CCQM

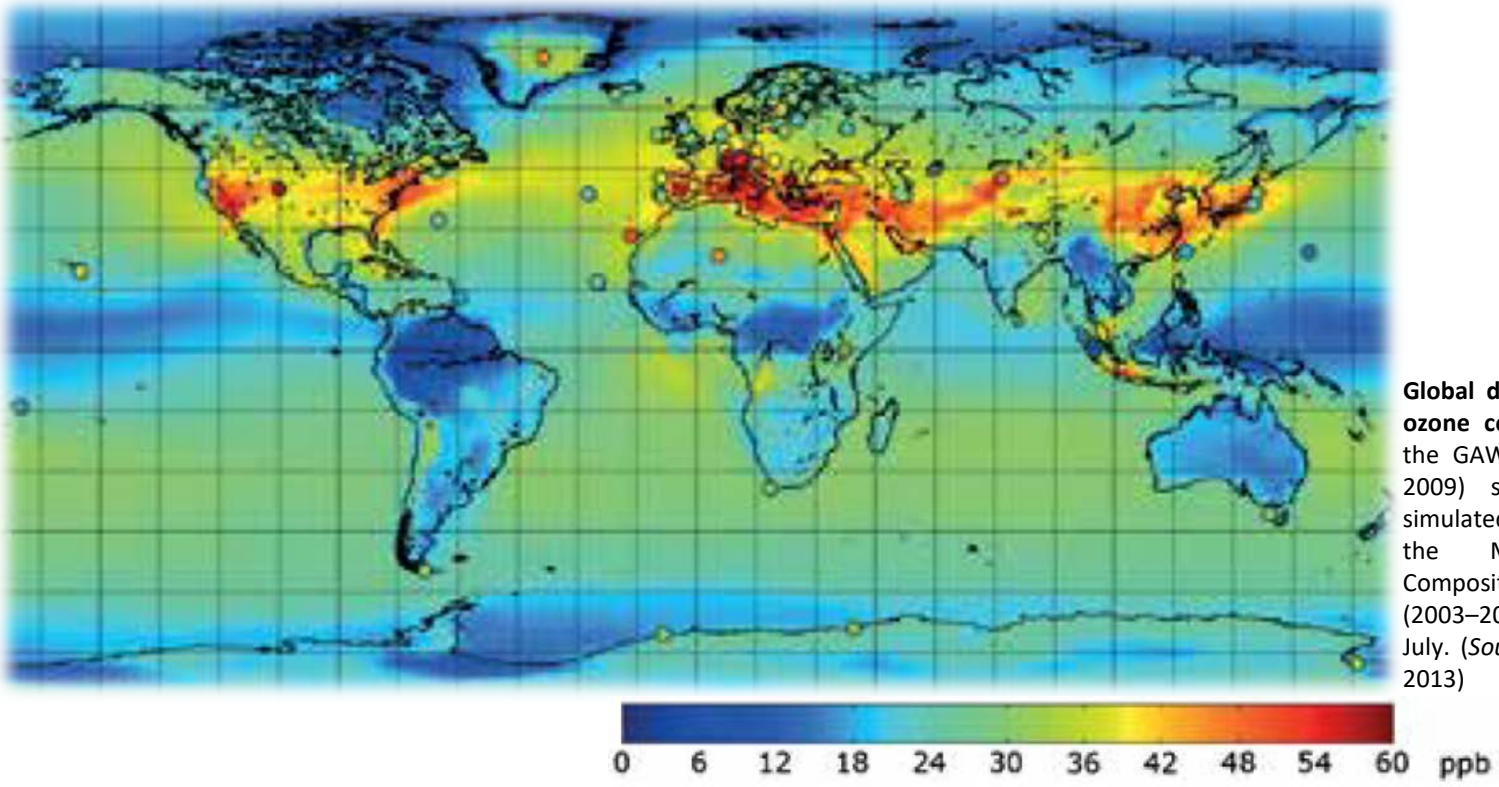
Accurate Monitoring of Surface Ozone
Virtual Workshop
5-9 October 2020

Implementing a Globally Coordinated Change in Ozone Cross Section Value for Surface Ozone Monitoring

Paul Brewer

5 October 2020

Introduction



Global distribution of near-surface ozone concentration measured by the GAW network stations (2000–2009) superimposed on model-simulated ozone concentration from the Monitoring Atmospheric Composition and Climate reanalysis (2003–2010). Monthly mean for July. (*Source*: *GAW Report No. 209*, 2013)

- Powerful oxidant, can impair the functioning of the human respiratory and cardiovascular systems
- Ozone pollution can affect the main ecosystem services provided by terrestrial plants
- Many countries have implemented ozone air quality standards for the protection of human health
- Role in climate

Ozone cross section at 254 nm (air)

Why is accuracy important?

- Comparable and accurate measurements of atmospheric ozone concentrations essential for human health and the environment
- Prevalence of standards and instruments based on the absorption of UV radiation at the mercury-line wavelength of 253.65 nm (air) for amount fraction measurements of surface ozone
- The uncertainty in the value of the ozone absorption cross-section per molecule is the biggest impediment to achieving accurate and SI-traceable values from ozone reference photometers that are useful to end users
- The value is an important anchor point for referencing the absorption cross-sections of ozone throughout the electromagnetic spectrum

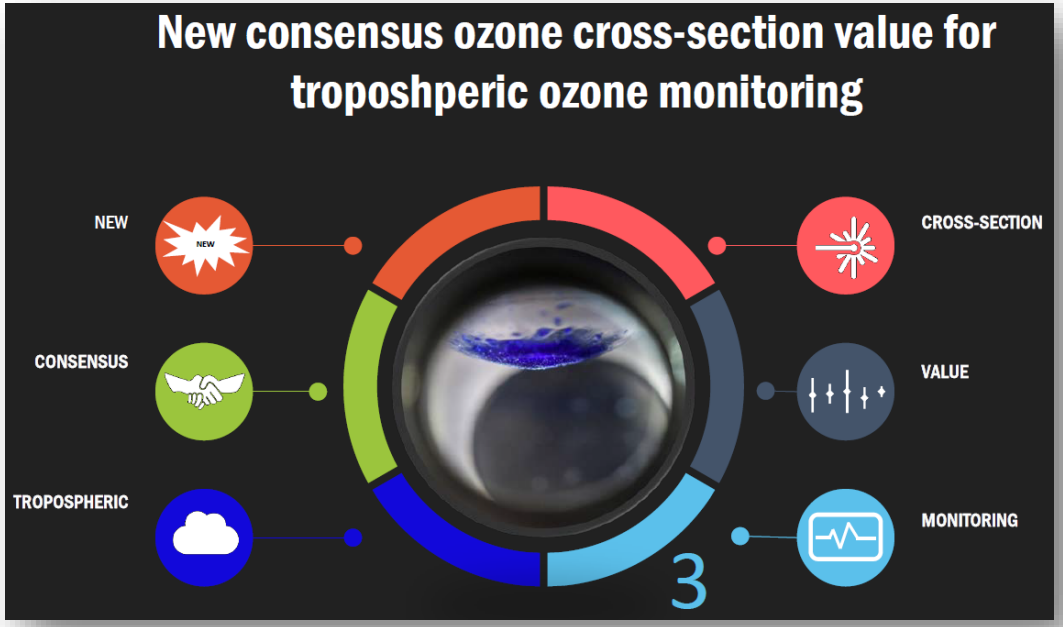
Why change?

- Ozone cross-section data (at 254 nm) suggests that historical data is biased by about 2%, confirmed by non-UV absorption measurements (Gas Phase titration)
- Recommendations of ACSO – change consistent with expected changes in values at other wavelengths

CCQM task group

Traceability for surface ozone measurements is established through ozone reference photometers, and the GAWG is the expert body in CCQM to recommend values for use in BIPM.QM-K1

- Established under the CCQM Gas Analysis Working Group
- Recommend SI-traceable value and uncertainty for O_3 cross section at 253.65 nm (air)
- Compare, evaluate, and review O_3 absorption cross section data in the scientific literature
- Assess completeness of the uncertainty budgets and quantify possible biases in published values
- Scientifically rigorous strategy to yield the recommended cross section and combined uncertainty
- Summarise results in an appropriate peer-reviewed journal
- Inform CCQM-GAWG regarding the recommended value for use in future BIPM.QM-K1 comparisons



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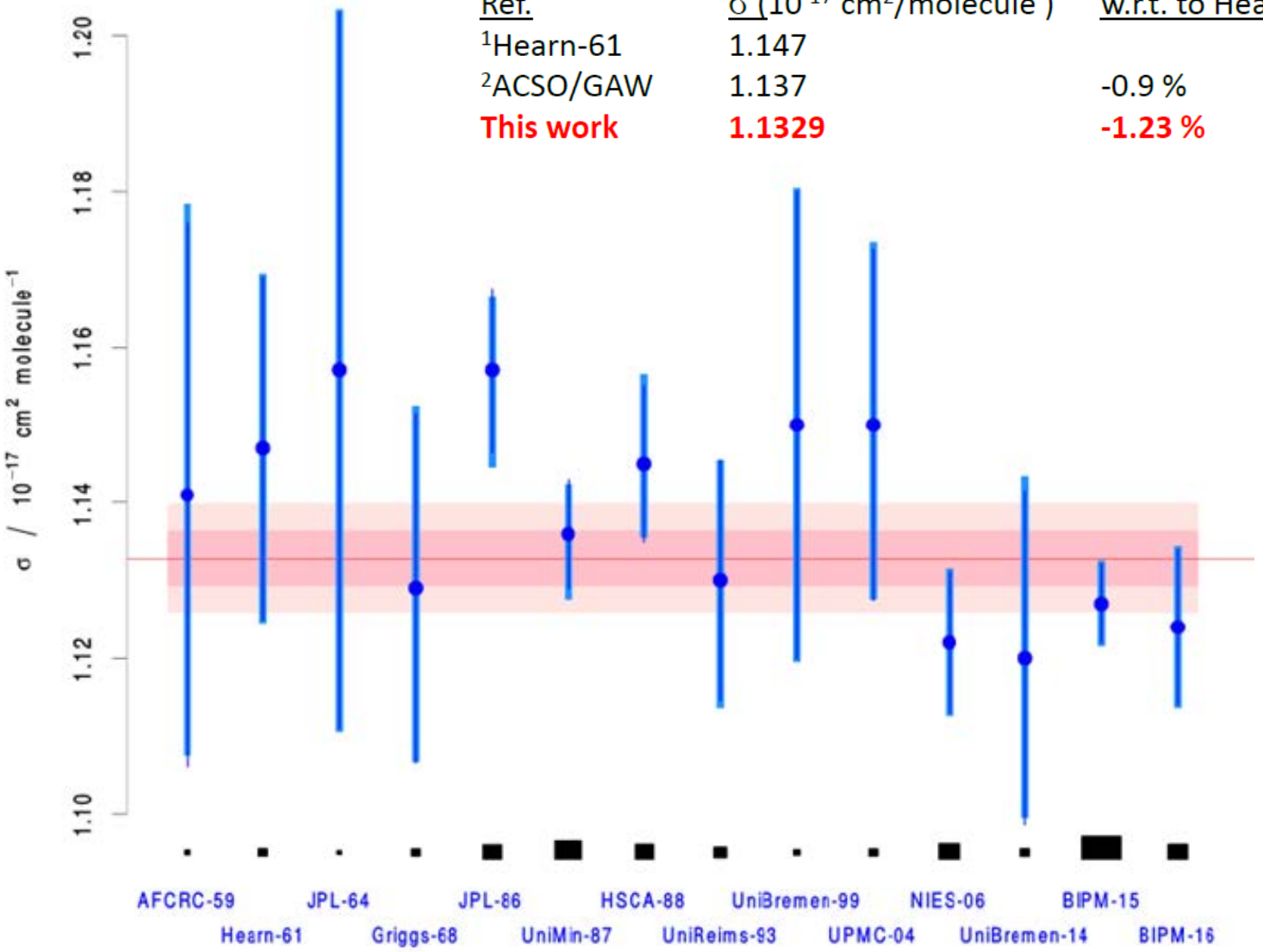
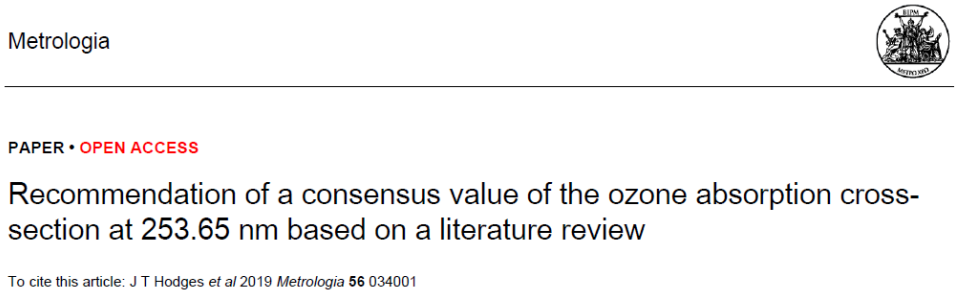
Ref.	σ (10^{-17} cm^2/molecule)	w.r.t. to Hearn	rel. std. unc. (%)
[1]Hearn-61	1.147		1.9
[2]ACSO/GAW	1.137	-0.9 %	0.8
This work	**1.1329**	**-1.23 %**	**0.31**



1. Hearn A. G., Proc. Phys. Soc. 78, 932-940 (1961)
2. WMO/GAW No. 218, Absorption Cross Sections of Ozone (ACSO) Status Report, (2015)

CCQM task group

Paper published in Metrologia



Metrologia

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Recommendation of a consensus value of the ozone absorption cross-section at 253.65 nm based on a literature review

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Recommendation of a consensus value of the ozone absorption cross-section at 253.65 nm based on a literature review

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Abstract
A detailed review and analysis of literature values for the absorption cross-section of ozone at room temperature at the mercury-line wavelength (253.65 nm, air) is reported. Data from fourteen independent sets of measurements spanning the years 1959–2016 were considered. The present analysis is based upon a revised assessment of all Type A and Type B uncertainty components for each previously reported cross-section. A consensus value for the absorption cross-section of $1.1329(35) \times 10^{-17}$ cm^2 molecule^{-1} is recommended based on statistical analysis of the weighted data. This new cross-section value is 1.23% lower and its uncertainty sixfold smaller than the uncertainty of the conventionally accepted reference value reported by Hearn (1961 *Proc. Phys. Soc.* **78** 932–40).

Keywords: ozone, absorption cross-section, reference data, troposphere

Supplementary material for this article is available online

(Some figures may appear in colour only in the online journal)

CCQM-20/30 Recommendation document approved by the CCQM in September

- The 2019 value of **1.1329 x 10-17 cm^2** and standard uncertainty **0.0035 x 10-17 cm^2** be adopted for the ozone absorption cross-section per molecule at 253.65 nm (air) for use in ozone measurement standards maintained at the BIPM and for the calculation of the reference value for the BIPM.QM-K1 on-going comparison of surface ozone measurement standards
- The BIPM and the NMIs work with the atmospheric monitoring community and other stakeholders towards a global implementation of the 2019 value
- The date of implementation of the 2019 value for the ozone absorption cross-section per molecule at 253.65 nm (air) be decided after consultation with stakeholder communities

Workshop Aims

To develop a plan and timetable for a globally coordinated and universal implementation of the ozone absorption cross-section value at 253.65 nm, published in 2019, for the measurement of surface ozone concentrations around the world.

Open sessions

5 October Surface Ozone Measurements and its Impact
6 October International Standards, Calibration Services and Monitoring Networks
7 October Air Quality Normative Aspects, Ozone Analyser Manufacturing

Task groups

1 Identifying and implementing change

How do we clearly identify the change being made?

Will a change be mandatory or voluntary?

2 Time line for change

How much time is required to prepare for change?

What is a reasonable implementation date and schedule?

3 Communicating change

How do we best publicise the change and its date/schedule?

What information needs to be provided for stakeholders?

4 Managing change

How do we best identify risks in making the change and mitigate them?

How do we deal with historic data?

8 October Breakout Sessions for Task Groups
9 October Feedback from Task Groups, Conclusions and Recommendations

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CCQM-GAWG Ozone Task Group

J T Hodges (NIST) | J Viallon (BIPM) | R I Wielgosz (BIPM) | S Lee (KRISS) | P J Brewer (NPL) | J Walden (FMI) | A Possolo (NIST) | V Gorshelev (IUP-Bremen) | C Janssen (Observatoire de Paris) |M A H Smith (NASA) | B J Drouin (JPL)

Workshop Steering Committee Members

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