SACD and the estimation of water vapor over land surface

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Introduction: A satellite-borne radiometer observing the Earth is sensitive to radiance which may emanate from both the surface and the atmosphere. Usually, a radiometer observation is expressed as a “brightness temperature” in degrees kelvin. If the earth/sea surface were a blackbody and the atmosphere were transparent then the brightness temperature would equal the sea surface temperature (SST). Unfortunately, there is not any wavelength where such ideal conditions hold, so in practice satellite measurements of SST are made using regions of the electromagnetic spectrum where the sea surface emissivity is nearly unity (>0.95) and the atmosphere is relatively transparent (50 to 90% transmission of surface emission to the top of atmosphere [TOA]).

The satellite SACD Aquarius takes on board a microwave radiometer (MWR) which is an 8 beam pushbroom, with a three channel Dicke radiometer that operates at 23.8 GHz (horizontal polarization) and 36.5 GHZ (vertical and horizontal polarization).

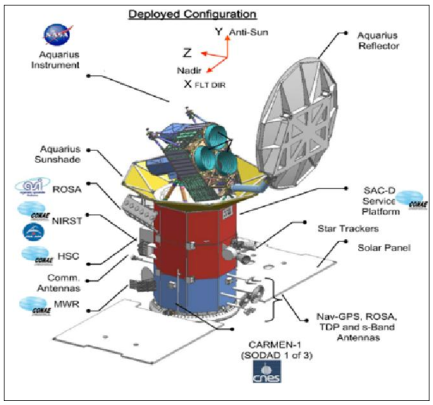

Figure 1. SACD-Aquarius

This work estimates the water vapour (WV) over the ground earth using brightness temperatures at 37 Ghz and 24Ghz which are SACD´s observables (currently calibrated to obtain WV over the sea surface).

To calculate water vapour content in the atmosphere, a first order statistical regression was performed, where the water vapour value was the independent variable.

The surface data is obtain by radiosonde and meteorological station over the ground.

The brightness temperatures for channels 24GHz and 37GHz both horizontal and only 37GHz vertical polarization, and surface temperature were the dependent variables in the statistical regression. The water vapour and surface temperature data were obtained from radiosondes in the Southern of United States. The figure 2 shows the selected radiosonde stations over the ground surface:

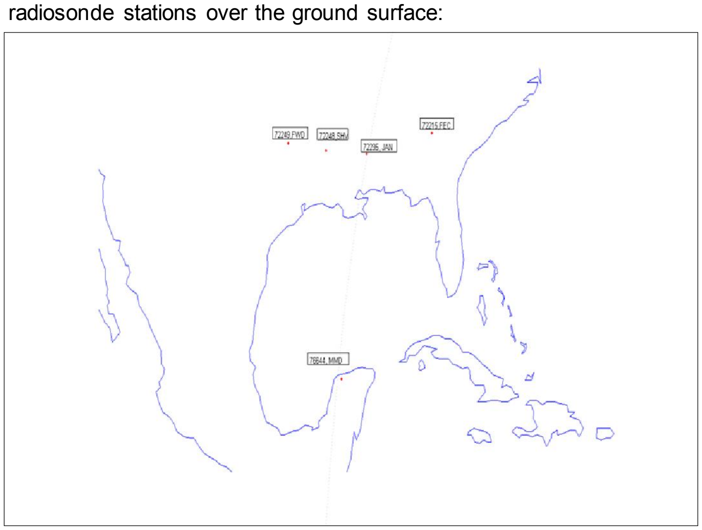

Figure 2. Selected radiosonde stations over the ground surface.

Equation 1 shows the regression statistics used:

$$Ipwv = a.tb_{24} + b.t_{37h} + c.t_{37v} + d.Tst + e \quad (1)$$

Where tb_{24} , t_{37h} , $c.t_{37v}$ are the brightness temperature measurements and Tst is the surface temperature

Results. The figures 4 and 5 shows the results for two stations:

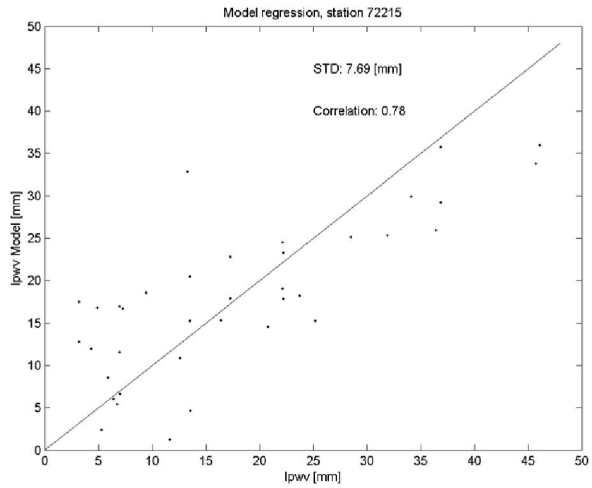

Figure 3 . Station 72215

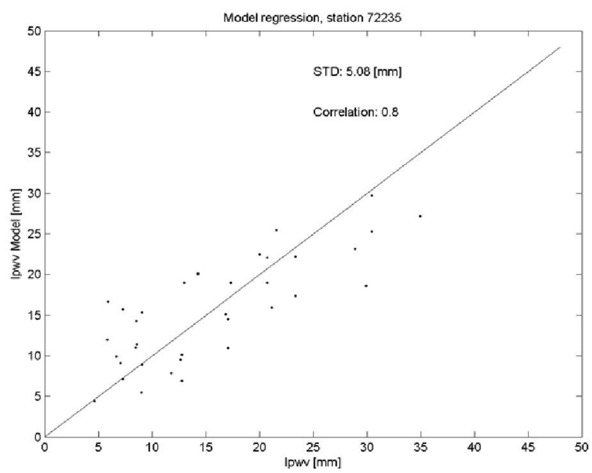

Figure 4. Station 72235

Table 1. Coefficients of the regression

Station	a	b	c	d	e
72215	0.92	-0.014	-0,016	0.45	-59.1
72235	0.87	-0.07	-0,010	0.3	-58.8

Conclusion:

The preliminary results shows that is possible to estimate the atmospheric water vapour from the 37 Ghz and 24Ghz brightness temperatures with a standard deviation less than 8 mm in a region around 100km from the radiosonde station.

References:

Rain rate retrieval algorithm for AQUARIUS/SAC-D microwave radiometer, Rosa Ana Menzeretolo O B.S. University of Central Florida, 2005

Frank J. Wentz, “A well-calibrated ocean algorithm for special sensor microwave / imager”, *Journal of Geophysical Research 102:C4*, 8703-8718,1997

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