Paper number: OS21E-1814 - Paper ID: 1488235

FIRST RESULTS AND VALIDATION OF MARINE SURFACE WIND SPEED OBTAINED FROM SAC-D/AQUARIUS MWR

C.B.Tauro[1], Y.Hezain[2], P. Etala[3], P. Echevarria[3], M.M. Jacob [1], L. Jones[2]

[1] Comisión Nacional de actividades espaciales (CONAE), Argentina [2] Central Florida Remote Sensing Laboratory (CFRSL) [3] Servicio de Hidrografía Naval (SHN), Argentina

carolina.tauro@conae.gov.ar yazan.hejazin@gmail.com paulaetala@hidro.gov.ar

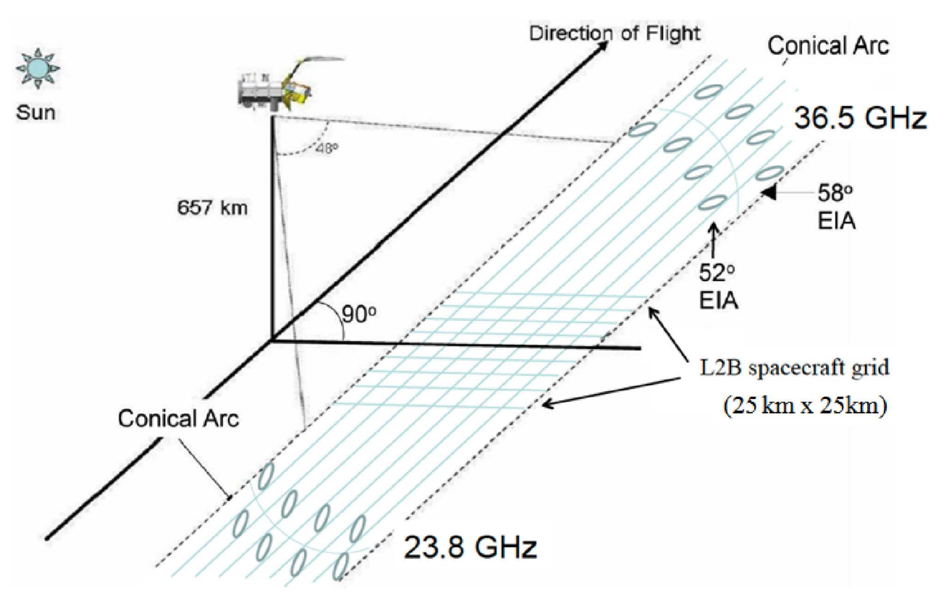
We present the first results of wind speed over the sea, obtained using the MWR data, onboard of SAC-D/Aquarius satellite, based on the microwave radiative transfer theory by Wentz, using MWR brigthness temperature at 36.5 GHz in both polarizations and sea surface temperature obtained from GDAS. As a result, the neutral stability ocean surface wind speed at 10 m height and the atmospheric trasnmissivity at 36.5 GHz are retrieved. In addition, a validation process in collaboration with the Naval Hydrographic Service of Argentina (SHN) has started. The final goal of this on-going work is to assess the quality of MWR wind data in conjunction with surface wind observations from other sources in a data assimilation system. At this first stage, MWR and WindSat collocated wind speed observations are analyzed.

INTRODUCTION

MWR (MicroWave Radiometer) is a radiometer on board SAC-D/Aquarius satellite, launched in June 2011. The SAC-D/Aquarius science mission was developed jointly by the Nacional Space Agency of Argentina (CONAE, Comisin Nacional de Actividades Espaciales) and the National Aeronautics and Space Administration of USA (NASA), that focuses on understanding the interaction between the global water cycle, ocean circulation and climate by measuring sea surface salinity.

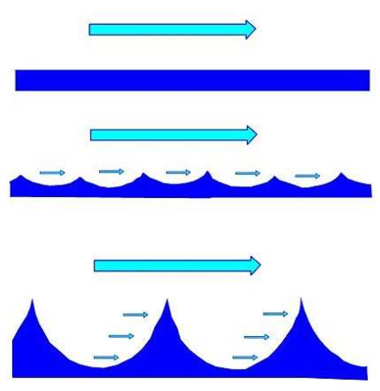
MWR is a three channel push broom, Dicke radiometer, that has 16 beams, 8 forward-looking at 36.5 GHz (in vertical and horizontal polarization) and 8 aft-looking at 23.8 GHz (in horizontal polarization), with a swath of approximately 380 Km. The beams are arranged to have two incidence angles, one of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

Since recently, CONAE with collaboration of CFRSL (Central Florida Remote Sensing Laboratory), are generating geophysical parameters, all over the sea surface, using brightness temperature measurements from MWR. These parameters include columnar water vapor, wind speed, sea ice concentration and rain rate, which are ancillary data for the Aquarius salinity measurements.



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 electromagnetic 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:

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

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

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:

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

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

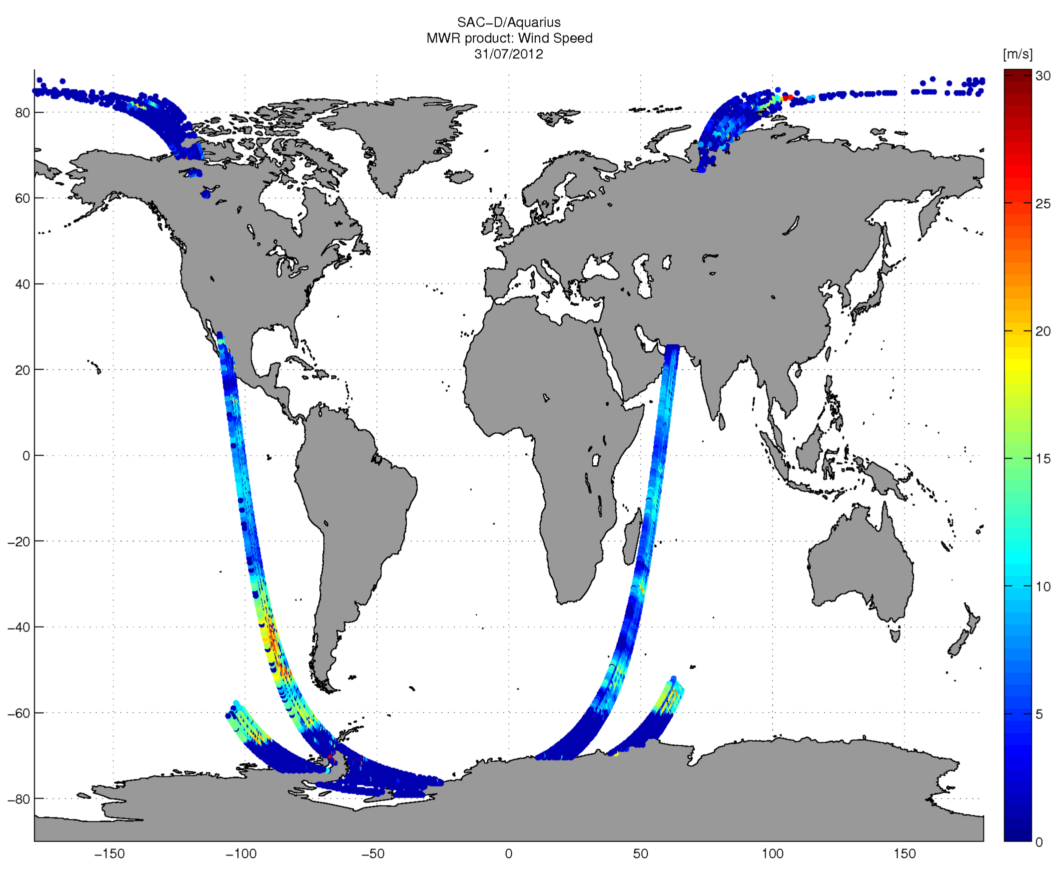
These systems of two equations with two unknowns (W and τ) can be solved using an iterative procedure with initial guess , and repeated until the wind speed value converges to a constant value.

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.

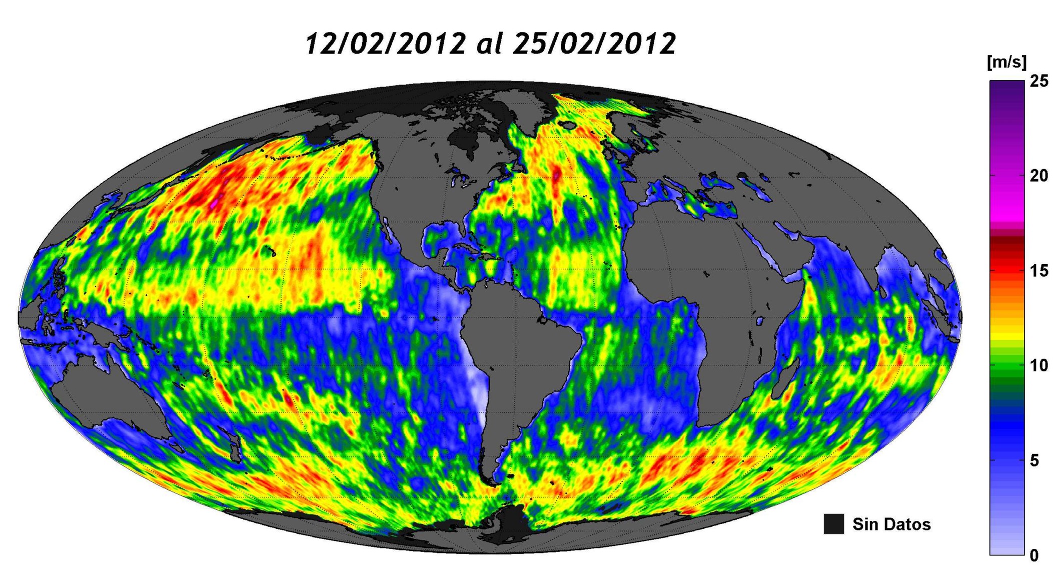
RESULTS

In this section we show plots of sea surface wind speed (10m height) from previous algorithm and available in CONAE server as a science product.

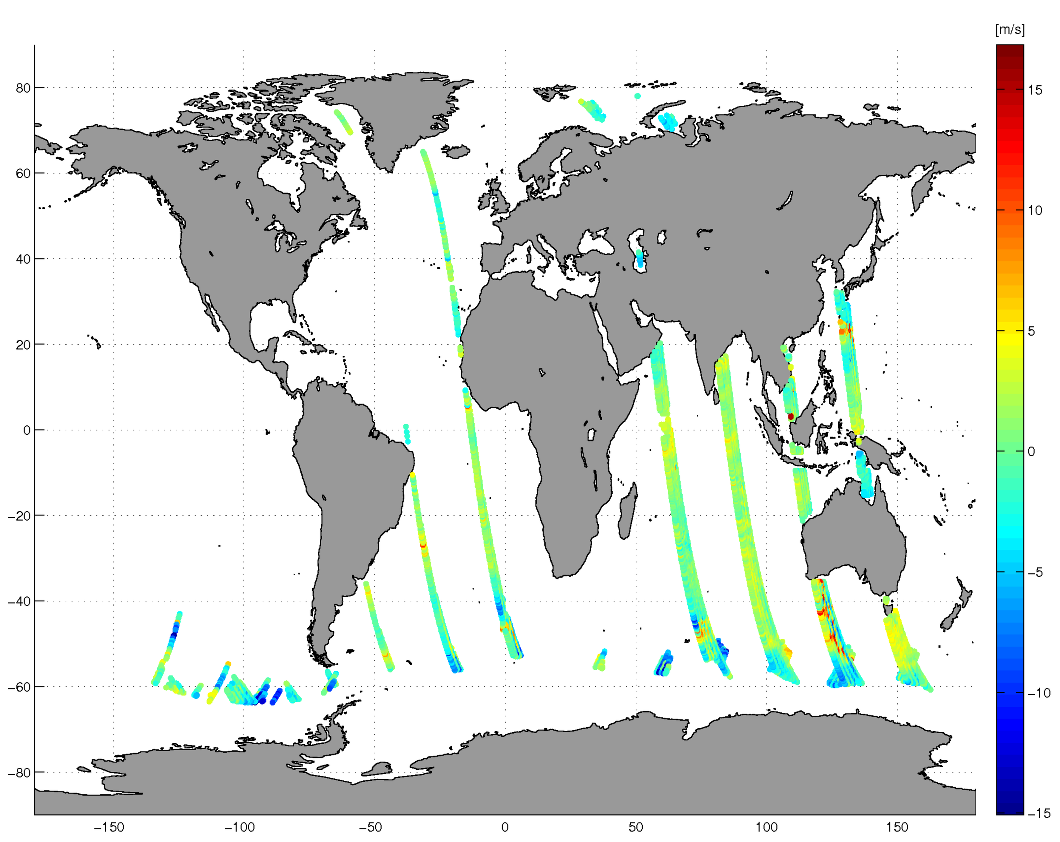
One pass (31th July 2012 at 00:32:05)



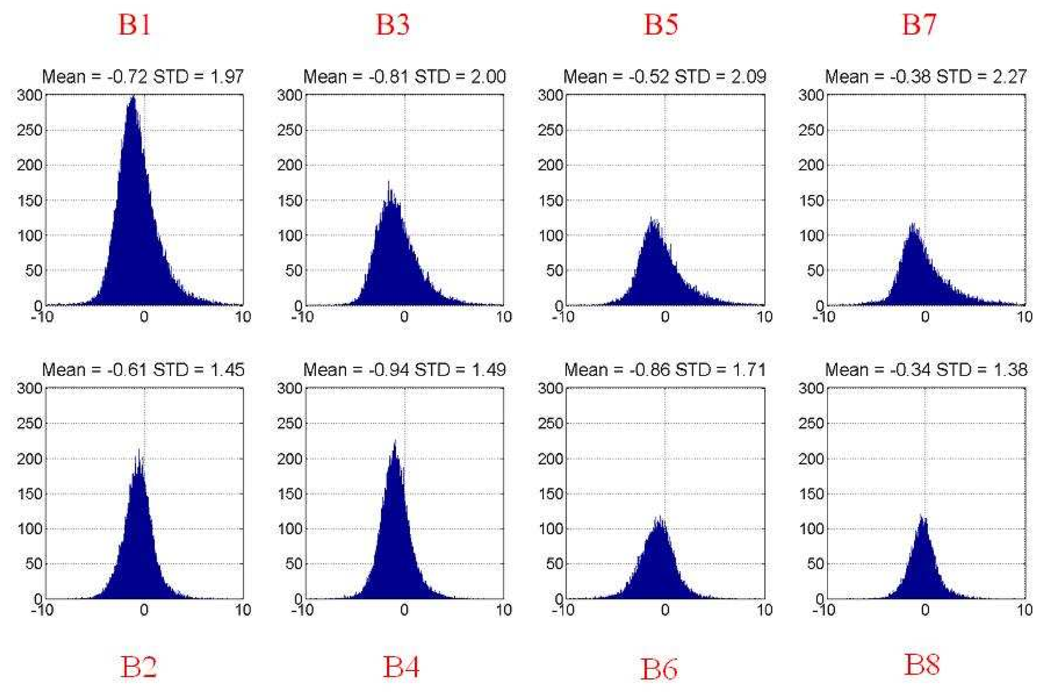
Average 12th to 25th February 2012



VALIDATION USING WINDSAT DATA

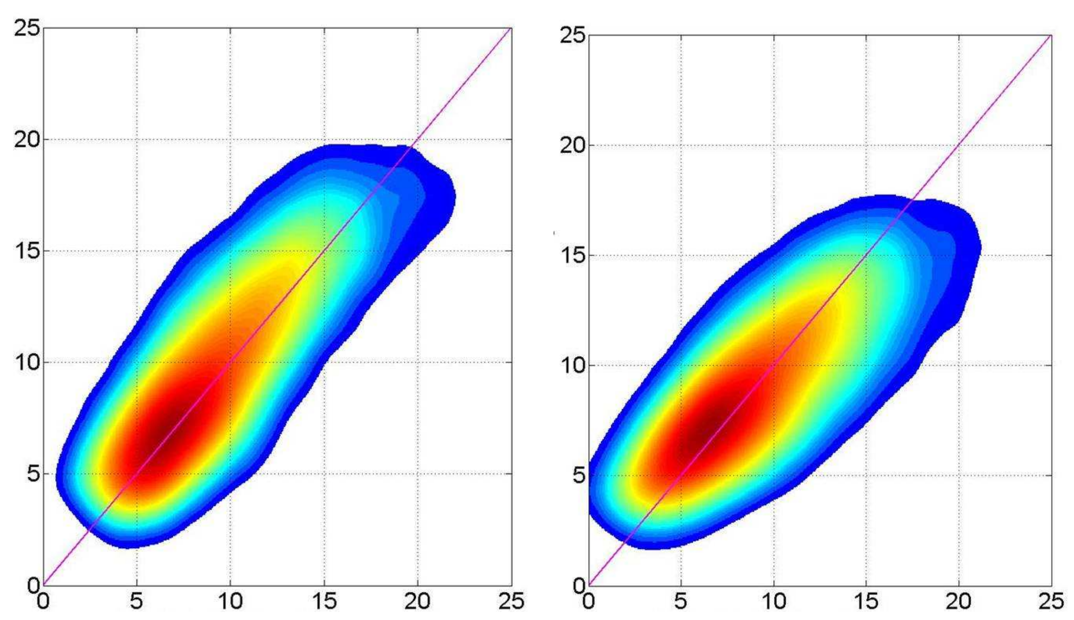


Differences between MWR and Windsat (October 2011 to June 2012)



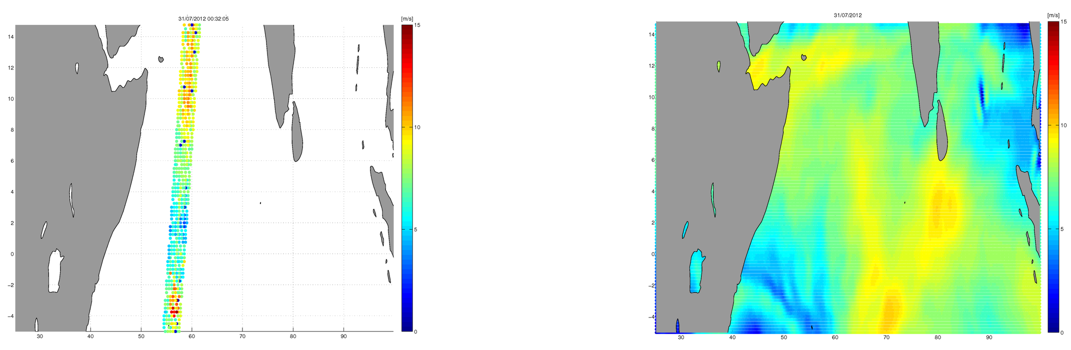
Even and odd Beams

We show scatter plots of WindSat wind speed (x-axis) vs. MWR wind speed (y-axis) for both even (on the left) and odd beams (on the rigth).

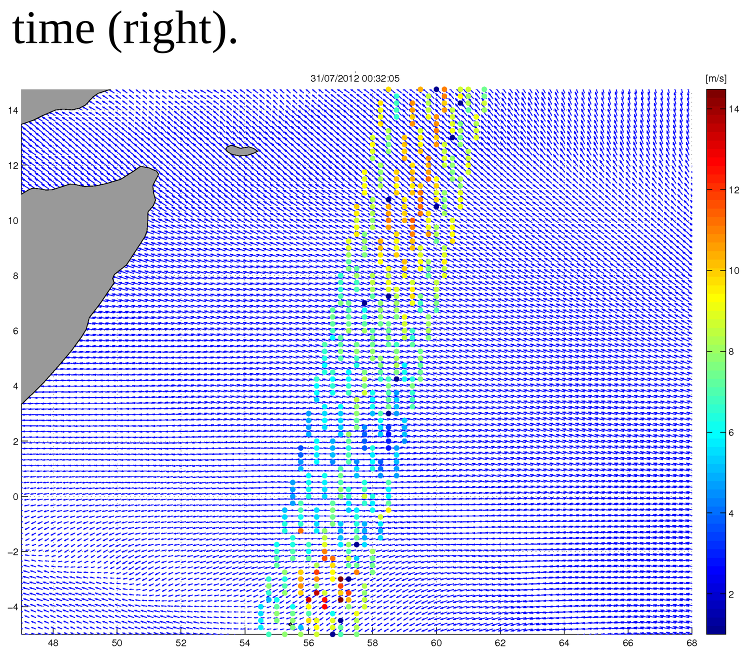


FURTHER WORKS

To assess the quality of MWR wind data using surface wind observations from other sources, for example the Global Forecast System (GFS).



Extract of one pass for MWR wind speed at 00:32:05 31th July 2012 (left) and the corresponding GFS wind speed at the same time (right).



MWR wind speed and GFS wind direction corresponding to figures above.

CONCLUSIONS

- The analyzed wind speed comparisons between Windsat an MWR data, gives a standard deviation of 1.67 m/s for even beams and 1.85 m/s for odd beams.
- A validation process in collaboration with the SHN has started, with the final goal to assess the quality of MWR wind data in conjunction with surface wind observations from other sources in a data assimilation system.

[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.