

Interactive
Comment

Interactive comment on “The Mediterranean is getting saltier” by M. Borghini et al.

M. Borghini et al.

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Overall response to both Reviewers 1 and 2

We thank the reviewers for their comments on our manuscript. The basic aim of the manuscript as stated in the Abstract was to show that there are 2 main processes that lead to higher salinities in the deep western Mediterranean Sea. The 2 processes are salt finger processes that transport heat, salt and density downwards below the core of Levantine Intermediate Water at about 400 m depth into the deep water and deep water formation events that sporadically inject new water properties into the deep ocean. We describe these processes using selected hydrographic stations and we try to compare their relative magnitudes in effecting the observed changes in deep salinity.

It was not our intention for this paper to make rigorous estimates of salinity change that would have required extensive analysis of thousands of historical profiles. Rather

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Interactive Discussion

Discussion Paper



we concentrate on using recent results quantifying salt finger fluxes and recent results on deep water formation events to compare the role of the processes in the observed increases in salinity of the deep water.

In the revised manuscript, we have made changes following Reviewers suggestions in Sections 1, 2 and 3; and we have done a major rewrite of the Discussion in Section 4 to focus the later stages of the paper on the two main processes and their implications for deep changes. Our reading of both Reviews is that the original Discussion section caused most of the problems for the Reviewers with respect to focus, clarity, and steady state assumptions. In the new Discussion, we have tried to avoid adding new material or drifting into extraneous topics and instead we now concentrate on the implications for the 2 processes in the observed salinity increase in the deep Mediterranean. We believe this focus improves the clarity of the entire manuscript. At the end, we have clearly stated that the Mediterranean is not in "steady state" and made some remarks on outstanding problems this lack of steady state condition causes for traditional understanding of Mediterranean circulation.

We have uploaded the new Discussion as a Supplement

Specific responses to Reviewer 2:

- A more thorough analysis of the data should lead to an idea of how long this transient state will continue. Will there ever be a steady state ? Was there ever one ?

We think this is an important research question and we identify it toward the end of the Discussion.

- The data used in this study is quite limited. While this has the advantage of being more coherent, it disregards the spatial variability in the Western Med. Are the same changes be visible in other parts ? Are the chosen locations representative ? What are the uncertainties of all your numbers ?

As stated above we are concentrating on the 2 processes that contribute to the increas-

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ing salinity in the deep water. Hence we are making indicative estimates of salinity and temperature changes in the deep water rather than doing a comprehensive analysis of the historical data. We now define the uncertainties in the text and in the Caption for Figure 2.

- What about the Tyrrhenian Sea ? Is there indeed a transport of deep levels into it and of deep to intermediate levels out of it and what fluxes of heat and salt do these represent ? Do you think them to be small compared to local fluxes ? Salt-fingering fluxes are even more relevant there.

We think the Tyrrhenian Sea is an ideal place to quantify the downward fluxes due to salt finger processes and we have begun to make new stations there (in 2013 and 2014) so we can compare them with historical stations in our next research effort.

- The numbers used in the manuscript are not very coherent. Sometimes it is absolute T,S differences, sometimes T,S changes per year, sometimes per decade. Maybe they can be unified.

In the revised manuscript we have tried to cite changes in units per decade.

All "Technical Corrections" have been considered and appropriate adjustments have been made to the revised text. Thank you for your suggestions.

Please also note the supplement to this comment:

<http://www.ocean-sci-discuss.net/11/C386/2014/osd-11-C386-2014-supplement.pdf>

Interactive comment on Ocean Sci. Discuss., 11, 735, 2014.

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