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Comment on nhess-2020-406

Anonymous Referee #1

Referee comment on "Investigating 3D and 4D variational rapid-update-cycling assimilation of weather radar reflectivity for a heavy rain event in central Italy" by Vincenzo Mazzarella et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2020-406-RC1>, 2021

Review of the paper:

"Investigating 3D and 4D Variational Rapid-Update-Cycling Assimilation of Weather Radar Reflectivity for a Flash Flood Event in Central Italy"

By: Vincenzo Mazzarella, Rossella Ferretti, Errico Picciotti, Frank S. Marzano

General comment

This paper shows the impact of 3D-Var/4D-Var cycling data assimilation of the WRF model for a case study occurred over central Italy in May 2018. CAPPI of radar reflectivity, provided by the Department of Civil Protection of Italy at 2, 3 and 5 km, are assimilated in WRF.

The Fraction Skill Score and the ROC curve and area are considered for the verification. Results show that the assimilation of radar reflectivity improves the precipitation forecast at 1h, 3h, 6h and 12h. Also, the 4DVar data assimilation shows better performance compared to 3DVar, especially considering the warm start.

While the paper is fluent and the subject interesting, there are major weaknesses that need to be addressed by the authors before this paper can be accepted for publication. In particular, there aren't maps of forecasted precipitation and maps to understand, physically, which is the impact of the analysis on the background field.

Major points

- The introduction of the paper is poor and not representative of assimilation systems and weather forecasting models operating over Italy. A more complete review must be provided.
- Precipitation thresholds: The precipitation thresholds considered in sections 6.1.1 and 6.1.2 are small and not representative of heavy precipitation. The maximum intensity considered is 7 mm/1h, which is too small to be representative of a deep convective event.
- Precipitation fields: there are no model output of the precipitation. The only precipitation shown is the observed one. Precipitation forecast is discussed only using a statistical approach, without any example of what is predicted and how the rainfall forecast is improved by radar data assimilation. A map comparison of forecasted precipitation and observed precipitation must be provided in order to understand which is the impact of data assimilation for the case study.
- Analysis fields: we know that the CAPPIS of radar reflectivity are assimilated in WRF but we don't know their effect. In general, when doing analyses, a comparison of the background and analysis fields must be shown to understand the impact of the data assimilation on the modeled fields. Nothing is shown.

Minor points

There are minor points to be considered. Please refer to the notes attached to pdf file to correct them.

Please also note the supplement to this comment:

<https://nhess.copernicus.org/preprints/nhess-2020-406/nhess-2020-406-RC1-supplement.pdf>