Carbon Dioxide (CO_2) and Methane (CH_4)

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Measurements of the greenhouse gases carbon dioxide (CO_2) and methane (CH_4) will be used to determine the sources and magnitudes of these emissions in the southeast U.S. during SENEX. CO_2 and CH_4 are measured aboard the NOAA P-3 aircraft using a modified commercial wavelength-scanned cavity ring-down analyzer (Picarro 1301-m). Atmospheric air is sampled through a 3/8 in. OD stainless steel rearward facing inlet on the NOAA P-3 and dried to a dew point temperature of –78°C after passage through a 200-strand Nafion dryer and a dry ice trap. The absorption cell pressure is controlled at 140 Torr (±0.2 Torr during smooth flight, and ±0.5 Torr during typical boundary layer flight conditions; all stated uncertainties are ±1σ).

Immediately inside the fuselage, two CO_2 and CH_4 calibration gas standards are regularly delivered to the inlet line during flight to evaluate instrument sensitivity. The calibration standards bracket the expected ambient range of each gas and are known to within ±0.07 ppm CO_2 and ±1 ppb CH_4 (all CO_2 and CH_4 mixing ratios are reported as dry air mole fractions). The calibration gases are added at a flow rate sufficient to overflow the inlet. These flight standard tanks, or secondary standards, are calibrated before and after the field project using primary CO_2/CH_4 standard tanks tied to the WMO standard scale from the Global Monitoring Division (GMD) at the NOAA Earth System Research Laboratory (ESRL). A third calibration standard (referred to as a "target") is regularly

introduced to the inlet between calibrations and treated as an unknown to evaluate long-term instrument performance.

Independent of the target retrievals, we estimate a total inaccuracy in the CO_2 measurement of ±0.10 ppmv and a total inaccuracy in the CH_4 measurement of ±1.2 ppbv for 20-second averages. One-second imprecision of the CO_2 measurement is ±0.10 ppmv during smooth flight and ±0.15 ppmv during turbulent flight. One-second imprecision of the CH_4 measurement is ±1.5 ppbv during smooth flight and ±2.0 ppbv during turbulent flight.

Reference

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