Royal Netherlands
Meteorological Institute
Ministry of Infrastructure and the Environment

Calibration, Validation and Status of OSI SAF ScatSat-1 products

EUMETSAT OSI SAF OCEAN AND SEA ICE

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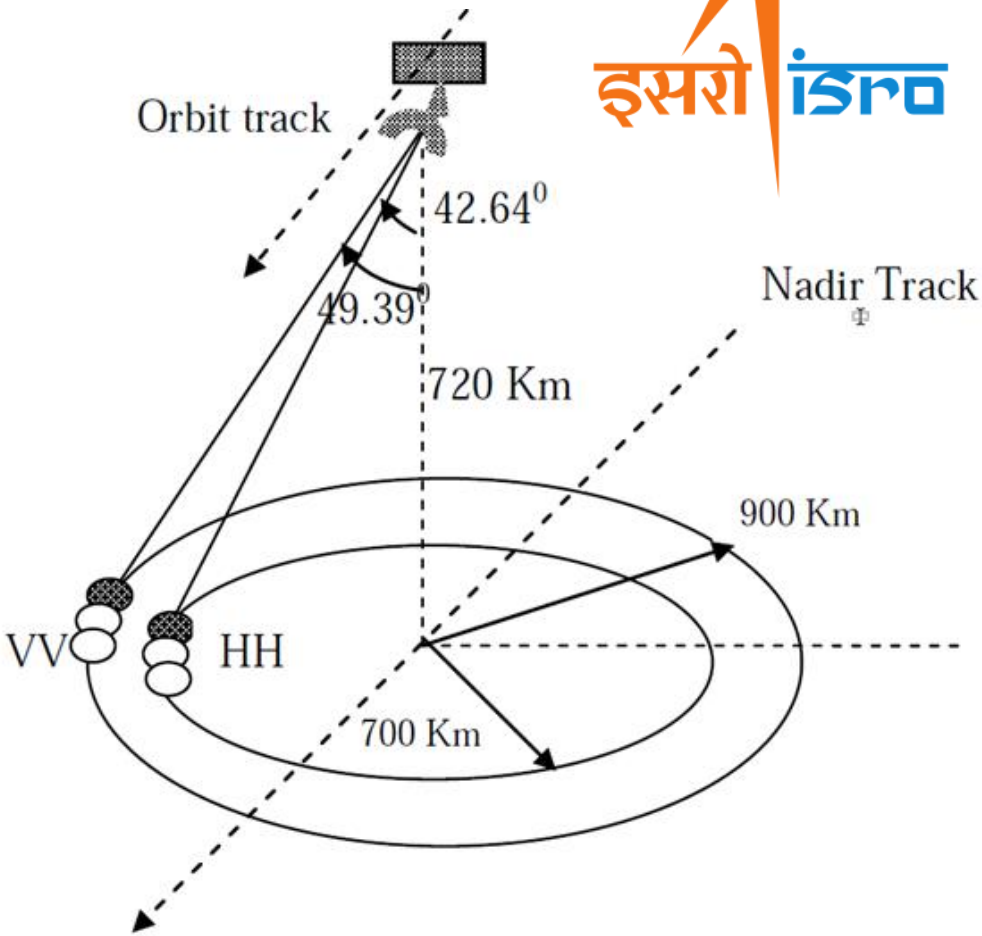
Outline

- ScatSat-1 mission
- Current status of wind products at KNMI/OSI SAF
- Calibration of backscatter slices and eggs
- Differences between versions 1.1.2 and 1.1.3
- Calibration of high winds
- Wind validation results
- Summary and conclusions

Introduction

- The ScatSat-1 satellite was launched by ISRO on September 26th, 2016
- OSCAT on ScatSat-1 is similar to OSCAT on Oceansat-2 (2009 – 2014), with some improvements
- Orbit is close to ASCAT-A and B so we get many collocations
- KNMI/OSI SAF near-real time winds are being produced and since September 2017 they are available to external users for evaluation and feedback
- End of March 2018 ISRO has upgraded from data version 1.1.2 to 1.1.3

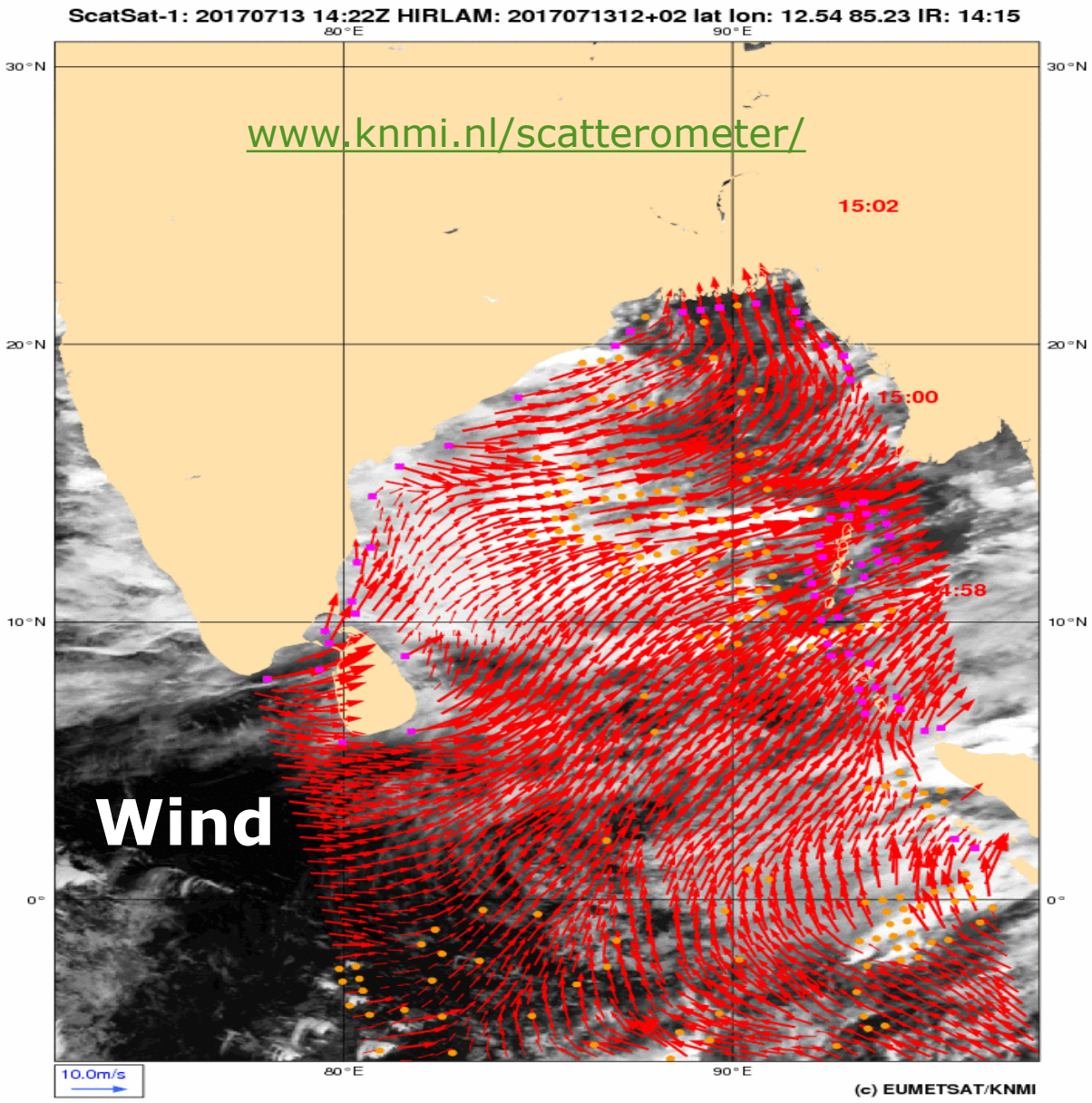


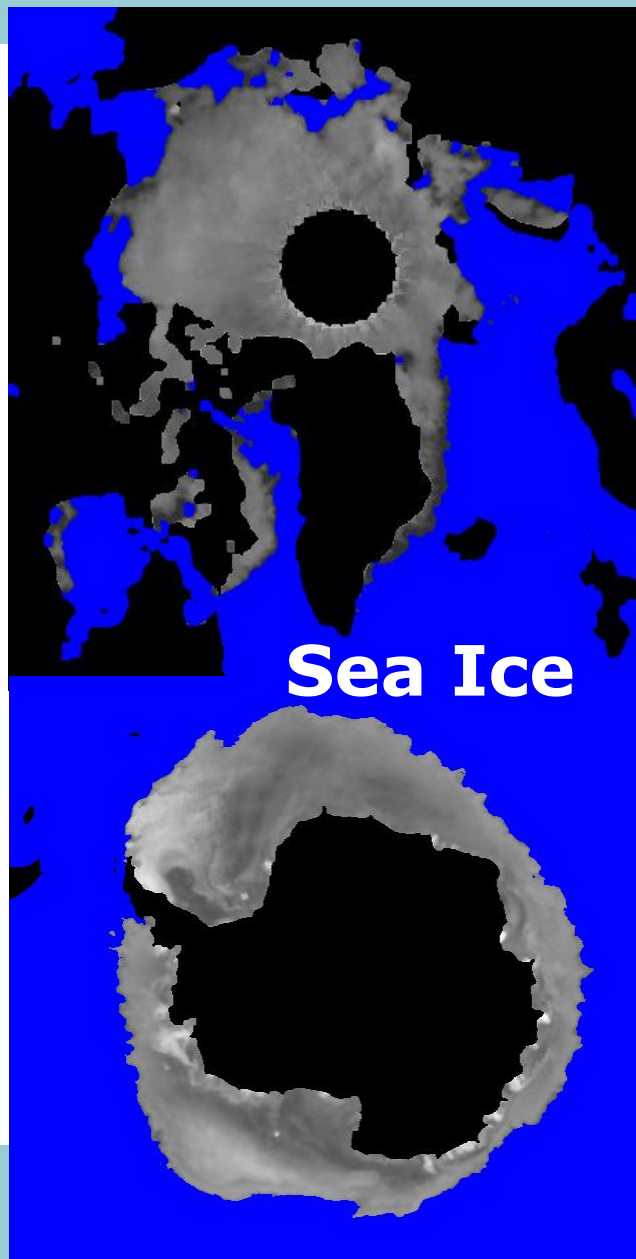
Introduction

- Data are being processed with the existing PenWP software package that has also been used for QuikSCAT, Oceansat-2 and RapidScat
- Our premise is that for given wavelength, polarization and geometry, σ^0 should be identical in identical geophysical conditions and independent of instrument settings
- Then we can compare ScatSat-1 behavior with QuikSCAT, Oceansat-2, and RapidScat for a given Geophysical Model Function (GMF, NSCAT-4) and NWP input
- First order σ^0 calibration corrections are being done by adding a constant dB value, dependent on polarization, to the input σ^0s; this minimizes the wind biases w.r.t. ECMWF and buoy winds

- Corrections are +0.61 dB for HH and -0.03 dB for VV (v1.1.2)
- Corrections are +1.14 dB for HH and +0.41 dB for VV (v1.1.3)

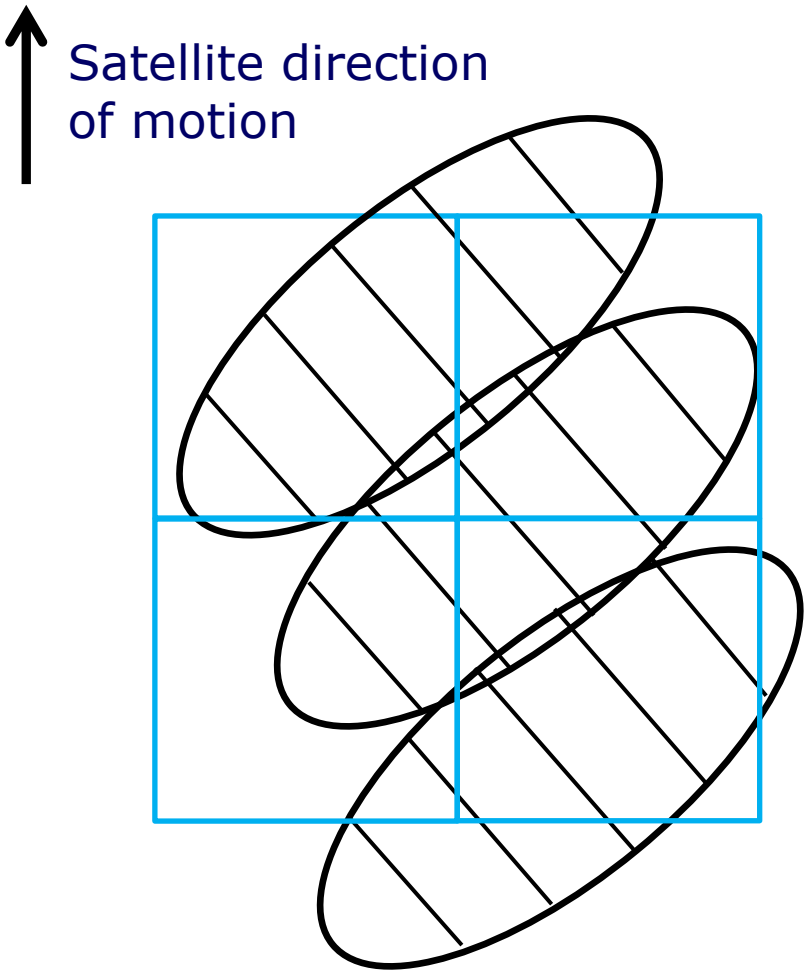
Products visualization





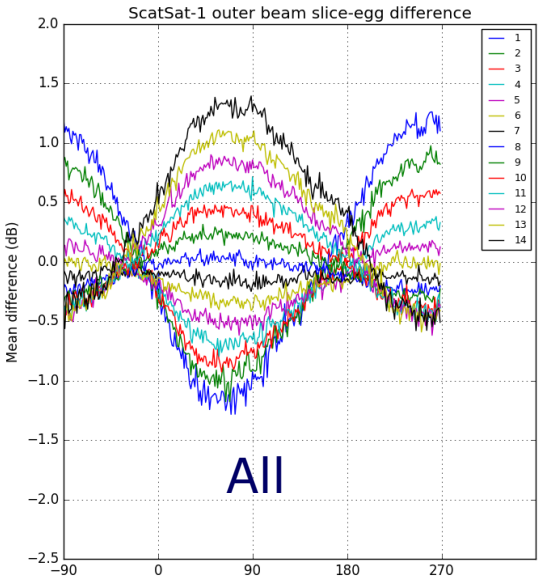
Egg or slice processing

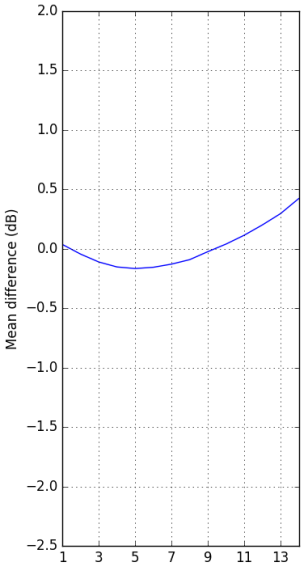
- The Level 1B data from ISRO contain both ‘egg’ sigma0 and ‘slice’ sigma0 data, we can choose to process either of the two
- Slices are obtained by signal return time discrimination
- Sigma0 observations are dropped in the nearest Wind Vector Cell and averaged
- Slices result in higher resolution winds since there is less overlap in neighbouring WVCs

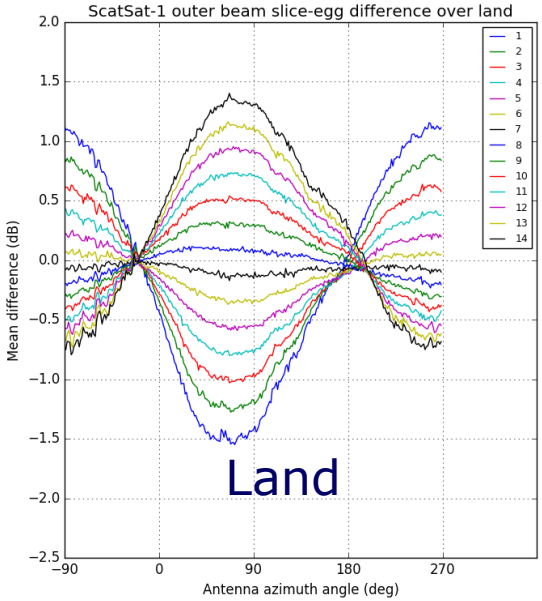


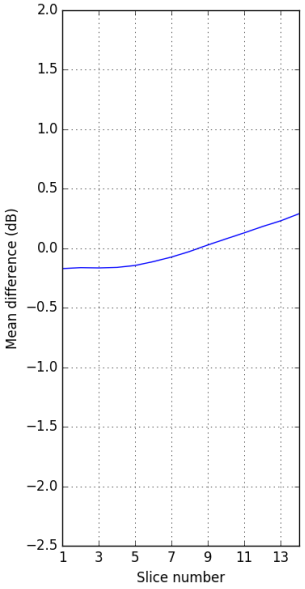
ScatSat-1 v1.1.2 outer beam slice balance

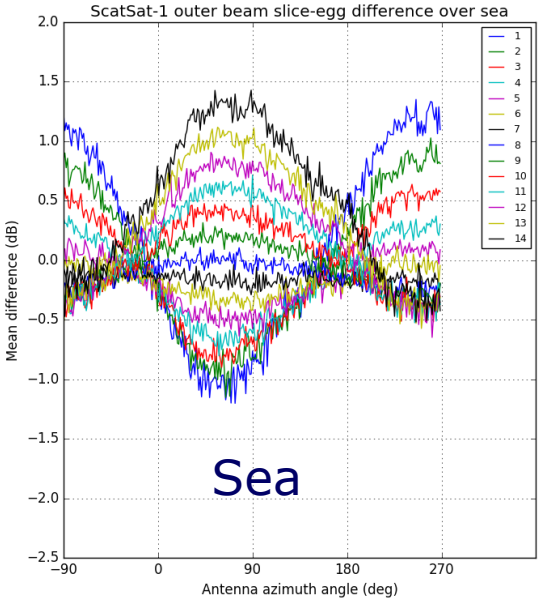
- Divide slice σ^0 / egg σ^0 (in linear space)
- Accumulate and average differences per slice number and azimuth over 2 days
- Substantial modulation with azimuth, almost 3 dB
- Modulation is corrected for

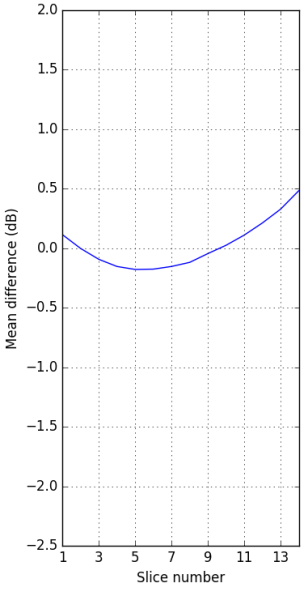






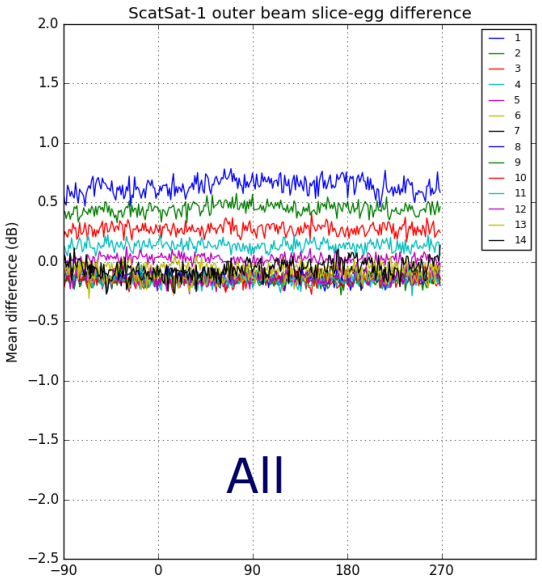


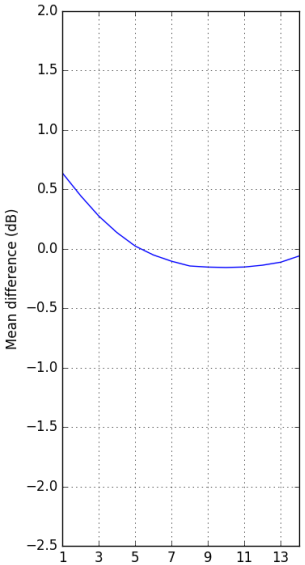


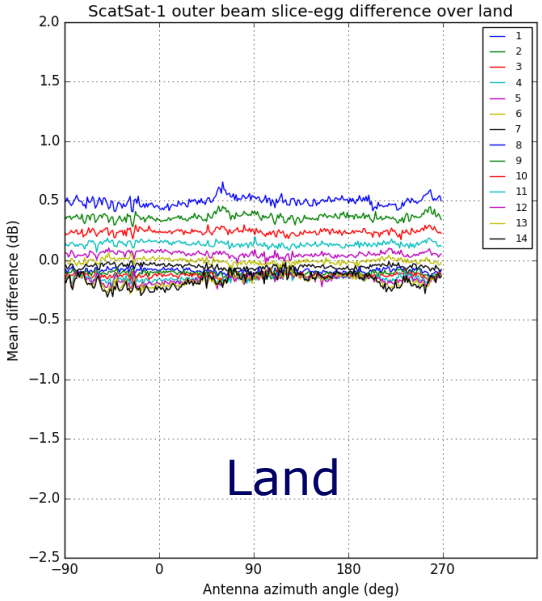


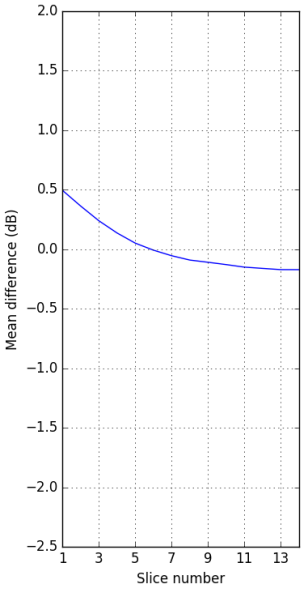
ScatSat-1 v1.1.3 outer beam slice balance

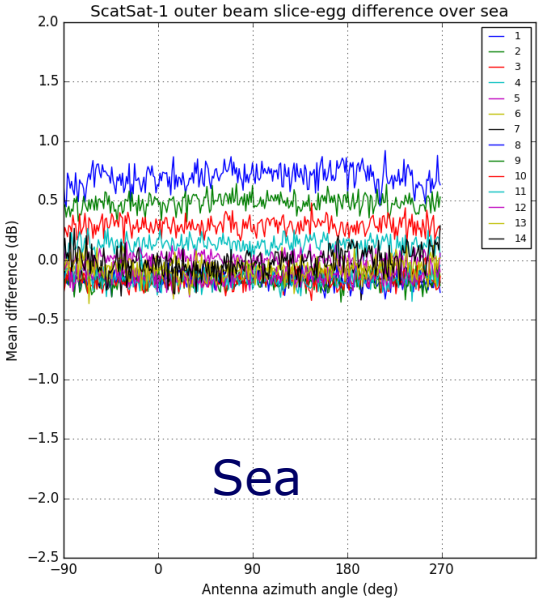
- Azimuthal variations have disappeared!
- Some slice/range dependencies remain

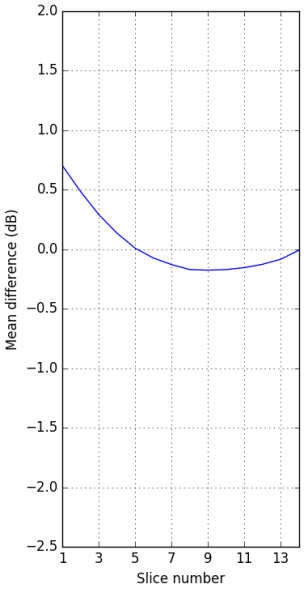






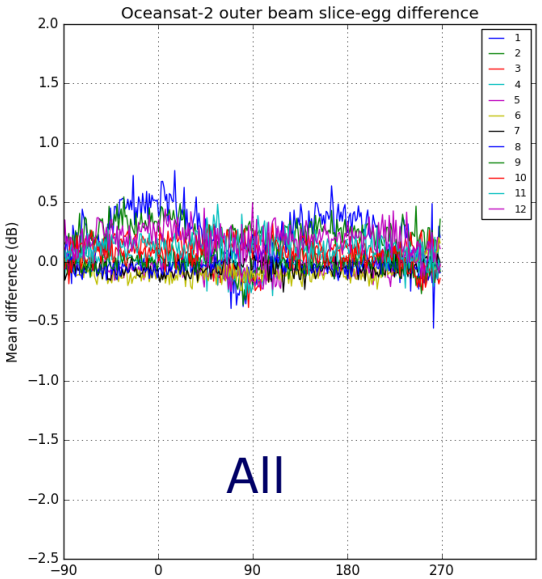


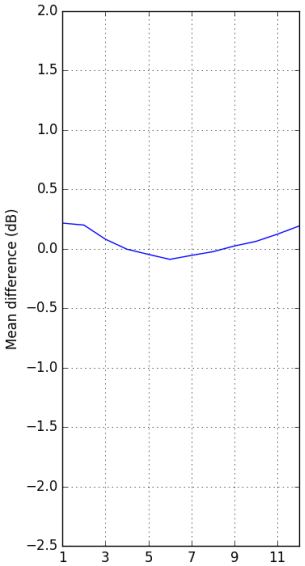


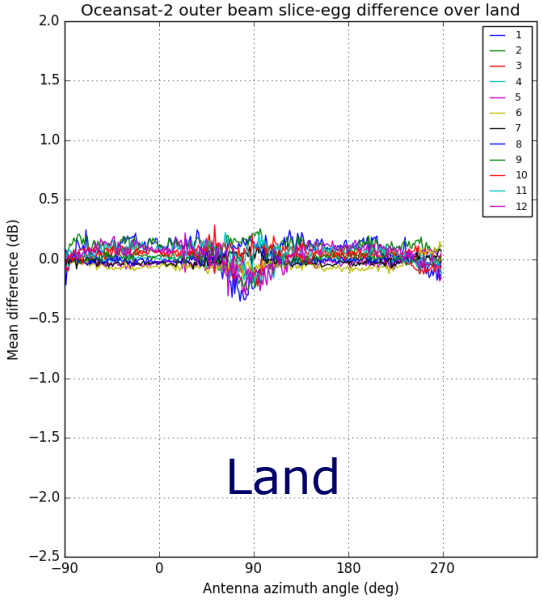


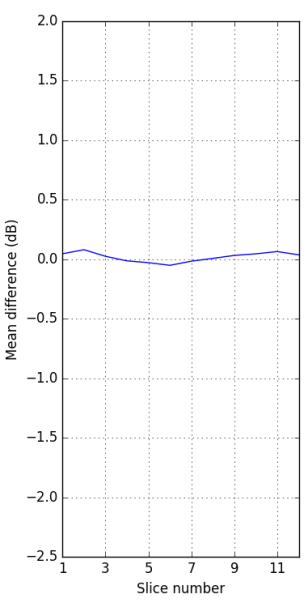
Oceansat-2 outer beam slice balance

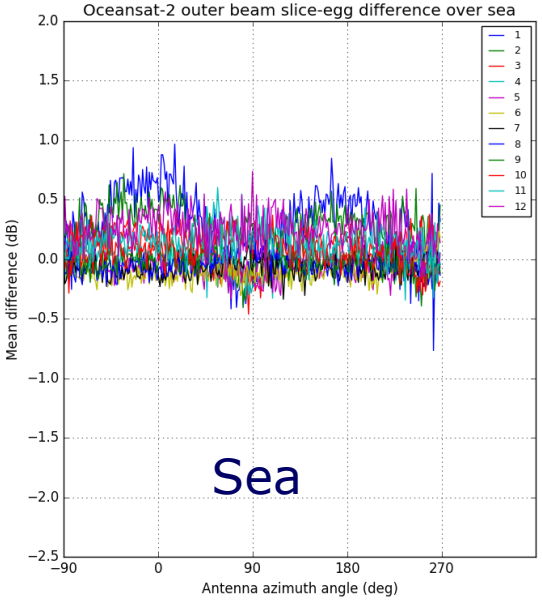
- Only limited slice and azimuth effects over sea
- Very similar to QuikSCAT

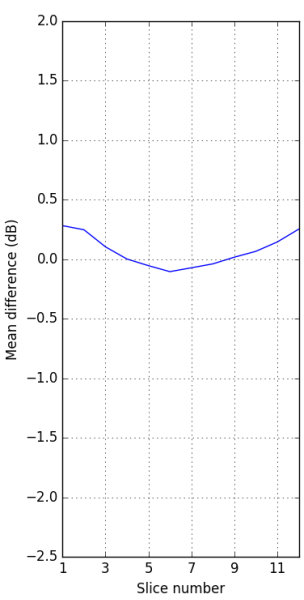






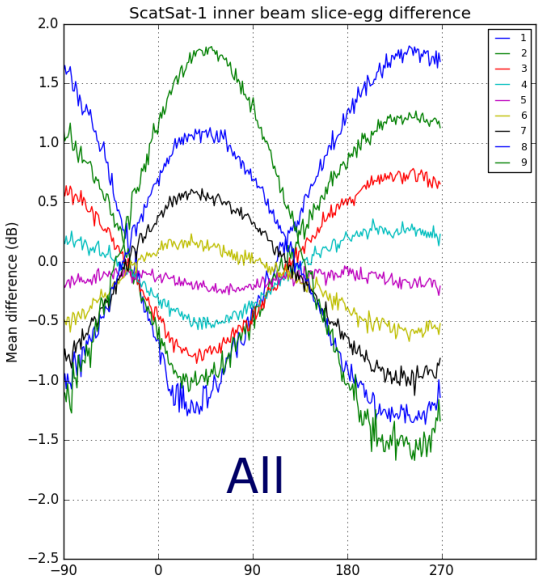


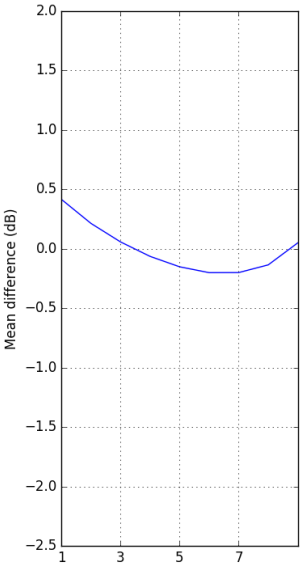


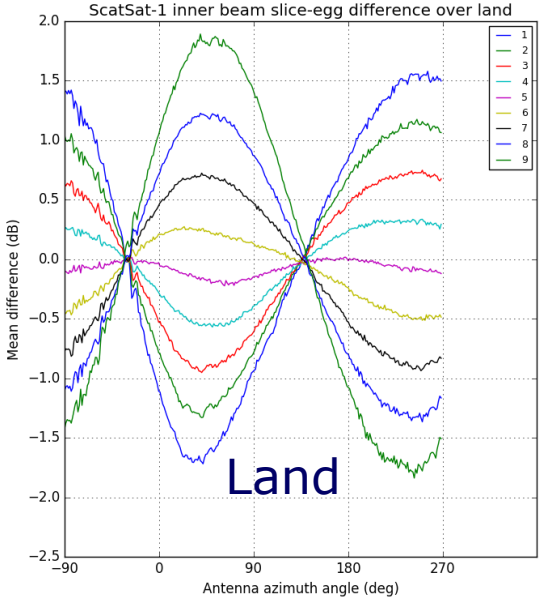


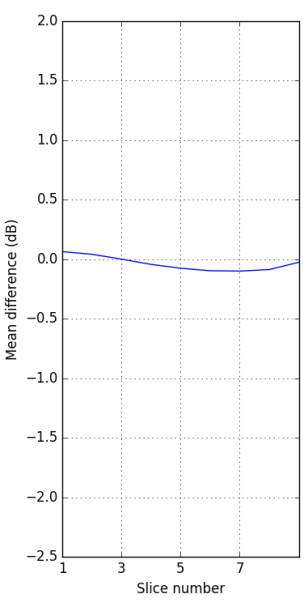
ScatSat-1 v1.1.2 inner beam slice balance

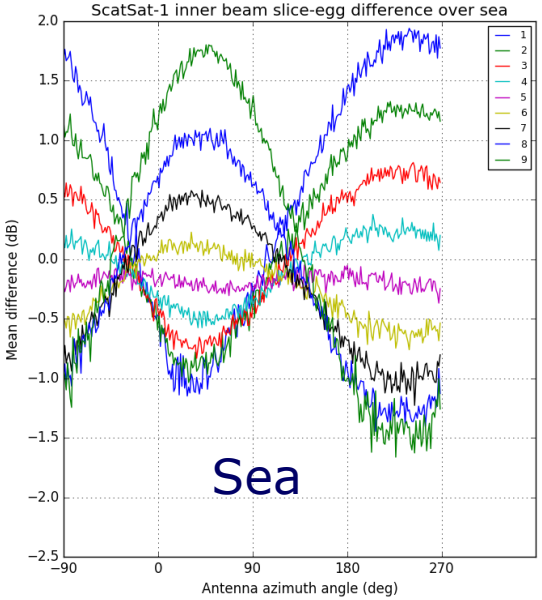
- Same issues as in the outer beam

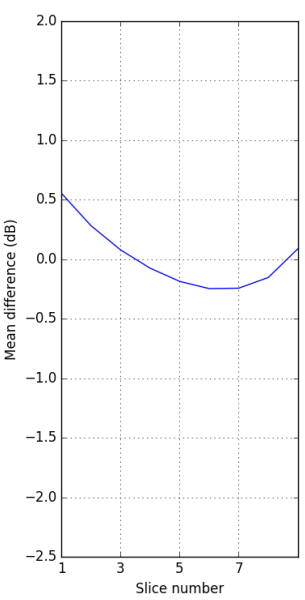






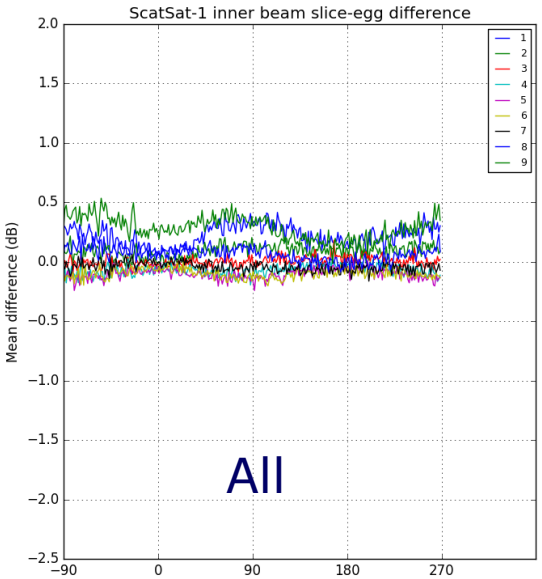


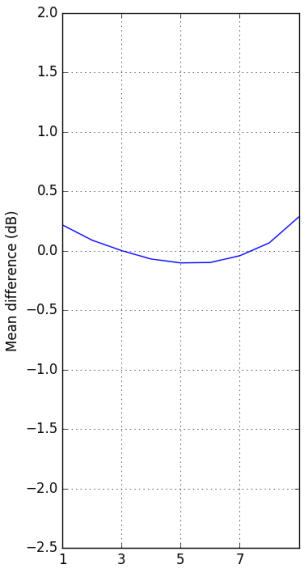


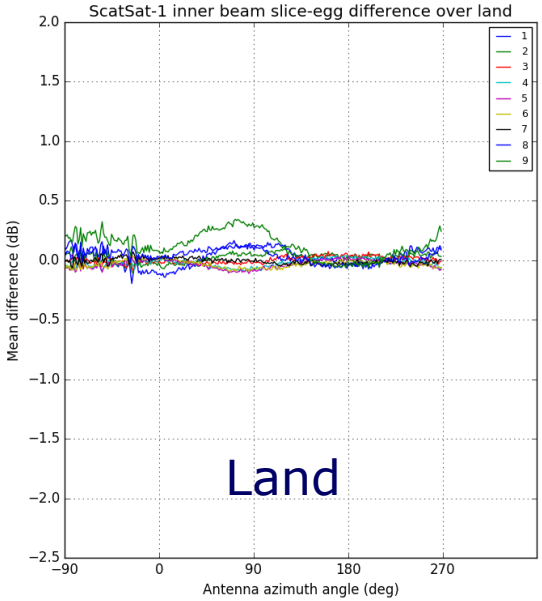


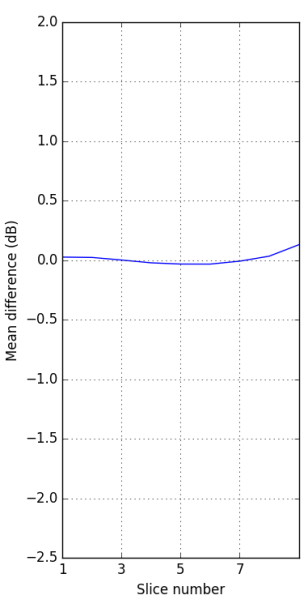
ScatSat-1 v1.1.3 inner beam slice balance

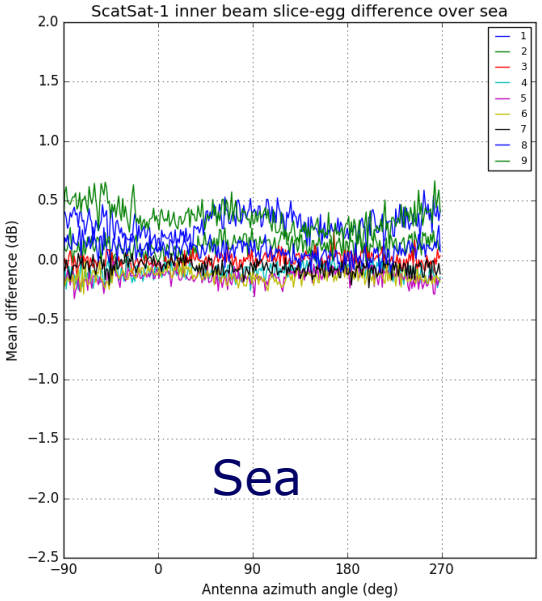
- Azimuthal variations have disappeared!

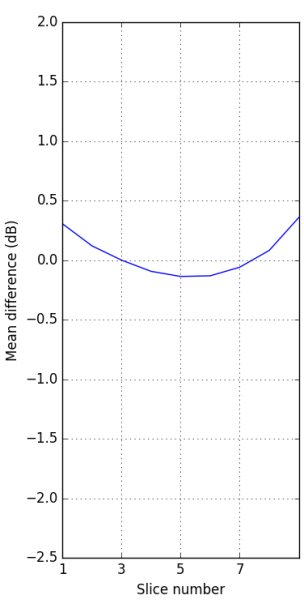




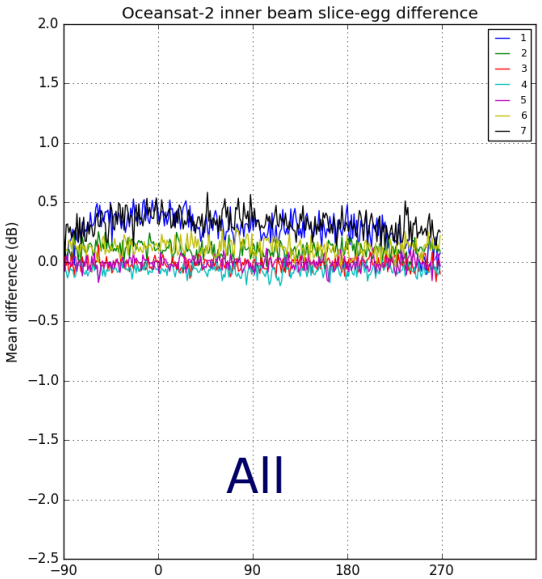


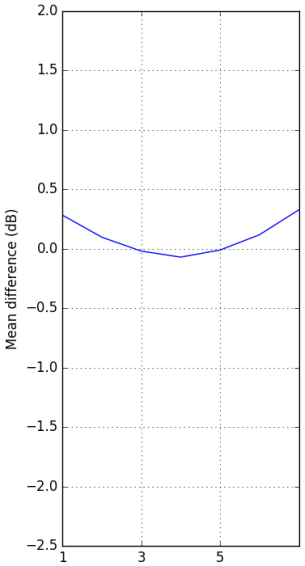


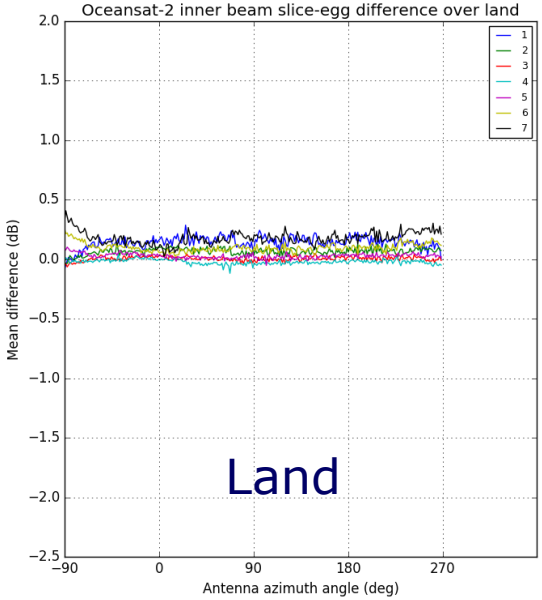


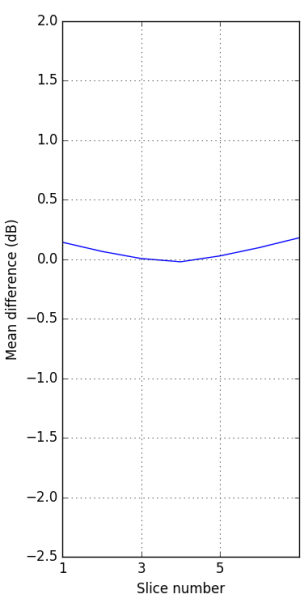


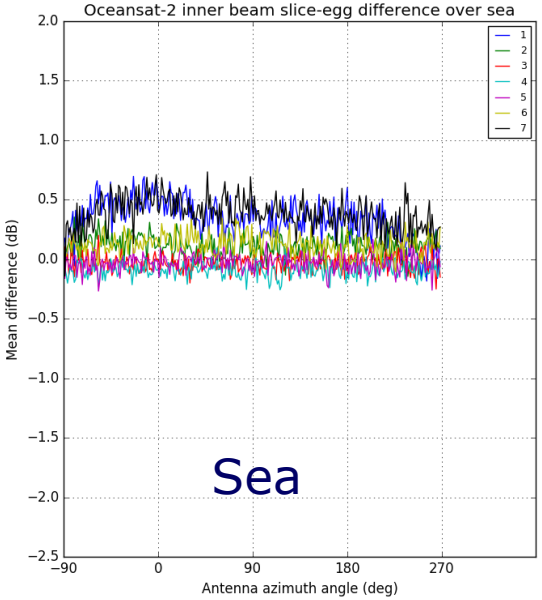
Oceansat-2 inner beam slice balance

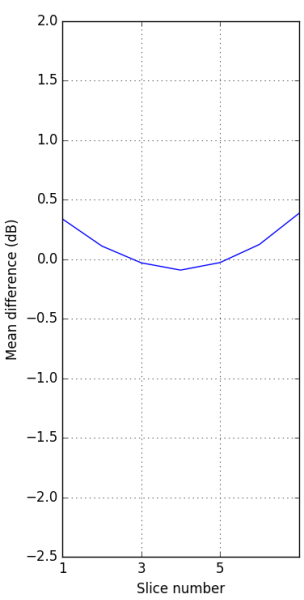






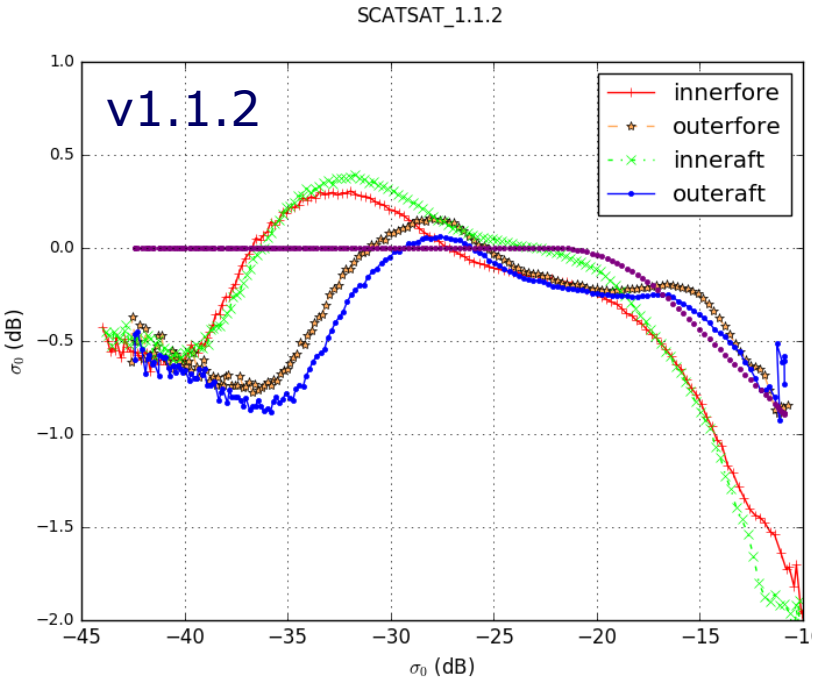


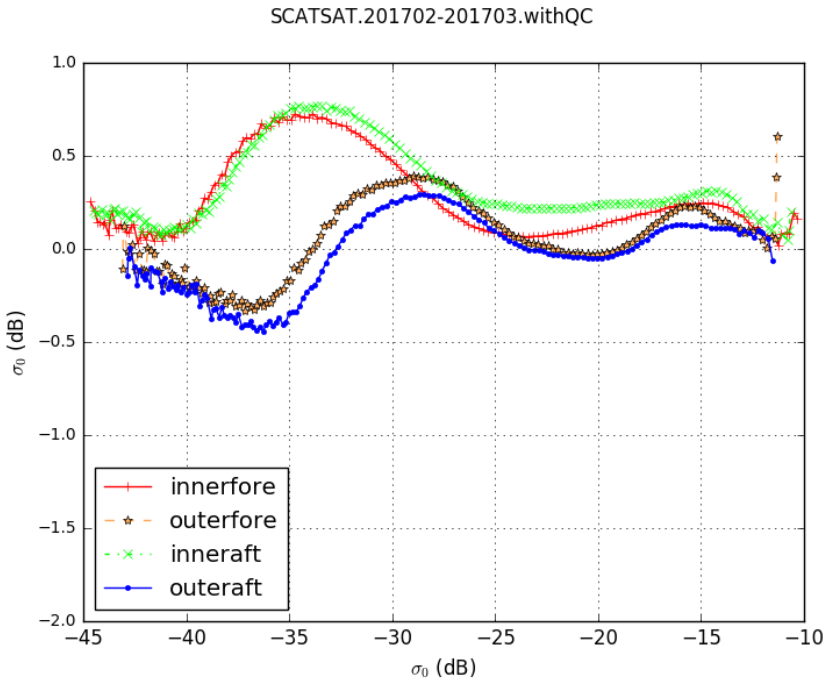




High sigma0 non-linearity

- Simulated minus ScatSat-1 σ^0 biases, without/with QC filtering
- Versions 1.1.2 and 1.1.3 appear to perform identically
- Suggested high σ^0 correction (purple)
  for σ^0 <= -19dB: σ^0 (new) = σ^0 (old)
  for σ^0 > -19dB: σ^0 (new) = σ^0 (old) - [σ^0(old)+19]*0.11





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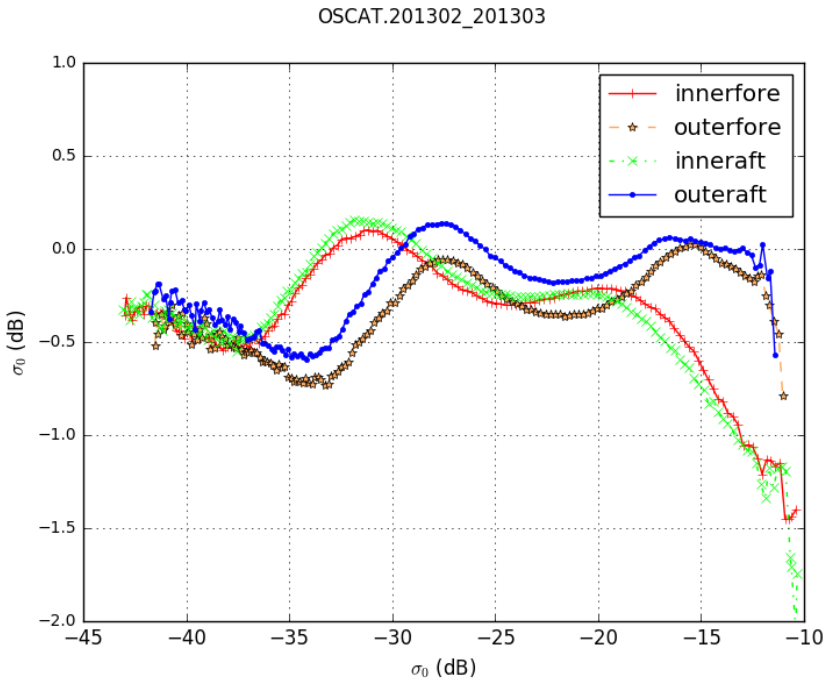
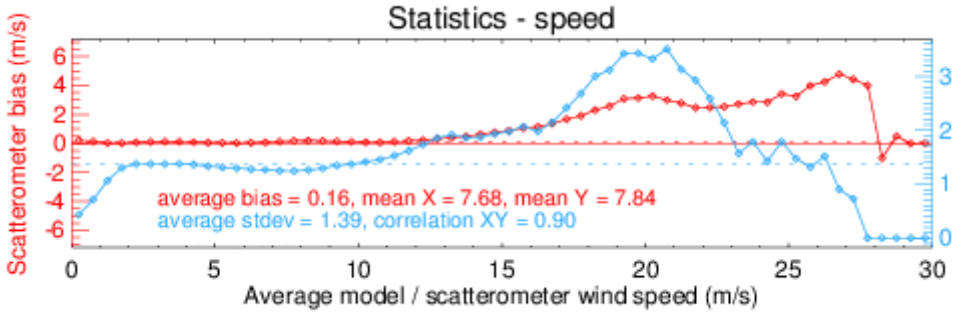
High sigma0 non-linearity

- QuikSCAT/Oceansat-2 winds, same NSCAT-4 GMF
- ERA-Interim winds used instead of operational ECMWF winds
- No correction, no QC filtering
- At high σ^0 QuikSCAT is very similar to corrected ScatSat-1
- At high σ^0 Oceansat-2 outer beam somewhat higher, inner beam somewhat lower
- Inner/outer differences at low σ^0 not present in QuikSCAT

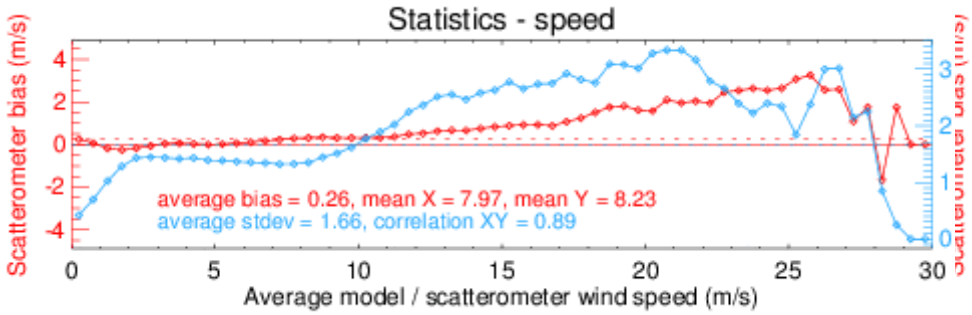


High sigma0 non-linearity

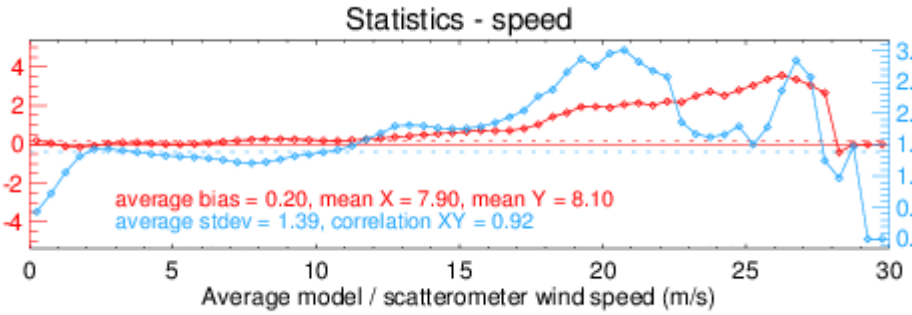


Before corrections

VV only

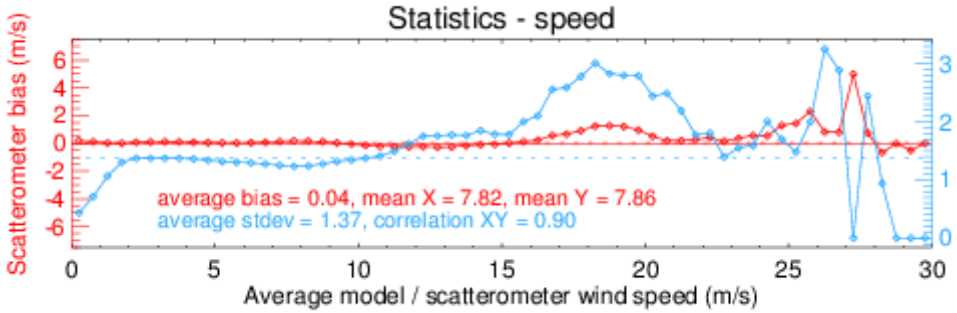


HH only



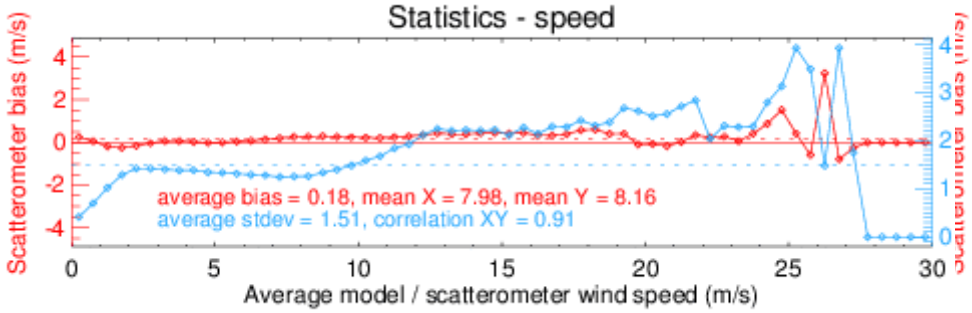
HH + VV

High sigma0 non-linearity

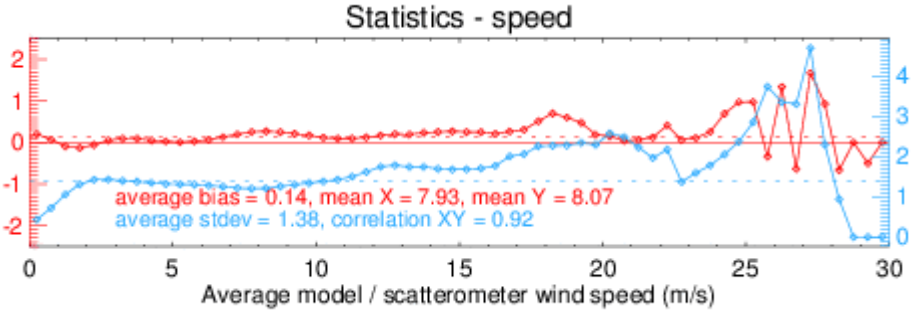


After corrections

VV only



HH only



HH + VV

NWP and buoy comparisons

- Wind components u and v have been compared to ECMWF winds (operational model) and to buoys
- Reprocessed Oceansat-2 and SeaWinds winds for comparison, compared to ECMWF ERA-Interim winds
- ScatSat-1 v1.1.3 has improved w.r.t. ScatSat-1 v1.1.2, but different data samples have been used
- ScatSat-1 comparable to Oceansat-2, SeaWinds still slightly better

Wind component std deviations in ms^{-1}	ECMWF		Buoys	
	Stdev u	Stdev v	Stdev u	Stdev v
25 km ScatSat-1 v1.1.2	1.39	1.33	2.03	1.90
25 km ScatSat-1 v1.1.3	1.29	1.29	1.83	1.76
25 km Oceansat-2	1.50	1.53	1.85	1.76
25 km SeaWinds	1.41	1.41	1.72	1.68

Triple collocation results

- Independent errors of scatterometer, buoys, and ECMWF
- Some differences may occur due to sampling differences
- ScatSat-1 v1.1.3 shows improvement as compared to v1.1.2, and also lower errors than Oceansat-2
- ERA-Interim winds show larger errors than operational model winds

Triple collocation in ms^{-1}	Scatterometer		Buoys		ECMWF	
	ε_u	ε_v	ε_u	ε_v	ε_u	ε_v
25 km ScatSat-1 v1.1.2	0.81	0.61	1.52	1.52	1.03	1.09
25 km ScatSat-1 v1.1.3	0.77	0.60	1.37	1.40	1.10	1.13
25 km Oceansat-2	0.80	0.71	1.44	1.45	1.33	1.40
25 km SeaWinds	0.64	0.54	1.39	1.41	1.28	1.35

Summary and conclusions

- ISRO has successfully removed slice-dependent biases in v1.1.3, also winds retrieved from v1.1.3 have been improved
- ScatSat-1 has a particular high bias at high σ^0, which was corrected to be consistent with QuikSCAT, RapidScat, and Oceansat-2 behavior; it improves wind biases against NWP and buoys
- ScatSat-1 and Oceansat-2 have a particular inner/outer beam inconsistency at low σ^0, which is to be further investigated
- Validation shows that wind product specifications are comparable to those of comparable instruments
- OSI SAF Operational Readiness Review has now started, operational status in the OSI SAF is expected to be accomplished soon
- Thanks to ISRO for providing the ScatSat-1 input data

Thank you!