Airborne Lidar Measurements of Atmospheric Column CO2 Concentration to Cloud Tops during ASCENDS Science Campaigns

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Introduction

Globally distributed atmospheric CO₂ measurements with high precision, low-noise and full temporal and spatial sampling are critical to advance carbon cycle science. However, ground-based campaigns are limited to fixed locations and have limited spatial coverage and poor data sampling in remote regions, even though some regional campaigns have active carbon cycle fluxes.

NASA Goddard Space Flight Center (GSFC) is developing an integrated platform for airborne measurement of atmospheric CO₂ column concentrations to cloud tops. NASA’s CO₂ sonde is a candidate for NASA’s AV-2020 mission. Measurements of fine-resolution backscatter profiles from the atmosphere allow for the retrieval of column CO₂ and range to cloud tops in addition to those in the ground with precise knowledge of the photon pathlength. This allows retrieval of column CO₂ concentrations to cloud tops, providing much higher spatial coverage and some information about vertical structure of CO₂. This is expected to benefit atmospheric transport process studies, carbon data assimilation models, and global and regional carbon cycle estimation.

Annual mean total cloud fraction

CO₂ Sonde measured cloud reflectivity

CO₂ Retrievals to the boundary layer cloud tops

In-situ CO₂ Vertical Profiles – Summer 2011

In-situ CO₂ Vertical Profiles – Winter 2013

Summary

* Demonstration CO₂ measurements capability to cloud tops and through aerosol layers using NASA GSFC CO₂ sonde field
* Demonstration of vertical cloud and aerosol measurements during space and atmospheric CO₂ measurement
* Improved vertical resolution of CO₂ retrievals with improved aerosol extinction accuracy for better retrievals of CO₂ profiles
* Significantly improved data coverage and sampling with large-scale aerosol layers

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