

General Comments:

The revised version of the manuscript has been largely rewritten based on the reviewers' comments. It seems that all of my comments to the previous version have been essentially considered. The paper has improved, but there are several issues in the new version (see below) which need to be addressed by the authors.

My main comment is that the aim of the paper should be pointed out more clearly in the text (and in the title). Especially, it should be clarified that the described procedure is not a correction for NWM data, it is a method to achieve improved results in case of a spatial interpolation of NMW data. I also miss a more quantitative assessment of the results by putting them into relation with previous work and by clarifying what is new/different in the current work.

Specific Comments:

1. Title:

The title has been changed as response to a comment of the other reviewer to:

“Analysis of the geopotential from NWM at GNSS sites and its influence in IWV computation”

I think this new title is not clearly formulated. There is no geopotential provided by NWMs at the GNSS sites, this is calculated by the authors. As I understand, the paper also does not analyse geopotential data, they are used in the context of a correction procedure, which shall be applied when interpolating NMW data (specifically IWV) to geolocations not on the NMW spatial grid. The improvement is then shown by comparison with GNSS data. Furthermore, I recommend to avoid acronyms in the title as far as possible.

2. Section 2.2:

The geopotential data from the NWMs which are used in this study (z_{NWM}^i, z_{level}) should also be mentioned in this section.

3. p. 4, l. 22–27:

I think these two paragraphs can be omitted or need to be reformulated because:

- If you want to mention the difference between geopotential and geopotential height, you should also explain why you use geopotential and not geopotential height (or other height coordinates) in this study.
- It is rather trivial that the vertical integral of water vapor depends on the vertical range you integrate over.
- The sentence on selection criteria seems not relevant as the correction is applied to all data.

4. p. 6, under-/overestimation of IWV by NWMs:

In the interpretation of differences between NMWs and GNSS data the expected accuracy (or variability / SD) of the GNSS data should be mentioned and taken into account (see also suggested modifications of Figs. 2 / 4 below). Are the observed under-/overestimations of IWV significant in this context?

5. p. 7, l. 5–6:

“Finally, the correlation coefficients between \overline{IWV}_{GNSS} values and the respective ones for both NWM, are higher than 0.95 in most of the cases (not shown).”

What exactly is meant with “in most of the cases”? When talking about averages, there should be only two cases: GNSS vs. ERA-Interim and GNSS vs. MERRA-2. Or, are you referring to correlations of time series at each station?

6. p. 7, l. 8:
 “Following we proceed to compensate the IWV_{NWM} at each of the grid points.”
 This sentence is unclear and needs to be reformulated. The method uses adjusted data at the grid points to provide a better model estimate at the locations of the GNSS stations, but the original grid values are still valid.
7. p. 7, l. 18–20:
 “the value of the geopotential (...) may differ several hundred meters.”
 Be consistent with quantities/units. “meters” refers to geopotential height, not geopotential.
8. p. 8, eqs. (7), (8) and related text:
 The formula in Eq. (5) (though correct) seems quite complicated. Why not integrate always from p_{GNSS} to p_{NWM} ? Then, the sign of the correction would automatically be correct without any $(-1)^n$ factors. This would also make some of the following (somewhat confusing) text about highest/lowest values and positive/negative corrections obsolete.
 I am also not sure why the additional eq. (8) is needed as we are just talking about a numerical (linear) integration of eq. (6) and (as described at the top of page 8) you already have all data interpolated to all required z levels (not only the 37 pressure levels).
 If you want to include eq. (8) as a special case, you need to explain the reasons for this.
9. p. 10, l. 11–18:
 This section refers to related studies, but there is no quantitative comparison of results given. Please specify how your results differ from or agree with the mentioned studies and especially what is the new aspect.
10. Fig. 2:
 Since there is no real dependence between Δz and mean IWV, I suggest to modify the two top plots such that they show ΔIWV (possibly with SD error bars) as function of Δz . Then, over- or underestimations of the interpolated model data could be seen more clearly (see also corresponding comment above).
 Please separate the color bar (for ΔIWV) from the x axis label of the top graphs (IWV) and provide a separate label for the color bar. Please add a grid (or at least a zero line) in the upper plots.

Technical Corrections:

1. p. 2, l. 33:
 “sign of IWV bias” → “sign of the IWV bias”
2. p. 3, l. 10–11:
 “Follows the explanation of the methodology and the presentation of the results obtained after applying the proposed correction to IWV values from ERA-Interim.”
 This is no sentence, please reformulate.
3. p. 4, l. 6–7:
 “MERRA-2 represents a quality improvement compared with MERRA because of the trends and jumps linked to changes in the observing systems.”
 This sentence is misleading and should be reformulated. You probably mean that MERRA-2 is improved because it contains less trends and jumps than MERRA.
4. p. 4, l. 11–12:
 “To this application we used two different data sets. First, the gridded values of the vertical Integral of Water Vapor (IWV) from both re-analysis models.”

This should be reformulated. The second part is again no sentence, and you use more than two data sets (profiles and maps of different parameters from different NWMs). Probably you want to distinguish here between 2D and 3D (profile) data.

5. p. 4, l. 12–13:
“Because the comparison is performed at each GNSS station, a bi-linear interpolation of each gridded data set was performed.”
This sentence refers to the methodology (described later) and can be removed.
6. p. 4, l. 14:
“vertical values” → “vertical profiles”
7. p. 4, l. 15:
“These variable,” → “These variables,”
8. p. 4, l. 28:
“we followed van Dam et al. (2010) algorithm.” → “we followed the van Dam et al. (2010) algorithm.”
9. p. 5, l. 3:
“with a = 6378137m. and b = 6356752.3142m. are the” → “with a = 6378137 m and b = 6356752.3142 m being the”
10. p. 5, l. 7:
“with e^2 ” → “where e^2 ”
11. p. 5, l. 16–17:
“corrects its values of IWV_{NWM} ” → “corrects the values of IWV_{NWM} ”
12. p. 6, l. 1:
“On the other hand, The” → “On the other hand, the”
13. p. 6, l. 35:
“Being these values the result of an average over all the ΔIWV differences.”
This is again no sentence, please reformulate.
14. p. 7, l. 11:
“Zhu (2014) compare” → “Zhu (2014) compared”
15. p. 7, l. 14:
“specific humidity the key variable” → “specific humidity, the key variable”
16. p. 8, l. 5:
“Because each value” → “Each value”
17. p. 8, l. 16:
The formulation “If z_{GNSS} and z_{NWM}^i are at the same level” is not correct. You probably mean that z_{GNSS} and z_{NWM}^i are in the same layer (i.e. the range between two adjacent levels).
18. p. 8, l. 27:
 $t \rightarrow T$
19. p. 9, l. 7:
“It can be seen that in general the values are resulted very close to zero.” → “It can be seen that in general the resulting values are very close to zero.”

20. Table 1 (caption):
The quantities z_{NWM} and z_{NWM}^i are not defined at this stage (and are not used in the table), so please reformulate.
21. Fig. 3:
Actually, the line for z_{GNSS} does not appear as a dark blue dashed line, it is more grey.
22. Fig. 4:
Should be aligned to top figures of Fig. 2 (see comments above). Actually, the left sub-figure in Fig. 4 is the same as the top left sub-figure of Fig. 2, only with a different color scale, so depending on alignment of figures this could be omitted.
23. Fig.5:
Please add grid / zero lines.