

**Review of: “The characteristics of tides and their effects on the general circulation of the Mediterranean Sea”**

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**Overview of the paper:**

This paper undertakes an assessment on a basin scale of the effects of tides on the Mediterranean Sea’s circulation. The methodology involves an analysis of two experiments, one with tides and one without. It should be noted that tides aside, the experiments do have some other differences. To my knowledge there has not been such a systematic analysis of the effect of tides to the Mediterranean basin as a whole and expands on several studies which focus on specific sub regions. Thus, the subject matter of this paper is both very relevant to the journal and makes a substantial contribution beyond what has been done to date.

The twin experiments are of 5 years duration. To understand the effect on the Mediterranean dynamics the first parts of the paper focus on sea level and kinetic spectra in the following locations, the Strait of Gibraltar, the Tyrrhenian Sea, and the Cretan Sea. Clear Amplification of several sub daily modes is demonstrated by the analysis. The next section goes on to investigate how this tidal amplification leads to deepening of the mixed layer depth. To finish the paper discusses the effects of the tides on the thermohaline structure of the Mediterranean and briefly the baroclinic transport through the Strait of Gibraltar.

**General constructive critiques:**

The sections on the energy spectra are in the end limited to specific locations of interest. I can see why this is done as a pragmatic decision, but it lessens the impact of the paper which is aimed at a more general analysis of impact to the basin scale circulation. Perhaps a broader scale analysis in complement to the site-specific analysis could be done to shore up the results here and conclusions inferred from them such as broader scale maps?

It might be worth raising limitations of the model at only 4km resolution with a hydrostatic model to faithfully represent internal tides. It wouldn’t detract from the paper overall as the point is increased tidal energetics exciting existing modes. But of course, the accuracy of the internal tides themselves would be questionable in such a configuration and miss some key processes. The point here is to bring such limitations of the configuration to the attention of the reader so they do not over infer the models representation of internal tides.

The twin experiments do have some differences other than the tides. I understand that the differences will probably be very small compared to the tides themselves, but I think it is worth at least conducting as short simulation (order 1 month) of the no tides solution with the exact same options as the tide simulation to confirm that the other differences are negligible.

The final 2 sections are quite abrupt and may in the end not particularly conclusive in either case. That said “negative results” are also of value and the suggestion with regards to resolution for 7 is a

very reasonable further line of inquiry. I would not demand that the sections are removed I just feel they may not in their current form be adding anything substantial to the paper in its current form and may be better left in 8 as future lines of inquiry to investigate further.

### **Section specific points**

(general tiny niggle, this is picky and trivial, but can the units and numbers be spaced out e.g. 3.5 TW instead of 3.5TW etc.)

#### **1 Introduction**

The introduction in my view does a good job of introducing the relevant background research. It might be worth mentioning the increasing importance of tides in coupled climate simulations, though the Arbic reference also goes into this, and perhaps that this is important for future simulations of the Mediterranean particularly at climate time scales if the water formation regions are affected.

#### **2 Data and Methods**

As mentioned above it might be nice to rule out any differences induced by the time stepping by a short run of the no tides simulation with the exact settings and bathy as used in the tides case. It should be negligible but to be concrete I think this would help buttress the conclusions firmly.

“The model was integrated starting from climatological temperature and salinity initial conditions”

It might be worth stating where the climatology was derived from. (is its time mean close to the period of simulation, e.g. how much spin up time does this configuration need are we still looking at largely transient behaviour)

#### **5 Mixed Layer depth**

The changes if deepened mixed layer depths fit the hypothesis if of the authors in relation to tidal effects. But 13.c also shows shallowing of the mixed layer depth for Tides -No Tides which is difficult to explain in the context enhanced preconditioning.

#### **7 The Gibraltar Strait,**

I'd be tempted to remove this section as it doesn't really add to the paper. If further analysis it to be added here the authors perhaps could investigate tidal excursions but that is in my option beyond the scope of this particular paper.

#### **8. Conclusions**

Given the quite short simulation length, longer simulations are really needed to understand the impacts with regards to climate scales and the changes in water mass formation. Furthermore, the feedback with coupling to the atmosphere could be a very interesting next line of inquiry to include in a tides versus no tides comparison. (e.g., what is the effect of different Mixed layer depths etc.)

