Earth System Dynamics Discussions

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Reply on RC3

Ole Bøssing Christensen et al.

Author comment on "Atmospheric regional climate projections for the Baltic Sea region until 2100" by Ole Bøssing Christensen et al., Earth Syst. Dynam. Discuss., https://doi.org/10.5194/esd-2021-51-AC3, 2021

In the following, the review is quoted in ordinary typeface, and our replies in boldface italics.

The authors would like to thank the anonymous reviewer for very useful comments. Most of the suggested changes will be carried out in the revision. Some specific rebuttal comments can be found below.

The manuscript is about an analysis of the results of a large number of simulations with several different atmospheric regional climate models. In addition the authors include 22 simulations performed with the coupled atmosphere-ocean model RCA4-NEMO. The climate changes of the quantities 2 metre temperature, precipitation (including extreme precipitation), wind speed, and solar irradiation are taken into account.

The manuscript is well structured and the figures are acceptable but the different symbols in figures like Fig.3 are hard to distinguish (e.g. the scenario means are not easy to spot).

The figures are going to be revised for several reasons, this being one of them.

While publications of analyses over the Baltic Sea catchment area for the above mentioned quantities are numerous throughout the last decade, the present analysis adds value by including a large ensemble of simulations of different regional climate models and for regional atmosphere-ocean coupled models a number of 22 climate simulations is also outstanding.

One critical comment from my point of view is that the authors did not took the opportunity to investigate a few additional quantities (e.g. sunshine duration, daily temperature range etc.) The ESGF provides a lot of these additional quantities and it is a pity that these data are used only very rarely.

This is a very good suggestion by the reviewer. However, the aim of the paper is to compare the latest results of scenario simulations with earlier simulations used for the assessment in BACC II and these additional quantities have not been analyzed previously. In addition, the paper is already quite long.

I would recommend the manuscript to be published after taking into account the few comments below.

Lines 137-138

„Higher warming than the global average is generally expected for land areas, which warm more quickly than sea areas". I agree, however, this cannot clearly be seen in Fig.1 where the North-South gradient is more dominant.

We have added a modification; the text now reads: "Higher 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."

Line 361-362

„This attributes to more extensive cloud cover (not shown) in most models for the future."

Can you add a sentence about the reason for the increase in cloud cover over the Baltic Sea Catchment area? Does the moisture in the atmosphere increase, i.e. does the precipitable water results in the ESGF archive show this? If this is not the reason what then? Maybe there is another publication which I am not aware of that covers this. If so please cite this publication.

We have revised this sentence so that it now reads "This has been proposed to be linked to the more extensive cloud cover in northern Europe in most EURO-CORDEX RCMs for the future (Coppola et al., 2021)."

Line 391

„Also the fact that increasing temperatures may not reach the melting point is significant."

How do the number of frost days change over the Baltic Sea catchment area? Can you give some numbers or point to a publication that covers this, please?

We have added a relevant reference and revised the text to:

"It is only in high-altitude parts of central and northern Scandinavia that changes are limited with relatively large amounts of snow also in the future. At high altitude, the increase of winter precipitation may be compensating for the increase in melting with higher temperature. Also the fact that increasing temperatures may not reach the melting point is significant; see, e.g., Gröger et al. (2021a) Fig. 12b. However, also in these high-altitude regions, the warmer future climate results in a shorter snow season with accumulation starting later and spring melt starting earlier that acts to reduce the total amount of snow (Räisänen et al., 2021)."

Figure 3

The sub figure (second column, second row) should be „land south" not a redundant „land north"

This mistake will be corrected; thanks for noting this.