(85-210426-A) **Top-down Atmospheric Inventories of CO_2 and CH_4 to Support the Global Stocktakes**

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Parties to the Paris Agreement are compiling greenhouse gas (GHG) inventories to support the 2023 Global Stocktake (GST). These inventories use bottom-up methods to estimate annual emissions and removals of GHGs from the sectors specified in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, including Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU), Waste and Other. These bottom-up methods usually provide accurate estimates of emissions from the fossil fuel sector, but can have large uncertainties in other sectors. They also only describe GHG emissions and removals from managed lands. They therefore provide an imperfect and incomplete picture of GHG source and sinks.

GHG emissions and removals can also be estimated from spatially- and temporally-resolved measurements of their atmospheric concentrations using inverse models. Top-down inventories derived from atmospheric inverse models are not as process-specific as bottom-up inventories, but complement those methods by providing an integrated constraint on fluxes from all processes across a wide range of spatial scales. Recognizing these developments, the IPCC Guidelines for National Greenhouse Gas Inventories acknowledges the value of top-down methods for quality assurance and quality control of bottom-up inventories.

Recent improvements in the accuracy, resolution and coverage of ground-based and airborne in situ measurements and space-based remote sensing estimates of CO_2 and CH_4, combined with advances in atmospheric inverse modeling systems are increasing the potential value of top-down inventories in the context of the GST. To demonstrate these advances, the Joint CEOS/CGMS Working Group on Climate Greenhouse Gas Task Team is working with the inverse modeling community to compile pilot top-down inventories of CO_2 and CH_4 emissions and sinks for the 2023 GST. Results from the OCO-2 Multi-model Intercomparison Project (Flux-MIP) were adopted for CO_2, while results derived for the CMS-Flux group have been adopted for CH_4. Here, we will review our progress of this efforts.

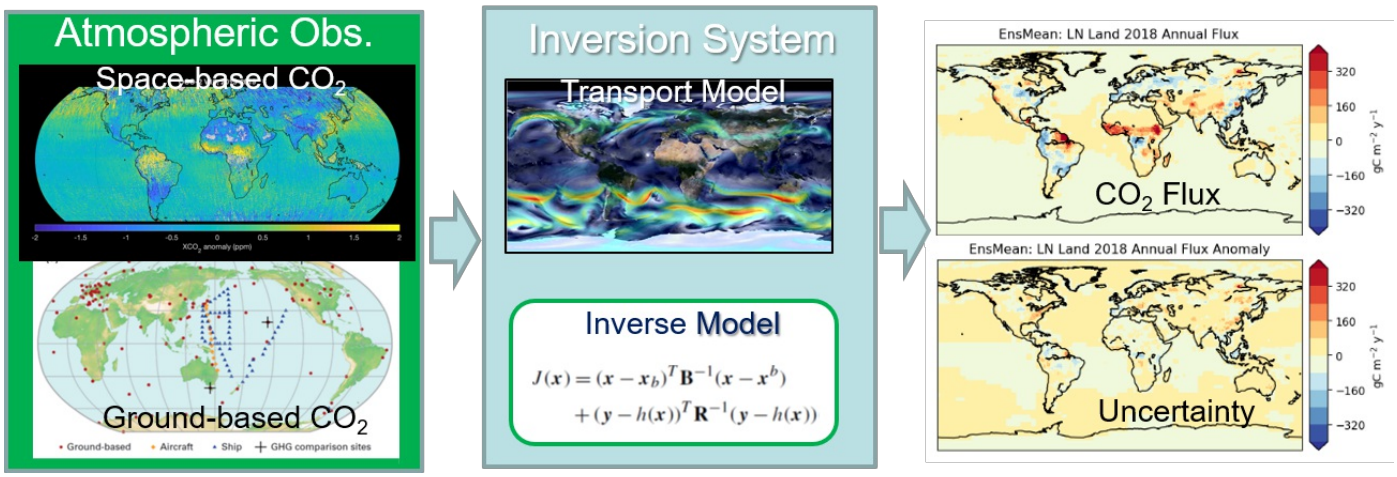

Figure 1. Top-down atmosphere inventories estimate emissions from direct measurements of the carbon dioxide or methane concentrations in the atmosphere at high spatial and temporal resolution. These measurements are analyzed with an atmospheric inverse modeling system to derive the flux distribution and amplitude needed to maintain the observed concentrations in the presence of the winds. Teh primary products of these sytems are spatially-resolved maps of fluxes.