

Atmos. Meas. Tech. Discuss., referee comment RC2
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Comment on amt-2021-79

Anonymous Referee #2

Referee comment on "GNSS-based water vapor estimation and validation during the MOSAiC expedition" by Benjamin Männel et al., Atmos. Meas. Tech. Discuss.,
<https://doi.org/10.5194/amt-2021-79-RC2>, 2021

Review: GNSS-based water vapor estimation and validation during the MOSAiC expedition

* General comments:

This paper describes ship-borne GNSS based water vapor retrieval in the Arctic Ocean in the framework of the MOSAiC project.

After the evaluation of the GNSS raw data quality, the processing strategy is described. The solution is first assessed by studying the scattering of GNSS position estimates as the ship was in the dry dock and, next, by comparing the GNSS vertical component to tide gauge data during a harbor stay. Then, the retrieved zenith total delay are compared to ERA5, ground-based GNSS and VLBI values with conclusive results (RMS between 10 and 15 mm). Finally, IWV are derived from ship-borne ZTD and compared to radiosonde measurements (on-board launch); results are conclusive too with RMS differences around 1,5 kg/m². Two cases of warm air intrusion are shortly described using GNSS-derived IWV.

The paper is well written, presents a relevant state-of-the-art and achieves to highlight the potentiality of the use of ship-borne GNSS antenna for ZTD/IWV retrieval for the

monitoring of the atmosphere over the oceans.

The bibliography is relevant and properly formatted (some typos left, see below)

I have no major concerns but I think that some points and figures could be improved to better enhance the paper (see "Specific comments" section).

I recommend the editor to accept the papers with ****minor revisions**** according to the following specific comments and technical corrections.

* Specific comments & technical corrections:

- line 15: I think you could add a sentence to establish the connection between (slant) "delays" and "ZTD".

- lines 85-86: please delete "therefore... estimated", estimation of ambiguity parameter is obvious (even if not fixed)

- line 86: you chose a low cutoff angle (3 deg), I guess, in order to decorrelate ZTD and height in estimation; however a low cutoff angle is more subject to multipath. Do you evaluate higher cutoff values?

- Tab1: it is not clear how do you apply VMF1 for hydrostatic delay computation and mapping function. The VMF1 is position-dependent: do you update hydrostatic delay and mapping functions values with position or do you consider that due to the slow ship's move, only values for a mean position is enough? I think you could clarify this point in the text.

- Tab1: what do you mean by "pre-eliminated" for coordinates and receiver clocks?

- line 94: maybe you could describe shortly what is mp12.

- Fig3: I think you should complete this figure by indicating the different periods that are mentioned between lines 94 and 106: periods when the ship is in dry dock, periods when the ship is moored, periods when water vapor measurements are not restricted.

- Fig3: How did you explain the increase of mp12 in May 2020?

- line 127: What is the standard deviation of the differences between antenna and tide gauge? Maybe you could add this value in the text. I guess that you took into account the vertical movements due to ocean loading, Earth tides, etc.

- line 127: How did you get the height difference between antenna and tide gauge? (empirically means: median, mean, rough draught measurement?)

- line 140: By "singular epoch", I guess you mean epoch without estimates just before and after; but what do you mean by "interpolated epochs"? Could you clarify this?

- line 143: I am not sure to understand "ZTD estimated for epochs with fewer than 800 observations are excluded": Does this correspond to the minimum number of observations available over a 1-hour period around the time of the ZTD estimate? Could you clarify it?

- line 156: Why did you use only 3-hourly ERA5 grids and not the hourly grids? Do you use the nominal ERA5 horizontal resolution ($0.25^\circ \times 0.25^\circ$)?

- line 161: since the ERA5 time resolution is 3h and the GNSS derived ZTD is 1h, how do you perform the outlier detection test for each ZTD values? From here, all the comparisons were realized using this "screened" dataset? (Fig8 too?)

- line 168: Could you add the ground stations location on Fig 6 and, maybe, add on Fig 7 the periods when comparisons with GNSS ground stations and VLBI are done?

- Fig9: Could you change the colors blue/green for SAPOS/ERA5 ZTDs: it is hard to distinguish the two time series.

- line 210: Did you study the evolution of ZTD differences as distance decreases/increases?

- line 245: Do you know which kind of radiosondes is used?
- line 313: please correct doi for Boniface et al., 2012
- line 325: please correct doi for Fujita et al., 2008
- line 335: please correct doi for Hesbach et al., 2020
- line 374: please correct doi for Rocken et al., 2005
- line 394: please add doi for Zumberge et al., 1997