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 coefficients for each incidence angle.

Here we present validation results obtained from comparisons between MWR wind speed and collocated WindSat and SSMI data (from Remote Sensing Systems). Some plots are present 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:

\[ \begin{align*}
T_{SST} & = F_1(W, \tau), \\
T_{BD} & = F_2(W, \tau)
\end{align*} \]

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

\[ F(W, \tau) = T_{BD} + \tau [\epsilon_{SST} + (1-\epsilon) (1+\omega W) / (T_{BD} + \tau T_{0})] \]

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:

\[ \begin{align*}
T_{SST} & \approx F_1(W_0, \tau_0) + \left( \frac{\partial F_1}{\partial W} \right) (W - W_0) + \left( \frac{\partial F_1}{\partial \tau} \right) (\tau - \tau_0) \\
T_{BD} & \approx F_2(W_0, \tau_0) + \left( \frac{\partial F_2}{\partial W} \right) (W - W_0) + \left( \frac{\partial F_2}{\partial \tau} \right) (\tau - \tau_0)
\end{align*} \]

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 known.

The model function \( F \) was generated using entire 2012 collocated data, namely: MWR brightness temperature, GDAS, WindSat, SSM/I and simulated surface temperature \( T_s \), \( T_{SST} \), \( T_{HPol} \) and \( \tau \). Four 3D tables (size 126 x 231 x 71) relating \( T_s \) as a function of \( W \), \( \tau \) and \( SST \) 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

\[ T_{E,BD} = \beta_0 \cos(W_{D,rel}) + \beta_1 \cos(2W_{D,rel}) \]

where \( \beta_0 \)’s fifth order polynomial in WS, and \( W_{D,rel} \) relative wind direction.

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