

Observations of atmospheric radiocarbon in carbon dioxide at Hateruma Island

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We have been conducted monthly air samplings for measurements of atmospheric radiocarbon in carbon dioxide ($^{14}\text{CO}_2$) at Hateruma Island (HAT, 24.05°N, 123.80°E, 47 m a.s.l.), Japan since 2004. We collected whole air samples using 2.5L glass flasks pressurized to 2.3 atm, and 5L air was used for radiocarbon analysis. The values of $\Delta^{14}\text{C}$ were measured using Compact Accelerator Mass Spectrometry (CAMS, NEC 1.5SDH). Uncertainty in $\Delta^{14}\text{C}$ measured by CAMS is less than 2 per mil, which is based on the number of ^{14}C counts and the scatter of $^{14}\text{C}/^{12}\text{C}$ ratios during measurements. The reproducibility of CAMS measurements is ± 1.4 per mil (standard deviation of $\Delta^{14}\text{C}$ values in a reference air cylinder). The $\Delta^{14}\text{C}$ values of background maritime air observed at HAT clearly show the seasonal cycle (minimum in March and October and maximum in August) with amplitude of 10 per mil. The simulation using atmospheric transport model (NIES TM) indicates that fossil fuel CO_2 causes seasonal cycle of $\Delta^{14}\text{C}$.

In HAT we can measure polluted continental air from the East Asia in winter. To capture the high CO_2 events of Asian outflow, we installed remote-controlled autosampling system at HAT in 2010. For example, between March 7 and 11, 2010, we observed two events of CO_2 enhancement. The $\Delta^{14}\text{C}$ values in the high CO_2 samples were significantly lower than the background level. The $\Delta^{14}\text{C}$ observations indicate that fossil fuel CO_2 contributes 73-83% of CO_2 enhancement in the first event and 47-72% in the second event. The simulation suggests that biospheric emissions cause the other part of CO_2 enhances. The keeling plot of $\Delta^{14}\text{C}$ shows the difference between two events clearly rather than that of $\delta^{13}\text{C}$, implying advantage of high precision $\Delta^{14}\text{C}$ measurements for CO_2 source appointment.

Keywords: carbon cycle, carbon isotope measurements, Accelerator Mass Spectrometry, Asian outflow, source appointment, atmospheric transport