

Earth Syst. Dynam. Discuss., author comment AC2  
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## Reply on RC2

Ole Bøssing Christensen et al.

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Author comment on "Atmospheric regional climate projections for the Baltic Sea region until 2100" by Ole Bøssing Christensen et al., Earth Syst. Dynam. Discuss.,  
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***In the following we quote the reviewer in ordinary typeface and set our replies in boldface italics.***

***The authors thank anonymous reviewer 2 for the very useful comments. In general we agree with the suggested changes. A few remarks can be found below.***

The manuscript updates former climate assessment reports for the Baltic Sea region with respect to the discussion of climate projections. They use simulated projections by an ensemble of atmosphere-only regional climate models (RCM) within the Euro-CORDEX (cf. [www.cordex.org](http://www.cordex.org)) initiative and additionally they use an ensemble of simulations by a coupled RCM (with RCA4-NEMO) which has been discussed in literature before. It would be nice to see a model ensemble of coupled simulations, but they are not available or at least not as easily available as the Euro-CORDEX simulations. In my opinion, the assessment update is worth to be published because it discusses causes of changes in the projections too. However, the manuscript needs some improvements before.

In the abstract the authors write "in this review paper, we will concentrate". The manuscript does not properly review, but in put the new simulations in context. I suggest to change the wording.

***This paragraph is planned to be reformulated, as it does not describe properly what the paper contains. We will take this comment into account.***

Line 140: "higher warming is expected for land areas" – the given arguments (a) miss references and (b) miss additional causes (e.g. as water vapor which is mentioned by the authors later at line 166). Line 143: "the spread between quartiles is lower" – here too references are missing. The manuscript tends to lack supporting references.

***The sentence starting on L140 has been revised and now reads "Larger warming than the global average is generally expected for land areas, which warm more quickly than sea areas where also enhanced evaporation tends to reduce warming (e.g. Sutton et al., 2007) ); it is most clearly seen in winter in the eastern part of the area.". We've also added a reference to the sentence starting on L143.***

Line 179: Is it possible that the simulated differential changes, change patterns in precipitation are biased by the selection of GCMs or the over-representation of GCMs (looking at Tab. 1, 3 of 8 GCMs are more often applied than average)?

***This is indeed possible, but the net effect is small due to the already large ensemble. A direct average, as also done here, has been compared to a "democratic" matrix with emulated values used for missing GCM-RCM combinations in a Deliverable report, D1.4.2 from the H2020 PRINCIPLES project. The technique is described in Christensen and Kjellström (2021). The effect of the incomplete combination matrix is negligible for the area and fields described in the current manuscript.***

***Christensen, O.B., and Kjellström, E. 2021: Filling the Matrix: An ANOVA-Based Method to Emulate Regional Climate Model Simulations for Equally-Weighted Properties of Ensembles of Opportunity, Clim. Dyn. In press. <https://doi.org/10.21203/rs.3.rs-366374/v1>***

Minor issues:

- Line 25: There is AR6 now using SSP scenarios. Should be mentioned, even with no RCM ensembles available yet.

***Here, we have added " The most recent, sixth assessment report (IPCC 2021; AR6) build on the successor CMIP6 (Eyring et al., 2016) that involves a new set of Shared Socioeconomic Pathway (SSP) scenarios (O'Neill et al., 2017). This has, however, not been addressed here as, at this point, downscaling activities based on CMIP6 projections are still lacking."***

- Lines 27 - 100: I have difficulties to understand these sentences and they are probably better placed in the Results section.
- Line 248: ".."
- Line 272: The lower limit of grey zone grid-spacing is ca. 3-5 km.

***We agree. This will be revised.***

- Line 377 "becausesnow"

***This will be corrected.***

- Line 393-4: Two times "may". Are there other possible causes?

***We will revise the text in the manuscript***

- Line 415: This is not true for all atmosphere-only models. Some have their own sea-ice parameterizations which were used, I guess, in their Euro-CORDEX set-up.

***We will revise the text in the manuscript***

- Line 421: How many ensemble members? Only 5 members in total?

***Only 5 ensemble members are represented in both ensembles, coupled and atmosphere-only. There are, unfortunately, known errors in the CNRM GCM simulation.***

- Line 572: The sensitivity of the regional models' newer versions decreased? Is there any idea why?

***We have revised this statement on regional sensitivity. Differences between the ensembles are very small in winter but more in line with the differences in the global mean temperature for summer.***

- Some of the Figs. titles are cut off (e.g. 11, S26, 27)

***This will be corrected, replacing the panel titles with column and row labels in the figure.***