Reviewer 1.

General comment ***This paper shows the impact of different sources of data on the second reanalysis dataset produced with AEROME-WMED for the HyMeX-SOP1 campaign period. The impact of reprocessed GNSS-ZTD, the assimilation of the Spanish radars, and of wind profilers are evaluated through a series of data deny experiments.***
Performances are shown both at analysis and forecast times using also independent observations. The paper is interesting and fits the scope of the journal. There are, however, many minor errors in the current version of the paper, which make the reading difficult. I have attached to this review the pdf with sticky notes. Also, the description of the background error matrix must be improved.

We thank Reviewer 1 for his/her comments which helped to improve, we hope, the quality of the manuscript. Please find below our response to your comments. Reviewer 1's comments are in bold font, our answers are written with normal font.

Major points ***The background error matrix is very important in the context of this paper. A detailed description must be provided, which is missing in the current form of the paper.***
The reviewer is right : the B matrix is a key point of this kind of study. The background error statistics used is the same as in Fourrié et al. (2019) : it is a climatological B matrix using Berre (2000) multivariate formulation under the assumption of horizontal homogeneity and isotropy. Cross-covariances between errors for different physical quantities are represented using scale-dependent statistical regressions, including an extra balance relationship for specific humidity. It is calculated using the Brousseau et al . (2011) approach based on forecast differences from a AROME-WMED Ensemble data assimilation over a longer period of the HyMeX special observation period (17 to 31 October 2012) to be representative of the encountered meteorological conditions. More information (and examples of vertical profiles of sigmab or variance spectra) are available in Fourrie et al. (2019). The following information has been included in the manuscript.
« The background error statistics are climatological. Based on the Berre (2000) multivariate formulation, cross-covariances between errors for different physical quantities are represented using scale-dependent statistical regressions, including an extra balance relationship for specific humidity. The background error statistics have been calculated using forecast differences from a AROME-WMED Ensemble data assimilation (Brousseau et al. (2011) approach) over a 15-day period of the HyMeX SOP1 (17 to 31 October 2012) to be representative of the encountered meteorological conditions of the SOP1 in average. More details on these background error covariances are available in Fourrié et al (2019). »

Minor points ***As stated above there are many minor points that must be solved before the publication of the paper. Some figures are unnecessary and only the comments should be provided. See the sticky notes in the pdf.***
We thank the reviewer for all his/her corrections and suggestions of modifications. Please find below our answers to his/her comments found in the pdf file.

Page 3 l 70 :Which is the horizontal resolution of the REANA dataset? Clarify.
The horizontal resolution of the REANA dataset is the same as the 2012 version (2.5km). This has been clarified in the text : "The REANA dataset has a 2.5 km horizontal resolution and the model has 60 vertical levels from 10 m above the surface to 1 hPa."

Page 4 l 85 The concept of operational and non operational data is vague. A specification of what is "operational" data is necessary.
We mean here to observations which were not assimilated in real-time in the operational version of AROME. These are research observations or reprocessed ones. However, referee 2 asked to change this paragraph and the sentence has disappeared in the new version of the paper.

L96 "." Done

L98 It is preferable to precise better the difference in the data among between the reprocessed data set and the operational data set.

In the operational data set provided by E-GVAP, ZTD data for one reception station may be provided by more than 10 processing centres (in that case the closest observation to the model is selected). The reprocessed data set provided by Bock et al (2016) was homogeneously produced by LAREG (IGN) research Laboratory and the Centro du Geodesia Spaziale of the Italian Space Agency (ASI/CGS) using a single software program, more precise satellite orbits and clocks . It considers the operational data but it also includes additional ZTD data which were note available in real-time (i. e. from Sardinia). In addition an updated bias correction for each GNSS station was computed in the REANA2 version.

We propose to modify the text with the following sentences in the paragraph: « In REANA2, we considered here reprocessed data with a homogeneous reprocessing using a single software and more precise satellite orbits position and clocks (Bock et al., 2016), which were available for the whole SOP1. Additional data were also considered compared to the operational and real-time data set. An updated bias correction for each GNSS station was also computed in the REANA2 version. NOGNSS is the experiment without the dense reprocessed GNSS network Another experiment without re-processed, but with the "operational" GNSS ZTD data assimilated in the real-time AROME-WMED version, called OPERGNSS, was also performed to test the impact brought by the reprocessing of the data and additional GNSS data. The operational data set provided by E-GVAP (EUMETNET EIG GNSS (Global Navigation Satellite System) water vapour programme), ZTD data for one reception station may be provided by more than 10 processing centres (in that case, the closest observation to the model is selected).

L101 Why these capital letters? It was a mistake and it was corrected.

Page 6 L126 Square. Corrected.

L134 "Figures?" . It is better to say what is shown in Figure 2 (ZTD. I.e. zenithal total delay). It is corrected with « with ZTD ranging from 2.2 m to 2.6 m. »

L135 Start a new paragraph here. Done

Page 7 l149 This is the largest dataset among those of the data denial experiments. The sentence was modified: This data set represents the largest one among those of the data denial experiments

Page 8 Figure 3

This should be "left panel" The should be "right panel" Changed

L 160 In the figure 4 it is indicated with RMSD. RMS Difference. It was changed in the figure 4.

L168 : "right panel". Be careful, throughout all the paper the panels in multi-panel figures are referred as lower and upper, while they are displayed left and right. The paper was prepared with a two-column manuscript. I have modified all the 2-panel figure captions to reflect what is seen in the manuscript.

Page 9 L 174 : This sentence is rather unclear. Do you mean that the assimilation of GNSS data has no impact when FG and analyses are compared with MSG water vapour channels (6.2 micron and 7.3 micron)?

We looked at the FG and AN departures (mean and standard deviations) for the MSG water vapour channels (6.2 micron and 7.3 micron) and no difference between experiments are observed for these observations. The sentence has been replaced by "No differences in the FG and AN departure statistics (average and standard deviations) were observed for these observations."

Figure 4 « Left and right panel not upper and lower. » Done
« mixing ratio is out of the parentheses. » Changed

Figure 5 « Panels are left and right » Changed
« Lower "B". » *Modified*

Page 12
L197 « While the 40 mm/day threshold represents a moderate rainfall with few cases, they are the most important for severe weather. I would remove this sentence "However .... cases". » Done

L200 "ranges". *Corrected*

L201 « The acronym "IWC" is never introduced before this point. Clarify. » IWC is in fact IWV. This was modified in the text.

Figure 9 « In addition to the fact that panels are left and right, the IWV is referred as IWC into the text. Please use a uniform notation. » *IWC was wrong, it is in fact IWV*

L205 « The better performance of REANA when comparison is made against Marfret Niolon data is hardly visible. I suggest to remove this part of the sentence. »
The Figure has been replaced with the following table :

Parameter	REANA	NOGNSS	OPERGNSS
Correlation (1-24h)	0,9619	0,9566	0,9572
Correlation (25-48h)	0,9216	0,9171	0,9190
Correlation (49-54h)	0,9061	0,9018	0,9046
Standard deviation (forecast -observation, 1-24h)	0,0154	0,0165	0,01613
Standard deviation (forecast -observation, 25-48h)	0,0223	0,0228	0,0224
Standard deviation (forecast -observation, (49-54h)	0,0244	0,0249	0,0244

Table 5. Correlation and standard deviation of integrated water vapour content between AROME-WMED forecasts and reprocessed GNSS observations averaged over forecast ranges.

The text was modified : "Compared to the observed ZTD from the Marfret Niolon ship, the signal is more noisy because of a smaller dataset but when comparing to values average over the forecast range (Table 5, the correlation for the NOGNSS is lower than REANA and OPERGNSS, which provides it-self lower correlation than REANA. The standard deviations are higher for the NOGNSS forecasts. In addition, a decrease of the correlation (respectively an increase of the standard deviation) is seen for forecast range over 24-h."

L203 « Here meters and 2 words after m. Choose a uniform notation. » *We choose 2 m.*

L210 « OPERGNSS » Corrected

Figure 10 « Are those deviations expressed in mm or in m. Please check. »
Thank you for spotting this typo. It should indeed be expressed in m (meters). The figure has been corrected.

Figure 11 « Panels are again left and right ». *Corrected*

L216 « I would not define the 10 and 20 mm/day thresholds as large rainfall. Moderate is more appropriate. » It was modified accordingly.

Page 15 L223 « Field » Corrected
L 226 « I suggest to remove this sentence and to plot the profile up to 300 hPa. ». *Done*

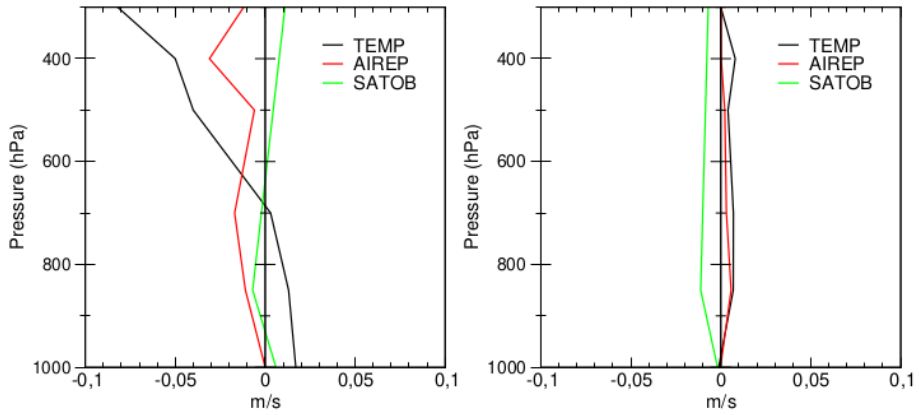

Figure 14. First-Guess (left plot) and analysis (right plot) RMS differences (REANA-NOWPROF experiments) computed against TEMP (black), AIREP (red) and SATOB (green) observations for the zonal wind component (m/s); negative value correspond to a positive impact of wind profiler.

Figure 14 :Left and right plots. *Corrected*

L228 : « Which is better? REANA or NOWPROF? »
A small improvement of REANA is found compared to NOWPROF. This has been added in the text: A small improvement of REANA compared to NOWPROF , but not significant (Figure 15), appears on the ETS of the 24 h accumulated precipitation accumulated from the 6 to 30 hour forecast ranges.
« I suggest to remove Figure 15 because it doesn't add much to the paper. It is better to retain the comment only. »
Even if Figure 15 does not add much information we choose to keep it in the paper.

Page 18
L259 « specify if they are observations or model output. »
They are observation and it was specified in the text : « Although observed accumulated surface precipitation... »

L267 and Figure 21 « This sign - is not clearly understandable. Please, use "from 06 h to 30 h forecast hours" to indicate the time interval. »
We change the text with the reviewer's suggestion : « from 06h to 30h forecast ranges ».

L283 "importance" modified