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Iterative adjustment of glacial radiocarbon histories by means of three-dimensional ocean circulation simulations

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Current radiocarbon dating of marine samples from the period beyond 10.5 kyr BP assumes a global-mean marine reservoir age (MRA) of 405 years constant with time (Hughen et al., 2004). On the other side, there is observational evidence for considerably higher MRA values, at least episodically and for certain regions (e.g., Bard et al., 1994). Moreover, modeling sensitivity studies indicate generally elevated MRA values due to a slowdown of radiocarbon air-exchange under glacial climate conditions (e.g., Butzin et al., 2005). Underestimates of the glacial MRA may also lead to systematic biases in atmospheric radiocarbon reconstructions which are based on marine samples. To account for changing glacial MRA values, we propose a 3D-model based iteration procedure. Our approach adjusts the current radiocarbon histories by repeated transient simulations using an ocean general circulation model which is coupled to an atmospheric radiocarbon reservoir. Several forcing scenarios are performed in order to establish the deglacial radiocarbon history, including the uncertainty in the ocean circulation during the last glacial maximum and deglaciation. The envelope of results is a step forward to more realistic glacial radiocarbon histories of the surface ocean and the atmosphere within reasonable uncertainty ranges.