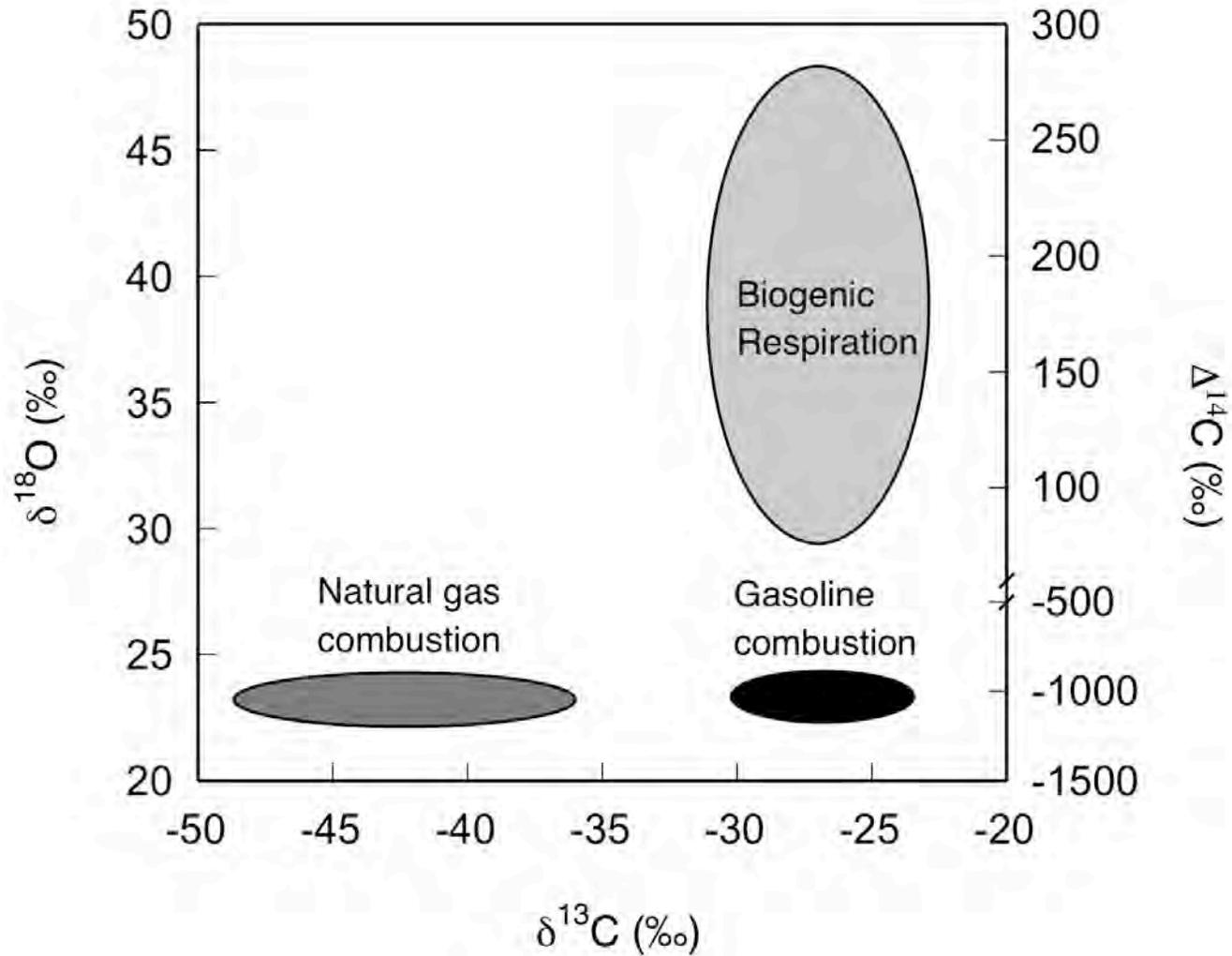
An aerial photograph showing a residential area with a large reservoir and a small white dome structure. The text is overlaid on the image.

Isotopic tracers of fossil fuel-derived CO₂

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Stable and radioisotopes trace the sources of CO₂



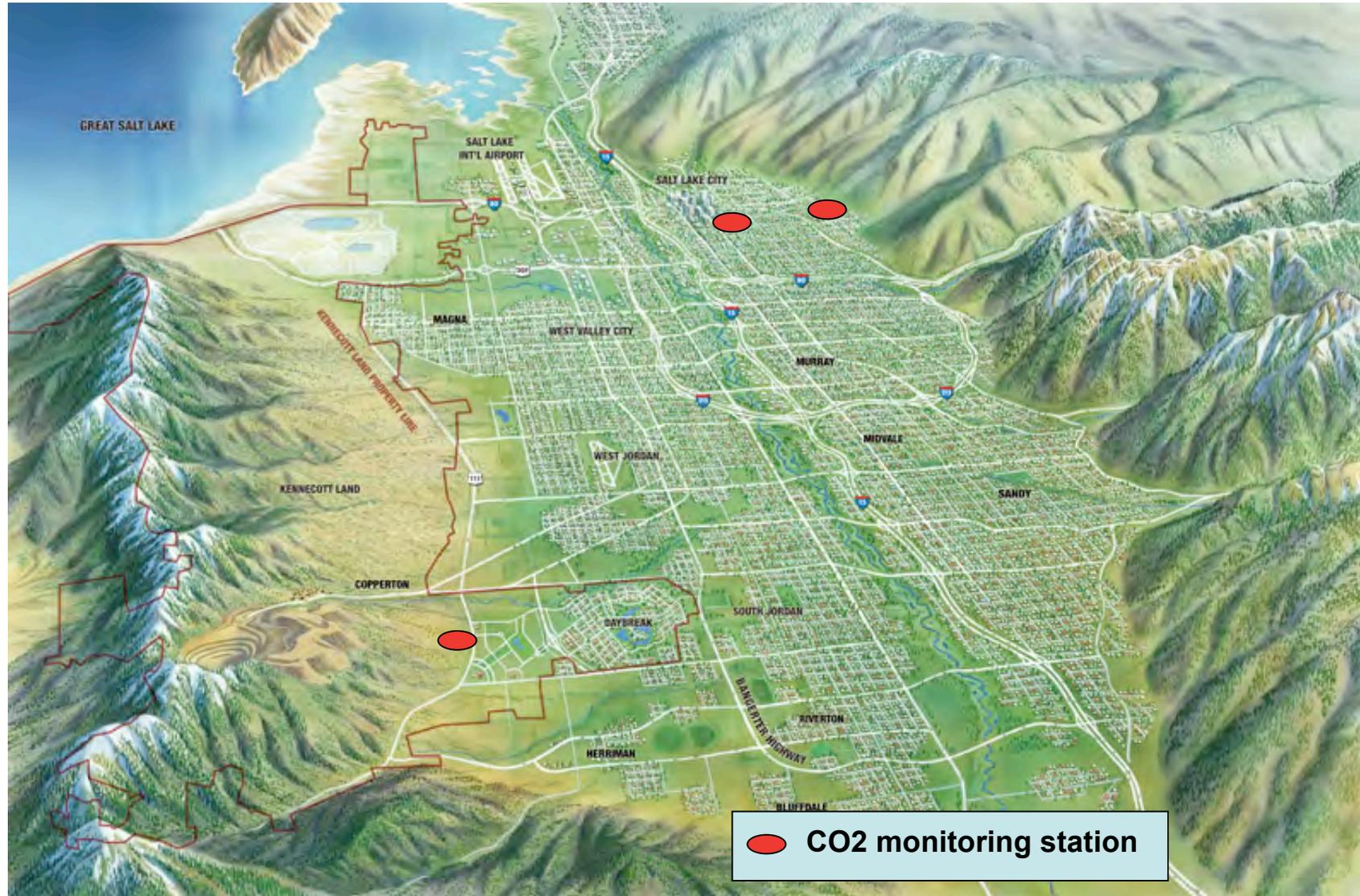
We can solve for the contributions of different CO₂ sources to the total mixing ratio at night

$$M_{\text{Total}} = M_{\text{Background}} + M_{\text{Gasoline}} + M_{\text{Natgas}} + M_{\text{respiration}}$$

$$\delta^{13}\text{C}_T M_T = \delta^{13}\text{C}_B M_B + \delta^{13}\text{C}_G M_G + \delta^{13}\text{C}_N M_N + \delta^{13}\text{C}_R M_R$$

$$\delta^{18}\text{O}_T M_T = \delta^{18}\text{O}_B M_B + \delta^{18}\text{O}_G M_G + \delta^{18}\text{O}_N M_N + \delta^{18}\text{O}_R M_R$$

Monitoring CO₂ concentrations across an urban to rural gradient in the Salt Lake Valley, Utah



Site 1: the University of Utah (residential)



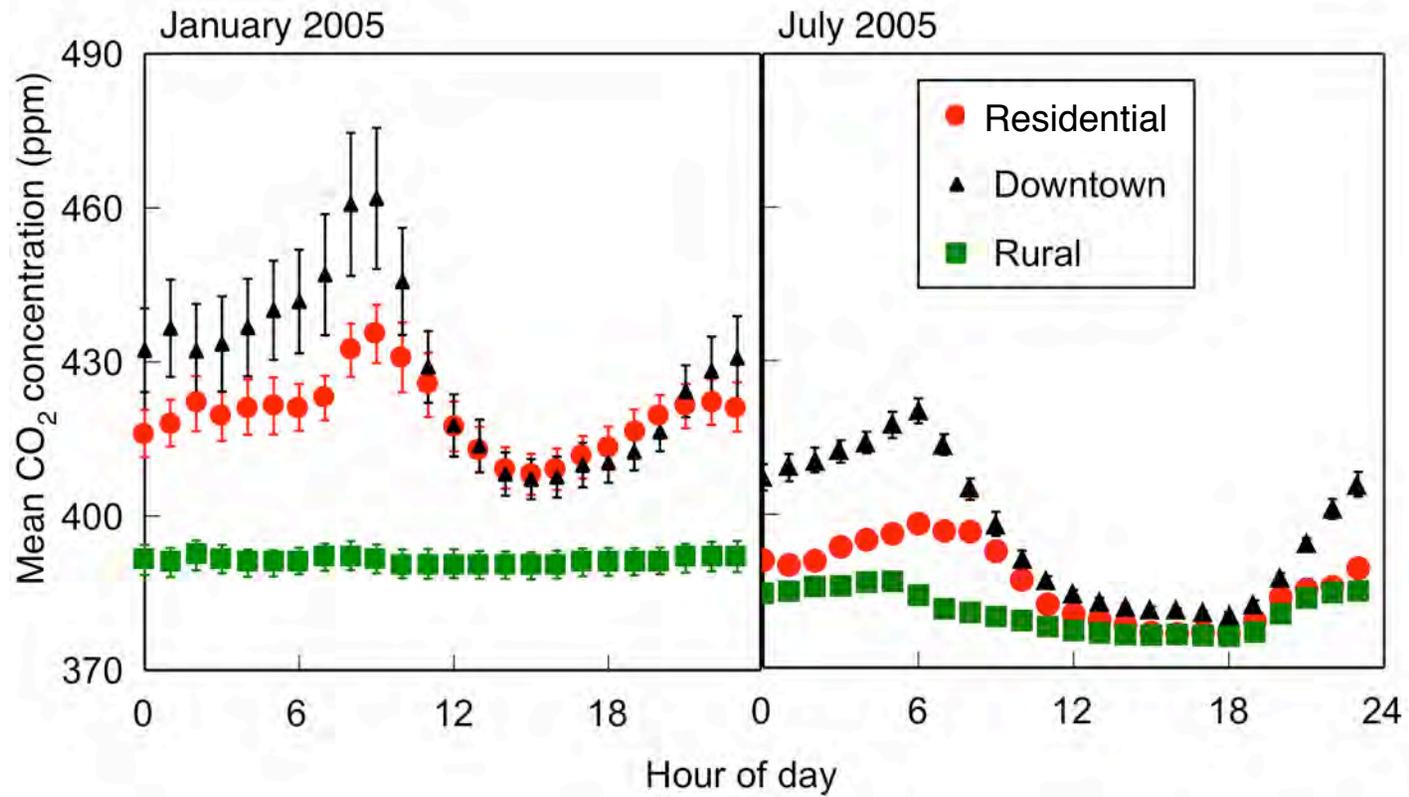
Site 2: Downtown Salt Lake City



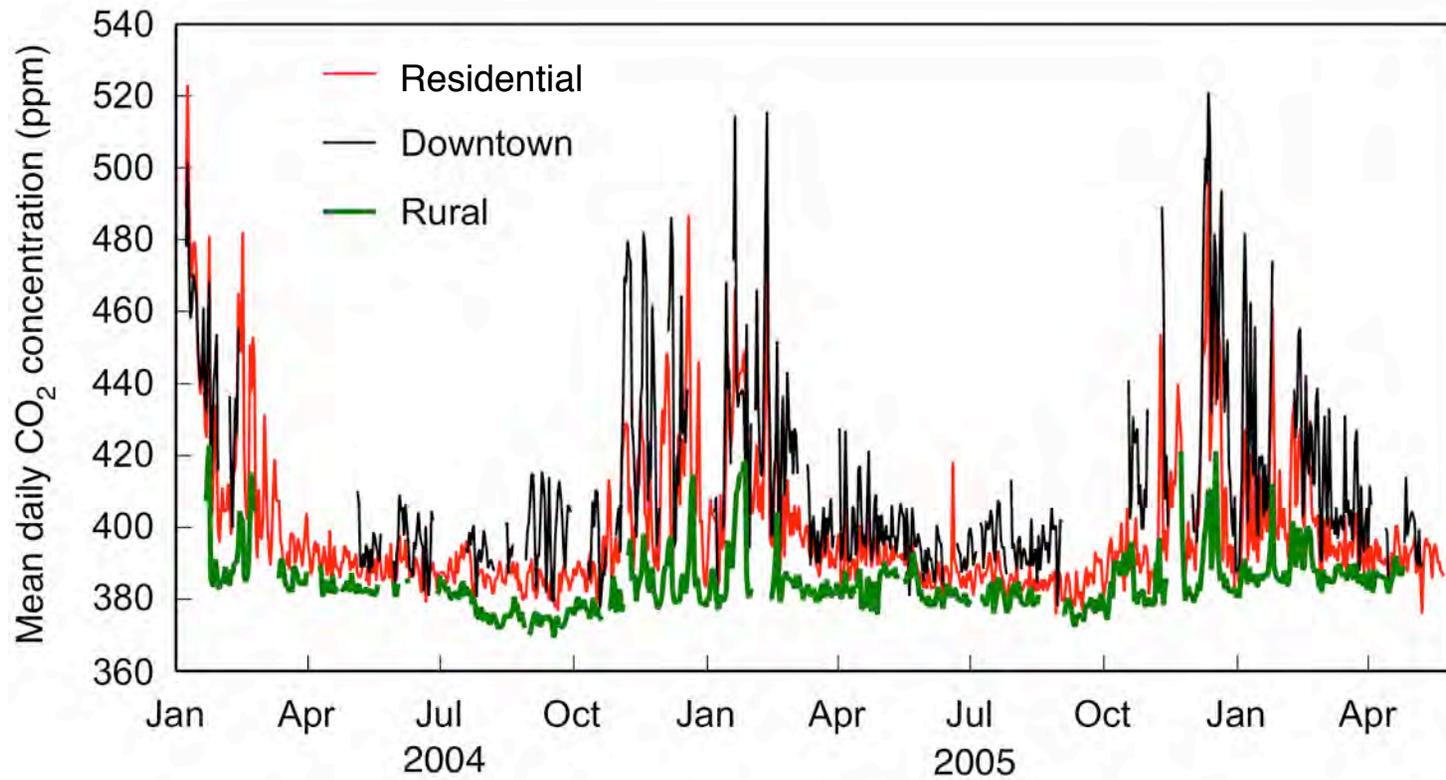
Site 3: Mixed sagebrush scrub-agriculture



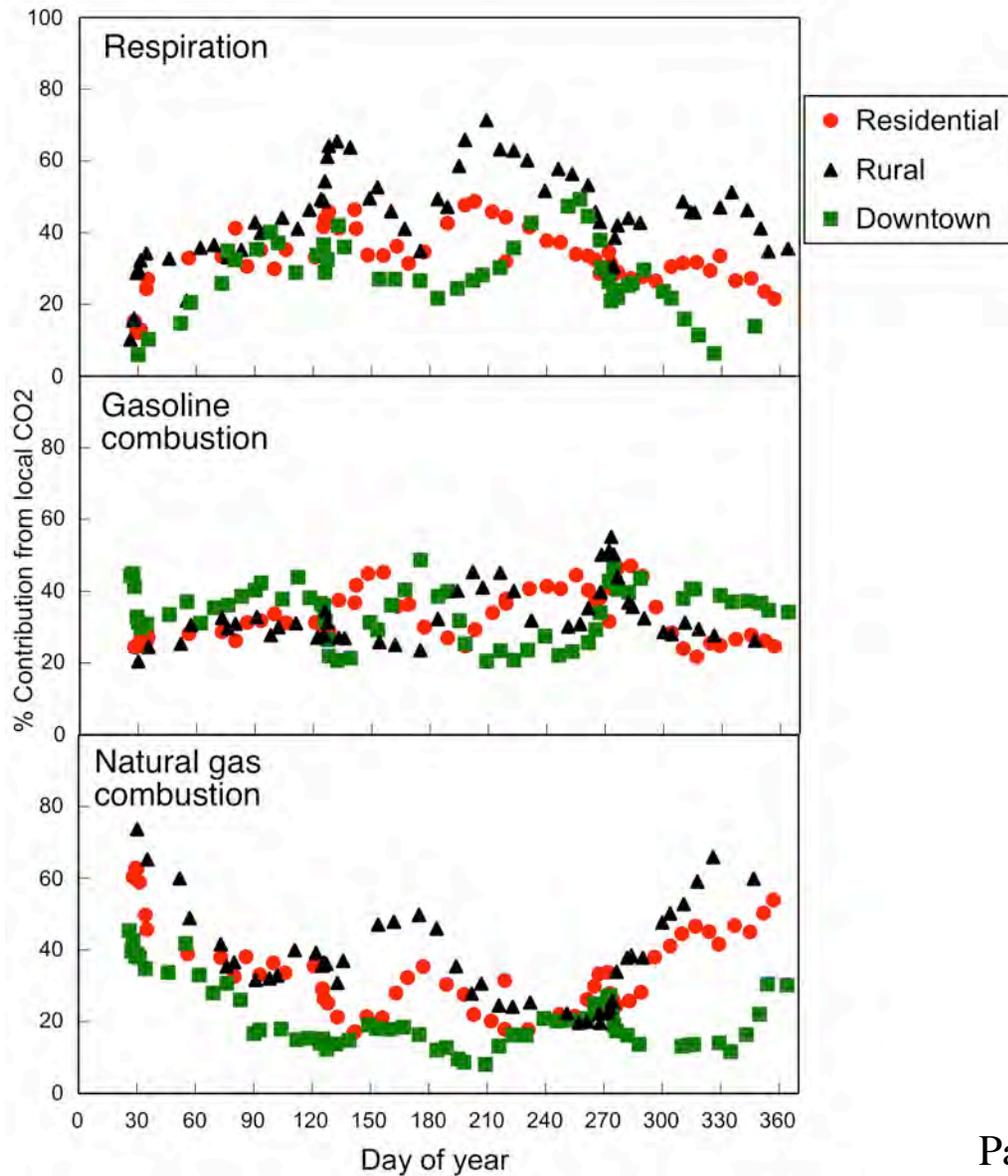
Diurnal CO₂ concentrations across the urban to rural gradient



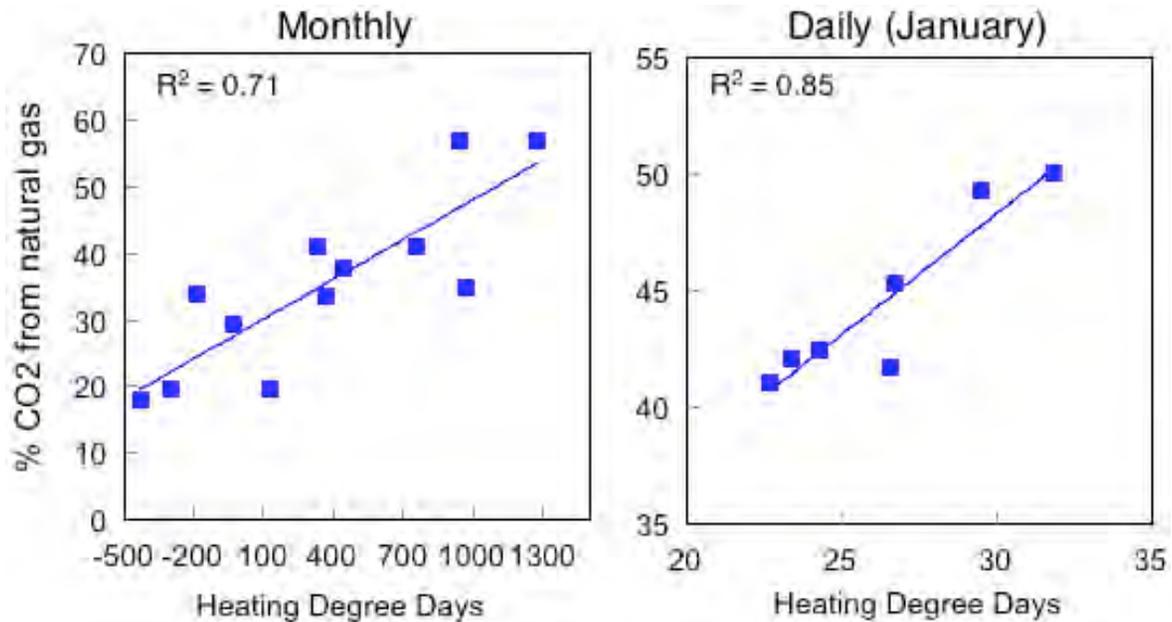
Daily CO₂ concentrations across the urban to rural gradient



Sources separated with carbon and oxygen isotopes

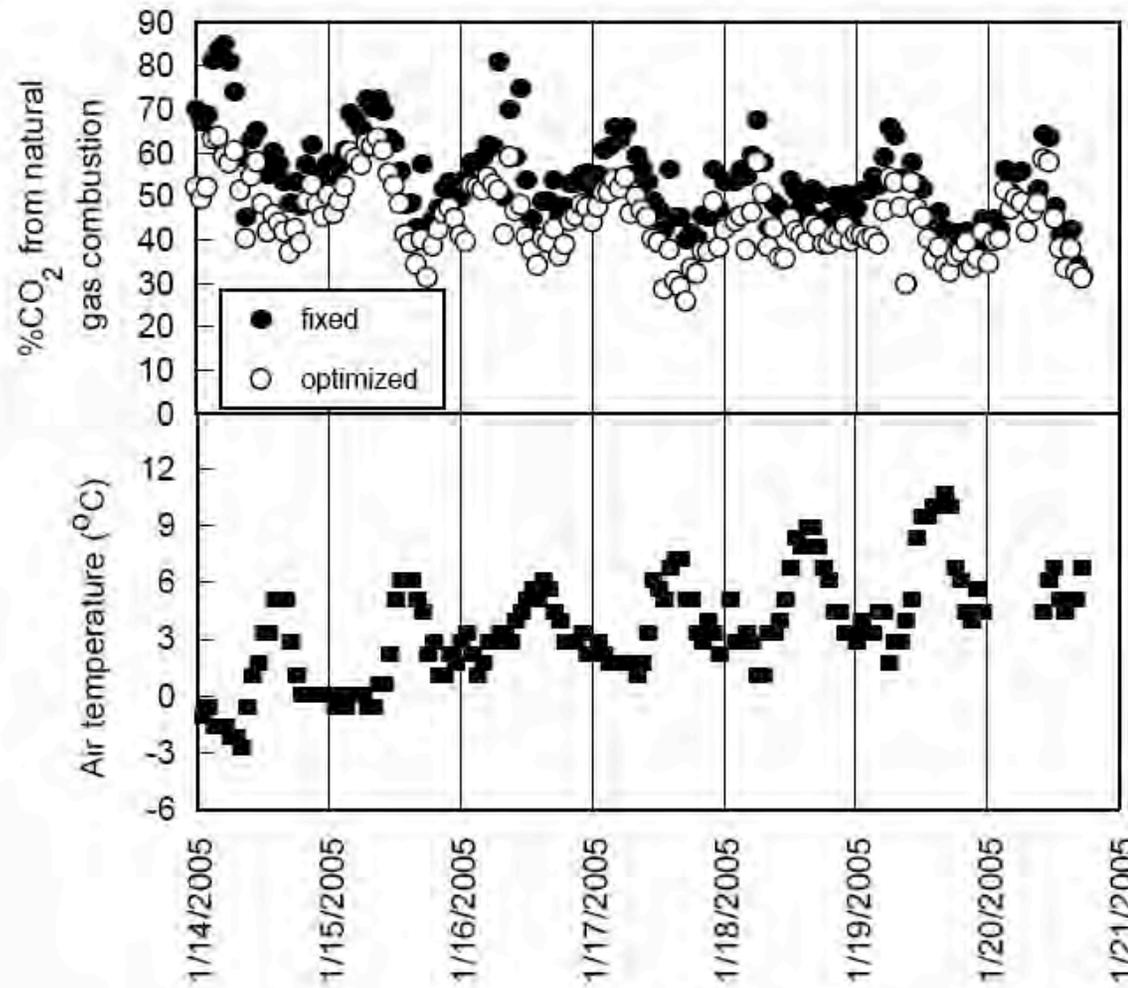


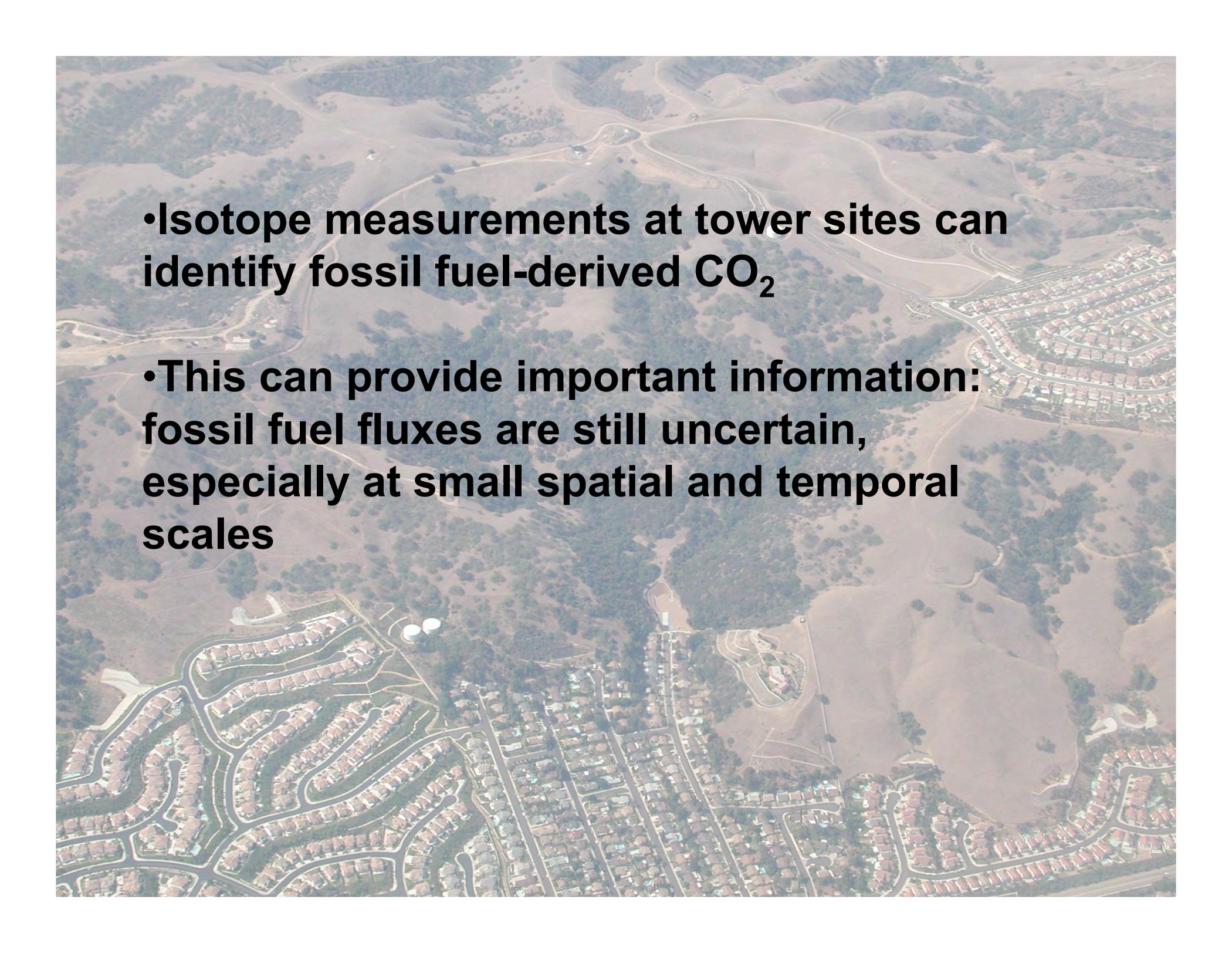
The proportion of CO₂ from natural gas combustion is related to temperature (heating degree days)



Mean annual measurements-based estimate: 35%
Mean annual inventory-based estimate: 34%

Optical methods (TDL) can provide very high resolution estimates





• Isotope measurements at tower sites can identify fossil fuel-derived CO₂

• This can provide important information: fossil fuel fluxes are still uncertain, especially at small spatial and temporal scales



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