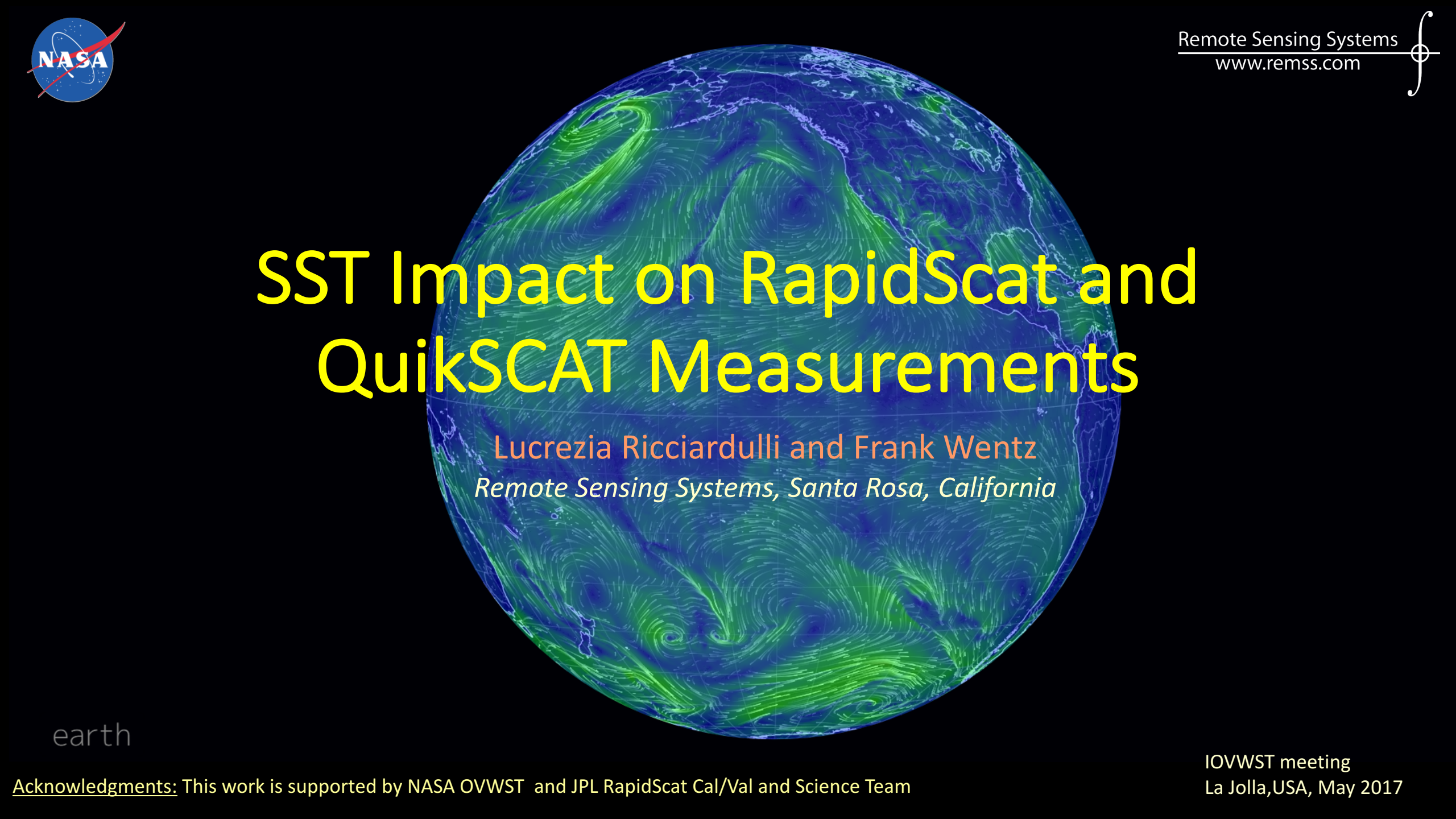

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SST Impact on RapidScat and QuikSCAT Measurements

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earth

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IOVWST meeting
La Jolla,USA, May 2017

Outstanding issues in Ocean Wind Climate Data Record development

Remote Sensing Systems
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RapidScat and QuikSCAT

- ✓ Verify RSCAT observed sigma0 follow Ku2011 Geophysical Model Function (GMF) at QuikSCAT incidence angles
- ✓ Tune RSCAT pre-launch GMF N2014 (inferred from NSCAT+QSCAT) to actually match RSCAT sigma0 at other incidence angles
- ✓ Explore SST-depend Ku-band GMF
- ✓ Analyze issue with RSCAT direction discontinuity at swath center

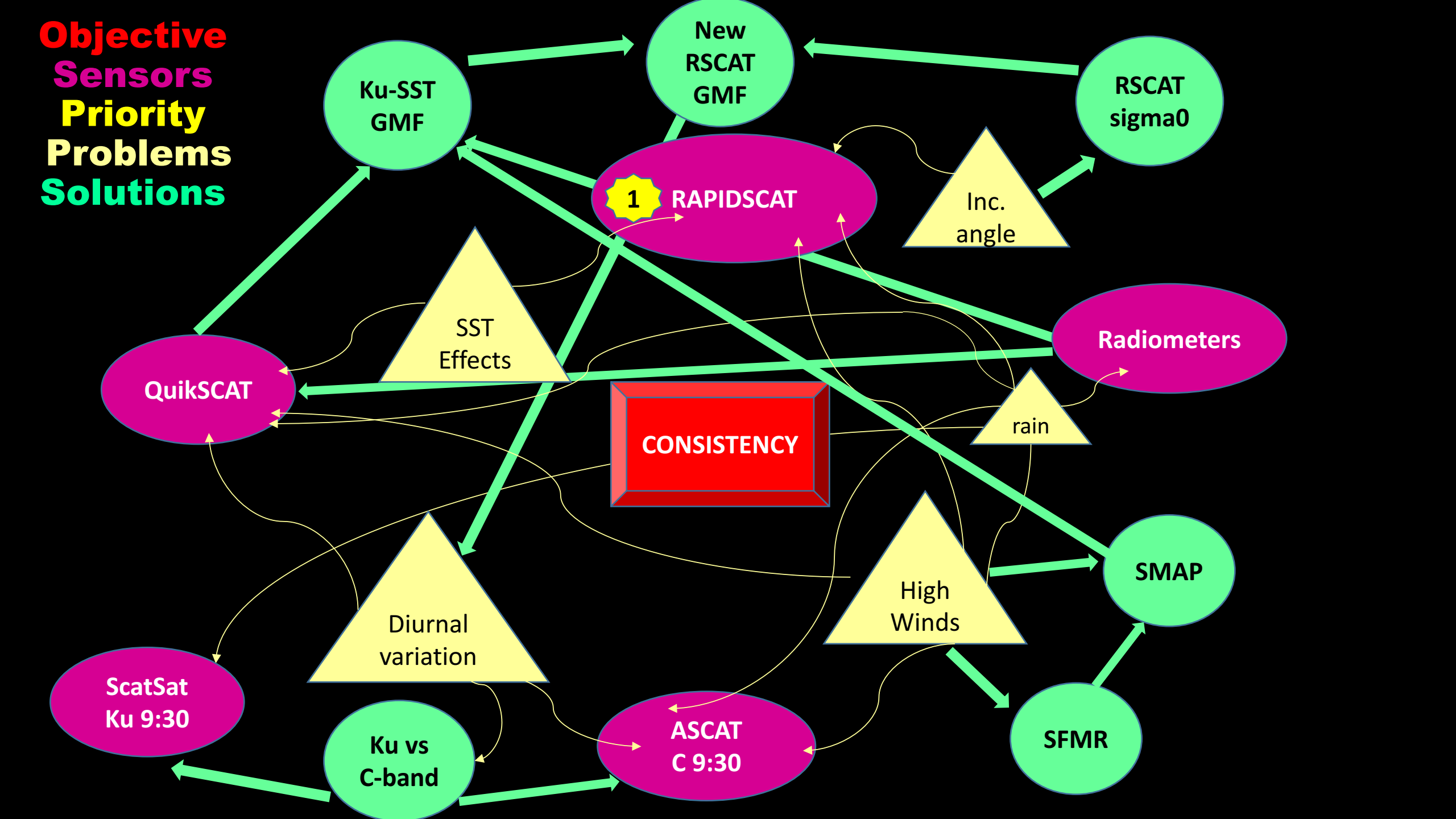
- ➢ Finalize new **Ku-SST GMF**
- ➢ Final end-of-mission **RapidScat reprocessing (JPL)**

QuikSCAT, ASCAT, WindSat

- ➢ Calibrate high winds using SFMR, SMAP (presentation Meissner et al)

ScatSat

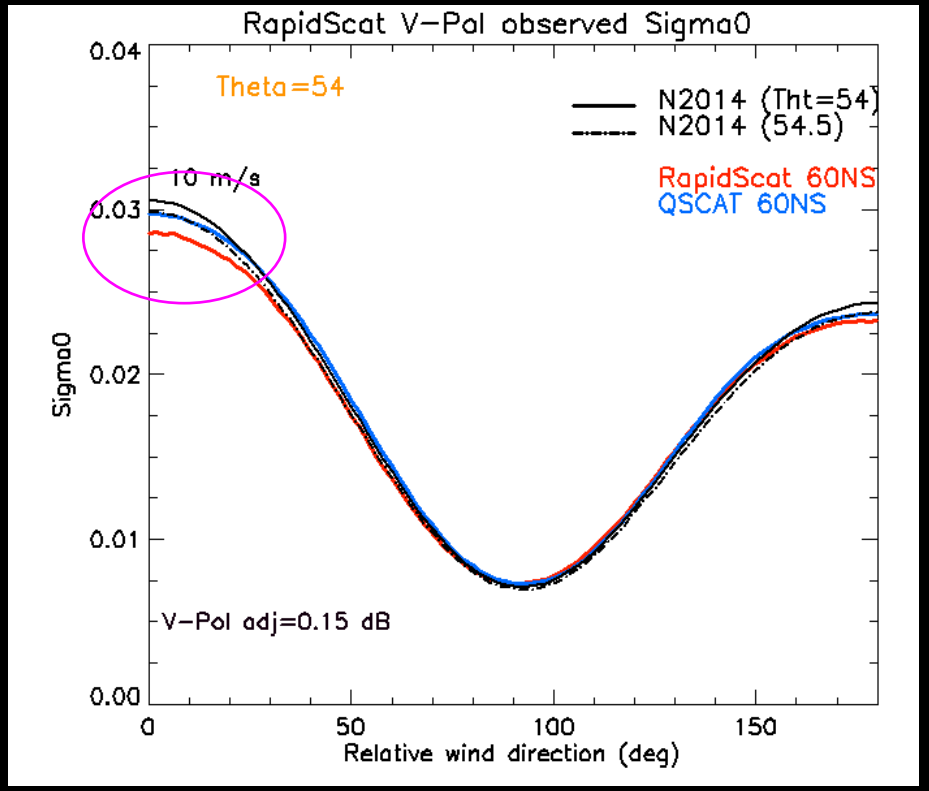
- ✓ Validation of early release data (see poster Ricciardulli et al.)


Objective
Sensors
Priority
Problems
Solutions
Ku-SST GMF
New RSCAT GMF
RSCAT sigma0
1
RAPIDSCAT
Inc. angle
SST Effects
QuikSCAT
Radiometers
CONSISTENCY
rain
Diurnal variation
High Winds
SMAP
ScatSat Ku 9:30
Ku vs C-band
ASCAT C 9:30
SFMR

1. Tune pre-launch GMF using observed RapidSCAT sigma0

Method

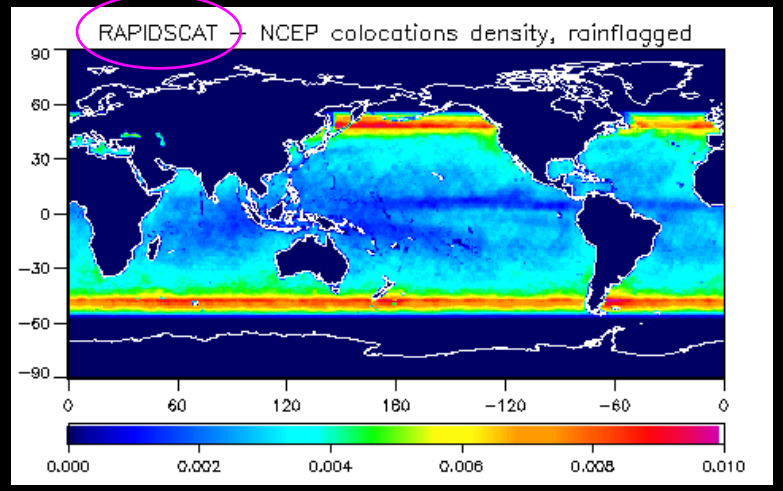
- Use only pre-anomaly data (High SNR I), GLOBAL
- Rain-free (radiometer flag)
- Only QSCAT angle
- Compare to QSCAT obs. sigma0 distribution
- Compare to pre-launch GMF (N2014)



Problem

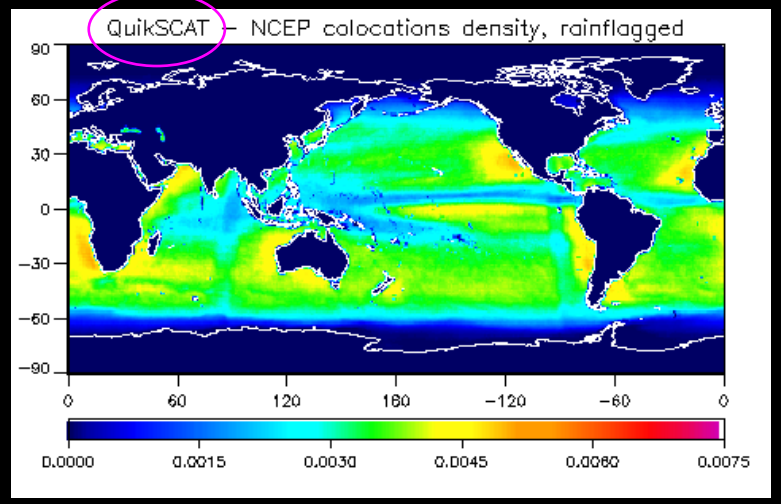
RSCAT sigma0 Did not match QSCAT sigma0 distribution at UPWIND for the same inc. angle

Solution: consistent RSCAT/QSCAT sampling 30NS

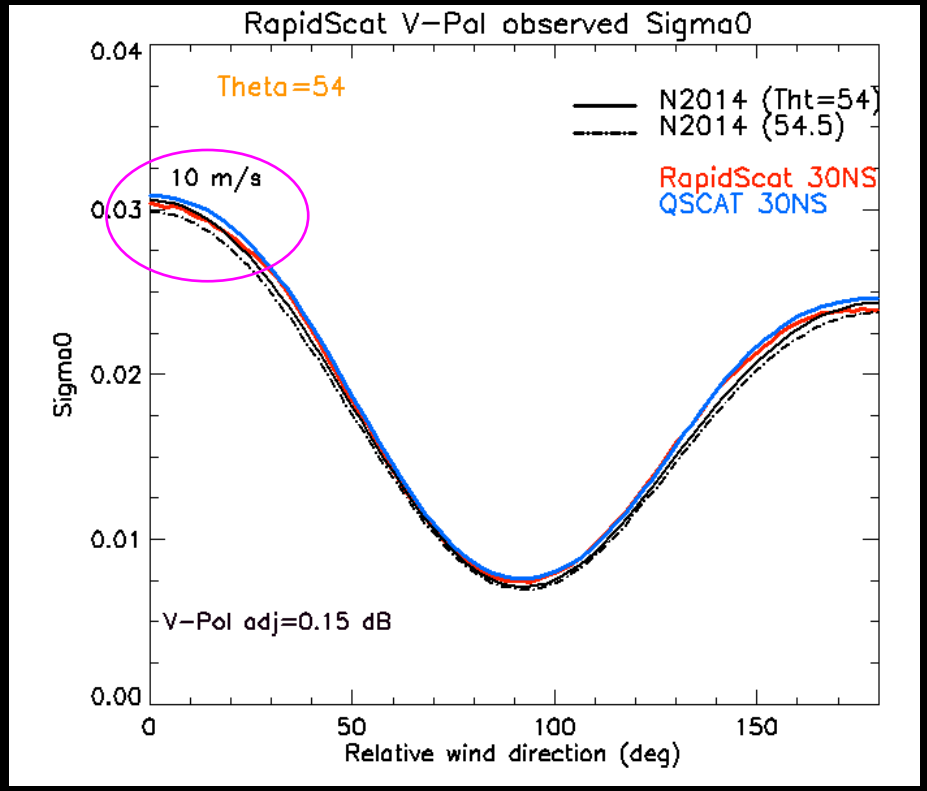


RapidScat sampled
Mostly mid-latitudes

Cold SST impact skews sigma0 distribution

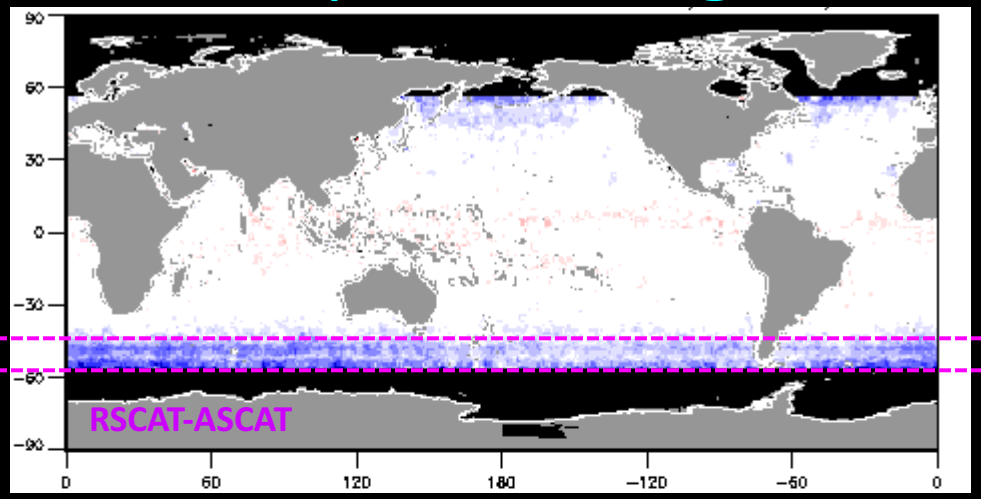


QuikScat samples 60NS almost uniformly



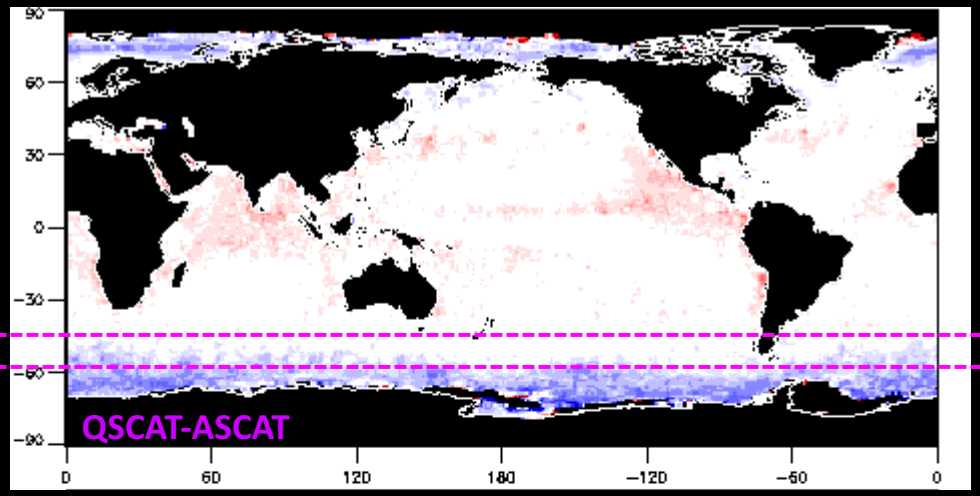
- ✓ Good match between RapidScat and QSCAT observed sigma0, and the pre-launch GMF (at QUIKSCAT angles)
- ✓ At other angles V-Pol RapidScat did not perfectly match GMF at upwind/downwind → we retuned RSCAT GMF
- ✓ But this turned out not to be the cause of discontinuity in wind direction (GMF acquitted)

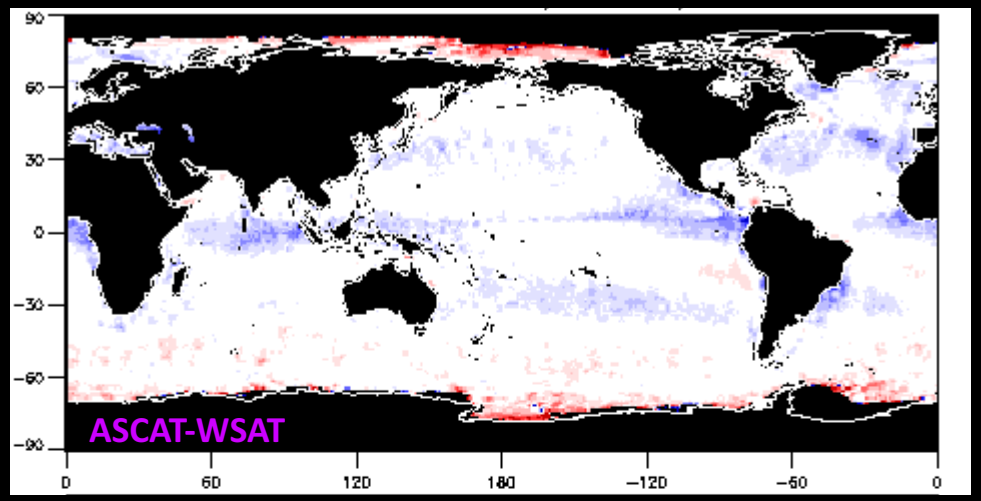
2a. SST-impact on sigma0 → regional wind speed bias



Ku-band is impacted

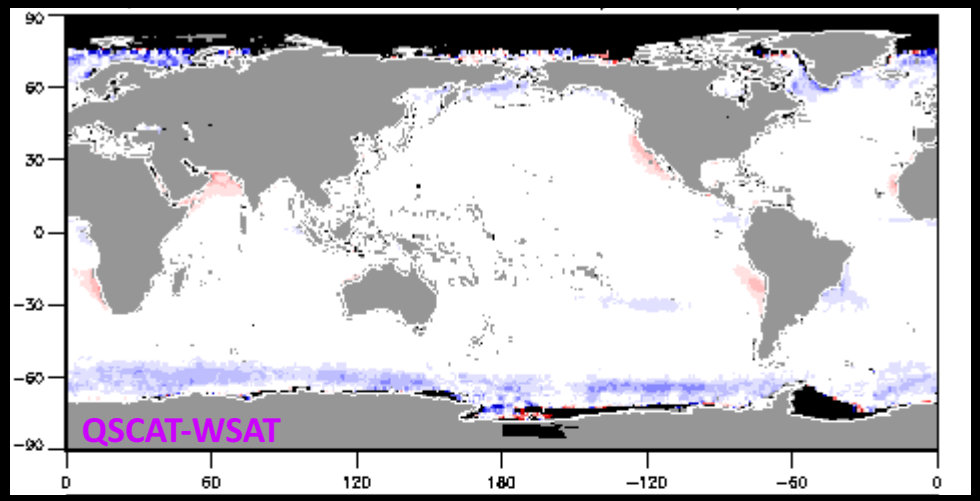
RSCAT bias > QSCAT bias

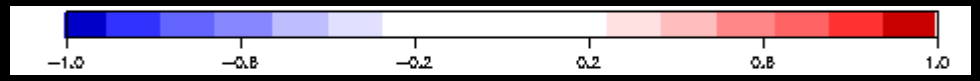




ASCAT – WSAT No bias

C-band impact Negligible (?)

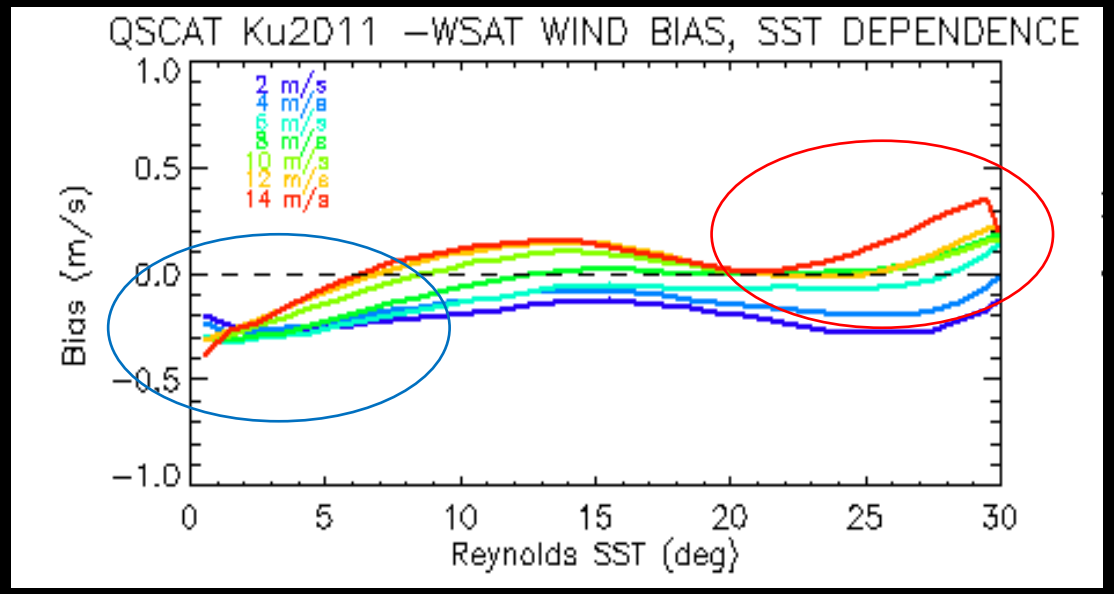




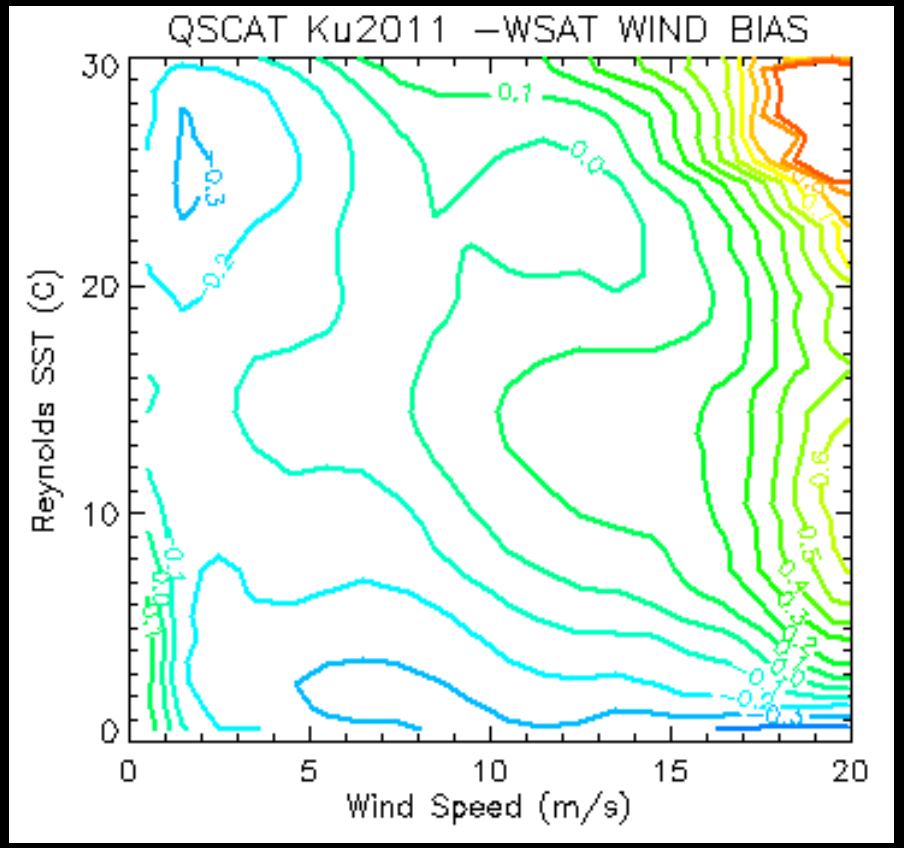
2b. SST-impact → wind speed bias estimates

Method

- Use 5 yrs rain-free QSCAT/WSAT colocation
- Use daily Reynolds SST as reference
- Buoys have too little data in cold SST, no ground truth
- Use WSAT as ground truth for wind speed
- Stratify bias as a function of wind speed and SST



Comparison with WSAT (calibrated on global scale with QSCAT) confirmed SST-dependency of bias



0 m/s
-0.2 m/s
-0.3 m/s

Largest effect

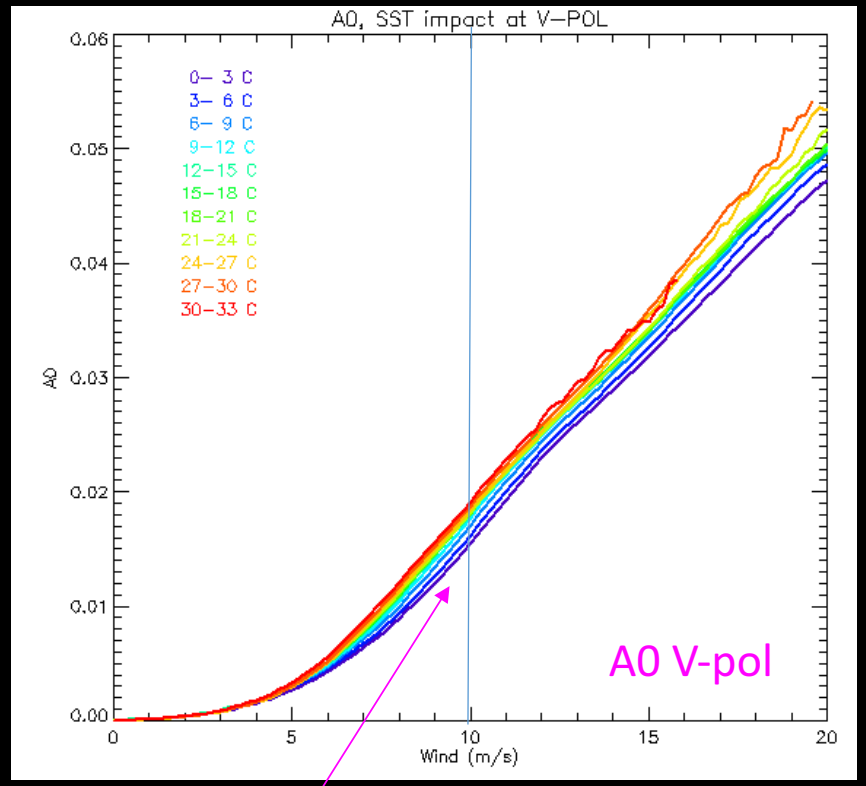
0.3-0.4 m/s negative bias in very cold water at 2-10 m/s

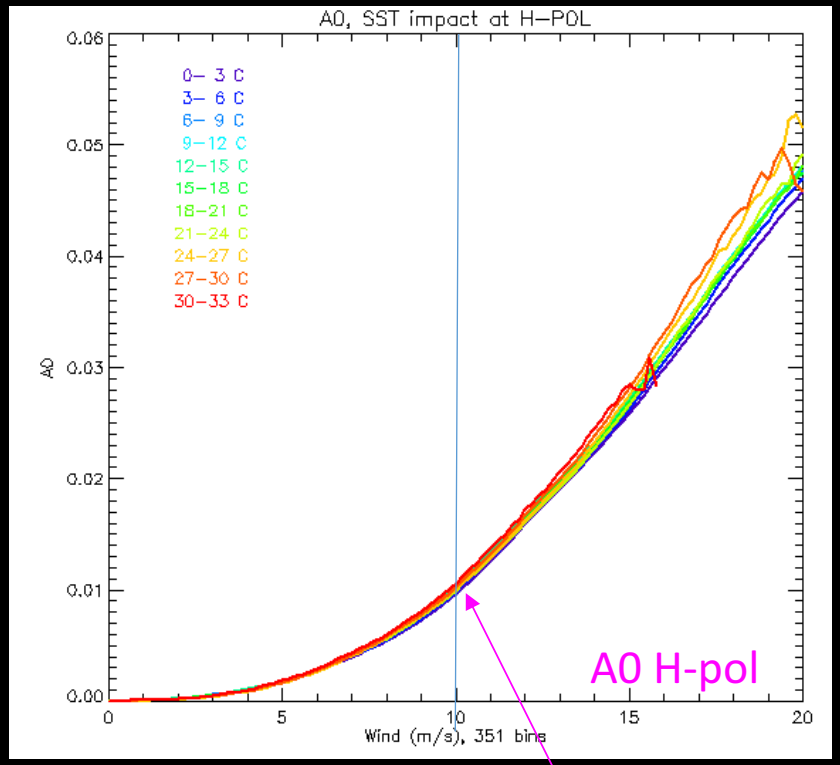
0.3-0.4 m/s positive bias at high winds for SST>25C

2c. SST-impact on QuikSCAT sigma0 → Ku-SST GMF

- We used 5 yrs of QSCAT observed sigma0 and stratified them as a function of SST, using WSAT as ground truth for winds
- We calculated new coefficients of the GMF as a function of SST

Non-directional coefficient A0 (90% signal)

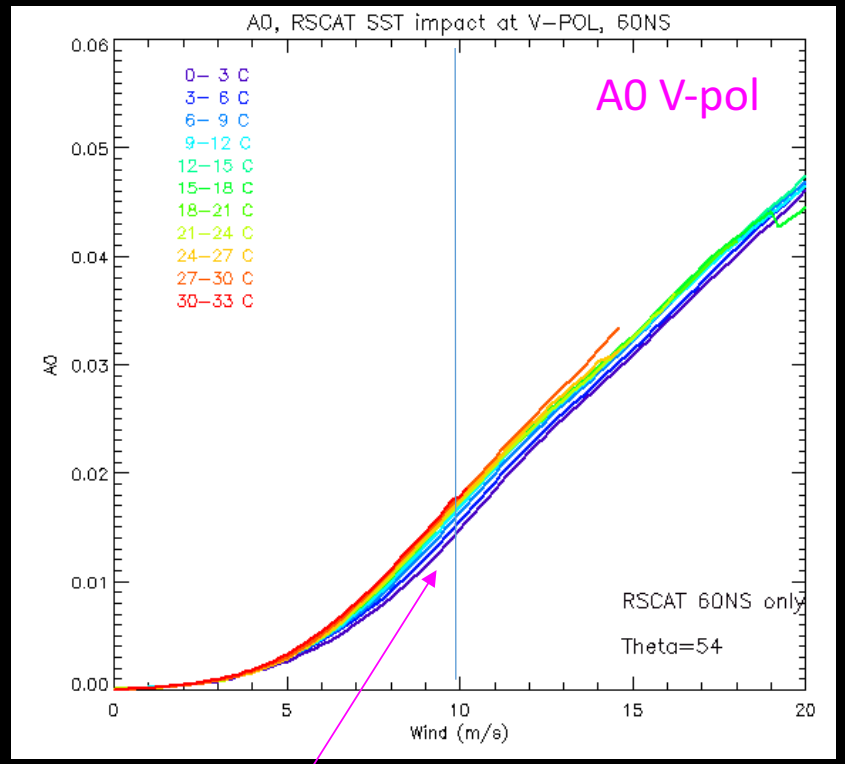


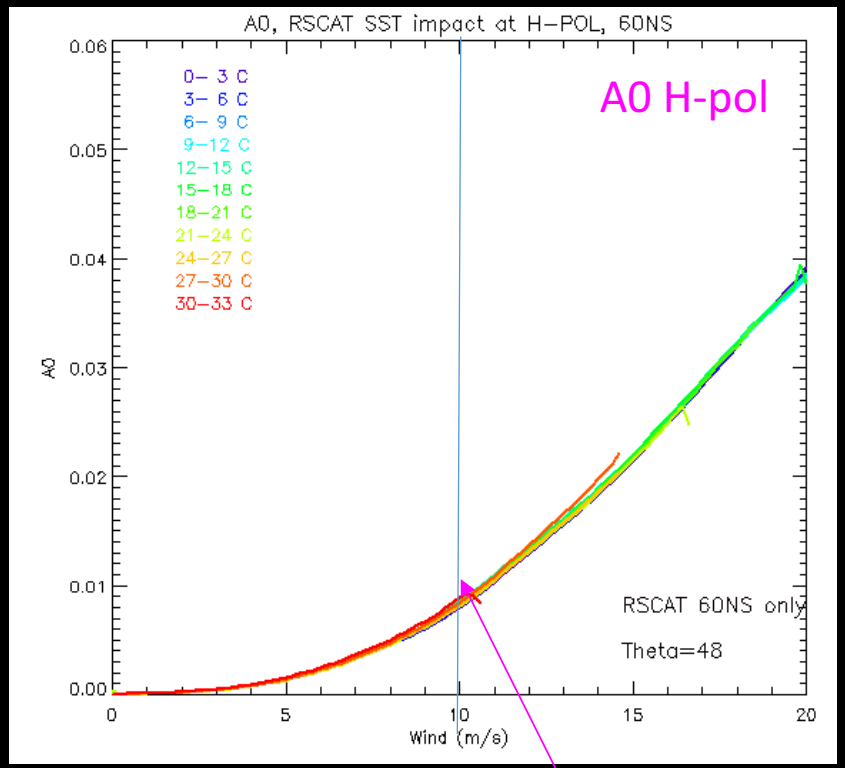


Significant spread of the coefficients at 10 m/s as a function of SST for V-Pol, but not for H-pol.
This indicates a real "physical" signal in the Ku-band sigma0, not in WindSat.
(See paper by Wang, Stoffelen et al (2016) for explanation of SST impact on V-pol and H-pol backscatter)

2d. SST-impact on RapidScat sigma0 (@ QSCAT angle)

Non-directional coefficient A0 (90% signal)

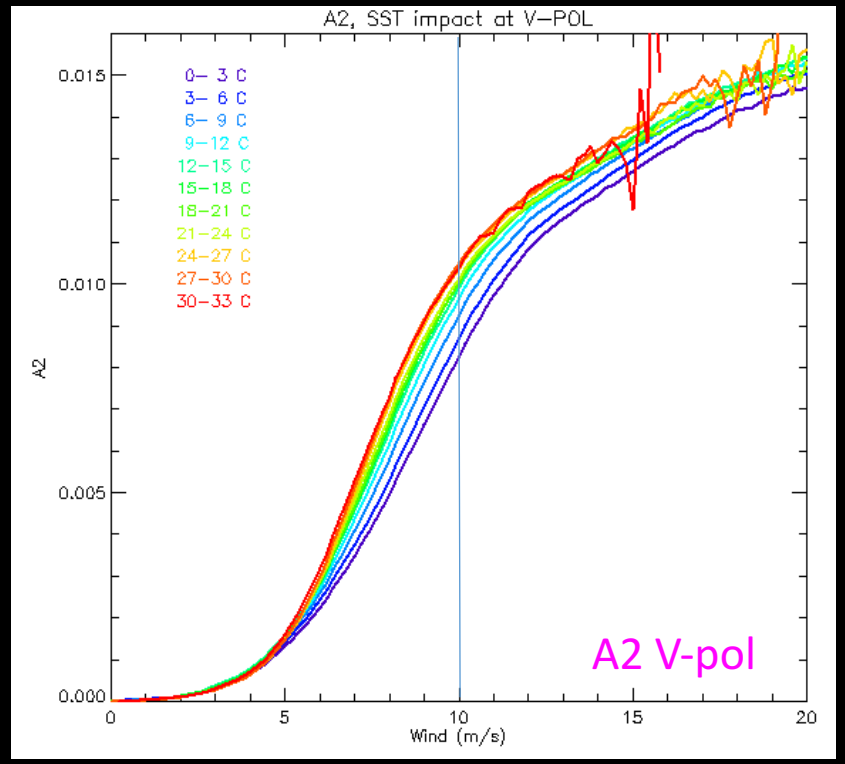


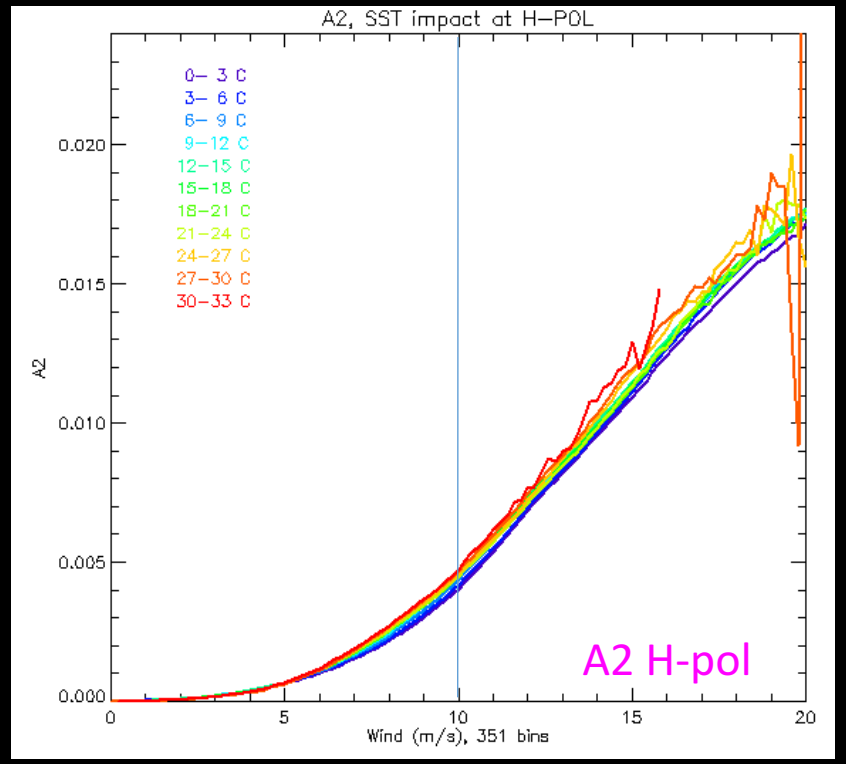


Very consistent SST-impact with QuikSCAT, V-pol affected, H-pol not (real signal !)

We also explored doing it separately for N and S hemisphere, there is no difference (ruled out geographical bias)

2e. SST-impact on QuikSCAT directional coefficient A2

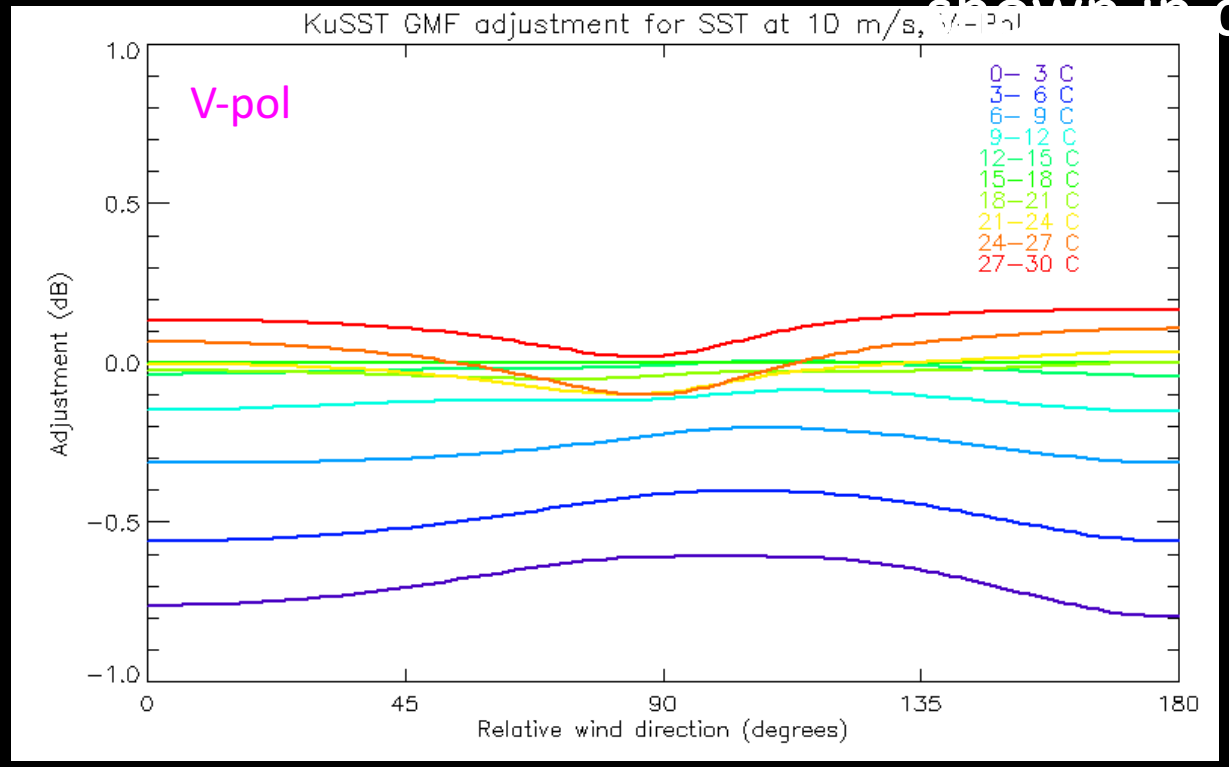


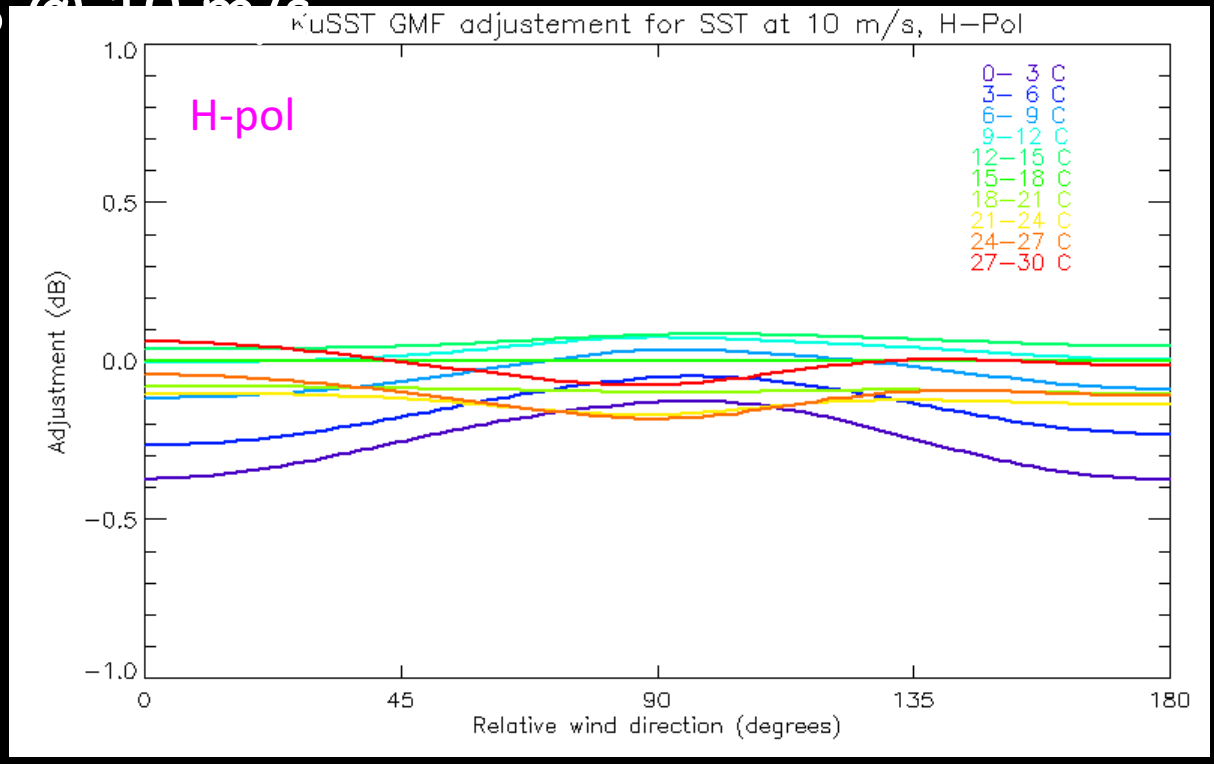


Similarly to A0, V-pol affected, H-pol not

3. Ku-SST: SST-dependent adjustment to current Ku2011 GMF

shown in dB @ 10 m/s





Total adjustment is about the average between V-Pol and H-Pol, max about -0.4 dB (~ 0.4 m/s) for very cold waters SST < 3C

Conclusions and work in progress

- SST-dependent GMF became high priority for scatterometers' consistency
- Corrects for real SST signal at Ku-band sigma0, mostly V-Pol
- Developed new GMF Ku-SST (QSCAT angles) as adjustment to Ku-2011
- Early results: no need to adjust GMF for high winds > 30 m/s (SMAP-SFMR-QSCAT cross calibration)
- RSCAT GMF: prelaunch GMF has been has been readjusted for average SSTs to tune it to actual RSCAT observed sigma0s

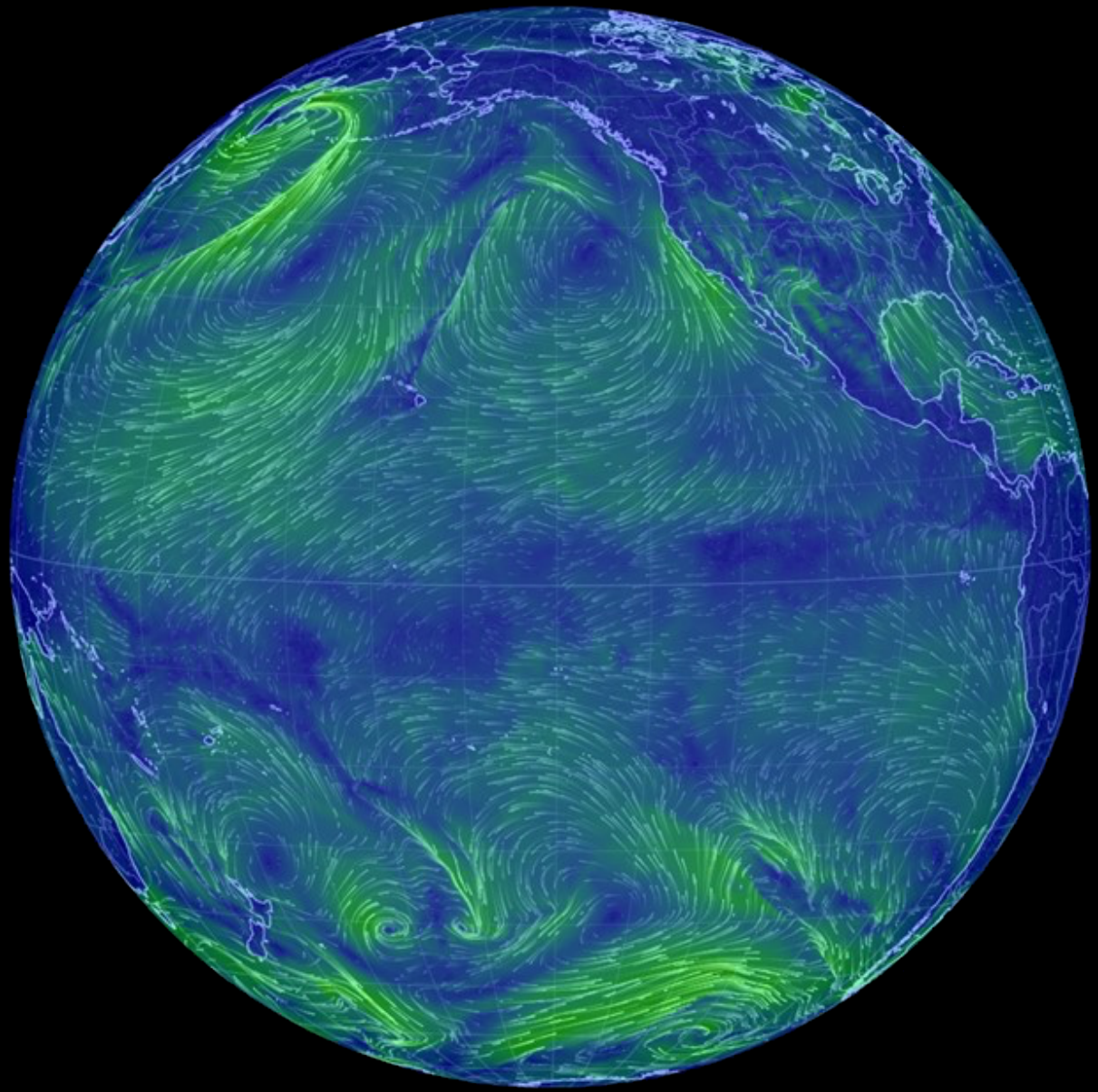
Work in progress

- We need to be very careful with new Ku-SST at high winds not to spoil the calibration
- Determine simple way to implement Ku-SST in QSCAT/RSCAT retrieval algorithm
- Ku-SST will be delivered in the next few months to JPL for final reprocessing of RSCAT

earth

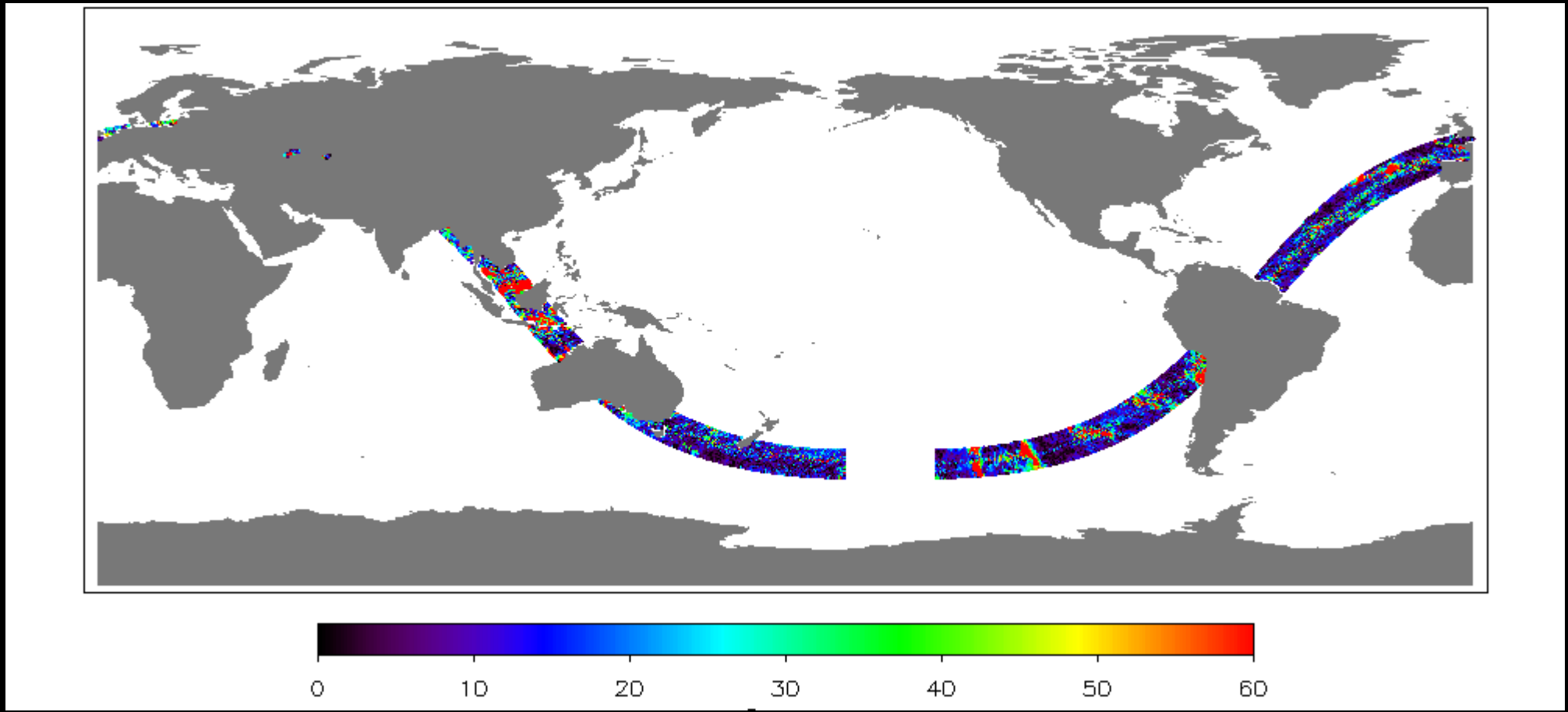
Image from https://earth.nullschool.net/

Extra slides



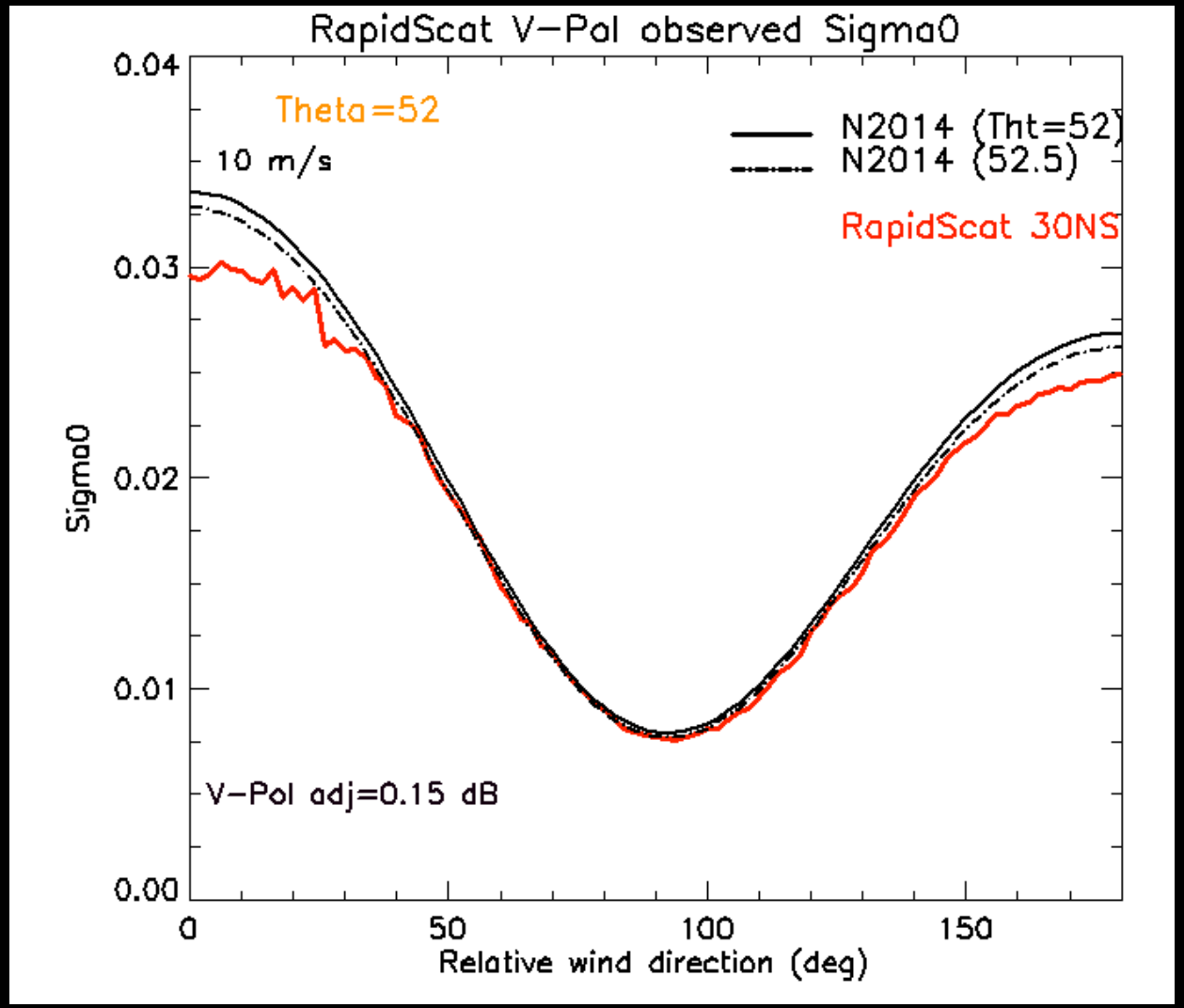
earth

RapidScat JPL 12.5 Km – NCEP wind direction (unflagged)



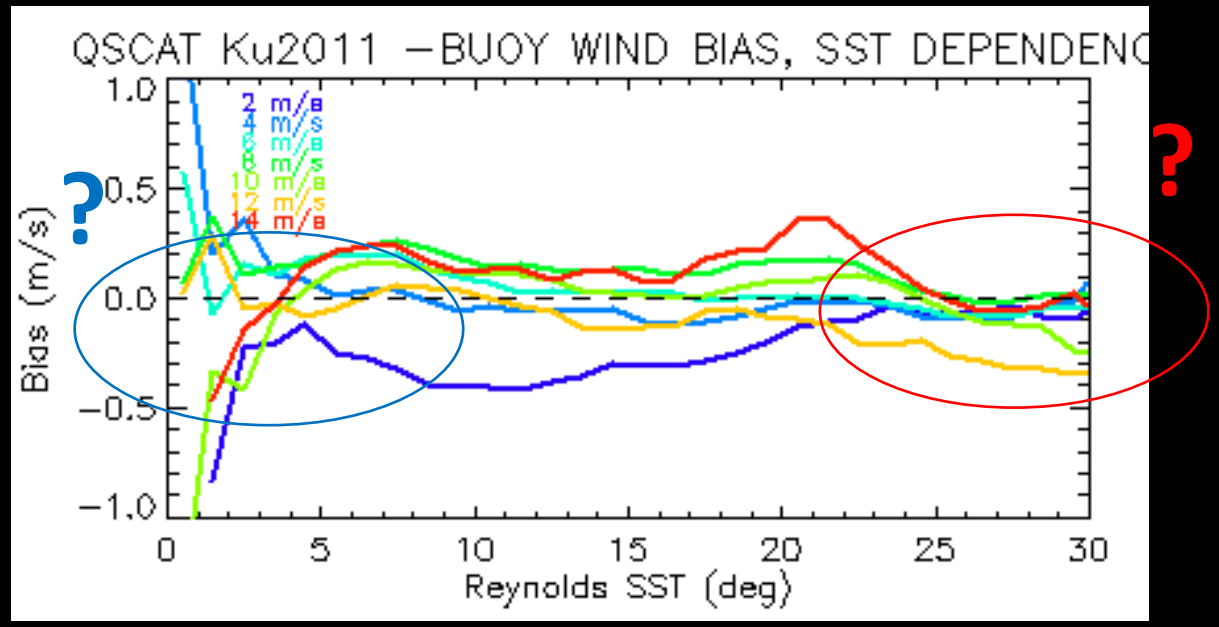
The figure highlights the largest error due a direction discontinuity in the middle of the swath

RapidScat sigma0
Distribution at some
incidence angles departed
From pre-launch GMF
at upwind and downwind
→ Need for a retuned GMF
R017 (directional coefficients)



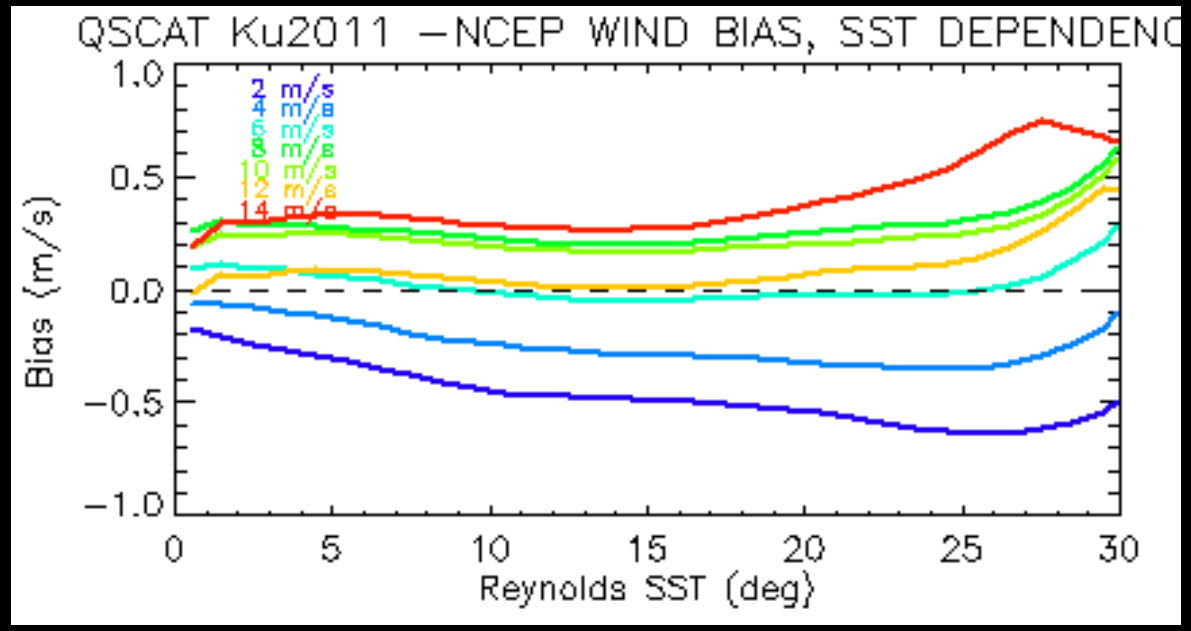
BUOYS

Noisy curves, and little buoy data in very cold waters lead to inconclusive result

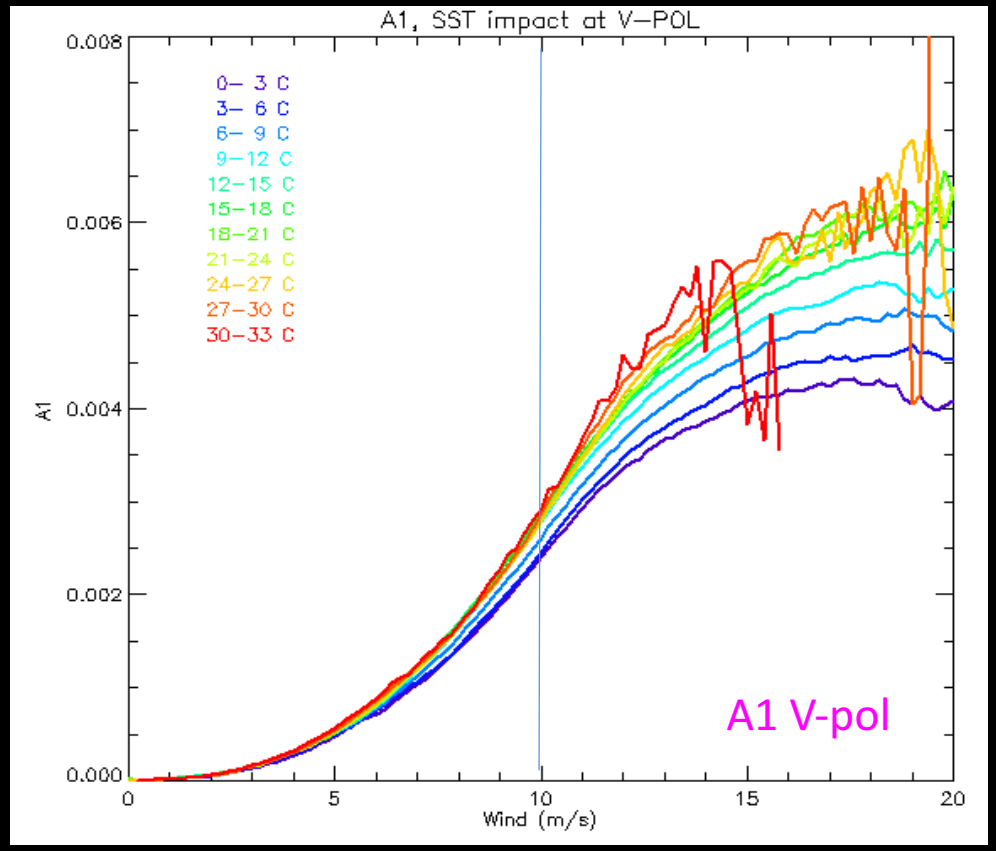


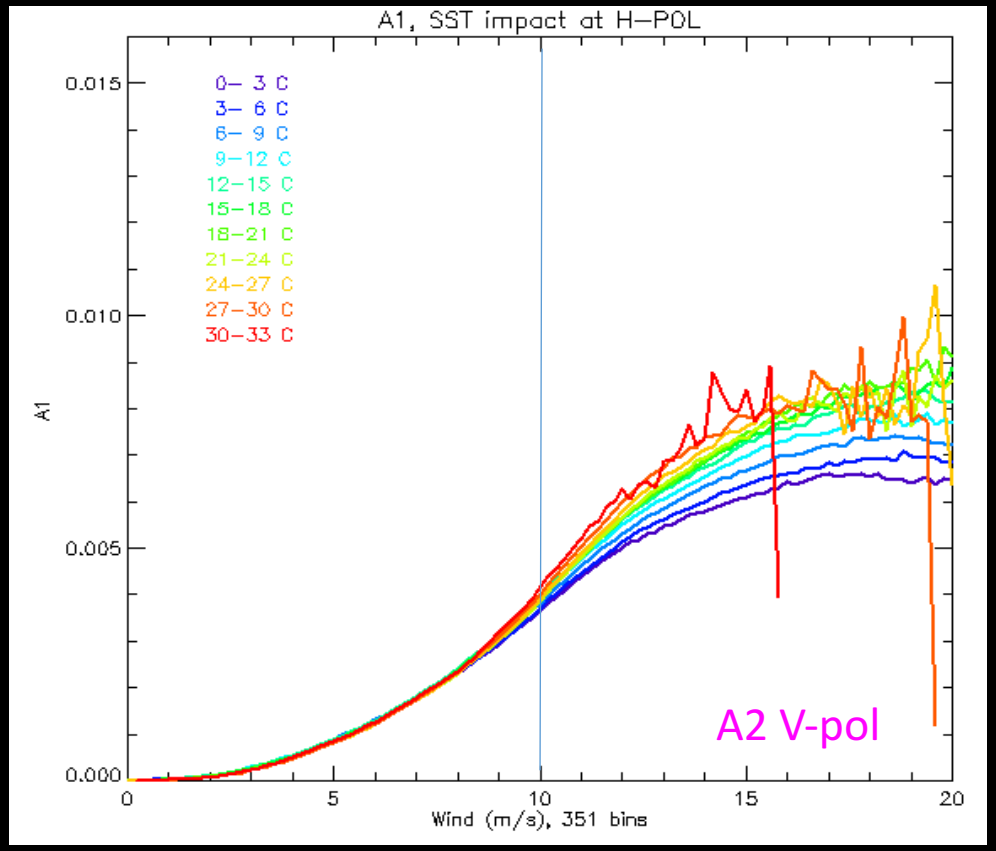
NCEP (or ECMWF)

NCEP regional biases mask SST-dependency
bias due to wind regime/region
Not a good ground truth for Ku-SST



SST-Dependence of A1 (directional) coefficients





A0 V- N and S Hemisphere, RapidScat