NETWORK FOR THE
DETECTION OF
STRATOSPHERIC CHANGE

Ozonesonde activities

Report to the NDSC Steering Committee

compiled by:

Geir O. Braathen,

Norwegian Institute for Air Research (NILU)

Sapporo, October 1999

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1. Introduction

This report summarises the ozonesonde activities carried out at the various NDSC ozonesonde stations between October 1998 and October 1999. This document is also available in electronic form from NILU's anonymous ftp server at: ftp://ftp.nilu.no/pub/NILU/geir/ndsc-sc

2. The ozonesonde working group

At present the ozonesonde working group representatives are Geir Braathen (NILU) and Terry Deshler (Univ. of Wyoming). Geir Braathen is responsible for the ozonesonde activities and Terry Deshler for particle and backscatter soundings.

3. The network

The following NDSC stations have been included as ozonesonde stations so far and are supposed to deliver sonde data to the NDSC data base: Ny-Ålesund, Thule, Eureka, Hohenpeißenberg, Payerne, Observatoire de Haute Provence, Mauna Loa, Lauder, Dumont d'Urville, McMurdo, South Pole.

At last year's steering committee meeting at Île de la Réunion (December 1998) the recommendation for the inclusion of Hohenpeißenberg and Payerne was presented to the committee. The recommendation was endorsed by the committee and the two stations received some weeks later a letter from the chairman, Dr. M. Kurylo informing them of their acceptance as NDSC complementary sites for ozonesondes.

Before the Sapporo meeting several other stations have been contacted:

- Aberystwyth,
- Andøya,
- Gardermoen (Harestua),
- Izaña,
- Kiruna,
- Moshiri,
- Scoresbysund,
- Sodankylä
- Syowa.

The outcome of these contacts is as follows:

- Aberystwyth and Sodankylä have submitted application and these have been reviewed by representatives of the ozonesonde working group.
- The sonde launch programme at Andøya is not regular and only a few sondes are launched per year. The PIs for this site (Georg Hansen and Bojan Bojkov of NILU) have therefore decided not to apply for NDSC membership at this time.
- The Gardermoen site has also had an irregular launch programme during the last year due to the opening of the new airport. This has hindered a regular launch programme. There are plans under way to start launching from NILU's premises at Kjeller, and when this activity has become regular one can consider to apply for NDSC affiliation.
- The Kiruna PIs (Sarri and Widell) have explained that they launch sondes on a campaign basis and for various customers. This means that there is no regular launch programme at this stations. They have been asked if someone at ESRANGE could assume scientific responsibility for the sonde data and whether agreements could be made with data owners to submit sonde data to the NDSC archive.
- No application has been received from the Izaña PI (Dr. Cuevas).
- The PIs for the Moshiri site (Dr. Nakane and Prof. Kondo) have replied that they can not promise a long term regular NDSC type of commitment of the ozonesonde programme since the soundings have been carried out there on a campaign basis. However, they suggest to stay in contact with the NDSC community for quality control of the sonde measurements. Should the funding situation improve so that Moshiri is included in a national monitoring programme they would like to come back with an application.
- The PI for the Scoresbysund station (Ib Steen Mikkelsen, DMI) wants to spend some more time on data quality control before submitting data to the NDSC database. He will probably apply for NDSC affiliation during 2000.
- The PI for the Syowa station has not yet replied.

4. Station reports

4.1. Ny-Ålesund

Submitted by: Peter von der Gathen, AWI

Figure 1 shows a photograph of an ozonesonde launch from the Koldewey station in Ny-Ålesund.

4.1.1. Personnel

Scientific personnel: Peter von der Gathen, Markus Rex, Astrid Schulz

Station personnel: Dirk Römermann (until March 1999), Thomas Schmidt (since Feb. 1999)

4.1.2. Status of the instrument

The thermistor for the box temperature had been situated on the inlet tube before Dec. 6, 1998. Since then the thermistor is inserted in the pump hole of the sondes.

Balloon house is in construction phase. It will be usable before the winter 1999/2000.

4.1.3. Technical developments

No change

4.1.4. Measurements and data evaluation

The number of launched ECC ozonesondes in 1998 and 1999 is given in Table 1.

In winter 1998/99 AWI coordinated the ozonesonde launches of the Arctic stations within the campaign Match 98/99 (THESEO-O3LOSS).

4.1.5. Data transfer to NDSC data bank

The data of 68 ozonesonde launches as well as a meta-data file have been transferred to the NDSC data bank (range: Jul. 1998 - Feb. 1999).

4.1.6. Participation in meetings and conferences:

- ✎ XXI General Assembly of the Europ. Geophys. Soc., The Hague, The Netherlands, 19-23 April 1999.
- ✎ 5th European Workshop on Stratospheric Ozone, St-

Figure 1. Ozonesonde launch in Ny-Ålesund. Photo: Thomas Seiler.

Table 1: Number of soundings from Ny-Ålesund

Month	1997	1998	1999
Jan	19	18	14
Feb	11	14	10
Mar	13	10	12
Apr	11	8	4
May	9	5	5
Jun	5	4	5
Jul	5	5	4
Aug	5	7	4
Sep	4	5	4
Oct	5	5	
Nov	9	9	
Dec	9	13	

Jean-de-Luz, France, 27 Sept. - 1 Oct 1999.

4.1.7. Scientific highlights

- ✎ No severe chemical ozone destruction in the winter 1998/99.
- ✎ High ozone concentration in winter and spring 1998/99.

The curves in the figure below show average profiles for various winters.

4.1.8. Projects

- ✎ EU project THESEO-O_3LOSS includes the Match activities in 1998/99.
- ✎ EU project PVC (Polar Vortex Change) includes climatological analysis of ozonesondes data of the past.
- ✎ EU project THESEO 2000 - EuroSOLVE includes the Match activities in 1999/2000. (In negotiation phase)

4.1.9. Planned activities

- ✎ Continuation of long term measurement program, i.e. 1 launch per week at least.
- ✎ Match 1999/2000 (ozonesondes and ozone lidars), i.e. increased launch frequency during winter.

4.1.10. Publications using Ny-Ålesund ozone sounding data

Rex, M., P. von der Gathen, N. R. P. Harris, D. Lucic, B. M. Knudsen, G. O. Braathen, S. J. Reid, H. De Backer, H. Claude, R. Fabian, H. Fast, M. Gil, E. Kyrö, I. S. Mikkelsen, M. Rummukainen, H. G. Smit, J. Stähelin, C. Varotsos, I. Zaitcev, In-situ measurements of stratospheric ozone depletion rates in the Arctic winter 1991/92: a Lagrangian approach, J. Geophys. Res., 103, D5,5843-5853, 1998.

G. Becker, R. Müller, D. S. Mc Kenna, M. Rex and K. S. Carslaw, Modelled ozone loss rates compared with Match observations in the Arctic winter 1991/92,Geophys. Res. Let., 25, 4325-4328, 1998.

Rex, M., P. von der Gathen, G. O. Braathen, N. R. P. Harris, E. Reimer, A. Beck, R. Alfier, R. Krüger-Carstensen, M. Chipperfield, H. De Backer, D. Balis, F. O'Connor, H. Dier, V. Dorokhov, H. Fast, A. Gamma, M. Gil, E. Kyrö, Z. Litynska, I. S. Mikkelsen, M. Molyneux, G. Murphy, S. J. Reid, M. Rummukainen, and C. Zerefos, Chemical ozone loss in the Arctic winter 1994/95as determined by the Match technique, J. atmos. Chem., 32, 35-59, 1999.

Rex, M., K. Dethloff, D. Handorf, A. Herber, R. Lehmann, R. Neuber, J. Notholt, A, Rinke, P. von der Gathen, A. Weisheimer, and H. Gernandt, Arctic and Antarctic ozone layer observations - chemical and dynamical aspects of variability and long-term changes in the polar strato-

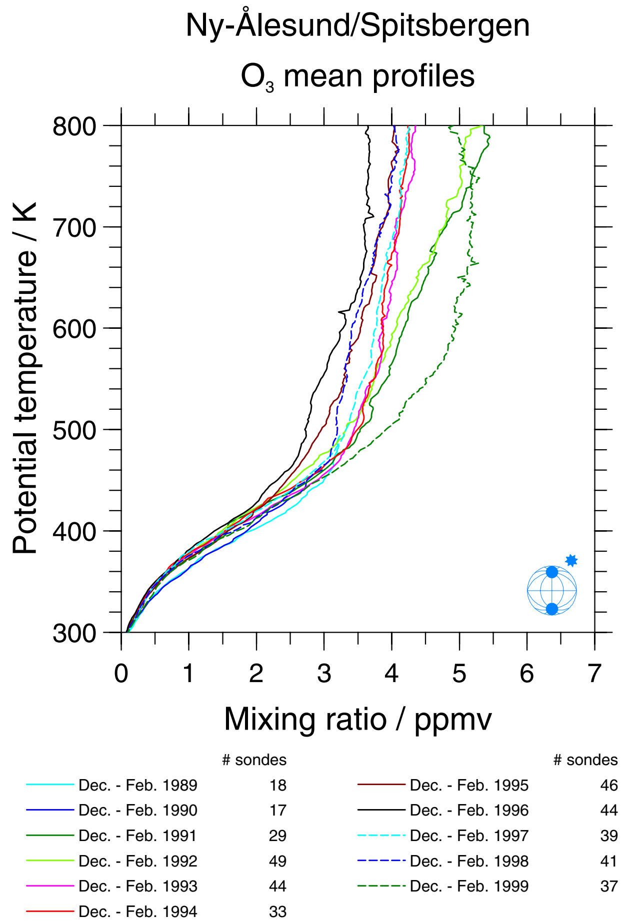

***Figure 2.** Mean ozone mixing ratio profiles based on soundings carried out in Ny-Ålesund, Spitsbergen.*

sphere, Polar Research,1999 in print.

Steinbrecht, W., M. R. Gross, T. J. McGee, R. Neuber, P. von der Gathen, P.Wahl, U. Klein, and J. Langer, Results of the 1998 Ny-Ålesund Ozone Measurements Intercomparison NAOMI, J. Geophys. Res., 1999 in print.

Schulz, A., M. Rex, J. Steger, N. Harris, G. O. Braathen, E. Reimer, R. Alfier, A. Beck, M. Alpers, J. Cisneros, H. Claude, H. De Backer, H. Dier, V. Dorokhov, H. Fast, S. Godin, G. Hansen, Y. Kondo, E. Kosmidis, E. Kyrö, M. J. Molyneux, G. Murphy, H. Nakane, C. Parrondo, F. Ravegnani, C. Varotsos, C. Vialle, V. Yushkov, C. Zerefos, P. von der Gathen, Match observations in the Arctic winter 1996/97: High stratospheric ozone loss rates correlate with low temperatures deep inside the polar vortex, Geophys. Res. Lett., submitted, 1999.

Guirlet, M., M. P. Chipperfield, J. A. Pyle, E. Kyrö, and P. von der Gathen, Modelled Arctic ozone depletion in winter 1997/1998 and comparison with previous winters, J. Geophys. Res., submitted, 1999.

G. Becker, R. Müller, D. S. Mc Kenna, M. Rex, K. S. Carslaw, H. Oelhaf, Ozone loss rates in the Arctic stratosphere in the winter 1994/95: Model simulations underestimate results of the Match analysis, J. Geophys. Res., submitted, 1999.

4.2. Thule

Submitted by: Ib Steen Mikkelsen, DMI

4.2.1. Personnel

Scientific personnel: Ib Steen Mikkelsen

Station personnel: Svend Erik Ascanius, Qaanaak, Greenland, Greenland Contractors.

4.2.2. Status of the instrument

No change

4.2.3. Technical developments

Thule (Greenland) ozone soundings, starting in October, 1991 and onward.

Science Pump, 5a, 6a, and ENSCI z-sondes have been used together with Vaisala RSA11 interface cards and RS80-18NE radiosondes. The Vaisala receiver, MARWIN MW12, and the Vaisala ‘ozone’ program have been used to receive and record the data.

Until the end of 1995 a home-made calibration unit has been used to prepare the ozone sensors. Unfortunately the high ozone level generated by the unit to clean the pump, tubes and empty cathode cell is far too low (25 mPa). The effect of this reduced cleaning is not known, but may have caused a 5% reduction in the measured ozone level according to private conversations with W. Komhyr. It has not been possible to detect such an effect by comparing the Thule soundings to other soundings, part of the Match data, according to M. Rex (private communication). The home-made unit did not allow a check of the sensor response time. Since 1996 the ozonizer/test unit, KTU-2, (Komhyr) has been used. In August 1999 KTU-2 has been replaced by a new home-made unit with a better micro-ampere meter, allowing accurate determinations of the sensor background.

The pump time, measured during the preparation by a gilibrator (Gilian Instrument Corp.), has been used in the data reduction. The measured pump rate is not corrected for the saturated water vapour pressure resulting from the passage of the air of the cathode solution. Starting in August 1999 the room temperature and humidity is recorded to make this correction possible.

In all soundings Oct 1991-August 1999, the following 1% cathode solution has been used: 10 g KI, 25 g KBr, 1.25 g $NaH_2PO_4*H_2O$, 3.73 g $Na_2HPO_4*7H_2O$ (from the Science Pump and ENSCI instruction manuals, amounts are per litre water), and the ‘New Stoic 89’ pump efficiency correction table has been used.

Until February, 1999 only one type of background current has been recorded during the preparation, the background current after extended ventilation of the cathode cell by clean air. This background current, without any altitude correction, has been subtracted from the measured sensor current. The current has been measured after connection to the interface/radiosonde to obtain sufficient accuracy (0.01 µA).

Starting in August 1999, the other type of background current will be recorded during the preparation and stored in the NASA/Ames file. This current is measured after 10 minutes ventilation of the sensor by an ozone level corresponding to a 5µA current, followed by 20 minutes of clean air ventilation. At the same time the old Vaisala ‘ozone’ data recording program is replaced by the Vaisala ‘metgraph’ program.

The raw 1.6 s data, the interface card parameters, and a preliminary file in the NASA/Ames format have been stored in three separate files. The raw data have been edited manually to remove glitches in the sensor current, and intervals of strong noise. Also, if the pump stops at the upper part of the sounding, the sensor current has been set undefined in this part. A local program, originally based upon the NILU ‘convert’ program, has been used to reduce the raw data. The data reduction has been cross-checked by E. Kyrö, The Finnish Meteorological Institute.

10-s values of the horizontal wind, retrieved separately in the MARWIN receiver, have been merged into the NASA/Ames files using the air pressure as independent parameter. After the closure of the Omega navigation system in October 1997, no winds have been recorded in the Thule ozone soundings. There are no plans (1999) to upgrade the MARWIN to the required GPS system to resume the wind recording.

4.2.4. Measurements and data evaluation

See the NDSC data bank for details

4.2.5. Data transfer to NDSC data bank

The data of 182 ozone sonde launches have been transferred to the NDSC data bank covering the period October, 1991 –

August, 1999.

4.2.6. Participation in meetings and conferences:

NDSC Ozonesonde PI meeting, Potsdam, Germany, June 29-July 1, 1998.

4.2.7. Intercomparison campaigns

None

4.2.8. Scientific highlights

The Thule ozone soundings are used in the European Match campaigns to determine the stratospheric ozone depletion and in campaigns to observe the Arctic spring time boundary layer ozone depletion. Like Alert, Thule is frequently affected by air advected from the Arctic Ocean over Northern Canada. These events may be followed in more detail in the surface ozone observations at the “South Mountain” (250 m above sea level) at Thule Air Base.

4.2.9. Projects

EU project OSDOC (Ozone Soundings as a tool for Detecting Ozone Change) included the Match activities 1996/97 1997/98.

EU project THESEO-O_3 is the follow up project to OSDOC and includes the Match activities in 1998/99.

4.2.10. Planned activities

Match 1999/2000 launches of 1-2 sondes per week in the period November 1999-April, 2000. Probably support of the TOPSE campaign with coordinated ozone sonde launches in the spring of 2000. (TOPSE aims at determining the influence of transport/chemistry upon the spring time high-latitude tropospheric ozone maximum).

4.2.11. Publications

See the Ny-Ålesund contribution for recent Match publications.

4.3. Eureka

Submitted by: Hans Fast, AES

4.3.1. Measurement programme

The ozonesonde program at Eureka in the past year was again similar to those of previous years. The weekly ozonesonde launches throughout the year were conducted on Wednesdays, whenever possible. From December to the end of March, approximately two additional sondes were launched per week in support of the NDSC measurements at Eureka, and whenever possible the launch times of the regular, as well as of the additional sondes, were moved to satisfy the Match ozonesonde project. The data up to June 1999 has been archived on the NDSC facility.

4.3.2. Technical Developments

For the winter of 1999/2000, approximately half the sondes will measure the
pump temperature and the other half will be measuring the box temperature.
This information will be recorded with the launch data.

4.3.3. Participation in meetings:

NDSC Ozonesonde PI meeting, Potsdam, Germany, June 29 - July 1, 1998.

4.3.4. NDSC data archive:

Ozonesonde data for 259 flights, from March 1996 to June 1999, are now catalogued on the NDSC Data Host Facility.

4.4. Hohenpeißenberg

Submitted by: Hans Claude, DWD

4.4.1. Personnel

Scientific personnel: Hans Claude, Ulf Köhler, Wolfgang Steinbrecht (until Dec. 1999)

Station personnel: Martin Adelwart, Sigi Steiner, Ferdinand Strommer

4.4.2. Status of the instrument

At Hohenpeissenberg the Brewer/Mast ozonesonde has been used since 1967. There were a few changes in the pump motor of the Brewer/Mast and in radiosonde type since 1994, especially from VIZ to VAISALA RS 80 radiosonde. These changes led to inconsistencies in the long record of ozone-data.

A detailed description of a study to detect and ruling out the jumps in our data set is presented at the Fifth European Workshop on Stratospheric Ozone, St. Jean de Luz (France), Sept. 1999.

4.4.3. Technical developments

No change

4.4.4. Measurements and data evaluation

The number of ozonesondes launched in 1997 - 1999 is given in Table 2.

4.4.5. Data transfer to NDSC data bank

The data of ozonesonde launches will be transferred to the NDSC data bank (range: Jan 1998 - June 1999).

4.4.6. Participation in meetings and conferences:

NDSC Ozonesonde PI meeting, Potsdam, Germany, June 29 - July 1, 1998.

Fifth European Workshop on Stratospheric Ozone, St. Jean de Luz, France, September 27th to October 1st, 1999.

Figure 3. An ozonesonde being launched from the Hohenpeißenberg observatory, Germany.

Table 2: Number of soundings from Hohenpeissenberg

Month	1997	1998	1999
Jan	12	14	13
Feb	11	12	13
Mar	11	12	15
Apr	13	12	12
May	9	8	9
Jun	9	9	10
Jul	9	9	7
Aug	22	9	9
Sep	11	9	
Oct	12	9	

Table 2: Number of soundings from Hohenpeissenberg

Month	1997	1998	1999
Nov	12	13	
Dec	14	12	

4.4.7. Scientific highlight

Figure 4 shows monthly means of total ozone, tropopause height and temperature at 5 km altitude, as observed at Hohenpeissenberg in February of each year. The February values of the Polar Eurasia Index, in the bottom panel, are used as a “nutshell” description of tropospheric circulation on the northern hemisphere. The Polar Eurasia circulation pattern is the most important circulation mode from December to February. Circulation changes summarized by this index are clearly reflected in Hohenpeissenberg tropopause height and 5 km temperature. The tropospheric circulation also affects the lower stratosphere and total ozone. This gives

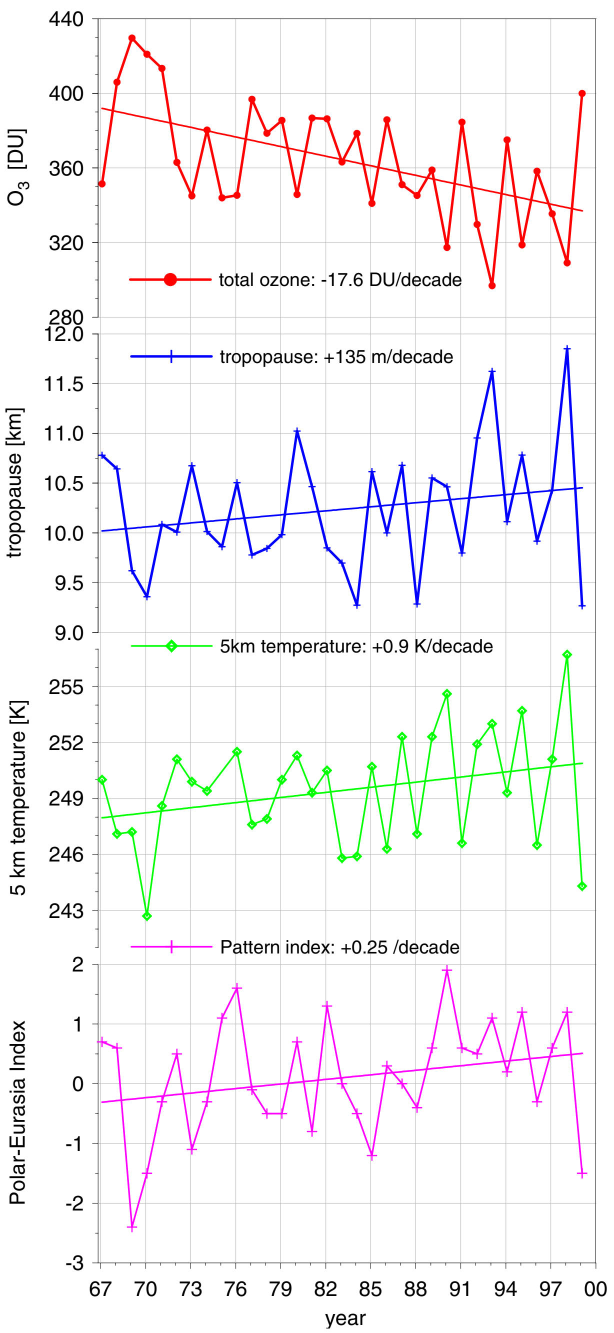

Figure 4. *Monthly means of total ozone, tropopause height and temperature at 15 km altitude. The bottom panel shows the February values of the Polar Eurasia index. See main text for further explanations.*

rise to the observed anticorrelation between total ozone and the Polar Eurasia Index.

The large total ozone increase from February 1998 to 1999 corresponds to large decreases in all three meteorological parameters. February 1998 was a very warm month in the troposphere with high tropopause and a high value of the Polar-Eurasia Index. In contrast, February 1999 was one of the coldest months (in the troposphere), with a very low tropopause and low Polar Eurasia Index. Apart from high total ozone, this unusual weather situation also lead to extreme snowfalls and damaging avalanches throughout the northern Alps. Details of this study are also presented at the **St. Jean de Luz meeting.**

4.4.8. Projects

- ✎ BMBF project "Investigation about the interaction between temperature and ozone in the stratosphere".
- ✎ EU project STREAMER includes ozone profile validation "sonde vs. satellite"

4.4.9. Planned activities

- ✎ Continuation of long term measurement program, i.e. 2 launches per week May-October, 3 launches per week November-April
- ✎ participation in the Match campaigns (ozonesondes and ozone lidar) with increased launch frequency.

4.4.10. Publications using Hohenpeissenberg ozone sounding data

Steinbrecht, W., H.Claude, U.Koehler and K.P. Hoinka, Correlations between tropopause height and total ozone: Implications for long-term changes, J. Geophys. Res., 103, D15, 19183-19192, 1998.

Rex, M., P. von der Gathen, N. R. P. Harris, D. Lucic, B. M.Knudsen, G. O. Braathen, S. J. Reid, H. De Backer, H.Claude, R. Fabian, H. Fast, M. Gil, E. Kyrö, I. S. Mikkelsen, M. Rummukainen, H. G. Smit, J. Stähelin, C.Varotsos, I. Zaitcev, In-situ Measurements of Stratospheric Ozone Depletion Rates in the Arctic Winter 1991/92: A Lagrangian Approach, J. Geophys. Res., 103, D5, 5843-5853, 1998.

Logan, J.A., I. A. Megretskaia, A. J. Miller, G. C. Tiao, D. Choi, L. Zhang, R. S. Stolarski, G. J. Labow, S. M. Hollandsworth, G. E. Bodeker, H. Claude, D. DeMuer, J. B. Kerr, D. W. Tarasick, S. J. Oltmans, B. Johnson, F. Schmidlin, J. Staehelin, P. Viatte, and O.Uchino, Trends in the vertical distribution of ozone: A comparison of two analyses of ozonesonde data, J. Geophys. Res., in press, 1999.

4.5. Payerne

Submitted by: Dominique Ruffieux, SMA

The Aerological Station of Payerne (SAP) is located on a hilly terrain, about 50km north of the Alps (see Figure 5). Ozone soundings are performed operationally three times a week (usually on Mondays, Wednesdays, and Fridays) at 12H00 UTC. The sonde used is a Brewer-Mast sonde flying together with the SRS400 Swiss radiosonde. The ozone profile time series covers more than 30 years. To enable tropo-

Figure 5. The Aerological Station of Payerne, Switzerland.

spheric and stratospheric ozone trend analyses, a complete homogenization is currently under way.

From 1 January 1998 to 31 December 1998, 155 operational ozone soundings were performed while 119 were launched from 1 January 1999 to 30 September 1999. From all these flights, 99.6% of the sondes reached 25km ASL, 94.5% 30km ASL, and 80% 33km ASL (see Figure 6).

In the framework of the Global Atmosphere Watch (GAW-WMO), various tests are currently performed with the goal of improving the sondes' preparation and of correcting the possible deficiencies of the sonde during flight. To better understand the characteristics of both the BM and the ECC sondes, parallel ECC-BM sondes were launched once a week during more than one year (78 twin-soundings from March 1998 to July 1999). The systematic differences appearing between both sonde types are actually analysed and compared with the results of the SONDEX96 intercomparison campaign organized jointly with NASA/WFF (Wallops Island, USA). About thirty twin ECC-BM soundings were successfully launched in Payerne during a two-week spring period of 1996.

4.6. OHP and Dumont d'Urville

Submitted by: Claude Vialle, IPSL

In either stations, there is no significant change from the last report.

At OHP station an ozonesonde is launched every Wednesday throughout the year. Some extra sondes were launched for the MATCH campaign during last winter (98/99).

At Dumont d'Urville 25 ozonesondes were launched per year (once a week during the austral winter, once a month during the austral summer). The recent soundings reached maximum altitudes lower than last year, probably due to stronger winds.

No more data from the both stations have been transferred to the NDSC data facility. The difficulty with the formatting program is not solved today (some erratic values are generated during the translation between acquisition data and AMES format)

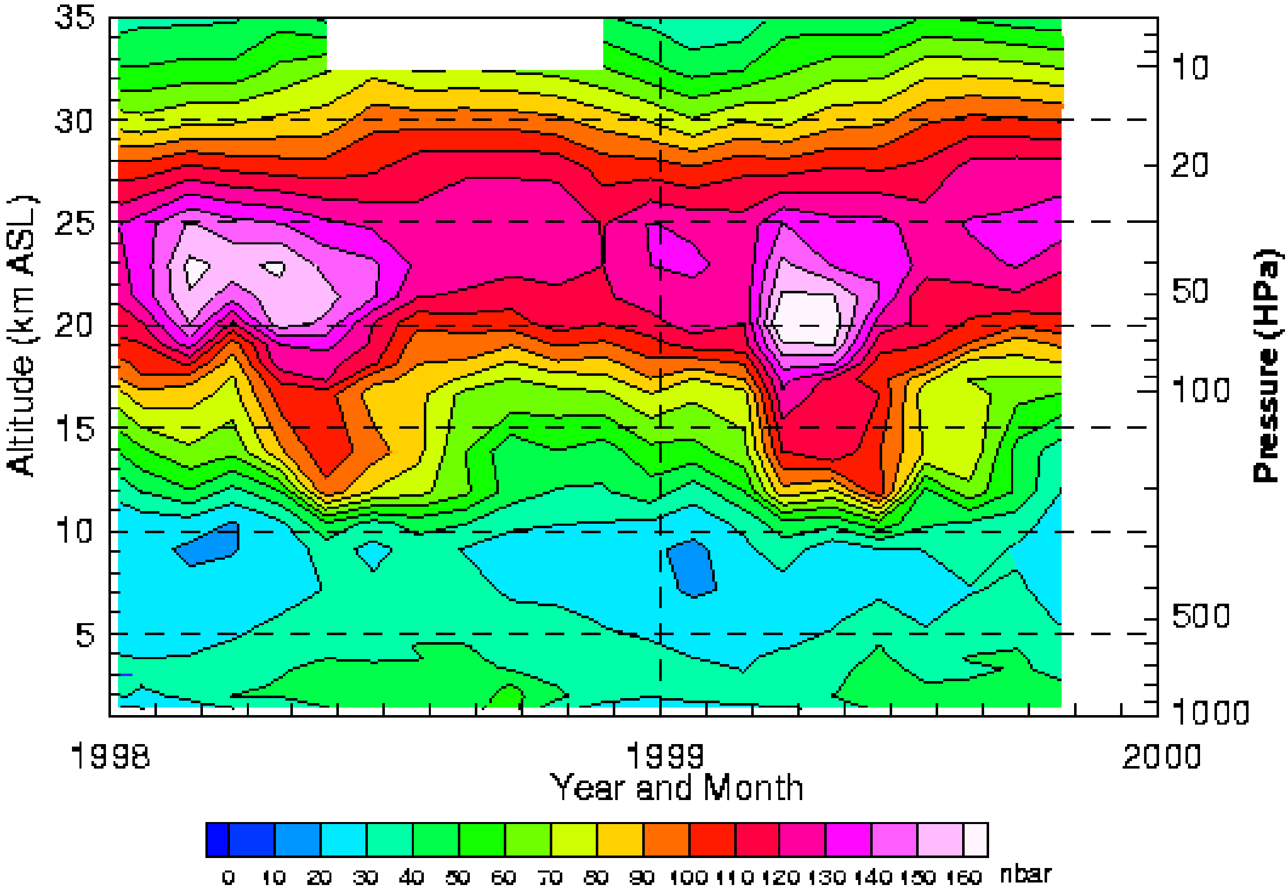

Figure 6. *Monthly averaged time series of ozone profiles measured in Payerne 1998-1999. High ozone concentrations during late winter in the region of the ozone maximum can be defined as well as ozone increase in the lower stratosphere during Spring. Summer low-tropospheric ozone maxima can also be detected. This cross section is based on 274 ozone soundings.*

4.7. Wallops Island

Submitted by: Francis J. Schmidlin, NASA

Measurement Program Wallops Flight Facility for period 1 October 1998-30 September 1999

4.7.1. ECC Observations

NASA Wallops Flight Facility (37.83˚N; 75.48˚W) releases weekly ozonesonde instruments and engages in periodic testing of new instruments and equipment. The number of ozonesonde soundings made each month during the period of this report is given in Table 1. Also shown is the number of observations reaching 20 hPa and 10 hPa, respectively. With the exception of one EN SCI ECC flown, all soundings were made using Science Pump, Inc. instruments. During the period a total of 97 ozonesondes were released, 76 to meet routine requirements and validation measurements for HALOE (all reported to WOUDC) and 21 special tests, e.g., new GPS instrument capability, comparisons of buffered vs non-buffered one-percent KI solutions, and testing of new software. Observations are forwarded to WOUDC each quarter.

Table 3: Monthly statistics of Wallops Island ozonesondes including number of observations reaching 20 hPa and 10 hPa.

Month	No	20 hPa	10 hPa
Oct	7	7	7
Nov	5	5	5
Dec	7	6	6
Jan	7	7	7
Feb	7	7	7
Mar	6	6	6
Apr	8	8	6
May	10	9	4
June	5	5	5
July	5	5	5
Aug	4	4	4
Sept	5	3	2
TOTAL	76	72	64

At this time programming of software is taking place to permit the Wallops Island ozonesonde data to be placed in the NDSC archive. The AMES format is under construction and is expected to provide the best definition of the Wallops Island ozonesonde profiles, Dobson Spectrophotometer and Microtops total column ozone.

As part of the new 10-year cooperative agreement between NASA and INPE, Brazil, ozone measurements are available from Natal, Brazil. Thirty-two ozonesonde observations have been made and are in the process of being submitted to WOUDC for archiving.

Additionally, ozonesondes were flown from Ascension Island, (7.98˚S; 14.42˚W) as part of a study to capture additional ozone information in the vicinity of the Equator. These observations are made as part of the program, Southern Hemisphere Additional Ozone, or SHADOZ. Weekly measurements are made, as circumstances permit. During the period of this report 38 ozonesonde profiles are available.

4.7.2. Total Column Ozone Measurements

Dobson Spectrophotometer

Dobson total ozone measurements are conducted between Monday and Friday, cloud cover and other weather permitting. Basically direct sun measurements are made. During May, the Wallops Island Dobson Spectrophotometer was calibrated against the Regional Standard Dobson located in Boulder, CO. CMDL conducted the calibration; the last calibration was in 1995. Change between the 1995 calibration and the 1999 calibration was 0.1 percent.

Microtops Photometer

Total ozone column measurements between the Wallops Island Dobson Spectrophotometer and two Microtops II photometers were compared to determine whether the Microtops II measurements would be reliable enough for remote site use. Microtops measurements are valid only when operated when the sky is clear or with thin clouds. Results showed that the hand-held photometer would provide measurements equivalent to those from the Dobson. It is our intention to deploy one Microtops II to Ascension Island to be used in lieu of a Dobson.

ECC Total Column Ozone vs. TOMS Total Column Ozone

Comparison between the Wallops Island ECC total ozone data and the TOMS total ozone are shown on Figure 7. The ECC agreement with TOMS requires analysis, but examination of the figure suggests that these instruments agree relative well.

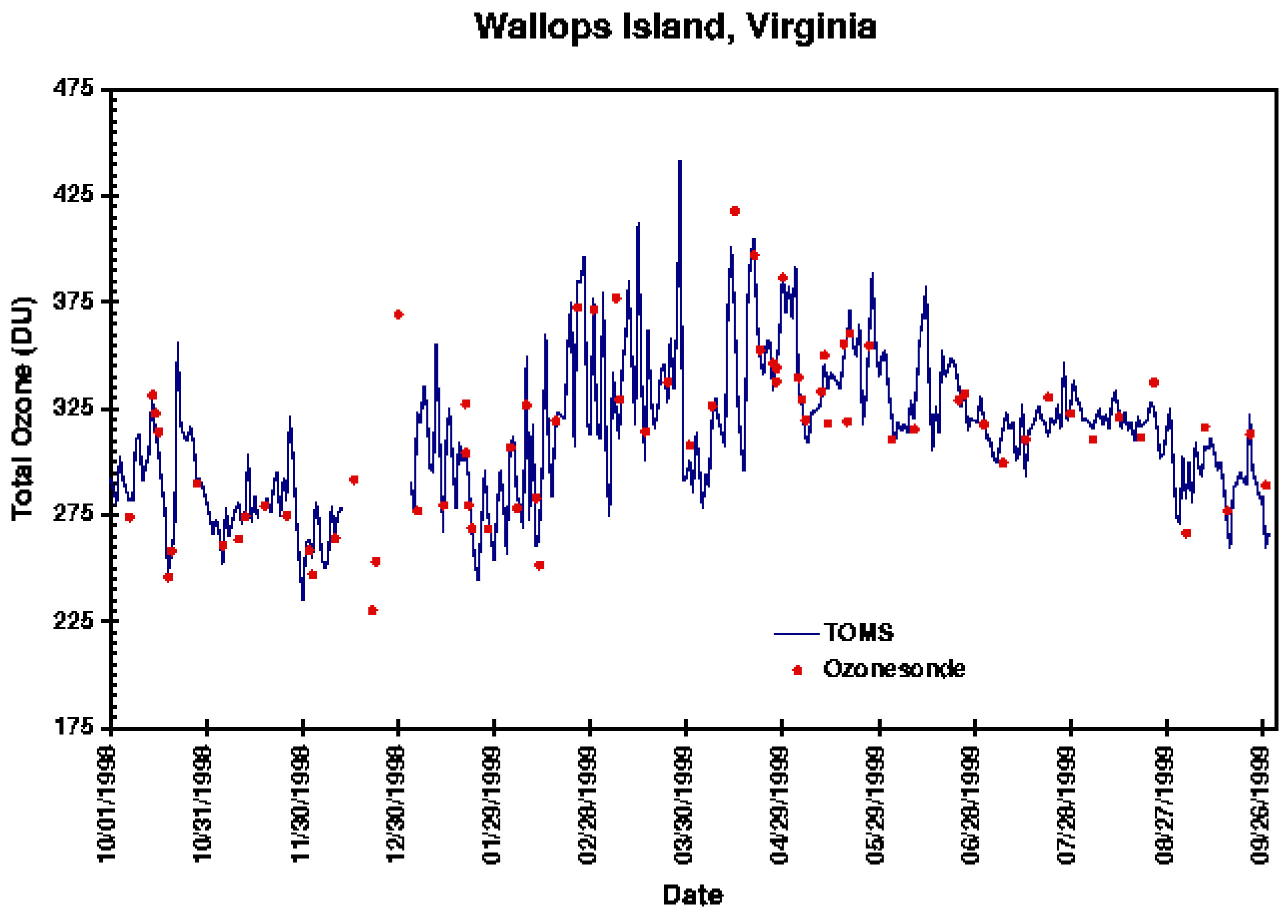

Figure 7. *Comparison of Wallops Island ECC integrated total ozone with TOMS total ozone for the year October 1998 through September 1999.*

4.8. Hilo and South Pole

Submitted by: Bryan Johnson, NOAA

The NDSC sites in the NOAA/CMDL ozonesonde network include Hilo, Hawaii and South Pole Station, Antarctica. Additional CMDL ozonesonde sites are located at Boulder, Colorado; Trinidad Head, California; Huntsville, Alabama; American Samoa; Fiji; Tahiti; and Galapagos. Ozone profiles are measured weekly at Hilo and South Pole using Science Pump and ENSCI electrochemical concentration cell (ECC) ozonesondes. The South Pole station ozonesonde frequency increases to approximately 2 or more per week each year in September and October, during the Antarctic ozone hole period. The minimum total ozone measured by ozonesondes at South Pole in 1998 was 95 dobson units on October 5. The minimum ozone, at the time of submitting this report, was 90 dobson units measured on September 29, 1999. NOAA/CMDL has performed ongoing laboratory and field tests to determine the performance of the ECC ozonesondes used in our network. The results of the tests prompted a major change in 1998 when the ECC sensor solution recipe was changed from a buffered 1% potassium iodide solution to a 2% unbuffered solution. South Pole switched in March, 1998, and Hilo in April, 1998. The unbuffered solution has improved the total ozone comparisons with the Dobson spectrophotometer measurements at both sites. The Hilo ozonesonde measurements from January 1 to September 17, 1999 averaged +3 5% higher than the Dobson spectrophotometer. The ozonesonde total was computed using a constant mixing ratio residual. The mixing ratio was extrapolated from 7 hPa, or from the highest altitude reached by the balloon, if it burst below 7 hPa. The ozonesonde total was also computed using the SBUV climatology residual tables from R. McPeters. The climatology residuals gave slightly lower total ozone than the constant mixing ratio method, with the ozonesonde total at -3 4% compared to the Dobson spectrophotometer. The ozone profile calculations use an average pump efficiency determined from more than 250 individual ozonesonde flow rate measurements made in our environmental chamber at 100 to 5 hPa. Four triple ozonesonde flights were flown at South Pole station in January, 1999 to compare 3 different ozonesonde models used by CMDL in the past and present. This experiment was part of an NSF funded education project called Teachers Experiencing Antarctica. Each flight had an ENSCI 2Z and Science Pump 6A and 4A models on the triple package. All three models compared very well in the troposphere, consistently agreeing within 5-10%. In the stratosphere, the ENSCI and 6A models agreed within 1 to 8% with the 6A model showing slightly lower ozone. The 4A model averaged 5 to 10% lower than the 6A and 2Z sondes in the stratosphere. Cathode solutions were also tested by using 1% buffered and 2% unbuffered in every other triple flight. Only the 6A and 2Z models were used to compare the total ozone with the Dobson spectrophotometer. The 1% buffered solution profiles were about 10% higher than the Dobson spectrophotometer, while the 2% unbuffered were only 2 to 3% higher. The constant mixing ratio residual method was used in all calculations. The pump efficiency was measured individually for each ozonesonde used in the triple flights. The most recent cathode solution tests we completed involved measuring surface ozone during the summer in moderately polluted urban air. Nine surface ozone experiments were conducted on the roof of the David Skaggs NOAA building in Boulder in July and August, 1999. During each test, two to four ozonesondes were run simultaneously alongside a TEI ozone analyser for approximately 5 hours. Science Pump 6A and ENSCI 2Z ECC ozonesondes were used in the tests. The preliminary analysis showed that the ozonesondes using the 2% unbuffered solution compared very well (1-5%) with the TEI ozone analyser throughout the 5 hour period. The results of all field and lab tests will be used to employ corrections to past ozonesonde data in order to produce a consistent long term data set. Figure 8 shows the launch of an ozonesonde from Hilo, Hawaii.

Figure 8. Launching an ozonesonde from Hilo, Hawaii.

4.9. Lauder

Submitted by: Greg Bodeker, NIWA

During the past year weekly ozonesonde flights were made from the NDSC station at Lauder (45.04°S, 169.68°E). Figure 9 shows the location of the observatory. Data to the end of 1998 have been submitted to the NDSC archives. Measurements were made using En-Sci 1Z series ozonesondes flown using a 0.5% cathode solution. Except for a few weeks when it was away on a field campaign, the GPS based Vaisala Marwin MW12 ground receiving system was used. During the field campaign, the previous ground receiving system was used and therefore no wind or package location data were available during this time.

4.9.1. New software development

Because of the limitations of the MetGraph software, code has been developed at Lauder which takes the raw ozonesonde data, logged using procomm, as input. This windows based software package is more flexible than MetGraph and allows incorporation of data quality control algorithms developed at Lauder e.g. calculation of evaporated cathode solution during the flight. It also allows logging of the data at the highest temporal resolution (typically 2 seconds); the MetGraph software smooths the data. The new software produces binary output files which, in addition to the flight data, contain all ancillary information regarding the flight e.g. simultaneous independent total column ozone measurements, integrated sonde ozone, background current measurements, corrections applied, and operator comments. A separate utility has been written to convert these binary files into text files in a variety of formats.

4.9.2. Ozone and temperature profile trend analysis

A paper on trends in ozone and temperature profiles in the first 10 years of ozonesonde measurements at Lauder was published in JGR: Bodeker, G.E.; Boyd, I.S.; Matthews, W.A. (1998). Trends and variability in vertical ozone and temperature profiles measured by ozonesondes at Lauder, New Zealand: 1986-1996. *Journal of Geophysical Research 103(D22)*: 28661-28681. The trends in ozone and temperature reported on in this paper are shown in Figure 10.

4.9.3. Ozonesonde/lidar intercomparisons

Recent intercomparisons between ozonesonde and simultaneous, collocated lidar ozone profiles show an apparent altitude error in the ozonesonde data of 125 50m. This error is thought to result from the ~25 second response time of the sonde. A paper reporting on these results has been submitted for publication (Brinksma et al., Validation of three years of ozone measurements over NDSC station Lauder, New Zealand, JGR 1999). Work is in progress at Lauder to understand how best to make use of the measured ozonesonde response times to correct for the induced lag in the profile.

Figure 9. The Lauder Observatory, New Zealand.

4.9.4. Participation in satellite ozone profile validation

The ozonesonde measurements at Lauder will be the southern hemisphere anchor site for the validation of ozone profiles measured by SAGE III. Currently ozonesonde launch times are selected to ensure simultaneity with HALOE and SAGE II overpasses to assist in the validation of these measurements. The sonde data are being used to assess the v6.0 SAGE II data which are currently in production. A comparison to interim V6.0 data was presented at the SAGE II Science Team Meeting in Hampton, Virginia, on 16 August 1999 by Brian Connor.

4.9.5. Analysis of low ozone events over Lauder

Ozonesonde measurements during the summer of 1998 showed the effect on southern hemisphere midlatitudes of ozone poor air exported from the Antarctic following the breakdown of the vortex. Significant ozone loss over a vertical range of more than 2 km was centred on the 600 K isentropic level. Reverse-domain-filling PV maps confirmed that the air at this level was of Antarctic origin and remained relatively stationary over Lauder since it was located close to the vertical zero wind line (Connor, B.J.; Kreher, K.; Lawrence, B.N.; Ajtic, J.; Bodeker, G.E.; Boyd, I.S.; Scott, J.C. (1999). “Antarctic air over New Zealand following vortex breakdown in 1998”. Presented at American Geophysical 1999 Union Spring Meeting, Boston, MA, USA, 1-4 June 1999).

4.10. Île de la Réunion

Submitted by: Françoise Posny, Univ. de la Réunion

4.10.1. Data acquisition in 1998:

Since the last report, 2 launches were performed in December 1998. That leads to a total of 35 launches for 1998. All these launches lead to an ozone profile but only 28 has been validated (the non validation of 7 profiles is due to the fact that their burst altitude was less than 27 km).

During 1998 the normal frequency was twice a month (early in the morning), but additional launches were performed for

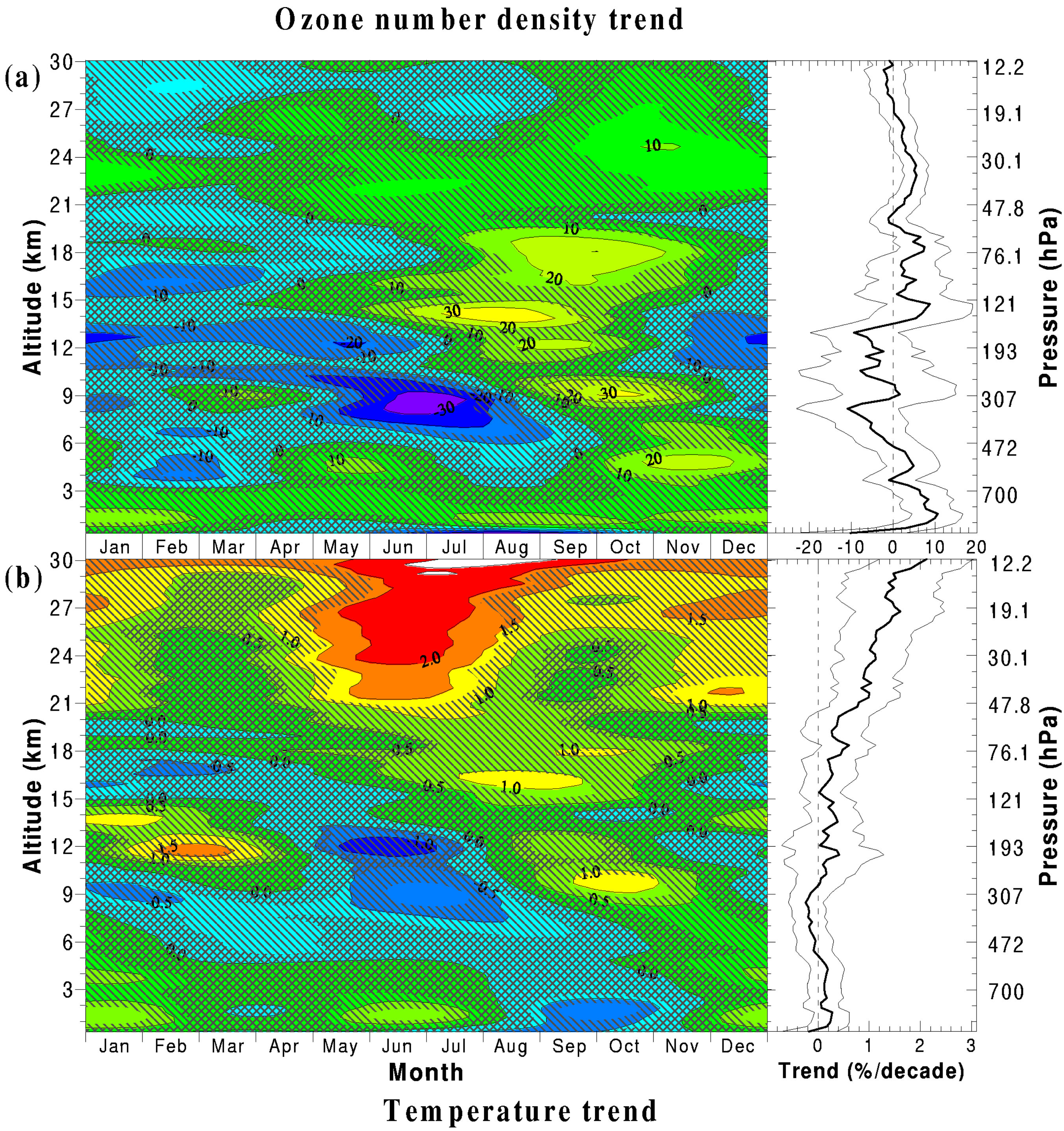

Figure 10. *Trends in (a) ozone number density and (b) temperature in percent per decade. The left part of each figure shows the seasonally dependent trend. Areas shaded in cross hatching indicate where trends are statistically insignificant (σ<1); areas shaded with diagonals where trends are weakly significant (1<σ<2); and areas with no shading indicate trends significant at the 2σ level. Contour spacing is 10% per decade for ozone number density and 0.5% per decade for temperature. The right part of each figure shows the seasonally independent trend (solid line) together with its 2σ uncertainty (thin solid lines).*

TRACAS campaign: 13 in July including 5 in the evening and 1 at noon.

4.10.2. Data acquisition in 1999:

Since January, the launch frequency has been increased to once a week in the frame of the SHADOZ campaign. From January to Sept. 22nd: 36 launches (on wednesday 8-9h local time which is +4h UT) plus an extra launch the 19th of February for the INDOEX campaign performed in the evening simultaneously with the launch from the Ron Brown ship which was at La Reunion at that date.

Between January and mid-June 17 profiles on 23 launches have been validated. For the mid-June to Sept 22nd period (14 launches), the validation is in progress.

For the SHADOZ campaign, The NASA partially supports the measurements at La Reunion by providing additional ozonesondes. The NASA sondes are 6A type as ENSCI-Z type are usually used at La Reunion. Therefore, from january 1999 to mid-june ENSCI-Z type have been used and from this date till now the NASA's 6A.

4.10.3. Papers which have used the ozone profiles measured at La Reunion:

Tropical cyclone Marlene and stratosphere-troposphere exchange J.L. Baray, G. Ancellet, T. Randriambelo and S. Baldy, Journal of Geophysical Research, vol. 104,NO.D11, pages 13,953-13,970,june20,1999.

Description and evaluation of a tropospheric ozone lidar implemented on a station of the NDSC: Reunion island J.L. Baray, J. Leveau, J. Porteneuve, G. Ancellet, P. Keckhut, F. Posny and S. Baldy Applied Optics, Lasers, Photonics and Environmental optics, Lidar and remote sensing (accepted the 5 august 1999 - in press).

4.11. McMurdo

Submitted by: Terry Deshler, Univ. of Wyoming

Ozone and temperature profile measurements from McMurdo Station, Antarctica, resumed on 23 August 1999. Since then, there have been 13 profile measurements with roughly 10 more planned extending to the end of October. Aerosol profiles were measured on 10 occasions between June and September of 1999. The measurements in late September indicate a total column of 144 DU reduced from 212 DU in late August; however, the 1999 minimum in ozone has not yet been reached as of the date of this report.

The data for 1986 – 1998 are now on the data base. For these measurements we use 1.0% buffered solution and individually calibrate all of the pumps. These are the same operating procedures used at McMurdo since 1987. We have made some comparison flights using ozonesondes with 1.0% and 0.5% buffered solutions, but have not yet been convinced that a change is necessary. There was a personnel change. Chris Kröger took over the position held by Bruno Nardi, after Bruno moved to the National Center for Atmospheric Research. Chris is presently in McMurdo completing the 1999 measurements.

A proposal was submitted to the National Science Foundation in June 1999 to continue the ozone and aerosol measurements at McMurdo for another three years.

5. JOSIE

Submitted by: Herman Smit, FZ Jülich

5.1. Introduction

The state of knowledge regarding long term trends of tropospheric as well as stratospheric ozone is limited due to insufficient global coverage of ozone sounding stations, poor assurance of continuity of data and questionable homogeneity of data (WMO Scientific Assessment of Ozone Depletion, 1995). Particularly, there is an urgent need for improved data quality which must be achieved by intercalibration and intercomparison of existing ozone sonde types as well as agreement on procedures for data processing and analysis (WMO-Report No. 104, 1995). During the fourth WMO meeting of experts on the QA/SACs (Quality Assurance and Science Activity Centres) of the GAW (Global Atmosphere Watch) at Garmisch-Partenkirchen (Germany) in March 1995 (WMO-report No. 104, 1995) it was decided to establish and to designate the environmental simulation chamber at Forschungszentrum Jülich as World Calibration Facility for Ozone Sondes (WCFOS): a facility for quality assurance of ozonesondes used in GAW and GLONET (Global Ozone Network) focusing on ozonesonde precision, accuracy and long term stability. The environmental simulation chamber at the Forschungszentrum Jülich in Germany enables control of pressure, temperature and ozone concentration and can simulate flight conditions of ozone soundings up to an altitude of 35 km. The controlled environment plus the fact that the ozonesonde measurements can be compared to an accurate UV-Photometer as reference (Proffitt et al., 1983, Smit et al. 1994) allows to conduct experiments that are designed to address questions which arose from field intercomparisons.

5.2. Tasks Facility

The Jülich Ozone Sonde Intercomparison Experiment (JOSIE, Smit et al., 1998) performed in 1996 was the first GAW-GLONET activity towards implementing a global quality assurance plan for ozone sondes in routine use today around the world. Long term objective is the establishment of a permanent facility for Quality Assurance (QA) of ozonesondes operated in the WMO/GAW-Program. The facility should be assigned with following three major tasks:

I. Quality check of the instrumental performance of different sonde types

II. Test of individual sonde profiling capabilities of different sounding laboratories

III. Establishment and up-date of Standard Operating Procedures (SOPs) of different sonde types

During the fourth WMO meeting of experts on the QA/SAC of GAW at Garmisch-Partenkirchen in March 1995 (WMO-report No. 104, 1995) a preliminary working plan was defined which was based on the assumption of a budget of approximately 300,000 US$ per year if all tasks of the facility were accomplished. However, an important constraint is the fact that the budgets for 1998 and 1999 to operate the facility are limited to about 40,000 US$ per year. This means that the activities of the facility in 1998 and 1999, addressed as JOSIE-98/99, has to be revised drastically with regard to the initial working plan of the WOSCF as defined in March 1995 (see above).

5.3. Revised concept for 1998/1999

JOSIE-98/99 Concerning the limited budgets over 1998 and 1999, JOSIE-98 will exclusively focus on task I while JOSIE-99 should be dedicated to task II. For a budget of about 40,000 US$ it is estimated that the WOSCF can perform:

- ✎ 1 month of simulation runs (incl. preparation, simulation flight, post-flight data processing: a total of about 25 sondes can be tested),
- ✎ 1 month to analyse/interpret the results and
- ✎ 1 month to prepare the documentation and report of the results of the running year. Further, within the activities of task III of the facility during 1998/1999 the SOPs (presently in preparations) for the different ozonesondes should be finalized.

5.4. Experimental Design of JOSIE-98

Concerning the limited sample of about 25 sondes which can be tested in the simulation chamber, the primary goal of JOSIE-98 will be dedicated exclusively to the quality check of the instrumental performance of ECC (=Electrochemical Concentration Cell)-sondes. More than 80 percent of the GAW/GLONET-ozone sounding network are using ECC-sondes which are manufactured by either Science Pump Corporation (model type SPC-6A[1]) or Environmental Science Corporation (model type: ENSCI-1Z). Small differences of instrumental lay out of the different sonde types exist which may influence the instrumental response of the different model types. The primary goal of JOSIE-98 is to do a quality check of the instrumental performance over a sample of 25 randomly selected ECC-sondes, representing the different model types and which would be provided by the different ECC-sonde users in the GAW-sounding network. The experimental design of the simulation experiments is to evaluate the sensitivity, precision and accuracy of the tested ECC-sondes at different pressure altitudes and ozone levels. Included are questions addressed by the experiments with regard to the sonde performance such as:

- ✎ influence of pre-launch procedures
- ✎ time response
- ✎ background signal correction
- ✎ total ozone normalization
- ✎ pump flow efficiency correction.

The experiments will be related to mid-latitude type of simulation profiles used during JOSIE-96 and based on the results obtained during the JOSIE-96 intercomparison. The evaluation of JOSIE-98 will primarily focus on the statistical analysis of the instrumental performance of the sample of 25 tested ECC-sondes. However, attention will also be paid to differences of sonde performance between the different ECC-model types type (SPC-5A, SPC-6A and ENSCI-1Z).

5.5. Strategy of JOSIE-98

Important objectives of JOSIE-98 are:

1. The ECC-sondes to be tested should be randomly picked from the stocks of new ECC-sondes at different, randomly selected, sounding sites of the GAW/GLONET-community. However, the final sample should contain at least 8 ECC-sondes of each model type (SPC-5A, SPC-6A and ENSCI-1Z). All selected ECC-sondes have to brand new, in the original packing of the manufacturer, while the manufacturing date has to be after January 1., 1997
2. The selection of the sounding sites has to be anonymous (included the people at the calibration facility to guarantee their independency) and only allowed to be known by the referee of JOSIE-98, Prof. Volker Mohnen
3. Due to the strictly blind character it is requested that Prof. Mohnen does the necessary arrangements with regard of composing a set of 25 ECC-sondes to be provided to the calibration facility.
4. The set of 25 ECC-sondes has to be available at the calibration facility before August 1., 1998.
5. All ECC-sondes will be operated according the procedures described by Komhyr, 1986.
6. All ECC-sondes will be prepared in the laboratory prior to their simulation runs using the same equipment
7. All ECC-sondes will have the same interfacing electronics to the data acquisition system of the facility.
8. Preparation of the sondes, simulation runs, data processing, data analysis and data evaluation will be carried out by the crew of the facility site.

5.6. Update on JOSIE-98

We tested 26 ECC-sondes from 2 manufacturers (13 x ENSCI-1Z & 13 x SPC-6A) as QA-Manufacturer to document the performance of the ECC in 1998. Report will be available around beginning of 2000.

1. Since early 1996 the previous SPC-5A type is not produced any more, such that this sonde type will not be participating in JOSIE-98

5.7. JOSIE 1999-2000

In 2000 we will do an intercomparison similar like JOSIE 1996, but now in parallel we want to start in 2000 a sort of WMO/GAW assessment on the SOP's for different ozone sonde types. The assessment should be a world-wide activity whereby for the ECC certainly also the NSDC network will be involved. The approach will be that a small group of experts set up the draft and then have the wide community of sounding laboratories, data users and scientific interpreters together reviewing the SOP-document. This document should then be a document established at WMO etc. as the guide to operate sondes. JOSIE-2000 should be dedicated to the most urgent issues (open questions). With this we (with Mike Proffitt from WMO and NASA) are in the middle of designing. JOSIE 1999 is more or less the preparations for JOSIE-2000 which will be done in November/December.

5.8. References

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Proffitt, M.H., and R.J. McLaughlin, Fast response dual-beam UV-absorption photometer suitable for use on stratospheric balloons, Rev. Sci. Instrum., 54, 1719-1728, 1983.

Smit, H.G.J., W. Sträter, D. Kley, and M.H. Proffitt, The evaluation of ECC-ozonesondes under quasi flight conditions in the environmental simulation chamber at Jülich, in P.M. Borell et al. (eds.), Proceedings of Eurotrac symposium 1994, 349-353, SPB Academic Publishing bv, The Hague, The Netherlands, 1994.

Smit H.G.J., W. Sträter, M. Helten, D. Kley, D. Ciupa, H.J. Claude, U. Köhler, B. Hoegger, G. Levrat, B. Johnson, S.J. Oltmans, J.B. Kerr, D.W. Tarasick, J. Davies, M. Shitamichi, S.K. Srivastav, C. Vialle, and G. Velghe, JOSIE: The 1996 WMO International intercomparison of ozonesondes under quasi flight conditions in the environmental simulation chamber at Jülich, Proceedings of the XVIII Quadrennial Ozone Symposium, Eds. R. Bojkov, and G. Visconti, L'Aquila, Italy, September 1996, 971-974, 1998.

WMO (=World Meteorological Organization), Scientific Assessment of Ozone Depletion: 1994, Global Ozone Research and Monitoring Project - Report No. 37, World Meteorological Organization, Geneva, 1995.

WMO report No. 104, Report of the fourth WMO meeting of experts on the quality assurance/science activity centres (QA/SACs) of the global atmosphere watch. Jointly held with the first meeting of the coordinating committees of IGAC-GLONET and IGAC-ACE at Garmisch-Partenkirchen, Germany, 13-17 March 1995, WMO TD.No. 689

6. Status on data delivery

Below follows a table showing the number of ozonesonde files submitted to the NDSC data base as of 26 November 1998.

Table 4: Number of submitted sondes

Station	Number of sondes in database			
	Nov. 1996	Aug. 1997	Nov. 1998	Oct. 1999
Ny-Ålesund	532	637	733	801
Thule	18	18	18	182
Eureka	0	105	181	258
Hohenpeißenberg				0
Payerne				0
OHP	0	0	0	0
Wallops Island				0
Mauna Loa (Hilo)	0	0	0	0
La Reunion	0	0	0	0
Lauder	111	209	277	330
Dumont d'Urville	0	0	0	0
McMurdo	0	76	416	506
South Pole	0	0	0	0

7. Sonde activities at NDSC stations that do not report to the NDSC data base

There are several NDSC stations that launch ozonesondes and aerosol sondes without these measurements being reported to the NDSC data base. The table below lists the stations that the working group is aware of as of October 1999.

Table 5: NDSC stations that launch ozonesondes and/or aerosol sondes and that have not been asked to report to NDSC

Station name	reported data
aberyst	uvvis
andoya	lidar
harestua	ftir (Gardermoen is close)
kiruna	uvvis
lerwick	uvvis
moshiri	uvvis
scoresby	uvvis
sodanky	uvvis
syowa	uvvis

These stations have been solicited to submit ozonesonde data to the NDSC database. More details can be found in chapter 3.