Global Challenge Network on Tropospheric Ozone

Ozone monitoring

How much, where and why?

Before industrialization, tropospheric (lower atmosphere) ozone concentrations were approximately 10 ppb (or 20 µg m^{-3}) globally. Man-made emissions of the precursor gases have increased this background concentration to 20-30 ppb. However concentrations of ozone can be much larger than the 'background', because of local or regional variations in precursor emissions and land-use.

Concentrations of ozone in the lowest part of the atmosphere, the surface or boundary layer, can vary by factors of 10 to 100 over a typical city and its suburban to rural surroundings. In order to warn of possible human health impacts and estimate the effects of ozone on environmental health, adequate monitoring is required, to quantify the spatial and temporal variations in ozone concentrations.

Ozone measurements at the EMEP Supersite at Auchencorth Moss, UK

Photo: Mhairi Coyle

Key Facts

- Ozone concentrations are monitored across the UK and in other countries using networks of automated instruments.
- These provide data to estimate risks to human and plant health from both short-term ozone 'episodes' and long-term exposure.
- Measuring fluxes, rather than concentrations, is not currently done routinely because of the need for faster instruments; this means that our estimates of damage to plants and overall removal rates from the atmosphere are uncertain.

Links

http://uk-air.defra.gov.uk/

http://www.emep.int

http://www.wmo.int/pages/prog/arep/gaw/ozone/

www.nceo.ac.uk

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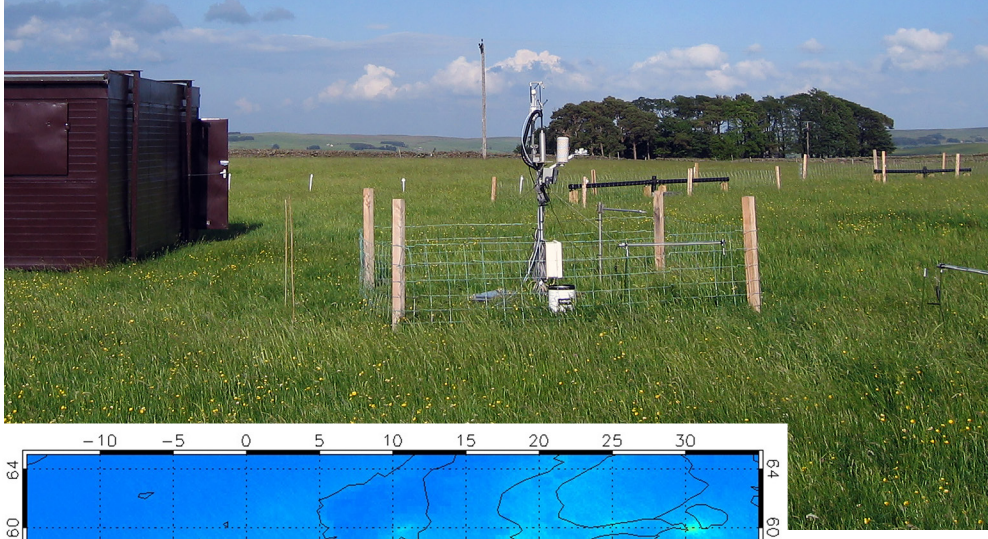


Ground-based measurements of tropospheric ozone deposition at a rural field site

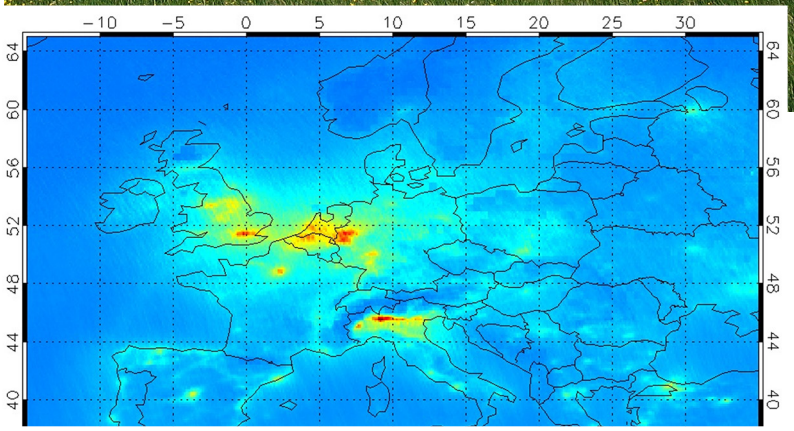
Photo: Mhairi Coyle

Recent developments

Ozone has been systematically measured across the UK using automatic analysers since ca. 1972, although some earlier research data exist. Since then, data have been compiled by the UK Photochemical Oxidants Review Group (PORG, who were a group of scientists brought together by the UK government to assess air pollution in the UK from gases such as O_3) and now form part of the national air quality data archive and monitoring network with ca 130 sites across the UK (http://uk-air.defra.gov.uk/).

UV-photometry instruments have become the standard method for measuring ozone, and are used by most national monitoring networks, industry and researchers.

However, their slow response time means they cannot be used for rapid (faster than 1 sec) monitoring of ozone fluxes, and semi-quantitative methods based on fluorescence have been developed. More recently, advances in Earth Observation, e.g. the Ozone Monitoring Instrument (OMI) enable satellite based monitoring of tropospheric ozone concentrations.



Earth observation of tropospheric chemistry (e.g. Ozone Monitoring Instrument (OMI)

Source: NASA

What is needed?

We need to monitor average atmospheric ozone concentrations to assess risks to people and ecosystems, and that requires the deployment of accurate low-cost, low-power instruments.

We also want to quantify the rate at which plants take up ozone, leading to damage.

The most direct way to measure this deposition is to use very fast response sensors but current methods must be calibrated in the field, and require a reactive chemical to be replaced regularly. Sensors such as quantum cascade lasers could be developed to measure ozone deposition more accurately, leading to better estimates of plant exposure, and better quantification of overall ozone removal rates at the earth's surface.

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 modelling
- Health effects of ozone
- Ecosystem effects of ozone
- Agricultural and crop-effects of ozone