

## ***Interactive comment on “HighResMIP versions of EC-Earth: EC-Earth3P and EC-Earth3P-HR. Description, model performance, data handling and validation” by Rein Haarsma et al.***

### **Anonymous Referee #1**

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This paper describes the EC-Earth3P and EC-Earth3P-HR models developed for the HighResMIP with a lot of details, including optimization (necessary for high-res modeling) technical aspects of scalability, performance, data-storage, and post-processing and documentation of model performance regarding the mean climatology as well as variabilities. The manuscript is generally well-organized and clearly written.

General comments:

My concern is that I feel it belongs to the “Model description paper” category instead of the “Model evaluation paper”. The model results seem not the primary focus and are mainly presented in a documentation manner without more in-depth analysis and

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scientific insights. As stated in the middle of the text, more extensive analysis will be shown in a future paper. I suggest the authors revise it to better fit the criteria of the model description type and leave more results and analysis in the other paper.

Specific comments:

Title: The “model performance” can mean either computational performance or the quality of simulation results. Putting in the middle of “description” and “data handling”, it sounds more of the former, so perhaps change it to “computational performance”. Also change “validation” to “initial validation” to coordinate with the second paper?

L87: seems a good place to add resolution info since that info is given for Earth3P-VHR on L89.

L100: temporal resolutions, time steps?

L175-177: It can be a bit misleading to imply the optimization of components and load balance are purely sequential. In practice, they can be parallel, for example in the incidents that component optimization is only possible with a load rebalance.

Figure 2: change the label “SYPD” to “coupled EC-Earth3P-HR”?

L216: Where on Figure 3 can we see the 4 times of communication pattern?

L225: I am not sure what parts on Figure 3 this paragraph refers to. Please clarify.

Figure 3: This figure is too noisy. Perhaps, the authors can replot it to better support the points they want to make with improved labels, organization, and clarity.

Figure 5: change “hist-1950” to italic

L383: ... in Table 2

Figure 6: Add the global means and RMS errors (which give some overall ideas about the model performance) and discuss these numbers in the text. Change the title of figures to, for example, “. . .EC-Earth3-HR minus ERA-Int” to be clearer. Add labels (a)

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and (b). Also make these changes on other figures where applicable.

L408: change to "...Greenland (Fig. 9), which is ... MSLP bias (Fig. 7a)."

L413: I would wonder whether enhancing horizontal resolution has a negative impact on performance. The global mean biases and RMS errors (suggested above) are helpful to provide some quantitative measure.

L430: Perhaps can add some figures to support this point.

L444: Any explanations why this activation of deep convection at the Labrador Sea occurs in the low-res version, but not in the high-res version?

Figure 11: I suggest using different colors for different simulations, but similar ones for the same resolution – redish for low-res; blackish for high-res. I also suggest the authors add a panel of net radiation fluxes at the top of the atmosphere to show the energy balance of the whole Earth system.

Figure 13: Isn't it clearer to compare if the model results are shown in the same manner (lines instead of bars) as the observation? I find it is difficult to follow the seasonal cycle of EC-Earth3P – The base changes every month. Please revise it.

L534: trend -> drift? The trend on this line has a different meaning than the ones towards the end of the paragraph, so should use different words to distinguish.

L535: change to "...hist-1950 minus control-1950..."

Figure 18: I understand the authors scale the right panel to fit the starting point of the curves. But it looks a bit weird to leave large white margins on it. Please revise.

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