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14C-based evaluation of ocean circulation models: why we need to care about correct preformed ages

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Global ocean models are routinely used to study the effects on and feedbacks of biogeochemical cycles induced by global warming, ocean acidification and de-oxygenation. The underlying circulation fields of such models are often evaluated by comparing the models 14C-tracer distribution with those observed in the real ocean. Using the output from three state of the art coupled carbon cycle ocean circulation models we study the impact of the preformed 14C-age on this evaluation. Similar to other preformed properties, the preformed 14C-age is defined as the age a water parcel has when it leaves the surface ocean and is subducted into the interior of the ocean. The preformed age component is highly variable between models. On global average it is equivalent to 30-55 percent of the apparent age (the age computed from the natural 14C content) in the deep ocean (below 1500m) and even more important in shallower waters. Concerning the observational data, the so-called 'bomb-corrected' 14C-distribution, we highlight the fact that this is a computed property with clear conceptual limitations. We discuss the reliability of current model evaluation procedures and propose improved evaluation schemes.