Data harmonization and quality management for atmospheric GHG measurements: what have we learned in the InGOS project?

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Continuous GHG observations in Europe… a real treasure but of variable quality

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What is NA2 about?

MPI-BGC Jena

FMI

LSCE

NILU

Umwelt Bundes Amt
Für Mensch und Umwelt

OMSZ

EMPA
Materials Science & Technology

JRC
EUROPEAN COMMISSION

UEA
University of East Anglia

THE UNIVERSITY OF EDINBURGH

ECN

ROYAL HOLLOWAY UNIVERSITY OF LONDON

ENEA

AGH

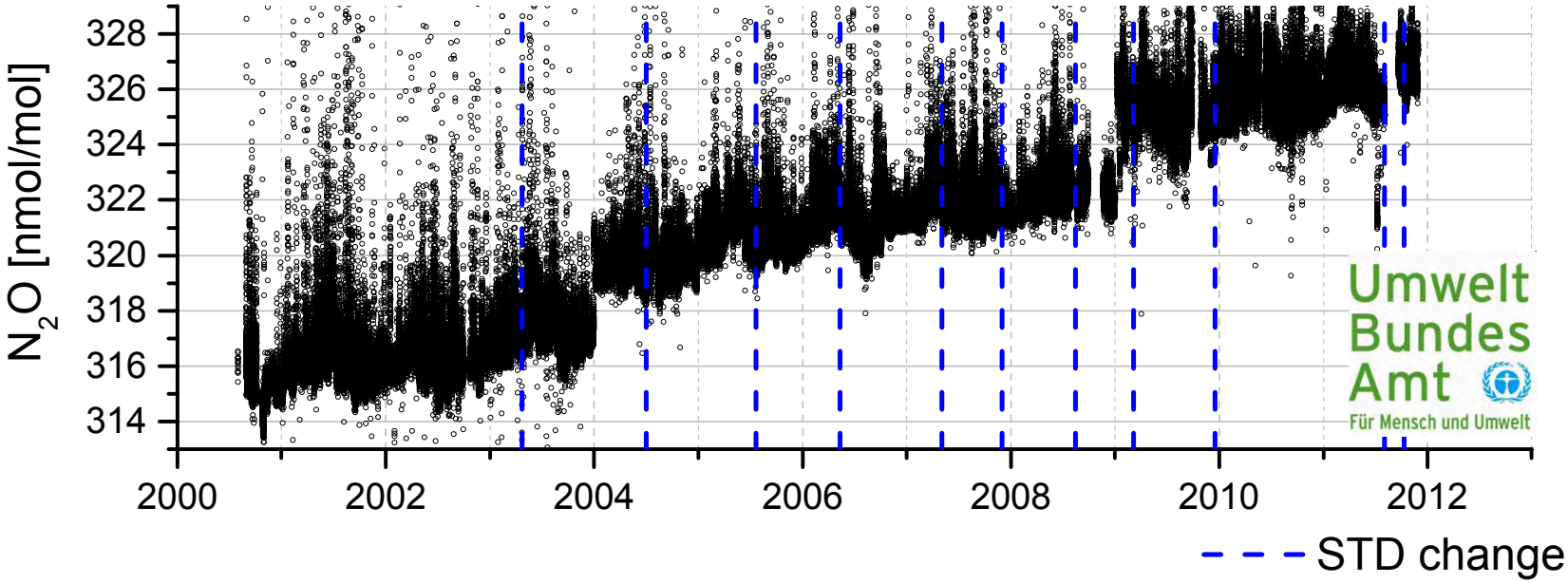
rijksuniversiteit groningen

InGOS

NA2: Correction and harmonization of historic measurements

The overall objective is to evaluate and harmonise the existing atmospheric data base for CH_4, N_2O and H_2. This will be done by critical inspection of the existing GHGs measurements of the last 10 years (2001-today) in Europe. We will re-evaluate the calibration history including quality control information. The aim is to obtain reliable estimates of the uncertainties of the individual GHGs data sets.

Example: N_2O at Schauinsland Germany

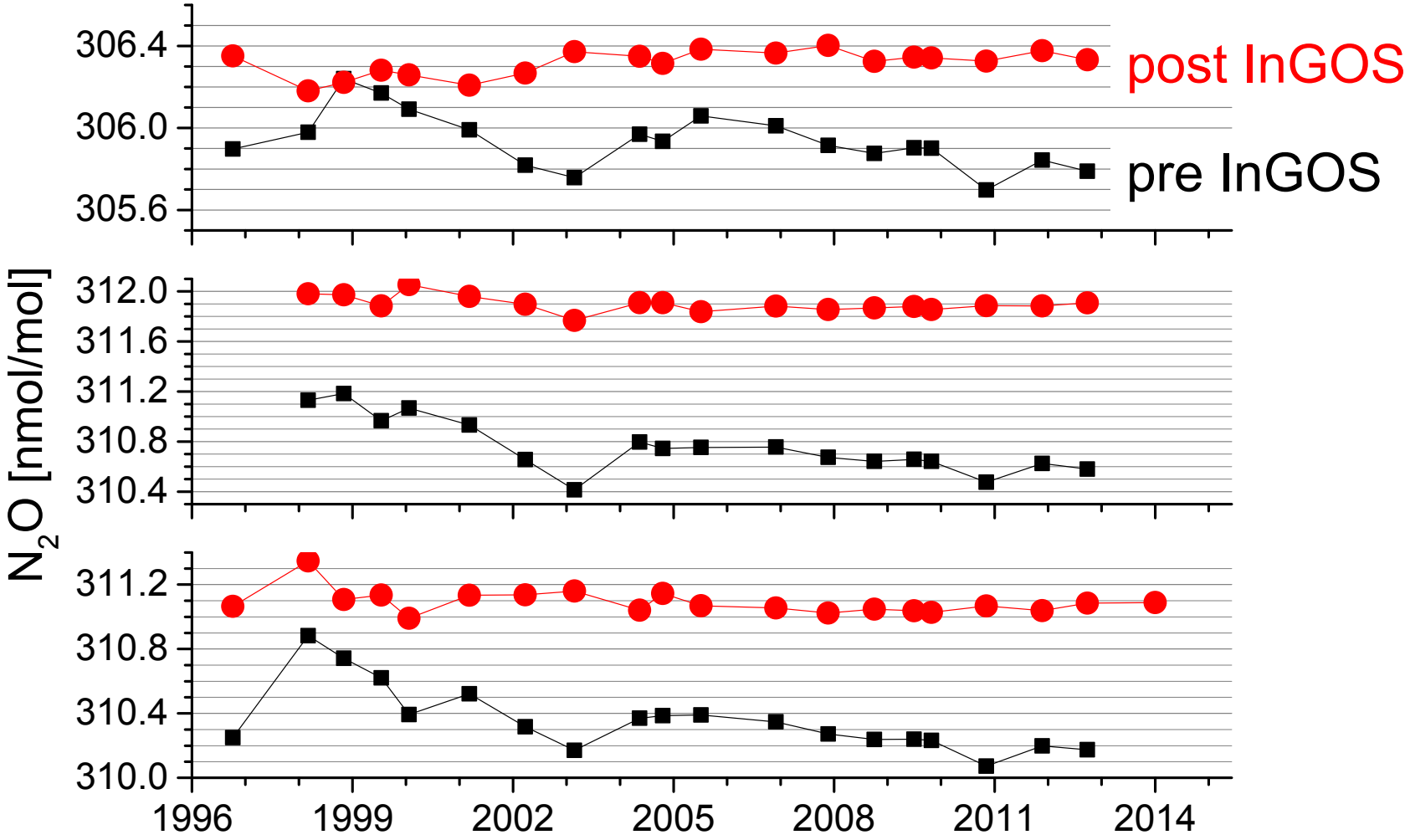


The InGOS harmonization made use of:

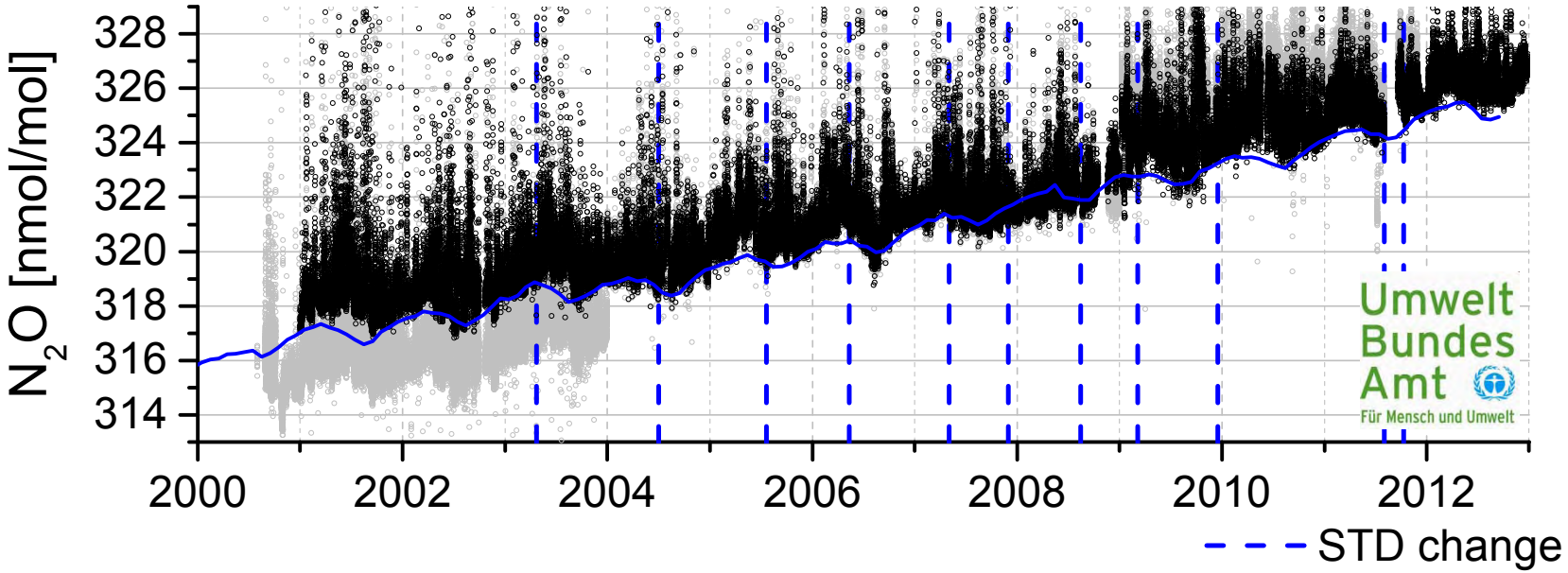
- working STD re-assignments
- target gas information
- co-located flasks
- improved determination of instrument response func.
- assignment of long-standing quality control cylinders

N_2O working standard re-assignment for Heidelberg

Tertiary calibration cylinder measurements against multiple WS

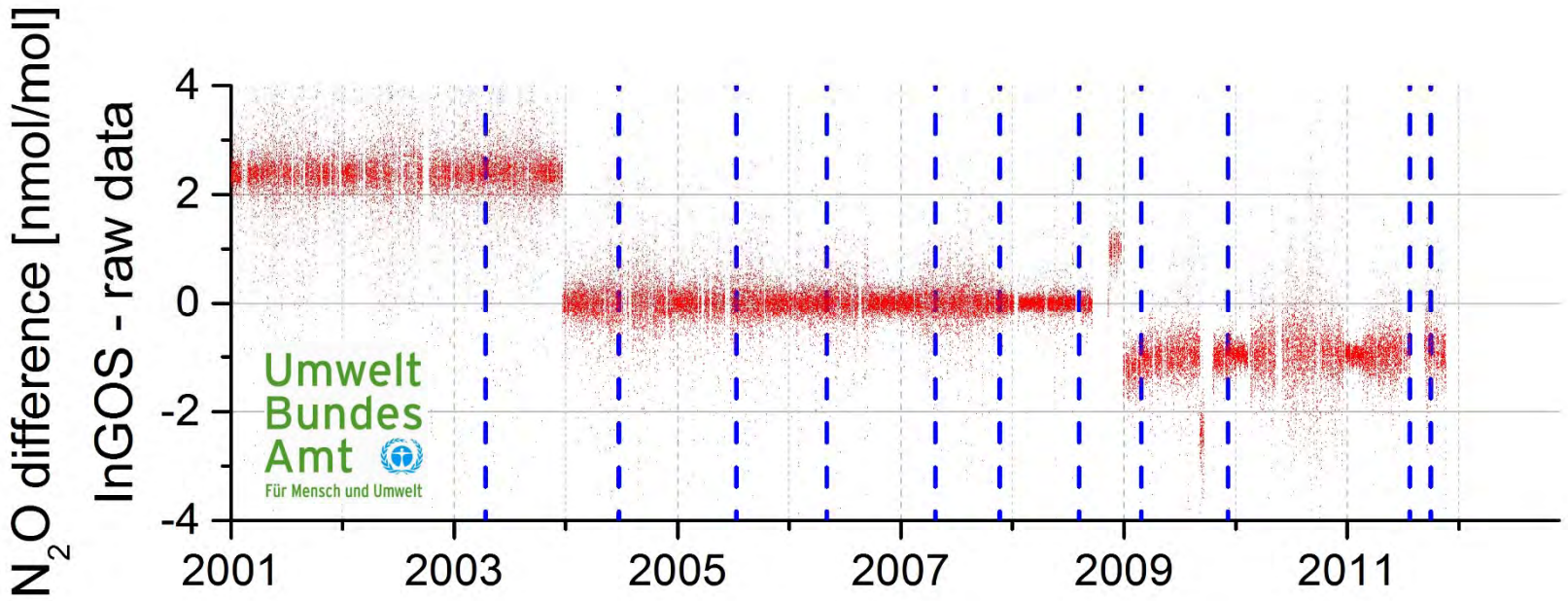


Re-assessed N_2O at Schauinsland, Germany



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

Differences N_2O pre and post InGOS data harmonization

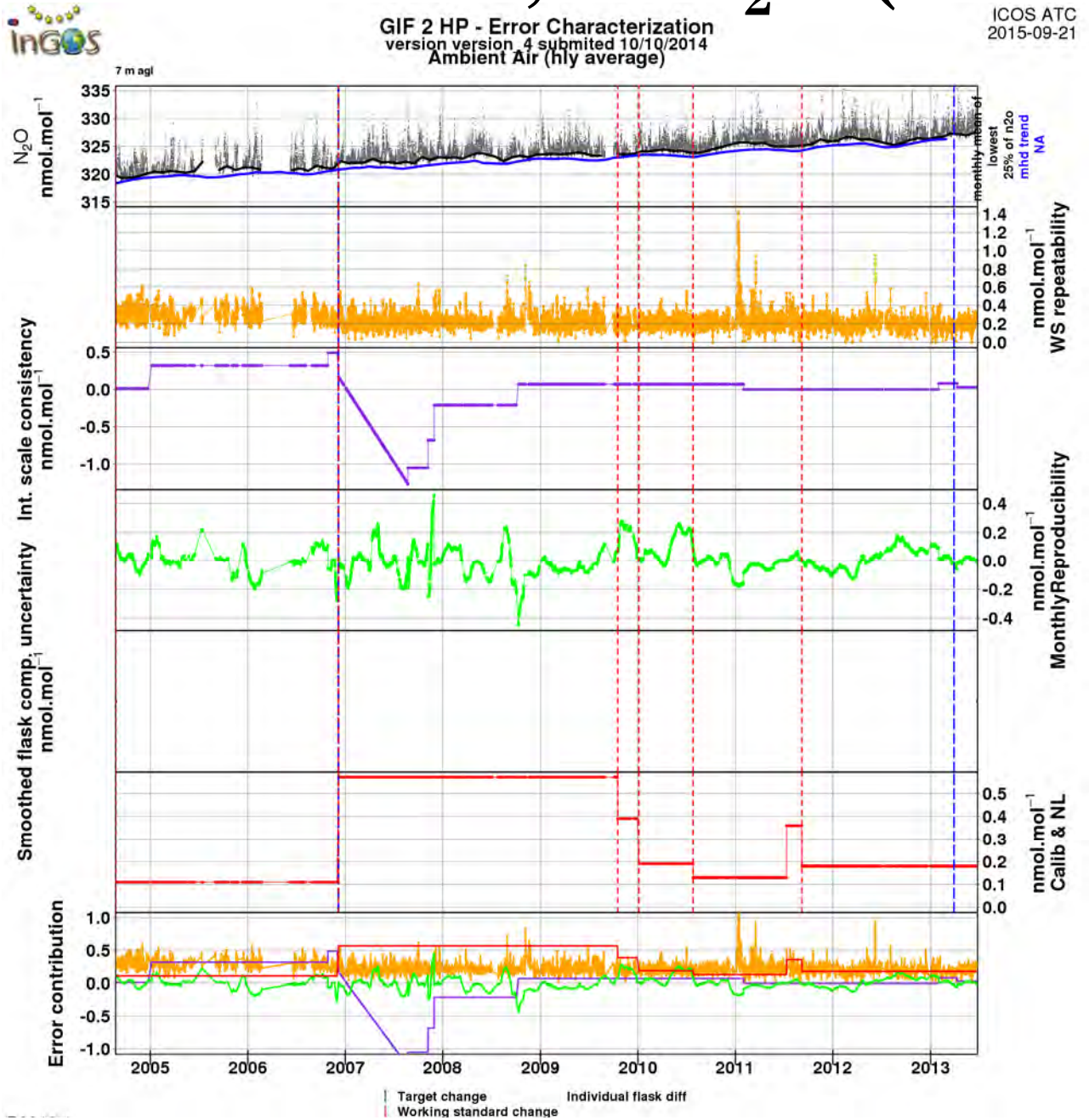


Uncertainties are needed to complete the re-assessed record.

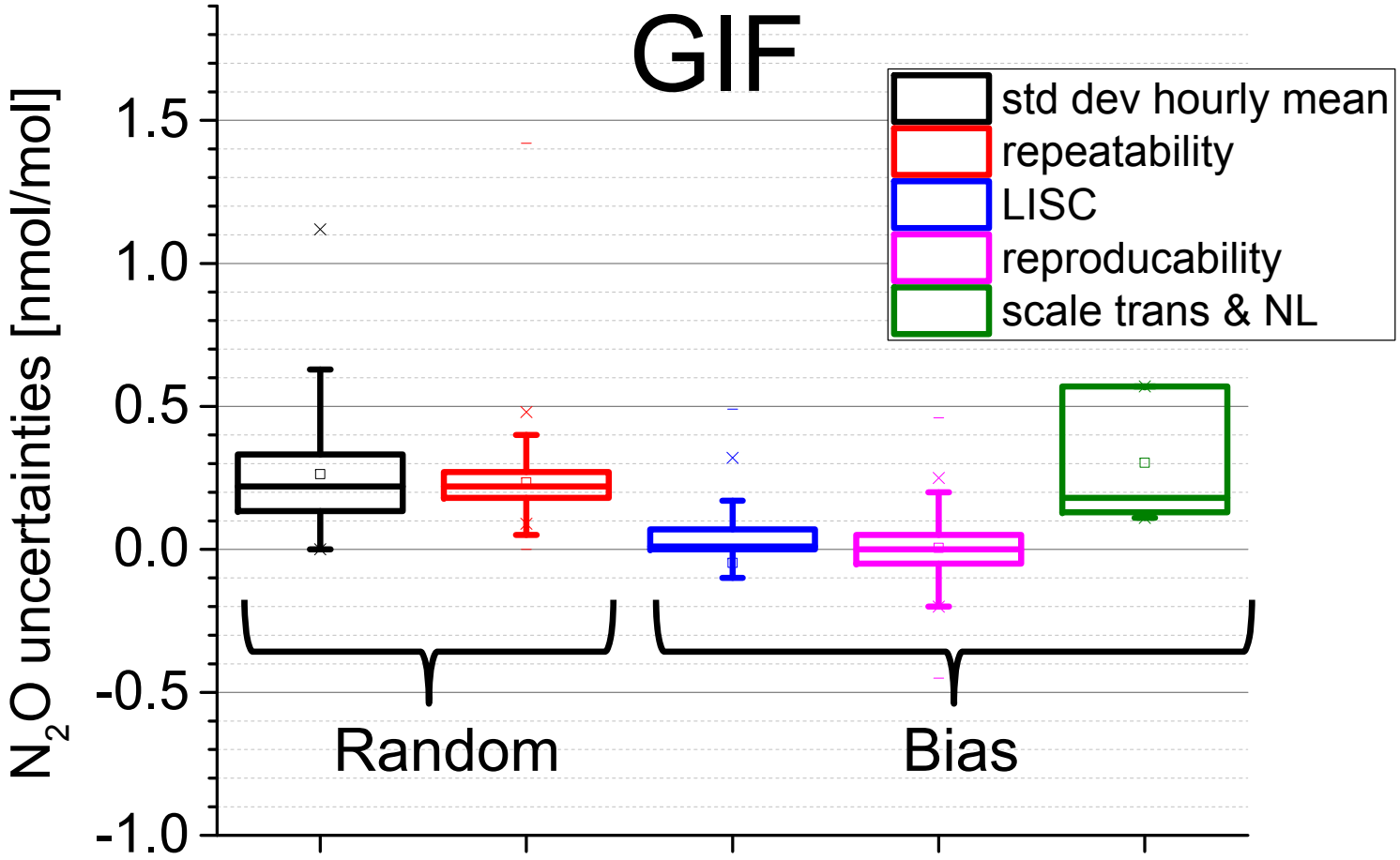
Uncertainty assessment

- Instrument and calibration uncertainties:
  - repeatability: Δ_{repeat}
  - lab int. scale consistency: Δ_{lisc}
  - scale transf. uncertainty: Δ_{trans}
  - flask comparison uncert.: Δ_{flask}
- Sampling uncertainties:
  - spatial & temporal representativeness
  - artefacts from pumps / drying systems
  - leaks or artefacts in sampling lines
  - ....

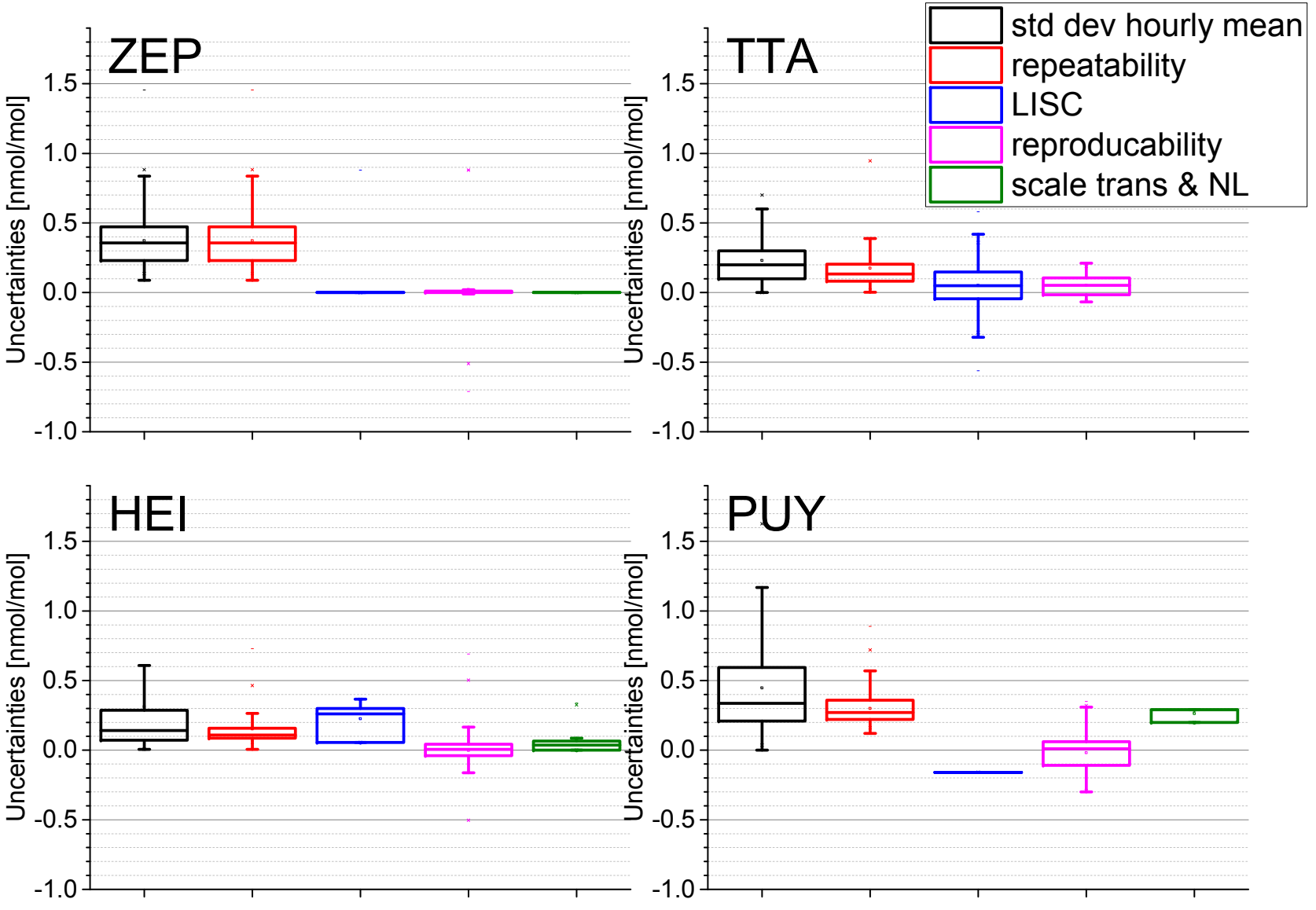
Gif-sur-Yvette, F: N_2O (LSCE)



Uncertainty comparison



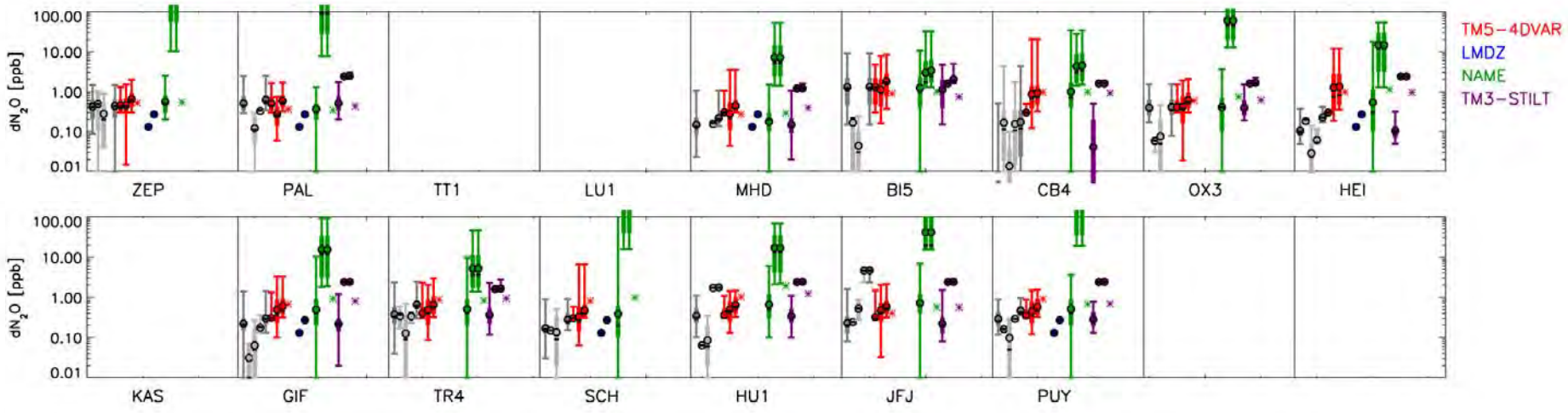
Uncertainty comparison



What have we learned in NA2?

- **Lock at your data!**
  - frequent and preferably among a group of peers
- **Calibrate your target**
  - important to calculate the LISC
- **Use two targets**
  - covering the ambient range at the station
- **Improve flask sampling**
  - integrated sampling, us as QC only
- **Assess sampling uncertainties**
  - ICOS mobile lab, target via sample inlet system

uncertainties: measurements and models courtesy: Peter Bergamaschi



Reported error types

- **Repeatability:** Robust uncertainty value of individual data points which **must** be considered in all inversion estimates
- **Lab-internal scale consistancy:** Indicator for internal consistancy of long-term record (potentially concentration-dependent non-correctable error in the data) – can be used for data selection, not quantitative
- **Scale transfer error:** Quantitative estimate of maximum bias correction in models
- **Flask comparison error:** Indicator for data selection – if small then indicator for good data, if large, then reason not immediately clear

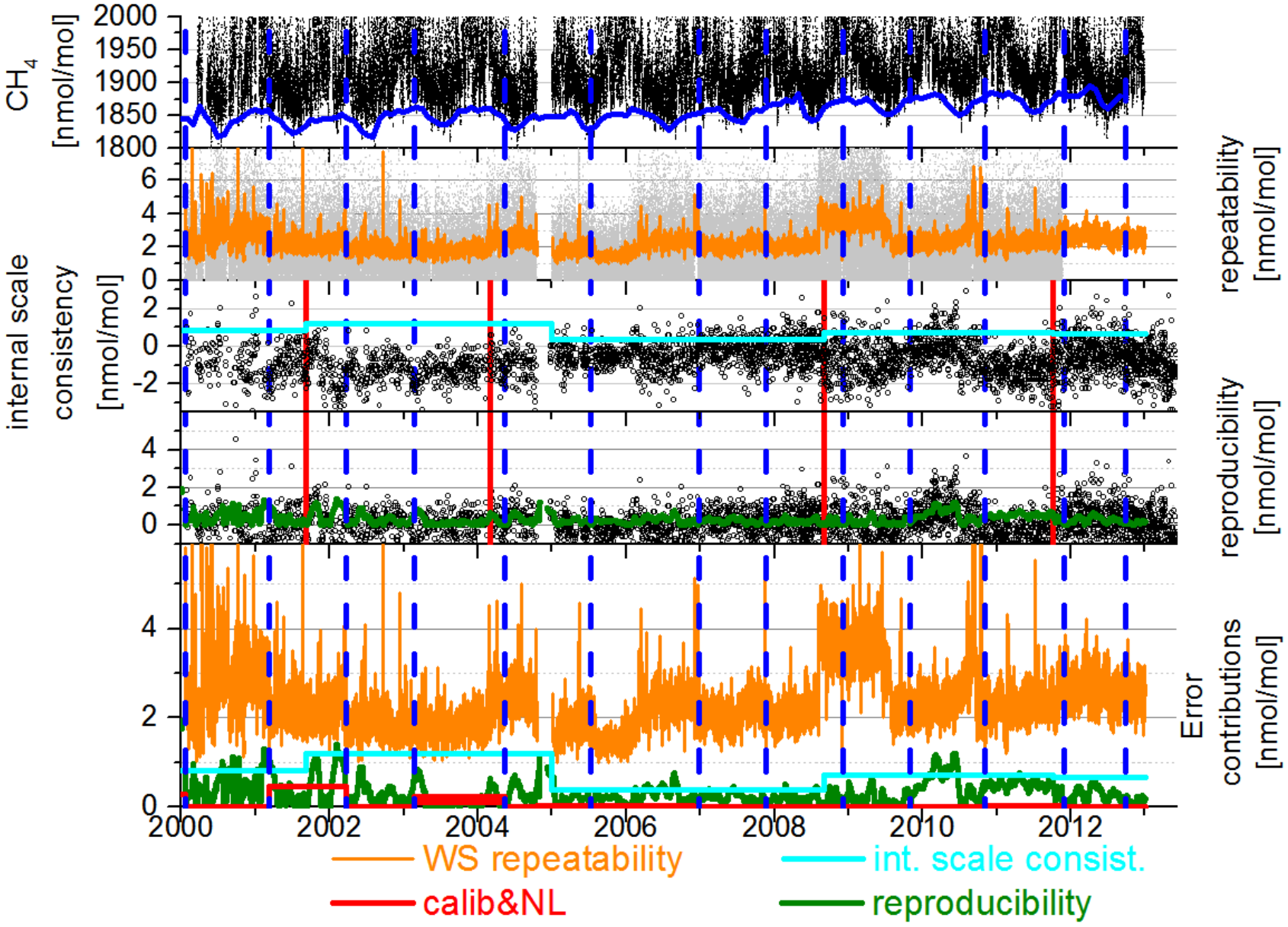
Uncertainty summary and the potential use in models

Uncertainty category	typ. temporal time scale	uncertainty value
repeatability	hourly	direct usage
reproducibility	monthly	% of Δ conc to WS
lab. int scale consistency	yearly	% of Δ conc to WS
flask comparison	monthly	% of Δ conc to WS
scale transfer	yearly	Direct usage

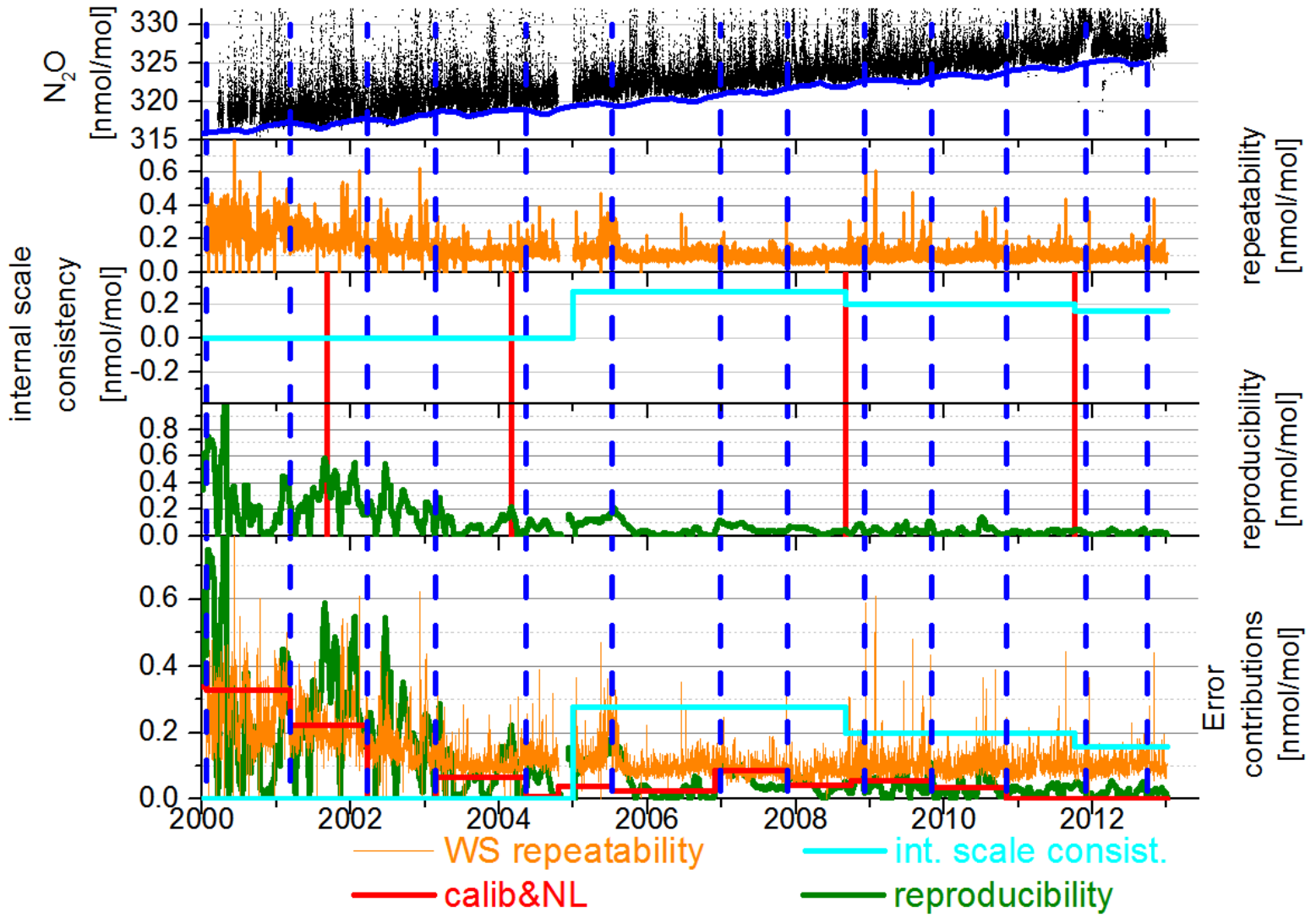
Summa

Suggestion: Error inflation with different

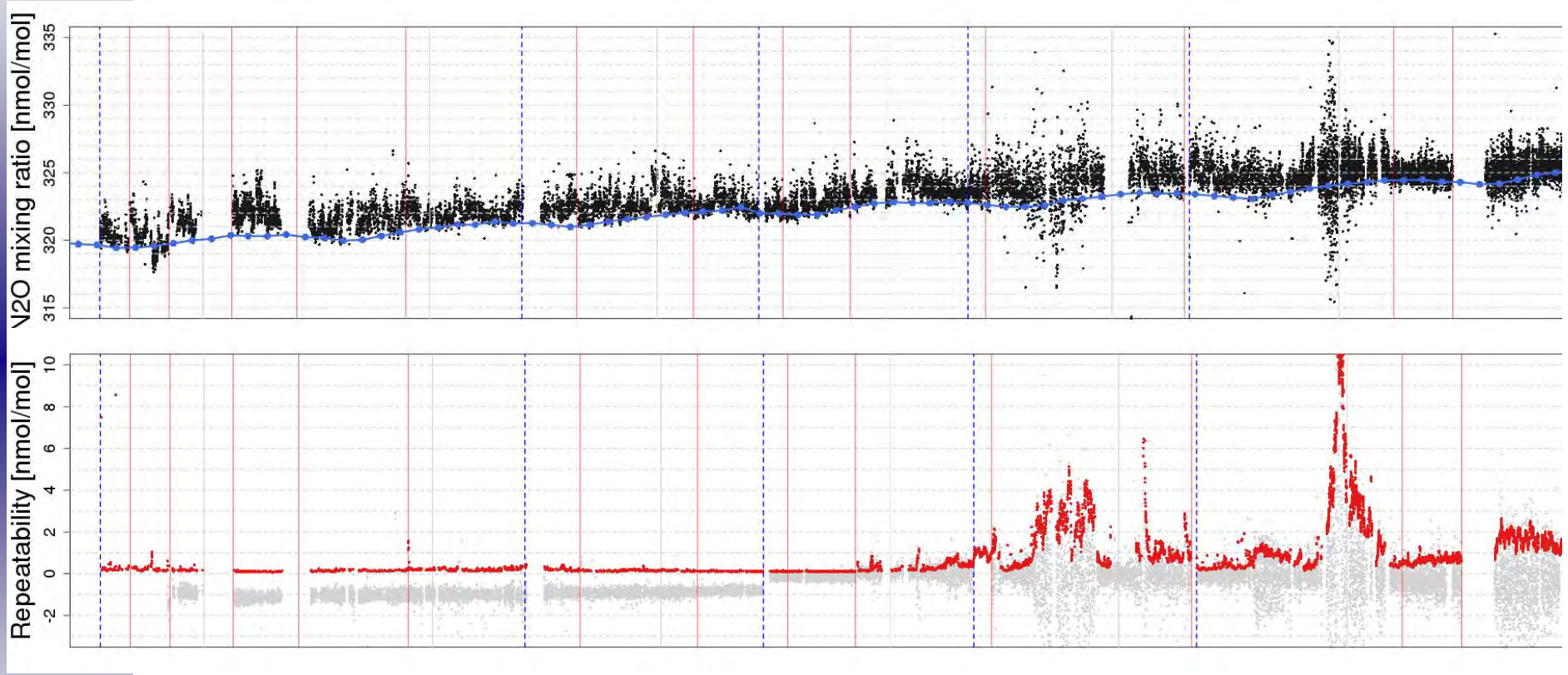
Heidelberg, D: CH_4 (UHEI-IUP)



Heidelberg, D: N_2O (UHEI-IUP)

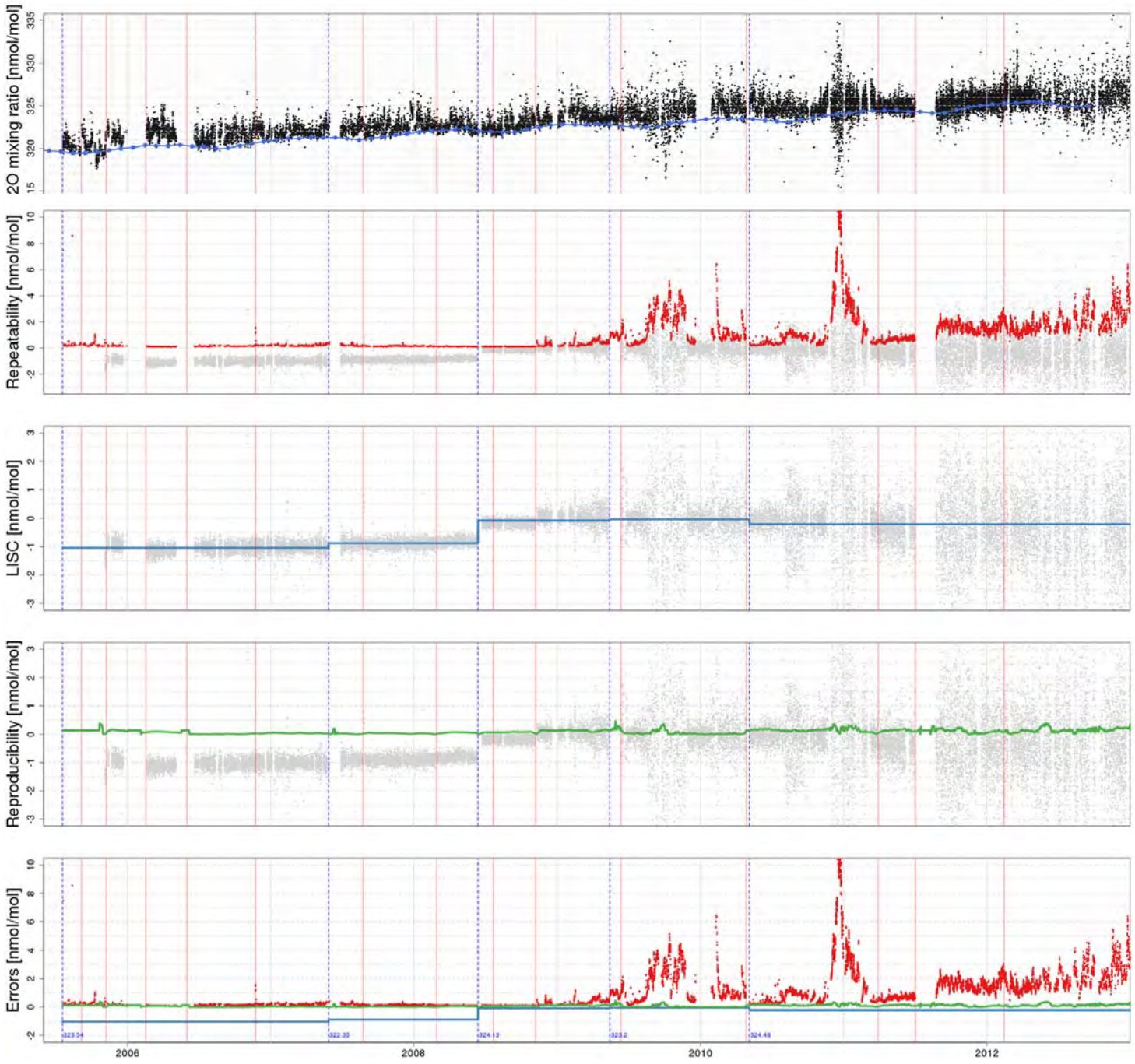


Bialystok, D (MPI-BGC)

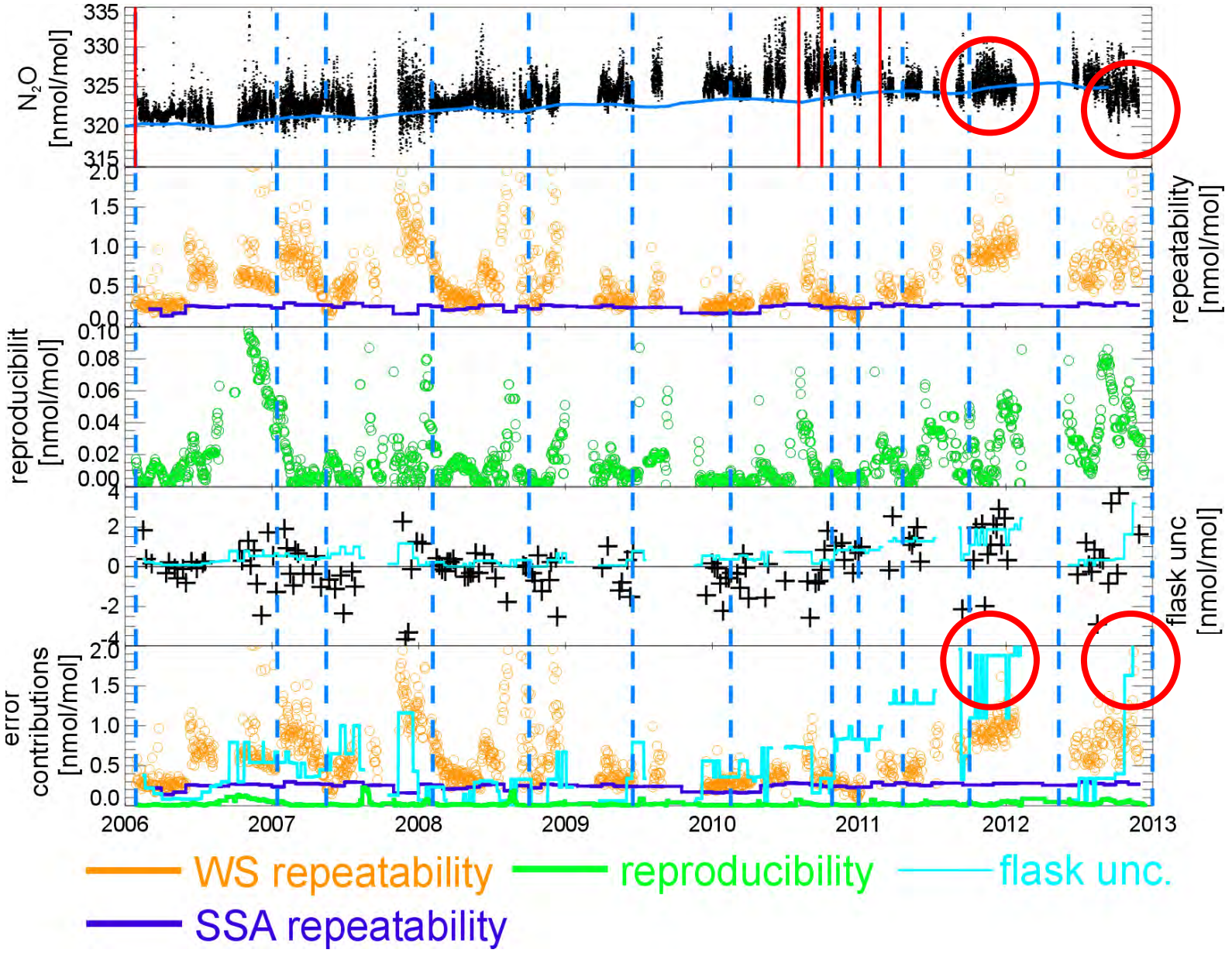


2006 ….. 2012

Bialystok (BIK) N_2O



Hegyhatsal


N2O [nmol/mol]
335
330
325
320
315
repeatability [nmol/mol]
2.0
1.5
1.0
0.5
0.0
reproducibilit [nmol/mol]
0.10
0.08
0.06
0.04
0.02
0.00
flask unc [nmol/mol]
4
2
0
-2
-4
error contributions [nmol/mol]
2.0
1.5
1.0
0.5
0.0
2006
2007
2008
2009
2010
2011
2012
2013
WS repeatability
reproducibility
flask unc.
SSA repeatability