

## Review of the manuscript

### „The impact of lightning and radar data assimilation on the performance of very short term rainfall forecasts for two case studies in Italy”

by

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The study discusses the impact of the assimilation of lightning and radar reflectivity data on the performance of very short-range rainfall forecasts for two convective case studies in Italy. They showed that especially the combined assimilation of both observation types has a clear and positive impact on the forecast performance.

The manuscript is interesting and tackles a very important subject, since the forecast of severe precipitation is still a major weakness of current forecast systems. With the supplemental material and the new material provided in the text, all my former comments are reasonably discussed.

One thing that is still open - the language needs a revision. English is not my mother tongue, but I stumbled over several things (some examples below in the minor comments – definitely not complete).

After a language revision, **I suggest the publication of the manuscript.**

#### **Minor Comments**

- Page 1 lines 16-17: ...two severe weather events that occurred in Italy ... over central Italy that occurred o 16 September 2017.
- Page 1, line 29: ... purpose because it changes a missed forecast ...
- Page 1, line 32: ... both data set are assimilated.
- Page 2, line 60 to 62: using the AROME model ... using the HARMONIE model ... using the JNoVa model
- Page 3, line 70: polar-orbiting satellite
- Page 3, line 79: I would replace “convective scheme” by “convection scheme”
- Page 3, line 83: convective events that occurred over Greece.
- Page 5, line 155-157: Infrared satellite images ..., show that the cold front moved slowly from NW to SE. ... it is apparent that the well-defined cloud system ... caused most of the daily ...
- Page 6, line 181: occurred within a few hours.
- Page 6, line 186/187: ... a trough extended from ...
- Page 6, line 188: “low pressure system”, instead of “pressure low”
- Page 6, line 189: It is noted that ... favoured ...
- Page 7, line 196: ... the Livorno and Serrano cases were similar and represented ...
- Page 7, line 197: ... the Livorno case was more intense ...
- Page 7, line 205: It is well evident that the cloud system was associated with a cold front ...

- Page 7, line 212: ...reflectivity factors up to ... Other clouds caused ...
- Page 7, line 213: The CAPPI shown in Figure 10a is the last one assimilated ...
- Page 7, lines 214 and 218: “described in detail in section ...” instead of “shown in section ...”
- Page 7, line 216: ... reflectivity factors up to ...
- Page 8, lines 241 to 243: Here it sounds as if it is not possible to implement the third domain only because of the complex orography. Clarify the sentence. I guess you mean:
  - Technically an operational implementation would be possible if enough computer performance is available
  - It is definitely not possible to do this for every region in Italy unless you have enough computer power to cover whole Italy with a 1 km nest
  - And the implementation needs careful testing – this is what you do in your manuscript
- Page 9: When you describe your simulations, I would consistently use past tense because the simulations are finished.
- Page 11, line 332: Use “with sensitivity studies for ...” instead of “by trial and errors considering “.
- Page 11, line 332: HYMEX-SOP1 occurs here for the first time. Describe the abbreviation here and not on the bottom of page 15.
- Page 12, line 354: What is DE?
- Page 13, line 407: It assumes a Marshall-Palmer hydrometeor size distribution ...
- Page 14, line 413: ... the control simulation ...
- Page 15, line 453/454: ... between 6 September and 6 November 2012; ...
- Page 15, line 463: ... choice is partially justified due to the sampling of ...
- Page 15, line 464: ... every fifth grid point ...
- Page 15, lines 471/472: Here it is not necessary to describe HYMEX-SOP1
- Page 16, line 505: Since lightning data assimilation also adjusts only the water vapour ...
- Page 18, line 557: Use “radar forward operator “ instead of “forward radar operator”
- Page 19, line 575: The RADLI forecast ...
- Page 19, line 580: A performance diagram ...
- Page 20, line 605: The location of the maximum is well represented, but the forecasted value ... underestimated ...
- Page 20, lines 627/628: ... heavy rainfall that occurred over the region.
- Page 22, line 675/676: ... caused by deeper convection ...
- Page 22, line 682: Comparing RAD and LIGHT, it is evident that ...
- Page 22, line 688: ... over the western part ...
- Page 22, line 689: ... reflectivity factor data assimilation.
- Page 24, line 751: “to some extent” instead of “in some measure”
- Page 25, line 780: “forecast range” instead of “forecasting time”