Historic European non-CO$_2$ atmospheric greenhouse gas records: Harmonization and uncertainty assessment


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InGOS: Integrated non-CO$_2$ Greenhouse gas Observation System (CH$_4$, N$_2$O, H$_2$, SF$_6$)
The InGOS harmonisation made use of:

- working STD re-assignments
- target gas information
- co-located flasks
- improved determination of instrument response func.
- assignment of long-standing quality control cylinders
Re-assessed $\text{N}_2\text{O}$ at Schauinsland, Germany

As thin blue line the Mace Head monthly means: selected for marine conditions

Uncertainties are needed to complete the re-assessed record.
Uncertainty assessment

- Instrument and calibration uncertainties:
  - repeatability: $\Delta_{\text{repeat}}$
  - scale transf. uncertainty: $\Delta_{\text{trans}}$
  - lab int. scale consistency: $\Delta_{\text{lisc}}$
  - reproducibility: $\Delta_{\text{reprod}}$
  - flask comparison uncert.: $\Delta_{\text{flask}}$

- Sampling uncertainties:
  - artefacts from pumps / drying systems
  - leaks or artefacts in sampling lines
  - temporal representativeness
  - ....
Repeatability:
short term instrument performance (UHEI)

Captures:
- instrument noise,
- pressure- / temp. fluctuations
- GC baseline variations
- other short-term variability

24 hour running 1σ standard deviation of bracketing working standard measurements
Scale transfer uncertainty

N\textsubscript{2}O [nmol/mol] vs assigned tertiary standards

measured peak area ratio relative to working std
Scale transfer uncertainty is a function of concentration.

Captures:
- Uncertainty of tertiary assignments
- Uncertainty tertiary measurement during scale transfer

Scale transfer uncertainty is a function of concentration.
Lab internal scale consistency (changing bias)

Captures:
- internal scale transfer
- non linearity issues
- major cylinder drifts

Heidelberg, Germany
Monthly reproducibility
monthly moving median filter

Captures:
- monthly to annual variation
- drifts at end of cylinder lifetime

30 day moving median filter on lab internal scale
consistency-corrected target gas measurements
Flask comparison uncertainty

Captures:
- Overall agreement
- Sample intake systems
- …
Application of uncertainty estimates

• **repeatability:** robust uncertainty value of individual data points which **must** be considered in all inversion estimates
• **scale transfer uncertainty:** quantitative estimate of maximum bias correction in models
• **lab internal scale consistency and monthly reproducibility:** indicator for internal consistency of long-term records should be used for data selection only, not quantitative
• **flask comparison uncertainty:** indicator for compatibility to external measurements should be used for data selection only
Results
Results

www.ingos-atm.lsce.ipsl.fr/dataproduct

Thank you for your attention!
Introduction and background

- **InGOS**: Integrated non-CO$_2$ Greenhouse gas Observation System

- **WG 2**: harmonizing historic greenhouse gas (GHG) observations

- **Situation**: Each European country has its own institution monitoring atmo. GHGs

- **Aim**: re-assesse and quality control European in-situ CH$_4$, N$_2$O and H$_2$ observations