

Atmospheric Carbon and Transport – America: An Earth Venture Mission Dedicated to Improving the Accuracy, Precision and Resolution of Atmospheric Inverse Estimates of CO₂ and CH₄ Sources and Sinks

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The Atmospheric Carbon and Transport-America (ACT-America) mission will enable and demonstrate a new generation of atmospheric inversion systems for quantifying carbon dioxide (CO₂) and methane (CH₄) sources and sinks at regional scales. These inversion systems will be able to 1) evaluate and improve terrestrial carbon cycle models, and 2) monitor carbon fluxes to support climate-change mitigation efforts. The overarching goal described above will be achieved via three mission goals: 1) quantify and reduce atmospheric transport uncertainties; 2) improve regional-scale estimates of CO₂ and CH₄ fluxes; and 3) evaluate the sensitivity of Orbiting Carbon Observatory-2 (OCO-2) column CO₂ measurements to regional variability in tropospheric CO₂. ACT-America will achieve these goals by deploying two aircraft instrumented with remote and in situ sensors to observe how mid-latitude weather systems interact with CO₂ and CH₄ sources and sinks to create atmospheric CO₂/CH₄ distributions. The ACT-America schedule includes five 6-week campaigns across four different seasons and 3 years (2016-2019). A model ensemble will be used to predict atmospheric CO₂ and CH₄ distributions. We will prune the ensemble to those members best able to simulate the measured CO₂ and CH₄ distributions. The pruned ensemble will form the basis of the next generation of atmospheric inversion systems, enabling more precise and accurate, regional-scale atmospheric inversions. ACT-America will also collect high-quality CO₂ measurements across a variety of conditions directly under OCO-2 overpasses to evaluate the ability of OCO-2 to observe high-resolution atmospheric CO₂ variations. The results of these studies will be integrated in the final year of the mission into an inverse analysis of North American sources and sinks of CO₂ and CH₄ from 2009 through 2018. The transport and flux processes, and OCO-2 data characteristics studied will be common across mid-latitudes, thus the mission should improve atmospheric inversions around the globe.

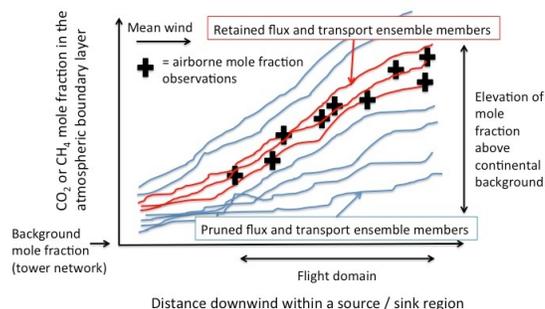


Figure 1. Conceptual view of the role of aircraft data in improving the ensembles used for regional atmospheric inverse estimates of greenhouse gas fluxes.