

Interactive comment on “Role of atmospheric horizontal resolution in simulating tropical and subtropical South American precipitation in HadGEM3-GC31” by Paul-Arthur Monerie et al.

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We thank the reviewers for their constructive comments and suggestions. We have given full consideration to the comments in the revised manuscript. Please find below a point-by-point reply to the questions raised.

Review: HadGEM3-GC3.1 atmospheric-only simulations are assessed to discuss the impacts of horizontal resolution increasing on the precipitation climatology and precipitation variabilities (in intensity and in the space and time) over South America. Three ensembles of HadGEM3-GC3.1 with horizontal grid spacing of approximately 130 (N96), 60 (N216) and 25 km (N512) are compared with reanalysis (NCEP

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and ERA-Interim) and satellite data (CMORPH) to evaluate the impacts of resolution on precipitation using different metrics (climatology, seasonality, large scale influences of MJO and ENSO, coupling between precipitation and soil moisture, intensity distribution, dry spells, etc.). The results are new and very relevant since are showing that improvements on precipitation occur when the resolution is increased from N96 to N216 for most regions of South America, while over the Andes Mountains the improvements continue until N512. The improvements are associated with better simulation of moisture flux convergence and daily precipitation distribution at fine resolution. In addition, the authors do not found any relevant impacts of resolution on low-frequency variability of precipitation (MJO and ENSO forcings). Overall, this study contributes to understanding the impacts of model resolution on precipitation at spatial and temporal and some limitation of resolution refinements. The manuscript has new contributions to the atmospheric modeling area and it is worthy of publishing after some minor revisions.

Minor comments

In some parts of the text appear “north-east”, “south-east” and in others, respectively, “northeast”, “southeast” to refer to the same geographical regions in Brazil ((Lines: 16,17, 31, 32, 43,..., 504, 508, L514,...). Please, to unify how to refer to these regions preferentially using “northeast” and “southeast”

» Thank you for your comment, we have rephrased the text, using northeast and south-east instead of north-east and south-east.

L32, L51, L82 – “de Souza Custodio et al. 2017)” to “Custodio et al. 2017)”

» We have changed the reference throughout text, editing the reference to Custodio et al. (2017).

L38 – to remove “over South America”

» We have removed “over South America”

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L57 – In relation to the “South American Monsoon System à ÈÀ ÌÀÌ...” to refer to Vera et al.(2006). Vera, C., et al. (2006), A unified view of the American monsoon systems, J.Clim., 19, 4977–5000.

» Thank you for the reference, we have now added Vera et al. (2006) in the main text.

L103 – should be “improves the modeled precipitation variability over...”

» We have changed the sentence accordingly to your comment.

L142-143 – Please, to include the information of what are the horizontal resolutions of GPCC, University Delaware, NCEP-NCAR and ERA-Interim.

» Both GPCC and UDEL precipitation are provided on a 0.5° horizontal resolution. NCEP-NCAR is gen at a 2.5° horizontal resolution and ERA-interim at a 1.5° horizontal resolution. This information has been added to the data section (Sect. 2.2). Please see: “To evaluate time-mean rainfall and sub-seasonal to seasonal variability, we compare HadGEM3 to longer-period, but lower-resolution, gauge-based datasets from the University of Delaware (Willmott et al. 2001) and from the Global Precipitation Climatology Centre (GPCC; Schneider et al. 2014), both at a 0.5° horizontal resolution. We assess mean circulation against the NCEP-NCAR reanalysis (Kanamitsu et al. 2002), given on a 2.5° resolution (144 × 72) with 17 vertical levels, and ERA-interim reanalysis (Dee et al. 2011), given on a 1.5° horizontal resolution.”

L146 – The citation of ERA-Interim in this context is wrong since it is available only from 1979. Please, check.

» Thank you for your comment. This is a mistake, we have used NCEP to assess biases in monthly mean wind. The sentence has been corrected.

L194 – I suggest to change “over the equator...” to “over tropical latitudes...”\

» We have changed “over the equator” to “over tropical latitudes”.

L195 – “eastern Brazil is relatively dry” should be “northeastern Brazil is relatively dry”

since in subtropical eastern of Brazil precipitation is between 4-6 mm/day, which cannot be considered dry

» Thank you for your comment, we have rephrased the text following your suggestion.

L231- Is hard to interpret Figures 2d-e-f since they do not show any important difference over the continent. This occurs because they are using the same scale of Figures 2-a-b-c. I suggest to the authors to remove Figures 2d-e-f or to change the scale to illustrates what is important in terms of evapotranspiration over continental areas.

» Our point is here to show that effect of the resolution it not mediated by changes in evaporation, and that effect on precipitation is primary due to large-scale changes rather than to local changes. Therefore, we think that it is important to keep the changes in evaporation in the main text. We do prefer to keep the same scale to compare changes in moisture flux convergence and evaporation so that both fields are easily comparable. We agree that patterns in evaporation but this is due to the fact that changes in evaporation are rarely significant and that changes in precipitation are most only due to changes in moisture flux convergence.

L346– change “1, 7 and 8...” to “1, 7 and 8 (Fig. 6a-g-h)...”

» We have corrected the typo.

L386 – change to “moisture flux convergence...”

» We have rephrased the sentence, using “moisture flux convergence” instead of “moisture convergence”.

L395 – “over eastern Brazil...” should be “over eastern Brazil and southeastern South America “

» Thank you for your comment, we have added “and southeastern South America” in the sentence.

L416 – I am seeing overestimation in Figure 9e over northeastern Brazil (the box to east 45oW and north 15oS) and not over “eastern Brazil”. Please, verify the affirmation.

» We have rephrased the sentence, changing “eastern Brazil” by “northeastern Brazil”.

L457-459 – Please, check the letters of Figures 10 and 12: a) L457 “Fig. 10c and Fig.10e” should be “Fig. 10h and Fig. 10j”; b) L458 “Fig. 10e; Fig. 12g” should be “Fig.10g; Fig 12e”; c) L459 “Fig. 10e; Fig. 12h-j” should be “Fig. 10h-j; Fig. 12e”.

» We have rephrases the text, correcting “Fig. 10c and Fig. 10e” by “Fig. 12c and Fig. 12e”, “Fig. 10e; Fig. 12g” by “Fig.10g; Fig 12e”, and “Fig. 10e; Fig. 12h-j” by “Fig. 10h-j; Fig. 12e”.

L461 – The correct location are “Peruvian Andes, Paraguay, and northeastern Argentina”

» We have rephrased the sentence, changing “eastern Argentina” by “northeastern Argentina”.

L475 – “function of time (Fig. 13a-d) and distance (Fig. 13e-h)...” should be “function of distance (Fig. 13a-d) and time (Fig. 13e-h)”

» Thank you to pointing this mistake out. We have corrected the text.

L489 – “precipitation features...” should be “simulated precipitation features...”

» We have rephrased the text following your suggestion.

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