Aquarius Sea Surface Salinity Retrievals using a Roughness Correction from the CONAE MicroWave Radiometer (MWR)

W. Linwood Jones[1], Yazan Hejazin[1], Maria Jacob[2] and Monica Rabolli[2]

1 - Central FL Remote Sensing Lab
Univ. Central Florida
Orlando, FL
2- CONAE
Buenos Aires, AR

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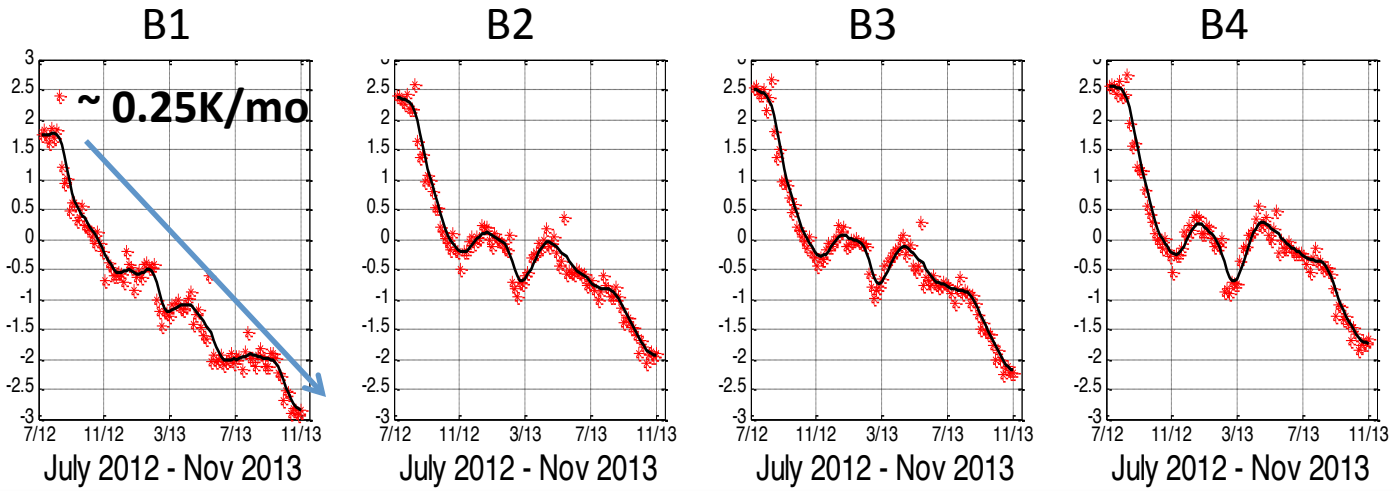
MWR Ocean Roughness Correction

- Pre-launch, ocean roughness correction was considered the dominant error for AQ SSS retrieval
- Baseline SSS retrieval algorithm uses the AQ Scat to provide the roughness correction (ΔTb)
  - ΔTb is correlated with measured radar backscatter
- MWR provides an alternative approach for obtaining an AQ roughness correction
  - MWR measured (top-of- atmos) Tb at Ka-band is used to calculate excess ocean emissivity due to wind speed (and wind direction)
  - Using ocean Radiative Transfer Model, measured Ka-band excess emissivity is translated to L-band ΔTb

MWR Roughness Correction Status

- At the end of 2014, the MWR roughness correction algorithm reached maturity
- Enabling factors:
  - Completion of MWR counts-to-Tb algorithm
    - Release of MWR L1B V7.0 beta Tb product Nov. 2014
  - Release of AQ L-2 V3.0

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



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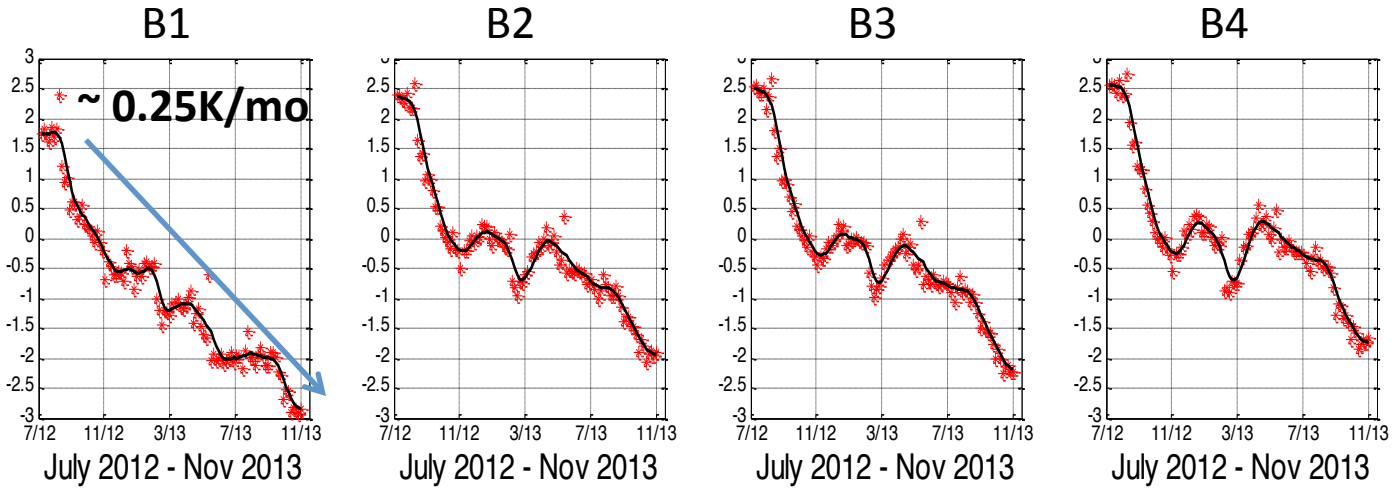
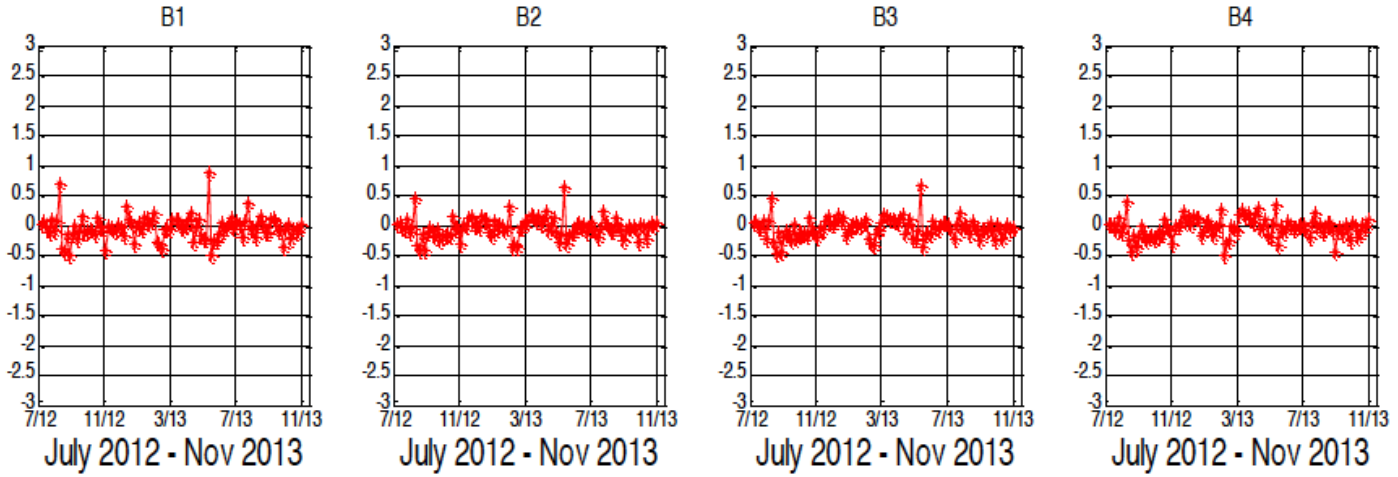


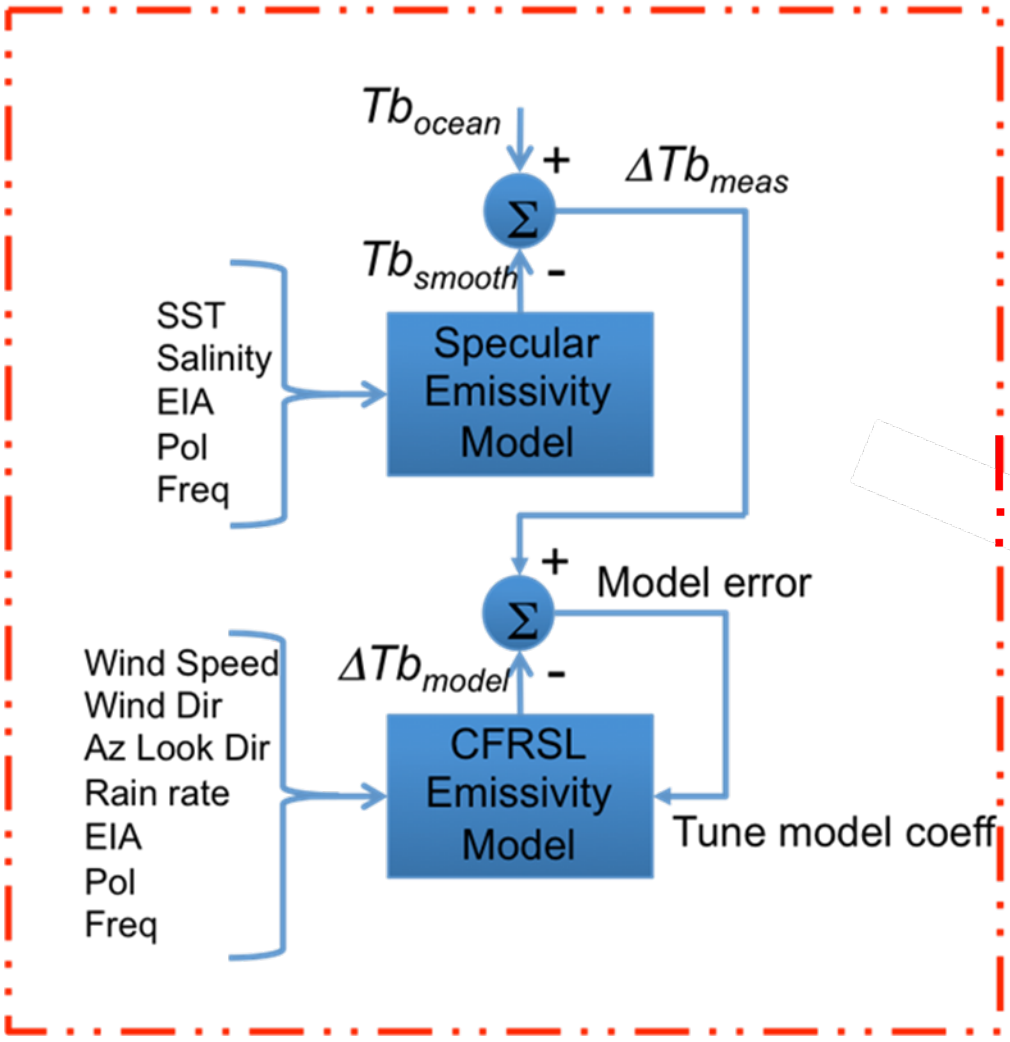
V7.0 DD Normalized to WindSat



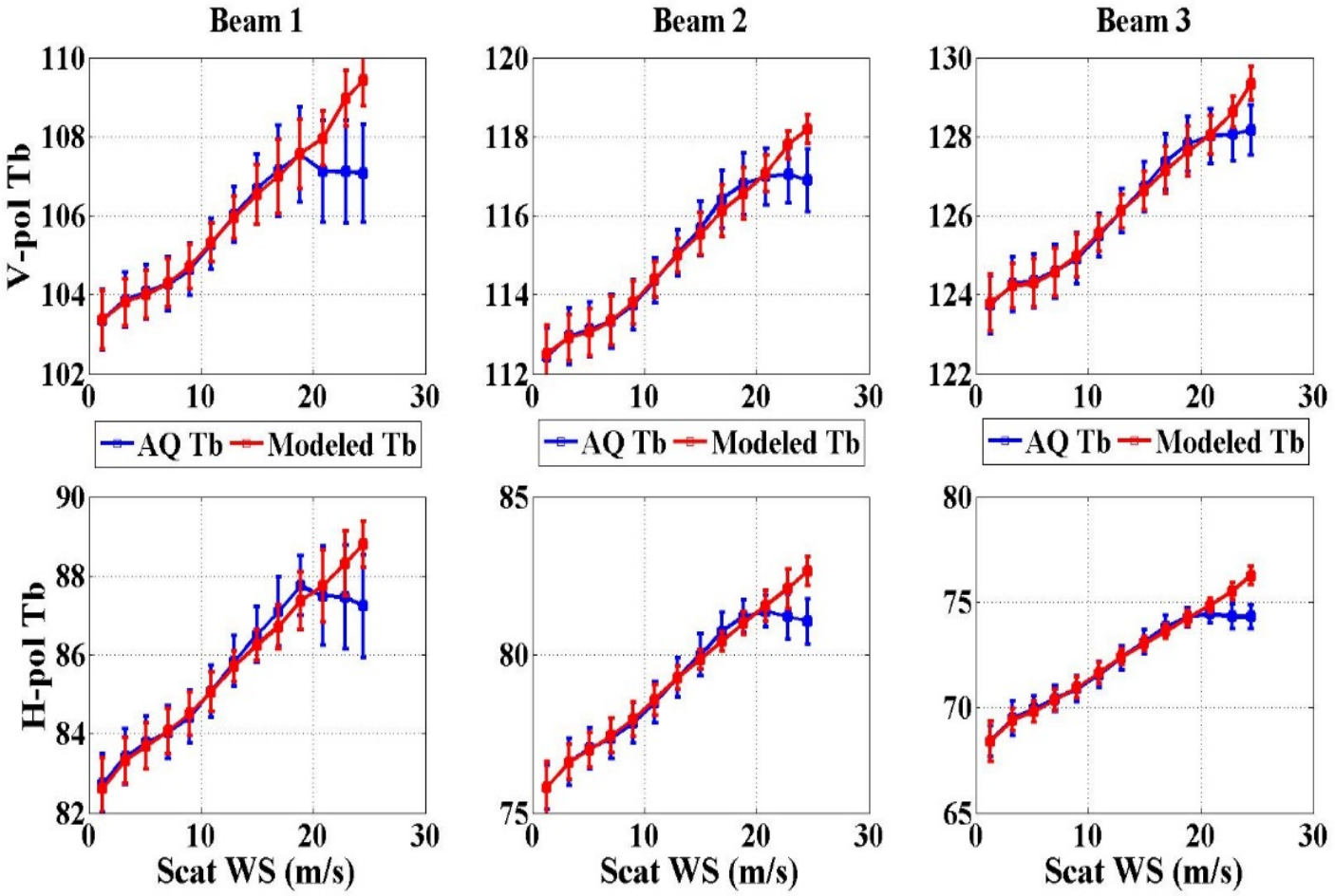
CFRSL

MWR Roughness Correction Algorithm

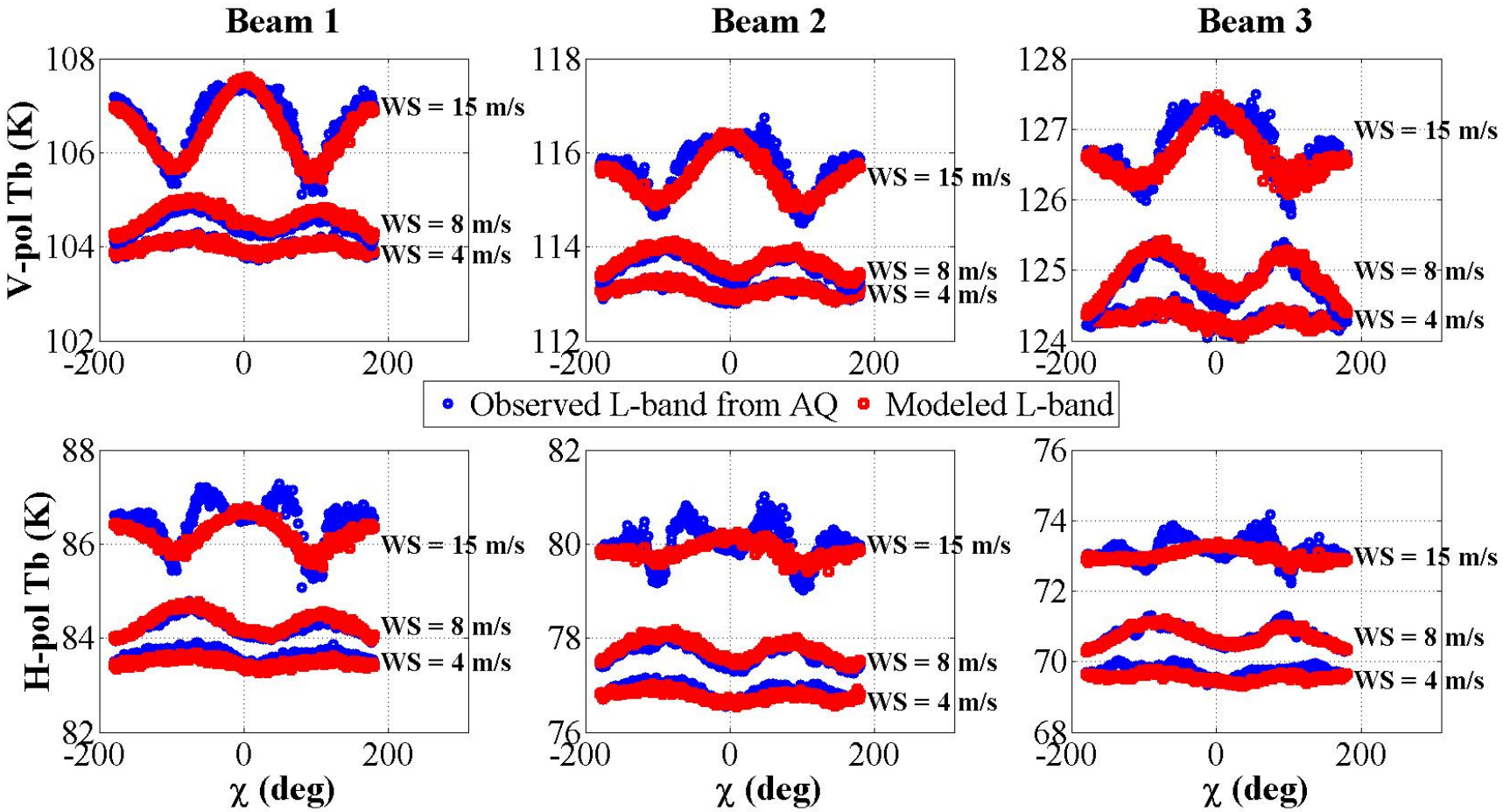
Theoretical Ocean Emissivity RTM L-band Tuning



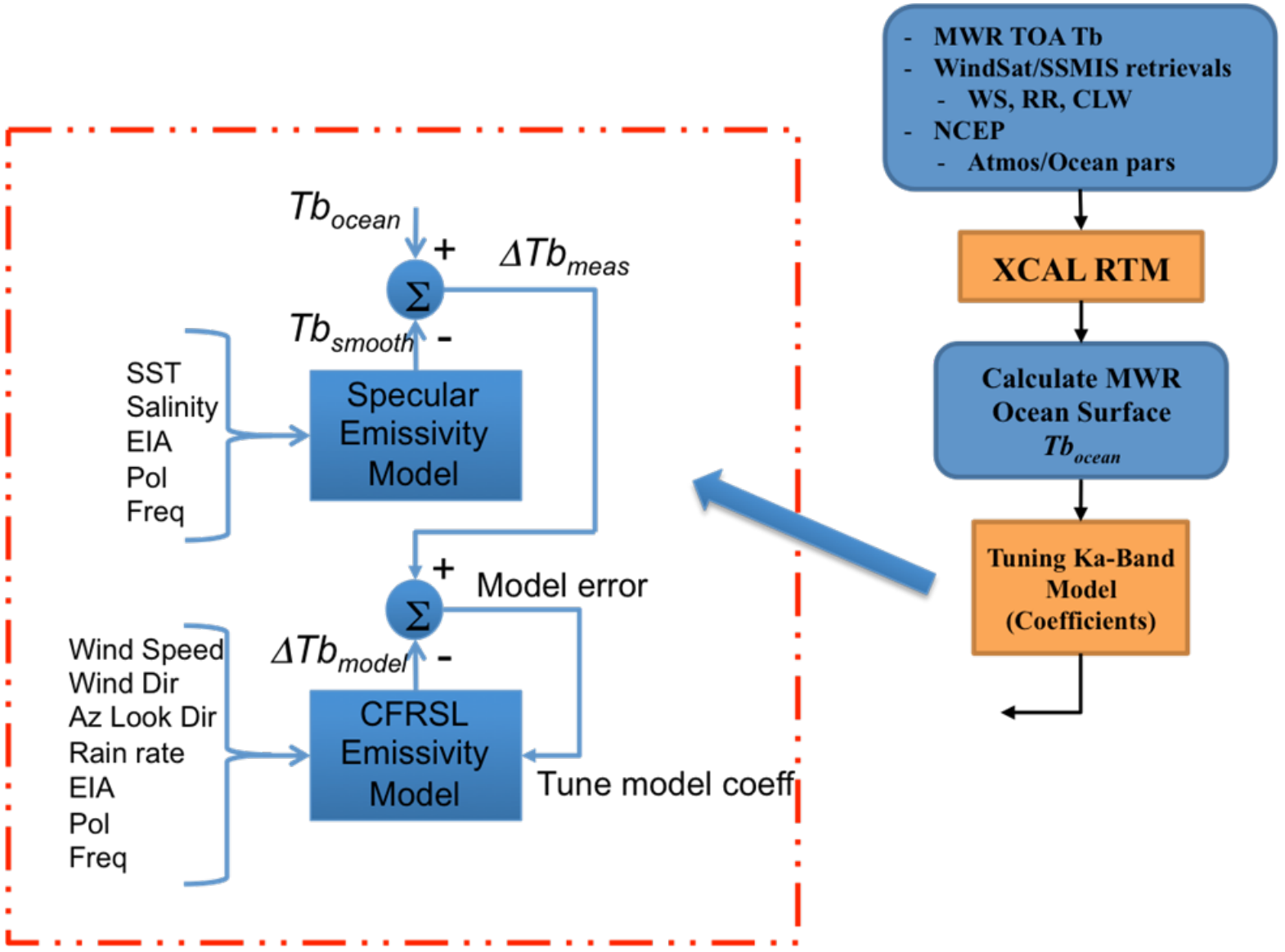
Tuning L-band RTM for Wind Speed



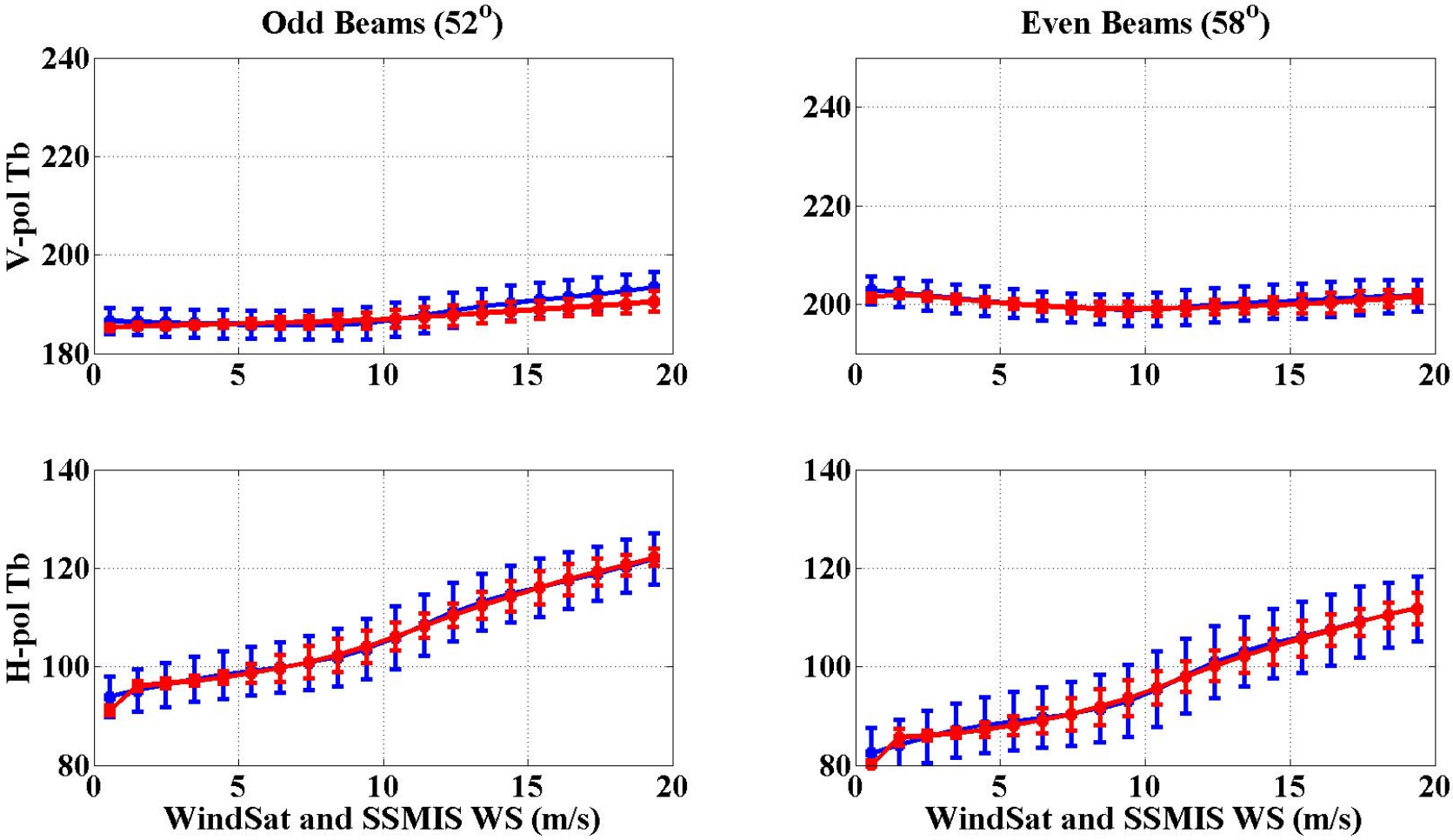
Tuning L-band RTM for Wind Direction



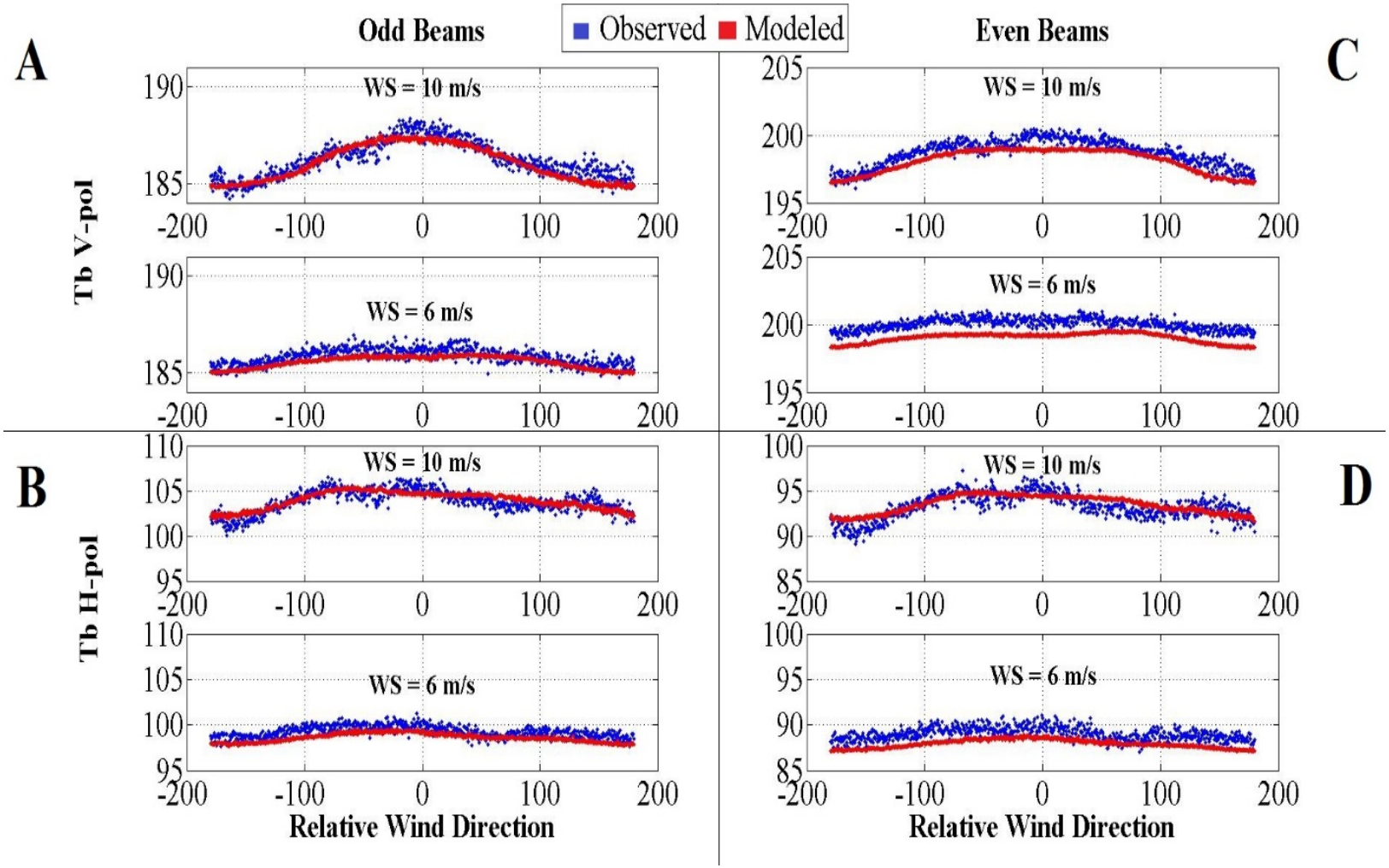
Theoretical Ocean Emissivity RTM Ka-band Tuning



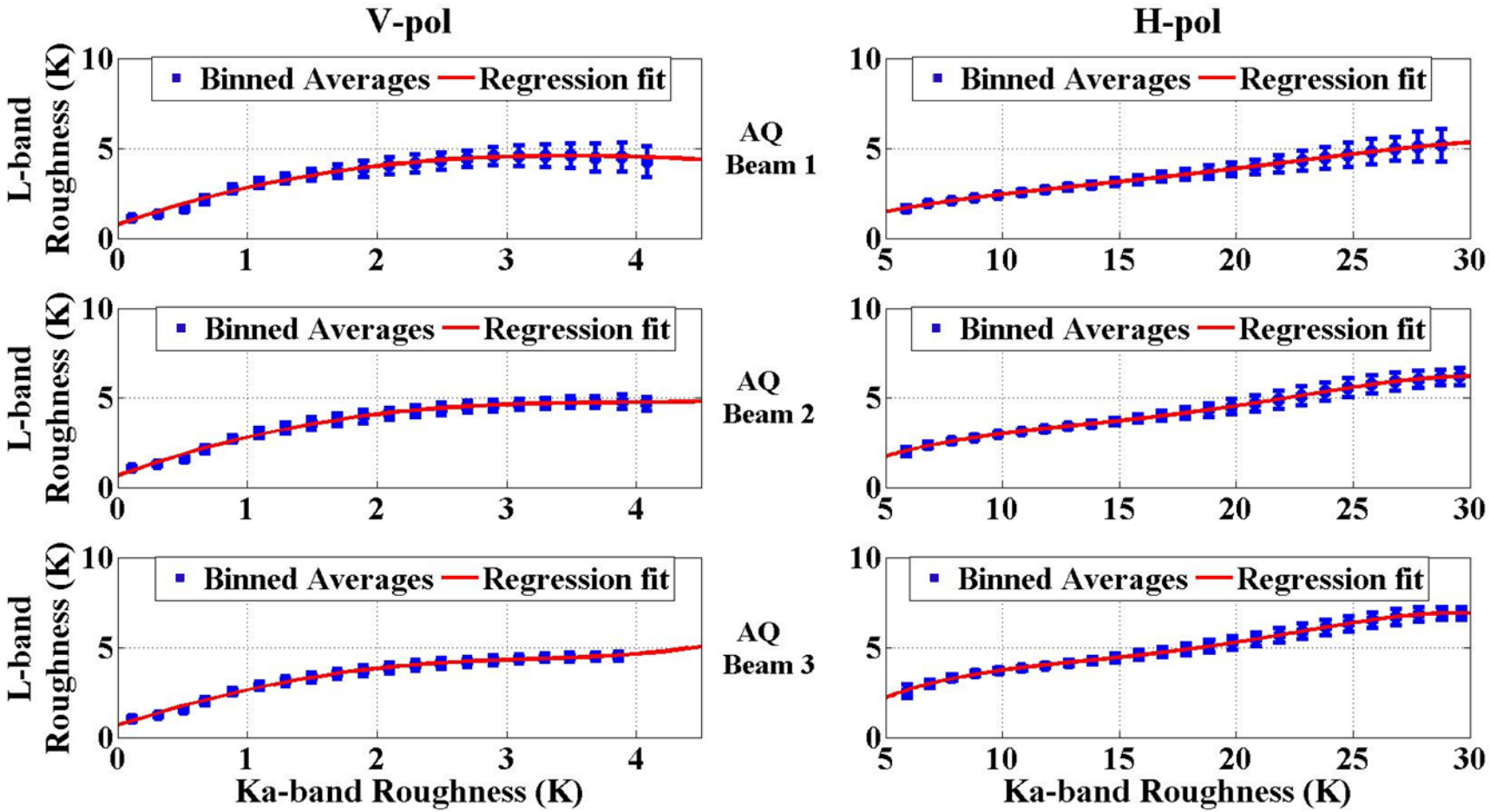
Tuning Ka-band RTM for Isotropic Wind Speed



Tuning Ka-band RTM for Relative Wind Direction



Empirical Roughness Correction Relationship (for Isotropic Winds)

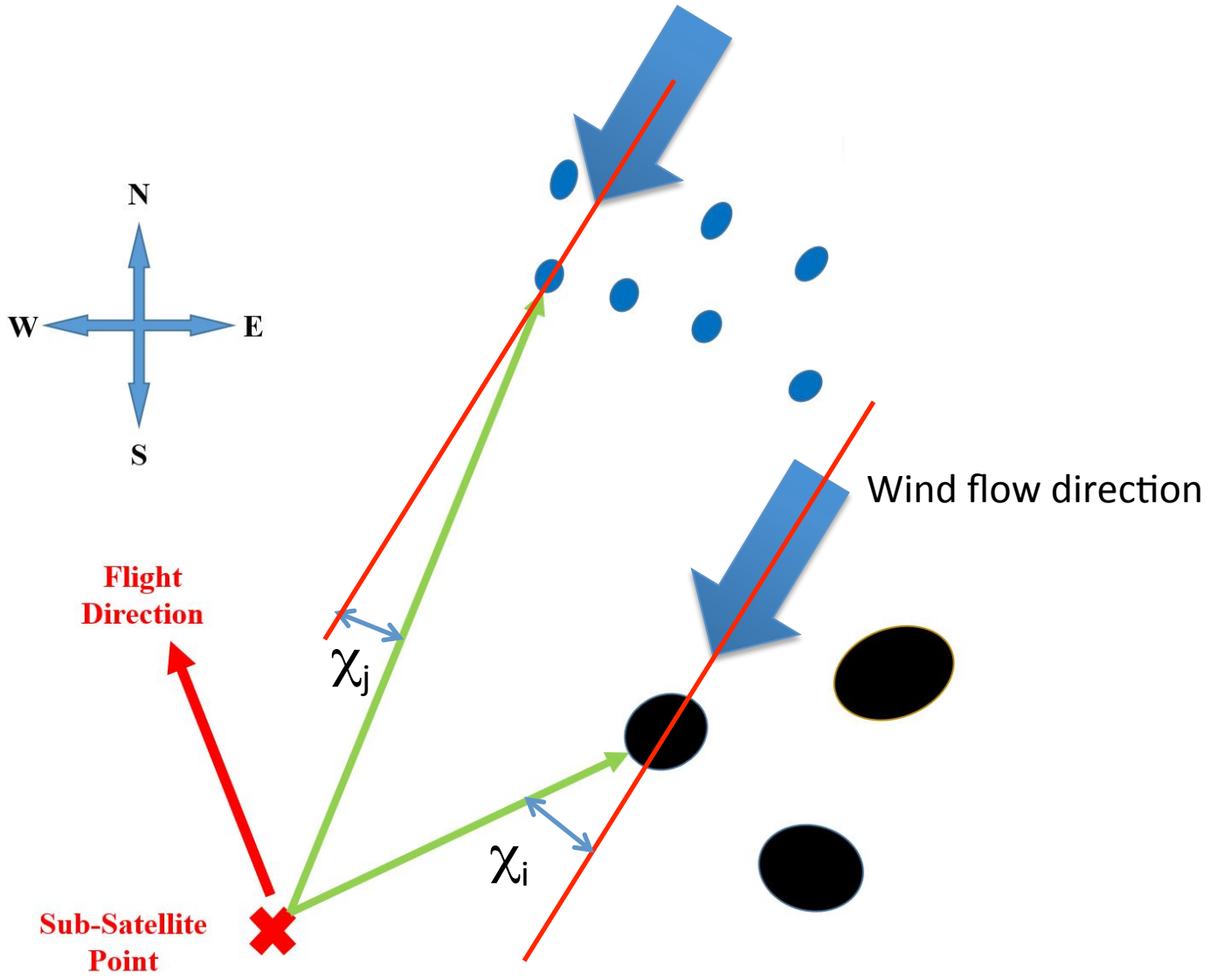


Wind Direction ΔTb_{WD} Adjustment

- Wind direction effects are removed using NCEP wind directions and corresponding AQ/MWR antenna "azimuth look" geometries
  - Wind direction effects removal are complicated because all IFOV's (L-band & Ka-band) have different relative wind directions χ

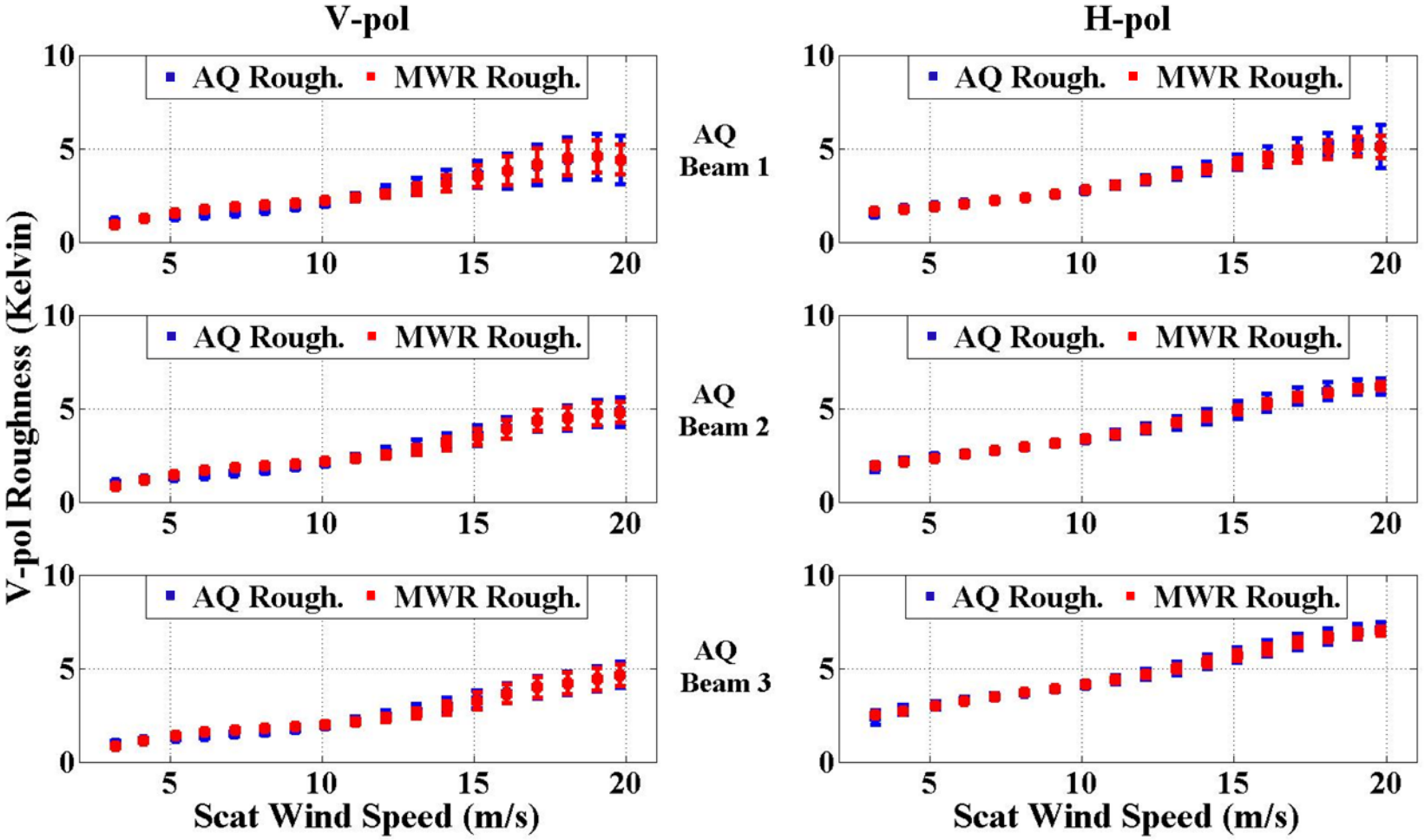
$$\chi = (\text{IFOV azimuth}) - (\text{wind flow direction})$$

Relative Wind Directions are Different for each IFOV

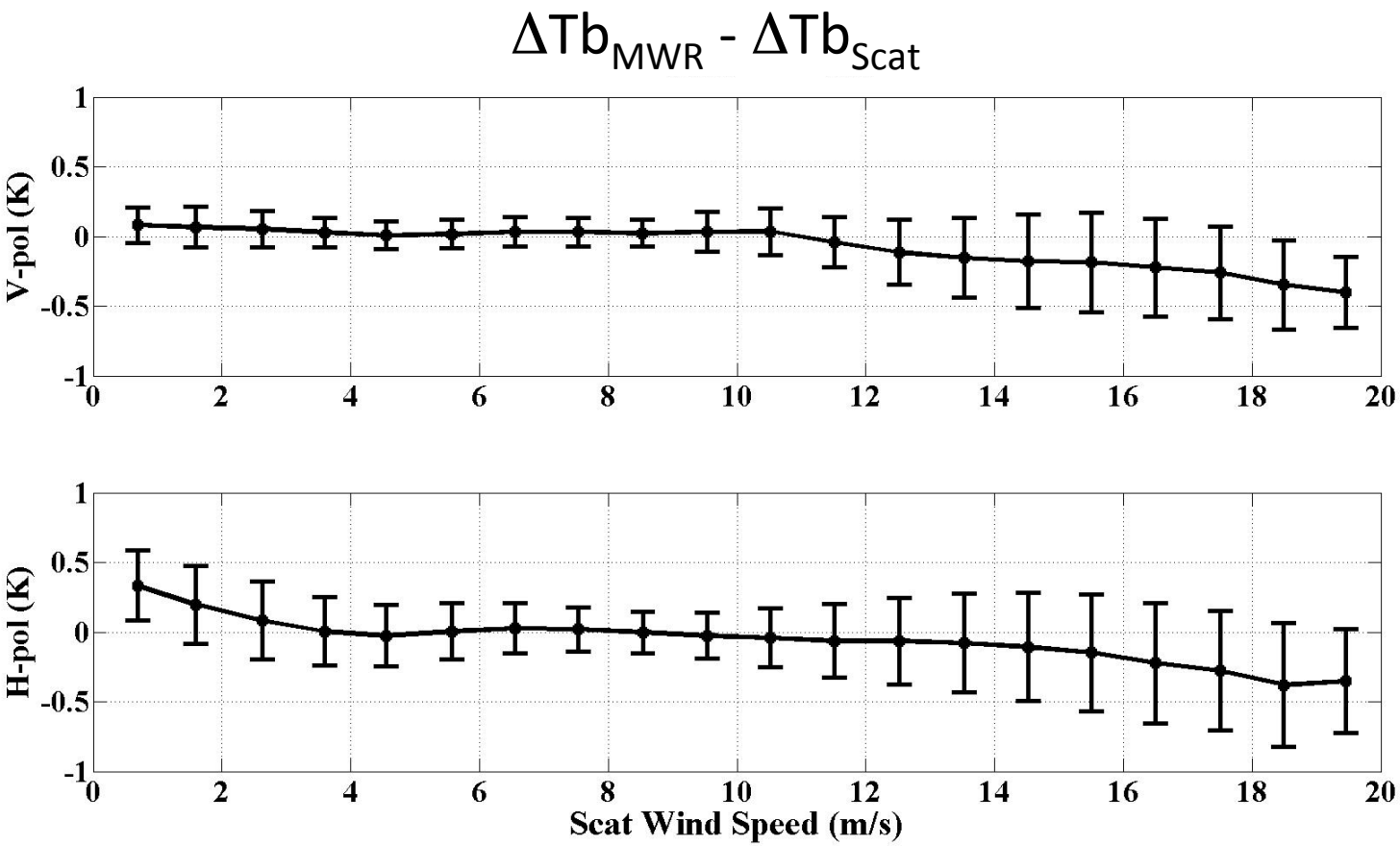


Roughness Correction for Both Methods

AQ Scat - blue & MWR - red



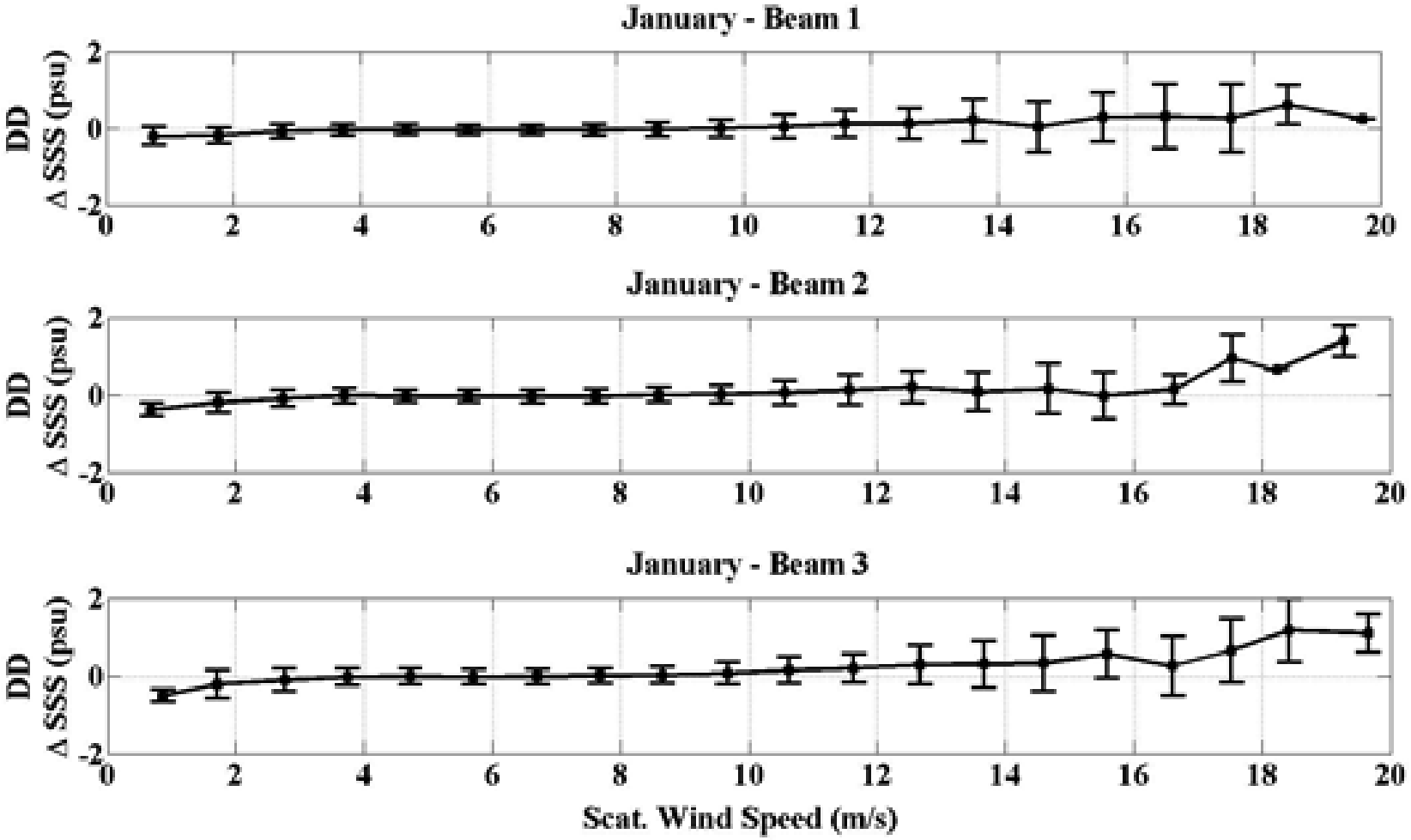
Differences Between Both Roughness Corrections



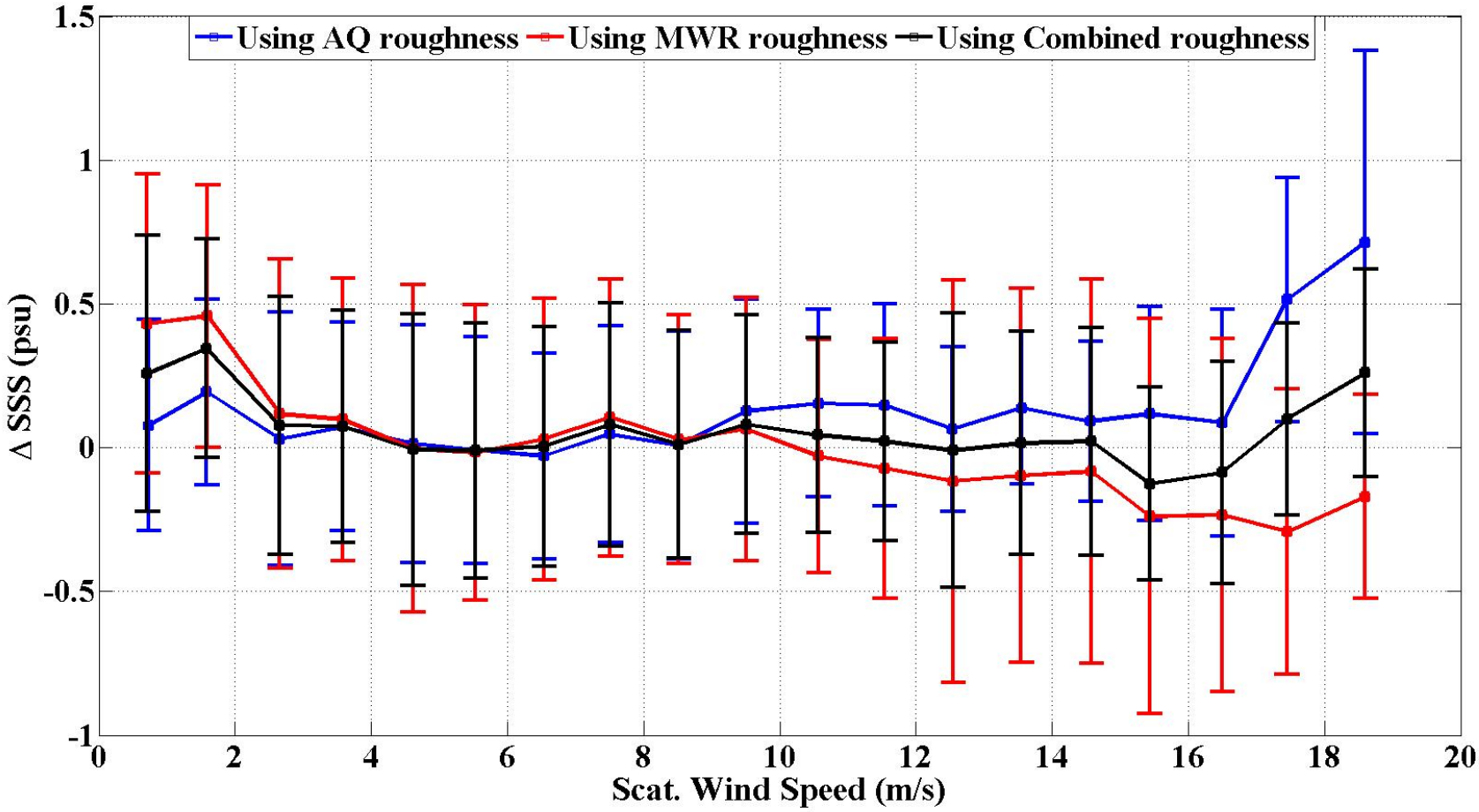
MWR Roughness Derived SSS: $(AQ\ SSS)_{MWR}$

- The MWR derived L-band roughness correction is applied to the L-2 ocean surface Tb
- Resulting Smooth Surface Tb is used to retrieve AQ SSS
  - Same ADPS SSS retrieval algorithm used as for L-2

ΔSSS = AQSSS - HYCOM
Double Difference = $(\Delta SSS)_{Scat} - (\Delta SSS)_{MWR}$



ΔSSS for Different Roughness Corrections: Scat, MWR & Avg, for AQ Beam-3, May 2013



ΔSSS for 3 Rough Corrections over WS AQ Beam-3 May 2013

Mean value (psu)				
Beam 3 (m/s)	0 –5	5 –10	10 –15	15 –20
AQ	0.05	0.02	0.15	0.17
MWR	0.11	0.04	–0.05	–0.25
Avg	0.07	0.02	0.03	–0.05
Standard deviation value (psu)				
Beam 3 (m/s)	0 –5	5 –10	10 –15	15 –20
AQ	0.43	0.44	0.40	0.42
MWR	0.57	0.53	0.56	0.62
Avg	0.46	0.45	0.41	0.39

Summary

- A legacy data set of 30 months of MWR data exist for roughness correction for all AQ Beams
  - Release of MWR roughness correction algorithm in Summer 2015
- Validation of $(\text{AQ SSS})_{\text{MWR}}$ was performed using HYCOM for Jan, April & July 2013
  - Also inter-comparison with $(\text{AQ SSS})_{\text{Scat}}$
  - Result show that MWR roughness correction is very similar to AQ Scat roughness
  - Further improvements may be possible using weighted averages of MWR & Scat roughness

Future Work

- Development of combined Scat & MWR roughness correction and associated AQ L-2 SSS
- Investigation of the differences between Scat & MWR roughness corrections
  - Especially for high WS
- Evaluation of roughness correction during salinity stratification