Seasonal and Regional Biases in Aquarius V4: Geophysical Model

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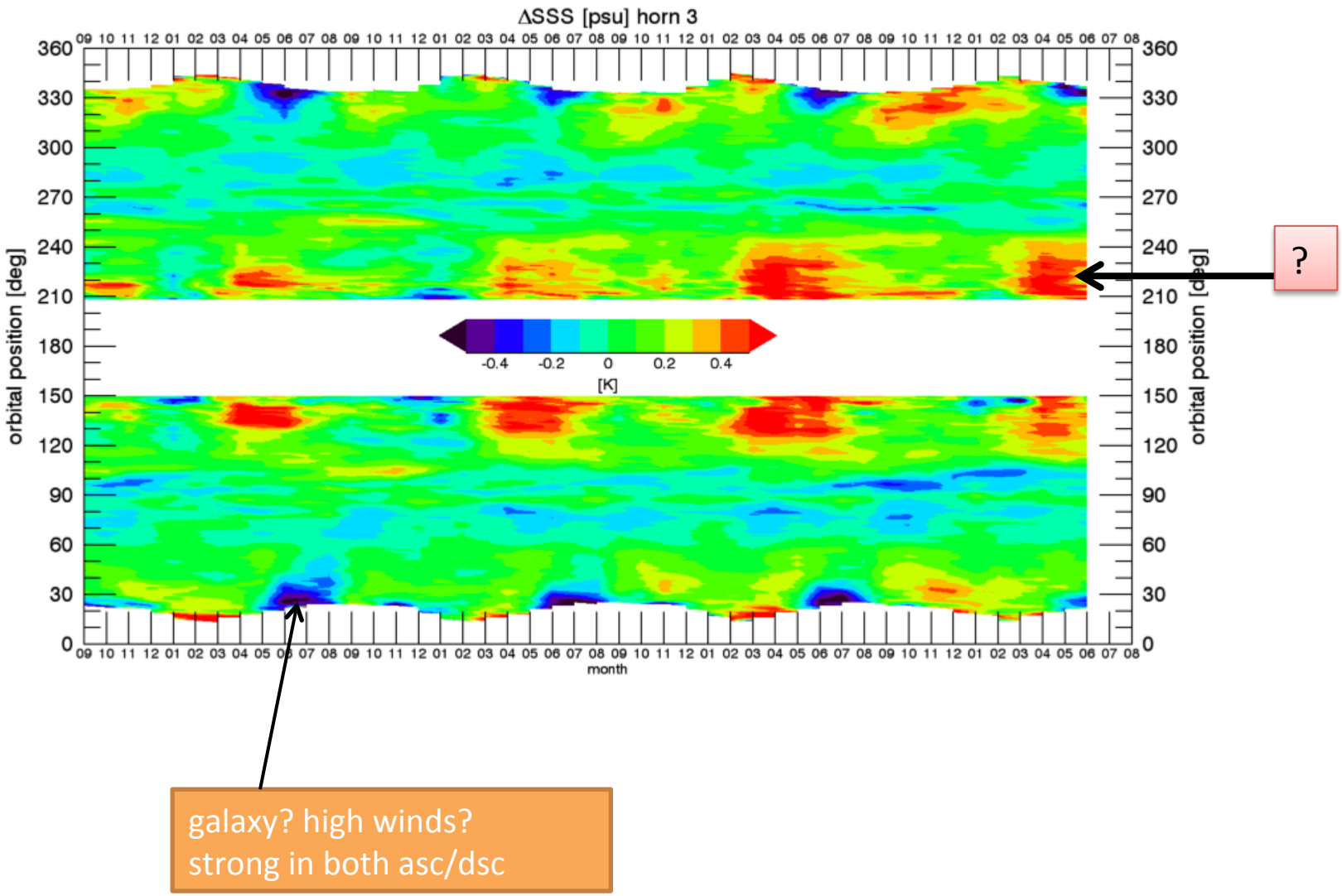
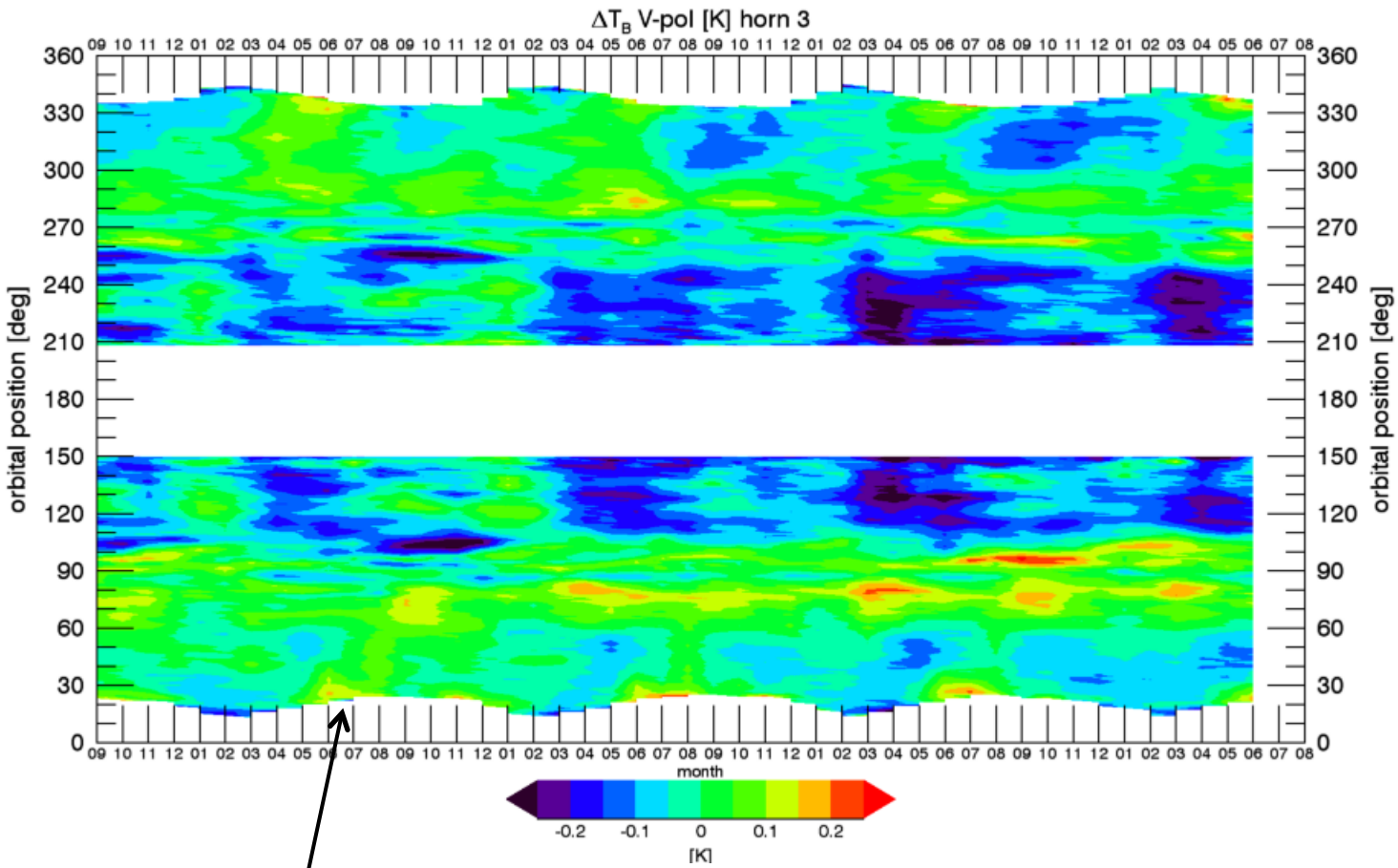
Background

- Last telecons:
  - V4.1 ("instrument only calibration") shows spurious annual signal (+ drift after October 2014 in some of the channels).
    - Most likely instrument related.
    - Visible in cold sky calibration in most of the channels.
- Go back to V4.0 (ocean calibration, global HYCOM)
  - Analyze seasonal and regional biases.

Salinity
V4.0

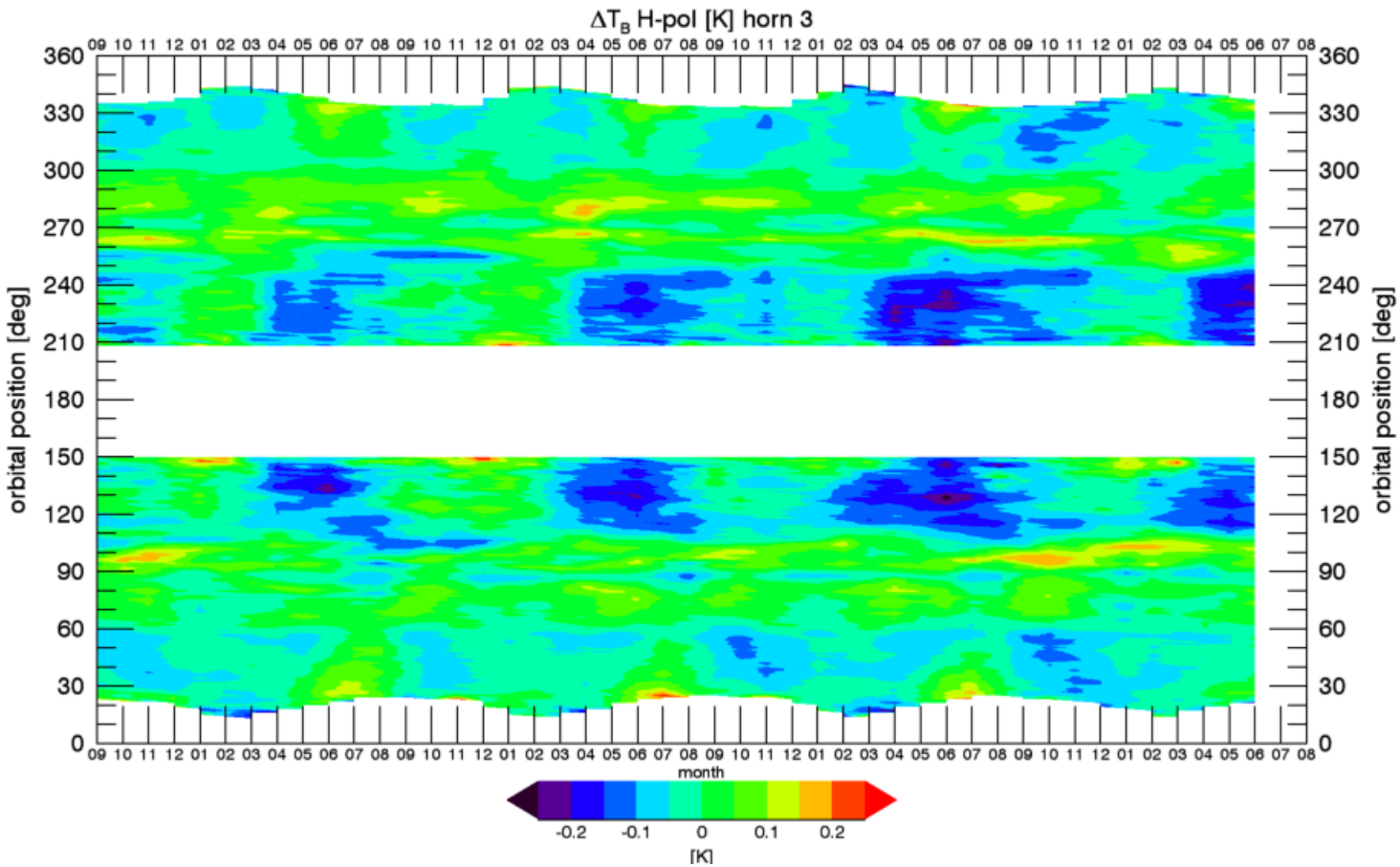


TB v-pol
measured - calculated

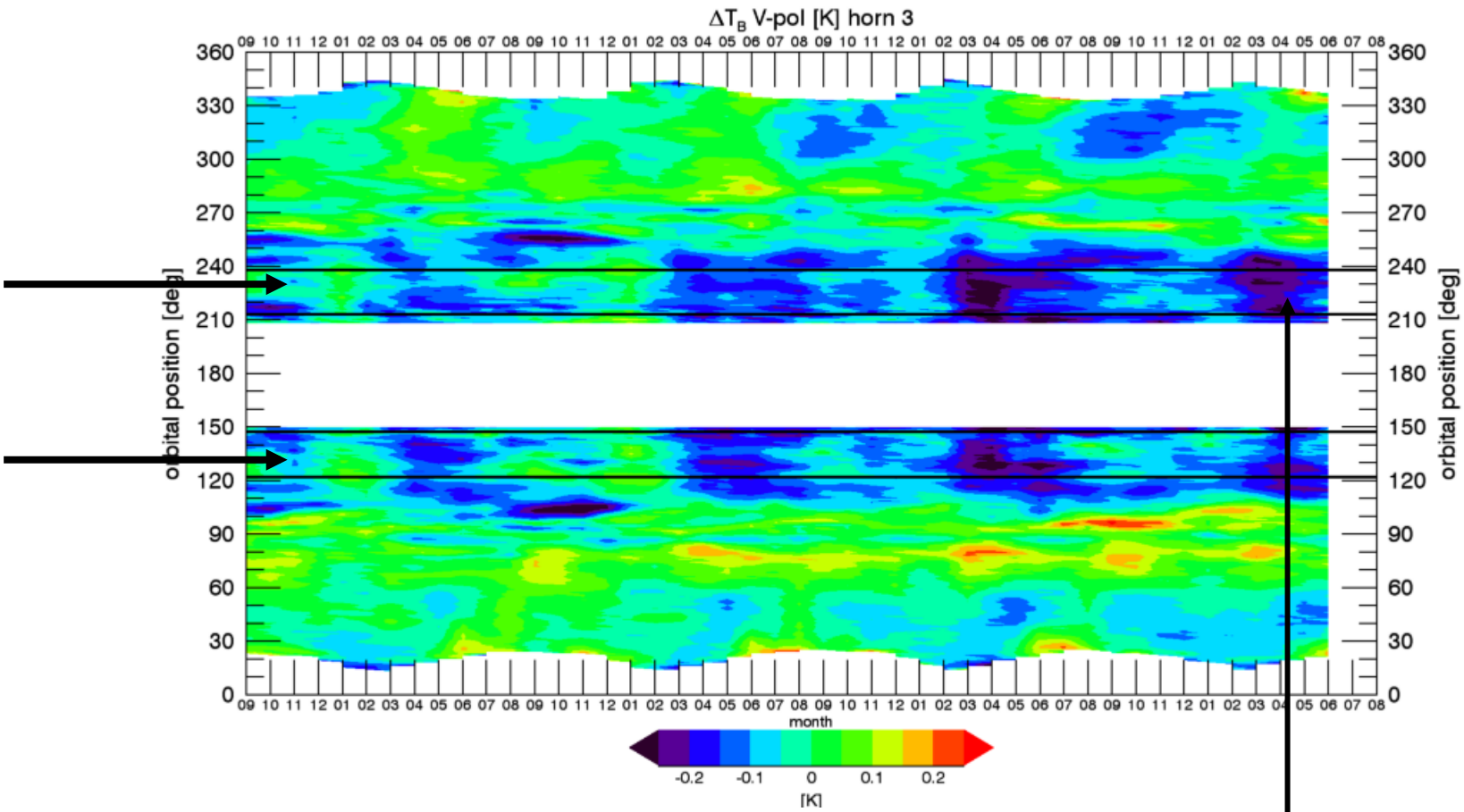


galaxy?
Radiometrically small
cold water !

TB h-pol

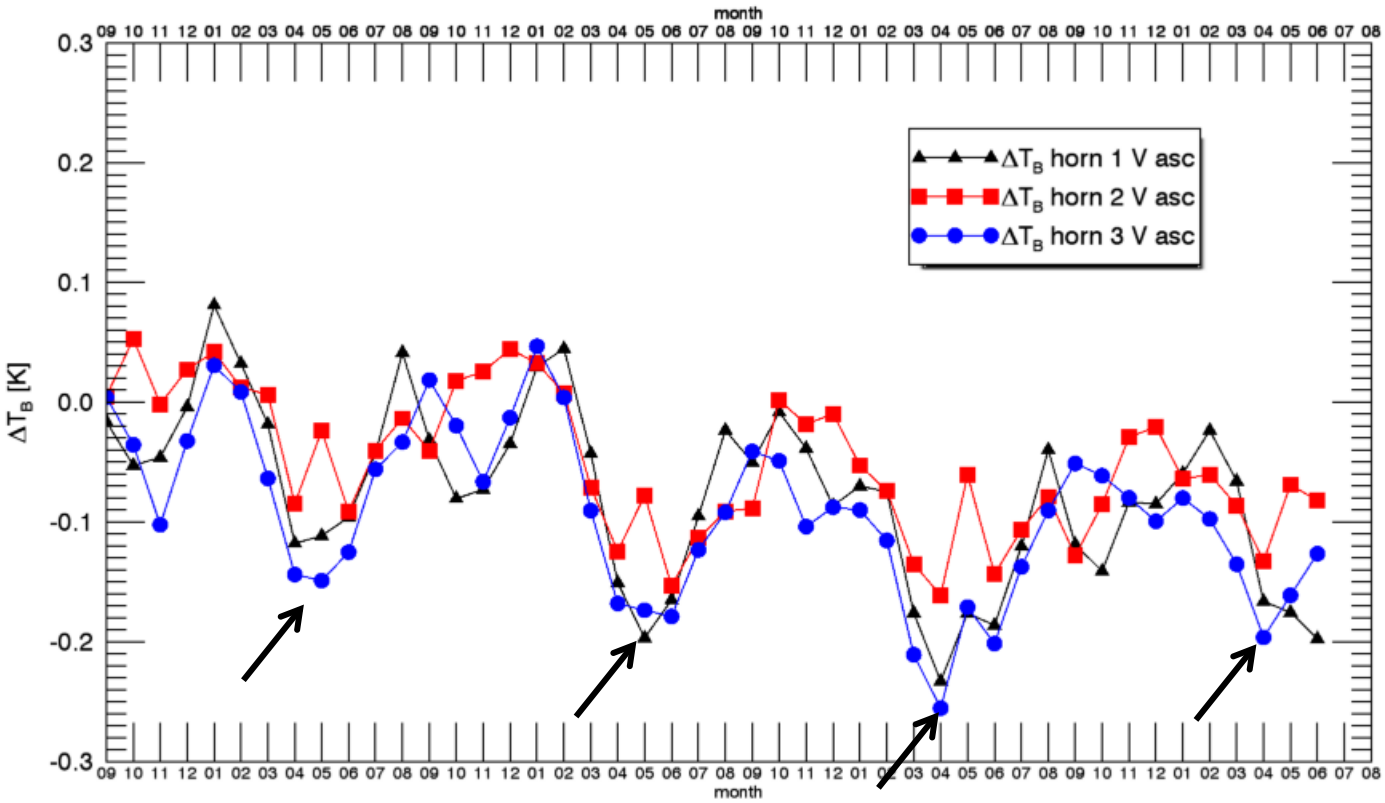


Time Series: Peak zonal average



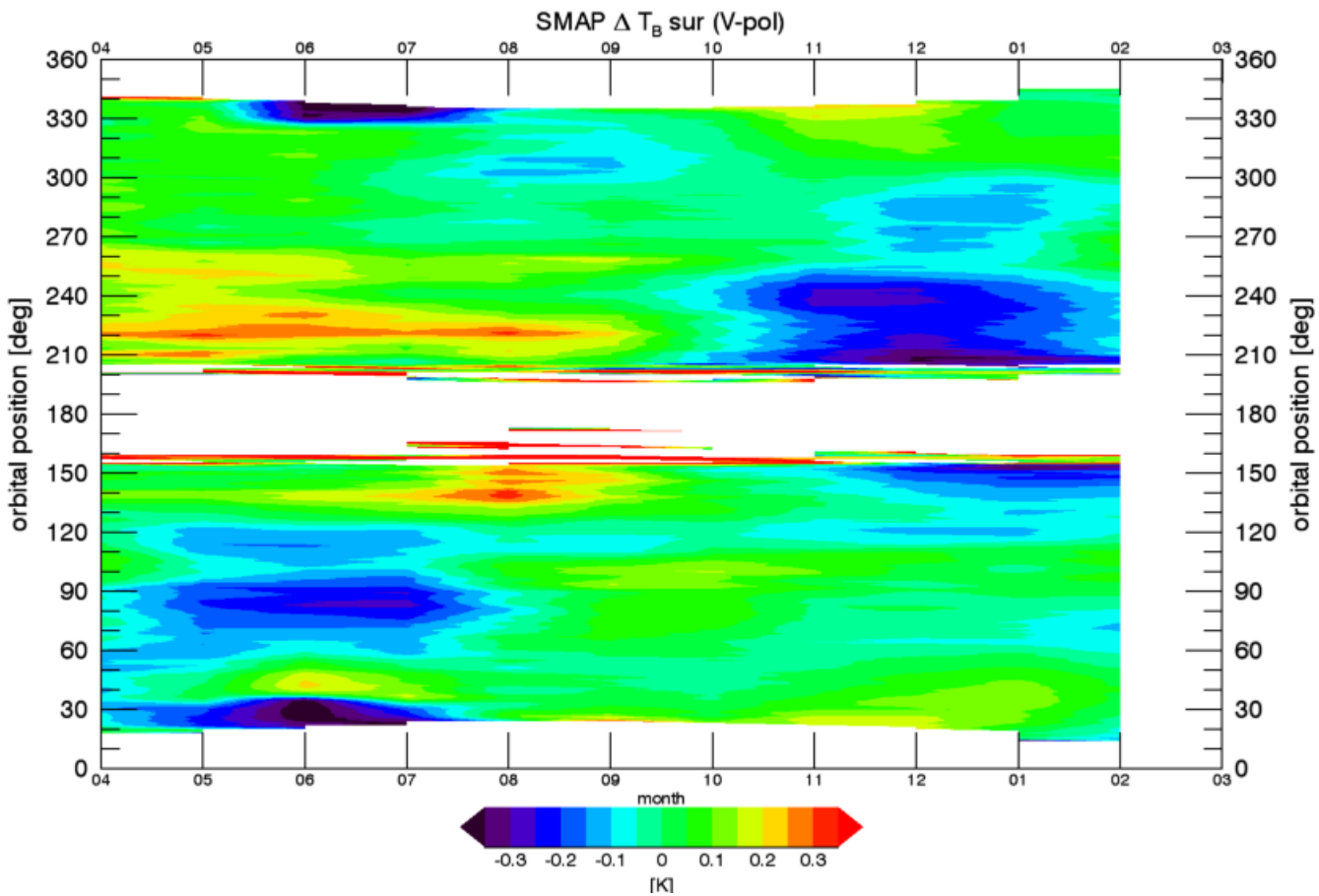
V-pol > H-pol
only small asc/dsc differences
intra-annual difference

Inter-Beam Differences



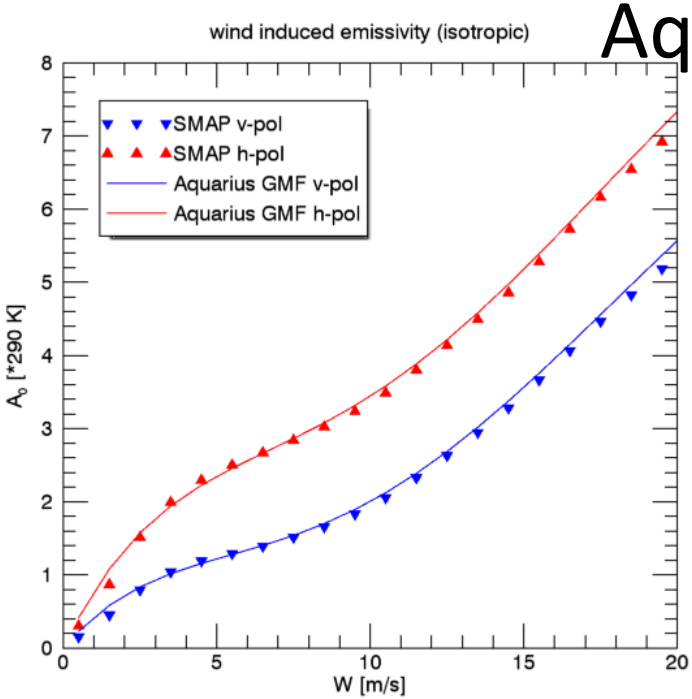
horn1, horn3 > horn 2
peak in MAM

SMAP

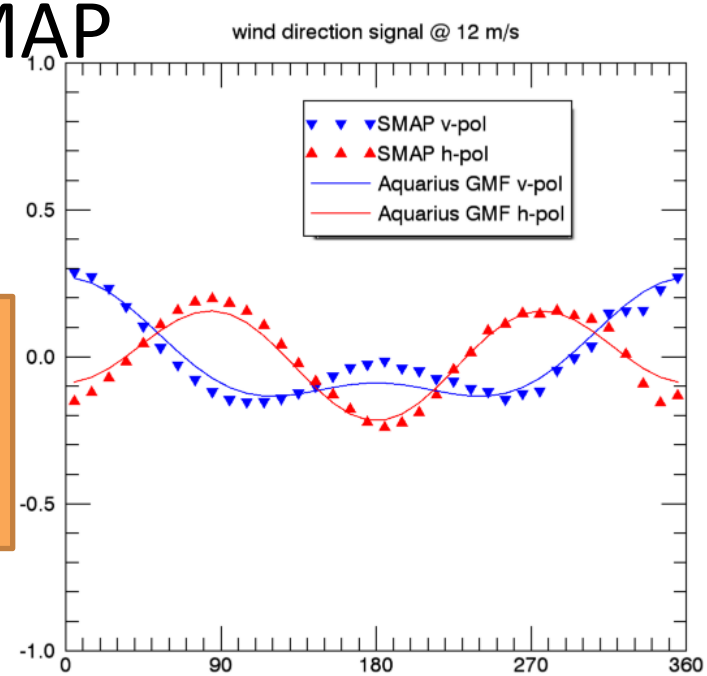


Seasonal and regional biases in SMAO are largely caused by emissive reflector and the deficiencies of the thermal model.
There is no resemblance in SMAP to the Aquarius biases in the N hemisphere during MAM.

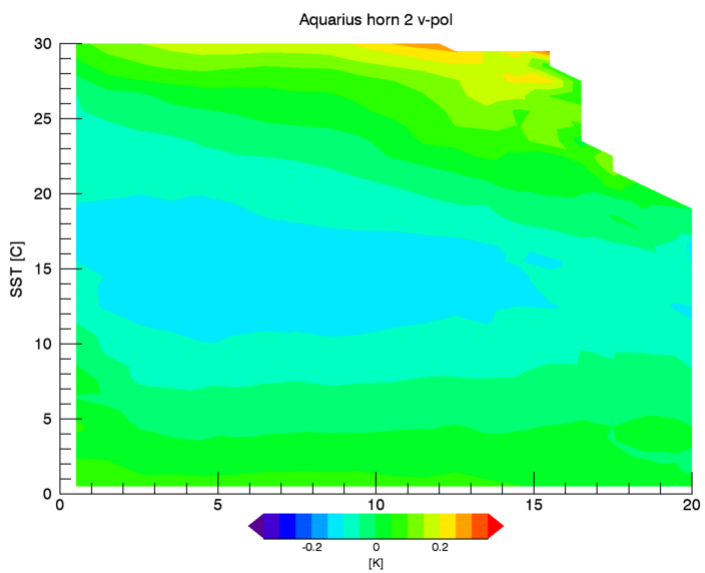
Aquarius vs SMAP

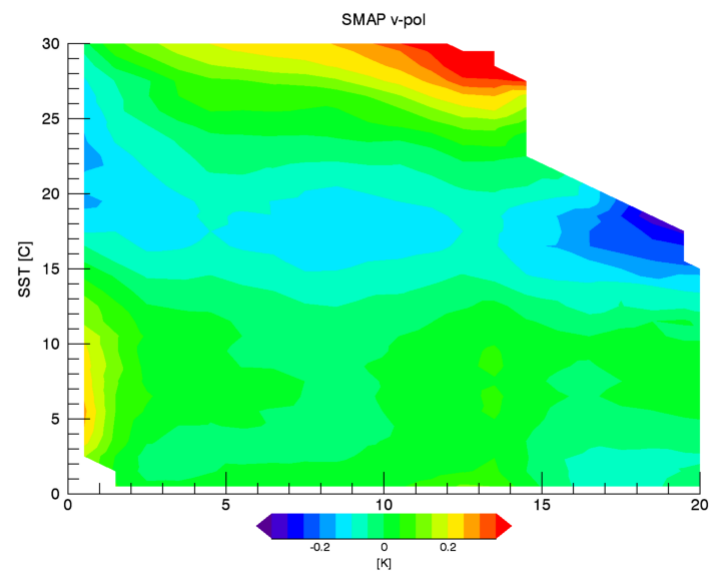


good consistency between Aquarius and SMAP roughness model

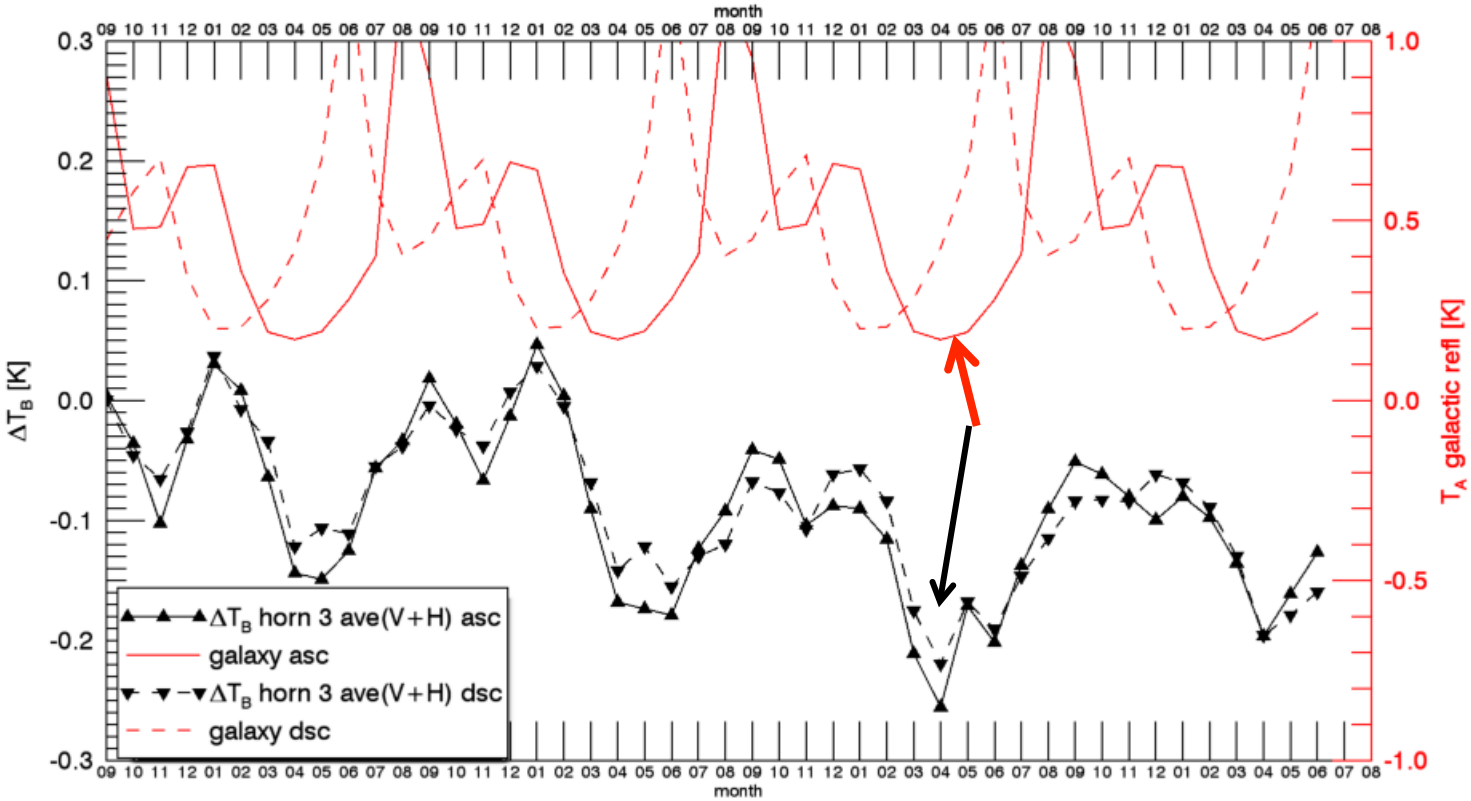


SST bias adjustment





Galaxy

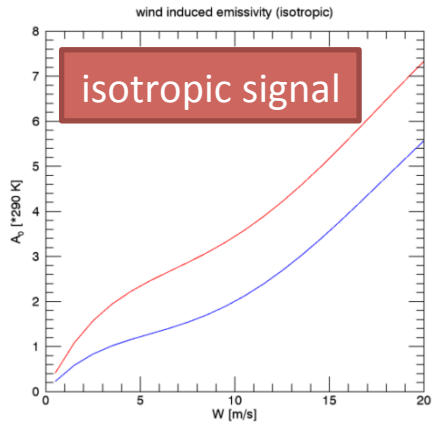


strong ascending/descending signature in galaxy
not observed in TB
very small values for TA gal refl at the times when we observe the large TB biases

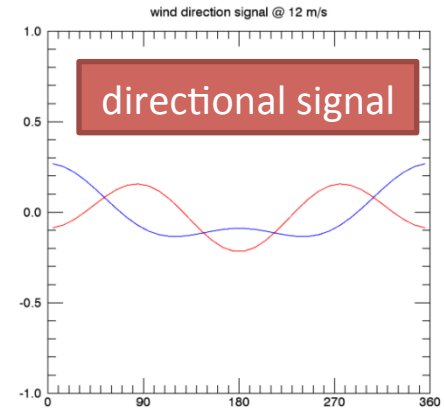
Surface Roughness Correction

In a nutshell

σ_{0HH} T_{BH} → Aquarius Wind Speed →



→



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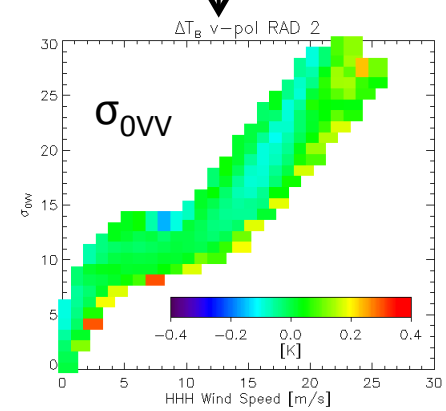
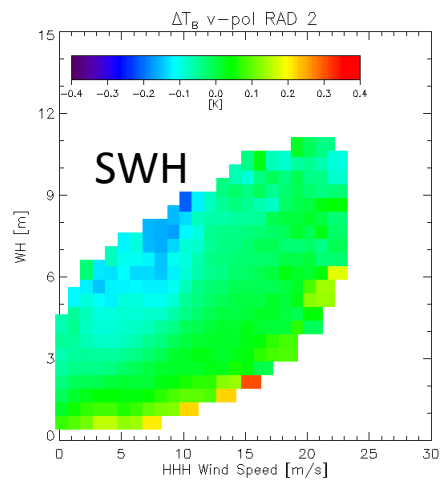


←



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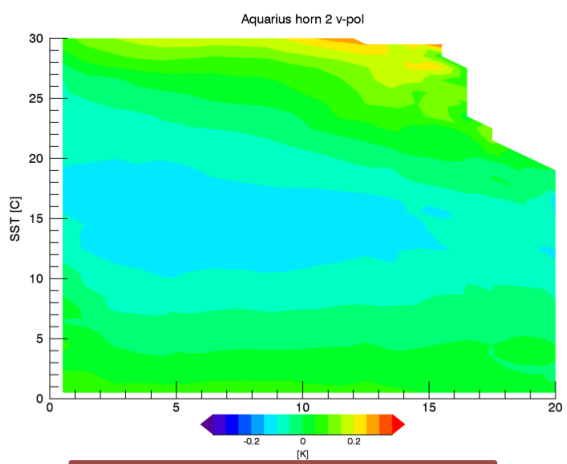
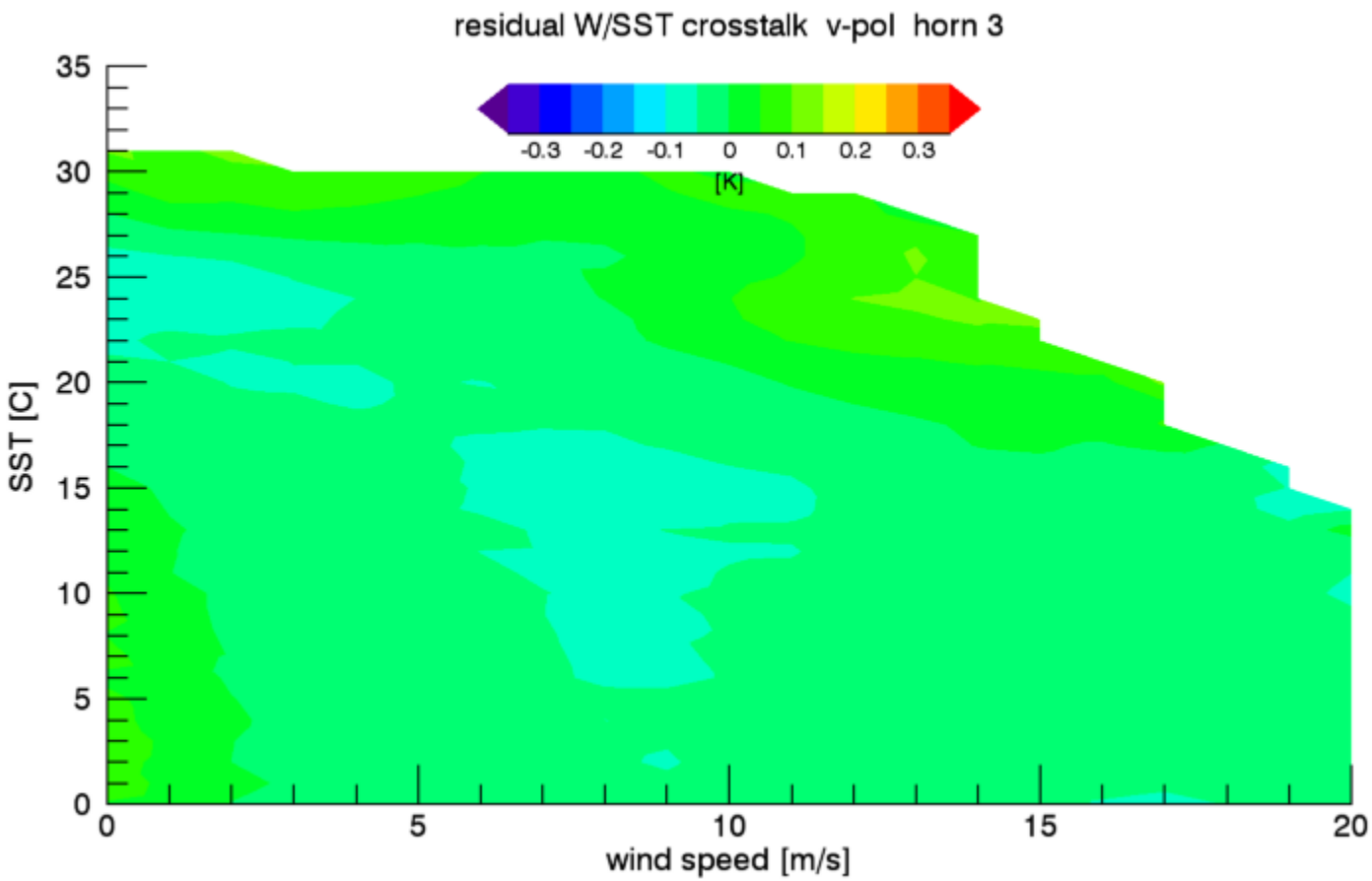


"higher order" roughness

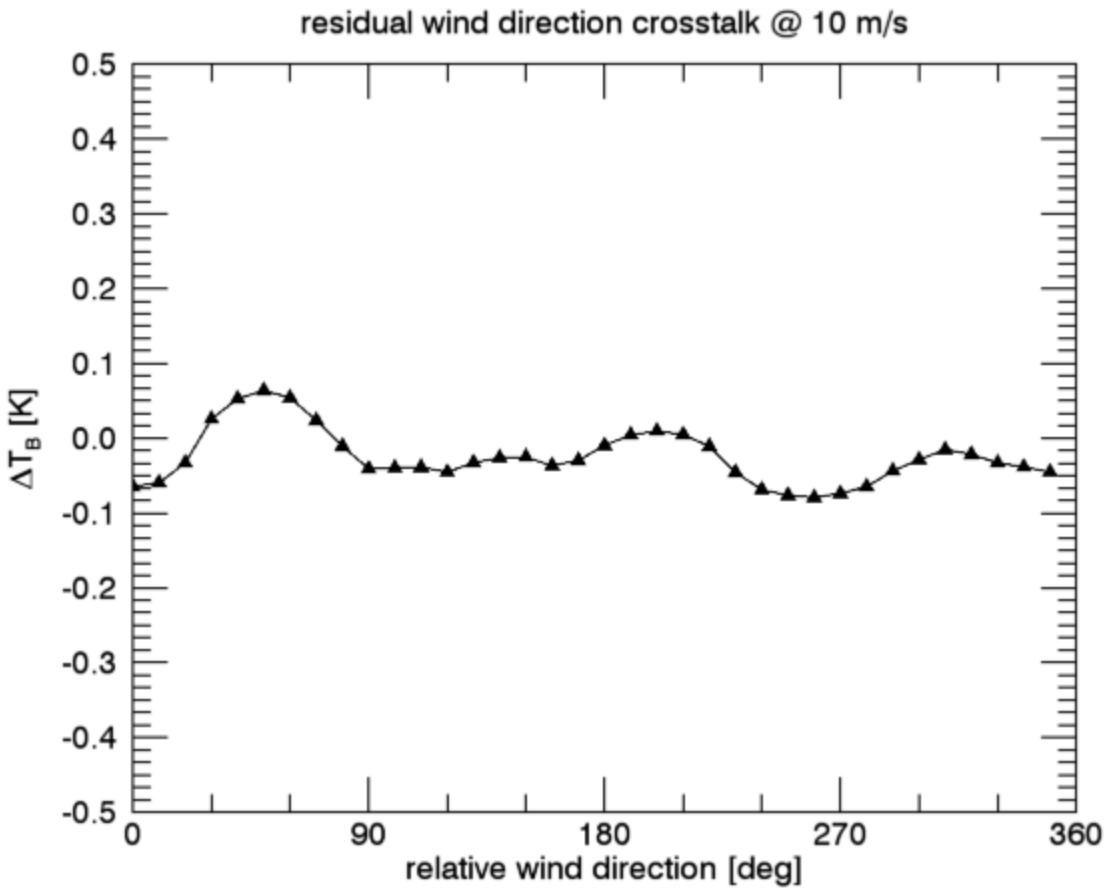
"SST bias adjustment

Residual SST/WSPD Dependence
global



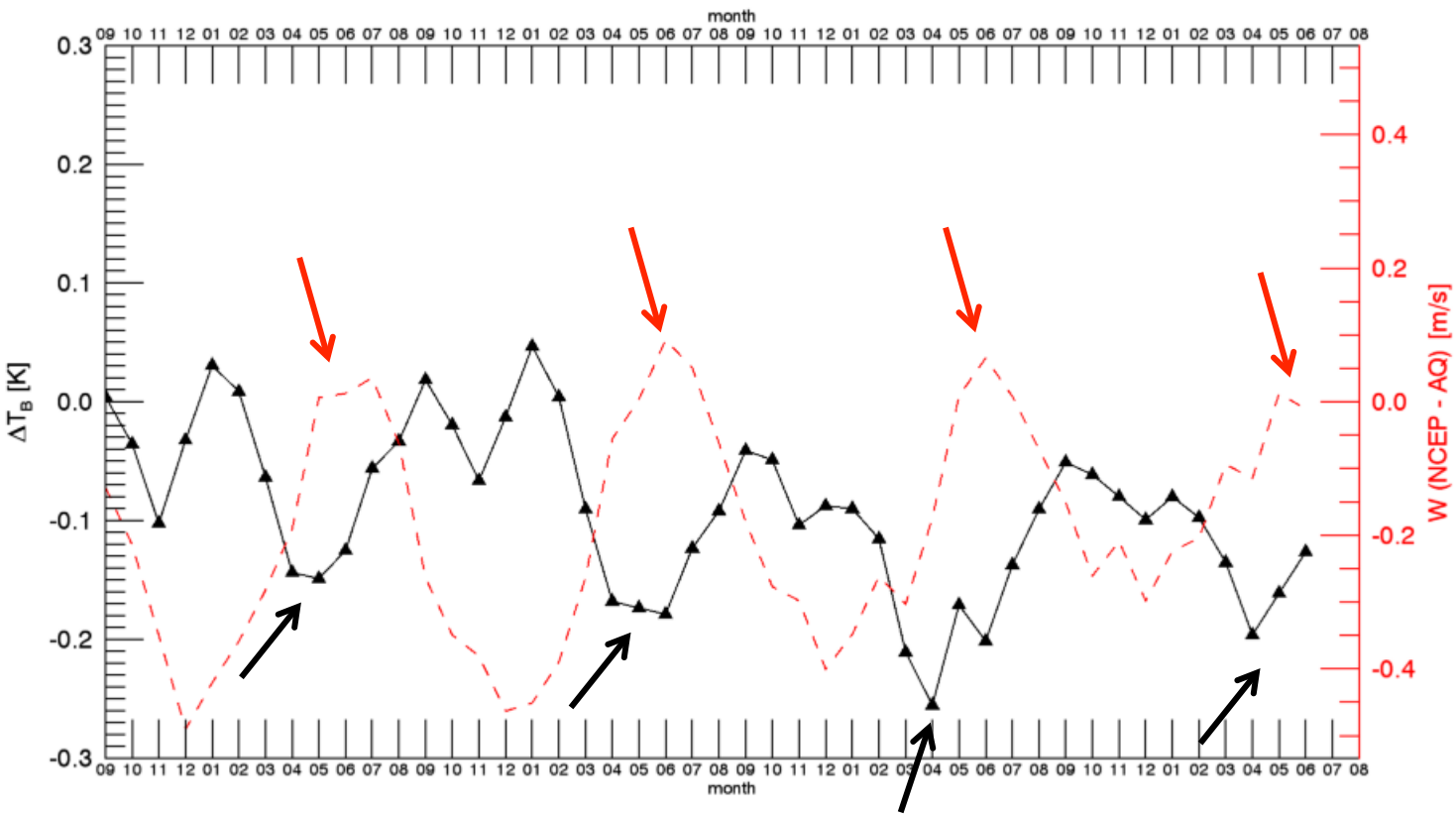
very small – none.
The SST bias adjustment in the roughness correction does what it is supposed to do.

Residual Wind Direction Dependence
global



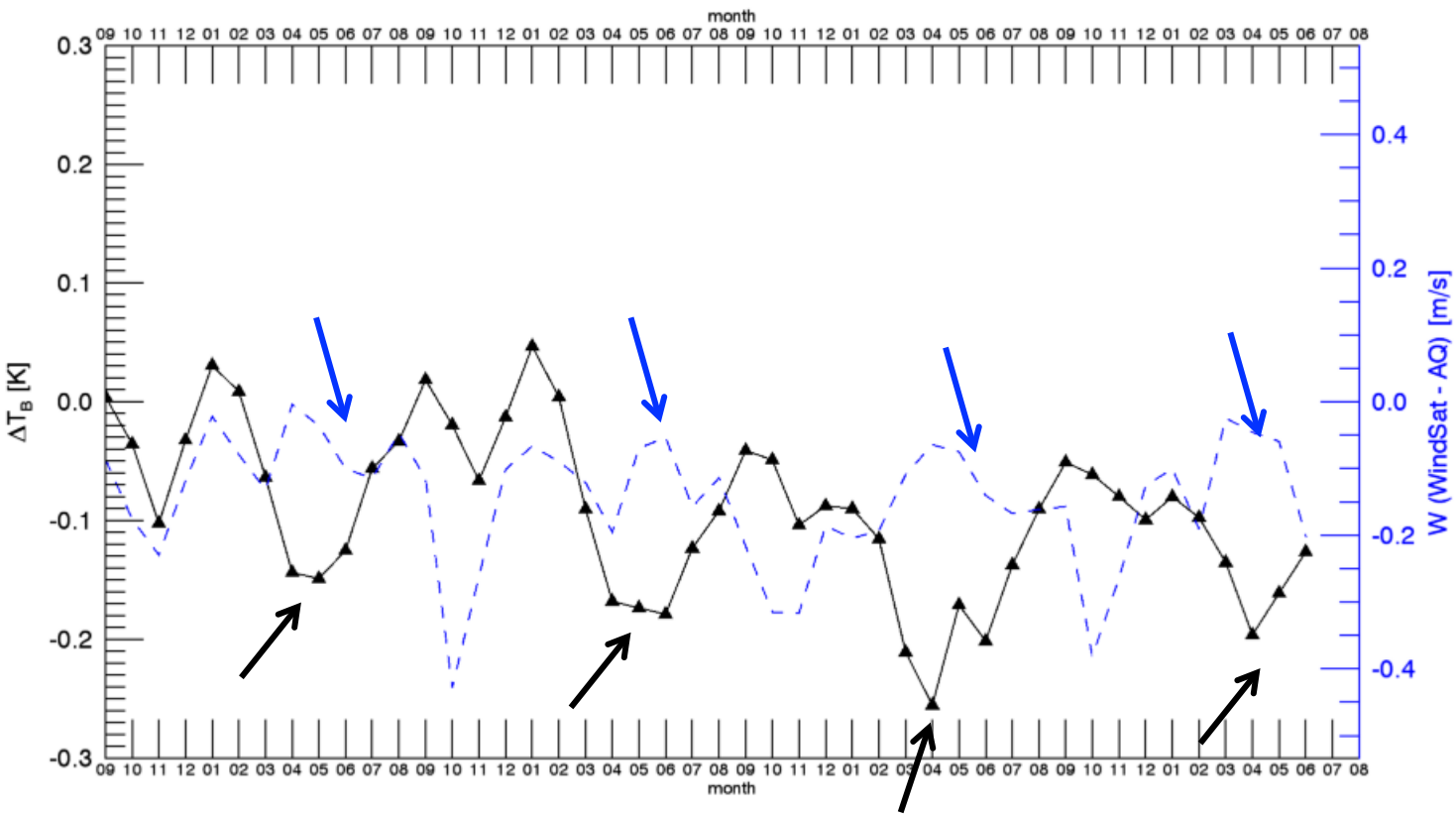
very small - none

Wind Speed: Aquarius versus NCEP



NCEP and Aquarius wind speed differences are very small during times of peak biases.

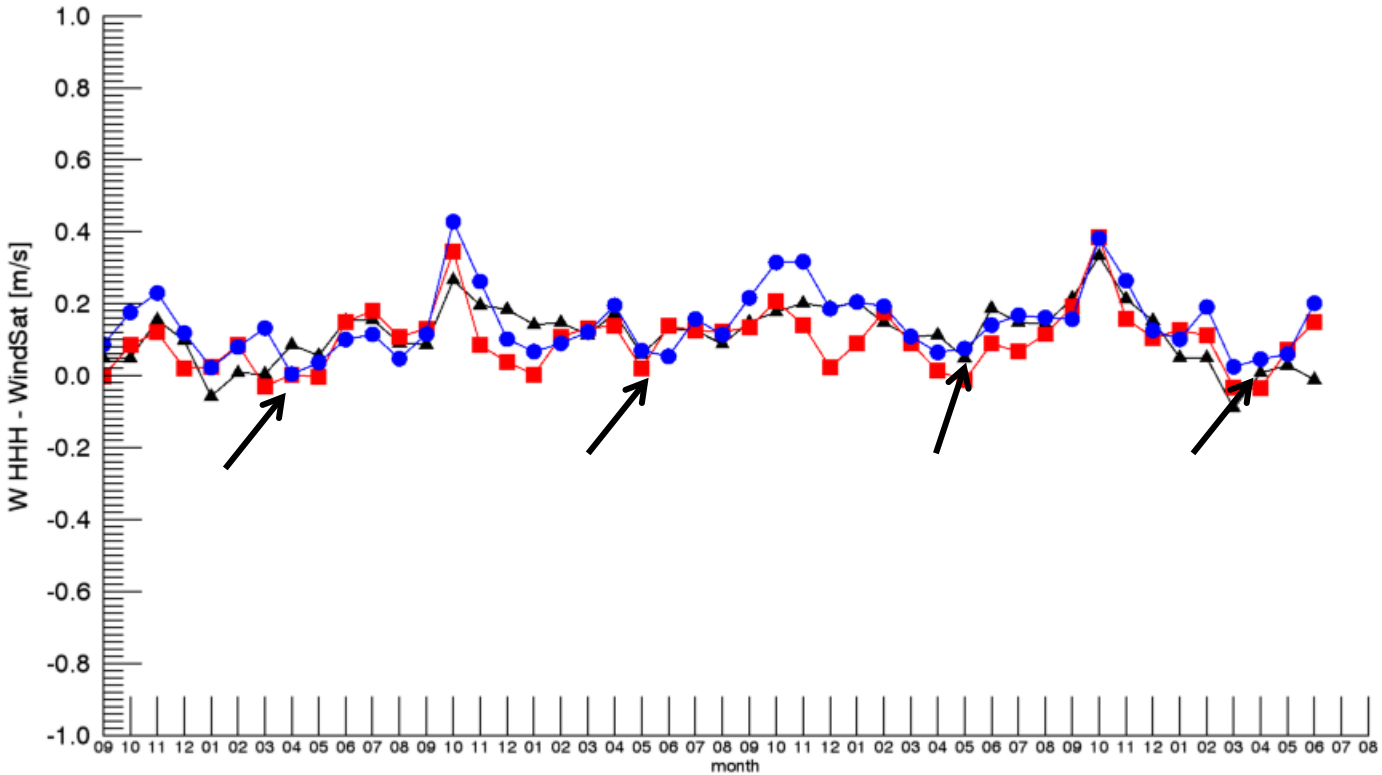
Wind Speed: Aquarius versus WindSat



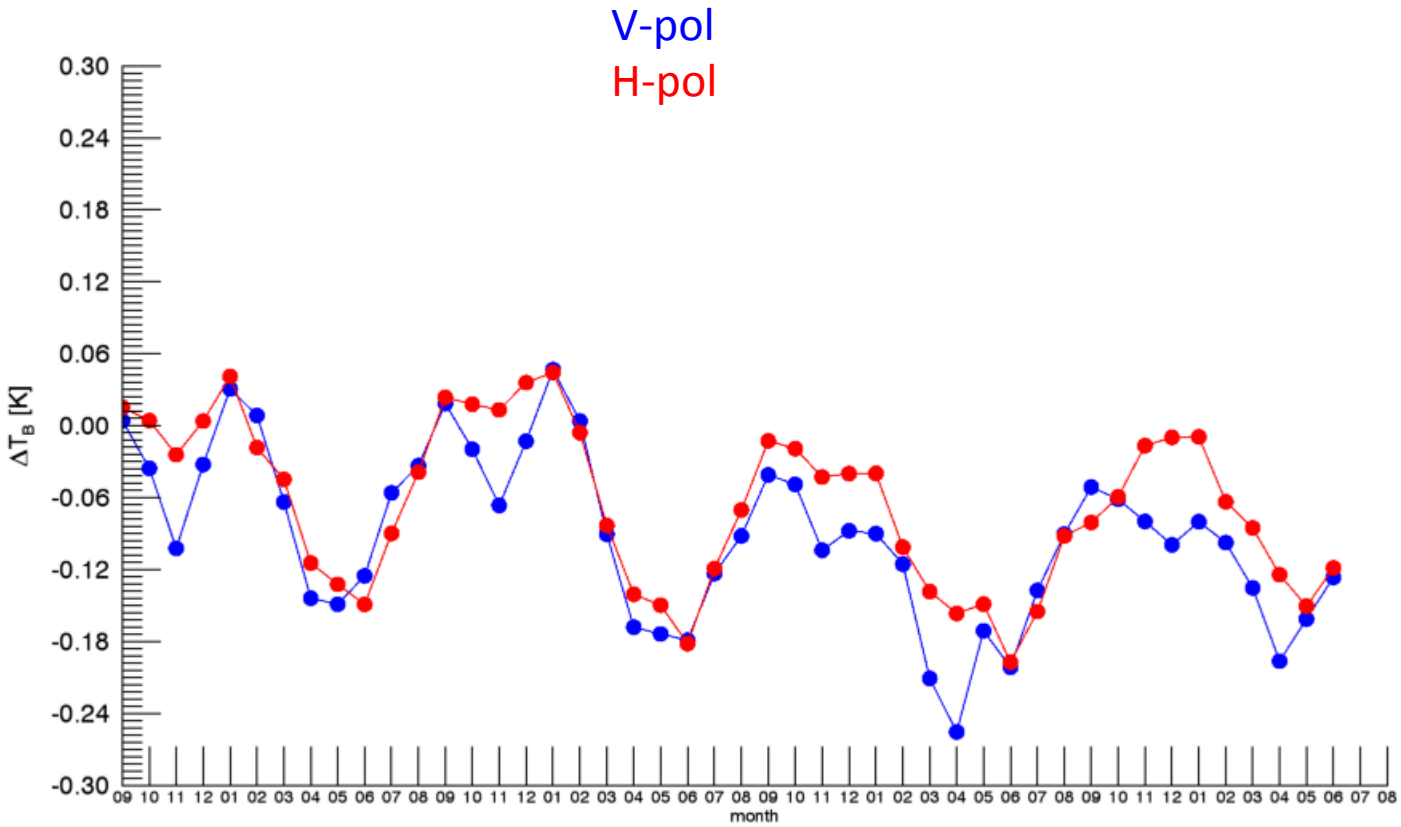
WindSat and Aquarius wind speed differences are very small during times of peak biases.

HHH – WindSat

Inter-Beam Differences

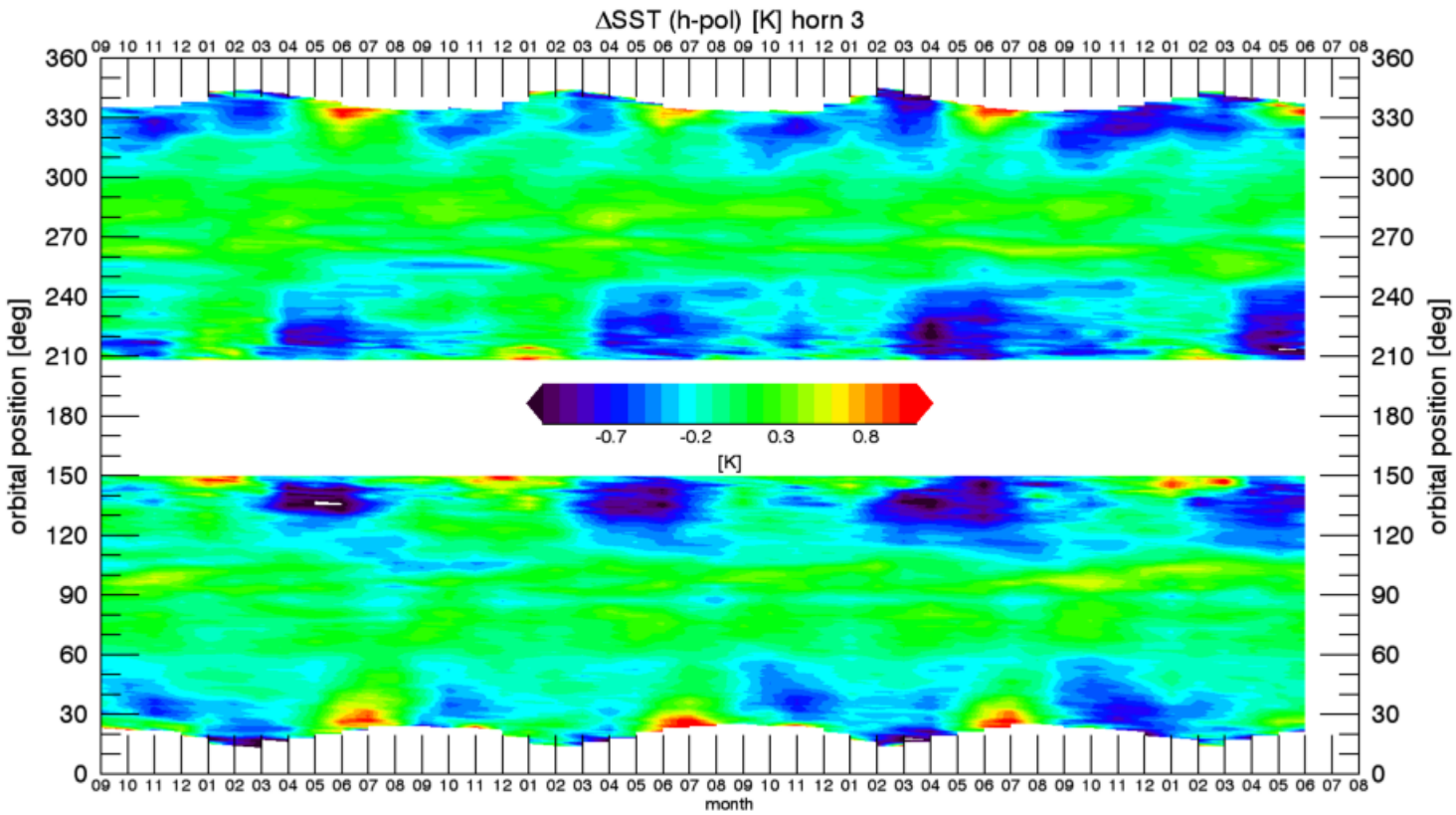


V-pol/H-pol



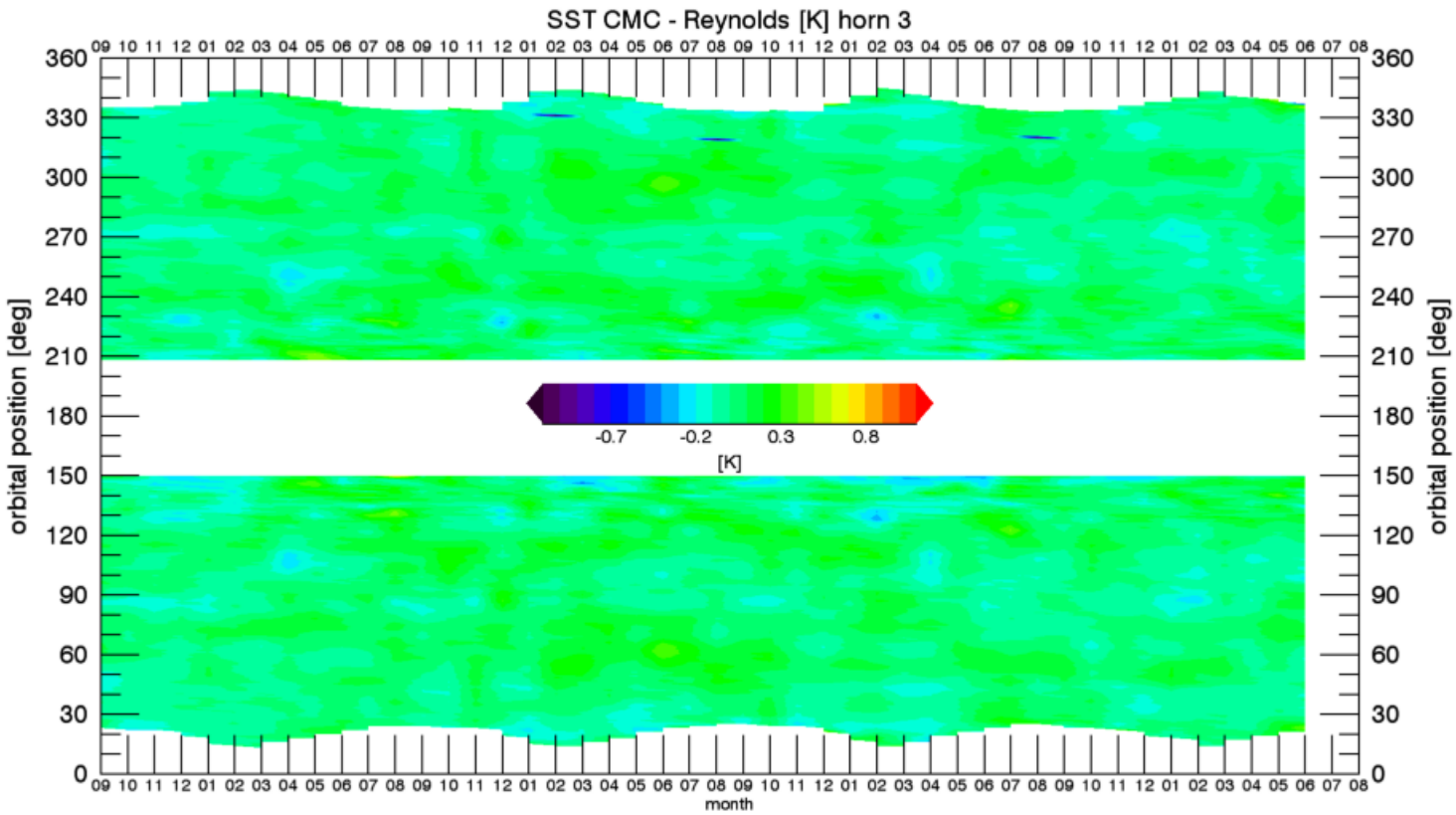
An error in input wind speed would affect H-pol stronger than V-pol.

Ancillary SST Input



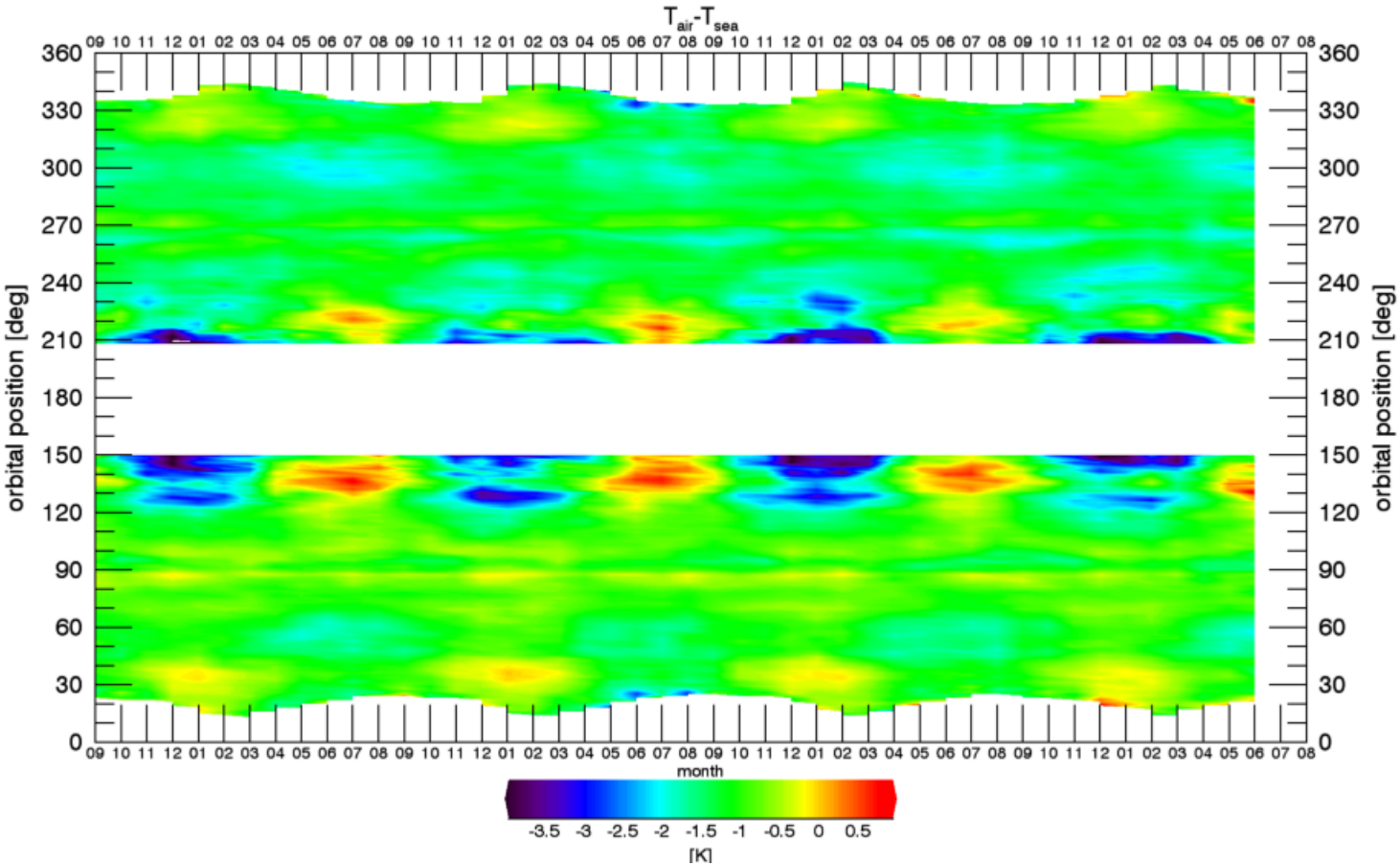
The figure shows the change in SST (from Reynolds) that one would need to explain the biases. The SST error would need to be very large.
Not observed at SMAP.

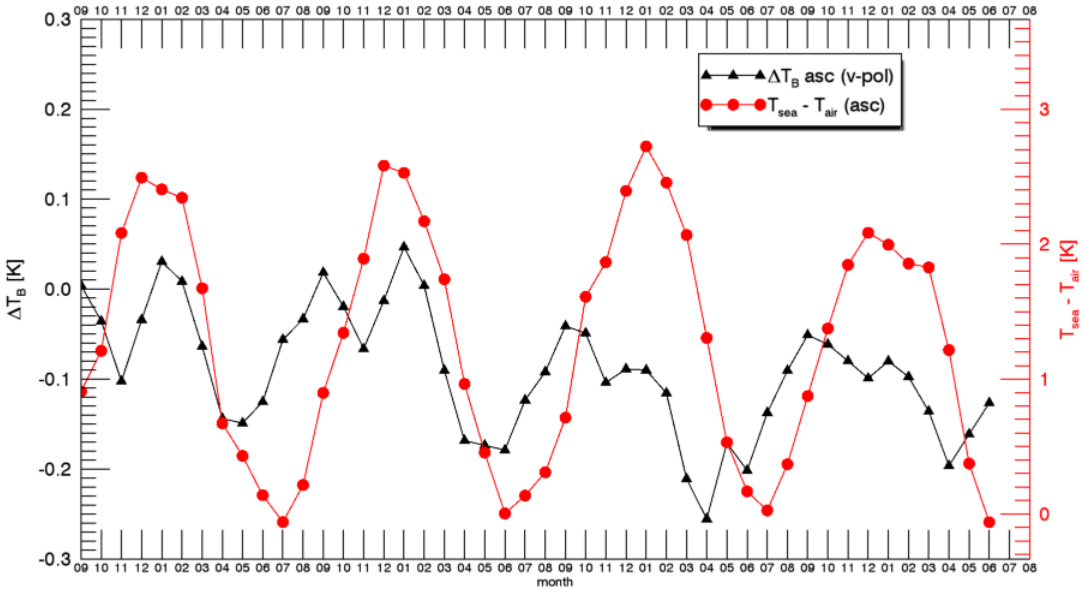
CMC – Reynolds SST

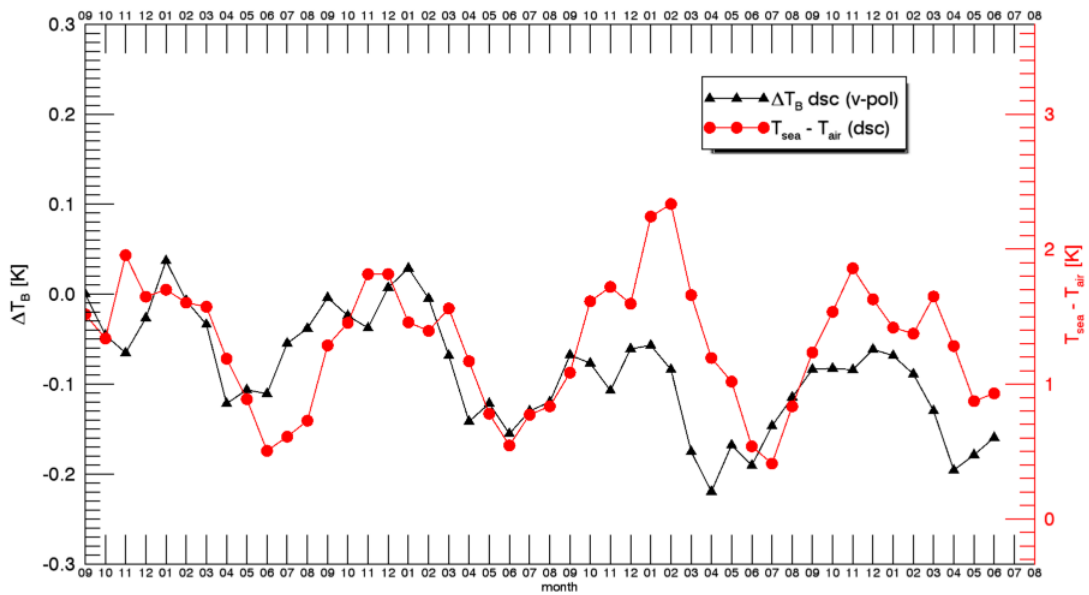


shows nothing like that

Air – Sea Temperature







A close look:

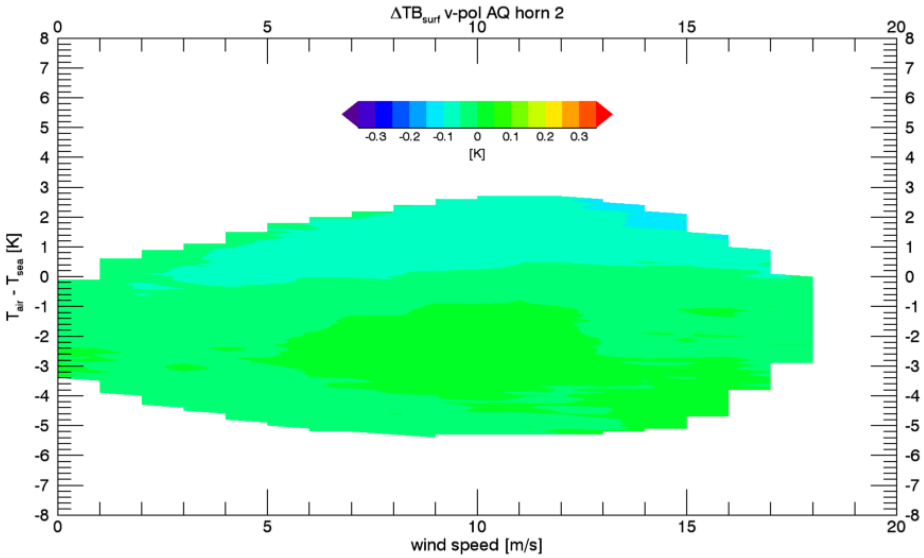
Aquarius TB bias in N hemisphere peaks during MAM.

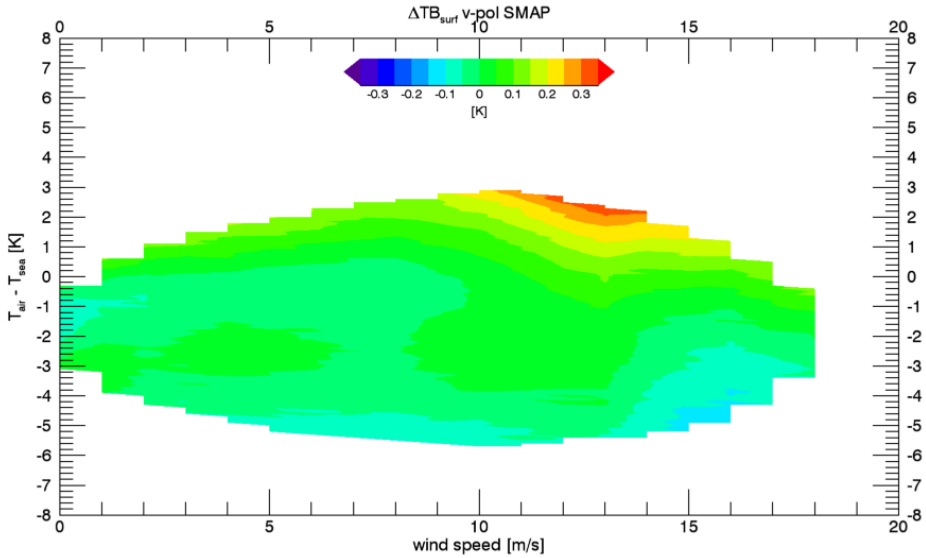
Tair – Tsea peaks in MJA.

Aquarius TB bias in N hemisphere has little-no asc/dsc difference.

Tair – Tsea has significant diurnal signal.

Residual Dependence on T_{air} - T_{sea}

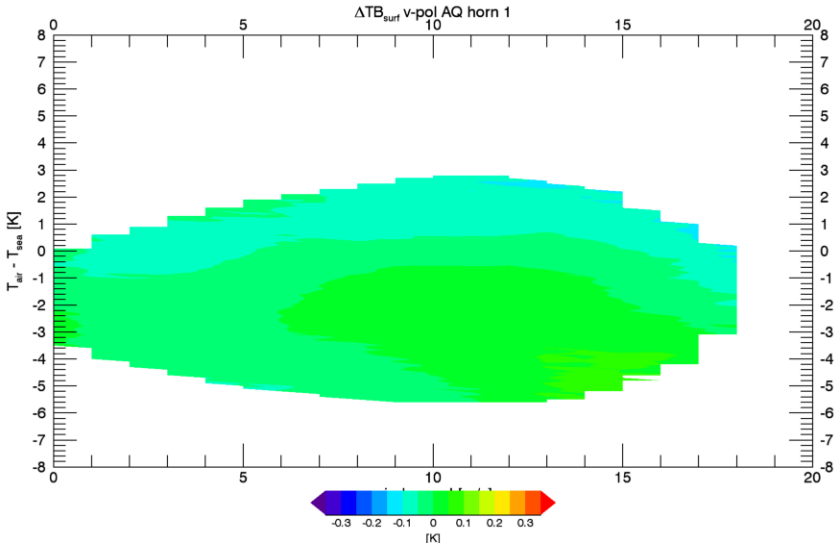


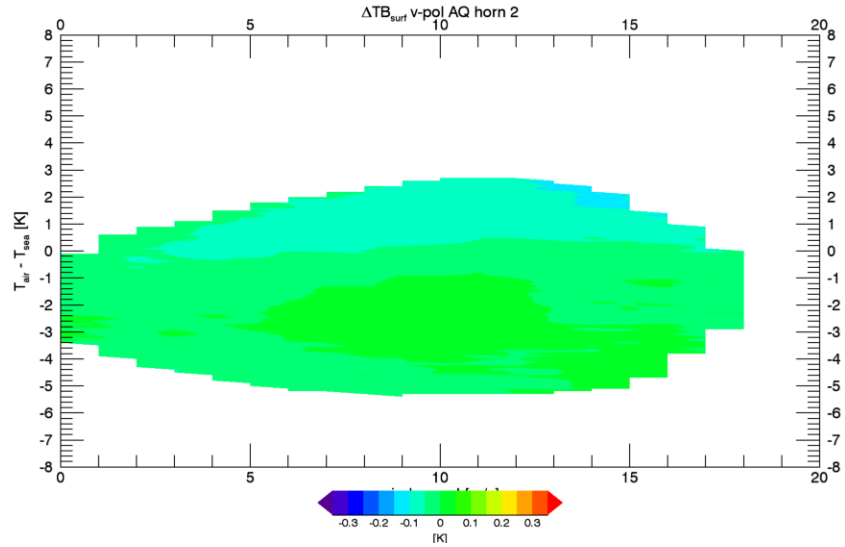


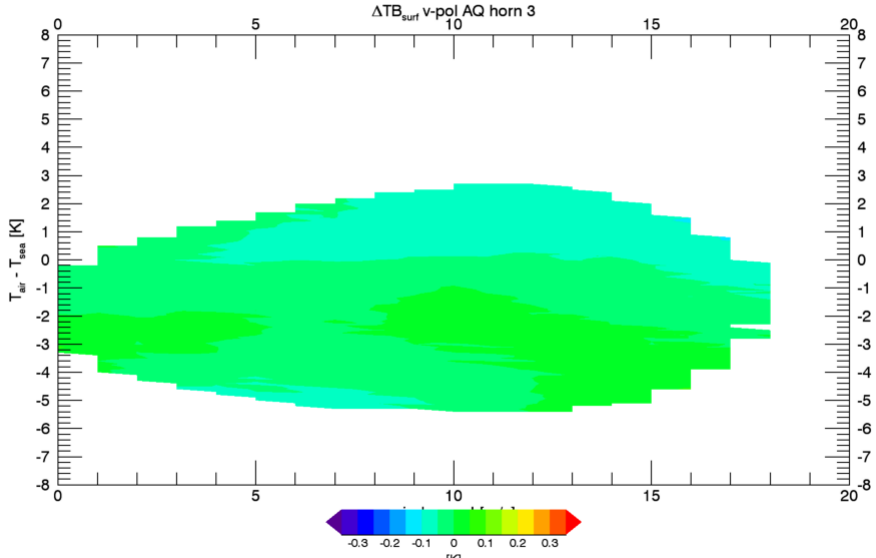
There is none in either Aquarius nor in SMAP.

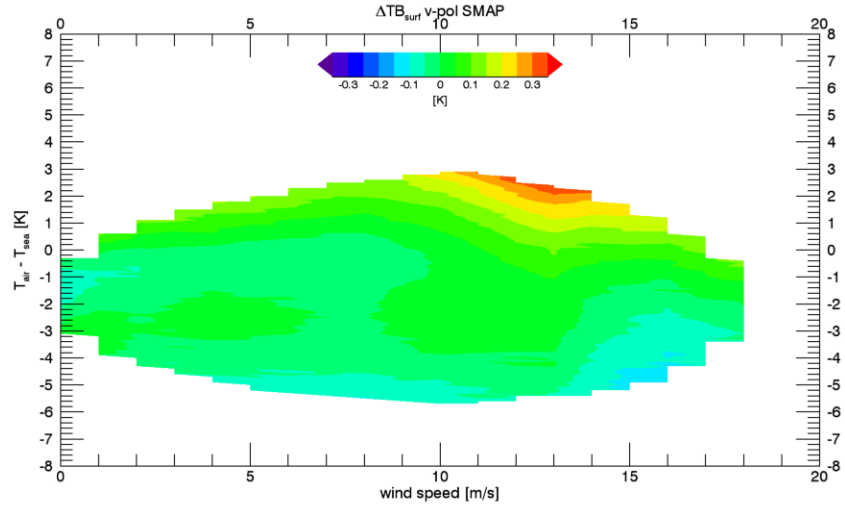
Using scatterometer (HHH) and WindSat in surface roughness correction takes care of it.

(Same applies to SWH).

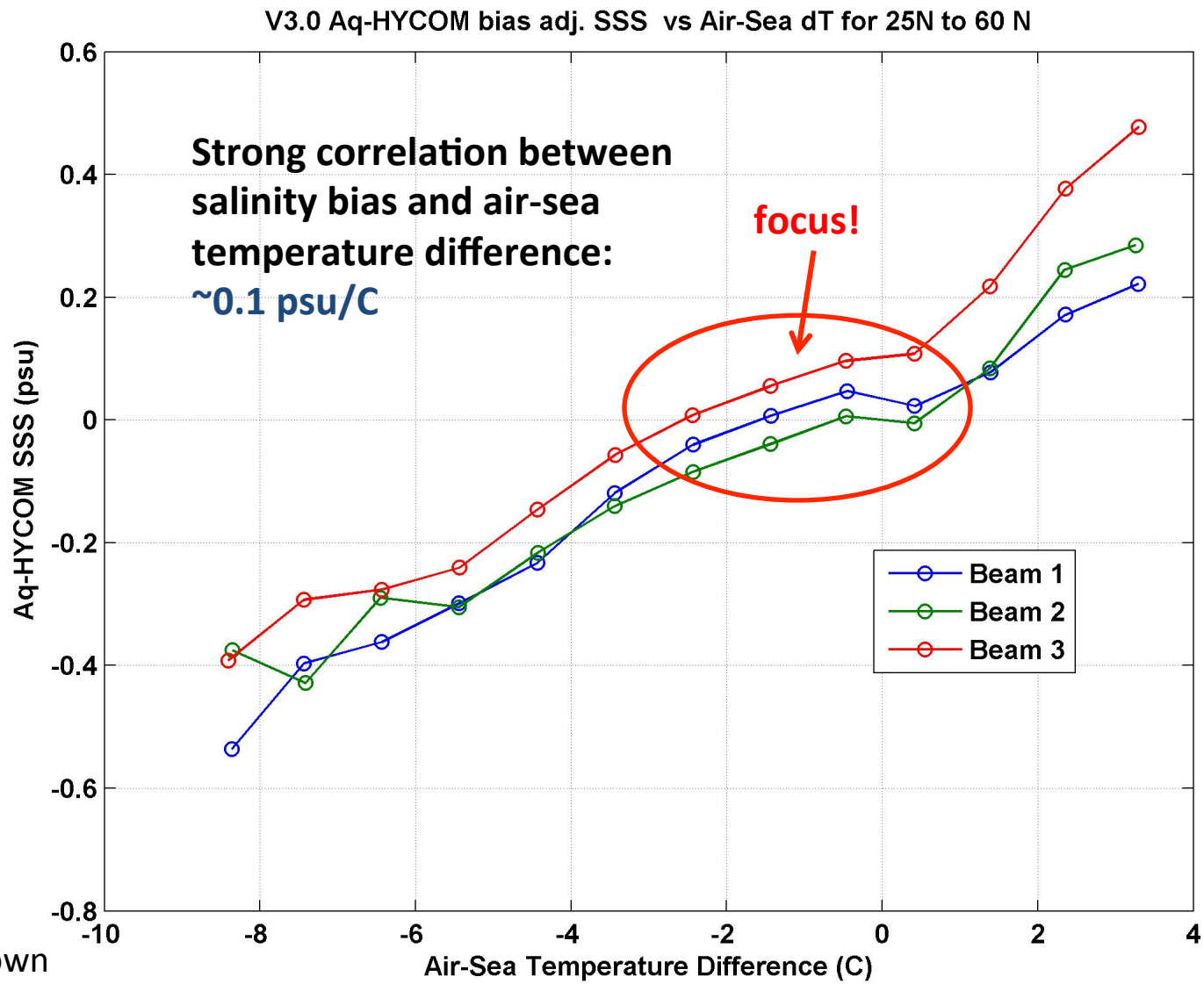

ΔTB$_{surf}$ v-pol AQ horn 1
T$_{air}$ - T$_{sea}$ [K]
-0.3 -0.2 -0.1 0 0.1 0.2 0.3
[K]


ΔTB$_{surf}$ v-pol AQ horn 2
T$_{air}$ - T$_{sea}$ [K]
-0.3 -0.2 -0.1 0 0.1 0.2 0.3
[K]


ΔTB$_{surf}$ v-pol AQ horn 3
T$_{air}$ - T$_{sea}$ [K]
-0.3 -0.2 -0.1 0 0.1 0.2 0.3


ΔTB$_{surf}$ v-pol SMAP
-0.3 -0.2 -0.1 0 0.1 0.2 0.3
[K]
T$_{air}$ - T$_{sea}$ [K]
wind speed [m/s]

V3 Aq(bias adj) – HYCOM vs NCEP Air-Sea ΔT



from S. Brown

Summary/Conclusions (1)

- Analysis of the N latitude biases in Aquarius V4.
  - Biggest problem in V4.
- Main pattern
  - horn1 ≈ horn3 > horn 2
  - Exceeds 0.25K (0.5 psu) in horn 1 and horn 3.
  - V-pol > H-pol
  - peak in MAM
  - ascending ≈ descending
  - Inter-annual variability: Weak in 2012. Strongest in 2014.

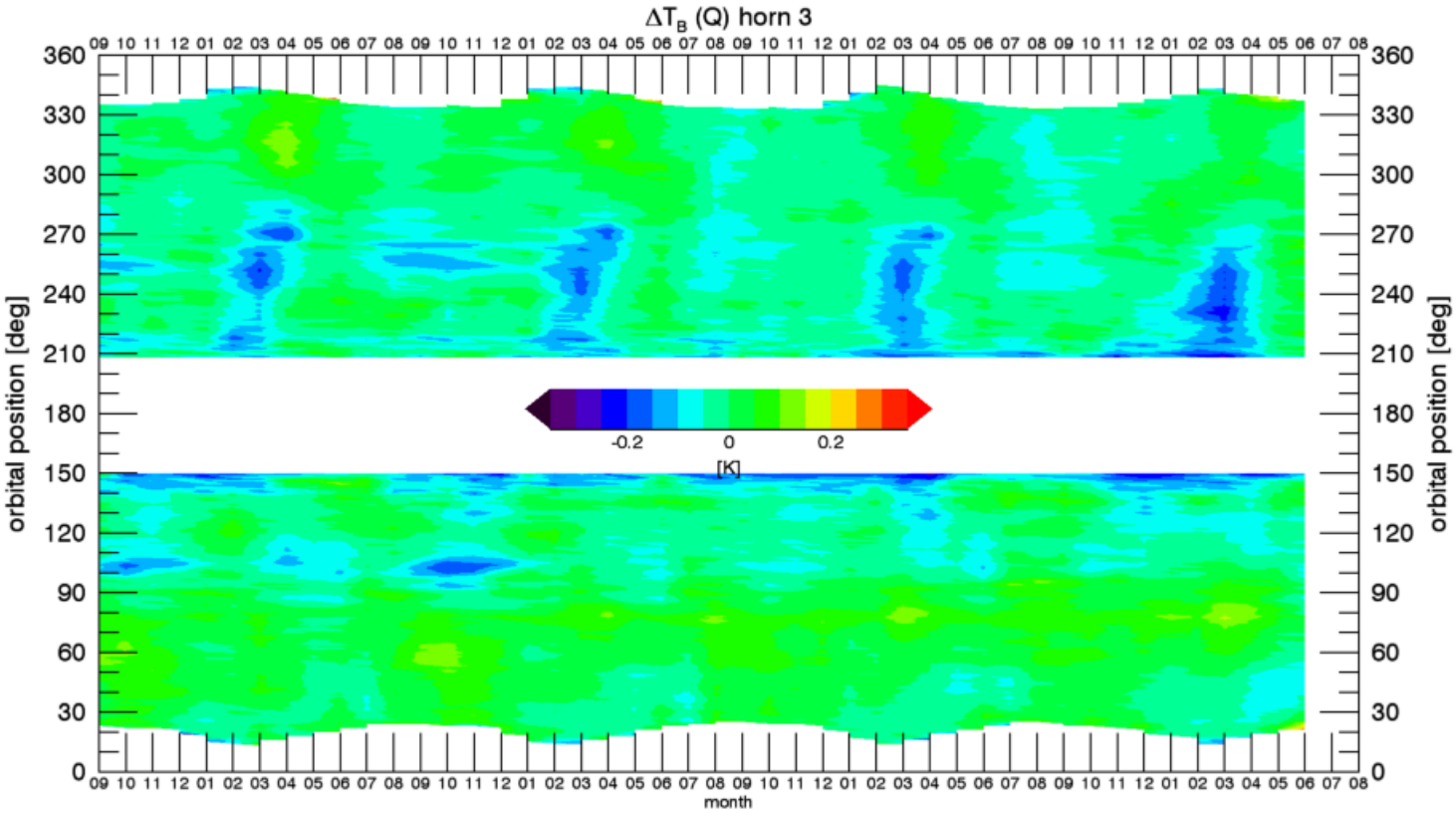
Summary/Conclusions (2)

- Not seen in SMAP (so far) and SMOS
- There are no indications that these biases can be reasonably explained within the geophysical model
  - Galaxy, sun, …
  - Surface roughness model: SST
  - Surface roughness model: wind speed
  - Surface roughness model: wind direction
  - Input wind speed
  - Input SST
  - Atmosphere
  - Air – sea temperature
  - SWH

Summary/Conclusions (3)

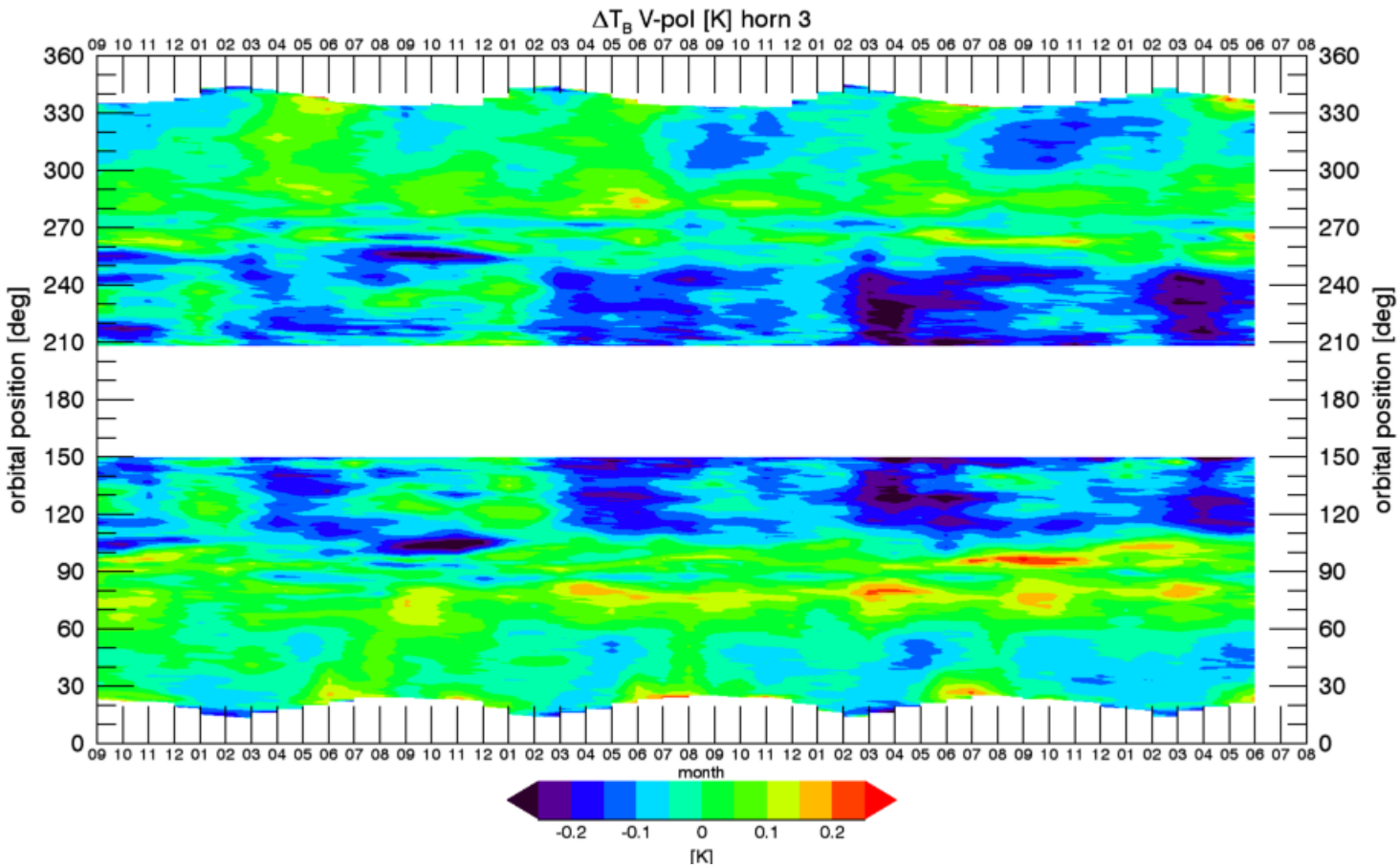
- Increasingly likely that it is Aquarius specific and instrument related
  - like it was the case with the non-linear IU coupling (only seen at Aquarius, absent at SMAP).
- Not clear if it is related to spurious annual oscillation in V4.1
- What to do about it in V5.0 ?!
- Bias in S hemisphere
  - Potentially galaxy, high winds

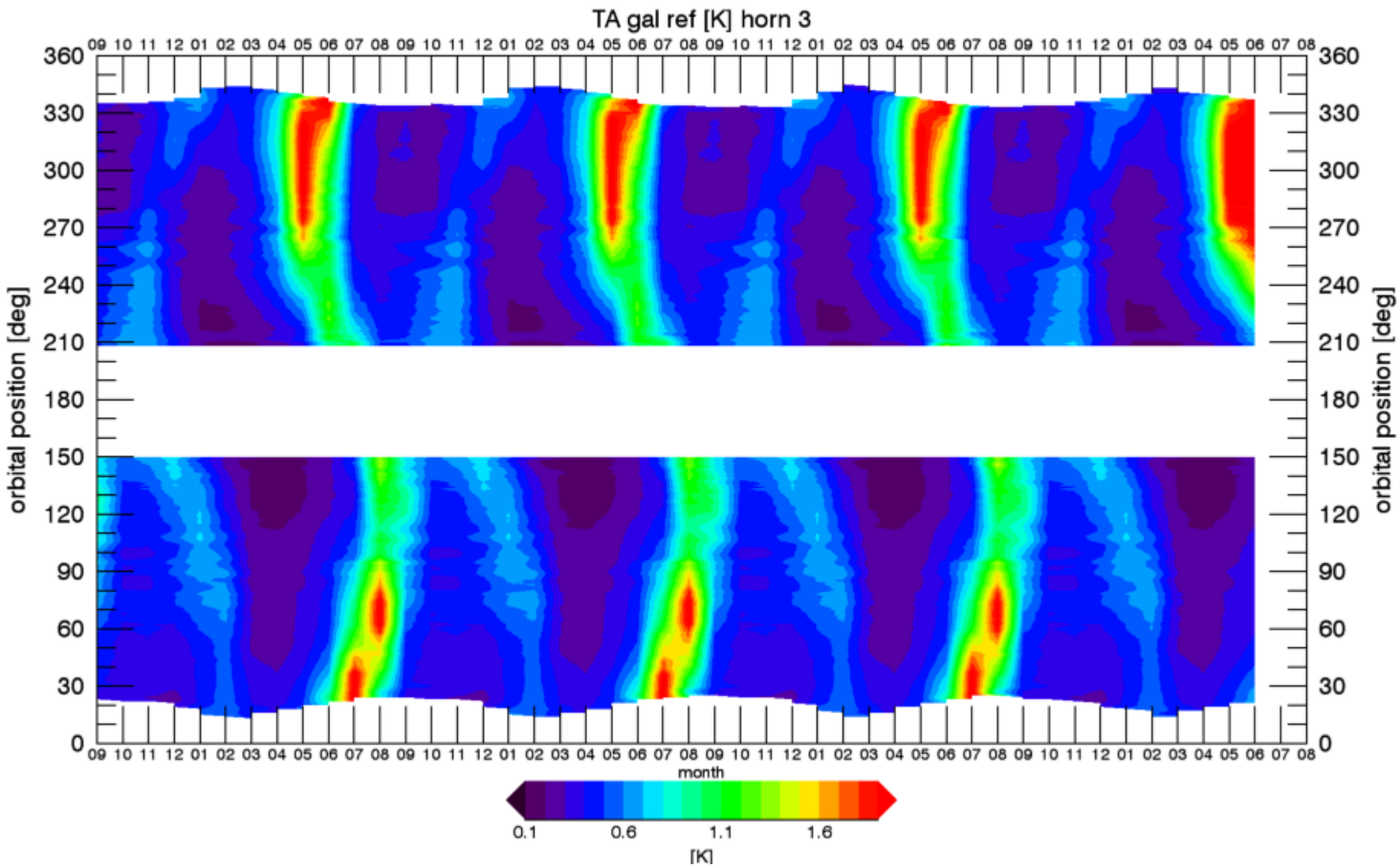
TB V-pol – H-pol (2nd Stokes)



asc/dsc bias in 2nd Stokes
issue with 3rd Stokes?

Backup Slides


ΔT_B V-pol [K] horn 3
orbital position [deg]
month
[K]
-0.2
-0.1
0
0.1
0.2


TA gal ref [K] horn 3
orbital position [deg]
month
0.1
0.6
1.1
1.6
[K]