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Climate of the Past Discussions

Interactive comment on "Ensemble cloud-resolving modelling of a historic back-building mesoscale convective system over Liguria: The San Fruttuoso case of 1915" *by* Antonio Parodi et al.

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We thank referee #2 for his/her positive comments on the topic of the manuscript and the analysis we carried out and for the many useful suggestions that will help us in preparing an improved version of the manuscript. In the following, we address his/her comments.

Main comments

1. Even if 56 members on the 20th century reanalysis were studied, only four of them reproducing the best the event's dynamics were taken into account while showing the

results. It would be interesting to have some comments about the members showing very "non-realistic dynamics" and also about the mean ensemble. Reply: we will consider this comment in revising the manuscript. Some information on the other members is indeed interesting, but we have also to keep the focus of the paper which investigates the ability of the ARF-WRF simulations to capture the MCS character of the event. The members showing very "non-realistic dynamics" and also the mean ensemble fail to capture the convergence line creation and its evolution responsible for the generation of the back-building MCS in 17 out of 56 members. We have therefore to balance the need of giving some information on the other members with the goal of keeping the focus of the paper on the back-building MCS character of the investigated event.

2. Convective systems are generally associated with vertical motion. WRF outputs offers 3D information allowing the generation of vertical cross-section plots or Skew-T diagrams, none of them are shown in the paper. Some graphs and words about this should be added. Reply: the physical mechanism responsible for the generation of the back-building MCS observed on 25 september 1915 also has been recently explained by Fiori et al. (2016). Taking advantage of the availability of both observational data and modelling results at the micro-α meteorological scale, Fiori et al. (2016) provide insights about the triggering mechanism and the subsequent spatio-temporal evolution of the Genoa 2014 back-building MCS. The major finding is the important effect of a virtual mountain created on the Ligurian sea by the convergence of a cold and dry jet outflowing from the Po valley and a warm and moist low level south-easterly jet within the PBL. The same mechanism is active also for this case. Let us consider, as an example, the convective flow field at 06UTC on 25 september 1915 (see Figure 1), as predicted by member 1 of the ensemble. Panel A shows the 2 m potential temperature field together with the 10 m horizontal wind vector field: the colder and drier jet outflowing from the Po valley and the warmer and moister air from southern mediterranean sea are evident. Panel B shows, by means of the potential temperature along the cross section corresponding to the green dotted line of Panel A, also the thin potential temperature layer (virtual mountain) in front of the actual Liguria topography. This acts,

in agreement with Fiori et al. (2016), to produce the strong convective cells in panel C (updraft velocity above 10 m/s) with the apparent back-building on the western side (less mature and intense cells around 8.4° latitude). The main updraft produces vertical advection of water vapor (panel D), thus resulting in significant production of rainwater (panel E), snow (panel F, significantly advected inland by the upper level south-westerly winds), and graupel (panel G). We will present this analysis in the revised version of the manuscript.

3. In general the writing style and content is of good quality but the graphs are not at the same level of quality. Fig. 2 has a background hard to see, Fig. 3 has low quality, Fig. 8 is upgradable, etc. (Check the Specific comments). Reply: we agree on the comments on the figures: in the revised version of the manuscript, we will reformat and reorganising them according to the suggestions from reviewers.

4. While the convergence line is a very important criteria for dynamics exploration, it hasn't been shown in any figure. Lines 273 and 274 signals the coordinates of this line but a graphical representation would clarify it. Reply: in the current version of the manuscript, the convergence lines corresponding to members 1, 13, 22 and 37 are highlighted by Figs. 10 and 11. These figures show the 10 m wind fields corresponding to the 4-hour periods with the minimum divergence values in Figure 9. In the revised version of the manuscript, we will highlight this point in the captions of figures 10 and 11, in order to better clarify that these figures correspond to the periods of minimum divergence in Figure 9.

Minor comments - L113 cites WRF version 2 while the work uses WRF version 3, the correct citation would be thus Skamarock et al. 2008 (NCAR/TN–475+STR) - L128 shows a good example in dates using sometimes upper-case and not using this. This is reproduced all over the paper. Consistency in the style should be shown. - L179 makes reference to Fig. 2b where it's shown 500hPa Geopotential but this is not stated in the text. Please add a comment on this field. - L280 text makes reference to QPF even if this abbreviation hasn't been introduced. Please define it. - L281 addresses

Fig. 13 while it should be Fig. 11. - L296 mentions a panel 6 which it's not shown in Fig. 10 Reply: we agree with all these comments and we thank the reviewer for these suggestions. The manuscript will be corrected accordingly.

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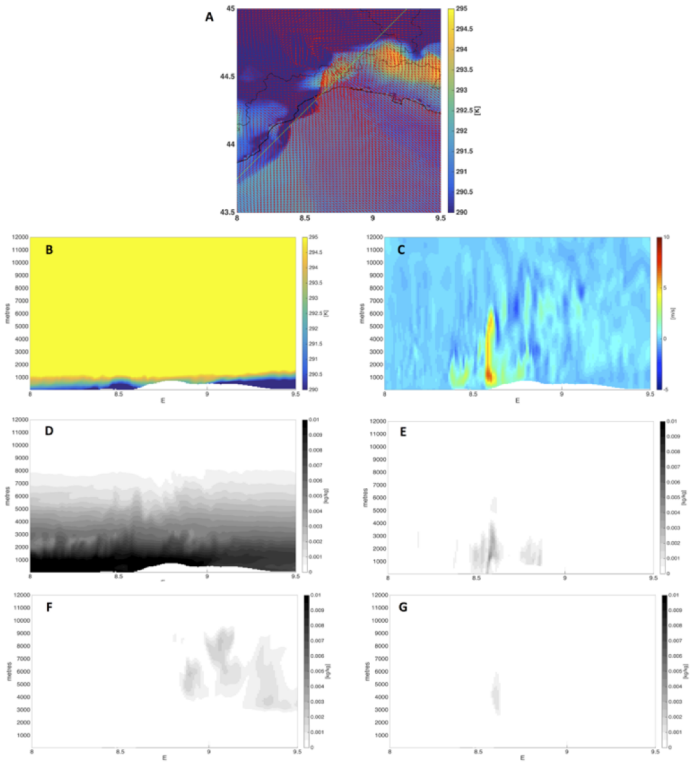

Fig. 1. Member 1, 06UTC on 25 september 1915. Panel A shows the 2 m potential temperature field together with the 10 m horizontal wind vector field. Panel B to G show the vertical cross sections of potential