Global Assessment of Sentinel-3A NRT Wind and Wave Products

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ECMWF

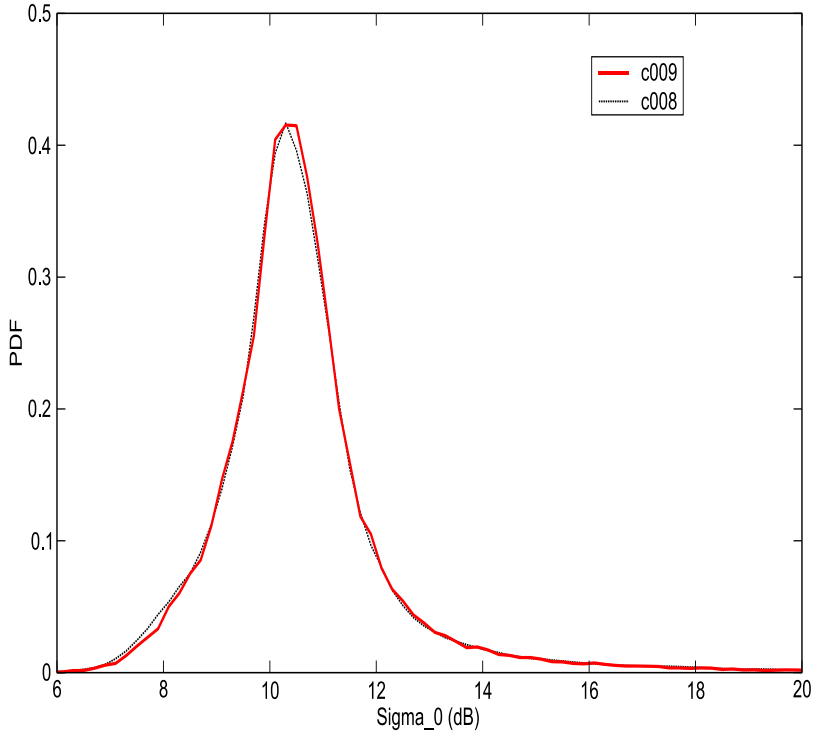
Sentinel-3A

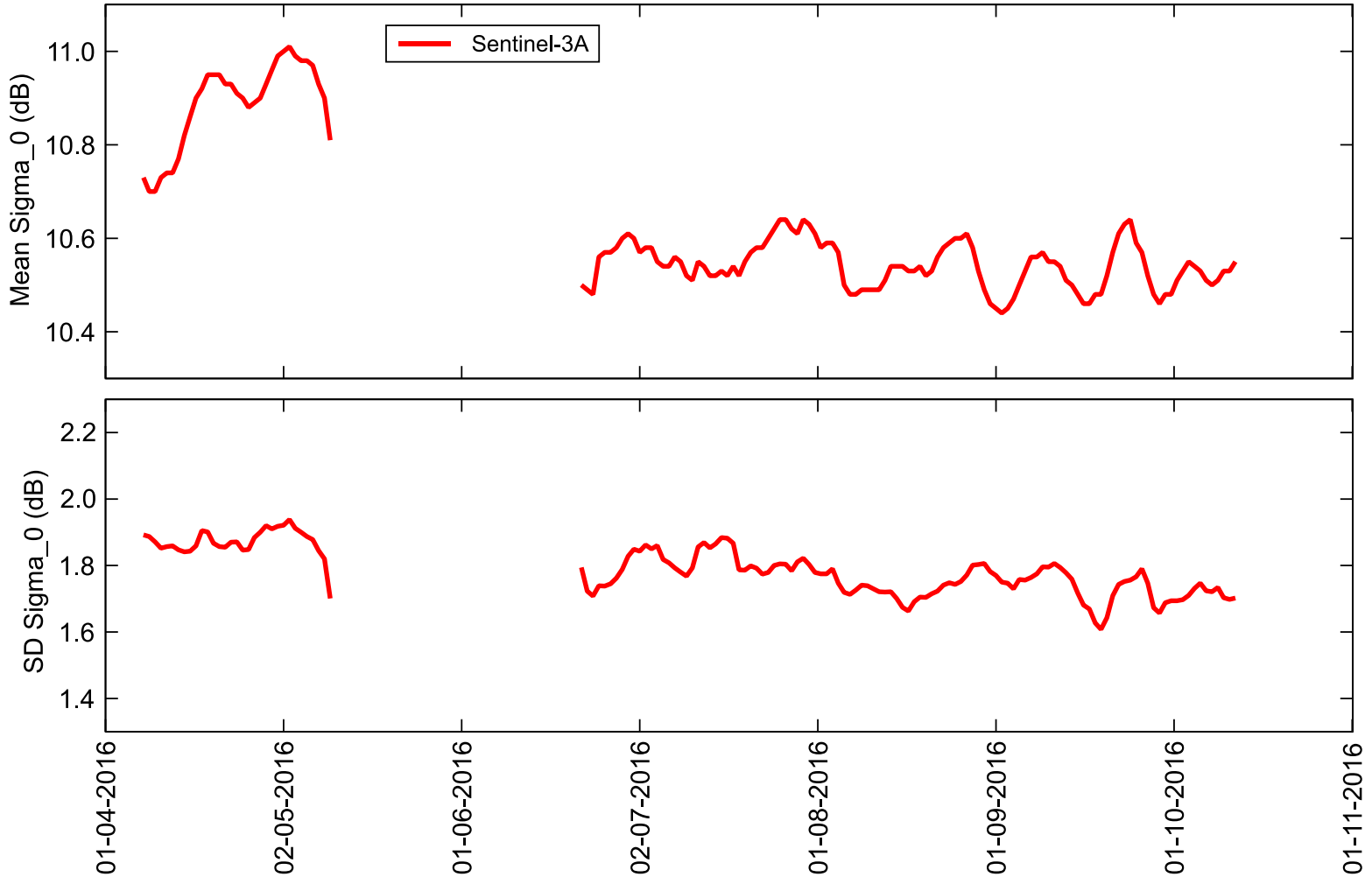
- Launched on 17 Feb. 2016.
- Sentinel-3A radar altimeter (SRAL) near real time (NRT) Level 2 STM Marine Product (SR_2_WAT) only.
- Sentinel-3A SRAL operates in SAR mode (exception: two days in April 2016).
- Results mainly from Cycle 9 (18 Sep. – 14 Oct. 2016)
- Latest IPF change (a couple of weeks ago) is not included.

Backscatter

- Stable since late June 2016.
- Slightly lower than usual.

SRAL Backscatter is stable since late June 2016

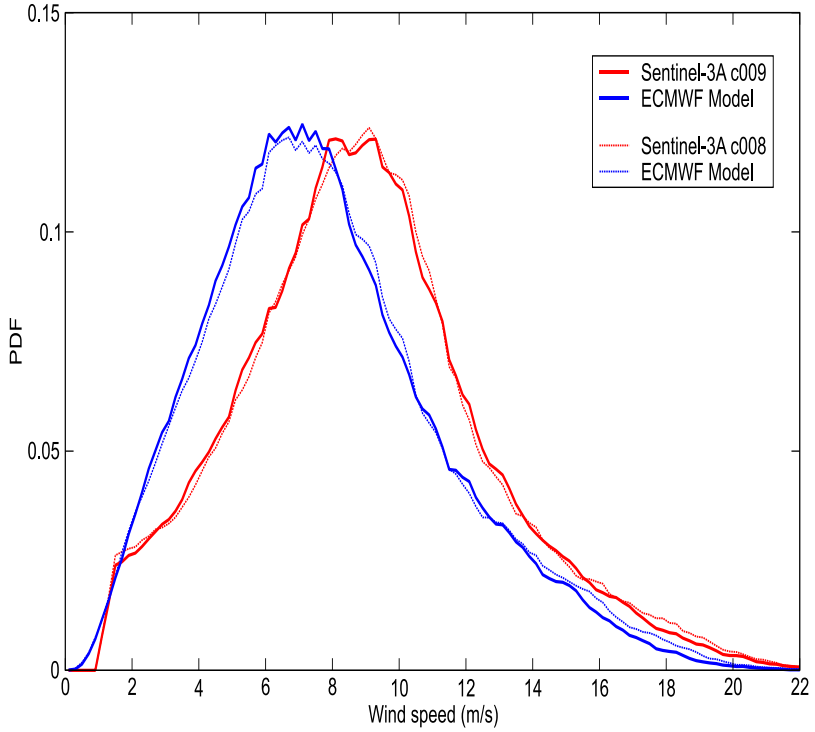


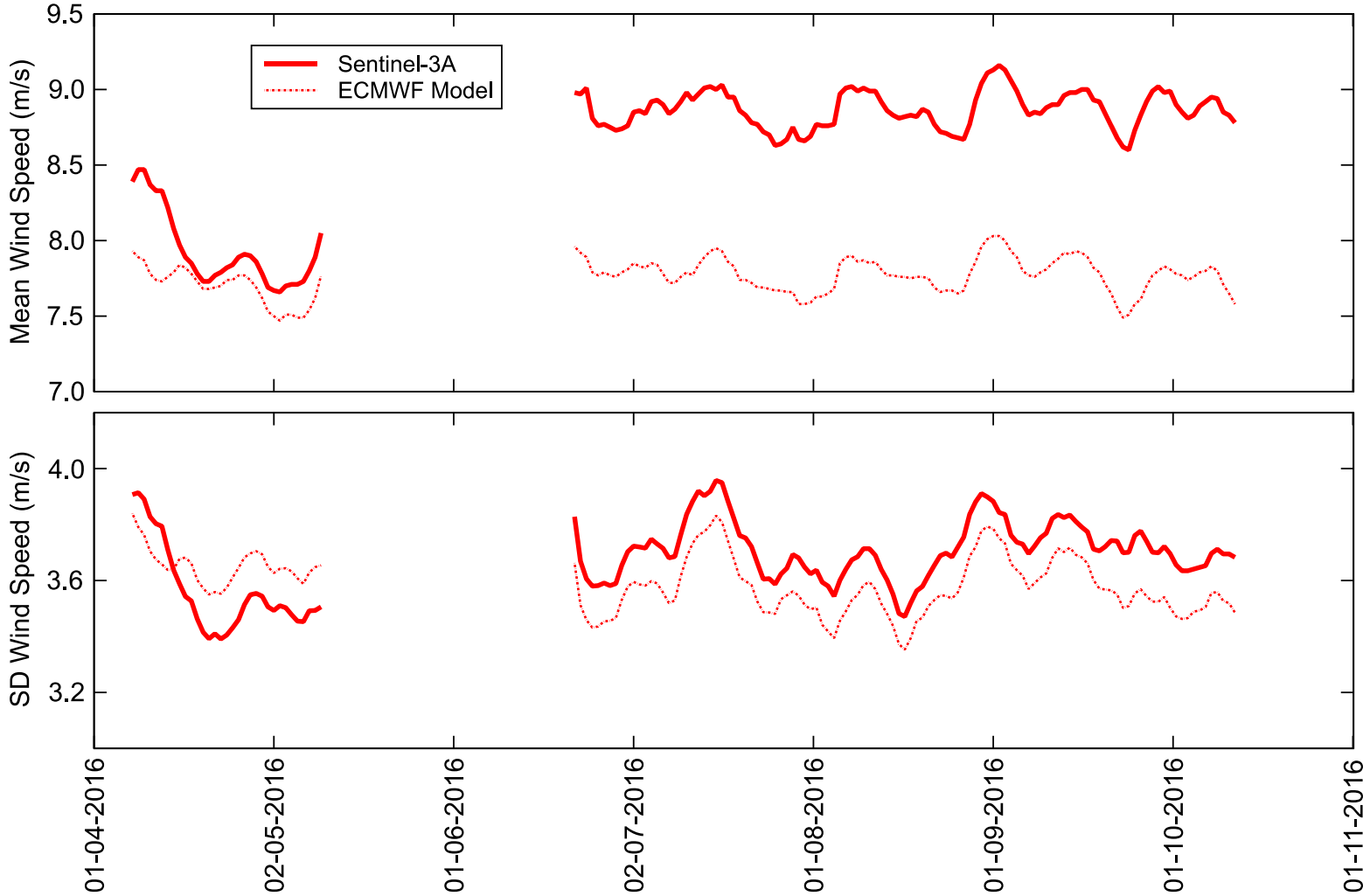


Surface Wind Speed

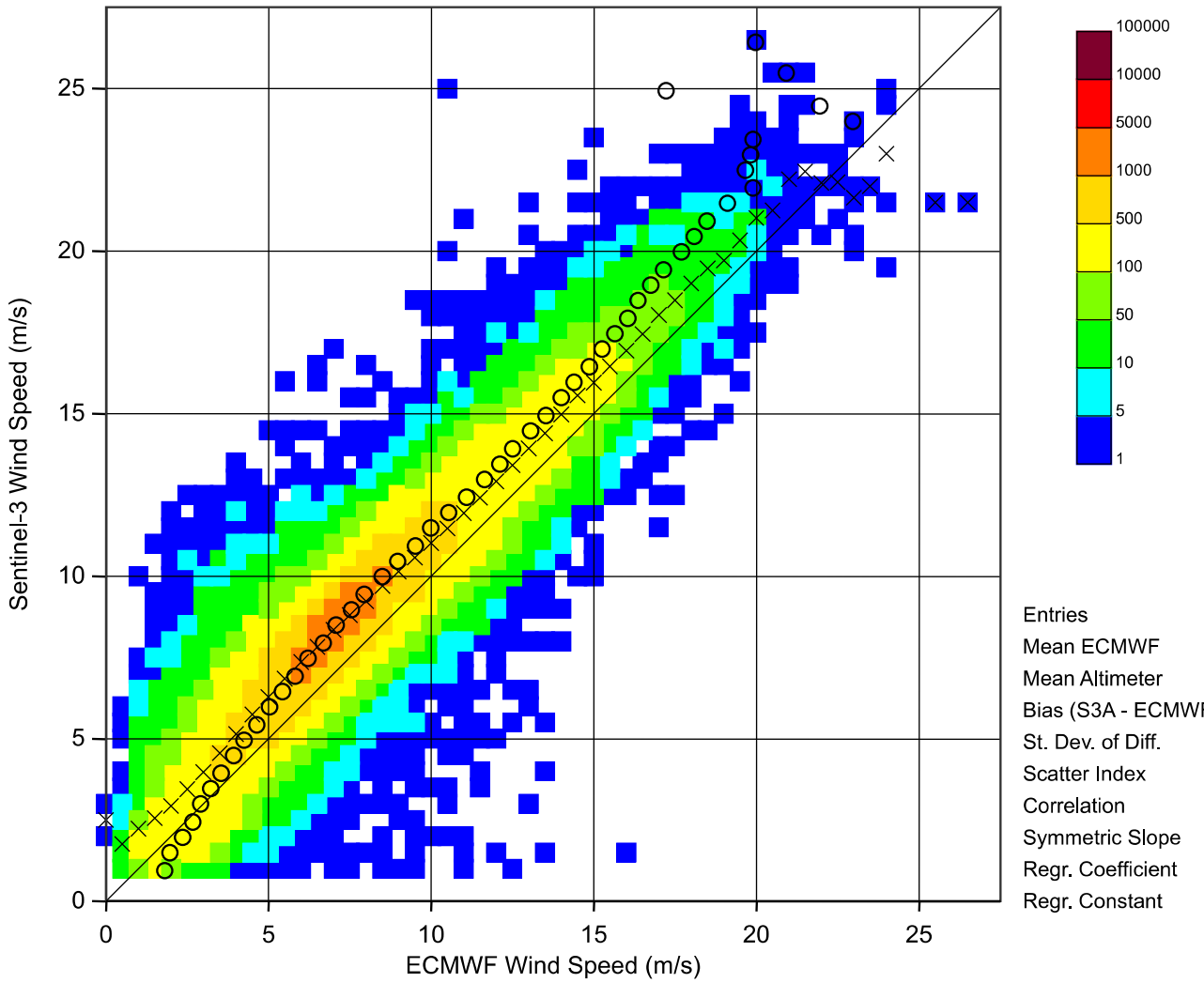
- Stable since late June 2016.
- Too high by ~ 1.0 m/s.
- Slightly noisier than the other altimeters.
- Possibly due to backscatter.
- Needs some tuning.

Surface wind speed stable since late June 2016
but it is ~ 1 m/s too high



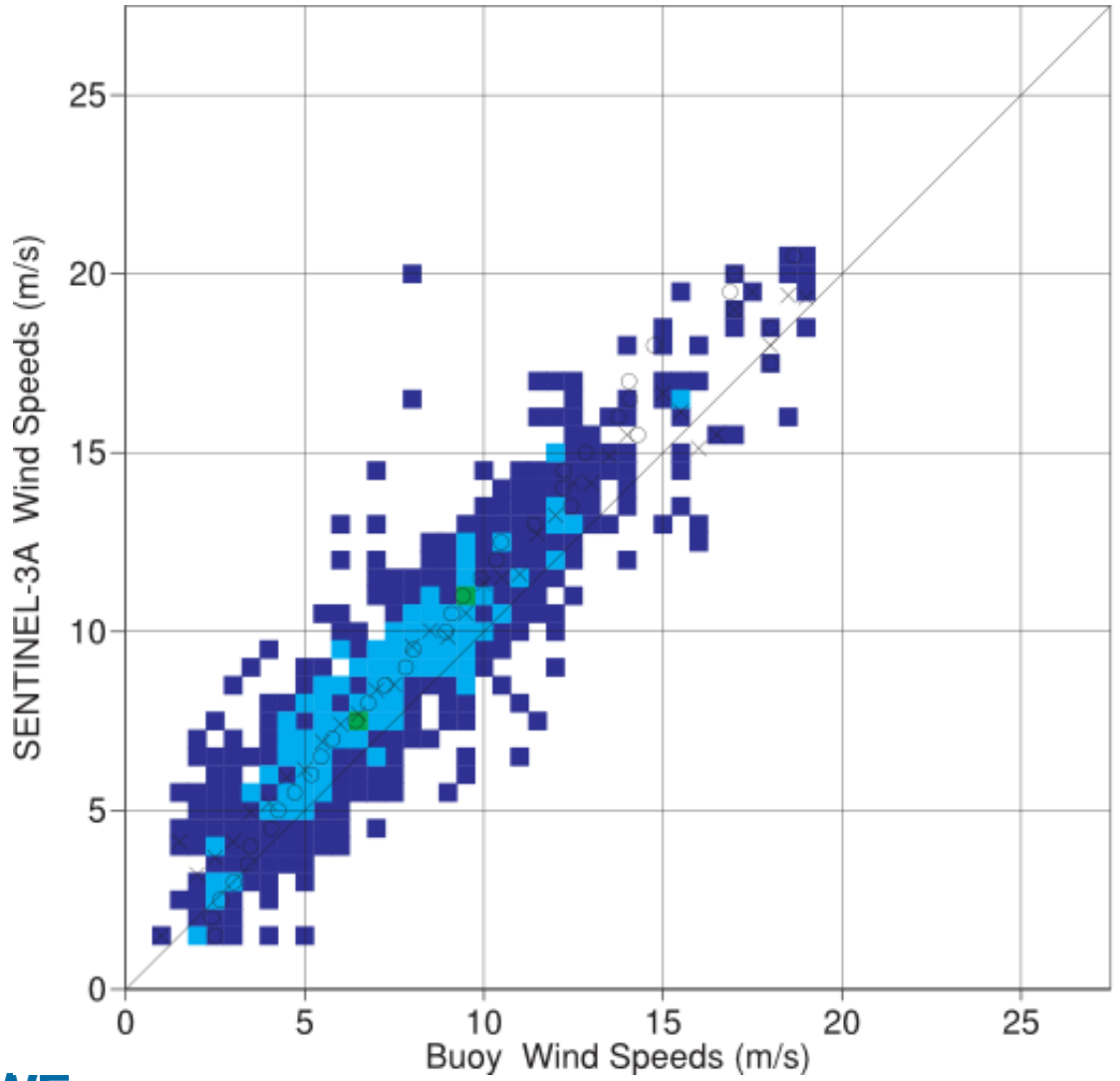


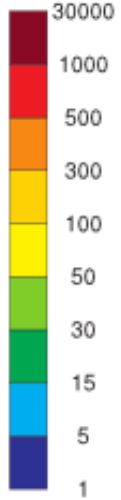
Global wind speed comparison between SRAL & ECMWF model (Cycle 9)



Entries	112057
Mean ECMWF	7.6768
Mean Altimeter	8.8320
Bias (S3A - ECMWF)	1.1552
St. Dev. of Diff.	1.3270
Scatter Index	0.1729
Correlation	0.9334
Symmetric Slope	1.1338
Regr. Coefficient	0.9806
Regr. Constant	1.3041

Global wind speed comparison between SRAL & buoys September 2016

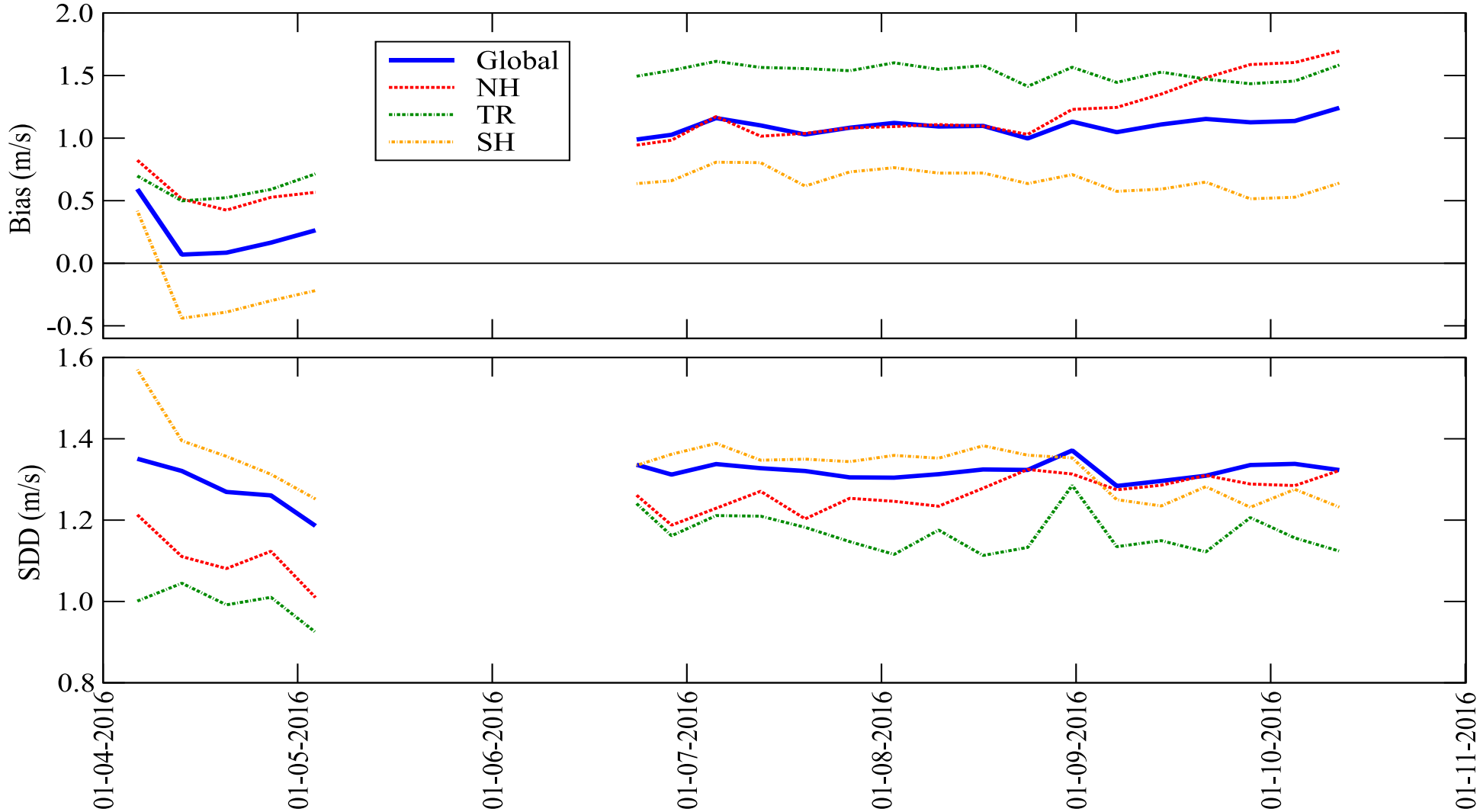




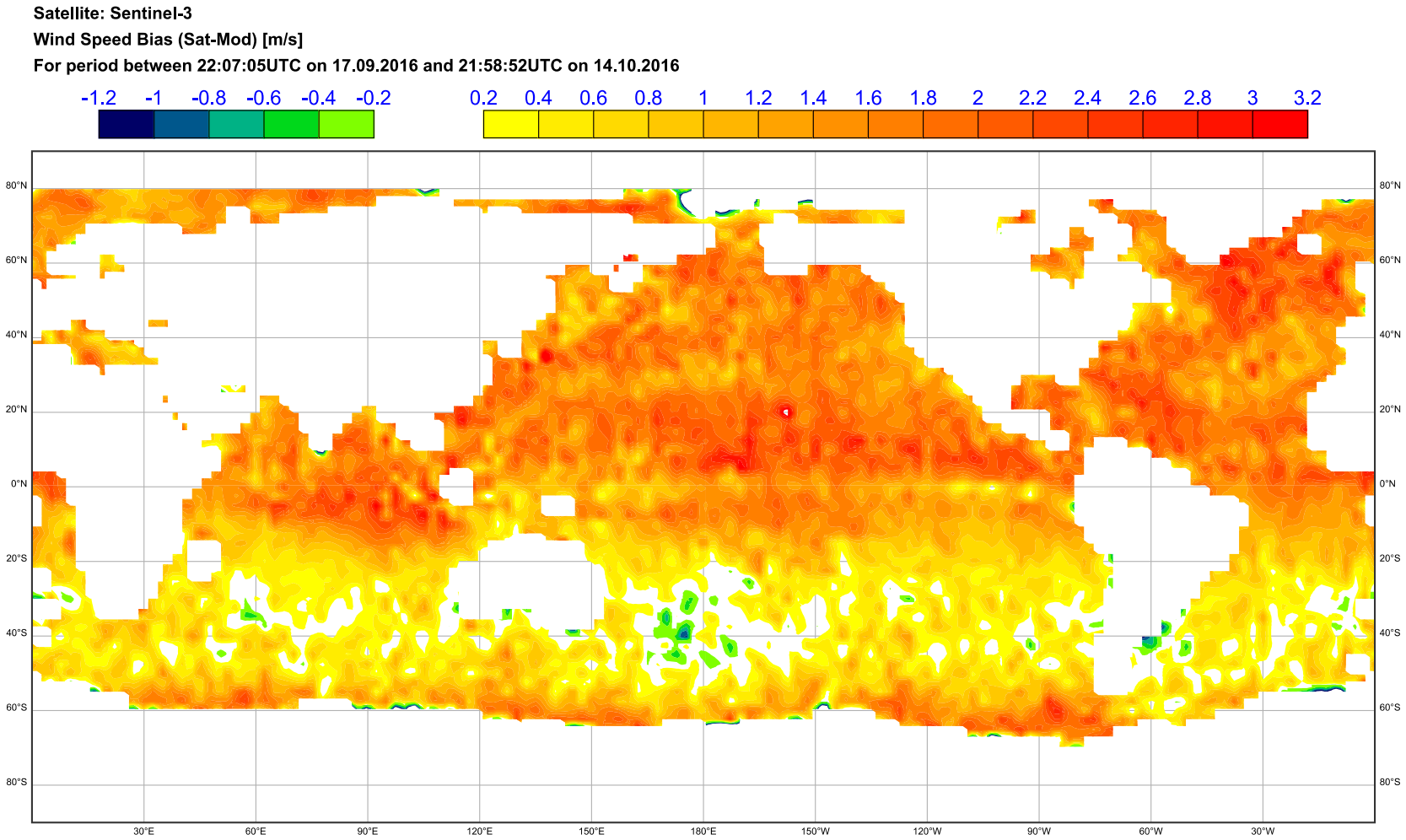
STATISTICS

ENTRIES	1080
MEAN BUOY	7.9142
MEAN SENTINEL-3A	9.1248
BIAS (SENTINEL-3A - BUOY)	1.2106
STANDARD DEVIATION	1.5063
SCATTER INDEX	0.1903
CORRELATION	0.9169
SYMMETRIC SLOPE	1.1395
REGR. COEFFICIENT	0.9801
REGR. CONSTANT	1.3685

Time series of SRAL wind speed Bias and SDD w.r.t. ECMWF model



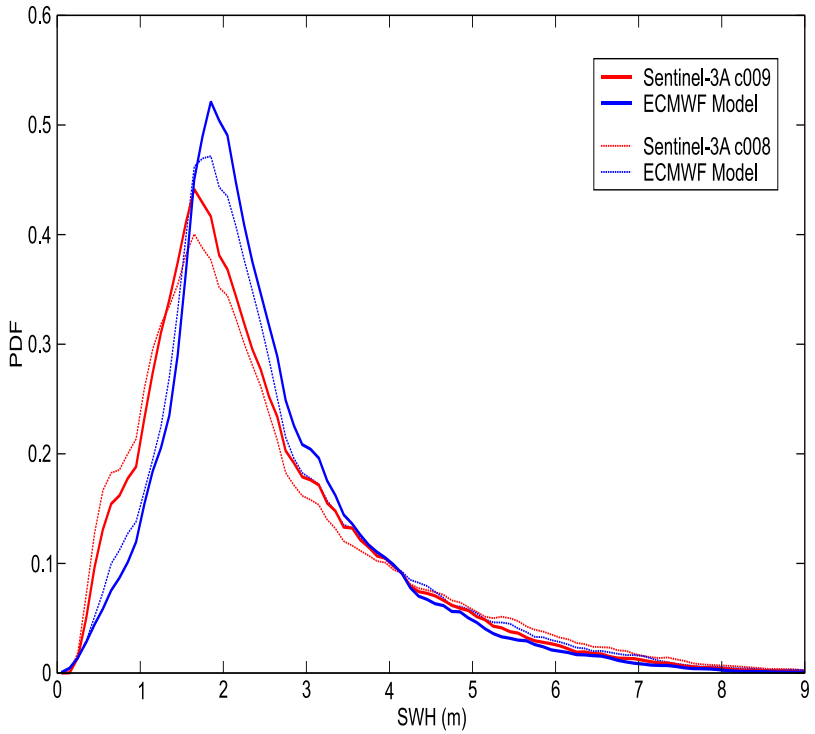
SRAL wind speed bias w.r.t. ECMWF model over Cycle 9

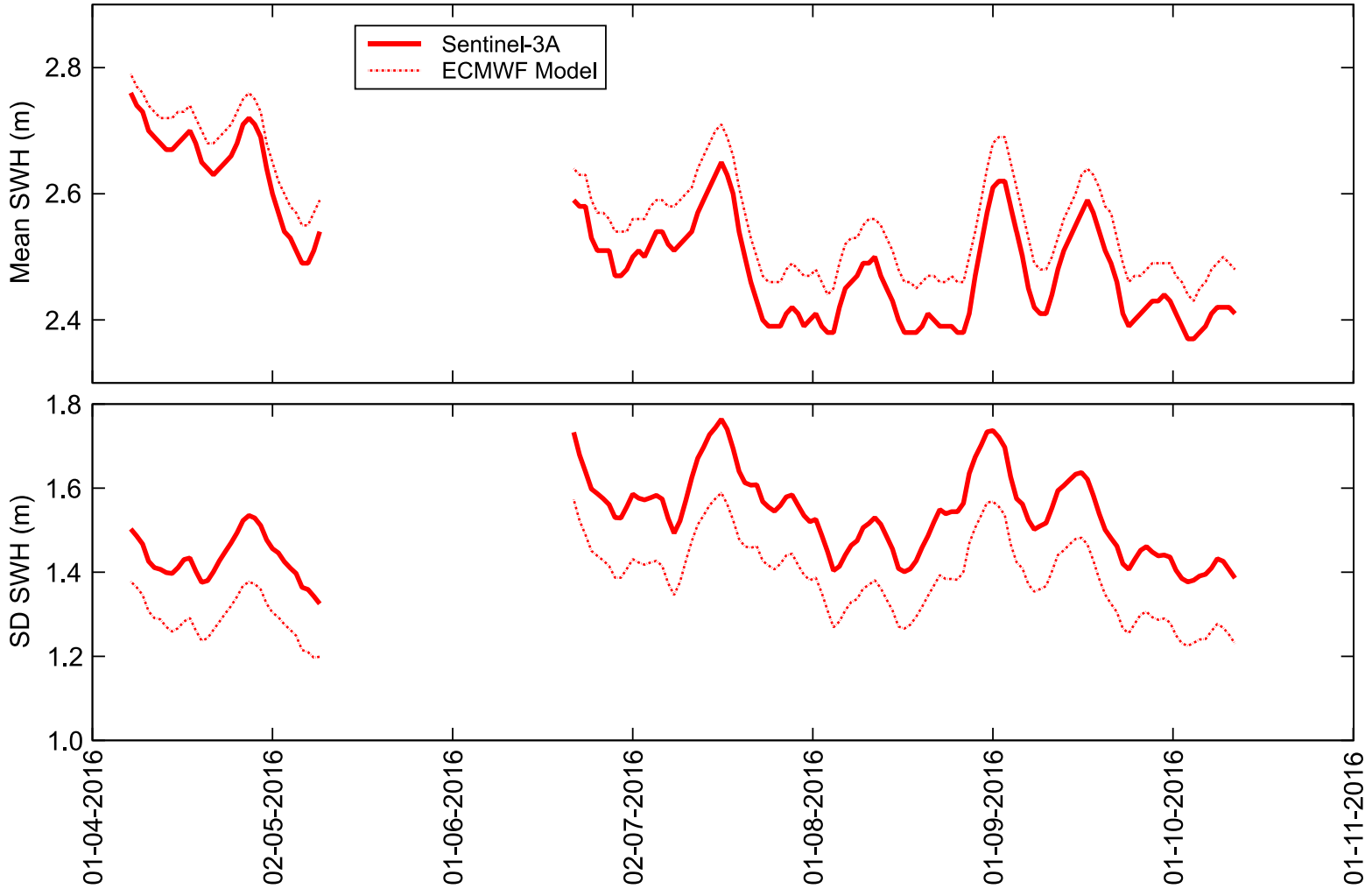


Significant Wave Height (SWH)

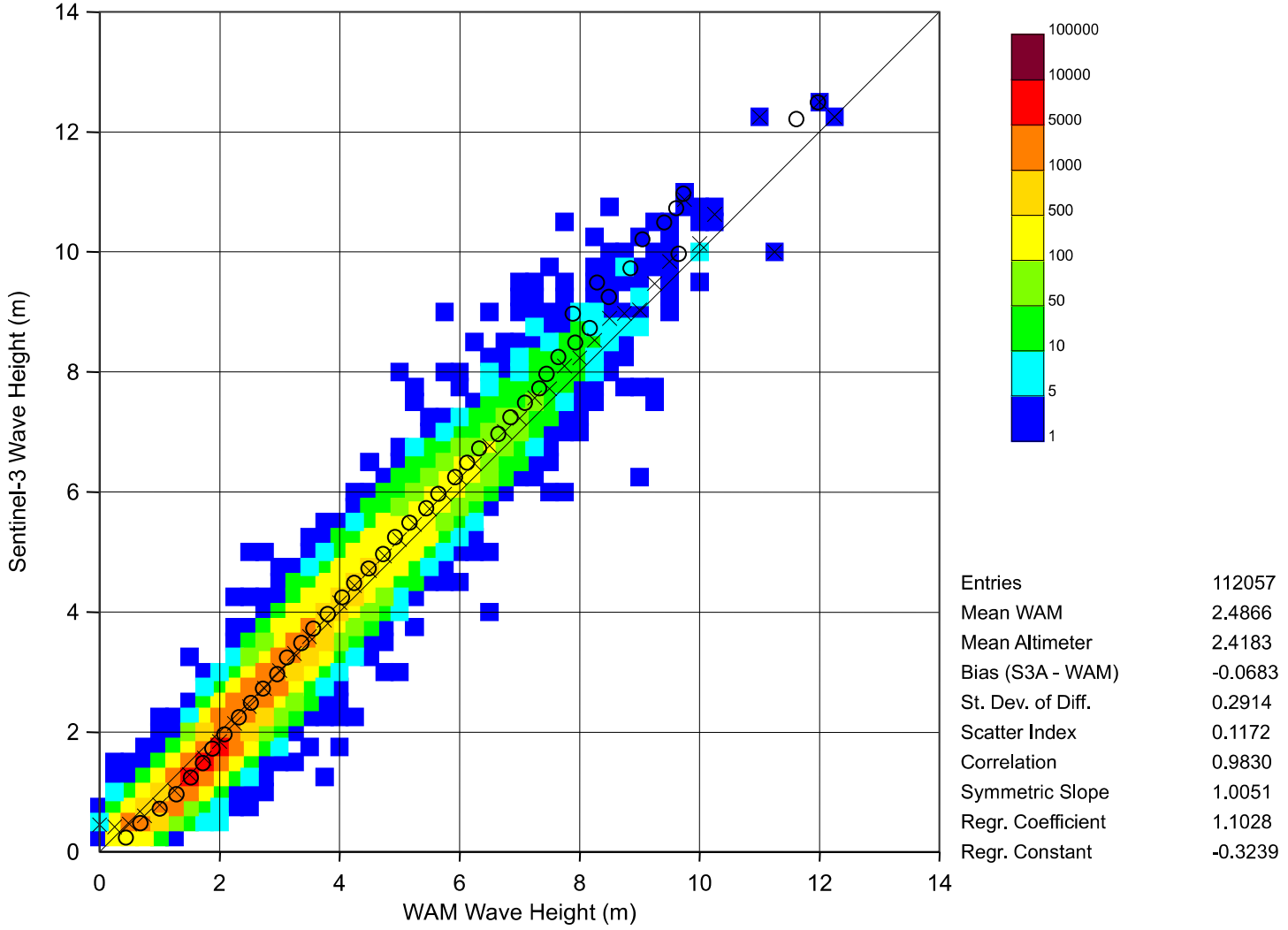
- Stable since late June 2016.
- Overall, underestimates SWH by ~6 cm (very small); but
- Underestimates low SWH (< ~2 m) & overestimate high SWH (> ~5 m).
- For SWH of 1 m, the underestimation is the worst (~25%).
- Slightly noisier than the other altimeters.
- There is some indication that swell has an adverse impact on SAR SWH.
- Although the product is suitable for practical applications, it still needs some fine tuning.

SWH is (almost) stable since late June 2016
but it underestimates low SWH & overestimates high SWH



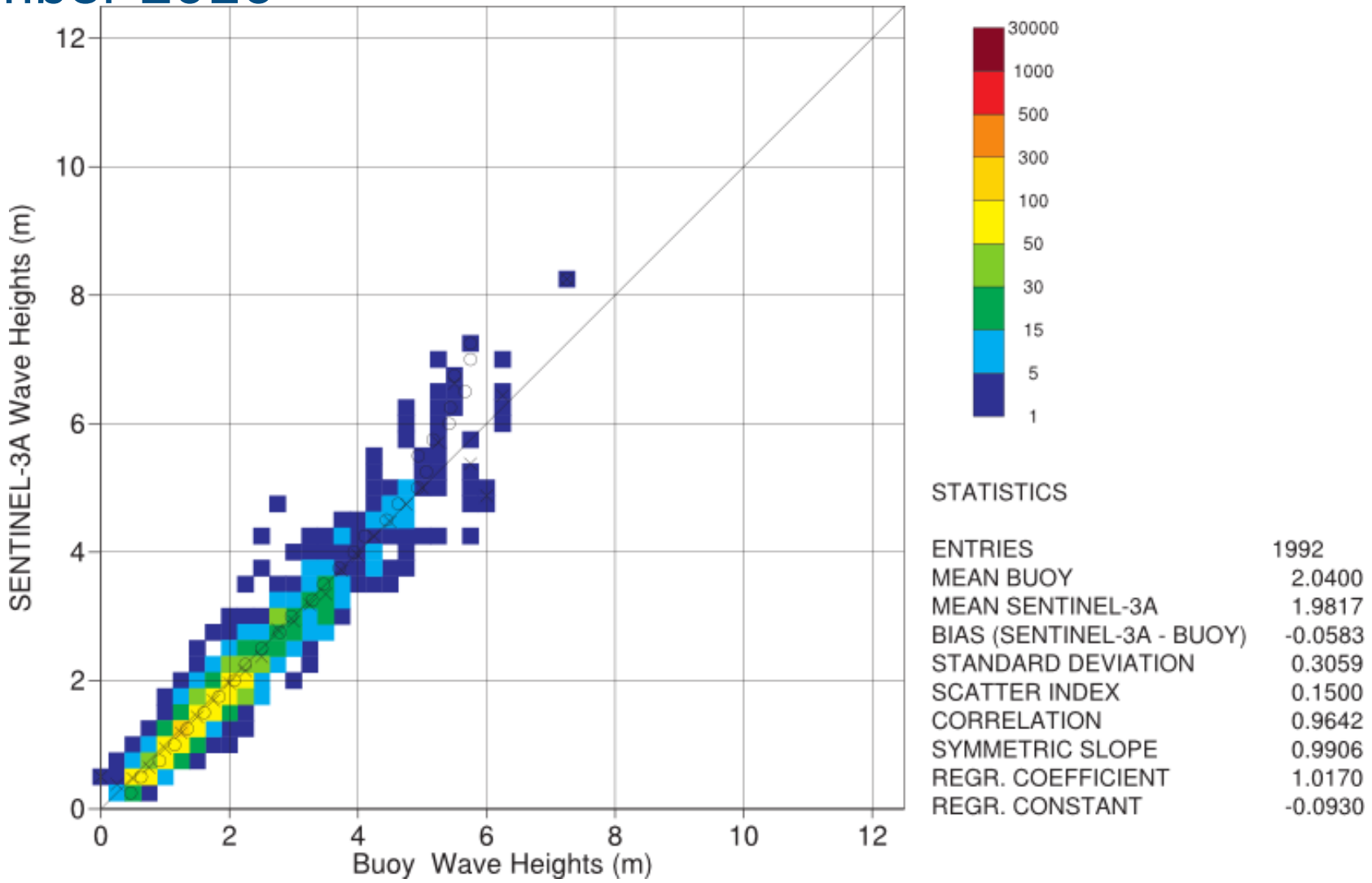


Global SWH comparison between SRAL & ECMWF model (Cycle 9)



Entries	112057
Mean WAM	2.4866
Mean Altimeter	2.4183
Bias (S3A - WAM)	-0.0683
St. Dev. of Diff.	0.2914
Scatter Index	0.1172
Correlation	0.9830
Symmetric Slope	1.0051
Regr. Coefficient	1.1028
Regr. Constant	-0.3239

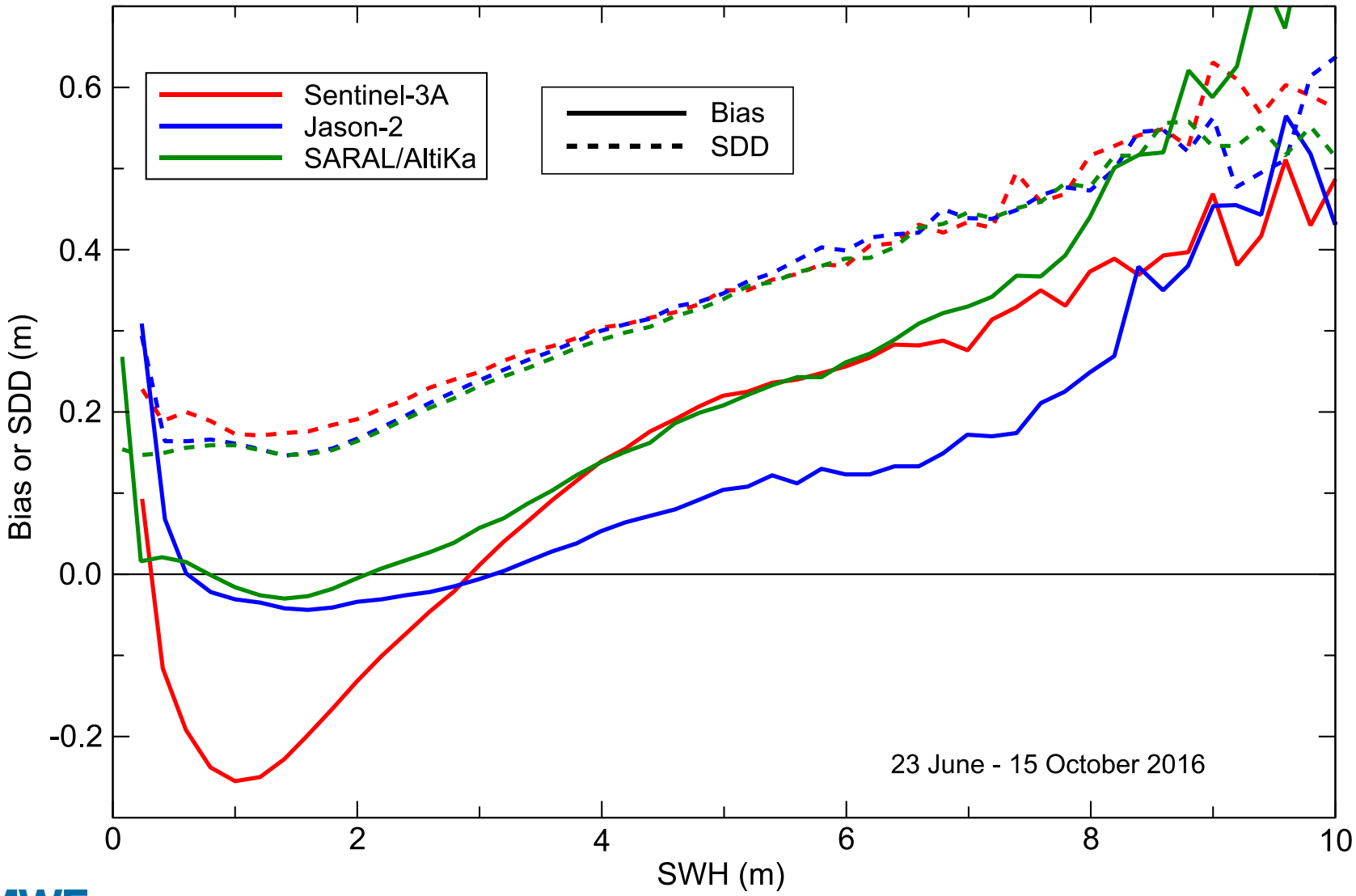
Global SWH comparison between SRAL & buoys September 2016



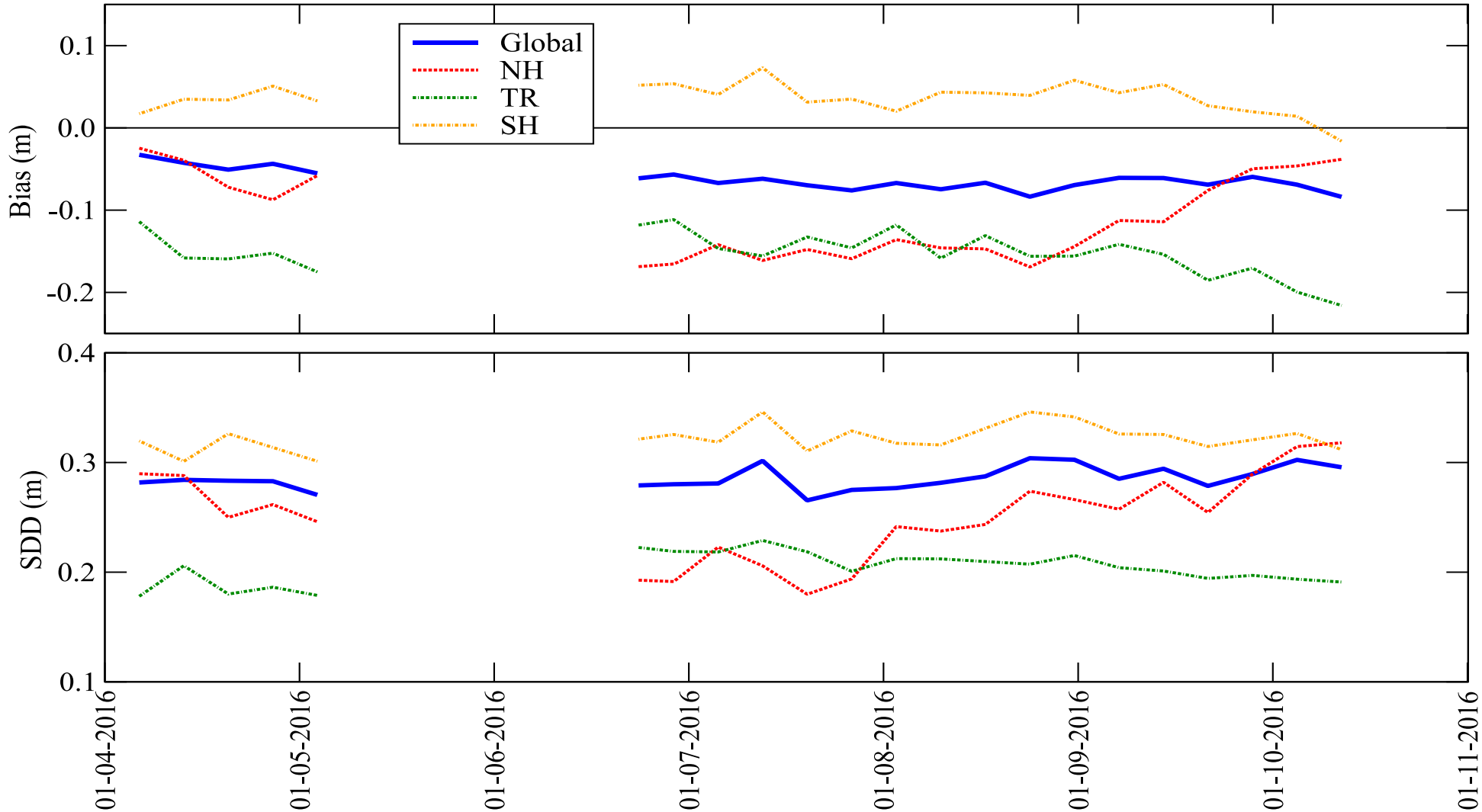
STATISTICS

ENTRIES	1992
MEAN BUOY	2.0400
MEAN SENTINEL-3A	1.9817
BIAS (SENTINEL-3A - BUOY)	-0.0583
STANDARD DEVIATION	0.3059
SCATTER INDEX	0.1500
CORRELATION	0.9642
SYMMETRIC SLOPE	0.9906
REGR. COEFFICIENT	1.0170
REGR. CONSTANT	-0.0930

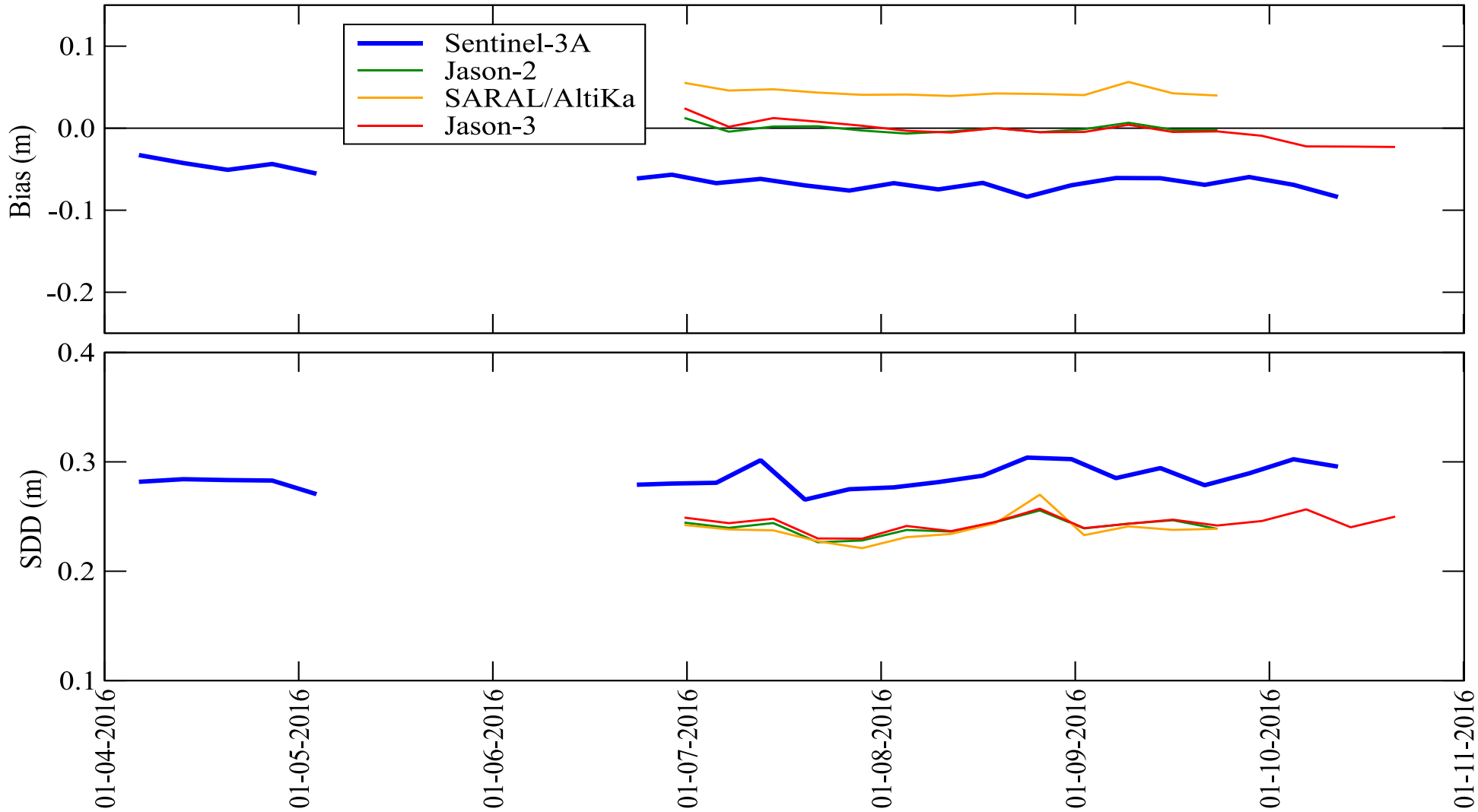
SRAL SWH bias and SDD w.r.t. ECMWF model as fuctions of SWH



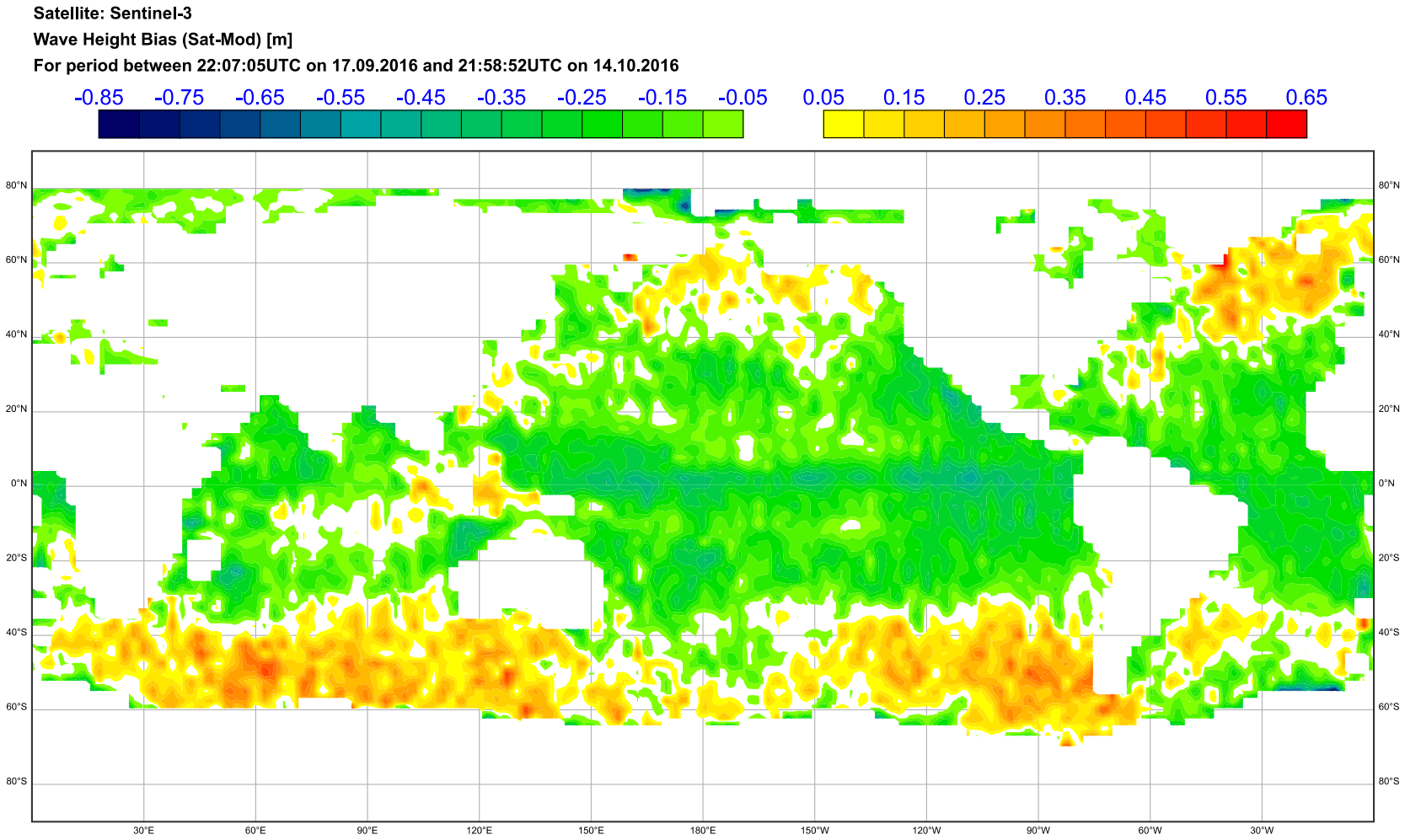
Time series of SRAL SWH Bias and SDD w.r.t. ECMWF model



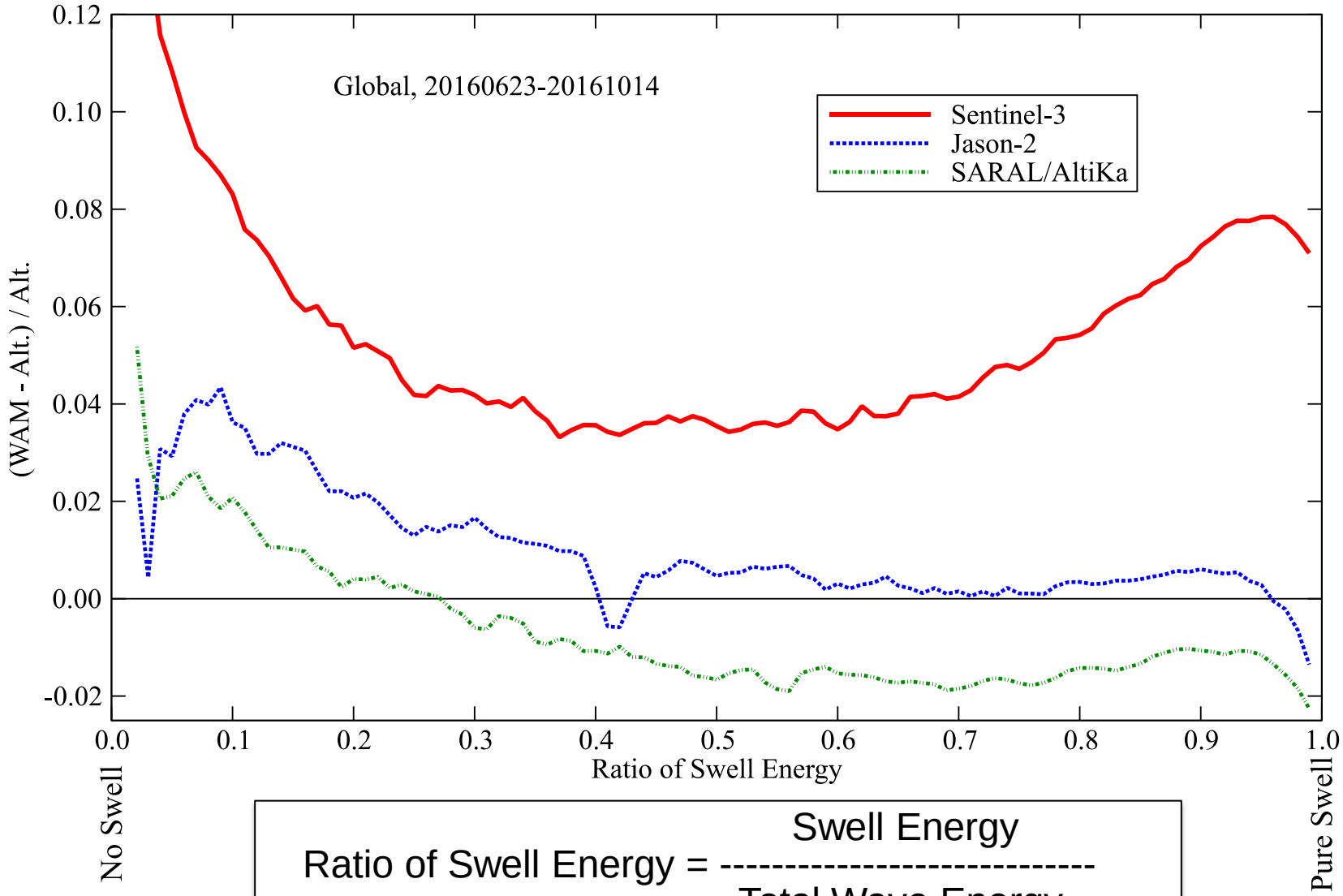
Time series of SRAL SWH Bias and SDD w.r.t. ECMWF model



SRAL SWH bias w.r.t. ECMWF model over Cycle 9

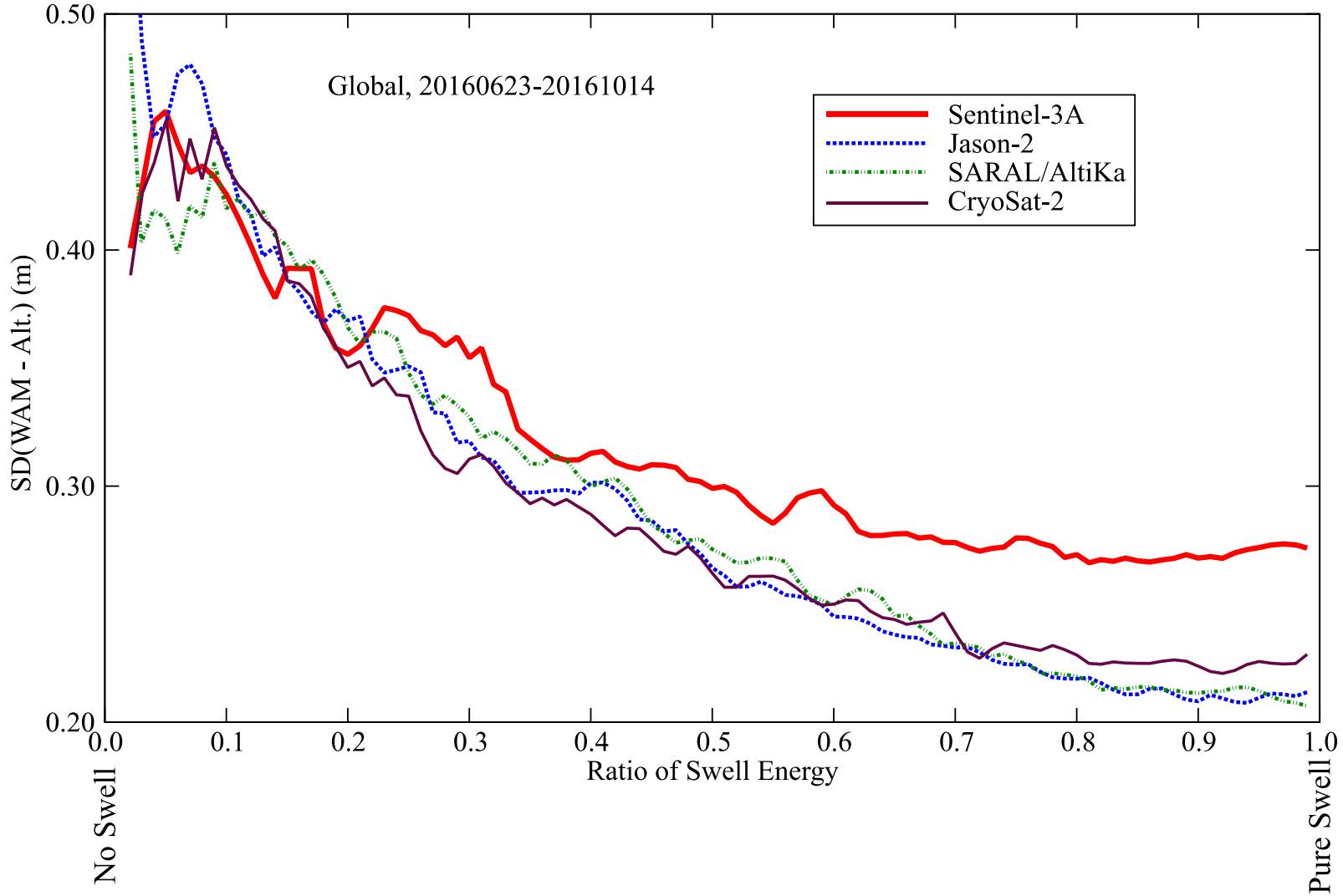


Variation of the Relative Difference w.r.t. Swell Ratio



$$\text{Ratio of Swell Energy} = \frac{\text{Swell Energy}}{\text{Total Wave Energy}}$$

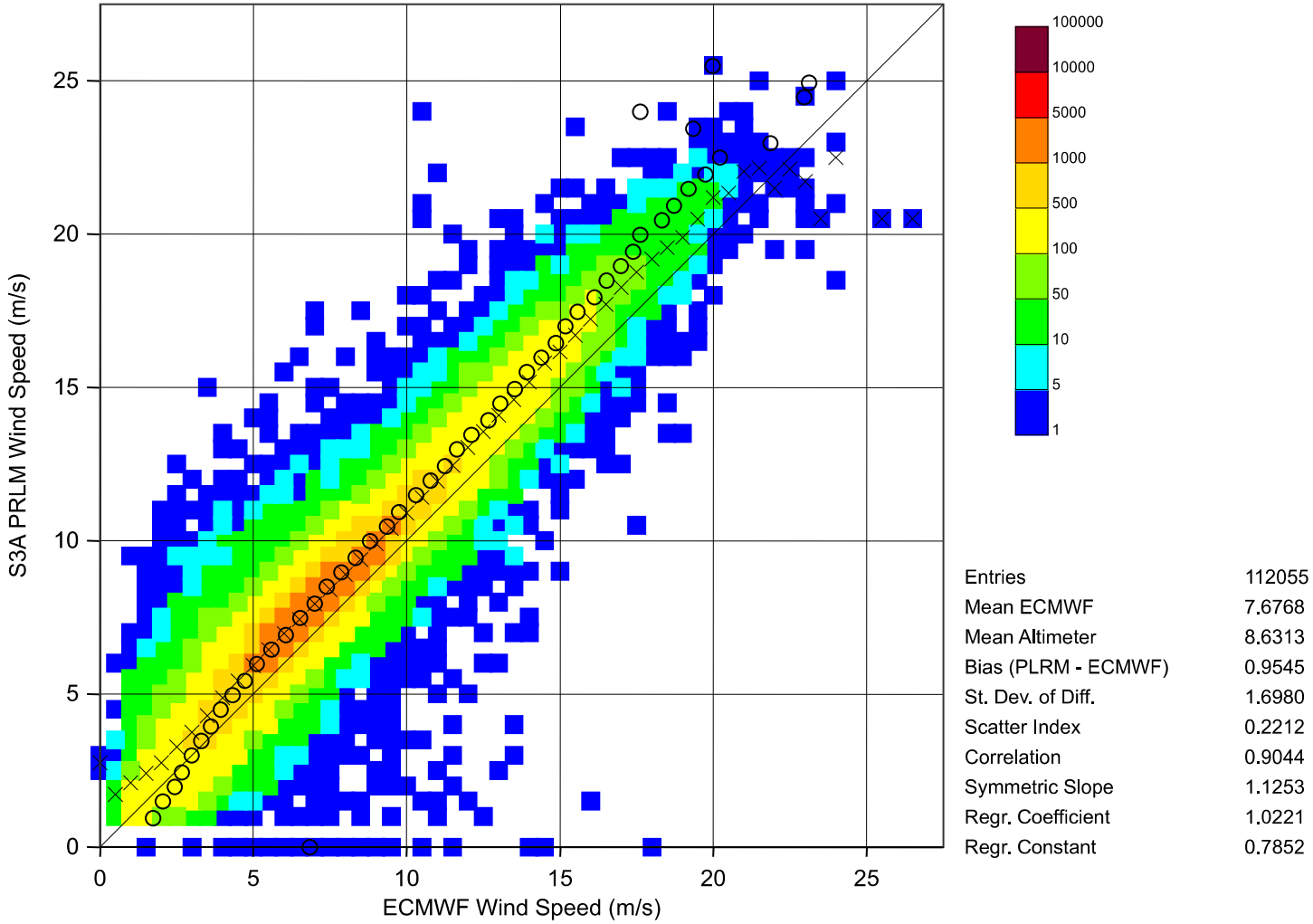
Variation of the St. Dev. of Difference (SDD) w.r.t. Swell Ratio



PLRM Surface Wind Speed

- Similar to the SAR mode wind speed
- Needs some tuning.

Global wind speed comparison between SRAL PLRM & ECMWF model (Cycle 9)



Entries	112055
Mean ECMWF	7.6768
Mean Altimeter	8.6313
Bias (PLRM - ECMWF)	0.9545
St. Dev. of Diff.	1.6980
Scatter Index	0.2212
Correlation	0.9044
Symmetric Slope	1.1253
Regr. Coefficient	1.0221
Regr. Constant	0.7852

Concluding Remarks – SRAL NRT Products

Backscatter:

- Stable since late June 2016.
- Lower than other altimeters.

Surface Wind Speed (both SAR & PLRM):

- Stable since late June 2016.
- Too high by ~ 1.0 m/s and slightly noisier than the other altimeters.

Significant Wave Height (SWH):

- Stable since late June 2016 but slightly noisier than the other altimeters.
- Underestimates low SWH (< ~2 m) & overestimate high SWH (> ~5 m).
- Possible adverse swell impact on SAR SWH.

Although the products are suitable for practical applications, they need some tuning.