Airborne In Situ CO₂ Measurements Used in Validation of Remote Sensing Measurements

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INTRODUCTION: The validation of observations from remote sensors is an important objective of airborne field campaigns conducted under NASA’s Tropospheric Chemistry Program. Through the quantitative comparison of retrievals and in-situ measurements from aircraft, the validation of remotely-sensed observations is feasible. As remote CO₂ sensors are evolving, airborne in-situ CO₂ measurements gain importance for evaluation of retrieved products. Since 1991, NASA LaRC has been funded to conduct airborne observations of atmospheric CO2 during numerous international field campaigns (e.g., PEM-WEST, TRACE-P, PEM-Tropics, INTEX, ARCTAS). Carbon dioxide measurements are made with an infrared gas analyzer (LI-COR) based sampling system. This instrument offers many high performance capabilities including high accuracy (± 0.25 ppm) and precision (0.1 ppm); fast-response; continuous; and real-time measurements. CO₂ concentrations are established relative to the WMO primary calibration standards maintained by NOAA GMD.

Intercomparison: Two in-flight intercomparisons with the Harvard instrument (S. Wofsy) during SOLVE-I (DC-8, ER2) and TC4 (DC-8, WB-57) show good agreement (± 0.25 ppm). Intercomparison (left) between the DC-8 (NASA LaRC) and WB-57 (Harvard) during TC4 on 20080807 at 35 kft [382.59 ± 0.15 (LaRC) and 382.34 ± 0.14 (Harvard)]. Comparison was made with a 1:1 match of 1s data along the same longitude.

In-situ measurement for validation: Since in-situ measurements are done frequently and at high accuracy on the global calibration scale, linking this scale with total column retrievals ultimately provides a calibration scale for remote sensing. During the summer of 2004, vertical profiles by the DC-8 (LaRC) and King Air (Harvard) at the WLEF Tall Tower site provided validation of column measurements by a solar-based observatory within the Total Carbon Column Observing Network envisioned for OCO validation [Washenfelder et al., 2006].

LaRC high resolution in-situ CO₂ measurements contribute to evaluating model simulations, TOVS-CO₂, and AIRS retrievals [Peylin et al., 2007; Chahine et al., 2008].

References:

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