Developing a reliable observational method for tracking fossil fuel emissions is a critical part of any carbon monitoring strategy. 

"14CO2 is an ideal tracer for fossil fuels because radioactive decay leaves fossil fuels like petroleum, coal and natural gas 14C-depleted relative to the atmosphere (see Table 1)." 

Separating Fossil and Biological Signals in Boundary Layer CO2

"In order to construct atmospheric time series, it is critical to have milli- to micro metric precision in addition to stability and accuracy of long-term precision. To assess our long-term precision, we have analyzed datasets of CO2 from a single high pressure cylinder (target tank) during four 4AMS analysis of authentic samples. As can be seen in Figure 4a, the long-term precision is <-2 ppm, which includes precisions of 3.2 ppm for samples measured more recently at U.C. Irvine (JDC). Mean values of our target tank from RRI and UCI are indistinguishable at 73.5 and 73.5 ppm. Analysis of replicate sample pair duplicates also shows uncertainty of 2 ppm.

Using 14CO2 to evaluate Atmospheric Transport

"Knowing an emissions source (fossil fuel CO2) and the atmospheric distribution of a tracer for that source (14CO2) allows us to test our knowledge of atmospheric transport. We make more and more measurement of 14CO2 over the United States and other continents, these will become powerful constraints for atmospheric transport models. Here, we present simulations of simulated and observed 14CO2 (Fig. 3a) in a transect across Siberia (Fig. 3b) showing its sensitivity to modeled transport. We used two variations of TM5: with standard gas-phase transport and with enhanced transport in which European emissions are modified by reinterpreting the effective emission ratio of CO:C, and not its gradient." 

NACP-related 14CO2 measurements

"Figure 4a: Air samples from Niwot Ridge (CO, NWR) can play an important role in numerous regional NACP investigations. It has been shown previously (e.g., Heflin et al., 2004) that the free troposphere air sampled here (all <3500m) can serve as proxy for free troposphere air at downwind locations. This means, for example, that boundary layer to free troposphere sampling efforts can use NWR time series to establish a reference for boundary layer air. By analyzing boundary layer CO2 and 14CO2 we can infer boundary layer CO2 by plants (Eq. 2b) may result in no CO2 gradient. Figure 2b shows large variations in boundary layer concentrations of fossil CO2 that are due to seasonal changes in fossil fuel use and meteorology. Correcting the raw CO2 `background' estimate of atmospheric 14CO2 over the United States and other continents, these will become powerful constraints for atmospheric transport models. Here, we present simulations of simulated and observed 14CO2 (Fig. 3a) in a transect across Siberia (Fig. 3b) showing its sensitivity to modeled transport. We used two variations of TM5: with standard gas-phase transport and with enhanced transport in which European emissions are modified by reinterpreting the effective emission ratio of CO:C, and not its gradient."

References and further reading