

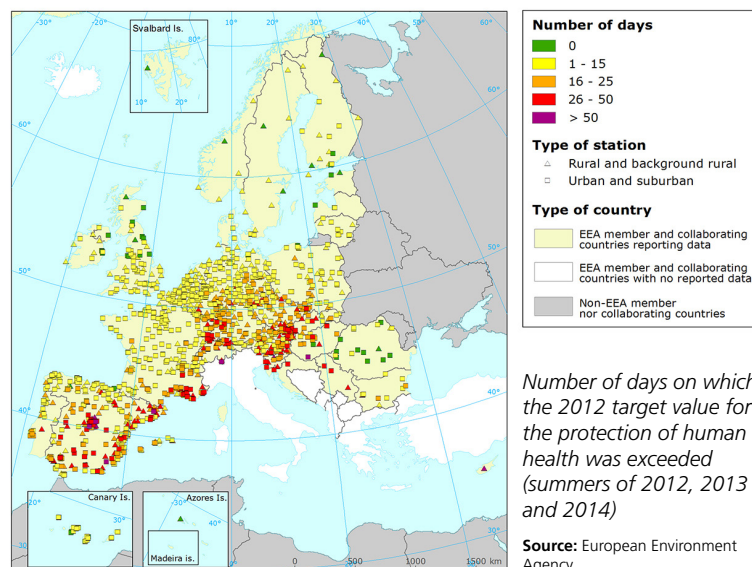


Global Challenge Network on Tropospheric Ozone

Health effects of ozone

Established & emerging findings on health effects of ground-level ozone

Exposure to ground-level ozone damages human health, especially, but not only, people's respiratory (lung system) health. The strongest evidence comes from numerous studies of short-term exposure, i.e. of daily concentrations measured variously as daily 1 hour maximum or daily 8 hour maximum or 24 hour mean concentrations. Daily ozone concentrations increase all-cause, cardiovascular and respiratory mortality; respiratory hospital admissions; asthma severity; and, less clearly, cardiovascular hospital admissions. A 2014 report by the European Environment Agency (EEA) calculated exposure to ozone leading to 16,000 premature deaths in the EU in 2011 (assuming a threshold of 35 ppb).



Key Facts

- Experimental studies suggest that high concentrations of ground-level ozone are a health hazard because ozone can irritate airways, cause breathing difficulties and damage lungs, with effects being more noticeable in people with asthma and other lung problems.
- These results are supported by animal and human exposure studies and experimental models on a range of outcomes relevant to lung health and, to a lesser extent, blood circulation.

Links

www.eea.europa.eu/publications/air-quality-in-europe-2014

uk-air.defra.gov.uk/library/aeqg

www.gov.uk/government/groups/committee-on-the-medical-effects-of-air-pollutants-comeap

www.euro.who.int/en/health-topics/environment-and-health

www.ersnet.org

royalsociety.org/policy/publications/2008/ground-level-ozone

Recent developments

In contrast to the established effects of short term exposure, there are far fewer studies of longer term exposures, i.e. exposure over months and years and these are more difficult and expensive to do.

Nevertheless, there is suggestive evidence from studies in the US that long-term exposure to high summer average ozone levels increases respiratory mortality, especially among people with serious health conditions such as Chronic Obstructive Pulmonary Disease (COPD), diabetes, congestive heart failure or myocardial infarction. Further evidence suggests that long-term exposure increases the number of new cases of asthma and slows lung function growth in children.

But there is no clear evidence of a threshold or safe level for the population as a whole. One possible reason is that exposure to ozone can further deplete anti-oxidant defences if these are already low for other reasons such as disease. Consequently some people are more vulnerable than others. Children and people with asthma or other respiratory illnesses are particularly high-risk groups.

One significant development in recent years is the new evidence, that long-term exposures to

summertime ozone may increase respiratory deaths, especially in warmer conditions or at higher ozone concentrations, and especially among individuals with predisposing chronic conditions. The evidence is limited so far, but the effect is now included in major impact assessments such as the recent Global Burden of Disease project. The issue of a threshold for ozone health effects is still debated.

The World Health Organisation (WHO) evidence review REVIHAAP reported inconsistent evidence for a threshold for short-term exposure; where a threshold is observed, it is likely to lie below $90 \mu\text{g}/\text{m}^3$ (45 ppb) for a one hour daily maximum.

REVIHAAP also reports emerging evidence suggesting that ozone exposure adversely affects cognitive development and reproductive health, including preterm birth.

What is needed?

Future increases of exposure of urban populations to high ozone levels are likely, due to rises in ambient temperature and frequency of heat-waves caused by climate change. Also, reducing emissions of nitrogen oxides (from road transport sources and the direct release of nitrogen dioxide from diesel vehicles equipped

with diesel oxidation catalysts) contributes to an alteration in the composition of the urban atmosphere, and in particular may increase ozone concentrations close to where emissions of nitric oxide (a precursor of nitrogen dioxide) have been reduced. This has two main consequences:

- First, it increases the importance of designing integrated emission control policies. Effects of short-term exposures are the focus of current regulation and REVIHAAP suggests that limit values and exposure metrics for ground level ozone need to be revised to improve the protection of public health. The review also recommends the development of Air Quality Guidelines for long-term average ozone concentrations, including the effects of long-term exposure and whether or not there is a threshold.
- Secondly, it emphasises the importance of gaining a better understanding of the human health effects of ground-level ozone, and especially of gathering further evidence on the effects of long-term exposure, whether or not there is a threshold, possible mechanisms of action, and on possible reproductive effects.

The Ozone Challenge

Ozone is formed in the lower atmosphere by the action of sunlight on nitrogen dioxide (NO_2), which is naturally present from lightning, biomass burning and soil emissions; man-made contributions to NO_2 from burning fossil fuels dominate in developed regions. Ozone formation is accelerated by the presence of organic gases, both biogenic and man-made. Ozone is toxic to plants, animals and humans; toxic concentrations are found in polluted air, downwind of NO_2 sources and especially in strong sunlight. Ozone is removed from the atmosphere by deposition to plants, and also by reaction with nitric oxide (NO) to form NO_2 .

Further information and contact details:

www.ozone-net.org.uk

Other Fact sheets in the series:

- Ozone monitoring
- Ozone modelling
- Ecosystem effects of ozone
- Agricultural and crop-effects of ozone