The Global Atmosphere Watch
Ozone Observing System

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History of total ozone monitoring

- **1924**
  - First observations with a the Dobson spectrophotometer

- **1957 (IGY)**
  - Beginning of systematic ground-based observations with Dobson spectrophotometers (17 + 37 new stations)
  - Establishment of the Global Ozone Observing System–GO³OS
  - Adoption of standard procedures for uniform observations

- **1980**
  - Introduction of the Brewer MkII spectrophotometer

- **2016**
  - About 200 (of 446) stations are currently in operation
Importance for GB monitoring of ozone

- Accurate long-term monitoring with same instrument at each location
- Capability of systematic monitoring and adjustment of instruments' calibration
- High temporal resolution of data within each day
- Provision of ground truth to satellite instruments
  - Satellite-borne and ground-based instruments are complementary and not contrasting systems

- Reflected in the GAW Implementation Plan 2016-2023
GAW and ozone monitoring

➢ Supports the WMO/UNEP international ozone assessments
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➢ Reporting on the state of the Antarctic and Arctic ozone

Antarctic Ozone Bulletin

South Pole

Arctic Ozone Bulletin

10th Meeting of the Ozone Research Managers, 28-30 March 2017
Main data repository: WOUDC database maintained by Environment Canada in Toronto

Recent enhancements of WOUDC:
- Improved data submission procedures
- Harmonization with EUBREWNET NRT data (in progress)
- Automatic notifications to stations for delayed data submission
- Archiving of raw (level 0) data metadata
- Automated Quality Assessment (web services to operators)
- Improved presentation of products and statistics
- Links to relevant services and programs of third parties

Concern: Parallel operation of other databases (e.g., NDACC)
Closing of stations
  – Funding issues, Shifting of priorities in monitoring

Delays in data submission to WOUDC (months to years)
  – Reduction of stations’ personnel, funding problems, loss of interest?
Accuracy and consistency of ozone data

Why?

– Changes in some effects are greater than in ozone (e.g. 1% change in ozone causes ~2.2% change in DNA-damage UV and ~1.5% change in Vitamin D production)

– Although important, observed long-term changes are generally small

Ensuring accurate and consistent measurements in the GO$_3$OS is top priority for GAW

– One of the three tools for realizing the Mission of GAW

QA and QC of ozone monitoring is achieved through:

– Primary Standard Instruments

– Regional Calibration Centers (with secondary standards)

– Intercomparison campaigns

– Continuous improvement of methods and data (e.g. EURAMET-ATMOZ)
Dobson Global Calibration System

Primary Standard
D083
NOAA, Boulder
USA

Secondary Standard
D065
NOAA, Boulder
USA

Regional Standard RA I
D105
Melbourne
Australia
Regional Standard RA II
D116
Tsukuba
Japan
Regional Standard RA III
D070
Buenos Aires
Argentine
Regional Standard RA IV
D064 / D074
MOHp / SOO-HK
Germany / Czech Rep.
Regional Standard RA V
D083 / D074
MOHp / SOO-HK
Germany / Czech Rep.

Operational Global Network
approx. 55 Dobsons reporting
World Standard (USA)
Regional standards (Japan, Australia)
Network Dobsons (N. Zealand, Philippines)

All standards were in close agreement
Consistency of Dobson instruments

Most instruments are within ±1%
QA of the Brewer network

- Reference Brewer Triads are maintained in Toronto, Canada and Izaña, Tenerife, Spain
- Two travelling standards (Brewers #017 and #109) are maintained and checked against the Toronto Triad before and after trips, and biannually at Mauna Loa Observatory, Hawaii
- The travelling standard #017 serves also as a proxy for the consistency between the reference Brewer Triads in Toronto and Izaña
- Network Brewers are regularly calibrated against the travelling standards either on site or during campaigns
- On average, about 35 Brewers are calibrated per year
Locations of Brewers calibrated in 2010-2016
Brewer Calibration Campaign 2015, Huelva, Spain

- 21 Brewer spectrophotometers from 10 Countries
- Goal: agreement in ozone column data within ±1%
Before Calibration

Ozone Deviations to Brewer IZO#185

Brewer Serial No.

Ozone Deviations [%]

005 017 033 044 070 075 117 126 150 151 158 163 166 172 186 201 202 214 228 230
After Calibration

Ozone Deviations to Brewer IZO#185

Brewer Serial No.
The European Brewer Network “EUBrewNet”

38 stations contribute NRT $O_3$ data

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Ozone monitoring: the new era

- New automated systems (mini-CCD or filter instruments) as complementary to the Dobson-Brewer network

- Ongoing assessment of stability and accuracy
Securing future ozone monitoring

- **Enhance reputation**
  - It is imperative that ozone data are timely submitted to WOUDC

- **Increase visibility**
  - Develop products and services for science and society

- **Adding value**
  - Capacity development, especially in developing countries

- **Attract funding**
  - Convince funding agencies for the necessity of continued GB total ozone monitoring
    - Satellite validation has been, is, and will be a major advantage

- **Advertise**
  - Ensure proper credit to data providers by the scientific community
Concluding remarks

- Ground-based monitoring of stratospheric ozone is an essential component for addressing the mandates of the Montreal Protocol and the Vienna Convention
- GB measurements ensure consistency of satellite data
- Unique long-term records of GB stations are critical for understanding past ozone variability and for predicting accurately the future
- GB ozone data should become more versatile in terms of delivery time and provision of near-real-time services

Thank you for your attention!