Report on Activities of the Regional Dobson Calibration Center (RDCC) for WMO RA VI: The Meteorological Observatory Hohenpeissenberg (Germany) and The Solar and Ozone Observatory Hradec Králové (Czech Republic)

2003

Introduction:

The European RDCC at the **M**eteorological **O**bservatory **H**ohenpeissenberg (MOHp)/**S**olar and **O**zone **O**bservatory **H**radec **K**rálové (SOO-HK) continued its regular work (service and calibration of operational Dobsons in the European network) in 2003 with two international Dobson intercomparisons held at Hohenpeissenberg in May/June (**MOHp2003-1**) and June/July (**MOHp2003-2**) and one intercomparison at Arosa in July/August (**Arosa2003**). In total 8 instruments got a maintenance service and were calibrated towards the MOHp reference instrument Dobson No. 064. The campaign for three Swiss instruments was held in Arosa for economical reasons, as it was cheaper to go with one reference instrument to the station than to ship three instruments to the RDCC at Hohenpeissenberg. This reason also led to the decision to postpone the necessary calibration of the Egyptian Dobson No. 69 (Hurghada) to 2004, when a joint intercomparison for all three Egyptian Dobsons should be held in Egypt. In the meanwhile it was agreed to take this chance to organize a big campaign for the WMO R(egional)A(ssociation) I (Africa) instruments in Dahab (Egypt). The function of SOO-HK as a training centre for Dobson operators was continued succesfully.

Similar to the previous years some of the originally designated candidates for calibration had to cancel their participation for financial or time reasons. One of the missing instruments (Dobson No. 050 from Iceland) was checked with the MOHp Microtops filter instrument No. 3785 on site. Although the calibration of this filter instrument was examined before shipment the results at Iceland were very doubtful. The Microtops obtained ozone values approx. 20 to 25 D.U. lower than the Dobson No. 50. Back at Hohenpeissenberg some fingerprints were found on the inlet window, which obviously changed the calibration level. The readings were significantly improved after cleaning the window and removing the fingerprints. It is supposed that this contamination of the inlet window happened during the customs procedure.

Despite the problems with cancelled participations the RDCC/E finished the first complete cycle of four years with the calibration of in total 23 instruments, which represent about 85% of the operational Dobsons in the European network. Only one instrument (D041 from UKMO) could not be finally calibrated within the campaign due to severe problems with photomultiplier mounting. Fortunately it could be left at Hohenpeissenberg until the 2004-campaigns, as it is only a spare instrument. Additionally, four non-operational Dobsons were sent to Hohenpeissenberg in 2003. Two from Italy (No. 46 and No. 113) probably need only a calibration check. The Dobsons No. 073 and No. 123 from the British Antarctic Survey are currently subjected a complete refurbishment (replacement of electronics etc.). This work will enable the BAS to continue its very important monitoring of the Antarctic ozone layer with instruments of a high quality calibration level. Thus MOHp and SOO-HK have confirmed during the past four years, that they are able to meet the

demands on maintenance the high quality calibration level in the expanded Dobson network in Europe. The **Q**uality **A**ssessment/**Q**uality **C**ontrol (QA/QC-programme of WMO) developed for the global total ozone monitoring network of Dobson spectrometers will be guaranteed by both institutions from Germany and Czech Republic in the RA-VI Region.

Provision of the Dobson community with spare parts, mentioned in former RDCC/E reports as one of the urgent problems has been improved very much. Companies were identified, which provide an excellent coating of mirrors, very stable SL power supplies at a reasonable price and shutter motors, respectively. The production of new sun directors can be done by a Czech workshop and the complete mechanics of the wedge unit (slides and brackets) are successfully produced by a DWD workshop.

The "Dobson – Brewer co-operation" was improved during 2003. Especially at the Dobson IC at Arosa, Switzerland during a meeting of the DAHC and at the Brewer workshop at El Arenosillo (Spain) it was agreed among the participants, that a good co-operation between both networks (either observation or calibration) is an urgent demand for improvement of the global ozone monitoring network. Both RDCC/E partners made further detailed investigations (SOO-HK under the project CANDIDOZ of the European Commission) related to the differences between their Dobson and Brewer instruments. Similar results were found and the reasons for this are still under discussion.

The following sections give a description of the offered services, the work done in 2003 incl. results and the activities planned for 2004. An outlook will outline further intentions in the near future.

Offered Services:

In the following the tasks and offered services of the RDCC/E MOHp/SOO-HK are listed with a short description - responsibilities are given in brackets:

- Maintenance/provision of absolutely calibrated regional reference instruments (D064 at MOHp, D074 at SOO-HK), being regularly compared with the WDCC (NOAA/CMDL, Boulder, Colorado) - standard instruments. These comparisons (as done in June 2002) and/or Langley measurements for absolute calibrations should be performed at least every two or three years.

- Technical and scientific organization, performance and evaluation of regular Dobson calibrations at MOHp, 2 – 3 campaigns per year if possible, each with 2 – 3 instruments (MOHp with support of SOO-HK).

- Refurbishment of Dobsons out of operation and/or with old equipment (e.g. electronics of new US style modified by MOHp etc.), provision of spare parts (mainly MOHp with support of SOO-HK). New sources for some special parts (e.g. sun director produced by a Czech workshop, provider of new type of a small and stable SL-power supply found in Germany) have been found or parts like wedge (slides etc.) were successfully re-produced in own workshops after the original technical drawings, received from Coherent-Ealing.

- Service for the European Dobson stations, technical/scientific support additional to the regular intercomparisons (MOHp, SOO-HK) incl. provision of a traveling instrument (e.g. Microtops) for in-situ calibration checks (MOHp).

- Development of new techniques, tools, software and other methods to improve instruments' maintenance, tests, operation and data processing/analyses in cooperation with the WDCC in Boulder, WMO and the Dobson Ad-Hoc Committee (MOHp, SOO-HK).

- Thorough and continuous analyses/control of data quality, support with data re-evaluations, comparison with other instruments (other Dobsons, other types: e.g. satellite validation), detection/explanation/quantifying of principal differences (e.g. to the Brewer) (MOHp, SOO-HK) in close co-operation with the **D**obson **A**d-**H**oc **C**ommittee (DAHC) and the **R**egional **B**rewer **S**cientific **G**roup (RBSG). See also recently published WMO/GAW Report No. 149 (Staehelin, Kerr, Evans and Vanicek, 2003) and the CANDIDOZ report (Vanicek, Stanek and Dubrovsky, 2003).

- Preparation and maintenance of Standard Operating Procedures in co-operation with WDCC Boulder, WMO and Dobson Ad-Hoc Committee (MOHp, SOO-HK). Continuous upgrading of the new special Dobson Manual for experts written by Archie Asbridge (MOHp mainly responsible, SOO-HK with advisory function) under WMO-auspices.

- Education and training of Dobson operators for the regular operation, common tests and maintenance work both for RA VI and stations located in developing countries selected after consultation with WMO (SOO-HK).

- Education and training of the own staff of RDCC/E (MOHp, SOO-HK).

- The following equipment (hardware and software) is already available for the above mentioned tasks:
  - Semi-automated two-lamp unit for wedge calibrations (MOHp).
  - Set of spectral lamps for calibration of wavelength setting with Q-levers → Q-tables (MOHp, SOO-HK).
  - Microtops Filter Ozonometer as traveling instrument for in-situ calibration checks (MOHp).
  - Traverse Microscope incl. video system for measurement and adjustment of slit width (MOHp).
  - Special tools like traverse lamp device, 1/3-2/3-device, miniature UV-spectrometer etc. for special tests and alignment procedures (MOHp, SOO-HK).
  - Completely equipped optical laboratory
  - Special Dobson software package for data processing, archiving and transfer, free release and available for users (SOO-HK)
  - Semi-automated PC-controlled facility for reading and processing the Dobson total ozone observations (SOO-HK)
  - Web pages of the Dobson network http://www.chmi.cz/meteo/ozon/dobsonweb/welcome.htm (SOO-HK)

Some other stations in Europe also have various tools (spectral lamps e.g. in U.K. and Switzerland), which can be used on demand.

Activities in 2003:

The RDCC/E MOHp/SOO-HK performed the following activities at various locations in 2003 - responsibilities are given in brackets:

- Maintenance and provision of the two regional reference Dobson instruments No. 064 (MOHp) and No. 074 (SOO-HK).

- Provision of a well calibrated Microtops filter ozonometer for in-situ calibration checks of Dobsons at their stations, here Dobson No. 050 at Reykjavik (Iceland) in June and July. Unfortunately the data from the Microtops did not agree very well with the Icelandic Dobson, as its inlet window was probably contaminated by fingerprints during customs procedure and/or shipment. Thus the calibration level, being checked and confirmed before shipment, was deteriorated significantly. Cleaning of the quartz window after return improved ozone measurements much, so we were able to state subsequently, that the Dobson

No. 050 has not been in a bad shape. This event confirms that handling of the Microtops has to be done very carefully (MOHp).

- Technical and scientific organization, performance and evaluation of two Dobson intercomparisons held at the RDCC Hohenpeissenberg: MOHp2003-1 with the D107 (Russia) from June 1 to 14 and MOHp2003-2 with D041 (UK) and D120 (Spain) from June 21 (29) to July 12. Additionally a campaign (Arosa2003) was held for the three Swiss Dobsons D051, D062 and D101, the Italian D048 and the US/French D085 at the Lichtklimatische Observatorium LKO at Arosa from July 20 to August 2. M. Stanek from SOO-HK gave technical support in MOHp2003-1 to refurbish the Russian Dobson, which additionally got one of the new "Czech" sun directors. He also participated in Arosa2003 providing technical assistance. Results of these three campaigns are given in **Attachment 1**: Both panels show the difference between the N-values ("raw data") of standard instrument D064 and the Dobsons to be calibrated. Left panel before adjustment during the initial calibration, right panel after adjustment during the final calibration (MOHp, SOO-HK). The right panels always show a significant improvement of the instrumental performance after the final calibration compared with the status of the Dobsons, when they arrived for the intercomparison (left panel). Only D041 as first instrument out of 23 Dobsons in four years could not finally be improved in 2003.

- Beginning of complete refurbishment of two Dobsons D073 and D123 ("Ozone hole instrument") from the **B**ritish **A**ntarctic **S**urvey BAS (replacement of electronics, optical alignment) (MOHp).

- Repair of the D041 after MOHp2003-2, as the fixing of the problem with the PMT-socket was not possible during the regular campaign (MOHp).

- Reception of two Italian Dobsons D046 and D113 for examination and preparation to be calibrated in 2004. This work had unfortunately be shifted to 2004 due to a full schedule at MOHp in 2003.

- Participation of U. Köhler and K. Vanicek in the DAHC-meeting held in Arosa from July 30 to 31 - discussion of the current state in the Dobson network, future developments (e.g. establishment of new stations equipped with Dobsons being now out of operation somewhere else) and the co-operation between Dobson and Brewer groups in the RA-VI (MOHp, SOO-HK).

- Supervision of the new Dobson station in Armenia, monitoring of the produced data and test results, "remote" assistance in technical problems (broken SL-lamp, doubtful symmetry test) (MOHp).

- Maintenance and updating of Dobson Web Pages - an Internet site of the Dobson part of the GAW ozone monitoring network, located at the server of CHMI (SOO-HK) with the following URL: **http://www.chmi.cz/meteo/ozon/dobsonweb/welcome.htm.** (SOO-HK).

- Training of 3 Dobson observers from Peru and Pakistan at SOO-HK (25.08.-05.09.2003) in operation and maintenance of the instrument and processing of measurements at their home stations. A detailed report has been prepared and submitted to WMO/ENV by K. Vanicek and can be found on the above mentioned Dobson Web Page (SOO-HK).

- Participation of K. Vanicek and U. Köhler in the Brewer workshop at El Arenosillo/Spain in September/October 2003. A closer co-operation between Dobson and Brewer calibration infrastructures mainly in the RA-VI region and establishment of a **R**egional **B**rewer **C**alibration **C**entre RBCC/E exploiting the experience from the global Dobson calibration system were discussed during a meeting of the Regional Brewer Scientific Group for Europe. Also differences between Dobson and Brewer ozone data and their trend were addressed (MOHp, SOO-HK).

- Further development and improvement of the software for controlling the new semi-automated wedge calibration unit (MOHp).

- Further development, production and purchase of necessary RDCC/E tools, equipment and Dobson spare parts (modification of the new US-type electronics, mirror coating, SL-power supplies, shutter motors, sundirectors) (MOHp, SOO-HK).

- Beginning of the preparations for the next Dobson-campaigns held in 2004 at MOHp and Dahab/Egypt (under the direction of WDCC and WMO/ENV) (MOHp, SOO-HK).

- Further development of a semi-automated facility for recording and processing of Dobson total ozone observations and its installation at the observatory ElArenosillo (Spain) for testing. (SOO-HK).

- Completing of a complex re-evaluation and analyses of relation between Dobson and Brewer total ozone data sets originated in Hradec Kralove under the project CANDIDOZ of the FP-5 of EC and publication of a relevant report (SOO-HK).

- Proposal by Dr. S. Oltmans (NOAA, Boulder) that U. Köhler should succeed him in his function as co-chair of the NDSC Dobson/Brewer Group and as member in the NDSC steering committee. This candidature is approved in the meanwhile (MOHp).

- Presentation of RDCC/E activities given by K. Vanicek at the meeting of the WMO Scientific Advisory Group for Ozone (SAG-Ozone) held in Prague, October 2003 (SOO-HK).

The following staff was responsible for the realization of the RDCC/E tasks and participated in particular activities:

Dipl. Met. Ulf Köhler, scientific head of the Dobson Calibration Centre (MOHp)
Dr. Karel Vanicek, head of the SOO-HK
Dr. Wolfgang Steinbrecht, scientist (MOHp)
Ing. Martin Stanek, engineer (SOO-HK)
Ing. Fritz Schönenborn, electronic engineer (MOHp)
Jiři Pokorny, technician (SOO-HK)
Bert Dömling, technician (MOHp)
Ferdinand Strommer, technician (MOHp)
Alois Stögbauer, workshop (MOHp)
Hans Eding, electrical workshop (MOHp)

Plans for 2004:

The following list gives an overview about the intended activities in 2004:

- Technical and scientific preparation, organization, performance and evaluation of three Dobson intercomparison at MOHp:
  - **MOHp2004-1**, tentatively from May 9 (16) to May 29.

  Possible participants are 4 instruments: three from UK (D032, D035 and D041, David Moore, Aidan Green and Les Thompson) and Denmark/Greenland (D092, Paul Eriksen). Jonathan Shanklin from BAS is announced to come for a one week visit (MOHp).
  - **MOHp2004-2**, tentatively from June 20 to July 3.

  Possible participants are at least 2 instruments: D073 and D123 from British Antarctic Survey (Steve Colwell) which have been completely refurbished. Participation of the Portuguese instrument D013 (Ana Marisa Delgado) is not yet confirmed, may be scheduled for MOHp2004-3. The calibration of the Italian instruments (D046, D113, PI Riccardo Santaguida) will be planned according the schedule of that Portuguese instrument (MOHp).
  - **MOHp2004-3**, tentatively from July 11 to July 24.

  Possible participants are at least 3 instruments: from Armenia (D044, N.N., PI is Dr. David Melkonyan), Germany (D071, Andre Knöfel) and Greece (D118, N.N., PI is Prof. Costas Varotsos). Other potential instruments see under MOHp2004-2 (MOHp).
  - **DICE2004**, held from February 22 to March 12 at Dahab, Egypt.

  Participants are 9 instruments: D011 (Algeria, O. Bouziane), D015 (Botswana, R. Mmusi, G. Salethake, E. Ditshwene), D018 (Kenya, N. Muthama), D057 (Seychelles, P. Alcindor), D059 (Egypt, W. Sharobiem), D069 (Egypt, M. Hussein), D089 (South Africa, D. van der Spuy, G. Meyer), D096 (Egypt, A. Gahein) and Shimadzu 5703 (Nigeria, S. Osaghaede). This WMO intercomparison is to be held under the scientific and technical organization of the WDCC/Boulder (B. Evans, M. O'Neill), participating with the secondary world standard D065, assisted by M. Stanek (SOO-HK, Czech Republic) and U. Köhler / B. Dömling (MOHp, Germany) with regional standard D064 to be compared against the world standard within the regular schedule of 2 years (last calibration at Boulder in 2002). This WMO RA-I campaign was originally planned instead the former calibrations of the three Egyptians instruments at MOHp and then extended to a complete campaign for RA-I (WDCC NOAA/Boulder, MOHp, SOO-HK).
- DAHC-Meeting during the DICE2004-campaign with at least U. Köhler, K. Vanicek and B. Evans to discuss urgent issues (Dobson network, Italian Dobsons, Dobson-Brewer) (MOHp, SOO-HK, WDCC) and during the Quadrennial Ozone Symposium (QOS) at Kos in June 2004. Additionally talks with Dr. M. Proffitt from WMO - AREP/ Environment Division are intended (WDCC NOAA/Boulder, MOHp, SOO-HK, WMO).
- Presentation of the latest activities and outputs of RDCC-E at the QOS in June (MOHp, SOO-HK).
- Completing and official introduction of the semi-automated data recorder for Dobson instruments developed at SOO-HK - technical design, software, operational instructions (SOO-HK) and its installation at selected GAW stations in developing countries.
- Further updating of the Dobson Web Pages with the aim to get suggestions from visitors and to announce actual events related to the GAW Dobson network; designing and creating an own RDCC/E-Web Page at the MOHp-server as supplement to the Czech presentation (SOO-HK, MOHp).
- Training of 3 Dobson operators from developing countries at SOO-HK. Selected after consultation with DAHC and WMO/GAW managers (SOO-HK).
- Further improvement of the technical equipment and software (wedge calibrator, Dobson software package) (MOHp, SOO-HK).
- Further supervision of the Dobson station in Armenia and monitoring of the produced data, to ensure the demanded data quality within the global Dobson network (MOHp).
- Presentation of the bilateral co-operation between MOHp and SOO-HK on activities of RDCC/E at the World Conference of the Montreal Protocol Parties, Prague, November 2004 (SOO-HK)

Further Outlook:

Financial problems in most of the countries engaged in ozone research, dominating the near and medium-term future of the work in this field of environmentally related science, are still relevant and urgent. Again, some potential candidates being on the regular schedule of ICs at RDCC/E canceled their participúation because of either actually financial/time problems (e.g. D050 from Iceland) or even because of the stop of their Dobson operation (Norwegian Dobsons, D040 from Belgium) Thus following two particular problems, already mentioned in previous Annual Reports, are still on the agenda being added by a third issue accrued after the experience of the full four-year calibration cycle:
1) The continuation of long-term records of total ozone measured with Dobsons is questioned.
2) The realization of the fundamental requirement of the global Dobson calibration system - the regular absolute calibration of the standard instruments (at least each two - three years) - is currently very difficult.
3) The new calibration concept of several small campaigns every year instead of one big in four years lead to an exorbitant volume of work especially during the summer season at MOHp.

The Staehelin et al.-paper on "Comparison of total ozone measurements of Dobson and Brewer spectrophotometers and recommended transfer functions" (*WMO/GAW Report No. 149, WMO TD No.1147, Geneva, March 2003),* initiated also by DAHC, is a good guidance how to handle the parallel Dobson and Brewer data series created at a considerable number of stations. The Report also suggests how to manage a possible transition from one instrument to the another without interruption or disturbance of quality of long-term series of total ozone observations. The use of joint campaigns like DICE2004 to combine regular calibration service for operational instruments with the check and calibration of the reference instrument D064 against the world standard from WDCC also helps to attenuate the problems of item 2.

The experience after a full four years calibration cycle initiated the discussion, how this new concept of small campaigns can be modified and improved to solve the problems mentioned in item 3. Discussion between U. Köhler - the scientific head of RDCC/E, B. Evans - the head of WDCC, K. Vanicek - the chairman of SAG-Ozone and M. Proffitt - WMO/ENV during the DICE2004 campaign has opened up new vistas. It has been concluded that a combination of one large campaign organized every four years for well-maintained instruments requiring only a small amount of technical work (initial and final calibration in the optimal case) and one small intercomparison each year for Dobsons, which need a more extensive treatment, could be a solution.

As the big campaigns need a high probability of occurance of sunny weather these can not be held at Hohenpeissenberg; Therefore, the observatories at Arosa, El Arenosillo or Izaña (Canary Islans) that are well equipped with technical facilities and have measuring platforms large enough for operation of a high number of instruments have been suggested to host these 4-year intercomparisons. Moreover, these big campaigns are expected to be used also for calibration check of the standard instruments and/or for the comparison of the Dobson with Brewer regional standards. This approach would be a good chance to extend co-operation between Dobson and Brewer communities and to support efforts and activities started in 2003 by K. Vanicek (SAG-Ozone) and E. Cuevas (Observatory Izana) on establishment of the European Regional Brewer Calibration Centre (System). There is an idea that will be more discussed by Dobson and Brewer experts during QOS at Kos that such co-operation should be supported by an EC/ESA funded project under the building up of the integrated ground and space ozone monitoring system in Europe. If such project is applied both MOHP and SOO-HK will actively contribute in its definition and realization.

Hohenpeißenberg, April 2004 Hradec Králové, April 2004

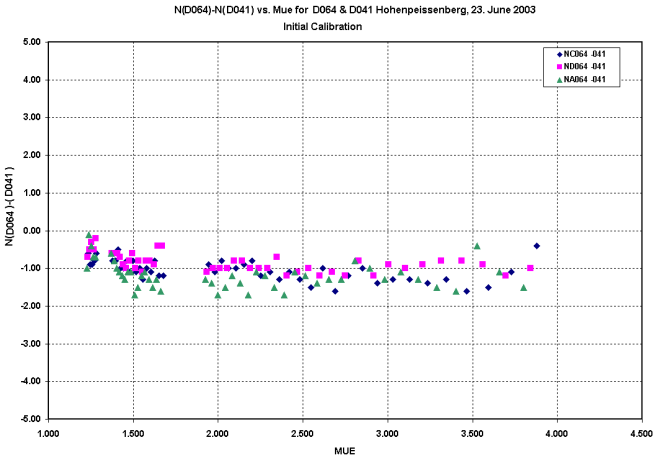
(Ulf Köhler) (Dr. Karel Vaníček)

Attachements:

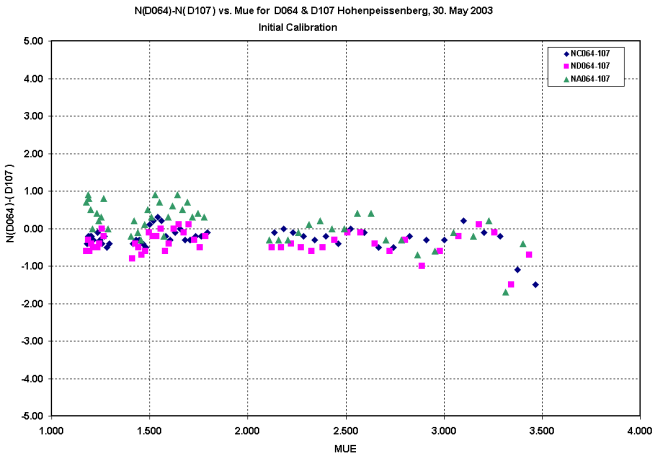
1. Summary graphs of the Dobson calibrations MOHp2003-1, MOHp2003-2 and Arosa2003: Initial calibrations of the various instruments on the left hand, final calibrations on the right hand; shown are the differences of the raw data between standard Dobson and instruments under calibration in the three used wavelength pairs (2 pages).

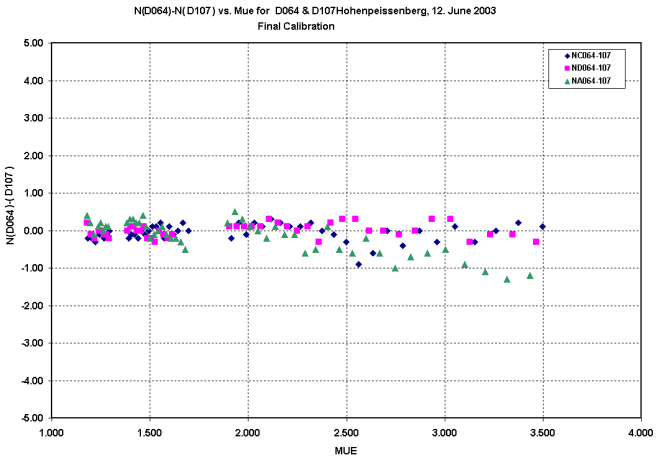
2. Actual table of all operational European Dobson stations incl. calibration state and schedule (1 page) for 2004.

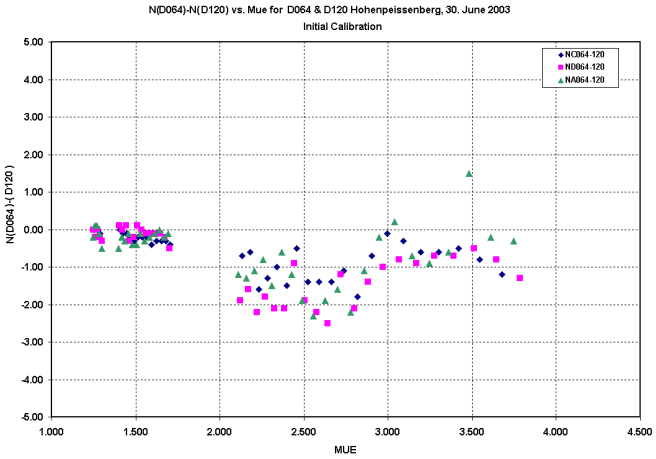
Attachment 1: Graphs of the Calibration Results

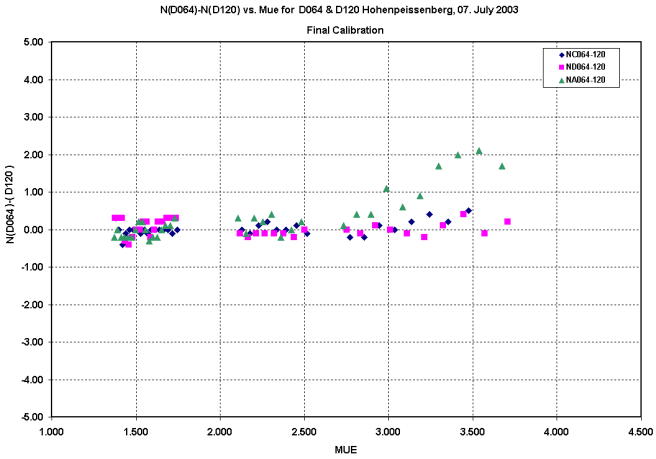


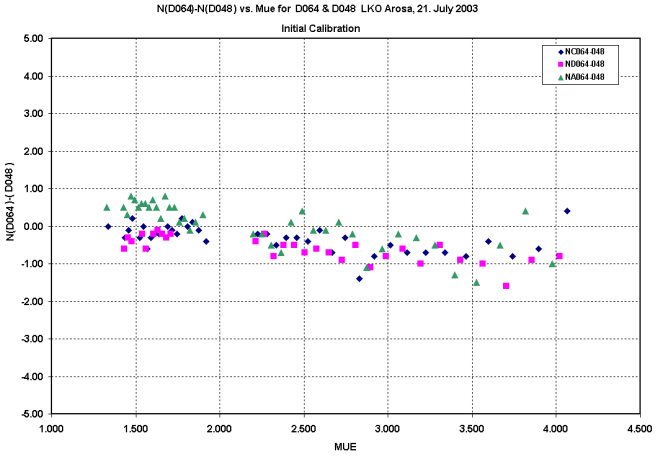
As the Dobson No. 041 could not be put into correct operation until the end of the campaign due to a defective photomultiplier socket, it was not possible to perform a final calibration. This will be done in 2004 after the successful repair together with the calibration service of the other two UK-Met Dobsons No. 32 and 35. This Dobson was fortunately a spare instrument, thus no break in a data record was caused.

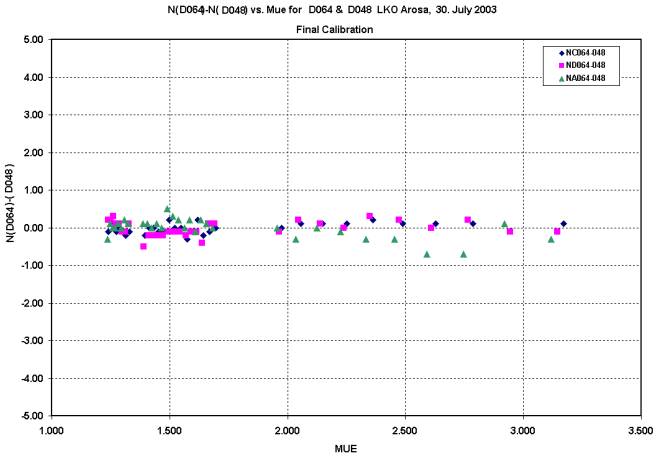


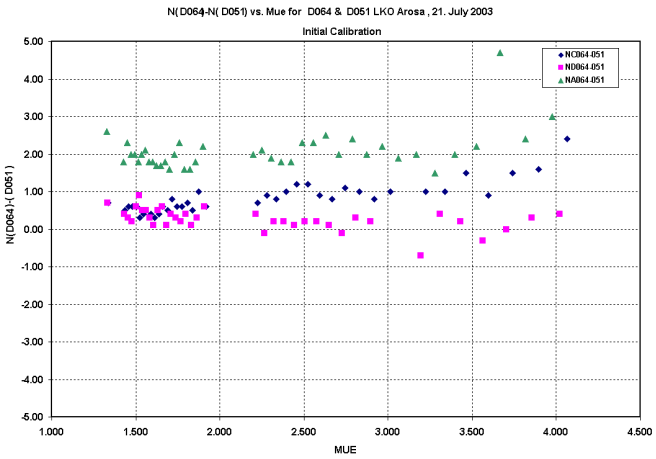


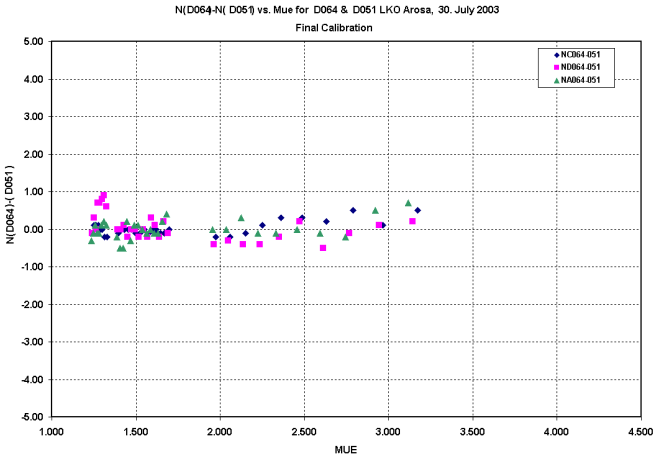


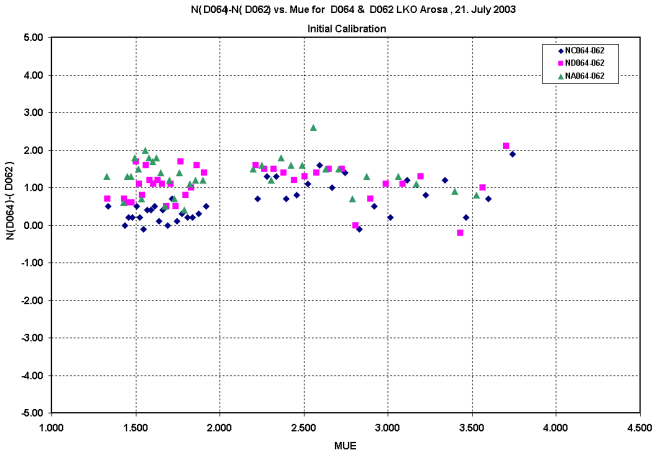


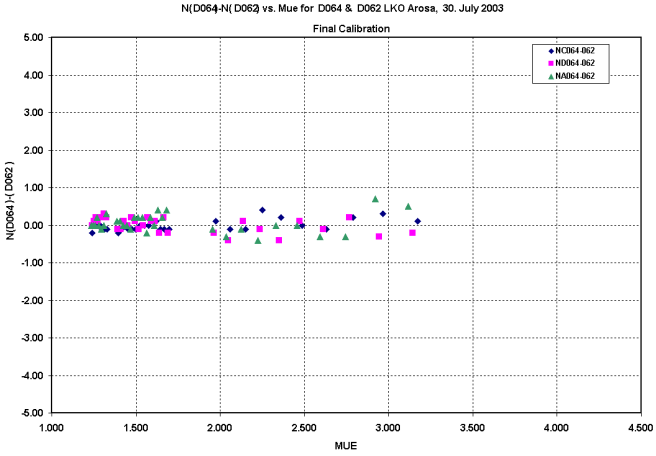


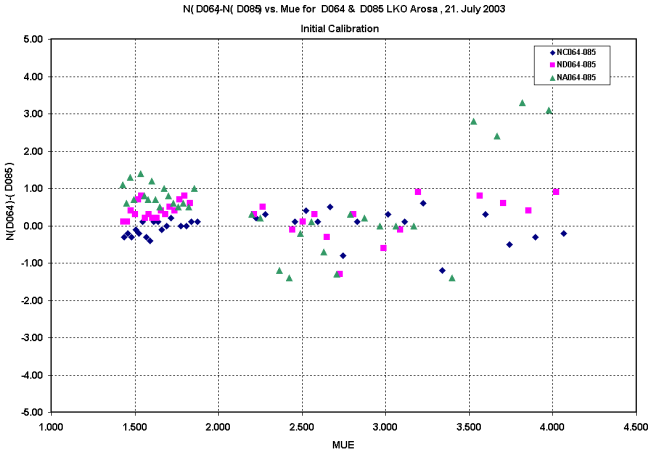


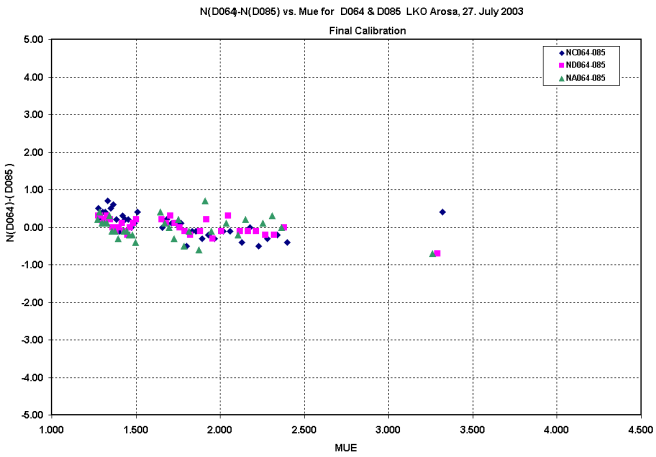

N(D064-N(D051) vs. Mue for D064 & D051 LKO Arosa , 21. July 2003
Initial Calibration
NC064-051
ND064-051
NA064-051
N(D064)-(D051)
MUE

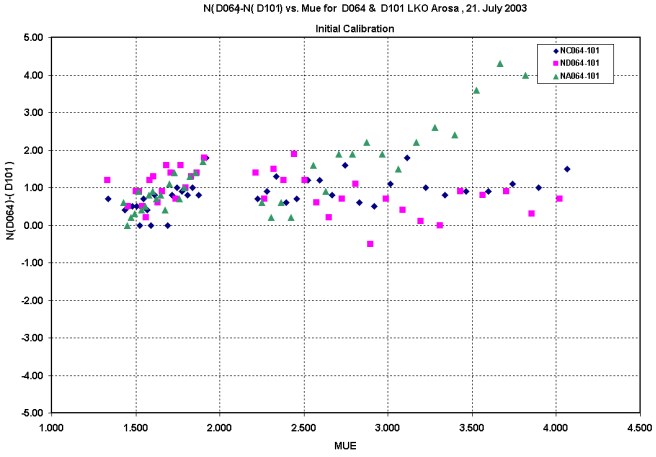

N(D064-N(D051) vs. Mue for D064 & D051 LKO Arosa, 30. July 2003
Final Calibration
NC064-051
ND064-051
NA064-051
N(D064)-(D051)
MUE

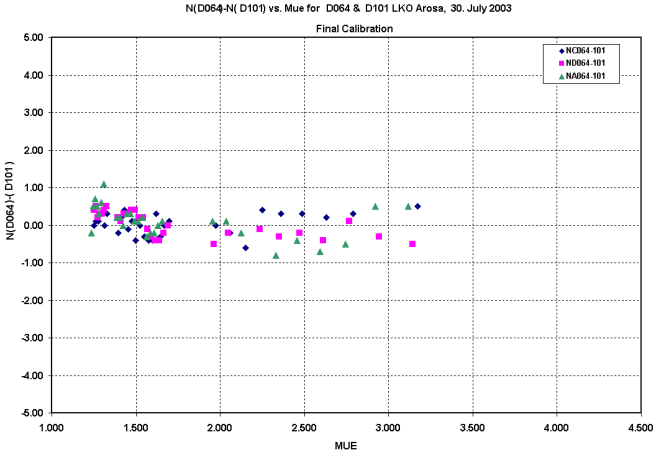

N(D064-N(D062) vs. Mue for D064 & D062 LKO Arosa , 21. July 2003
Initial Calibration
NC064-062
ND064-062
NA064-062
N(D064)-(D062)
MUE


N(D064-N(D062) vs. Mue for D064 & D062 LKO Arosa, 30. July 2003
Final Calibration
NC064-062
ND064-062
NA064-062
N(D064)-(D062)
MUE


N(D064-N(D085) vs. Mue for D064 & D085 LKO Arosa , 21. July 2003
Initial Calibration
NC064-085
ND064-085
NA064-085
N(D064)-(D085)
MUE


N(D064-N(D085) vs. Mue for D064 & D085 LKO Arosa, 27. July 2003
Final Calibration
NC064-085
ND064-085
NA064-085
N(D064)-(D085)
MUE


N(D064-N(D101) vs. Mue for D064 & D101 LKO Arosa , 21. July 2003
Initial Calibration
NC064-101
ND064-101
NA064-101
N(D064)-(D101)
MUE


N(D064-N(D101) vs. Mue for D064 & D101 LKO Arosa, 30. July 2003
Final Calibration
NC064-101
ND064-101
NA064-101
N(D064)-(D101)
MUE

Attachement 2: Table of State and Schedule for the European Dobsons 2004

Summary of European Dobson Stations							
No.	Dobson No.	Country	Location	Last Cal.	L. Cal. Location	Next Cal.	N.Cal. Location
2	D013	Portugal	Lisbon	8/2000	MOHp	2004	MOHp
4	D015	Botswana	Maun	3-4/2000	Pretoria	2004	Dahab
7	D032	UK	Lerwick	5-6/00	MOHp	2004	MOHp
8	D035	UK	Camborne	5-6/00	MOHp	2004	MOHp
10	D041	UK	Camborne	6-7/03 5/04	MOHp	2004	MOHp
11	D044	Armenia	Nor Amberd	8/2000	MOHp	2004	MOHp
12	D046	Italy	Brindisi	?	?	2004	MOHp
19	D059	Egypt	Harghada	6-8/2000	MOHp	2004	Dahab
21	D064	Germany	Hohenpeissenberg	6/2002	Boulder	2004	Dahab
23	D069	Egypt	Aswan	7/99	Arosa	2004	Dahab
24	D071	Germany	Lindenberg	8/2000	MOHp	2004	MOHp
25	D073	UK	?	?	?	2004	MOHp
29	D092	Denmark/Gree	Thule	7-8/90	Arosa	2004	MOHp
30	D096	Egypt	Cairo	6/2001	MOHp	2004	Dahab
37	D113	Italy	Cagliari/Elmas			2004	MOHp
38	D118	Greece	Athens	7-8/97	Kalavryta	2004	MOHp
41	D123	UK	?	?	?	2004	MOHp
5	D030	Sweden	Vindeln	6/2001	MOHp	2005	MOHp
16	D050	Iceland	Reykjavik			2005	MOHp
26	D074	Czech	Hradec Kralove	7/2002	MOHp	2005	MOHp
27	D084	Poland	Belsk	6/2001	MOHp	2005	MOHp
33	D104	Germany	Hohenpeissenberg	7/2001	MOHp	2005	MOHp
35	D108	Russia	Voeikovo	7/2001	MOHp	2005	MOHp
40	D121	Romania	Bucharest	7/2001	MOHp	2005	MOHp
13	D047	Italy	Vigna di Valle	7/2002	MOHp	2006	MOHp
15	D049	France	Observatoire De	7/2002	MOHp	2006	MOHp
14	D048	Italy	Sestola	7/03	Arosa	2007	MOHp
17	D051	Switzerland	Arosa	?	?	2007	Arosa
20	D062	Switzerland	Arosa	7/99	Arosa	2007	Arosa
28	D085	France	Haute Provence	7/99	Arosa	2007	Arosa
31	D101	Switzerland	Arosa	7/03	Arosa	2007	Arosa
34	D107	Russia	Moscow	5-6/03	MOHp	2007	MOHp
39	D120	Spain	El Arenosillo	7/99	Arosa	2007	MOHp
1	D008	Norway	Ny Alesund			-	-
3	D014	Norway	Tromsö	5/1998	Oslo	-	-
9	D040	Belgium	Uccle	5-6/00	MOHp	-	-
18	D056	Norway	Oslo	7/99	Arosa	-	-
22	D066	Italy	S. Pietro Capofiume	?	?	-	-
36	D110	Hungary	Budapest-Lorinc			-	-
6	D031	UK (Ukraine)	Vernadsky	?	?	?	?
32	D103	UK	Halley	?	?	?	?

Description:

Next Calibration

Calibration in 2 years

Calibration next year

Calibration recently

Status unknown/not operational