

**Response to review of an ensemble study of HyMeX IOP6 and IOP7a:  
sensitivity to physical and initial and boundary conditions**

**Anonymous Referee #2**

The authors wish to thank the anonymous reviewer for his/her helpful and constructive comments which led to an improvement in the quality of our paper.

- Pag. 7741, line 24: "large upper-level trough". Maybe it is "large scale upper-level trough"

Yes, thank you for this. This has been modified. "In south-eastern France, these HPEs develop principally associated with a large-scale upper-level trough over the North Atlantic which brings southerly low-level marine flows towards Mediterranean coastlines."

- p. 7742, l. 4: I would suggest "low-level convergence possibly reinforced by an evaporative cold pool". As far as I know, the triggering mechanism is the convergence associated with flow-orography interaction. Then the cold pool may form and impact as well on the convective system development.

Of course the reviewer is correct on this point. The text has been changed to imply that the triggering mechanism is either convergence or the flow-orography interaction with re-intensification of the convection by an evaporative cold pool. "When heavy rainfall accumulations are observed on the plains or the sea, other mechanisms of convection triggering and sustainment are suggested, such as low-level convergence reinforced by an evaporative cold pool (Bresson et al., 2012; Ducrocq et al., 2008)."

- p. 7742, l. 8: "at meso-scale". Mesoscale ranges between 2000 and 2 km, stopping short of synoptic-scale phenomena (AMS glossary). "kilometric resolution" would be better.

Yes, kilometric resolution is much better. This has been rectified.

- p. 7742, l15: "They also showed . . ."

This has been changed

- p.7742, l24: I do not like "overcoming predictability", I would prefer "cope with" or something similar.

The reviewer is again correct. The phrasing has been changed to "cope with".

- p. 7742, l.27-30: I found this sentence a bit misleading. "Knowing which uncertainties" seems that you know a-priori which are the uncertainties that are important. However, it is clear that you try to take into account all the sources of

error (IC, BC, model) and the dynamics of the system will "select" those that grow faster.

On re-reading, the authors agree that the sentence was perhaps badly phrased. It has been re-written and is hopefully now clearer. "Taking the different sources of uncertainty into account in an ensemble design is a challenge, as the uncertainties can depend upon the biases of the computational model and on the situation under examination."

- p. 7744, l.7: "Mediterranean HPE simulations" are sensitive to IC and BC, not "Mediterranean HPEs" themselves.

Yes of course, thank you for pointing this out. This has been changed.

- p. 7745, l.2 "associated with"

Yes, this has been corrected.

- p. 7745, l.24: "warm unstable air converged". Was it really convergence or orographic uplift?

According to the HyMeX IOP7a report, convection was initiated for this case by the convergence of a warm unstable air-mass over the Gard and Ardeche departments. It seems as if the convection was then further enhanced by the local orography.

- p. 7748, l.8: turbulent parameterization time tendencies

This has been modified.

- p. 7748, l.9-13: Are the microphysics perturbations of WC and MT the same or different? In other words, do WC and MT differ only for the turbulence perturbations, or also for microphysics perturbations?

As correctly stated, the microphysical perturbations of the WC and MT ensembles are identical and the two ensembles differ solely in the perturbations applied to the turbulence parametrization time tendencies.

- p. 7749, l. 3 "ECMWF member simulation", otherwise it seems you are running IFS

Yes thank you, this has been changed.

- p. 7749, l. 12: How did you compute the averaged rainfall displayed in Fig. 5? Is it an average over the n. of grid points? And what about observations? Did you interpolate raingauges on a grid or just compute the average rainfall on the n. of observations in the domain?

The averaged rainfall is computed at the lat and lon points of the observations and is averaged by the number of stations in the domain. Does the reviewer wish that an explanation on this be included in the text?

- p. 7750, l. 15: were compared is repeated twice

One of them has been removed.

- p. 7751, l.24: it is not clear what is the role of the orography that should be increased. In the event description you wrote just something about convergence.

Thank you for pointing out this inconsistency. As mentioned previously, the authors still believe the convection to have been initiated by a convergent air-mass but that the orography then played a significant role in the development of the convective rainfall. This, we hope, is now reflected in the passage cited above which has been corrected to read "Although convective initiation was the result of a convergent air-mass, the orography played a substantial role in the evolution and sustainability of the convective system."

- p. 7752, l.11: indicates

Corrected.

- Fig. 5 and Fig. 10: it would be interesting to see the same figures including also the precipitation of the perturbed runs of the ensemble, just to have an idea of the impact of physical perturbations on the total precipitation. I am not suggesting to insert new figures in the paper, but maybe a comment if relevant.

The figures in question were plotted to include the perturbed runs of the ensemble, but they do not offer a very clear view of the impact of the perturbations upon the rainfall evolution and thus were not included. Because of this, the authors believe a comment upon such figures to be of little relevance.

- p.7753, l.16: ECMWF member simulation

Corrected.

- p.7753, l.28: "for cases. . . ." In the present form it seems a general conclusion, valid for all the cases characterized by precipitation in mountainous areas. I do not believe it can be really a general result.

The authors agree that such a claim cannot be made in a general sense and have changed the sentence to reflect the fact that the conclusions drawn are for this case only. "This lack of spread in the members' representation of the rainfall underlines the small role played by the microphysical processes for this case."

- p.7754, l.24: "Plots (not shown)": what are the plotted fields illustrating this?

The plots in question have now been specified. "A plot of the horizontal flow along the mountainous regions (not shown) illustrates that the turbulence perturbations change the interaction of the flow with the local orography, and thus displace the point of convective initiation."

- p.7755, l.13: Mediterranean HPE simulations"

Changed.

- p. 7758, l.1-5: is the intensity of the flow or the direct orographic lifting the very key factor?

Following the work of Bresson et al.(2012), where it was demonstrated that the strength of the impeding flow was the key factor in determining where convective initiation occurred for these Mediterranean HPEs, we also argue that the strength of the flow will decide whether or not the physical process and ICBC perturbations will induce comparable levels of dispersion.

- p. 7758, l.11-12: Comment: I would expect a much larger impact of the ICs wrt BCs, given the short forecast range.

The authors have performed some tests for the 2 HPEs described within this study and it was seen that the role of the BC is more important than the role of the IC, especially for the stratiform rainfall period of IOP7a. It seems as if the IC signal becomes overwhelmed by the BC after a number of forecast hours.

- References: Drobinky et al.is now available on-line with a doi

<http://dx.doi.org/10.1175/BAMS-D-12-00242.1>

Instead of the two papers of Fiori et al., you may want to cite Fiori et al paper on JAS <http://journals.ametsoc.org/doi/abs/10.1175/2010JAS3359.1>

The Drobinski reference has been updated and the suggested Fiori reference from JAS has been cited instead of the articles from the NHES and Atmos. Research

- Figs 4, 9: please, specify the period of accumulation.

This has been specified.

- Figs. 5, 10: please specify the date

The date has now been included.