Arctic-CAP: Northern High Latitude CO₂, CH₄, and CO Airborne Vertical Profile Surveys during the Arctic-Boreal Vulnerability Experiment (ABoVE)

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The Arctic-CAP project obtained monthly airborne surveys of Alaska and northwestern Canada from April through November 2017 to capture the spatial and temporal dynamics of the northern high latitude carbon cycle as part of the Arctic-Boreal Vulnerability Experiment (ABoVE). The Arctic-CAP sampling strategy involved acquiring 25 vertical profiles of carbon dioxide (CO₂), methane (CH₄), and carbon monoxide (CO) from the surface to 5 km altitude around the domain each month. These data spatially link the regular vertical profiles obtained at Poker Flats, AK and East Trout Lake, SK as part of the ESRL/GMD Aircraft Program. These measurements were complemented by additional vertical profiles at altitudes up to 14 km were acquired by the NASA DC-8 during flights of opportunity in August (Active Sensing of CO₂ Emissions over Nights, Days, & Seasons [ASCENDS]) and October (Atmospheric Tomography Mission [AToM]). We observed strong seasonal cycles of CO₂ and CH₄ that vary with latitude as well as persistent CO₂ and CH₄ emissions extending into November across the entire domain. Comparisons with the Goddard Earth Observing System Model, Version 5 (GEOS-5) forward modeled CO₂, CH₄, and CO fields reveal the significant differences in the modeled and observed vertical profiles that can be used to improve modeling of the northern high latitude carbon cycle. We also compare the Arctic-CAP 2017 results with other airborne data collected in Alaska over the last decade.



Figure 1. Arctic-CAP flight lines sample Arctic and boreal regions of Alaska, the Yukon Territory, and the Northwest Territories. Monthly campaigns extended from April through November, capturing the carbon dynamics of the 2017 growing season. Pins mark the locations of the 25 vertical profiles acquired during each monthly campaign.



Figure 2. The Arctic-CAP vertical profiles were recorded up to 5,000 masl across the experimental domain each month. The color coding of the profiles links to the color coding of the individual flight legs in Figure 1.