AirCore: An Innovative Atmospheric Sampling System

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This work describes the AirCore, a simple and innovative atmospheric sampling system. The AirCore used in this study is a 150 m long stainless steel tube, open at one end and closed at the other, that relies on positive changes in ambient pressure for passive sampling of the atmosphere. The AirCore evacuates while ascending to a high altitude and collects a sample of the ambient air as it descends. It is sealed upon recovery and measured with a continuous analyzer for trace gas mole fraction. The AirCore tubing can be shaped into a variety of configurations to accommodate any sampling platform; for the testing done in this work it was shaped into a 0.75 m diameter coil. Measurements of CO\textsubscript{2} and CH\textsubscript{4} mole fractions in laboratory tests indicate a repeatability and accuracy of better than 0.05 ppm for CO\textsubscript{2} and 0.4 ppb for CH\textsubscript{4} under a variety of conditions. Comparisons of AirCore data with continuous \textit{in situ} and flask data in aircraft field tests indicate average absolute differences of 0.3 ppm and 5 ppb for CO\textsubscript{2} and CH\textsubscript{4}, respectively, with no apparent bias. Accounting for molecular diffusion and flow-induced mixing, the expected measurement resolution for CO\textsubscript{2} and CH\textsubscript{4} is 110 m at sea level and 260 m at 8000 m above sea level after three hours of storage, decreasing to 170 m and 400 m, respectively, after nine hours. Validation tests confirm that the AirCore is a robust sampling device for many species on a variety of platforms including balloons, unmanned aerial vehicles, and aircraft.

\textbf{Figure 1.} Pressure profiles for CO\textsubscript{2} (left) and CH\textsubscript{4} (right) by three different methods from a profile Cessna flight on 13 June 2009.