Urban fossil fuel CO2 emissions from space: lessons learned from the OCO missions

Thomas Lauvaux¹, Sha Feng², Ruixue Lei², Tomohiro Oda³, Alexandre Danjou¹, Gregoire Broquet¹, Andrew Schuh⁴, Ryan Pavlick⁵, and Annmarie Elderling⁵

¹LSCE, CEA Saclay, Gif sur Yvette CEDEX, France (tul5@psu.edu)
²PennState University, State College, PA, USA
³Universities Space Research Association, Columbia, MD, USA
⁴Colorado State University, CIRA, Fort Collins, CO, USA
⁵NASA Jet Propulsion Laboratory, Pasadena, CA, USA

Pledges from nations and cities to reduce their carbon footprints have reinforced the needs for accurate and transparent reporting of fossil fuel emissions at various scales, with the ultimate goal of the establishments of carbon stocktake as defined by the Paris Agreement. But the assessment of anthropogenic emissions results primarily in collecting socio-economic indicators and emission factors, hence difficult to evaluate, track, or compare without a more standardized and robust methodology. Atmospheric measurements of greenhouse gases are of particular interests by offering an independent and global source of information thanks to satellite platforms observing continuously the atmospheric content of the major gases responsible for human-induced climate change.

Based on lessons learned from the NASA Orbiting Carbon Observatory (OCO)-2 mission, we present the potential of satellite-based approaches to monitor greenhouse gas emissions from large metropolitan areas across the world (Riyadh, Lahore, Los Angeles). After exploring the technical aspects and challenges of the approach, potential aerosol contamination (CALIPSO), and model requirements, we introduce the upcoming capabilities from the follow-up mission, OCO-3, dedicated in part to urban emissions with the Snapshot Area Mapping mode, the first imagery of atmospheric CO2 concentrations for hundreds of targeted cities and power plants. Early snapshots are examined with high-resolution simulations over a handful of cities. The ongoing development of assimilation systems to inform policy makers about current trends and inter-annual variations is presented and discussed. We finally examine the potential roles and objectives of satellite missions by exploring recent trends in fossil fuel emissions along with proxies of air quality (MODIS) as a unique opportunity to track not only greenhouse gas emissions but more generally the evolution of urban environments.
