Revisiting the Effects of Rain on Ku-band Scatterometers

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Remote Sensing Systems

We are looking at rain and QuikSCAT again Why?

- 1. Accurately describe what rain does to Ku-Band retreivals.
 - Wind Speed
 - Direction
 - Effects on Trends/Fluxes?
 - Inform ingest into merged products like CCMP
- 2. Devise a rain correction for low rain rate.
 - Low rain rate (<1-2mm/hour) is much, much, more common than higher rates.
 - Effect of light rain on moderate and high winds is not so large.
 - Bias-Free winds are important for various climate applications.

What can we do now that we couldn't do before?

We now have:

- Global high resolution rain products (e.g. CMORPH)
 - Available everywhere at high temporal resolution
 - Independent of QuikSCAT
- 3rd Gen Reanalysis products at high spatial resolution (e.g. ERA5)
 - Resolution is close to matching satellite products
 - Less trouble from model (over) smoothness
 - Neutral Winds Available

Extended Rain Flag (RR = 0.0, no rainy neighbors)

QSCAT RF_ext asc





RR = 0.0

QSCAT Rain = 0.0 asc





Corrected, RR <= 1.0 mm/hr

QSCAT Corrected asc





Challenges and a plan to correct for low rain rates.

- Problem
 - Not enough buoy collocation to train a rain correction
- Approach
 - Use ERA5 as a transfer standard to remove bias relative to buoys for different rain rates from CMORPH
- For wind speed, buoys and ERA5 comparisons with QuikSCAT show similar behavior.

Triple Collocations at Moored Buoys



Triple Collocations at Moored Buoys Extended Rain Flag



Triple Collocations at Moored Buoys No Rain, but rain present in near-neighbor



Triple Collocations at Moored Buoys Rain Between 1.0 and 2.0 mm Hour



Triple Collocations at Moored Buoys Rain Between 3.0 and 4.0 mm Hour



Now move to Analysis everywhere, 2000-2009



Constructing an Adjustment



The Adjustment is constructed to match to QuikSCAT with No Rain, not ERA5

Adjustments as a function of Rain, QSCAT W10



Note – It is important that this is a function of *reported* QuikSCAT Wind Speed, not the true windspeed

Effects of the Correction – RR = 0.0, Rainy Neighbors



Effects of the Correction – 0.01< RR 0.5 mm/hr



Effects of the Correction – 0.5 < RR 1.0 mm/hr



Effects of the Correction – 1.0 < RR 2.0 mm/hr



Effects of the Correction – 2.0 < RR 3.0 mm/hr



Buoy Collocations Effects of the Correction – 2.0 < RR 3.0 mm/hr



CMORPH Rain Rate 0.5 to 1.0 mm/hr







Lots More Things to Do

- Wind Direction/Vector Errors
- Investigate Other Sources of Rain Info
- Investigate Other Reanalyses/Analysis
- Uncertainty in Adjusted Wind Any improvements in RMS
- What about stress/pseudostress?
- Use in CCMP
- Rain-rate Dependent Model Function??