SWEDEN

Ground based monitoring of UV

Broadband and spectral UV-monitoring has been done in Sweden at a number of sites by SMHI (Swedish Meteorological and Hydrological Institute). A selection of data sets is freely available at http://www.smhi.se. Measurements are still recorded, at two sites in Sweden, in Norrköping by SMHI and in Stockholm by SSI (Swedish Radiation Protection Institute). SSI has plans to start monitoring also at other sites.

At both institutes UV-spectroradiometers has been calibrated using absolute irradiance calibrated 1000 W halogen lamps giving a trace to NIST. The instruments have also participated in several international intercomparison campaigns; Norrköping (1991), NOGIC93, NOGIC96, SUSPEN (1997) and NOGIC2000. Last year several institutes in Europe have tested a system using a travelling lamp. J. Gröbner, at the Joint Research Center, EC, Ispra, took this initiative.

Broadband meters from SMHI and SSI have also been intercompared at campaigns; NOGIC93, NOGIC96, STUK/WMO (1995), LAP/COST/WMO-99 and NOGIC2000.

Because of the lack of an international adopted reference and calibration procedure for UV-measurements comparisons are very valuable.

Swedish activity: SMHI and SSI.

UV-index forecasting for public information

The distribution of the daily UV-index forecasts from SMHI started in 1993 at the end of June and lasted to the end of the summer. In 1994 the distribution started in spring as a weekend forecast at the end of each week. This forecast was valid for clear skies and for the optimal slope (the sloping surface receiving the maximum radiation). During the summer season the daily forecast produced included the effect of clouds.

At a WMO-meeting in July 1994 it was agreed that the UV-information to the public should be harmonised. The meeting agreed on a minimum set of criteria that the UV-information should be based on. Starting in spring 1995 the Swedish UV-index was changed according to these recommendations. One large change was the introduction of the new action spectrum (from ACGIH-NOISH to the CIE-erythemal action spectrum recommended by WMO, WHO and ICNIRP. For the public the most apparent change was seen in the new scale range. This was a shift from 0-100 to roughly 0-16.

In 1996 the UV-index forecast was introduced on the World Wide Web (http://www.smhi.se) as a Table for 15 regions in Sweden and three resorts. Next year, 1997, the graphical layout was improved and since then the daily course of the UV-index is presented for a number of climatological similar regions in Swedish. During the first winters there was no forecasting of UV-index done. The season started in late March and stopped at the end of August. Now, it is in operation all the year around. There is also some additional text presenting the some specific features of interest regarding UV-radiation in general.

Swedish activity: SMHI and SSI.

Modelling UV-radiation

A system, STRÅNG, for modelling radiation parameters has been developed at SMHI, with additional funding from the Swedish Environmental Protection Agency and the Swedish Radiation Protection Institute (SSI). There are older systems in operation for different applications, time and spatial scales. The main object of the new system is to produce field data in *near real time* with hourly resolution. At the moment the following variables are considered: global irradiance, CIE-weighted UV (Figure 1), photosynthetic active irradiance, direct solar irradiance and sunshine duration.

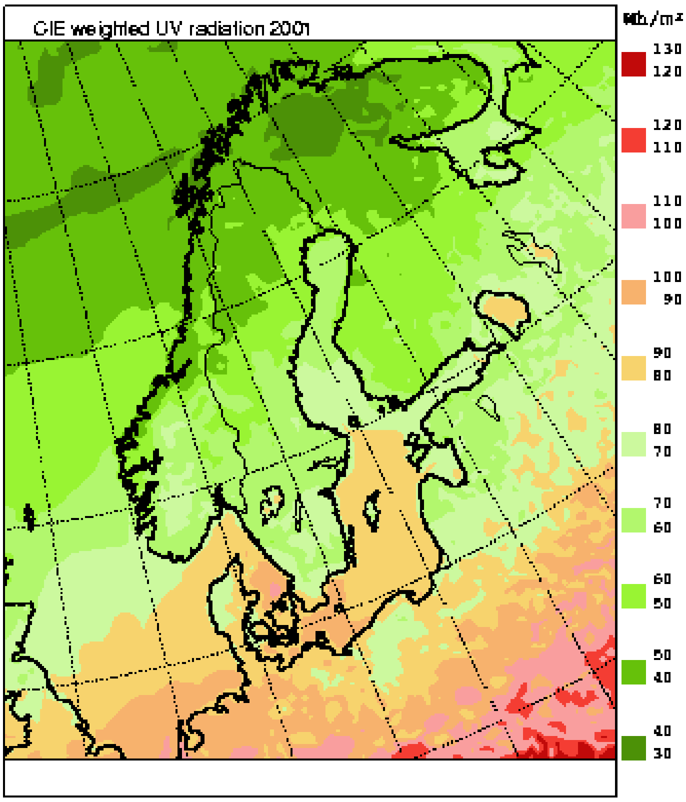

Figure 1. CIE-weighted UV-radiation for 2001 from STRÅNG.

The most important variable input fields for computing the UV are cloud parameters and the total ozone. The latter is retrieved from satellite data, when available, and the cloud data is available at relatively high resolution in an operational system Mesan (Mesoscale analysis), that is operated at SMHI. It compiles information from a number of sources including satellite and ground based stations. The Mesan set the practical limits of both the spatial (22km) and the temporal resolution (hourly). The core radiation model implemented into the system is SMARTS2 developed by Gueymard (1995). It covers the full solar spectrum.

Swedish activity: SMHI, Swedish Environmental Protection Agency and SSI.

Ground based monitoring of total ozone

Daily monitoring is done at two sites in Sweden. The instruments Brewer and Dobson ozone spectrophotometers are regularly calibrated approximately at three years interval according to WMO-recommendations. Data are sent to the World Ozone and Ultraviolet radiation Data Centre (WOUDC) at MSC in Toronto, Canada, every month. Preliminary data are also sent to MSC (WOUDC) and to the WMO Ozone Mapping Centre, Thessaloniki, Greece for the production of near real-time maps. All total ozone data are available at WOUDC and at the web-site of SMHI (www.smhi.se). Beside of monitoring, efforts are mainly directed on quality assurance and on improving the observations at low solar elevations (focused sun observations), which is a challenge at high latitudes.

Swedish activity: SMHI on behalf of Swedish Environmental Protection Agency.

Ozone data from the ODIN-satellite

The Swedish Odin satellite was launched 20 February 2001. The Swedish Space Corporation, on behalf of the Swedish National Space Board and the space agencies of Canada, Finland and France, developed the satellite. It combines two scientific disciplines on a single platform astronomy and aeronomy. Briefly observations will be used for studies of star formation/early solar system and for studies of the atmosphere with the aim of better understanding the physics and chemistry controlling the distribution of ozone and other gases.

For this task Odin not only uses the sub-mm radiometer but also an Optical Spectrograph and InfraRed Imaging System, OSIRIS. The two instruments complement each other with the distribution of some gases being more accurately determined by one or other of the instruments. For aeronomy the spacecraft follows the Earth limb - scanning the atmosphere up and down from 15 to 120 km at a rate of up to 40 scans per orbit. Measurements are made from 82 S to 82 N.

Unique capabilities for the radiometer are measurements of ClO in the stratosphere and water vapour to altitudes over 90 km in the mesosphere as well as night and daytime measurements of ozone, nitric acid and dinitrous oxide. The OSIRIS instrument provides high precision measurements of ozone and nitrogen dioxide under sunlit conditions and should also provide measurements of OClO and BrO under suitable conditions.

During the northern hemisphere summer months noctilucent clouds have been observed at 82 km altitude and simultaneous measurement of the water vapour concentration as the same altitudes made. When fully analysed these observations should allow us to determine the budget and conditions required for the formation of these particles. Although plagued by a progressive problem with maintaining pointing, a problem now solved, the first observations of the Antarctic ozone hole were made by the OSIRIS instrument (Figure 2).

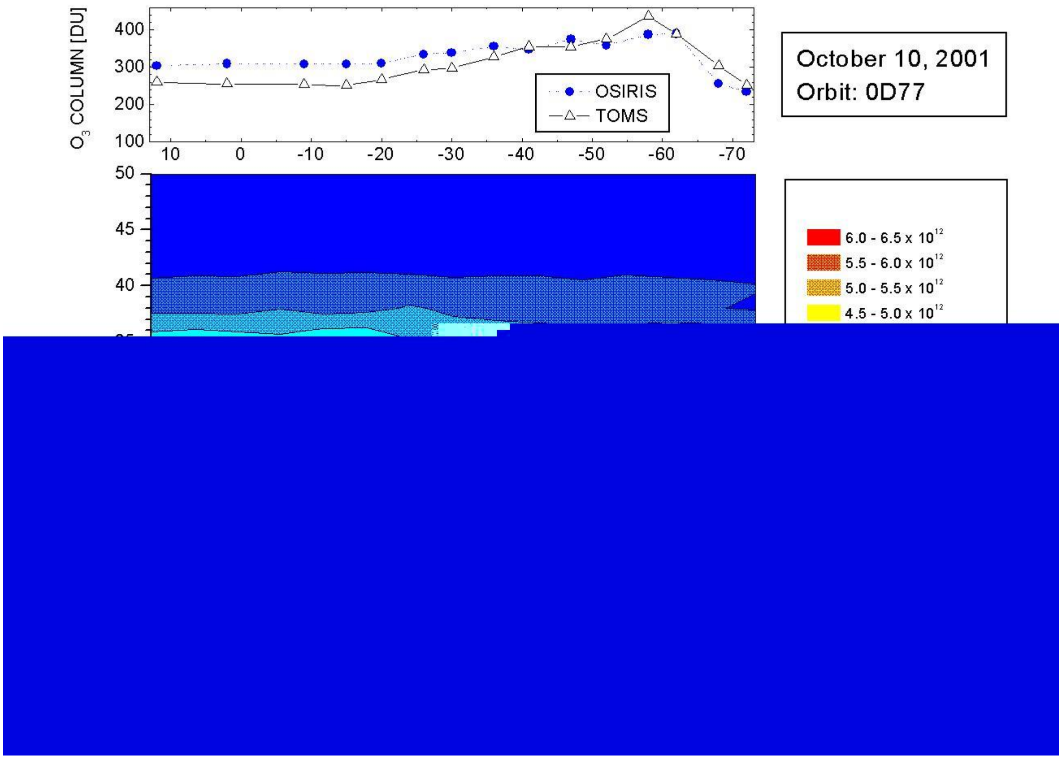

Figure 2. Example of ozone data from the OSIRIS instrument on ODIN satellite.

Swedish activity: Chalmers University of Technology and Department of Meteorology at Stockholm University on behalf of the Swedish Space Corporation

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