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Comment on nhess-2021-392

Anonymous Referee #1

Referee comment on "The role of heat wave events in the occurrence and persistence of thermal stratification in the southern North Sea" by Wei Chen et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2021-392-RC1>, 2022

GENERAL COMMENTS

This work provides an interesting insight in the relation between heat waves and thermal stratification in the southern North Sea, by relying on a coupled hydrodynamic-wave model and observational data. The work is flanked by supplementary material containing the results of an uncoupled run. My overall opinion on this manuscript is positive. As general comments, there are two main aspects on which I would like to draw the authors' attention.

1) It is not obvious from the text whether in-situ or potential temperature was used to compute water density for this study. While the latter is the typical choice in physical oceanography (see for instance Cushman-Roisin and Beckers - Introduction to Geophysical Fluid Dynamics) as potential density contains the actual dynamical information on the water column conditions, the former case would probably need at least some additional discussion. For instance, if in-situ temperature has been used instead of potential temperature (thus providing in-situ density instead of potential density), the results would obviously be affected by water depth with impacts on some of the conclusions (Lines 320-324). Please clarify this point and, if in-situ density has been used instead of potential density, please discuss the choice and its implications.

2) The manuscript and the supplementary material are well written and informative. Nonetheless, I think that including in the manuscript some further comments on the effect of model coupling (besides the mention at L270-276), particularly in terms of the impact of wave description on vertical mixing and heat fluxes at the sea surface and through the water column, would significantly enhance the reach of this work.

SPECIFIC COMMENTS

L81: Please explain the choice of the study period

L86: Why no other campaigns were considered for model validation?

L150 and Figure 3: since this is potentially relevant for the conclusion, it could be worthwhile discussing more in detail the mismatch in the profile shape and the modelled anticipation of the cooling at the surface at Dogger Bank (see also General Comment #2).

L175-180, Figure 3 and Figure 4: could the range of the modelled heat spikes compared with satellite SST be related with the description of vertical mixing?

L185-190: this result should be discussed in the light of the implications of the mismatch in vertical profile description (Figure 3) for Potential Energy Anomaly

Figure 5: is there a definition for "rapidly"? If the criterion is the one defined in L245, it

could be a good idea to state it also here.

Figure 7: it could be interesting to see also the winter months, in support of the statement at L180.

L215-216: this could be due to the use of in-situ temperature in the computation of water density, if this was the case.

L227: How was the 50Jm^{-3} threshold chosen for the identification of stratified column?

L228 and L245-246: I do see the correlation between stratification and occurrence of heatwaves, but my impression is that the causality here could be somewhat overrated. Of course stratification hampers the transfer of heat along the water column, and therefore it is likely to be intensified in the occurrence of a MHW, but I would say that the interesting point here is rather the role of winter-spring "preconditioning" and the quantification of the processes driving the redistribution of heat through the water column.

L246-247: Is this a standard criterion?

L319-320: Again, this could be related to how stratification and water density were defined. Please discuss.

TECHNICAL COMMENTS

Abstract: The time reference of the study is not clear from the abstract, I would suggest to add a few words about this.

L26: is this really "fastest" or just "faster"?

L237: Is a "where" missing here?