New characterization of radiometer wet troposphere correction errors thanks to the ERA-interim reanalysis and AMSR products

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Overview

The Wet Tropospheric Correction (WTC) :

• One of the main contributors to the uncertainties in long-term sea level trend derived from altimetry.

• Provided by onboard microwave radiometers for the main altimeter missions due to high variability of water vapor in time and space.

What about WTC models ?

• Use only as a backup correction because of their poor temporal and spatial resolution.

• But very useful as reference in analyses of radiometer WTC errors.

Objective :

To Assess the quality, for climatic studies, of WTC from the ERA interim atmospheric model reanalyzes provided by European Centre for Medium-range Weather Forecast (ECMWF) with respect to :

• ECMWF operational fields.

• Reanalyzes from National Centers for Environmental Predictions / National Center for Atmospheric Research (NCEP/NCAR).

• Radiometers : TOPEX/Jason1/Jason-2, ERS-1/ERS-2/ENVISAT, AMSR-E

Conclusion :

The ERA-Interim is probably the best model to allow the identification of errors such as drift in the radiometers :

• data from ERA-Interim have been processed homogenously and its performances are stable with respect to the other WTC products

• ERA-Interim is the closest, among the studied models, to radiometers in terms of WTC dynamic.

However, notable discrepancies between radiometers and ERA-Interim are still present, especially in wet atmosphere. Such differences could create artifacts when comparative analyses are made with ERA-Interim to detect radiometer errors.

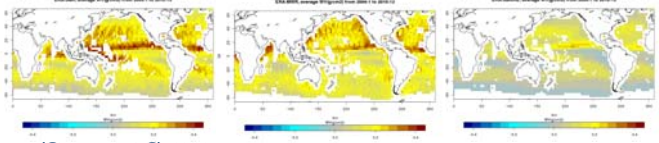
A good reference for altimetry missions ?

Water vapor (WV) main component of WTC: 1g/cm2(wv)~-6.4cm(WTC)

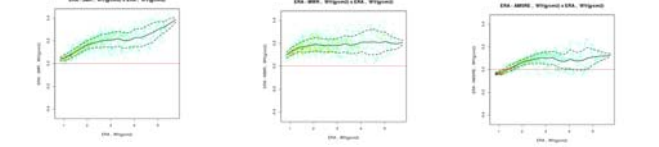
Water vapor (WV) geographic distribution.

Comparison of average water vapor maps (2004-2010) between ERA-interim and radiometers

ERA-Jason-1 | ERA-ENVISAT | ERA-AMSRE



(ERA-AMSRE)xWV | (ERA-AMSRE)xWV | (ERA-AMSRE)xWV



• Overestimation of WV by ERA-Interim with respect to radiometers, especially in low latitudes.

• Discrepancies with the radiometers are related to WV : the higher WV is, the stronger are the differences

-> ERA-interim behavior in very wet atmosphere differs from the radiometer behaviors.

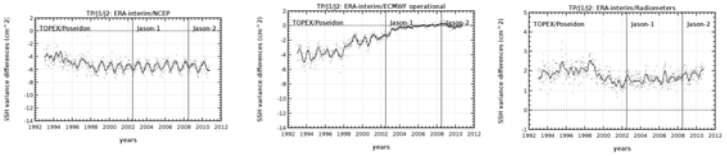
Since, WV and WTC are highly correlated these differences are probably also present in WTC.

ERA interim is the best WTC model for the altimeter sea level at short temporal and climate scales.

Short temporal scales of the altimeter sea level

SSH variance differences at TP/J1/J2 crossovers using different WTC :

ERA -NCEP | ERA -ECWMF | ERA -RAD



•ERA-Interim variance is by far smaller than the NCEP one: around 5cm² difference for the altimetry era

•ERA-Interim was much better in terms of variance that ECWMF at the beginning of the period (4cm2) but variance difference has regularly decreased and is today negligible

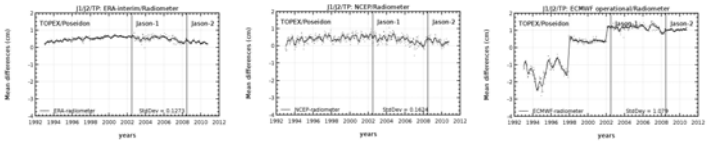
• Radiometers (Topex, then Jason-1 and Jason-2) still provide a much smaller variance than ERA-Interim (2cm2 difference)

The long-term stability of the altimeter sea level

Global Mean Sea level

Global mean sea differences between models and TOPEX/JASON-1/JASON-2

ERA -RAD | NCEP -RAD | J1 -RAD



•ERA-Interim and NCEP are relatively stable compared to the TOPEX/J1/J2 series

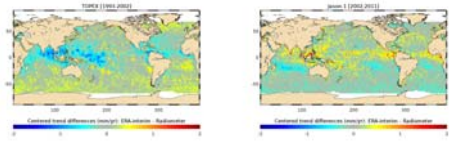
• Jumps are present in the global mean differences due to regular updates in the operational ECWMF model

Regional Mean Seal Level

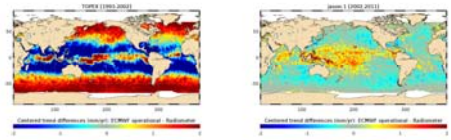
Regional mean sea level trend differences between models and TOPEX/Jason-1/JASON-2

TOPEX (1993-2002) | Jason-1 (1993-2002)

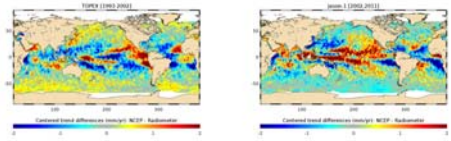
ERA



ECMWF



NCEP



•ECMWF is inconsistent with TOPEX (poor quality of the model for this period). Better consistency is achieved during Jason-1 period when the operational model is more accurate

•NCEP show high regional discrepancies (>3.0/mm/an) in trends at low and mid latitudes with TOPEX and Jason-1.

•The smallest differences are obtained with ERA-Interim, especially in the first decade but regional discrepancies are still present

(*) references :

• Legeais J.-F, and M. Ablain, 2013 :New characterization of radiometer wet troposphere correction errors for the altimeter sea level estimations thanks to the ERA-interim reanalysis. Manuscript submitted for publication.

• Thao S. et al, Trend and Variability of the Atmospheric Water Vapor: a Mean Sea Level Issue. Manuscript submitted for publication.

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