Impact of the ozone cross-section on air quality compliance

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Ambient air quality standards for ozone

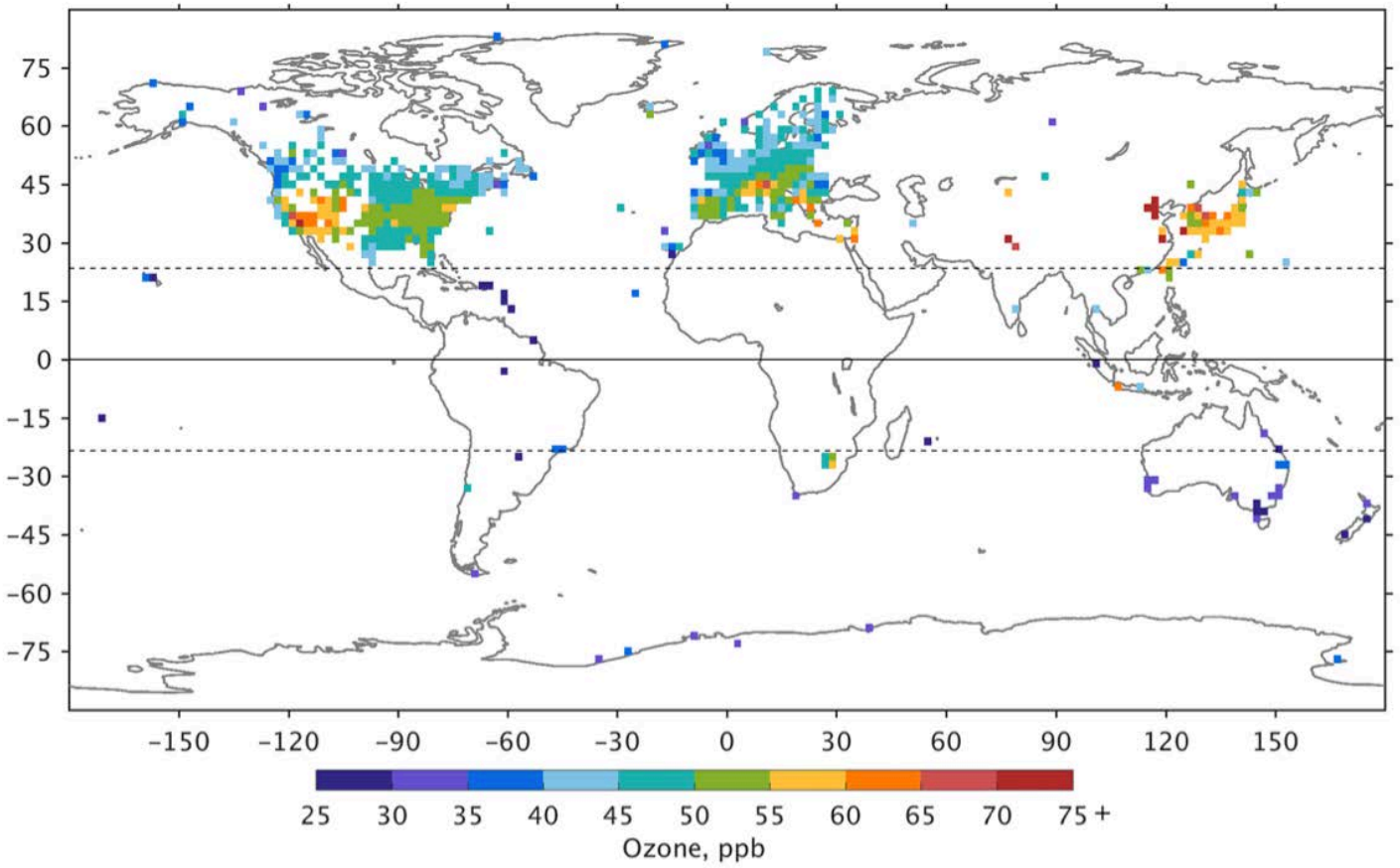
Entity	Air quality standard	Monitoring network and data source
European Union	Non-attainment if there are more than 25 days year^{-1} in which the maximum daily 8 h average (MDA8) ozone concentration exceeds 120 μg m^{-3}, averaged over 3 years (EEA, 2002).	European Environment Agency AirBase; http://www.eea.europa.eu/data-and-maps/data/airbase-the-european-air-quality-database-8
United States	Non-attainment if the annual fourth-highest ozone MDA8 mixing ratio averaged over 3 years is above 75 ppbv (EPA, 2008).	Environmental Protection Agency Air Quality System (EPA AQS); http://www.epa.gov/airquality/airdata/ad_data.html
Canada	Non-attainment if the annual fourth-highest MDA8 ozone mixing ratio averaged over 3 years is above 63 ppbv (CAN, 2012).	Environment Canada National Air Pollution Surveillance Program (NAPS); http://maps-cartes.ec.gc.ca/rnspa-naps/data.aspx

Some other countries, not included in this analysis:

Japan	Hourly maximum not to exceed 60 ppb
Australia	4-hour mean not to exceed 80 ppb
China	8-hour mean: Class 1: 100 μg m^{-3}, Class 2: (urban) 160 μg m^{-3}
WHO (2005)	8-hour mean 100 μg m^{-3}

Why a small change in the cross section can make a large difference

- Since the mid 2000s many monitoring locations in N America and Europe sit close to, (either above or below) the relevant national air quality limit or standard for ozone.
- In the USA – large number of sites clusters around annual means in the range 50-80 ppb
- In Southern Europe, many sites around 60 ppb annual mean



TOAR tropospheric ozone assessment report

IGAC

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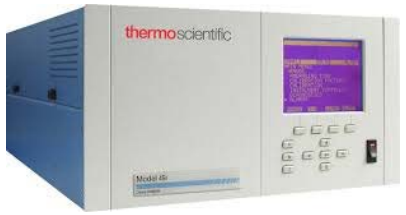
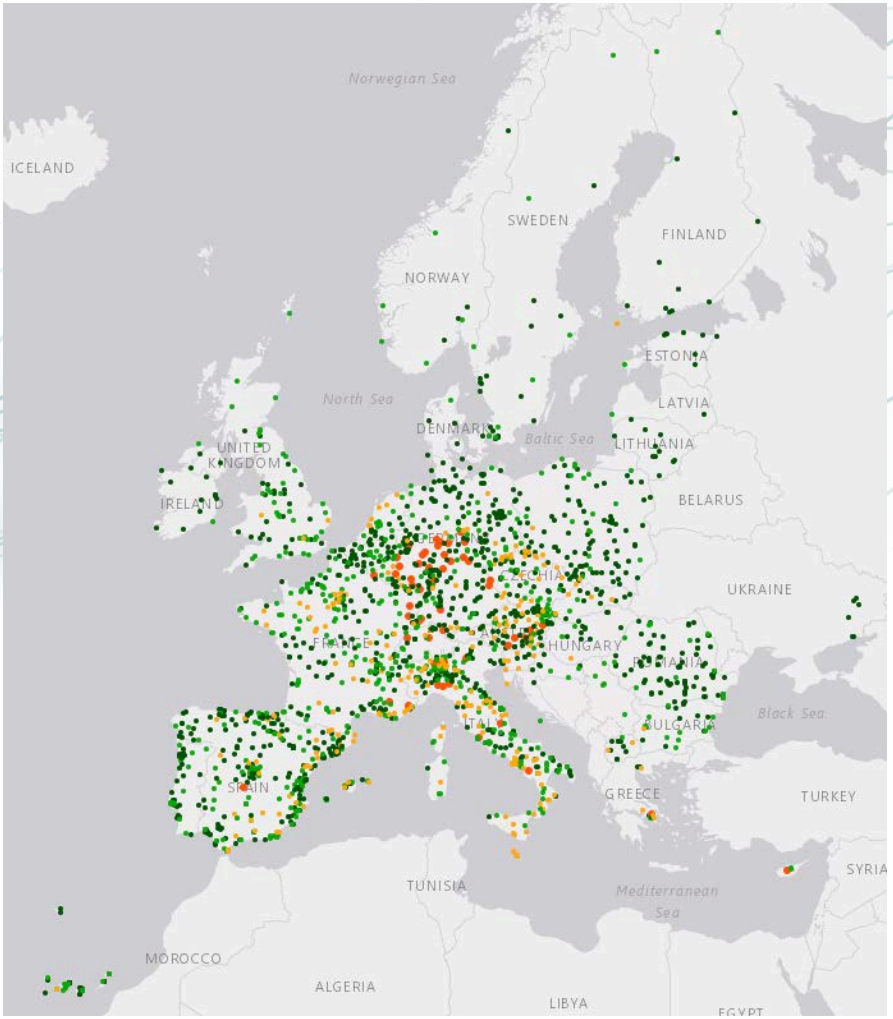
Surface annual ozone: Data reproduced from the Tropospheric Ozone Assessment Report – see Elementa Special issue at https://collections.elementascience.org/toar/

The dominance of the UV spectrometer and compliance



- The EU AirBase is a composite database made up of air quality data contributed by 40 European member states with a total of 3524 sites that measure ozone.
- The vast majority of observations are made using UV absorption instruments, with a very small subset using other methods such as chemiluminescence.
- Eight of the 3524 AirBase sites used chemiluminescence in 2012.
- Out of 2326 EPA sites that have reported ozone, only 52 have used chemiluminescence at some point since 1993. None were used after 2012.



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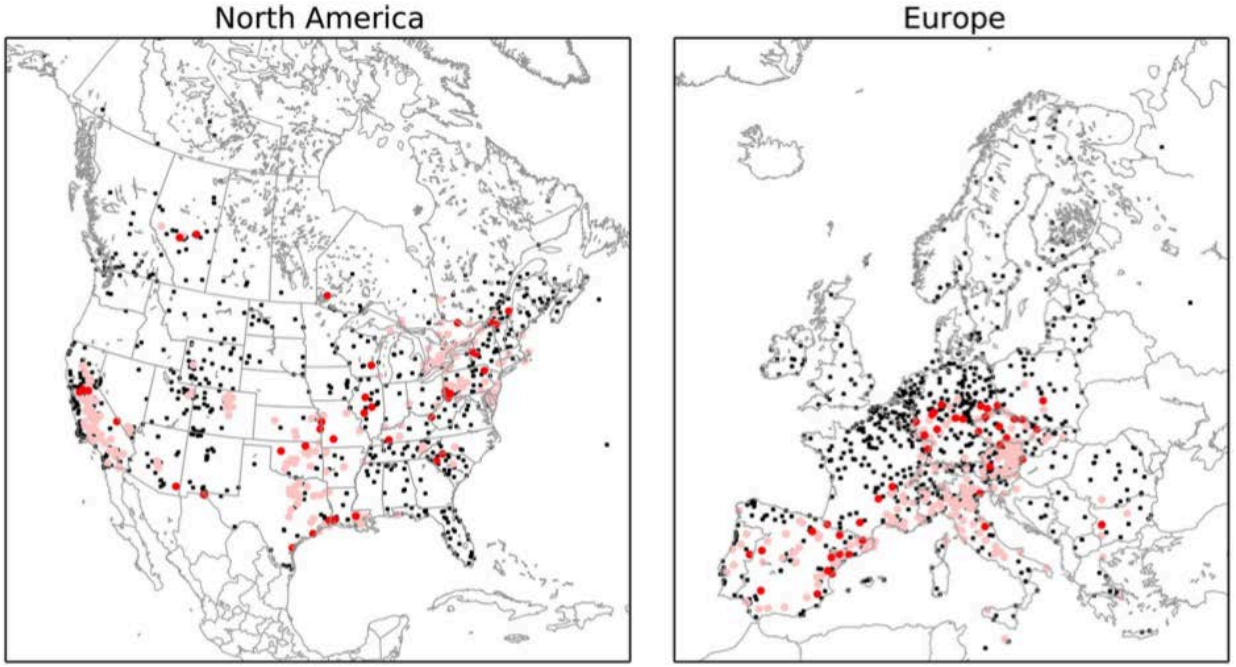
Quantifying the impact of a change in cross section on compliance

(An initial analysis in 2015 based on Viallon et al. ACP 2015)



18% increase in sites non-compliant in USA
23% increase in sites non-compliant in Canada
20% increase in sites non-compliant in Europe

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www.atmos-meas-tech.net/8/1245/2015/
doi:10.5194/amt-8-1245-2015

Atmospheric Measurement Techniques

Accurate measurements of ozone absorption cross-sections in the Hartley band

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Atmospheric Chemistry and Physics

Updated ozone absorption cross section will reduce air quality compliance

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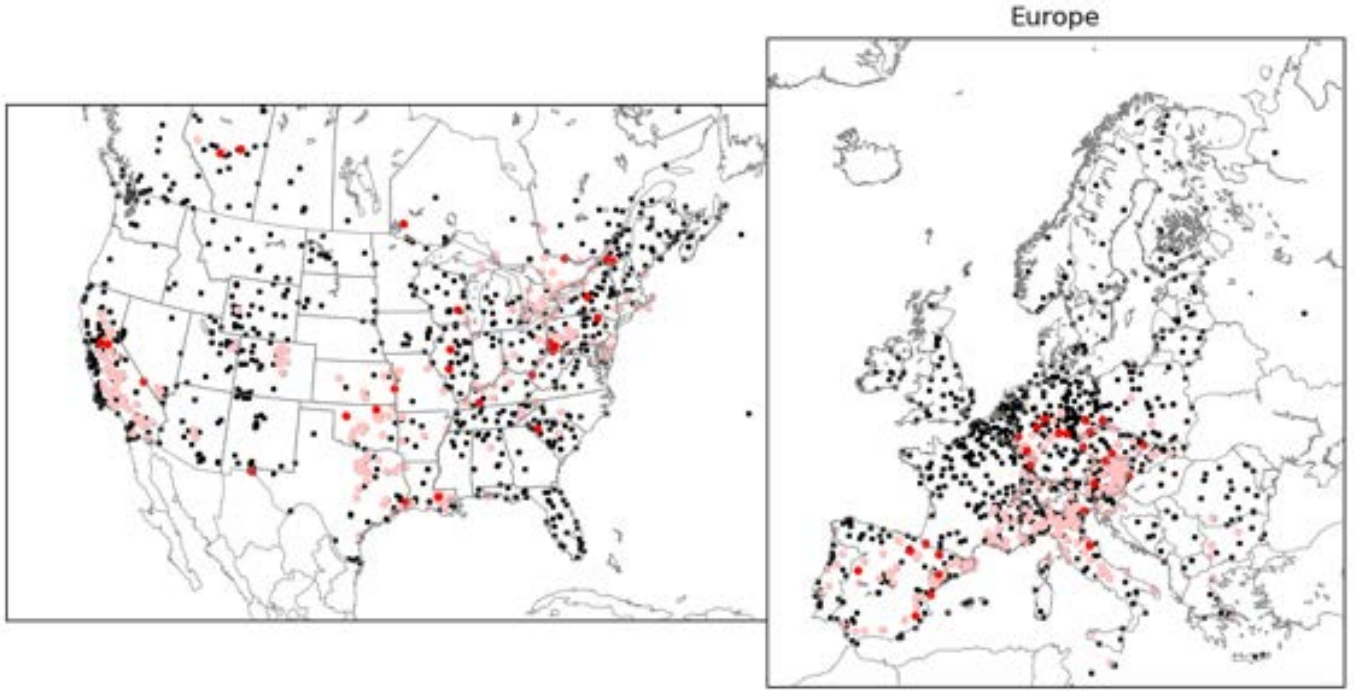
Quantifying the impact of a change in cross section on compliance

(Re-analysis, same methods and data but with the **2019 consensus value**)



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https://doi.org/10.1088/1681-7575/ab0bdd

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

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Newly non-compliant under Hodges et al. [2019].
Non-compliance under Hearn [1961] and Hodges et al. [2019]
Other sites compliant or missing data

11% increase in sites non-compliant in USA
20% increase in sites non-compliant in Canada
12% increase in sites non-compliant in Europe

→ **Impacts e.g. tips Wisconsin and Illinois into non-compliance?**

→ **Impacts e.g. tips Belgium into non-compliance?**

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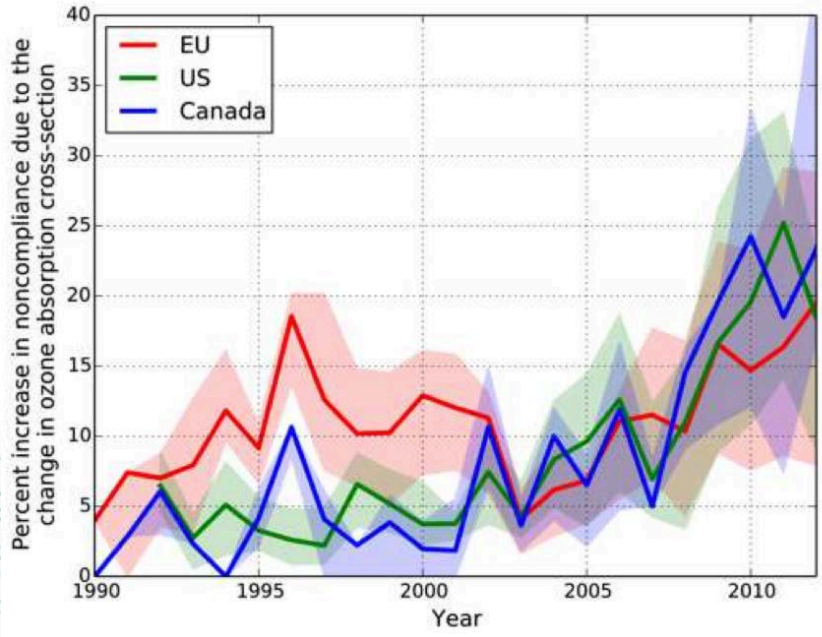
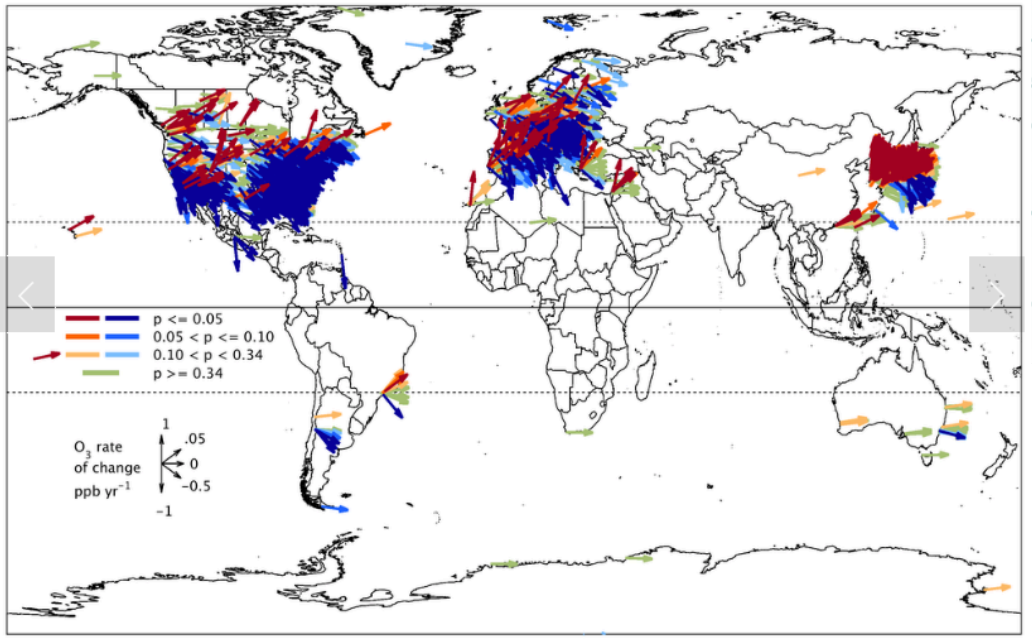
Long-term trends in ozone and impact on non-compliance

- The change in ozone cross-section has an increasing effect over time.
- Ozone in North America and Europe has broadly fallen over 30 years
- More locations are now coming close to the compliance threshold compared to the mid-90's when many were above



Increase in non-compliant monitoring sites due if past values changed to new ozone cross section value



Trends in surface ozone
from Chang, K.-L. *et al*., 2017. Regional trend analysis of surface ozone observations from monitoring networks in eastern North America, Europe and East Asia. *Elem Sci Anth*, 5, p.50. DOI: http://doi.org/10.1525/elementa.243

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Will this all matter?

- The key trends in ozone over time don't change.
- Scientists / professional users can likely handle any change if implemented.
- Previous studies of health and ecosystem damage remain valid, since all were undertaken relative to old cross-section
- Possible impacts will be challenges to compliance with legal obligations for clean air
- **Legal challenge of compliance with standards** is an increasingly popular route for campaigning groups and NGOs

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Unsafe ozone levels blight Britain's urban areas daily

Analysis of Met Office data show air pollution levels above WHO limits

Cambridge was one of two places in the UK with the most days of potentially harmful levels of ozone pollution in 2018 © Brian Harris/Alamy

Camilla Hodgson in London FEBRUARY 21 2020

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Air pollution: UK government loses third court case as plans ruled 'unlawful'

High court says approach to tackling pollution in 45 local authority areas is 'not sufficient' and orders urgent changes

▲ The case is ClientEarth's third legal challenge against plans to reduce illegal levels of nitrogen dioxide. Photograph: Nick Ansell/PA

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