World Meteorological Organization
Working together in weather, climate and water

GAW Ozone Layer Monitoring

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Monitoring matters!

First 2.5 years of CO_2 observations at Mauna Loa, Hawaii: Seasonal cycle, but no trend is visible

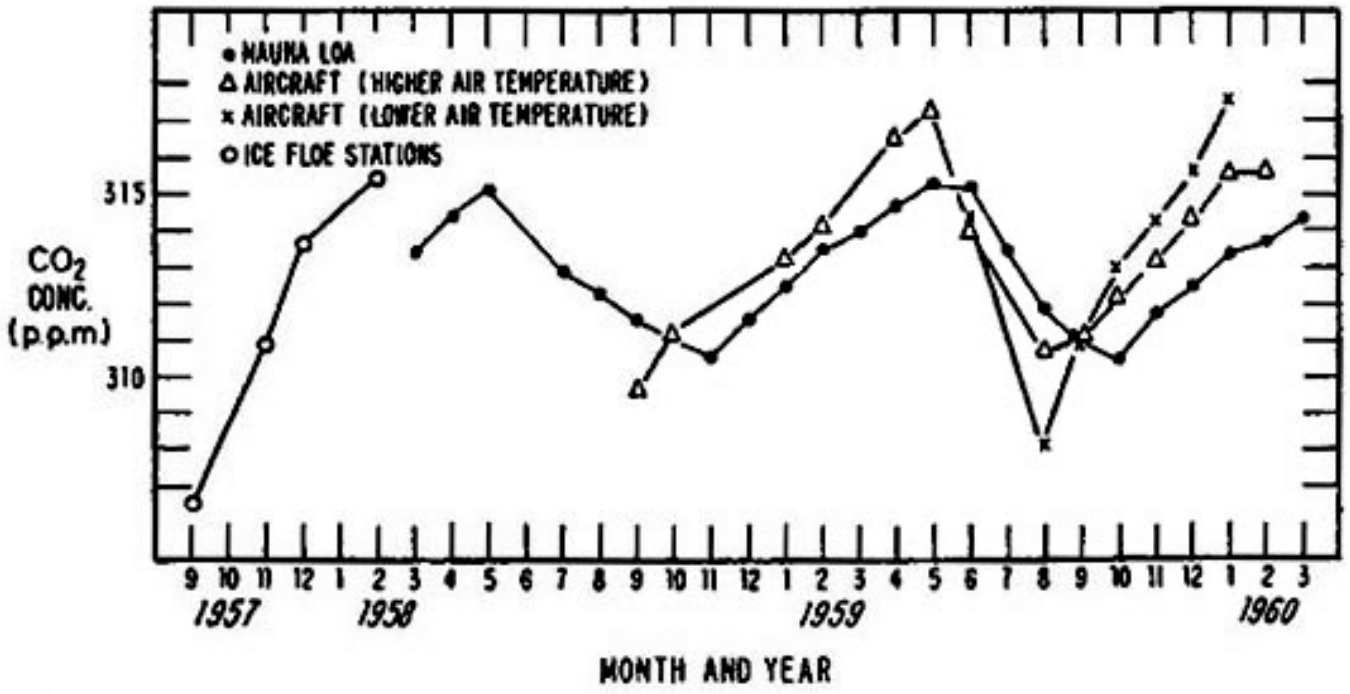
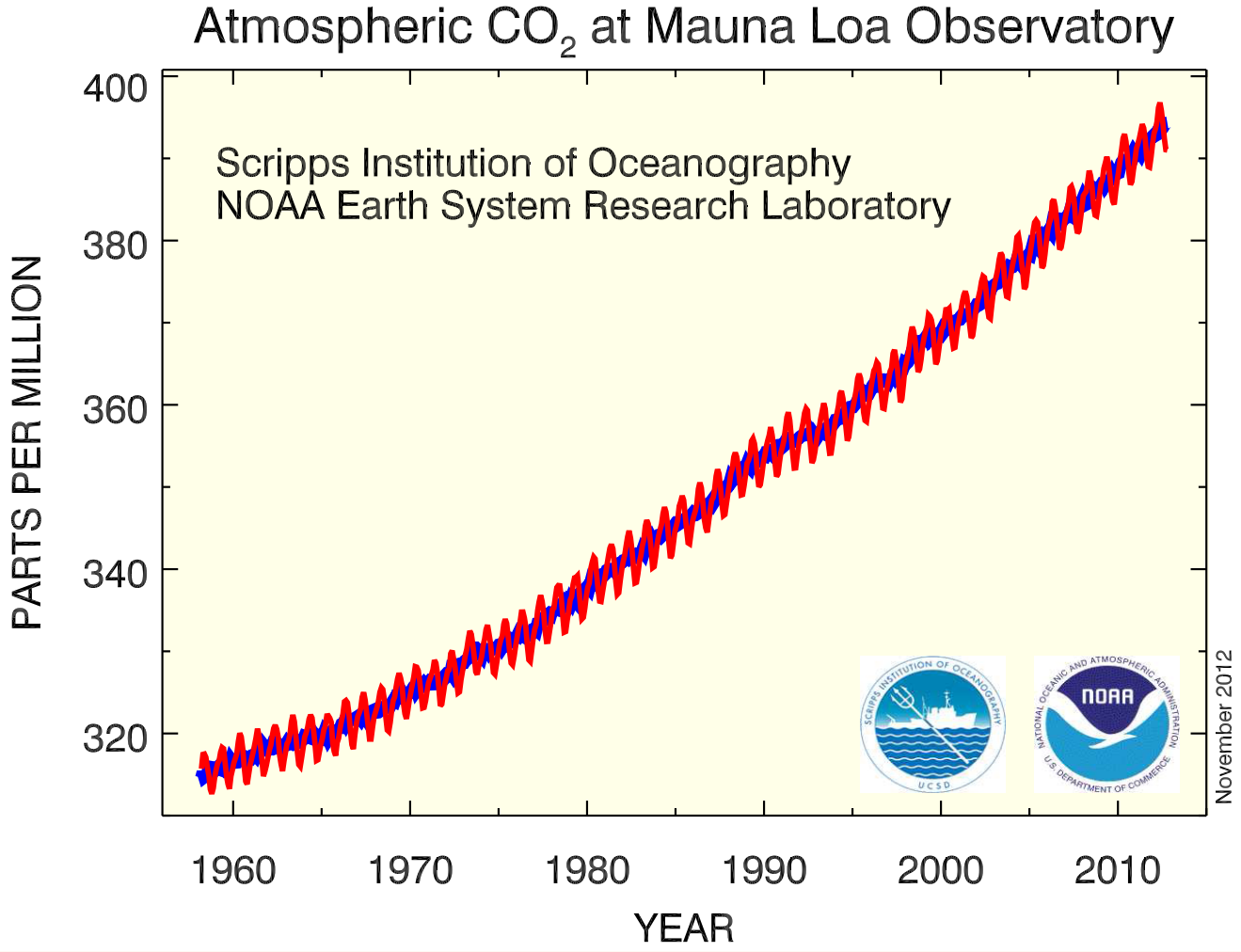


Fig. 1. Variation in concentration of atmospheric carbon dioxide in the Northern Hemisphere.

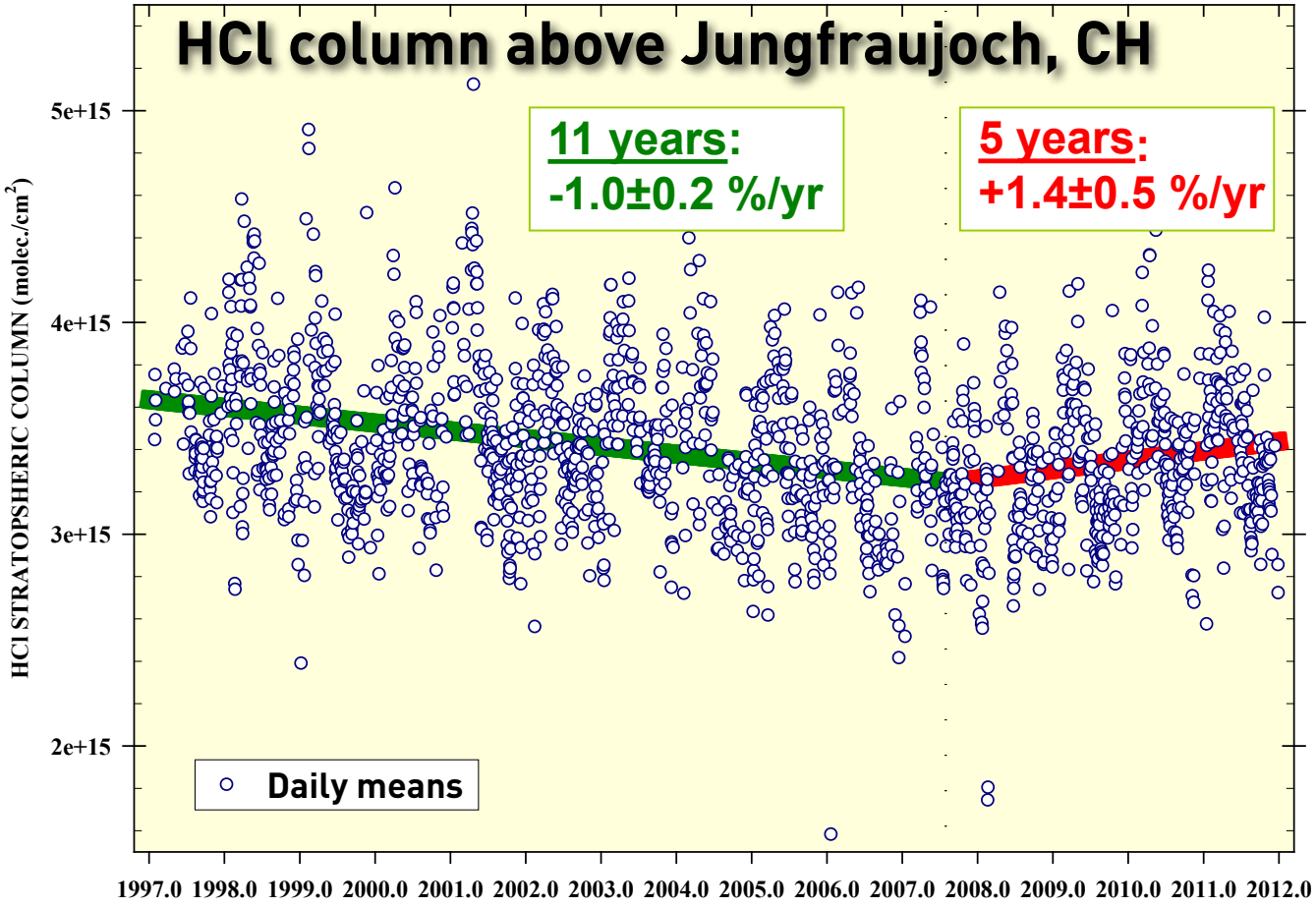
Tellus XII (1960), 2

C. D. Keeling

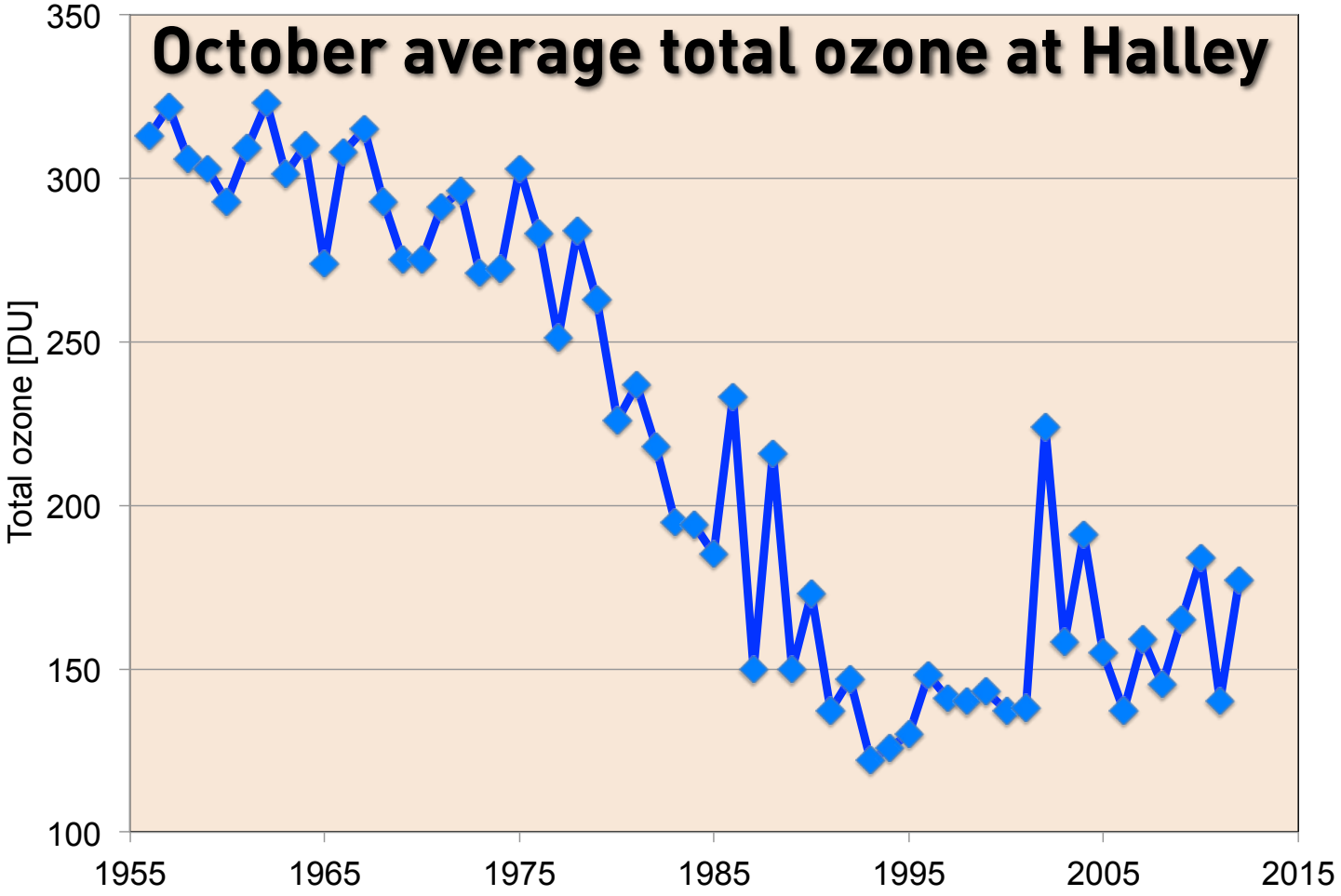
After 55 years of continuous observations: The amount of CO_2 in the atmosphere is increasing exponentially (approx. 0.5%/yr)



Unexpectedly, stratospheric HCl is inreasing again after a decade of gradual decline



Ground based observations at Halley led to the discovery of the Antarctic ozone hole



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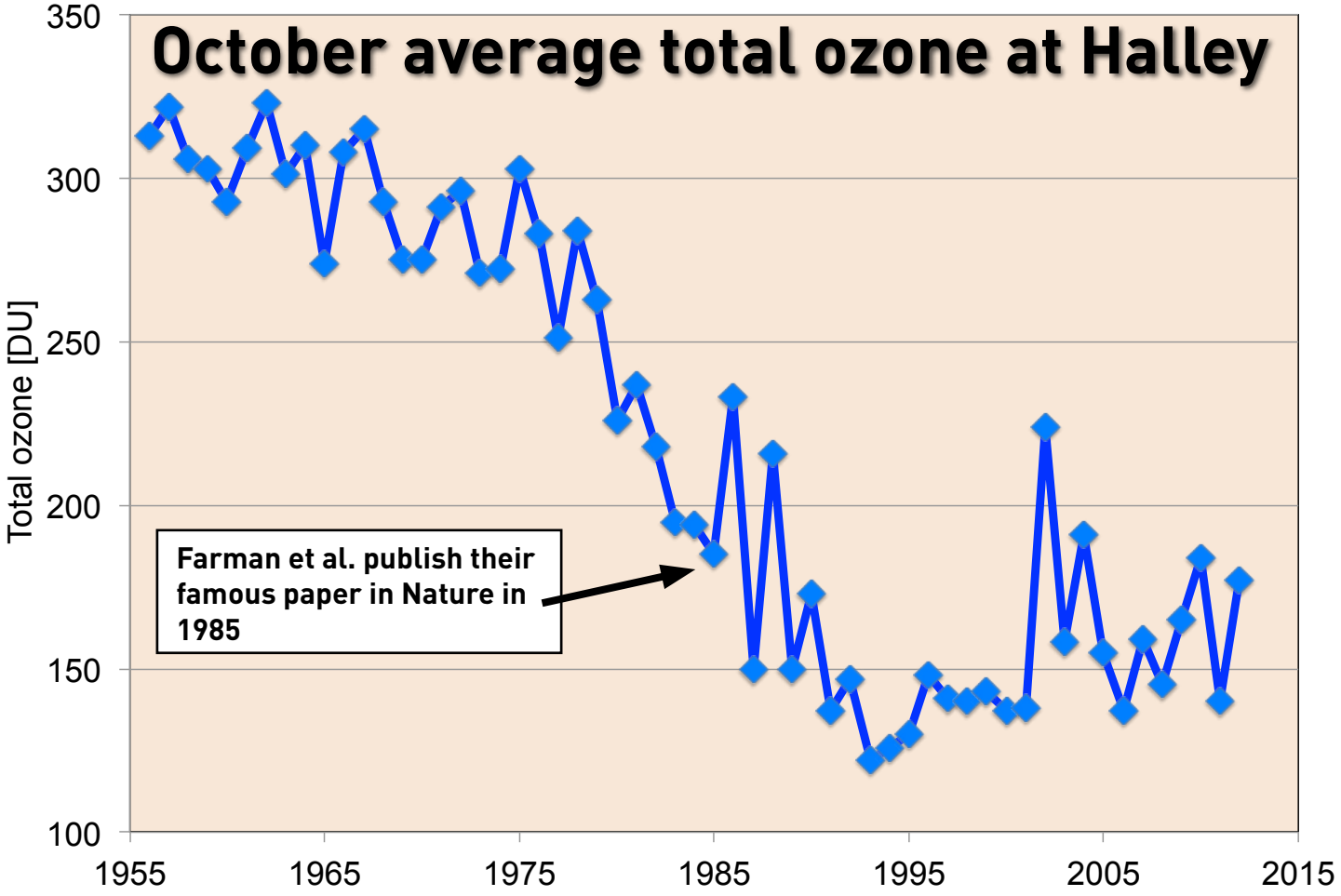
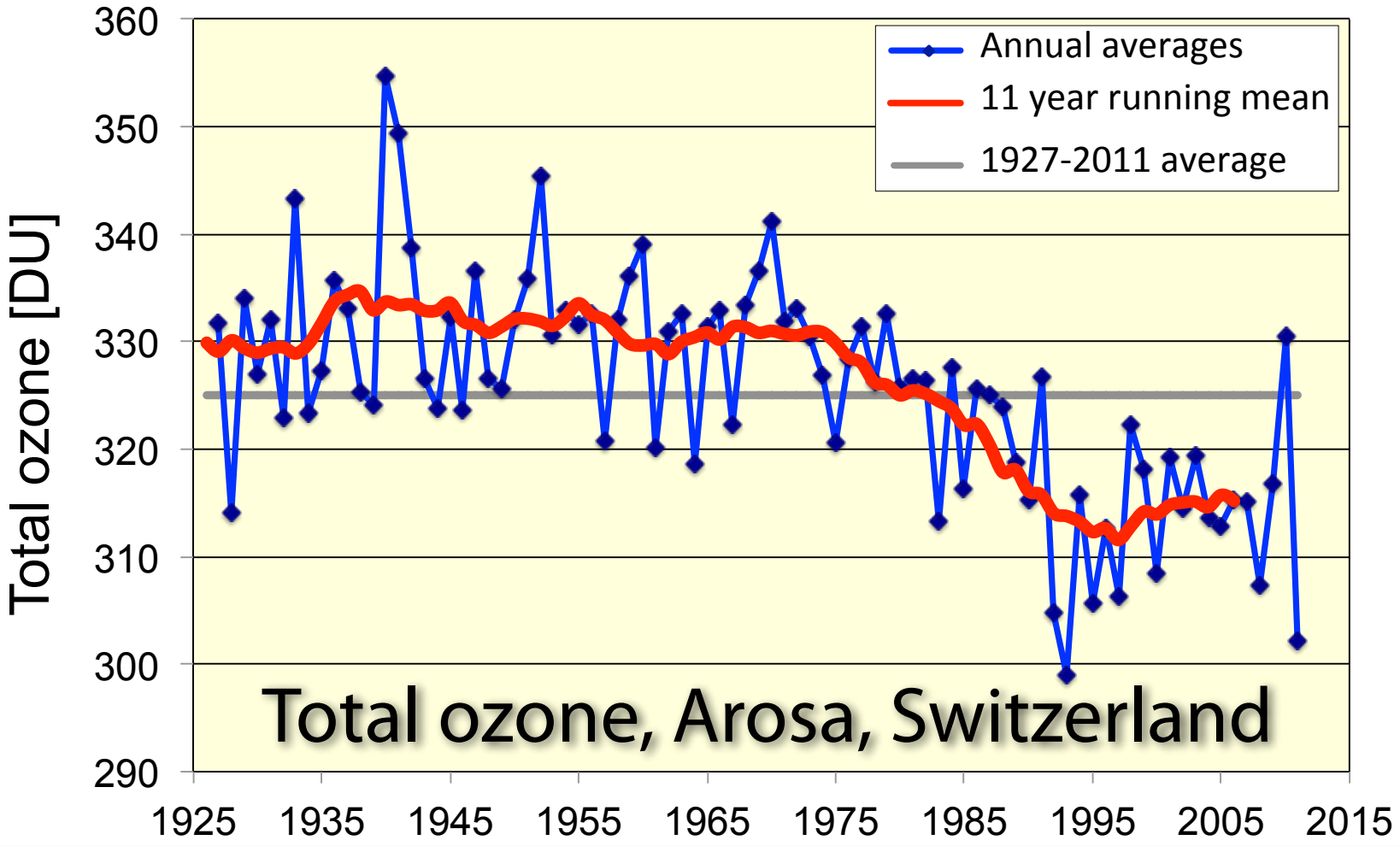


Long term time series put recent development into perspective



GAW Ozone System

SAGs

- Ozone
- UV
- IGACO-Ozone/UV

GAW Secretariat

WMO GAW

CAS Open Programme Area Group

EPAC

Environmental Pollution & Atmospheric Chemistry

Joint Scientific Steering Committee

Quality Assurance & Science Activity Centres

World & Regional Calibration Centres

Total ozone

3 WCC (US, CA, RU), 1 Brewer RCC (ES),
6 Dobson RCC (JP, AU, ZA, AR, DE, CZ)

Ozonesondes

FZJülich (DE)

Central Calibration Laboratories

Host GAW World Reference Standards

Dobson total ozone	Brewer total ozone	Ozonesondes
NOAA ESRL/GMD (USA)	Environment Canada	FZJülich (DE)

Contributing networks

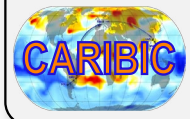
NDACC — NETWORK FOR THE DETECTION OF ATMOSPHERIC COMPOSITION CHANGE

SHADOZ — Southern Hemisphere ADditional OZonesondes

GAW stations & GAWSIS

Satellites & Aircraft



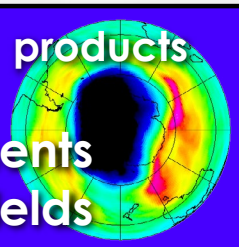
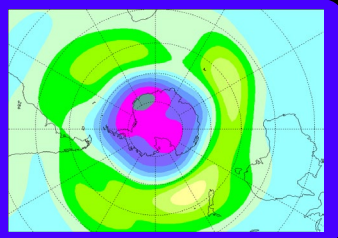


World Data Centres

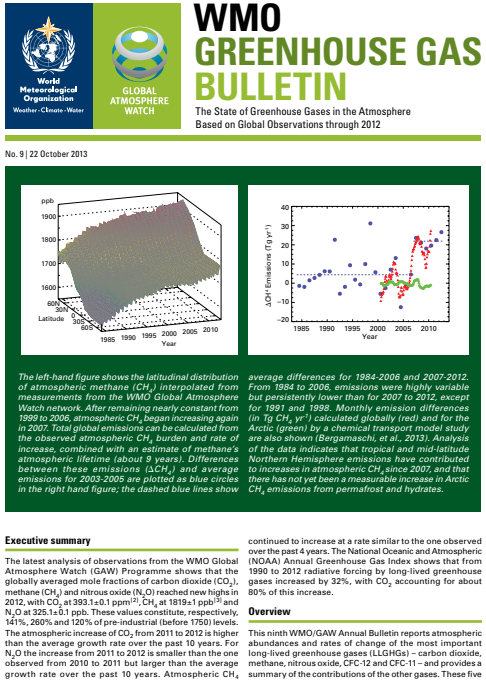
World Ozone and UV Data Centre	WDC-RSAT
Environment Canada	DLR, Germany

IGACO products

- Bulletins
- Assessments
- Global fields

GAW is much more than just observations. It is also an end to end programme contributing to international assessments and with its own dissemination products, such as the WMO Greenhouse Gas Bulletin and the WMO Antarctic Ozone Bulletin



WMO
GREENHOUSE GAS
BULLETIN

The State of Greenhouse Gases in the Atmosphere
Based on Global Observations through 2012

World Meteorological Organization
Weather · Climate · Water

GLOBAL ATMOSPHERE WATCH

No. 9 | 22 October 2013

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The left-hand figure shows the latitudinal distribution of atmospheric methane (CH_4) interpolated from measurements from the WMO Global Atmosphere Watch network. After remaining nearly constant from 1999 to 2006, atmospheric CH_4 began increasing again in 2007. Total global emissions can be calculated from the observed atmospheric CH_4 burden and rate of increase, combined with an estimate of methane's atmospheric lifetime (about 9 years). Differences between these emissions (ΔCH_4) and average emissions for 2003-2005 are plotted as blue circles in the right hand figure; the dashed blue lines show average differences for 1984-2006 and 2007-2012. From 1984 to 2006, emissions were highly variable but persistently lower than for 2007 to 2012, except for 1991 and 1998. Monthly emission differences (in Tg CH_4 yr^{-1}) calculated globally (red) and for the Arctic (green) by a chemical transport model study are also shown (Bergamaschi, et al., 2013). Analysis of the data indicates that tropical and mid-latitude Northern Hemisphere emissions have contributed to increases in atmospheric CH_4 since 2007, and that there has not yet been a measurable increase in Arctic CH_4 emissions from permafrost and hydrates.

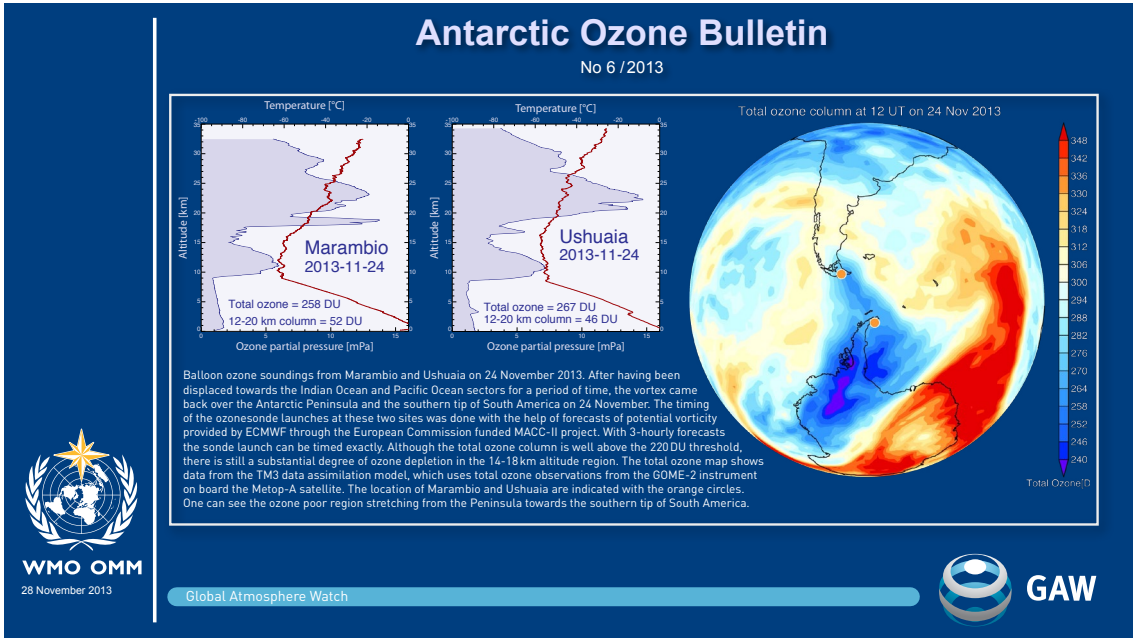
Executive summary

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 2012, with CO_2 at 393.1±0.1 ppm[2], CH_4 at 1819±1 ppb[3] and N_2O at 325.1±0.1 ppb. These values constitute, respectively, 141%, 260% and 120% of pre-industrial (before 1750) levels.

The atmospheric increase of CO_2 from 2011 to 2012 is higher than the average growth rate over the past 10 years. For N_2O the increase from 2011 to 2012 is smaller than the one observed from 2010 to 2011 but larger than the average growth rate over the past 10 years. Atmospheric CH_4 continued to increase at a rate similar to the one observed over the past 4 years. The National Oceanic and Atmospheric (NOAA) Annual Greenhouse Gas Index shows that from 1990 to 2012 radiative forcing by long-lived greenhouse gases increased by 32%, with CO_2 accounting for about 80% of this increase.

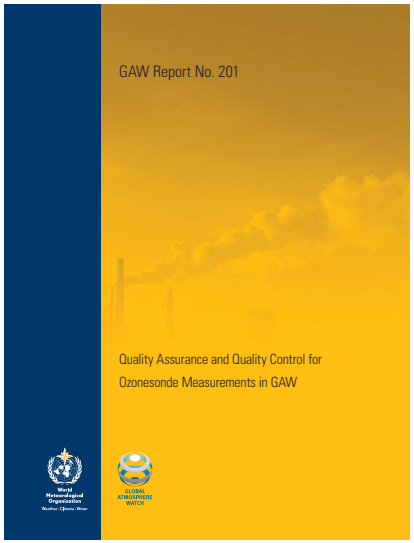
Overview

This ninth WMO/GAW Annual Bulletin reports atmospheric abundances and rates of change of the most important long-lived greenhouse gases (LLGHGs) – carbon dioxide, methane, nitrous oxide, CFC-12 and CFC-11 – and provides a summary of the contributions of the other gases. These five

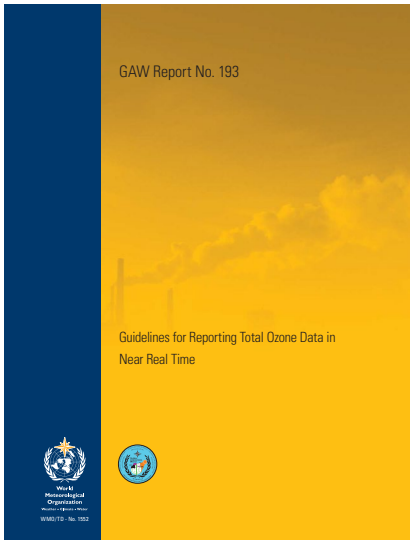


http://www.wmo.int/gaw

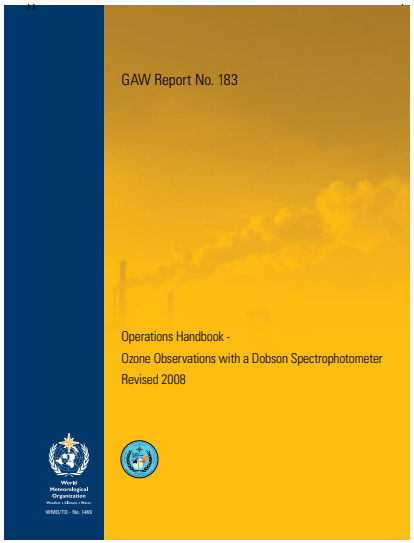
GAW reports dealing with ozone measurement guidelines and NRT data delivery



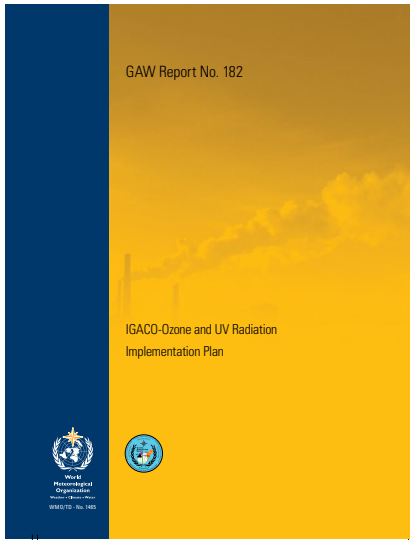
Ozonesondes



NRT Data



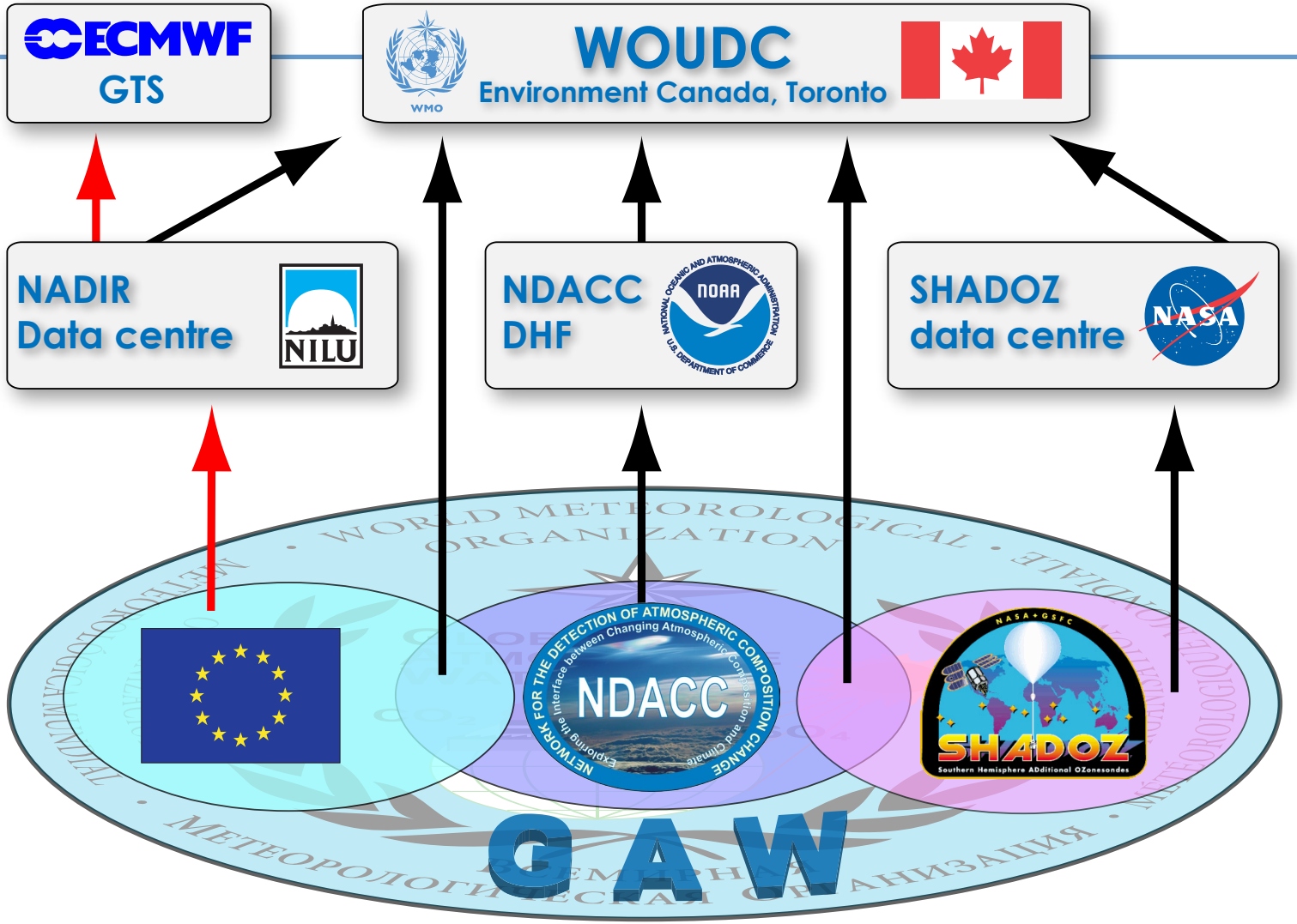
Dobson



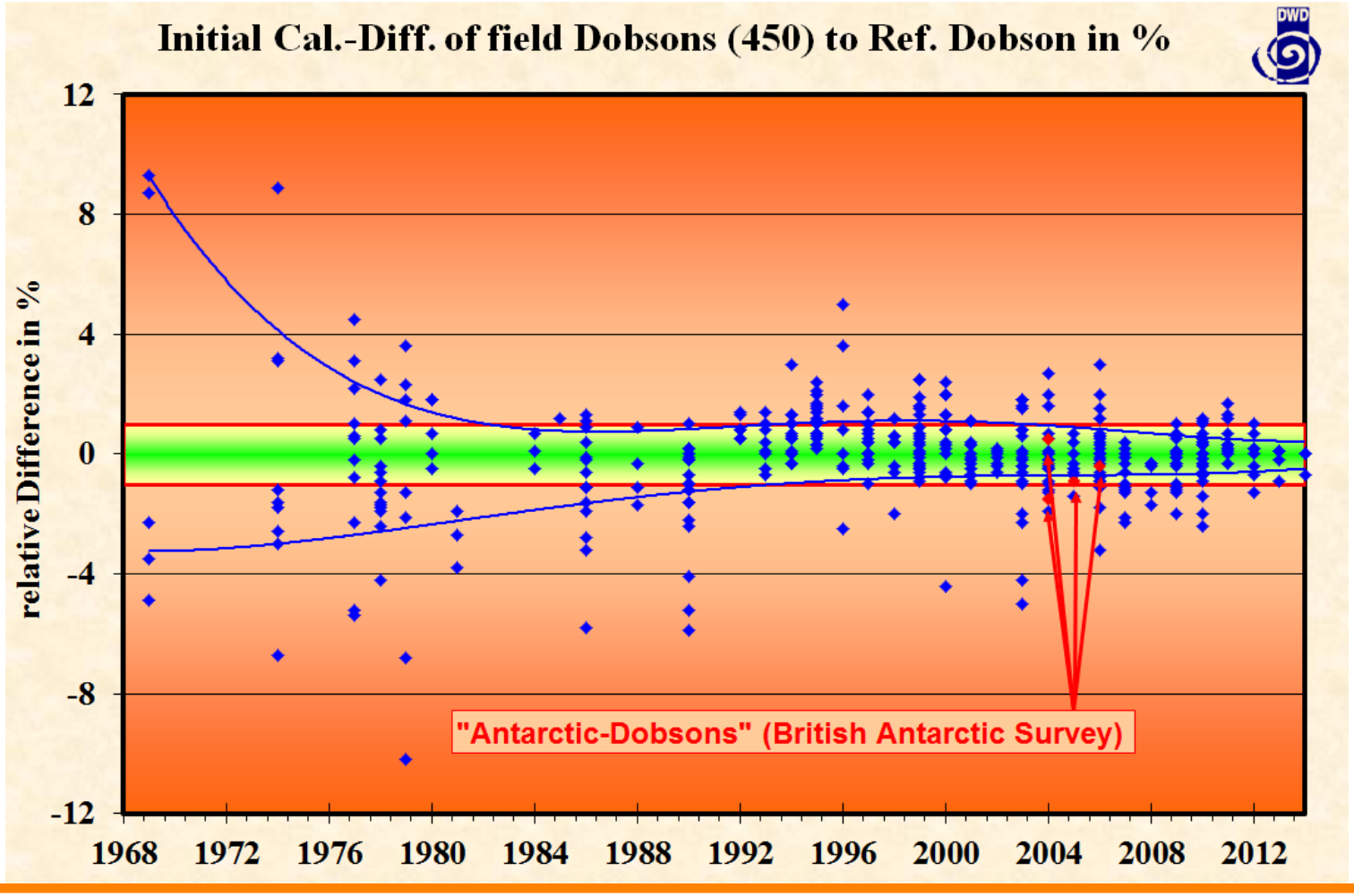
IGACO-O_3/UV

Guidelines for Brewer measurements are planned as output from the European COST Action EUBrewNet

Flow of ozonesonde data



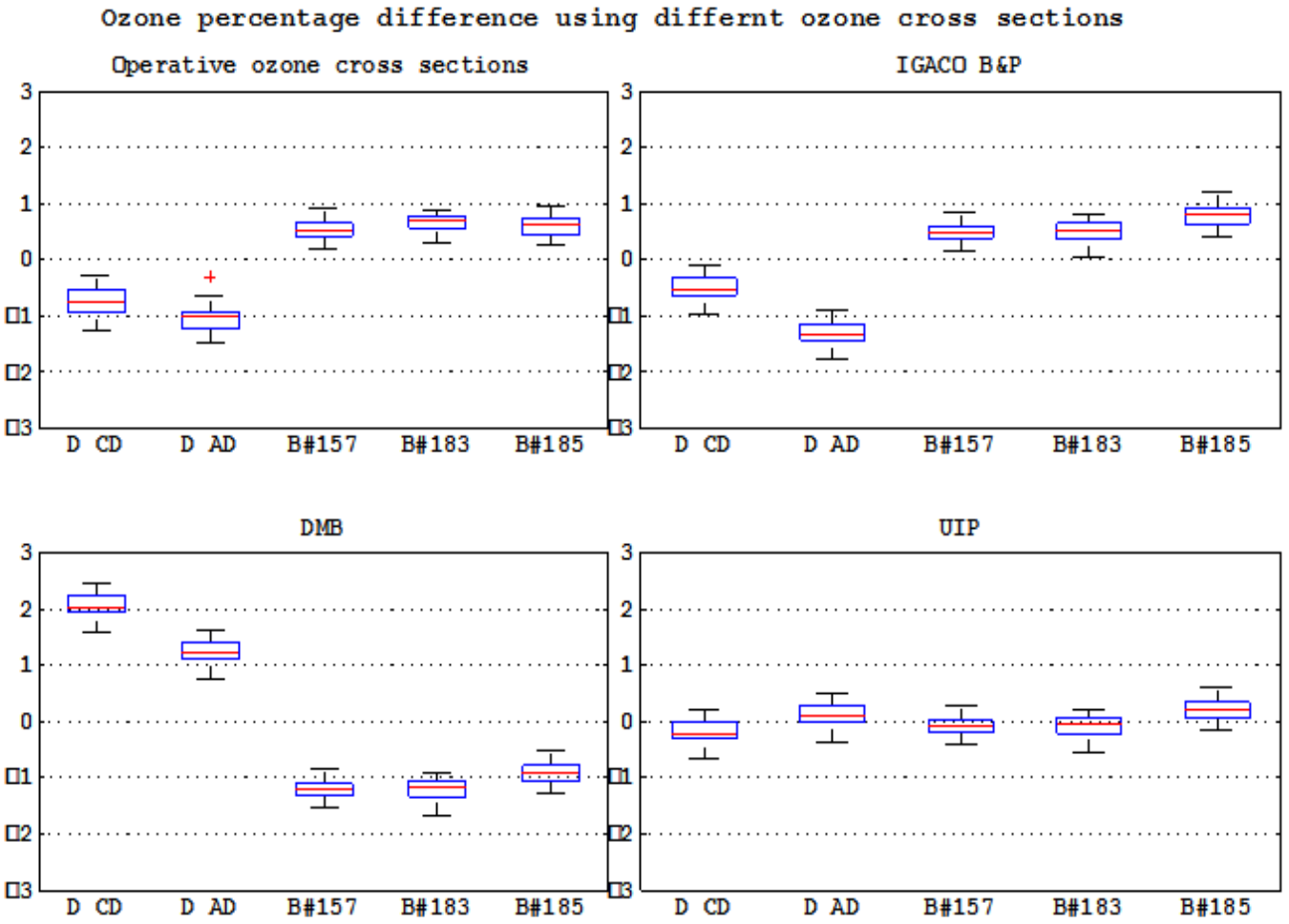
Importance of regular calibrations and intercomparisons



IGACO-O_3/UV

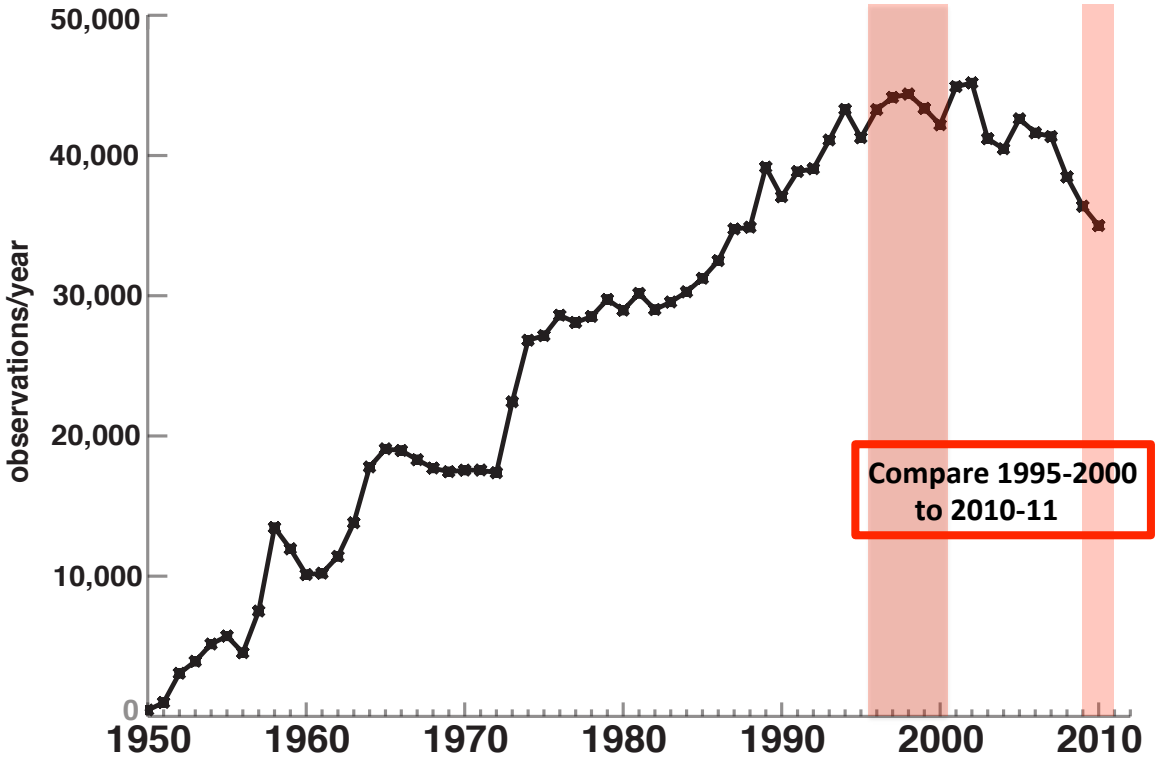
- Various activities to improve the quality of ozone observations
- Outlined in the IGACO-O_3/UV Implementation Plan
  - ✔ GAW Report no. 182.
- Recently, focus has been on ozone absorption cross sections
- NASA satellites now use the Brion, Daumont, Malicet (BDM) cross sections
- For ground-based measurements (Dobson and Brewer) the new Bremen cross sections (Serduychenko et al.) give the most consistent results
- A decision on a possible change from Bass & Paur to Serduychenko will be made soon

New cross sections give better agreement between Dobson and Brewer



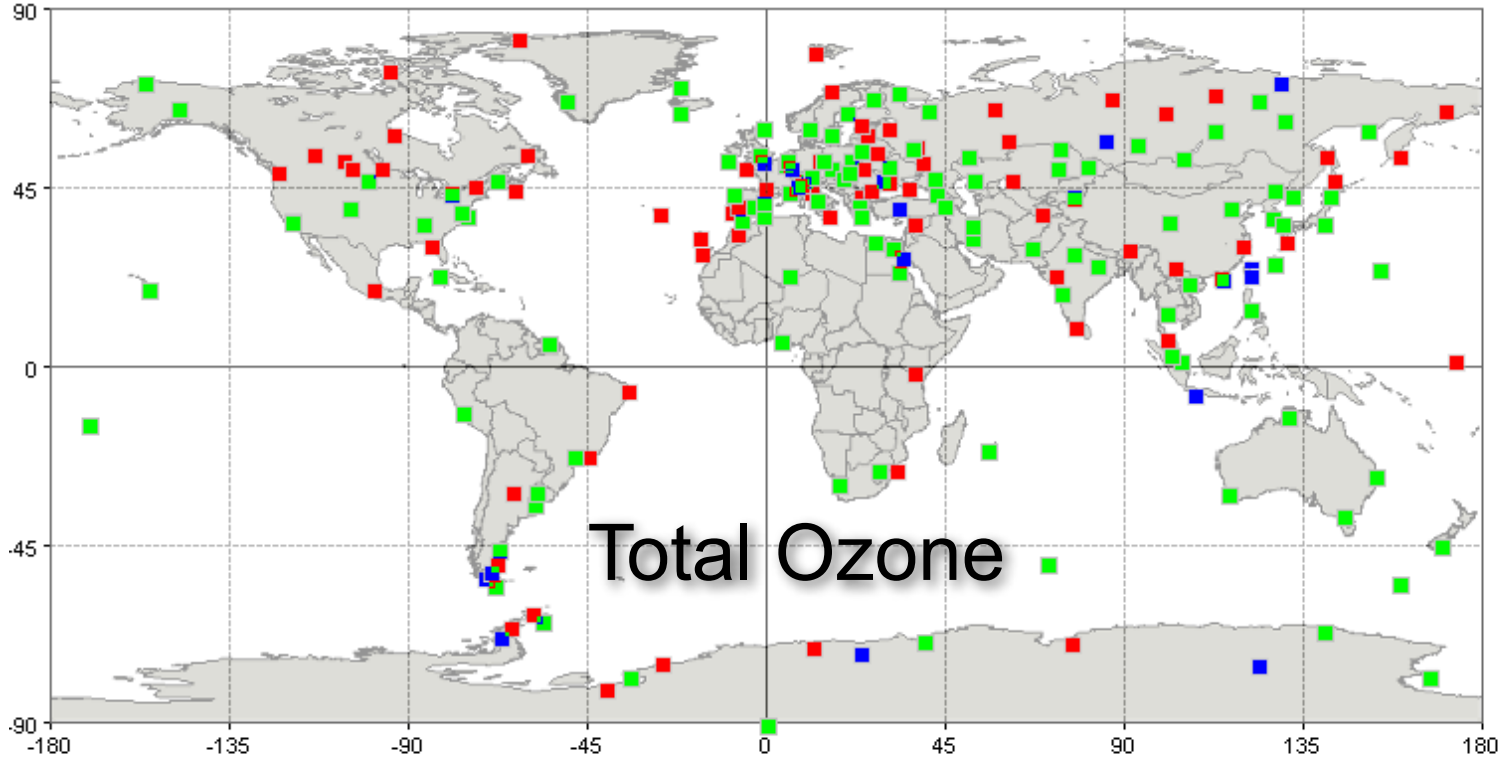
Decline in number of stations and observations

Total ozone observations globally



Decline in number of stations and observations

Difference 1995-2000 and 2010-2012



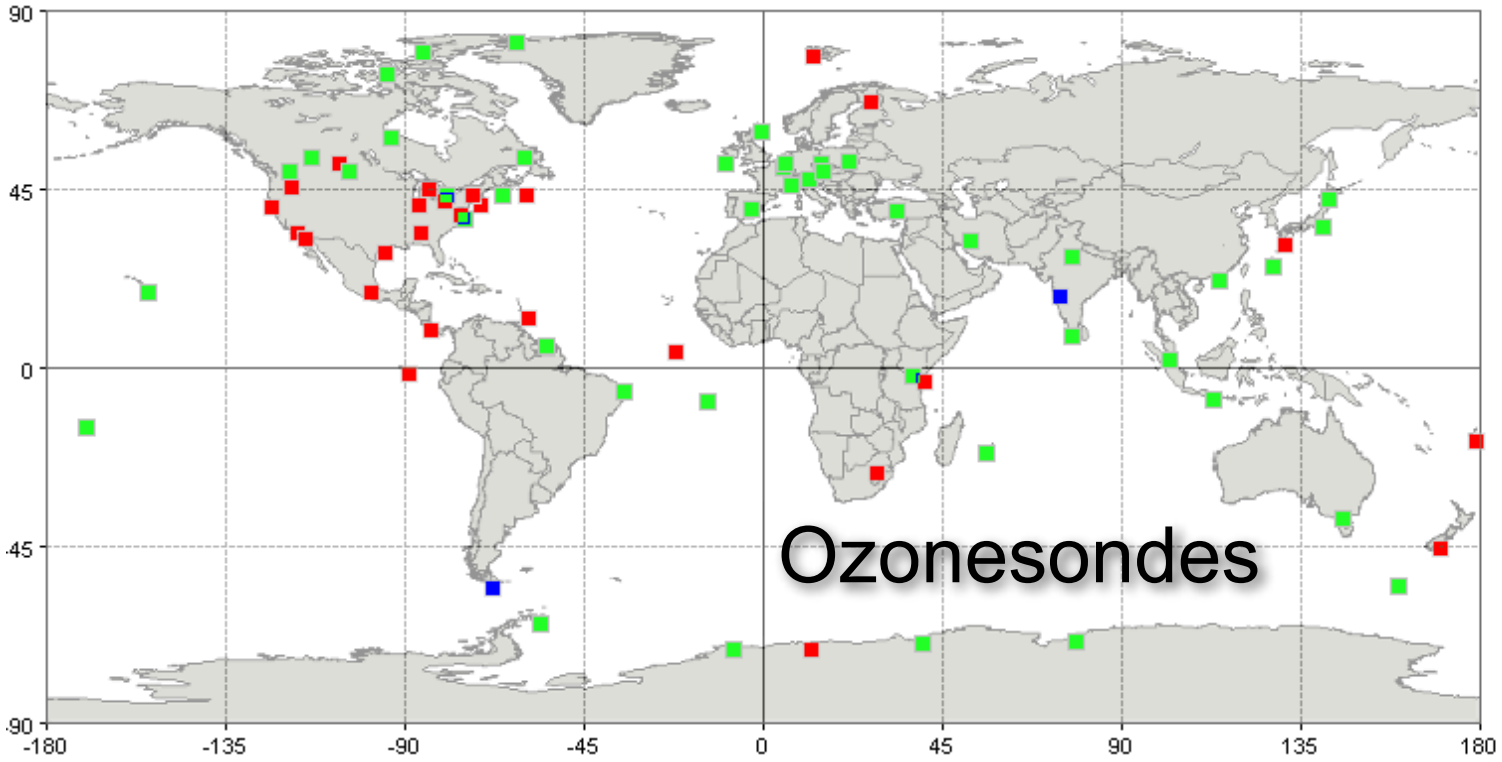
Station that reported in both periods

Not reporting 2010-2012, did report 1995-2000

New station (now reporting 2010-2012)

Decline in number of stations and observations

Difference 1995-2000 and 2010-2012



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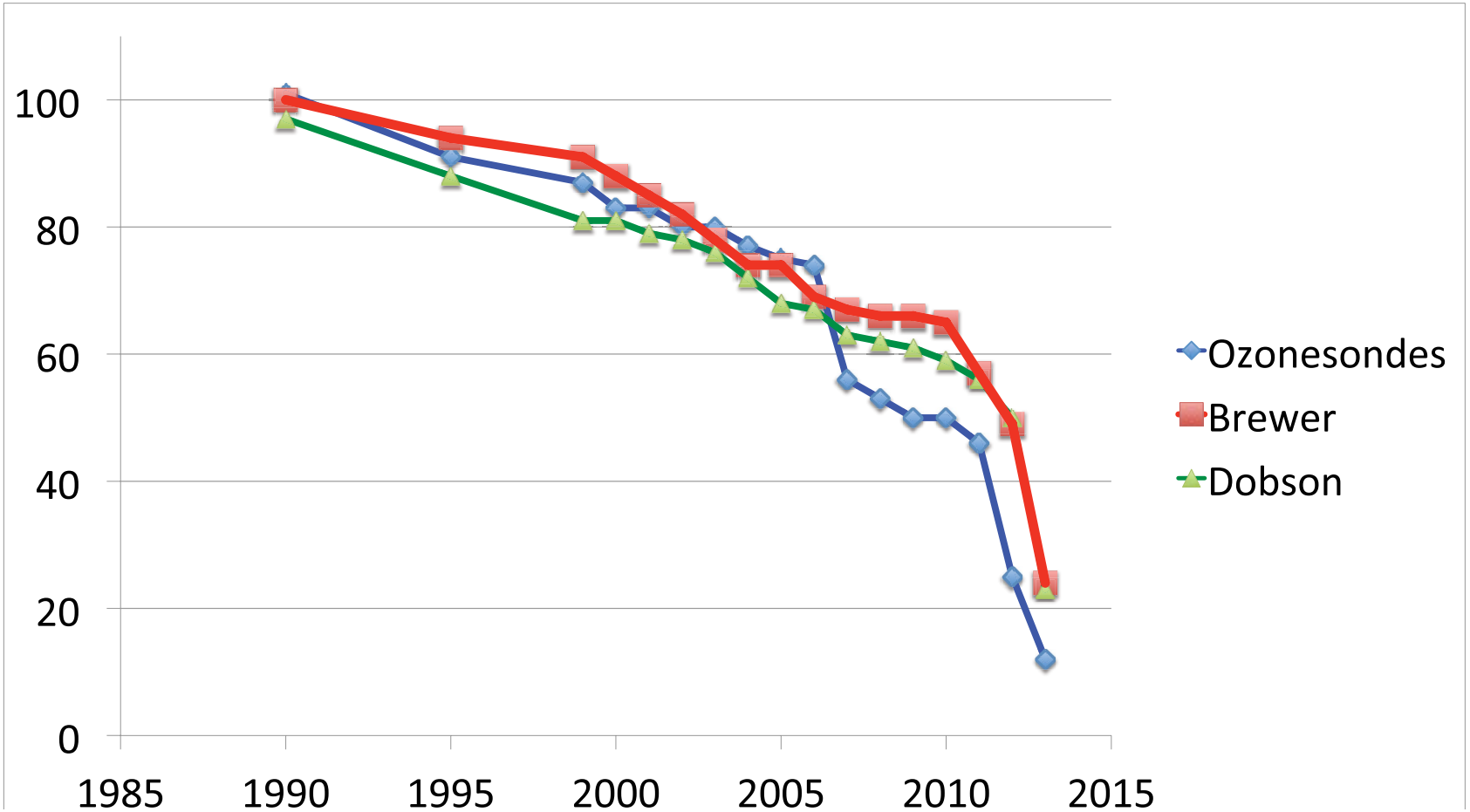
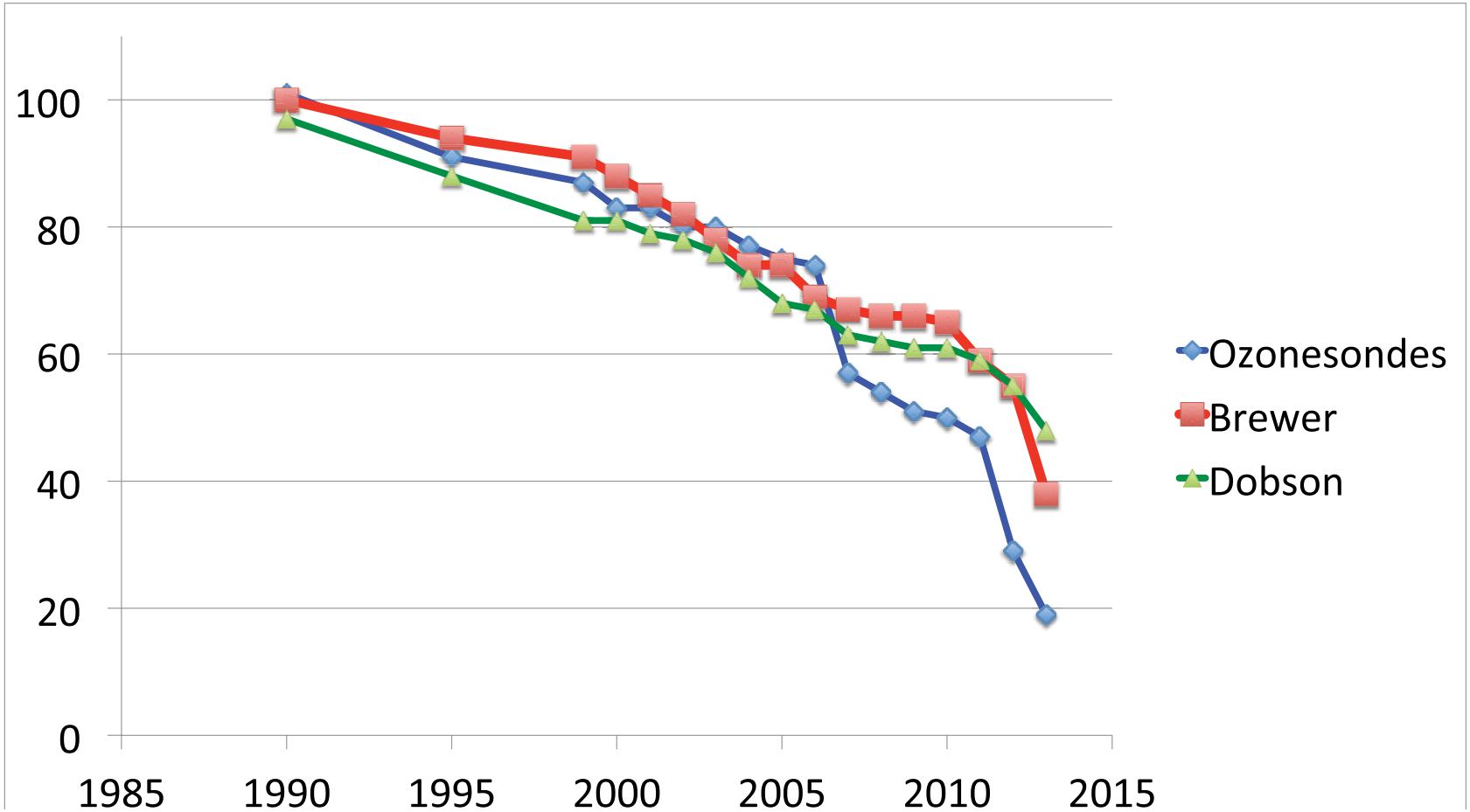
Decline in number of stations and observations as of 06-2013



Decline in number of stations and observations as of 05-2014



Conclusions

- **Long-term ozone trends can be estimated from satellites, but the integrity of these estimates will be diminished without independent ground measurements.**
- **New ozone absorption cross sections will most likely be adopted for Dobson and Brewer spectrophotometers.**
- **The number of reported total ozone and ozonesonde measurements has decreased by a substantial number since the 1995-2005 period.**
- **The situation looks somewhat better now in May 2014 compared to one year ago.**
- **A part of the difference may be due to a certain time lag in data reporting, but this does not change the fact that many stations have ceased to observe and report ozone data. Fortunately, some new stations have been established in recent years.**
- **Capacity building is important for the continued high quality of ground based data.**

Thank you for your attention!

GLOBAL ATMOSPHERE WATCH

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