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Ocean Science
Discussions
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Interactive comment on "Determining the dependence of the power supply to the ocean on the length and time scales of the dynamics between the meso-scale and the synoptic-scale, from satellite data" *by* Achim Wirth

Anonymous Referee #1

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This study aims to explore the dependency of wind energy input to the ocean on the scales of time and space. This is a very important research topic and the results of the study are also interesting enough to show the extreme sensitive to the scales at small time and space scales. As such, this paper have a big potential to be constructive to this topic. However, the results are presented alone without much explanation and details, also without comparing with some recent similar studies in details. Also the study does not dig into the assumption of the method it uses (idealized equations): the idealized equation is very useful to show some key characters but need to be

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verified by comparing with more realistic models. These are shown by my comments below. Therefore, I encourage the author to have a major revision to include very thick explanation/analysis of their results. Then this study will be quite useful to this topic.

* sec 4: “The power input is found to increase monotonically with shorter coarse-graining in time but not with ïňĄner coarse-graining in space (see ïňĄgs. 1 2).”

Why does it increase monotonically with shorter timescale? This needs explanation

* Figure 2: when lambda=0, the solid line case without eddy killing, why does the power input not always increase monotonically with smaller space scale? Eq1 shows the wind stress should definitely increase with smaller space scales, but eq4 indicates the wind correlation with the ocean current at different scale may have different magnitude and sign. You should explore this very carefully, otherwise your results are not deep enough. I would suggest you perform wavelength-frequency co-spectrum analysis, which can show clearly the scale-dependency of power input, see Figure 3 of Partitioning Ocean Motions Into Balanced Motions and Internal Gravity Waves: A Modeling Study in Anticipation of Future Space Missions, Journal of Geophysical Research, 123, 8084–8105.

* sec 4: “We further consider the eddy-killing through the parameter r kill (l,τ) deïňĄned in eq. (5). It is positive for all averaging scales and time-intervals (l,τ) (not shown), that is “eddy killing” always reduces the power input (ïňĄg. 2 and also a comparison of the blue isolines and black isolines in ïňĄg. 1). This comes at no surprise as it says that the ocean velocity at the surface and at 15m depth are on average positively correlated. ”

The results here are interesting. However, it lacks details and explanation. - There are many studies there about eddy killing; how is your results similar or different comparing with past studies on eddy killing? Any new findings in your study. - your analysis on this results is too little; you should try to explain why you get different order of magnitude of eddy killing in different case, which can be new finding; is it due to different velocity difference between ocean and atmosphere in different case? is it always so in certain region or vary dramatically from year to year (time dependent)? You should dig enough to explain why the blue case in figure 2 is so significant while the black case is minor? Rather than only presenting your calculation result without explanation.

* you results is based on the highly idealized and parameterized equation 4, and you use ocean current at 15m, which is limited since different ocean area have different mixed layer depth. Thus, how good is your method? you should compare with more realistic method/results. e.g., you should compare with the wind input in state of art coupled ocean model to make people trust your results, although this topic is really important. You should also compare with previous studies, e.g. do you have new findings in contrast to this paper: Global estimates of the energy transfer from the wind to the ocean, with emphasis on near-inertial oscillations. Journal of Geophysical Research: Oceans, 124, 5723–5746.

* sec5: “It is interesting to note that the strong decline in the power-input, in the extensions of the western boundary currents, between a day and a week is well ïňĄtted by a P(5 o ,τ) âĹİ τ $-$1/2 law (not shown). The increase of energy input at 10 days from 0.5 o to 4o (see ïňĄg 2) is well ïňĄtted by a P(l,10 days) âĹİ l 1/2 .”

You should try to explain why, if any.

* figure 2 shows extreme sensitivity of power input to the small scales, e.g. blue and red dashed curves. Will this converge? This suggests that smaller scales may be important. So will the resolution of submesoscale be crucial for the power input, similar to the fact that submesoscale is key to the the vertical motions/fluxes in the oceans, some discussion will be useful, e.g. see/cite: An Annual Cycle of Submesoscale Vertical Flow and Restratification in the Upper Ocean. Journal of Physical Oceanography, 49, 1439–1461. Wind-forced symmetric instability at a transient mid-ocean front. Geophysical Research Letters, 46, 11,281–11,291; Ocean submesoscales as a key component of the global heat budget. Nature Communications, 9, 775.

* sec 5: “This high frequency forcing might not be important for the geostrophic circu-

lation but might be important only for the mixed layer, as noted by Zhai et al. (2012). this is why I considered the power input to the mixed layer, rather than the geostrophic circulation, in the present work."

Do your ocean current include the Ekman current and wave velocity? why or why not.

* line 5: "The abundant energy at the eddy scale ($\approx$ 100km) in the ocean is found to be mostly supplied by baroclinic and barotropic instability of the basin scale circulation and the extensions of the western boundary currents to the ocean interior."

Recent studies indicate the possibility that another kinetic energy source of ocean mesoscale is from inverse cascade of KE from small scale (submesoscale) to large scales. It would be helpful to remind the readers of this. See/cite, e.g., Ocean-Scale Interactions from Space. Earth and Space Science, 6, 795-817; Impact of oceanic-scale interactions on the seasonal modulation of ocean dynamics by the atmosphere. Nature Communications, 5(1), 5636;

Also, for this sentence itself, it is helpful to the reader if you cite some papers that show the energy source of ocean mesoscale from baroclinic and barotropic instability.

* The writing should be polished further: e.g. "The power input is maximum for a coarse-graining of 6 ofor KUE and around 3 ofor GSE. Meaning that the dynamics at smaller scales reduces the power-input"

* line 20: "Eddy-killing is not restricted to eddies, its quantiïňĄcation over a large range of scales in space and time is considered here."

If Eddy-killing is not restricted to eddies, then why it is called "eddy"-killing? Please explain.

* line 30: "In the present work I determine the scales which are important for the mechanical power supply to the ocean. To this end a velocity vector is ïňĄrst averaged over a horizontal square of length l and a time interval τ to obtain the coarse-grained velocity"

Do you mean you first use mean velocity, then use higher-resolution velocity? you should explain it here. It is a little confusion.

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