Nr 136, 2009

SMHI

Meteorologi

Measurements of total ozone 2006-2008

Weine Josefsson and Mikaell Ottosson Löfvenius

Cover photo: Weine Josefsson. Sun glitter and morning mist in Stockholm archipelago.

Meteorologi
Nr 136, 2009

Measurements of total ozone 2006-2008

Weine Josefsson and Mikaell Ottosson Löfvenius

Report Summary / Rapportsammanfattning

Issuing Agency/Utgivare	Report number/Publikation
Swedish Meteorological and Hydrological Institute S-601 76 NORRKÖPING Sweden	**136**
	Report date/Utgivningsdatum 2009-03-31

Author (s)/Författare

Weine Josefsson and Mikaell Ottosson Löfvenius

Title (and Subtitle/Titel

Measurements of total ozone 2006-2008

Abstract/Sammandrag

This report summarises the quality control, quality assurance and measurements of total ozone at Norrköping and Vindeln for the period 2006-2008. Significant incidents affecting the measurements are noted. Daily data are listed and plotted.

Key words/sök-, nyckelord

Total ozone, Brewer, Dobson ozone spectrophotometer, ozone layer

Supplementary notes/Tillägg	Number of pages/Antal sidor	Language/Språk
This work was supported by the Swedish Environment Protection Agency (Miljöövervakningen)	32	English

Avtal Nr. 211 0605 och **211 0804** Dnr. 721-1561-06Mm och **235-1769-08**Mm
Programområde Luft, Delprogram Ozonskiktet

ISSN and title/ISSN och titel
0283-7730 SMHI Meteorology

Report available from/Rapporten kan köpas från:

SMHI
S-601 76 NORRKÖPING
Sweden

Table of contents

1. Introduction

The purpose of this report is to summarize and document the ozone monitoring project for the period 2006-2008. The measurements are done by SMHI within the Swedish national environmental monitoring, which is funded by the Swedish Environmental Protection Agency. The status of the involved instruments is described briefly. Performed calibrations and their results as well as test data are reported. Measured daily data are plotted, listed and shortly commented.

2. General comments

The total ozone is measured at two sites. In Norrköping on a platform on top of the roof of SMHI located at 58.58°N 16.15°E 43m and at Svartbergets försökspark in Vindeln at 64.24°N 19.77°E 225m. Regular monitoring started for these two sites in 1988 and 1991 respectively. Responsible for the project and the monitoring at Norrköping is Weine Josefsson and in Vindeln Mikaell Ottosson Löfvenius.

At Norrköping the total ozone is measured by a Brewer ozone spectrophotometer #128 MkIII. In Vindeln there is also a Brewer ozone spectrophotometer #006 Mk II since 1996, but also a Dobson ozone spectrophotometer #30. The latter is the instrument that was used in Uppsala in the period 1951-1966.

The total ozone data from Uppsala have been used as a reference both for Norrköping and Vindeln. The yearly average course of daily total ozone and the corresponding daily standard deviations can be seen in the yearly plots presented in this report.

Brief descriptions of quality control, quality assurance and measurements of total ozone at Norrköping and Vindeln for the years 2006, 2007 and 2008 are reported in the following chapters. Events that may have affected the monitoring are compiled in Appendix A. Those compilations indicate the complexity of the monitoring and points at the need of daily maintenance. Efforts are spent to minimize breaks in measurements and if they occur they should be as short as possible. The lists are also useful to consult in case something odd appears in the analysis.

Plots of the daily data are given, see figures in chapter 5, and the daily standard lamp test values, figures in chapter 4. Monthly values of total ozone for all years are presented in Appendix B and daily values for the years 2006-2008 in Appendix C. Older values and instrument status are reported in earlier reports see References in chapter 7.

All Brewer values refer to Bass-Paur scale and are traceable to the Brewer Triad kept at Meteorological Service of Canada in Toronto via the traveling reference Brewer #017. International Ozone Services (IOS) operates Brewer #017 and makes calibrations roughly every third year on the Swedish Brewer instruments #006 and #128. The results are compiled in Appendix D for both instruments. The Dobson total ozone values also refer to the Bass-Paur scale. They can be traced back to the world standard Dobson #83 for Dobson total ozone measurements via the regional standard Dobson #104 kept in Hohenpeissenberg, Germany.

Data are regularly sent to the WOUDC (World Ozone and Ultraviolet Data Centre) about once a month. In case of eventual corrections to data they are re-submitted. Therefore, the data kept at WOUDC should agree with the data kept at the national data centre at SMHI in Norrköping. The latter data as well as graphs are also freely available on the web site of SMHI (www.smhi.se), which is updated about once a week.

3. International use of data

Data has been used for validation of satellite algorithms for total ozone. The recent European SCIAMACHY-instrument on board the satellite ENVISAT has been validated using data from Norrköping and Vindeln see for example:
http://www.temis.nl/protocols/validation_tosomi_25032004.pdf
http://www.copernicus.org/EGU/acp/acpd/5/4429/acpd-5-4429_p.pdf
http://www.temis.nl/docs/AD_TOSOMI.pdf

It is notable in this study (Table 1.2) that the number of used data points from our Swedish stations is relatively high, despite the fact that we have problems measuring due to frequent clouds and low solar elevations

Data from the parallel measurements of the total ozone using the Brewer and the Dobson spectrophotometers has been used in the study of Staehelin et al (2003), see Chapter 4.3.1. Interestingly, the results from Vindeln differ significantly from the results of mid-latitude stations. The cause of the difference is not yet clear. This underlines the value of high quality measurements at high latitude sites. Within an EC-financed project SAUNA several Dobsons and Brewers have been together in Sodankylä in northern Finland to get more data to study how well these instruments measure at low solar elevations. There are plans to repeat the experiment in 2010.

4. Instrument status

4.1 Brewer #128

The latest comparison of Brewer #128 was done at the site in Norrköping in 2006. The change relative the previous comparison in the year 2003 was not so large. These and older comparisons are compiled in Appendix D.

The standard lamp test is done daily by measuring towards an internal halogen lamp in the same way as one make observations of the total ozone. This test is very sensitive for changes of the relative spectral responsivity that can have severe effects on the observations, see Figure 4.1. Changes in the relative sensitivity between the radiance measured at the selected wavelengths for ozone observations is measured and can be expressed as a ratio called R6. In principle, corrections to the measured total ozone, TOZ_{uncor}, can be applied directly by

$$TOZ_{cor} = TOZ_{ucor} + (R6_{ref} – R6) / (\mu*10*\alpha),$$

where the corrected total ozone, TOZ_{cor}, can be deduced by inserting the observed daily standard lamp test value R6, the $R6_{ref}$ value which was measured and established at the last intercomparison, the relative optical airmass valid for the ozone layer, μ, and the differential ozone absorption coefficient α (=0.3491 for Brewer #128).

The result of the standard lamp tests over the years since 1999 indicates that gradual and sometimes large changes of the relative spectral responsivity have occurred. Since the comparison in 2003 the R6-value decreased roughly by 15 units up to the comparison of 2006. This corresponds to about 2 DU. A smaller decrease has been observed after that. The sudden jump in mid 2008 is due to a change of the standard lamp. Thus the jump can be attributed to the change of lamp rather than a change in the instrument responsivity. It is probable that the next comparison in Norrköping in 2009 will show only a small change.

Another interesting feature that can be observed in Figure 4.1 is the seasonal variation for several years in the past. It has apparently disappeared after the comparison in 2003 when a new set of temperature coefficients were introduced.

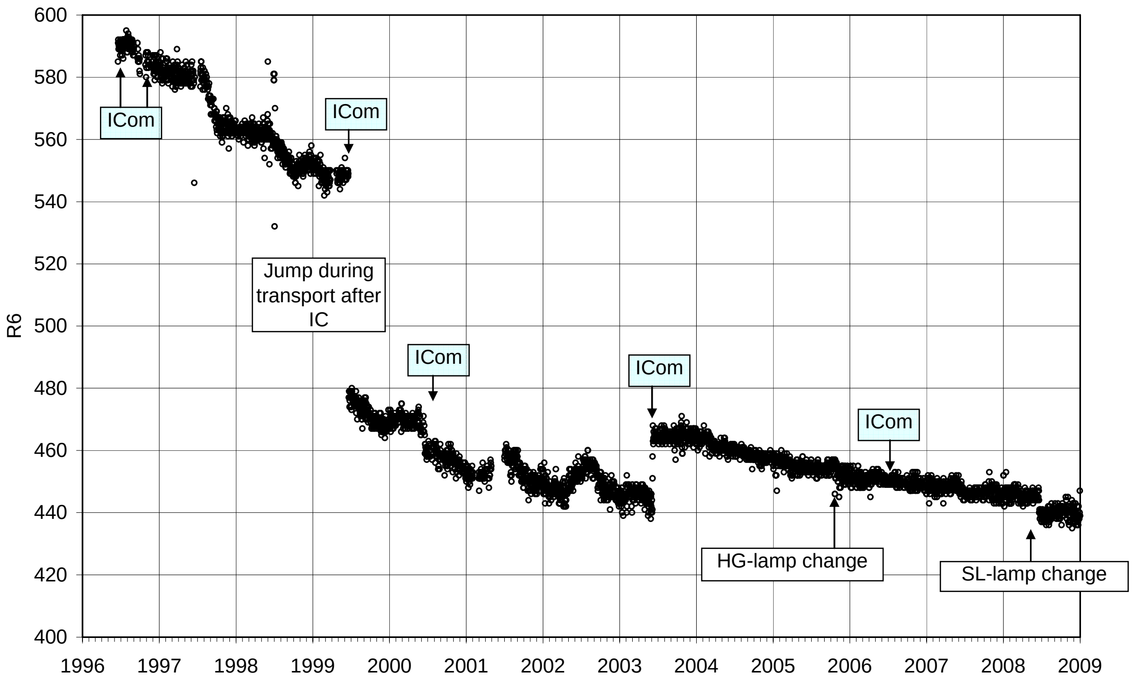

Figure 4.1 Standard lamp test value R6 for Brewer #128 over the period 1996-2008. The large change after the calibration in 1999 is clearly seen. Times for intercomparisons are noted as well as lamp changes.

Another test of state of the Brewer is the so called dead-time test. A photomultiplier (PM) is used to measure the radiance. A counting system tries to count the impinging photons. When a pulse is detected the counter must wait a moment for another pulse to be detected. This time interval is called the dead-time. However, even at low count rates there is a probability that two photons arrive very close in time and thus cannot be distinguished. This causes a non-linear response. Assume that the time interval distribution of arriving photons follow a Poisson distribution. The probability, Po, that a pulse overlaps with another pulse inside a certain time interval is given by

$$Po = 1 - \exp(-N^*\tau)$$

where τ is the dead-time and N is the count rate. The true count rate N_0 can be found by iteration of $N=N_0^*\exp(-N^*\tau)$. This correction is applied for all measurements of the Brewer and is thus sensitive for the value of τ. The dead-time test gives information on the temporal development of the dead-time, Figure 4.2. It is measured at two levels of radiance presented by blue (right) and red (left scale) dots. It can be seen that the dead-time has slowly decreased from about 43 ns to about 38 ns over the period 1997 to 2008. The increased scatter in late 2008 is due to the fact that the new standard lamp is weaker the previous ones. This increases the random scatter.

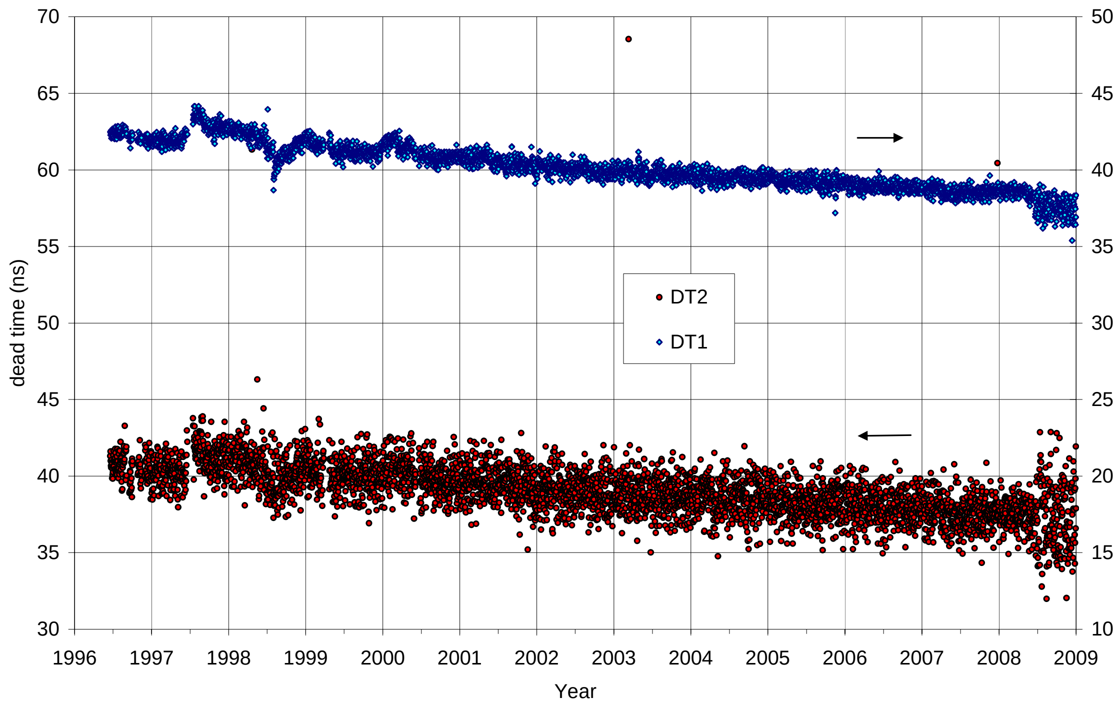

Figure 4.2. Dead-time for Brewer #128.

In front of the photomultiplier tube (PMT) there is a plate with the exit slits of the spectrometer. The spectrum produced by the gratings is projected over the exit slits. To prevent the exposure of the PMT for the radiance of all wavelengths at the same time there is a shutter mask in front of the exit slits. This mask moves up and down in cycles exposing one slit a time. One cycle takes about one second. Typically, a single measurement of total ozone uses 20 cycles. The average of the photon counts for each slit (wavelength) of the 20 cycles can be regarded as recorded simultaneously at the mean time of the cycles.

The mask moves very rapid and the photon counting must be done when each slit is exposed. This demands a good synchronization between the mask movement and the reading of the PMT. A special test is done to check this. It is called the run and stop test, Figure 4.3. Using the internal standard lamp a measurement is taken with the mask moving. The next step is to do the same measurement stopping the mask at each slit. Then the ratio between the two measured photon counts is computed. This ratio should be 1 within an uncertainty of ±0.002. If not the synchronization must be adjusted. The parameter to do this is called the shutter delay time. The outliers in Figure 4.3 are probably due to random disturbances in the measurements.

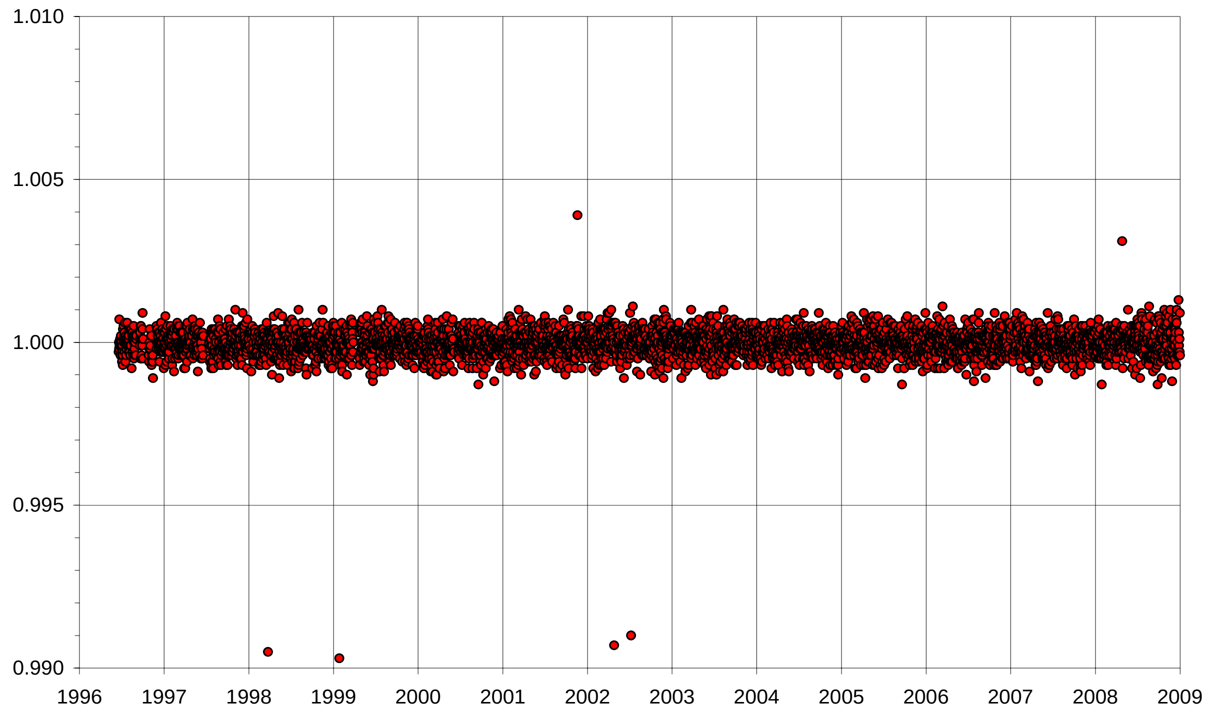

Figure 4.3. Run and stop test for Brewer #128 for the double slit position of the shutter mask for the period 1996-2008.

4.2 Brewer #006

As for the Brewer #128 the Brewer #006 status is tracked by doing the same type of tests on a daily schedule. At longer time intervals comparisons and service is done. Data on the results of these can be found in Appendix D.

The change in the responsivity of the Brewer #006 instrument is tracked using the standard lamp tests, Figure 4.4.

With similar routines as for Brewer #128, the observed differences in the SL-test R6-values can be added as a correction term to the calculated total ozone, TOZ_{ucor}, as

$$TOZ_{cor} = TOZ_{ucor} + (R6_{ref} - R6) / (\mu * 10 * \alpha),$$

where

$$TOZ_{ucor} = (R6 - ETC) / (10 * \alpha * \mu)$$

R6 is the measured weighted ratio of the radiances between the four wavelengths, ETC is the instrument constant, sometimes called the extraterrestrial constant, and α is the differential absorption coefficient, and μ is the relative optical path-length through the ozone layer. It can be seen that the correction term is μ-dependent meaning that the applied corrections will mostly be smaller in the winter, with a low sun, compared to the summer, with a high sun.

Mostly, Brewer #006 has shown only small changes in standard lamp tests results. However, as can be seen in Figure 4.4 there are exceptions. In 2002 a set of other absorption coefficients and a wavelength setting error caused a shift in the R6-values. A larger scatter in data can be seen mostly in 2003. This was first thought to be a consequence of a new electronic board. But, it remained after switching back to the old one. A visit to Vindeln in November 2003 revealed the reason. A bad contact had halted one of the filter wheels in a fixed position and the ground quartz plate was not used. This of course affected the standard lamp test. When the contact was re-established the standard lamp test results went back to their old values. However, the next day the lamp broke and had to be replaced. A new lamp will mostly give a slight shift in the test values. There will also take some time for the lamp to burn in giving rise to a slight drift in the results.

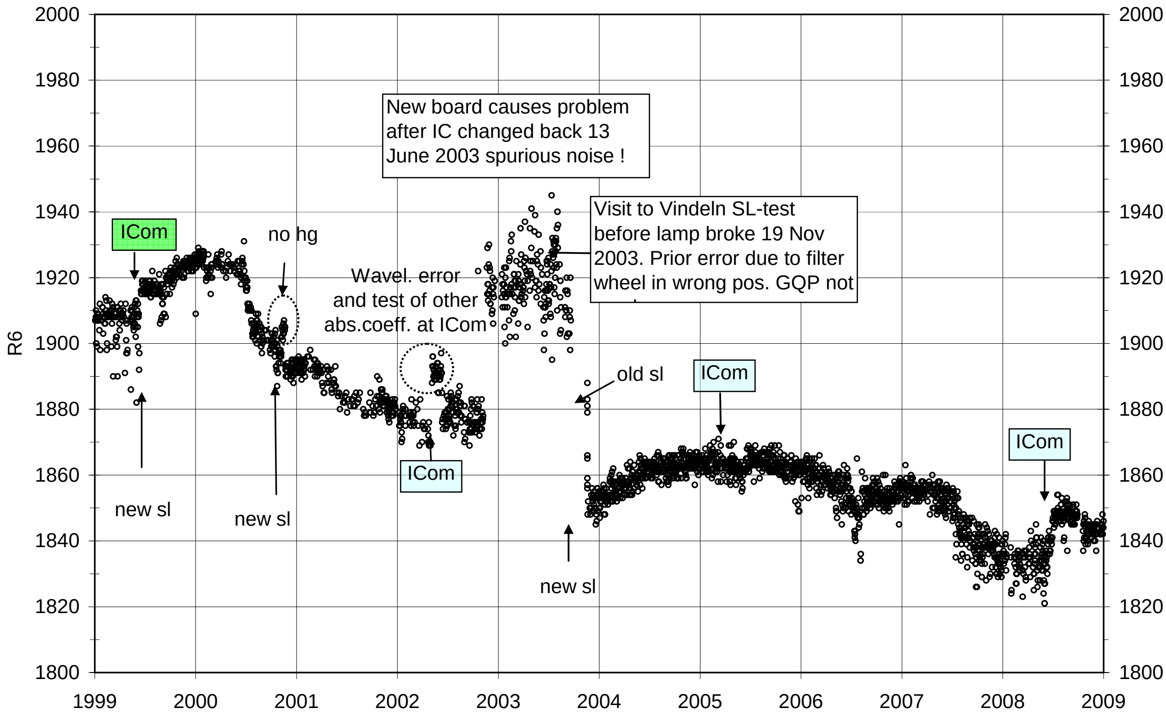

Figure 4.4. Standard lamp test value R6 for Brewer #006 over the period 1999-2008. Comparisons and lamp changes are noted as well as comments to some outliers.

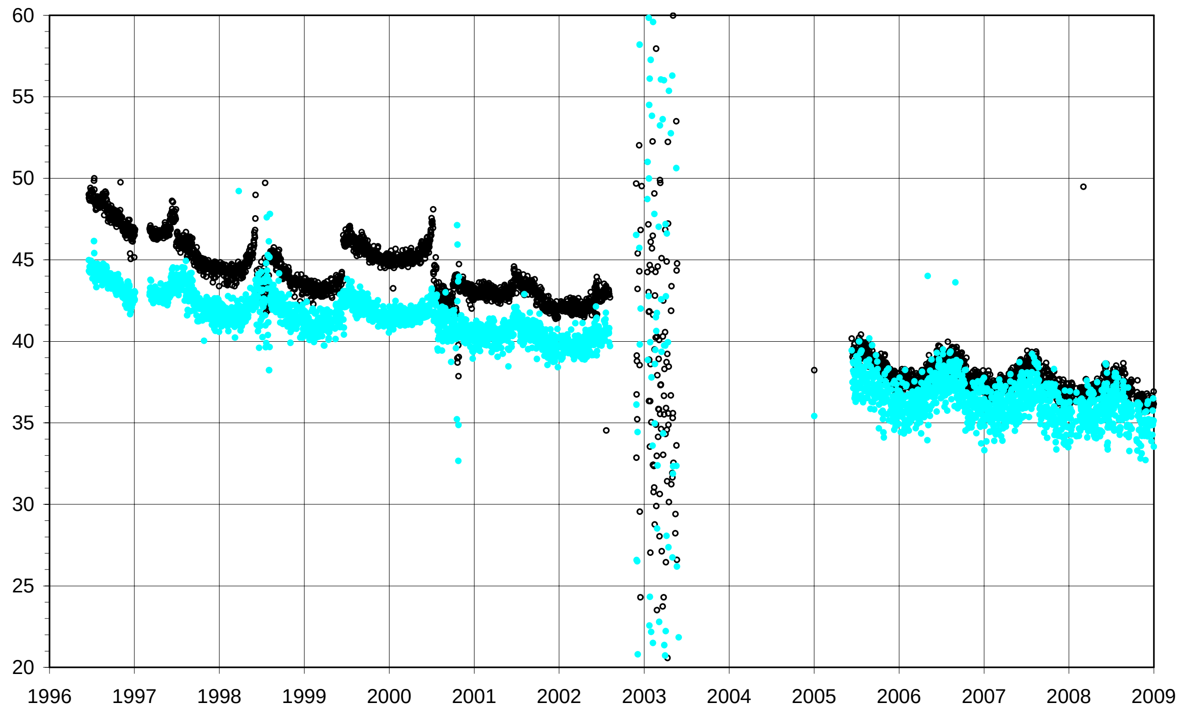

Figure 4.5. Dead-time (ns) for Brewer#006.

The dead-time of the Brewer #006 has decreased over the period 1996 to 2008, Figure 4.5. There has also been a clear yearly cycle. This is probably due to some temperature dependence. The filter wheel problems in 2003 also affected the dead-time tests which gave the large scatter seen in Figure 4.5. When the filter position error was corrected the dead-time test was not restarted. This was not noticed until the intercomparison in 2005. A new lower value of the dead-time was applied after the intercomparison.

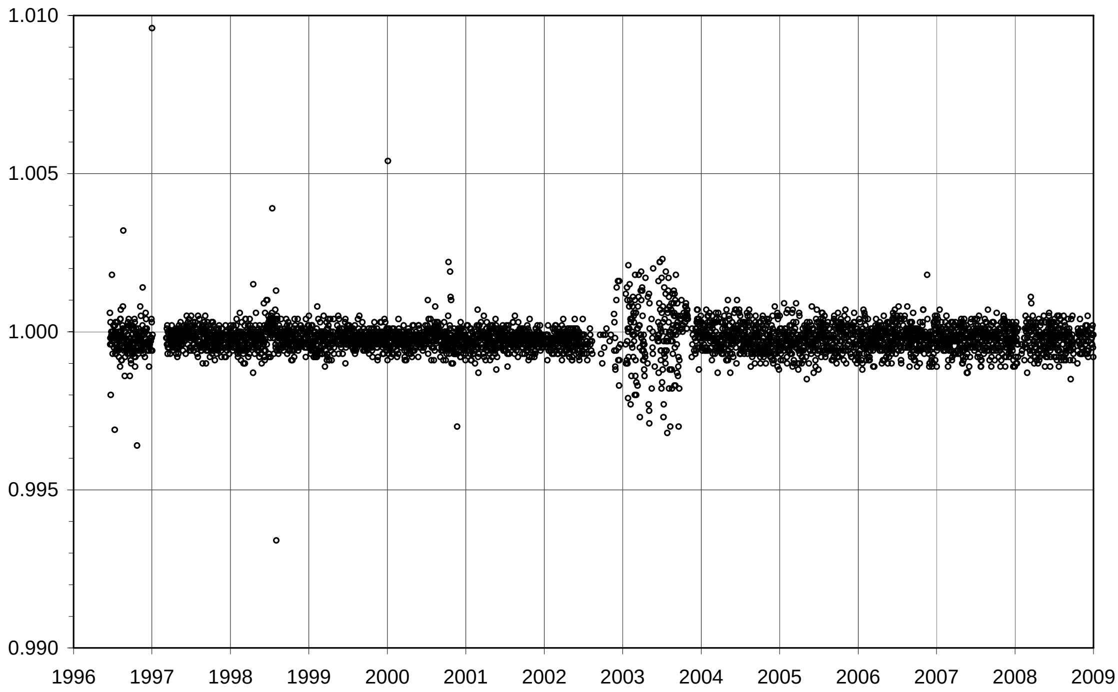

Figure 4.6. Run and stop test for Brewer #006 for the double slit position of the shutter mask for the period 1996-2008. Note the problems in 2003.

The run and stop test of Brewer #006 for the double slit position is shown in Figure 4.6. The result is very good with the exception of the period late 2002 and most of 2003 when a filter was stuck in an erroneous position. This caused a larger scatter in the data.

4.3 Dobson #30

The Dobson #30 was calibrated in June 2001 at Hohenpeissenberg, Germany. The results were encouraging. Initially there was a small difference versus the reference instrument Dobson #64. However, after cleaning the optics the following calibration showed very good agreement with the previous calibration at Arosa in 1996.

Next calibration was done in Hohenpeissenberg in June 2007. Again, the result was very good, especially for the C-wavelength. The instrument was cleaned and equipped with a new mercury lamp holder and a new standard lamp electric power supply. The mechanical holder for Q-levers and the electronics are rather old and need to be replaced preferably at the next calibration in 2010.

On basis of 17 years of semi-simultaneous measurements, in total 741 pairs of zenith sky and direct sun observations, a model for deducing total ozone out of zenith measurements was created. The empirical model has a site specific algorithm which enhances the quality of zenith observations, Josefsson and Ottosson Löfvenius (2008). All historic data since 1991 has now been reprocessed and updated. The model was fully implemented 2008 as a standard routine for zenith measurements.

Data are delivered to WOUDC. Lamp calibrations are made once a month. The lamp 30Q1 is used every month, the lamp 30Q2 twice a year and the others once a year. Luckily, nothing spectacular has happened as can be seen in Figure 4.7. A slow change can be seen for the standard wavelength pairs A and D in 2008. The more sensitive wavelength pair C' is not used for standard observation and has not been calibrated since Arosa 1996, and shows more variation, which is natural.

There is probably also a small temperature effect that is revealed in the yearly course. Although the instrument is kept inside a small hut there might be slightly lower temperatures in mid winter. Annual cleaning of the inlet quartz-glass lens affects the level of the correction coefficients (see April 2006 in fig 4.7), although not the difference between them which is of importance for the measurement quality.

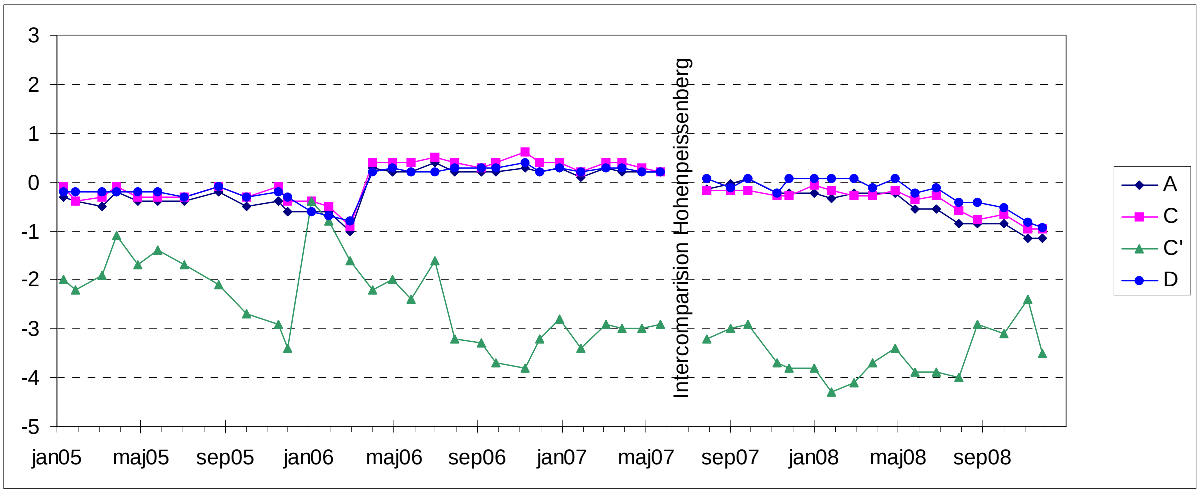

Figure 4.7. Correction coefficients based on the Dobson standard lamp tests (30Q1) for the period Jan 2005- December 2008. The various lines denoted by letters A, C, C' and D refer to the used wavelength pairs. Wavelength pairs of C' are not used for standard observations. Cleaning of inlet quartz lens was done in April 2006

4.3.1 Dobson and Brewer comparison

In a special project supported by WMO a comparison between total ozone as measured by co-located Dobson and Brewer instruments were done, Staehelin et al (2003). The goal was to establish a transfer function between the two observing systems. Both types of instruments, have shown their capabilities for reliable long-term total ozone monitoring.

Both types of instruments have their advantages and disadvantages. The wavelengths used in the Brewer spectrophotometers have ozone absorption cross sections less dependent on temperature, which leads to a weaker seasonal dependence of in the observations. Normally, the measurements of Dobson and Brewer spectrophotometers show characteristic seasonal differences, and are at least partially attributable to the different wavelengths chosen for the instruments. However, this is not the case for Vindeln.

The reason for this difference as compared with other sites is not yet known. It might be an effect from the specific instruments at Vindeln or it may be that Vindeln is a high latitude station. Measuring in the winter half year is a challenge because of the low sun and consequently the low signal involved. In any case it strongly supports that parallel monitoring should go on.

5. Observations

Over the period 2006-2009 the total ozone has varied a lot, which is the normal of total ozone at higher latitudes. In this section the daily data are plotted as one graph per year and site, Figures 5.1-5.6. The individual daily data are also given in Tables of Appendix C. Monthly mean values of the total ozone are listed in Appendix B. In these tables all monthly mean values since 1988 and 1991 are included for Norrköping and Vindeln respectively.

The nowadays typical deficit during spring-time is clearly seen for the years 2007 and 2008. The yearly course of the year 2006 is more closely positioned around the long-term mean. In late May early June of 2007 we had a very long period with large deficits, roughly -15% on average. At this time of the year the solar altitude is high and thus also the UV-radiation reached higher values.

In a special UV-project the total ozone series has been extended back to 1983 using TOMS-data (TOMS web-site). Linear trends were fitted to the individual months and their significances were tested at the 95% level. The result can be found in Table 5.1. Most monthly trends are negative and so was the trend for the year (-0.10% per year). But, the trends are usually very small and they are not significant. Only for one month the trend was significant, namely for September, with -0.20% per year.

The small trend in the last decades is also confirmed in Figure 5.7, where the long-term variation of the total ozone can be seen. It is a composite of Uppsala, Riga and Norrköping. To fill some gaps TOMS-data have been used. In general the ozone layer has been slightly thinner in later decades compared to earlier observations.

Table 5.1 Linear trends (%/year) for each month and for the year of total ozone at Norrköping 1983-2008. The observations starting in 1988 has been extended backwards to 1983 using TOMS-data . Tested for 95% significance only September is significant.

Month	Trend (% per year)	Significance @95%
January	-0.23	0.45
February	-0.03	0.43
March	+0.01	0.39
April	-0.11	0.31
May	-0.09	0.22
June	-0.11	0.21
July	-0.08	0.15
August	-0.07	0.19
September	**-0.20**	0.18
October	-0.11	0.23
November	+0.08	0.17
December	-0.31	0.34
Year	-0.10	0.15

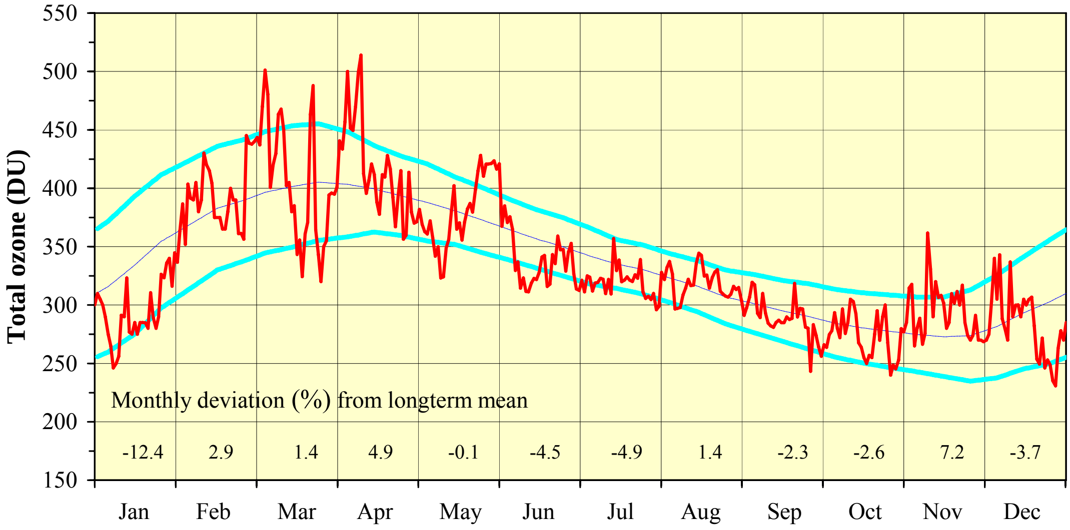

Figure 5.1 Daily 'noon' values of total ozone (red) recorded by Brewer #128 at Norrköping in 2006. Long-term mean and standard deviation are from Uppsala 1951-1966. The values at the bottom are the monthly deviations (percent) from the long term monthly means. All data refer to Bass-Paur scale. Missing data are replaced by satellite data (purple).

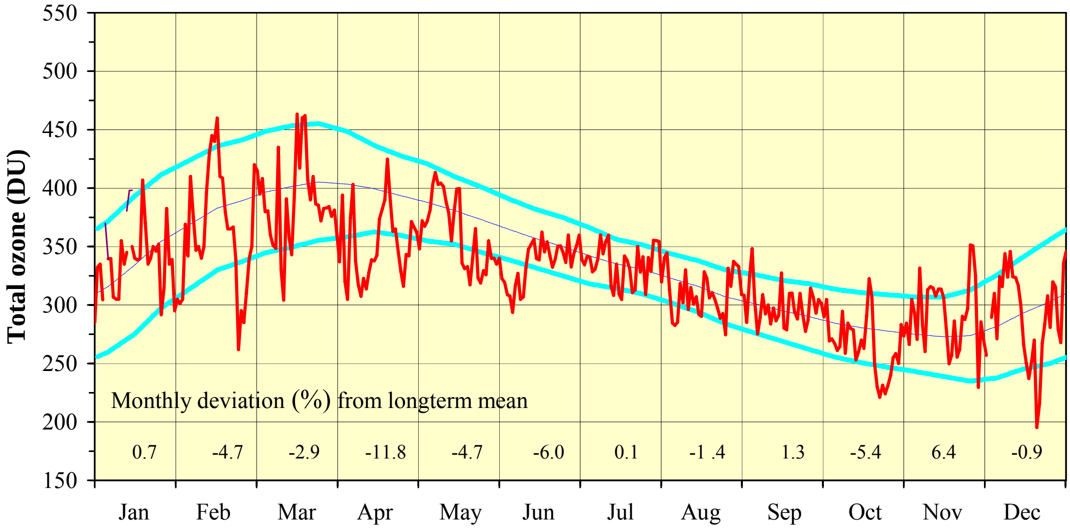

Figure 5.2 Daily 'noon' values of total ozone (red) recorded by Brewer #128 at Norrköping in 2007. Long-term mean and standard deviation are from Uppsala 1951-1966. The values at the bottom are the monthly deviations (percent) from the long term monthly means. All data refer to Bass-Paur scale. Missing data are replaced by satellite data (purple).

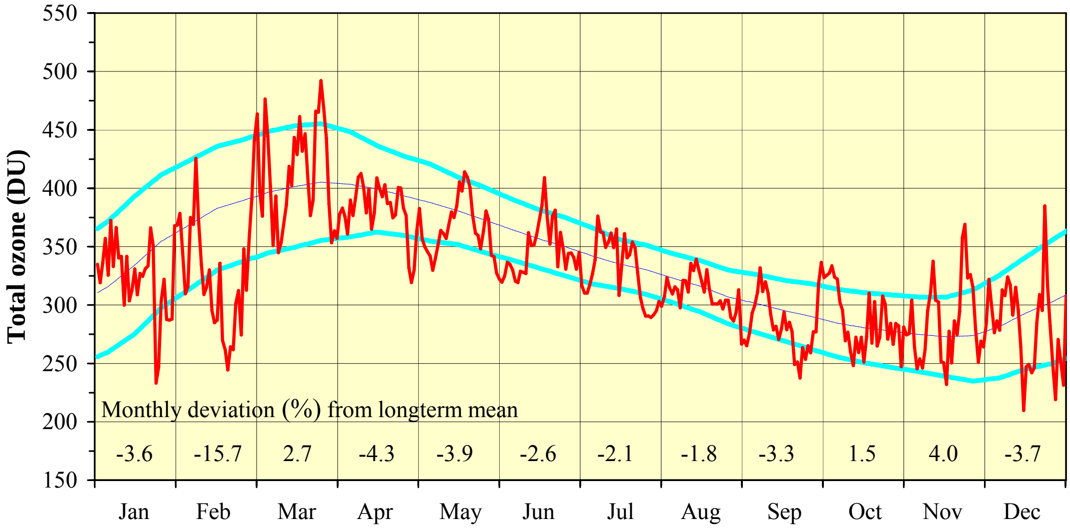

Figure 5.3 Daily 'noon' values (red) of total ozone recorded by Brewer #128 at Norrköping in 2008. Long-term mean and standard deviation are from Uppsala 1951-1966. The values at the bottom are the monthly deviations (percent) from the long term monthly means. All data refer to Bass-Paur scale. Missing data are replaced by satellite data (purple).

Figure 5.4 Daily 'noon' values of total ozone recorded by Brewer #006 (red) and by Dobson #30 (green) at Vindeln in 2006. Long-term mean and standard deviation are from Uppsala 1951-1966. The values at the bottom are the monthly deviations (percent) from the long term monthly means. All data refer to bass-Paur scale. Missing data are replaced by satellite data (purple line).

Figure 5.5 Daily 'noon' values of total ozone recorded by Brewer #006 (red) and by Dobson #30 (green) at Vindeln in 2007. Long-term mean and standard deviation are from Uppsala 1951-1966. The values at the bottom are the monthly deviations (percent) from the long term monthly means. All data refer to Bass-Paur scale. Missing data are replaced by satellite data (purple line).

Figure 5.6 Daily 'noon' values of total ozone recorded by Brewer #006 (red) and by Dobson #30 (green) at Vindeln in 2008. Long-term mean and standard deviation are from Uppsala 1951-1966. The values at the bottom are the monthly deviations (percent) from the long term monthly means. All data refer to Bass-Paur scale. Missing data are replaced by satellite data (purple line).

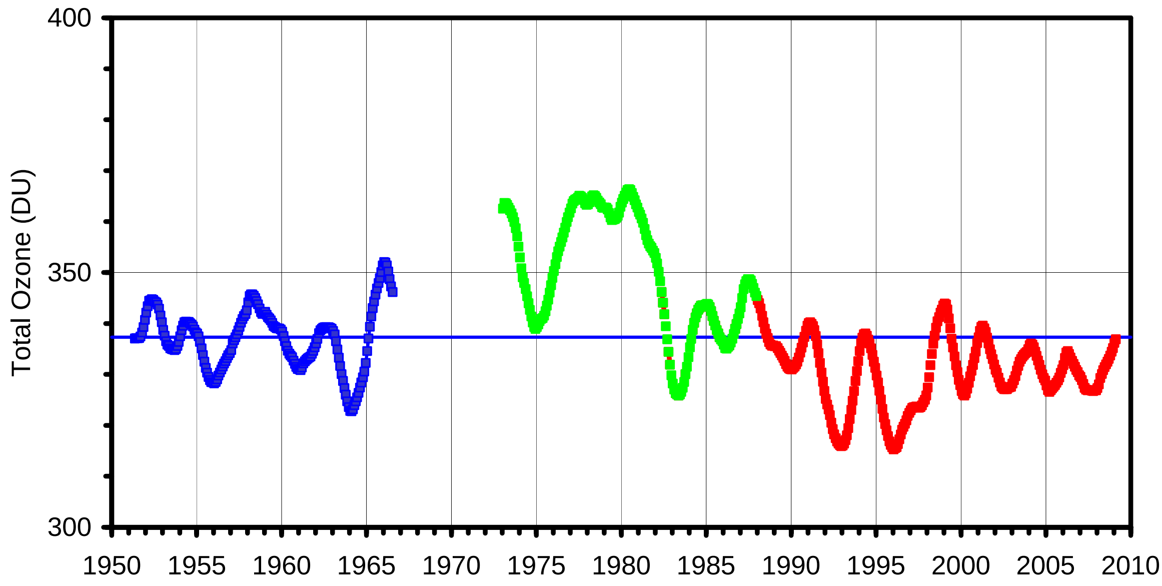

Figure 5.7 The long-term variations of the total ozone in Uppsala 1951-1966 (blue), Riga+TOMS 1974-1987 (green) and Norrköping 1988-2008 (red). The smoothed lines are based on monthly mean values that have been filtered by a two-year triangular filter. The blue horizontal line is the average from Uppsala.

6. Conclusions

Most of the months and also the yearly values of total ozone show a negative trend over the period 1983 to 2008 over Norrköping. However, it is not significant when tested at the level of 95%. Therefore, during the last decades the total ozone over Sweden is neither decreasing nor increasing significantly. The natural variation is very large and therefore we must wait to observe, with significance, the expected recovery.

Despite some problems the monitoring delivers daily data for the time of year when the solar elevation is not too low. The daily data are stored and they are available at "Datavärden" www.smhi.se and at the WOUDC (World Ozone and Ultraviolet Data Centre).

7. References

Josefsson W., 1988, Mätning av totalozon, SMHI Meteorologi, No.43, December 1988.

Josefsson W., 1990, Measurements of Total Ozone 1989, SMHI Meteorologi, No.16, March 1990.

Josefsson W., 1991, Measurements of Total Ozone 1990, PMK-rapport, SNV, 91-620-3944-x, 1991/06.

Josefsson W., 1992, Measurements of Total Ozone 1991, PMK-rapport, SNV, Solna, 91-620-4093-6, 1992/10.

Josefsson W., 1993, Measurements of Total Ozone 1992, PMK-rapport, SNV, Solna, 1993/10.

Josefsson W., 1996, Measurements of total ozone, National Environmental Monitoring 1993/94, Swedish Environment Protection Agency, ISBN 91-620-4405-2, Stockholm 1996/01.

Josefsson W. and J-E. Karlsson, 1997, Measurements of total ozone 1994-1996, SMHI Reports Meteorology and Climatology, RMK No.79, Sep 1997, ISSN 0347-2116.

Josefsson W., 2000, Measurements of total ozone 1997-1999, SMHI Reports Meteorology and Climatology, RMK No.91, Sep 2000, ISSN 0347-2116.

Josefsson, W. and Ottosson Löfvenius, M. 2008. Total ozone from zenith radiance measurements - an emperical model approach. SMHI Reports Meteorology, No 130, ISSN 0283-7730.

Staehelin, J., J. Kerr, R. Evans and K. Vanicek, (2003), Comparison Of Total Ozone Measurements of Dobson and Brewer Spectrophotometers and Recommended Transfer Functions, WMO TD No. 1147, World Meteorological Organization, Global Atmosphere Watch, No. 149, ftp://ftp.wmo.int/Documents/PublicWeb/arep/gaw/gaw149.pdf http://www.wmo.int/pages/prog/arep/gaw/gaw-reports.html

TOMS, The author gratefully acknowledge the NASA/GSFC's Ozone Processing Team in providing the TOMS total ozone data over their web site http://toms.gsfc.nasa.gov/

Appendix A

Events that affected the monitoring during the period 2006-2008

At the following dates, the Brewer #128 in Norrköping has had problems affecting the monitoring. After the hyphen the eventual measure taken is given. The list may not be complete but it gives an idea of typical problems and their frequency.

2006-03-29 solar eclipse 10-12 UTC at max around 11 UTC 0.3 of the diameter was covered. Clouds As translucidus and snow 80% on ground.
2006-04-08 power break for almost four hours at 6 UTC. The PC did not restart automatically. Restart at 12.45 UTC. The day was rainy and overcast.
2006-06-12—14 the platform was painted.
2006-06-14 cold front passage caused jump in ozone data
2006-06-16—19 calibration and service. New constants and new program

2007-01-01 Brewer stopped at 9.53 UTC, unknown cause.
2007-01-03 Restart 9.50 UTC. Electrical reinstallations started on the measurement platform
2007-01-03 COM err during focused moon measurement caused stop and missed data 4 Jan. There was also some power breaks both on the 3 and 4 Jan.
2007-01-05 restart 7.45 UTC.
2007-01-09 Power break caused stop at 10.52
2007-01-10 restart at 9.30 UTC.
2007-01-12 In the evening power break in parts of Norrköping caused a stop and no data 13 Jan.
2007-01-14 restart at 7.50 UTC. The Brewer power was now connected to an indoor power-line due to the work on the platform.
2007-02-20 low temperatures outdoors causes the inner temp of the Brewer to cycles due to heating on off.
2007-03-22 Brewer power now at 7.00 UTC re-connected to the platform plug using a "jordfelsbrytare" connection.
2007-02-23 power breaks due to work on the platform
2007-06-09 stopped in the evening. Probably electrical installation work on the platform.
2007-06-10 Restart at 05.50 UTC.
2007-07-04—05 clock problems large time errors several minutes. Fixed.
2007-07-05 Power break caused by work on the platform

2008-02-05 Power break
2008-02-06 Restart at 7.30 UTC
2008-03-05 Power break at 13.54 UTC stopped the instrument
2008- 03-06 Restart at 8.30 UTC
2008-05-01 removed the Polar kit
2008-05-09 Power break
2008-05-10 Restart at 12.30 UTC
2008-06-18 Standard lamp exchange at 14 UTC. Silica gel also exchanged. When restarted problems with filter wheel #3. made some extra SL-tests to burn the new lamp.

=============================

At the following occasions, dates, the Brewer #006 in Vindeln have had problems affecting the monitoring. After the hyphen the eventual measure taken is given. The list may not be complete but it gives an idea of typical problems and their frequency as well as an explanation of missing data.

2006-01-04 stopped when trying to do focused moon measurements
2006-03-01 COM err causes data missed
2006-08-01 COM err probably caused by power failure instrument stopped
2006-08-03 restart and silica gel exchange
2006-10-19 missed day, probably due to error in schedule at end of day
2006-10-27 low signal during day probably caused by snow covering the entrance optics. In the evening power break caused by the weather.
2006-11-13—17 several power breaks caused stops
2006-11-22—24 instrument stop. Restart 24 Nov with wrong date. Corrected at 11 UTC.

2007-01-31 measurements stopped, probably due to communication over the internet with Norrköping. Restarted during the same day.
2007-03-29 COM-err caused a stop between 9-11 UTC
2007-04-04—05 some COM err
2007-04-06 Azimuth zeroing tracker failure caused a stop over the Easter
2007-04-10 Restart of the azimuth tracker at 11.40 UTC. The safety break had stopped the instrument.
2007-06-23 COM err at midnight caused erroneous date for the coming days. Date corrected 30 June.
2007-07-18 stop at 13.50 UTC unknown reason. Missing day 19 July.
2007-07-20 restart at 8 UTC
2007-08-07 PC-reinstallation
2007-09-04 In the morning attempt to use internet as communication link instead of modem. Change of computer and hard drive disk moved. Stop at 9 UTC. Restart at 11.32 UTC.
2007-09-08 stop during night reset at 00.52 UTC. During the coming days several attempts were made to get the system work.
2007-09-10 Finally we had to restart the old computer system using the modem.

2008-01-15—29 Brewer stop for a long period.
2008-01-30 restart
2008-02-02--10 Power break caused stop in measurements
2008-02-11 restart
2008-04-11 COM err restart at 13 UTC
2008-04-21 Restart after a short break
2008-05-08—12 No data recorded because disk full
2008-06-14 New constants after calibration
2008-08-19 Azimuth tracker zeroing failure. Restart at 11.30 UTC
2008-09-28 brewer stopped at 11.24 UTC “subscript out of range”. No success to restart the instrument it cannot find the micrometer zero setting which in turn prevents mercury calibrations.
2008-09-28—10-16 Brewer stopped. Then a new attempt was successful. Unknown cause of the problems it may have been bad connections in connectors?
2008-11-04 problems with the time causing large errors in the clock, which in turn affects the tracking and the computation of airmass. Luckily the UV is too weak to give any reliable observations of the total ozone.
2008-11-09 the problem with the time was detected, error in date and in time.
2008-11-18 The problem was found to be the clock board, which is the internal Brewer clock. Instead of using the internal clock the PC-clock was used which solved the problem.
2008-12-06—08 Azimuth tracker zeroing failure. Restart at 12.20 UTC 8 Dec.

Appendix B.

Monthly values of total ozone (DU) for the whole period at Vindeln (1991-2008) and at Norrköping (1988-2008).

Table B1. *Vindeln monthly values of total ozone (DU). Uncertain values (italic) are largely based on satellite observations. The highest monthly value is red and the lowest is blue for each month. The lack of data during the winter is mainly due to low solar elevation and the corresponding weak UV-radiance.*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991		*360.3*	366.7	403.5	398.3	**373.1**	330.3	315.8	305.3	*281.1*	*273.5*	
1992		*316.2*	355.1	409.0	348.3	330.4	328.6	307.7	279.4	277.1	*274.9*	
1993	*323.6*	***287.0***	339.3	331.7	**334.5**	348.0	308.3	303.2	273.7	***256.1***		
1994		370.3	347.4	400.6	379.5	356.8	**308.2**	300.2	**310.8**	*267.5*		
1995			*347.2*	375.2	354.2	**319.1**	*325.2*	***278.0***	280.4	*257.1*		
1996			337.3	***330.8***	361.1	336.4	329.7	291.9	**271.3**	264.8	*278.6*	
1997		*347.8*	381.7	355.2	378.4	338.3	317.8	288.6	284.7	287.5	*269.2*	
1998		*339.2*	394.3	407.7	**395.5**	343.6	**347.7**	**339.0**	290.0	289.7	*277.4*	
1999		*382.8*	**430.0**	386.5	390.4	329.8	326.8	317.0	279.7	289.1	*268.0*	
2000	*308.0*	348.5	348.4	353.7	348.0	347.3	315.1	305.7	275.4	278.6	***253.8***	
2001	*315.9*	384.9	421.3	400.8	372.8	352.9	314.1	306.8	283.4	283.3	*285.6*	
2002	***307.2***	399.0	397.9	371.8	339.0	337.9	315.9	293.3	275.3	289.7	*265.9*	
2003	*320.8*	*317.6*	**335.4**	391.2	380.7	359.5	316.0	310.9	281.7	271.9	*285.0*	
2004	*338.2*	*362.3*	397.7	372.2	385.2	364.7	330.1	304.4	290.9	271.0	*263.2*	
2005	*322.0*	297.6	337.9	403.9	372.0	342.5	320.3	295.6	287.6	262.0	*282.6*	
2006	*316.1*	**402.6**	426.2	**419.4**	379.0	339.7	313.5	289.0	287.3	269.4	***304.4***	
2007	***357.4***	354.9	373.8	363.9	365.2	335.4	319.6	296.8	299.5	288.1	*291.6*	
2008	*320.7*	331.2	418.8	372.4	365.9	342.3	325.0	309.8	280.0	**290.9**	*284.9*	*285.2*

Table B2. *Norrköping monthly values of total ozone (DU). Italic values are largely based on satellite observations and may be uncertain. The highest monthly values are bold and red and the lowest ones are bold and blue for each month.*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1988	*333.6*	380.7	**418.5**	393.3	366.7	343.0	336.3	319.5	286.5	275.0	283.3	326.1	338.4
1989	*306.6*	394.5	391.4	383.7	371.1	347.7	335.9	322.5	287.7	278.7	280.1	*314.0*	334.1
1990	*322.8*	346.4	383.5	381.8	355.7	343.6	331.1	312.9	295.8	280.9	**302.5**	*310.5*	330.5
1991	361.6	383.1	376.1	400.2	**393.2**	**377.2**	332.8	321.4	298.9	286.2	286.4	287.9	**341.8**
1992	**265.8**	343.8	365.8	392.2	352.3	336.8	326.9	300.3	**279.8**	293.0	284.4	295.7	319.5
1993	316.7	**296.6**	342.8	**335.1**	**340.3**	340.9	326.1	315.7	284.0	*286.9*	*297.9*	*302.0*	**315.6**
1994	***363.6***	388.1	369.2	397.9	376.2	358.5	322.2	320.4	**320.0**	284.1	283.0	*315.7*	341.2
1995	310.5	370.2	370.0	378.0	360.4	**323.1**	323.7	**295.8**	288.8	270.5	271.9	297.0	321.3
1996	287.9	341.6	**332.5**	337.7	363.8	346.2	341.4	300.7	284.3	270.3	279.4	302.6	315.6
1997	318.2	369.0	365.5	361.7	367.7	345.8	333.1	296.4	281.0	290.7	276.7	**250.1**	321.0
1998	311.4	341.3	383.1	391.1	383.6	349.7	**361.0**	**341.6**	292.2	**303.2**	287.0	329.5	339.6
1999	352.7	**394.8**	414.9	*379.5*	376.7	335.3	330.5	320.4	280.5	296.0	276.2	325.4	340.0
2000	312.1	353.1	344.2	355.1	350.3	343.1	335.5	312.2	282.6	282.6	**269.1**	***333.4***	322.7
2001	340.7	389.9	417.6	405.7	374.4	365.4	326.0	310.6	295.2	280.2	282.0	297.8	340.1
2002	304.1	376.7	391.4	386.6	342.5	348.3	325.8	305.8	281.4	300.6	286.5	265.2	325.8
2003	334.9	344.0	345.2	402.3	381.6	362.5	334.0	319.5	293.4	289.9	281.8	292.9	331.7
2004	336.8	381.0	398.7	373.3	374.6	362.0	334.6	312.8	290.0	277.5	279.7	326.4	337.2
2005	337.8	321.7	342.3	390.2	357.4	344.3	335.6	307.5	284.3	**264.0**	295.7	300.5	323.4
2006	294.9	391.0	406.4	**418.1**	379.6	340.7	**318.8**	318.7	288.6	273.4	294.0	283.0	333.5
2007	338.8	362.0	389.4	355.3	361.8	335.3	335.6	310.0	299.0	265.7	291.8	291.2	327.8
2008	324.6	320.9	411.7	381.2	364.9	347.4	328.4	308.9	285.6	284.8	285.3	283.0	327.3

Appendix C.

Table C1. *Daily values of total ozone (DU), Vindeln 2006 Brewer # 006*

2006	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1		375.5	455.0	457.5	402.0	414.2	302.5		296.5	255.0	286.2	
2			450.0	434.5	369.2	384.2	306.4		287.2	251.1	324.0	
3			434.6	450.0	378.9	384.2	309.6	303.7	284.8	250.0	284.8	
4		406.1	485.0	435.7	366.3	404.0	322.4	307.1	318.8	260.0		
5		417.1	485.0	467.6	344.1	376.0	316.6	299.5	304.1	260.0		
6			489.9	497.0	348.0	360.1	317.2	266.0	298.0	270.0	332.2	
7			431.4	415.0	357.9	343.1	315.5	259.1	297.9	245.0		
8			445.2	465.0	325.7	325.5	316.1	258.6	320.0	255.0	321.3	
9			431.3	480.0	348.3	312.7	306.3	266.0	303.9	278.2	354.7	
10		440.0	411.3	490.0	325.5	315.7	328.3	275.6	304.0	265.0	305.6	
11	305.0	415.5	400.2	457.4	333.4	314.8	309.9	276.0	307.1	290.9		
12	280.0	398.0	380.0	397.9	350.1	314.4	336.4	300.7	289.9	300.4		
13	290.0	397.8	370.6	420.0	366.2	316.9	310.8	287.2	294.5	289.3		
14	282.0	389.5	379.4	395.0	383.9	348.0	339.2	291.9	292.0	285.1		
15	282.6		369.8	415.0	436.6	312.8	317.5	282.9	268.3	255.0		
16			369.9	391.9	428.0	329.3	305.2	282.3	268.7	250.0		
17		403.5	384.2	395.0	422.0	316.1	309.6	294.0	272.1	253.7		
18	285.0	415.0	394.3	404.7	410.4	324.4	356.6	288.4	279.0	261.2		
19	292.3	395.0	491.9	414.6	366.3	319.8	337.9	287.8	286.4			
20	293.9	402.8	496.4	440.4	363.3	326.9	327.5	295.2	323.2	290.0		
21		393.4	486.1	440.4	373.3	339.0	324.3	299.7	285.0	265.0		
22		376.6	474.0	385.2	376.1	348.9	300.3	297.3	291.4	305.0		
23		367.1	457.8	347.0	395.0	334.3	305.5	288.3	281.7	345.0		
24		350.1	452.0	389.0	384.5	344.1	316.2	281.8	291.4	315.0		
25	337.7	417.7	446.5	355.3	383.3	337.6	299.0	280.5	263.2	269.6		
26		460.8	373.6	350.4	395.8	350.6	303.5	287.5	270.0	266.2		
27	333.8	461.6	389.9	368.8	409.6	319.5	296.9	290.9	285.0			
28		450.0	385.0	379.9	406.6	323.4	284.6	302.1	260.0			
29	329.7		395.4	425.0	405.0	339.0	302.2	301.9	238.4	235.4		
30			400.8	417.1	395.4	312.5	303.7	300.0	255.0	264.1		
31			395.0		399.4		289.2	294.1				

Table C2. *Daily values of total ozone (DU), Vindeln 2007 Brewer # 006*

2007	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1		279.1	385.0	334.2	364.4	315.5	314.0	327.9	315.9	320.0	311.6	
2	280	355	397.7	335.8	380.0	298.1	326.4	314.0	285.0	280.0	294.3	
3	287	372.0	369.5	385.1	387.8	291.2	324.1	318.7	288.3	244.9		
4	276	356.7	382.4	315.8	392.9	282.4	326.8	302.6	301.1	242.5		
5		367.5	392.0	414.3	392.5	296.7	321.4	272.2		243.4		
6	247	330.3	315.0		380.4	307.6	315.7	276.1	290.5	255.8		
7		331.0	315.0		377.1	305.3	320.0	267.3	275.0	290	260.7	
8		377.8	340.0		391.4	326.3	323.6	270.4		282.8	256.5	
9		323.4	325.9	315.0	392.0	307.9	360.0	286.3		259.4		
10		355.0	453.6	320.0	384.4	338.9	340.0	283.1	310.0	306.8	287.2	
11		382.0	351.4	338.8	400.7	345.1	302.7	261.7	284.5	289.5		
12		391.0	311.2	340.5	399.2	346.3	340.2	277.0	302.6	298		
13		450.0	388.7	355.3	387.6	357.9	330.1	290.0	290.8	253.4		
14		370.7	374.2	342.6	370.0	371.7	314.2	277.8	280.6	275		
15		420.0	351.7	338.8	375.0	372.3	308.1	284.1	311.4	276.4		
16		410.0	423.4	349.0	400.0	354.1	313.1	290.0	323.9	295		
17		385.0	460.0	389.4	391.3	349.9	297.8	315.8	340.0	313.1		
18			402.0	365.5	368.7	368.0	292.2	318.1	337.7	304.4	253.6	
19		421.7	435.0	411.2	335.0	356.5		300.8	341.0	278		
20		392.2	467.8	433.7	378.3	357.8	292.2	292.3	315.5			
21		335.5	432.9	396.5	350.9	363.8	320.3	297.7	311.7	201.5		
22		314.6	357.1	353.4	343.9	336.7	296.7	289.9	341.3			
23	317.4	278.8	375.4	355.0	376.8	331.2	297.3	277.0	305.2			
24	324.2	260.0	380.7	343.1	355.4	336.9	322.0	293.0	281.4	213.9		
25		275.0	368.6	334.0	355.6	348.8	320.3	301.4	275.2	204		
26	344.5	285.0	327.3	307.8	317.9	357.7	312.5	319.3	292.0	241.6		
27	347.6	315.0	319.2	360.2	336.6	341.0	309.8	310.0	305.9			
28	335.2	355.0	351.0	399.9	315.8	340.1	318.2	317.3	270.7			
29	346.1		366.7	364.3	312.5	331.6	336.4	316.4	271.0			
30	293.4		340.5	402.9	301.5	325.2	335.3	327.6	270.0	286.2		
31			328.1		306.5		360.0	325.9		297.2		

Table C3. *Daily values of total ozone (DU), Vindeln 2008 Brewer # 006.*

2008	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1		339.1	450.0	380.4	321.9	328.7	327.3	311.4	293.6		249.3	
2			415.0	369.8	329.0	349.7	342.5	306.1	295.0			
3			425.0	385.0	349.8	317.0	308.2	308.6	290.0			
4			455.7	375.0	351.7	316.9	311.5	316.3	314.6			
5			411.0	395.4	335.0	305.9	334.8	310.5	318.0		250.5	
6			402.2	370.0	353.4	307.0	345.8	315.4	293.7		214.9	
7			400.0	370.0	352.6	315.2	341.2	319.7	303.5			
8				360.0		319.5	334.3	304.9	277.0			
9			380.0	360.0		330.0	335.1	318.9	275.1			
10			340.0	395.0		335.0	355.3	322.5	266.8			
11		286.9	340.6	400.0		338.9	366.3	318.9	270.0			
12		298.7	390.0	365.5	382.3	344.7	351.5	331.9	265.0			
13		334.8	425.0	355.0	402.7	345.3	365.7	350.0	269.7			
14		419.7	425.0	355.7	397.6	347.7	350.5	339.1	275.0			
15		346.8	423.1	377.9	382.3	346.3	323.9	332.2	265.0			
16			433.4	423.0	400.4	367.9	344.0	322.9	256.3	280.0		
17		305.6	439.9	392.3	407.7	387.8	339.1	303.4	265.0	305.0		
18		300.9	425.0	387.6	413.2	358.4	329.7	350.0	265.0	273.0		
19		268.7	421.2	409.0	406.6	382.9	340.3	303.0	245.9	325.0		
20		265.1	386.9	401.6	410.2	359.1	322.8	299.0	271.8	280.0		
21			386.5	389.8	404.3	364.0	340.0	291.9	222.8	284.3		
22		326.1	445.4	388.2	384.0	362.3	330.0	290.0	246.4	340.7		
23		344.4	485.0	387.1	383.8	331.7	316.6	293.1	255.2	335.4		
24		319.8	478.3	355.3	366.2	366.5	290.8	291.3	274.5			
25		400.2	481.2	364.7	359.0	347.7	286.3	290.1	275.0	307.3		
26		344.4	432.5	364.8	382.9	339.6	287.4	268.6	302.2	281.1		
27			475.0	322.9	344.3	343.1	274.0	295.0	305.0	300.0		
28			489.7	331.1	344.1	336.6	286.8	300.0	343.3	278.4		
29		359.6	368.6	314.0	316.8	340.1	298.5	293.5		296.9		
30			368.0	324.8	324.6	334.0	298.5	306.7		266.6		
31			385.0		331.7		296.4	297.4		270.0		

Table C4. *Daily values of total ozone (DU), Norrköping 2006 Brewer # 128.*

2006	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	310.0	363.7	440.0	400.9	371.2	421.0	312.6	327.9	291.2	266.0	285.0	270.0
2	305.0	386.6	443.6	440.7	382.0	367.4	321.2	321.8	297.9	263.8	314.7	275.0
3	300.0	351.8	437.1	433.5	369.0	384.9	311.4	332.0	306.7	274.8	317.6	302.7
4	290.0	403.5	469.9	456.9	362.9	370.7	325.1	337.3	319.5	278.0	265.0	340.0
5	275.0	391.5	501.2	500.0	360.8	375.7	323.9	326.6	317.3	293.5	280.0	305.0
6	265.0	390.0	480.5	451.5	372.1	364.6	312.0	296.6	292.8	280.0	288.7	342.9
7	246.2	405.0	400.6	449.5	357.5	329.7	318.8	297.1	289.3	272.0	266.3	288.3
8	250.0	380.0	420.0	470.0	341.8	336.8	319.4	297.9	309.9	296.7	275.7	279.8
9	256.1	390.0	429.8	499.0	349.8	314.4	323.0	308.6	293.2	275.8	361.7	270.0
10	291.3	430.0	463.5	514.0	323.2	323.2	322.1	314.2	284.4	285.2	330.9	336.9
11	290.0	420.1	467.7	412.4	324.2	311.6	309.8	322.1	282.0	305.0	290.0	290.0
12	323.1	415.0	450.2	395.6	348.8	311.4	322.0	316.6	280.9	303.0	320.0	299.9
13	276.8	404.3	402.1	406.6	356.1	318.9	309.4	316.9	285.0	292.5	306.3	300.0
14	275.0	374.9	405.0	420.9	380.8	322.8	357.0	335.7	287.1	267.6	308.3	290.0
15	285.0	375.0	380.0	411.8	402.1	321.8	329.5	344.4	284.9	263.8	301.7	305.0
16	275.0	375.0	385.0	388.1	364.8	327.9	338.6	342.6	284.9	255.0	280.0	300.0
17	285.0	365.0	343.4	377.8	370.3	341.1	319.9	324.9	289.7	250.0	285.0	304.6
18	285.0	365.0	355.6	411.6	355.6	342.5	321.4	325.7	287.6	257.0	309.8	306.8
19	284.9	380.0	324.3	409.5	371.1	316.0	324.2	314.4	288.6	255.0	301.8	282.2
20	280.0	400.0	360.8	428.0	382.3	317.9	321.2	323.7	318.6	275.0	311.5	253.7
21	310.6	390.0	370.8	416.5	386.9	343.2	320.3	328.2	289.8	295.0	300.0	249.4
22	289.5	390.0	463.3	392.5	379.6	335.4	325.8	330.4	297.2	269.7	317.0	271.7
23	280.0	361.2	487.9	366.9	399.1	359.1	322.9	311.8	296.7	290.0	285.0	246.1
24	290.0	361.3	364.3	395.0	415.0	347.3	338.9	309.5	281.1	300.0	273.9	253.0
25	326.4	356.3	343.2	415.0	428.2	347.6	311.3	307.5	280.2	267.5	270.0	248.9
26	323.3	445.1	320.0	356.4	410.2	329.2	305.7	306.8	243.3	240.0	274.0	235.0
27	335.9	438.5	350.0	360.0	420.6	345.0	307.5	309.3	283.3	248.6	291.2	230.8
28	340.0	437.8	355.0	413.7	420.9	352.8	304.6	316.1	274.2	245.3	270.0	262.7
29	316.1		394.3	379.6	421.2	326.7	309.9	313.4	264.1	253.0	270.0	277.9
30	344.7		395.8	370.2	423.5	313.8	295.9	315.0	256.0	279.8	268.6	270.0
31	336.6		395.0		416.4		298.8	303.7		277.1		285.0

Table C5. *Daily values of total ozone (DU), Norrköping 2007 Brewer # 128.*

2007	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	332.4	301.2	420.0	359.7	362.1	340.0	359.8	319.7	308.2	290.0	284.4	256.9
2	335.0	304.9	415.0	337.0	348.1	322.6	339.0	340.2	285.2	304.6	266.1	
3	304.5	369.0	395.0	393.9	372.0	319.4	334.5	344.5	324.4	269.2	304.6	289.4
4		342.0	408.1	320.0	367.5	308.8	341.8	313.0	348.1	271.0	293.2	310.0
5	339.5	410.0	380.0	304.8	371.7	307.7	341.1	284.7	303.4	267.2	270.7	271.2
6	339.8	375.0	380.7	374.4	381.5	293.7	328.5	282.6	275.3	261.2	331.5	324.2
7	306.8	347.0	360.0	403.2	403.2	316.7	330.6	285.4	289.5	264.5	282.9	315.8
8	305.0	350.0	351.0	337.5	413.5	327.1	339.2	318.4	308.8	294.5	260.2	343.9
9	305.0	340.0	348.4	317.4	403.2	304.9	360.0	301.9	292.3	258.6	313.0	323.9
10	355.0	350.0	434.8	307.4	404.3	306.9	343.8	330.0	300.0	284.5	315.6	345.8
11	335.0	396.6	330.0	322.8	401.3	331.8	353.9	296.3	283.8	280.0	314.6	324.1
12	345.0	430.0	304.1	313.7	387.9	347.8	359.7	315.0	297.5	278.7	307.5	323.4
13		445.0	390.9	327.7	378.7	352.2	315.9	300.7	286.6	253.0	313.7	316.8
14	350.0	440.0	357.7	338.7	354.8	356.3	308.2	307.1	291.2	260.0	313.6	300.1
15	340.0	460.0	343.0	337.7	378.9	339.8	334.9	292.0	327.5	270.0	306.4	265.8
16	338.6	410.0	391.8	342.3	399.2	338.7	309.3	290.3	280.2	262.9	277.4	250.4
17	339.9	408.6	463.3	373.6	399.6	362.4	304.6	328.4	278.8	290.7	249.7	237.1
18	406.8	380.0	417.1	382.1	335.8	345.5	342.0	322.9	310.0	322.4	257.0	252.2
19	370.0	365.0	460.0	390.0	331.2	354.0	338.2	306.0	310.2	306.9	286.4	269.9
20	335.0	365.0	462.0	424.7	332.7	342.1	331.1	310.4	294.2	249.1	255.4	195.2
21	340.0	366.8	407.3	389.5	317.4	332.3	310.6	304.9	288.1	230.0	261.9	215.9
22	350.0	338.8	390.0	363.0	339.6	339.2	312.8	297.9	309.9	221.0	290.3	267.3
23	346.1	261.9	410.0	365.0	365.4	350.3	350.0	288.7	292.8	231.3	287.5	284.0
24	352.1	295.0	386.5	345.0	323.2	350.5	328.1	292.7	277.4	224.1	296.9	307.9
25	291.6	285.0	385.5	328.6	318.8	344.6	341.2	274.5	286.9	230.5	351.4	280.9
26	315.0	310.0	371.9	316.1	329.3	336.4	309.0	331.4	314.4	240.0	350.4	319.7
27	382.7	340.0	382.6	343.2	325.8	360.0	340.6	316.2	306.6	255.0	325.2	315.4
28	335.0	350.0	383.1	342.2	355.0	332.6	328.7	337.3	293.1	258.4	229.5	279.3
29	338.9		384.3	371.4	340.0	343.7	355.3	335.0	304.6	250.0	285.4	268.0
30	295.0		375.9	366.5	340.0	350.2	355.2	332.9	301.4	283.3	270.9	335.9
31	305.0		381.3		335.0		354.5	308.9		273.6		345.9

Table C6. *Daily values of total ozone (DU), Norrköping 2008 Brewer # 128.*

2008	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	334.9	378.5	463.6	377.7	382.6	319.6	316.8	307.3	265.1	325.4	275.5	321.9
2	319.1	344.8	396.8	382.9	356.7	324.8	310.3	323.4	276.2	327.3	304.1	300.1
3	336.1	309.7	376.0	375.7	350.0	336.6	310.1	315.0	293.1	333.5	263.7	276.2
4	357.0	315.8	476.5	360.7	345.9	334.9	317.5	309.4	299.7	323.9	245.4	286.4
5	325.5	375.0	444.6	389.9	342.0	329.9	326.7	315.6	311.3	322.3	253.8	278.5
6	372.5	369.0	401.9	376.7	329.8	320.4	338.6	313.1	331.9	302.5	246.1	312.9
7	333.1	425.5	351.1	391.9	339.6	319.2	376.2	297.7	311.5	295.7	261.9	308.1
8	366.3	373.6	393.3	409.5	352.1	328.9	362.6	321.1	319.9	269.5	295.1	324.1
9	340.2	334.8	344.8	412.7	363.9	328.0	361.8	320.9	310.0	276.7	310.3	317.4
10	341.6	309.1	353.2	401.1	361.3	327.1	349.4	311.1	291.9	260.1	337.5	291.6
11	299.8	315.1	369.1	378.9	357.1	361.9	353.9	335.8	278.6	248.3	304.0	315.2
12	341.7	330.0	385.7	399.4	368.4	350.9	361.7	329.5	281.9	272.4	302.6	295.7
13	303.6	295.4	418.8	364.9	379.8	351.2	349.1	339.3	270.6	259.3	251.7	263.9
14	313.0	284.9	402.4	378.8	374.9	359.5	365.0	329.9	279.7	272.3	250.6	209.8
15	330.8	287.0	443.5	408.8	384.9	372.3	308.2	321.1	293.8	251.1	231.9	247.1
16	308.7	335.8	428.9	400.2	405.5	385.1	333.6	311.2	278.8	273.0	277.6	249.1
17	327.0	269.8	461.4	392.7	397.8	409.1	361.2	330.2	285.3	310.1	250.4	242.1
18	324.6	261.6	431.8	403.1	414.1	375.2	340.5	313.6	277.4	267.4	286.3	246.1
19	331.1	244.4	446.7	387.0	409.4	352.2	343.0	300.7	249.0	302.9	274.8	284.9
20	333.4	264.1	410.6	387.8	400.5	376.2	353.9	301.1	251.1	264.8	294.6	308.9
21	366.0	261.8	376.6	374.7	377.1	381.3	348.8	300.8	237.4	272.4	357.9	295.4
22	350.9	301.4	389.9	377.2	361.5	332.7	327.7	303.7	263.4	307.7	369.0	384.9
23	233.2	312.3	466.0	400.6	359.5	362.2	306.5	296.6	253.5	300.9	323.2	316.6
24	246.9	274.5	465.2	400.2	348.2	348.1	296.9	304.1	265.1	270.8	326.1	282.6
25	303.4	348.1	492.1	383.2	363.3	330.6	290.4	304.1	259.1	284.3	315.1	248.5
26	322.1	312.7	468.8	376.6	380.6	344.2	290.7	289.4	277.2	266.3	280.3	219.0
27	287.5	358.1	442.5	331.9	373.3	344.5	289.5	286.3	277.1	284.1	251.0	270.4
28	287.0	390.8	386.7	319.2	342.5	340.7	291.5	293.9	318.3	282.0	269.0	250.9
29	288.0	441.0	353.2	330.1	341.5	330.7	295.1	313.0	336.5	247.2	264.2	231.2
30	367.9		363.5	363.1	327.2	345.2	303.1	266.5	323.5	281.1	284.8	307.9
31	368.5		357.2		322.3		299.0	269.9		274.4		286.9

Table D1 History of intercomparisons, used instrumental constants and major changes of Brewer #006.

DATE	**OZONE**		**SO_2**		**SL**		**REFERENCE Calibration site**	**Temperature coefficients**					**Remarks**
	ETC	**Abs**	**ETC**	**Abs**	**Ra 5**	**Ra 6**							
1982 May	2832	.3583	2595	1.150	3520	1820	Br MkI #1 Toronto	4.8	5.14	4.77	3.71	3.07	
1983 Sep	3070	.3436	2935	1.1458	3710	1970	Br#008 Toronto	1.517	1.16	1.912	3.71	5.298	
		.3570		1.190									not used but in the result
1987 Oct	2792	.3409	2420	1.1354	3200	1685	Br#008 Toronto	-1.206	-0.6622	-0.9659	-1.630	-3.176	
					3165	1665							typical values Jan-May 1989
1989 Jun	2826	.3314	2582	1.11369	-	-	Br#017 Norrköping						#017 old temp coeff. Used
	3031	.3409	2970	1.1354	-	-							SL temporary values used by K.Lamb probably from SL-test
													POLARIZ. PRISM REMOVED
	3045	.33483	3100	1.11876	3665	1895	Br#017 Norrköping	-1.206	-0.6295	-0.9765	-1.747	-3.043	
1991 Jul					3665	1897	Br#017 Norrköping						No change of current parameters
1992 Mar		.34412		1.14980									Change to Bass-Paur scale 0.973
1993 Nov	3034.098	.3509	3003.625	1.1712		1927	Br#017 Izaña						Note: New dispersion coeff. The change appeared at Izana
1995 Dec													The dispersion was changed back Izana disp. probably in error
1996 May	no change	no change			3720	1935	Br#017 Norrköping						Br#128 was calibrated, no change of Br#006 because close to Br#017 and Br#128
1997 Jan	OK	OK					Br#128 Norrköping						Power supply burned. Comp. vs Br#128 no change of ozone calibration
1999 June	no change	no change			3685	1915	Br#017 Vindeln						New SL, dispersion file change introduced DCF16999.006
2002 June	2995	.3509	2945	1.1702	3610	1875	Br#017 Vindeln						
2005 June	2995	.3509	2945	1.1702	3610	1875	Br#017 Vindeln						Dead time change from 44 to 40ns
2008 June	2965	.3509	2870	1.1702	3550	1840	Br#017 Vindeln						

Table D2 History of intercomparisons, used instrumental constants and major changes of Brewer #128.

DATE	OZONE		SO_2		SL		REFERENCE	Temperature coefficients					Remarks
	ETC	**Abs**	**ETC**	**Abs**	**Ra 5**	**Ra 6**							
1995 Dec							Br #017 Saskatoon						
1996 May	1829	0.3491	827	1.171	1290	590	Br#017 Norrköping	0	1.2642	2.0027	2.3022	2.5021	hg-cal step 287
1996 Oct	OK					590-> ->585	Br#017 NOGIC96 Izaña						
1997 Jul	OK					582	other Brewers at SUSPEN Thessaloniki						
1999 Jun	1795 1723	0.3491	760 644	1.171	1225 1107	550 484	Br#017 Vindeln Standard Lamp Norrköping decreased during the year						Sudden change after transport home change of constant based on change in SL-values
2000 Jun	1715	0.3491	635	1.171	1065	470	Br#017 Tylösand						Changed dispersion coeffi.
2003 Jun	1700	0.3491	600	1.171	1000	463	Br#017 Norrköping	0	0.1029	.0962	.3465	.2688	New temp coeff
2006 Jun	1687	0.3491	520	1.171	970	450							

SMHIs publiceringar

SMHI ger ut sex rapportserier. Tre av dessa, R-serierna är avsedda för internationell publik och skrivs därför oftast på engelska. I de övriga serierna används det svenska språket.

Seriernas namn	**Publiceras sedan**
RMK (Rapport Meteorologi och Klimatologi)	1974
RH (Rapport Hydrologi)	1990
RO (Rapport Oceanografi)	1986
METEOROLOGI	1985
HYDROLOGI	1985
OCEANOGRAFI	1985

I serien METEOROLOGI har tidigare utgivits:

1985

1 Hagmarker, A. (1985)
Satellitmeteorologi.

2 Fredriksson, U., Persson, Ch., Laurin, S. (1985)
Helsingborgsluft.

3 Persson, Ch., Wern, L. (1985)
Spridnings- och depositionsberäkningar för av fallsförbränningsanläggningar i Sofielund och Högdalen.

4 Kindell, S. (1985)
Spridningsberäkningar för SUPRAs anläggningar i Köping.

5 Andersson, C., Kvick, T. (1985)
Vindmätningar på tre platser på Gotland. Utvärdering nr 1.

6 Kindell, S. (1985)
Spridningsberäkningar för Ericsson, Ingelstafabriken.

7 Fredriksson, U. (1985)
Spridningsberäkningar för olika plymlyft vid avfallsvärmeverket Sävenäs.

8 Fredriksson, U., Persson, Ch. (1985)
NO_x- och NO_2-beräkningar vid Vasaterminalen i Stockholm.

9 Wern, L. (1985)
Spridningsberäkningar för ASEA transformers i Ludvika.

10 Axelsson, G., Eklind, R. (1985)
Ovädret på Östersjön 23 juli 1985.

11 Laurin, S., Bringfelt, B. (1985)
Spridningsmodell för kväveoxider i gatumiljö.

12 Persson, Ch., Wern, L. (1985)
Spridnings- och depositionsberäkningar för avfallsförbränningsanläggning i Sofielund.

13 Persson, Ch., Wern, L. (1985)
Spridnings- och depositionsberäkningar för avfallsförbränningsanläggning i Högdalen.

14 Vedin, H., Andersson, C. (1985)
Extrema köldperioder i Stockholm.

15 Krieg, R., Omstedt, G. (1985)
Spridningsberäkningar för Volvos planerade bilfabrik i Uddevalla.

16 Kindell, S. Wern, L. (1985)
Luftvårdsstudie avseende industrikombinatet i Nynäshamn (koncentrations- och luktberäkningar).

17 Laurin, S., Persson, Ch. (1985)
Beräknad formaldehydspridning och deposition från SWEDSPANs spånskivefabrik.

18 Persson, Ch., Wern, L. (1985)
Luftvårdsstudie avseende industrikombinatet i Nynäshamn – depositionsberäkningar av koldamm.

19 Fredriksson, U. (1985)
Luktberäkningar för Bofors Plast i Ljungby, II.

20 Wern, L., Omstedt, G. (1985)
Spridningsberäkningar för Volvos planerade bilfabrik i Uddevalla - energi-centralen.

21 Krieg, R., Omstedt, G. (1985)
Spridningsberäkningar för Volvos planerade bilfabrik i Uddevalla - kompletterande beräkningar för fabrikerna.

22 Karlsson, K.-G. (1985)
Information från Meteosat - forskningsrön och operationell tillämpning.

23 Fredriksson, U. (1985)
Spridningsberäkningar för AB Åkerlund & Rausings fabrik i Lund.

24 Färnlöf, S. (1985)
Radarmeteorologi.

25 Ahlström, B., Salomonsson, G. (1985)
Resultat av 5-dygnsprognos till ledning för isbrytarverksamhet vintern 1984-85.

26 Wern, L. (1985)
Avesta stadsmodell.

27 Hultberg, H. (1985)
Statistisk prognos av yttemperatur.

1986

1 Krieg, R., Johansson, L., Andersson, C. (1986)
Vindmätningar i höga master, kvartals-rapport 3/1985.

2 Olsson, L.-E., Kindell, S. (1986)
Air pollution impact assessment for the SABAH timber, pulp and paper complex.

3 Ivarsson, K.-I. (1986)
Resultat av byggväderprognoser - säsongen 1984/85.

4 Persson, Ch., Robertson, L. (1986)
Spridnings- och depositionsberäkningar för en sopförbränningsanläggning i Skövde.

5 Laurin, S. (1986)
Bilavgaser vid intagsplan - Eskilstuna.

6 Robertson, L. (1986)
Koncentrations- och depositions-beräkningar för en sopförbrännings-anläggning vid Ryaverken i Borås.

7 Laurin, S. (1986)
Luften i Avesta - föroreningsbidrag från trafiken.

8 Robertson, L., Ring, S. (1986)
Spridningsberäkningar för bromcyan.

9 Wern, L. (1986)
Extrema byvindar i Orrefors.

10 Robertson, L. (1986)
Koncentrations- och depositions-beräkningar för Halmstads avfalls-förbränningsanläggning vid Kristinehed.

11 Törnevik, H., Ugnell (1986)
Belastningsprognoser.

12 Joelsson, R. (1986)
Något om användningen av numeriska prognoser på SMHI (i princip rapporten till ECMWF).

13 Krieg, R., Andersson, C. (1986)
Vindmätningar i höga master, kvartals-rapport 4/1985.

14 Dahlgren, L. (1986)
Solmätning vid SMHI.

15 Wern, L. (1986)
Spridningsberäkningar för ett kraftvärme-verk i Sundbyberg.

16 Kindell, S. (1986)
Spridningsberäkningar för Uddevallas fjärrvärmecentral i Hovhult.

17 Häggkvist, K., Persson, Ch., Robertson, L (1986)
Spridningsberäkningar rörande gasutsläpp från ett antal källor inom SSAB Luleå-verken.

18 Krieg, R., Wern, L. (1986)
En klimatstudie för Arlanda stad.

19 Vedin, H. (1986)
Extrem arealnederbörd i Sverige.

20 Wern, L. (1986)
Spridningsberäkningar för lösningsmedel i Tibro.

21 Krieg, R., Andersson, C. (1986)
Vindmätningar i höga master - kvartals-rapport 1/1986.

22 Kvick, T. (1986)
Beräkning av vindenergitillgången på några platser i Halland och Bohuslän.

23 Krieg, R., Andersson, C. (1986)
Vindmätningar i höga master - kvartalsrapport 2/1986.

24 Persson, Ch. (SMHI), Rodhe, H. (MISU), De Geer, L.-E. (FOA) (1986)
Tjernobylolyckan - En meteorologisk analys av hur radioaktivitet spreds till Sverige.

25 Fredriksson, U. (1986)
Spridningsberäkningar för Spendrups bryggeri, Grängesberg.

26 Krieg, R. (1986)
Beräkningar av vindenergitillgången på några platser i Skåne.

27 Wern, L., Ring, S. (1986)
Spridningsberäkningar, SSAB.

28 Wern, L., Ring, S. (1986)
Spridningsberäkningar för ny ugn, SSAB II.

29 Wern, L. (1986)
Spridningsberäkningar för Volvo Hallsbergverken.

30 Fredriksson, U. (1986)
SO_2-halter från Hammarbyverket kring ny arena vid Johanneshov.

31 Persson, Ch., Robertson, L., Häggkvist, K. (1986)
Spridningsberäkningar, SSAB - Luleåverken.

32 Kindell, S., Ring, S. (1986)
Spridningsberäkningar för SAABs planerade bilfabrik i Malmö.

33 Wern, L. (1986)
Spridningsberäkningar för svavelsyrafabrik i Falun.

34 Wern, L., Ring, S. (1986)
Spridningsberäkningar för Västhamnsverket HKV1 i Helsingborg.

35 Persson, Ch., Wern, L. (1986)
Beräkningar av svaveldepositionen i Stockholmsområdet.

36 Joelsson, R. (1986)
USAs månadsprognoser.

37 Vakant nr.

38 Krieg, R., Andersson, C. (1986)
Utemiljön vid Kvarnberget, Lysekil.

39 Häggkvist, K. (1986)
Spridningsberäkningar av freon 22 från Ropstens värmepumpverk.

40 Fredriksson, U. (1986)
Vindklassificering av en plats på Hemsön.

41 Nilsson, S. (1986)
Utvärdering av sommarens (1986) använda konvektionsprognoshjälpmedel.

42 Krieg, R., Kvick, T. (1986)
Vindmätningar i höga master.

43 Krieg, R., Fredriksson, U. (1986)
Vindarna över Sverige.

44 Robertson, L. (1986)
Spridningsberäkningar rörande gasutsläpp vid ScanDust i Landskrona - bestämning av cyanvätehalter.

45 Kvick, T., Krieg, R., Robertson, L. (1986)
Vindförhållandena i Sveriges kust- och havsband, rapport nr 2.

46 Fredriksson, U. (1986)
Spridningsberäkningar för en planerad panncentral vid Lindsdal utanför Kalmar.

47 Fredriksson, U. (1986)
Spridningsberäkningar för Volvo BMs fabrik i Landskrona.

48 Fredriksson, U. (1986)
Spridningsberäkningar för ELMO-CALFs fabrik i Svenljunga.

49 Häggkvist, K. (1986)
Spridningsberäkningar rörande gasutsläpp från syrgas- och bensenupplag inom SSAB Luleåverken.

50 Wern, L., Fredriksson, U., Ring, S. (1986)
Spridningsberäkningar för lösningsmedel i Tidaholm.

51 Wern, L. (1986)
Spridningsberäkningar för Volvo BM ABs anläggning i Braås.

52 Ericson, K. (1986)
Meteorological measurements performed May 15, 1984, to June, 1984, by the SMHI.

53 Wern, L., Fredriksson, U. (1986)
Spridningsberäkning för Kockums Plåtteknik, Ronneby.

54 Eriksson, B. (1986)
Frekvensanalys av timvisa temperaturobservationer.

55 Wern, L., Kindell, S. (1986)
Luktberäkningar för AB ELMO i Flen.

56 Robertson, L. (1986)
Spridningsberäkningar rörande utsläpp av NO_x inom Fagersta kommun.

57 Kindell, S. (1987)
Luften i Nässjö.

58 Persson, Ch., Robertson, L. (1987)
Spridningsberäkningar rörande gasutsläpp vid ScanDust i Landskrona - bestämning av cyanväte.

59 Bringfelt, B. (1987)
Receptorbaserad partikelmodell för gatumiljömodell för en gata i Nyköping.

60 Robertson, L. (1987)
Spridningsberäkningar för Varbergs kommun. Bestämning av halter av SO_2, CO, NO_x samt några kolväten.

61 Vedin, H., Andersson, C. (1987)
E 66 - Linderödsåsen - klimatförhållanden.

62 Wern, L., Fredriksson, U. (1987)
Spridningsberäkningar för Kockums Plåtteknik, Ronneby. 2.

63 Taesler, R., Andersson, C., Wallentin, C., Krieg, R. (1987)
Klimatkorrigering för energiförbrukningen i ett eluppvärmt villaområde.

64 Fredriksson, U. (1987)
Spridningsberäkningar för AB Åetå-Trycks planerade anläggning vid Kungens Kurva.

65 Melgarejo, J. (1987)
Mesoskalig modellering vid SMHI.

66 Häggkvist, K. (1987)
Vindlaster på kordahus vid Alviks Strand - numeriska beräkningar.

67 Persson, Ch. (1987)
Beräkning av lukt och föroreningshalter i luft runt Neste Polyester i Nol.

68 Fredriksson, U., Krieg, R. (1987)
En överskalig klimatstudie för Tornby, Linköping.

69 Häggkvist, K. (1987)
En numerisk modell för beräkning av vertikal momentumtransport i områden med stora råhetselement. Tillämpning på ett energiskogsområde.

70 Lindström, Kjell (1987)
Weather and flying briefing aspects.

71 Häggkvist, K. (1987)
En numerisk modell för beräkning av vertikal momentumtransport i områden med stora råhetselement. En koefficientbestämning.

72 Liljas, E. (1988)
Förbättrad väderinformation i jordbruket - behov och möjligheter (PROFARM).

73 Andersson, Tage (1988)
Isbildning på flygplan.

74 Andersson, Tage (1988)
Aeronautic wind shear and turbulence. A review for forecasts.

75 Kållberg, P. (1988)
Parameterisering av diabatiska processer i numeriska prognosmodeller.

76 Vedin, H., Eriksson, B. (1988)
Extrem arealnederbörd i Sverige 1881 - 1988.

77 Eriksson, B., Carlsson, B., Dahlström, B. (1989)
Preliminär handledning för korrektion av nederbördsmängder.

78 Liljas, E. (1989)
Torv-väder. Behovsanalys med avseende på väderprognoser och produktion av bränsletorv.

79 Hagmarker, A. (1991)
Satellitmeteorologi.

80 Lövblad, G., Persson, Ch. (1991)
Background report on air pollution situation in the Baltic states - a prefeasibility study.
IVL Publikation B 1038.

81 Alexandersson, H., Karlström, C., Larsson-McCann, S. (1991)
Temperaturen och nederbörden i Sverige 1961-90. Referensnormaler.

82 Vedin, H., Alexandersson, H., Persson, M. (1991)
Utnyttjande av persistens i temperatur och nederbörd för vårflödesprognoser.

83 Moberg, A. (1992)
Lufttemperaturen i Stockholm
1756 - 1990. Historik, inhomogeniteter och urbaniseringseffekt.
Naturgeografiska Institutionen, Stockholms Universitet.

84 Josefsson, W. (1993)
Normalvärden för perioden 1961-90 av globalstrålning och solskenstid i Sverige.

85 Laurin, S., Alexandersson, H. (1994)
Några huvuddrag i det svenska temperatur-klimatet 1961 - 1990.

86 Fredriksson, U. och Ståhl, S. (1994)
En jämförelse mellan automatiska och manuella fältmätningar av temperatur och nederbörd.

87 Alexandersson, H., Eggertsson Karlström, C. och Laurin S. (1997).
Några huvuddrag i det svenska nederbördsklimatet 1961-1990.

88 Mattsson, J., Rummukainen, M. (1998)
Växthuseffekten och klimatet i Norden - en översikt.

89 Kindbom, K., Sjöberg, K., Munthe, J., Peterson, K. (IVL)
Persson, C. Roos, E., Bergström, R. (SMHI). (1998)
Nationell miljöövervakning av luft- och nederbördskemi 1996.

90 Foltescu, V.L., Häggmark, L (1998)
Jämförelse mellan observationer och fält med griddad klimatologisk information.

91 Hultgren, P., Dybbroe, A., Karlsson, K.-G. (1999)
SCANDIA – its accuracy in classifying LOW CLOUDS

92 Hyvarinen, O., Karlsson, K.-G., Dybbroe, A. (1999)
Investigations of NOAA AVHRR/3 1.6 µm imagery for snow, cloud and sunglint discrimination (Nowcasting SAF)

93 Bennartz, R., Thoss, A., Dybbroe, A. and Michelson, D. B. (1999)
Precipitation Analysis from AMSU (Nowcasting SAF)

94 Appelqvist, Peter och Anders Karlsson (1999)
Nationell emissionsdatabas för utsläpp till luft - Förstudie.

95 Persson, Ch., Robertson L. (SMHI) Thaning, L (LFOA). (2000)
Model for Simulation of Air and Ground Contamination Associated with Nuclear Weapons. An Emergency Preparedness Model.

96 Kindbom K., Svensson A., Sjöberg K., (IVL) Persson C., (SMHI) (2001)
Nationell miljöövervakning av luft- och nederbördskemi 1997, 1998 och 1999.

97 Diamandi, A., Dybbroe, A. (2001)
Nowcasting SAF
Validation of AVHRR cloud products.

98 Foltescu V. L., Persson Ch. (2001)
Beräkningar av moln- och dimdeposition i Sverigemodellen - Resultat för 1997 och 1998.

99 Alexandersson, H. och Eggertsson Karlström, C (2001)
Temperaturen och nederbörden i Sverige 1961-1990. Referensnormaler - utgåva 2.

100 Korpela, A., Dybbroe, A., Thoss, A. (2001)
Nowcasting SAF - Retrieving Cloud Top Temperature and Height in Semi-transparent and Fractional Cloudiness using AVHRR.

101 Josefsson, W. (1989)
Computed global radiation using interpolated, gridded cloudiness from the MESA-BETA analysis compared to measured global radiation.

102 Foltescu, V., Gidhagen, L., Omstedt, G. (2001)
Nomogram för uppskattning av halter av PM_{10} och NO_2

103 Omstedt, G., Gidhagen, L., Langner, J. (2002)
Spridning av förbränningsemissioner från småskalig biobränsleeldning
– analys av PM2.5 data från Lycksele med hjälp av två Gaussiska spridningsmodeller.

104 Alexandersson, H. (2002)
Temperatur och nederbörd i Sverige 1860 - 2001

105 Persson, Ch. (2002)
Kvaliteten hos nederbördskemiska mätdata

som utnyttjas för dataassimilation i MATCH-Sverige modellen".

106 Mattsson, J., Karlsson, K-G. (2002)
CM-SAF cloud products feasibility study in the inner Arctic region
Part I: Cloud mask studies during the 2001 Oden Arctic expedition

107 Kärner, O., Karlsson, K-G. (2003)
Climate Monitoring SAF - Cloud products feasibility study in the inner Arctic region.
Part II: Evaluation of the variability in radiation and cloud data

108 Persson, Ch., Magnusson, M. (2003)
Kvaliteten i uppmätta nederbördsmängder inom svenska nederbörskemiska stationsnät

109 Omstedt, G., Persson Ch., Skagerström, M (2003)
Vedeldning i småhusområden

110 Alexandersson, H., Vedin, H. (2003)
Dimensionerande regn för mycket små avrinningsområden

111 Alexandersson, H. (2003)
Korrektion av nederbörd enligt enkel klimatologisk metodik

112 Joro, S., Dybbroe, A.(2004)
Nowcasting SAF – IOP
Validating the AVHRR Cloud Top Temperature and Height product using weather radar data
Visiting Scientist report

113 Persson, Ch., Ressner, E., Klein, T. (2004)
Nationell miljöövervakning – MATCH-Sverige modellen
Metod- och resultatsammanställning för åren 1999-2002 samt diskussion av osäkerheter, trender och miljömål

114 Josefsson, W. (2004)
UV-radiation measured in Norrköping 1983-2003.

115 Martin, Judit, (2004)
Var tredje timme – Livet som väderobservatör

116 Gidhagen, L., Johansson, C., Törnquist, L. (2004)
NORDIC – A database for evaluation of dispersion models on the local, urban and regional scale

117 Langner, J., Bergström, R., Klein, T., Skagerström, M. (2004)
Nuläge och scenarier för inverkan på marknära ozon av emissioner från Västra Götalands län – Beräkningar för 1999

118 Trolez, M., Tetzlaff, A., Karlsson, K-G. (2005)
CM-SAF Validating the Cloud Top Height product using LIDAR data

119 Rummukainen, M. (2005)
Växthuseffekten

120 Omstedt, G. (2006)
Utvärdering av PM_{10} - mätningar i några olika nordiska trafikmiljöer

121 Alexandersson, H. (2006)
Vindstatistik för Sverige 1961-2004

122 Samuelsson, P., Gollvik, S., Ullerstig, A., (2006)
The land-surface scheme of the Rossby Centre regional atmospheric climate model (RCA3)

123 Omstedt, G. (2007)
VEDAIR – ett internetverktyg för beräkning av luftkvalitet vid småskalig biobränsleeldning
Modellbeskrivning och slutrapport mars 2007

124 Persson, G., Strandberg, G., Bärring, L., Kjellström, E. (2007)
Beräknade temperaturförhållanden för tre platser i Sverige – perioderna 1961-1990 och 2011-2040

125 Engart, M., Foltescu, V. (2007)
Luftföroreningar i Europa under framtida klimat

126 Jansson, A., Josefsson, W. (2007)
Modelling of surface global radiation and CIE-weighted UV-radiation for the period 1980-2000

127 Johnston, S., Karlsson, K-G. (2007)
METEOSAT 8 SEVIRI and NOAA Cloud Products. A Climate Monitoring SAF Comparison Study

128 Eliasson, S., Tetzlaf, A., Karlsson, K-G. (2007)
Prototyping an improved PPS cloud detection for the Arctic polar night

129 Trolez, M., Karlsson, K-G., Johnston, S., Albert, P (2008)

The impact of varying NWP background information on CM-SAF cloud products

130 Josefsson, W., Ottosson Löfvenius, M (2008)
Total ozone from zenith radiance measurements. An empirical model approach

131 Willén, U (2008)
Preliminary use of CM-SAF cloud and radiation products for evaluation of regional climate simulations

132 Bergström, R (2008)
TESS Traffic Emissions, Socioeconomic valuation and Socioeconomic measures Part 2:
Exposure of the European population to atmospheric particles (PM) caused by emissions in Stockholm

133 Andersson, S., Bergström, R., Omstedt, G., Engardt, M (2008)
Dagens och framtidens partikelhalter i Sverige. Utredning av exponerings-minskningsmål för PM2.5 enligt nytt luftdirektiv

134 Omstedt, G., Andersson, S (2008)
Vintervägar med eller utan dubbdäck. Beräkningar av emissioner och halter av partiklar för olika dubbdäcksscenarier

135 Omstedt, G., Andersson, S., Johansson, Ch., Löfgren, B-E
Luftkvalitet och småskalig biobränsle-eldning. Tillämpningar av SIMAIRved för några kommuner

Sveriges meteorologiska och hydrologiska institut
601 76 Norrköping · Tel 011-495 8000 · Fax 011-495 8001
www.smhi.se

ISSN 0283-7730