

## ***Interactive comment on “An intercalibrated dataset of Total Column Water Vapour and Wet Tropospheric Correction based on MWR on board ERS-1, ERS-2 and Envisat” by Ralf Bennartz et al.***

**Anonymous Referee #1**

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This short paper introduces a retrieval of total column water vapour (TCW), liquid water path (LWP) and wet tropospheric correction (WTC) for three microwave radiometers. As part of this study an intercalibration of this datasets is introduced. A comparison of TCW versus TCW measured with ground based GPS is presented.

The subject matter of this paper is appropriate for AMT as no science is really discussed. The manuscript is overall well written, however some important details regarding the retrieval and intercalibration needs to be expanded (see below). The comments below should be addressed before publication.

Section 2.1 needs to include a more detailed satellite description: launch dates, termination dates, type of orbits, etc. It also needs to include more details on the microwave

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radiometers (MWR): location of the channels, width, footprint size, are the channels exactly the same for the three instruments? Error characterization for the channels (expected error in brightness temperature), lat lon coverage in an average day, numbers of measurements per day, etc.

Section 2.3.1 needs to be expanded to include details on the forward model, spectroscopy used, do you use the Liebe model or something similar? mention the gases absorbing in this region? mention why you need the surface air temperature, surface specific humidity and the wind speed? which model do you use for sea surface roughness? Are you sure that the LWP from ERA-interim is accurate? How many iterations are needed for convergence?, which apriori errors are assumed in  $S_b$ , is  $S_o$  assumed to be diagonal? Which cost function value is used as convergence criteria?

Section 3.1: Please explain how you select the 4% of the observations, could there be a sampling bias? Are they distributed through out the globe?

Section 4. Please include a comparison against ERA-Interim vs the GNSS stations as well as versus the ERS1, ERS2 and ENVISAT data. The purpose of this comparison is to see if the new dataset posses more information than ERA-Interim (i.e., hopefully the comparison of the new datasets vs the GNSS stations is going to be better than the ERA-Interim / GNSS comparison)

Further, LWP has not been validated. Comments on its usefulness are needed.

## Appendix B

The sensitivity study needs to be expanded further. No information is given on the impact of the surface wind speed and sea surface temperature.

The statement “as long as the actual TCWV is less than maybe 5-10...” needs to be proved (change the background by 5 -10 km/m<sup>2</sup> randomly through-out the vertical profile and do the scatter plots).

What is the impact of the temperature being off by 3, 5, 10K.

Again, prove the statement: the choice of background is uncritical as long as it represents the general conditions for the geographical region and season.

### Specific Comments

P2 L2: Define ERS

P3 L3: Define GNSS (it was defined in the abstract but it needs to be defined again in the text)

P3 L12: Define CLS (currently, only defined in the affiliations)

P3 L13 please explain the anomaly and if know, the cause of the anomaly.

P3 L22: Define GNSS in P3 L3 not here.

P4 L2: Should this section be called TCWV and LWP?

P4 L8: Could you please explain if this retrieval is exactly the same as optimal estimation (it looks like it) or if there is any difference could you mention those.

P4 L10: Please give some basic details about ERA-Interim or at least provide a reference.

P4 L13: Mention that the channel at 23 is close a line emission center and that the channel at 36 is a window channel.

P5 L11: Appendix B seems to indicate that the retrieval is based on  $\ln(q)$  which will make it impossible to get negative values for TCW please explain why  $TCWV > 0$  is possible.

P5L12: Why such a big value of a cost function shouldn't this be close to 1?

P8 L13: Is this 3 a footnote? It needs to be a superscript. Also, which figure in this link is related to your statement. Please clarify further.

P8L29: Delete extra dot.

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P9L4: Define MSL.

P11L14: delete frequencies below 37 GHz and change to limited to two frequencies 23 and 36 GHz.

P15L17:  $x_b$  needs to be bold because it is a vector and the  $b$  needs to be a subscript.

P15L18:  $S_b$  needs to be bold because it is a matrix and the  $b$  needs to be a subscript.

Figure1 caption: Envisat was launch in 2002 so the date most be wrong or this is a different satellite, please check.

Figure 2: There is redundant information on both panels please delete one. Also specify for which satellite/month this is.

Figure 5 top add number of co-locations to the color bar.

Figure 5 bottom right: there is a clear bias in the time series not shown in the scatter plot above please fix.

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