We thank reviewer #2 for her/his constructive comments on the manuscript. We have carefully considered all questions and concerns raised. The structure of our reply is as follows; each comment from the anonymous reviewer is recalled in blue, and our reply in black.

Specific comments:

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 (â´Lij100 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?

In many study the Mediterranean Sea is described as a miniature ocean (e.g. Lascaratos et al 1999) based on the difference of the overturning time of the Mediterranean/world ocean. Most of the physical processes that characterize the global general ocean circulation (e.g. intermediate and deep water formation) also occur in the Mediterranean Sea but at shorter time scale. This allows investigating human-induced climate modifications that are rapidly transferred to sub-surface waters in the entire Mediterranean Sea. For example, the increase of seawater temperature at intermediate and deep level due to the effect of the present global warming is stronger in the Mediterranean Sea compared to that observed at similar depths in the global ocean. Similarly, acidification due to uptake of anthropogenic carbon is already affecting all deep water masses of the Mediterranean Sea (Palmieri et al, 2015) Owing to its small size and limited exchange with the Atlantic Ocean, the Mediterranean Sea amplifies the effects of global changes, which can be then studied at shorter temporal scales.

The shorter Mediterranean turnover timescales permits to perform longer and more computational efficient simulations.

For the sake of clarity, we have modified this sentence in the revised version of the manuscript.

[See changes p 2, line 2-4 in the revised manuscript.]

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.

We thank the referee for this suggestion; this conceptual difference between ^{14}C and the other tracers has been clarified in the revised manuscript.

[See changes p 2, line 25-26 in the revised manuscript.]

p.3, l.6-8 and p.33, l.31 Here and at some other passages in the paper the role of 14C for the determination of water mass ages and constraining the deep water circulation is mentioned. This is not wrong, but regarding ages, 14C 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 14C. This should be made clear somewhere in the text.

We agree with the referee, that tracers with shorter input histories are more adapted to investigate water mass ages and circulation in the Mediterranean Sea (see for example Ayache et al., 2015a for anthropogenic tritium and Palmieri et al., 2015 for CFCs).
The present radiocarbon simulation aims at implementing a geochemical tracer with a longer time scale allowing more paleo-oriented applications. This ^{14}C modelling would help improving the knowledge of the natural distribution of ^{14}C in the Mediterranean, providing a unique opportunity to explore the impact of the interannual/decadal variability on radiocarbon distribution in the Med Sea.

Clarified in revised version

[See changes p 4, line 19-21 in the revised manuscript.]

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 14C data. So this topic might be given more room in the description and discussion.

For the Mediterranean Sea we have studied the impact of Kw on the radiocarbon distribution in this semi-enclosed basin, and we have chosen a value that gives the best agreement with available in-situ data. On the other hand the present simulation was done in a computationally efficient off-line mode (as mentioned in section 2.2), i.e. the dynamic was run independently from the ^{14}C module and the Kw parametrization was adapted for the Mediterranean Sea.

A sentence was added to clarify this point.
[See changes p 7, line 4-7 in the revised manuscript.]

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 ‰

The referee is correct, the value is closer to -44 and this has been corrected in the revised version. The -46 ‰ has no special meaning.

[See changes p 8, line 20 in the revised manuscript.]

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

The referee is correct, there are no significant differences between WMed and the EMed average values. However, if we look at Fig. 3 (data from Siani et al. 2000) there is an important spatial gradient across the different sub-basins in the Mediterranean Sea as a consequence of old carbon impact near the coastal areas. This effect is not represented in the present simulation. On the other hand, our model results are in good agreement with average values provided by

Reimer and McCormac (2002) for each sub basin in the Mediterranean. Other in-situ data would help to improve the model parametrization.

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 14C 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?

The vertical profile shown in Fig. 4a is a composite of seawater observations from different locations (Brocker et al., 1969) as represented in Fig. 2 for the pre-bomb situation. The measured EMed surface value shown in Fig. 2e is much larger than the value from Fig. 4a because the latter presents the average value of all in-situ data and model output on the same position. However the representation of the pre-bomb distribution is more contrasted in the simulation, where several issues complicate the simulation of the natural steady state distribution of ^{14}C using ocean-model circulation (e.g. the uncertainty associated with the boundary conditions).
For the sake of clarity, we have modified Fig.4 caption in the revised manuscript.

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

Added in the revised manuscript.
[See changes p 10, line 11 in the revised manuscript.]

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?

We agree with the referee that the model values in the Adriatic deep water are higher compared to those obtained for the Meteor M84/3 cruise. However the high ^{14}C level in the deep water proved that the model simulates deep convection in the Adriatic sub-basin. Nevertheless, the outflow of this deep water through the Strait of Otranto is weaker in the model and the simulated signal of deep-water ventilation from the Adriatic sub-basin is propagating at too shallow depth compared to the observations. This shortcoming was also noticed for the other tracer simulations with the same model NEMO-MED12 (e.g. Ayache et al. 2015a; Palmiéri et al., 2015; Ayache et al. 2015b; Ayache et al. 2016). In the Adriatic sub-basin, the contribution of rivers is very important; however, the atmospheric forcing ARPERA combined with the river runoff data set overestimates the freshwater flux, and provides too much freshwater on this domain. This results in unusually low-salinity water compared to observations, preventing winter convection and the propagation of AdDW to the bottom of the Ionian sub-basin.

Figures:

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.

Adjusted

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

Corrected

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

Adjusted

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

Adjusted

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

Corrected

Minor comments/corrections:

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

Corrected

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

Corrected

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

Corrected

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’.

Replaced by ‘more difficult”

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

Done

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.

The transfer of radiocarbon was higher during the bomb peak as a consequence of large amount of ^{14}C in the atmosphere. We agree with the referee that this sentence is not clear and it can be easily misinterpreted. It has been modified in the revised version.

[See changes p 13, line 16-17 in the revised manuscript.]

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

Corrected.