

Remote Observation Techniques for Greenhouse Gases

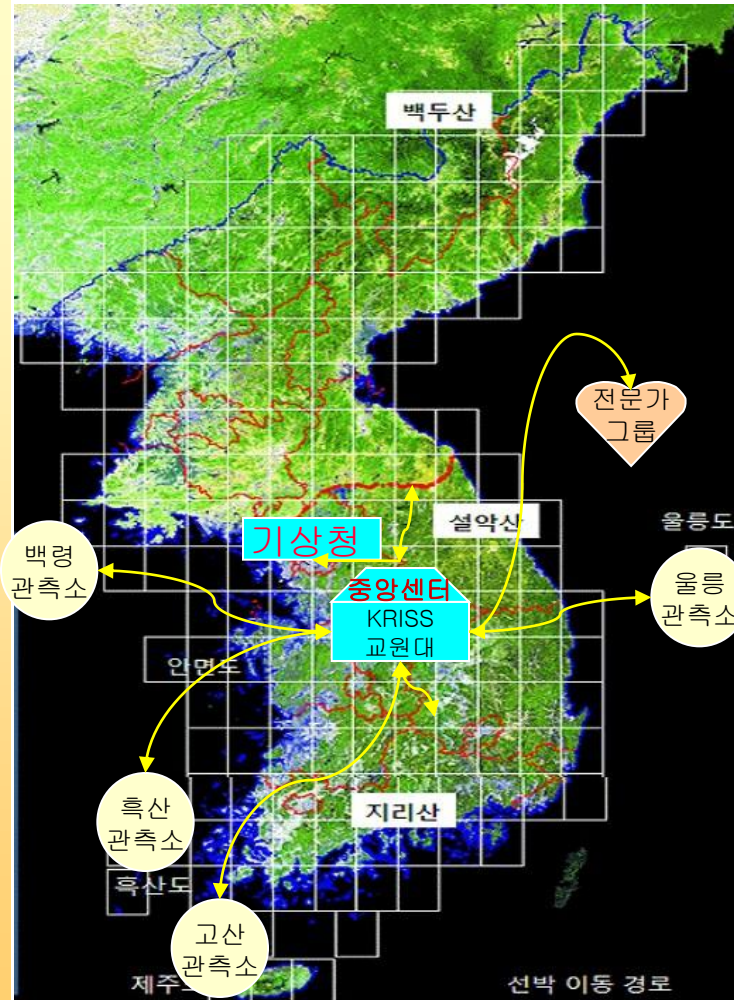
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KRISS

Introduction

- KMA would like to expand Global Atmospheric Watch Program
- Greenhouse gases should be observed accurately according to WMO Guideline with an efficient manner
- KRIS has developed related technologies for remote monitoring system such as automated sample pretreatment, remote calibration, remote analytical equipment operation and remote data management

Future Remote Observation Sites for Greenhouse Gases



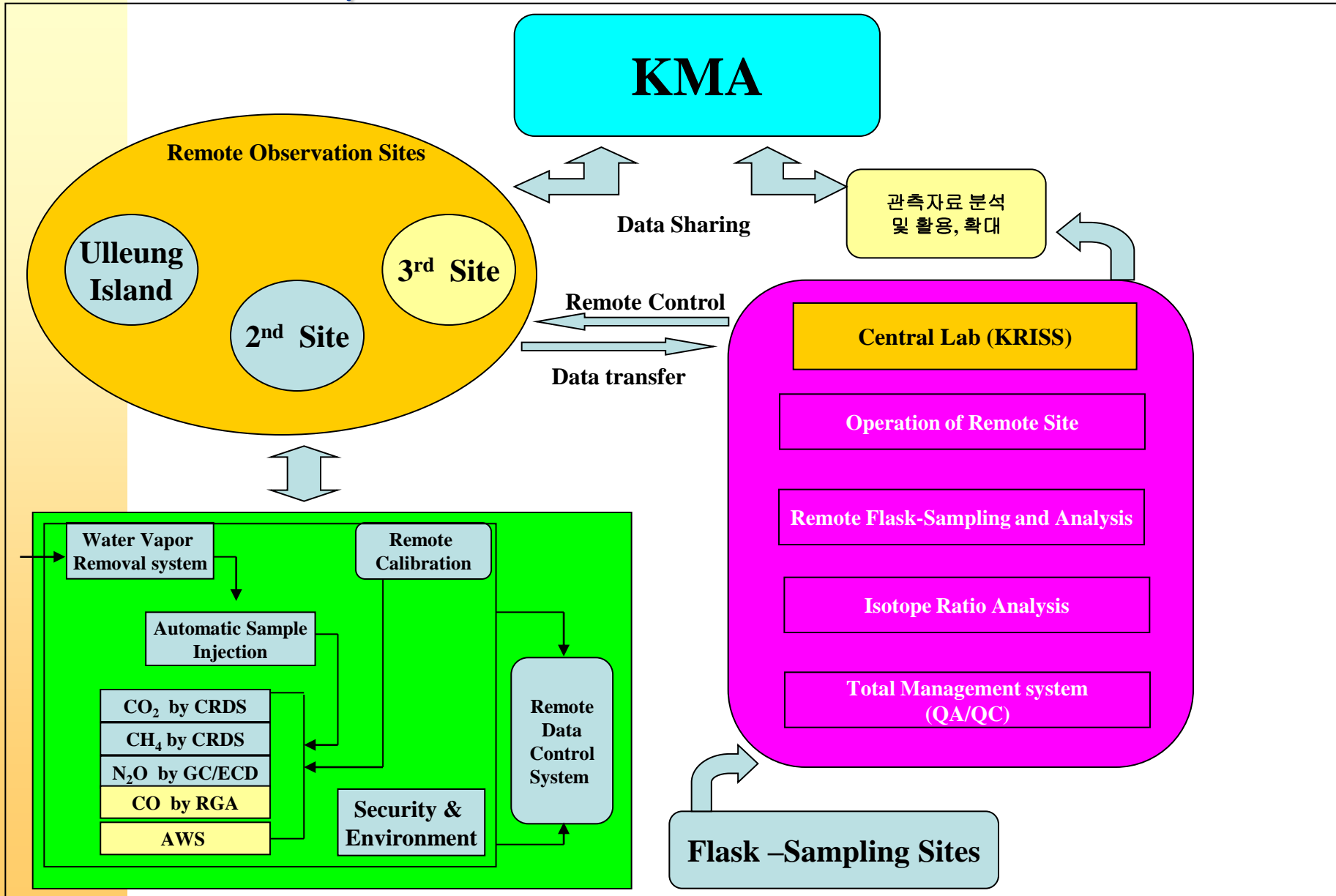
- Monitoring sites
 - Anmyeon Island
 - Kosan observatory, Jeju
 - Ulleung Island
- Remote Sampling sites
 - Baekryeong Island
 - Hucksan Island

- Observation Components:

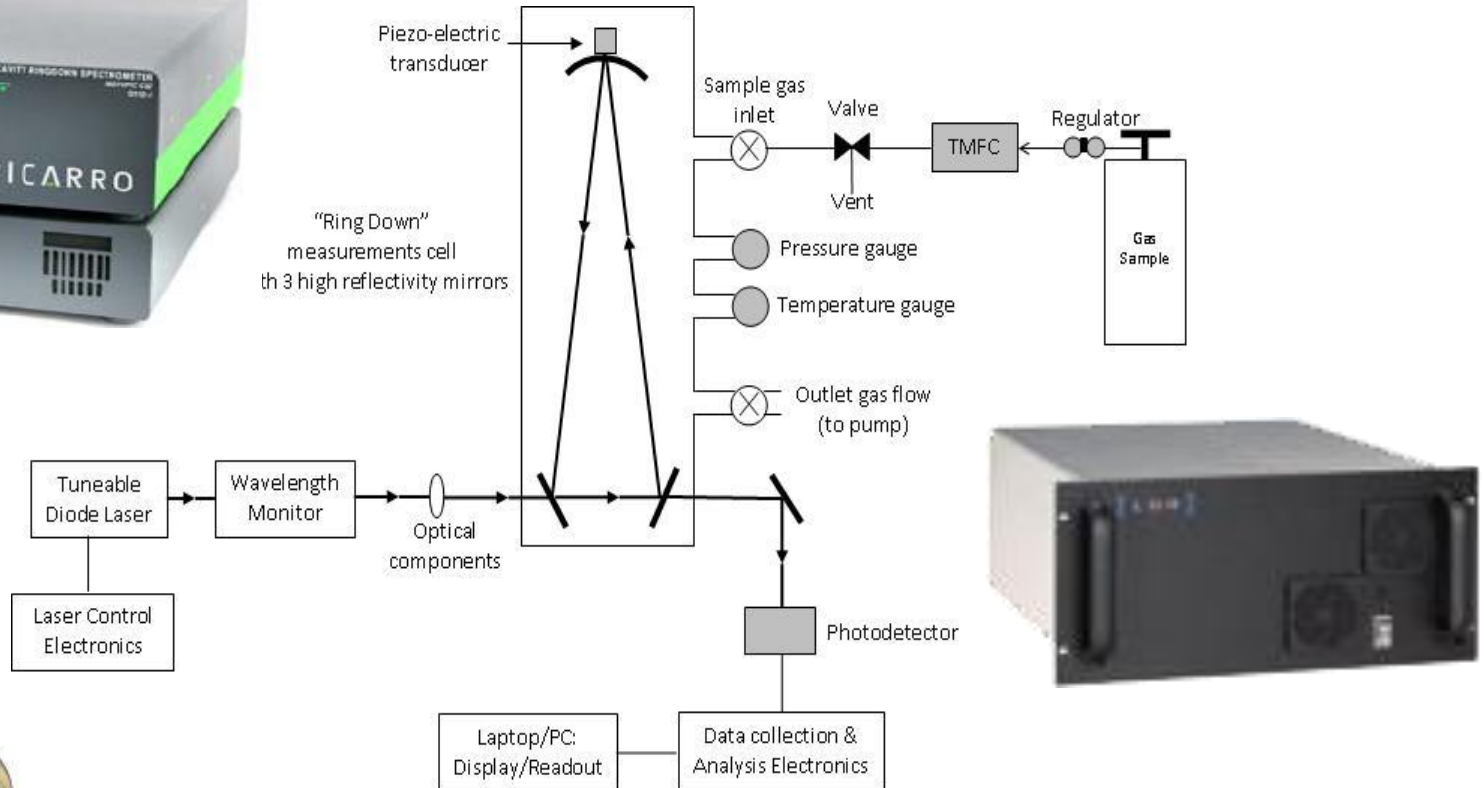
CO₂, CH₄, N₂O, CO, AWS

CFCs, SF₆, PFCs, HFCs, $\delta^{13}\text{C}$, $\delta^{18}\text{O}$, δD

Operation Schematics



CRDS CO₂/CH₄ Analyzer



CRDS CO₂ characteristics

Repeatability

CO₂ value: 386.62 $\mu\text{mol mol}^{-1}$

CRDS value : 386.61 $\mu\text{mol mol}^{-1}$

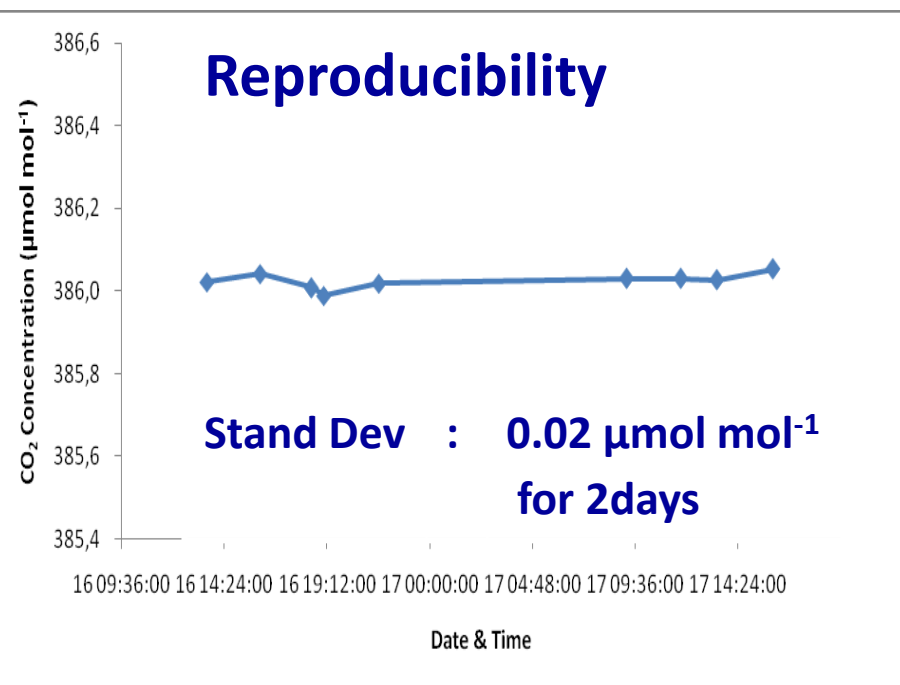
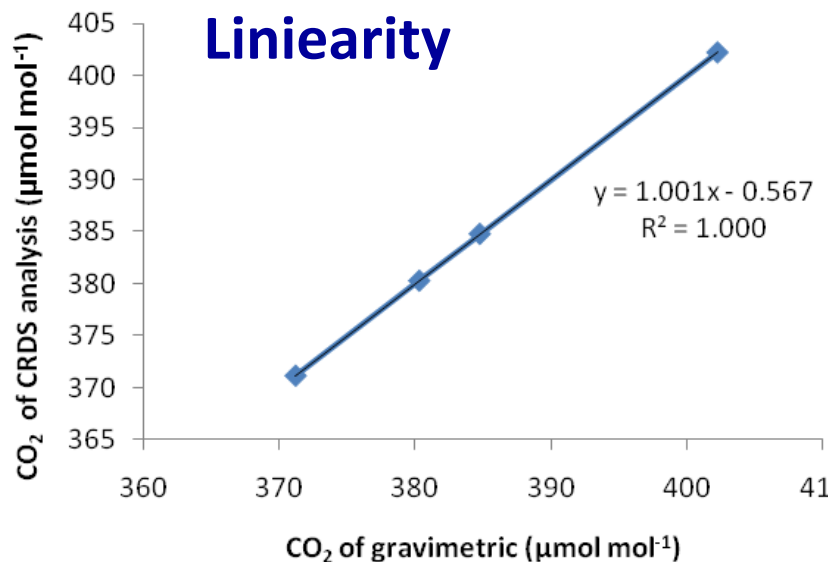
Stand Dev : 0.03 $\mu\text{mol mol}^{-1}$

% RSD : 0.0078

Zero gas (Liquid N₂)

CRDS value : 0.00 $\mu\text{mol mol}^{-1}$

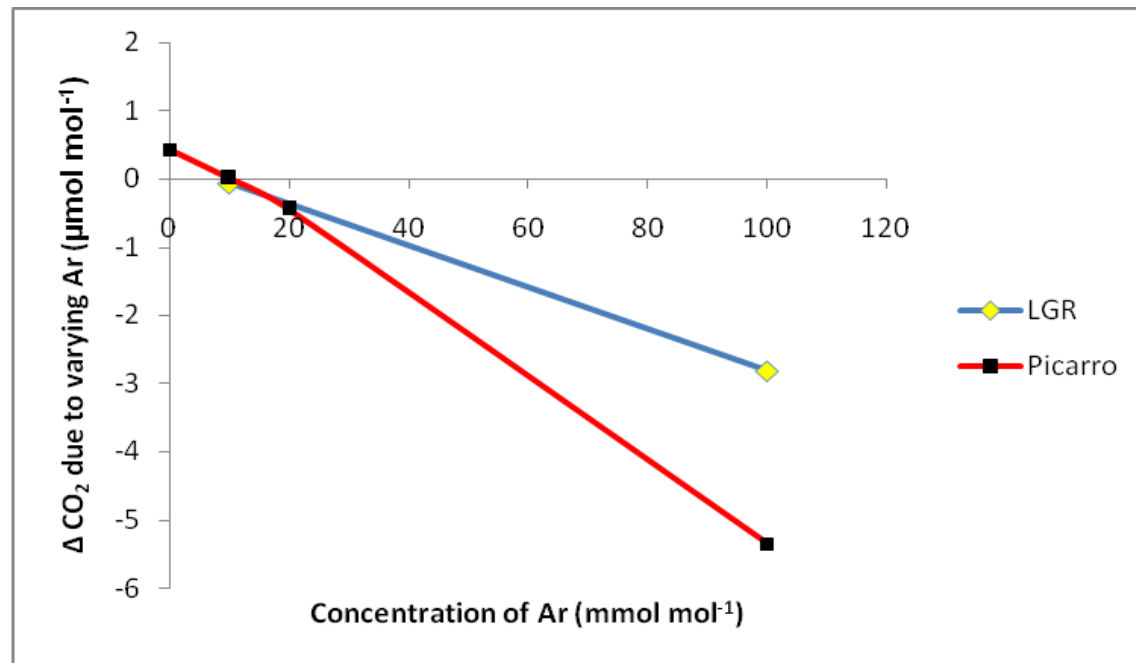
Stand Dev : 0.02 $\mu\text{mol mol}^{-1}$



Isotopic effect in CRDS

Description	CO ₂ Concentration (μmol mol ⁻¹)			
	CRDS		Gas/MS	
	Picarro	LGR	44CO ₂	Total CO ₂
¹³ C Enriched CO ₂ Sample/He	68.33	16.78	61	623

Matrix effect in CRDS



- Linearity: One point calibration in 1.5 – 2.0 $\mu\text{mol/mol}$
- Reproducibility: 0.0002 $\mu\text{mol/mol}$ for two weeks
- Calibration Period: Once in two weeks

Linearity

CRM Cylinder	CH ₄ concentration ($\mu\text{mol mol}^{-1}$)	
	Gravimetric value	Measured Value by CRDS
ME0424	1,5860	1,5860
ME5532	1,9385	1,9383

Reproducibility

Time	Stabilizing time (min)	CH ₄ ($\mu\text{mol mol}^{-1}$)
3월 29일	4 min 44 sec	2.0163
3월 30일 9시	4 min 15 sec	2.0162
3월 30일 11시	4 min 31 sec	2.0162
3월 30일 13시	4 min 42 sec	2.0161
3월 30일 15시	4 min 51 sec	2.0163
4월 13일	5 min 11 sec	2.0163

Moisture Effect

Description	CH ₄ $\mu\text{mol mol}^{-1}$		H ₂ O mmol mol^{-1}
	CH ₄	CH ₄ corr	
Dry air → Tubing Line	1.9270	1.9275	0.281
Dry air → Cryogenic Liq N ₂	1.9277	1.9277	0.031
Dry Air → Water → Cryogenic Liq N ₂	1.9276	1.9276	0.030
Dry air → Water	1.8615	1.9238	32.4
Direct dry air	1.9275	1.9275	0.011

Sample & Standard Gas Inlet System



Multi-Position Valve

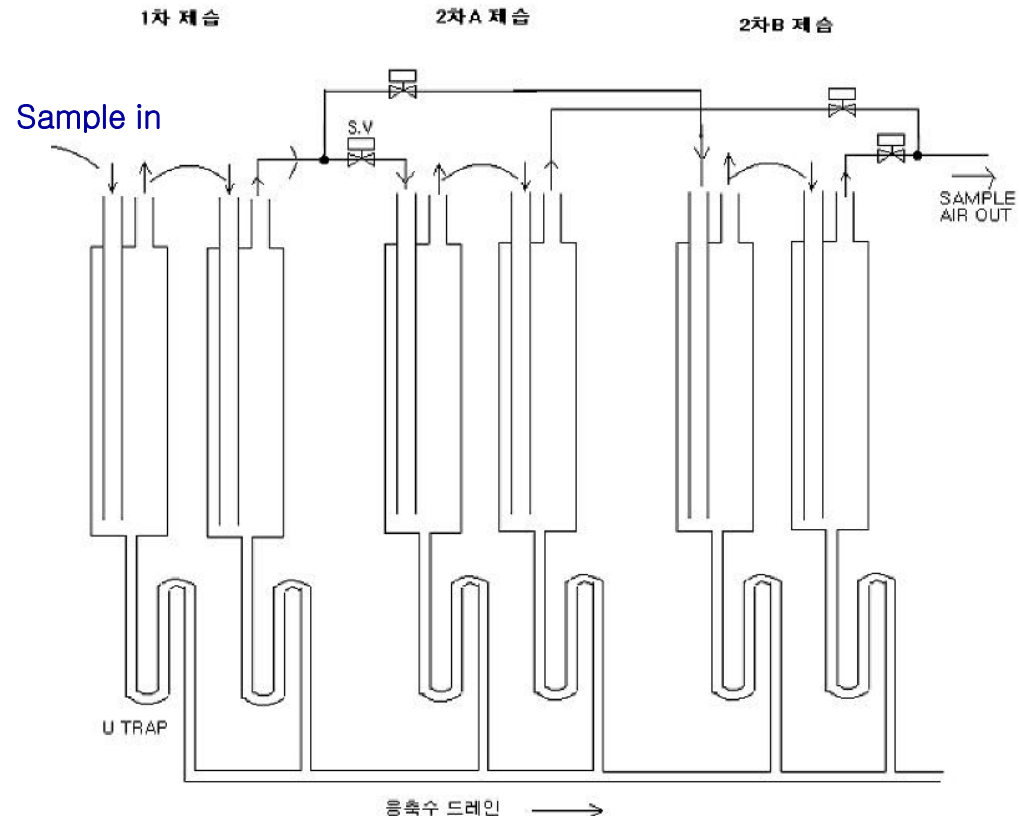
MFC

MFC Readout Box

Sample Inlet system

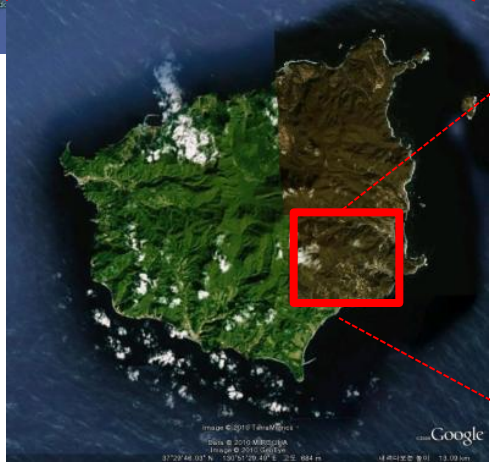
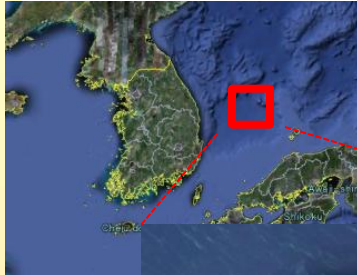
- Multi-Position Valve
Selection of Standard Gas or ambient air sample
- MFC
Flow Control
- MFC Readout Box
MFC control & Remote Access

1st type Water Vapor Removal System



Less than 7 ppm with 10 L/min inlet flow

Remote Site: Ulleung Observatory



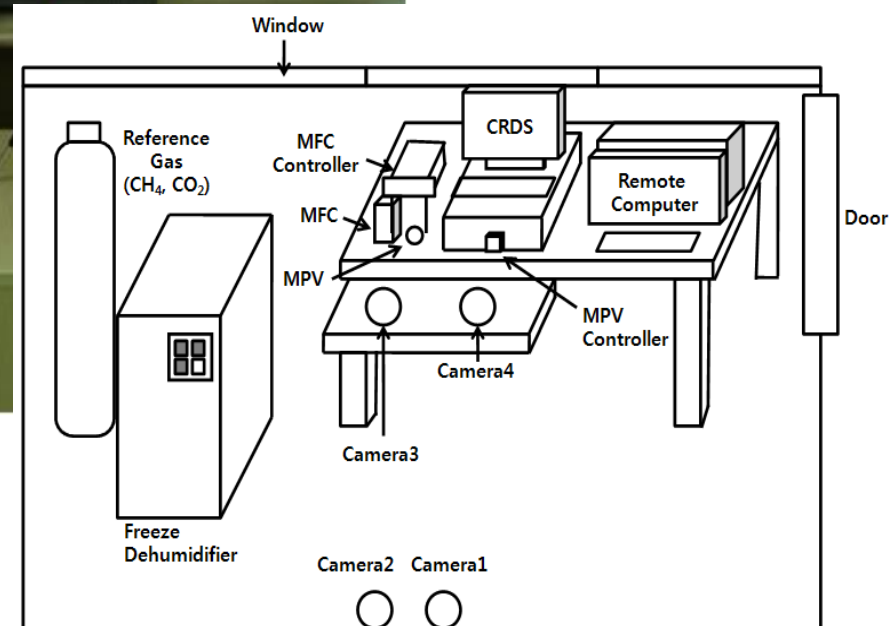
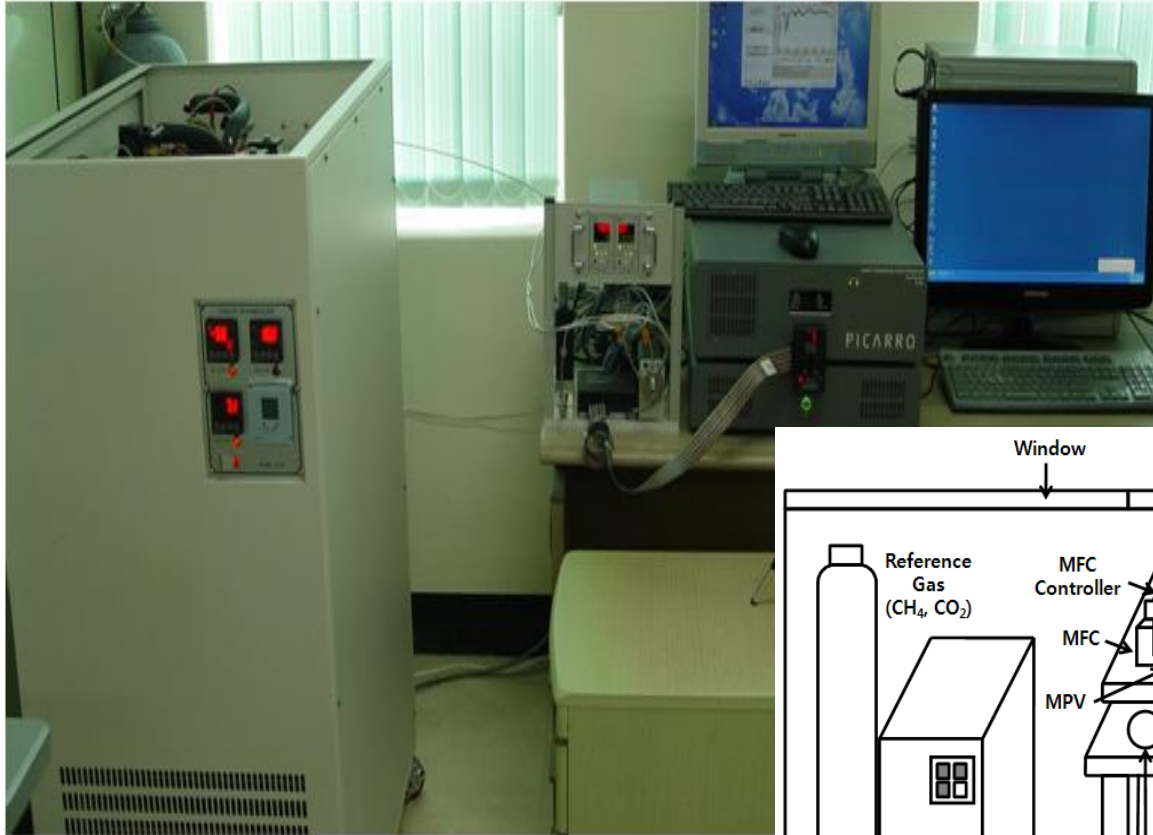
Selection of Site

- Clean area in East Sea of Korean Peninsula

Geographical Information

Latitude 37°28'37", Longitude 130°53'53" ,
Altitude 220.87m
Characteristic : South-West and North-East
Wind, Average Temp 12.0°C, Average Daily T
range 5.9 °C **Oceanic Climate**

CO₂/CH₄ CRDS Operation at Ulleung Observatory



The screenshot displays a Windows XP desktop with several active windows:

- Picarro Trace Gas Analyzer.vi:** A window titled "Carbon Dioxide and Methane Monitor" showing a graph of CH4 concentration (ppmv) over time. The current reading is 0.000 ppmv. It includes control buttons for "Shutdown" and "Stop Data Log", and a "Status log" section with a table of recent measurements.
- QuickCam® QuickCapture:** A window showing a video feed of the Picarro analyzer's display, which shows CH4, CO2, and H2O readings. It has "Take Photo" and "Record Video" buttons.
- mpv_test.mth:** A small window displaying a list of data points (e.g., 20 3g01, 30 3g02) and control buttons like "Start", "Pause", "Reset", and "Close".
- LG데이콤 네트루 정보 - LGDacom N...:** A system information window for "NetuRo" software, showing version 3.1.3.2 and user ID miniky94.
- File Explorer:** Two windows showing the file system structure, including folders like "Documents and Settings", "Instrument Install Software", and "Picarro".
- 대화 중인 상태: JEJU_PICCAR...:** A window for a remote connection, showing "Host" and "Port" fields.

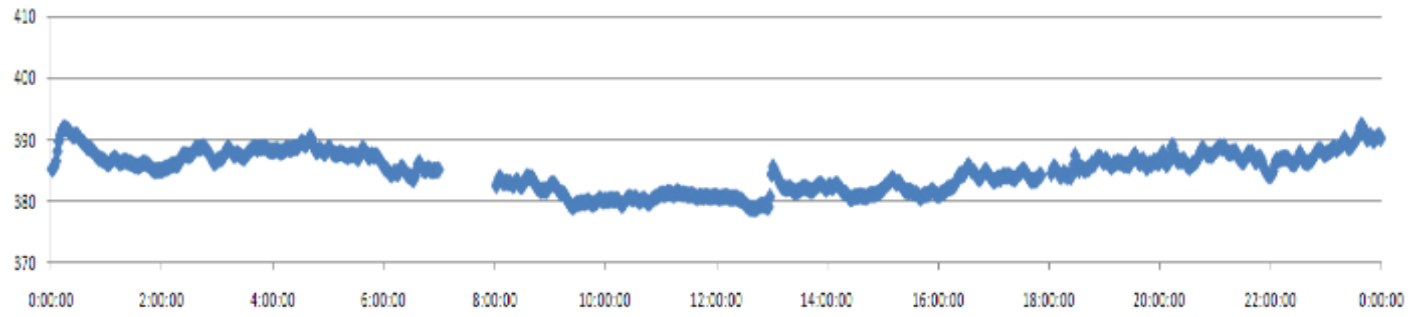
The taskbar at the bottom shows the Start button, several open applications, and the system tray with the date and time (2009-08-23, 10:34 AM).

Modified Water Vapor Removal System

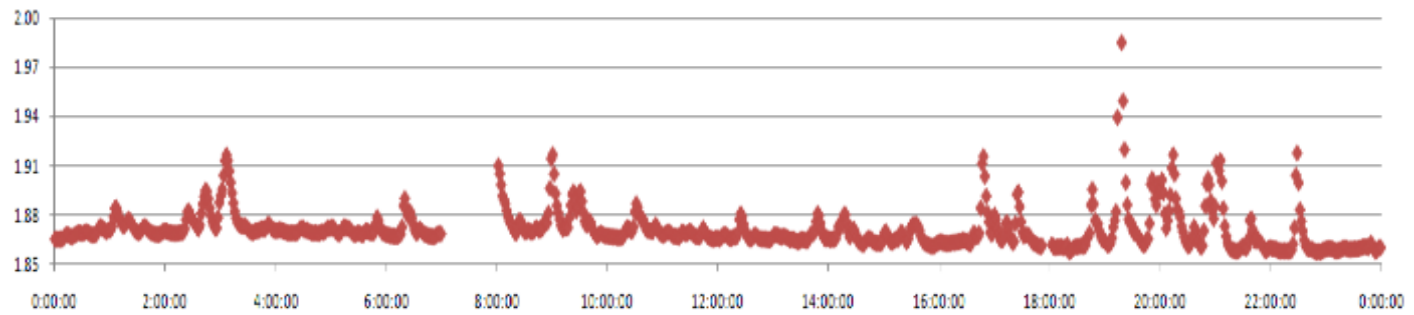


Continuous Monitoring of CO2/CH4

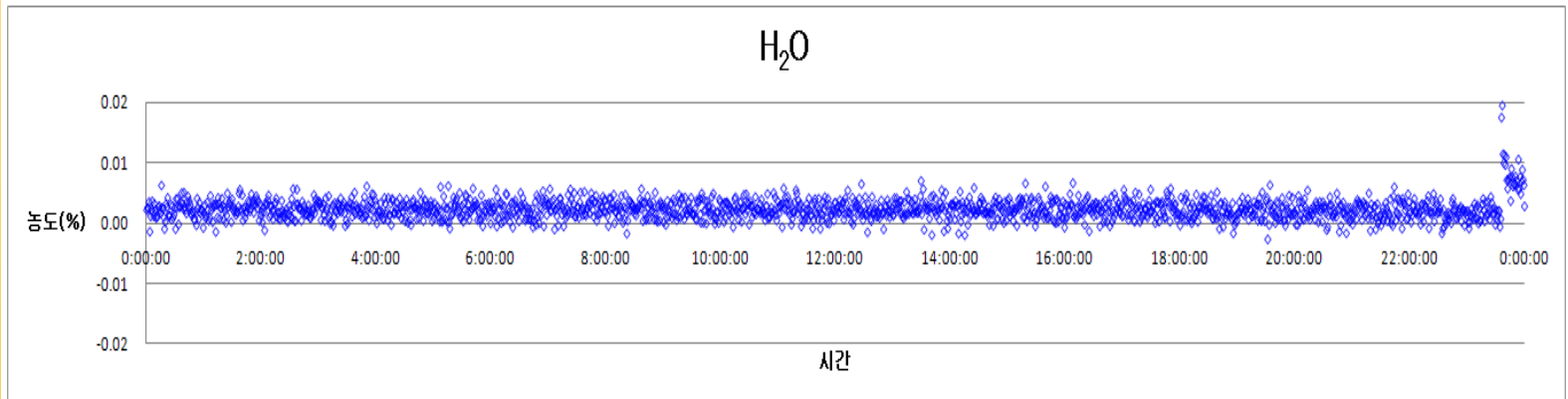
CO2



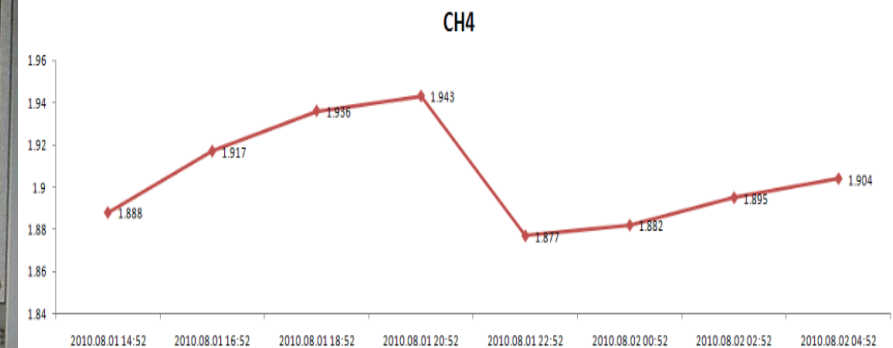
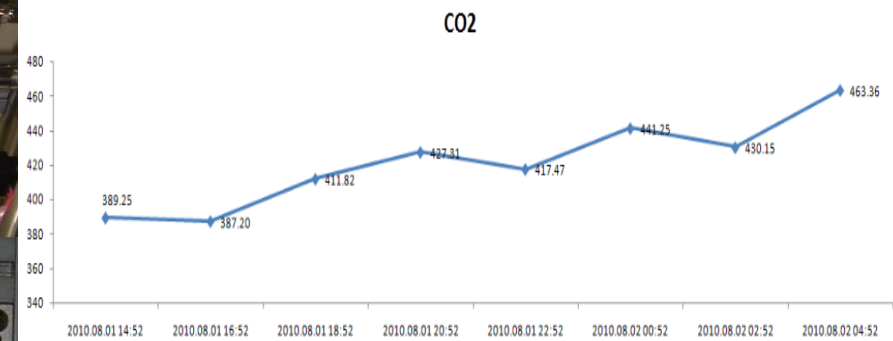
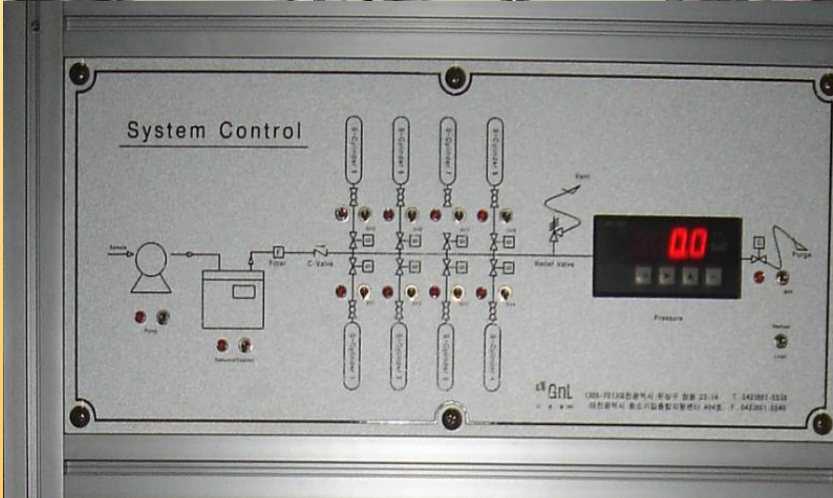
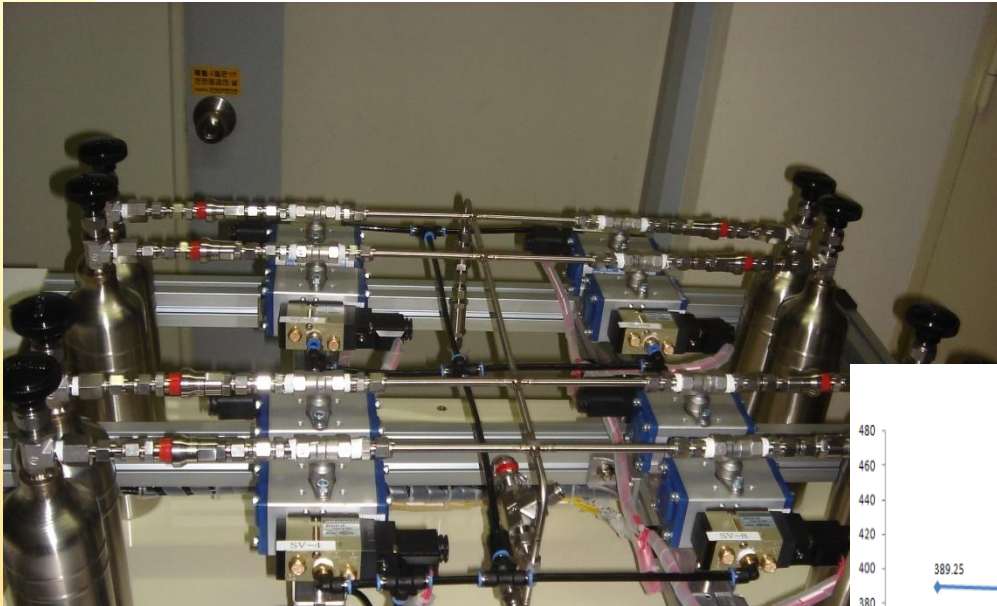
CH4



H₂O



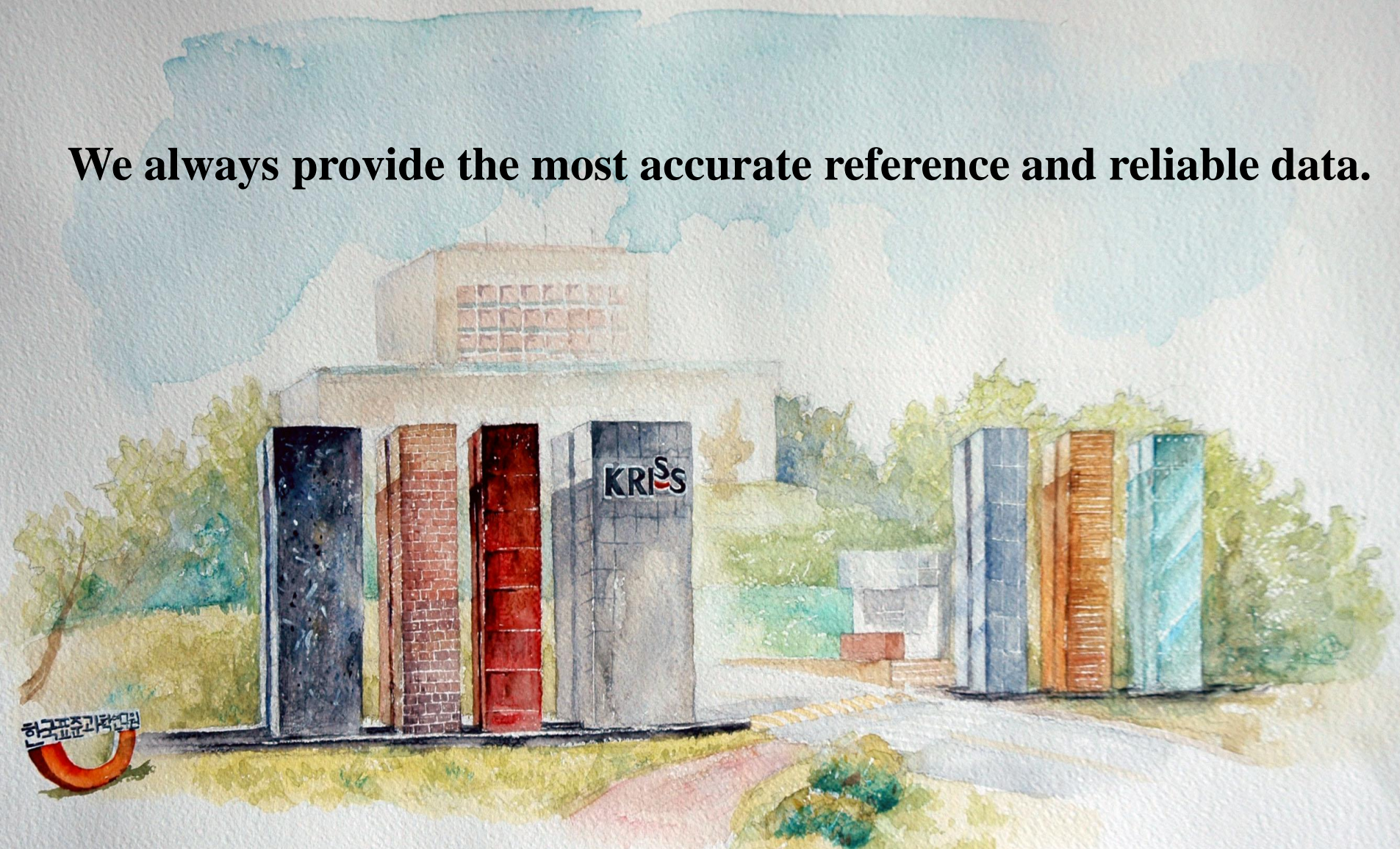
Remote Flask Sampling System



Present Observation

- **Ulleung Site : CO₂, CH₄, N₂O, CO**
- **Baekryeong Site: Weekly sampling**
(CO₂, CH₄, N₂O, CO, SF₆)

We always provide the most accurate reference and reliable data.



Thank you for your attention !