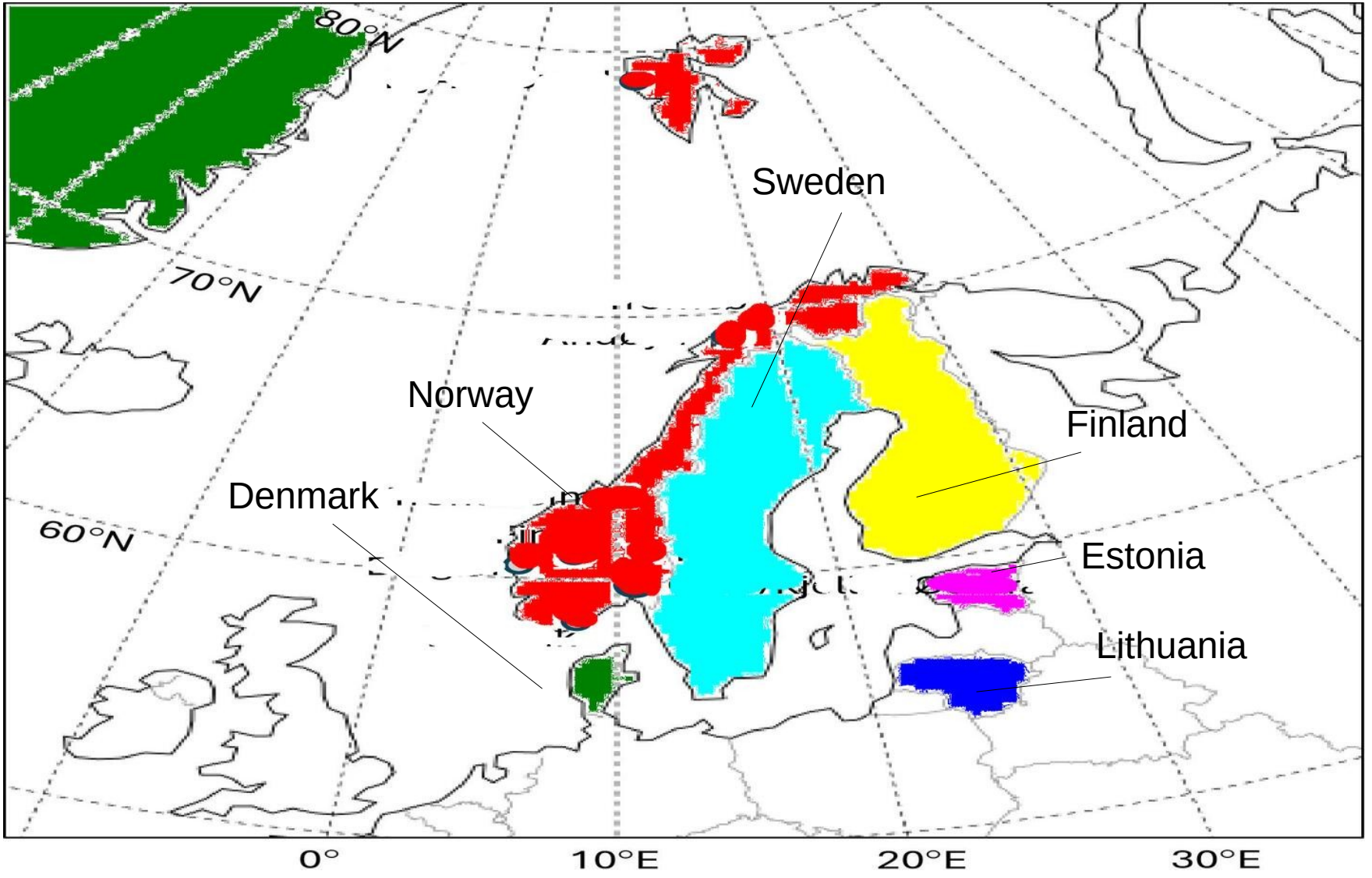
Northern Europe

Current ozone and UV measurement network

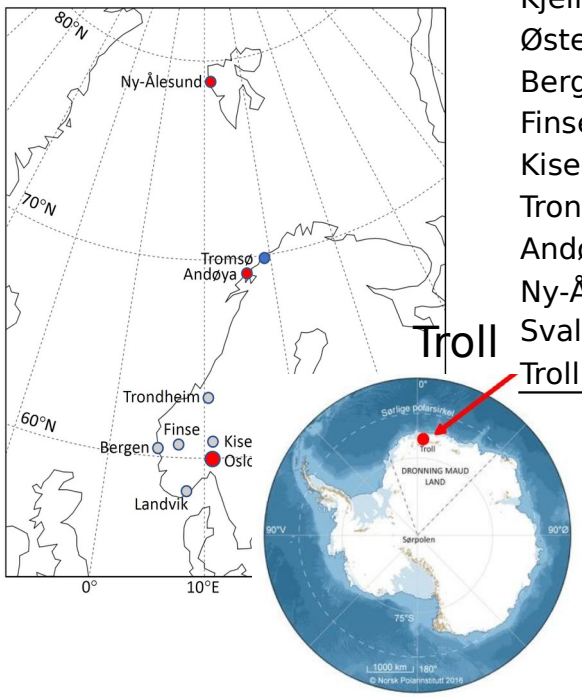
Compiled by: Nis Jepsen


80°N
70°N
60°N
0°
10°E
20°E
30°E
Sweden
Norway
Finland
Denmark
Estonia
Lithuania

Norway

Ozone and UV monitoring stations

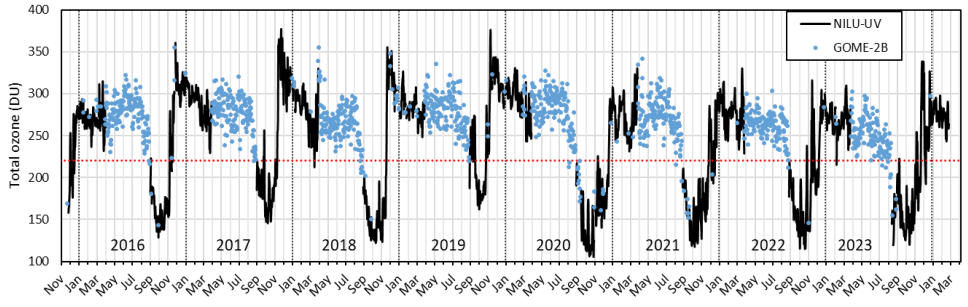
Station	Location	Instrument (UV)	Instrument (TOC)	Institute
Landvik/Grimstad	58°N, 08°E	GUV-541		DSA
Kjeller (Oslo)	60°N, 11°E	GUV-511, NILU-UV	Brewer MKV, GUV	NILU
Østerås	60°N, 10°E	GUVis-3511; Bentham		DSA
Bergen	60°N, 05°E	GUV-541		DSA
Finse	61°N, 07°E	GUV-541, GUVis3511		DSA
Kise	61°N, 11°E	GUV-541		DSA
Trondheim	63°N, 10°E	GUV-541, GUVis3511		DSA
Andøya	69°N, 16°E	GUV-541	Brewer MKIII, GUV	NILU
Ny-Ålesund, Svalbard	79°N, 12°E	GUV-541	SAOZ, GUV, Pandora	NILU
Troll in Antarctica	72ºS, 03ºE	NILU-UV	NILU-UV, Pandora	NILU

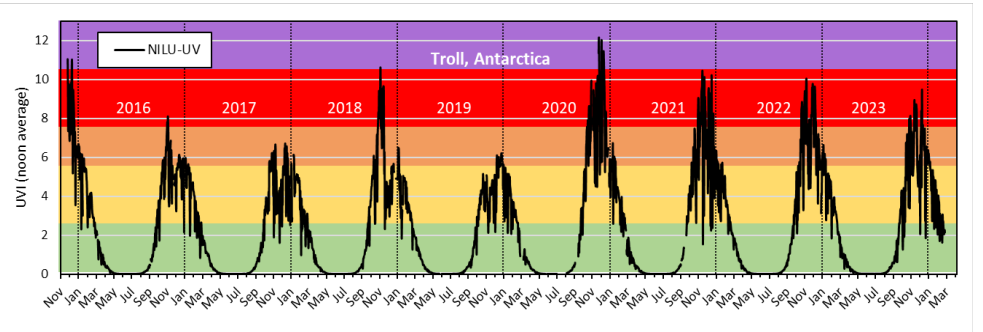


Monitoring of ODSs (CFCs, HCFCs….)

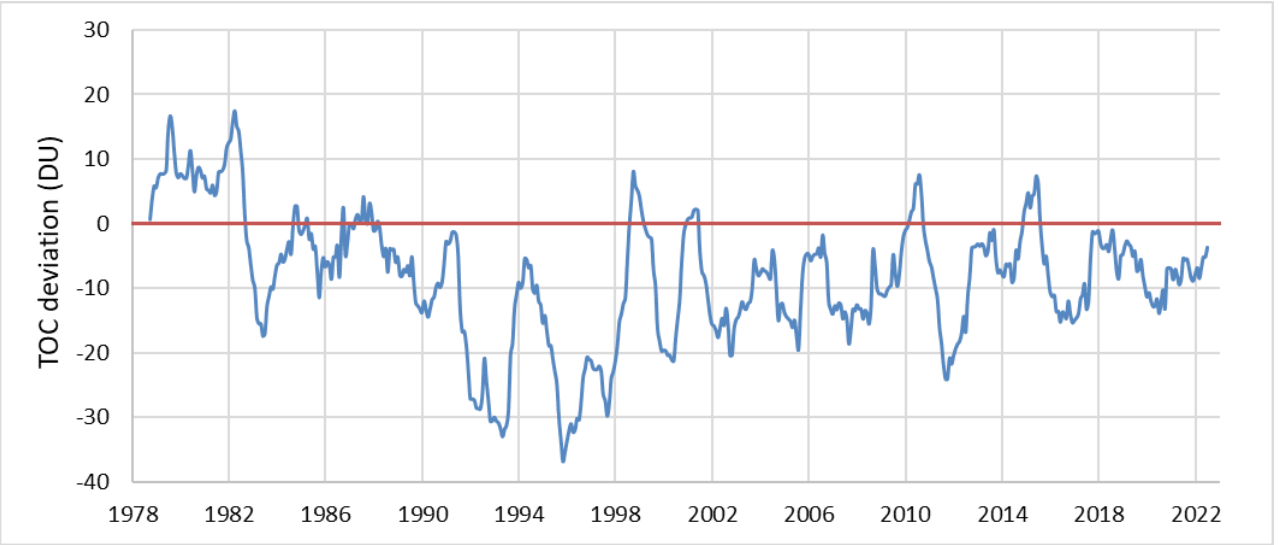
Station	Location	Instrument	Frequency	Institute
Ny-Ålesund, Svalbard	79°N, 12°E	Medusa-GCMS	3-h (since 2001)	NILU
Troll in Antarctica	72ºS, 03ºE	3-L stainless steel canister	Weekly (since 2007)	NILU

Total ozone and UVI at Troll station

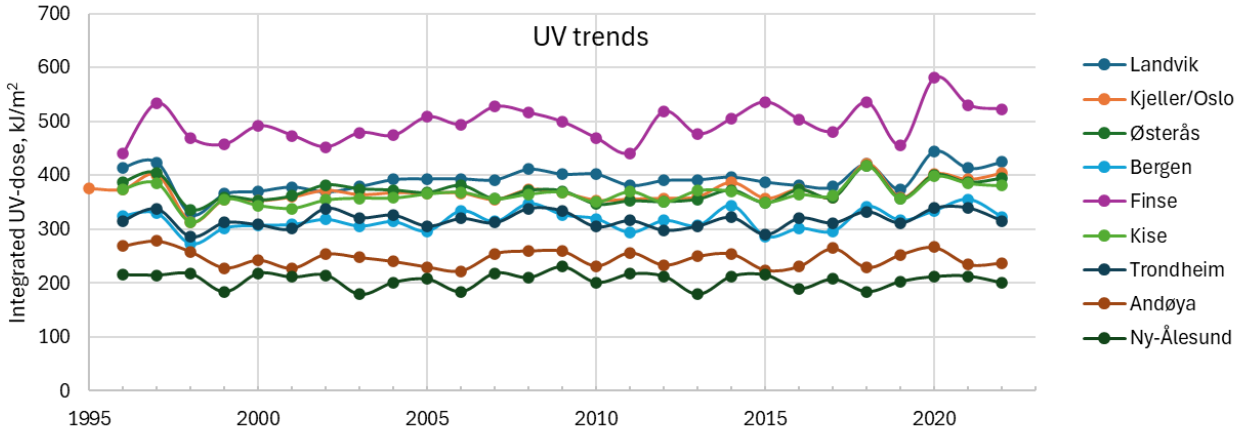




Trends in ozone and UV Norway

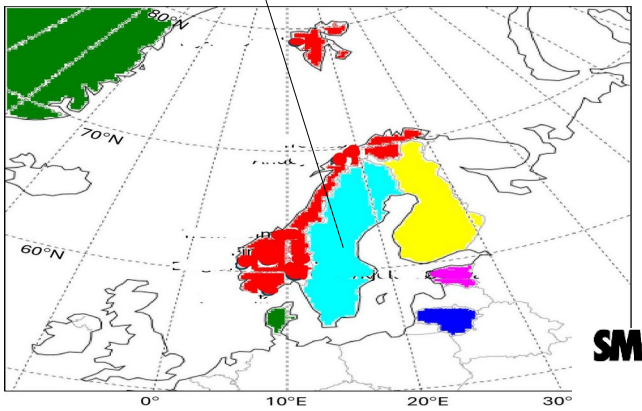


Twelve months running total ozone mean from Oslo & Kjeller. Deviation from 1979-1989 average.



%/decade	Landvik	Kjeller/ Oslo	Østerås	Bergen	Finse	Kise	Trond-heim	Andøya	Ny-Ålesund
Trend ± 2	3.2 ± 3.0	2.8 ± 2.6	1.2 ± 2.8	2.3 ± 3.0	4.1 ± 3.2	3.5 ± 2.6	0.9 ± 2.4	0.7 ± 3.6	-1.0 ± 3.2

Sweden

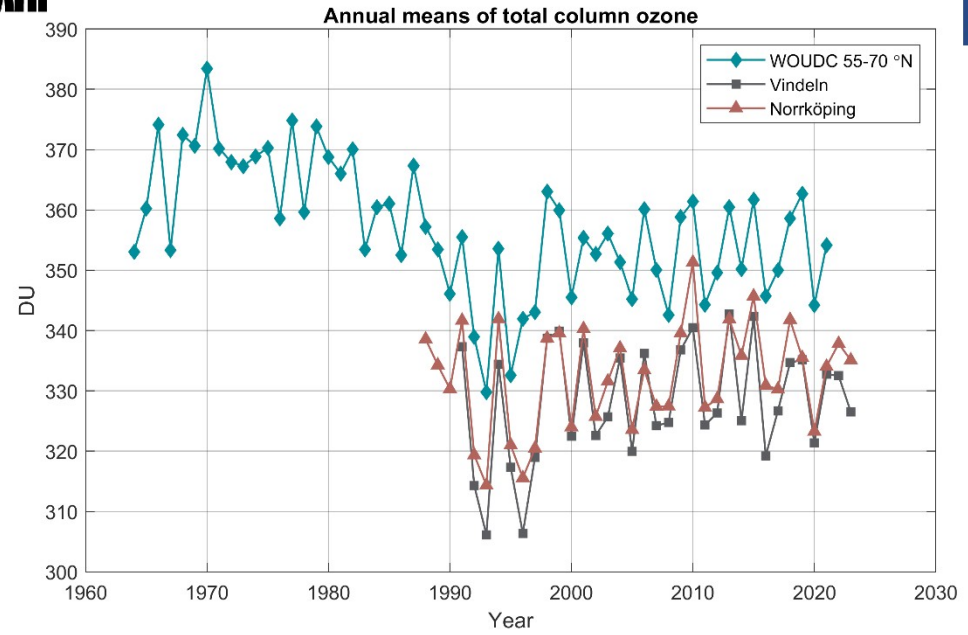


Data contributions from:

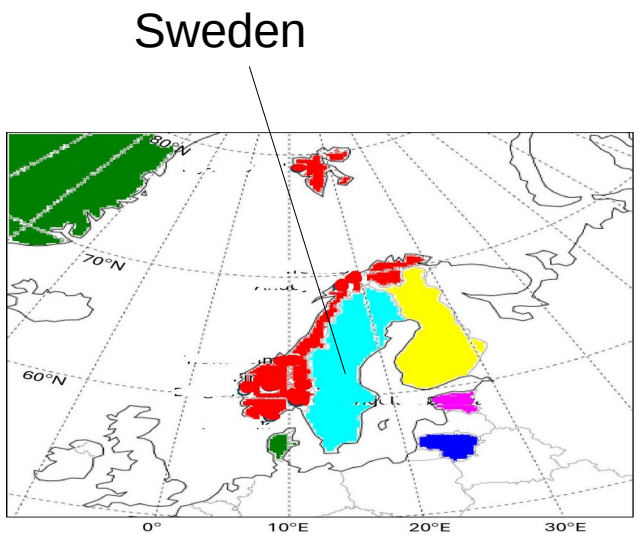
Swedish Meteorological and Hydrological Institute (SMHI)

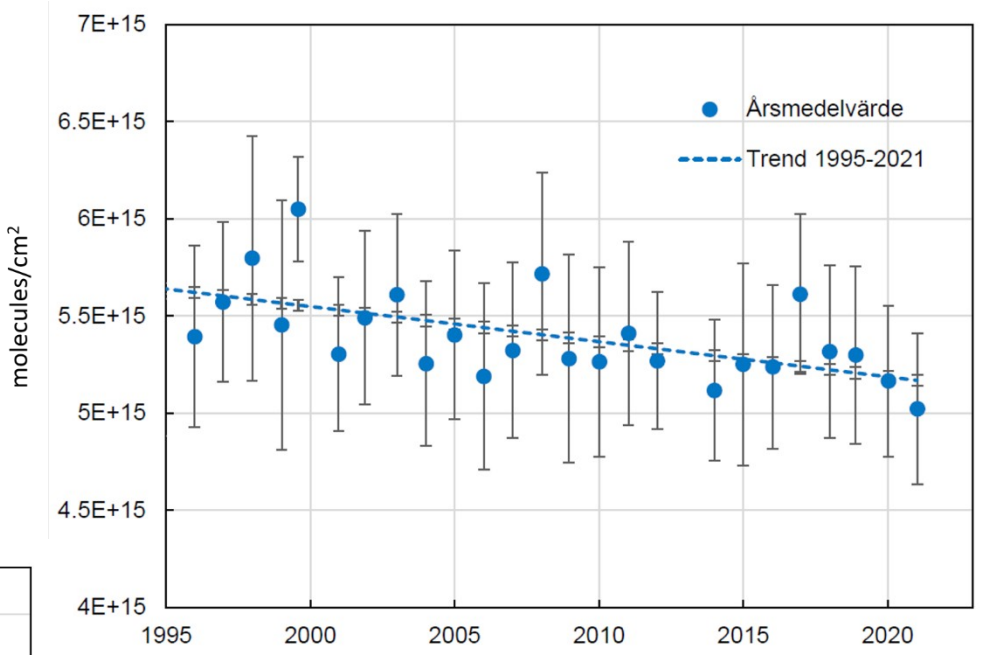
Chalmers University of Technology

Swedish Institute of Space Physics (IRF)

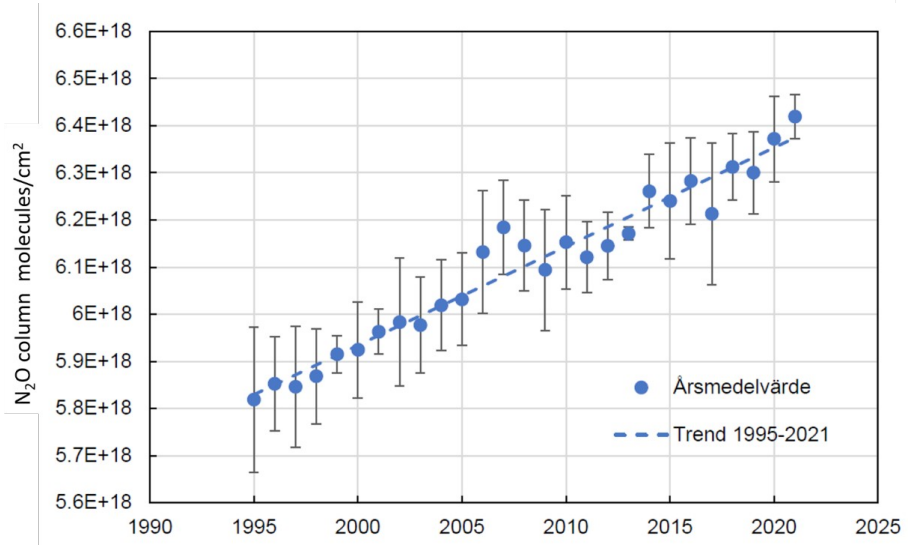


Annual mean total column ozone from the Swedish Brewer/Dobson stations Vindeln and Norrköping. For comparison with a longer time series also the average value for the latitude band 45-75 ˚N based on WOUDC data (Fioletov et al., 2002).

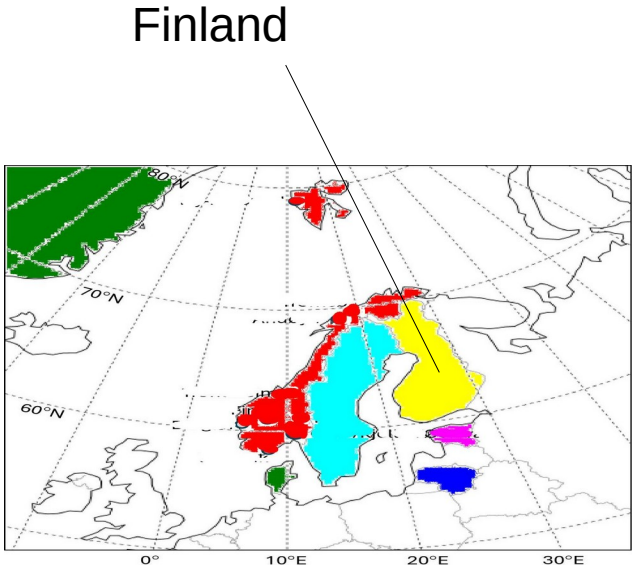


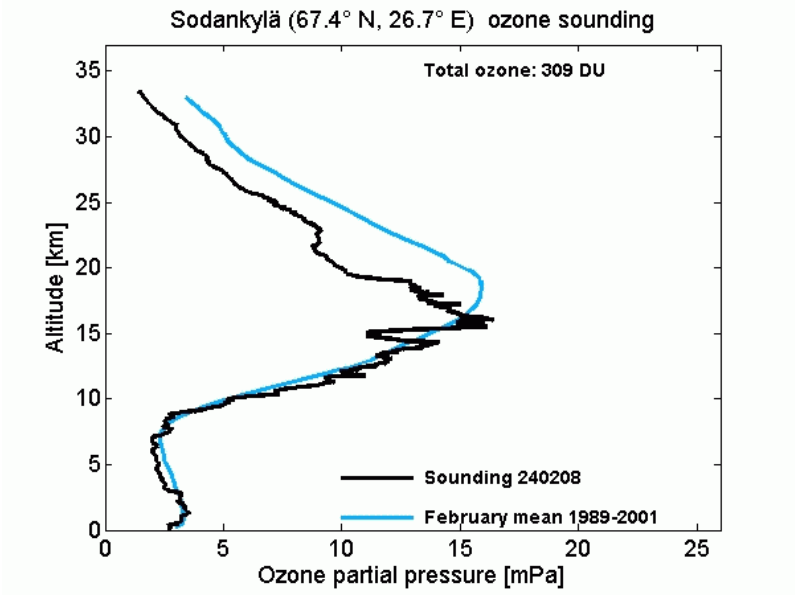


Chlorine column values from Harestua Norway (60N, 11E) measured by solar FTIR. The data corresponds to annual means and standard deviation of HCl and ClONO2, primarily measured during the summer half year.



Columns of N_2O measured with solar FTIR at Harestua solar observatory. The data corresponds to annual means and standard deviation.





Ozone sounding at Sodankylä in February 2024

GROUND BASED OBSERVATIONS

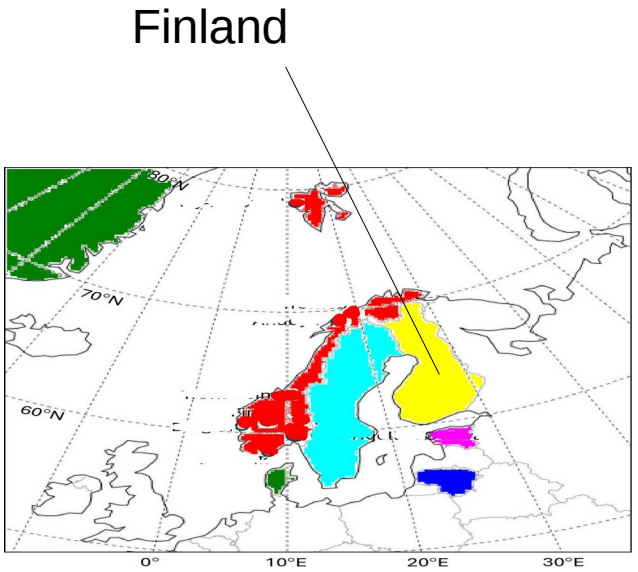
Column measurements of ozone and other gases/variables relevant to ozone loss

Ozone column monitoring has been carried out by the Finnish Meteorological Institute (FMI) at Sodankylä (67.4°N, 26.6°E) since 1988, at Jokioinen (60.5°N, 23.3°E) during 1994—2015 and at Helsinki since 2016. At the stations an automated system based on Brewer spectrophotometer is continuously operated.

Profile measurements of ozone and other gases/variables relevant to ozone loss

Ozone soundings have been carried out since 1989 at Sodankylä on regular basis throughout the year, while in Jokioinen these measurements have been conducted during winter and spring when chemical ozone depletion is expected.

Measurements of polar stratospheric cloud (PSC) properties have been carried out at Sodankylä since 1991/1992 by lidar and since 1994 by aerosol backscatter sondes. Stratospheric water vapor is measured at Sodankylä during all seasons using Cryogenically cooled Frost point Hygrometer (CFH). Sodankylä site is participating in GCOS Reference Upper-Air Network (GRUAN). The national meteorological institutes in Finland (FMI) and Argentina (SMN) jointly carry out regular ozonesonde measurements at Marambio (64.1°S, 56.4°W), Antarctica, since 1988.



GROUND BASED OBSERVATIONS, UV measurements

Broadband measurements

FMI operates SL501 broadband instruments at seven sites in Finland. These instruments provide on-line information on the erythemal irradiance that is published through the internet along with the UV-Index forecast (http://en.ilmatieteenlaitos.fi/uv-index). FMI measures incoming and outgoing broadband SL501 UV radiation (UV albedo) in the GAW station of Marambio since 2013.

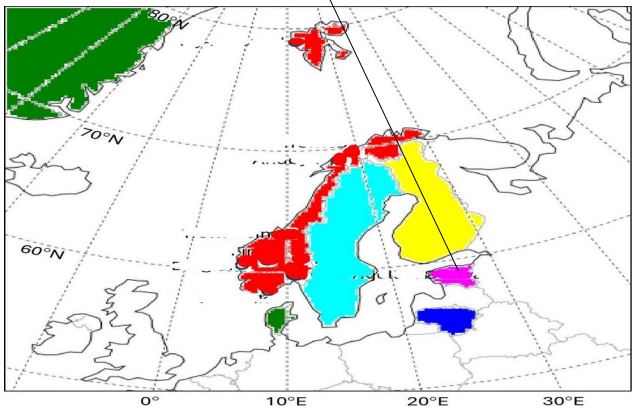
Narrowband filter instruments

FMI has three narrowband NILU-UV filter instruments, from which two measures at the measurement platform of the sounding station in Sodankylä and one is located in Helsinki and used for campaigns. In 2016, FMI purchased two GUV multifilter radiometers, which are used for continuous UV measurements in the Antarctic in the research station of Marambio. The time series started in March 2017 and has been continuous since then. The near real time data is daily plotted on the web page http://fmiarc.fmi.fi/sub_sites/GUVant/. The GUV measurements are part of the existing Antarctic research cooperation between FMI and SMN.

Spectroradiometers

FMI has monitored the spectral UV irradiance with Brewer instruments in Jokioinen (Mark III during 1995-2015), Helsinki (Mark III since 2016) and Sodankylä (Mark II since 1990, Mark III since 2013).

Estonia



Data contributions from:

Estonian Environment Agency;
Tartu Observatory (part of the University of Tartu since Jan., 2018); & the Tartu-Traverse Meteorological Station

OBSERVATIONAL ACTIVITIES

Ozone measurements

Column ozone data is received from satellite measurements. No profile measurements of ozone and other gases/variables relevant to ozone loss have been performed.

UV measurements

Broadband instruments

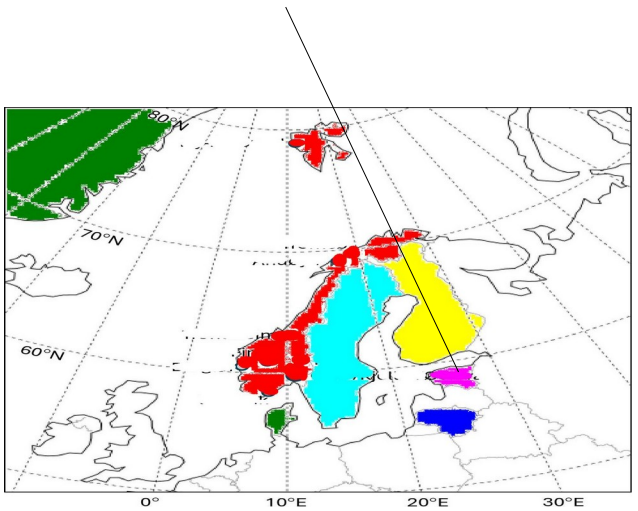
There are five meteorological stations in Estonia measuring UV index (UVI) with erythemally weighted sensors UV-S-E-T (Kipp & Zonen): Tartu-Tõravere, Haapsalu, Pärnu (located in Pärnu-Sauga until 31.03.2019), Roomassare and Tallinn-Harku.

Narrowband filter instruments

From 2002 until May 2020, a Kipp & Zonen narrowband filter instrument CUVB1 with an effective wavelength of 306±0.2 nm and bandwidth 2±0.5 nm operated at the Tartu-Tõravere Meteorological Station from 2002 until May 2020.

Spectroradiometers

Spectral measurements of solar UV radiation have been performed by Tartu Observatory since 2004.
In 2009, a spectrometric system based on a DMc150F-U double monochromator by Bentham Instruments Ltd. was installed, which measured regularly from sunrise to sunset with a period of 15 min in the wavelength range of 280-400 nm.



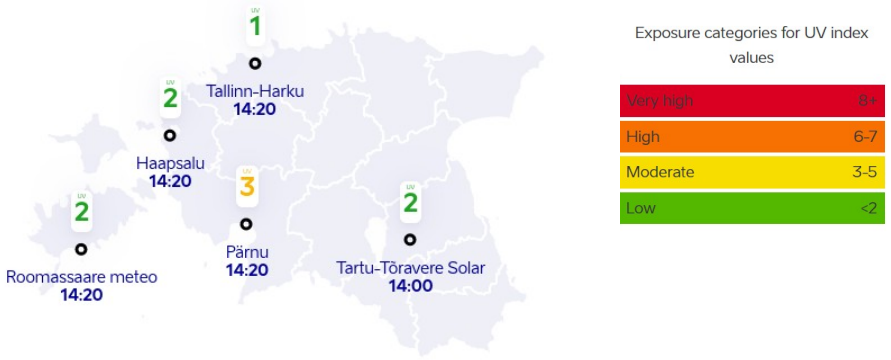
DISSEMINATION OF RESULTS

Data reporting

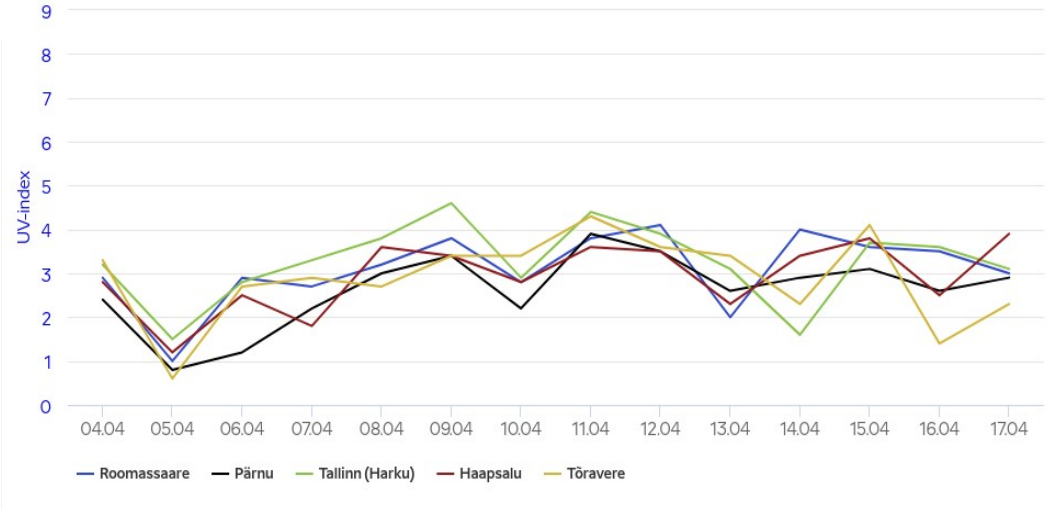
Data on UV measurements by the Estonian Environment Agency is collected in the database and is available on request through the Estonian Environment Agency online form (https://www.ilmateenistus.ee/teenused/teenuste-tellimine/tellimisvorm/?lang=en).

Information to the public

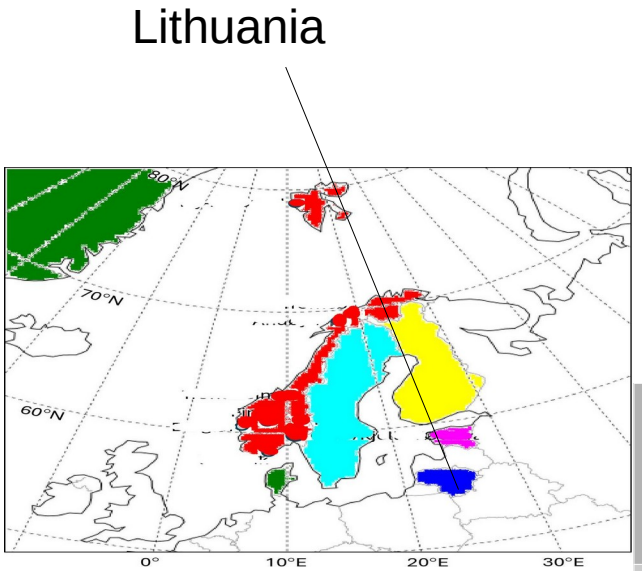
UVI is reported online to the public at the Estonian Environment Agency web page (https://www.ilmateenistus.ee/ilm/ilmavaatlused/uv-indeks/?lang=en).



UVI measurements on April 18th 2024 at the five stations



Daily maximum UVI at all 5 stations, April 4th – April 17th 2024



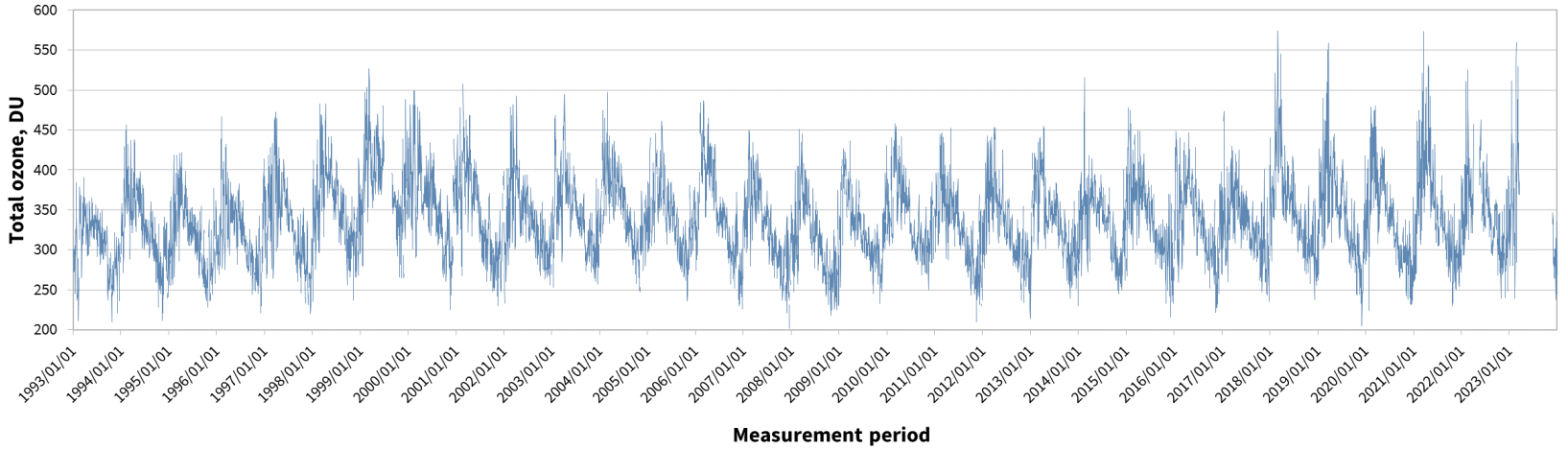
OBSERVATIONAL ACTIVITIES

Ozone and UV monitoring are conducted mainly by the Lithuanian Hydrometeorological Service under the Ministry of Environment of the Republic of Lithuania (LHMS).

Measurements are done at:

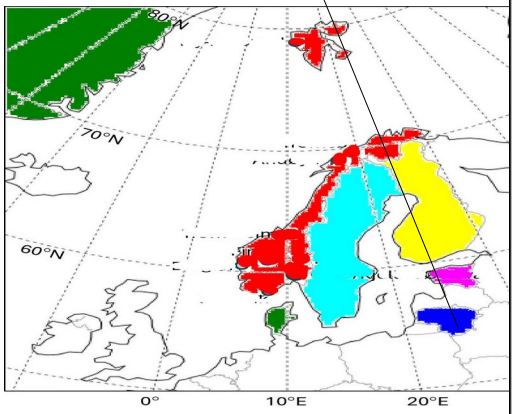
Meteorological station	Location	UV-A	UV-B	UV-E	Total column ozone
Kaunas	54º53'N, 23º50'E	x	x	x	x
Vėžaičiai	55º43'N, 21º28'E		x	x	

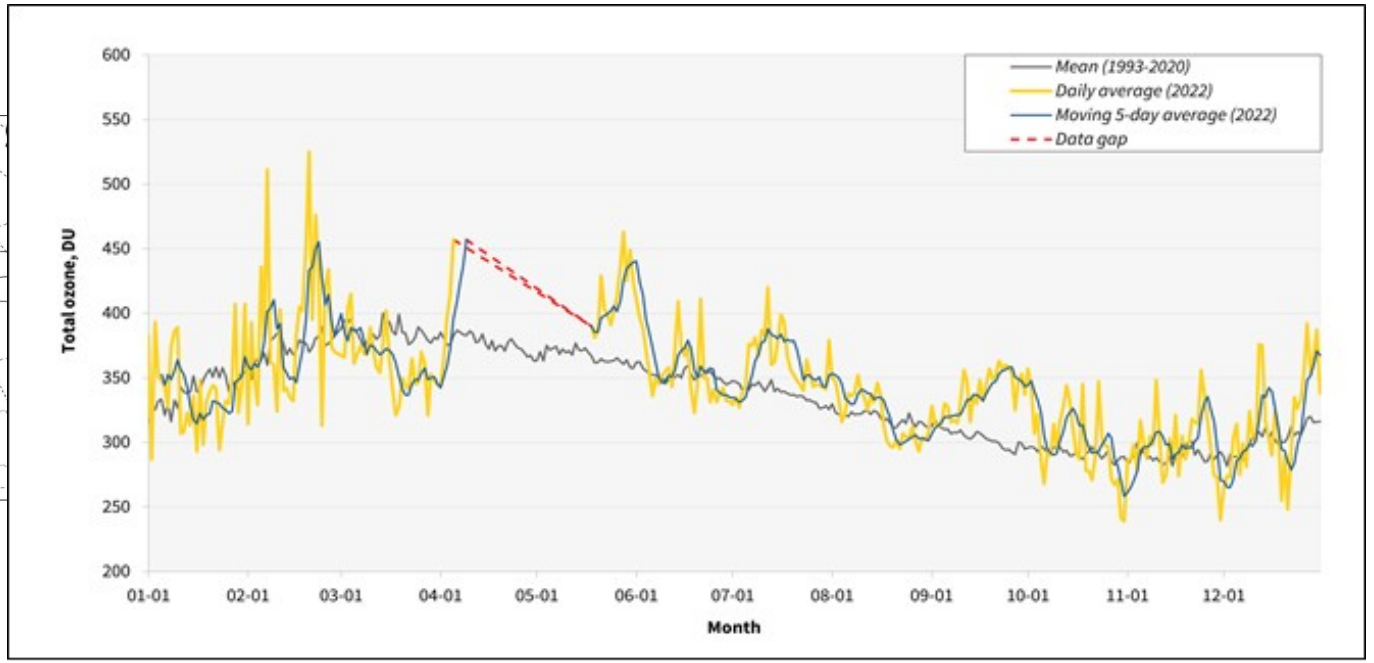
RESULTS



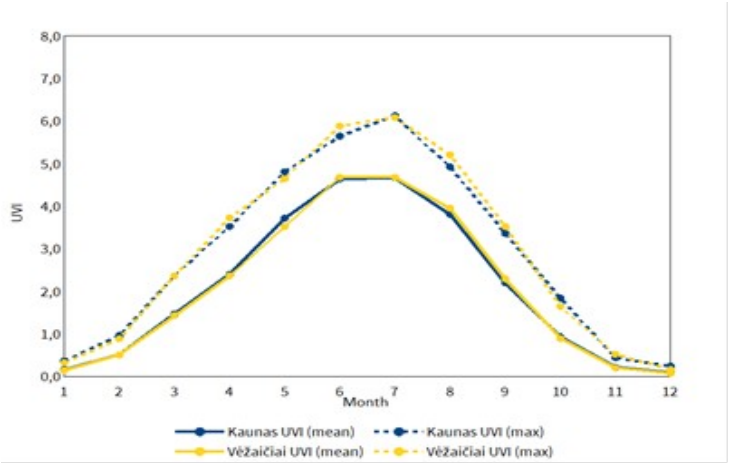
Total column ozone daily fluctuations 1993–2023 (Station N 312, Kaunas)

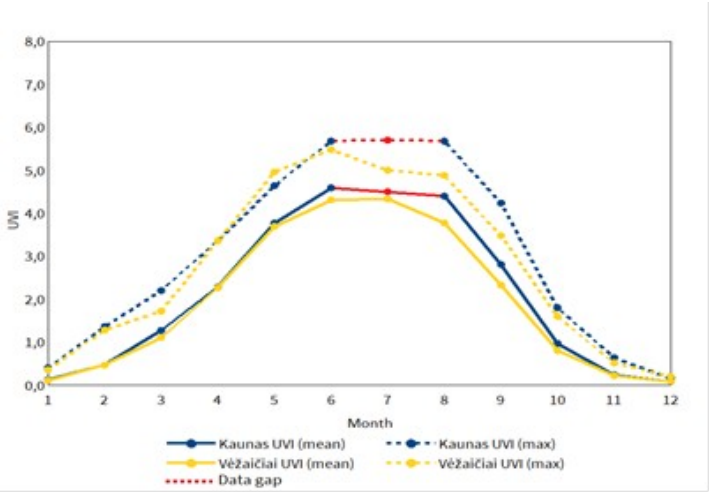
Lithuania





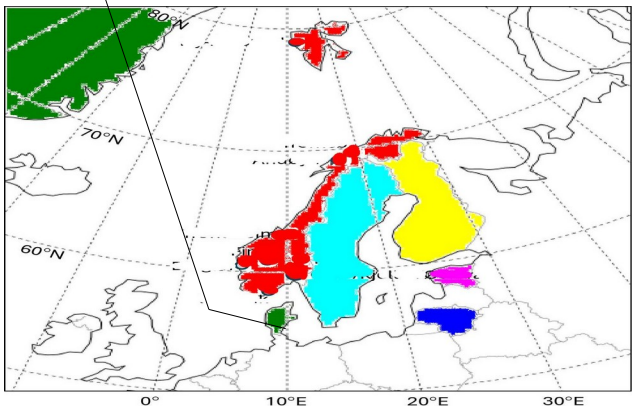
Total column ozone fluctuations in 2022 (station N 312, Kaunas)





UVI annual cycle in Kaunas and Vėžaičiai in a) 2022 and b) 2023

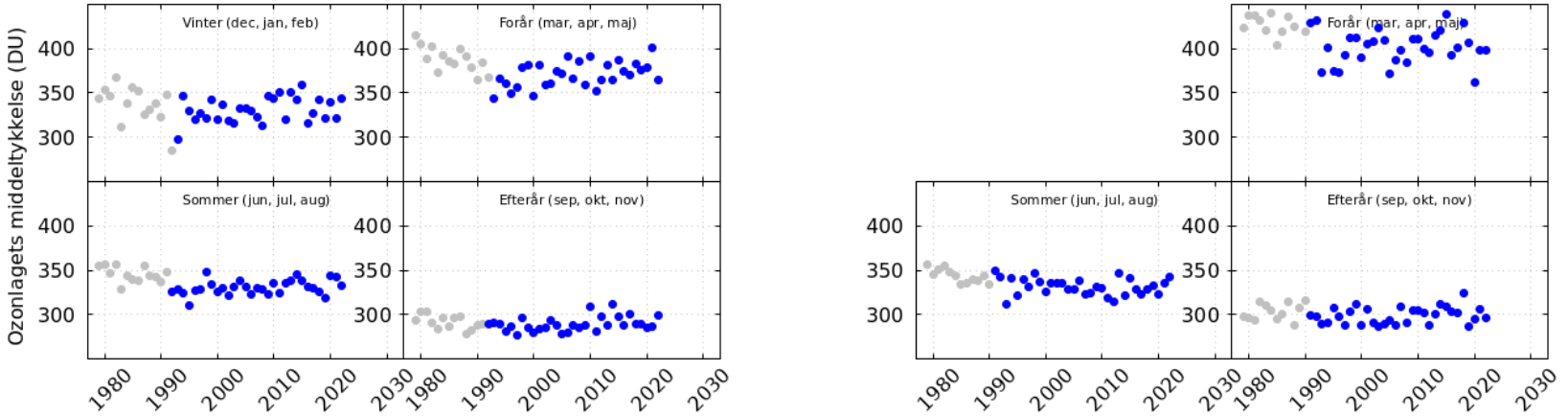
Denmark



OBSERVATIONAL ACTIVITIES

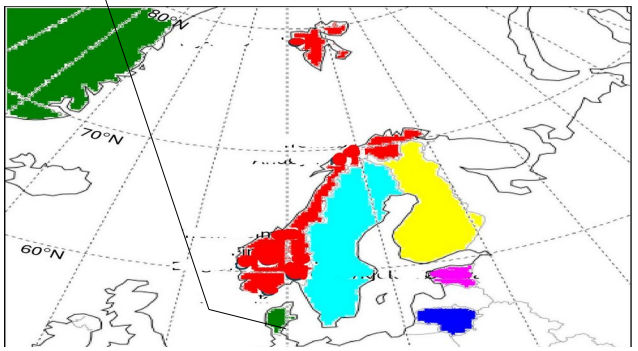
Site	Latitude	Longitude	Instrumentation	Species
Copenhagen (DK)	55.7N	12.6E	Brewer MkIII & MkIV, UV Index	O3, UV
Kangerlussuaq (GL)	67.0N	50.7W	Brewer MkIII & MkII, Saoz, Aeronet	O3, UV, AOD
Ittoqqortoormiit (GL)	70.3N	21.6E	Saoz, Ozonesonde, Aeronet	O3, AOD

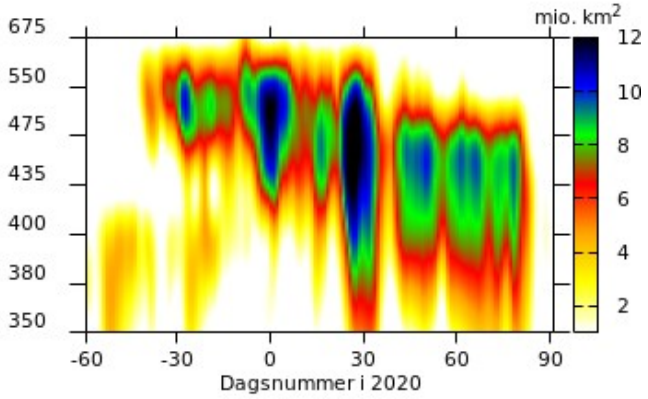
RESULTS FROM OBSERVATIONS AND ANALYSIS

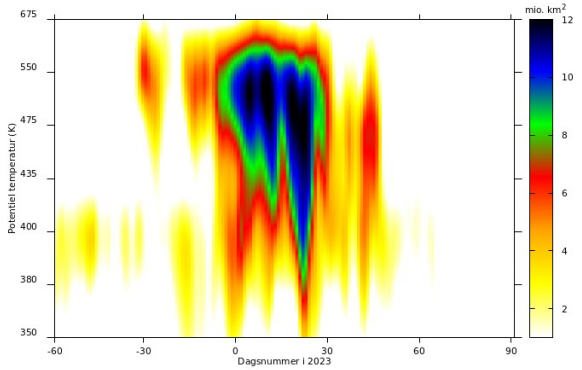


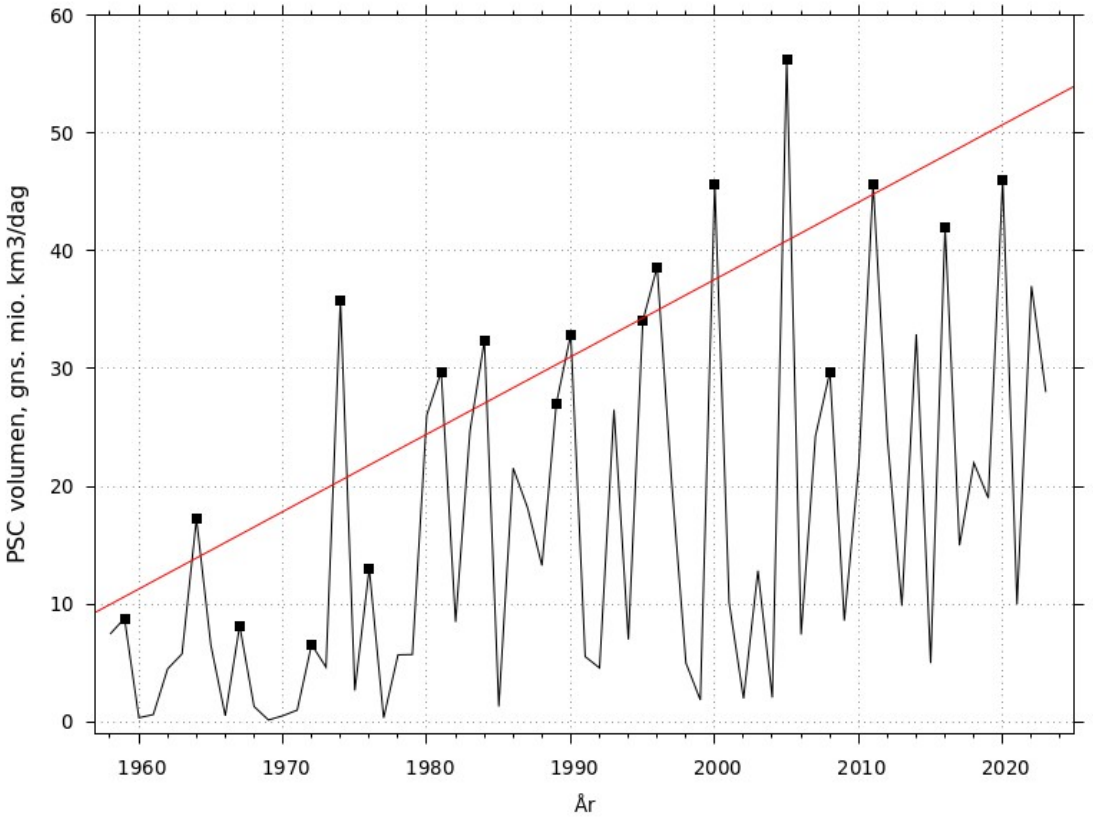
The figures show the average ozone layer thickness in DU for Copenhagen (left) and Kangerlussuaq (right).The figure is divided into the 4 seasons: winter, spring, summer and fall. For Kangerlussuaq there is virtually no sunlight in the winter season so this one is omitted. Blue dots are Brewer measurements and grey dots are values from the Toms satellite.

Denmark









The Figure above shows the psc volume in the arctic vortex. The black dots is ‘all time high’ in a 5 year period. The regression line is based on these dots. As is seen the cold winters are getting colder as the psc volume is increasing over the years.

The Figure on the left show the psc area for the year 2020 when a larger ozone depletion occurred, and for the year 2023 where a sudden warming destroyed the vortex.