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Validation and Early Science from AMSR2

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Introduction

The Advanced Microwave Scanning Radiometer 2 (AMSR2) became part of the A-Train constellation in July 2012. AMSR2 continues the successful decade of science started by AMSR-E (June 2002 to October 2011). The design of the AMSR2 sensor is very similar to AMSR-E, but it contains enhancements for improved RFI mitigation and an improved hot calibration source. This poster presents an evaluation of AMSR2 over-ocean retrievals of wind speed, water vapor, and sea surface temperature. **We are evaluating a preliminary version of AMSR2 geophysical retrievals produced with Remote Sensing Systems Version-7 retrieval algorithm.** Even at this preliminary stage, we found AMSR2 retrievals are in excellent agreement with buoys, other passive microwave satellites, and NCEP GDAS.

Validation

Figure 1 shows the excellent agreement of AMSR2 wind speed retrievals with moored buoy observations from NDBC and PMEL buoys. For the Atlantic Ocean, this includes buoys all along the east coast from Nova Scotia down to the Bahamas, as well as in the Gulf of Mexico and Caribbean Sea. For the Pacific Ocean, this includes buoys in the Pacific Northwest up to the Gulf of Alaska and Bering Sea along the Aleutian Islands. It also includes buoys around Hawaii and TAO/TRITON buoys in the tropics. There are a total of 11,380 collocations for the period 7/12/2012 - 6/13/2013. The table below summarizes the wind speed statistics for a triple collocation of AMSR2, buoy, and NCEP. The mean differences are around 0.2 m/s and the difference standard deviation is just over 1 m/s. This is the same level of wind speed accuracy achieved by other passive microwave sensors, including SSM/I and AMSR-E.

Datasets	Mean (m/s)	Std. Dev. (m/s)
AMSR2 minus Buoy	0.14	1.14
AMSR2 minus NCEP	0.23	0.99
Buoy minus NCEP	0.10	1.15

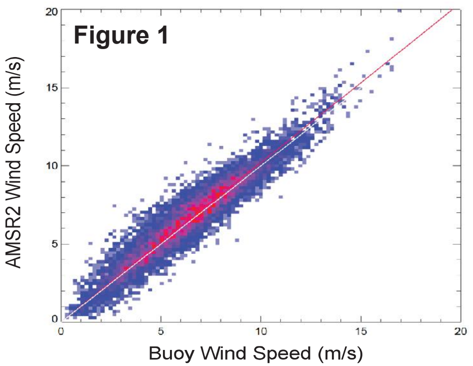
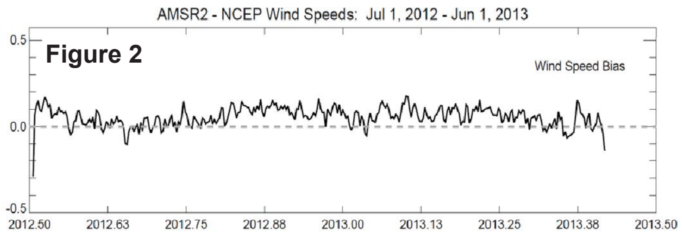


Figure 2 shows a difference time series between AMSR2 minus NCEP GDAS wind speeds. There are a total of 209,038,052 collocations. The figure demonstrates that AMSR2 has been stable over its first year of operation. The difference does not vary with time, and no drifts are evident. The overall mean difference is 0.03 m/s and the standard deviation is 1.35 m/s.



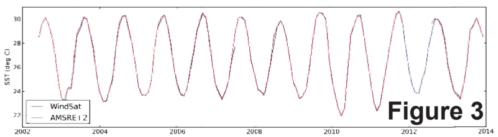
The table below provides AMSR2 minus TMI differences for wind speed, sea surface temperature, and water vapor (total precipitable water). There are a total of 10,688,482 collocations. The mean difference for wind is comparable with buoy and NCEP comparisons, while the standard deviation is much lower for this satellite-to-satellite comparison. Wind and SST both have negligibly small biases, and all parameters three have standard deviations comparable with SSM/I and AMSR-E.

Variable	Mean	Std. Dev.	Units
Wind	0.11	0.51	m/s
SST	0.00	0.56	deg C
TPW	-0.28	0.80	mm

Early Science

In recent work, *Barandiaran, Wang, and Hilburn* [2013, *GRL in review*] examined the 25-year time series of SSM/I + SSMIS TPW over the Gulf of Mexico and found that the atmosphere is moistening in the summer and drying in the winter. In contrast, the North American Regional Reanalysis found drying in the summer and intense drying in the winter. This left open a very fundamental scientific question: **is the atmosphere over the Gulf of Mexico moistening or drying, and how does this depend on season?**

What can the AMSR-E + AMSR2 time series tell us about the changes that have occurred over the last decade? **Figure 3** shows the average SST over the Gulf of Mexico. All three time series move in lock-step with each other. This confirms that RSS V7.0.1 WindSat can be used as a bridge to connect RSS V7 AMSR-E and AMSR2 data.



Notable in **Figure 3** is that the annual minimum SST exhibits strong interannual variability. In a typical year, the minimum is 23.3 deg C on average. In 2010, the SST went as low as 21.9 deg C. It does so in winter months, the same months where the Loop Current is especially evident in microwave SST imagery. **Figure 4** shows an example of an active Loop Current from February 15, 2009. The features in AMSR-E SST and the ocean currents from OSCAR align extremely well. The currents are useful in confirming that the anomalously warm SSTs are due to the Loop Current.

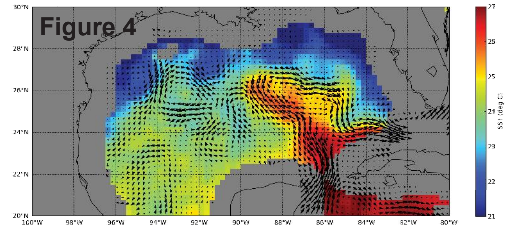
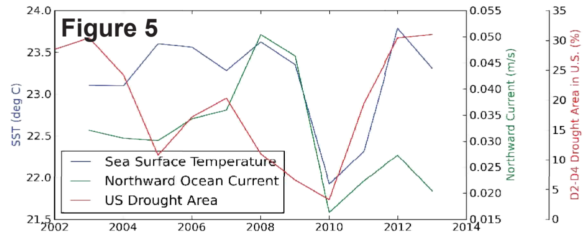


Figure 5 shows a time series of the annual minimum SST in the Gulf of Mexico. Again, 2010 stands out as an exceptional year during the first decade of the 21st Century. The 2010 minimum in SST corresponds to a minimum in northward ocean current velocity. The physical connection between SST and currents is consistent with **Figure 4**, which illustrates that a strong current is associated with warm water. Even more revealing is the correlation with severe drought over the United States. In 2010, the area of severe drought is only 3.3%, compared with the average of 19.5%. This indicates that variability in the Loop Current can have profound impacts on precipitation (and hence agriculture) in the United States.



Just over one year into its mission, AMSR2 is already providing high-quality data that can be used for scientific inquiry. The 2010 minimum in SST also corresponds to a minimum in TPW. That year the TPW minimum was 20.1 mm, compared with an average minimum of 24.7 mm. This might seem paradoxical that low vapor would be associated with less drought, but this is evidence of the complex interaction with the atmosphere. *Barandiaran et al.* discuss how the changes in the location and intensity of the Great Plains Low Level Jet impact the spatial distribution of precipitation across the United States.

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