Opportunity Title: Megacity CO2 Monitoring
Opportunity Reference Code: 0092-NPP-NOV23-JPL-EarthSci

Organization National Aeronautics and Space Administration (NASA)

Reference Code 0092-NPP-NOV23-JPL-EarthSci

Application Deadline 11/1/2023 6:00:59 PM Eastern Time Zone

Description Sustained atmospheric observations have accurately quantified the unprecedented rise in global atmospheric carbon dioxide (CO2) over the last 50 years. This trend correlates with estimates of CO2 emissions from global fossil fuel consumption during the same period; however, it has not been possible to directly attribute observed trends in atmospheric CO2 to the actions of any nation, state, or city. Attribution is challenging given that the 8.4 ± 0.5 GtC emitted from global fossil-fuel combustion in 2009 constituted only about 2% of the gross surface-atmosphere carbon flux. The attribution challenge is compounded by current limitations in national-scale estimates of emissions, with reported uncertainties of 5-10% for national inventories of developed countries and 10-20% or more for developing countries.
Urbanization has concentrated ~50% of the current global population and ~75% of the fossil fuel CO2 emissions into less than 3% of the earth's land surface (11,12). Therefore monitoring of urban CO2 domes – stable air masses that form over cities and have CO2 mixing ratios that may be 100 ppmv or more higher than in air surrounding the city (13) – will be critical in addressing the anthropogenic attribution challenge. Integrating the monitoring of urban CO2 domes with improved fossil-fuel activity data can help directly validate the efficacy of specific CO2 emissions mitigation actions.

A strategy focused on monitoring urban CO2 domes, particularly those of megacities, for attributing fossil fuel CO2 emissions offers compelling advantages compared to monitoring the diffuse emissions of entire countries. The rapid growth of megacities – metropolitan areas with populations greater than 10 million – has further concentrated fossil fuel CO2 emissions: emissions from the 10 largest cities equal emissions from Japan, and emissions from the 50 largest cities constitute the third largest anthropogenic source, trailing only China and the United States (14). The intensity of emissions and confined spatial extent of megacities translate into CO2 flux signals of 20,000 to 160,000 gC/m2/yr on spatial scales of 1-10km (15). These fluxes exceed the largest natural carbon fluxes by factors of 20 to 200. Near-continuous monitoring of urban domes could reduce reliance on complex, global inverse modeling over large regions to disentangle fossil fuel CO2 fluxes from the natural background fluxes.

This project has four primary objectives:
1. Monitor atmospheric concentrations of CO2 and CH4 over the Los Angeles megacity with precision capable of verifying changes in emissions of 10% or more over a 5 year period attributed to the anthropogenic activity (or a null result) with a confidence of 95%.
2. Produce a space-time resolved carbon inventory for the Los Angeles megacity domain (incorporating top-down and bottom-up data) on an annual basis – including major emission sectors to support assessments of

stabilization policies.
3. Provide a flexible testbed for evaluating new in-situ and remote sensing measurement technologies relevant to carbon monitoring in a complex megacity environment.
4. Develop and demonstrate methods and protocols enabling extension of the Los Angeles framework to other cities in California, US, and internationally.

Successful candidates will have expertise in atmospheric physics and chemistry, carbon cycle science, airborne instruments, atmospheric remote sensing, regional scale CO2 flux inversions, or the equivalent. They will join the Megacity CO2 Monitoring Team and have the opportunity to collaborate with investigators from Paris and other megacities; install, operate, calibrate, validate and analyze measurements of CO2, CH4 and other trace gases in the LA megacity; ingest observational data into sophisticated high resolution inversion models to assess LA carbon fluxes (WRF, STILT, HYSPLIT, FELXPART, etc.); design and validate space-based megacity monitoring solutions using these data in observing system simulation experiments (OSSEs); incorporate existing and future satellite remote sensing data into megacity CO2 emissions monitoring; develop protocols for reconciling top-down and bottom-up estimates of megacity CO2 emissions; interface with decision makers to assess the impact of urban emissions reduction policies.

Location:
Jet Propulsion Laboratory
Pasadena, California

Field of Science: Earth Science

Advisors:
Charles Miller
Charles.E.Miller@jpl.nasa.gov
818-393-6294

Applications with citizens from Designated Countries will not be accepted at this time, unless they are Legal Permanent Residents of the United States. A complete list of Designated Countries can be found at: https://www.nasa.gov/oiir/export-control.

Eligibility is currently open to:

- U.S. Citizens;
- U.S. Lawful Permanent Residents (LPR);
- Foreign Nationals eligible for an Exchange Visitor J-1 visa status; and,
- Applicants for LPR, asylees, or refugees in the U.S. at the time of application with 1) a valid EAD card and 2) I-485 or I-589 forms in pending status

Opportunity Title: Megacity CO2 Monitoring
Opportunity Reference Code: 0092-NPP-NOV23-JPL-EarthSci

Eligibility Requirements	• **Degree:** Doctoral Degree.