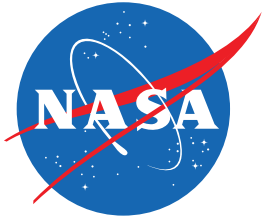


SCATSAT-1 Calibration and Data Quality

Alexander Fore, Bryan Stiles, Sermsak Jaruwatanadilok, Ernesto Rodriguez

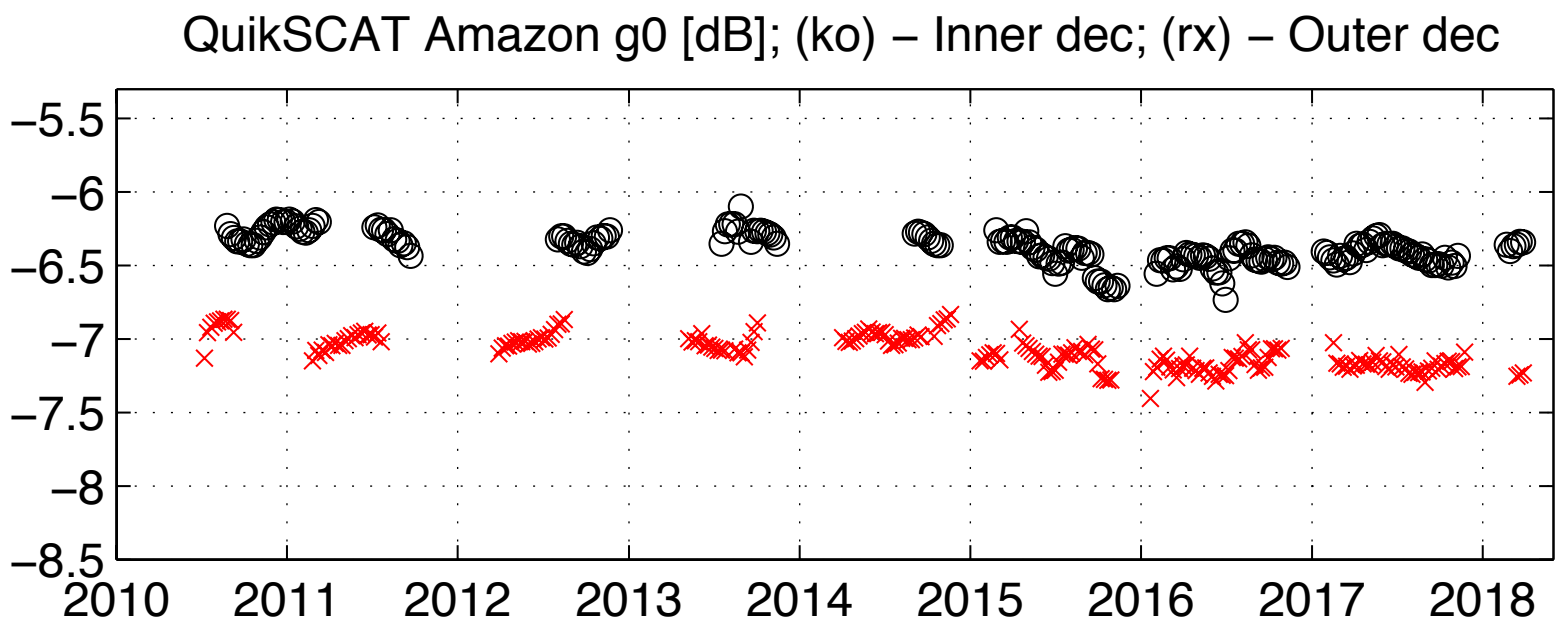
Jet Propulsion Laboratory, California Institute of Technology

IOVWST 2018

Status of Non-Spinning QuikSCAT for SCATSAT Calibration

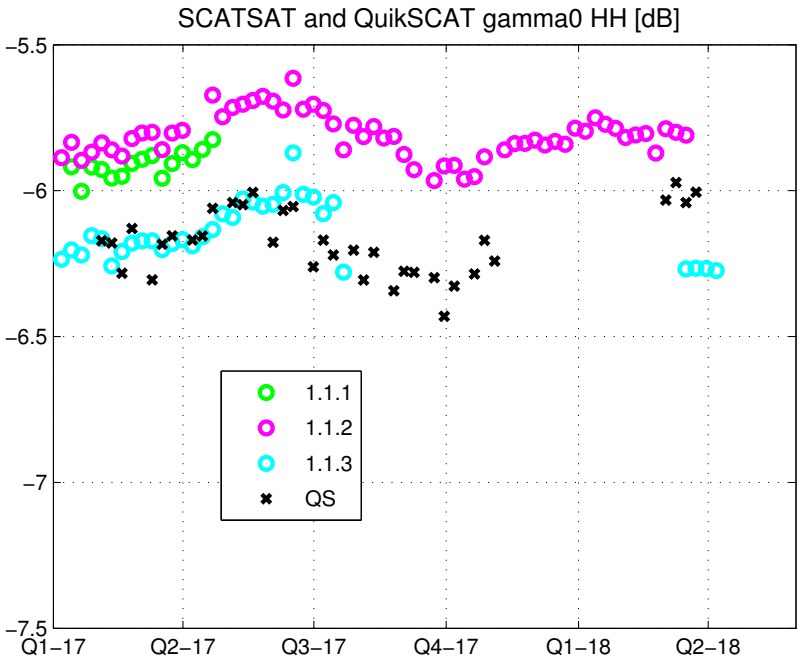
- QuikSCAT remains stable, with a possible drift estimated to be no larger than 0.03 dB / year.
- No sudden changes or jumps in calibration.
- *QuikSCAT enables temporal tracking of SCATSAT calibration at the 0.03 dB/year level.*
- *We presume at (0.2, 0.3) calibration adjustment for possible drift of QuikSCAT for use in SCATSAT calibration.*

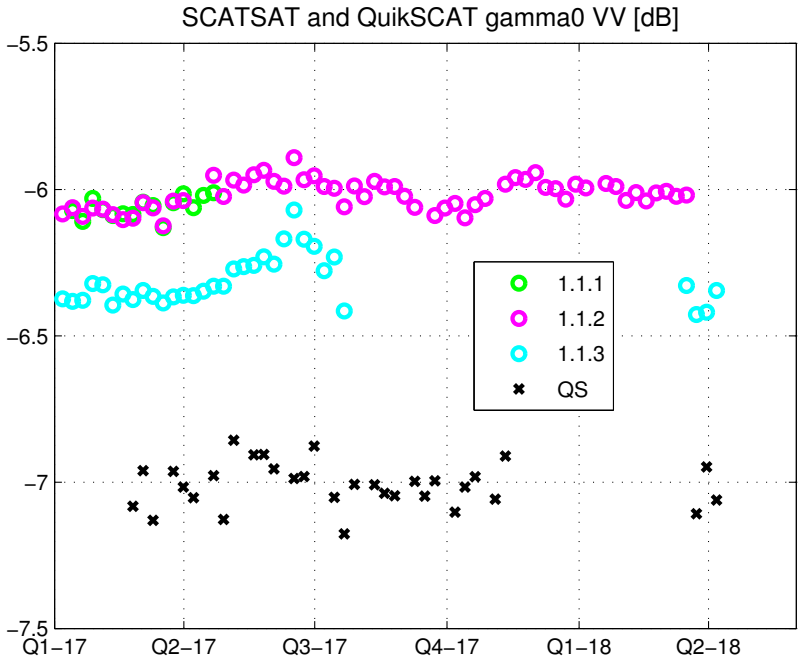
g0 := sigma0/cos(inc angle)



SCATSAT Temporal Stability

- 1.1.3 data is most recent operational version:
  - 1.1.3 data in 2017 is a beta version; while 1.1.3 in 2018 is operational.
  - We presume the calibration is the same, however, insufficient data to determine (yet).
- *We don't see evidence of a calibration drift in 1.1.3; SCATSAT seems stable to at least 0.2 dB/year level.*





QuikSCAT Cross-Calibration Methodology

- Amazon based method:
  - Select a region over Amazon with nearly all volume scattering (we use mask from D. Long).
  - Compute time series of QuikSCAT and SCATSAT, averaged over the region, averaged up to two week periods.
  - Compute difference of the two time series.
- Ocean based method:
  - Collocate both QuikSCAT and SCATSAT with ECMWF.
  - Compute bin-mean sigma0 and 2D PDF of each with respect to ECMWF wind speed and relative azimuth.
  - Use PDF from *spinning* QuikSCAT as weights for computing overall mean sigma0 from bin-mean sigma0s.
  - Compute one sigma0, using those PDF weights, for each instrument, for each two week period.
  - Compute difference of the two time series.

Overall Calibration

- Using QuikSCAT we determined calibration estimates from both Ocean and Amazon.
  - We correct for LOTD between QuikSCAT and SCATSAT using data derived from RapidSCAT.
  - *They are not in agreement, neither were they for OSCAT, and to a lesser degree RapidScat.*
- *For SCATSAT, we use the ocean calibration adjusted by the (0.2, 0.3) dB QuikSCAT drift estimate.*

SCATSAT	Ocean via QS	Amazon via QS	Difference	Used in proc.
HH adjustment	+0.31 dB	-0.15 dB	+0.46 dB	+0.51 dB
VV adjustment	-0.56 dB	-0.82 dB	+0.26 dB	-0.26 dB

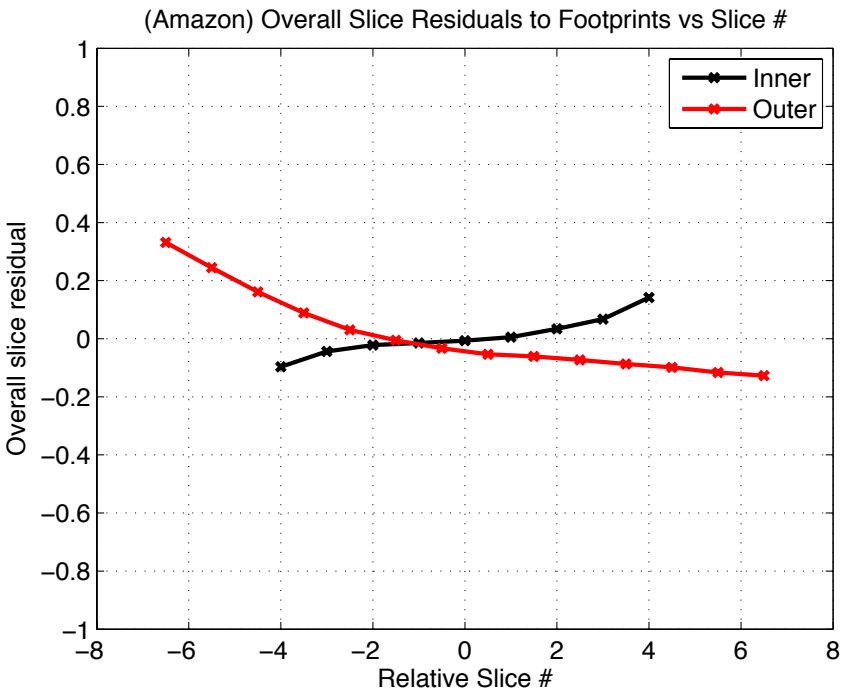
RS (High SNR)	Ocean via QS	Amazon via QS	Difference	Used in proc.*
HH adjustment	+0.02 dB	+0.02 dB	0.00 dB	+0.00 dB
VV adjustment	+0.15 dB	-0.06 dB	-0.21 dB	+0.00 dB

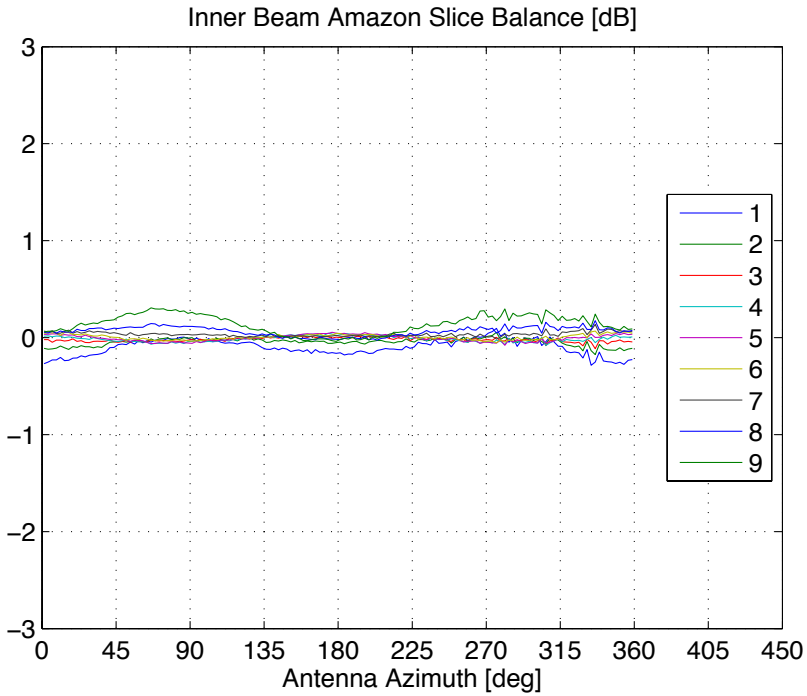
OSCAT	Ocean via QS	Amazon via QS	Difference	Used in proc.
HH adjustment	+0.53 dB	+0.15 dB	+0.38 dB	+0.53 dB
VV adjustment	+0.30 dB	-0.06 dB	+0.36 dB	+0.30 dB

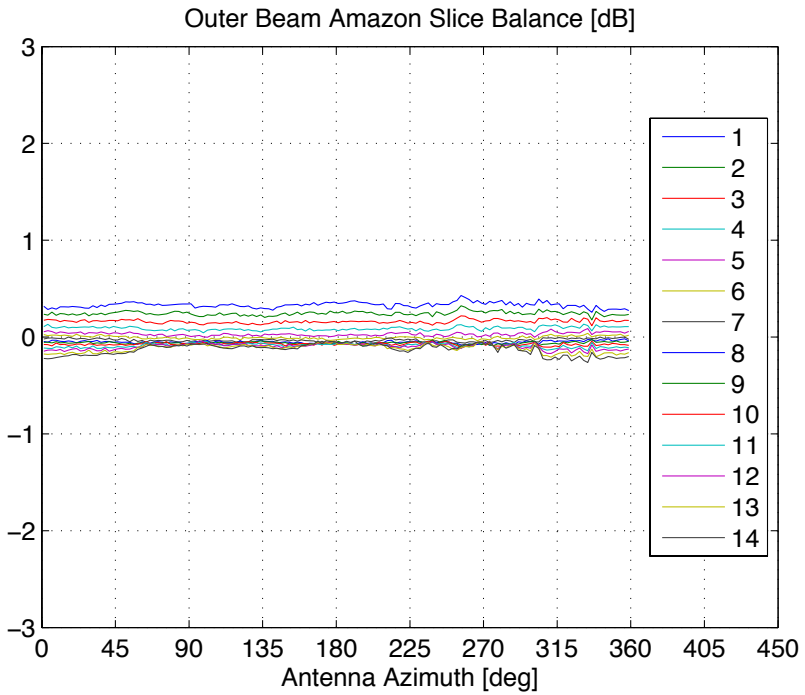
*RS High SNR was a validation of the calibration; based on analysis we did not change calibration.

Slice Calibration using Amazon

- 1.1.3 SCATSAT L1B data
- Compare slice γ_0 to cell γ_0 as function of slice number and antenna azimuth.
- $\gamma_0 = \sigma_0 / \cos(\text{inc\_angle})$

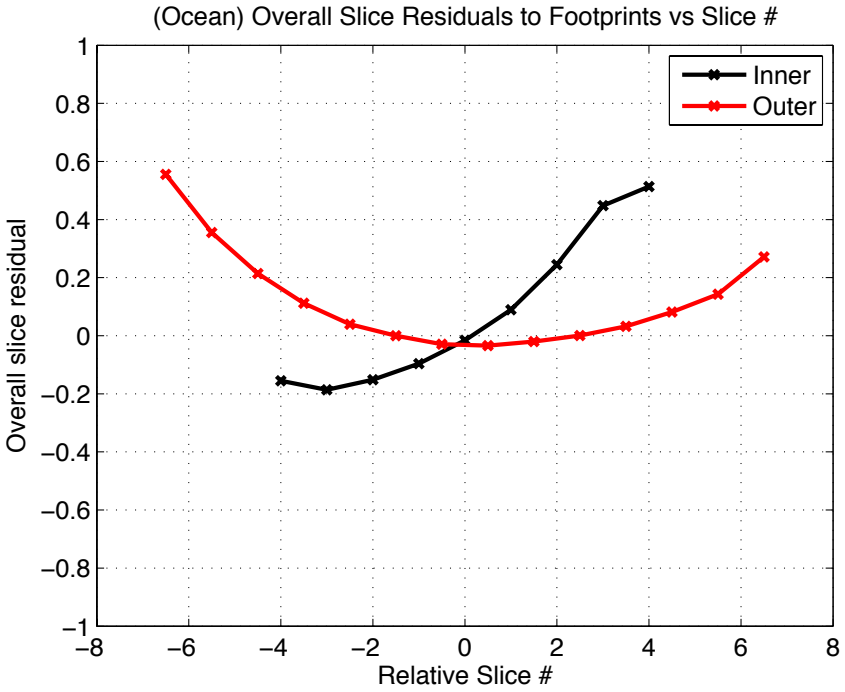


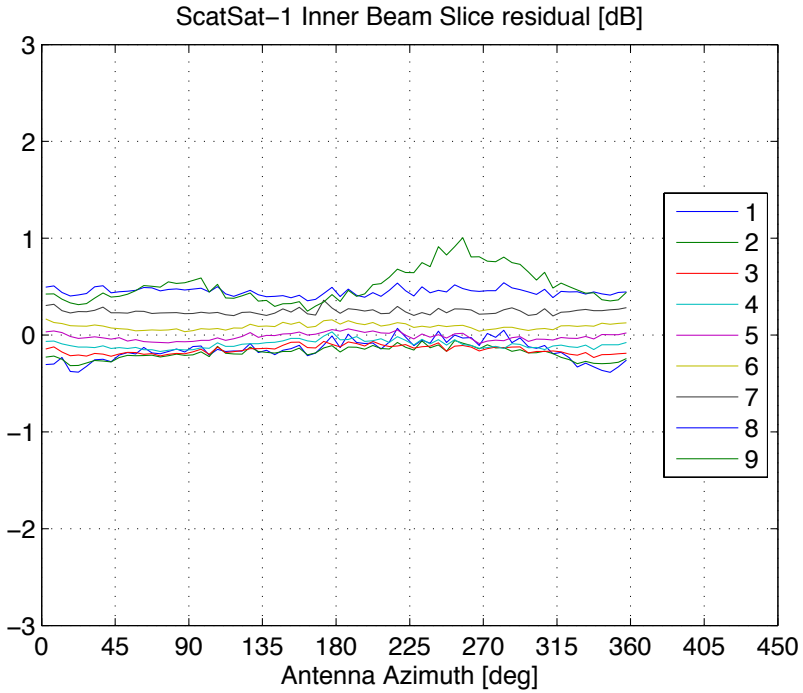


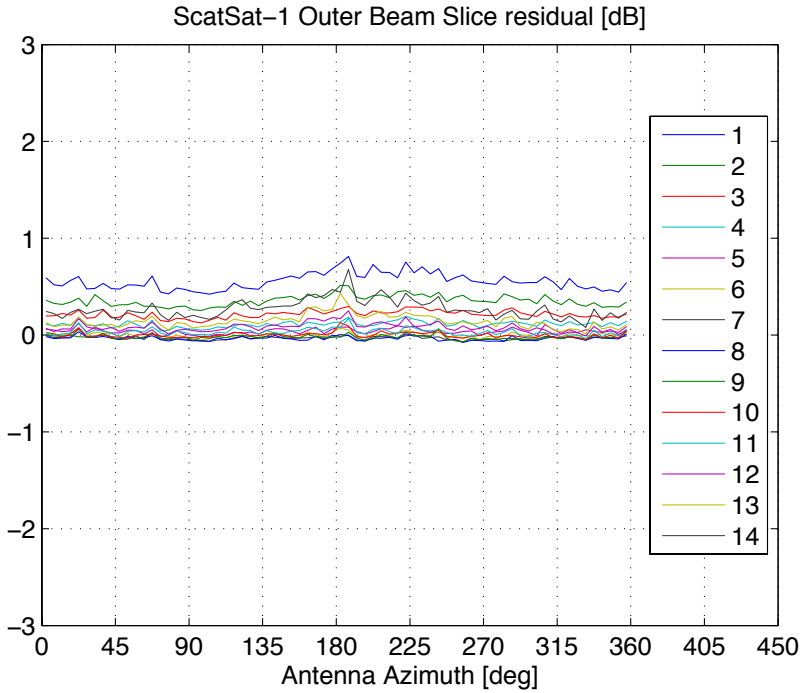


Slice Calibration using Ocean

- 1.1.3 SCATSAT L1B data
- Double ratio:
  - Residual = (slice σ_0/ cell σ_0) * (cell_model σ_0/ slice model σ_0)
- Filter using IMERG HQ precip to remove rain

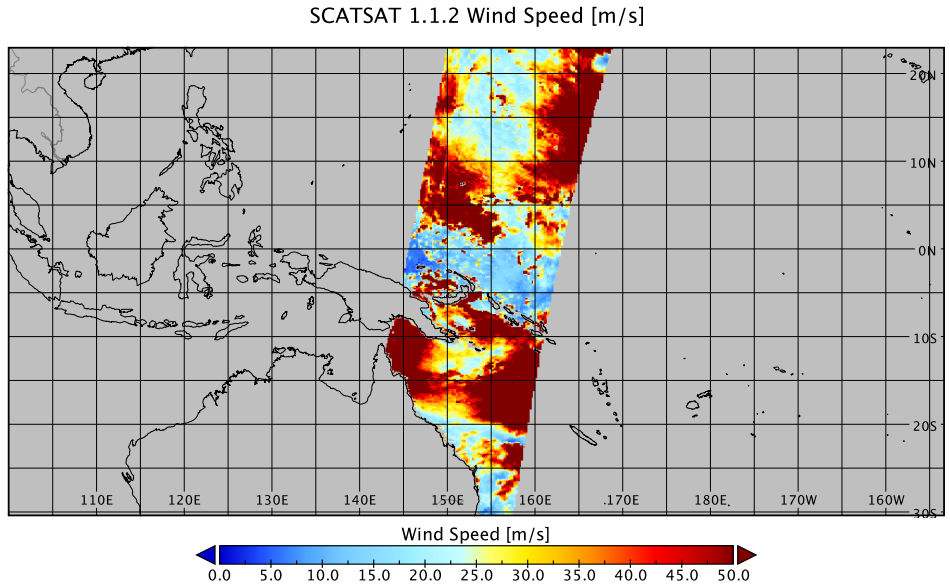


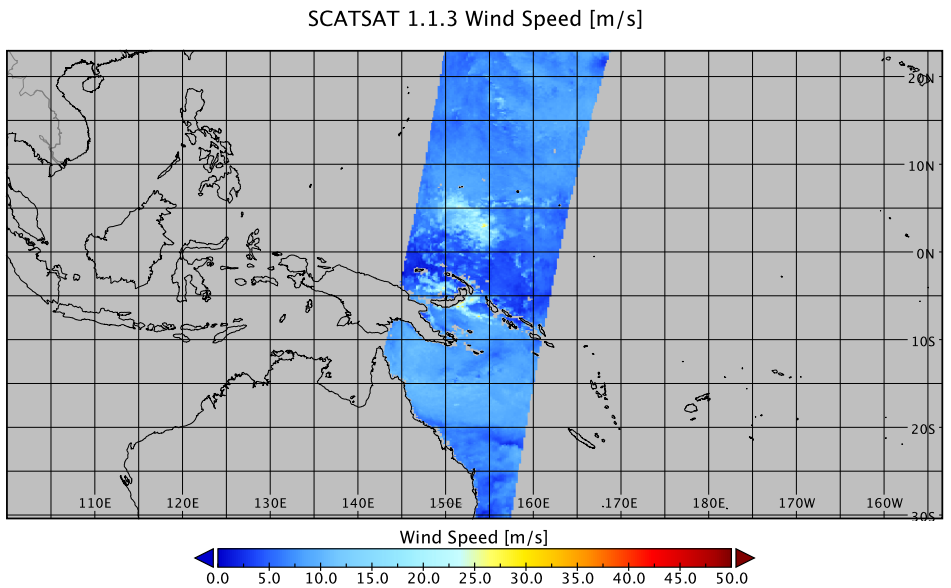




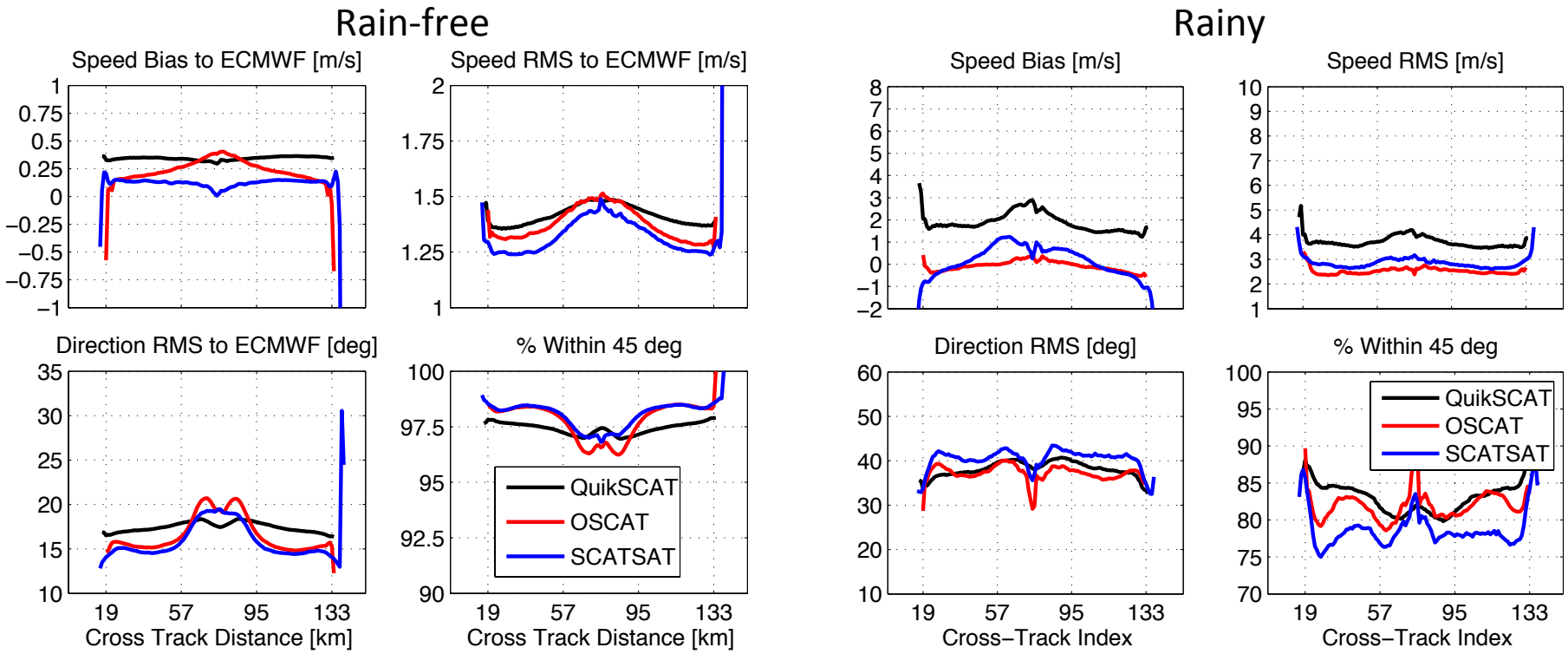
1.1.3 Calibration Improvements

- ISRO changed the source of calibration signal in 1.1.3.
- 1.1.2 has occasional large calibration error, which seems to have been fixed in 1.1.3.
  - Still needs to be evaluated.

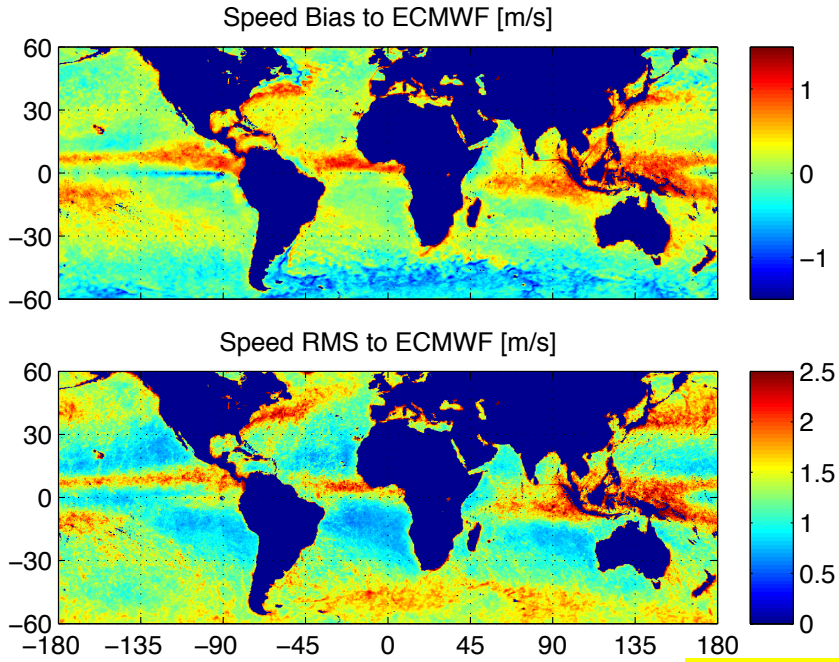


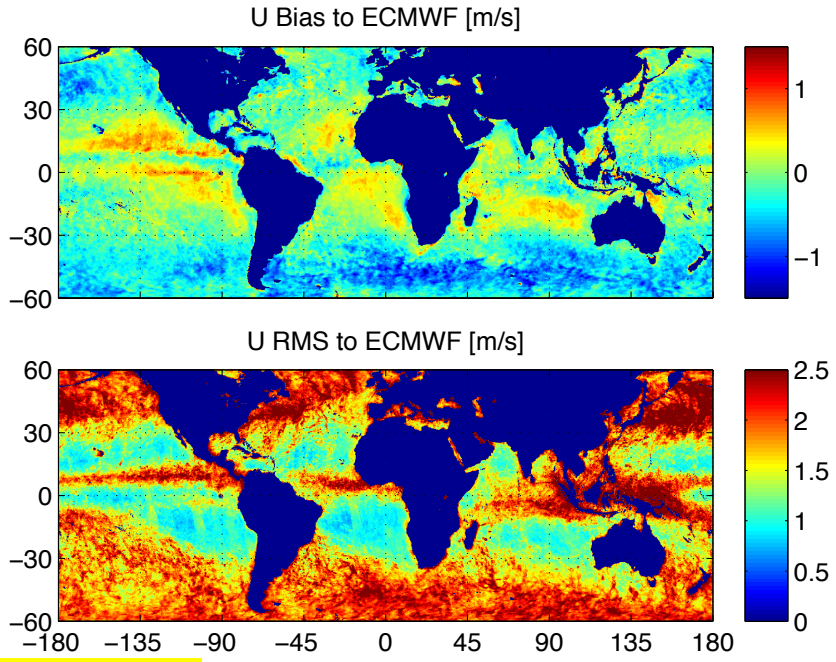


SCATSAT-1 Performance vs ECMWF

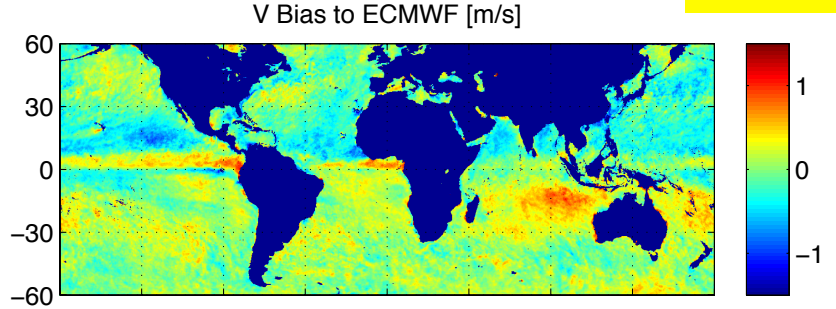


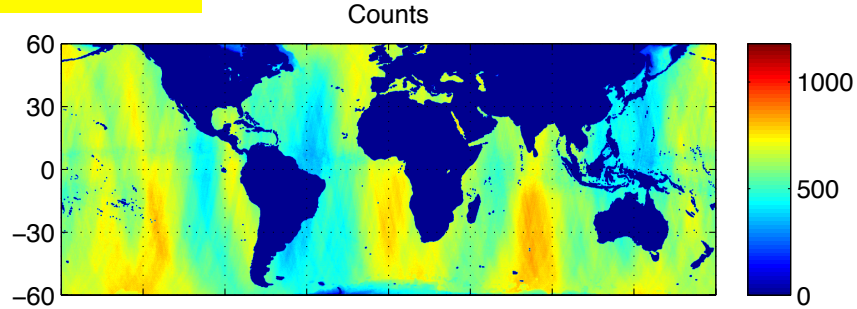
- SCATSAT better than OSCAT
- SCATSAT meets QuikSCAT science requirements
  - < 20 deg RMS direction error
  - < 2 m/s RMS wind speed error

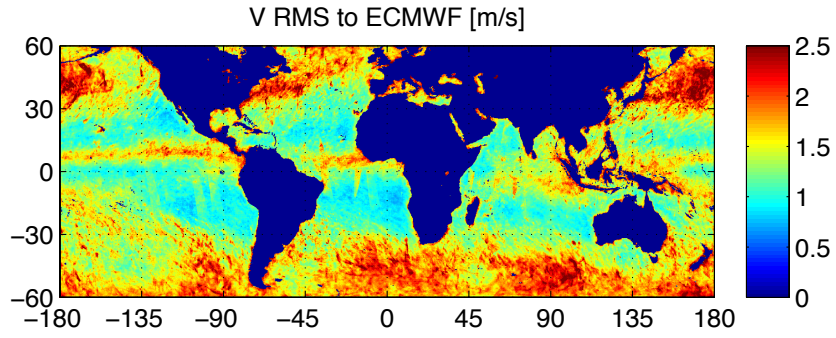


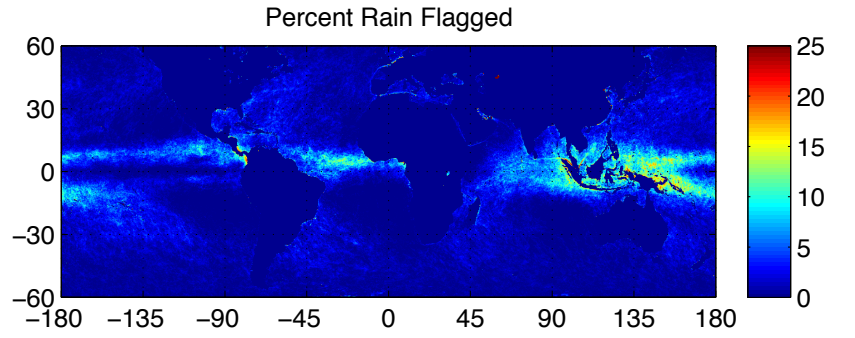


JPL 12.5 km Product



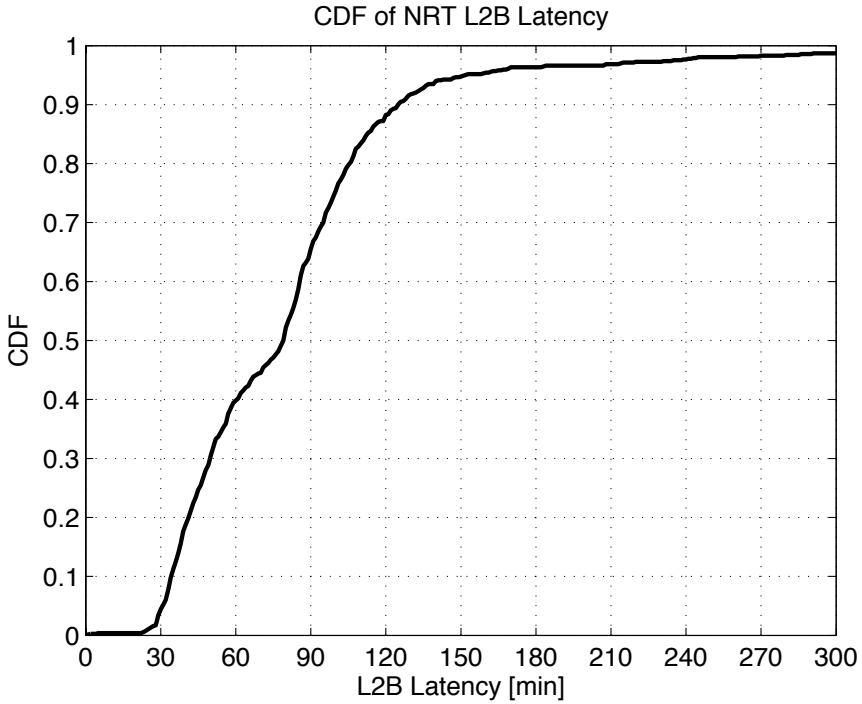


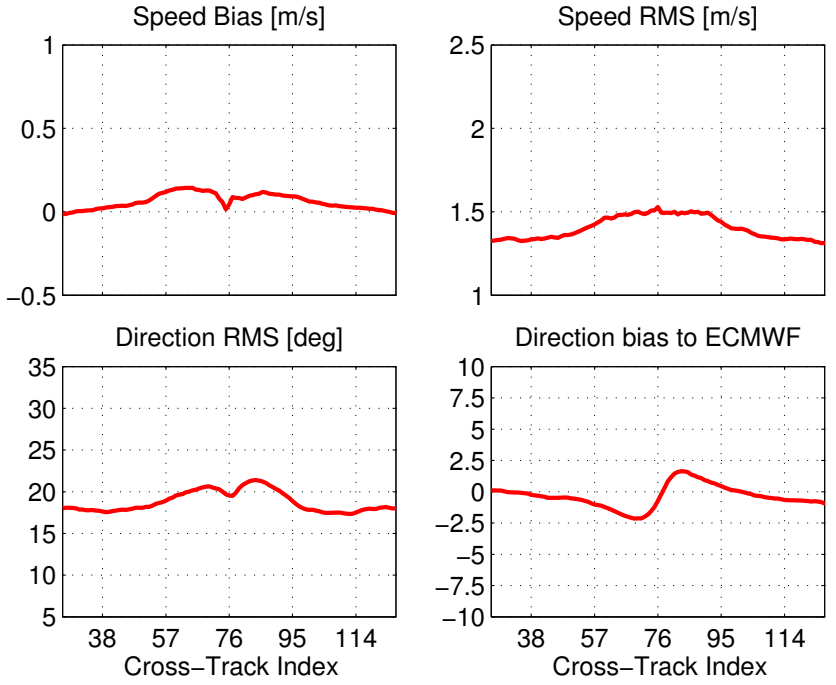




SCATSAT NRT Data

- At JPL we have been receiving the SCATSAT L1B data with sufficiently small latency for a NRT product.
  - We have implemented a test-bed NRT data processor.
  - Median latency of 90 minutes from sensing to L2B data availability at JPL.
- NRT data meets QuikSCAT type science requirements.
- *Soon to be released!*

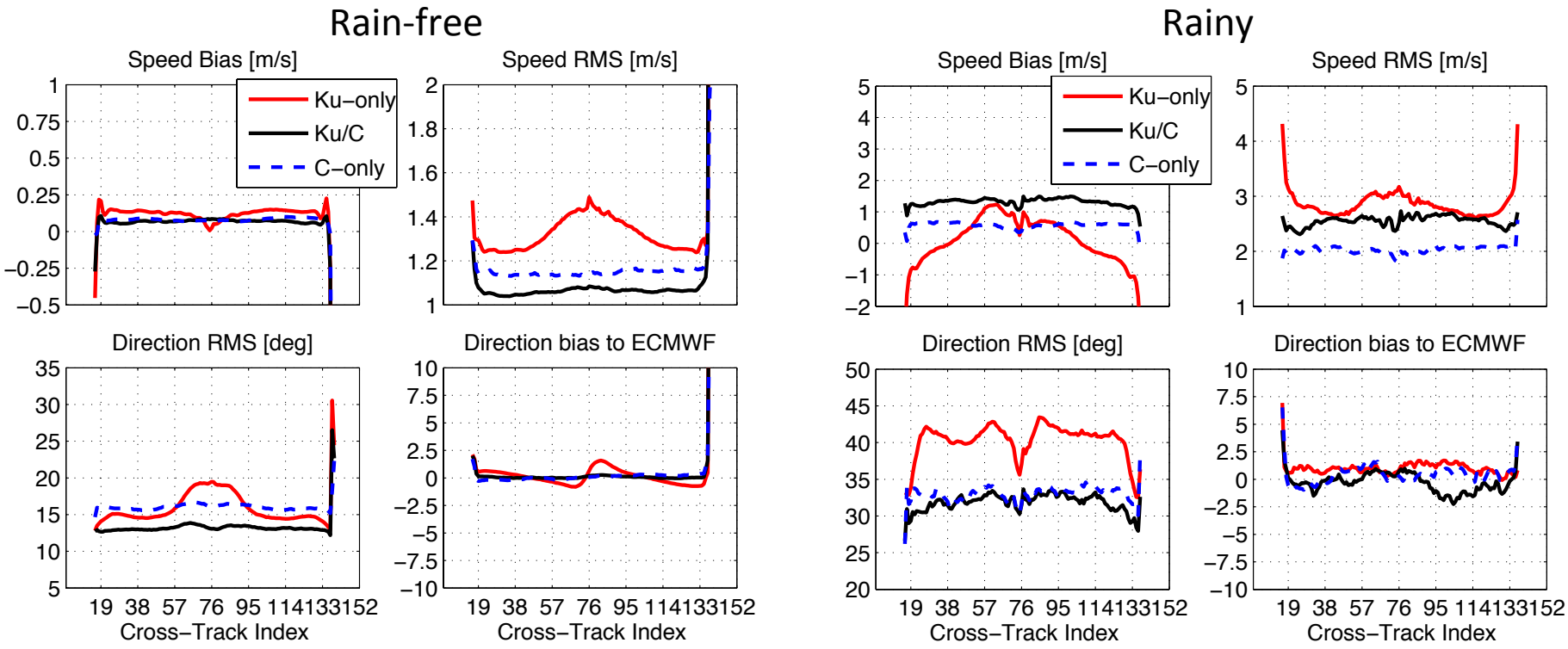


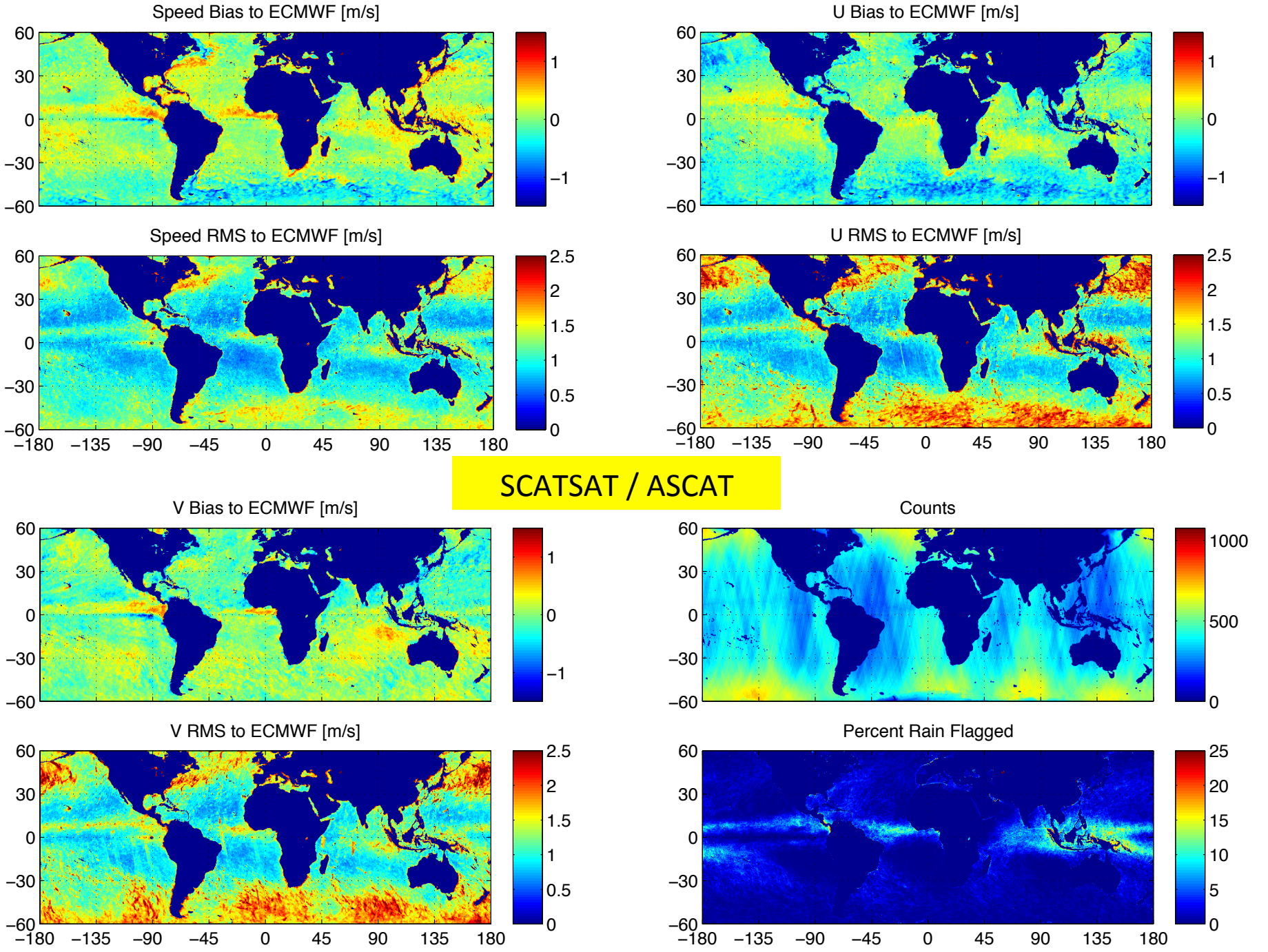


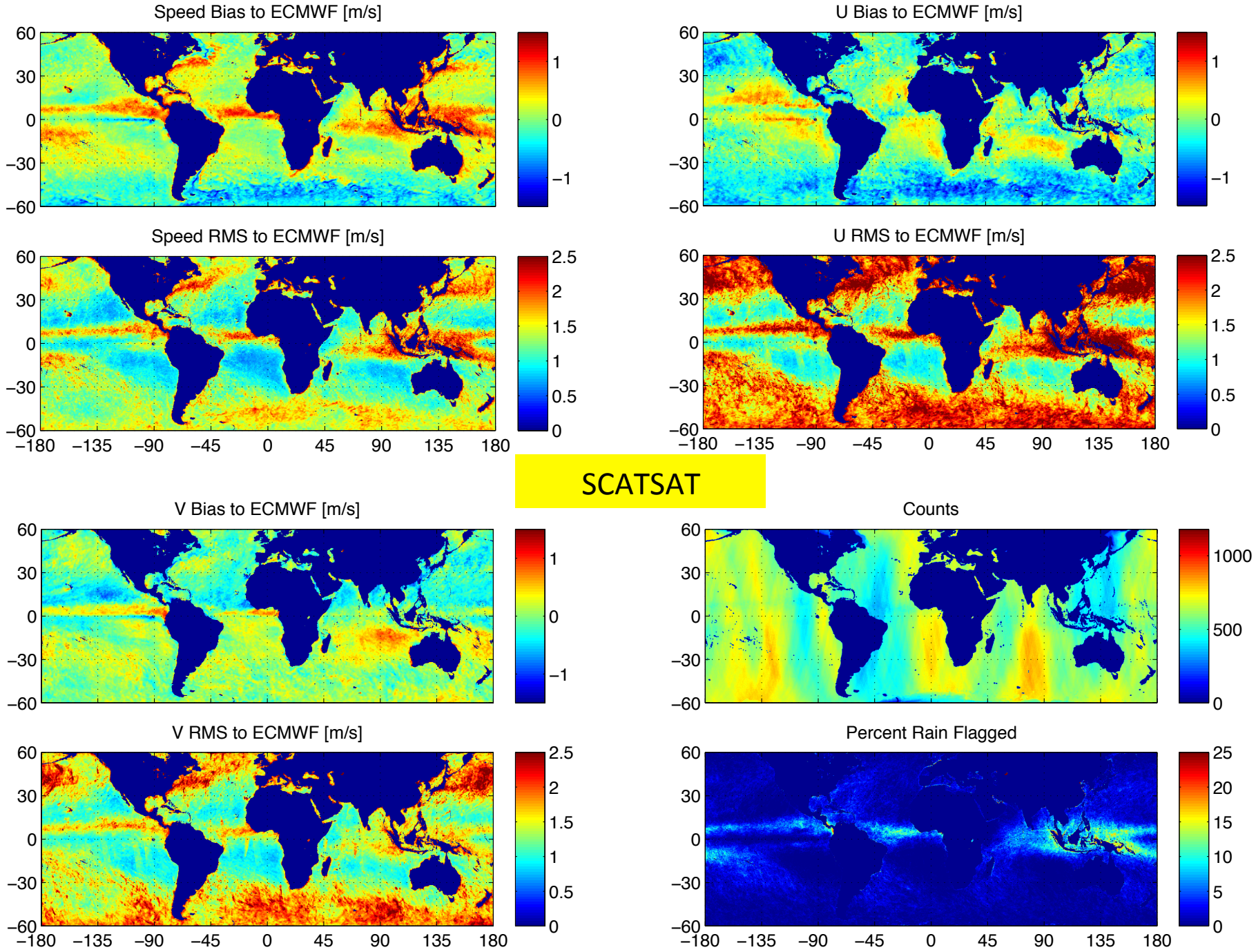
SCATSAT-1 and ASCAT-A/B

- SCATSAT-1 is in a 20:45 LTAN orbit.
- ASCAT-A/B are both in 21:30 LTAN orbits with opposite phase in orbit plane. (50 minutes apart).
- SCATSAT-1 collocates extremely well with the two of them.
  - More than 60% of SCATSAT-1 have a matchup with either ASCAT-A /B
  - All within 50 minutes.
  - Have to use both ASCAT-A and B to get best collocations.
- Orbit period difference between SCATSAT-1 and ASCAT of two minutes
  - Makes matchup time offsets and swath locations non-stationary in time.
  - Cycling of matchup times and swath locations every 50 orbits or so (100 minutes / 2 minutes)

SCATSAT/ASCAT Performance vs ECMWF




Speed Bias to ECMWF [m/s]
U Bias to ECMWF [m/s]
Speed RMS to ECMWF [m/s]
U RMS to ECMWF [m/s]
SCATSAT / ASCAT
V Bias to ECMWF [m/s]
Counts
V RMS to ECMWF [m/s]
Percent Rain Flagged
60
30
0
−30
−60
−180
−135
−90
−45
0
45
90
135
180
1
0
−1
2.5
2
1.5
1
0.5
0
1000
500
25
20
15
10
5


Speed Bias to ECMWF [m/s]
U Bias to ECMWF [m/s]
Speed RMS to ECMWF [m/s]
U RMS to ECMWF [m/s]
SCATSAT
V Bias to ECMWF [m/s]
Counts
V RMS to ECMWF [m/s]
Percent Rain Flagged
60
30
0
−30
−60
−180 −135 −90 −45 0 45 90 135 180
1
0
−1
2.5
2
1.5
1
0.5
0
1000
500
25
20
15
10
5

Summary

- Using QuikSCAT we generate consistently calibrated record of Ku-band scatterometer sigma0 and winds.
- Analysis of most recent 1.1.3 SCATSAT indicates stability to at least the 0.2 dB/year level.
- SCATSAT provides quality ocean vector winds:
  - Significantly improved from OSCAT.
  - Nearly as good as QuikSCAT.
- SCATSAT data may be generated in near-real-time:
  - Sufficiently small latency for operational use (median 90 minutes).
  - Sufficient data quality (meets QuikSCAT science requirements).
- SCATSAT collocates extremely well with ASCAT:
  - Can use ASCAT-A/B to track calibration drifts in SCATSAT.
  - Can perform joint C/Ku retrievals of ocean vector winds
  - Improved and consistent rain impact flagging and correction algorithms may be developed for QuikSCAT / OSCAT / ASCAT using the joint data record to train.