Exploring Spatial and Temporal Gradients in Atmospheric CO_2 and CO Using *in Situ* Observations in the Los Angeles Megacity

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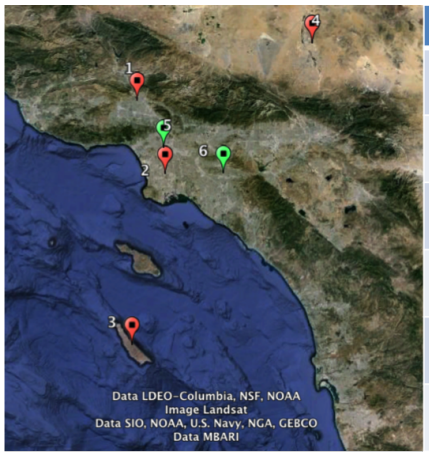
Global atmospheric observations show an unprecedented rise in atmospheric carbon dioxide (CO_2) levels since the pre-industrial period. This trend correlates with estimates of CO_2 emissions from global fossil fuel consumption during the same period. Anthropogenic fossil fuel carbon dioxide ($FFCO_2$) is defined as the mole fraction of CO_2 in dry air resulting from fossil fuel combustion relative to some pre-determined background concentration. Globally, urban regions account for roughly 70% of the fossil carbon emissions; therefore measurements in urban areas are critical for estimating $FFCO_2$ emissions. Linking urban atmospheric observations with fine-scale emissions data will help improve our understanding of the relationship between social, behavioral and economic activity and $FFCO_2$ emissions. Carbon monoxide (CO) has been widely used as a tracer for $FFCO_2$. CO is emitted during the incomplete combustion of fossil fuels and is thus closely linked to fossil fuel CO_2 emissions. However, atmospheric CO measurements alone do not give a quantitative estimate of $FFCO_2$ and require calibration using discrete radiocarbon ($^{14}CO_2$) observations.

In this study, we use *in situ* measurements from a network of sensors in the Los Angeles (LA) megacity and its surrounding areas to explore spatial and temporal patterns in the surface mole fractions of carbon dioxide (CO_2) and carbon monoxide (CO). The LA network is part of the Megacities Carbon Project, which was established to develop and test robust techniques for monitoring distributions and trends of fossil carbon emissions in large cities (megacities.jpl.nasa.gov). The *in situ* data are used to estimate CO_2 and CO enhancements at the urban LA sites relative to the nearby background (outflow) sites (Figure 1). This work is complementary to an ongoing $^{14}CO_2$ flask-sampling project led by NOAA/GMD. The ^{14}C flask sampling began at a subset of the LA sites in Fall 2014, with samples taken every 3-4 days. Future work will involve testing the use of CO as a tracer for excess $FFCO_2$ (ΔCO_2ff) in LA.



Site number	Site name	Description	Gases measured
1	Granada Hills	Tower, foothills	$CO_2/CH_4/CO$
2	Compton	Tower, Downtown 1	$CO_2/CH_4/CO$
3	San Clemente	Tower, Outflow 1	$CO_2/CH_4/CO$
4	Victorville	Tower, Outflow 2	CO_2/CH_4
5	USC	Rooftop, Downtown 2	$CO_2/CH_4/CO$
6	Fullerton (CSUF)	Rooftop, Inland basin	$CO_2/CH_4/CO$

Figure 1. *In situ* measurement sites in the Los Angeles basin and surrounding areas. The red markers indicate the location of the tower sites and green markers indicate the location of the rooftop sites used in this study. All sites shown have continuous measurements of $CO_2/CH_4/CO$, with the exception of the Victorville tower, which has continuous CO_2 and CH_4 measurements.