

Comments on the paper „The climate change signal in the Mediterranean Sea in a regionally coupled atmosphere-ocean model”

General comments

The paper describes simulations with a coupled ocean-atmosphere model with the interesting feature that the ocean is in a global set-up coupled to a regional atmospheric model. The analyses are interesting and the paper is generally very interesting for the scientific community.

However, the paper needs major revisions before it can be published. The English has to be checked by someone professional, at the moment the paper is full of strange formulations and errors. It is unclear to me, why the chapters 3 lack almost completely citations, except 3.4, and all the relevant point and citations are to be found in chapter 4. It would be easier to read when the results are compared to other scientific publications and in the discussion, the processes are discussed. My annotations are full of “whys” and almost no answers can be found.

There is no explanation about the initialization of the ocean model. Was there a spin-up calculated and if yes how? Usually MPI-OM needs a couple of hundred years to reach quasi-equilibrium. This is the big disadvantage of a model setup like yours so it should be discussed.

Please use ROM_P0 or P1 everywhere in the text where you discuss your runs and not the model in general. It is less confusing than comparing the discussions with the figures, where these names are used. Please label the figures itself with DJF or SST or whatever, so it is faster to grasp what is shown.

In detail:

Page 1, line 13: the Black Sea is mentioned already in the abstract but no results regarding climate change variability w.r.t. the Black Sea is discussed. And no results at all about the Black Sea are shown, not to speak of the circulation as mentioned here.

Line 20: Please add citation for hot spot. The 2nd sentence of the Introduction is mere speculation without any base.

Line 26f: the deficit is compensated by the Strait of Gibraltar. Does this mean the inflow of fresh water from the Black Sea does not play a role in the budget?

Line 28: local intense air-sea interaction does not make sense. Only if the whole MedSea is local, which is kind of strange in this paper.

Page2, line 12: pls skip the “was”.

Line 27f: This is also a strange perspective. It is not the choice of the scenario which conditions the signal, it is driving factors which are prescribed in the scenario. And the scenarios are well thought off pathways of the future evolution of the climate change signal. This sentence here can be understood by climate critics that you only have to choose the right scenario to get the answer you want. This should not be written like this.

Line 32f: what are the problems with open boundary conditions you mention here? This is one of the key features of your model setup so please describe it with more insight.

Line 34: it is the first detailed evaluation but the run has also been used in other studies? A bit of a contradiction here.

Page 3: line 4: evolution at the end? Maybe towards the end would be better. It is a process.

Line 6: skill not skills

Line 8: better: driving model (mpi-esm) and skip the last part of the sentence.

Line 24: *information*

Page 4, line 27: "we make a dynamical downscaled of present time simulation". Please rewrite this sentence. Why did you force the ROM with MPI-ESM-LR? Later it is getting clear, that LR and MR differ very much although it is nowhere discuss why, so why this forcing?

Page 5, line 23: "we made comparisons". No good english.

Line 25: based on the NEMO code. Which model do you talk about here. Generally, I would skip a lot of information on the data but the resolution in space and time and the citations. But this is your choice.

Line 30: against *other* ESMs are required.

Line 30: Why and how is the setup of MPI-OM different compared to MPI-ESM? And how are these differences relevant when looking at the results of ROM compared to the MPI-ESM-LR/MR?

Page 6, line 1: is HAMOCC used? What role does it play in the MedSea climate change simulations? Why is OASIS3 used and not OASIS3-MCTx?

Line 17f: what is the explanation for the overestimation of the azores high? The location is quite close to the boundary of REMO so where does it come from? The boundary formulation? If the ocean is the source, then there are deficits in the ocean circulation in the Atlantic which might play a role in the MedSea as well.

Line 23f: Could it be that REMO has a problem simulating the circulation over mountainous areas? There used to be a formulation in REMO smoothing out this effect, maybe this was not used? Generally, the great benefit of regional climate modelling is the higher resolution accompanied by a better representation of mountains. There is a sentence (Page 7, line 9f) in the paper talking about the benefits but leaving out this mountain/orography effect. So please discuss this point somewhere.

Line 26: could play a role. Good question. Do they? Did you look at this point in more detail? Or is it due to interpolation artefacts?

Line 30: Same is true for the last sentence on this page, did you check where the anomalies come from?

Page 7, line 11ff: Why is MSLP higher in the coupled run?

Page 8, line 2: more the northern part of the eastern MedSea.

Line 6: higher resolution where ocean or atmos?

Line 8: what simulation is discussed here? P0?

Line 17f: what data set configuration?

Line 20: this is the first time, aerosols are mentioned. It would be nicer to have this information in the general description of the model. And then, why are aerosols neglected?

Line 21: offset of SST: what about the spin-up of the ocean model?

Line 25f: last part of the sentence is not understandable. And what is climate uncertainty? Please define.

Line 27: Chapter 3.3: The influence of HD is nowhere discussed. Why is there so much freshwater inflow from HD? This is missing in this chapter.

Page 9, line 3: why is ROM always saltier? HD? Spin-up? Surface fluxes? Please explain.

Line 29: RCSM4 model turns up out of the blue. What model is this, citation?

Page 10, first paragraph: global warming everywhere? Please skip such general sentences.

Line 13: Figure 13 is not easy to understand, so please label this figures themselves with variable and time slot.

Line 6f: which run is discussed, which period. And an av. Zonal SST from north to south is really hard to distinguish from that figure.

Line 21: already in the present day simulation is too much fresh water in the Bosphorus and close to the Nile, this will be transported to the future scenarios.

Line 26f: where does the diff between MR and LR come from?

Line 19: where did you discuss the circulation in the Adriatic Sea and compared it to observations?

Page 12, first paragraph: the discussion would be a bit more interesting if the resolution of the different models mentioned compared to ROM would be written somewhere.

Line 27f: so why do you speculate and not do some analysis and answer this question?

Page 13, line 4: please mention the 31m in the model description. Is this the depth of the first layer or only the choice to compare it to other studies? Unclear.

Line 11: RCSM4 is not to be found in Fig 12b.

Line 17: what is the absence of resolution? Sound more like a philosophical question.

Line 24: what is the multi-model Mediterranean? And what are model increases? Lot of errors on this page. ☹ Like differences instead of different and filed instead of field and so on. Not very nice to read. Lots more.

Page 14, line 9: where was the transport through the Dardanelles Strait discussed?

Generally: in the conclusion: I would like to see a good overview about the benefits of this coupled system ROM compared to others without the global ocean, a short overview over the evaluation, i.e. how well is the model behaving in the ERA-Interim simulation to have a good feeling about the future projections. And then the climate change signal which was simulated. Maybe some problems/shortcomings of the model and some ideas how to improve well known deficits.