Observations and modeling of the seasonality of $\Delta^{14}C$ of atmospheric CO_2 at Point Barrow, Alaska

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$\Delta^{14}C$ is an isotopic ratio uniquely suited for discriminating between fossil and biosphere carbon emissions, but few long-term measurement series exist. We have measured $\Delta^{14}C$ in about 2 air samples monthly from the Point Barrow Observatory, Alaska (71°N, 157°W) since July 2003 with precision of around 2‰. In this period, $\Delta^{14}C$ decreased by 7‰/year, to ~57‰ in mid-2005. We find a seasonal cycle in $\Delta^{14}C$ with a broad minimum in January-June, a maximum in September and an amplitude of 6‰. Compared with these observations, simulations with the Model of Atmospheric Transport and Chemistry (MATCH) predict a seasonal cycle with broadly similar phase, with seasonality in fossil and biosphere CO_2 emissions predicted to make about equal contributions. However, the simulated seasonal cycle has ~70% the observed amplitude, and it has $\Delta^{14}C$ starting to increase earlier in the spring. The shape of the observed cycle suggests a larger biosphere contribution, possibly due to either longer carbon mean residence time (so that respired carbon contains more bomb ^{14}C) or higher net primary production in the region, than assumed in our simulation. We plan to use our measurements from Point Barrow and elsewhere in North America to test the regional carbon balance inferred from inverse modeling using only measurements of the CO_2 concentration and $\delta^{13}C$.