



The Bureau  
of Meteorology

# The WMO Global Atmosphere Watch Ozone Observing System

Matt Tully

Chair of the WMO Scientific Advisory Group on Ozone  
and UV radiation

WMO/UNEP Ozone Research Managers of the parties to the Vienna Convention  
for the Protection of the Ozone Layer

Twelfth Meeting Geneva, 24-26 April 2024

# Outline

- Background
- Status of networks
- Dobson calibration
- Some recent highlights





# Part 1 - Background

# Vienna Convention

## Article 3: Research and systematic observations

2. The Parties undertake to promote or establish, as appropriate, directly or through competent international bodies and taking fully into account national legislation and relevant ongoing activities at both the national and international levels, joint or complementary programmes for systematic observation of the state of the ozone layer and other relevant parameters, as elaborated in annex I.

### Annex I (d)

#### Systematic observation on:

The status of the ozone layer (i.e. the spatial and temporal variability of the total column content and vertical distribution) by making the Global Ozone Observing System, based on the integration of satellite and ground-based systems, fully operational;



# Global Atmosphere Watch (GAW)

- The Global Ozone Observing System (GOOS) developed in the years around the International Geophysical Year (1957) when WMO took on the role of encouraging expansion of the fledgling Dobson network, as well as the standardisation of observations and the central collection of data.
- Since 1960, the World Ozone & Ultraviolet Data Centre has been hosted by Environment & Climate Change Canada
- In 1987, the GOOS was merged with the Background Air Pollution Monitoring Network (BAPMoN) to form Global Atmosphere Watch (GAW).
- Stratospheric Ozone & UV are only one focus area in GAW these days

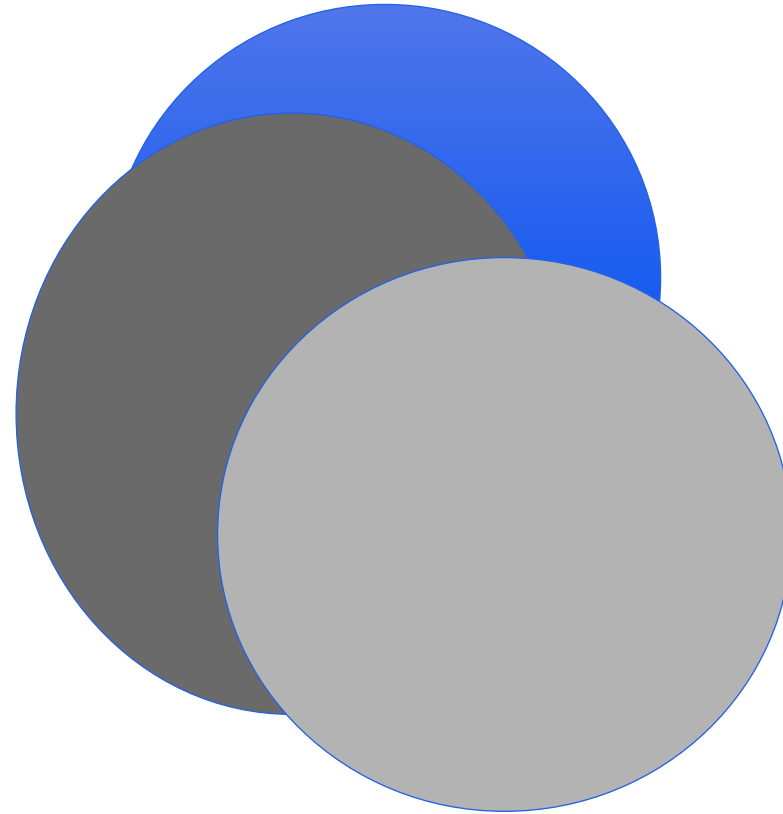




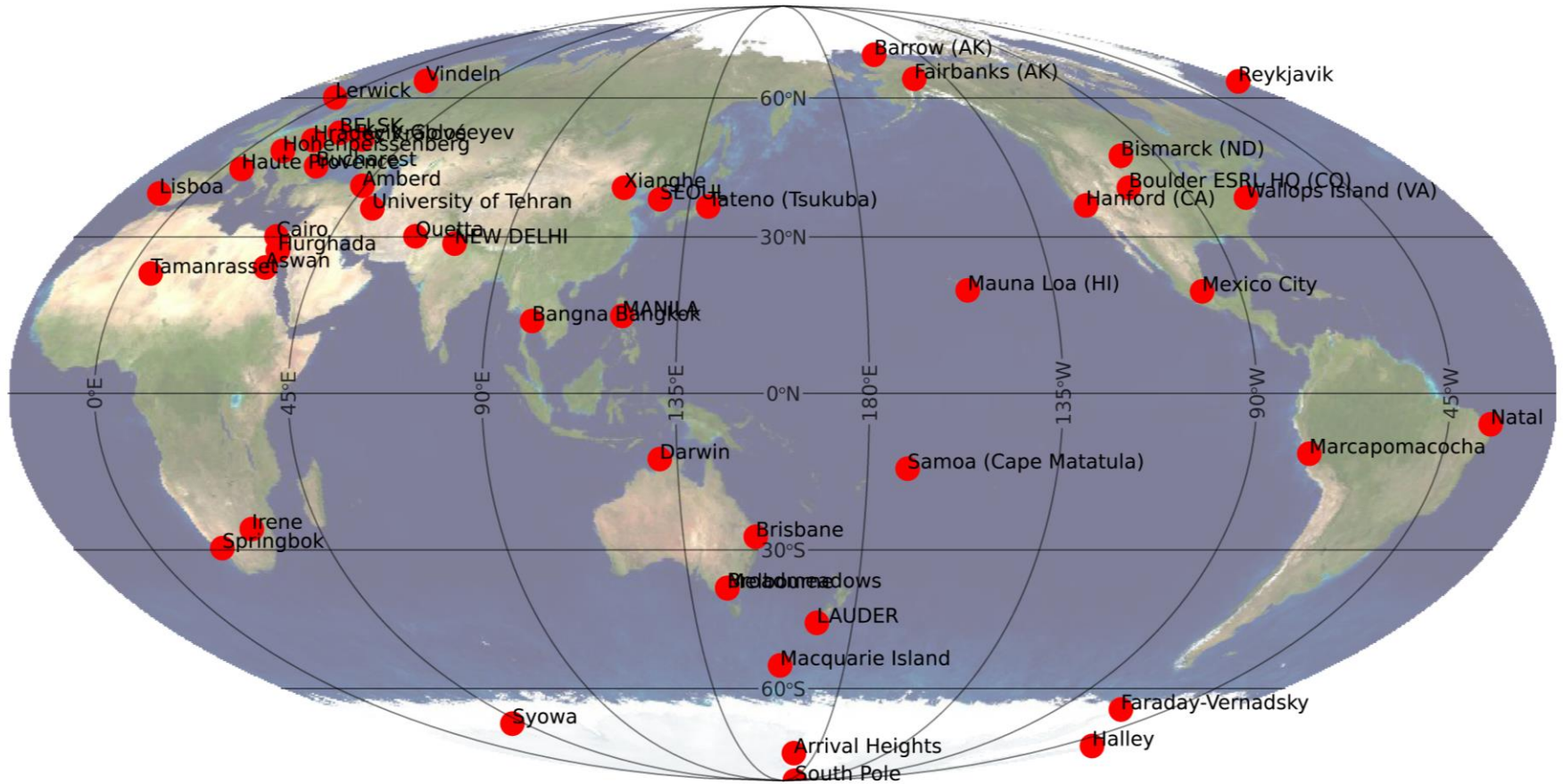
## Part 2 – Status of networks

# Multiple overlapping networks

- Dobson (**GAW, NDACC**)
  - Brewer (**GAW, NDACC, EUBrewNet**)
  - Ozonesonde (**GAW, NDACC, SHADOZ, NOAA-GML, GRUAN**)
  - SAOZ (**GAW, NDACC**)
  - LIDAR, FTIR, DOAS (primarily **NDACC**)
- Relations between networks are generally very friendly and collaborative but difficulties still remain for both data providers and data users



# Dobson data at WOUDC (2020-2024)

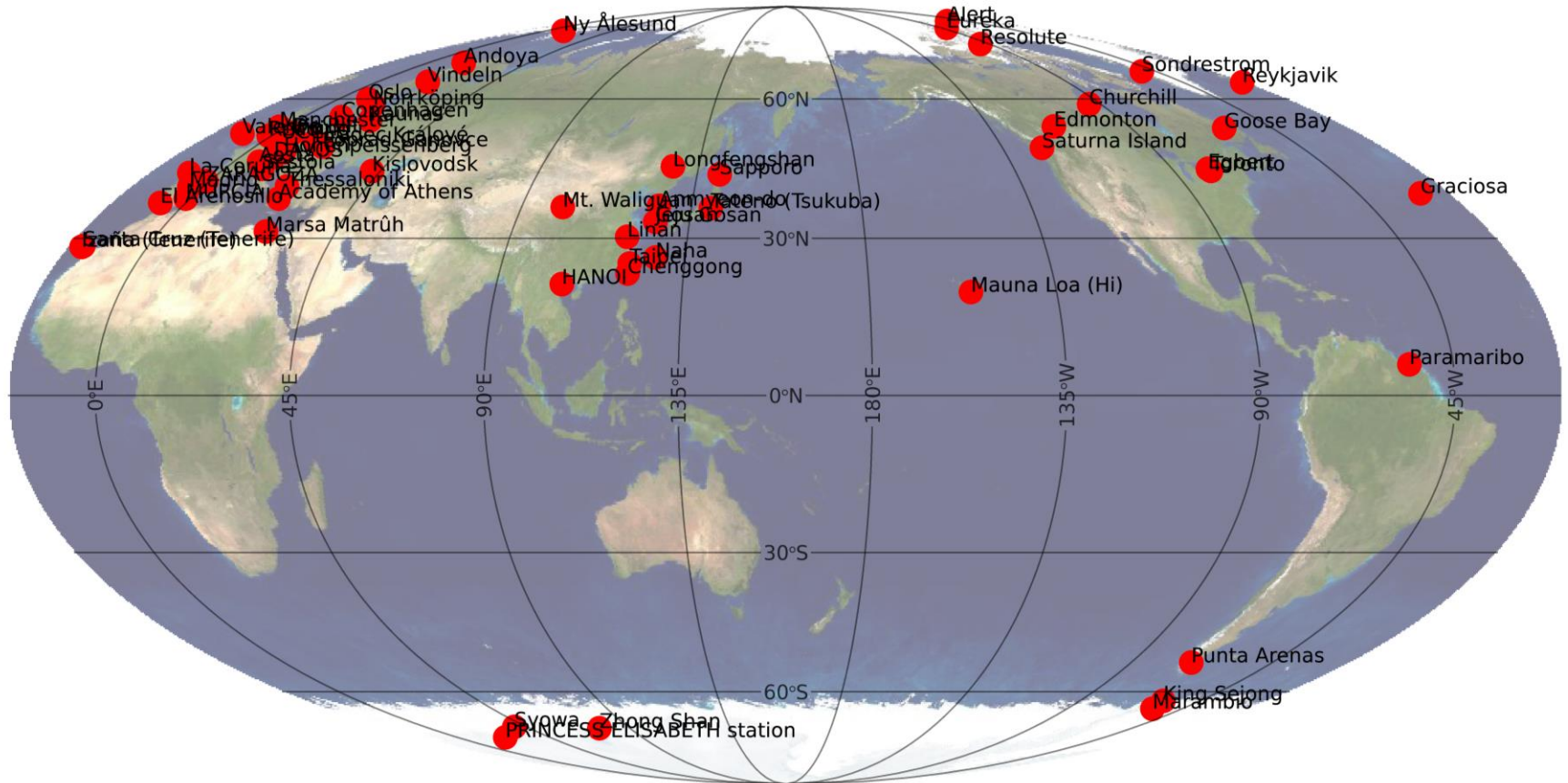


Japan - Some Dobsons replaced by Brewers from 2018. Athens working with WMO to re-start operations. Argentina – 4 stations haven't submitted data for the last few years. Caribou (USA) not currently operating

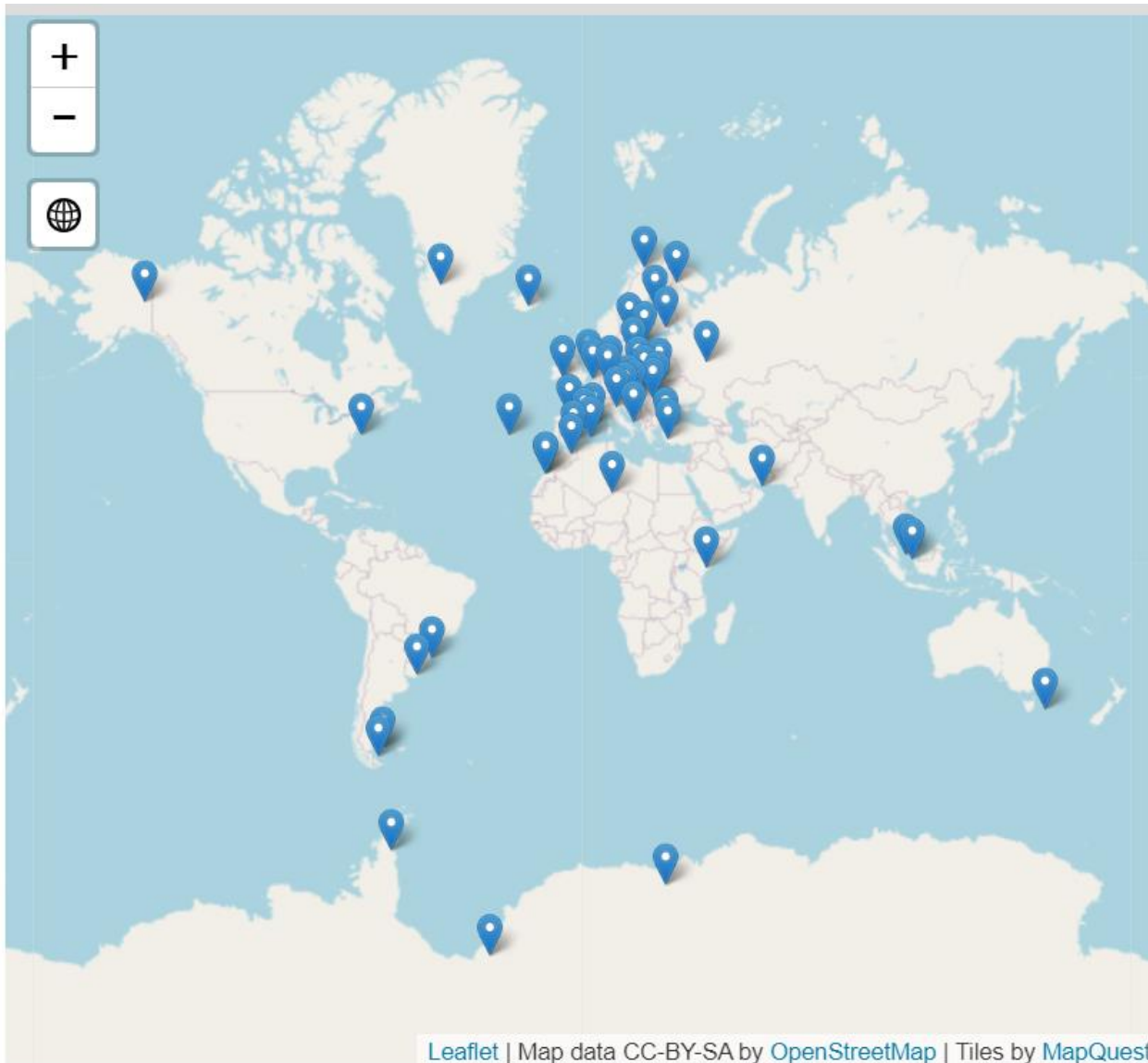




# Brewer data at WOUDC 2020-2024

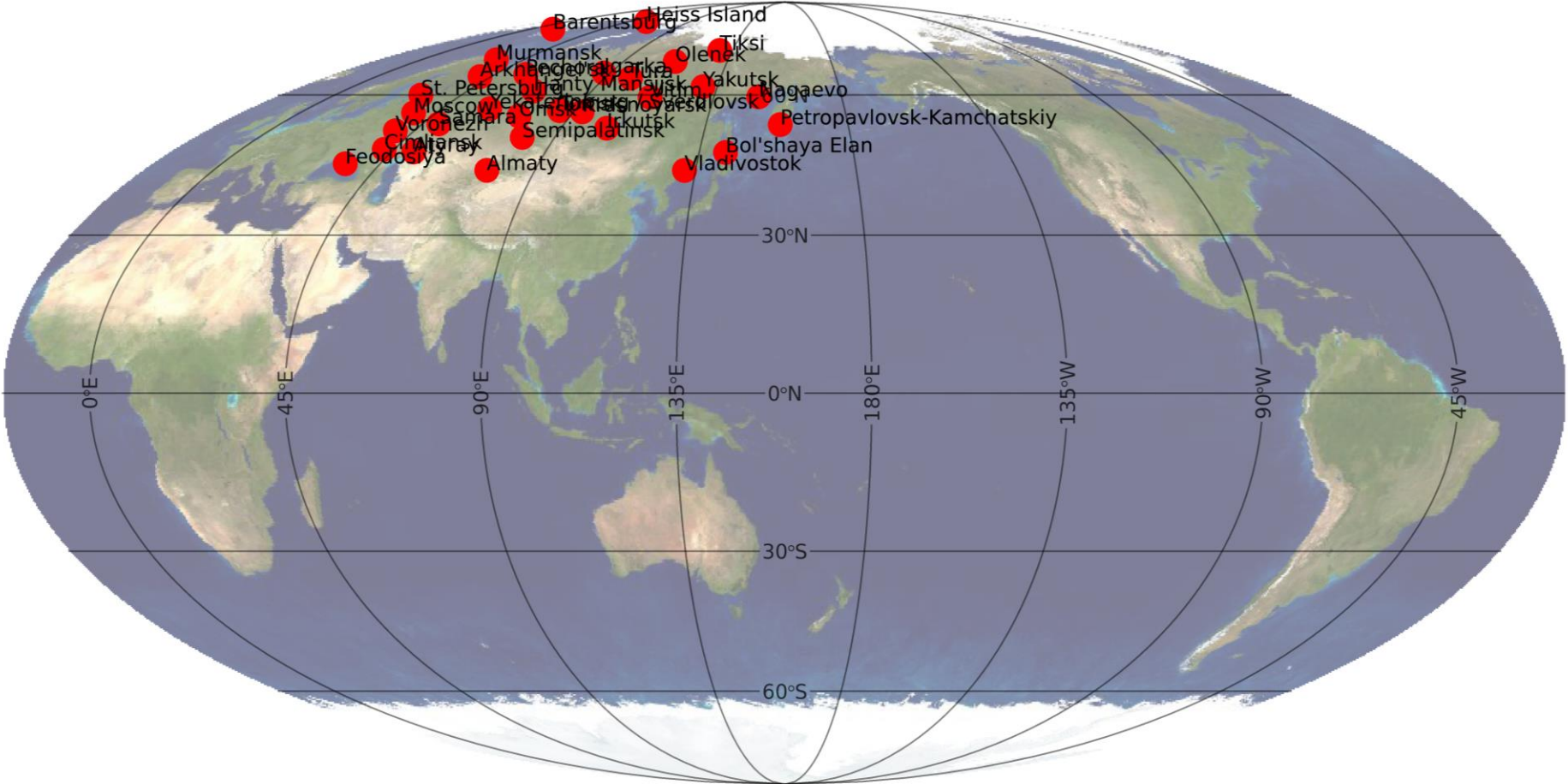


# EUBREWNET sites discoverable at WOUDC

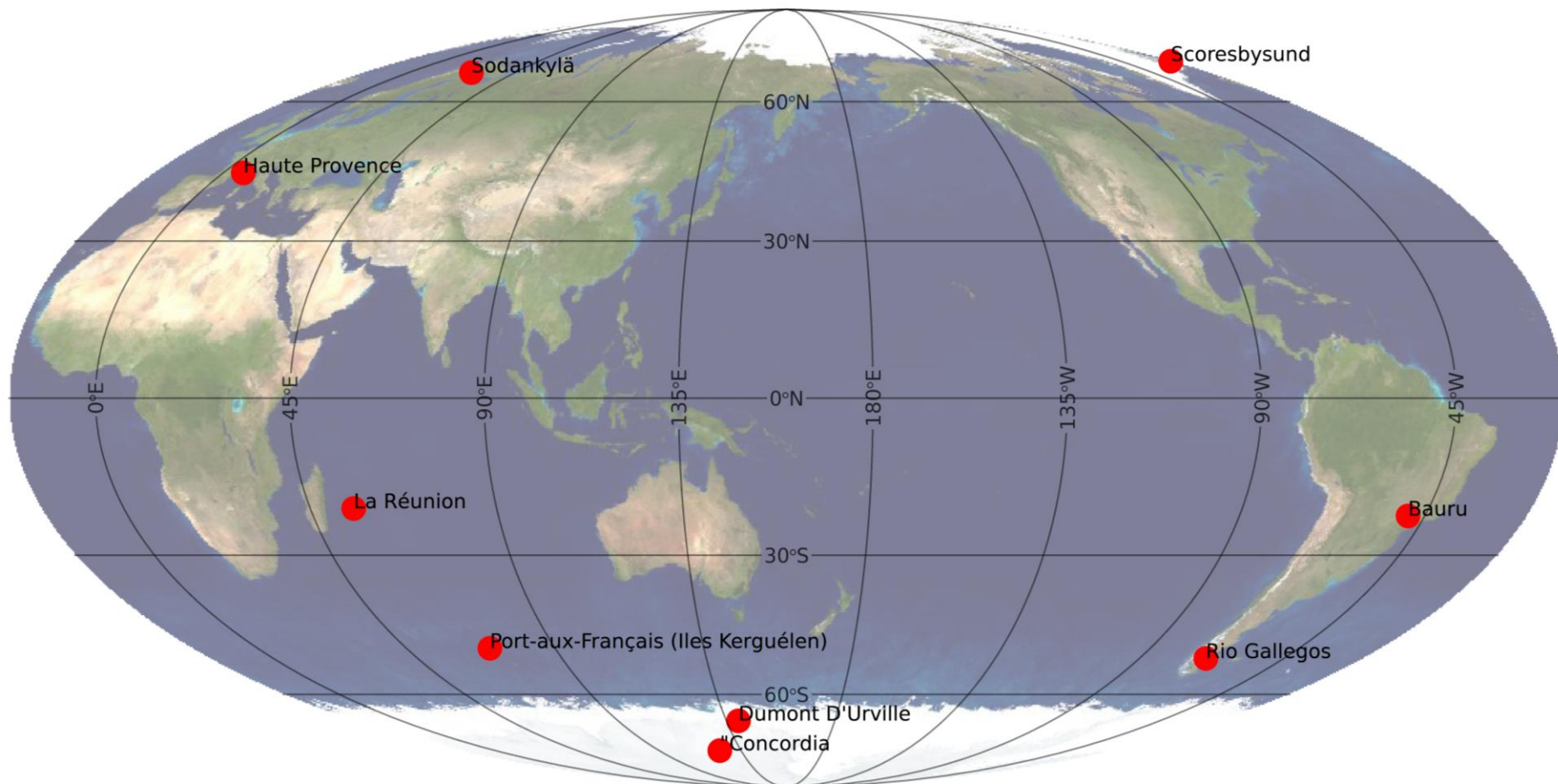




# Filter data at WOUDC 2020-2024

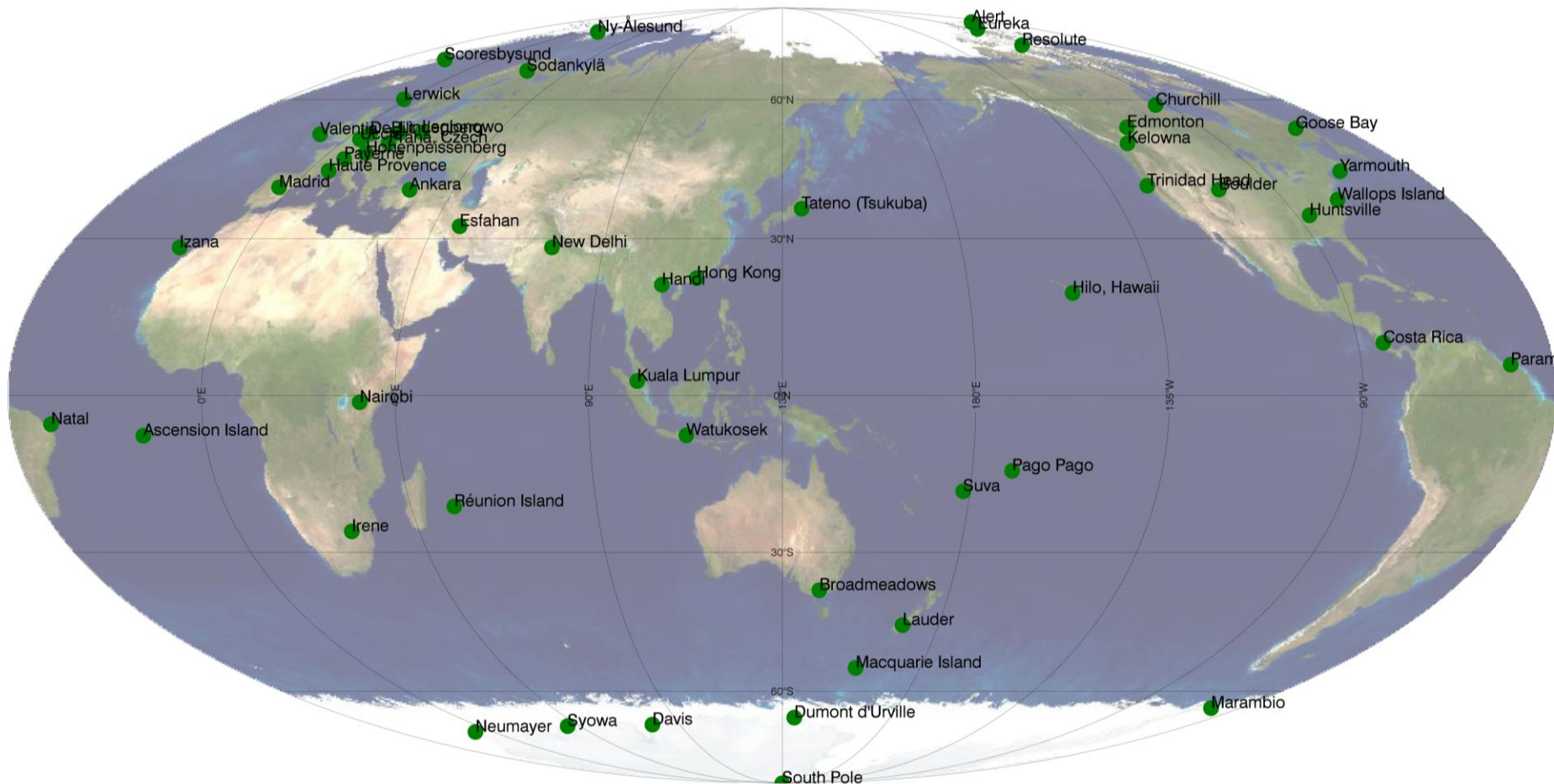


# SAOZ data at WOUDC 2020-2024





# Estimate of active Ozonesonde sites (WOUDC+NDACC+SHADOZ+NOAA)





## Part 3 - Dobson calibrations



World Standard  
USA

Secondary Standard  
USA

RA I  
South  
Africa

RA II  
Japan

RA III  
Argentina

RA V  
Australia

RA VI  
Germany

***Regional Dobson Calibration Centres** should be a resource for instrument operators in their Region but not all have full capacity*

GLOBAL NETWORK INSTRUMENTS

# Dobson intercomparison campaigns supported by the Vienna Convention Trust Fund for Research & Systematic Observations

2016 Tsukuba (Japan) – China, Thailand, Pakistan

2017 Broadmeadows (Australia) - Philippines

2017 El Arenosillo (Spain) – Uganda, Egypt

2019 Buenos Aires (Argentina) – Cuba, Argentina, Peru, Brazil, Mexico, Uruguay

2019 Hurghada (Egypt) - Egypt

2019 Irene (South Africa) - Botswana, Kenya, India

- In-kind support from World and Regional Dobson Centres
- Non-article 5 countries expected to pay their own way
  
- Upcoming Dobson intercomparisons are now being discussed for Africa, South America and Asia







## Part 4 – Recent highlights

# Implementation of new cross sections for Dobsons and Brewers incorporating stratospheric temperature

Atmos. Meas. Tech., 17, 2277–2294, 2024

<https://doi.org/10.5194/amt-17-2277-2024>

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Atmospheric  
Measurement  
Techniques



## The transition to new ozone absorption cross sections for Dobson and Brewer total ozone measurements

Karl Voglmeier<sup>1</sup>, Voltaire A. Velazco<sup>1</sup>, Luca Egli<sup>2</sup>, Julian Gröbner<sup>2</sup>, Alberto Redondas<sup>3</sup>, and Wolfgang Steinbrecht<sup>1</sup>

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<sup>2</sup>Physikalisch-Meteorologisches Observatorium Davos, World Radiation Center (PMOD/WRC),  
7260 Davos Dorf, Switzerland

<sup>3</sup>Izaña Atmospheric Research Center, Agencia Estatal de Meteorología, 38001 Santa Cruz, Tenerife, Spain

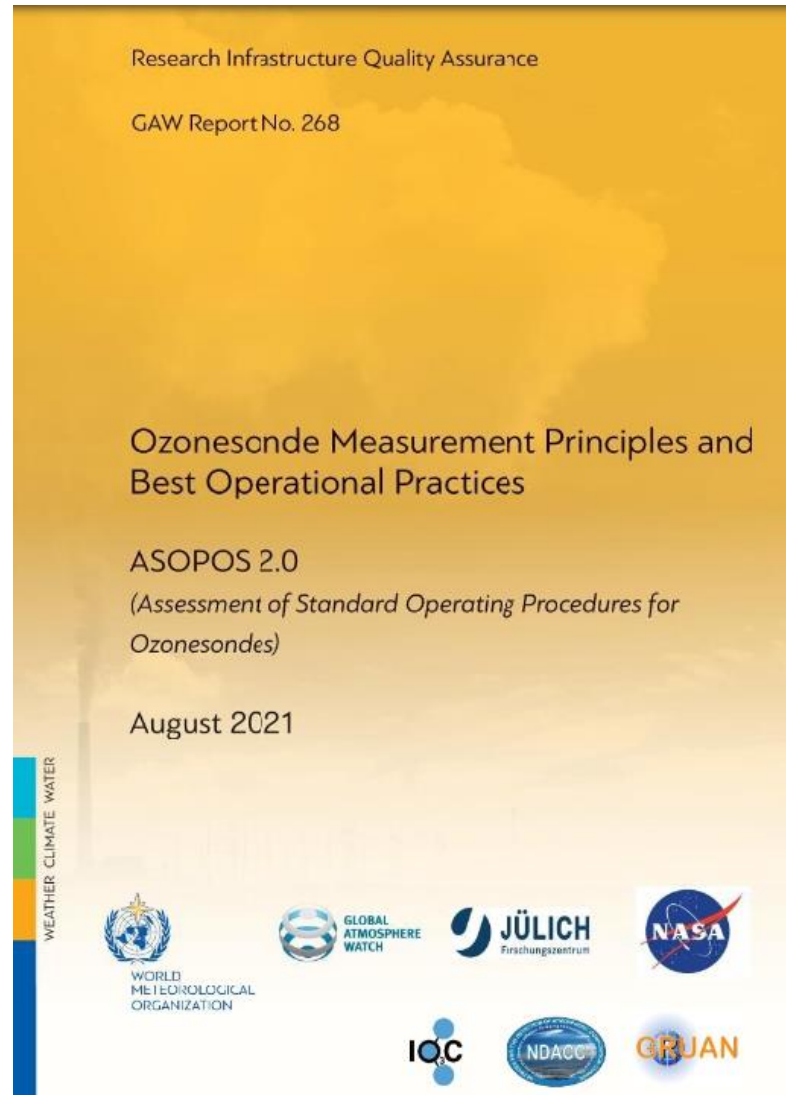
**Correspondence:** Voltaire A. Velazco ([voltaire.velazco@dwd.de](mailto:voltaire.velazco@dwd.de))

Received: 18 October 2023 – Discussion started: 24 November 2023

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# Ozonesondes – GAW Report #268 ASOPOS 2.0



# New annual, global MO Ozone and UV Bulletin



**WMO OZONE AND UV BULLETIN**

1 June 2023

**Forecast**

1 June 2023, WMO, in collaboration with the European Centre for Medium-Range Weather Forecasts (ECMWF), presents the 2023 forecast for the ozone layer and the amount of UV radiation reaching the Earth's surface. The forecast is based on the latest available data and the most up-to-date scientific understanding of the ozone layer and UV radiation. The forecast is presented in a series of maps and graphs, showing the expected changes in ozone levels and UV radiation levels over the next year. The forecast is based on the latest available data and the most up-to-date scientific understanding of the ozone layer and UV radiation. The forecast is presented in a series of maps and graphs, showing the expected changes in ozone levels and UV radiation levels over the next year.

**Introduction**

In 1985, the governments of the world agreed to the Vienna Convention for the Protection of the Ozone Layer, which was followed by the Montreal Protocol in 1987. These two treaties have led to a significant reduction in the amount of ozone-depleting substances being released into the atmosphere. As a result, the ozone layer is slowly recovering, and the amount of UV radiation reaching the Earth's surface is decreasing. However, there are still some concerns about the ozone layer, and it is important to continue to monitor and protect it. The WMO Ozone and UV Bulletin provides information about the current state of the ozone layer and UV radiation, and offers forecasts for the future. The bulletin is based on the latest available data and the most up-to-date scientific understanding of the ozone layer and UV radiation. The bulletin is presented in a series of maps and graphs, showing the expected changes in ozone levels and UV radiation levels over the next year.

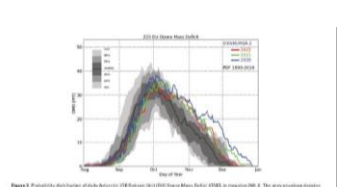
### The ozone layer in 2022

The Montreal Protocol and its amendments have successfully reduced and stabilized the production and consumption of controlled substances. The concentration of ozone-depleting substances in the atmosphere has declined significantly since 1995. This has led to a steady recovery of the ozone layer. In 2022, the ozone layer was 10% above its 1961 level. This is a significant improvement over the 1990s, when the ozone layer was 10% below its 1961 level. The recovery of the ozone layer is a result of the successful implementation of the Montreal Protocol and its amendments. The ozone layer is now recovering faster than it was in the 1990s, and it is expected to reach its 1961 level by 2036. This is a significant achievement, and it shows that international cooperation can make a difference in protecting the environment.

### The Arctic ozone hole in 2022: Later and longer in duration

The late winter observations of the Arctic ozone hole in 2022 were the latest and longest in duration since 1992. The ozone hole was first observed in 1992, and it has since become a regular feature of the Arctic region. In 2022, the ozone hole was observed from 15 February to 15 April, which is a significant increase in duration compared to previous years. The ozone hole was also deeper than in previous years, with a minimum of 1.5 Dobson Units (DU) observed in the Arctic region. This is a significant concern, as it indicates that the Arctic ozone hole is still recovering. The recovery of the Arctic ozone hole is slower than that of the mid-latitude ozone hole, and it is expected to take several more years to fully recover. This is a significant challenge, and it highlights the need for continued international cooperation to protect the ozone layer.

### 700K Eq.-TMs MSL v5.0 H<sub>2</sub>O Difference from Clim. 2006-2022

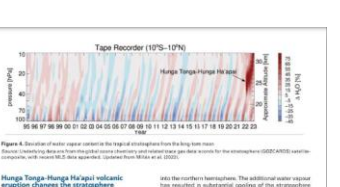


This graph shows the difference in 700K equivalent thicknesses (Eq.-TMs) between the 2006-2022 period and the 1961-2022 period. The y-axis represents the difference in Eq.-TMs, and the x-axis represents the month. The graph shows a significant increase in Eq.-TMs during the 2022-2023 period, particularly in the winter months. This is a significant concern, as it indicates that the atmosphere is becoming more humid, which can lead to more extreme weather events. The increase in Eq.-TMs is a result of the increase in water vapor in the atmosphere, which is a result of global warming. This is a significant challenge, and it highlights the need for continued international cooperation to address climate change.

### Hang Tuah Hanga Hapai volcanic eruption changes the atmosphere

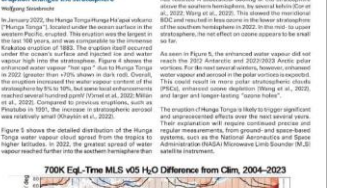
The eruption of the Hang Tuah Hanga Hapai volcano in 2022 had a significant impact on the atmosphere. The eruption released a large amount of ash and sulfur dioxide into the atmosphere, which led to a significant decrease in UV radiation levels. The decrease in UV radiation levels was observed globally, and it was most significant in the region of the eruption. This is a significant concern, as it indicates that volcanic eruptions can have a significant impact on the ozone layer and UV radiation. The recovery of the ozone layer and UV radiation levels after a volcanic eruption is slow, and it can take several years to fully recover. This is a significant challenge, and it highlights the need for continued international cooperation to protect the ozone layer and UV radiation.

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### The SunSmart Global UV app increasing UV awareness and sun protection habits across the globe using the Global Index UV Index

The SunSmart Global UV app is a free mobile application that provides users with real-time UV index information and sun protection advice. The app is available in multiple languages and is accessible to users worldwide. The app provides users with information about the current UV index, the expected UV index for the next few hours, and sun protection advice based on the current UV index. The app also provides information about the health effects of UV radiation and the benefits of sun protection. The app is a valuable tool for increasing UV awareness and sun protection habits across the globe. The app is available on both the App Store and Google Play.

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### The General Trust Fund for Financing Activities on Research and Scientific Cooperation for the Protection of the Ozone Layer

The General Trust Fund for Financing Activities on Research and Scientific Cooperation for the Protection of the Ozone Layer was established in 1992. The fund provides financial support for research and scientific cooperation activities related to the protection of the ozone layer. The fund is managed by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO). The fund has supported a wide range of research and scientific cooperation activities, including the development of ozone monitoring networks, the implementation of ozone assessment programs, and the development of ozone protection policies. The fund is a valuable resource for supporting research and scientific cooperation activities related to the protection of the ozone layer.

### European Emission Network: Five years on

The European Emission Network (EEN) is a network of national emission inventories for greenhouse gases and air pollutants. The EEN was established in 2017, and it has since become a key component of the European Union's climate and air quality policies. The EEN provides a common framework for reporting and verifying emission data, which is essential for the development of climate and air quality policies. The EEN is a valuable resource for monitoring and reducing greenhouse gas emissions and air pollution in the European Union.

### Delson network and Work Delson

The Delson network is a network of ozone monitoring stations in the Delson region of the United Kingdom. The network was established in 2017, and it has since become a key component of the United Kingdom's ozone monitoring network. The network provides a common framework for reporting and verifying ozone data, which is essential for the development of ozone protection policies. The network is a valuable resource for monitoring and protecting the ozone layer in the Delson region.

### Climate protection: Scientific Assessment Panel Environmental Effects Assessment

The Scientific Assessment Panel (SAP) is a key component of the Montreal Protocol. The SAP provides scientific assessments of the environmental effects of ozone-depleting substances. The SAP's assessments are based on the latest available data and the most up-to-date scientific understanding of the ozone layer and UV radiation. The SAP's assessments are essential for the development of ozone protection policies. The SAP is a valuable resource for providing scientific assessments of the environmental effects of ozone-depleting substances.

### Environmental Effects of Stratospheric Ozone Depletion, UV Radiation, and Interactions with Climate Change

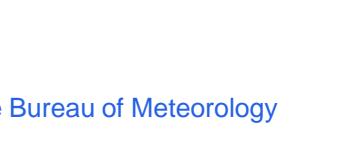
The Environmental Effects of Stratospheric Ozone Depletion, UV Radiation, and Interactions with Climate Change is a report published by the Scientific Assessment Panel (SAP) of the Montreal Protocol. The report provides a comprehensive assessment of the environmental effects of ozone-depleting substances, UV radiation, and their interactions with climate change. The report is based on the latest available data and the most up-to-date scientific understanding of the ozone layer and UV radiation. The report is a valuable resource for providing scientific assessments of the environmental effects of ozone-depleting substances, UV radiation, and their interactions with climate change.

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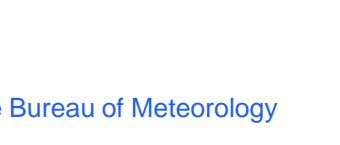
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# Thank you

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