# MWR Retrieval Performance Improvement After Smear Effect Correction

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## INTRODUCTION

The Microwave Radiometer (MWR), on board of SAC-D/Aquarius satellite, measures the surface brightness temperature $T_B$ at the top of the atmosphere in a frequency range sensitive to geophysical parameters over the ocean (surface wind speed, rain rate, water vapor, cloud liquid water and sea ice concentration). MWR is a push-broom 3 channel, Dicke radiometer, operating at K (23.8 GHz H-Pol) and Ka (36.5 GHz, H- & V-Pol) band. The instrument has 16 beams, 8 forward-looking 36.5 GHz and 8 aft-looking 23.8 GHz. The beams are arranged in a configuration with two incidence angles, one of 52° (4 odd beams) and one of 58° (4 even beams), for both forward and aft-looks. Since the first global $T_B$ images, there has been observed an anomalous recurrent effect, coined as *Smear Effect*. This effect is present in all push-broom beams and results in a "smearing" of Tb observations, that is more noticeable near high contrast areas, such as land/water crossings, rain events, and in the presence of clouds. After a detail analysis it was determined that the smear effect strongly affects the geophysical retrieval products. CONAE studied the effect, in a variety of cases, and developed a method to try to mitigate this smearing effect. The correction was applied to $T_B$ counts and with this data the retrievals was reprocessed. We present in this paper a comparison between the results obtained before and after the correction with noticeable improvement in MWR products, i. e., more realistic geophysical retrieval products. The improvement is demonstrated by both global and regional studies over land and ocean.

## THE MISSION

SAC-D/Aquarius was launched June 10th, 2011

- Cooperative Mission between:

  CONAE: Microwave Radiometer (23.8 & 36.5 GHz)

  NASA: Aquarius (1.4 GHz)

- Primary mission: Understanding the interaction between Global Water Cycle, Ocean Circulation & Climate by measuring Sea Surface Salinity

  Done by Aquarius instrument

  Accuracy: Changes in salinity as small as about two parts in 10,000

- MWR complements Aquarius by retrieving oceanic:

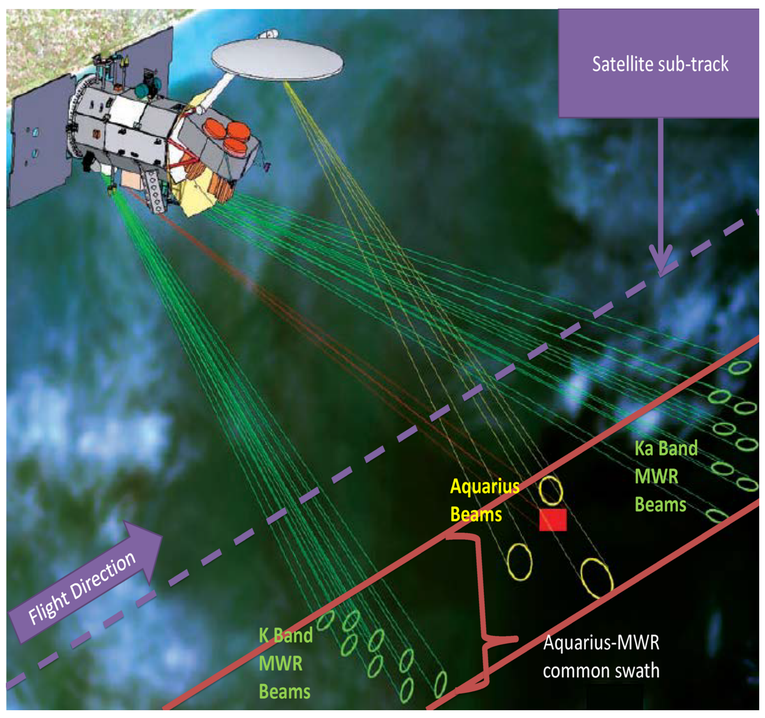
  Wind speed for roughness correction

  Rain rate for flagging

  Columnar Water Vapor

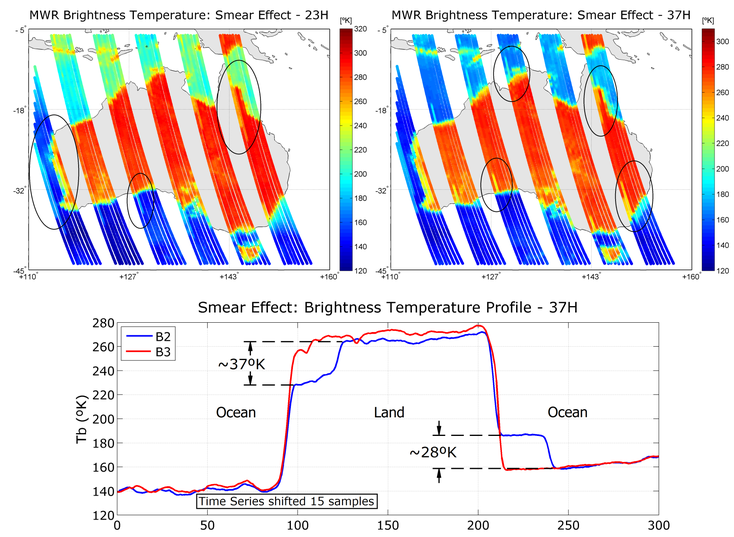
  Sea Ice Concentration

## MWR SENSOR GEOMETRY



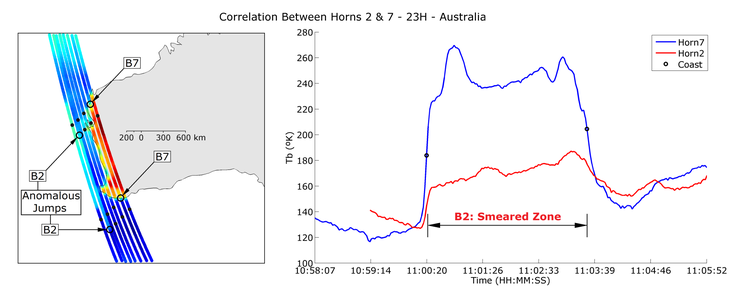

## THE SMEAR EFFECT

Since the first Global $T_B$ images were created an anomalous recurring pattern was observed for beam 1 & 2 for all channels. It was observed that the $T_B$ time series for 23.8 H and 36.5 V & H-Pol varied significantly from its adjacent beams, 3 to 8, for ascending and descending passes. In the next figures some examples of this effect are presented.

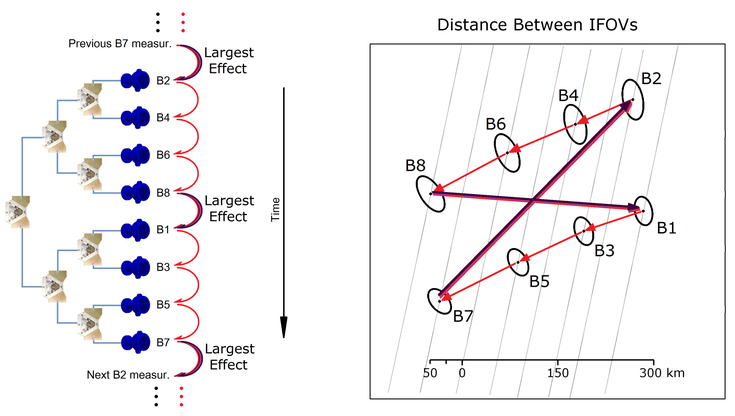



## SMEAR EFFECT ANALYSIS

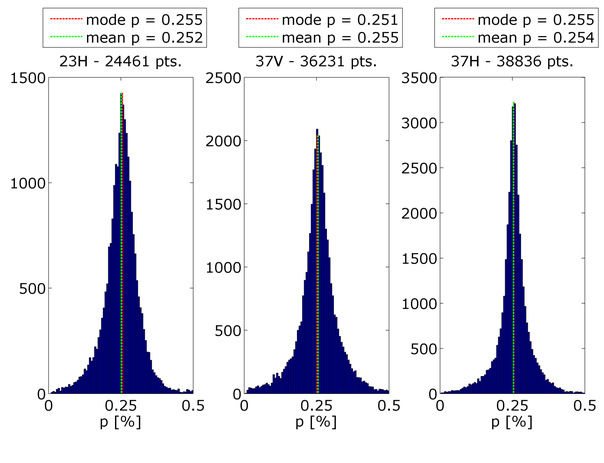
The brightness temperature jump points were studied (or the points of the beginning or end of the smear effect).




This figure above shows that beams 2 become warmer over ocean during the time beam 7 begin to observe land. Once beams 8 leave land the smear effect for beam 2 subside to expected scene temperatures. The effect is present in all beams but it can be seen that is more noticeable in beam 1 & 2. The next figures illustrate (in the right) the difference between the lines of sight of the MWR horns; in the left shows the sequence of contamination of the measurements.

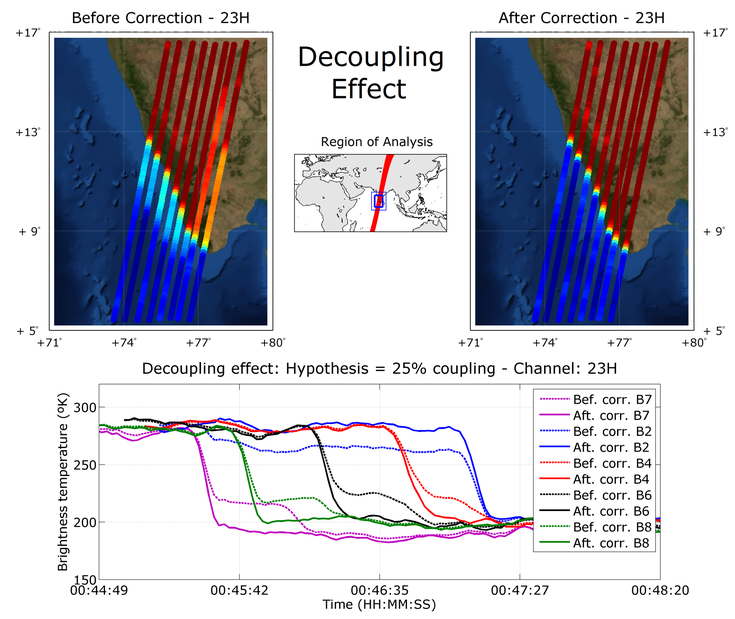



Evidence would indicate that each measurement is affected only by the preceding measurement. Analysis and tests show that this contribution between pairs of beams is always present between the same pair of beam and in all cases the mixing ratio of data is exactly the same.
Results revealed a coupling percentage very close to 25%:

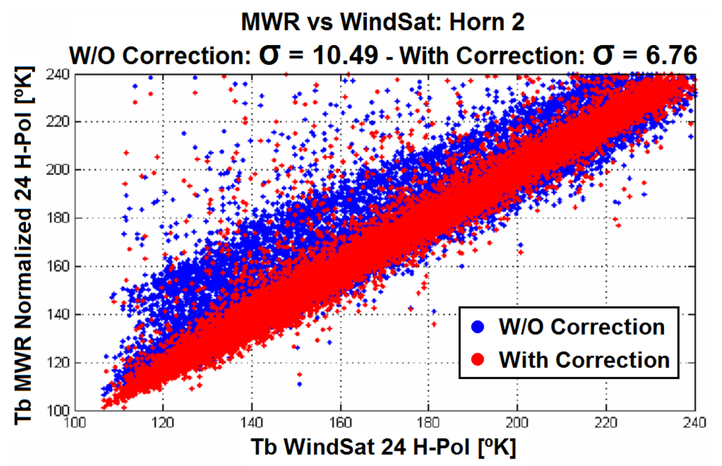



## BEFORE AND AFTER CORRECTION

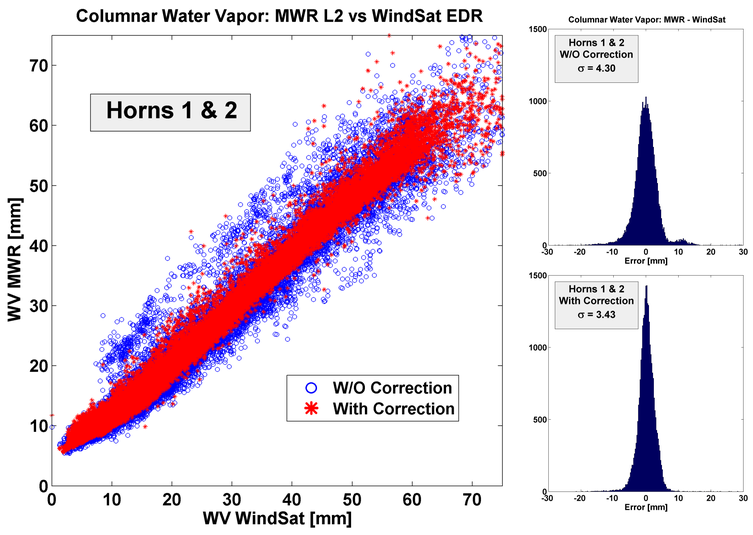
### Brightness Temperature



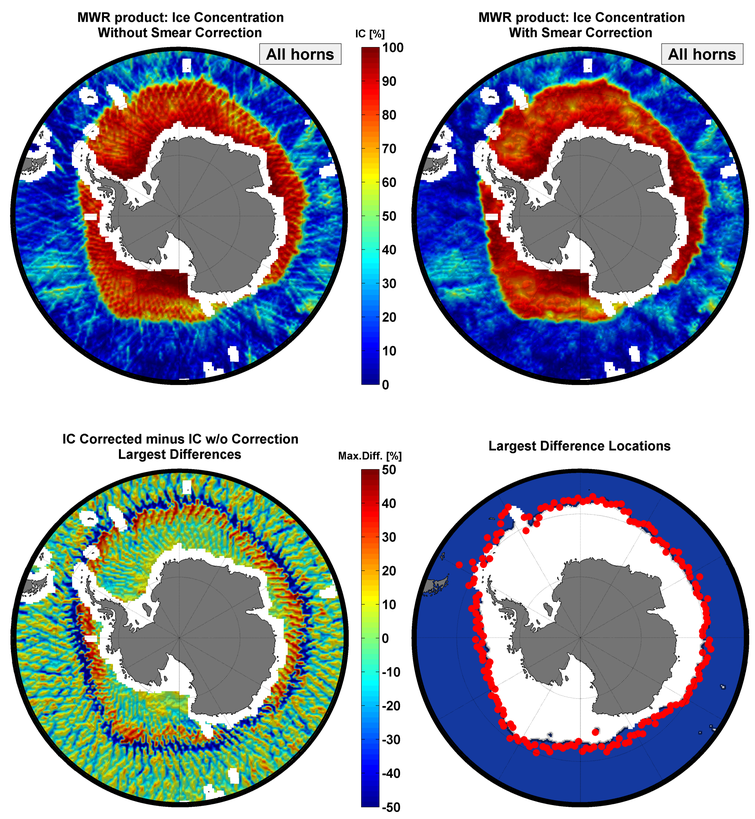

Next figure shows a inter-satellite radiometric $T_B$ comparison for MWR 23.8H GHz and WindSat. $T_B$ without smear correction shown in blue and with smear correction in red:




### Columnar Water Vapor

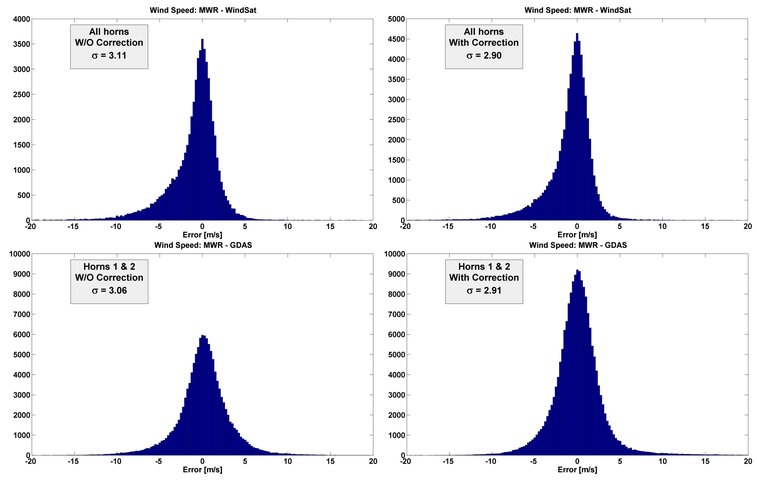



### Sea Ice Concentration




Largest differences are concentrated near the ocean/high IC interface as expected, and can be seen in the figure above. In these cases, IC product improvements are greater than 40%.

### Wind Speed




## CONCLUSIONS

- The comparison between MWR and WindSat data products (Brightness Temperature, Wind Speed & Columnar Water Vapor) showed an improvement in all cases, after applying the smear correction.
- With the smear correction, the Sea Ice Concentration product has experienced a great improvement, particulary in the ocean/ice interface where the product showed the mayor flaws before correction.