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 CO2, CH4, CO, H2, N2O, and SF6.
- Data quality assurance (QA) and quality control (QC) are fundamental parts of our long-term data records.

Data Quality Assurance
Measurement:

<table>
<thead>
<tr>
<th>Gas</th>
<th>Technique</th>
<th>Calibration</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>NDIR</td>
<td>3 standards</td>
</tr>
<tr>
<td>CH4</td>
<td>GC, FID</td>
<td>1 standard</td>
</tr>
<tr>
<td>N2O/SF6</td>
<td>GC, ECD</td>
<td>8 standards offline relative to reference</td>
</tr>
<tr>
<td>CO</td>
<td>VUVRF</td>
<td>6 standards offline relative to reference and a “zero”</td>
</tr>
<tr>
<td>H2</td>
<td>HePDD</td>
<td>1 standard</td>
</tr>
</tbody>
</table>

- QA is performed in the CCGG measurement lab with daily control checks, 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 CH4 since 2005.

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.

Selection of Data for Spatial Representativeness
- Ensure data can be compared with model results

<table>
<thead>
<tr>
<th>Gas</th>
<th>Filtering Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Symmetrical statistical filter</td>
</tr>
<tr>
<td>CH4</td>
<td>Consider other species</td>
</tr>
<tr>
<td>N2O/SF6</td>
<td>Non-symmetrical stiff filter</td>
</tr>
</tbody>
</table>

- CO2 is selected by fitting a smooth curve, then iteratively flagging values outside ±3-σ (Fig. 12).
- For N2O and SF6, a stiff fit and asymmetrical filter is used. Fig. 13 and 14 compare loose and stiff filters for SF6 at TAP.

Data Quality Control
- Flask pairs:
  Example: PSU failed at the site causing insufficient flushing in flasks (Fig. 4).

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

- Flask sample contamination:
  Example: High N2O at certain sites with, as yet, unknown cause (Fig. 6).

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

Summary and Conclusions
- Data from NOAA/ESRL/GMD’s Cooperative Global Air Sampling Network are vital to large-scale studies of atmospheric CO2, CH4, N2O, SF6, 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 CO2, N2O, and SF6.
- Increase our supply of spare samplers (PSUs) and parts.
- Administrative issues: keeping contracts current, shipping problems/delays

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

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

- Independent measurements (co-located or same-air comparisons):
  Example: Mauna Loa CO2 flask results compared to in situ data (Fig. 11).