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Marine radiocarbon simulations carried out with a global multi-resolution ocean model

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Radiocarbon (^{14}C) is an ideal tracer to study the uptake of carbon dioxide by the seas and the ocean circulation during the past 50,000 years. However, there are various issues impeding a straightforward interpretation of marine ^{14}C records. The spatial and temporal variability of marine ^{14}C records is superimposed by a systematic isotopic depletion of the sea surface with respect to the atmosphere. This effect is frequently expressed as Marine Reservoir Age (MRA), ranging from ~400 years in subtropical oceans to more than 1000 years in polar seas during the late Holocene. Prior to the Holocene, MRAs are poorly constrained through reconstructions. Moreover, the entire database of marine ^{14}C records gets increasingly patchy and sparse the further one steps backwards in time. Model simulations provide a valuable interpretation tool and can help to fill spatial and temporal gaps. However, ^{14}C paleorecords typically originate from continental margins, marginal seas, or tropical lagoons. These regions are not properly resolved by default coarse-resolution ocean models, which may result in regional model and hence interpretation biases. The alternative are marine ^{14}C simulations with high(er) resolution, but the conventional approach involving uniform meshes results in computational costs which are prohibitive in most cases. To overcome these issues, we have implemented ^{14}C into the state-of-the-art ocean model FESOM2 which employs unstructured meshes with variable resolution. This approach permits zooming into certain regions of interest while keeping the model resolution in other areas sufficiently moderate. Here, we present first simulation results considering the Anthropocene, the late Holocene, and the Last Glacial Maximum, focusing on the evolution of Marine Reservoir Ages.