

Interactive comment on “High resolution regional modeling of natural and anthropogenic radiocarbon in the Mediterranean Sea” by Mohamed Ayache et al.

Anonymous Referee #2

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Review on 'High resolution regional modeling of natural and anthropogenic radiocarbon in the Mediterranean Sea' by M. Ayache et al.

The paper presents the results of a modeling study of radioactive carbon (^{14}C) for the whole Mediterranean Sea over the pre- and after bomb peak periods. The applied circulation model has been tested before with hydrographic and tracer data (tritium and helium). The model results help to interpret the (sparse) ^{14}C observations in the Mediterranean both from sea water and sediments, and I recommend publication in BG after revision. At some points, I am not quite satisfied with the description/interpretation of the results, and the graphical design of some figures should be improved.

Specific comments:

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p.2, l.1-3 'The Mediterranean Sea can be considered as a "miniature ocean", where global change can be studied at smaller/shorter spatial and temporal scales ($\Delta t \leq 100$ yr compared to more than 1000 yr for the global ocean ...).' The mentioned time scales of 100 vs. 1000 years refer to the overturning time of the Mediterranean/world ocean. Is that really identical with the time scale on which global change is going on, as it is implied by this sentence?

p.2, l.19-22 In this paragraph, ^{14}C is characterized as conservative tracer such as CFCs and tritium. This is not exactly true, as ^{14}C is changed by biology, especially the remineralisation of organic matter. This effect is small and often neglected, but it still is a conceptual difference.

p.3, l.6-8 and p.33, l.31 Here and at some other passages in the paper the role of ^{14}C for the determination of water mass ages and constraining the deep water circulation is mentioned. This is not wrong, but regarding ages, ^{14}C is normally used in older waters with ages of order 1000 yr (comparable to the half life time). For the Mediterranean, tracers with shorter input histories such as CFCs and tritium are more useful. They are also more useful in constraining the deep water pathways in circulation models because the number of observations is much larger than for ^{14}C . This should be made clear somewhere in the text.

p.7, first paragraph on the choice of kw: It seems to me that the choice of kw is the main work regarding the tuning of the circulation model on the base of ^{14}C data. So this topic might be given more room in the description and discussion.

p.8, l.17-18 '... leading to a relatively higher ^{14}C level in the EMed surface water closer to -46 ‰.' Has the value of -46 ‰ a special meaning? Then this should be mentioned in the text. According to Fig. 2a, the values are close to -44 ‰.

p.8, l.18-20 'For both western and eastern surface water, the model simulates ^{14}C concentrations slightly higher than the in-situ observations...' I don't see this from the data. In Fig. 2d, 2e and 3, the data are sometimes smaller and sometimes higher than

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the model results. The values given in table 1 for model and observations are almost identical for the WMed and EMed, only smaller subregions show significant differences.

p.8, l.20-21 'A careful comparison between model outputs and seawater observations (1959) reveals a more pronounced dis-agreement, especially in the EMed surface water where the model overestimates the 14 C values by more than 10 %. (Fig.4a).' Where is the profile shown in Fig. 4a located? Or is it a composite from different locations? If it is one complete profile, the location should be indicated in the inlet map of Fig. 2e or given in coordinates. Second, the measured EMed surface value shown in Fig. 2e is much larger than the value from Fig. 4a, around -45 %. So how representative is the profile shown in Fig. 4a for the whole EMed?

p.10, first paragraph Only the higher 14C values in the deepwater in the Levantine basin are mentioned here, although in the western Med. the values are comparably high between 4°E and 10°E.

p.10, l.13-14 'However the model simulates well the 14 C values in the surface and deep water of Adriatic sub-bassin (Figure 7a and 7c) compared to Meteor M84/3cruise data (Tanhua et al., 2013).' According to Fig. 7a and 7c the model values are too high, which is even more pronounced in Fig. 7b for the intermediate layers.

Figures:

All horizontal maps are strongly distorted. I would prefer a more equidistant representation.

Fig.2: In subfigures b and c, the y-labels have a larger fontsize than the x-labels. The fontsize of the colour bar is too small, and the space between the colour bar and the upper maps should be enhanced.

Fig.3: The font size of the axis labels is too large and of the labels of the color bar too small.

Fig.5: Exactly the same as for Fig.2.

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Fig.7: Exactly the same as for Fig.2.

Fig.11: The ylabel 'Time (yr)' should be centered.

Minor comments/corrections:

p.6, Eq.1 the vector 'u' should be notated in bold math

p.9, l.26 '... when we compare...' (not compared)

p.10. l.13 '...values in the surface and deep water of the Adriatic sub-basin' ('the' is missing and 'basin' is misspelled)

p.12, l.3 'However the representation of the pre-bomb distribution is more contrasted in the simulation' I don't understand the meaning of 'contrasted'.

p.13 l.7 '... to prolonged exposure of the surface water to the atmosphere.' (add 'the' before 'atmosphere')

p.13 l.7-8 'where it depends on convection processes with higher convection occurring especially during the bomb peak' I don't see why higher convection has occurred during the bomb peak. Maybe it is meant that the amount of 14C entering the deep water was higher during that time.

p.13, l.18 '... at the bottom of the Levantine sub-basin' ('the' is missing)

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