MWR MARINE SURFACE WIND SPEED: L2 PRODUCT AND VALIDATION

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In this work we present the wind speed retrieval obtained using MWR instrument data. The retrieval model was developed jointly between CONAE and CFRSL, and is actually used to generate Wind Speed L2 product distributed by CONAE and PODAAC. We also show typical results for a pass and global wind speed averages in different seasons. In addition, we present validation results using Windsat data for comparisons, based on statistical procedures.

INTRODUCTION

MWR is a three channel push broom Dicke radiometer on board SAC-D/Aquarius, that has 16 beams, 8 forward-looking at 36.5 GHz (in vertical and horizontal polarization) and 8 aft-looking at 23.8 GHz (in horizontal polarization), with a swath of approximately 380 Km. The beams are arranged to have two incidence angles, one of 52° (odd beams) and one of 58° (even beams) for both forward and aft-looks.

The model is based on the microwave radiative transfer theory developed by Remote Sensing System (Wentz et al [1]). It uses MWR brightness temperature at 36.5 GHz in both, horizontal and vertical polarizations and auxiliary data (such as sea surface temperature obtained from GDAS, wind direction from NCEP, etc). As a result, the neutral stability ocean surface wind speed at 10 m height and the atmospheric transmissivity at 36.5 GHz are retrieved.

THE ALGORITHM

The characteristic sea surface radiation emission in the microwave range depends on the surface roughness. A calm sea behaves as a flat surface, so its electromagntic behavior can be described by the Fresnel reflection coefficients, presenting a highly polarized emission. But this description does not apply where the sea surface stops being flat and becomes rough. The main cause of appearance of the surface roughness of the sea for areas away from the coast is the surface wind.

The algorithm to calculate sea surface wind speed at 10 m height developed by CRFSL, is based on a procedure developed by Wentz [1], which solves the next pair of simultaneous equations for two unknowns:

$$T_{b37V} = F_V(W,\tau), \qquad T_{b37H} = F_H(W,\tau)$$

Where τ is the transmissivity and W is the wind spped. According to [1], the model function (F) for both H-pol and V-pol can be expressed as:

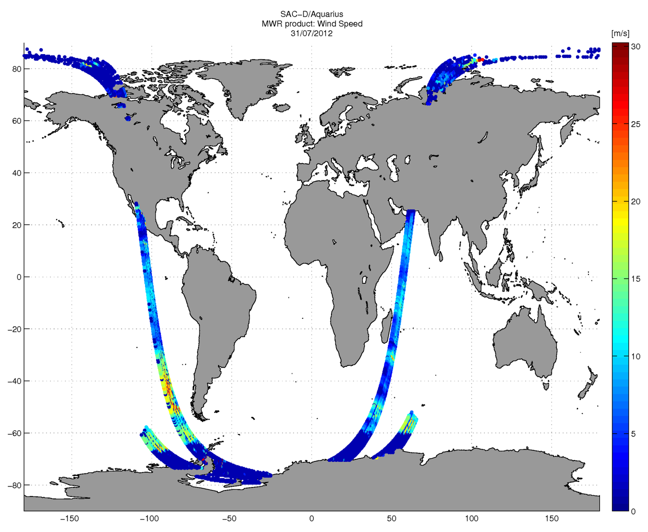
$$F(W,\tau) = T_{BU} + \tau[\varepsilon\, SST + (1-\varepsilon)(1+\omega W)(T_{BD} + \tau T_{ex})]$$

On the other hand, this system can be solved numerically using the bi–dimensional Newton–Raphson's method, accordingly, such a system can be re–written as follows:

$$T_{b37V} \approx F_V(W_0,\tau_0) + \left(\frac{\partial F_V}{\partial W}\right)(W-W_0) + \left(\frac{\partial F_V}{\partial \tau}\right)(\tau-\tau_0)$$

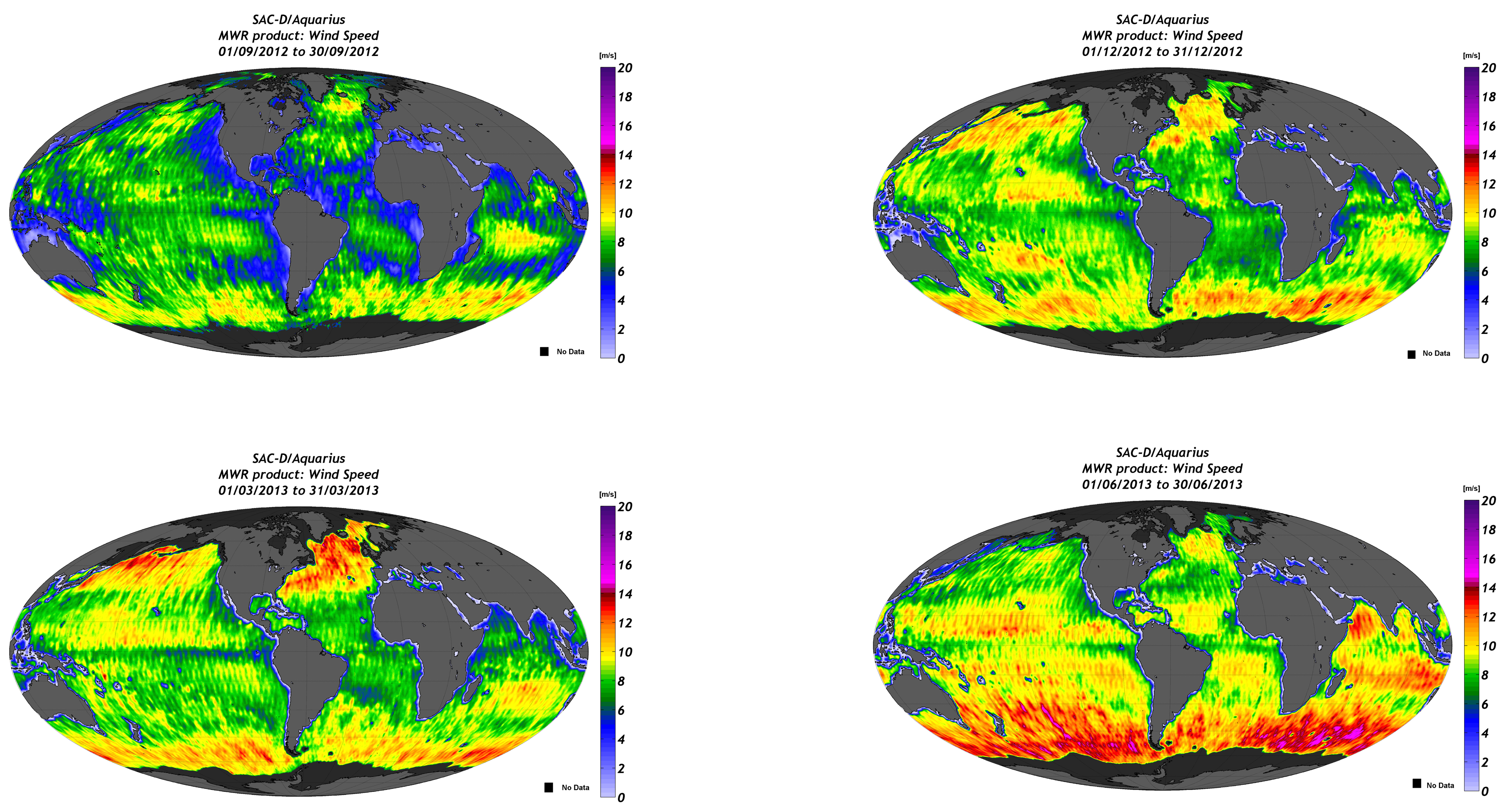
$$T_{b37H} \approx F_H(W_0,\tau_0) + \left(\frac{\partial F_H}{\partial W}\right)(W-W_0) + \left(\frac{\partial F_H}{\partial \tau}\right)(\tau-\tau_0)$$

These systems of two equations with two unknowns (W and τ) can be solved using an iterative procedure with initial guess , and repeated until the wind speed value converges to a constant value. Also, since the MWR T_b's are measured at 52° and 58°, empirical linear translations are used to produce 53° EIA equivalent T_b's in order to normalize at the same Windsat data. Sea surface wind speed (10m height) from previous algorithm is available in CONAE webpage as a science product.



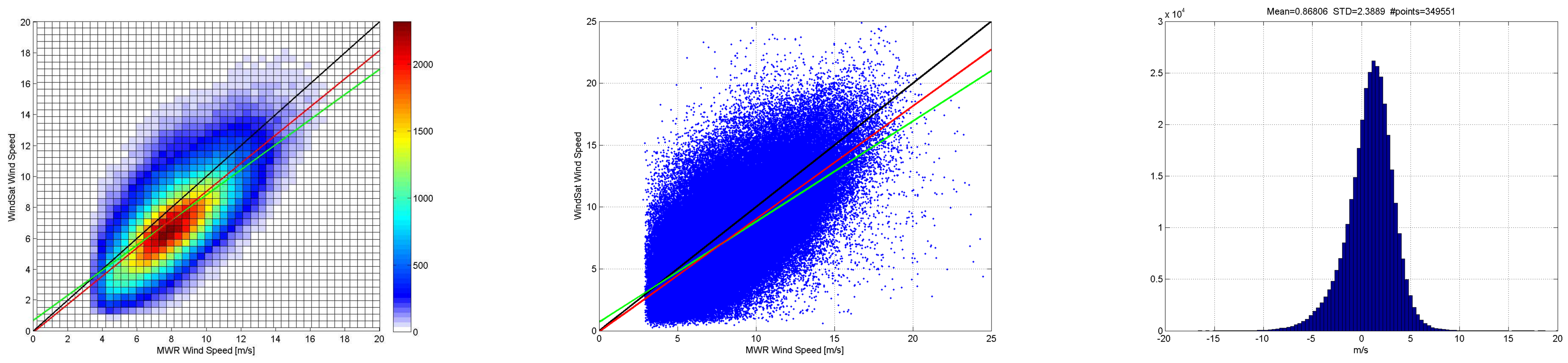
WIND SPEED RETRIEVAL

Averaged in different seasons

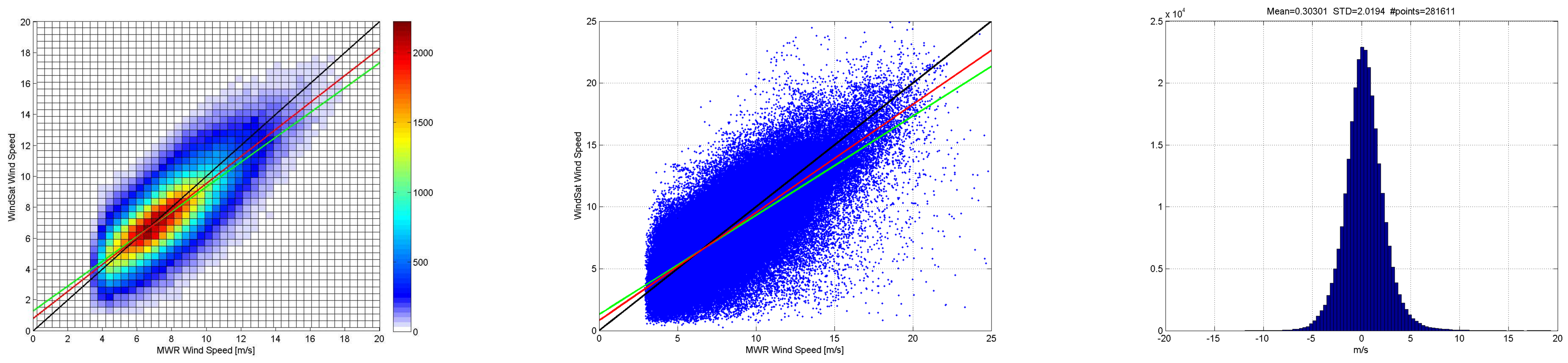


VALIDATION USING WINDSAT DATA (AUGUST TO DECEMBER 2012)

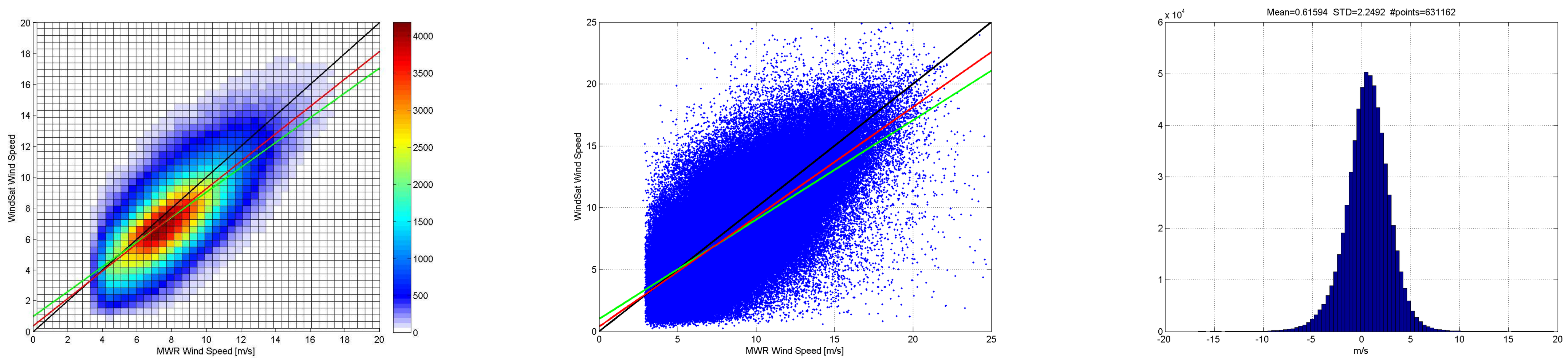
Odd Beams



Even Beams



All Beams



Statistical results

outliers	N	a	b	Residual Std error	r squared	p value	Abs Error Mean	Abs Error Std Dev
				Odd Beams				
With	349551	0.812045	0.688298	2.338	0.4489	< 2.2e-16	0.8680494	2.388919
Without	313034 (89.6%)	0.911678	-0.085668	1.768	0.6314	< 2.2e-16	0.863362	1.781929
				Even Beams				
With	281611	0.801771	1.295646	1.938	0.583	< 2.2e-16	0.3030005	2.019417
Without	266433 (94.61%)	0.872718	0.810337	1.576	0.7025	< 2.2e-16	0.2014053	1.615574
				All Beams				
With	631162	0.803203	0.994681	2.185	0.5	< 2.2e-16	0.6159366	2.249232
Without	579467 (91.8%)	0.8876892	0.3773268	1.708	0.6551	< 2.2e-16	0.5281952	1.733866

[1] F.J.Wentz,*Measurements of oceanic wind speed vector using satellite microwave radiometer*, IEEE Transaction on Geoscience Remote Sensing, vol. 30, pp.960-972, Sep. 1992.