NETWORK FOR THE
DETECTION OF
STRATOSPHERIC CHANGE

Ozone and aerosol sonde activities

Report to the NDSC Steering Committee

compiled by:

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NILU

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Table of Contents

List of Tables

1. Introduction

This report summarises the ozonesonde activities carried out at the various NDSC ozonesonde stations between September 1999 and August 2000. 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 ozone and aerosol sonde 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, Sodankylä, Aberystwyth, Hohenpeißenberg, Payerne, Observatoire de Haute Provence, Izaña, Mauna Loa, Lauder, Dumont d'Urville, McMurdo, South Pole.

At last year's steering committee meeting in Sapporo (October 1999) the recommendation for the inclusion of Aberystwyth, Izaña and Sodankylä was presented to the committee.

The recommendation for Izaña was given on the condition that they include the box temperature data in the archived files.

The recommendation was endorsed by the committee and the PIs of Aberystwyth and Sodankylä received some weeks later a letter from the co-chairs, informing them of their acceptance as NDSC complementary sites for ozonesondes. The Izaña stations received an acceptance letter later and is now also part of the NDSC.

Before the Thun meeting several other station PIs have been contacted.

The outcome of these contacts is as follows:

Alert: The PI for Alert, Hans Fast of AES, has submitted an application for NDSC affiliation. Alert started ozonesonde operations in 1988 and has a valuable data set. It is operated according to the same procedures as the Eureka station.

DeBilt: The PIs for DeBilt, Marc Allaart and Hennie Kelder of KNMI, have submitted an application for NDSC affiliation. DeBilt is not a particularly unique site since there are many ozonesonde stations at mid-latitudes in Europe. However, the stations has acquired data since 1992, and the data quality is high.

Neumayer: This station is located far from the other NDSC sites in Antarctica (South Pole, McMurdo and Dumont d'Urville) are therefore fills a gap. The procedures used in the preparation and data handling are identical with the ones in use at Ny-Ålesund.

Paramaribo: This site is a very important one since it is located in a region of minimal NDSC presence as well as a region of geophysical interest. Of all the sites being considered for ozonesonde NDSC affiliation this is the most important. The sonde program started in 1999 and data from this station has not been seen yet. However, the station is operated by the same research group that operates the DeBilt station.

Uccle: The longest data record comes from Uccle station. They started soundings in 1969 and switched from Brewer-Mast type to ECC type in 1997. The group has undertaken great care to ensure a homogeneous data set over the whole period. The use 0.5% KI is not a standard procedure, but this is also used by other NDSC stations, such as Lauder and Réunion. Together with laboratory measured pump efficiency correction this constitutes a consistent procedure.

Common to all stations is that they use the ECC type of ozonesonde and that they follow the Vaisala/Komhyr procedures for sonde preparation and data evaluation. They are all willing to submit data to the NDSC archive and to participate in intercomparisons. The ozonesonde working group recommend that all four stations be accepted as NDSC complementary sites.

4. Station reports

4.1. Ny-Ålesund

Submitted by: Peter von der Gathen, AWI

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

4.1.1. Personnel

Peter von der Gathen, Markus Rex, Astrid Schulz, Peter Herrmann

Station personnel: Thomas Schmidt (until March 2000), Andrew Klaas (since Feb. 2000)

4.1.2. Status of the instrument

The new balloon house started operation phase in autumn 1999.

4.1.3. Technical developments

No change

4.1.4. Measurements and data evaluation

In winter 1999/2000 AWI coordinated the ozonesonde launches of the Arctic stations within the campaigns THESEO-2000 and SOLVE.

Table 1: Number of sondes launched from Ny-Ålesund

Month	1999	2000
Jan	14	18
Feb	10	15
Mar	12	17
Apr	4	8
May	5	5
Jun	5	6
Jul	4	4
Aug	4	
Sep	5	
Oct	5	
Nov	7	
Dec	11	

4.1.5. Data transfer to NDSC data bank

The data of 135 ozonesonde launches have been transferred to the NDSC data bank (range: March 1999 - June 2000).

Photo 1. Ozonesonde launch in Ny-Ålesund.

4.1.6. Participation in meetings and conferences

- 1999 Conference on the Atmospheric Effects of Aviation, Virginia Beach, VA, USA, April 19 - April 23, 1999.
- AGU Spring Meeting, Boston, MA, USA, May 31 - June 4, 1999.
- IUGG XXII General Assembly, Birmingham, UK, July 18 - July 30, 1999.
- EGS XXV General Assembly, Nice, France, April 24 - April 29, 2000.
- Quadrennial Ozone Symposium, Sapporo, Japan, July 3 - July 8, 2000.

4.1.7. Scientific highlights

Strong chemical ozone destruction in the winter 1999/2000 with strongest destruction ever observed in one level.

4.1.8. Projects

- EU project THESEO-O3LOSS includes the Match activities in 1998/99.
- EU project PVC (Polar Vortex Change) includes climatological analysis of ozonesondes data of the past.
- EU project EuroSOLVE includes the Match activities in 1999/2000.

4.1.9. Planned activities

- Continuation of long term measurement program, i.e. 1 launch per week at least.
- Match 2000/01 (ozonesondes), i.e. increased launch frequency during winter.

4.1.10. Publications using Ny-Ålesund ozone sounding data

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 stratosphere, Polar Research, 1999 in print.

Steinbrecht, W., R. Neuber, P. von der Gathen, P. Wahl, T. J. McGee, M. R. Gross, U. Klein, and J. Langer, Results of the 1998 Ny-Ålesund Ozone Measurements Intercomparison NAOMI, J. Geophys. Res., 104, D23, 30515-30523, 1999.

Schulz, A., M. Rex, J. Steger, N. R. P. 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

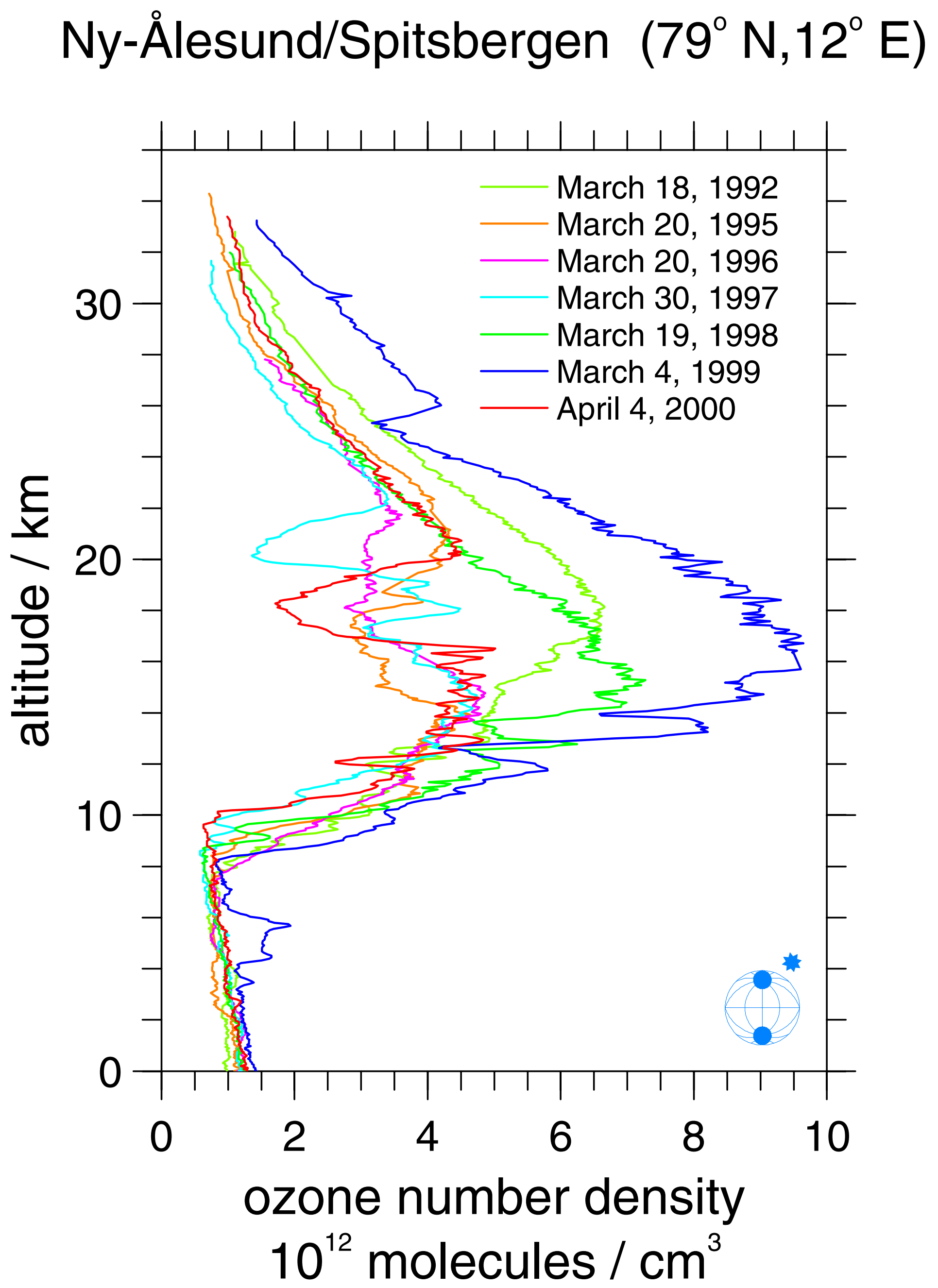

Figure 1. Ozone sonde profiles characterizing the state of the ozone layer above Ny-Ålesund at the end of recent winters.

correlate with low temperatures deep inside the polar vortex, Geophys. Res. Lett., 27, 205-208, 2000.

Becker, G., R. Müller, D. S. Mc Kenna, M. Rex, K. S. Carslaw, and 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., 105, D12, 15175-15184, 2000.

Schulz, A., M. Rex, N. R. P. Harris, G. O. Braathen, E. Reimer, R. Alfier, I. Kilbane-Dawe, S. Eckermann, M. Allaart, M. Alpers, B. Bojkov, J. Cisneros, H. Claude, E. Cuevas, J. Davies, H. De Backer, H. Dier, V. Dorokhov, H. Fast, S. Godin, B. Johnson, Y. Kondo, E. Kosmidis, E. Kyrö, Z. Litynska, I. S. Mikkelsen, M. J. Molyneux, G. Murphy, H. Nakane, F. O'Connor, C. Parrondo, F. J. Schmidlin, P. Skrivankova, C. Varotsos, C. Vialle, P. Viatte, V. Yushkov, C. Zerefos, P. von der Gathen, Arctic ozone loss in threshold conditions: Match observations in 1997/98 and 1998/99, J. Geophys. Res., submitted, 2000.

Rex, M., R. J. Salawitch, N. R. P. Harris, P. von der Gathen, G. O. Braathen, A. Schulz, H. Deckelmann, M. Chipperfield, B. M. Sinnhuber, E. Reimer, R. Alfier, R. Bevilacqua, K. Hoppel, M. Fromm, J. Lumpe, H. Küllmann, A. Kleinböhl, H. Bremer, M. von König, K. Künzi, D. Toohey, H. Vömel, E. Richard, K. Aikin, H. Jost, J. B.

Greenblatt, M. Loewenstein, J. R. Podolske, C.R. Webster, G.J. Flesch, D.C. Scott, R. L. Herman, J. W. Elkins, E. A. Ray, F. L. Moore, D. F. Hurst, P. Romashkin, G. C. Toon, B. Sen, J. J. Margitan, P. Wennberg, R. Neuber, M. Allart, M. Alpers, B. R. Bojkov, J. Cisneros, H. Claude, J. Davies, W. Davies, H. De Backer, H. Dier, V. Dorokhov, H. Fast, S. Godin, B. Johnson, Y. Kondo, E. Kyrö, Z. Litynska, I. S. Mikkelsen, M. J. Molyneux, E. Moran, G. Murphy, T. Nagai, H. Nakane, C. Parrondo, F. Ravegnani, F. J. Schmidlin, P. Skrivankova, C. Varotsos, C. Vialle, P. Viatte, V. Yushkov, and C. Zerefos, Chemical loss of Arctic ozone, Nature, submitted, 2000.

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

No change

4.2.4. Measurements and data evaluation

A graphical tool has been developed to examine the raw data output from the Vaisala RSA11 interface card. The graphical tool handles both old data from the Vaisala data taking program, ozone, and new data from the Vaisala data taking program, metgraph, and is used to remove glitches in the sensor current, drops at the top of the sounding due to pump failure and/or evaporation of the electrolytes. Sections where the sensor current exceeds the range (4096) of the counter in the RSA11 card can also be corrected. Finally the time interval during which the surface ozone is measured prior to the launch of the sonde may also be defined in the display of the raw data, and the surface ozone computed. During conditions of strong surface winds the balloon is launched immediately after it is brought out of the balloon house. As the ozone is normally very low inside the balloon house, and because of the finite response time of the ozone sensor, the first few hundred meters of the ozone profile will be very low in such cases. Such low values are set undefined to avoid that they are interpreted as boundary layer ozone destruction, like the polar sunrise surface ozone destruction. The raw, filtered, and edited data may be contrasted in the graphical tool to detect possible errors in the data reduction, and procedures are included to re-compute the final edited data.

4.2.5. Data transfer to NDSC data bank

The 22 ozone soundings from the winter 1999-2000 will be transferred to NDSC before 30 September, 2000.

4.2.6. Participation in meetings and conferences:

None

4.2.7. Intercomparison campaigns

None

4.2.8. Scientific highlights

The Thule ozone soundings showed a 70% drop in the ozone mixing ratio at the 475 K isentropic level in the period 1 January – 31 March, 2000. As the ozone mixing ratio profiles were flat above and at this isentropic level, the ozone destruction, the computation of which includes the diabatic descent, is of the same value. For a discussion of the ozone soundings from all the THESEO/SOLVE stations see the match reports by M. Rex.

4.2.9. Projects

The TOPSE project was supported with a few launches. 22 soundings were made during the winter 1999/2000 as part of the THESEO/SOLVE project.

4.2.10. Planned activities

Winter campaigns mainly and a small number of launches during the spring and equinox to support the calibration of other instruments, like SAOZ.

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

Table 2 presents the ozonesonde activity at Eureka for 1999 and 2000. Figure 2 shows an example of two ozonesonde profiles obtained in the same air mass passing over Eureka ten days apart. According to preliminary Match analysis results (M. Rex e-mail to Match participants, 6 March, 2000) the Eureka profile of 20 January coincided with the period of maximum ozone loss rate in the polar vortex whereas the 30 January profile represents a time when the loss rate was smaller.

4.3.2. Instrument status

No change

4.3.3. Technical Developments

Tests are being conducted this August in Vanscoy, Saskatchewan, Canada. The tests consist of launching two ozonesondes on the same payload to see the effects of using different solution volumes and concentrations.

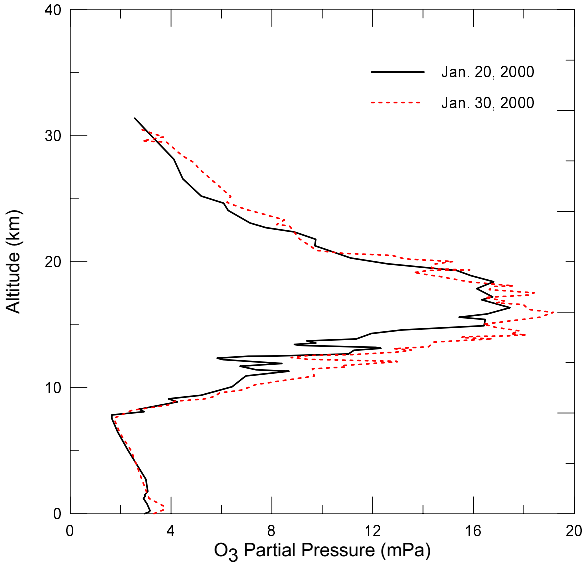

***Figure 2.** Two ozonesonde profiles of the same airmass, sampled over Eureka on 20 January and again ten days later on 30 January. The integrated profiles gave column amounts of 305 DU and 343 DU on 20 January and 30 January, respectively.*

Table 2: Number of sondes launched from Eureka

Month	1999	2000
Jan	11	17
Feb	14	17
Mar	10	13
Apr	3	4
May	4	2
Jun	4	4
Jul	4	3
Aug	4	3
Sep	5	
Oct	4	
Nov	4	
Dec	7	

4.3.4. Participation in projects

The ozonesondes were launched in support of the Eureka lidar and FTIR measurements, the Match campaign and the ER-2 research flights.

4.3.5. NDSC data archive

Ozone profiles obtained from 88 ozonesondes launched in the period 1 July, 1999 to 31 July, 2000, were added to the archive. This brings the total for Eureka to 346 profiles since 1996.

4.3.6. Planned activities

These consist of support to the winter 2000/01 lidar and FTIR measurements at Eureka, the Match campaign and participation in the JOSIE-2000 workshop.

4.4. Sodankylä

Submitted by: Esko Kyrö, FMI

4.4.1. Personnel

Scientific personnel: Esko Kyrö, Rigel Kivi, Timo Turunen, Juha Karhu, Tuomo Suortti

4.4.2. Status of the instrument

No change

4.4.3. Technical developments

No change

4.4.4. Ozonesonde measurements and data evaluation

The number of launched ECC ozonesondes in 1999 and 2000 by month is given in Table 3. Total of 38 ozone soundings were launched at Sodankylä during the MATCH campaign coordinated by AWI between 1 January 2000 and 31 March 2000.

4.4.5. Data transfer to NDSC data bank

The data of ozonesonde launches has been transferred to the NDSC data bank for the period Jan. 2000 - Apr. 2000.

***Photo 2.** Ozone sonde station at Sodankylä.*

Table 3: Number of sondes launched from Sodankylä

Month	1999	2000
Jan.	11	13
Feb	8	12
Mar	8	13
Apr	4	5
May	4	5
Jun	5	4
Jul	4	4
Aug	4	5
Sep	6	
Oct	4	
Nov	5	
Dec	5	

4.4.6. Participation in meetings and conferences

European Workshop on Stratospheric Ozone, St. Jean de Luz, France, 27 Sep- 1 Oct 1999.

EGS XXV General Assembly, Nice, France, 25-29 April 2000.

Quadrennial Ozone Symposium, Sapporo, Japan, 3-8 July 2000.

4.4.7. Scientific highlights

In the winter of 1999/2000 at Sodankylä regular ozone observations were performed by balloon borne ECC sondes and by ground based spectrophotometers. Compared to long-term records significant reduction of total ozone was observed during early March: between 1 March and 13 March 2000 daily values of total ozone column were up to 37% reduced compared to long-term mean. As an example inside-vortex ozone sonde profile of 10 March shows largest reduction of ozone at around 20 km of altitude, where over 50% less ozone was observed compared to long-term mean ozone profile of Sodankylä station for March (Figure 3).

4.4.8. Projects

- EU project: PVC (Polar Vortex Change) climatological analysis of ozonesonde data
- EU project: THESEO-2000 – EuroSOLVE (Match activities in winter 1999/00)
- EU project: THESEO-O3 LOSS (Match activities in winter 1998/99)
- EU project: COSE (Compilation of atmospheric Observations in support of Satellite measurements over Europe)

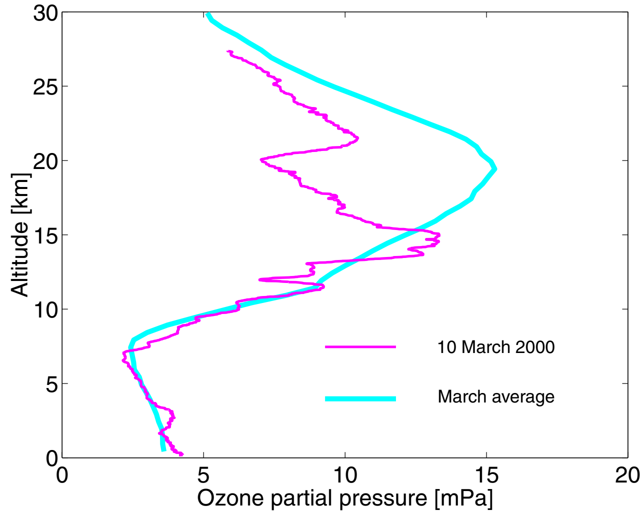

Figure 3. Ozone sonde profile inside polar vortex on 10 March 2000 compared to long-term mean profile for March at Sodankylä.

4.4.9. Planned activities

- Continuation of long term launch program with the basic frequency of one sounding per week.
- Match 2000/2001campaign will increase sounding activity during winter months.

4.4.10. Recent publications using Sodankylä ozonesounding data

Kyrö, E., R. Kivi, T. Turunen, H. Aulamo, V. V. Rudakov, V. V. Khattatov, A. R. MacKenzie, M. P. Chipperfield, A. M. Lee, L. Stefanutti, and F. Ravegnani, Ozone measurements during the Airborne Polar Experiment: aircraft instrument validation; isentropic trends; and hemispheric fields prior to the 1997 Arctic ozone depletion, *J. Geophys. Res*, 105, 14599-14611, 2000.

Kyrö, E., R. Kivi, H. Aulamo, T. Turunen, Changes in Arctic Polar Vortex, Proc. of the Quadrennial Ozone Symposium, Hokkaido University, Sapporo, Japan 3-8 July 2000, p. 109-110, 2000.

Kivi, R., E. Kyrö, T. Turunen, T. Ulich, and E. Turunen, Atmospheric trends above Finland. Part II. Troposphere and stratosphere, *Geophysica*, 35, p.71-85, 1999.

Kivi, R., E. Kyrö, A. Dörnbrack, M. Müller, H. Wille, B. Stein, V. Mitev, R. Matthey, L. Stefanutti, M. Del Guasta, and V. Rizi, Observations of stratospheric temperatures, ozone and aerosols above northern Finland in the winter of 1998/99, Proceedings of the Fifth European Workshop on Stratospheric Ozone, St. Jean de Luz, France, 27 September to 1 October 1999, in press, 2000.

4.5. Aberystwyth

Submitted by: Geraint Vaughan, University of Wales

4.5.1. Personnel

Scientific and station personnel: Geraint Vaughan, Fiona O'Connor (until Jan 2000), Wendy Davies (Jan-Sep 2000).

4.5.2. Instrument status

Aberystwyth is a University site, launching ozonesondes on a campaign basis. There is no commitment to a long-term regular measurement series; nevertheless, soundings have been performed since 1991 and are funded to continue for the next two years. All the data have been transferred to the NILU data base in NASA-AMES format.

All soundings so far have used either Science pump (5A/6A) or EnSci sondes, most with a TMAX-H interface card; a few recent flights used TMAX-C cards. Vaisala RS-80 (type A humicap) radiosondes provide the ptu sounding and telemetry. No wind sounding has been performed to date. Ground receiving equipment comprise a Vaisala antenna and UHF receiver, a modem and PC running software originally written by Herman Smit, Jülich and modified locally.

Preparation of sondes follow the Match convention: 1% KI solution (with other chemicals as recommended by Science Pump and EnSci) and STOIC 1989 pump correction. With the ECC-6A sondes the thermistor is placed in the base of the pump. Sonde preparation follows the Science Pump handbook, using a TSC-01 ozoniser unit. Several background currents are measured; that used for the data analysis is the one measured after the sonde is exposed to ozone, with a pressure-dependent correction.

Although total ozone is measured routinely at Aberystwyth with a SAOZ spectrometer, no total ozone correction is made to the ozonesonde profile.

***Photo 3.** Ozonesonde launch at Aberystwyth*

4.5.3. Scientific highlights, 1999-2000

Aberystwyth took part in the Theseo-2000 Match experiment, to measure polar vortex ozone depletion in the very cold winter of 2000. In May the Aberystwyth Egrett experiment was conducted to investigate turbulence, filamentation and mixing at tropopause level, and as part of this work experimental packages were flown from Aberystwyth comprising ozonesonde, RS80 and Snow White humidity sensors. UK Met Office involvement in this campaign allowed a comparison between the Vaisala and Snow White humidity sensors (see Figure 4).

4.5.4. Planned activities.

Over the next two years we will be conducting a campaign to

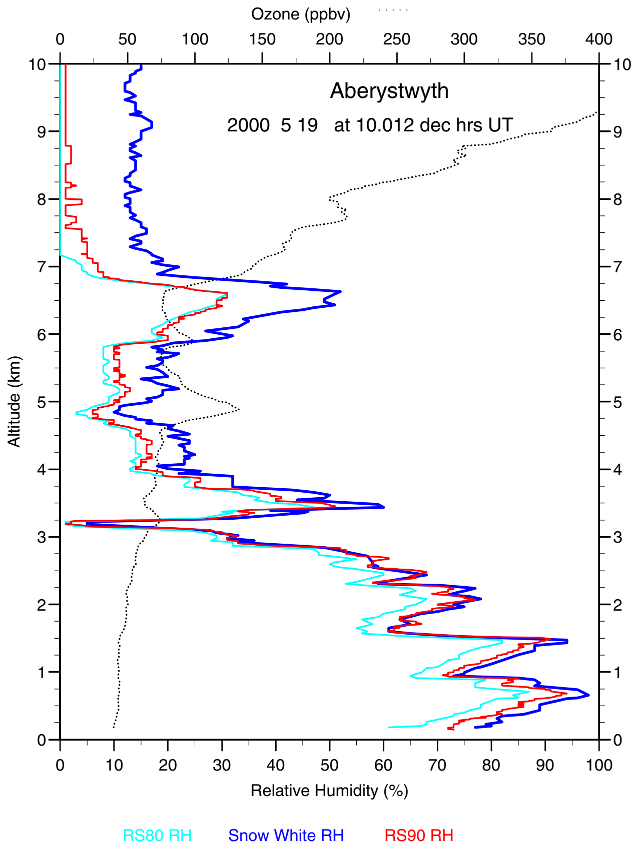

***Figure 4.** Profile of ozone, temperature and humidity measured from Aberystwyth by Snow White, RS90 and RS80A sondes, 19 May 2000. Humidity is not reliable above 7 km in this case.*

study ozone and water vapour at and immediately above the tropopause, in collaboration with the University of Cambridge.

4.5.5. Papers published

In addition to the Match papers (see AWI report) the following papers used UWA ozonesonde measurements:

F. M. O'Connor, G.Vaughan and H. de Backer. Observations of sub-tropical air in the European mid-latitude lower stratosphere. Quart. J. Roy. Met. Soc. 125, 2965-86, 1999.

M. Bithell, L. J. Gray and G. Vaughan. Persistence of stratospheric ozone layers in the troposphere. Atmos Environ 34, 2563-2570, 2000

4.6. Hohenpeißenberg

Submitted by: Hans Claude, DWD

4.6.1. Personnel

Scientific personnel: Hans Claude, Ulf Koehler.

Station personnel: Martin Adelwart, Sigi Steiner, Ferdinand Strommer

4.6.2. Status of the instrument

At Hohenpeißenberg the Brewer/Mast ozonesonde has been used since 1967. A change in radiosonde type, from VIZ to VAISALA RS 80 in August 1995 effected also the ozone data causing inconsistencies in the long record of ozone-data. A detailed description of these inconsistencies and the method of data revision is given in the proceedings of the Fifth European Workshop on Stratospheric Ozone, St. Jean de Luz (France), 1999.

4.6.3. Technical developments

No change

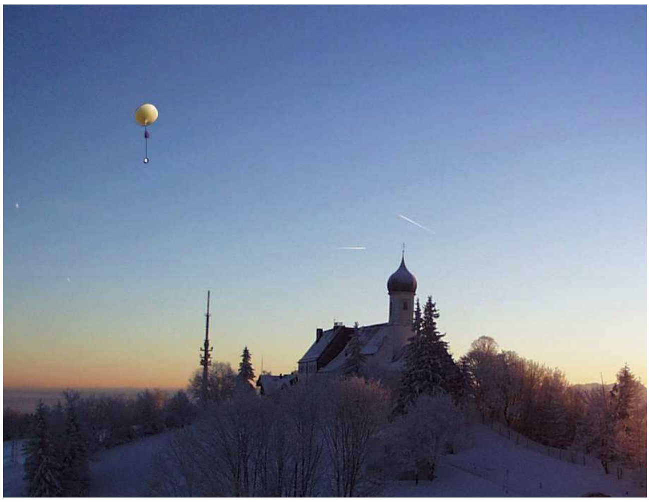

Photo 4. *An ozonesonde launched at Hohenpeißenberg drifting over the old monastery on top of the mountain.*

4.6.4. Measurements and data evaluation

The sonde preparation and data evaluation are made according to WMO-Report No. 17, (1987) by Claude et al.

The number of ozonesondes launched in 1998, 1999 and 2000 is given in Table 4.

Table 4: Number of sondes launched from Hohenpeißenberg

Month	1998	1999	2000
Jan	14	13	11
Feb	12	13	11
Mar	12	15	14
Apr	12	12	12
May	8	9	11
Jun	9	10	8
Jul	9	7	9
Aug	9	9	
Sep	9	9	
Oct	9	11	
Nov	13	12	
Dec	12	12	

4.6.5. Data transfer to NDSC data bank

The data of ozonesonde soundings are in the NDSC data bank (range: Jan 1998 - Nov. 1999). Next data transmission will be in December 2000.

4.6.6. Participation in meetings and conferences:

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

Quadrennial Ozone Symposium, Sapporo (Japan), July 2000.

4.6.7. Scientific highlight

The ozone trend from 1968 onward is shown in Figure 5.

4.6.8. Projects

EU project STREAMER includes ozone profile validation „sonde vs. satellite".

4.6.9. Planned activities

Continuation of long term measurement program, i.e. 2 launches per week May-October, 3 launches per week November-April.

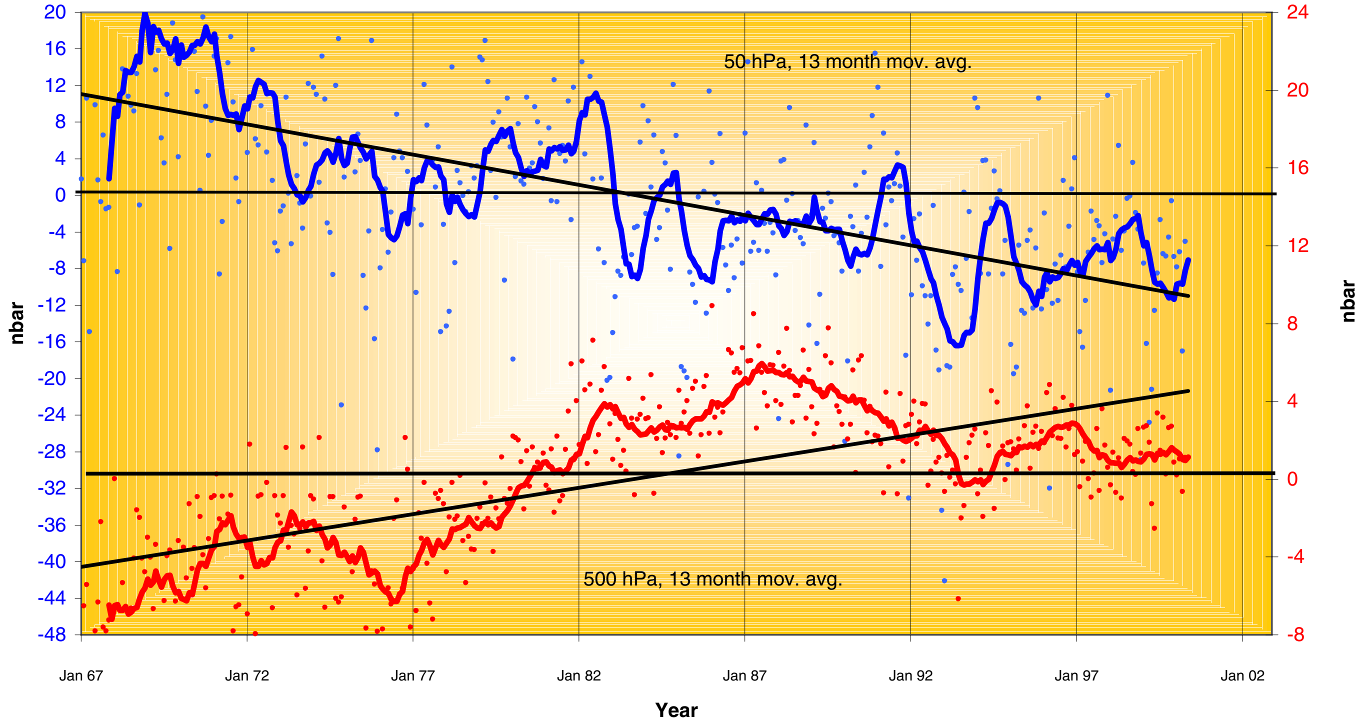

***Figure 5.** Evolution of the ozone anomalies at 500 and 50 hPa since 1968 over Hohenpeißenberg (Brewer-Mast soundings).*

4.6.10. Publications using Hohenpeißenberg ozone sounding data

Claude, H., W. Steinbrecht, and G. Reich, Impact of radiosonde changes on a long-term ozone record: The Hohenpeißenberg experience, Proceedings of the Fifth European Workshop on Stratospheric Ozone, St. Jean de Luz, France, 1999.

Calisesi, Y., N. Kämpfer, R. Stübi and P. Viatte, Intercomparison of 5 years ozone profile measurements using Brewer-Mast Ozonesondes and ground-based microwave radiometry, Proceedings of the Quadrennial Ozone Symposium, Sapporo (Japan), 2000.

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, 104, D21 p26373, 1999.

Schulz, A., et al.,. 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. Vol. 27, No. 02, p. 205, 2000.

4.7. Payerne

Submitted by: René Stübi, MeteoSwiss

4.7.1. Personnel

Scientific personnel: R. Stübi, P. Viatte, B. Hoegger. Station personnel: B. Henchoz, G. Levrat.

4.7.2. Measurement programme

The measurement program in Payerne was unchanged during the year. It consists in three launches per week at 11 UTC on Monday, Wednesday and Friday using Brewer-Mast (BM) sondes. A few extra soundings were made for the MATCH campaign. The intercomparison program between BM and ECC sondes were continued with one dual flight every month since summer 1999.

4.7.3. BM - ECC Intercomparison campaign

As mentioned above, the Payerne BM ozone sonde is not the NDSC recognized ECC sonde (see picture).

The reason is mostly historical since the 30 years old sounding series were based on the BM sonde and today there are still some open questions on the most appropriate operating procedure for ECC sondes. A JOSIE experiment is planned for September 2000 to solve some of these issues. In Payerne, experiments are performed to evaluate how BM sonde compare with respect to ECC sondes (EN-SCI, 1% buffered solution). The experiment consists in doing dual flight with the two sondes attached under the same balloon. In Figure 6, the mean difference profile is reported for a one year cam-

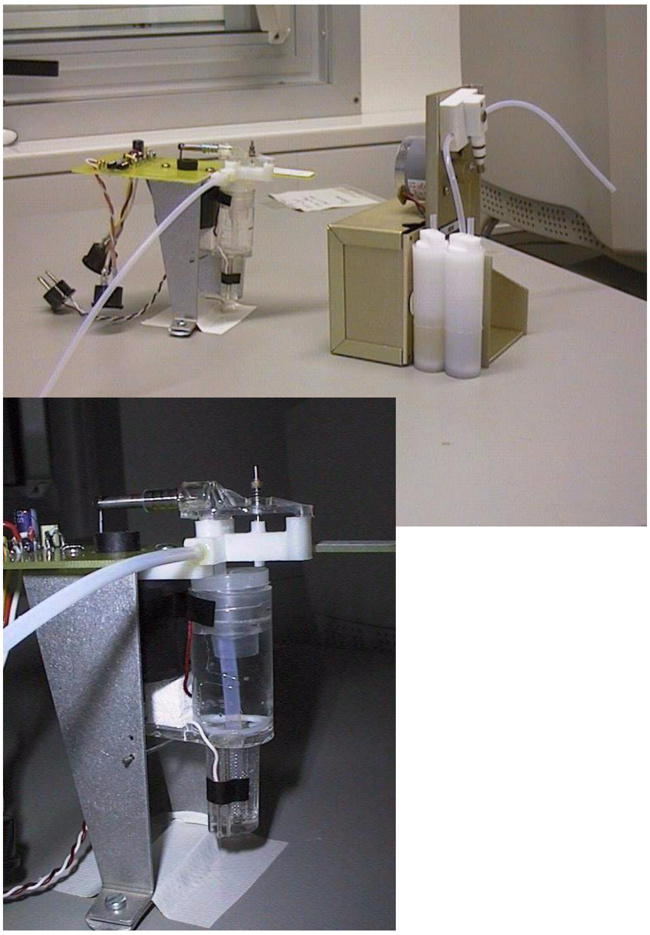

Photo 5. Detailed view of the Brewer/Mast ozonesonde.

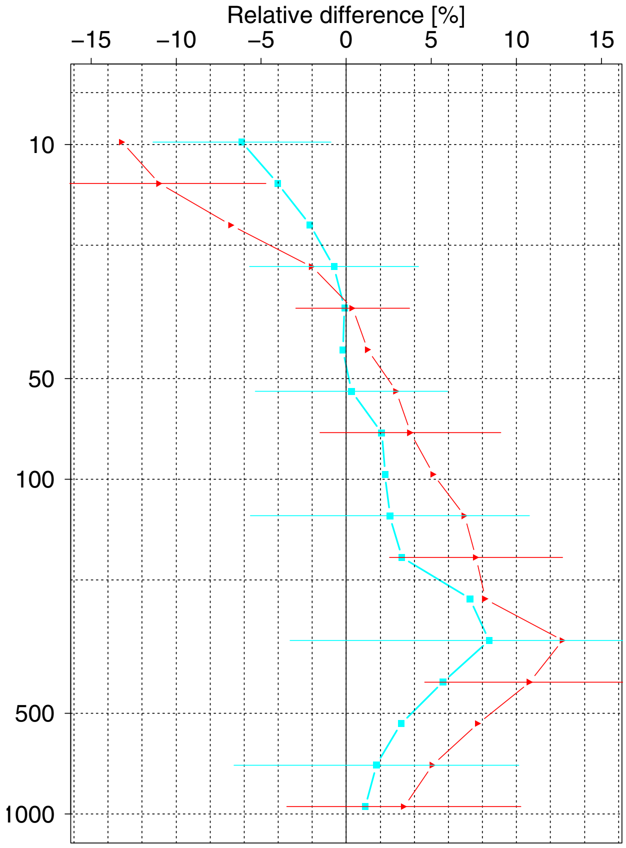

Figure 6. Profile of the relative difference between BM and ECC sondes. The red line corresponds to a two weeks intensive comparison campaign (~ 30 dual flights). The blue line corresponds to the one year campaign of dual flight (one / week).

paign of weekly dual sounding.

The main differences appear at the tropopause level and above 30 km. The mean ozone pressure at mid-latitude tropopause is of the order of 20 nbar. The +10% difference shown in fig. 1 represent 2-3 nbar which is close to the precision of both sonde types and therefore close to the noise limit. At the higher levels, the -10% difference is significant but it is presently not clear whether the ECC, the BM or both sondes are responsible for the observed discrepancy.

4.7.4. Data transfer to NDSC data base

The ozone sounding back to April 1990 have been loaded in the NDSC data base. For the more recent ones, see the NDSC archives.

4.7.5. Participation to meetings

Quadrennial Ozone symposium, July 2000, Sapporo.

4.7.6. Publications

R. Stübi, C. Ammann, D. Ruffieux, G. Levrat, B. Hoegger, P. Viatte, "Comparability of BM and ECC ozonesondes", Proceedings of the Quadrennial Ozone Symposium, July 2000, Sapporo.

Y Calisesi, N. Kämpfer, R. Stübi, P. Viatte, "Intercomparison of 5 years ozone profile measurements using BM ozonesondes and Ground-based Microwave Radiometry", Proceedings of the Quadrennial Ozone Symposium, July 2000, Sapporo.

A. Schulz et al., "Chemical ozone loss rate in the Arctic stratosphere and their dependence on temperatures as determined with MATCH", Proceedings of the Quadrennial Ozone Symposium, July 2000, Sapporo.

4.8. OHP

Submitted by: Claude Vialle, ISPL

4.8.1. Personnel

Operators in station : Gérard Velghe helped by Pierre Da Conceicao

PI : Claude Vialle

4.8.2. Status of instruments

No change for the ozonesondes equipment from the last significant changes in 1997:

Vaisala radiosonde RS80-15 for RS80-18H in January,

ECC 5A for ENSCI-1Z in march

Continuous monitoring of ozone concentration at ground level in OHP station from January 1st, 1999

4.8.3. Measurements and data evaluation

The number of launches during 1998 and 1999 is summarized in Table 5.

Each launch is planned every Wednesday at 09h UT throughout the year.

Extra sondes are launched for both MATCH and METRO campaigns as showed by the table during Dec 98 to Mar 99.

Photo 6. *Launching an ozonesonde from Observatoire de Haute Provence.*

Table 5: Number of sondes launched from OHP

Month	1998	1999
Jan	4	6
Feb	5	6
Mar	5	7
Apr	5	5
May	4	4
Jun	4	5
Jul	5	4
Aug	4	4
Sep	4	5
Oct	5	4
Nov	5	4
Dec	9	4

4.8.4. Data transfer to NDSC data bank

The data transfer from the OHP station to the NDSC data facility has begun. The difficulty with the formatting program (in the NDSC/ AMES format) is now solved.

On august, 10th 2000, 56 profiles from 1995/11/23 to 1997/04/03 were transferred. Before the end of the year, the data from 1997 up to-day will be transferred.

4.8.5. Planned activities

Continuation of long term measurement program, i.e. an ozonesonde once a week, each Wednesday at 09h00 UT.

Participation in campaigns as MATCH or METRO

Technical developments : the acquisition system of OHP station must be improved to use Tmax-C interface against H model which is no more build. Simultaneously the acquisition software will be upgraded.

4.9. Wallops Island

Submitted by: Francis J. Schmidlin, NASA

4.9.1. ECC Routine Observations 1 September 1999 – 30 August 2000

NASA/GSFC/ Wallops Flight Facility (37.83N; 75.48W) is engaged in a program of long-term ozonesonde observations. The first Electrochemical Concentration Cell (ECC) ozonesonde observation made as part of the NASA program was flown from Wallops Island in 1967 using a Science Pump Corp., 1A ECC instrument. Earlier measurements were conducted in cooperation with the US Air Force Geo-

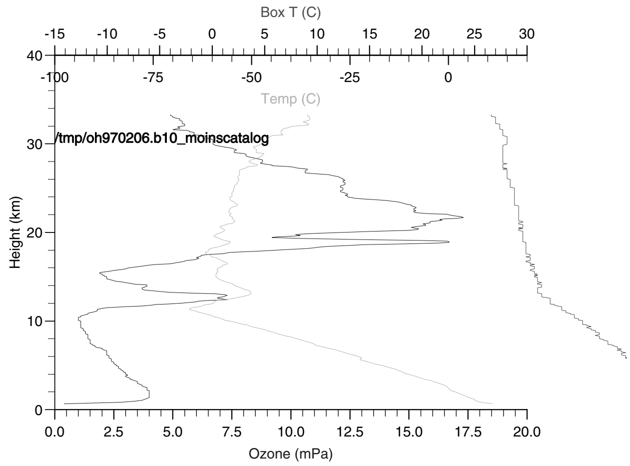

Figure 7. Ozonesonde profile measured at OHP on 6 Feb. 1997. The data are transferred to the NDSC database and the profile has been used in the Match campaign of that year.

physics Laboratory. Attempting to maintain a continuous program of at least one launch per week was not always possible because of limited resources

During the period 1 September 1999 through 30 August 2000, 113 ECCs were released, 86 for routine weekly observations and satellite validation requirements and 27 special observations to enhance knowledge of ECC behaviour. The number of routine observations reaching 20 hPa and 10 hPa each month, respectively, is presented in Table 6. Although not all observations reached 10 hPa 70 flights exceeded the altitude of the ozone peak. Residual total ozone is derived using the constant Mixing Ratio method; whether climatology (McPeters, et al, 1997) would improve the total ozone calculation is under consideration.

Observations are periodically forwarded to the World Ozone and Ultra-violet Data Center (WOUDC). Software for preparing the ozonesonde data into the AMES format required by the NDSC archive system was completed in late 1999. Three hundred nine observations were prepared and delivered to the NDSC archive in Spring 2000. The data will continue to be placed in the required format and delivered to the NDSC archive.

ECC observations from Natal, Brazil (5.92S; 25.17W) are available as part of the NASA/INPE long-term agreement. Thirty-seven ECC observations between 1 September 1999 and 30 August 2000 are being prepared for delivery to the NDSC archive. There would have been a larger number of observations but this was not possible due to irregularities with the ground equipment and a shortage of expendables. A delay of radiosonde delivery was one of the major reasons.

Ozonesondes were obtained from Ascension Island, (7.98S; 14.42W) as part of the study to capture additional ozone information in the vicinity of the Equator. This effort is being conducted as part of the Southern Hemisphere Additional Ozone project, or SHADOZ. The ECC preparation and instrument releases are provided with the cooperation of the US Air Force group located on Ascension Island. Weekly

Table 6: Number of Monthly ECC ozonesonde observations from Wallops Island including the number of observations reaching 20 hPa and 10 hPa, respectively.

Month	No	20 hPa	10hPa
Month	No.	20Hpa	10hPa
Sept	7	6	5
Oct	17	17	12
Nov	4	4	2
Dec	10	10	8
Jan	5	5	5
Feb	6	6	5
Mar	5	5	4
Apr	8	8	6
May	5	5	1
June	7	5	2
July	6	5	3
Aug	6	4	3
TOTAL	86	80	56

measurements are made, as circumstances permit. During the period of 1 September 1999 to 30 August 2000 36 ozonesonde profiles were provided. These data also will be placed in the NDSC archive.

It is important to note that the ECC instruments flown from Wallops Island, Natal, and Ascension Island use the same procedures established for the NASA program at Wallops Island. Pump efficiencies (Torres, 1981) are measured prior to use. And, in the case of Natal and Ascension Island are done prior to shipping instruments from Wallops. Each site continues to use a 1% buffered KI solution.

4.9.2. ECC Test Observations

During the report period, tests designed to better characterize ECC performance were conducted. Fifteen paired instrument comparisons between 1% buffered KI solution and 2% unbuffered KI solution was conducted. All of the instruments used the same pump efficiency procedure and ECC preparation and data reduction were identical. The major difference between the results of each solution used was found to occur in the stratosphere with the largest difference in the mean at the ozone peak. Further results are being prepared for publication.

A test of the Background Current performance was also conducted. Twelve instruments attached with destruct filters were released between February and April. The Background Current measured prior to release was found to be stable, i.e., little variation from the value of approximately 0.02µA. Following the instrument release the Background Current gradually increased to about 0.05µA near 600 hPa and then decreased to values between 0.00µA and 0.02µA. Although there is not yet an explanation for the small increase, it is possibly a result of atmospheric pollution.

4.9.3. Total Column Ozone Measurements

Direct sun Dobson observations continue to be made Monday through Friday, weather permitting. Coincident Microtops photometer measurements also continue to be made with the Dobson (Holdren, et al, submitted to GRL). Our Microtops instruments (two) were recalibrated in late 1999. Because of the excellent agreement we are experiencing between the Microtops and Dobson measurements, one Microtops photometer was sent to Ascension Island. This enables total ozone measurements to be made in conjunction with the ECC observations; Ascension Island does not possess a Dobson. Results from the Microtops are available for only a few months, but are comparable to what would be expected if a Dobson were available.

4.9.4. JOSIE

Between 18-27 September 2000 NASA will participate in the JOSIE ECC intercomparison in Jülich, Germany. Procedures used to prepare NASA ECC instruments during this test will follow those used at Wallops Island. It is of great concern to us to know how well we agree with the reference UV photometer.

4.9.5. References

Holdren, D. R., R. O. Olsen, and F. J. Schmidlin, 2000: Comparison of total ozone overburden from hand-held photometers with the Wallops Island Dobson Spectrophotometer. Submitted to Geophys. Res. Lett.

McPeters, R. D., G. J. Labow, and B. J. Johnson, 1997: A satellite–derived climatology for balloonsonde estimation of total column ozone. J. Geophys. Res., 102, 8875-8885.

Torres, A. L., 1981: ECC ozonesonde performance at high altitudes: Pump Efficiency. NASA Memorandum TM-73290, 10 pages.

4.10. Izaña

Submitted by: Juan-Manuel Sancho, Izaña Observatory - INM (Spain).

4.10.1. Personnel

Scientific personnel: Emilio Cuevas and Juan-Manuel Sancho

Station personnel: Sergio Afonso and Victor Ayala.

4.10.2. Measurement programme

The ozonesonde program at Izaña started in November 1992 with weekly ozonesonde launches throughout the year conducted on Wednesdays, whenever possible. The soundings are performed at Santa Cruz de Tenerife station (36 m.a.s.l.), distant 28km from Izaña Observatory. Izaña has participated in annual THESEO campaigns and in field experiments carried out within the framework of different EC projects (BOA, CRISTA and REVUE). In 1999, additional sondes were moved to satisfy the Match ozonesonde project and in the period February-April 1999, an intensive ozonesounding campaign of 41 sondes was performed in the framework of TRACAS project (**TRA**nsport of **C**hemical species **A**cross the **S**ubtropical tropopause).

4.10.3. Technical developments

Until August 1998 Science Pump 5A sondes were used. Since September 1998, 6A sondes are used together with Väisäla RSA11 interface cards. After the closure of the Omega navigation system in October 1997, the radiosondes were upgraded to RS80-15GE which include GPS system to resume the wind recording.

The Väisäla receiver, DIGICORA-MW11 and the Väisäla Metgraph software are used as data acquisition system. In July 2000 the Metgraph program was upgraded from version 5.12 to 5.21.

Since August 1998 the thermistor for the box temperature has been inserted into the pump hole of the sondes, in accordance with the Potsdam PI meeting recommendation.

In all soundings, 3.0cm^3 of 1% KI cathode solution buffered, following Science Pump instruction manuals, has been used.

The STOIC pump corrections from 1986 have been used in all the cases as it was agreed in the Potsdam meeting.

The background current is measured after 10 minutes ventilation of the sensor by an ozone level corresponding to 5µA current and followed by 15 minutes of clean air ventilation.

A new ozonesonde laboratory was constructed in May 2000 and now is already in use.

4.10.4. Measurements and data evaluation

The ozonesondes are checked using a Ground Test with an Ozoniser/Test Unit TSC-1 before launching. A constant mixing ratio above burst level is assumed for the determination of the residual ozone if the 17hPa level has been reached. The integrated ozone column (starting at 2400 m.a.s.l.) for the sondes reaching at least the 17hPa level is ratioed with the same column amount measured with the Brewer #157 installed at Izaña Observatory. The calculated Brewer/ECC coefficients are in the 0.95-1.05 range in most cases. These coefficients are not applied to correct the ozonesonde data but used for quality control. Data in NASA Ames format are submitted to NADIR Data Centre on a monthly basis since May 1999.

The number of launched ECC sondes, since 1996, is given in Table 7.

Table 7: Number of sondes launched from Izaña

Month	1996	1997	1998	1999	2000
Jan	5	5	4	5	4
Feb	4	4	4	12	4
Mar	4	4	4	18	5
Apr	5	5	5	12	4
May	4	4	4	4	5
Jun	4	3	4	5	4
Jul	23	25	5	4	4
Aug	4	6	4	2	-
Sep	4	4	5	5	-
Oct	6	5	4	4	-
Nov	4	4	4	4	-
Dec	4	5	5	5	-
Total	71	74	52	80	-

4.10.5. Data transfer to NDSC data bank

As soon as we receive information from NOAA/NCEP regarding data submission, the complete Izaña's ozonesonde data set will be archived in the NDSC Data Host Facility.

4.10.6. Participation in meetings and conferences

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

4.10.7. Scientific highlights

An intensive campaign of 41 ozonesoundings was conducted from February 1st to April 23rd 1999 within the framework of TRACAS project. The Subtropical Jet Stream (STJ) is located at south close to Canary Islands, in this period. A good correlation between the ozone amount and the position of the STJ was found. As the STJ moves northward and it is located near Tenerife,

lower ozone values are recorded in the lower stratosphere (above 13km), and conversely, layers of relatively high ozone (>160ppbv) are observed in the upper troposphere (9km-12km). This fact confirms the persistent role played by the STJ in the transport of subtropical tropospheric air into the lower mid-latitude stratosphere. The ozonesonde statistical analysis show evidences of subtropical upper tropospheric ozone-poor air intrusions into the mid-latitude lower stratosphere. Injections of mid-latitude stratospheric air into the subtropical troposphere are observed when the STJ is located above the Canaries. The STJ disturbs significantly the upper troposphere and the lower stratosphere between 9km and 16km altitude.

On the other hand, the final report of the EC REVUE Project ("REconstruction of Vertical ozone distribution from Umkehr Estimates"; EC contract ENV4-CT95-0161) was submitted in June 1999. In this report the Izaña group presented an analysis of the different Umkehr algorithms for the Brewer instrument, as well as a validation against ECC profiles.

The existing Umkehr codes for Brewer instruments were recompiled in 32-bits and validated against ECC profiles. An ozone first-guess based on the ECC climatology was obtained. Different tests performed with the quasi-simultaneous ECC-Umkehr profiles corresponding to two intensive campaigns that were held in July 1996 and July 1997, showed that the best results are obtained using the Wave5-old (1991) Umkehr code, and the ozone first-guess derived from the ozonesonde climatology of Tenerife station.

All the Umkehr profiles measured since September 1992 were then re-processed using the Wave-5 (1991) code and the Izaña ozone climatology first-guess. The re-processed Umkehr profiles were compared with the IZO's ECC series.

A good agreement between the ECC and the Umkehr method exists, mainly for Umkehr layers 4, 5 and 6.

In the framework of the EC Project "Small Scale Structure Early Warning and Monitoring in Atmospheric Ozone and Related Exposure to UV-B Radiation (STREAMER, EC contract ENV4-CT98-0756), validation analysis of assimilated/interpolated GOME Ozone vertical profiles using Izaña ozonesondes were performed by the INTA/INM group.

4.10.8. Projects

EU project THESEO-O_3 (Third European Stratospheric Experiment on Ozone) including the Match activities in 1999.

EU project TRACAS (**TR**Ansport of **C**hemical species **A**cross the **S**ubtropical tropopause)

EU project REVUE (Reconstruction of Vertical ozone distribution from Umkehr Estimates)

4.10.9. Planned activities

Continuation of long term measurement program (one launch per week).

Improve the water vapor measurements near the tropopause using new developed sensors in order to get a better approach to stratosphere-troposphere exchange processes associated to the STJ.

4.10.10. Publications and communications using Izaña ozone sounding data

Cuevas, E., M. Carretero, M.J. Blanco, *The Ozone Soundings Program at Izaña GAW Station: First Results*; WMO/GAW No.91, pp. 21-24; WMO Region VI Conference on the Measurements and Modelling of Atmospheric Composition Changes including Pollution Transport; 4-8 October, Sofia (Bulgaria), 1993.

Cuevas, E., K. Lamb, A. Bais, *Total Ozone Contents derived by Different Instruments and Soundings*, Meteorological Publications No 27, Finnish Meteorological Institute,

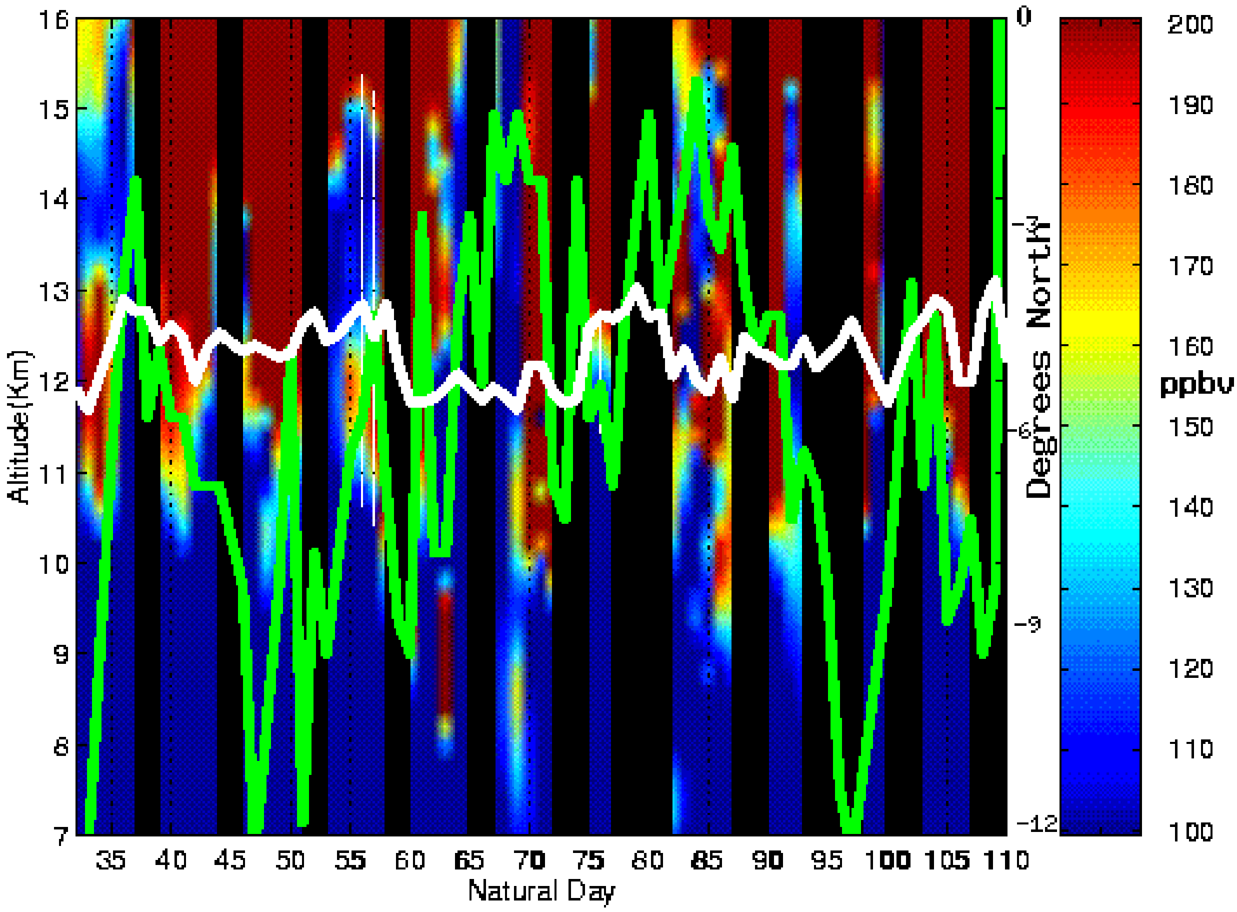

Figure 8. *Evolution of ozone mixing ratio between 7 km and 16 km over Tenerife during the TRACAS intensive ozone sounding campaign (from February 1st to April 23rd 1999). The white line represents the tropopause altitude and the green one shows the relative position of the STJs core to Tenerife (latitude differences). In this case zero degrees means that the STJ is located above Tenerife.*

105-119, Helsinki, 1994.

Cuevas, E., *Estudio del comportamiento del ozono troposférico en el Observatorio de Izaña (Tenerife) y su Relación con la Dinámica Atmosférica*, Memoria de Tesis Doctoral, Facultad de Ciencias Físicas, Universidad Complutense de Madrid, (in Spanish), 1995.

Prospero, J.M., R. Schimtt, E. Cuevas, D. Savoie, W. Graustein, K.Turekian, A. Volz- Thomas, A. Diaz, S. Oltmans, and H. Levy-II, *Temporal Variability of Summertime Ozone and Aerosols in the Free Troposphere over the Eastern North Atlantic*, Geophys. Res. Lett., 22,21,2925-2928, 1995.

Cuevas, E., J. Manzano, J. Sancho, S. Afonso, *Winter and Summer Intensive Ozone Sounding Campaigns at Tenerife and Madrid Stations*, 3rd BOA EU-Project Meeting, Paris, France, October 20-21, 1995.

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Oltmans, S., H. Levy II, J.M. Harris, J.T. Merrill, J.L. Moody, J. Lathrop, E. Cuevas, M. Trainer, M. S. O´Neill, J.M. Prospero, H. Vömel, and B.J. Johnson, *Summer and Spring Ozone Profiles Over the North Atlantic from Ozonesonde Measurements*, J. Geophys. Res., 101, D22, 29179-29200,1996.

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Cuevas, E., J. Sancho, A. Redondas, *Investigaciones sobre Ozono Troposférico en el Observatorio de Vigilancia Atmosférica de Izaña*, Física de la Tierra, nº 9, 67-106, Servicio de Publicaciones de la Universidad Complutense, Madrid, Editorial Complutense, 1997

Timmis, C., G. Vaughan, E. Cuevas, Z. Xiangdong, *Evidence of Exchange between the Troposphere and Strato-*

sphere in the Region of the Subtropical Jet Stream, IUGG, The 22nd Union General Assembly, Birmingham (United Kingdom), July, 1999.

A. Schulz 1, M. Rex, N. Harris, G. O. Braathen, E. Kyrö, E. Reimer, R. Alfier, S. Eckermann, I. Kilbane-Dawe, M. Allaart, M. Alpers, B. R. Bojkov, J. Cisneros, H. Claude, E. Cuevas, J. Davies, H. De Backer, H. Dier, V. Dorokhov, H. Fast, B. Johnson, Z. Litynska, I. S. Mikkelsen, M. Molyneux, G. Murphy, H. Nakane, F. O'Connor, C. Parrondo, P. Skrivankova, C. Varotsos, C. Vialle, P. Viatte, C. Zerefos, and P. von der Gathen, *Ozone loss rates determined with Match: Arctic winters 1997/98 and 1998/99*, Proceedings Fifth European Symposium on Stratospheric Ozone, St Jean de Luz (France), 27th of September to 1st of October 1999.

Cuevas, E., J.M. Sancho, J.J. Bustos, M. Gil, J. Rodriguez, *Analysis of Stratosphere-troposphere exchange processes associated to the Northern Subtropical Jet Stream*, Contribution of INM and INTA to TRACAS project (ENV4-CT97-0546), 2000.

Kentharchos, A., G.J. Roelofs, J. Lelieveld, and E. Cuevas, *On the origin of elevated surface ozone concentrations at Izaña Observatory during the last days of March 1996: a model study*, Accepted in Geophys. Res. Lett., 2000.

Cuevas, E., Diamantino V. Henriques, J.M. Sancho, *Stratosphere-Troposphere Exchange events over North Atlantic subtropical region*, Proceedings 2ª Asamblea Hispano-Portuguesa de Geodesia y Geofísica, Lagos (Portugal), 8-12 February 2000, pp 451-452, 2000.

Parrondo, C., M. Gil, J. M. Sancho, E. Cuevas, *WP5020 Validation of assimilated/interpolated GOME Ozone vertical profiles using balloon sondes*, STREAMER EU Project El Arenosillo, May 2000.

Kowol-Santen, J., G. Ancellet, and E. Cuevas, *Transport across the subtropical tropopause: observations and model analyses*, Proceedings of the Quadrennial Ozone Symposium, Sapporo, Japan, 3-8 July 2000.

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4.11. 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. Both sites use a 2% unbuffered potassium iodide (no potassium bromide) cathode solution and an average pump efficiency correction based on measurements done at NOAA/CMDL. Both sites use model 6A Science Pump and model 2Z ENSCI electrochemical concentration cell (ECC) ozonesondes. The sites also use NOAA/CMDL telemetry and data processing software. Vaisala RS-80 radiosondes are interfaced with the ozonesondes.

4.11.1. Hilo

Hilo, Hawaii has continued launching one ozonesonde per week. There were 47 profiles obtained in 1999, and 29 profiles measured from January 1 to August 22, 2000. The ozonesondes are launched in the morning between 18:30 and 19:00Z GMT time. On 3 to 4 occasions in the past year, eruptive plumes of volcanic gases have drifted over Hilo causing the ozonesonde to read zero at the surface due to the high sulphur dioxide content. The ozonesonde has a negative response to SO_2. Generally the ozonesonde recovers when it rises above 500 meters.

Total ozone measured by the ozonesondes and the Dobson spectrophotometer at Mauna Loa (3397 meters) compare very well. The total ozone between sea level and Mauna Loa elevation is about 8 Dobson Units. This value is subtracted from the ozonesonde totals for the comparison. The ozonesonde total depends on the residual ozone computation method, which accounts for ozone above the balloon burst point. The constant mixing ratio assumption gives an average of 10 Dobson Units higher total ozone than the SBUV climatological tables. The ozonesondes were 2 5% higher than the Dobson using the constant mixing ratio extrapolation, while using the SBUV residual resulted in slightly lower ozonesonde values at –2.5 3.5%

4.11.2. South Pole

At South Pole Station the frequency of ozonesonde flights increases from weekly to approximately 2 per week by August 25, and every other day during the ozone hole minimum. There were 79 profiles measured in 1999, and 34 flights from

Photo 7. *Launching an ozonesonde from Hilo, Hawaii.*

January 1 to August 23, 2000. The minimum total ozone observed during the 1999 ozone hole was 90 Dobson Units on September 29. Figure 9 shows the total ozone and average 20-24 km temperatures over South Pole from January 1, 1999 to August 23, 2000. Stratospheric temperatures were colder than normal in June and July of 1999 and 2000. The 20-24 km layer was consistently between 180-184 K, well below the threshold for producing polar stratospheric clouds, which are the precursors to severe ozone depletion.

The South Pole station used both Science Pump 6A and ENSCI 2Z ozonesondes, alternating with each flight. There was no apparent difference between the two models of ozonesondes. The ozone concentrations in the lower troposphere and from 25 km to burst altitude usually remain very consistent at South Pole during the winter months, so approximate comparisons at those levels are fairly reliable. Also, a field test in January, 1999 showed good agreement between the two models of ozonesondes. Four triple ozonesonde flights were completed during the tests. The ENSCI 2Z ozonesondes gave about 3% higher total ozone than the Science Pump 6A ozonesondes.

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.

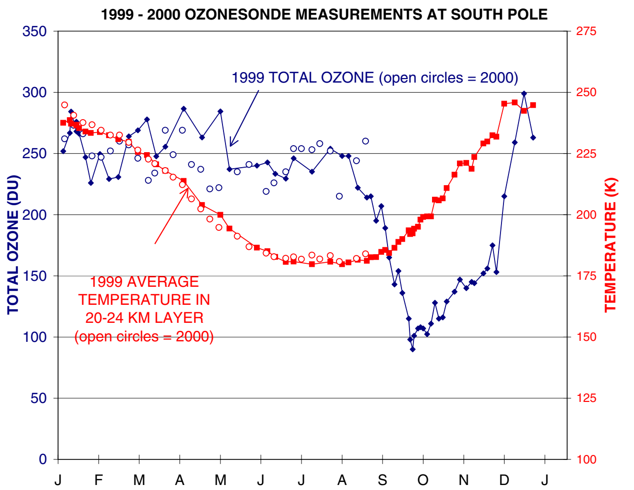

Figure 9. Temperature and ozone at the South Pole in 1999 and 2000. The red curve shows the average temperature in the 20-24km layer for individual soundings. The black curve shows the total ozone column as derived from the soundings. Filled markers represent 1999 and open circles are for 2000.

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 Teacher's 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.

Pump efficiencies for ECC ozonesondes are measured in the CMDL environmental chamber at pressures from 100 to 5 hPa. The average pump efficiency (from more than 250 ozonesonde calibrations) is used in the ozone profile calculations.

Since 1998, a humidity correction has been applied to the soap bubble flow meter measurement at South Pole and when using the soap bubble flow meter.

The combination of the 2% unbuffered KI solution and measured by our lab in Triple ozonesondes were flown at South Pole Station during an NSF sponsored project (Teacher's Experiencing Antarctica)

4.11.3. Additional field tests

The ozone hole showed very low ozone in both 1998 (95 Dobson Units on October 5, 1998), and has reached 90 DU by The minimum ozone measured at South Pole was 95 Dobson Units on October 5, 1998. At this time the 1999 season has a 90 DU measure on October 1.

Photo 7 shows the launch of an ozonesonde from Hilo, Hawaii.

4.12. Île de la Réunion

Submitted by: Françoise Posny, Univ. de la Réunion

4.12.1. Personnel

Françoise Posny, Jean-Marc Metzger, Guy Bain (until August 2000), Emmanuel Riviere (since July 2000).

Additional (students): Thierry Portafaix, Denis Faduilhe, Jean-Luc Baray.

4.12.2. Status of instrument

These last two years the type of ozone sondes used at La Reunion has been dependent on the sources of funding. From June to November 1999 SPC 6A ozone sondes have been used: there were the additional sondes provided by the NASA in the frame of the SHADOZ campaign. For the month of December 1999 ENSCI-Z have been then used and from January to July 2000 we have returned back to SPC 6A sondes. From August 2000 ENSCI-Z have been used again. Since the end of December 1999 the RS80-15 Vaisala PTU sonde has been changed for the RS80-18H type (new humidity sensor).

4.12.3. Measurements and data evaluation

Since January 1999 the launch frequency has been increased to once a week (Wednesday morning) for the SHADOZ campaign. That have led to a total of 50 soundings for 1999 given 37 validated profiles (total measured ozone quantity in agreement with TOMS values +/- 10%). Thirteen profiles have been not accepted because of measurement problems (5), bad reception of the signal (4) or burst altitude below 27 kilometres (2).

From January to mid-August 2000, 27 soundings have been performed: January 4, February 4, March 2, April 4, May 5, June 3, July 3, mid-August 2. For January to March period 13 profiles (on 14 soundings) have been found acceptable. This "good score" has been reached due to the fact that the 4 profiles obtained with a bad signal reception have been accepted because they have presented a good tropospheric or stratospheric part. The soundings after March 2000 are still under evaluation.

Photo 8. Ozonesonde launch at Ile de la Réunion.

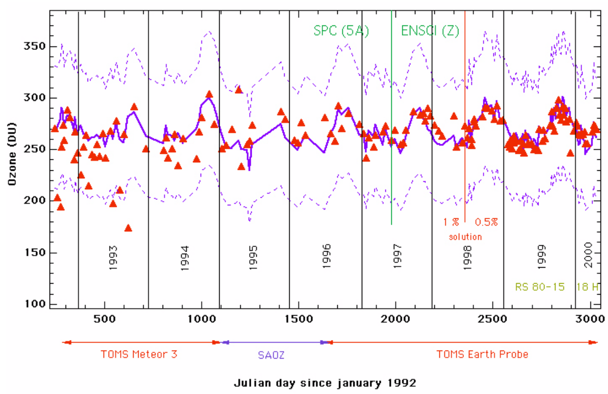

Figure 10. Comparison between the total "measured" ozone quantity (triangles) and TOMS or SAOZ data (middle solid line). The upper and lower dotted lines represent TOMS or SAOZ values plus and minus 20%. The total "measured" ozone quantity is obtained from the measured profile completed above 27 kilometres (about 20 mb) by monthly climatological SAGE II data.

4.12.4. Planned activities

Continuation of long term measurements with one launch per week if the SHADOZ project is extended (problem of funding for La Reunion), - Participation in the JOSIE-2000 intercomparison (18-27 Sept.)

4.12.5. Participation in meetings and conferences

- ✎ First SHADOZ Workshop, INPE, Sao Jose dos Campos, Nov. 1999
- ✎ Second SHADOZ Workshop, Washington DC, June 2000
- ✎ AGU Spring Meeting, Washington DC, June 2000
- ✎ Quadrennial Ozone Symposium, Sapporo, July 2000
- ✎ 20th International Laser and Radar Conference, Vichy, July 2000.

4.12.6. Publications using La Reunion ozone sounding data:

Measurement of vertical ozone distributions by radiosoundings at Reunion Island (southern tropics). Posny F., Portafaix T., Baray J.L., Baldy S. and Leveau J., 2000 Spring Meeting AGU, June 2000, Washington DC.

Analyses of 8-years ozone measurements in the tropics: Reunion Island field observation. Randriambelo T., Baray J.L. and Baldy S., 2000 Spring Meeting AGU, June 2000, Washington DC.

Vertical short-scale structures in the tropical upper troposphere-lower stratosphere temperature and ozone. Chane-Ming F., Molinaro F., Leaveau J., Keckhut P., Hauchecorne A. and Godin S., J. Geophys. Res., 2000 (in press).

The effect of biomass burning, convective venting and transport on tropospheric ozone over the Indian ocean: Reunion Island field observations. Randriambelo T., Baray J.L. and Baldy S., J. Geophys. Res., 105, 11813-11832, 2000.

Vertical ozone distributions measured at La Reunion Island (southern tropics) between 1992 and 1999. Posny F., Portafaix T., Baray J.L., Baldy S. and Leveau J., Quadrennial Ozone Symposium, July 2000, Sapporo.

Stratosphere-troposphere exchanges at the southern edge of the tropical zone and impact on the tropospheric ozone balance. Baray J.L., Baldy S., Ancellet G., Daniel V. and Legras B., Quadrennial Ozone Symposium, July 2000, Sapporo. Lidar Raman measurements of temperature in the southern tropics: instrumentation description and first result checking on radiosoundings and model data. Faduilhe D., Bencherif H., Baldy S., and Keckhut P., 20th International Laser and Radar Conference, July 2000, Vichy, France.

Tropospheric ozone Lidar at Reunion Island. Baray J.L., Randriambelo T., Baldy S. and Ancellet G., 20th International Laser and Radar Conference, July 2000, Vichy, France.

4.13. Lauder

Submitted by: Greg Bodeker, NIWA

4.13.1. Personnel

Ian Boyd has recently moved to the University of Massachusetts where he will be working in a NIWA collaboration with Alan Parrish on microwave radiometer measurements of ozone profiles. Ian will continue to be involved in the Lauder ozonesonde programme while at UMass. Ian's position at Lauder has been primarily taken over by a new employee, Sonia Petrie, with technical expertise being provided by the seasoned Lauder technician, Alan Thomas.

4.13.2. Status of the instrument

A new balloon filling and launch facility has been constructed at Lauder. This consists of three concrete panels 6 meters wide and 4 meters high arranged in a tripod pattern (looking from the top). This structure provides shelter from the wind irrespective of direction and allows greater flexibility in deciding when to launch ozonesondes. This has made it easier to launch ozonesondes to coincide with satellite overpasses and has improved the usefulness of our data for satellite validation.

4.13.3. Technical developments

Calibration of pressure sensors both at the surface and at 10 hPa and correction of the ozonesonde pressure profile to achieve better altitude registration.

4.13.4. Measurements and data evaluation

During the last year weekly ozonesonde flights have been made from Lauder bringing the total number of flights since August 1986 to 966. Measurements were made using En-Sci 1Z series ozonesondes flown using a 0.5% cathode solution. Except for a few months 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

Photo 9. The Lauder Observatory, New Zealand.

ground receiving system was used and therefore no wind or package location data were available during this time. The ozone profile measurements are regularly compared against simultaneous ozone lidar and microwave radiometer ozone profile measurements.

In August 1996 the ozonesonde KI cathode solution concentration was changed from 1% to 0.5%. This resulted in a discontinuity in the data set. A number of experiments were performed to quantify the vertical structure of the discontinuity. These results were written up in *Boyd et al.,* [1998]. Based on the results from these experiments it was possible to create an homogeneous data set amenable to long-term trend detection (see below).

4.13.5. Data transfer to NDSC data bank

The data from 53 ozonesonde flights made during 1999 have been transferred to the NDSC data base and the meta-data file has been updated.

4.13.6. Participation in meetings and conferences

- The following talk was given at the NDSC session of the AGU WPGM: Bodeker, G.E.; Boyd, I.S. (2000), Advances in ozonesonde data quality control at the Lauder NDSC site and resultant updated trends in vertical ozone profiles, presented at the 2000 Western Pacific Geophysics Meeting of the AGU, 27-30 July 2000, Tokyo, Japan.
- The following poster was presented at the QOS in Japan: Bodeker, G.E; Boyd, I.S.; Matthews, W.A.; Canziani, P.; Compagnucci, R. (2000), Analysis of trends and variability in vertical ozone and temperature profiles at Lauder, New Zealand, using linear least squares trend analysis and principal component analysis: 1986 to 2000, presented at the XIX Quadrennial Ozone Symposium, 3-8 July 2000, Sapporo, Japan.

The results of the updated trend analysis presented at these conferences are shown in Figure 11.

4.13.7. Scientific highlights

Trend analysis of the Lauder ozonesonde data shows small positive trends below the tropopause and small negative trends above the tropopause. Trends in the coincident temperature profiles show clear cooling in the lower stratosphere during February, March and April and warming in the lower troposphere which is consistent with what would be expected from increases in atmospheric CO_2.

4.13.8. Projects

- Submission of ozonesonde data to GSFC for use in the ozone profile climatology for TOMS retrievals.
- Validation of version 6.0 SAGE II data.

4.13.9. Planned activities

- Continuation of our long-term measurement programme.

Trends in ozone and temperature profiles at Lauder New Zealand from Aug 1986 to Mar 2000

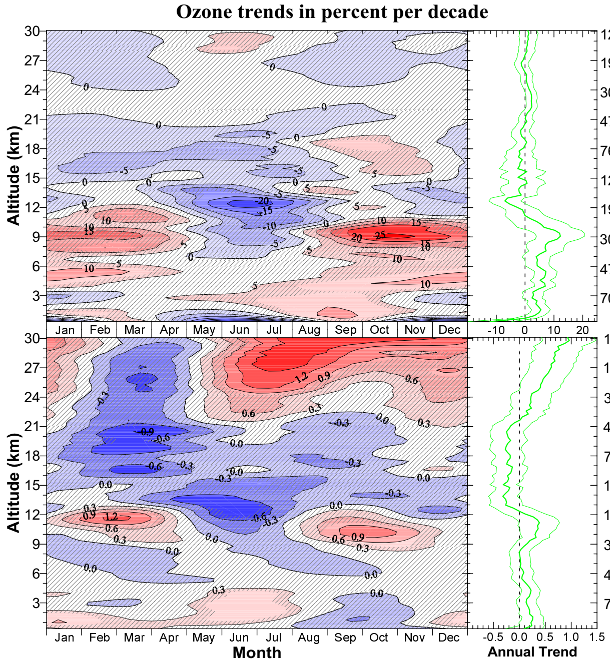

Figure 11. Trends in (a) ozone number density and (b) temperature in percent per decade. The left part of each figure shows the seasonally dependent trend. Shaded areas indicate where the trends are not statistically different from zero at the 2σ level. Contour spacing is 10% per decade for ozone number density and 0.3% 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).

If we can obtain increased funding for the programme we will increase our number of flights from 1 per week to 70 per year which is the schedule that was maintained for the first 12 years of the programme.

- Participation in the JOSIE-2000 ozonesonde intercomparison experiment in Jülich in September 2000.
- Detailed analysis of sources of anomalies in Lauder ozonesonde profiles and presentation of the results at the SPARC conference in Mar del Plata, Argentina, in November 2000.
- Participation in validation of new TOMS experiments in terms of confirming the validity of the TOMS vertical ozone profile climatology for total column ozone retrievals over southern hemisphere midlatitudes.

4.13.10. Recent publications using Lauder ozonesonde data

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, *Journal of Geophysical Research*, *104* (D21), 26373-26399, 1999.

Brinksma, E.J., J.B. Bergwerff, G.E. Bodeker, K.F. Boersma, I.S. Boyd, B.J. Connor, J.F. de Haan, W. Hogervorst, J.W. Hovenier, A. Parrish, J.J. Tsou, J.M. Zawodny, and D.P.J. Swart, Validation of 3 years of ozone measurements over Network for the Detection of Stratospheric Change station Lauder, New Zealand, *Journal of Geophysical Research*, *105* (D13), 17291-17306, 2000.

4.14. Dumont d'Urville

Submitted by: Florence Goutail, CNRS

4.14.1. Personnel

PI : Florence Goutail

Engineer : Claude Vialle

Software Engineer for NDSC data transfer: Françoise Pinsard

Operators in station : changing every year during the austral summer period.

4.14.2. Status of instruments

No changes

4.14.3. Measurements and data evaluation

The number of launches during 1998, 1999 and 2000 are summarized in Table 8.

There has been a problem in sending the sondes hardware from France to Dumont d'Urville, during last austral summer. The package has arrived in Hobart a few hours after the last departure of the « Astrolabe » to Antarctica.

Only a few sondes are now in Dumont d'Urville. It has been decided to keep them for the ozone hole period. This is the reason why there are no ozone sounding since January 2000 in this station.

In the future, it has been decided to have 20 sondes one year in advance, not to reproduce this bad scenario.

4.14.4. Data transfer to NDSC data bank

The data transfer from the DDU station to the NDSC data facility will start soon.

The metafiles are under construction.

There are no major difficulties to format the files except that for some soundings the technical information (balloon, gas, etc.…) is missing.

It has not been done yet because the software engineer in our laboratory was not available, she has started to build the conversion program with the ozone files from OHP and the work will be similar for the DDU files.

The transfer will be done during first trimester 2001.

Table 8: Number of sondes launched from Dumont d'Urville

Month	1998	1999	2000
Jan	1	1	1
Feb	1	0	
Mar	1	0	
Apr	1	1	
May	1	1	
Jun	1	1	
Jul	2	2	
Aug	1	4	
Sep	5	4	
Oct	4	4	
Nov	2	4	
Dec	0	2	

4.14.5. Planned activities

- ✎ Continuation of long term measurement program, i.e. an ozonesonde once a month except during the ozone hole period where there can be up to 4 per month.
- ✎ Technical developments : New PC for the data acquisition.

4.15. McMurdo

Submitted by: Terry Deshler, Univ. of Wyoming

Ozone and temperature profile measurements from McMurdo Station, Antarctica, were completed between 21 August and 30 October 1999. The flight frequency was roughly every 3 days, but this varied according to surface weather. Altogether 25 flights were completed. There was an unexpected change in the operating procedures for 1999. Because of a confusion amongst new personnel, the ozonesondes were routinely flown with a 0.5% buffered solution instead of the 1.0% buffered solutions which have been used since 1986. For future measurements the 1.0% buffered solutions will again be used. The 1999 ozone data were placed on the data base in September 2000. Comparing the 1999 total and 12-20 km column ozone to our previous measurements indicates that in late August 1999 ozone was near the previously recorded minimums and remained at these levels until the middle of October, with minimum total ozone near 120 DU in early October 1999.

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. This proposal was approved for funding in May 2000. The measurements, under this new proposal, began on 22 August 2000. These measurements will continue in the period late August – October through 2002 under this new funding.

5. Aerosol sondes

Submitted by Terry Deshler, University of Wyoming

Two instruments are included in this group: a) The University of Wyoming backscattersonde developed in the 1990s by J. M. Rosen and used for measurements by a number of investigators including J. M. Rosen and B. Liley in New Zealand, and b) The University of Wyoming optical particle counter, developed by J. M. Rosen in the 1970s, and modified in the late 1980s and used for measurements by T. Deshler. Both of these instruments have been used for stratospheric aerosol measurements in the mid latitudes and polar regions of both hemispheres. The two sites approved for inclusion in the NDSC data base are Lauder, New Zealand, and McMurdo Station, Antarctica.

5.1. Backscattersondes

Both J. Rosen and B. Liley were approached in 1999 about archiving the backscattersonde data in the NDSC data base and both were interested. J. Rosen was interested in extending this effort and archiving all of the backscattersonde data on the NDSC data base. He felt that if the effort was expended to prepare some of the data for the data base, that it would not be much more work to prepare all of the data. J. Rosen supplied the following table indicating the amount of data which is involved.

Table 9: Number of backscattersondes launched

Locations	Dates	Number of soundings
Lauder, New Zealand	2/94 – 3/00	77
Laramie, Wyoming, USA	5/89 – 11/99	90
Natal, Brazil	8/95 – 11/99	18
A variety of Arctic stations	1988 - 1999	162
South pole	Winters 1990, 1991	11
Miscellaneous		17

The Arctic stations include: Alert, Canada, Heiss Island, Russia; Dixon, Russia; Resolute, Canada; Archangle, Russia; Scoresby, Greenland; Søndre Strømfjord; Greenland; Kiruna, Sweden; Yakutsk, Russia; Sodankylä, Finland; Spitsbergen; Scoresby; and Salekhard, Russia;

Concerning the quality of the measurements, there have been a number of direct comparisons of the backscattersonde with lidar systems, and some have been published. J. Rosen is just now completing a manuscript that describes in detail how the backscattersonde is calibrated against pure molecular scattering and how the results compare with SAGE as well as several lidar systems.

Concerning the future, it appears that the Arctic stations will continue to launch backscattersondes at approximately the same rate for another year or two. The backscattersonde series at Lauder has been completed but there are plans to conduct a 3 year monthly series from Natal, Brazil.

5.2. Optical Particle Counters

Measurements with optical particle counters at McMurdo Station, Antarctica, began in 1989 and continue to the present during the months of August and September each year. These measurements were extended into the winter period in 1994 and again in 1998 – 2000. The measurements will be continued for another 3 years in the June – September period based on approval of the latest 3 year proposal submitted to the National Science Foundation. McMurdo is the only NDSC station which regularly uses these instruments.

6. JOSIE

Submitted by: Herman Smit, FZ Jülich

6.1. Introduction

The state of knowledge regarding long term trends of tropospheric as well as lower stratospheric ozone is limited due to insufficient global coverage of ozone sounding stations, poor assurance of data continuity and questionable homogeneity of data [*WMO Scientific Assessment of Ozone Depletion,* 1995, 1999]. 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 [*SPARC/IOC/GAW-Assessment of trends in the vertical distribution of ozone,* 1998].

In order to assess the performance of the different types of ozone sondes used within GAW (=Global Atmosphere Watch) and GLONET (=Global Ozone Network) the environmental simulation chamber at the Forschungszentrum Jülich (Germany) is established as World Calibration Facility for Ozone Sondes (WCFOS) since 1996. The simulation chamber enables control of pressure, temperature and ozone concentration and can simulate flight conditions of ozone soundings up to an altitude of 35 km [*Smit et al.,* 1998, 2000]. A controlled environment plus the fact that the ozone sonde measurements can be compared to an accurate UV-photometer as a reference [*Proffitt et al.,* 1983] are essential elements for addressing questions that arise from previous field intercomparisons.

The Jülich Ozone Sonde Intercomparison Experiment (JOSIE), performed in 1996 [*Smit et al.,* 1998], was the first GAW-GLONET activity towards implementing a global quality assurance plan for ozone sondes in routine use today around the world. JOSIE-1996 was attended by eight ozone sounding laboratories from seven countries representing the major types of ozone sondes (Electrochemical Concentration Cell (=ECC) of two different manufacturers, Brewer/Mast (BM-original), Indian (modified BM-type) and Japanese (KC79). JOSIE brought important information about the performance of the different ozone sonde types and the influence of the operating procedures for preparation and data correction applied by the participating laboratories. JOSIE showed also that there is a permanent need to validate ozone sondes on a routine basis. Ozone sondes have gone through several modifications since they were first manufactured, which adds uncertainty to trend analysis. Routine testing of newly manufactured ozone sondes on a regular basis and establishing standard operating procedures for different sonde types will help to ensure more confidence in observed trends in the future. A pre-requisite thereby is the standardization of the preparation procedures and data correcting methods in the near future, but also a better and more detailed documentation of the procedures and methods applied in the past at the different long term ozone sounding stations.

Long term objective of WCFOS is the establishment and maintenance of a facility for Quality Assurance (QA) of ozonesondes operated in the WMO/GAW-Program with following three major tasks:

- ✎ QA-Manufacturers:Quality check of the instrumental performance of sondes from different manufacturers
- ✎ QA-Operation:Test of individual sonde profiling capabilities of different sounding laboratories
- ✎ QA-Procedures:Establishment and up-date of Standard Operating Procedures (SOP's) of different sonde types

Due to a limited budget the JOSIE-activities are dedicated in a way as to alternate between the three above major QA-tasks.

6.2. Concept of JOSIE-activities for 1998-2001

The concept of JOSIE-activities for 1998-2001 follows a step by step approach. While JOSIE-1998 was exclusively focused on the QA-Manufacturers task (See Annex-B), JOSIE 1999-2001 is dedicated to support the assessment of standard operating procedures (SOP's) for the different ozone sonde types operational in GAW/GLONET. The establishment of the SOP's for each sonde type as a WMO/GAW-document is of great importance (See Section 5). Therefore, the major task of JOSIE-1999/2001 will be to conduct intercomparison experiments which address the most urgent questions with regard to the influence of instrumental factors such as background signal, sensing solution, pump efficiency and their uncertainties on the data quality of ozone soundings. The JOSIE-activities in 1999-2001 are split into three phases:

6.2.1. JOSIE-1999

- ✎ Preparation of an international ozone sonde intercomparison campaign (JOSIE-2000 campaign) to be conducted at WCFOS in 2000.

6.2.2. JOSIE-2000

- ✎ Conducting JOSIE-2000 intercomparison campaign at WCFOS dedicated to QA-operation whereby key questions with regard to instrumental performance of the different ozone sonde types will be addressed to support the assessment for SOPs.
- ✎ Start of Assessment of SOPs for Ozone Sondes (ASOPOS)

6.2.3. JOSIE-2001

- ✎ Intercomparison experiments addressing important open questions raised by the JOSIE-2000 campaign and by the SOP-Assessment with regard to sonde performance.
- ✎ Continuation of Assessment of SOPs for Ozone Sondes (ASOPOS)

The role of WCFOS in the assessment of SOP's will be only that of a coordinator and adviser. The actual preparation of the SOP's (incl. Report(s)) for the different ozone sondes will be the responsibilities of the groups of experts in collaboration with WMO.

6.3. JOSIE-1999

The main task of JOSIE-1999 was the preparation of an international ozone sonde intercomparison campaign (JOSIE-2000) to be conducted at the WCFOS in 2000 and which will be dedicated to QA-operation and support the assessment of SOPs. In the JOSIE-1999 preliminary simulation experiments with 12 ECC-sondes were made in order to address the sonde performance under different sensing cathode solutions which at present is the most urgent issue of ECC-performance. The experiments have been conducted by the WCFOS team according the same procedures followed during JOSIE-1998.

From recent laboratory investigations [*Johnson et al.,* 1998] it appears that for ECC-sondes a change of the chemical composition of sensing solution will prevent the increase of sensitivity of the ECC-sensor caused by evaporation during flight which might be an improvement. However, this change of SOP should not be undertaken until the full implications of such a change will have been evaluated and its impact on the interpretation of ozone trends is well understood. This will be a key issue for the ECC-sondes to address for the JOSIE-2000 campaign. In preparation to the campaign simulation experiments of a random sample of 12 sondes (6 ECC-sondes of ENSCI-1Z type and 6 ECC-sondes of SPC-6a type) under two different sensing solutions (Type II-A: 3 ENSCI-1Z & 3 SPC-6A and Type III: 3 ENSCI-1Z & 3 SPC-6A) will be conducted in the simulation chamber. Sensing solution types are defined as:

Type I (Conventional, Komhyr, 1986): Cathode:1% KI + Full-Buffer & KBr (like Komhyr, 1986)Anode:Cathode solution with saturated KI

Type II-A (Komhyr, 1997): Cathode:0.5% KI + Full-Buffer & KBr (like Komhyr 1986). Anode:Cathode solution with saturated KI (like Komhyr 1986)

Type III (Johnson, 1998): Cathode:2% KI, No Buffer, No KBr. Anode:Saturated KI, No Buffer, No KBr.

Type I solution has been used in JOSIE-1998 experiments. The operational procedures followed during JOSIE-1998 were the same as during JOSIE-1998 experiments [*Komhyr,* 1986].

6.4. JOSIE-2000

6.4.1. Introduction

JOSIE-2000 will be an international ozone sonde intercomparison campaign participated by 7 ozone sounding laboratories using ECC-sondes and one laboratory deploying the Japanese KC96 (See Table 10).

Table 10: List participating ozone sounding groups at JOSIE-2000 campaign. Campaign I: 4-13 September 2000 and Campaign II: 18-27 September 2000.

No	Participating Group Code	Participating Sounding Laboratory	JOSIE Campaign Period	Participating Persons	Ozone Sonde Type	SST No.
1	JS_PG1 (CMD)	NOAA/CMDL (Boulder, Colorado, USA)	C-I	Bryan Johnson (PI), Sam Oltmans	ECC ENSCI-Z & SPC-6A	III
2	JS_PG2 (AES)	AES (Ontario, Canada)	C-I	Jonathan Davies (PI), David Tarasick	ECC SPC-6A	III
3	JS_PG3 (NIW)	NIWA (Lauder, New Zealand)	C-I	Greg Bodeker (PI), Ian Boyd Alan Thomas	ECC ENSCI-Z	II-B
4	JS_PG4 (FZJ)	FZJ/ICG2 (Jülich, Germany)	C-I	Manfred Helten (PI) Marcel Berg	ECC SPC-6A	II-B
5	JS_PG5 (WFF)	NASA/WFF (Wallops Island, Virginia, USA)	C-II	Frank Schmidlin (PI), E. David Ross E Thomas Northam	ECC SPC-6A	I
6	JS_PG6 (SAP)	MS/SAP (Payerne, Switzer-land)	C-II	Bruno Hoegger (PI) Rene Stübi, Gilbert Levrat	ECC ENSCI-Z	I
7	JS_PG7 (URI)	URI (Reunion Island, France)	C-II	Françoise Posny (PI), Jean-Marc Metzger	ECC ENSCI-Z	II-B/ III
8	JS_PG8 (JMA)	JMA (Tokyo, Japan)	C-II	Toshifumi Fujimoto (PI), Takahiro Sato	KC96	-
MT = Mid Troposphere; LS = Lower Stratosphere						

The ECC-ozone sonde operating laboratories will bring together a pool of ECC-sondes from two different manufacturers (Type SPC-6A of Science Pump Corporation and Type ENSCI-1/2Z of Environmental Science Corporation) which will be operated according different procedures of preparation and data reduction. JOSIE-2000 will focus on key questions with regard to the instrumental performance of the ECC ozone sonde type and the Japanese KC96-ozone sondes. Specific questions addressed to support the Assessment for SOPs of Ozone Sondes (ASOPOS), a WMO-initiative to start in the course of 2000 (see Section 5).

The JOSIE 2000-campaign is scheduled in September 2000 at WCFOS. The participating laboratories will be split into two groups whereby each group will participate in a 10 days period doing intercomparison experiments in the simulation chamber. Within each campaign a total of about six simulation experiments of vertical ozone soundings will be performed in the simulation chamber whereby different types of vertical profiles of ozone will be simulated up to an altitude of about 35 km. JOSIE-2000 is designed to evaluate the sensitivity, precision and accuracy of each sonde type at different pressure, altitude and ozone level. Special attention will be paid to the influence of instrumental factors such as background signal, pump flow efficiency, sensing solutions and their uncertainties on the data quality of ozone soundings. Important aspect is to test recent instrumental/procedural developments of the ECC and KC96 (former KC79) sonde types since JOSIE 1996.

6.4.2. Experimental Design

The design of the JOSIE 2000 simulation experiments are strongly related to previous investigations about the performance of ozone sondes under quasi flight conditions in the environmental simulation chamber which were conducted during JOSIE-1996 [*Smit and Kley,* 1998] and JOSIE 1998/1999. In several simulation experiments 4 different ozone sondes will be "flown" simultaneously and compared to the dual beam UV photometer as reference. Different types of vertical profiles of pressure, temperature and ozone concentrations can be simulated. For example, during JOSIE-1996 two types of profiles were simulated. The first type of profile was a typical mid-latitude profile taken from the US Standard Atmosphere (1976) for 40-50 ˚N with a tropopause height of 12 km. The second type of profile related to typical tropical conditions of a high tropopause at 18 km, a low tropopause temperature and extremely low ozone values in the middle and upper troposphere due to high convective activity. Because of these extreme tropospheric conditions, particularly the extremely low ozone pressures of about 0.1 mPa, makes the second type of profiles very suitable to investigate and to compare the performance of the different ozone sondes with regard to the influence of any "background". Pre-and post-flight check of the "flown" sondes will be made to record performance of instrumental parameters like background signal, conversion efficiency, response time, pump flow rate, pump motor current and weight of ECC-cell before and after a simulation run.

The pressure and temperature in the ESC will change according to an ascent velocities of 5 m/s up to a burst altitude corresponding to 35 km. A total of 6 simulation experiments of vertical ozone soundings will be performed. During the simulation runs several tests with different types of ozone step functions or zero ozone will be included in order to investigate instrumental aspects like response time and background characteristics of the different ozone sondes in the troposphere as well as in the stratosphere. The specifications of the six simulation experiments are summarized in Table 11.

With regard to the development of SOP's for ECC-sondes one of the key questions to be addressed by JOSIE-2000 is the comparison of the performance of the ECC-sonde types at different sensing solutions. Thereby the following types of sensing solutions are defined:

Type I (Conventional, Komhyr, 1986): Cathode:1% KI + Full-Buffer & KBr as described by Komhyr, 1986). Anode: Cathode solution with saturated KI

Type II-A: Cathode:0.5% KI + Full Buffer & KBr as described by Komhyr 1986. Anode:Cathode solution with saturated KI (like Komhyr 1986)

Type II-B (Komhyr, 1997): Cathode:0.5% KI + Half of the Buffer & KBr as described by Komhyr 1986. Anode:Cathode solution with saturated KI (like Komhyr 1986)

Type III (Johnson, 1998): Cathode:2% KI, No Buffer, No KBr. Anode:Saturated KI, No Buffer, No KBr.

It is attempted to test equal amounts of SPC-6A sondes (manufactured by Science Pump Corporation) and ENSCI-Z sondes (manufactured by Environmental Science Corporation) at the different sensing solutions.types (SST-I, SST-IIA, SST-IIB and SST-III, respectively) as proposed in Table 10. However, it is intended to focus on SST-IIB and SST-III. SST-I has been extensively tested during JOSIE 1998. Further, JOSIE-1999 has indicated that the ECC-response with SST-IIA will be rather similar to SST-I. Laboratory experiments made by Bryan Johnson [private communications] have indicated that the different sonde performance characteristics are probably for a major part caused by the addition of the buffer solution and its concentration.

6.5. ASOPOS: Assessment of SOPs for Ozone Sondes

An assessment of the SOP's for the major type of ozone sonde (ECC, BM+hybrids and KC79/96) used in the global ozone sounding network should be conducted in 2000/2001. As base can serve the procedures/actions decided at the JOSIE/SPARC-OTA workshop (24-27 February 1997) at Hohenpeißenberg, Germany, and at the NDSC ozonesonde meeting (29 June-1 July 1998) at Potsdam, Germany.

The major tasks of the assessment will be to set-up, evaluate and establish SOP's for the 3 major sonde types. The strategy or design of the assessment proposed to follow:

1. *For each major sonde type a small group of experts prepare a document SOP-Version 1.0 describing the SOP's for the 3 sonde types based on the existing documents of guide lines to operate ozone sondes and the experience/*

Table 11: Specifications of JOSIE-2000 simulation experiments

Sim. Exp. No.	Profile Type	Profile Type Index	Specifications	Step-Response (Down & Up)	Comments
Sim. Exp. Nr.	Profile Type	Profile Type Index	Specifications	Step-Response (Down & Up)	Comments
1	Mid-Latitude	I-A	Ascent V=5m/s, Z=0-35 km	MT at Z≈5km LS at Z≈20km (O_3=0 for 3 min.)	
2	Mid-Latitude	I-A	Ascent V=5m/s, Z=0-35 km	MT at Z≈5km LS at Z≈20km (O_3=0 for 3 min.)	
3	Tropical	II-A	Ascent V=5m/s, Z=0-35 km	MT at Z≈5km LS at Z≈20km (O_3=0 for 3 min.)	
4	Tropical	II-A	Ascent V=5m/s, Z=0-35 km	MT at Z≈5km LS at Z≈20km (O_3=0 for 3 min.)	
5	Step Up/Down	III-A	Different O_3-levels at discrete Pressures (1000 hPa-5 hPa)	-	
6	Sub-Tropical	IV-A	Ascent V=5m/s, Z=0-35 km	MT at Z≈5km LS at Z≈20km (O_3=0 for 3 min.)	Sinus Wave Modulation

conclusions obtained from MOHP-97 and Potsdam-98 meeting of ozone sonde experts.

2. *SOP-Version 1.0 documents is distributed among the entire community of ozone sounding station/laboratories/scientist for opinions/comments/suggestions/additions etc.*
3. *For each sonde type the group of experts evaluate and implement the comments etc. submitted by the sounding community into a SOP-Version 2.0 document*
4. *SOP-Version 2.0 is distributed among the community of ozone sounding station/laboratories/scientist for review.*
5. *A final assessment meeting should be dedicated exclusively to the evaluation of the SOP-documents. Participants: Major sounding stations in the global network, WMO/GAW, IGAC/GLONET and dedicated experts. Goal: Finalize SOP-Documents.*
6. *For each major sonde the SOP-documents should be published as WMO-Technical Reports establishing the SOP as standard guide to operate ozone sondes.*

At the Hohenpeißenberg-97 meeting the three major types of ozone sondes and the major, most important SOP's were identified. Also, possible candidates for lead authors to prepare a SOP-Version 1.0 were suggested:

1. *ECCLead Author:Sam Oltmans, CMDL/NOAA*
2. *Brewer-Mast:Lead Author:Hans Claude, MOHp/DWD*
3. *KC-79/96Lead Author:NN, Japan Meteorology Agency*

At the Potsdam-98 meeting after a broad discussion about SOP's for ECC-sondes some recommendations were given. The assessment groups of BM and KC79/96 are rather small. However, ECC-group of sounding stations is large, such that the group of experts for ECC should set up the draft of the SOP-document for the ECC-sonde before discussing/evaluating in the entire ECC-sounding community.

A complete list with all ECC-, Brewer-Mast-, and KC79/96-sounding stations will be set up and distributed in the course of 2000. In coordination and agreement with the leading authors a time schedule of the assessment will be made short after JOSIE-2000 campaign. A proposal for an outline of SOP-contents, based on the minutes of the Hohenpeißenberg-1997 and Potsdam-1998 meeting will be prepared and distributed.

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6.7. JOSIE Scientific Steering Committee

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7. Status on data delivery

Below follows a table showing the number of ozonesonde files submitted to the NDSC data base as of 5 September 2000. It can be seen from the table that the number of profiles in the database has more than doubled since last year. From Nov. 1996 to Sept. 2000 the number of ozonesonde profiles in the database has increased from 661 to 5402.

Table 12: Number of ozonesonde profiles in database

Station	Number of sondes in database				
	Nov. 1996	Aug. 1997	Nov. 1998	Oct. 1999	Sep. 2000
Ny-Ålesund	532	637	733	801	932
Thule	18	18	18	182	182
Eureka	0	105	181	258	346
Sodankylä					0
Aberystwyth					366
Hohenpeißenberg				0	0
Payerne				0	1397
OHP	0	0	0	0	56
Wallops Island				0	309
Izaña					0
Mauna Loa (Hilo)	0	0	0	0	326
La Reunion	0	0	0	0	0
Lauder	111	209	277	330	383
Dumont d'Urville	0	0	0	0	0
McMurdo	0	76	416	506	506
South Pole	0	0	0	0	599
Total	661	1045	1625	2077	5402