Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-106-RC2, 2016

Hydrology and Earth System Sciences
Discussions
Open Access
EGU

Interactive comment on "Local impact analysis of climate change on precipitation extremes: are high-resolution climate models needed for realistic simulations?" *by* H. Tabari et al.

J. Olsson (Referee)

Jonas.Olsson@smhi.se

Received and published: 14 April 2016

The authors compare climate model simulations and observations at different spatial and temporal resolutions with respect to extreme precipitation (rainfall) statistics. Further, (Delta Change) climate factors are calculated and compared for different model resolutions. The topic is interesting and relevant, the material/methods/results are overall accurate as far as I can judge and overall the study should be worth publishing. However, I am not completely satisfied with the presentation and I also have some doubts about the experimental set-up as well as the interpretation of the results; a major revision is recommended.

General comments:

Printer-friendly version

Discussion paper

- Using data from just one climate model grid cell is questionable (or, essentially, not allowed), especially when the topic is rainfall extremes. There can be a quite pronounced variability between neighbouring cells and this variability needs to be sampled, maybe by using (at least) 3×3 matrices or something.

- In some figures (e.g. 1, 3, 4 and 6) the authors lump (or pool) observations and simulations on widely different spatial resolutions and sometimes different temporal resolutions too. This first of all makes the figures difficult to read but also the interpretation is rather confusing. Extremes on different resolution conceivably represent different types of physical processes, in different seasons, but this is not much considered in the discussion. The issue is (according to the title) "local impact analysis" and it is not very clear what the low-resolution analyses add in this respect.

- There are different types of observations/analyses (gauge, E-OBS, ERA) as well as many model versions (resolutions, model types, forcing) included in the diagrams but the significance of these different dimensions are seldom assessed but the versions are lumped which makes the text hard to follow. If including all these data/dimensions the results must be accompanied by a very systematic evaluation.

- Please make the figures a bit more reader-friendly by a more systematic use of colours and symbols to represent different dimensions of the data shown (Fig. 6 is quite good in this respect, although it pools different temporal resolutions).

- About permitting convection or not, we have shown that only by increasing the spatial resolution a non-convection permitting model can quite well reproduce local sub-daily extremes (Olsson et al., 2015). Possibly the spatial resolution itself (and associated effects such as topographical representation) is at least (or more) important than whether convection is parameterized or explicit. This needs to be discussed. And it would be interesting to compare both options on the same resolution (maybe already done?), I have heard that in some cases too much convection becomes permitted and the extremes go wild.

I started commenting with a high level of detail below but after the end of page 5 I ran a bit out of time and after that only some selected comments are included.

Specific comments (page, line):

- (1,17-19): Do you intend to say that the high-resolution models better capture local sub-daily extremes than the larger-scale forcing?

- Fig. 1: It would be easier to read if different panels were used for different resolutions (or resolution intervals). Try to use similar symbols or colours to represent similar features in the data (resolution, model, etc.).

- (4,26-30): How well do the different data sets (point, E-OBS) agree on daily/monthly/annual scales? This should be shown.

- (5,6-8): How do you mean “higher resolution results in more extreme precipitation”? Extremes exist at all resolutions.

- (5,9-10): Which 2.8 km CCLM are you referring to here? At least one of them looks quite biased.

- (5,10): “increasing skill with increasing resolution”, how do you conclude that from Fig. 1?

- (5,9-15): It is hard to see any clear difference above and below T=2.

- (5,12-13): Very difficult to judge from the figure.

- In Fig. 1 the period 1961-2000 looks to have higher observed daily summer extremes than 2001 but in Fig.2 it looks like the opposite.

- Fig. 2 is basically redundant if dividing Fig. 1 into resolution-specific panels.

- (5,18-20): In winter CNRM-CM3 is closer.

- (5,22-24): Confusing sentence. In what sense does CCLM show a “great ability”? And there is no large underestimation in EC-EARTH what I can see.

- (5,24-25): From the figure it is not obvious that the % bias decreases with increasing time scale.

- Fig. 3: Please add minute and hour on x-axis for improved readability. And I do not like that identical lines and symbols are used to represent different return periods, it is not very helpful for the reader.

- (5,30-31: Which “ALARO runs”? There are several and they are very different, it is not meaningful to talk about “most runs” (same goes for next sentence). What do you mean by extrapolated?

- (5,33): Why “design storms”?

- (6,2-3): I think EC-EARTH agrees quite well with the gridded observations ($\geq$1 day).

- (6,5-7): This sweeping statement about “the CCLM model” is not very helpful; there are many and very different models.

- Fig. 4: What is the added value compared with Fig. 3? How much in Fig. 4 is not based on extremes from JJA. An in-depth look at this issue could potentially reveal interesting features and limitations in the models.

- (6,26): “imaginary extending” is generally not a very accurate concept and quite difficult in this specific case, then better parameterize the curve and extrapolate it.

- (6,35-37): What do you intend to say with this sentence?

- (7,8-9): In relation to what? It would be very surprising if EC-EARTH captured the local sub-daily extremes (also a bit worrying, as it is not supposed to do that). And if imaginary extending the gridded curves the underestimation does not look very remarkable (if I imagine correctly). Please clarify.

- (7,26): It is not relevant to talk about “drier summer” and “wetter winter” when extremes are analysed and not seasonal totals.

- (8,2): Please discuss the figures one at a time, now it is unclear to which figure the following text refers.

- (8,4-7): How do you interpret the fact that summer extremes decrease in the 7-km projections (esp. at 3-h scale)?

- (8,25-27): Do you mean local sub-daily precipitation?

- (8,27-28): Or that the impact of spatial averaging decreases with increasing resolution.

- (9,3-5): Again, do you mean local sub-daily precipitation?

- (9,8-12): Long and hard-to-read sentence.

- 9,15-19): On the daily scale also CCLM(2.8) is quite similar to the driving GCM (EC-EARTH) (Fig. 6), the agreement looks overall similar to ALARO/CNRM (Fig. 5). The differences found seem to be a function of time scale rather than model. Again, this pooling of resolutions makes interpretation difficult.

Olsson, J., Berg, P., and A. Kawamura (2015) Impact of RCM spatial resolution on the reproduction of local, sub-daily precipitation, J. Hydrometeorol., 16, 534–547 doi:10.1175/JHM-D-14-0007

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-106, 2016.

Printer-friendly version

Discussion paper