Advanced Infra-Red Water Vapour Estimator (AIRWAVE) algorithm updates

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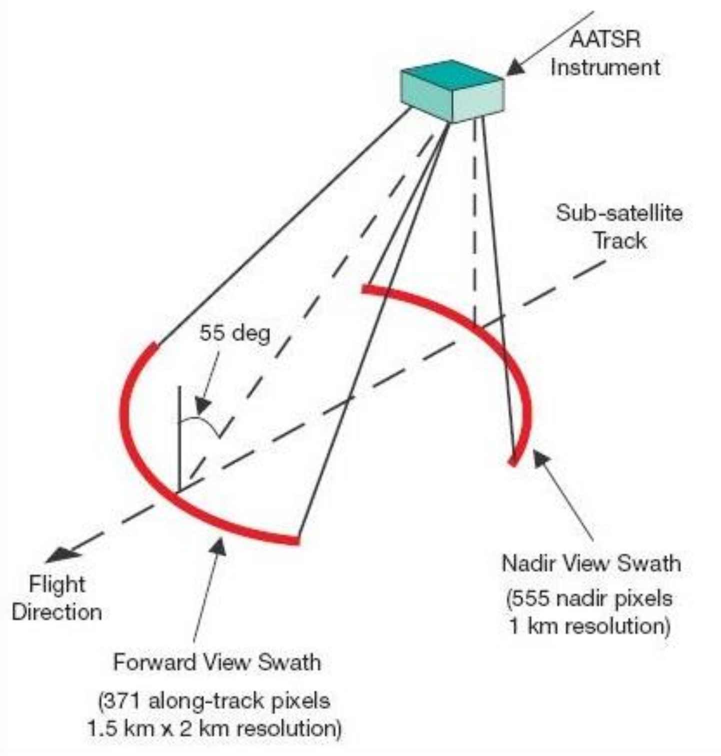
AIRWAVE algorithm

The AIRWAVE algorithm has been developed for the retrieval of TCWV from the measurements of the Along Track Scanning Radiometer (ATSR) missions. The first version of the algorithm makes use of the TIR channels of ATSR-like instruments, exploiting the dual viewing geometries to infer the TCWV over the sea. When applied to the whole ATSR missions (ATSR-1, ATSR-2 and AATSR) it produced TCVW in good agreement with the results obtained by the (SSM/I) and radiosondes.

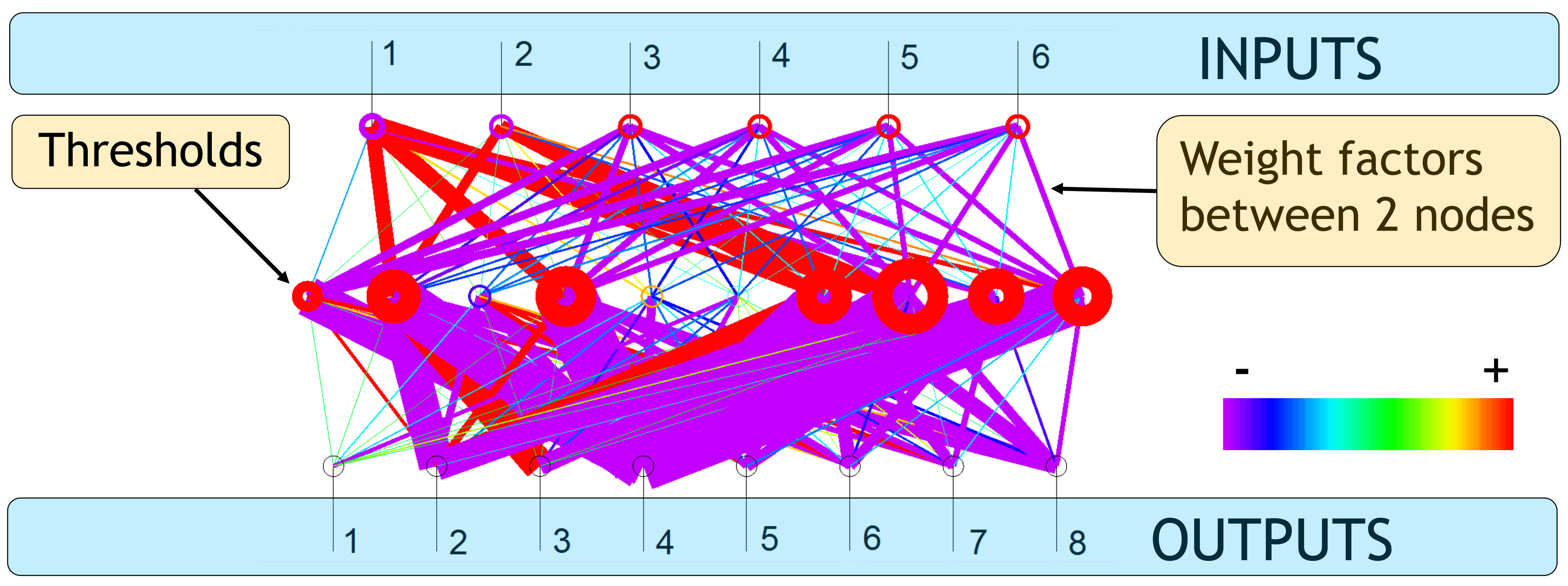


The algorithm makes use of a set of tabulated parameters. In the first version of the algorithm, these parameters were fixed along the whole globe. In the new version, AIRWAVE parameters were calculated accounting for different scenarios:

Scenarios	Effect on RTM inputs
Across track position (-250/250, every 50)	NAD and FWD angles
Instrument (AATSR, ATSR1, ATSR2, SLSTR)	Slit function
Latitude (TRN,TRN, MDN, MDS, PLN, PLS)	T,p,VMRs, Tsurf, Emissivity
Season (JAN, APR, JUL, OCT)	T,p,VMRs, Tsurf, Emissivity
H2O variability (x0.5, 0.75, 1, 1.25, 1.5)	H2O VMR

Neural Network approach

Since each of the simulated conditions produce a different set of retrieval parameters, we had to solve how automatically chose the most suitable ones to be used in each case. The choice is now performed through the use of a Neural Network (NN) that was trained using the above mentioned parameters over a set of radiances simulated with the RTM code and ECMWF temperature, pressure and water vapour profiles.



TCWV retrieval over land

$$\ln\left(\frac{J_1^{\lambda_1}}{J_2^{\lambda_2}}\right) = \ln\left(\frac{F_1^{\lambda_1}}{F_2^{\lambda_2}}\right) + \ln\left(\frac{\varepsilon_1^{\lambda_1}}{\varepsilon_2^{\lambda_2}}\right) + \ln\left(\frac{\gamma_1^{\lambda_1}}{\gamma_2^{\lambda_2}}\right) + \lambda_2 \cdot \tau_2 - \lambda_1 \cdot \tau_1$$

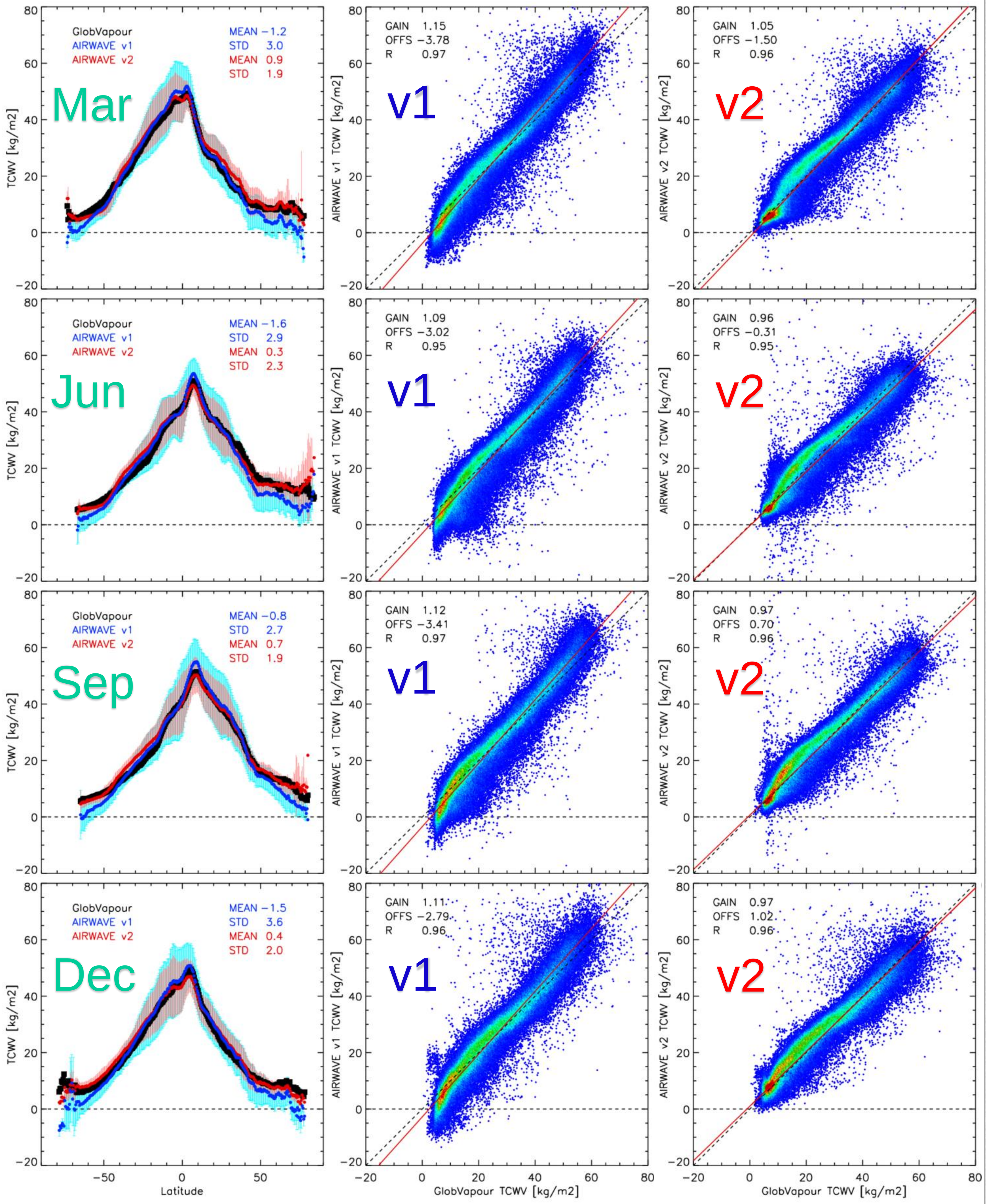
radiance; surface emissivity; wavenumber; surface + atmosphere; constant; optical thickness

Surface emissivity at 11 and 12 um and at NADIR and FORWARD

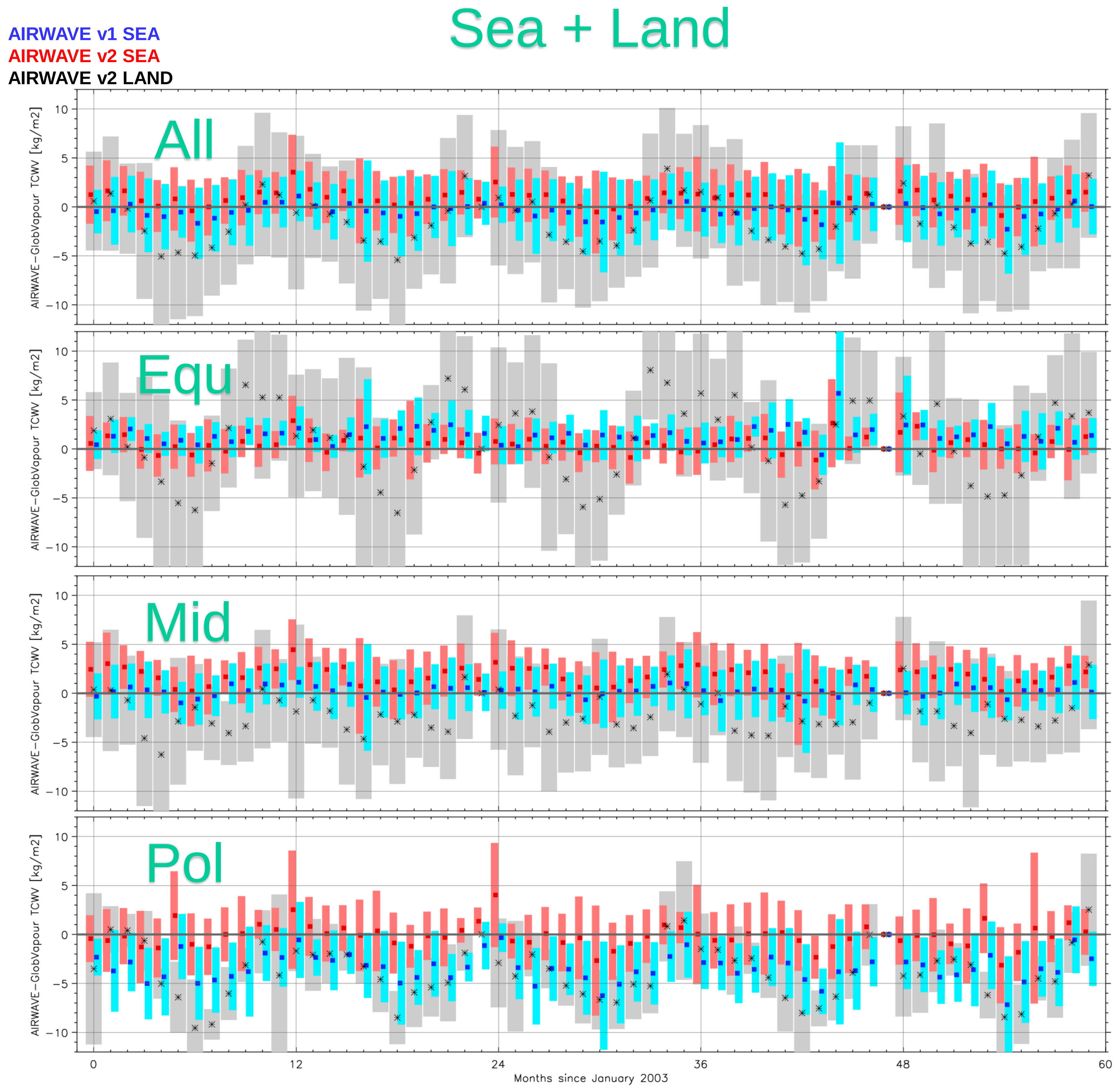
- ✓ Surface Type and Emissivity for AATSR from University of Wisconsin and Glob Cover Land dataset (LST retrieval)
- ✓ Fractional vegetation cover form Geoland-2 FCOVER product
- ✓ Angular dependence of IR surface emissivity from RTTOV code

Comparison/validation with ESA DUE GlobVapour http://www.globvapour.info/index.html products: combined SSM/I (over sea) and MERIS (over land) for 2003-2008; spatial resolution of 0.5°.

Monthly means (2003) - Sea



Sea + Land



Casadio, S, E. Castelli, E. Papandrea, B.M. Dinelli, G. Pisacane, A. Burini, and B.R. Bojkov, "**Total column water vapour from along track scanning radiometer series using thermal infrared dual view ocean cloud free measurements: The Advanced Infra-Red WAter Vapour Estimator (AIRWAVE) algorithm**", *Remote Sensing of Environment*, vol. 172, pp. 1-14, 2016.