Atmospheric
Measurement
Techniques
Discussions

Interactive comment on "The use of GNSS zenith total delays in operational AROME/Hungary 3D-Var over a Central European domain" *by* Máté Mile et al.

Anonymous Referee #3

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This paper describes experiments made with ground based GNSS observations as an additional observation type in the Hungarian NWP setup. There is nothing novel presented but it is an interesting contribution to the field in the sense that it confirms previous results also in a model domaine over central Europe. The paper describes the setup and assimilation procedure well and can be published. There are however a few things that need to be clarified first. One thing that is valid through the entire manuscript is that the figures are unreadable and not well explained. For example are the labels on the x-axis on figures 3, 5 and 6 impossible to read.

Specific comments: Page 2, line 33: The authors should also mention the project

TOUGH, Targeting Optimal Use of Gps Humidity measurements in meteorology which was the predecessor to E-GVAP. Perhaps also a reference to the projects mentioned here, final report or a publication (e.g. http://tough.dmi.dk/deliverables/d14-final-rep.pdf)

Page 3, line 23, Remove "to" in "...started in the 1990s joining to..."

Page 3, line 27, Missing reference right after Meso-NH?

Page 3, line 36-37: Remove "called OI_main"

Page 3, figure 1: I would like to see a map over a slightly larger area with the model domain indicated by lines. It will make it easier to orient oneself and get a better feeling of where we are in the world.

Page 4, lines 7-10: Please explain figure 2 in more detail. What does absolute and relative mean?

Page 4, section 3: It would be helpful with a figure indicating the position of the GNSS stations. Perhaps include it in figure 1? It would also be nice to see which of all stations that are active in the assimilation, i.e. highlighted in some way.

Page 5, lines 31-33: Very strange sentence. I do not really understand. Please reformulate and clarify.

Page 5, line 35: "...GNSS ZTDs by default are blacklisted in the system." Why is this the case and what does it mean?

Page 5, line 37: It is assumed that the training period is sufficient. Can this be verified in some way.

Page 6, line 13: Since the study includes a bias correction the predefined limits of OMF can be set more tolerant during the training period. This may include stations with a large bias that after bias correction can give a useful contribution.

Page 7, line 8: "...a space/time -average..." How does the space-part come into this? This is done fore each observation station individually is it not?

Page 7, equation 3: What is n here? All observations in total or all observations from one station during the training period? I hope for the latter and that BIAS really is BIAS(i).

Page 7, line 14: OK, so the bias is calculated for each station separately. It is not really clear from the above.

Page 8, figures 4 and 5: Is the time period the same for both figures?

Page 8 line 24: "...default set to 60..." 60 what?

Page 8 line 25: Is 15 days enough for all stations, even those with a very large bias? Has this been checked?

Page 10, lines 5-7: Why only 30 synop stations? How are these selected? Are the ZTD observations distributed over the entire model domain?

Page 11, figure 7: Perhaps outside the scope of this study but there is a very strange diurnal (?) cycle in the verification. Just a few words to explain would be good.

Page 11, line 20: Overfitting is not likely the explanation here. That would show up in the 1-3 hour forecast range and would be clearly visible in figure 10.

Page 11, lines 26-27: I do not understand the conclusion that the results are neutral since it was verified against Hungarian synop stations. Would the conclusion be different if it was verified against more stations?

Page 14, figure 10: Again a strange cycle in the verification that could be explained with a few words (if possible).