# VALIDATION OF MWR MARINE SURFACE WIND SPEED

**C.B.Tauro[1], Y.Hezain[2], M.M Jacob[1], L. Jones[2]**

[1] Comisión Nacional de actividades espaciales (CONAE) [2] Central Florida Remote Sensing Laboratory (CFRSL)

carolina.tauro@conae.gov.ar yazan.hejazin@gmail.com maria.jacob@conae.gov.ar

*The CONAE and CFRSL MWR team has developed an improved algorithm for retrieving ocean wind speed using the newest MWR V7.0 brightness temperature data. This poster presents a description of the algorithm and results of a comprehensive on-orbit validation using coincident ocean wind speed retrievals provided by Remote Sensing Systems.*

## INTRODUCTION

The previous MWR Wind Speed algorithm was based on MWR ocean Tb measurements at 36.5 GHz (52° and 58° incidence angles), ancillary Aquarius (GDAS) SST and the microwave radiative transfer theory developed by Wentz, 1992. A linear regression was used to translate the MWR Tb at 36.5 GHz V and H-pol to match WindSat brightness temperature at 53° incidence angle. During the on-orbit Cal/Val period, a simple regression was applied to remove the mean wind speed biases compared to collocated WindSat wind speed retrievals.

The new model is also based on the same microwave radiative transfer theory, but now all coefficients have been tuned using one year of MWR brightness temperature at 23.8 (H-pol) and 36.5 GHz (H and V-pol) and auxiliary data. Unlike the previous algorithm, this version makes a wind direction correction to the surface Tb before retrieving atmospheric transmissivity and the isotropic ocean surface wind speed at 10 m height, and has two different sets of coeffecients for each incidence angle.

Here we present validation results obtained from comparisions between MWR wind speed and collocated WindSat and SSMI data (from Remote Sensing Systems). Some plots are presente in order to show the general procedure, as well as the summary of statistical parameters.

## THE ALGORITHM

The algorithm to calculate sea surface wind speed at 10 m height developed 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 $\tau$ 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 $\tau$) can be solved using an iterative procedure with initial guess, if the model function $F$ is knonwn.

The model function $F$ was generated using entire 2012 collocated data, namely: MWR brightness temperature, GDAS, WindSat, SSM/I and simulated surface $T_b$, $T_{bUp}$, $T_{bDown}$ and $\tau$. Four 3D tables (size 126 x 231 x 71) relanting $T_b$ as a funtion of WS, $\tau$ ans SST were generated, one for each beam and band: Hpol Even beams (58°), Hpol Odd beams (52°), Vpol Even beams (58°) and Vpol Odd beams (52°).

In addition, wind direction effect was modeled

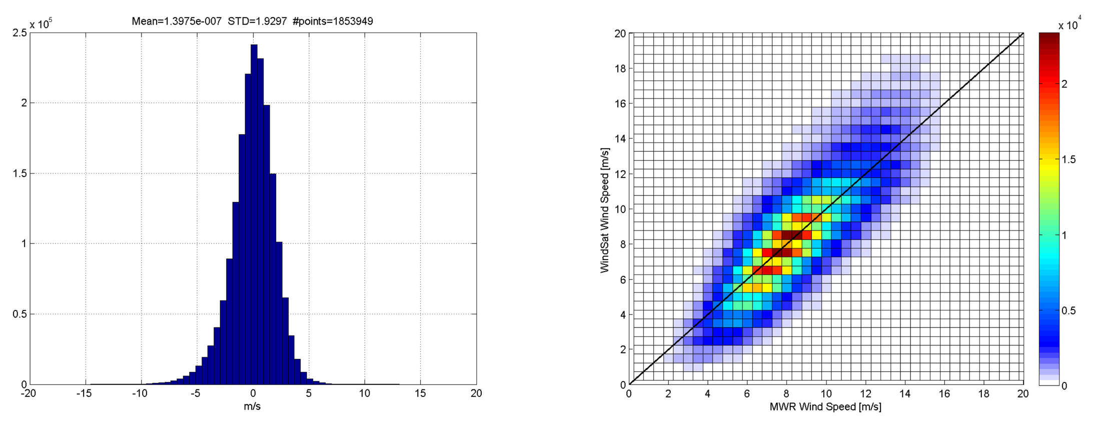
$$T_{BExcess} = \beta_1 cos(WD_{rel}) + \beta_2 cos(2 * WD_{rel})$$

where $\beta$'s fifth order polinomial in WS, and $WD_{rel}$: relative wind direction.

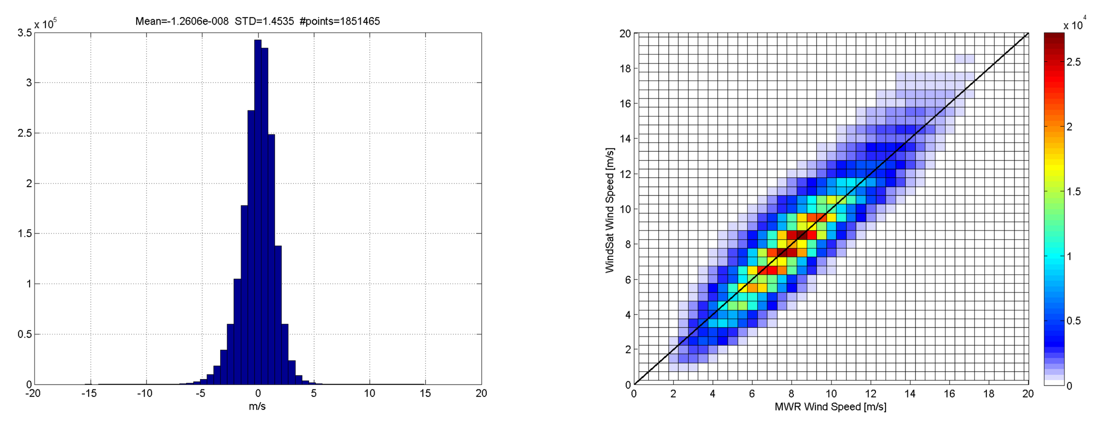
Finally, a correction was applied in order to match MWR wind speed with WindSat data.

## WIND SPEED RETRIEVAL TRAINING PERIOD

***Odd beams***



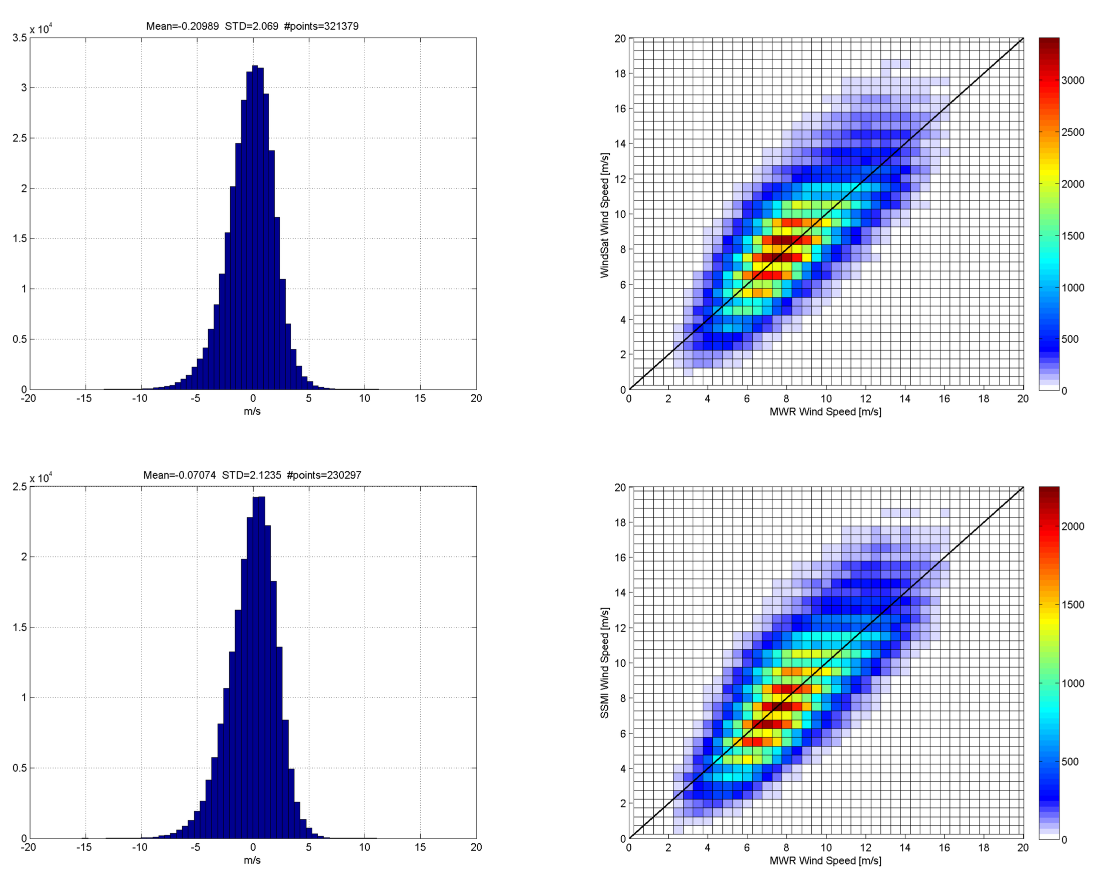
***Even beams***



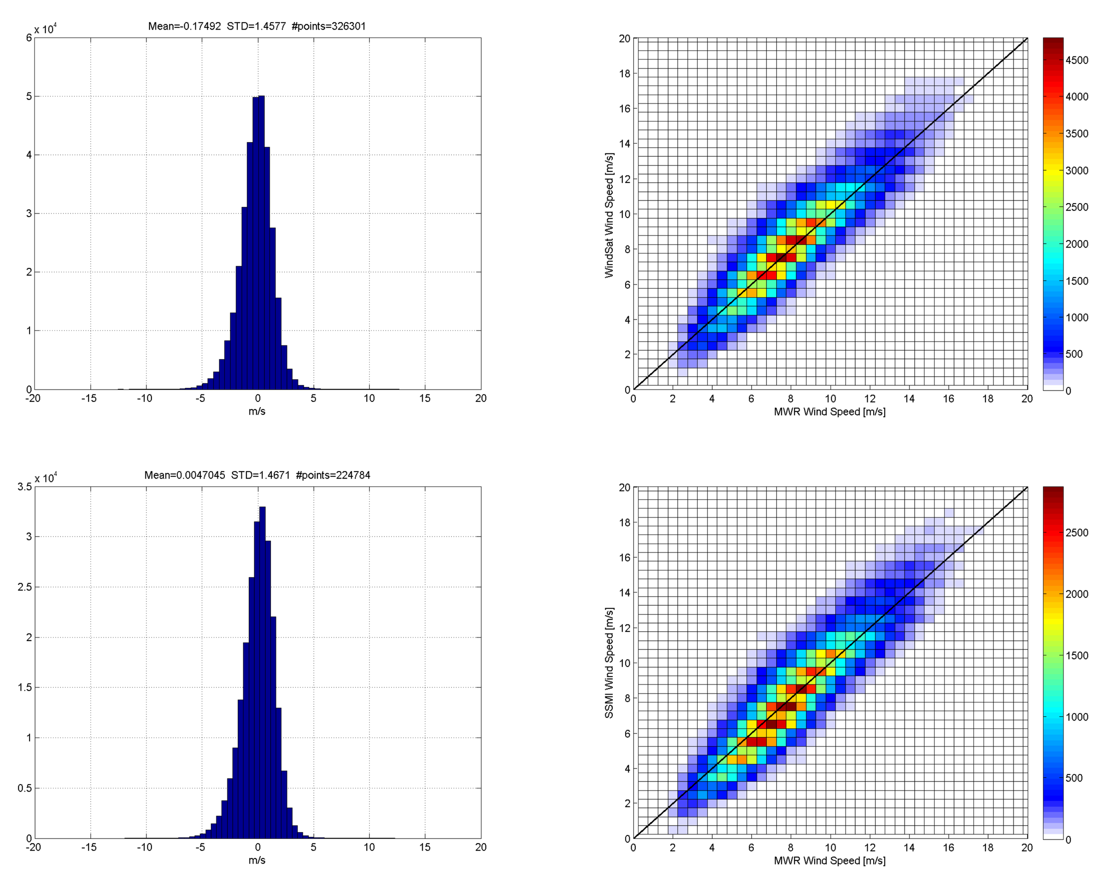
| | N | a | b | Residual Std error | r squared | p value | Abs Error Mean | Abs Error Std Dev |
|---|---|---|---|---|---|---|---|---|
| Odd beams | | | | | | | | |
| WindSat | 1853949 | 1.00 | -7.73e-7 | 1.93 | 0.63 | < 2.2e-16 | 1.39e-7 | 1.93 |
| SSMI | 1336398 | 1.05 | -0.56 | 2.01 | 0.64 | < 2.2e-16 | 0.17 | 2.01 |
| Even Beams | | | | | | | | |
| WindSat | 1851465 | 1.00 | 3.95e-8 | 1.453 | 0.79 | < 2.2e-16 | 1.26e-8 | 1.45 |
| SSMI | 1296128 | 1.04 | -0.51 | 1.49 | 0.81 | < 2.2e-16 | 0.16 | 1.49 |

## VALIDATION vs WINDSAT DATA (JANUANY TO SEPTEMBER 2013)

***Odd beams***



***Even beams***



### *Summary of statistical results*

| | **N** | **r squared** | **Abs Error Mean** | **Abs Error Std Dev** | **N** | **r squared** | **Abs Error Mean** | **Abs Error Std Dev** |
|---|---|---|---|---|---|---|---|---|
| | Odd Beams | | | | Even Beams | | | |
| Jan WS | | | | | | | | |
| Jan SSMI | | | | | | | | |
| Feb WS | | | | | | | | |
| Feb SSMI | | | | | | | | |
| Mar WS | | | | | | | | |
| Mar SSMI | | | | | | | | |
| Apr WS | | | | | | | | |
| Apr SSMI | | | | | | | | |
| May WS | | | | | | | | |
| May SSMI | | | | | | | | |
| Jun WS | | | | | | | | |
| Jun SSMI | | | | | | | | |
| Jul WS | | | | | | | | |
| Jul SSMI | | | | | | | | |
| Aug WS | | | | | | | | |
| Aug SSMI | | | | | | | | |
| Sep WS | | | | | | | | |
| Sep SSMI | | | | | | | | |

[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.