UNITED KINGDOM

MONITORING STRATOSPHERIC AND BOUNDARY LAYER OZONE

Defra funds an on-going monitoring programme that records total values of stratospheric ozone at two UK locations. At the end of 2003 the measurements from the Dobson instruments at Camborne Observatory were replaced by a Brewer spectrophotometer in Reading. The UK Met Office continues to make measurements with the Dobson instrument at the Lerwick Observatory in the Shetland Islands. The spectrophometers are used to record daily values, except when weather conditions prevent values from being recorded and during the winter in Lerwick when the sun is too low in the sky.

The data are processed daily by the local operators and then quality checked and disseminated. A number of checks are performed in order to ensure the integrity of these data, including comparison of daily results with satellite measurements, and the nearest ground-based measurements. Dissemination involves uploading a 'best daily average' to a dedicated web page on the internet and issuing the results to the World Ozone and Ultra Violet Data Centre (WOUDC) Real-time Mapping Centre. Monthly data are submitted to the WOUDC for inclusion on their archive.

Days where the processed total ozone is below two standard deviations less than the long-term average mean for that month are designated as 'low ozone' events and are reported to the UK government immediately along with additional analysis.

The Reading Brewer 075 instrument (operated by Manchester University) was serviced and calibrated against a reference standard by IOS (International Ozone Services) in April 2004. It is intended to take both Brewer instruments to the first Regional Brewer Calibration Centre-Europe (RBCC-E) intercomparison exercise for the RA IV region at EL Arenosillo Spain in September 2005.

The Dobson spectrophotometer intercomparison, took place at the Regional Dobson Calibration Centre (MOHP), Hohenpeissenberg, Germany from 9th May 2004 to 29th May 2004. This forms part of the World Meteorological Organisation's QA/QC programme to assure the quality of the measurements and to assess the performance of the instruments. All instruments are carefully maintained and checked monthly.

Manchester University has two ozone lidar instruments; a fixed system for upper troposphere/lower stratosphere, and a trailer-mounted system for boundary layer/lower troposphere. They are both used on a campaign basis to study particular scientific issues. Most of their recent ozone work has been concerned with the boundary layer.

STRATOSPHERIC OZONE RESEARCH

Defra funds a research project that analyses the ozone data collected at Reading and Lerwick. This research focuses on identifying low ozone events, and predicting how the frequency of low ozone events could alter as stratospheric levels change.

The Natural Environment Research Council (NERC) funds the Upper Troposphere/ Lower Stratosphere (UTLS) OZONE Programme, which commenced in 1999 and will continue for 7 years to 2006. The main aim is to improve understanding of the causes of ozone change in the UTLS in the past, present and future. This is a region where ozone has been changing but the causes still remain uncertain. To date, 43 scientific research projects have been funded which cover a wide variety of research topics. These range from transport of trace gases on annual and seasonal timescales, dynamical processes occurring on short-timescales, studies of chemical processes in the atmosphere and the laboratory and modelling studies of chemistry-climate interactions. This research has led to an improved understanding of chemical composition and structure in the UTLS

region between 6 and 20km and has resulted in 157 refereed publications to date. Results from the Programme have shown, in particular, that interactions between dynamics (meteorology) and chemistry in the atmosphere play an important role in governing the distribution of ozone and other trace gases in the UTLS.

The European Commission (EC) research programmes encourage collaborative projects involving research groups in different countries. The European Ozone Research Co-ordinating Unit (EORCU), which is based at the University of Cambridge was set up in 1989 to coordinate stratospheric ozone research in Europe from both the national research programmes and the European Union research programme. There are now many joint projects between European scientists. Those listed below are coordinated by UK institutions.

The UK Met Office was the coordinator of the EuroSPICE project (Stratospheric Processes and their impacts on Climate and the Environment) which completed in 2003 (other partners were: CNRS-SA, France, CNRS_LMD, France, Finnish Met. Inst., Finland, Free University of Berlin, Germany, University of Reading, UK, University of Buenos Aires, Argentina). The specific aim of the EuroSPICE project was to update the observed stratospheric trends in ozone, surface UV and temperature and simulate those trends using climate models with/without coupled chemistry. The simulations were then used to predict the behaviour of these parameters over the period 2000-2019, determining the likely cause of past stratospheric trends and developing understanding of the impact of stratospheric change.

Imperial College, London coordinated SOLICE (SOLar Impacts on Climate and the Environment) was funded under the 5th FP and completed in March 2003 (other partners were: Free University of Berlin, Germany, University of Oslo, Norway, CNRS-SA, France, University of Thessaloniki, Greece, CCLRC, UK, University of Arizona, USA, Goddard Institute for Space Sciences, USA). Objectives included the assessment of the impact of solar variability on stratospheric ozone, radiative forcing and surface UV using coupled chemistry-climate models and to produce 3-D measures of the solar signal in temperature, geopotential height and ozone over the next solar maximum.

The university of Cambridge coordinate SCENIC (Scenario of Aircraft emissions and impact studies on chemistry and climate), which is part of CORSAIRE a European research cluster used to coordinate stratospheric ozone research (5th FP funding) (other partners were Airbus, France, University of Oslo, Norway, Airbus GmbH, Germany, Centre National de Recherches Meteorologiques (CNRM), France, Deutsches Zentrum fur Luft- und Raumfahrt e.V (DLR), Germany, Office National d'Etudes et de Recherches Aerospatiales (ONERA), France, University of L'Aquila, Italy, Airbus, UK, Centre National de la Recherche Scientifique (CNRS), France). SCENIC is investigating the potential future impact of aviation on atmospheric composition and climate, and how possible environmental impacts may be reduced. These questions are addressed by performing modeling studies and will influence the detailed design and operation of a possible new supersonic fleet. Atmospheric researchers and the aviation community are collaborating closely in SCENIC. Specifically, this work package aims to study the direct impact of supersonic emissions of water vapour and NOx on ozone chemistry and transport in the UTLS, and secondly the feedback of climate change, due to supersonic aircraft emissions, on ozone chemistry and transport.

TROPOSPHERIC OZONE MONITORING AND RESEARCH

Ground-level ozone is recorded hourly at 73 automatic recording stations (52 urban and 19 rural) across the UK.

A number of research programmes both funded by Defra and NERC and looking into the impacts of tropospheric ozone on vegetation and the impact o the global carbon cycle. Research into the impacts of changing tropospheric ozone levels on vegetation has also been funded by Defra.

Tropospheric ozone modelling is carried out at the Met Office as part of the Climate Prediction Programme funded by Defra. Prediction of future climate requires predictions of radiatively-active trace gases such as ozone, and a coupled climate-chemistry model has been developed to fulfil these requirements. Work continues to develop and validate chemical and aerosol aspects of the model. Work is underway to validate the model against ozonesonde (a lightweight, balloon-borne instrument that is mated to a conventional meteorological radiosonde) and other measurements.

Defra also fund a project across a number of UK Universities to develop tropospheric ozone models. Forecasting the formation of ground-level ozone requires the use of sophisticated numerical models to understand the factors affecting its production and subsequent control. The objective of the project is to develop a modelling capability to treat ozone formation (a) on all spatial scales from urban areas at high spatial resolution to the global scale so that ozone production on the regional and global scales is linked and (b) from timescales of hours, to reproduce the diurnal behaviour of ozone to decades so that the influence of climate change can be assessed.

MONITORING OZONE-DEPLETING SUBSTANCES

Defra has provided support for projects that monitor ozone-depleting substances by analysing ground-based measurements at Mace Head (Ireland). Since 1987, high frequency, real time measurements of the principal halocarbons and radiatively active trace gases have been made at Mace Head, Ireland.

Using the Mace Head data and a Lagrangian dispersion model, NAME (Numerical Atmospheric dispersion Modelling Environment), driven by the output from the U.K. Met Office's Numerical Weather Prediction model it is possible to estimate Northern Hemisphere baseline concentrations for each trace gas and their European and UK emission distributions. This verification work is consistent with good practice guidance issued by the Intergovernmental Panel on Climate Change (IPCC).

MONITORING AND RESEARCH INTO EFFECTS OF INCREASED UV-B RADIATION

Two UV monitoring sites are in operation – there is a green-field site at Reading, and a city site in Manchester. The Reading site spectroradiometer is calibrated on site and has been providing regular measurements since 1993. It provides hourly spectrums between sunrise and sunset in the 280-500nm range. Periodic international comparisons with other UV spectroradiometers have provided consistently good results. The Manchester instrument provides five minute averages in each of five narrow wavebands (305, 313, 320, 340, 380nm). Apart from calibration periods, the instrument has been in continuous operation since 1997, and provides a southern site in the Nordic network of GUV radiometers. The measurement data are submitted to the World Ozone and Ultraviolet Data Centre.

The solar UV index is measured at seven the sites in the UK by the Radiation Protection Division of the Health Protection Agency. The Department of Health provides support for UV monitoring performed by the National Radiological Protection Board (NRPB). The Solar Radiation Monitoring Project at NRPB provides information for the Global Solar UV Index in association with WHO, WMO, UNEP and the International Commission on Non-Ionizing Radiation Protection.

Commitment to future monitoring and research

At this stage Defra has not specified the areas that will receive direct government funding in the future. However, given the high priority of VCV/3 part (d), some research into stratospheric interactions and climate will be included in the contract funded by Defra at the Met Office. Monitoring of a comprehensive range of ODSs will be funded, for at least the next three years, in

line with VCV/3 part (a). The current basic level of ozone monitoring will be maintained, but any expansion of the monitoring activities will depend on budgetary constraints.

NERC are planning to support future ozone research through their UTLS (Upper Troposphere Lower Stratosphere) completing in 2006 www.utls.nerc.ac.uk.

Further information

Details of Defra funded research, including the full reports for scientific contracts, can be accessed from the Defra website at www.defra.gov.uk by following the links to the environment pages.

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