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Sensitivity of the uptake of bomb 14C to the air-sea exchange scheme in the Pacific Ocean model

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Bomb 14C is one of important tracers, which is often used for the assessment of the ocean general circulation model (OGCM). Thus much attention has been paid to the distribution and storage of bomb 14C, which is also related to the air-sea exchange of bomb 14C. Using a basin-wide OGCM of the Pacific Ocean, two numerical experiments are designed to examine the role of the air-sea exchange scheme, including the constant exchange rate (RUN1) and the wind-dependent exchange rate (RUN2). The different spatial patterns for the sea water to absorb bomb 14C in the two runs produce a significant difference in the distribution of bomb 14C at the sea surface in 1973. Relative to the observations, RUN2 can reduce the phenomenon of overestimates of the bomb 14C concentration at the sea surface. Because of the weak transport, the penetration depth of bomb 14C in the subtropical North Pacific is lower than the data-based estimate. The difference in column inventory between the two runs is mainly controlled by the distribution of bomb 14C in the upper ocean. Because of the persistent decrease of the air-sea exchange flux, the concentrations of bomb 14C at the sea surface in both runs in 1994 are less than those in 1973, while through the interior transports by the physical processes, the penetrate depth of bomb 14C in the main storage area is deepened in the two runs in 1994. The inventory north of 20ºN increases by 23.5% and 15.1% from 1973 to 1994 in RUN1 and RUN2, respectively. In addition, the similar interior transports under the same physical fields and the reducing exchange flux induce much closer surface concentrations and much closer characteristic of the inventories to the observations. As a result, in 1994, the zonal mean inventories of bomb 14C in the two runs are much closer to each other than those in 1973. Furthermore, the comparison of the two runs indicates that the role of the Okhotsk Sea in the transport of the passive tracer in the North Pacific cannot be ignored. The comparison of different uptake schemes is useful to evaluate interior transport processes because of the different absorbing abilities in these key regions.