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Ocean Science
Discussions

Interactive comment on "Modelling deep-water formation in the North-West Mediterranean Sea with a new air-sea coupled model: sensitivity to turbulent flux parameterizations" *by* Léo Seyfried et al.

Anonymous Referee #1

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The authors are presenting a novel study assessing the ability of a regional ocean atmosphere coupled system to correctly represent ocean convection, especially the sensitivity of the system to the parameterization of turbulent fluxes. First, the authors assessed the model results through detailed comparisons with different observational data sets and show that the coupled system satisfactorily simulates the formation of deep water. After evaluating the uncertainties associated with the different turbulent fluxes parameterizations, the authors carried out several simulations based on 3 commonly used turbulent flux parameterizations. Their results highlight that the choice of

the turbulent flux parameterization strongly influences the simulation of open ocean deep convection, especially in terms of volume of newly-formed deep water that can be different from one order of magnitude according to the parameterization choices.

Open ocean deep convection plays a key role in the ocean circulation and the results found by the authors are important and will be certainly useful not only for the research groups working on the Mediterranean Sea but also in the North Atlantic, Nordic Seas, and/or Antarctic Seas. From my point of view, the manuscript represents an important contribution to our understanding of modeling deep water formation. If the scientific and presentation quality of this article are good in general, I have some (minor) comments for the authors:

p5,l16 & p8,l31: What do you mean by "departure"?

p6,l11: the "MAW" are not introduced before. What is the difference with the AW?

P6,l27: "(ECMWF) with a horizontal resolution of 1/8" → is it the horizontal resolution of the grid choose to export the reanalysis, or is it the resolution of the atmospheric model ?

P8,l8: What do you mean by "sound interpretation"?

p8,l10 : "two simulations do". → two simulations.

P9,l1 : "give good agreement" → are in good agreement

p9, l24: Maybe you could had that if the SST doesnt decrease at that time, it's because the mixed layer is deepening and SI continue to decrease

p10,l3 : "... the water column experienced ..." → the water column could experience [...], in absence of horizontal advection

p11,l12-15: Maybe you could quantify this , for example by calculating RMSE for each case and add them to the table. What about the excess of mixing outside the deep-mixing area, is it due to the ocean model or the air-sea flux? Is it more important using

the MOON simulation? To answer these questions, it might be interesting to look at the bias in different sub-regions (Northern Current, Deep Mixing, NBF-South) instead of a single one.

P12, section 5.3.2 → Are you expecting to really be able to simulate the exact timing of convective mixing as in the obs? Is the too early mixing in MOON due to too important BMF? By looking figure 11, the stratification at the end of January in the obs seem to be small. Maybe adding the MLD superimposed to the 4 different sections and a 5th sub-panel with a comparison of IS calculated from the simulations and the observation would be clearer for the reader to appreciate the time evolution of the mixing and the difference between simulations and observations.

P13, l12-14: " Our study demonstrates that are strongly sensitive to the turbulent flux parameterizations, not only air surface temperature and moisture but also sea surface temperature" → you should simplify this sentence. For example: In addition to air surface temperature and moisture , sea surface temperature is also strongly sensitive to the turbulent flux parameterizations.

P13: l26: " In terms of stratification, the effect of MOON was also found to be positive, with again a general reduction of the bias between observed and computed parameters." → you should simplify this sentence to make it clearer (e.g.: In terms of stratification, the use of MOON also led to a general reduction of the bias between observed and computed parameters.

Table2: It seems that there are extra zero in front of some first digits.

Figures: - A lot of the figures are very low resolution (label difficult or impossible to read) and should be of better quality before being published (increase dpi or export in pdf) - Figures 4,6,7: you should add in the legend that the grey shaded areas correspond to strong wind periods. The grey areas are also very difficult/impossible to see and should be darker, or you could replace the grey shade by an horizontal line on the upper and lower part of each panel. - Figure 11: During the mixing period in mid-February The

instrument at 500m and 700m seem to give a lower potential density that the upper and lower instruments (>29.12). Is it a calibration issue or a colobar effect?

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