

# Comparison for Vertical Distribution of Greenhouse Gases Between Aircraft-based and Satellite-based Measurements At Global Atmosphere Watch site in Anmyeondo

Tae-Young Goo<sup>1</sup>, Jeong-Soon Lee<sup>3</sup>, Yeon-Jin Jung<sup>1</sup>, Mi-Lim Ou<sup>1</sup>, Chun-Ho Cho<sup>2</sup>

<sup>1</sup>Remote Sensing Research Team / NIMR, <sup>2</sup>Climate Research Division / NIMR

<sup>3</sup>Korea Research Institute of Standard and Sciences

## Introduction

### Background

Aircraft canister sampling was carried out at GAW (Global Atmosphere Watch) site, Anmyeondo (36°32'N, 26°19'E), on 27 May 2010 in order to measure four greenhouse gases and one trace gas (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, SF<sub>6</sub>, and CO).

### Objective is:

to study diurnal variation of CO<sub>2</sub> vertical distribution as well as to compare both profiles measured from aircraft and satellite.

## Measurements

Sampling instrument in Fig. 2a consists of (b) canister, (c) diaphragm pump, (d) battery, (e) power supply and (f) moisture trap (MgClO<sub>4</sub>).

In order to analyze greenhouse gases in canister, cavity ring-down spectrometer (picarro G1301) for CO<sub>2</sub> and CH<sub>4</sub>, gas chromatograph (GC6890) for N<sub>2</sub>O and SF<sub>6</sub> and residual gas analyzer (Ametec Ta3000) for CO were employed as pictured in Fig. 3.

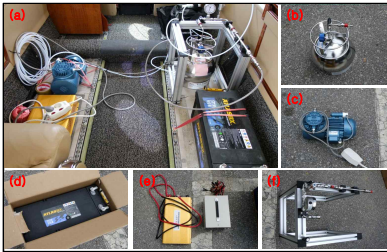


Fig. 2. Canister sampling instrument



Fig. 3. Instruments for greenhouse gases.

## Experimental Design

### Sampling height:

7-level heights from surface to 5 km (surface, 150, 300, 500, 1000, 3000 and 5000 m)

### Sampling time:

five flights (2200, 0100, 0400, 0600 and 0900 UTC).



Fig. 4. Sampling aircraft (Kingair).

## Weather Maps

### Synoptic weather condition

After low pressure passed through Korea, weather was fine in high pressure.

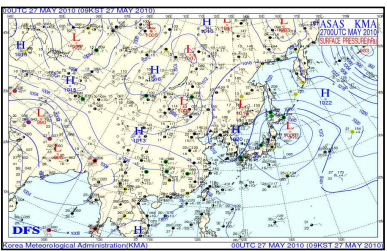


Fig. 5. Weather map at 0000 UTC on 27 May.

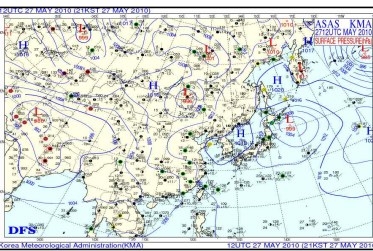


Fig. 6. Weather map at 1200 UTC on 27 May.

## Validation

### Aircraft canister sampling

- Site : Anmyeondo (S. Korea)
- Period : 2010. 5. 27. 2200 UTC - 0900 UTC
- Measurement : Canister measurement (daily mean)

### CONTRAIL (Comprehensive Observation Network for Trace gases by AirLiner)

- Site : Incheon (S. Korea)
- Period : 2006-2007
- Measurement : Continuous measurement (monthly mean)

## Acknowledgements

This study was supported by the project "Research for the Meteorological Observation Technology and Its Application" at National Institute of Meteorological Research.



Fig. 1. Anmyeondo GAW site.

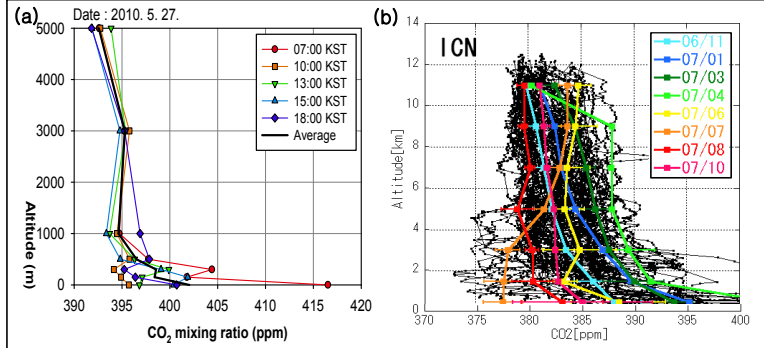


Fig. 7. CO<sub>2</sub> profile comparison between (a) Anmyeondo and (b) Incheon.

## Comparisons

### Aircraft canister sampling

- Site / Period : Anmyeondo (S. Korea) / 2010. 5. 27. 0100 and 0400 UTC
- Data : Profile average

### Satellite-based measurement

- AQUA / AIRS (Atmospheric InfraRed Sounder) on 0000 UTC
- METOP / IASI (Infrared Atmospheric Sounding Interferometer) on 0400 UTC

### Target greenhouse gases

- Carbon dioxide and Methane

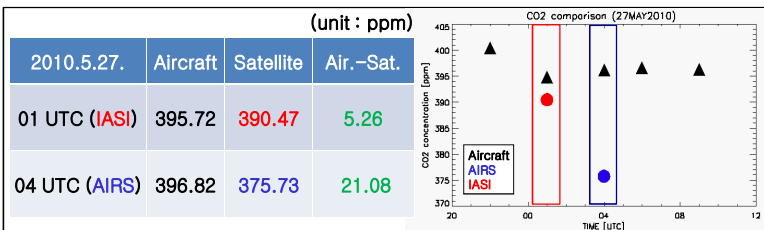


Fig. 8. Column averaged CO<sub>2</sub> comparison of aircraft-based and satellite-based measurements.

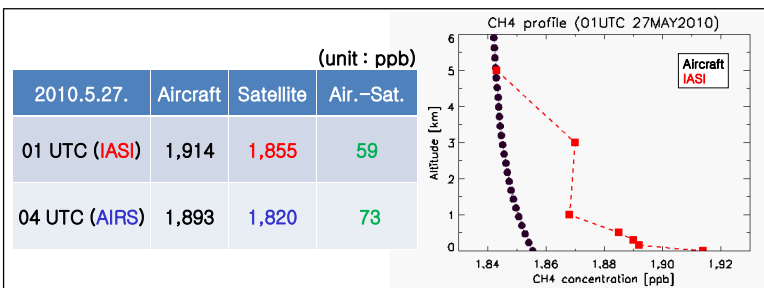


Fig. 9. CH<sub>4</sub> comparison for column mean and profile from aircraft and Satellites

## Conclusions

- Comparison for vertical profiles of greenhouse gases between aircraft-based and satellite-based measurements at GAW site in Anmyeondo was carried out.
- Approximately, the pattern of CO<sub>2</sub> profile has a good agreement with other air sampling experiment.
- For satellite comparison, underestimated CO<sub>2</sub> retrievals were shown compared with air measurement since greenhouse gas retrieval from AQUA/AIRS and METOP/IASI is focusing on mid-atmosphere.
- Further study is necessary to compare CO<sub>2</sub> retrieval from GOSAT and ground-based FTIR with aircraft CO<sub>2</sub> measurement.

## Future Plans

- 2<sup>nd</sup> air sampling experiment is planned in early November 2010.
- Periodical aircraft experiment is scheduled to make a reasonable result.
- CO<sub>2</sub> profiles between aircraft and GOSAT measurement will be compared.

## References

- M. Yu. Arshinov et al. 2009: Vertical Distribution of Greenhouse Gases above Western Siberia by the Long-Term Measurement Data, *Atmos. Ocean. Optics*.
- T. Machida et al. 2008: Worldwide Measurements of Atmospheric CO<sub>2</sub> and Other Trace Gas Species Using Commercial Airlines, *J. Atmos. Ocean. Tech.*