

## ***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.***

**Anonymous Referee #1**

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The paper proposes to simulate, with the WRF model, the San Fruttuoso case of 1915 using the 20th Century Reanalysis ensemble as boundary conditions. Some model of the ensemble simulations are able to reproduce the strong convergence over the Liguria Sea and precipitation fields that are consistent with the occurrence of highly localized and persistent back-building mesoscale convective systems. The results are also supported by unconventional data such as historical meteorological bulletins newspapers and photographs.

Major Points: 1. The 20th Century ensemble reanalysis at 2.0o is used as boundary

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conditions for simulations with a 25km ( $\sim 0.22\sigma$ ) outer domain. In the analysis, the poor alignment of the convergence zones is attributed to the low resolution of the reanalysis but this could be mitigated by introducing a WRF domain with 125km. This should be attempted at least for the four members analysed. 2. The advantage of high resolution simulations is their ability to provide 3D information of an event. No analysis of the upper air results, vertical profiles or 2D vertical cross-sections has been presented. The dynamics of the storm evolution should be added to the manuscript. 3. Although an ensemble of 56 members is produced, only 2 deterministic measures of individual ensemble members are presented but no analysis of the quality of such ensemble is provided. A shortcoming of deterministic measures of skill is that information about prediction uncertainties is not available, thus categorical measures like Brier skill score, continuous ranked probability score, ROC skill score are a useful tool to assess the quality of an ensemble forecast. In the following references examples such types of analysis can be found. Please add some categorical measures.

4. The deterministic measures are also evaluated by comparing observations and simulations with different time spans. In lines 209-218 reference is made to rainfall depths for a 4 hour period thus QPE should be computed for the same time period as the simulation and only then should the evaluation be performed. In case that is not possible, the simulation should cover the same time period of the observations.

Corti, S., A. Weisheimer, T. N. Palmer, F. J. Doblas-Reyes, and L. Magnusson (2012), Reliability of decadal predictions, *Geophys. Res. Lett.*, 39, L21712, doi:10.1029/2012GL053354 Wilks, D. S. (1995), *Statistical Methods in the Atmospheric Sciences*, 467 pp., Academic, San Diego, Calif. Doblas-Reyes, F. J., and Coauthors, 2009: Addressing model uncertainty in seasonal and annual dynamical ensemble forecasts. *Quart. J. Roy. Meteor. Soc.*, 135, 1538–1559, doi:10.1002/qj.464.

Minor Points: Figure 3 is very difficult to read. Since its quality cannot be enhanced I would suggest adding a figure 3b with the ensemble mean slp with the same domain and isobar resolution in order to better assess the resemblance between the

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20th Century Reanalysis and the forecasted conditions on the 25th of September. The approximate pressure gradients in the Po Valley, Mediterranean and France, in both analysis, would be appreciated. Figure 4c is as difficult to read as figure 3. Figures 4a and b should represent the same domain as figure 4c. Same argument as before. In lines 209-218 reference is made to rainfall depths for a 4 hour period. If sub-daily precipitation is available please add either QPE or individual stations time series for the periods analysed in figures 10 and 11. The topography of the WRF plays a fundamental role in the development of the convective system but is missing from the manuscript. I suggest replacing the map in figure 8 with the model topography for all the domains. To facilitate the comparison with the real topography, I would suggest the merger with figure 1 as figure 1b. Also in figure 1 there is no reference to the source of the topographic map. Lines 95-100 – Paragraph is too long, please rephrase. Line 170 – The paragraph refers to 500hPa chart, i.e. figure 2b Line 178 – Should be figure 2a, not 2b Line 746 – Y axis in figure 9 difficult to read. Reduce the resolution and increase the caption font. Line 755 – Indexation of figure 10 and 11, hard to follow. Attribute the indices sequentially. Legend should describe better the individual panel figures.

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