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Interactive comment on "Changes in Mediterranean circulation and water characteristics due to restriction of the Atlantic connection: a high-resolution parallel ocean model" *by* R. P. M. Topper and P. Th. Meijer

Anonymous Referee #1

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This paper uses a numerical model of the Mediterranean to look at impacts of the depth of the sill at the Strait of Gibraltar on the Mediterranean's exchange and circulation. The authors show that the salinity increases as the sill shallows. The authors show the magnitude of the exchange governs the strength of the upper ocean overturning cell. The authors show the modelled transport is smaller than predicted from hydraulic control theory. The authors also show that outflow is blocked for sill depths less than 10 m. They use these results to explain a scenario for the Messinian Salinity Crisis during the Late Miocene.

This is a well written paper that is easy to read. It covers interesting topics that would be of interest to a number of potential readers. However, before the paper can be published, there are a number of issues that the authors must consider, and at the very least, touch on and explain within the paper. Thus I recommend major revisions. Details are given below.

The authors change the depth of the sill at Gibraltar, but don't modify ocean depths elsewhere. I think this needs more justification. Especially for places like the Straits of Sicily and Otranto, which might be significantly impacted if the depth change assumed for Gibraltar is related to large scale sea level changes. Which might significantly impact exchanges between the different sub-basins within the Mediterranean, salt exchange, deep water formation, etc. Therefore I think that the authors have to be careful with their conclusions based on changes only at Gibraltar given one would expect more broad scale depth changes.

I understand why the authors use annual forcing, although including a seasonal cycle with a perpetual year should not have been difficult. But is it certain that a basin with continuous water formation will behave the same as one with episodic winter formation? I don't think it is obvious, especially as the stratification might be quite different. I think, at the very least, more discussion is needed on this topic. I'm also concerned that the mixed layers in the western basin are way too shallow to represent Western Mediterranean Deep Water. Also, the model doesn't seem to have any Levantine Intermediate Water formation, and given the importance of that watermass, without it, can one believe issues of salinity change and exchange between the eastern and western basins?

Might the results be a function of both sill depth, and net Evaporation? I.e. With different climate conditions and sea levels, might net E also change, with such changes having feedbacks on the behavior just do to the change in sill depth?

It seems like a large number of additional sensitivity experiments were performed, but

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not discussed, other than vague statements like “in a series of sensitivity experiments”. This is not good enough for the reader. Either remove these comments if they aren’t key to the paper. Or add more detail on them.

I think the terms shallower/deeper would be better for referring to sill depth changes than lower/higher. One could think of lower as deeper (as the sill is lower in the water column) but also as shallower (lower depths), which can confuse the reader.

In the title, the word parallel is not needed. Many ocean models are run in parallel now. In any case, this is just a technical detail about the computing (and the time needed to run it) and has nothing to do with the underlying science and results.

How many sigma levels does the model have? Are there enough such that the thermocline can be resolved in deeper water within the basin interior?

How many grid points does the model have in the Strait of Gibraltar? Thus, how sensitive are the results to potential cross-strait variability?

For the Atlantic relaxation being applied in the first 18 columns of the grid, how does that relate to the location of Gibraltar? I.e. Does any relaxation extend into the strait?

Interactive comment on Clim. Past Discuss., 10, 2979, 2014.