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Roughness Correction for Aquarius (AQ) Sea Surface Salinity (SSS) Algorithm using MicroWave Radiometer (MWR)

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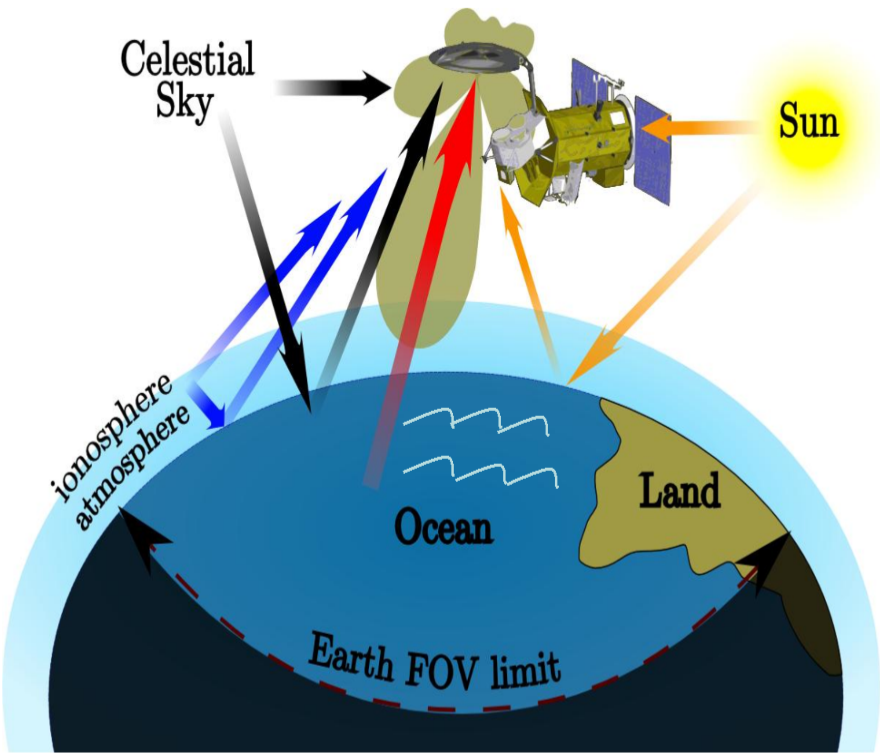
AQ Smooth Surface Tb Measurement

- Smooth ocean surface Tb is used to retrieve SSS
  - There are 12 major sources of Tb, which must be corrected before retrieving SSS
  - Of these, ocean surface roughness (wind speed) correction has the greatest residual error



Aquarius Ocean Roughness Correction

- Baseline SSS retrieval algorithm uses the AQ Scat to provide the roughness correction (ΔTb)
  - ΔTb is correlated with measured radar backscatter
- The CONAE MWR provides an alternative approach for obtaining an AQ roughness correction
  - MWR measured Tb at Ka-band is used to calculate excess ocean emissivity due to wind speed (and wind direction)
  - Using ocean Radiative Transfer Model (RTM) it is possible to translate Ka-band excess emissivity to L-band ΔTb

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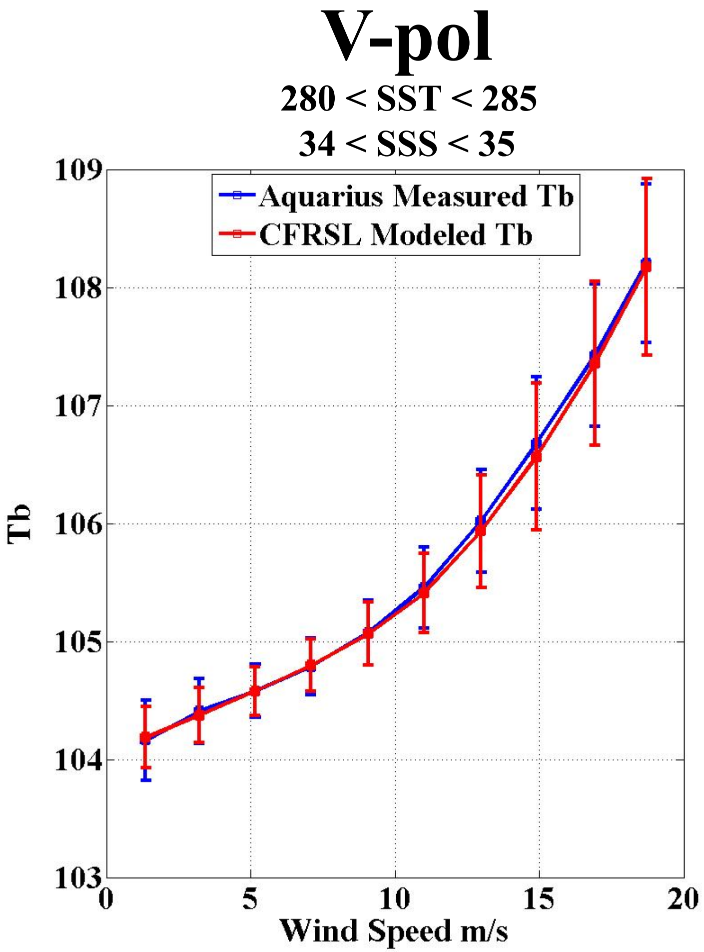
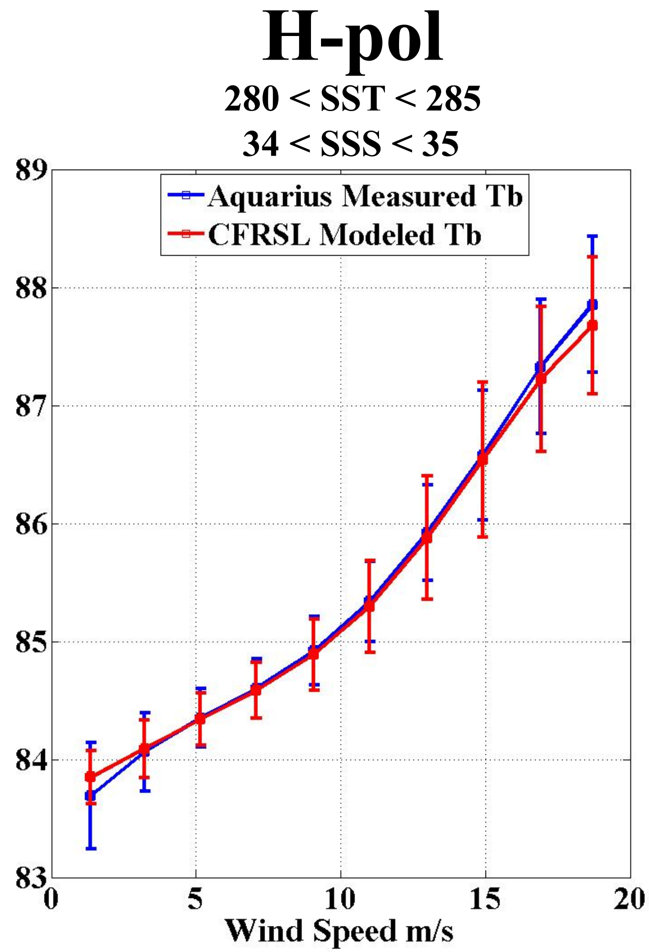
MWR Roughness Correction: L-Band RTM

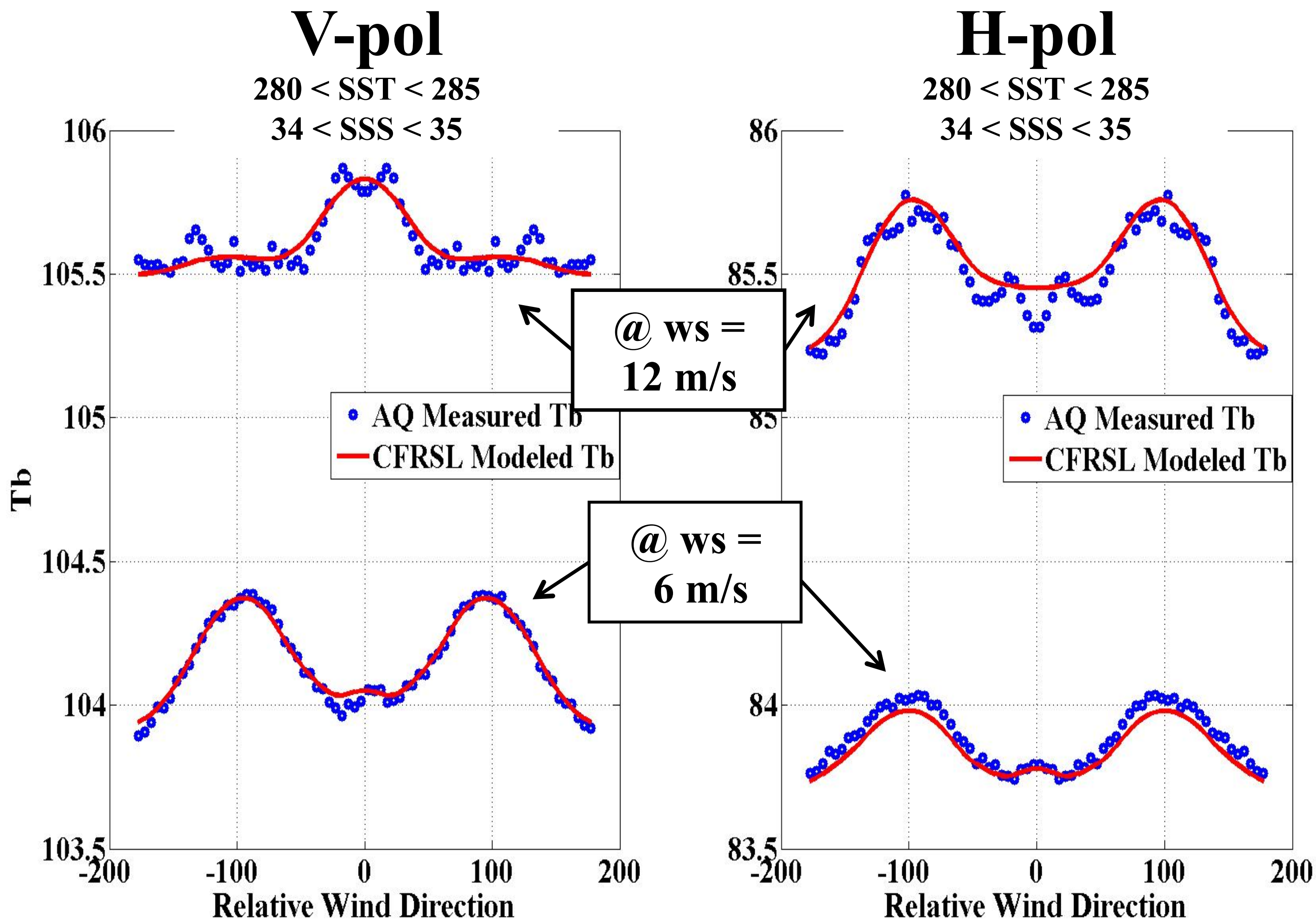
- The MWR roughness correction algorithm has made a significant advances over the past year
  - Tuning of the L-band RTM for ocean emissivity using the AQ L-2 V3.0 ocean surface Tb and NCEP wind vector

Tuning L-band RTM for Wind Speed





Tuning L-band RTM for Wind Direction

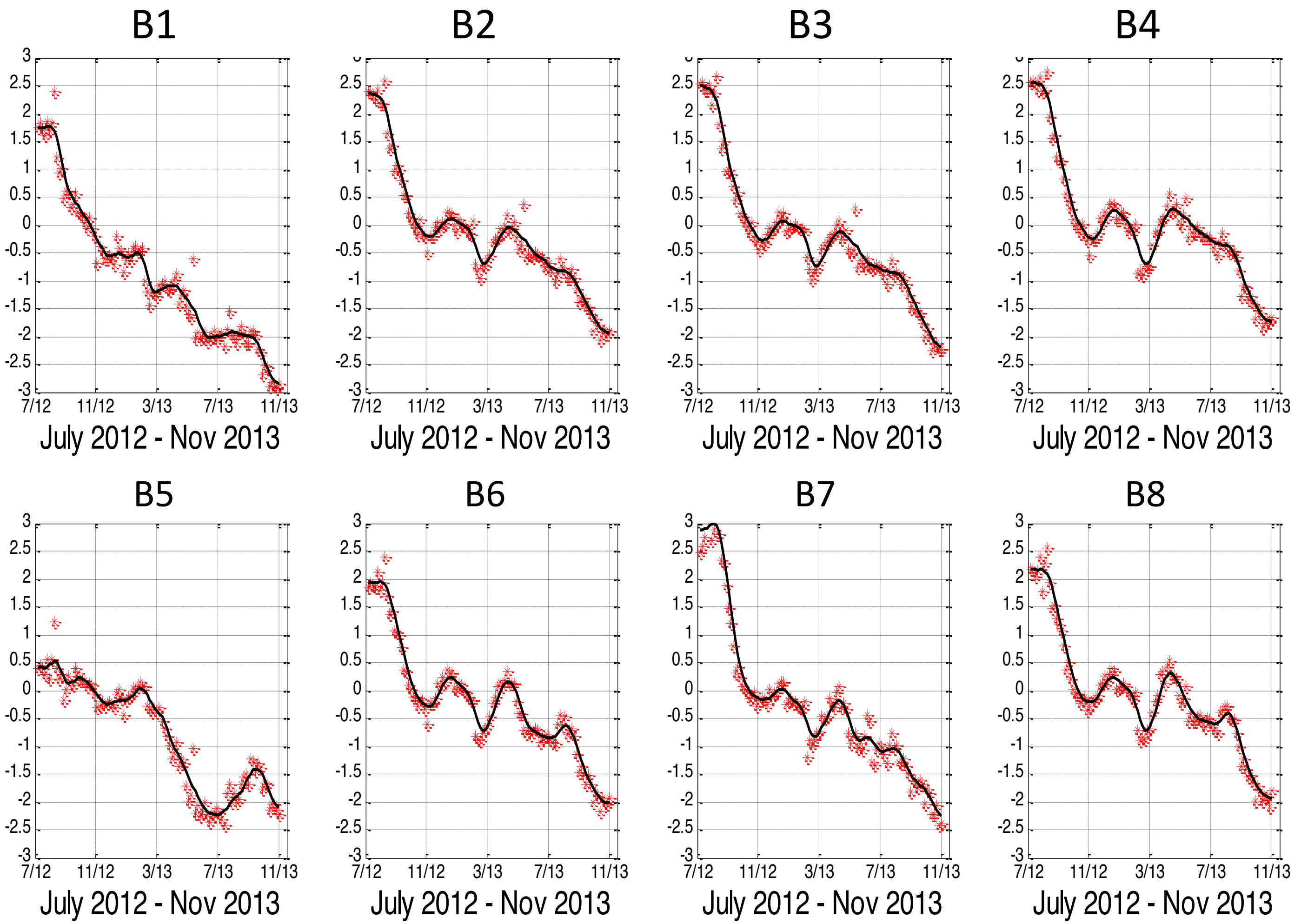


Yueh, S.H.; Dinardo, S.J.; Fore, A.G.; Fuk K.Li, "Passive and Active L-Band Microwave Observations and Modeling of Ocean Surface Winds," *Geoscience and Remote Sensing, IEEE Transactions on* , vol.48, no.8, pp. 3087,3100, Aug. 2010

MWR Roughness Correction: MWR Tb's

- The MWR roughness correction algorithm has made a significant advances over the past year
  - Improved MWR counts-to-Tb algorithm V6.0
    - Incorporates non-linearity correction
    - Validated using WindSat Tb XCAL
      - Revealed systematic radiometric calibration drift

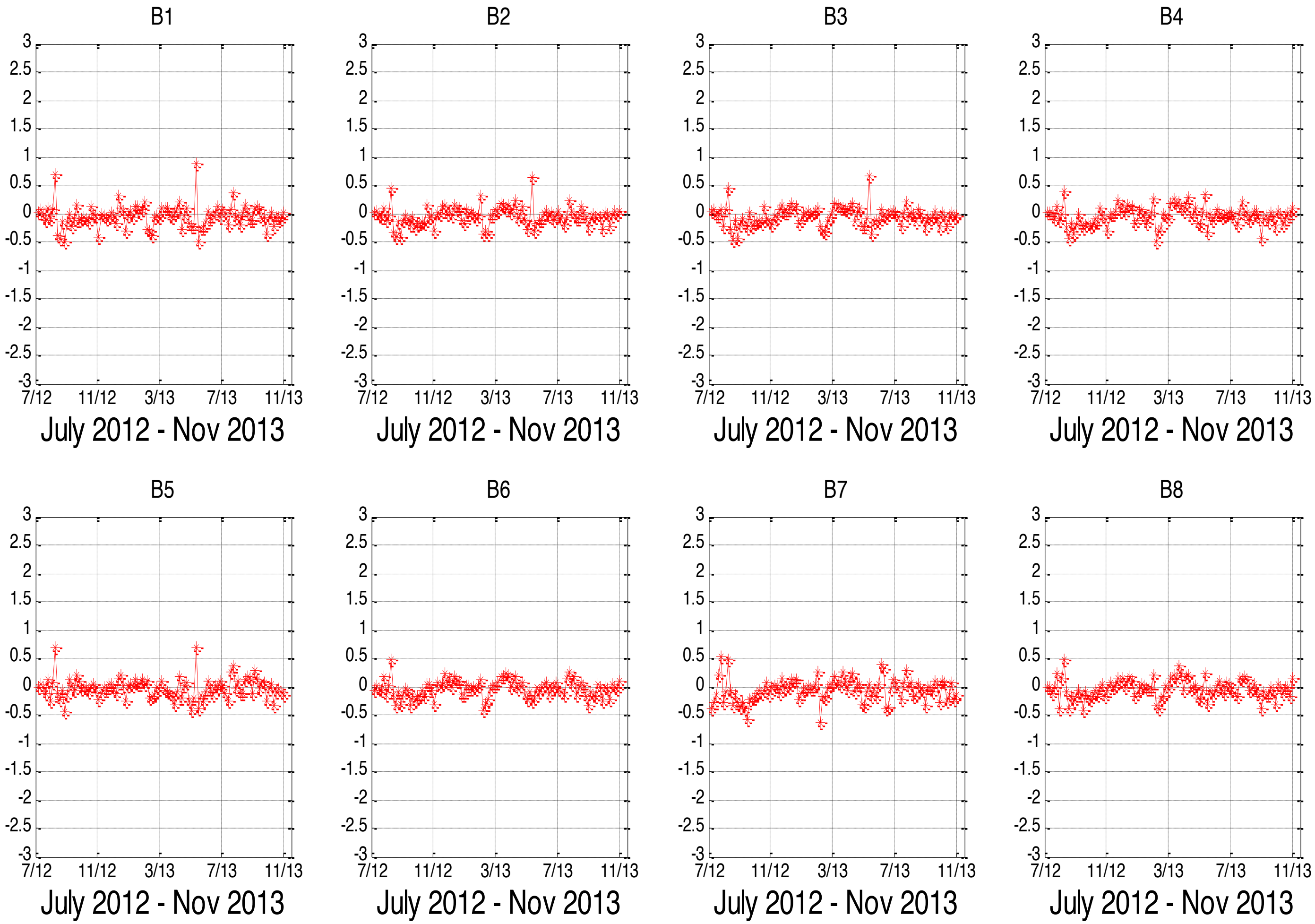
V6.0 23H, DD biases (MWR-WS)
July 2012 – Nov 2013



MWR Roughness Correction: MWR Tb's

- The MWR roughness correction algorithm has made a significant advances over the past year
  - Improved MWR counts-to-Tb algorithm V6.0
    - Incorporates non-linearity correction
    - Validated using WindSat Tb XCAL
      - Revealed systematic radiometric calibration drift
  - Removed XCAL Tb biases using WindSat V7.0

V7.0 DD Adjusted to WindSat 23H July 2012- Nov 2013



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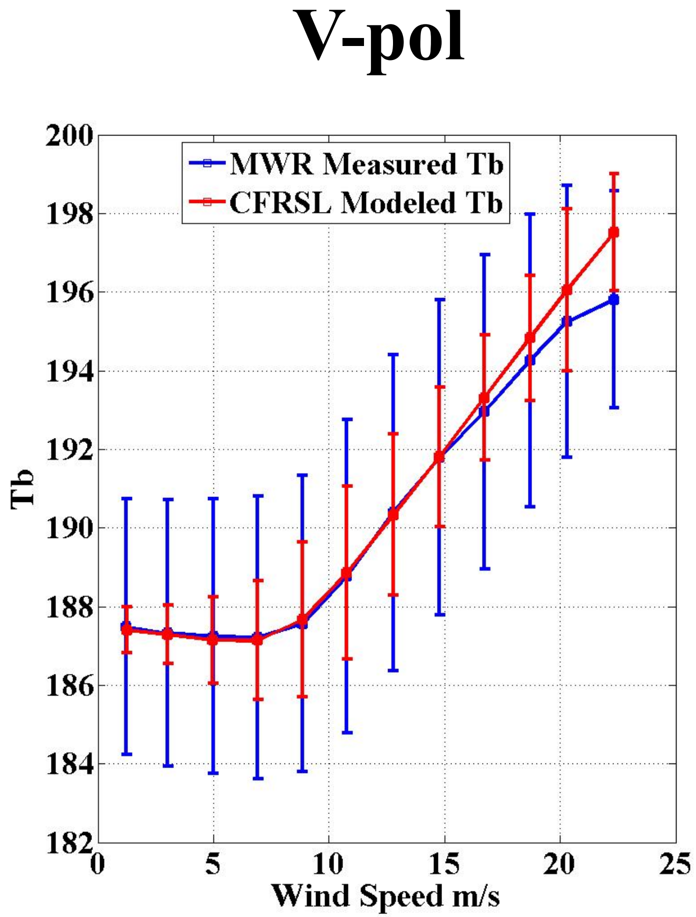
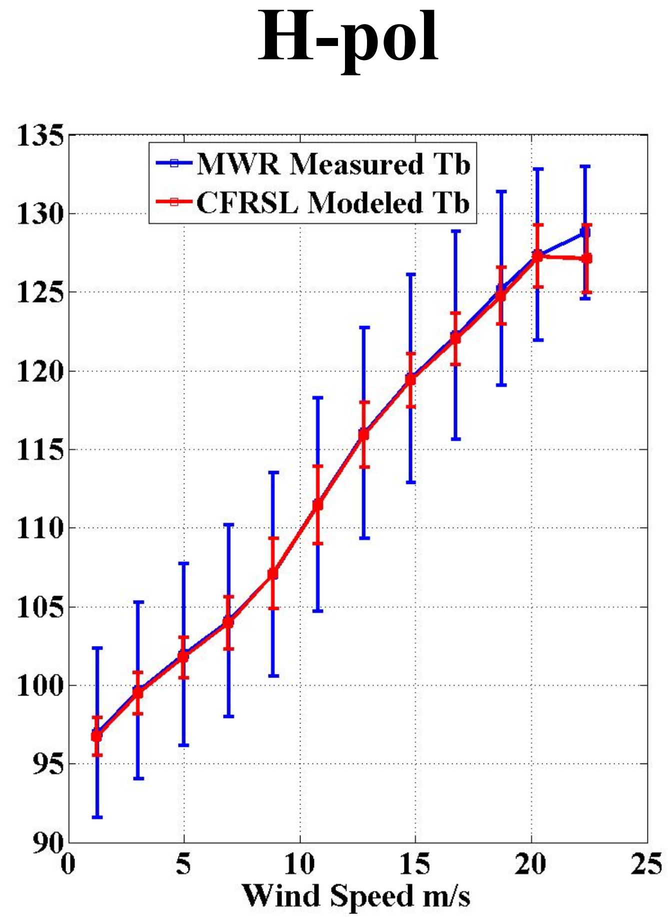
Tuning Ka-band RTM using V7.0

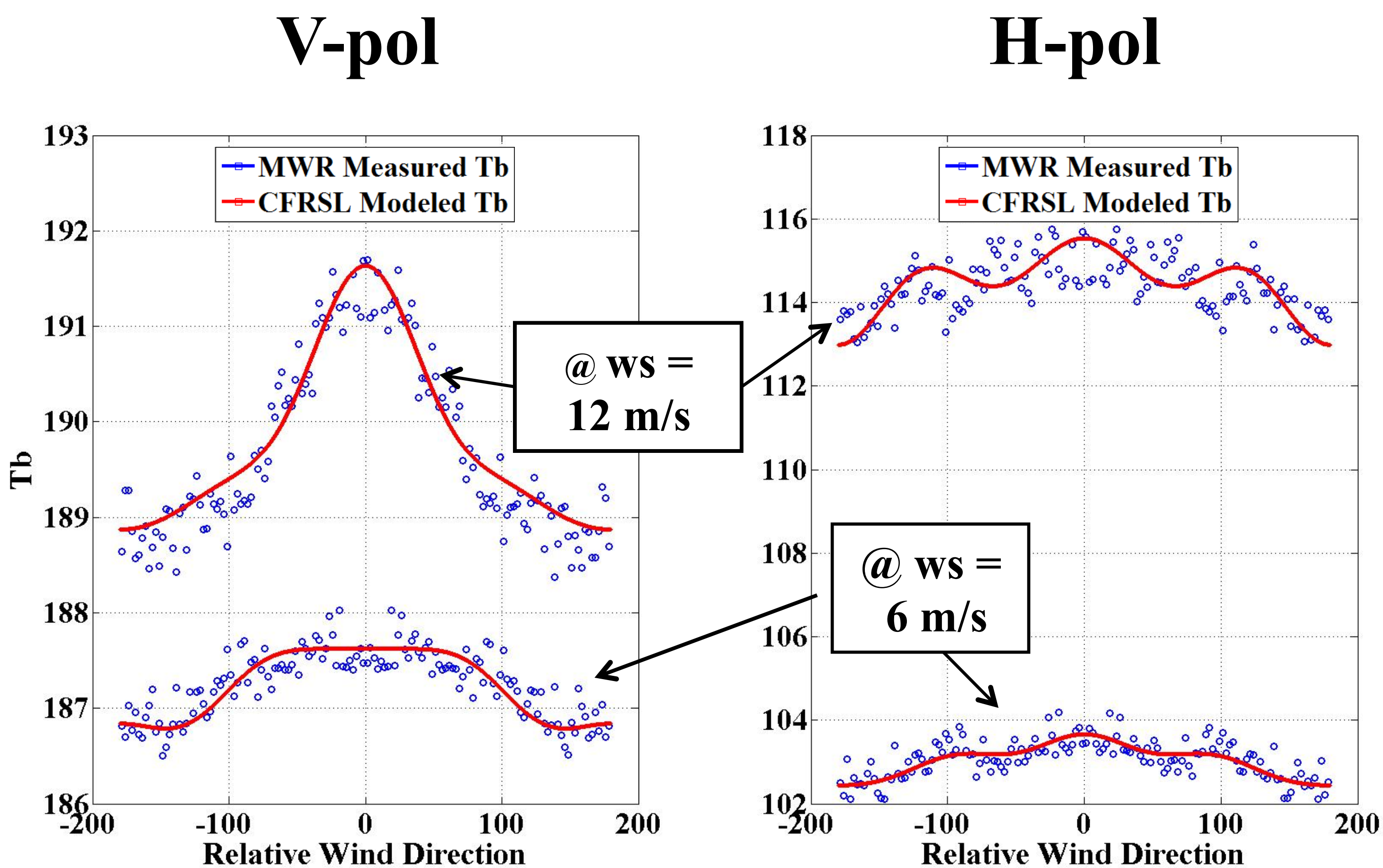
- Tuning coefficients of Ka-band ocean emissivity RTM for wind speed to minimizes the difference between model and observed Tb's
  - Averaged over all relative wind directions
- Added effect of wind direction
  - Ocean anisotropy is function of:
    - Relative wind direction (χ),
    - Earth incidence angle
    - Wind speed

Tuning Ka-band RTM for Isotropic Wind Speed





Tuning Ka-band RTM for Relative Wind Direction

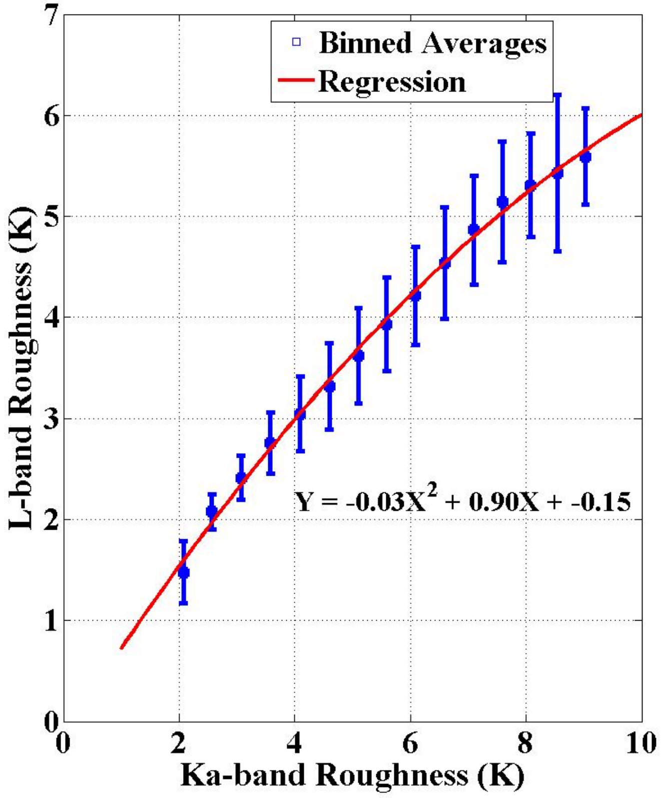


Empirical MWR Roughness Correction

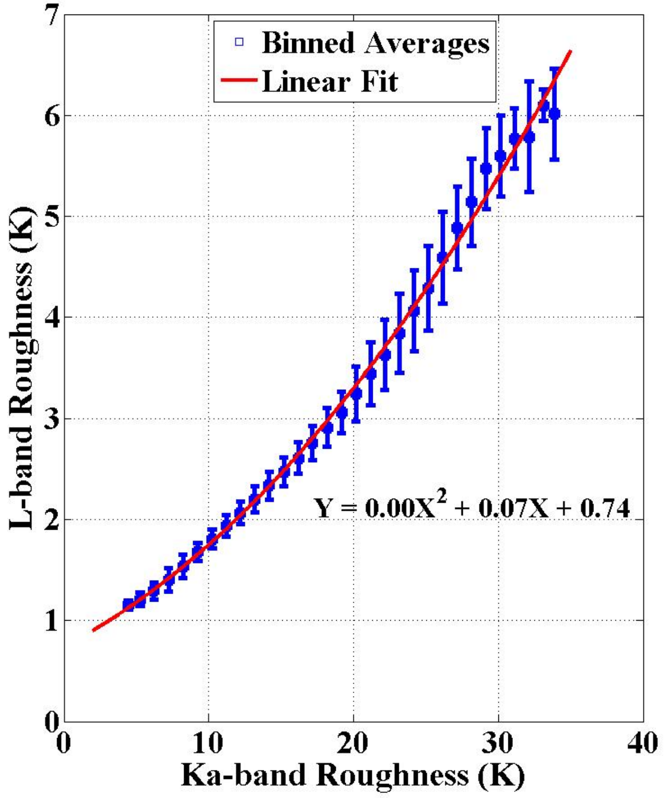
- Cross-correlation between L-band and Ka-band RTM establishes the AQ ΔTb roughness correction
  - First wind direction effects are removed using NCEP wind directions and corresponding AQ/MWR antenna azimuth geometries
  - AQ ΔTb calculated using measured MWR ΔTb and Empirical X-correlation relationship by AQ beam with corresponding MWR collocated beams

Empirical Roughness Correction Relationship (for Isotropic Wind)

V-pol

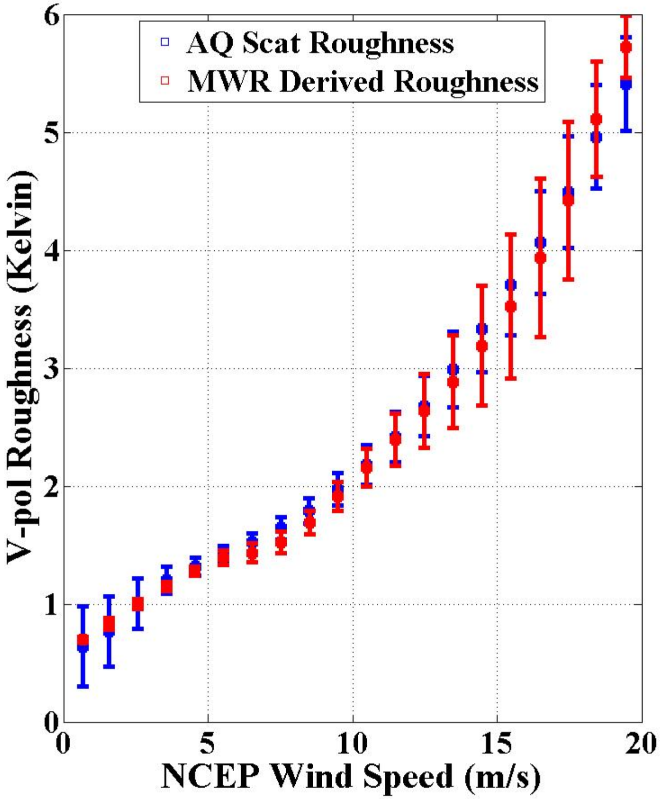


H-pol



AQ ΔTb Comparison with NCEP Wind Speed

V-pol



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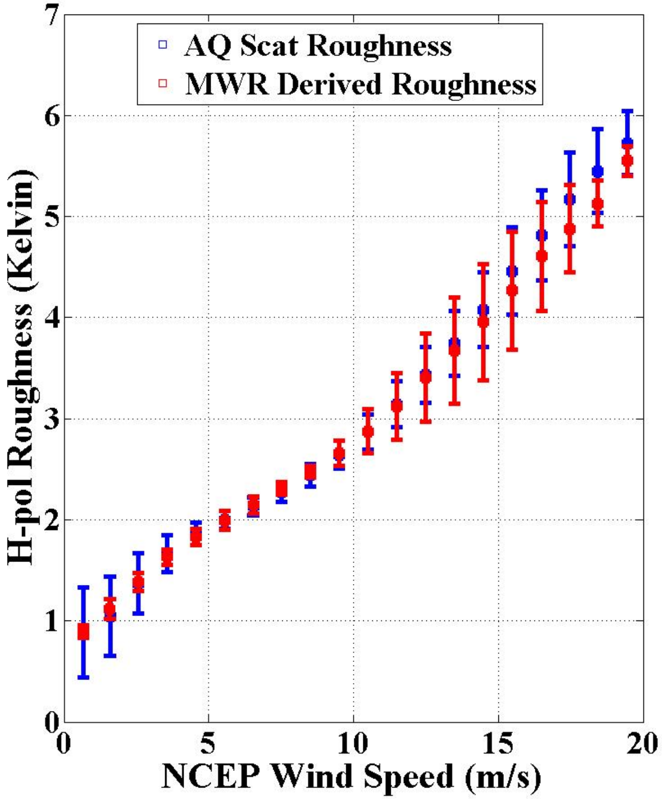
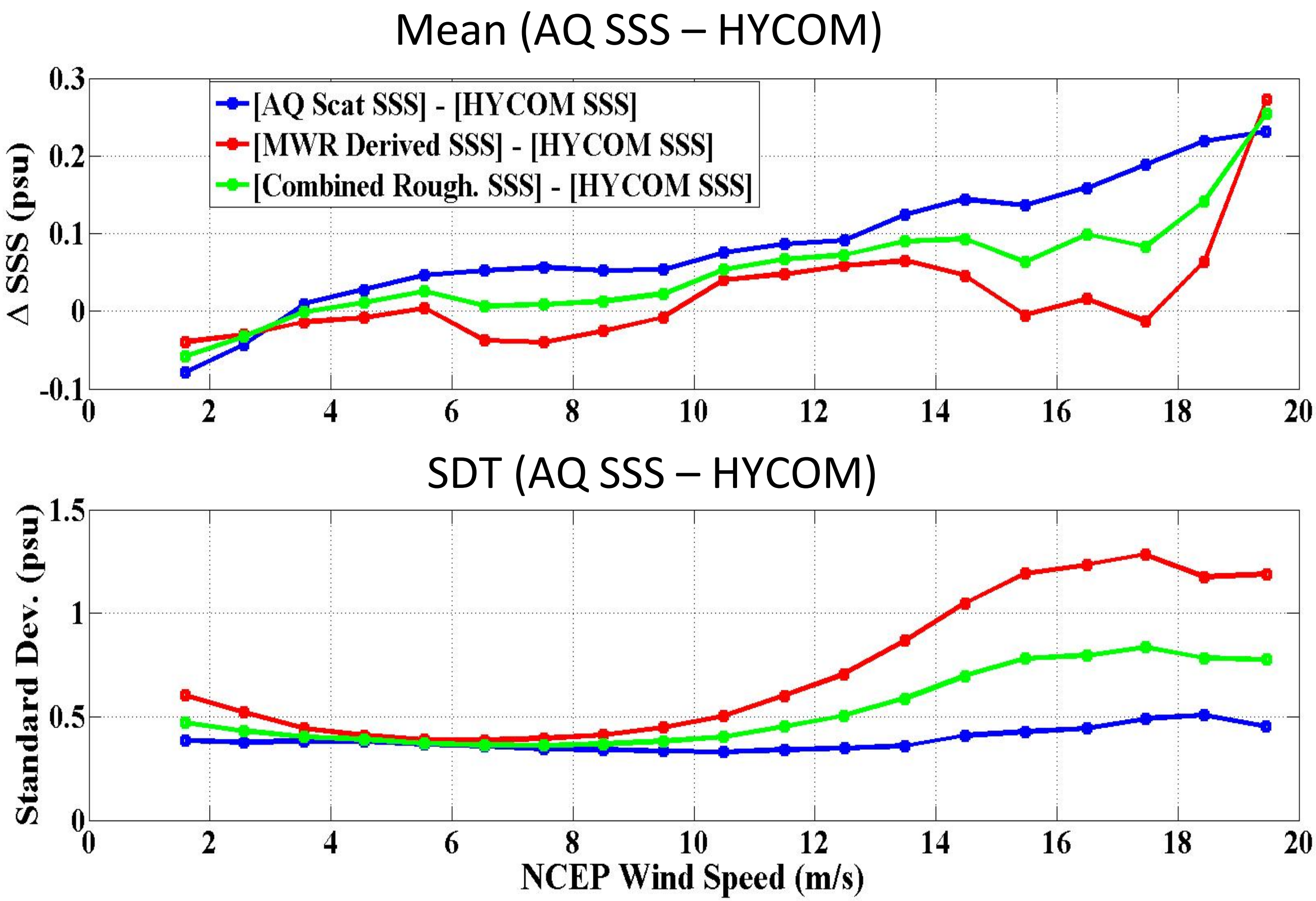


Salinity Retrieval Comparison for Various Roughness Corrections (3 months global avg)



Summary

- A legacy data set of 30 mos of MWR data exist for roughness correction
- Preliminary roughness correction algorithm completed for AQ Beam-1
- Release of MWR derived AQ roughness correction (3 beams) in Summer 2015
- Validation of SSS will be performed using MWR derived roughness correction using AQ SSS comparisons with HYCOM
  - Also inter-comparison with scatterometer derived roughness correction