Compatible N_2O Data in the WMO-GAW Network: Still an issue that matters?

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in memoriam to
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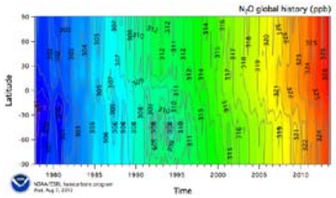
http://imk-ifu.kit.edu/wcc-n2o/

World Meteorological Organization
Working together in weather, climate and water

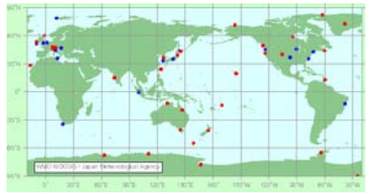
GLOBAL ATMOSPHERE WATCH

Outline

- **Nitrous oxide in the global atmosphere**

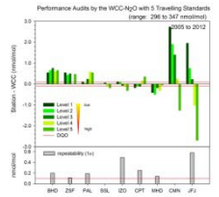


- **The GAW network for N_2O**



- **Analytical systems for airborn N_2O**

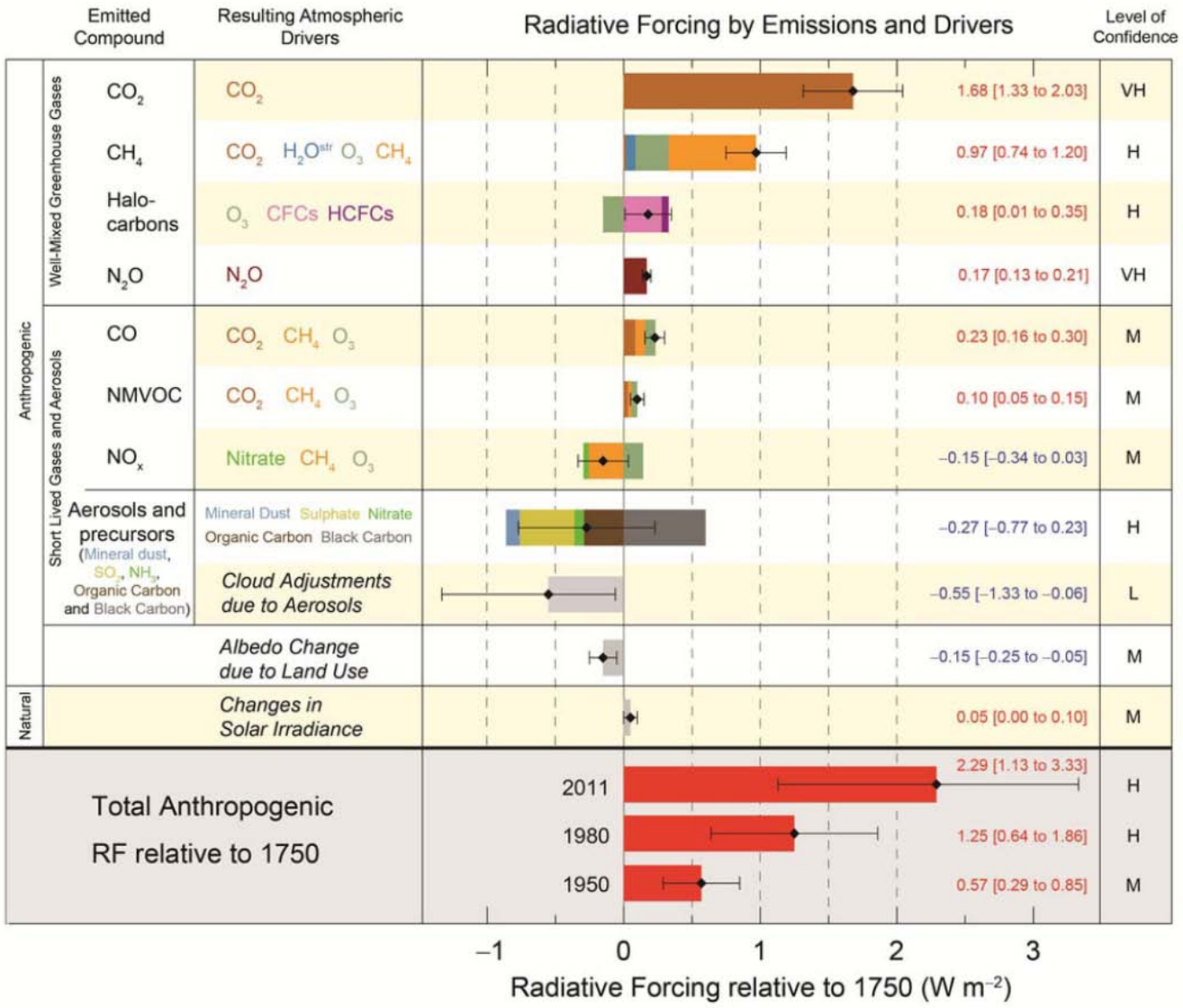
- **Compatibility for N_2O in the GAW network**



- **Summary and conclusions**

Nitrous oxide in the global atmosphere

N_2O and global warming

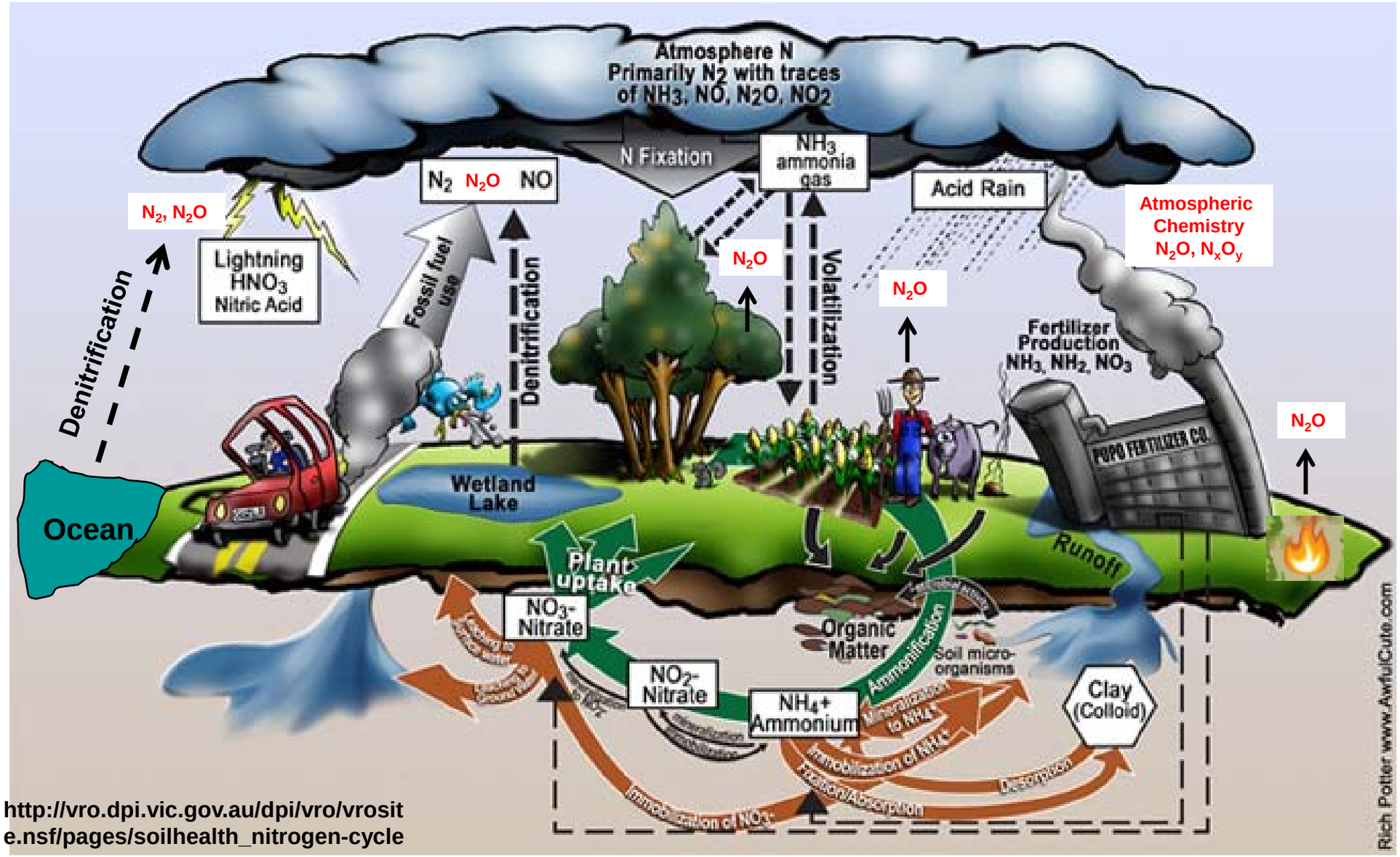


N_2O contributes 7.4% to total anthropogenic RF relative to 1750

(IPCC-Report , 2013)

Nitrous oxide in the global atmosphere

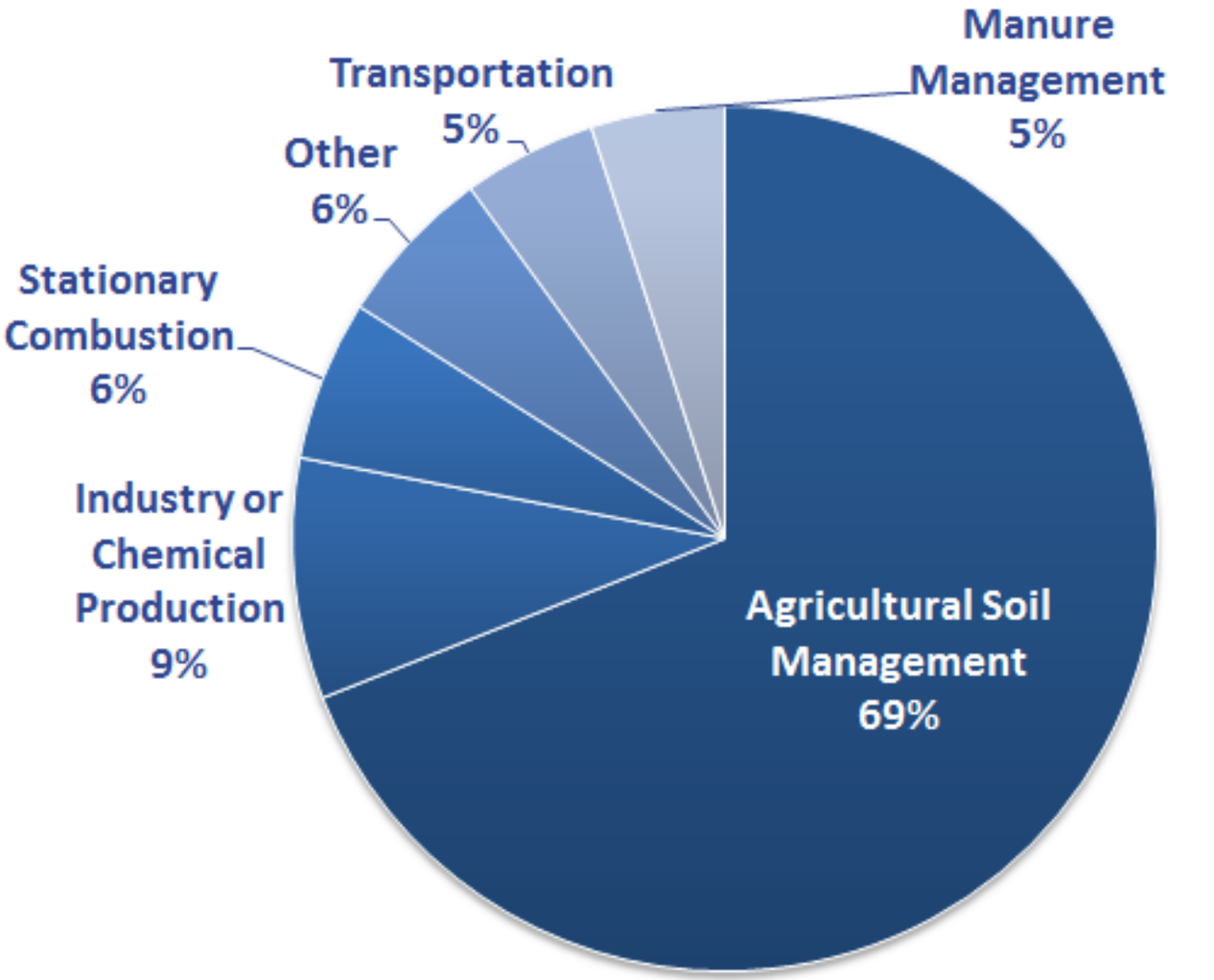
N_2O and global sources



http://vro.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/soilhealth_nitrogen-cycle

Nitrous oxide in the global atmosphere

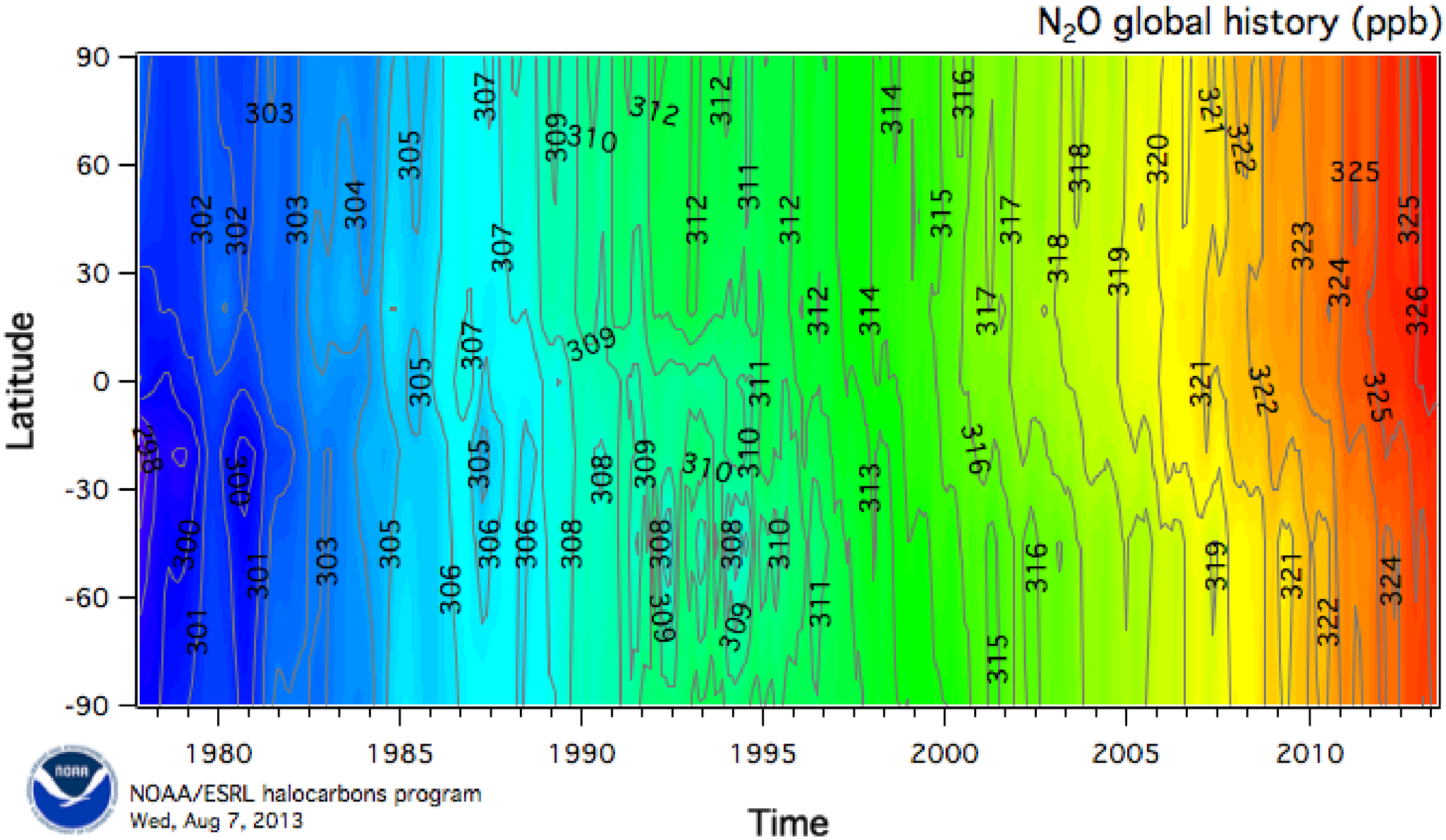
N_2O sources in USA



http://epa.gov/climatechange/ghgemissions/gases/n2o.html

Nitrous oxide in the global atmosphere

N_2O and global distribution



5th Asia-Pacific GAW Workshop on Greenhouse Gases, Jeju, Rep. Korea

GLOBAL ATMOSPHERE WATCH

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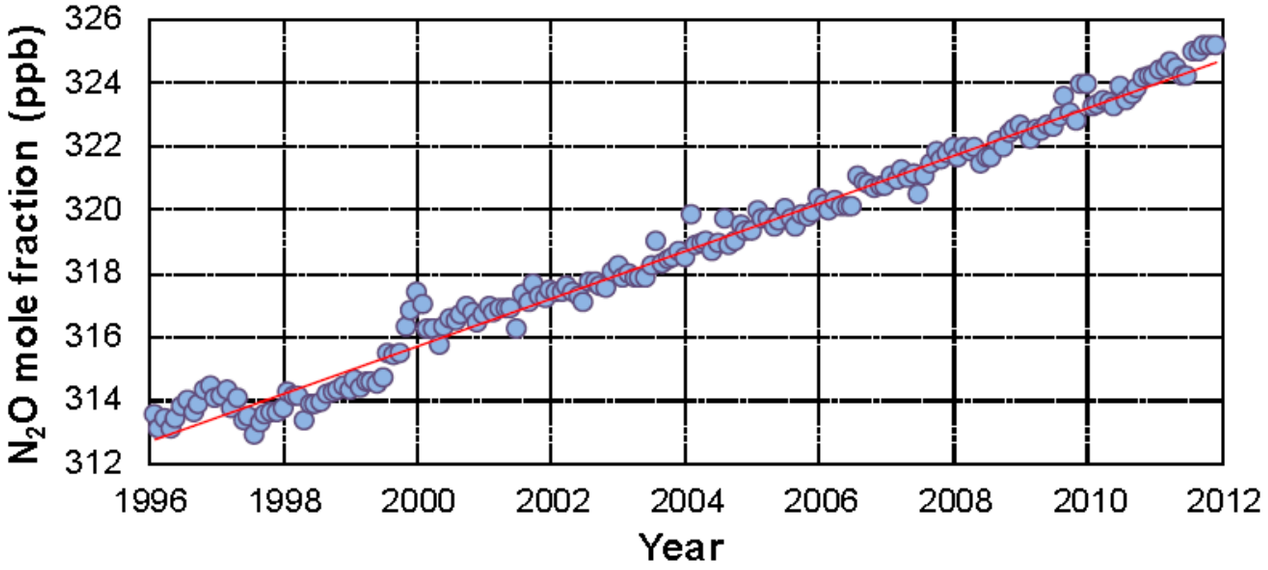
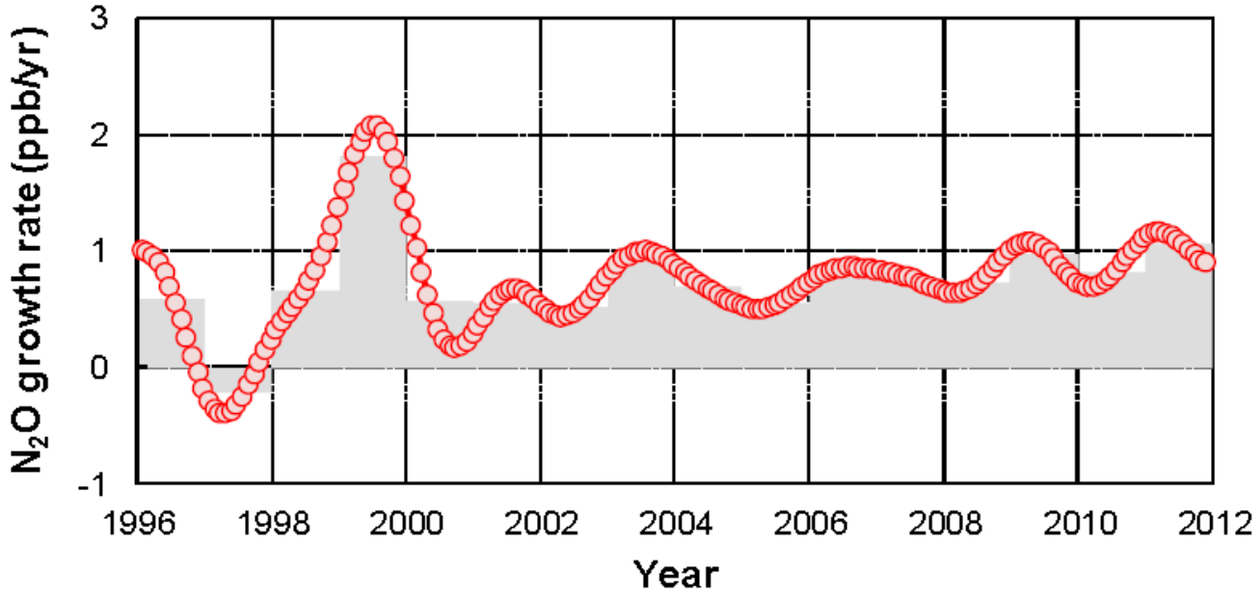
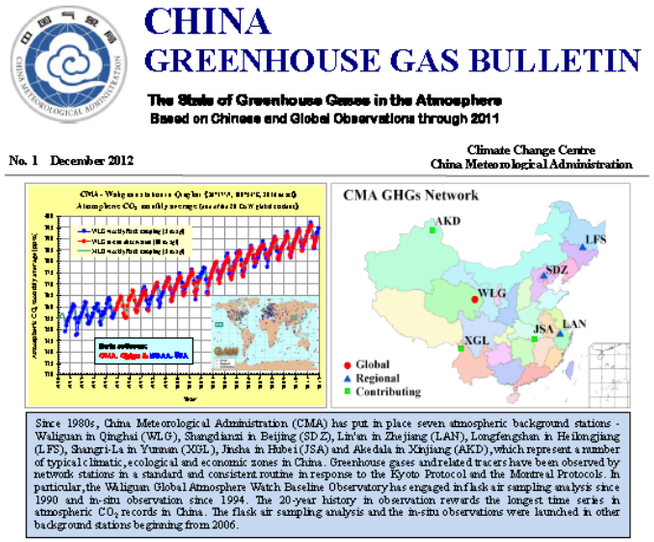
Nitrous oxide in the global atmosphere

N_2O in China (Mt. Waliguan)

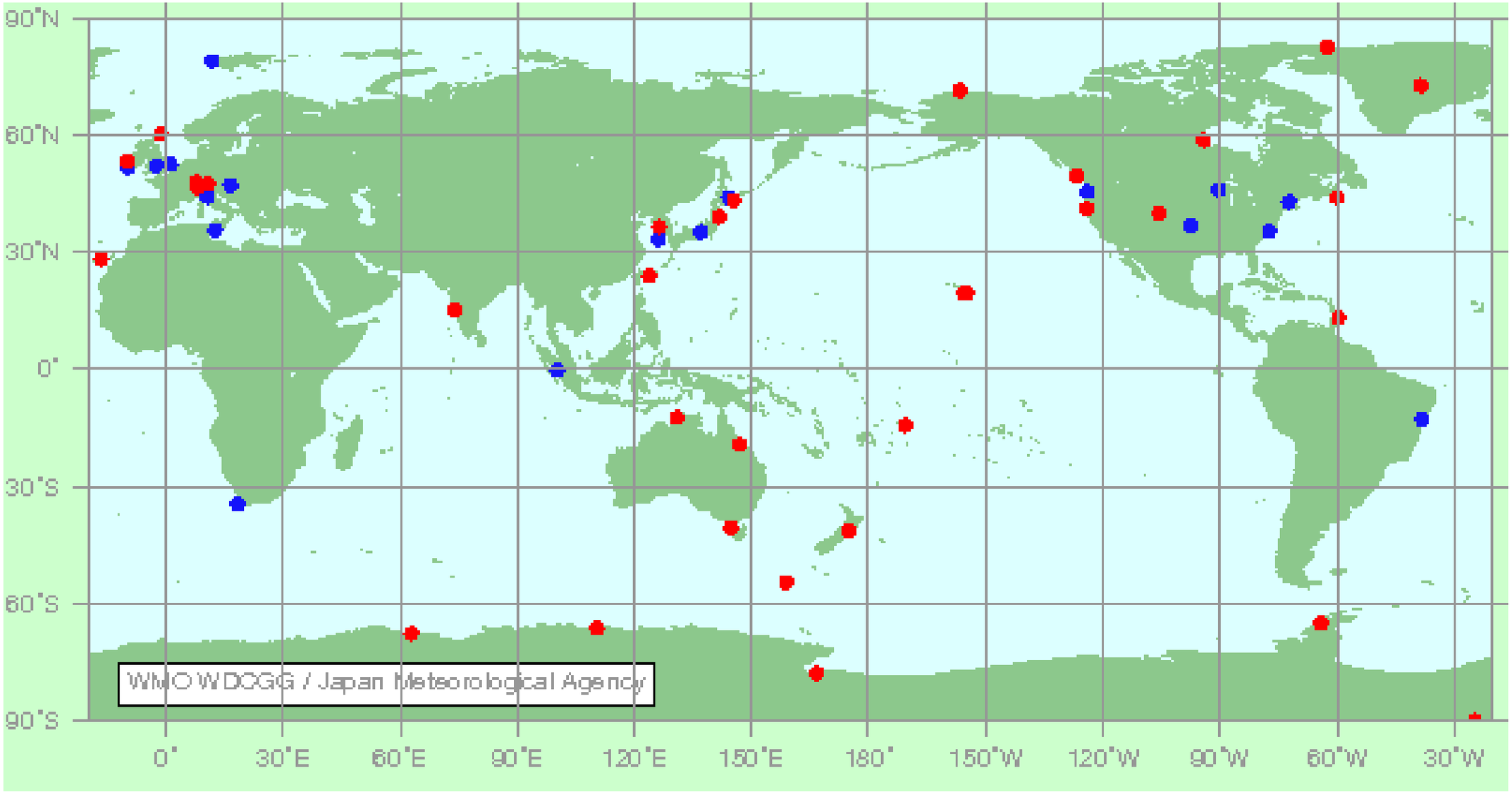






The GAW network for N_2O

Status 2013



The symbol "•" denotes: the data from the station has been updated in the last 365 days.

The GAW network for N_2O

Contributors

Global networks — **NOAA ESRL GMD**, **AGAGE**, **GAW Global**

Other stations — **GAW Regional**

Laboratories
Sampling sites

⇩

WDCGG

***Comment*:**

In the case of different calibration scales, the existing data cannot be simply merged to yield a global picture

⇒ Goal: Traceability to a single scale

The GAW network for N_2O

Data availability

GAW WDCGG

WMO Global Atmosphere Watch

World Data Centre for Greenhouse Gases

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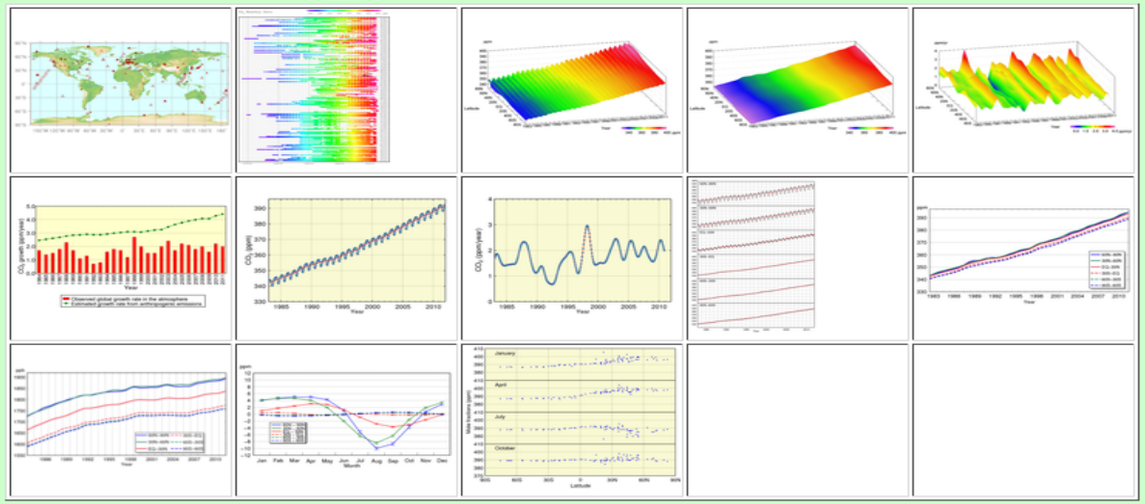
Images based on the data up to 2011
WDCGG DATA SUMMARY No.37 should be referred to for explanation

CO_2	CH_4	N_2O	Halocarbons	O_3	CO	NOx	SO_2	VOCs



WDCGG Data Submission and Dissemination Guide (PDF 1.2Mbyte)

This site is operated by the Japan Meteorological Agency
in cooperation with the World Meteorological Organization
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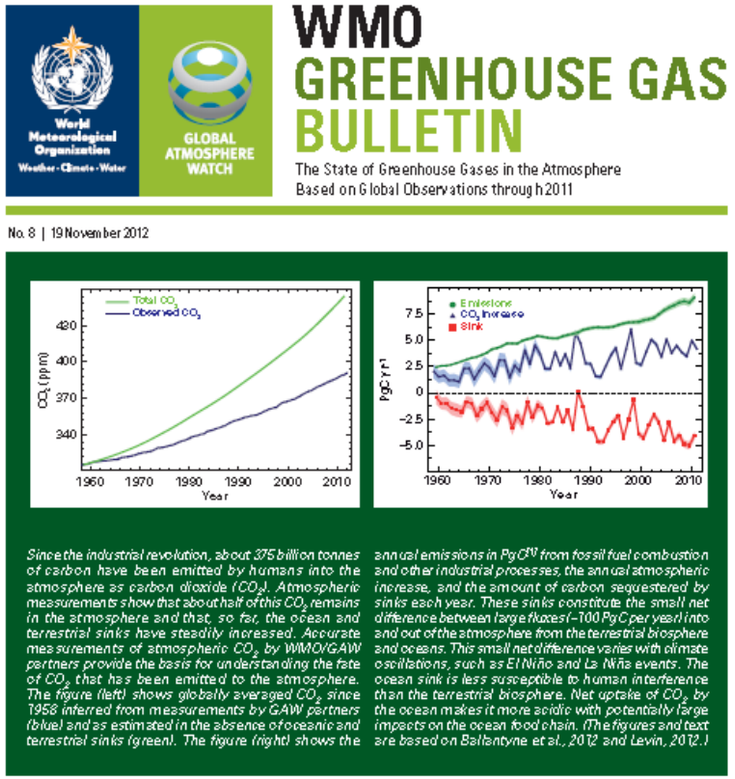


WMO GREENHOUSE GAS BULLETIN

The State of Greenhouse Gases in the Atmosphere
Based on Global Observations through 2011

No. 8 | 19 November 2012

ISSN 2078-0796

Since the industrial revolution, about 375 billion tonnes of carbon have been emitted by humans into the atmosphere as carbon dioxide (CO_2). Atmospheric measurements show that about half of this CO_2 remains in the atmosphere and that, so far, the ocean and terrestrial sinks have steadily increased. Accurate measurements of atmospheric CO_2 by WMO/GAW partners provide the basis for understanding the fate of CO_2 that has been emitted to the atmosphere. The figure (left) shows globally averaged CO_2 since 1958 inferred from measurements by GAW partners (blue) and as estimated in the absence of oceanic and terrestrial sinks (green). The figure (right) shows the annual emissions in PgC[1] from fossil fuel combustion and other industrial processes, the annual atmospheric increase, and the amount of carbon sequestered by sinks each year. These sinks constitute the small net difference between large fluxes (~100 PgC per year) into and out of the atmosphere from the terrestrial biosphere and oceans. This small net difference varies with climate oscillations, such as El Niño and La Niña events. The ocean sink is less susceptible to human interference than the terrestrial biosphere. Net uptake of CO_2 by the ocean makes it more acidic with potentially large impacts on the ocean food chain. (The figures and text are based on Ballantyne et al., 2012 and Levin, 2012.)

Executive summary

The latest analysis of observations from the WMO Global Atmosphere Watch (GAW) Programme shows that the globally averaged mole fractions of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) reached new highs in 2011, with CO_2 at 390.9±0.1 ppm[2], CH_4 at 1813±2 ppb[3] and N_2O at 324.2±0.1 ppb. These values constitute 140%, 259% and 120% of pre-industrial (before 1750) levels, respectively. The atmospheric increase of CO_2 from 2010 to 2011 is similar to the average growth rate over the past 10 years. However, for N_2O the increase from 2010 to 2011 is greater than both the one observed from 2009 to 2010 and the average growth rate over the past 10 years. Atmospheric CH_4 continued to increase at a similar rate as observed over the last 3 years. The NOAA Annual Greenhouse Gas Index shows that from 1990 to 2011 radiative forcing by long-lived greenhouse gases increased by 30%, with CO_2 accounting for about 80% of this increase.

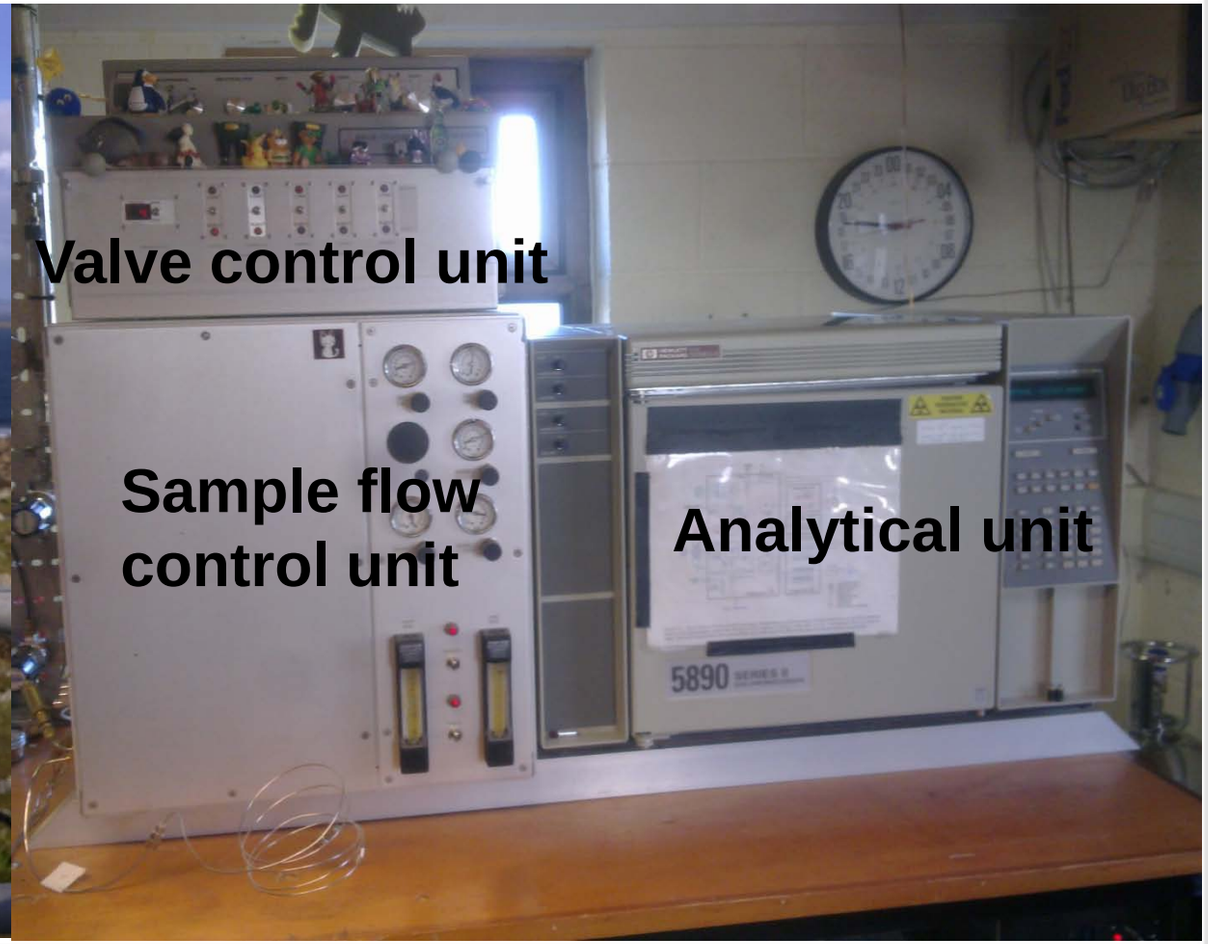
Overview

This eighth WMO/GAW Annual Bulletin reports on the atmospheric burdens and rates of change of the most important long-lived greenhouse gases (LLGHGs) – carbon dioxide, methane, nitrous oxide, CFC-12 and CFC-11 – and

Analytical systems for airborn N_2O

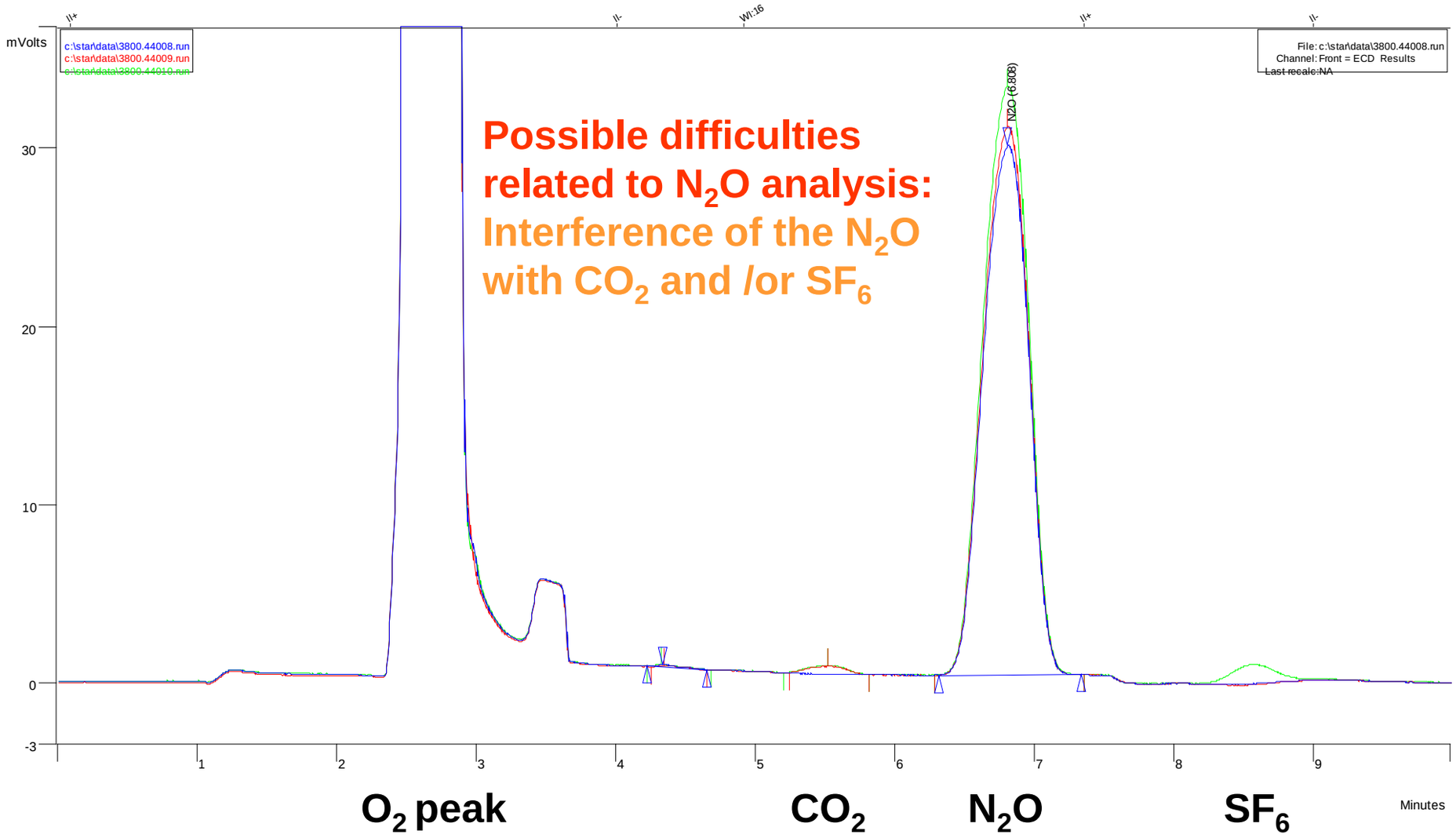
- **Widlely used gas chromatography with electron capture detection (GC/ECD)**

Example: GAW station Mace Head (MHD) in western Ireland (53.32583 °N; 9.89944 °W; 5 m a.s.l.)



Analytical systems for airborn N_2O

Chromatography in the WCC-N_2O with GC/ECD



Compatibility for N_2O in the GAW network

Some words to GAW terminology

At present, some of the terms related to measurements as well as to Quality Assurance & Quality Control (QA/QC) are frequently used with different meanings and/or on the basis of different definitions.

Therefore, uniform terminology is of paramount importance for the activities within GAW.

Compatibility for N_2O in the GAW network

Some words to GAW terminology

WMO/GAW Glossary of QA/QC-Related Terminology

Version 1.0 2010-09-14
Version 0.4 2007-04-26 (for comparison only - no longer recommended)

Editors: J. Klausen, H.-E. Scheel and M. Steinbacher

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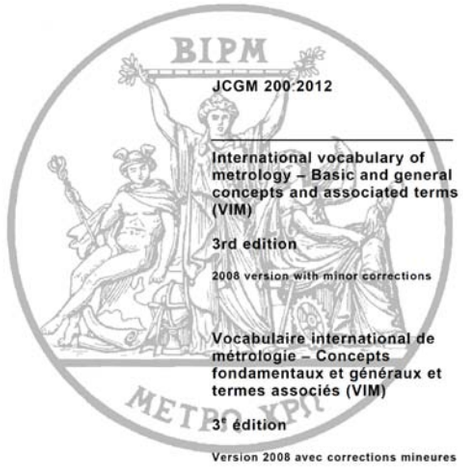
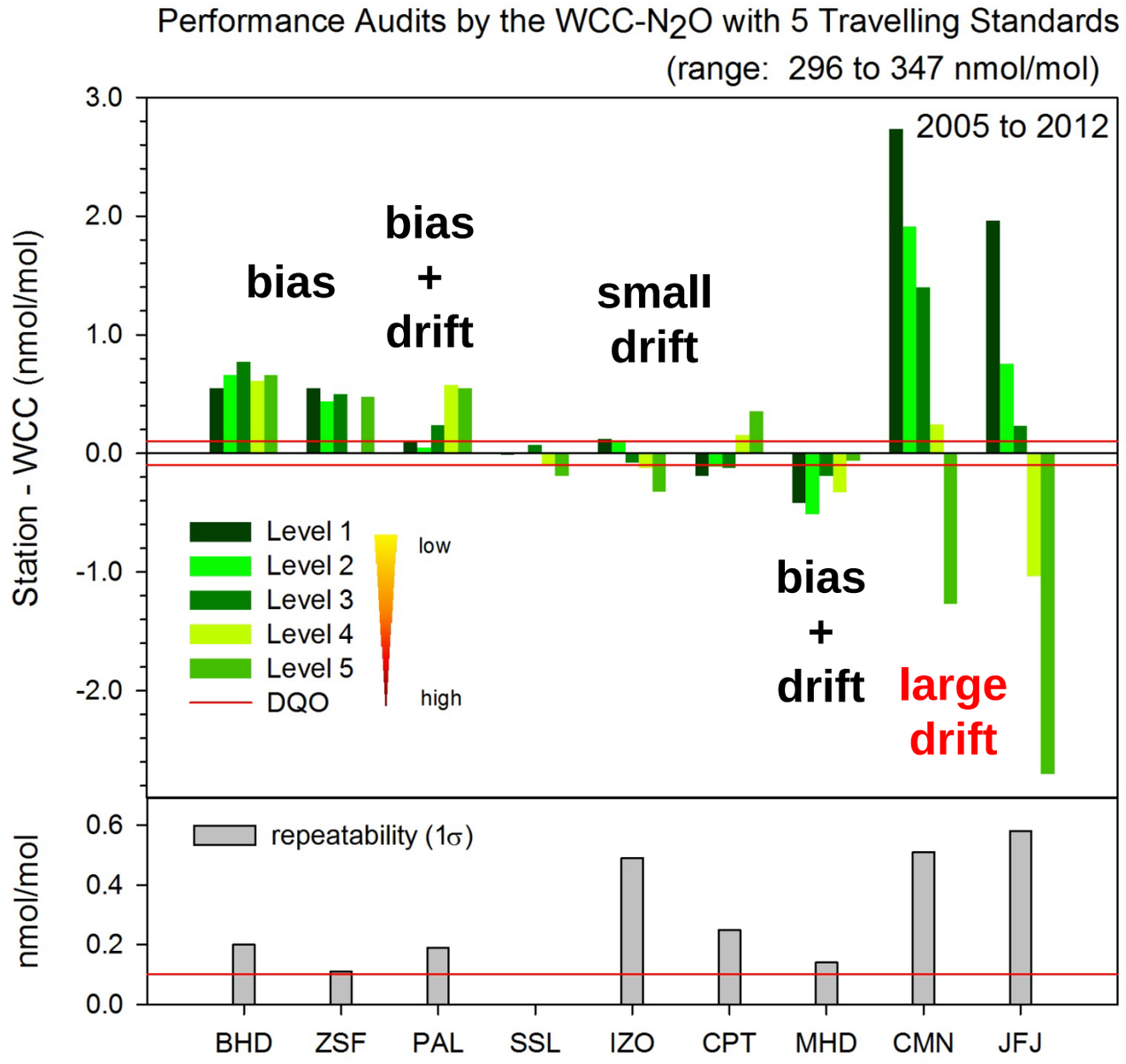


e.g. compatibility:
difference of any pair of values from different measurement results (should be) smaller than some chosen uncertainty of that difference

http://gaw.empa.ch/glossary/glossary.html

Compatibility for N_2O in the GAW network

Results compiled by the WCC-N_2O



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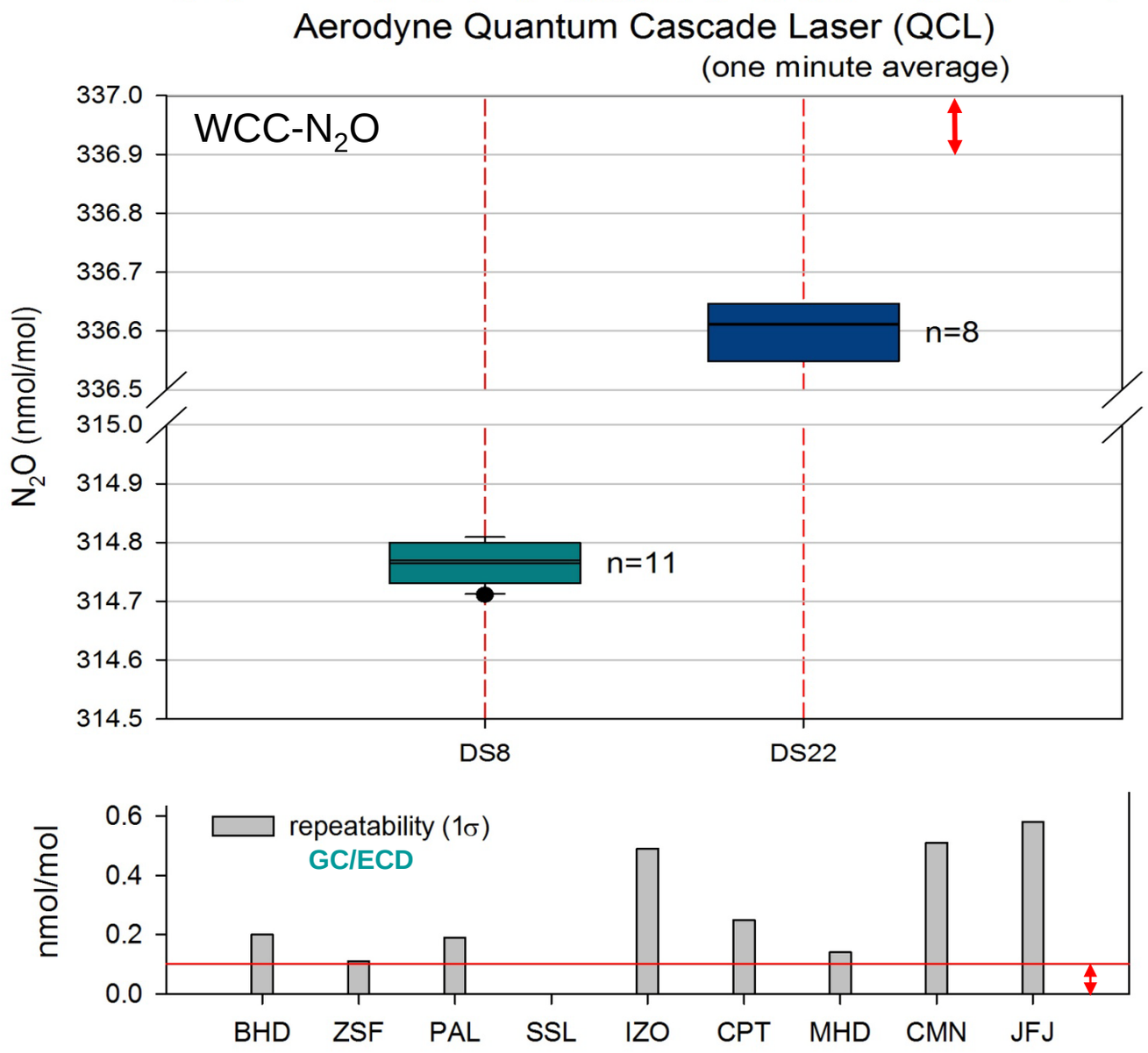
Compatibility for N_2O in the GAW network

Measurement performance of N_2O analytical systems



Data quality objective for N_2O: 0.1 nmol/mol

Summary and Conclusions

Compatible N_2O Data in the WMO-GAW Network: Still an issue that matters?

- Global warming is a fact with a steadly increasing contribution of N_2O.
- The analysis of trends, hemispheric differences, seasonal cycles, including studies on the effectivenss of mitigation measures require data of known quality.
- Current studies to data compatibilty in the GAW network demonstrate the need for continued QA/QC measures as
- With the established GC techniques the DQOs for N_2O still remain a challenge to achieve.
- But: Recent optical measurement techniques seem to be more accurate and precise and a promising alternative to the classical GC/ECD method.

Thanks for your attention and the

German Environmental Agency for funding.

Particular thanks goes to all GAW staff in particular:

Oksana Tarasova (GAW Secretariat)

Brad Hall (Central Calibration Laboratory, NOAA)

Christoph Zellweger, EMPA Switzerland,

Elisabeth Weiß, Stephan Thiel WCC- N_2O

(Photo: Short course, Flux measurement fundamentals KIT Campus Alpine IMK-IFU)