

## DENMARK

### Stratospheric ozone monitoring

Daily observations of total ozone are performed by the Danish Meteorological Institute (DMI) in Denmark and Greenland:

Station	Location	Instrument	Start of observations
Copenhagen	56°N, 12°E	Brewer Mark IV	May 1992
Sondre Stromfjord (Kangerlussuaq)	67°N, 51°W	Brewer Mark II	September 1990
Thule Air Base (Pituffik)	77°, 69°W	SAOZ UV-vis 1024 diode array	September 1990

On non-regular basis, total ozone has also been measured from Qaanaaq in Greenland (78°N, 69°W), using the DMI Dobson #92 instrument since early 2000. One reason for moving the instrument to this location is the possibility to measure total ozone in the polar night in winter time using the Moon as the light source.

Weekly ozone soundings have been performed using balloon-borne ECC sensors from Scoresbysund (Illoqqortoormiut, 71°N, 22°W) since January 1993. Additional ozone soundings have also been performed on campaign basis from Scoresbysund and Thule each winter since January 1992 and occasionally from Copenhagen. Many of these ozone soundings have been used in European Match-campaigns to assess the chemical ozone depletion in recent Arctic winter/spring seasons.

The measurements are reported to databases under Network for the Detection of Stratospheric Change (NDSC) and World Ozone and UV-radiation Data Center under the WMO-programme Global Atmosphere Watch.

Thule and Sondre Stromfjord are primary Arctic stations within the Network for the Detection of Stratospheric Change (NDSC). Scoresbysund is a complementary NDSC-station. In addition to the DMI-instrumentation, aerosol lidars are operated at Thule and Sondre Stromfjord by the University of Rome (Italy) and SRI International (USA), respectively, together with an FTIR spectrometer at Thule, operated by National Center for Atmospheric Research (USA). A long series of balloon-borne backscatter soundings of polar stratospheric clouds (PSCs) and aerosol have been performed from Thule, Sondre Stromfjord, and Scoresbusund by DMI in collaboration with the University of Wyoming (USA). DMI also collaborates with Service d'Aeronomie du CNRS (France) for daily total ozone measurements by a SAOZ UV-vis spectrometer at Scoresbysund.

### Ozone research

DMI has participated in all major European/US Arctic ozone research campaigns since the beginning the 1990'es such as EASOE, SESAME, THESEO, THESEO-2000/SOLVE and VINTERSOL. DMI has also participated in the HIBISCUS campaign from Bauru, Brazil, in February 2004, investigating cirrus formation and transport of water vapour in the tropical tropopause. In addition, DMI has participated in numerous past and ongoing research project, funded by the European Commission and Danish research agencies. DMI currently participates in the integrated EU-projects "Stratosphere-Climate links with emphasis on the UTLS" (SCOUT-O3), "Quantifying the climate impact of global and European transport systems" (Quantify), and "Global Earth-System monitoring using satellite and in-situ data" (GMES-GEMS). DMI will be CO-PI together with the Alfred Wegener Institute (Germany) in coordinating bi-polar stratospheric ozone and UV research in connection with the International Polar Year 2007-2008 (IPY).

The ozone research at DMI relates to:

- Transport studies of stratospheric ozone, including dilution effects at mid-latitudes from Arctic ozone depletion. In this research domain filling trajectory calculations, based on meteorological analyses from the European Centre for Medium-Range Weather Forecasts (ECMWF), are applied together with available observations of total ozone and ozone profiles. This modelling concept is expanded to include microphysical and chemical modules.
- DMI has also been involved in studies of the accuracy of stratospheric temperatures in ECMWF and other analyses products, used for stratospheric research.
- Studies of polar stratospheric clouds (PSCs) by microphysical simulations and balloon-borne experiments from Greenland and Northern Scandinavia. For several years, the DMI has been collaborating with the University of Wyoming on balloon-borne backscatter soundings of stratospheric aerosols and PSCs from Greenland. This collaboration has been extended into a European/US collaboration on balloon-borne in-situ measurements of chemical and physical properties of PSC particles, performed from Northern Scandinavia.
- Microphysical modelling of cirrus clouds, including the formation of sub-visible cirrus in the tropics of relevance for transport of water vapour to the stratosphere.
- Studies of the effects of aircraft on cirrus formation and their radiative properties in the upper troposphere.
- Climate modelling, relating to the influence of ozone on the stratospheric circulation and climate. DMI operates climate models which include the effects of changes in stratospheric ozone.
- The DMI participates in several scientific and validation studies to utilise data from ESA's Envisat and other satellites, both on ozone, other trace gases, and aerosol measurements.
- Ozone and UV trend assessments. The DMI has contributed to the latest WMO/UNEP and European assessments on stratospheric ozone and to the Arctic Climate Impact Assessment Report and have taken part in the review process of assessment reports. DMI is currently involved in preparing a SPARC-assessment report on PSCs.

## Ultraviolet radiation

Daily measurements of the surface UV-B radiation are performed by DMI at Thule, using a high resolution spectroradiometer, since summer 1994. The instrument has been intercompared to a NIWA instrument to become NDSC classified.

The DMI participates in EUMETSAT's Satellite Application Facility on Ozone Monitoring, aiming at the development of operational UV-index products, based on satellite measurements of the ozone layer.

UV-B index forecasts, based on Danish total ozone measurements, were initiated at DMI in summer 1992. This public service runs every summer season, made public on the Internet and in several media.

## Further information

Further information on the stratospheric ozone research and monitoring at DMI, including publication lists and lists of past and ongoing research projects can be obtained on the Internet at [http://www.dmi.dk/eng/index/research\\_and\\_development/the\\_division\\_fo.htm](http://www.dmi.dk/eng/index/research_and_development/the_division_fo.htm)

General information about DMI can be obtained at [www.dmi.dk](http://www.dmi.dk)

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