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Hydrology and Earth System Sciences Discussions

Interactive comment on "Simulation of a persistent medium-term precipitation event over the Western Iberian Peninsula" *by* S. C. Pereira et al.

Anonymous Referee #2

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The authors present a case study of a large precipitation event in December 2009, which is used to test the ability of the WRF regional model, run with different nudging schemes, to reproduce the event. The event is resolved on a high horizontal grid of 1 km using two-way nesting. They apply three different methods: no nudging, observational nudging and grid nudging. This study can make an interesting contribution to testing the performance of high-resolution regional models on high precipitation events but its presentation is hard to follow at times which hinders the validation of some of their conclusions. I have several questions which should be clarified in the text before publication. Also so many metrics for model validation, most of them in a table format, are presented that it is really hard to grasp the main findings. Could the verification

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metrics be shown in bar plots, for example, instead of tables? Another issue is that most of the figures and tables are illegibly small. The size of the axis labels has to be increased significantly and perhaps even consider dividing them into more figures with less information in them. The language could be more accurate.

Furthermore, I have some concerns on the methodology used for nudging.

1) Only one data point (Pousada) was used for observational nudging. This will obviously have no impact on the results some distance away from the station and therefore no large improvement can be expected. I see that the authors do not want to use all of their station data for nudging, leaving them with no data for validation, but this point should be made clear. The reader needs to grasp what can be expected from the results.

2) Grid nudging is used in all domains, even the 1-km one, with 2-way nesting. Nudging too strongly towards coarse resolution data may overrule the benefits obtained from downscaling. This approach is likely to produce results very similar to the GFS. For this reason spectral nudging is often used, limiting the nudging only to long waves. Did you consider nudging in the outer domain only, or using the spectral nudging option in WRF? There should be some discussion on these points.

3) The main results seem to conclude that the timing of the precipitation occurrence was well simulated in every case, but the precipitation intensity was largely overstimated, independent on the nudging used. I think one should start with looking into the boundary conditions, is the precipitation rate overestimated in the GFS data as well? If I understand you correctly, the Dec 2009 included many frontal systems coming from the Atlantic. Were indications of such systems visible in the SLP fields, for example? My point is, was there any improvement to expect from the downscaling if boundary conditions were wrong to begin with?

More detailed comments:

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Abstract: I think it should be stated more clearly in the Abstract why the period of December 2009 was picked. "The heavy to extreme rainfall periods were caused by..." are you referring to the period of Dec 2009 or some other periods?

Points (1), (2) and (3): either make a sentence, including a verb, of all or none of them.

Introduction

p. 1425, l. 11: it looks like the abbreviation l30 is not used for anything and could be dropped.

p. 1426, l. 7-8: "domain resolution" and later "domain"? Do you mean domain horizontal resolution and size/position of domain? Please clarify.

p.1426, l. 14: "similar results..." , similar to what?

p. 1426, l.18: "precipitation integrated over time and space" I'm not sure what is meant here.

p.1426, l. 18-22: I have trouble following this sentence. "not dependent on cumulus cell parameterisations ... against explicit precipitation calculation"

p. 1426, l. 22-24: Same with this sentence. Perform worse than what? Either you use cumulus parameterisation, or if your grid size is fine enough, you resolve the precipitation explicitly.

2 Materials and methods

Remove "materials", to my understanding there are no materials associated with this model study.

p. 1427, l. 26: Is there no influence of the Atlantic on the climate? p. 1430, l. 13 states that the western boundary is important for the model to capture the dominant atmospheric circulation patterns.

p. 1428, l. 25: "IDF long-term IDF curves in the dataset". Please explain IDF and

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double check the sentence.

p. 1429, l. 16: Andaluzia -> Andalucia

p. 1429, l. 22: "on the winter modelled precipitation..." -> "on the modelled precipitation in winter than in summer" or similar

p. 1430, l. 16: are 27 vertical levels enough for an 1-km resolution?

p. 1430, l. 28: was the convective parameterisation used even in the 1-km domain? Probably p. 1426 lines 18-24 justified this somehow but it was hard to follow.

Section 2.3

My comments 1)-3) regarding nudging could be discussed here.

Section 2.5

If the metrics used are standard statistical measures it may not be necessary to write them here, just refer to a book.

p. 1432, l. 14: add a comma before "namely" and remove -ly from "spatially"

p. 1435, l. 15: remove comma after "Meaning"

p. 1435, l. 17: "neither rescaled nor transformed", what do you mean by that?

Table 4: perhaps the errors could be given relative to the mean, or %, to be able to intercompare the numbers.

p. 1436, l. 24-> why do you think these stations behaved differently, are they located in a similar area?

p. 1437, l. 3: remove "of"

p. 1437, l. 3-7 & Figure 2: The figure is barely readable in my copy of the manuscript. Its size needs to be increased. Why do you expect all grid points in the domain to correlate with any given station? My suggestion would be to show the correlations

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station-nearest grid point at the location of the station to see how the model performation varies spatially, with three figures, one for each run.

p. 1437, l. 9: "+3" add unit, is it 3 hours?

p. 1437, l.9-10: "the association among series was .." I do not understand, what kind of association do you mean?

p. 1437, l. 12: "slightly worst" sounds strange.

p. 1437, l. 13: what is "mode"?

p. 1437, l. 24: "week" -> weak

p. 1437, l. 27: " This result was not detected in the ME", why not? If the mean values are too high, shouldn't that be seen in the ME?

p. 1438, l. 4: the frequency distributions are very typical for rainfall (see Wilks, 2006, for example).

p. 1438, l. 7-8: what is "the three times the IQR area"?

p. 1438, l. 18: There are three experiments: one free run and one with observational nudging on one single point, which is likely to produce similar results to the free run outside of the (small) area influenced by the obs. nudging. Then there's the very strongly nudged RunGridN which is likely to produce very similar results to GFS, and different from the two other experiments. This is mainly what you see but the background for it should be made clear in the manuscript.

p. 1438, l. 20: slight -> slightly

p. 1438, l. 21: "this charasteristic is more pronounced", please be more explicit. The RunGridN results perform better for the .... thresholds, or similar.

The fact that the grid nudged experiment performs well in reproducing low precipitation values is not surprising because it is forced towards the coarse resolution GFS data,

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which is probably averaging out the high precipitation events due to reduced orography and coarser time resolution.

p. 1439, l. 11: remove comma after "study"

p. 1439, l. 17, "WRF model" -> WRF model's or of the WRF model

p. 1441, l. 10-14: I guess which scheme works best depends on the typical weather regimes and the time of the year you're simulating. Simulating areas with high convection is typically a hard task and would probably lead to better agreement with observations in winter. Therefore comparing various case studies in different regions is difficult.

4 Conclusions

Mention the period of the study right at the start.

p. 1441, l. 18: "measured gaps" -> gaps cannot be measured, do you mean gaps in measurements or similar?

p. 1441, l. 24: explain abbreviations in "Conclusions"

p. 1442, l. 9: introduce classes rather than use abbreviations

p. 1442, l. 11-15: What kind of skill are you referring to? The very coarse vertical resolution versus fine horizontal one might cause problems, especially in complex terrain. What were the resolutions studied in Liu et al., 2011? In your case the precipitation rates are overestimated throughout the region so too large spatial scatter doesn't seem to be the reason for the discrepancy. It should be easy enough to assess by looking at 2D fields whether these problems arise from too much spatial noise. In mountainous areas the use of a coarse resolution will lead to an underestimation of the orography and orographic precipitation, so concluding that the best results are achieved with a coarse resolution probably won't hold. I think a starting point would be to increase the vertical resolution. Then apply spectral nudging and perhaps try reducing the down-

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scaling ratio to 3 between the domains.

p. 1442, l. 19: You mention that your model reproduced the timing correctly?

p. 1442, l. 25: RUNGridN -> RunGridN

Tables 1 and 4 are very small.

Increase the size of text in figures 1, 3, 4, 5, 6 and 7.

Figures 2, 6 and 7 are nearly impossible to read.

Table 4: better to show the errors in %.

Table 7: the title says "RunObsN" instead of RunGridN

A comment to tables 5-7: the correlation coefficients are surprisingly low. Looking at figure 3 the model seems to capture the timing of the events quite well. What is the reason for this?

Table 8: What is "mode"?

Figure 1 caption: D03 frame marks... I think the triangle marking Pousada is red "area of ..." perhaps rather give the dimensions of the domain in X km x X km which is easier to grasp.

Figure 3: the titles say RunObs-OBS suggesting we're seeing the difference. However, the caption simply states "precipitation series". "second" and "third" experiment are confusing, simply use the abbreviations RunRef etc.

Figure 5: What is IQR? Cannot it be expressed in percentiles for consistency? I would call this plot a frequency distribution to be consistent with the terminology used in the text.

Figure 6 caption: "negative values of the measurement", do you mean negative difference from measurement, i.e. model underestimates observation?

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Figure 7: This figure requires more explanation. What are the blue, green, orange and blue bars representing? What is "PC measurement"? Perhaps draw a line at 1 or whatever is the perfect measure to be able to assess the errors.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 1423, 2013.