

**Response to Anonymous Referee Comment (RC2), 16 May 2021**  
(<https://doi.org/10.5194/gmd-2020-443-RC2>):

We much appreciate the positive assessment provided by the reviewer. All parts in the manuscript pointed out by the reviewer have been adapted or clarified. A point-by-point response to the comments from the reviewer is given below, where for convenience we have copied in the reviewer's comments followed by our reply (the reviewers' comments are in blue text). When we are referring to a specific line, if nothing else is stated, we are using the line numbering in the document with the track change.

A Review of "COSMO-CLM Regional Climate Simulations in the CORDEX framework: a review" by Sørland et al.

General comments

This is a review paper intended to document the development, progress, and performances of COSMO-CLM regional climate simulations over a number of CORDEX domains including Europe, Africa, South Asia, East Asia and Australasia. While there have been many scientific publications of COSMO-CLM over individual domains, this review paper inter-compares its performances among different domains. I find this paper is useful and can provide guidance to future work in regional climate simulations especially in non-native domains of COSMO-CLM. The structure and logical flow of this review paper made it easy to read and follow. I have a few suggestions for further improvement.

Specific comments

1. In Figure 5 to 8, the last Taylor Diagram was labelled as "South-west Asia". I suppose this refers to "South Asia". Perhaps some changes should be made to supplementary figures as well.

Changed

2. "East Asia" was one of the CORDEX domains included in this study. However, this "East Asia" is the "old" domain prior to the establishment of "Southeast Asia" CORDEX domain (e.g. Tangang et al. 2020; [www.cordex.org](http://www.cordex.org)). The new "East Asia" CORDEX domain was shrunk a smaller domain. Hence, a sentence is needed to explain this and avoid confusion.

We had already included this information in the text and have now added more details (marked in italics) on lines 443-447 to make the reader better aware of this:

"CORDEX simulations over East Asia at 0.44 (EAS-44) and 0.22 (EAS-22) have been performed with version CCLM5-0-2 and CCLM5-0-9, respectively. Due to an updated EAS-CORDEX domain, the domains are not identical: while the EAS-44 is following the CORDEX framework for the first phase *which covers a large area*

*including southeast Asia and northern Australia, the EAS-22 is following the second phase with a smaller domain excluding tropical southeast Asia (Zhou et al., 2016). Note that a Southeast Asia CORDEX domain has been established (Tangang et al. 2020)."*

3. While much has been written on the performances of COSMO-CLM among its different versions and regions, very little review was provided on how this RCM fares compared to other RCMs in different regions.

In Figure 1, we compare the COSMO-CLM performance over Europe to the other RCMs. It would be ideal to include other RCMs for the other regions as well, but that needs to be a study of its own. We do refer to studies we are aware of, that are comparing different RCMs for the different CORDEX domains, see e.g. on line 209 ("... and compared to the other CORDEX-Africa RCMs in a number of studies (e.g., Dosio et al., 2019, 2020).") . and on line 227 ("The CCLM4-8-17-CLM3-5 simulations are analyzed in model comparison studies (Di Virgilio et al., 2019; Hirsch et al., 2019) over the Australian part of the CORDEX-Australasia domain."

4. List of GCMs in lines 295 – 303 is better placed in a proper table.

We have now included the GCMs in a table (Table 2).

5. I am not sure the real purpose of having a detailed analysis of evaluation of GCM driven simulations in the context of providing a review on COSMO-CLM here? In Figure 5 to 8, the performances of various GCM driven runs were shown to be different. However, these differences are expected and reflect inter-GCM differences. I don't see the relevance of this detailed analysis here in reviewing COSMO-CLM performances.

This is a valid point, and the reviewer is correct that the results from the different downscaled GCMs are expected to diverge. However, one of the motivations for including these simulations in this study is to explore how much the results from e.g. one downscaled GCM, vary when there are changes in the model configuration or horizontal resolution. For instance for temperature, changing the model resolution or configuration (marginally) is not influencing the results a lot, but for precipitation, the model resolution and configuration plays a bigger role (see lines 557-561).

We have also made some changes in the manuscript (particularly regarding section 4.3) related to distinguishing the discussion of the RCM performance, GCM/RCM errors, and added value. See also the reply to RC1 (comment 26).

6. I think in the "Summary and outlook" section, the authors did not adequately address the issue of uncertainty in the simulations. Even within different versions of COSMO-CLM, we can see different biases (e.g. Figure 2 and 3). What does this mean in terms of uncertainty of using COSMO-CLM in different regions? Should this review paper recommend the use of different RCMs i.e. multi-RCM approach?

We cannot address the uncertainty with only one RCM, for this it is needed to span the full 3-D GCMxRCMxRCP (or 4-D matrix if you include all the realizations), thus

this review paper only explores a subsample of the uncertainty. We never state that we will address the uncertainty in regional climate projections in this study, but this review paper is more meant to guide RCM modelers (and also GCM modelers) in how to design their experimental settings, which is particularly important now before next CORDEX simulations will be started. We state the scope of the manuscript on line 91-97 in the introduction as: *“... in this study we assess and compare the model performance over Europe with the four CORDEX-CORE domains Africa, East Asia, Australasia and South Asia. Since the existing COSMO-CLM CORDEX simulations differ in more than one way (i.e. versions, configurations and resolutions), we do not perform a systematic analysis of each simulation but rather a qualified judgement, based on all model integrations that are currently available (as of February 2020). Such an analysis will support the future design of model simulations in the community. The dependence of the model results on the driving GCM is also discussed.”*

and in the summary and outlook on lines 634-636, we summarize the main results with respect to the scope of the study (see e.g. *“Nevertheless, our analysis of all the available model runs, can provide guidance for the future design of regional climate projections by the CLM-Community as well as by other RCM-groups. Moreover, as the focus on downscaling CMIP5 GCMs will be replaced by CMIP6 in the near future, we anticipate this is a good time to reflect how coordinated RCM simulations can contribute in an optimal way.”*)

Ref:

Tangang et al. 2020. Projected Future Changes in Rainfall in Southeast Asia based on CORDEX – SEA Multi-model Simulations. *Climate Dynamics*, 55, pages1247–1267, <https://doi.org/10.1007/s00382-020-05322-2>

Thanks for the suggested reference, which is now included on line 447