Wet Tropospheric Correction for Sentinel-3:
a better tuned retrieval algorithm for open-ocean

Telmo Vieira | M. Joana Fernandes | Clara Lázaro

Universidade do Porto, Faculdade de Ciências (FCUP), Portugal
Centro Interdisciplinar de Investigação Marinha e Ambiental (CIIMAR)

U.PORTO FACULDADE DE CIÊNCIAS UNIVERSIDADE DO PORTO
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Objective

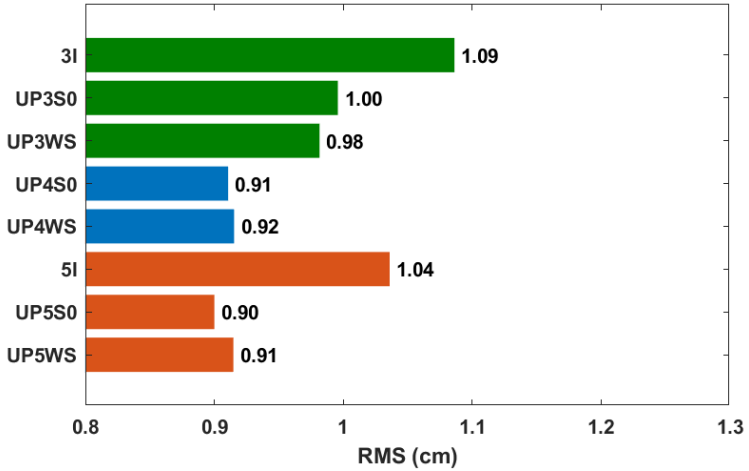
Development of an improved algorithm for the WTC retrieval from MWR measurements over open ocean, better tuned for Sentinel-3.

- Considering a suitable learning, temporally closer to the S3 mission period;
- Better account for the contribution of the surface in the MWR measurements (a weakness in the 2-band MWR such as that of S3), by means of Sea Surface Temperature (SST) interpolated from ERA5, instead of seasonal tables as adopted in S3 products.

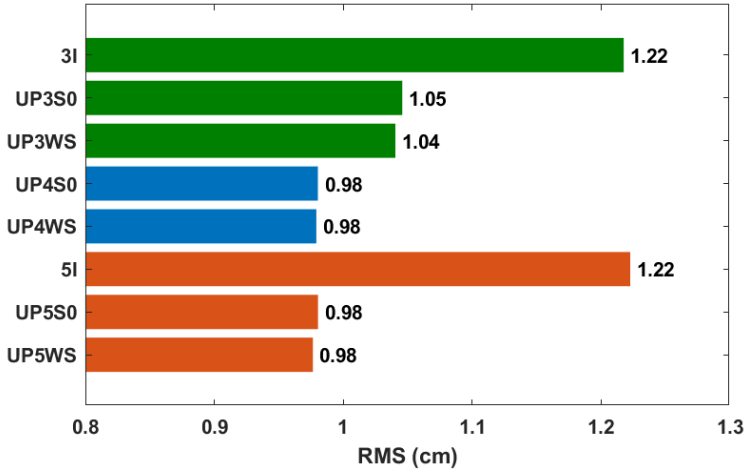
WTC retrieved from various algorithms

- Retrieved from 3 and 5-input algorithms (as available in the S3 products):
  - **3I:** TB23.8, TB36.5 and σ0 (Brightness temperatures and backscattering coefficient);
  - **5I:** TB23.8, TB36.5, σ0, SST and γ800 (Decrease rate of atmospheric temperature);
- Different neural networks have been tuned with different combinations of inputs:
  - **UP3S0:** TB23.8, TB36.5 and σ0;
  - **UP4S0:** TB23.8, TB36.5, σ0 and SST;
  - **UP5S0:** TB23.8, TB36.5, σ0, SST and γ800;
  - **UP3WS:** TB23.8, TB36.5, u10 and v10 (wind speed in the zonal and meridional directions);
  - **UP4WS:** TB23.8, TB36.5, u10, v10 and SST;
  - **UP5WS:** TB23.8, TB36.5, u10, v10, SST and γ800;

Comparison with WTC from imaging radiometers (SIMWR)

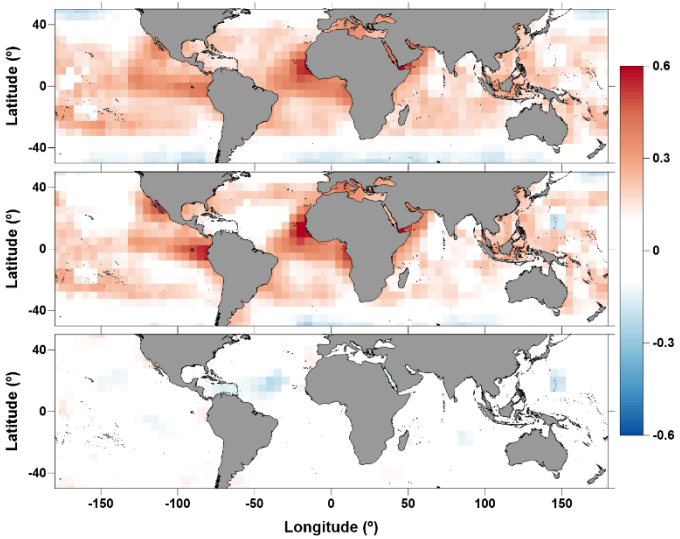


↑ Global RMS of the WTC differences between SIMWR and the various S3 MWR retrievals considering 1-year of S3A data (2018).

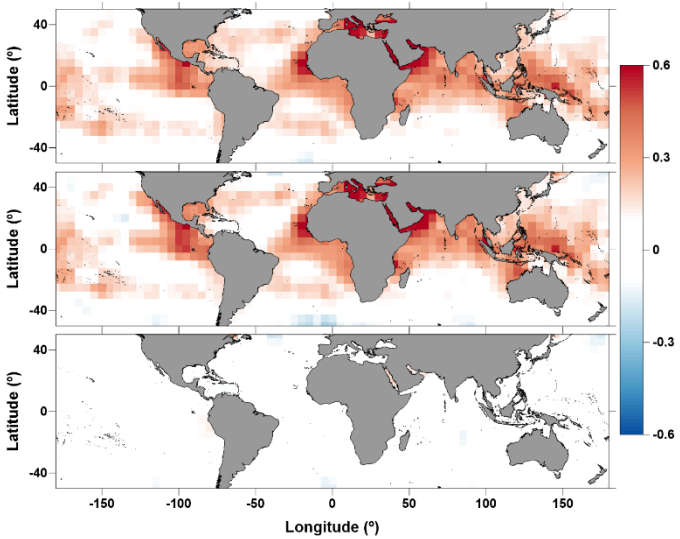


↑ The same RMS considering only S3A along-track points with distances from coast in the range of 30-250 km.

Comparison with SIMWR

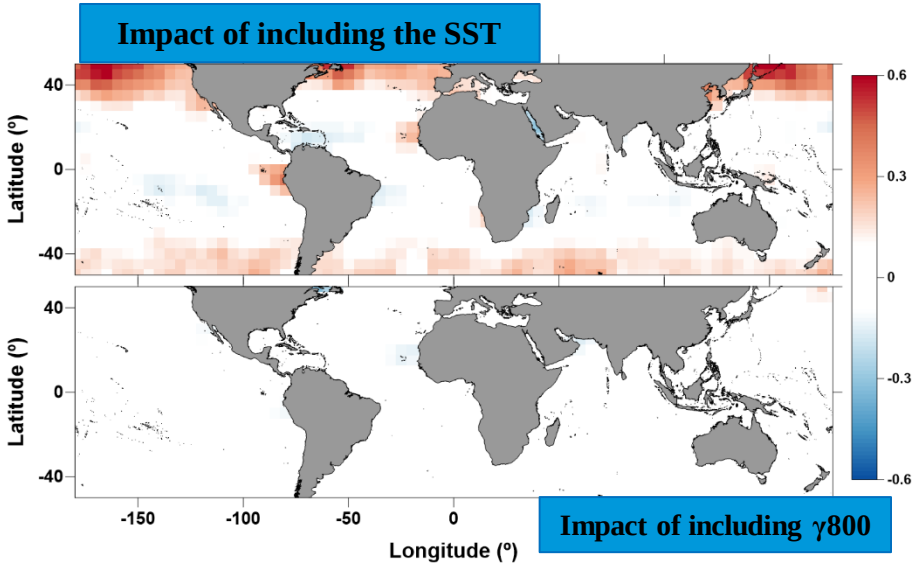


↑ RMS decrease (cm) when compared with SIMWR for 3I-UP3S0 (top panel), 3I-UP3WS (middle panel) and UP3S0-UP3WS (bottom panel). Red colour indicates decrease in the RMS.

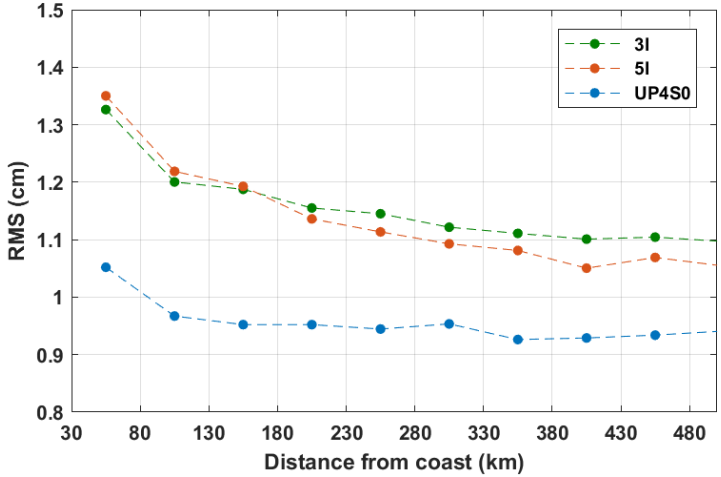


↑ RMS decrease (cm) when compared with SIMWR for 5I-UP5S0 (top panel), 5I-UP5WS (middle panel) and UP5S0-UP5WS (bottom panel). Red colour indicates decrease in the RMS.

Comparison with SIMWR



↑ RMS decrease (cm) when compared with SIMWR for UP3S0-UP4S0 (top panel) and UP4S0-UP5S0 (bottom panel).



↑ RMS of the WTC differences between SIMWR and 3I, 5I and UP4S0 function of distance from coast.

Conclusions

- The two MWR-derived WTC provided in the S3 products (3I and 5I) **are not significantly different**, suggesting that a proper learning was not carried out and these algorithms were simply inherited from EnviSat.

- Once the short time-scales of the SST are included, the fifth input (γ800) becomes redundant/unnecessary.

- An independent comparison with reference WTC from imaging MWR shows that WTC derived from the proposed algorithm, instead of those available in the S3 products, leads to a decrease in the RMS values of WTC differences by about **1 mm** globally, while this decrease can reach almost **1 cm** locally.

- These results are more pronounced for distances from coast between 30 and 250 km, where the global improvement (in RMS) w.r.t. the WTC adopted in Sentinel-3 products is almost **3 mm**.

- The 4-input WTC algorithm here described shows **a better performance** against those adopted in the S3 products (3I and 5I), in particular for large SST (and WTC) variability and distances from coast shorter than 250 km.