

# The Global Atmosphere Watch (GAW) <u>Reactive Gases</u> Measurement Network

# **Detlev Helmig**

(on behalf of the RG Scientific Advisory Group)

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# **Global Atmosphere Watch Program**

Provides international leadership in research and capacity development in atmospheric composition observations and analysis through:

- maintaining and applying long-term systematic observations of the chemical composition and related physical characteristics of the atmosphere
- emphasizing quality assurance and quality control
- training, coordination, standardization
- data harmonization, archiving, dissemination

GAW builds on partnerships involving contributors from >100 countries

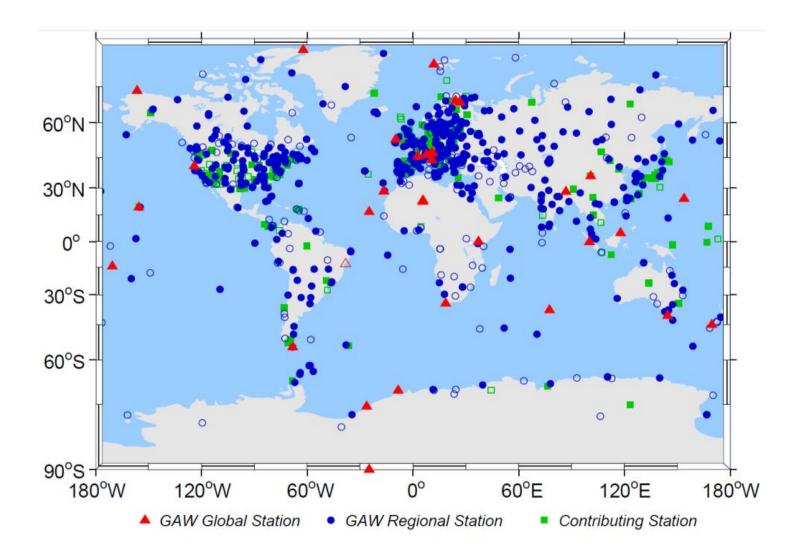






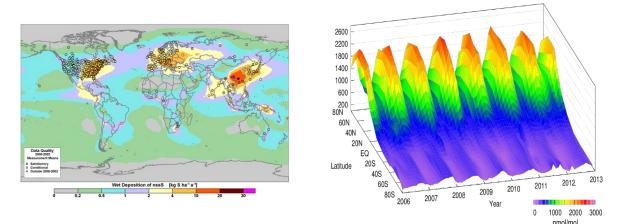


## **Global GAW Station Network**



# **GAW Focal Areas:**

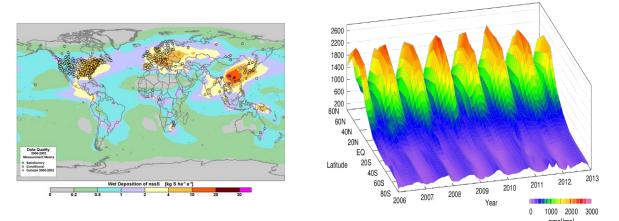




- Stratospheric Ozone and Vertical Ozone Distribution
- Greenhouse Gases (CO<sub>2</sub> and its isotopes, CH<sub>4</sub> and its isotopes, N<sub>2</sub>O, SF<sub>6</sub>, CFCs)
- Reactive Gases (O<sub>3</sub>, CO, VOC, NO<sub>x</sub>, SO<sub>2</sub>)
- Precipitation Chemistry
- Aerosols (chemical and physical properties, AOD)
- UV Radiation

# **GAW Focal Areas:**





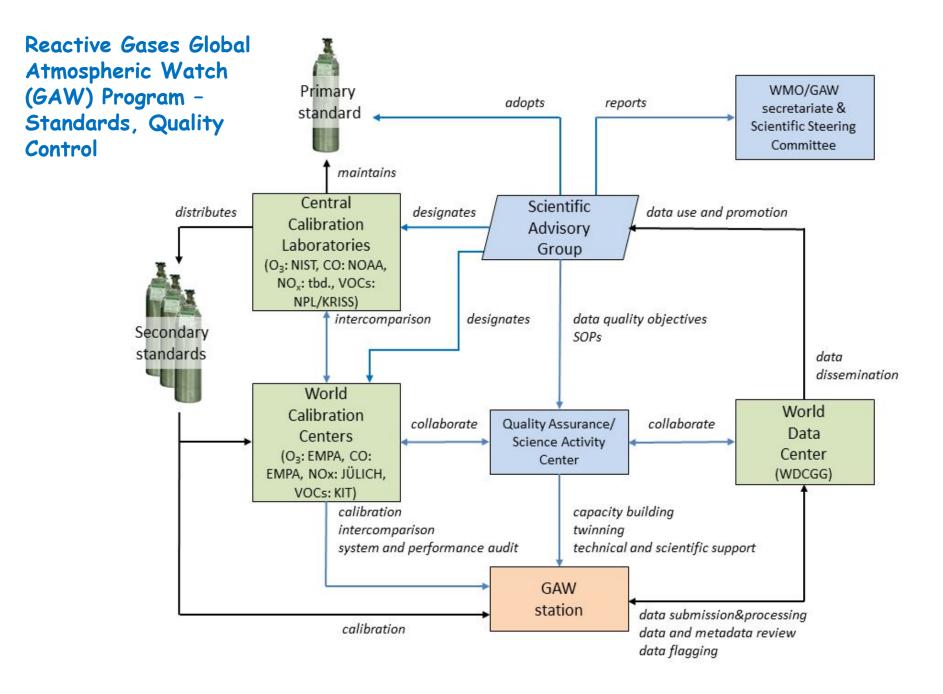
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## Reactive Gases Global Atmospheric Watch (GAW) Program





Scientific Advisory Group Meeting, Osaka, October 2018

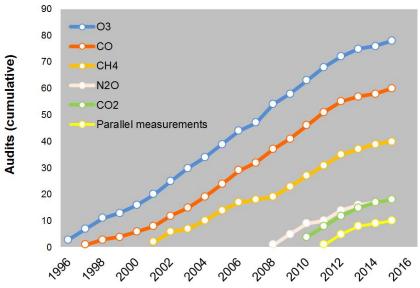


### Reactive Gases Global Atmospheric Watch (GAW) Program – Standards, Quality Control

System and performance audits by WCC-Empa (sfc. ozone and CO):

Mt. Waliguan (China), O<sub>3</sub>, CO, CH<sub>4</sub>, Sept 2009 Lauder (New Zealand), O<sub>3</sub>, CO, CH<sub>4</sub>, CO<sub>2</sub>, N<sub>2</sub>O, March 2010 Cape Grim (Australia), O<sub>3</sub>, CO, CH<sub>4</sub>, CO<sub>2</sub>, N<sub>2</sub>O, March 2010 Mt. Kenya (Kenya), O<sub>3</sub>, CO, June 2010 Cape Point (South Africa), O<sub>3</sub>, CO, CH<sub>4</sub>, CO<sub>2</sub>, March 2011 Zugspitze (Germany), O<sub>3</sub>, CO, CH<sub>4</sub>, CO<sub>2</sub>, N<sub>2</sub>O, June 2011 Hohenpeissenberg (Germany), O<sub>3</sub>, CO, CH<sub>4</sub>, CO<sub>2</sub>, July 2011 Bukit Kototabang (Indonesia), O<sub>3</sub>, CO, CH<sub>4</sub>, CO<sub>2</sub>, November 2011 Pallas (Finland), O<sub>3</sub>, CO, CH<sub>4</sub>, CO<sub>2</sub>, April 2012 Zeppelin Mountain (Norway), O<sub>3</sub>, CO, CH<sub>4</sub>, CO<sub>2</sub>, August 2012 Mt. Cimone (Italy), O<sub>3</sub>, CO, CH<sub>4</sub>, CO<sub>2</sub>, N<sub>2</sub>O, September 2012 Cape Verde (Cape Verde), O<sub>3</sub>, CO, CH<sub>4</sub>, CO<sub>2</sub>, N<sub>2</sub>O, December 2012

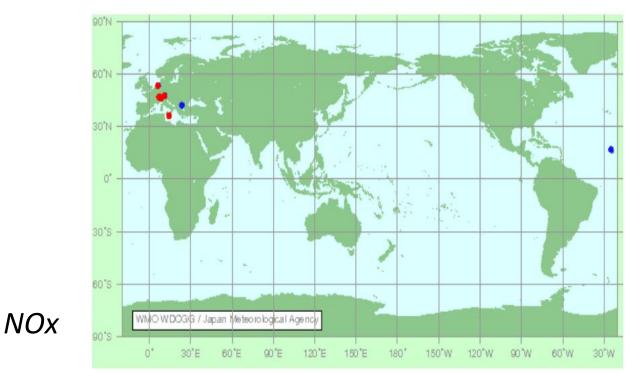
### Audits by WCC-Empa from 1996 - 2015

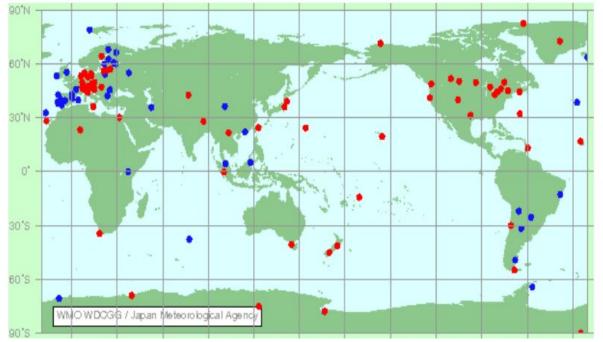


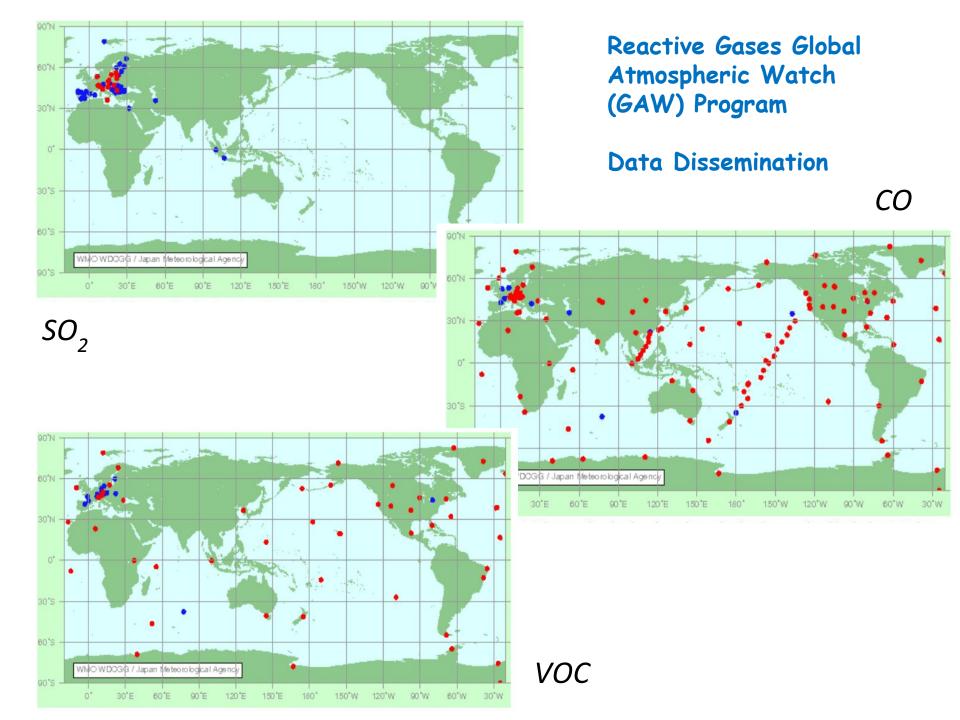
Reactive Gases Global Atmospheric Watch (GAW) Program

Data Dissemination

Surface Ozone







## **GAW** Reactive Gases Literature



Guidelines for the Measurement of Atmospheric Carbon Monoxide Guidelines for Continuous Measurements of Ozone in the Troposphere 8 GLOBAL AUNIOSPHER WATCH

United States "NASA Goddard Institute for States Studies, New York, New York, United States "NASA Goddael Institution for Space Studies, New York, New York, Ustrand Stanse "NASA/Coddael Institution Paylow Characterization (New York, Ustrand Stanse "NCNRS Laboration Charatogic and Université & Foliavae, Transea, Prores "Ministry of Elizariants Ford Laboratory for Chara System Modeling, Cleants for Earth System Sokrere, Institute for Gabiel Change Studies, Tengiau University, Battype, Clean "NCNRM CAMM, Minister-Fonce and CNNS, Foliashow, Prores warzoope Prouger

#### Abstract

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#### Eos, Vol. 90, No. 52, 29 December 2009

tion Bossarch Laboratory through their Cooperative AIT Sampling Network. In the labor program, nine VOC species (ethans, propraine, Societane, ethaliane, deventiane, are currently analyzed in the sample portion that remaints in the fassics after analyses of

greenhouse gases and of CO<sub>2</sub> and methane stable isotopic ratios are completed. Pairs of

samples are typically collected on a weakly schedule, and about 2000 samples per year are analyzed by an automated gas chroma-

tography system at the University of Color. do's Institute of Arctic and Alpine Researc (INSTAAR).

One of the longest and most complete VOC records available to date is from the German Weather Service station at

Drug the Matthew Develophere

A VOC Broad

ediation budget and cloud dropist nucle-ion. Through these complex interactions, DCs play an important role in air quality sd climate. WOC is pair important from is any equaty actual. te regions can provide valuable insight long-ferm impacts of VOCs on the reac-of the almosphere. Furthermore, such data support the development and e lion of coupled chemistry and clima els and help in further deciphering s and sinks of climate forcing gase

VOLUME 90 NUMBER 52 29 DECEMBER 2009 PAGES 513\_520

### Hohenpetsenberg, located on a mountain Hotempretesenberg, located on a mountain-log in southern Germany. A series consisting of approximately 50 VCC species has been quantified at this site since 1988 by two gas chromatography systems. This of this sites 'a clear seasonal cycle of all quantified species (Pigure Ia). The light nonmeliane hydrocarticota and solicided aro-matic composities shows in the figure are mate compounds shown in the ngure an altituted primarily to arthropogenic emis-sions, with the antimate species known to be specifically linked to gaotine usage. Emis-sion rakes of the anthropogenic VOCs are nei-abiedy constant year-round, suggesting that the home semantic protection in them dots. are due primarily to the sease atmospheric exclusion strong rates of these compounds. The major depietion route VOCs is via exclusion with the OH is formed exclusively by a pho cal mechanism, i.e., from light-indi sociation of atmospheric ozone an exidation strength roughly is ance of a subset of ultraviole let blue, or UVE). This exida let blue, or UVB). This oxidation stren al a maximum in the summer and in r with high humidity such as the tropics seasonal cycles and spatial distribution therefore serve as prime indicators for radical distribution. In addition to depicting the seasons behavior, the data from the Hohenpels berg station also show statistically sign cant downward therefs for nearly all o sphere and are allributed to gasoline reto mutation and stricter VOC emission limit VOC Records Prom the Southern Hendsphere Ethane and propane measu soumern Hemisphere stations are shown in Figure 1b. Overall lower values in the South ern Hemisphere, as well as a 6-month shift in the seasonal cycle in WIP representation in the seasonal cycle in VOC concentrations, are obvious from the comparison of the data from the two hemispheres shown in Fig-tures is and its. Furthermore, at Cape Orim (Tasmania, Australia) the other



#### The Global Atmosphere Watch reactive gases measurement network

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GAW Report No. 209

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#### Abstract

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#### 1. Introduction

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An Elementa Special Feature

### Reactive Gases in the Global Atmosphere

Frank Flocke, Guest Editor • NCAR Earth System Laboratory

### **Published Articles**

Additional articles under review

Cooper, O. R., Parrish, D. D., Ziemke, J., Balashov, N. V., Cupeiro, M., Galbally, I. E., Gilge, S., Horowitz, L., Jensen, N. R., Lamarque, J. F., Naik, V., Oltmans, S. J., Schwab, J., Shindell, D. T., Thompson, A. M., Thouret, V., Wang, Y., and Zbinden, R. M.: Global distribution and trends of tropospheric ozone: An observationbased review, *Elementa: Science of the Anthropocene*, *2*, 000029, doi:10.12952/journal.elementa.000029, 2014.

Cristofanelli, P., Busetto, M., Calzolari, F., Ammoscato, I., Gulli, D., Dinoi, A., Calidonna, C. R., Contini, D., Sferlazzo, D., Di Iorio, T., Piacentino, S., Marinoni, A., Maione, M., and Bonasoni, P.: Investigation of reactive gases and methane variability in the coastal boundary layer of the central Mediterranean basin, *Elementa-Science of the Anthropocene*, *5*, 1-21, doi:10.1525/elementa.216, 2017.

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Petetin, H., Thouret, V., Athier, G., Blot, R., Boulanger, D., Cousin, J. M., Gaudel, A., Nedelec, P., and Cooper, O.: Diurnal cycle of ozone throughout the troposphere over Frankfurt as measured by MOZAIC-IAGOS commercial aircraft, *Elementa-Science of the Anthropocene*, *4*, doi:10.12952/journal.elementa.000129, 2016. Insights from contributions to the World Meteorological Organization Global Atmosphere Watch program



Reactive trace gases in the Earth atmosphere can have adverse effects on human health, environment and materials, they influence regional

climate and are involved in many biogeochemical cycles. Atmospheric chemical reactions also play an important role in cleansing the atmosphere from anthropogenic and natural emissions. Assessing the importance and impacts of



(4 more)