

Interactive comment on “Modelling of the anthropogenic tritium transient and its decay product helium-3 in the Mediterranean Sea using a high-resolution regional model” by M. Ayache et al.

Anonymous Referee #1

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Ayache et al. present a basin-wide model simulation of anthropogenic tritium (^3H or T) and its decay product helium-3 (^3He) in the Mediterranean Sea by using a high resolution regional model (NEMO-MED12) for the past several decades. They compared the model results with the observation data collected at various times during this time period along the main E-W axis of the Sea throughout the water column. From this study they can analyze the decadal-scale ventilation and mixing processes in the thermocline, intermediate and deep waters, and better delineate the effects of episodic deep water formation events (i.e. The Eastern Mediterranean Transient: EMT in the

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eastern part in 1995 and the Western Mediterranean Transient: WMT, the deep convection event in the Gulf of Lions in the west in 2005). A combined use of two transient tracers (T and ^3He) allow the investigators to estimate the T- ^3He tracer age fields along the model-data comparison sections and infer the ventilation time scales for different water masses. The evolution of the tracer age fields also allow the investigators to infer the effect of renewal of deep water by the episodic deep water convection events. The reviewer recommends minor revision for this manuscript before it should be accepted for publication. Below are detailed comments for the manuscript.

General Comments:

* Although the authors cite the other paper about the model performance, it would be helpful to give some basic information along with the quantified data of model-data differences (e.g. P2703 L10-12).

* It is not immediately clear whether the model was calibrated by the transient T- ^3He tracers (i.e. constrained by data), or just run by the prescribed conditions for the given time period and compared with the observations along the select locations and times?

* I would suggest to include some basic information of the transient tracer age concept & its implication and limitations (P2697).

* I think it would be helpful to include a brief background of EMT and WMT, as they serve as significant benchmark timings for the model design and performances.

* The authors should use certain terms in consistent manner (e.g. model produced / reproduced / simulated). What does it mean by the model ‘correctly’ reproduced? Model can only simulate certain patterns of actual condition.

* I wonder if the authors checked the physical water mass structure in different years by looking at the distributions on density surfaces as well. What were the tracer distributions on isopycnal surfaces (besides the distributions in depth layers as shown in the figures)? Since there were episodic deep water formation events and apparent

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water mass structures during the study period, it would be useful to discuss the tracer ventilation signature in context of non steady-state conditions of water mass structure in the Sea.

* The observation data and model outputs look 'reasonably' similar (Figs. 7-8) but what are the quantitative differences? Can the authors provide more quantitative information about the model's performance by estimating the model-to-observation differences and their uncertainties of the tracer data on select density surfaces or at certain water mass layers?

Specific Comments:

P2694 L12/13: peaks/peak alone - Please be more specific what the 'peaks/peak' is

P2694 L26: WMDW - Please define when the acronym was first used

P2695 L10: Broecker and Peng, 1982 -> I would suggest to use a more recent reference

P2695 L10: These geochemical tracers -> I would suggest to state "These geochemical transient tracers"

P2695 L22: particularly 'suitable' for -> Please explain why anthropogenic tritium and helium-3 are good for evaluating the large scale ocean dynamics

P2696 L22: Tritium Units (TU) -> Can you provide the reference scale year for TU (e.g. TU-81)?

P2696 L24: Please add "at the peak time of atmospheric nuclear weapons tests" after "25-30 TU in 1964"

P2696 L26: Please insert "cessation of new bomb tritium from the atmosphere" between "combination of" and "its radioactive decay"

P2698 L11: real age -> What is the definition for this term? Please specify.

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P2699 L1-3: What is the time steps used in the numerical model?

P2703 4.1 Global distributions -> This should be 'Basin-wide distributions' as 'global' means worldwide.

P2705 4.2 Model evaluations against in situ data -> I would suggest 'observation data' or 'observations' instead of 'in situ data.'

P2705 L22: 1997. -> I would suggest to state "1997 along the actual cruise sections in the E-W main axis of the Mediterranean Sea."

P2706 L3: contrasted -> I would suggest to use a different word

P2706 L8-13 (and other related parts): Please make a clear distinction of descriptions for observation vs. that of model

P2709 L15: lower ages -> I would suggest to use 'young ages' instead

P2711 L28: tracer-age -> is it model-based?

P2712 L2-3 transit time of 12+/-2 years (by Roether et al. 2013) -> Is it based on data-based estimates or model-derived? Please clarify.

P2714 L14: true age as about 150 years -> Please specify the meaning of 'true age.' The model can only generate certain age estimates but it shouldn't claim it as 'true' age, I suppose.

Figure 7: Please explain the circle symbols (are the colors of the symbols coded by concentrations? same as that of the model outputs?)

Technical Corrections:

P2698 L11: age tracer -> tracer age

P2696 L12: "isotopes of helium with" -> "isotope of helium, with"

P2699 L2-3: move "in latitude" at the end of "46N to 30N"

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P2703 L9 and all other same expressions: maps -> The indicated images are not maps but figures. I would suggest to use "figures" instead

Fig.1: scale bar needs a legend (Depth [m]); insert "(solid lines)" between "The trans-mediterranean section" and "from the Meteor".

Figs. 3-8: All scale bars show increase in numbers toward left, which may confuse the readers. I would suggest to keep the gradient of the scale bars increasing toward right

Figs. 7 & 8: Change "and the racer age" to "and the tracer age"

Interactive comment on Ocean Sci. Discuss., 11, 2691, 2014.