Response to the referees

Thank you very much for the large number of comments and constructive suggestions!
Please find below the answers to the comments of the reviewers in blue text. The technical corrections that were included are commented with [done] for simplicity.

Anonymous Referee #3:

General comments
I missed a description of the assumed aerosol vertical distribution and type. Perturbations are discussed in Sect. 3.3, but there appears to be missing a description of the assumptions before this. Aerosol scale height is mentioned in several places, so the assumptions about the exact vertical distribution (assumed shape) should be discussed.

Inserted in Section 3.1:
"The scattering correction factor f has been calculated beforehand from radiative transfer simulations and stored in look-up tables presuming a continental aerosol layer (Hess et al., 1998) with an exponential increase from 1000 m to the bottom.
…
The phase functions were calculated with the Mie code based on (Wiscombe, 1980)."

Inserted in this Part:
"Consequently, f* was calculated presuming an aerosol layer at 6000 m with a thickness of 500 m."

On p. 7769, it is stated that all outliers are removed. Approximately what fractional percent of the data does this represent? To what do you attribute these outliers? Might they not be correct measurements or do you have a reason to suspect these as poor quality?

Initially, that filter was added in order to remove the cases that are still contaminated by clouds (uncertain cloudmask). Consequently, we removed the 3 sigma filter from the scatterplots. It turned out that is has not big influence, probably due to the reliably MODIS-cloud-cask.
In case of the MWR data comparison the removal of the 3 sigma filter added 13 samples in.

On p. 7770 it is mentioned that only cases with 100% valid MODIS pixels were considered. What happens to the comparison with a less stringent test. How many data are excluded with this check?

The scattering will be incresed and more MODIS values will appear in the dry part (below the angle bisector). With our strikt filtering conditions we exclude 90% of the available Data.

Section 5: It is not necessary to repeat the statistics shown in the figures in the text unless there is a subsequent discussion of these statistics and reason to repeat this information. The figures should be reordered in the number in which they are discussed. As mentioned in the previous review, the figures need some work. A color scale for the frequency of occurrence plots is not optional. Since AMT is an online journal, there is no excuse not to use color and in fact other figures are in color. Most of the scatter plots have a lot of white space and the scale could be cut off at 50 mm for example.

[done]

Are all of the bins actually shown here down to the smallest one?

Yes, they are.

Typically there is alot more scatter when comparing water vapour measurements from different

sources (see Wang et al., 2014 for example).

This is probably due to the strict cloud mask. The small scattering is an additional prove of the hi qualitiy of the retrieval.

As suggested by the other reviewer, color maps are desirable for validation (evaluation), particularly comparing the standard MODIS product or the MERIS product (during overlap) to this one (both plots of the actual field and difference maps).

We included a comparison of a sample track of MODIS and the corresponding MERIS over-path in an extra paragraph in the validation section:

“Figure * shows the comparison of TCWV derived from MODIS and MERIS Lindstrot et al., 2012 on a regular grid of 0.05° resolution. Each data-point is the mean of all valid corresponding sensor pixels. In the left panel, the MODIS over-path over Europe and northern Africa for the 2 July 2008 (09:32 - 09:49 UTC) is presented. On the right side plot, the corresponding MERIS over-path is shown (09:42 - 09:59 UTC). In the middle panel the difference between both fields is plotted (MERIS minus MODIS). Only pixel with a valid MERIS and MODIS TCWV value were taken into account.
Generally, MERIS has a smaller swath (1150 km) and it just covers the west side of the MODIS track. The structures in the TCWV field agree with each other although the location of cloudy pixels is different.
However, there are significant differences. MERIS TCWV is systematically higher than MODIS (1 to 3 mm apart from a small region above the Sahara. Lindstrot et al., 2012 discovered a small wet bias in comparison to ground-based TCWV measurements. Whether this or an error in the MODIS retrieval explanes the differences will be envisaged in future studies. Up to now the comparison to ground-based measurements suggests that the MODIS retrieval is not the reason. Furthermore, along-track stripes appear in the difference plot. These features are due to the architecture of the MERIS instrument. It is built out of 5 individual cameras that have slightly different spectroscopic properties. The central wavelengths of the MERIS channels are viewing angle-dependent. The later indicates that there is still some improvement possible in the MERIS retrieval as well. “

The samegoes for comparisons with other data sets, particularly the GNSS that has decent coverage. A map of the biases provides more information than a frequency of occurrence plots and may show for example a pattern of bias such as latitudinal that would be important. Scatterplots do not convey such information and are therefore limited.

Thank you for that suggestion! We included such a plot and added the following text:
“Figure * shows the bias between the two datas-sets for each station on a world map. Generally, the biases are low (around 1 mm. The majority of station has a negative bias meaning that MODIS TCWV values are in average larger than the GNSS values, which corresponds to Fig. **}. Although GNSS stations are not distributed equally over the world, Fig. * shows that there is no dependency of the location of the station and the bias. “

Technical comments
There are a lot of technical issues with the manuscript. I expect most will be caught in the light copy editing. Here are just a few examples.
pg. 7757, L. 15: Change sensible to sensitive, L. 18, change is to are., L. 20 change this to these., enables to enable., L. 23 change sufficient to sufficiently pg. 7759, L. 3, remove comma. L. 12, change at to from. pg. 7765, L. 17, change is to are. pg. 7767, L. 24, suggest to replace ‘change a lot’ with ‘vary substantially

[done]