Ensuring High-Quality Data from NOAA's Cooperative Global Air Sampling Network

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Introduction

• NOAA/ESRL/GMD Cooperative Global Air Sampling Network started in the 1960s and now includes weekly samples at ~60 sites (Fig. 1, red circles).
• Prepared flasks are shipped to a site, air samples are collected in series in two flasks, and then the flasks are returned to Boulder, Colorado for measurement (Pics. 1-3).
• In 2015, more than 6,000 discrete air samples collected from this network were measured for atmospheric CO_2, CH_4, CO, H_2, N_2O, and SF_6.
• Data quality assurance (QA) and quality control (QC) are fundamental parts of our long-term data records.


Pic. 1

Prepared flasks are shipped to sites around the world…

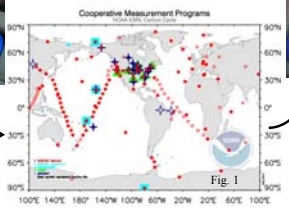
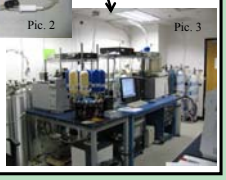


Fig. 1


Pic. 2

and then returned to Boulder, Colorado for measurement

where they are filled with local air…


Pic. 3

Summary and Conclusions

• Data from NOAA/ESRL/GMD's Cooperative Global Air Sampling Network are vital to large-scale studies of atmospheric CO_2, CH_4, N_2O, SF_6, and CO.
• To be most effective, these long-term data records must be carefully scrutinized so samples with collection or measurement problems are identified.
• Quality assurance and quality control (QA/QC) are performed with several different methods and programs developed in GMD. This includes:
- Monitoring flow rates, flask pressures, and reference gas responses from every analysis performed.
- Comparing results from flask pairs, different gases, different sites, and different sampling methods.

Remaining Issues

• Assign uncertainties for CO_2, N_2O, and SF_6.
• Create a sample collection video to use as a tutorial for site staff turn-over.
• Increase site visits or bring sample collectors to Boulder for training when needed.
• Increase our supply of spare samplers (PSUs) and parts.
• Administrative issues: keeping contracts current, shipping problems/delays

Data Quality Assurance

Measurement:

Gas	Technique	Calibration
CO_2	NDIR	3 standards
CH_4	GC FID	1 standard
N_2O/SF_6	GC ECD	8 standards offline relative to reference
CO	VUVRF	6 standards offline relative to reference and a "zero"
H_2	HePDD	1 standard

• QA is performed in the CCGG measurement lab with daily control flasks, weekly field samples, short-term target tanks analyzed every two weeks, and long-term target tanks analyzed twice per year.
• Fig. 2 shows short-term target tank results for CH_4 since 2005.

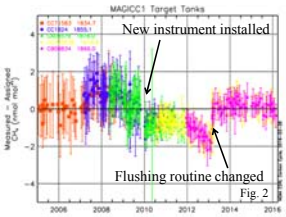


Fig. 2

Equipment and Training:

• All portable sampling units (PSUs) are tested in Boulder before they get deployed to a field site (Fig. 3).
• Flasks are prepared with fill gas before they are shipped to a site.
• Budget constraints prohibit routine site visits and technician training in Boulder.

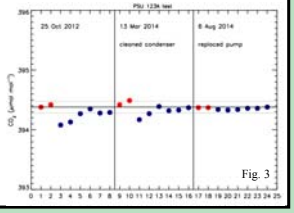


Fig. 3

Selection of Data for Spatial Representativeness

- Ensure data can be compared with model results

Gas	Filtering Technique
CO_2	Symmetrical statistical filter
CH_4	Consider other species
N_2O/SF_6	Non-symmetrical stiff filter

• CO_2 is selected by fitting a smooth curve, then iteratively flagging values outside ±3-σ (Fig. 12).
• For N_2O and SF_6, a stiff fit and asymmetrical filter is used. Fig. 13 and 14 compare loose and stiff filters for SF_6 at TAP.

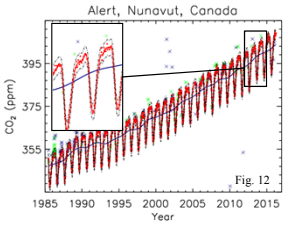


Fig. 12

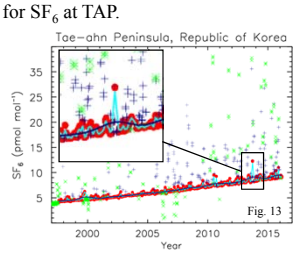


Fig. 13

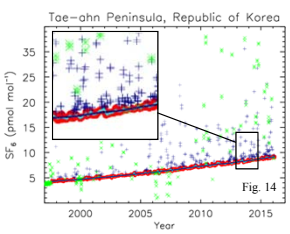


Fig. 14

Data Quality Control

• Flask pairs:
Example: PSU failed at the site causing insufficient flushing in flasks (Fig. 4).

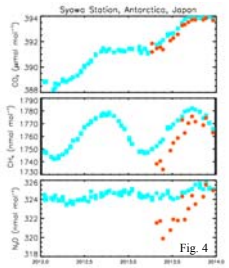


Fig. 4

• Sites at similar latitudes:
Example: Leak in sample collection system at Cold Bay, Alaska (CBA, Fig. 5).

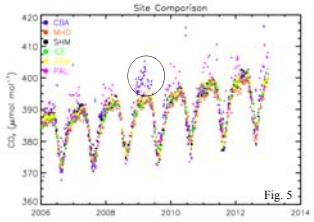


Fig. 5

• Flask sample contamination:
Example: High N_2O at certain sites with, as yet, unknown cause (Fig. 6).

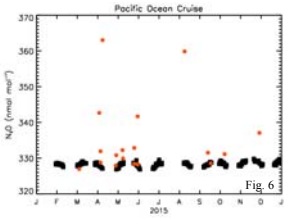


Fig. 6

• Known analytical problems:
Example: Anomalous results caused by measurement delays (Figs. 7 and 8).

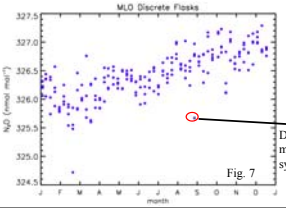


Fig. 7

Delay on measurement system

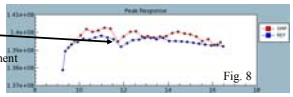


Fig. 8

• Time series:
Example: Sampling location moved closer to local sources at the airport (Fig. 9).

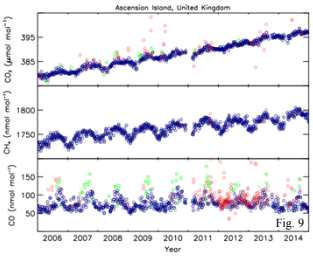


Fig. 9

• Flask pressures during measurement:
Example: Equipment problems at Shemya Island, Alaska (Fig. 10).

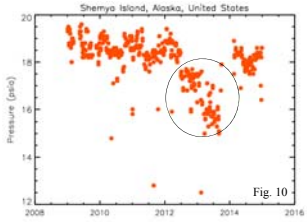


Fig. 10

• Independent measurements (co-located or same-air comparisons):
Example: Mauna Loa CO_2 flask results compared to in situ data (Fig. 11).

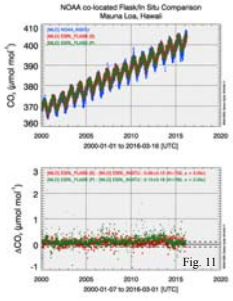


Fig. 11