# Development of a High Precision Detection Capability for Recently Added Fossil Fuel $CO_2$ in the Atmosphere Using $^{14}C$

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$^{14}CO_2$ provides a direct tracer for recently added fossil fuel $CO_2$ in the atmosphere. Use of this method has been limited in the past by the precision of $^{14}C$ measurements. However, unlike other methods (e.g., CO and $SF_6$), $^{14}CO_2$ measurements are not confused by biases. In order to utilize this method, we have developed the ability to measure $^{14}CO_2$ to 2‰ precision, equating to ~1 ppm detection of fossil fuel $CO_2$ on air samples of 3-6 liters. We use cryogenic extraction of $CO_2$ followed by graphitization and accelerator mass spectrometry. Repeated measurements on aliquots from a single tank of air show a precision of better than 2‰ at 1σ. Using recent results from Niwot Ridge, Colorado, we compare $^{14}C$, CO, and $SF_6$ methods for fossil fuel $CO_2$ detection and show that $^{14}C$ provides accurate detection versus the other methods.

Using the TM5 atmospheric transport model, we estimate the global $\Delta^{14}C$ spatial distribution (Figure 1). The model predicts a west-east $\Delta^{14}C$ signal across the continental United State of ~6‰, easily detectable with our measurement precision. A combination of the $^{14}C$ result with other tracers will thus allow us to separate fossil fuel and biological $CO_2$ contributions across the United States.

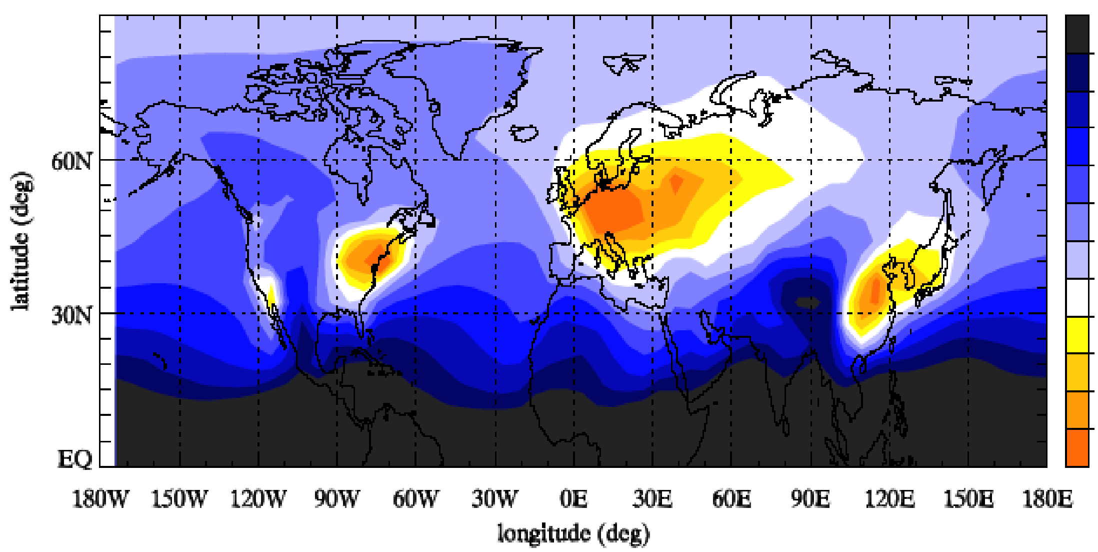


Figure 1. $\Delta^{14}C$ (‰) in the annual mean surface layer simulated using the TM5 transport model. Fossil fuel emissions, set at 7 GtC (representing estimated 2005 emissions), are spatially distributed according to population, and emissions are seasonally varying (30% peak to trough amplitude). Simplifications (no stratospheric $^{14}C$ reservoir and ocean disequilibrium flux is spatially uniform) bias the absolute $\Delta^{14}CO_2$ values but not the spatial gradient over the continents.