Earth System Dynamics Discussions

Earth Syst. Dynam. Discuss., referee comment RC4
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Comment on esd-2021-49

Anonymous Referee #1

Referee comment on "Atmospheric rivers in CMIP5 climate ensembles downscaled with a high-resolution regional climate model" by Matthias Gröger et al., Earth Syst. Dynam. Discuss., https://doi.org/10.5194/esd-2021-49-RC4, 2021

In the present work, the authors used downscaled versions of global climate simulations from the CMIP5 ensemble using RCA-NEMO to study the atmospheric rivers over Europe in the present and future climates and compared the same with runs using ERA-I and using different RCPs. Results show that ARs will become more frequent and stronger in the future. Furthermore, the authors highlighted the variability of precipitation in different scenarios and different model simulations.
Though the study consists of some interesting results, the presentation of results, description and quality need to be improved. Information on the methods and quality of the figures including the methodology needs to be elaborated. Many typos, Grammar, missing words are found. Therefore, I would recommend the manuscript for major revision before accepting it for publication.

Major comments:
L100: Please elaborate on the purpose of the study.
L105: Please rephrase the sentence and carefully check the text corrections.
Section 2.1:
Please give more details on the model setup, spatial and temporal resolutions of climate models, comparison with ERA-I etc.
Also, it would be interesting to see a case study showing how later boundary forcing is influencing the AR characteristics in the RCA-climate model.
Section 2.2:
Table 2: Please provide a reason for leaving out the RCP2.6 cases for RCA – IPSL-CM5A-MR, RCA – CanESM2 and RCA – CNRM-CM5 despite their availability to force the RCA.
Section 2.3: In addition to figure 2, a figure with the IVT threshold difference w.r.t historical mean in different RCPs would give a robust picture of the difference in magnitude of IVT thresholds.
How do the discrepancies in IVT thresholds from different models and different RCPs are attributed to? Please give a brief note on the reasons for the biases in the IVT thresholds. Could it be due to bias in RCA runs or due to bias in the lateral boundary conditions from the GCMs?
Figure 3: How do authors justify the large difference in IVT of ARs in hindcast and reanalysis? Though both reanalysis and hindcast data use observations, I would assume that the model parameters such as lead time, assimilation methods etc might be causing the bias here. Please discuss the same.
Section 3.1:

L235: I would agree with the authors that the RCA impact on detecting the number would be less. However, it is to be noted that RCA could impact the strength of the ARs including the length to width ratio, footprint over a region, persistence etc. Please discuss these issues here.
Table 3: Why is RCA-MIROC showing a different trend in frequency expressed as the number ARs detected in a 30 year period of different climate scenarios? I suspect the value 445 8 from RCP45 in RCA-CAN. Please verify it.
Section 3.2:
L290: I would recommend authors include more details on rainfall variability by describing the dynamics and synoptic conditions responsible, rather than simply showing some stats.
Section 3.2.3:
L325: Please verify the Figures numbers cited here. Through precipitation patterns are modulated by stochastic processes and further modulated by topography, the magnitude of IVT is affected by the small scale processes such as fluxes, SST and winds etc. Please go through the literature and discuss the same here.
L335: Please describe the reasons for the bias in RCA ARs inland propagation.
Section 4.2:
L385: Not sure if the figures cited here are relevant to the context. Please verify
L400: Increase in AR forced heavy precipitation over Eastern Europe may also associate with changes in absolute path of the ARs, increase in IVT/moisture availability and duration/persistency of the ARs over the land. Please discuss these issues.
Section 4.3:
It is a good practice to present figures with lat-long labels which are missing for almost all spatial figures in the manuscript. Please redraw them in the revised manuscript.
L450: The approach selected by the authors in finding the source region of ARs raises many questions. For example, earlier the authors mentioned that As originate from open oceans. But taking 10W as a reference for finding the source region does not line up with the earlier statement and may induce errors in results. Furthermore, it is not customary to find the source region according to the AR incidence/landfalling.
L460, 465, 470: Please rephrase the sentences with proper citations to the figures.
L475: " we can conclude that ARs from the southern Atlantic sectors are more present over most land regions in a warmer climate" is a strong statement in this context.
Section 5.1: Please describe how and why the higher latitudes experience increasing precipitation despite the decrease in ARs.
P495: How the decreased AR impact over Norway can be explained with the decrease of ARs arising from >60N. Earlier authors claim that Scandinavian ARs originate from the south.
L515: A figure showing regional mean precipitation change in the historical/future scenarios from individual models with error bars would give a better idea of the magnitude of precipitation changes.
Section 6:
L590: Figure 9 shows the opposite result. Please explain the same.
Minor comments:
1. Please carefully go through the text and sentences and correct the typos, values, and grammar.
2. Authors are requested to re-check the references as some of them are not matching the context they are cited.
3. Please improve the quality of the figures.