Estimating air-sea gas exchange using bomb $^{14}$C: Revisited

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Wind-speed dependent bulk formulations of gas transfer velocity have traditionally been scaled to the oceanic inventory of bomb $^{14}$C (Wanninkhof 1992, Wanninkhof and McGillis 1999). The recent advances in our ability to estimate both the first two moments of global wind-speeds and the inventories of bomb $^{14}$C inventories call for a reanalysis of this anchor point as well as an exploration of its implications on oceanic carbon uptake. We present a reanalysis of $^{14}$C flux estimates which proceeds from global to regional scales using both the traditional global inventory approach directly from data as well as inverse calculations of oceanic transport which permit us to resolve atmosphere-ocean $^{14}$C flux in 10 regions. Using a best fit, in a least squares sense, between 8,000 measurement-based estimates of bomb $^{14}$C in the upper 1500 m of the water column and three different configurations of a GCM we see a discrepancy between our inventory and the Broecker et al. (1985 and 1995) bomb $^{14}$C inventories used by Wanninkhof (1992) and Wanninkhof and McGillis (1999). Our preliminary results suggest that the average global piston velocity may be overestimated by as much as 25%. However, large discrepancies between data and model-based inversions in surface waters of the high latitudes will need to be further investigated. A regional analysis shows that while total world ocean inventories are similar, there is a large model dependent variation in the location of the bomb $^{14}$C surface fluxes. In particular, average surface fluxes of bomb $^{14}$C from 1954-1994 are extremely dependent on the model parameterizations picked in the Southern Ocean.

REFERENCES