The Prospects for Top-down Atmospheric Flux Inventories for CO₂ and CH₄

D. Crisp¹, and for the OCO-2, OCO-3 and GeoCarb Teams²

¹NASA Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109; 818-687-9939, E-mail: David.Crisp@jpl.nasa.gov
²NASA Integrated Project Teams, Washington, DC 20546

Atmospheric CO₂ and CH₄ measurements complement bottom-up greenhouse gas (GHG) inventories by providing an integrated constraint on the exchanges of these gases between land and ocean surfaces and the atmosphere (including anthropogenic emissions) and their trends over time. While CO₂ and CH₄ fluxes inferred from atmospheric measurements are not as source-specific as the data sources typically used in inventories, they include contributions from sources that are often omitted or poorly characterized by bottom-up inventory methods. At global scales, atmospheric concentrations of CO₂, CH₄ and other well-mixed GHGs are well characterized by precise, ground-based, in situ measurements from surface and airborne systems. Recent advances in space-based remote sensing methods are providing new opportunities to augment the resolution and coverage of the ground and airborne measurements with estimates of the column-averaged CO₂ and CH₄ dry-air mole fractions (XCO₂ and XCH₄). These XCO₂ and XCH₄ estimates are less precise and accurate than the in situ measurements, but can provide near-global coverage at spatial scales as fine as a few km. These ground-based, airborne, and space-based atmospheric CO₂ and CH₄ estimates are now being assimilated into atmospheric transport models to estimate CO₂ and CH₄ fluxes on scales spanning individual large power plants to nations. The long-term objective of these efforts is to develop top-down global inventories that (i) reduce uncertainty of national emission inventory reporting, (ii) identify additional emission reduction opportunities and provide nations with timely and quantified guidance on progress towards their emission reduction targets, and (iii) track changes in the natural carbon cycle caused by human activities and climate change. This presentation will summarize ongoing efforts by the OCO-2 Science Team and its partners in the measurement and modeling community to create a prototype atmospheric inventory by 2021 that can support the 2023 global stocktake mandated by the Paris Agreement.

Figure 1. A system-level approach for generating a top-down atmospheric CO₂/CH₄ inventory.