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Interactive comment on "Estimation of oceanic sub-surface mixing under a severe cyclonic storm using a coupled atmosphere-ocean-wave model" *by* Kumar Ravi Prakash et al.

Anonymous Referee #3

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Prakash et al. present a study about the effects of very strong storm on the ocean mixing and energy penetration in the water column. Study area is a single station in the Bay of Bengal. A 3D coupled is used for this.

Generally the study is well structured and provides and overview over dominant frequencies found in the models simulated kinetic energy and mixing characteristics. There are some points however, that prevent me from recommending publication in Ocean Science in its present form:

1) It becomes not clear to me what found the frequencies are related to. Are they specific for this special model used? Are they influenced by the frequency of coupling

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fluxes between ocean and atmosphere? The coupling time step is also not noted in the manuscript nor which fluxes/variables are exchanged. Or is a physical process possible behind the found frequencies. Could be worth to look at the atm. variable likewise to figure out similar frequencies.

2) The analysis of only one single station is not enough to draw wider robust conclusions. The usage of a 3D high resolution model, however, provides the possibility to extent and confirm the findings for whole domain and eventually further cluster the results according regional characteristics like water depth or hydrographic conditions (background stratification, salinity, river influenced region etc).

3) No motivation for the selection of the abalysis station is given. Is it believed to be representative for a wider region? Why not take one along the main storm track shown in Fig.2 and another one further remote from the storm center. Or just anaylyze a section along the track and another outside the track.?

4) Validation. No attempt is made to demonstrate the ocean modells ability to reproduce generell hydrodynamic and hydrographic characteristics like simply surface SSS and SST. Where are the strengths and weaknesses of this model? When one aims to look at the energy cascade also the winds should be somehow assessed or at least showing the wind characteristics over the station(s) focused.

5) No specific scientific or technical problem is addressed in this study. The manuscript aims at analyzing and quantify subsurface mixing and near inertial mixing. But why is this important and why can this only be done at this single station?

Its difficult to see any broader implication in the manuscript at its present form but rather reads as an execise.

Specific comments

line 27ff Introduction

The motivation of using a coupled atmosphere ocean model should be explained as

this is by no means standard in regional modelling. What is here advantage over stand-alone components which justifies the more computer power required by coupled models. Refer other studies that used coupled models and summarize which improvements or problems they report. What is the added value you expect from a coupled model in you region?

line 76: biological primary productivity is a flux rather not a concentration. I would remove ”concentration” in this sentence. Chlorophyll on the other hand is a concentration.

Line 120 – 130.

Here a number very specific parameterization schemes for the atmospheric model are named. Why where these chosen and not others? Are there more options available in this mode? If yes explain why you chosed the ones you explicitly named. Can it be expected that they have impact on the result?

134 – 155: Please tell the reader which variables or fluxes are communicated between the ocean-atmosphere-wave models and which is the coupling time step?

192 – 201

The validation is by far not sufficient here. The track is obviously ok. But no validation for wind is provided which would likewise influence SST and thermocline depth level.

It would be also helpful to judge the general performance of the ocean model for temperature and salinity therby taking account also in situ measurements not only satellite data. Apparently the model exists at least since 2005. Has there ever been a validation undertaken for the ocean model showing general characteristics of the thermocline etc?

What is figure 3 showing? snapshots, daily averages?

Magnitude of cooling: how large is it? Corresponds your single analysis site with the

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maximum cooling seen in Fig. 3?

203 – 215

Its no surprise the isotherms are deepening during a storm. What information do you want to give by chosing a 23C isotherm at a single place? Are other processes more important when considering other isotherms?

line 228:

That's intressting. Is it possible to make a more general statement that the baroclinic component is higher than the barotropic here ? how is it in the center of the storm/ in peripherals of the storm?

line 241:

Figure 5 show maximun spectral power in frequency band between roughly 0.03 and 0.04 cycles per hour. Please make more clear which frequencies you attribute to tidal forcings and inertial mixing.

244:

When tidal oscillation were absent at the whole vertical section shown in Fig. 5 how can these oscillation then dominate at the surface (sentence line 240)?

250-251:

Is it meant that NIO dominates the mixing at 14 m depth when windstress would be absent?

252 – 268 (Figure6, Fig. 7):

Here higher order statistics is applied. Which frequency has the input data? The scale in Figure 6 goes until 60 periods/hour, so you need a minimum of 60 seconds in the output frequency of the model, right? Also, Figure 6 show the percentage at 40m depth but the text discusses it at 14 m.

Using filter techniques a number of values for the baroclinic current strengths and kinetic energy are given. The temporal evolution of these parameters is proven to be related to the storm activity. But what else can we learn from that.

Figure 6 contains no white dashed line as mentioned in the text.All this seems not be surprising, so are there more general implications from these singels events analyzed at a single location? This reads more like an exercise.

line 311ff Conclusion

The conclusions lists all the above mentioned phenomena which might be intressting but no attempt is made to put the results in wider context or to draw more general implications for the community. Can corresponding frequencies also be found in atmospheric variables like air temperature, heat fluxes etc? This could be an argument for using coupled models.

No attempt is undertaken to further interpret the found frequencies. Are they model specific i.e. dependent parametrizations, numerical schemes etc or can they be explained physics? And how robust are they when only one anaysis station is used? What is the roles of NIO compared to other processes of vertical mixing especially if you analyze them more on the shelff with shallow water depths?

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