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Reply on RC2

Saoussen Dhib et al.

Author comment on "Sensitivity of the Weather Research and Forecasting (WRF) model to downscaling extreme events over Northern Tunisia" by Saoussen Dhib et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2020-376-AC2, 2021

Response to reviewer comments

Title: Sensitivity of the Weather Research and Forecasting model (WRF) to downscaling extreme events over Northern Tunisia Authors: Saoussen Dhib, Víctor Homar, Zoubeida Bargaoui, Mariadelmar Vich

We thank the reviewers for their time and helpful comments. We have addressed each point below. Reviewer comments are shown in bold, while author responses are shown in unformatted text.

This work presents a sensitivity analysis to the modification of the cumulus and boundary layer parameterizations in WRF in extreme precipitation events. The objective of this study seems to be focused on obtaining a better prediction of extreme events in the study area based on an optimal ensemble.

Response:

Yes, this is the main objective. Thank you.

Although the underlying idea of the work is interesting, the structure of the work, the exposition of the methodology and the discussion of the results is poor.

Response: the structure of the work needs to be improved. Authors recognize this fact. In the next proposal, section 2 will be dedicated to present data and section 2 for the methodology. In section 2 the reference to our previous work using MSG-MPE will be added. Paragraph 81-91 will be reformulated. the subsection 2.2 will be removed (as title). The word "event" will be replaced by "day" in all the manuscript. Also Section 2.4 will be suppressed (as title).

-The methodology is based on the use of conventional performance criteria such as RMSE, Pearson correlation coefficient and ratio test in the comparison of the maps obtained by

interpolating ground observations and those obtained using WRF predictions. In addition more sophisticated performance criteria such as SAL and FSS are used because they consider the internal spatial variability of the rainfall fields. Moreover, the methodology adopts the combination of PBL and Cu schemes assuming a given MP scheme. The criteria as rescaled and summed in order to base the comparison on a single composed criterion.

-the analysis is applied to the study of 4 days representing different conditions with respect to rainfall amounts and spatial variability. Results show that no single scheme can be recommended for the 4 studied days. The more difficult to be predicted are the day displaying the greatest rainfall amounts (12/1/2009) and that with the highest spatial variability (13/9/2008).

The objectives of the work are not clearly established, and the low quality writing makes very difficult to find a storyline.

Response: Thank you for critical feedback. We ensure that the overall purpose of the study will be more clearly defined.

WRF has many parametrizations the most common in the literature sensitive parametrizations for rainfall localization and intensity, are Cu, and much less PBL and Mp (Hewitson et al.2004; Tadross et al.2006). In this study, for each day, we will need to do 792 simulations (Cu with 11 schemes, PBL with 9 schemes and Mp with 8 schemes) to get a satisfactory configurations which can be find only with testing numerous physical parameterizations. 10 simulations takes in average 4 days which depends on the UIB department server availability. Also, usually we should run again about 20% of the simulations each time because of WRF crash or internet interruption. Then, for the 792 simulations we will need 380 days for each event. It is clear that the simulations duration is very long and it should be reduced with conservation of the performance of the WRF rainfall estimation. The aim of this study is to choose the best representing schemes of extreme rainfall by WRF over Northern Tunisia which will make the use of WRF more efficient for users in short time.

In general, the article is written in a fuzzy and lazy way. This makes very difficult to follow it and understand the message that the authors try to send. For all these reasons, I cannot recommend this paper for publication.

Response: We ensure that the revised manuscript will be edited by a native English speaker to improve comprehension and quality.

The authors should rewrite the article again, trying to give it a rational structure, a more complete and rational exposition of the configuration of the experiments carried out, and a more detailed and clarifying analysis of the results.

Response:

Thank you for the suggestion. In the updated manuscript, we will ameliorate the redaction quality of the whole paper, add deeper discussion, compare our results with many previous founds as suggested.

Below I list as an example some of the points on which I base my review l-15. latitude should be location

Response: Yes, thank you. **l-22. "What schemes?"**

Response: WRF is based on parameters representing the various physical processs. We consider particularly Cumulus (Cu), Planetary boundary level (PBL) and micro physics

(MP).These parameters have many options which depend of the physical process complexity. These options are what we call "schemes". The schemes description is presented in Table 1. They are 9 different schemes for representing Cu and 11 for representing PBL.

-After line 58. What are your objectives? What do you can provide as new knowledge?

Response: the reviewer is right. The literature review shows that the performance of the parameterization of WRF is not known a priori. No best parameterization can be recommended for a given case study. It depends on the metrics used for evaluation, and on the case study itself (the geographical region and the type of rainfall event). All previous mentioned research examines few schemes from each parameter. It is the first sensitivity study for rainfall estimation over Tunisia. The originality of this research appears in two components. Firstly, we will test all the schemes of each parameter. Secondly, we will choose not one best combination but the 10 best combinations which will be averaged later to give an ensemble map. This ensemble map will give the best estimation in comparison with all the other individual combinations. Secondly, based on the sensitivity study we selected 3 best schemes for each parameter (PBL, Cu) which have the ability to give a good results for the various extreme event types.

l-63. In situ data....Observations??

Response: In situ data are observed rainfall amounts using the national rainfall network of Tunisia. Observations are daily rainfall.

l-68. spatial resolution?

Response: interpolation of in situ data is achieved using a 10 km spatial resolution

l-72,94. Where do you interpolate precipitation data? Some information about the mesh must be provided.

Response: the mesh is 10 km. It is represented in figure 1.

l-94. Why interpolate data?? In fact, the results of the crossvalidation show not very good results.

Response: The in-situ stations are not well scattered in the 10 km resolution. Some pixels have 5 stations and many others pixel without any information. That is why we interpolated data. Other approaches may be used such as comparing WRF grid nodes with the nearest observed locations.

l-112 are these the variables you use to build initial and boundary conditions. This has no sense.

122 (ERA) is dynamically downscaled using WRF to obtain downscaled reanalysis at 10 km resolution.

Response: paragraph 108-122 is aimed to briefly describe the ERA-Interim global atmospheric reanalysis variables and WRF model. We will rewrite it in clearer way.

l- 119. (Figure 4) What domain is that? How many domains do you use? Which

resolucion?

Response: We will change the Figure 4 with a figure showing the two used domains with their coordinates. The resolutions of the two domains are 30 km and 10 km.

**** Here, a complete model configuration should be exposed (radiation, LSM, etc), as well as spatial configuration (vertical levels, soil ... etc) In addition how simulations were done (simulated time, spin-up period,**

Response: Yes thank you. We will add all the setup details.

l-125 The description of Cumulus schemes is not usefull at all. If authors try to explain something they have to clasify the schemes used, for example if they are or not flux mass schmes, trigger mecanish . etc.

Response: the classification is presented in Table 1. The text will be reformulated in order to be more informative and in relation with the rainfall estimation. You are right. Thank you.

-134 The same as before

Response: In the updated manuscript, we will highlight the difference of the various schemes in Table1 and how it will influence the rainfall forecast.

- About the metrics.. It is really necessary to use all these metrics? Each metric focus on different aspects of the skill. What is the sense of use a metric that is sum of all?

Response: Each metric gives an evaluation aspect and has drawbacks and good points. Before doing the sum we rescale the metrics. This is a way to weight to metrics in order to consider one single evaluation score.

Yes the reviewer has right. One can consider one single criterion in a time, rank the schemes and identify the best in the light of each criterion separately. This will be done.

l-244 You inverse the metric (X) ... what do you mean?? 1/X???

Response: Yes. in order to allow it the give the best result correspond to the low values of the metric.

****Some more comments.**

-Figure captions should be improved. All information needed to interpret the figures must be in the caption.

Response: We will do it.

- You dont argue why the selection of these 4 cases. I do not understand why undetected evens by satellite are candidates for the case selection.

Response: This research is a continuity of previous evaluation of extreme events over Tunisia using satellite data (Dhib et al. 2017). These 11 cases remained without response when using satellite information. We looked for other means to predict them. These 4 cases are well selected to represent the 11 cases. We took the day displaying the greatest average rainfall, greatest spatial variability represented by spatial standard deviation, the day which is ranked second for the average, and an average day for both spatial average

and spatial variability. They are shown in Figure 2a.

- FIgures 8, 9, 10, 11. why they have different styles??

Response: This will be homogenized. Thank you.

We would again like to thank the reviewers for their time and helpful comments.