

Review of “The AROME-WMED re-analyses of the first Special Observation Period of the Hydrological cycle in the Mediterranean experiment” by Nadia Fourrié, et al.

This paper aims at assessing the main differences between the real-time version of the AROME-WMED model and two distinct re-analyses strategies during the first special observation period (SOP1) that took place in Autumn 2012 (05 September to 06 November). In particular, it is highlighted that the second re-analyses assimilates much more observations than the first re-analyses (in particular, it uses 15% of additional information), and it also uses an updated version of the real-time version of the AROME-WMED model. Furthermore, the second re-analyses also uses a more realistic background error covariance matrix, that plays a crucial role in the data assimilation process, and allows that a higher number of observations can be assimilated. As it is expected, due to the usage of a more realistic background error covariance matrix and the assimilation of a higher number of observations from different instruments, results obtained from the second re-analyses depicts the best verification scores.

This study is interesting but additional work is needed to improve the quality of the present manuscript to be considered in this journal. Main concerns and some suggestions are listed below. Taking into consideration these comments, I recommend some minor modifications before it can be accepted for publication in the ***Geoscientific Model Development*** journal.

General comments:

As it is state above, this study clearly shows the benefits of the second re-analysis in comparison with the first re-analysis and the real-time version of the AROME-WMED model. However, it is not explained which factors (i.e., topography, background error covariance matrix, type of observations assimilated or number of observations assimilated) have played a key role in the improvement of the second re-analysis. With the main objective of improving the quality of the manuscript, a more detailed discussion about the main reasons of these benefits should be addressed performing some numerical sensitivity experiments. For instance, if the second re-analysis used the same topography (GTOPO30) and assimilates the same type and number of observations than the first re-analysis, would the results be very different from the obtained originally? In this example, the differences obtained could be attributable to the effect of the background error covariance matrix.

Regarding the implementation of the 3DVar data assimilation technique, no information about the observational errors assigned to the different kind of data assimilated is provided along the entire manuscript. Taking into account the relevant role of this parameters in the effectiveness of the data assimilation algorithm, I strongly suggest the authors to add this information.

Minor comments:

The following are some suggestions that could help to improve the quality of the manuscript:

Introduction Section:

- 1) Page 3 (line 3): “the AROME-WMED re-analyses and the real-time versions The different...” → “the AROME-WMED re-analyses and the real-time versions. The different...”
- 2) Page 3 (line 6): “Intensive Observation Period (IOP) 8” → “Intensive Observation Period (IOP8)”
- 3) Page 3 (Table 1): Remove open parenthesis “ (” appeared in the REANA1 box. This open parenthesis should be located in the REANA2 box: “(from 17 to 31 October 2012)”. Also, the caption is located very close to the table. Add some additional vertical space between them.

Description AROME-WMED Model Section:

- 4) Page 3 (line 21): “The model grid includes a 960x640 point matrix...” → “The **horizontal** model grid includes a 960x640 point matrix...”
- 5) Page 4 (Figure 1): Add label to the left panel colorbar. In addition, add some extra horizontal white space between panels, they are quite close.
- 6) Page 4 (line 9): Add space after the second 06 UTC: “period 06 UTC-06UTC on the following day” → “period 06 UTC-06 UTC on the following day”
- 7) Page 4 (line 12): It is stated that an assimilation window of +/- 1h30 is used. Is this assimilation window used indistinctly for all types of observations? Observations with high temporal resolution, such as radar observations, should not use this large assimilation window. Could the authors provide detailed information of how they apply this assimilation window?
- 8) Page 4 (line13): “analysed **parameters** are temperature,...” → “analysed **variables??** are temperature,...”
- 9) Page 5 (Figure 2): Add a), b), c) and d) labels to panels.
- 10) Page 6 (Figure 3): Same that in Figure 2.
- 11) Page 7 (line 13): “horizontal correlation length-scales are slightly longer”. Do the authors refer to the horizontal correlation scales from REANA2? Please improve this sentence.

Assimilated Data Section:

12) Page 8 (Table 2): The caption is located very close to the table. Add some additional vertical space between them.

13) Page 9 (line 9): igher → higher

Assimilation Results Section:

14) Page 20 (line 14): cumulated → accumulated

15) Page 20 (Figure 15): Add labels to figure colorbars

IOP8 Qualitative Evaluation Section:

16) Section title: IOP8 **Q**ualitative evaluation → IOP8 **q**ualitative evaluation

17) Page 22 (line 12): Gulf ol Lion → Gulf of **f** Lion

18) Page 23 (lines 10-11): Regarding ETS verification score obtained from the daily accumulated precipitation amounts exceeding 50 mm/day, it is stated that ETS scores are better for the 24-48 hour forecast range than for the 00-24 hour forecast period. Could the authors provide some explanation of this result?