AIRWAVE-SLSTR version 2: implementation and preliminary validation results of the retrieved TCWV

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Abstract

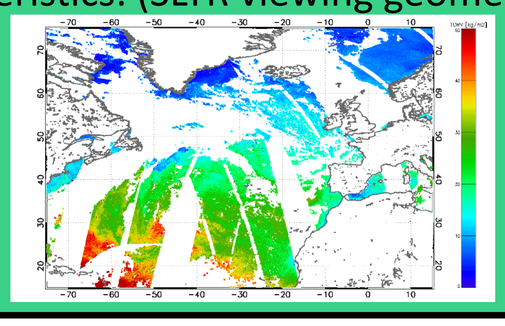
The Advanced Infra-Red WAter Vapour Estimator (AIRWAVE) algorithm originally designed to obtain the Total Column of Water Vapor (TCWV) from the measurements of the Along Track Scanning Radiometer (ATSR) instrument series (Casadio et al. 2016, Castelli et al. 2019) has been modified for the analysis of the Sea and Land Surface Temperature Radiometer (SLSTR) on board the Copernicus Sentinel 3 satellites (https://www.eumetsat.int/AIRWAVE-SLSTR). The new algorithm has been called AIRWAVE-SLSTR. The algorithm makes use of a set of tabulated parameters calculated off-line using a Radiative Transfer Model (RTM) specifically developed to simulate the SLSTR radiances. The approach exploits the clear sky Brightness Temperature measured over the sea in forward and nadir directions in the Thermal InfraRed (TIR) channels. The quality of the obtained datasets has been evaluated against independent products derived from space borne sensors (SSMI/S) and in situ measurements (IGRA database), showing very good performances. However, the validation exercise showed a seasonal behaviour of the bias at polar and mid latitudes, that could not be explained by instrumental effects. Therefore, a new version of the retrieval parameters has been produced, using the latest release of the spectroscopic database used in the RT calculation and new atmospheric climatology. The AIRWAVE-SLSTR version 2 is currently under development and will be applied to a validation dataset.

AIRWAVE-SLSTR ALGORITHM

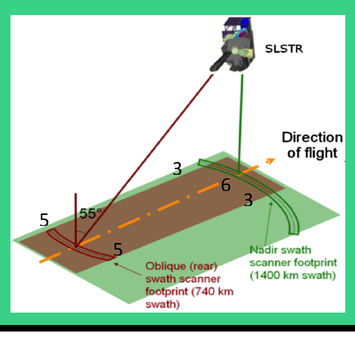
pre-computed parameters for the retrieval:

- CO_2 and CFCs climatology, accounting for their trends over the years.
- Use of IG2 climatology for atmospheric profiles (developed for MIPAS - limb - low vertical resolution in lower part of the atmosphere)
- Instrumental characteristics: (SLTR viewing geometry and SRFs)

AIRWAVE TCWV between 12:00 and 23:59 UTC of 03/10/2020



	ATSR	SLSTR
Viewing geometries	nadir/forward	nadir/oblique
Across track positions	512 both nadir and forward	1500 nadir; 900 oblique



AIRWAVE-SLSTR vs SSMI/S F17

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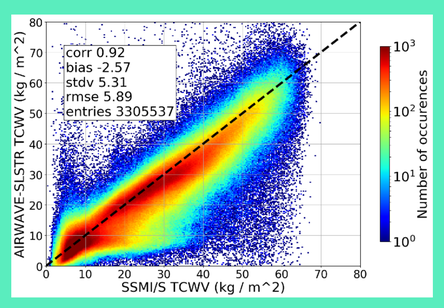

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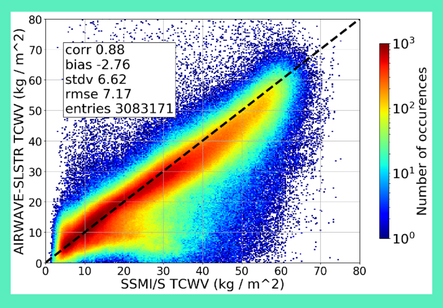

Not perfect cloud filtering

Larger bias in the Summer hemispheres

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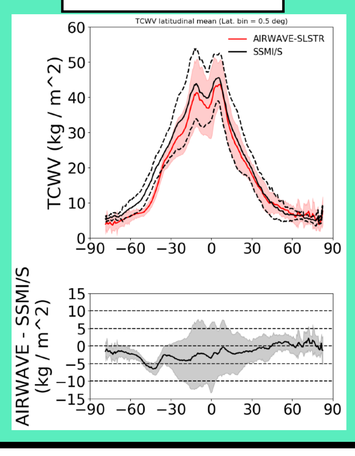

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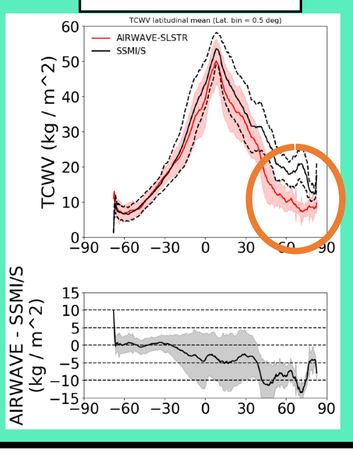

Summer hemisphere: differences linked to atmospheric profile shape (same in ATSR even if with reduced bias)

AIRWAVE Follow On Study (kick-off July 2022)

The Follow on study motivated by:

SLSTR-TCWV over water surfaces has a dry bias of about 2 kg/m^2 that shows some seasonal effect. The Seasonality is partially removed by using a different set of parameters obtained using climatology over water surfaces from ECMWF re-analises instead of the IG2 climatology

Retrieval parameters need to be updated

- New spectroscopic data (HITRAN2020) and water vapor continuum model now available

The validation with EMiR has been performed on a reduced dataset, and needs to be expanded

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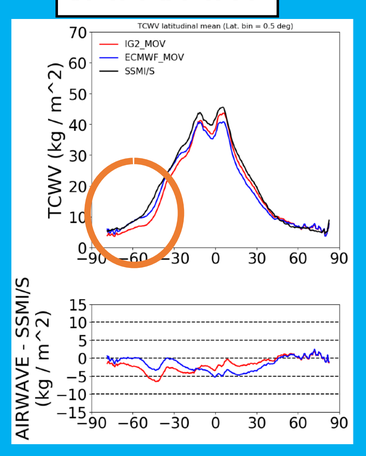

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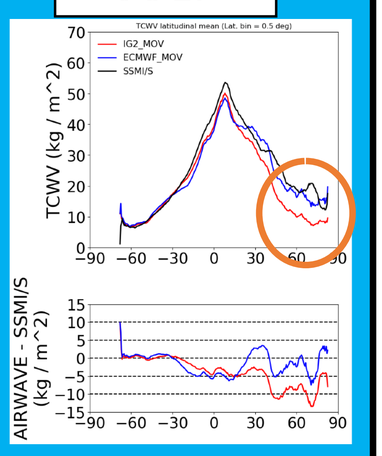

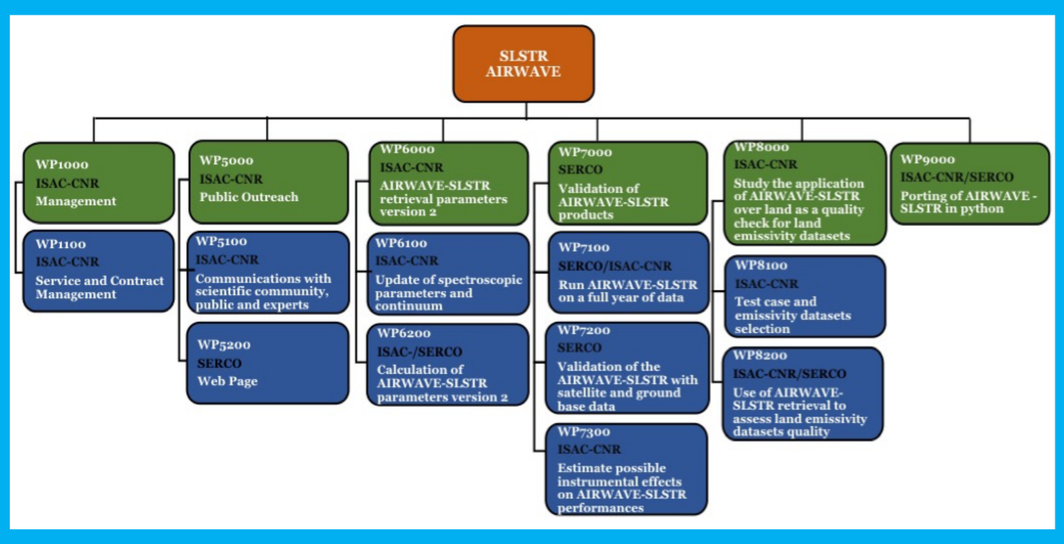

The AIRWAVE-SLSTR algorithm has been programmed using the IDL language. This poses some problem with both IDL licences and versions —> porting in python

AIRWAVE-SLSTR can also be applied to measurements over land.
The results strongly depend on the used land emissivity data.

References

Casadio, S., Castelli, E., Papandrea, E., Dinelli, B. M., Pisacane, G., and Bojkov, B. (2016), **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 Sens. Environ., 172, 1–14.

Papandrea, E., Casadio, S., De Grandis, E., Castelli, E., Dinelli, B. M., Bojkov, B. (2018), **Validation of the Advanced Infra-Red Water Vapour Estimator (AIRWAVE) Total Column Water Vapour using Satellite and Radiosonde products**, Annals of Geophysics, 61, Fast Track 8.

Castelli, E., Papandrea, E., Di Roma, A., Dinelli, B. M., Casadio, S., and Bojkov, B. (2019), **The Advanced Infra-Red WAter Vapour Estimator (AIRWAVE) version 2: algorithm evolution, dataset description and performance improvements**, Atmos. Meas. Tech., 12, 371–388.

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https://www.eumetsat.int/AIRWAVE-SLSTR

a set of experimental data is available upon request