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Comment on wcd-2021-2

Anonymous Referee #2

Referee comment on "The impact of GPS and high-resolution radiosonde nudging on the simulation of heavy precipitation during HyMeX IOP6" by Alberto Caldas-Alvarez et al., Weather Clim. Dynam. Discuss., https://doi.org/10.5194/wcd-2021-2-RC2, 2021

In this paper, the impact of assimilating GPS-ZTD data and sounding observations at low and high vertical resolution is evaluated on a case study of heavy precipitation. The COSMO model is employed at 3 different resolutions over 3 domains and observations are assimilated by a nudging technique. Verification of experiments is performed using several metrics, especially regarding precipitation. Regardless of the model resolution, only the assimilation of operational low vertical resolution radiosondes improves precipitation accuracy, while both high-resolution soundings and GPS observations have a negative impact. This is probably due to deficiencies in model physics and, for GPS, to lack of vertical information.

In my opinion, the topic is relevant and the experiments presented by the authors are interesting. The paper is well written and results are discussed in detail. However, I think that some aspects of the manuscript need to be improved, as reported in the following comments.

Major comments:

- High vertical resolution radiosondes (HR) are assimilated without performing any thinning or data reduction. As far as I understand, since HR vertical levels are much more than model levels (700 compared to 40-80), this means that HR observations are overweighted. I think that this point should be reported and discussed in the manuscript.
- Figure 5 is crucial to quantitatively assess the impact of the various experiments on precipitation accuracy. However, some aspects are not clear and should be discussed

further. First of all, it should be explained how the 99th percentile of 3h precipitation is computed, Moreover, how are the raingauges treated? For example, for the domain average, are they aggregated to the same grid of MSWEP to take into account spatial variability? Finally note that the title of subplot "b" has to be swapped with that of subplot "c".

Minor comments:

L56-58. In contrast to GPS, satellite and radar are claimed to not be all-weather observations. Regarding radar reflectivity, even if it is particularly useful in case of precipitation, it can be gainfully assimilated also in no-precipitating conditions to suppress spurious model rainfall (see for example Bick et al. (2016) and Gastaldo et al. (2021) for COSMO-LETKF, but the same holds for nudging schemes). About satellite observations, clear-sky observations have been assimilated for many years, but there are several studies dealing with the all-sky assimilation (see for example Geer et al. (2018) for a review). So, please explain more in detail what you mean.

L61-62. I am not sure that Davolio et al. (2017) restrict the correction to boundary layer. Looking at their Table 3, the moisture correction is smoothed in the boundary layer.

L69-70. A citation would be desirable

L74-75. Is the acronym LFT correct? Here "tropospheric" is employed, however in other parts of the text "troposphere" would be correct.

L180. I would write "shallow convection parametrization scheme"

L190-231 Several symbols employed in the equations and in the text are not explicitly defined like, for instance, F, x, t, xk in eq 1, all variables in eq 2, ps and Tm at line 220. It is true that most symbols are easy to interpret, but I think it would be more clear to define all of them.

L233. Here and throughout the manuscript, time is in the format HHMM while HH:MM is preferable.

L276. Replace the point before “Where” with a comma.

L275-280. Some aspect are not clear to me. Are you computing FSS employing moving boxes consisting of 18 grid points? Why 18 is the maximum number o grid points in the RhoAlps domain? Please rephrase these lines.

L282. I suggest to make clear that FSS=1 when there is a perfect agreement between observations and forecast, in terms of FSS.

L294 Some cities are reported here. They should be indicated on the map or, at least, geographical coordinates have to be specified.

Figure 2, 3 and 4. When a nonlinear colorbar is adopted, as for precipitation here, all bin extremes should be specified.

L311-312. MSWEP clearly underestimates precipitation over Liguria region compared to RG, This should be reported. Moreover, this may also be taken into account for the subsequent qualitative verification (Fig. 3 and 4).

L347. Qualitatively or quantitatively?

L414. Replace “Only” with “only”.

L464-465. As in L294, some cities are reported here. They should be indicated on the map or, at least, geographical coordinates have to be specified.

L555. Replace Nimes_0500UTC with Nimes_0515

References

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