Mid-Stratospheric Measurements of CO_2, CH_4, and CO Using AirCore

H. Chen[1], A. Karion[2], T. Newberger[2], C. Sweeney[2], F.L. Moore[2], A. Andrew[1] and P.P. Tans[1]

[1]NOAA Earth System Research Laboratory, 325 Broadway, Boulder, CO 80305; 303-497-3541, E-mail: Huilin.Chen@noaa.gov
[2]Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309

AirCore, a long tube descending from a high altitude with one end open and the other closed, has been demonstrated to be a reliable, cost-effective sampling system for CO_2 and CH_4 measurements. Previous studies show that vertical profiles from the ground level up to ~ 20 km (~ 40 mbar) can be achieved during a balloon flight. The ceiling of the profile is restricted mainly by the diffusion of air in the AirCore and the resolution of the analyzer used for the analysis. Here air with an extremely high CO mixing ratio (~ 10 ppm) has been employed as the initial filling air in the AirCore. This high CO filling gas is used to label the mixing process between the sampling and filling air at the top of the profile, thus, providing the ability to retrieve full profiles for CO_2 and CH_4 up to the balloon's ceiling height of ~ 30 km (~ 11 mbar). Stratospheric measurements of CO lack agreement among previous studies, (i.e. cryogenic sampling, *in situ* measurements, and remote sensing) due to difficulties that are inherent to the various techniques, and possibly due to latitudinal and seasonal variations that could not be represented by the available sparse observations. Efforts have been made to accomplish an accurate profiling of stratospheric CO using the AirCore, dealing mainly with the potential interactions of CO and high O_3 in the stratosphere. Stratospheric profiles of CO_2, CH_4, and CO can not only be used to validate total column measurements by remote sensing techniques, such as Fourier Transform Spectometer and satellite, and would be extremely valuable in characterizing stratospheric chemical processes, especially when such profiles can be made reliable and cheap enough for regular deployments in the field.

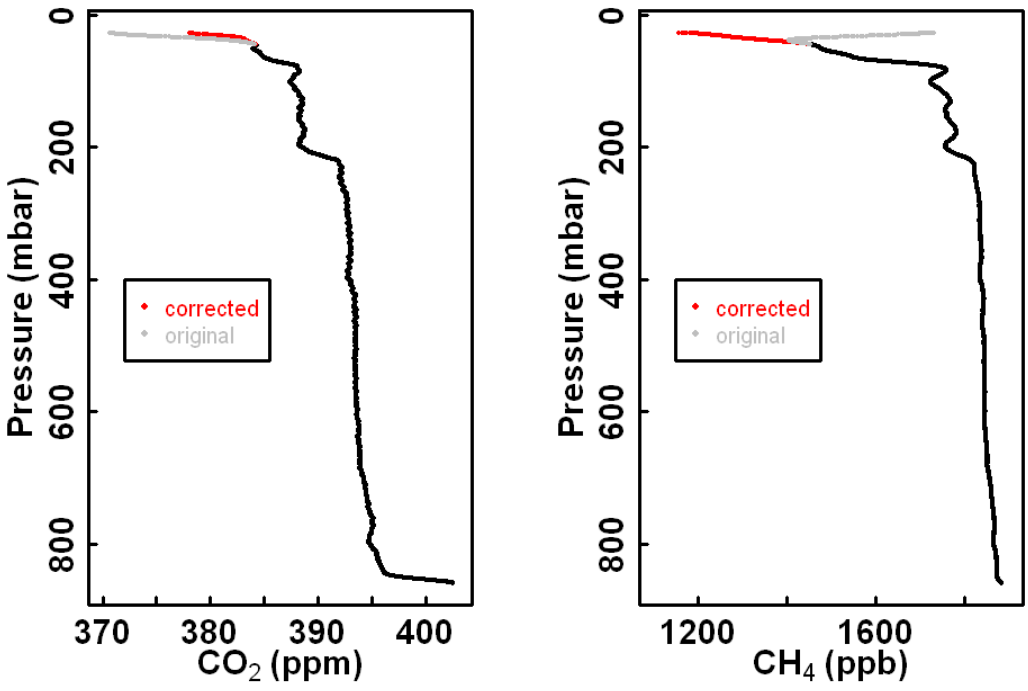

Figure 1. The AirCore balloon flight on March 12, 2011, for CO_2 and CH_4. The red curves are the derived profiles based on the mixing processes labeled by a filling air with ~10 ppm CO, and the grey curves are the original parts of the profiles that are affected by the filling air.