

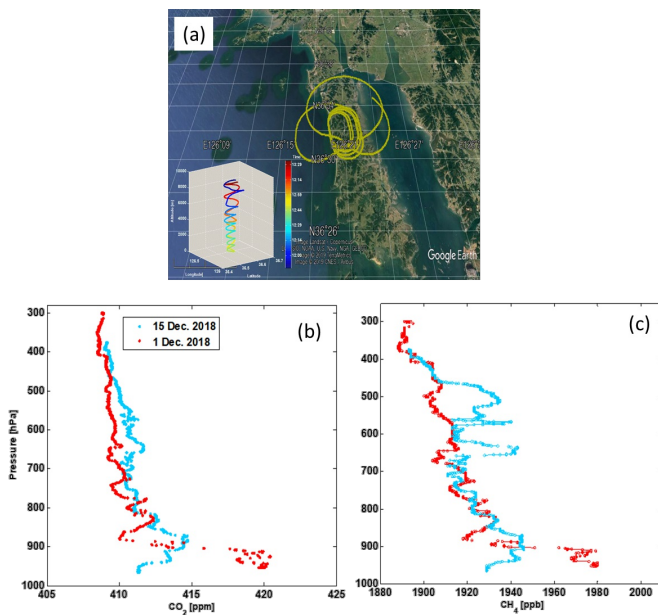
## Airborne *in situ* Measurement of CO<sub>2</sub> and CH<sub>4</sub> in South Korea

S. Li, S.T. Kenea, L. Labzovskii, Y. Oh, T. Goo, and Y. Byun

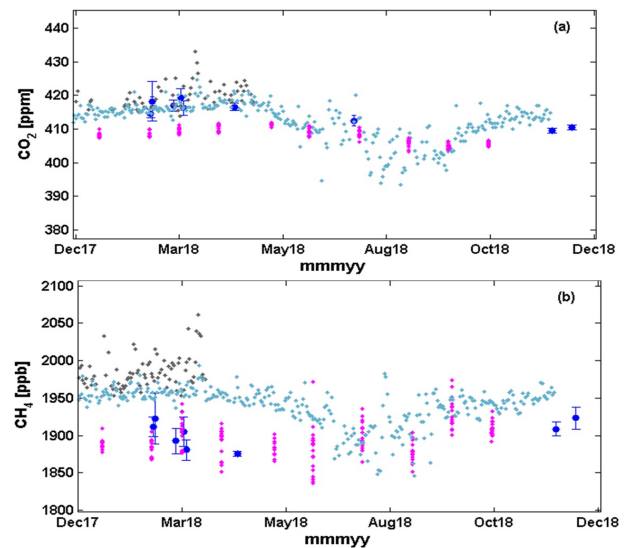
National Institute of Meteorological Sciences, Seogwipo-si, Jeju-do, South Korea; +82-64-780-6675, E-mail: sunranlee@korea.kr

A new Korean Meteorological Administration (KMA) airborne measurement platform has been established for regular observations with scientific purpose over South Korea since 2018. The Beechcraft King Air 350HW was used to measure *in situ* CO<sub>2</sub>, CH<sub>4</sub>, CO, and H<sub>2</sub>O with the cavity ring-down spectrometer G-2401m analyzer. The overall uncertainty of airborne measurements is estimated to be 0.16 ppm for CO<sub>2</sub>, 2.1 ppb for CH<sub>4</sub>, and 5.0 ppb for CO by combination of NOAA whole-air accuracy, cavity pressure sensitivity and water vapor correction uncertainty. The airborne vertical profile measurements were performed at a regional GAW Anmyeon-do (AMY) station that belongs to the Total Carbon Column Observing Network (TCCON) and provides concurrent observations to the Greenhouse Gases Observing Satellite (GOSAT) overpasses [Fig. 1(a)]. The vertical profile of CO<sub>2</sub> shows clear altitude gradient [Fig. 1(b)], while the CH<sub>4</sub> shows a non-homogenous pattern in the free troposphere [Fig. 1(c)]. The 1.5–9.0 km vertically averaged CO<sub>2</sub> mixing ratios are comparable with background surface values at AMY and Ryori station but CH<sub>4</sub> mixing ratios show lower levels than those from ground GWA stations, comparable with flask airborne data taken in the Western Pacific region [Fig. 2 (a, b)]. Furthermore, this study shows that the combination of CH<sub>4</sub> distribution in free troposphere and trajectory analysis, taking convective mixing into account, is a useful tool in investigating CH<sub>4</sub> transport processes.

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**Figure 1.** Typical spiral flight track (a) and vertical descending profiles of CO<sub>2</sub> (b), CH<sub>4</sub> (c) on 1, 15 December in 2018 at AMY station in South Korea.



**Figure 2.** Time series of daily mean surface CO<sub>2</sub> (a) and CH<sub>4</sub> (b) mixing ratio measured at AMY (36.53°N, 126.33°E) in South Korea (gray circle) and Ryori (39.03°N, 141.82°E) in Japan (sky blue circle) and flask aircraft measurement (above 5 km) from Tokyo to Minamitorishima (pink circle). The blue circles with vertical bars are the 1.5–8 km average CO<sub>2</sub>, CH<sub>4</sub> with one standard deviation from KMA Kingair 350 measurements during 2018, respectively.