Atmospheric $^{14}CO_2$ over the mid Pacific Ocean and at Point Barrow, Alaska, USA from 2002 to 2004

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$^{14}CO_2$ is a useful tracer for studying the carbon cycle, in terms of determining residence times and fluxes between different carbon reservoirs, and understanding the various underlying processes. Knowledge of the regional and global distribution of atmospheric $^{14}CO_2$ is essential for many of these applications. We have recently begun measuring atmospheric $^{14}CO_2$ in the mid-Pacific and at stations in the US to add to the sparse available data for atmospheric ^{14}C distribution. Our samples represent air collected over the time span of a few minutes from flasks. All of our samples were analyzed for $\Delta^{14}C$ at the Keck AMS facility at UC Irvine. Atmospheric CO_2 samples were collected on a shipboard transect over the Pacific Ocean between Los Angeles (34°N, 118°W) and Auckland, New Zealand (37°S, 174°E) from fall 2002 to spring 2004. These samples were also measured for C-trace gas abundance (CO, CH_4 in addition to CO_2, and their stable isotopes). The 2002 transect (collected from Sept. 23 to Oct. 4, 2002) terminated in Manzanillo, Mexico (16°N, 109°W) instead of from Los Angeles. The 2002 transect showed that $\Delta^{14}C$ in atmospheric CO_2 in this latitude range was relatively uniform spatially during the collection period. The average $\Delta^{14}C$ value of all 24 samples was 79.9±2.3‰ (1 σ). The spread of the data was comparable to our analytical error estimated by standard measurements. There was a slight decreasing trend in $\Delta^{14}C$ of air CO_2 northward of 6°N, consistent with an increase in fossil fuel inputs to air in the northern hemisphere. The 2003 transect (from July 2003 to Aug. 2003) was similar to that of 2002 transect, in terms of the latitudinal distribution. It gave an average $\Delta^{14}C$ value of 75.4±2.7‰ (1 σ), indicating a decrease of approximately 4.5‰ per year. Samples from a coastal mid-latitude sites (Montaña de Oro State Park, CA (35°N, 121°W) show a similar average $\Delta^{14}C$ value of 76.1±6.5‰ from January 10, 2003 to April 27, 2003, while data from a mid-continental site at Niwot Ridge, CO (41°N, 105°W) were significantly higher during the same period (83.7±1.7‰). The time series of atmospheric $^{14}CO_2$ at a coastal site at Point Barrow, Alaska (71°N, 157°W) from July 12, 2003 to August 18, 2004 shows a general decreasing trend with time. The average $\Delta^{14}C$ of this time series was 66.6‰ with a range of about 11‰, showing a hint of a seasonal cycle and lower ^{14}C values at high northern latitudes. Low $\Delta^{14}C$ values in Pt. Barrow air correlate with wind direction, indicating that part of the temporal variation may be caused by the advection of low ^{14}C air from lower latitudes. Our results confirm large-scale patterns in atmospheric ^{14}C predicted using carbon cycle models coupled with models of atmospheric transport. We plan to continue measuring radiocarbon in CO_2 in the mid-Pacific and at the surface US stations in different seasons for the next several years for a fuller picture of seasonal and latitudinal variation in atmospheric $\Delta^{14}C$.