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.
galaxy? high winds? strong in both asc/dsc
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
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.
good consistency between Aquarius and SMAP roughness model

SST bias adjustment
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

\[ \sigma_{0HH} T_{BH} \rightarrow \text{Aquarius Wind Speed} \rightarrow \]

isotropic signal
directional signal

"SST bias adjustment"
"higher order" roughness
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
NCEP and Aquarius wind speed differences are very small during times of peak biases.
Wind Sat and Aquarius wind speed differences are very small during times of peak biases.
HHH – WindSat
Inter-Beam Differences
An error in input wind speed would affect H-pol stronger than V-pol.
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 $T_{\text{air}} - T_{\text{sea}}$

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

Strong correlation between salinity bias and air-sea temperature difference:
~0.1 psu/C

from S. Brown
Summary/Conclusions (1)

• Analysis of the N latitude biases in Aquarius 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
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 (2\textsuperscript{nd} Stokes)

asc/dsc bias in 2\textsuperscript{nd} Stokes
issue with 3\textsuperscript{rd} Stokes?
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