

2.13 Aerosols

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Atmospheric aerosols are small particles in the air that may be formed by natural or human activities. They include volcanic dust, wind-lifted dust, sea salt from spray, soot, industrial dust and sulphates. Industry, burning of fossil fuels and vegetation fires are some of the primary human activities that generate aerosols. They are relevant to climate in that they influence the global radiation balance directly by scattering and absorbing radiation and indirectly through influencing cloud albedo (reflectivity), cloud cover and lifetime. However, the magnitude of their effects on climate remains a significant source of uncertainty.

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Map 2.13. Location of aerosol observation stations.

‘The magnitude of the effects of aerosols on climate is a significant source of uncertainty.’

Measurements

Observations are made at the Mace Head Atmospheric Research Station, Carna, Co. Galway and Valentia Observatory, Co. Kerry. A range of aerosol parameters has been measured on a continual basis at Mace Head since 1986, although some measurements took place on an intermittent basis from 1958. Measurements made include the scattering, backscattering and absorption coefficient at various wavelengths; the total

particle number concentration, particle size and mass distribution; particulate matter (PM) mass (PM10 and PM2.5); black carbon mass concentration; aerosol flux, aerosol optical depth, cloud condensation nuclei; and aerosol chemical composition. This suite of measurements is one of the most comprehensive made at any remote location in the world, and measurements are webcast in near real time every 10 minutes. Routine condensation nuclei measurements were made at Valentia Observatory between 1951 and 1994. Measurements of aerosol optical depth are currently carried out at the Observatory.

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Range of satellite sensors, such as MODIS on board the *NASA TERRA* and *AQUA* satellites make observations from which the aerosol optical depth can be inferred. *In situ* measurements are critical for validation of such observations.

'The suite of aerosol measurements at Mace Head is one of the most comprehensive in any remote location in the world.'

Time-series and Trends

The quantity, composition and location of aerosols in the atmosphere vary throughout the year. An example of aerosol measurements made at Mace Head is shown in [Fig. 2.25](#). This time-series of monthly geometric mean values of aerosol scattering coefficient for the period from 1999 to 2010 is an estimate of aerosol concentration. No trend is evident in the time-series.

[Figure 2.26](#) shows a global map of aerosol optical depth as inferred from the MODIS sensor on the *AQUA* satellite, for the period August to October 2010. High aerosol optical depth over the Amazon region, parts of Siberia and south-western Africa is likely due to vegetation fires. Dust from the Sahara is carried out over the Atlantic Ocean and industrial aerosol is evident across southern Asia.

'The Mace Head aerosol observation programmes lack long-term and sustainable operational support.'

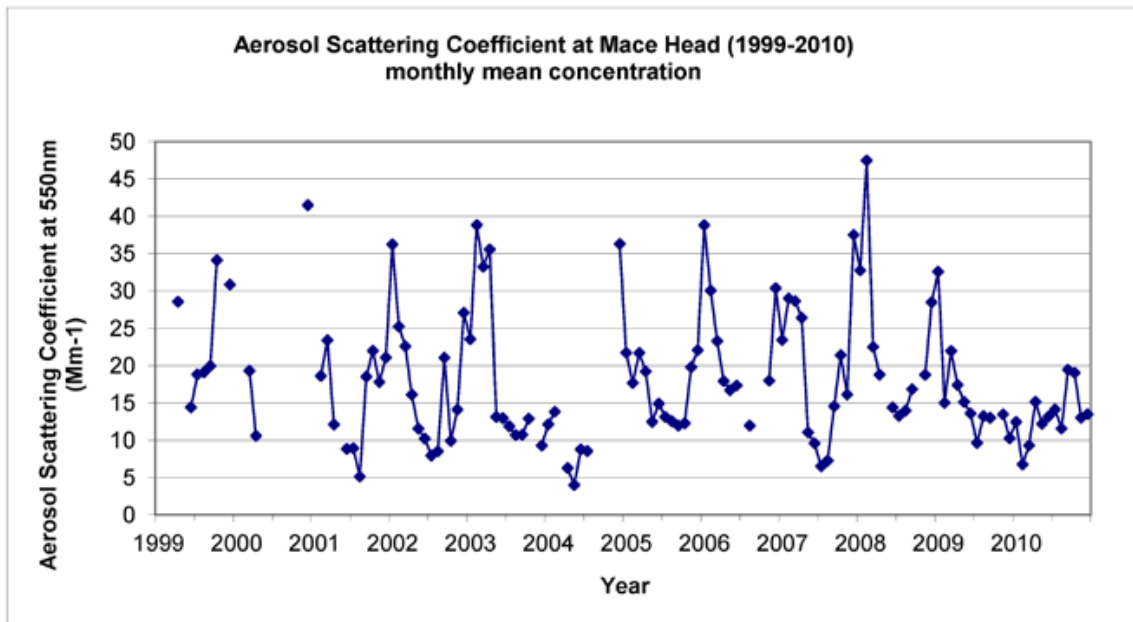


Figure 2.25. Monthly geometric mean values of aerosol scattering coefficient observed at Mace Head (1999–2010). There are some gaps in the data record.

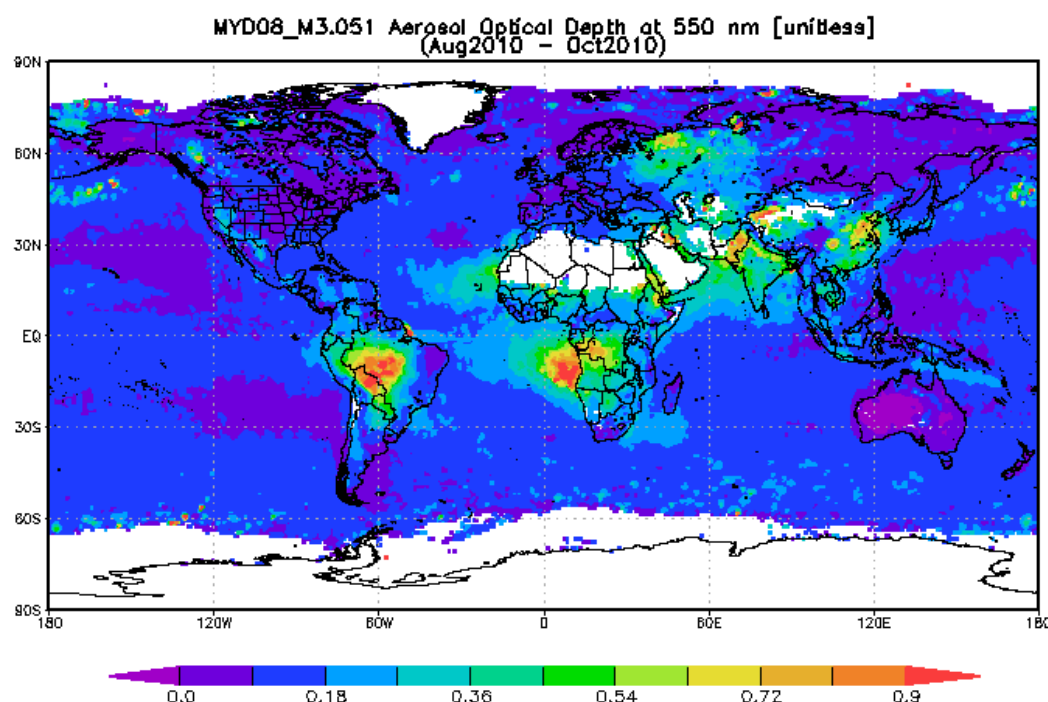


Figure 2.26. Example of global aerosol optical depth for the period August to October 2010 as derived from satellite observations.

Maintaining the Observations

Funding for aerosol observations at Valentia Observatory is provided from Met Éireann's operational budget. Equipment maintenance and data-handling are carried out by skilled on-site staff, in cooperation with the World Optical Depth Research and Calibration Centre. The Mace Head aerosol observation programmes are funded on an ad hoc basis from a range of projects by the Centre for Climate and Air Pollution Studies [C-CAPS], School of Physics at the National University of Ireland, Galway, but lack long-term and sustainable operational support.

Further Information and Data Sources

O'Connor, T.C., Jennings, S.G. and O'Dowd, C.D. (2008) Highlights from 50 years of aerosol measurements at Mace Head, *Atmospheric Research*, Vol. 90, pp. 338–55.

Information on the Mace Head Facility:

<http://www.macehead.org>

A description of the Aerosol Optical Depth Measurement Programme at Valentia Observatory:

<http://www.met.ie/about/valentiaobservatory/aerosol.asp>

World Data Centre for Aerosols: <http://ebas.nilu.no/>

Aerosol optical depth observations from Irish and international stations may be accessed at the World Optical Depth Research and Calibration Centre:

<http://www.pmodwrc.ch/worcc/>

Information and data from ESA's Climate Change Initiative aerosol project:

<http://www.esa-aerosol-cci.org/>

Aerosol optical depth as inferred from satellite sensors may be accessed at: http://gdata1.sci.gsfc.nasa.gov/daac-bin/G3/gui.cgi?instance_id=aerosol_monthly