A Study of Carbon Monoxide Stable Isotopes at the Indianapolis Flux Project (INFLUX)

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Carbon monoxide (CO) is a short-lived trace gas in the atmosphere, produced by combustion and atmospheric oxidation of organic compounds. While not a strong greenhouse gas, CO's strong role in atmospheric chemistry, particularly in the HOx cycle, means it can indirectly affect the lifetimes of other, more important greenhouse gasses, such as methane. In addition, CO can be used as a correlate tracer of fossil fuel-produced carbon dioxide. Stable isotopes of CO have been shown to yield important information about the source and sink processes of CO. At INFLUX, mole fraction and stable isotopes of CO have been measured for the same samples at roughly 6 samples per month for 18 months. Three sites have been measured: a background site, and two "downwind" sites, which are situated so they capture the urban plume of Indianapolis when the wind is westerly.

During the winter months, the biogenic sources of CO are reduced and as such, the primary source of CO is likely anthropogenic. Thus far, the data support this conclusion; in addition, the primary anthropogenic source may be traffic emissions. Correlation plots are made where the product of the isotope value and the mole fraction of the background site is subtracted from the product of the isotope value and mole fraction at one of the urban sites. This difference is plotted on the y-axis against the difference in the mole fractions of the same two sites on the x-axis. These correlation plots remove the background signal from the urban plume, and a regression slope is used to calculate the source isotopic value. These data suggest that there is a single source, urban traffic emissions, and that traffic in Indianapolis has a lighter CO isotopic signature than traffic in Europe.

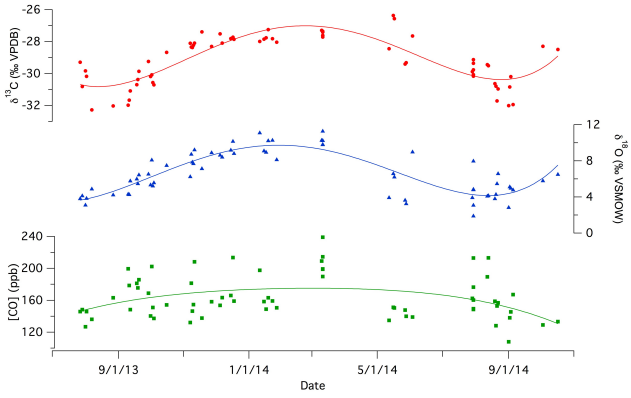

Figure 1. Time series of ^{13}CO and $C^{18}O$ as well as CO for INX Tower 2, which is east of the urban center of Indianapolis

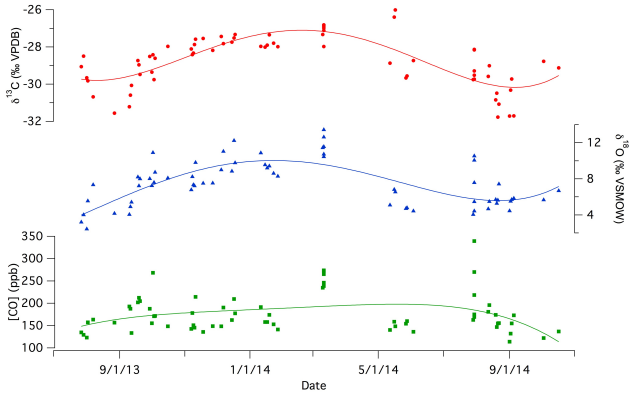

Figure 2. Time series of ^{13}CO and $C^{18}O$ as well as CO for INX Tower 3, which is in downtown Indianapolis