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Tracking greenhouse gas emissions from a U.S. megacity by remote sensing from a mountaintop site

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Cities, such as Los Angeles, are significant sources of anthropogenic greenhouse gases (GHGs). With the growth of populations in cities worldwide, GHG emissions will increase, and monitoring the temporal trends will provide crucial data for global climate models as well as assessments of the effectiveness of control policies. Currently, continuous GHG observations in the Los Angeles basin are limited to a few in situ measurements, which are shown to be sensitive to local emissions and do not represent the Los Angeles basin well. To quantify GHG emissions from the metropolitan area, which tend to have heterogeneous characteristics, it is important to perform measurements which provide both continuous temporal and spatial coverage of the domain.

Here we present observations of the major greenhouse gases, CO_2 and CH4, using a spectroscopic remote sensing technique from the California Laboratory for Atmospheric Remote Sensing (CLARS) at Mount Wilson, California (1.7 km elevation). A Fourier Transform Spectrometer (FTS) deployed at the CLARS site points downward at 28 selected land surfaces in the LA basin to measure the slant column abundances of CO_2, CH4, N2¬O, CO and O_2 using reflected sunlight in the near-infrared and short-wave infrared regions. This remote sensing technique provides continuous temporal and spatial measurements in the Los Angeles basin to achieve the goal of quantifying emissions of GHGs and CO. It also serves as a test-bed for future geostationary satellite missions to measure GHGs from space such as NASA JPL's Geostationary Carbon Process Investigation (GCPI). The path-averaged dry-air mixing ratio, XCO_2 and XCH4, observed by the CLARS FTS, showed significant diurnal variability that arises from emissions in the Los Angeles basin and atmospheric transport processes. High-precision data have been collected since August 2011. We analyze the seasonal trends of the ratio XCH4:XCO_2 and estimate the seasonal and annual CH4 emission in the Los Angeles basin observed by the CLARS FTS from August 2011 to present. This work demonstrates the ability to quantify and track GHG emissions in a megacity using ground-based remote sensing from an elevated platform and the potential for future geostationary satellite missions, such as GCPI, to monitor carbon fluxes in cities.