# Comparing simulated marine reservoir ages of the non-polar surface ocean between different models under consideration of abrupt changes in the Atlantic Meridional Overturning Circulation during the last 55 kyr

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## Abstract

The marine reservoir age (MRA) of the non-polar surface ocean is an important information used for the establishment of age models for marine sediment cores and/or artifacts found in latitudes <50°. This MRA is dependent on the underlying radiocarbon calibration curve. For the most recent one, IntCal20, this MRA (Marine20) was directly calculated from the atmospheric $\Delta^{14}C$ record using a carbon cycle box model, that considered observed changes in the carbon cycle, but neglected changes in the strength of the Atlantic meridional overturning circulation (AMOC) related to Dansgaard/Oeschger and Heinrich events. A recent study (Köhler et al., 2024) suggested that abrupt AMOC changes would lead to changes in MRA of less than 100 $^{14}C$ yrs in the non-polar surface ocean. Although this is within the uncertainty range of Marine20, the effects of abrupt AMOC changes have not been considered during the calculation of the uncertainties in Marine20, which might add additional uncertainties to the calculated MRA. Abrupt AMOC changes might thus be considered in the next iteration of IntCal. To better constrain the impact of AMOC changes on MRA we here compared these previous box model results with the output from three Earth System Models of Intermediate Complexity (EMICs) over the last 55 kyr. The applied models are LOVECLIM, Bern3D, ClimberX. The setups of the models are not identical, but all models are forced by atmospheric $CO_2$ and $\Delta^{14}C$ to have the surface ocean carbon cycle as close as possible to reconstructions. We find that the size of the abrupt AMOC changes in the EMICs is also in the order of less than ±100 $^{14}C$ yrs with Bern3D simulating changes up to ±200 $^{14}C$ yrs. While the models tend to agree that a reduced AMOC leads to smaller MRA in the non-polar surface ocean, under some conditions the opposite is found (e. g. simulations with LOVECLIM across the Heinrich 1 event). Thus, the amplitude of the AMOC-related changes in the non-polar surface ocean MRA are indeed to a certain degree model-dependent and one needs to discuss how these findings are implemented in the next iteration of IntCal. For a better evaluation model results are also compared with data for the surface and deep Atlantic Ocean, since this is the area most important for AMOC changes, and best covered by data.

### References

Köhler, P., L. C. Skinner, and F. Adolphi (2024), Radiocarbon cycle revisited by considering the bipolar seesaw and benthic $^{14}C$ data, Earth and Planetary Science Letters, 640, 118801, doi:10.1016/j.epsl.2024.118801.