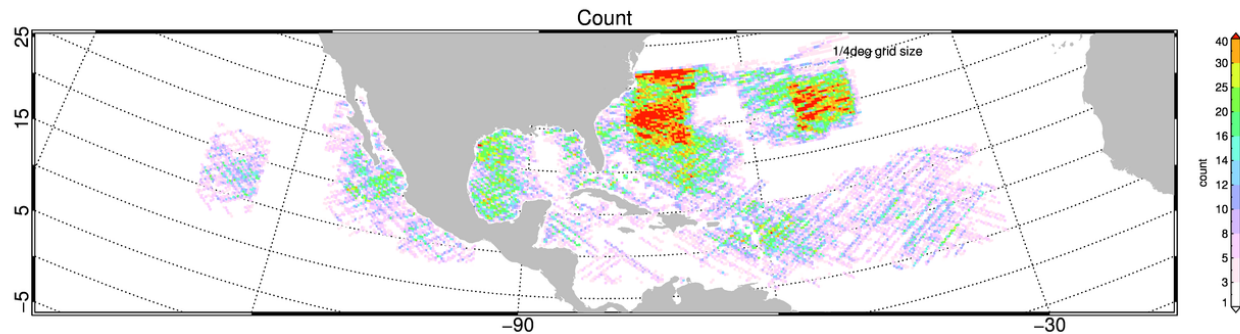
All basins (2018)



CyGNSS L2- 2017



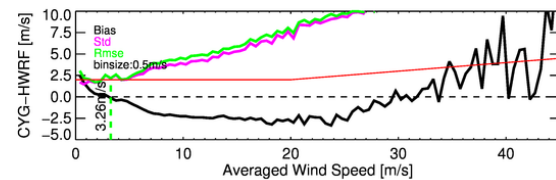
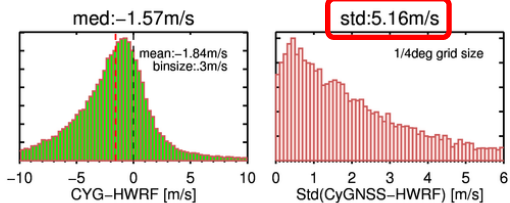
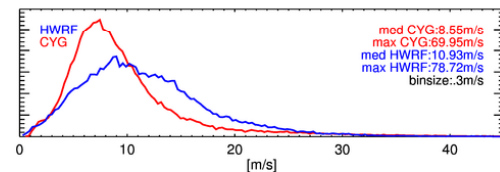
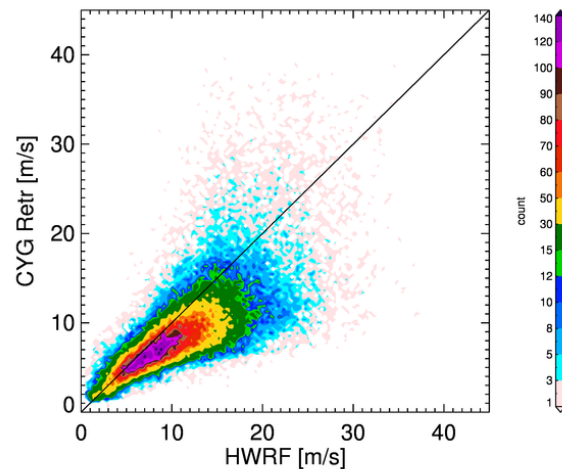
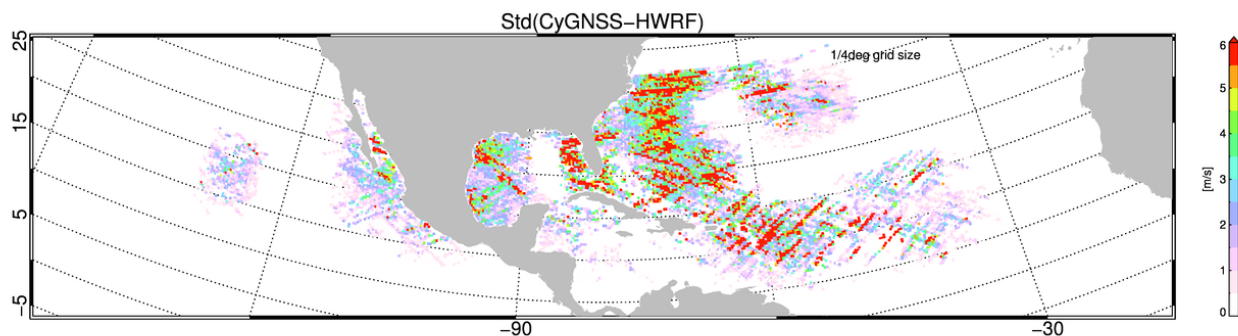
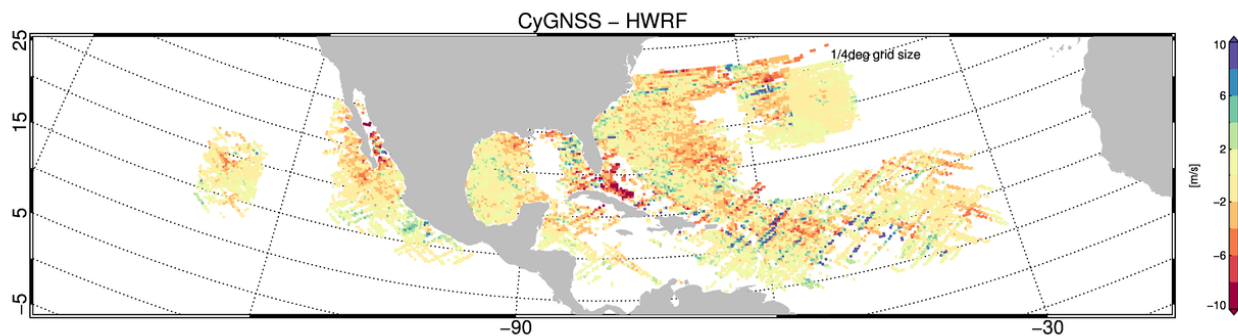
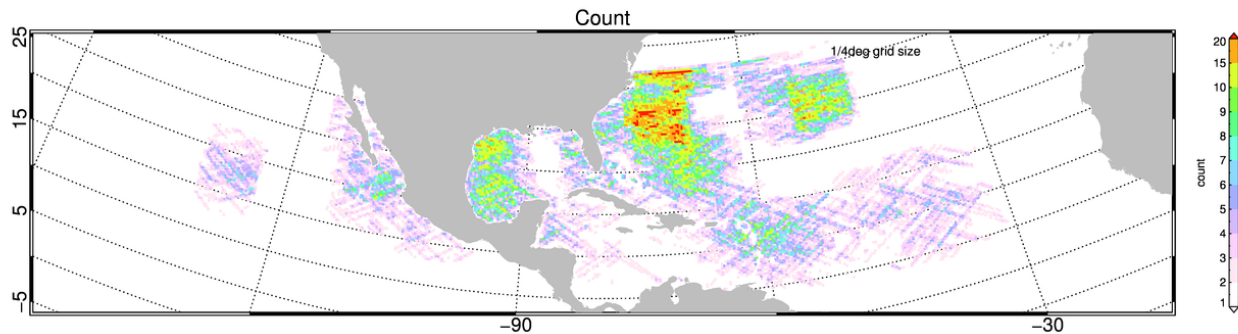
all FMs | All blocks | Time period: Aug 1-Sep 30 2017 | L2 dataset | Applied flag:yslf_sample_flags bit 0 unset and range_corr_gain > 3



CyGNSS NOAA - 2017



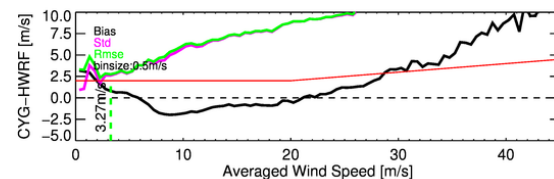
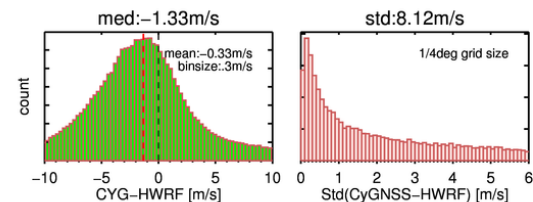
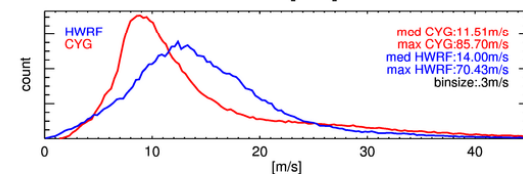
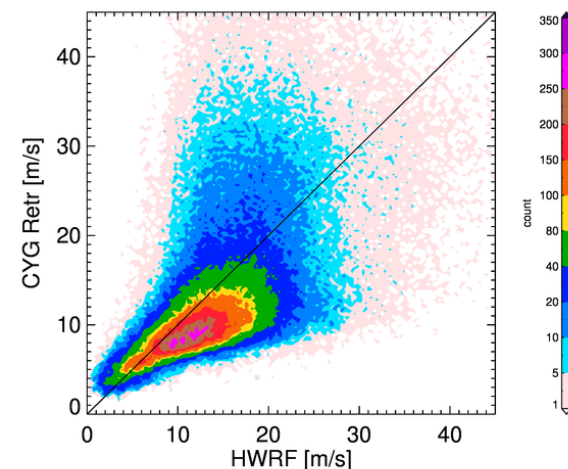
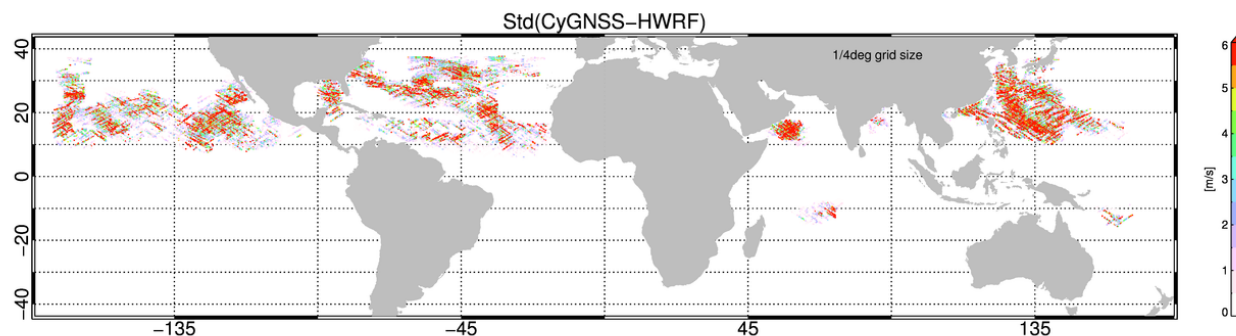
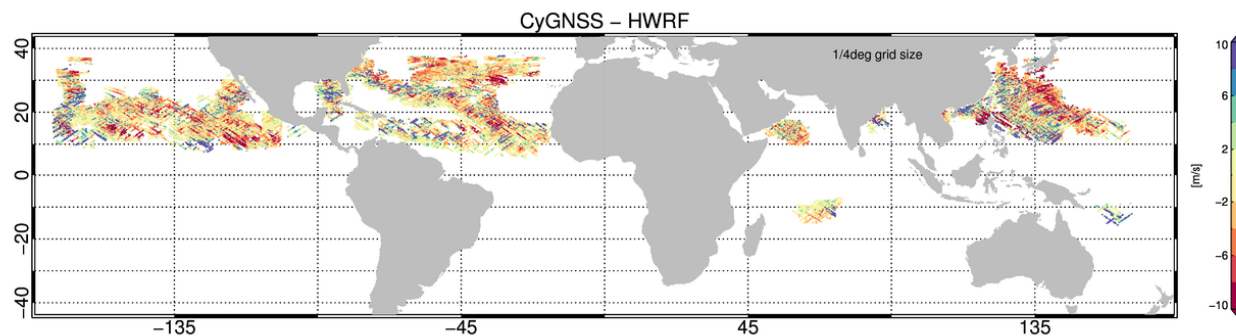
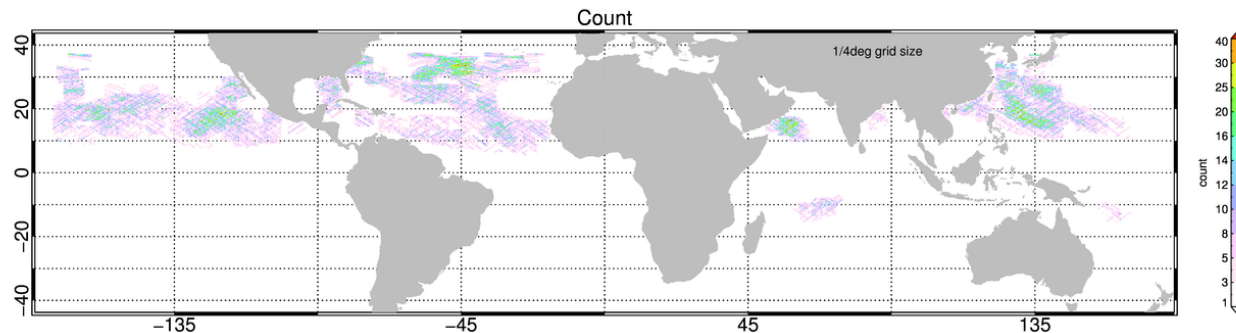
all FMs | All blocks | Time period: Aug 1-Sep 30 2017 | NOAA dataset | Applied flag:snr > 1 dB and $-2 < \text{roll} < 2$ deg



CyGNSS L2 - 2018



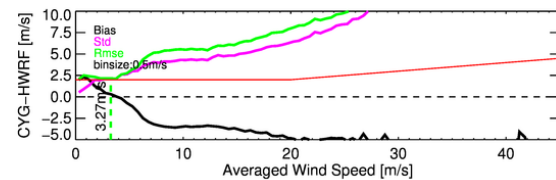
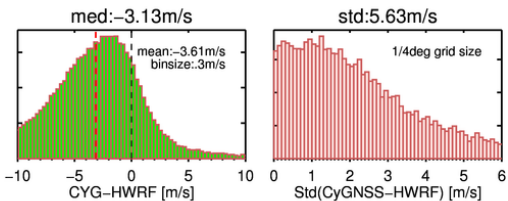
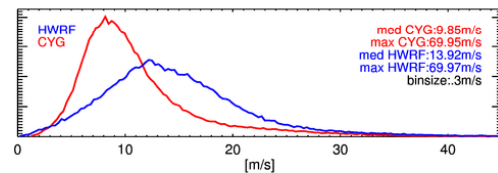
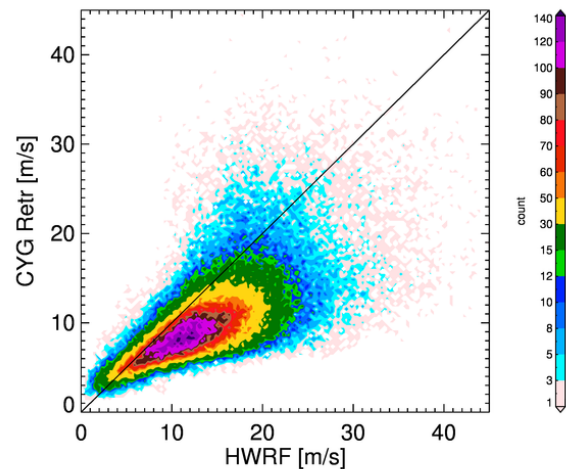
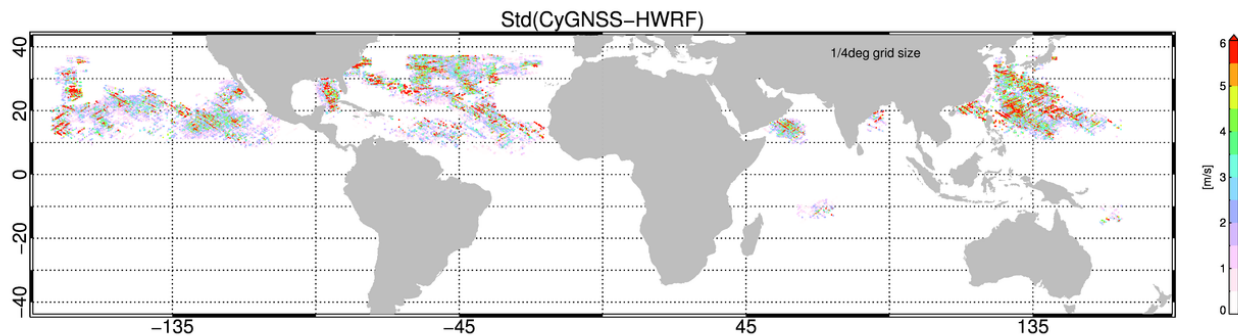
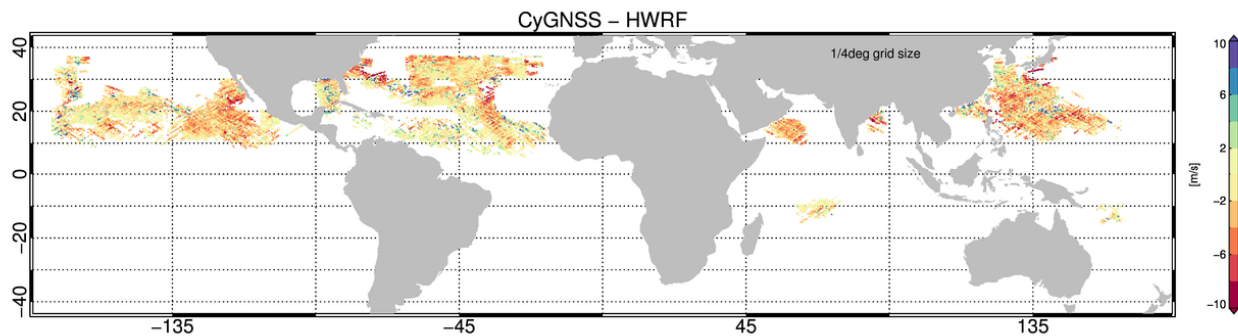
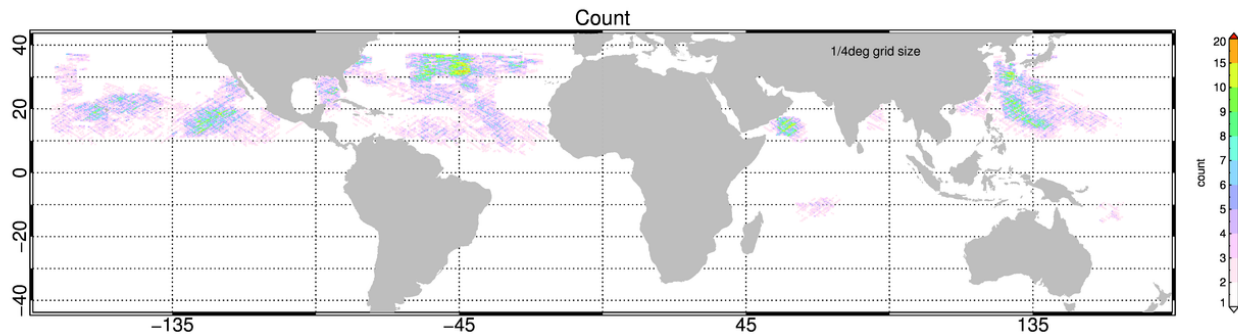
all FMs | All blocks | Time period: Aug 1–Oct 15 2018 | L2 dataset | Applied flag:yslf_sample_flags bit 0 unset and range_corr_gain > 3



CyGNSS NOAA - 2018



all FMs | All blocks | Time period: Aug 1–Oct 15 2018 | NOAA dataset | Applied flag:snr > 1 dB and $-2 < \text{roll} < 2$ deg

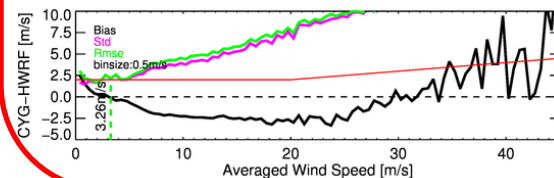
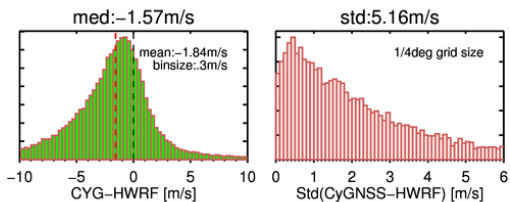
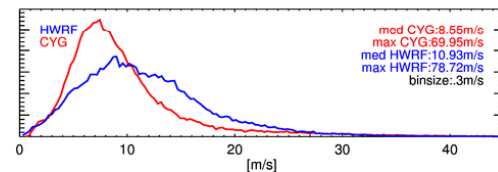
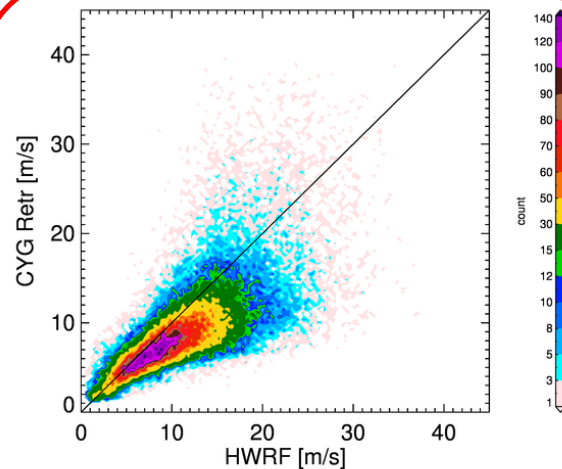
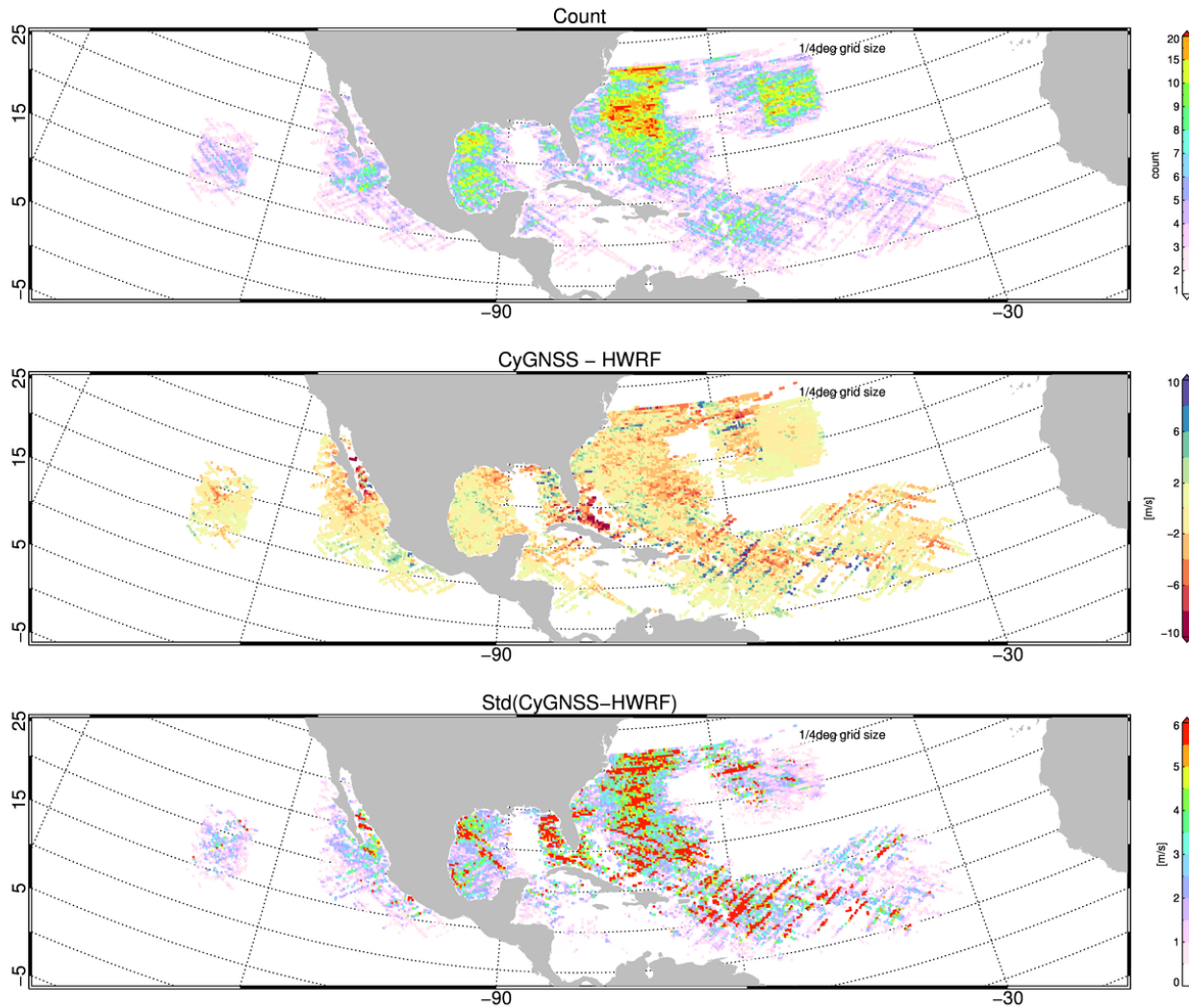


2017 vs. 2018

CyGNSS NOAA - 2017



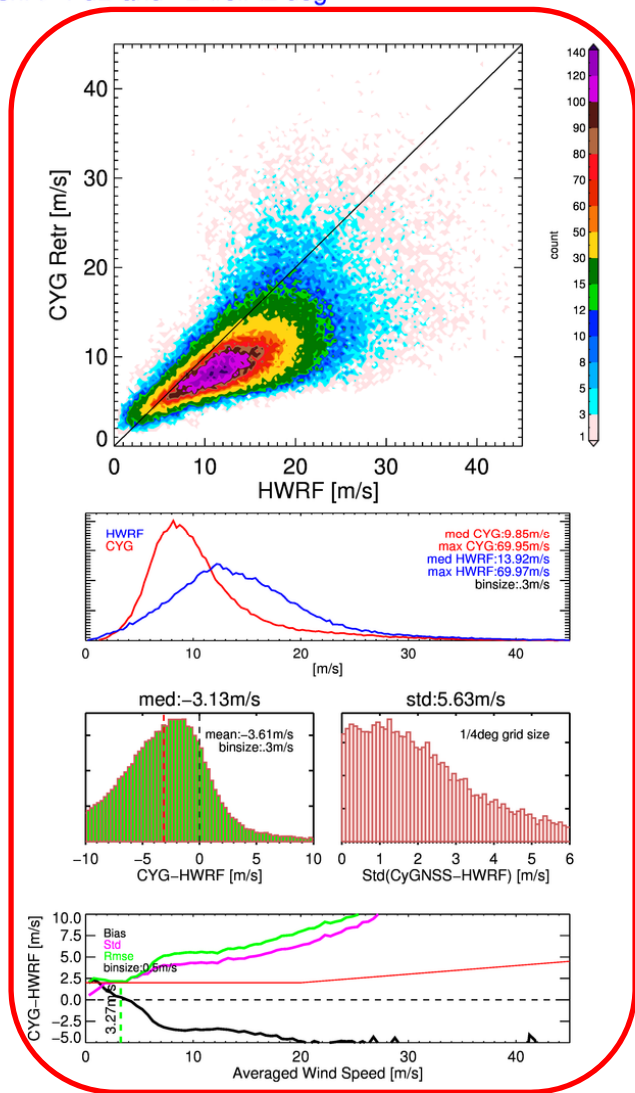
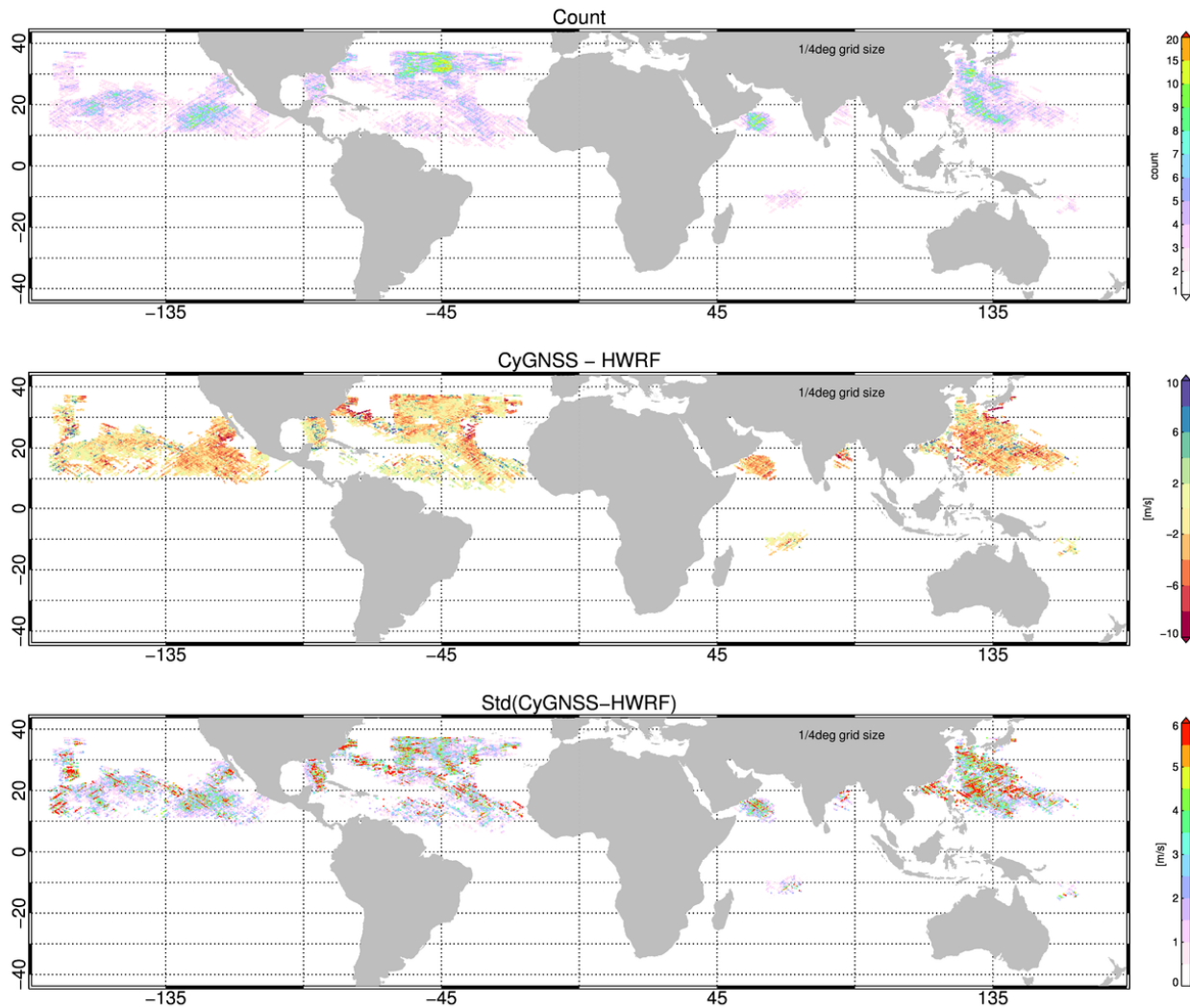
all FMs | All blocks | Time period: Aug 1-Sep 30 2017 | NOAA dataset | Applied flag:snr > 1 dB and $-2 < \text{roll} < 2$ deg



CyGNSS NOAA - 2018



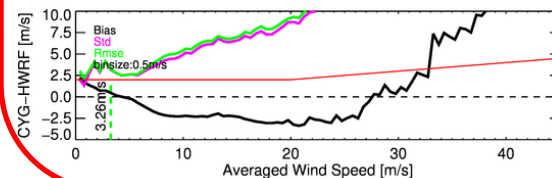
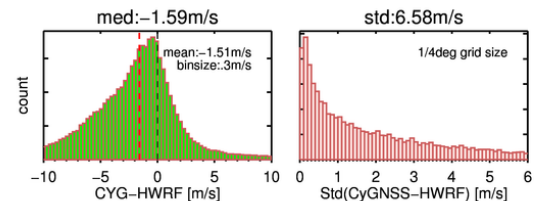
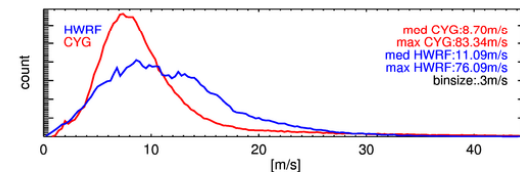
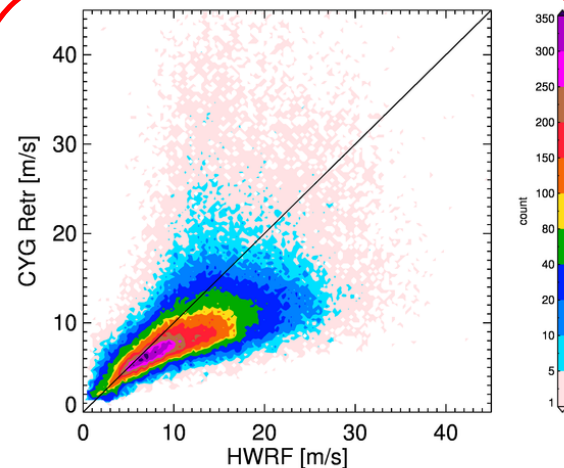
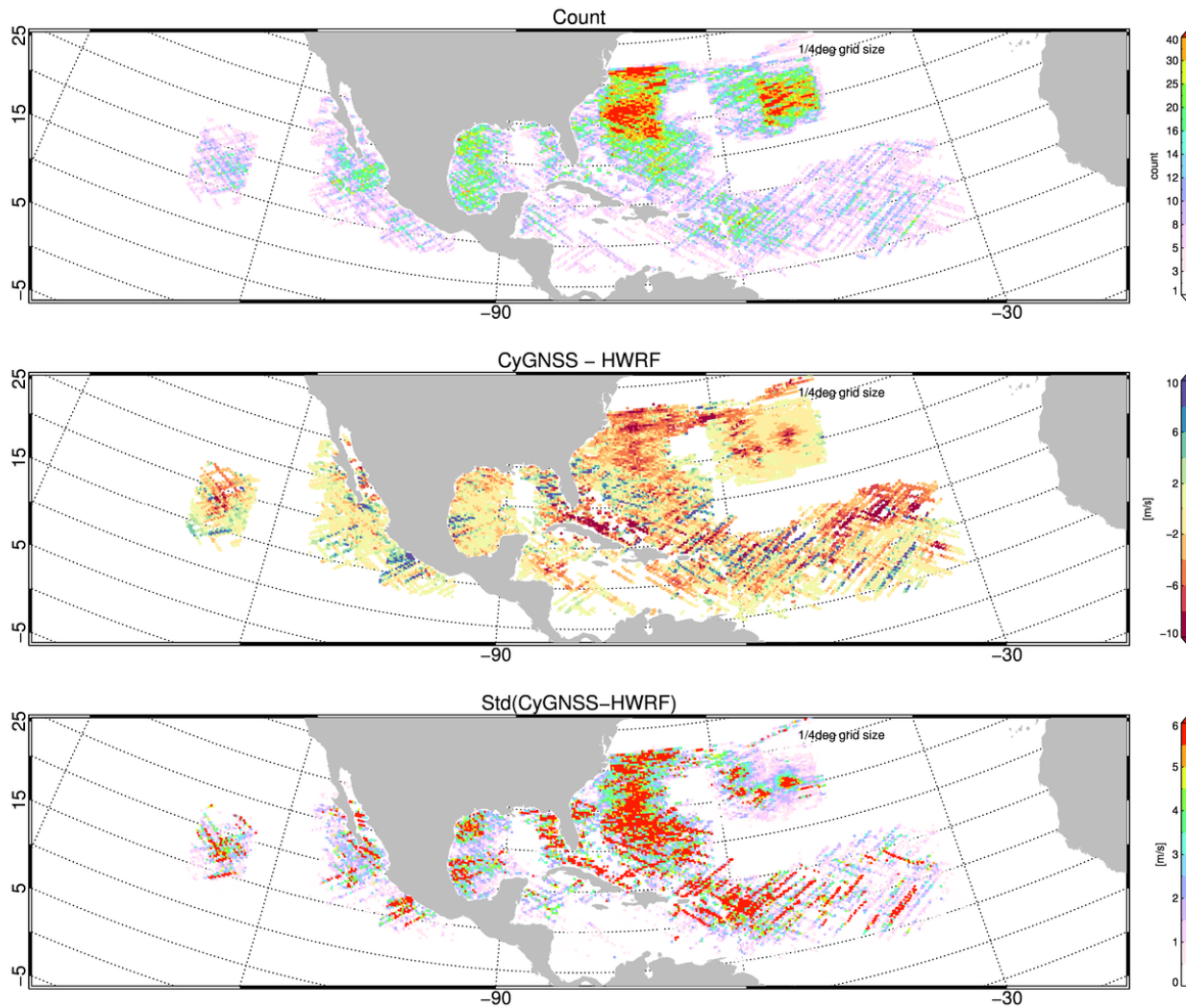
all FMs | All blocks | Time period: Aug 1–Oct 15 2018 | NOAA dataset | Applied flag:snr > 1 dB and $-2 < \text{roll} < 2$ deg



CyGNSS L2 - 2017



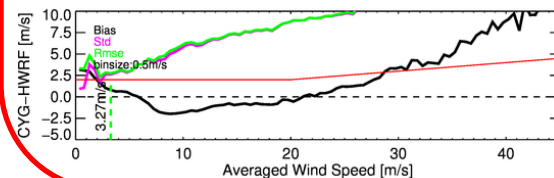
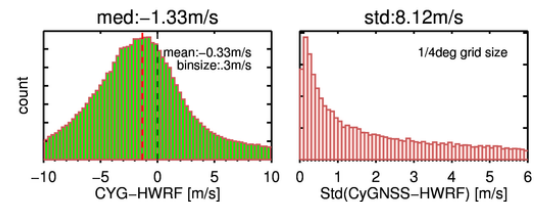
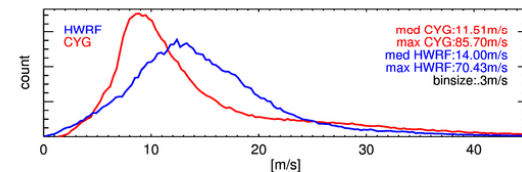
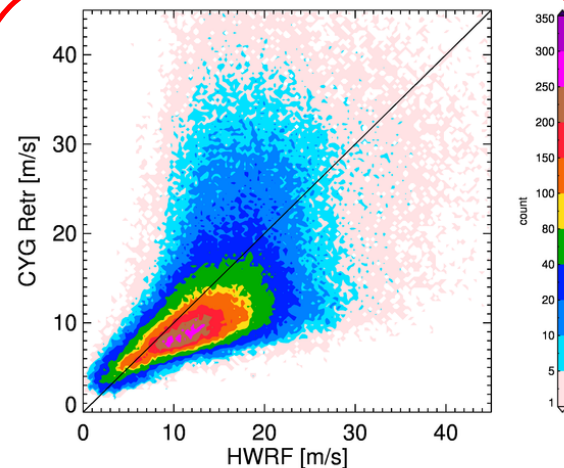
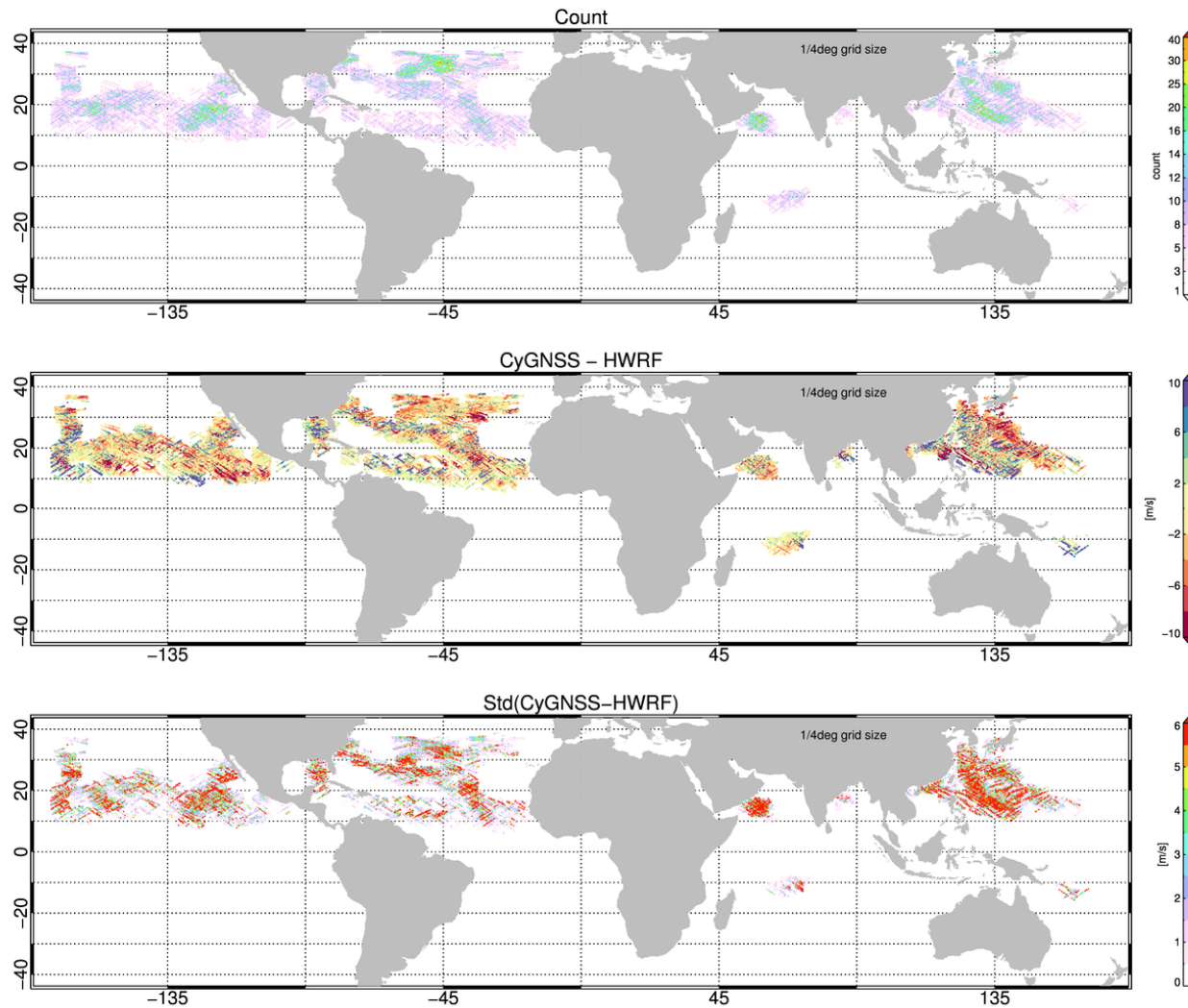
all FMs | All blocks | Time period: Aug 1-Sep 30 2017 | L2 dataset | Applied flag:yslf_sample_flags bit 0 unset and range_corr_gain > 3



CyGNSS L2 - 2018



all FMs | All blocks | Time period: Aug 1–Oct 15 2018 | L2 dataset | Applied flag:yslf_sample_flags bit 0 unset and range_corr_gain > 3



Statistical Summary

Against ECMWF

		Aug-Sep 2017	Aug-mid Oct 2018
Bias [m/s]	NOAA	-0.18	-0.20
	L2	-0.0037	0.66
Std [m/s]	NOAA	1.62	1.64
	L2	1.76	1.87

Against HWRF

		Aug-Sep 2017	Aug-mid Oct 2018
Bias [m/s]	NOAA	-1.84	-3.61
	L2	-1.51	-0.33
Std [m/s]	NOAA	5.16	5.63
	L2	6.58	8.12

Observations and recommendations:

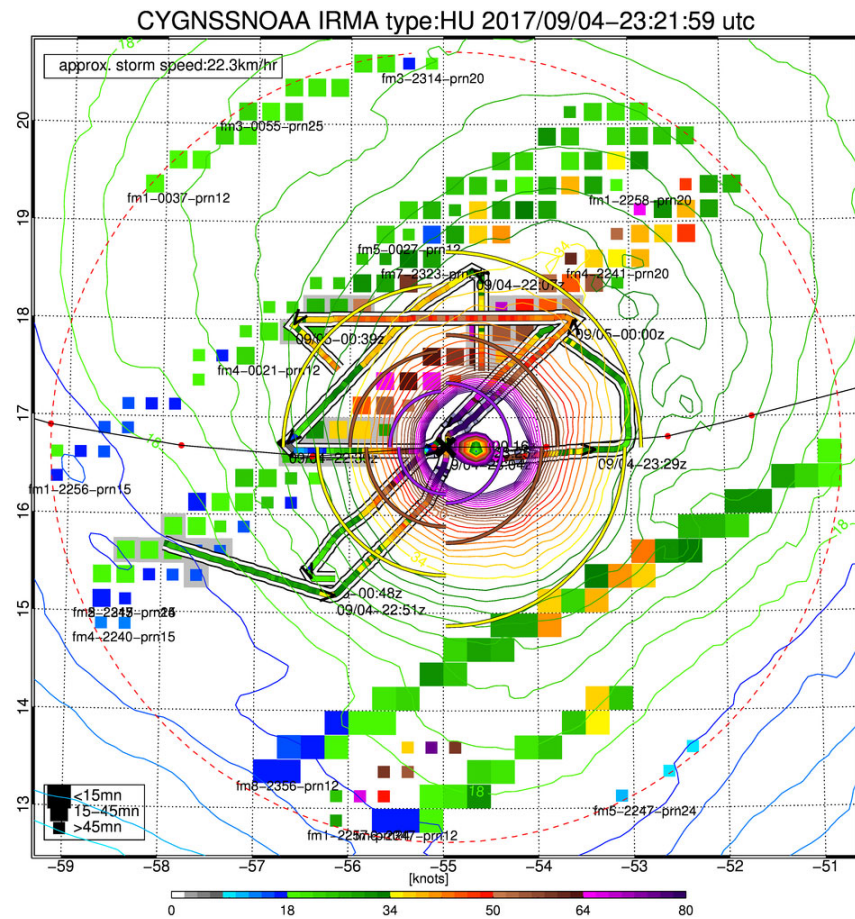
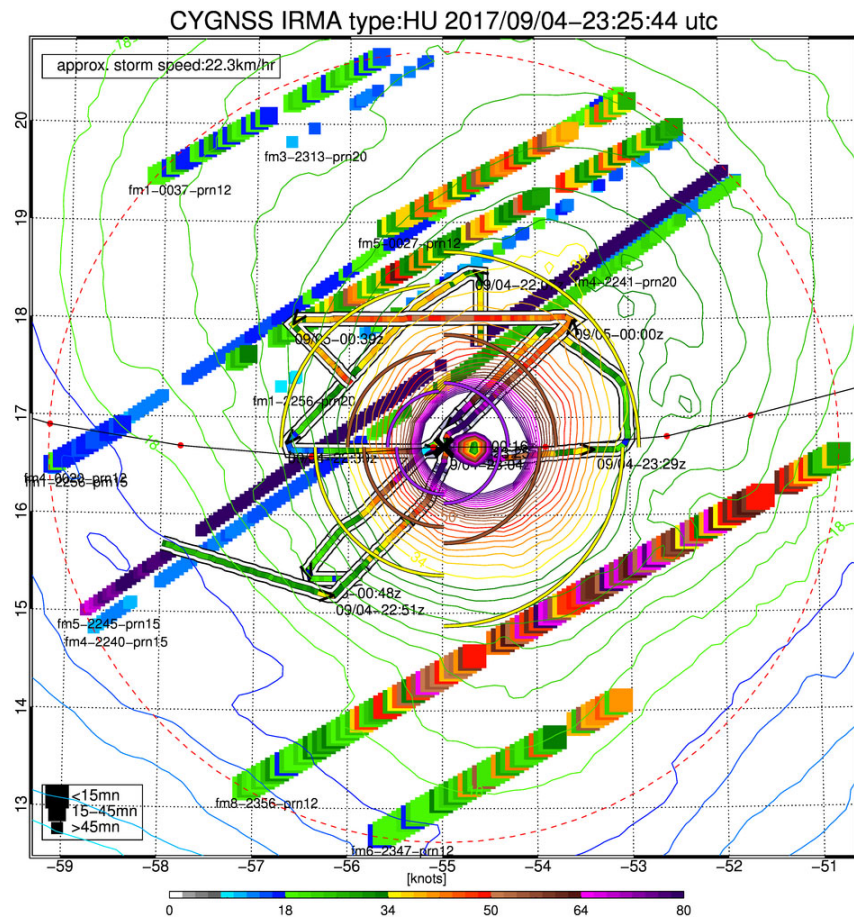
- NBRCS still noticeably high during high roll manoeuver, particularly on the starboard side
 - Consequence: L2 winds/mss are affected during these periods

Possible recommendations:

- Include a flag in L2 data to identify high roll data
- Noticeable **upward** trend in L2 wind bias/std and mss timeseries starting ~Sep 2017. More pronounced after Sep 2018
 - *may be related to increase in Noise Floor across all instruments*
- Given the same observatory, L2 wind biases are quite different (~0.5-1 m/s) between antenna
- Aforementioned trends are also noticeable when L1/L2 variables are plotted as a function of incidence angle (note: FM#5 shows the worst performance as time evolves)

Additional Observations

- Globally,
 - L2 winds statistics are OK on a global scale (particularly in 2017) most likely due to the implementation of 'CDF matching technique'
 - *however*, wind speed correlation in the lat/lon space is poor at times
 - performance worsens over time
 - increased sigma0 trends show little effect on preliminary NOAA L2 winds
- In TC wind analysis,
 - Comparing 2017 vs. 2018, standard deviation against HWRF went from 6.58 to 8.12 m/s. Quite large increase.
 - Bias actually decreased. Yet, bias/std on lat/lon grid is very noisy
- Future works
 - Refine 'track wise' wind retrieval using our in house geophysical model function
 - Careful L2 analysis on a storm by storm basis vs. SFMR/HWRF/sensors, etc...



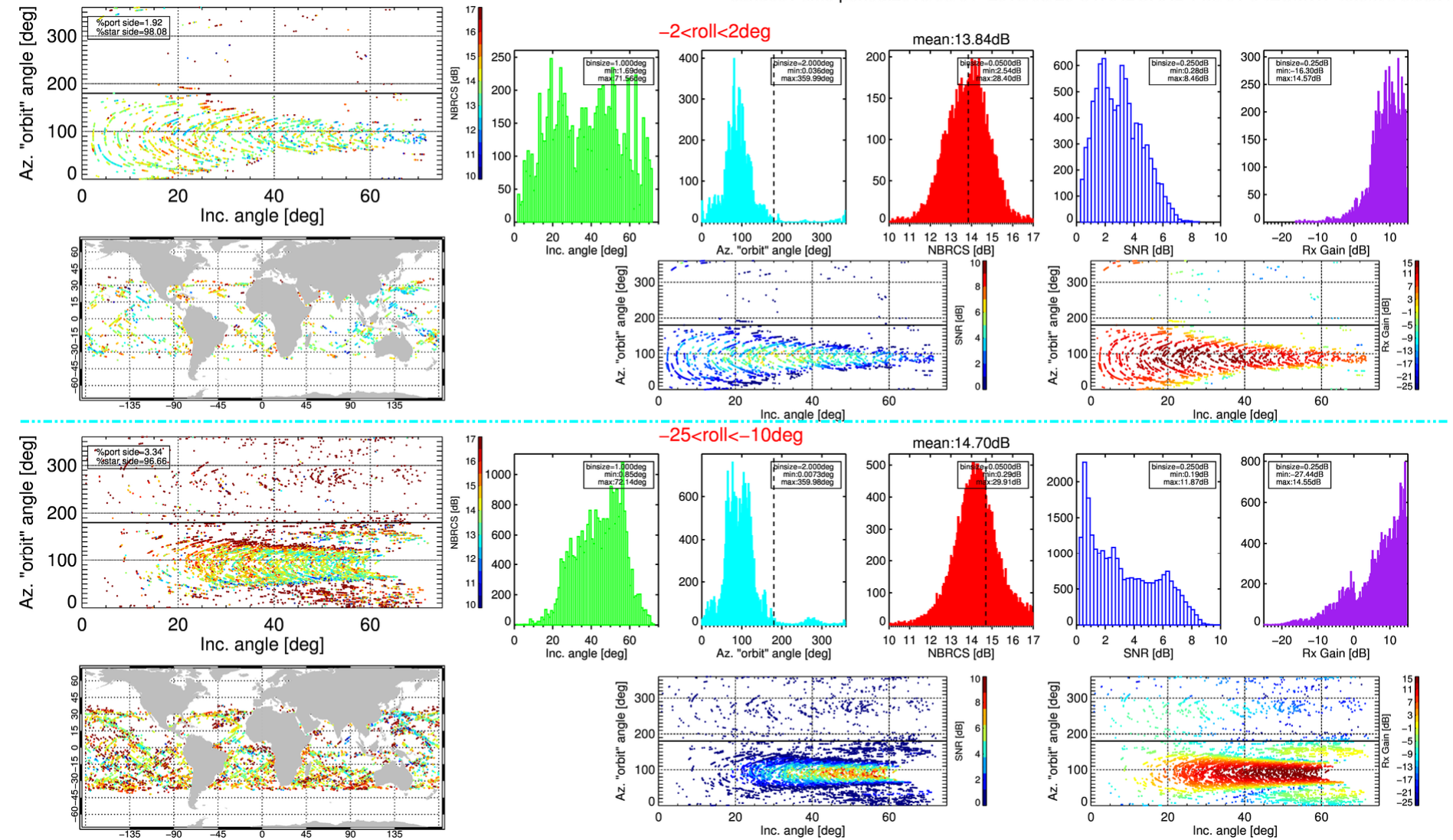


Additional slides

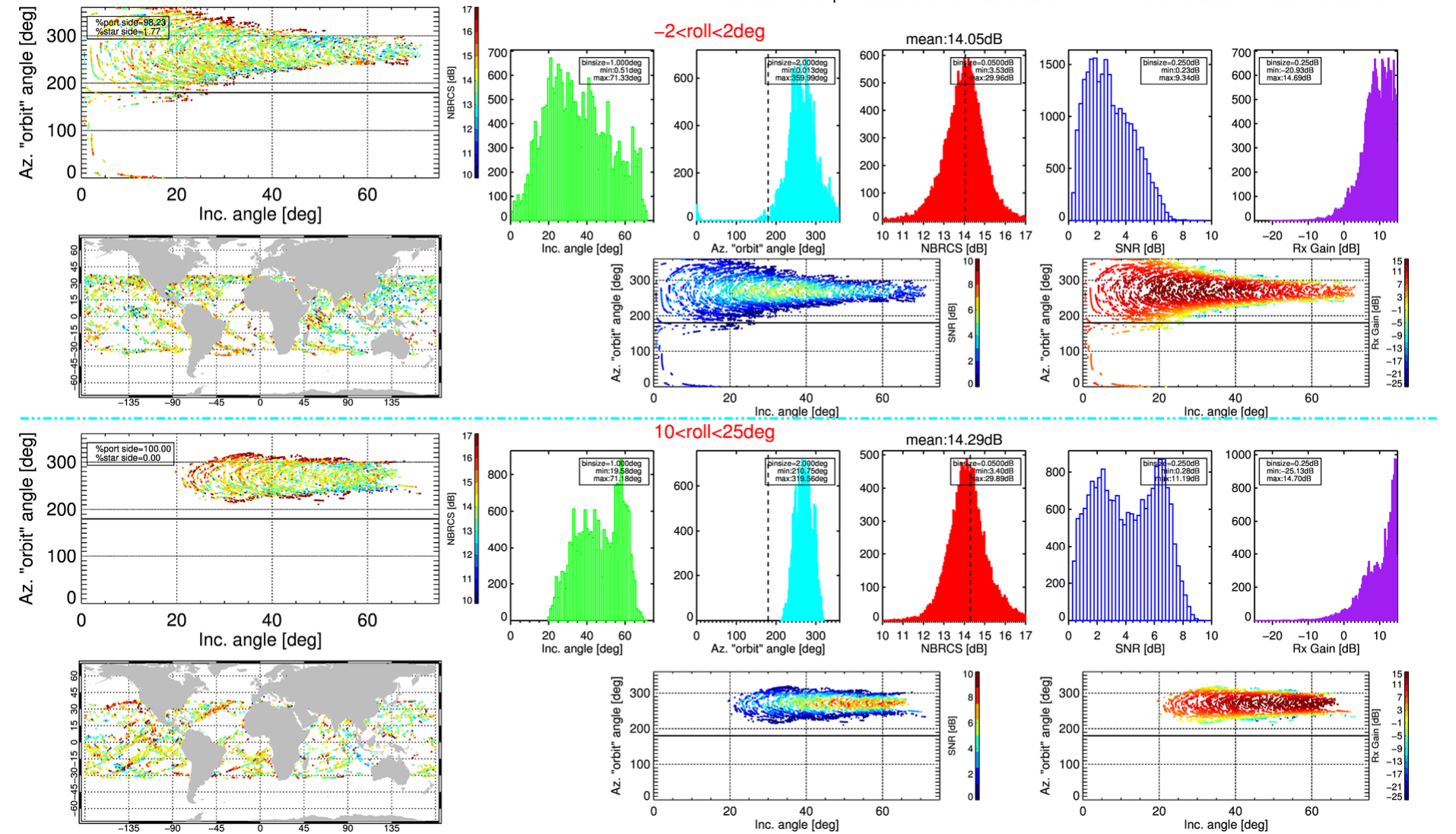
STARBOARD



sand031 time period:2018/05/01–2018/05/20 STARBOARD FM#01 6<ECMWF<6.5m/s block I

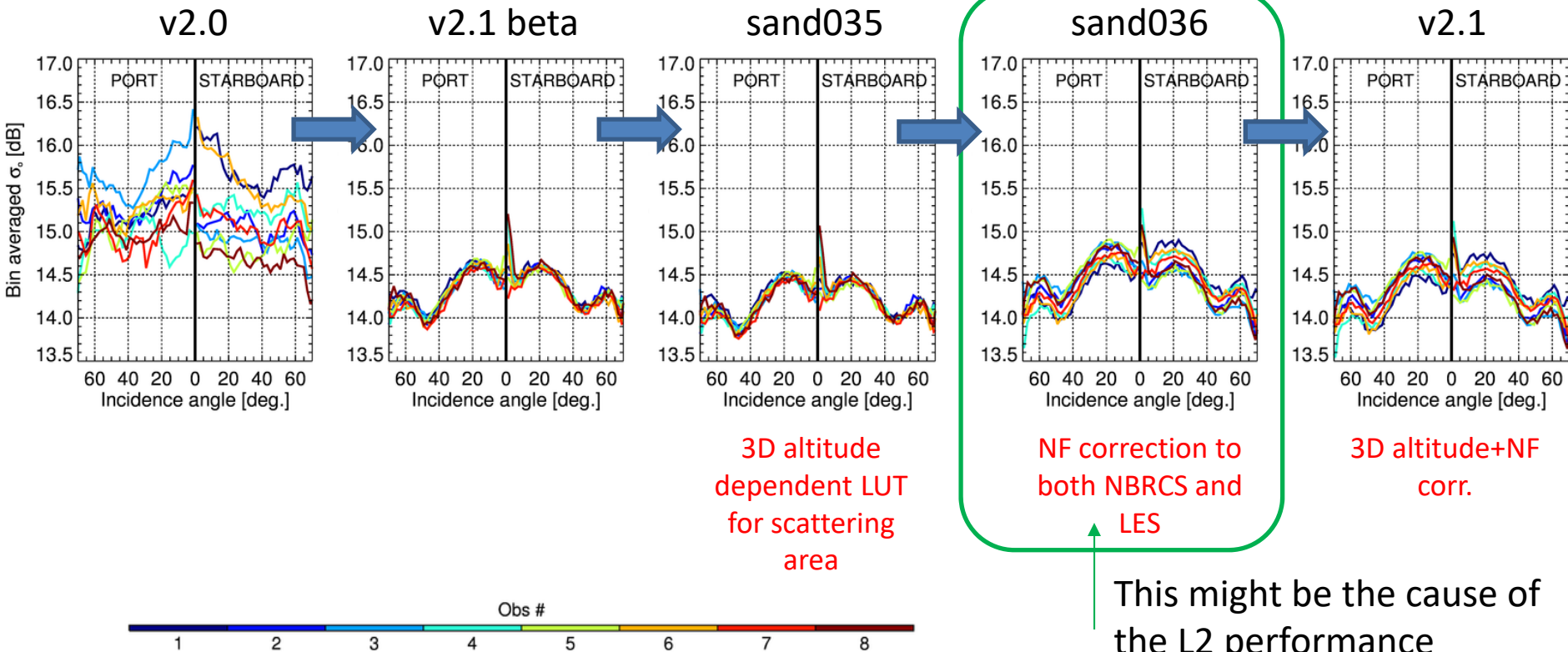


sand031 time period:2018/01/01–2018/02/01 PORT FM#01 6<ECMWF<6.5m/s block IIR



Bin averaged Sigma0 vs incidence angle separated by antenna and observatory

ALL PRNs except block IIF— $-6 \leq u_{10} \leq 6.5 \text{ m/s}$ —time period: May–Dec 2017

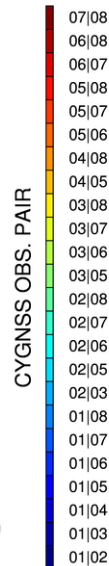
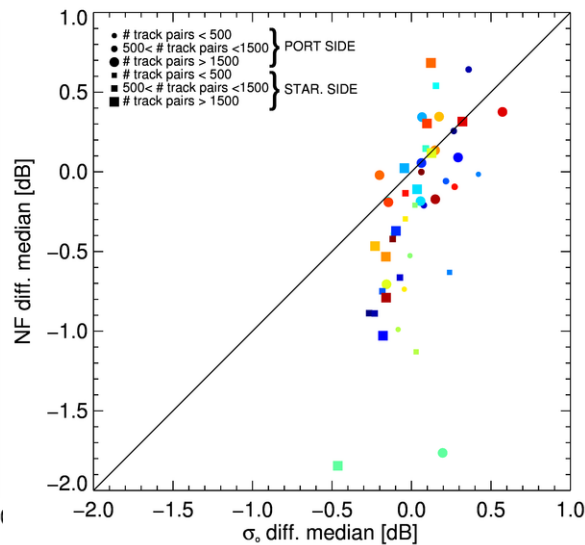
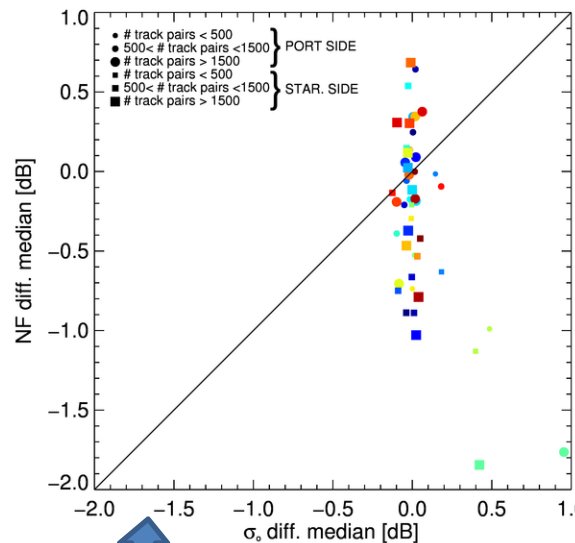
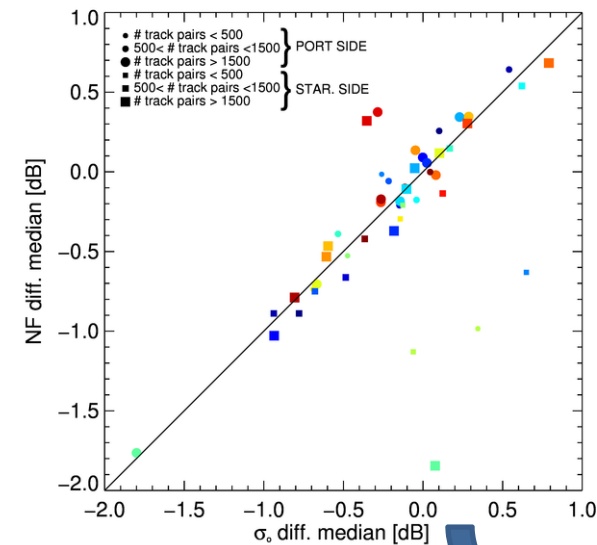


This might be the cause of the L2 performance degradation previously noted

v2.0

v2.1 beta

v2.1



D/A conversion from Rx power cal. was removed

