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

2001

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 2001 with two international Dobson campaigns. In total 6 instruments got a maintenance service and were calibrated towards the MOHp reference instrument Dobson No. 064. The function of SOO-HK as a training centre for Dobson operators was continued succesfully.

It has again been proved by these campaigns, that MOHp and SOO-HK are able to meet the demands on maintaining the high level of calibration quality in the expanded Dobson network in Europe. Thus the **Q**uality **A**ssessment/**Q**uality **C**ontrol (QA/QC-programme of WMO) developed for the global total ozone monitoring network of Dobson spectrometer will be guaranteed by both institutions from Germany and Czech Republic in the RA-VI Region.

The solution of one of the issues addressed in the 2000-report - the provision with spare parts and the missing support by Ealing - is currently under progress. Ealing agreed to clear its stock of Dobson parts and to make it available to the Dobson community. Only the costs for shipment have to be covered.

An additional issue unfortunately arose during the past year: Due to financial problems at least one station (Budapest, Hungary) with simultaneous operation of Dobson and Brewer decided to stop the long-term Dobson record and to continue only with Brewer observations. There is much fear that other station with similar conditions will follow. The consequences of such a rash decision on reliable trend analyses are not yet foreseeable. Therefore the **D**obson **A**d **H**oc **C**ommittee (DAHC) took the chance at its last meeting in May 2001 during the workshop on the occasion of the 50th anniversary celebration of the SOO-HK, to discuss this problem and to propose solutions. It must be stated, that there is currently no technical or scientific forcing to close down the Dobson network. The stations with long-term Dobson records are still the backbone for the monitoring of the current and future state of the ozone layer and for validation of satellite observations. Brewer observations are a very valuable supplement of these observations, but as long as the global calibration system of these new type of instruments has not yet reached the level of that of the Dobson network, it is a risk to replace the "old-fashioned" system completely by the modern one.

The following sections give a description of the offered services, the work done in 2001 and the activities planned for 2002. An outlook will outline further intentions in the near future.

Offered Services:

In the following the tasks and offered services of the RA VI-DCC 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 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, 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 etc.) (mainly MOHp with support of SOO-HK).

- 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).

- 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 (MOHp, SOO-HK).

- The following equipment (hardware and software) is already available for the above mentioned tasks:
  - Newly developed and constructed 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 etc. for special tests and alignment procedures (MOHp, SOO-HK).
  - Special Dobson software package for data processing, archiving and transfer, free release and available for users (SOO-HK)
  - Web pages of the Dobson network (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 2001:

The European RDCC MOHp/SOO-HK performed the following activities at various locations in 2001:

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

- Provision of a Microtops filter ozonometer for in-situ calibration checks of Dobsons at their stations (MOHp).

- Technical and scientific organization, performance and evaluation of two Dobson intercomparisons at MOHp with the D030 (Sweden), D084 (Poland), D096 (Egypt), D104 (Germany), D108 (Russia), D121 (Romania) from June 10 to June 23 (MOHp2001-1) and July 8 to July 21 (MOHp2001-2). Additionally a Microtops filter ozonometer (Prof. Stan Anderson, at that time at the American University of Cairo) and a Russian filter instrument M124 (No. 315, reference instrument for the M124-network) were intercompared with D064. A detailed report on the campaigns in 2000 and 2001 is in preparation and will be published as WMO report and also on the Dobson Web Page of SOO-HK (see below).
  The graphs in attachment No.1 give a good impression of the success of the calibrations (MOHp, SOO-HK), the graph in attachment No. 2 shows the comparison between the Russian filter ozonometer M124 and the spectrometers D064 and BR010.

- Updating and release of the Dobson software package prepared at SOO-HK - implementation of total ozone CREX and extCSV encoders for operational data exchange to WOUDC Toronto and through WMO/GTS links (SOO-HK).

- 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 Kenya (1) and P.R. China (2) at SOO-HK (3.-14.09.2001) in operation and maintenance of the instrument and processing of measurements at their home stations. A detailed report is given by Dr. Vanicek and can be found on the above mentioned Dobson Web Page (SOO-HK).

- Participation in the meeting of the Dobson Ad-Hoc Committee during the 50th International Anniversary Workshop at the SOO-HK from May 23 to 25 to discuss past, present and future tasks and activities (MOHp, SOO-HK). The problems at stations with Dobson and Brewer spectrometers (possible stop of the long-term Dobson observations like in Budapest) were discussed and solutions (intense investigation of the principal differences Dobson-Brewer and the consequences for the total ozone time series) were proposed. The corresponding report on the results can be found on the Dobson web pages of SOO-HK.

- Separate meeting of the RDCC-partners Dr. Vanicek and U. Koehler during the workshop at SOO-HK to discuss future joint tasks (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-tools, equipment and Dobson spare parts (delivery of the complete Dobson stock of the former manufacturer Ealing Company to Hohenpeissenberg is expected), upgrading of the facilities like the optical laboratory (MOHp).

- Beginning of the preparations for the next MOHp Dobson-campaigns in 2002 (MOHp).

- Development of a semi-automated facility for recording and processing of Dobson total ozone observations (SOO-HK)

The following staff was responsible for the fulfilment of the RDCC-tasks and participated in the different activities:

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

Plans for 2002:

The following list gives an overview about the intended activities in 2002:

- Presentation of results of SOO-HK and MOHP cooperation performed in the frame of RDCC activities as valuable contribution to the QA/QC-activities in GAW at the GAW Workshop for RA VI in Riga (Latvia) in May (SOO-HK, MOHp).
- Refurbishment (new mirrors) of reference Dobson No.064 (MOHp).
- Calibration of D064 with primary standard Dobsons D065/083 at Boulder in June instead of the originally planned absolute calibration campaign after Langley (MOHp) associated with a meeting of managers of WRDCC and RDCCs.
- Technical and scientific preparation, organization, performance and evaluation of one Dobson intercomparison at MOHp with support from SOO-HK, participation of Martin Stanek (MOHp, SOO-HK):
  - MOHp2002-1, tentatively from July 7 to July 20.

  Possible participants are 5 instruments: from Norway (D008, Arne Dahlback), Italy (D047, Riccardo Santaguida), France (D049, Jerome de la Noe) and Greece (D118, Costas Varotsos), sure is the participation of the Czech reference D074 to be compared towards D064 after its calibration. The proposed instruments D050 (Iceland, Bardi Thorkelsson) and D092 (Denmark/Greenland, Paul Eriksen) have again to be shifted to 2003 due to timing problems (see table in attachment) (MOHp, SOO-HK).
- Completing and official introduction of a semi-automated data recorder for Dobson instruments developed at SOO-HK - technical design, software, operational instructions (SOO-HK).
- 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-Web Page at the MOHp-server as supplement to the Czech presentation (SOO-HK, MOHp).
- Training of 2-3 Dobson operators from developing countries at SOO-HK.
- Further improvement of the technical equipment and software (wedge calibrator, Dobson software package) (MOHp, SOO-HK).
- Further supervision of the new Dobson station in Armenia and monitoring of the produced data, to ensure the demanded data quality within the global Dobson network, provision with necessary equipment like notebooks (MOHp, SOO-HK).
- Scientific investigation of the principal differences between Dobson and Brewer by means of a spectral radiation model of the Ludwig-Maximilians University Munich (STAR) in connection with a diploma thesis. Simulation of the ozone observations obtained from these different types of instruments with the possibility to improve data processing algorithms (e.g. stray light problems). This might be a valuable contribution to the investigation of the above mentioned "stop of Dobson - continuation with Brewer"-issue.

Further Outlook:

Financial problems in most of the countries engaged in ozone research will dominate the near and medium-term future of the work in this field of environmetally related science. Two particular problems have occured:
- The continuation of long-term records of total ozone measured with Dobsons is questioned.
- The fulfilment of the fundamental requirement of the global Dobson calibration system - regular absolute calibration of the standard instruments (at least each two - three years) - is currently very difficult.

The unreflecting and inconsiderate replacement of Dobsons by Brewers is - as already mentioned above - no short-term solution of these problems. Scientists and engineers dealing with ozone monitoring by satellite borne instruments should be aware of the fact, that well calibrated Dobsons are still necessary for validation and verification of their ozone data. The financial funding, which is necessary to maintain the Dobson network and its calibration system, is only a fraction of that amount of money which has been and will be spent for the satellite programmes. Representatives of both Dobson and satellite community should come together and discuss, how the problems of the Dobson network can be solved. A need of such support and co-operation will be presented by RDCC representatives at all relevant occasions including at the WMO/GAW RA-VI workshop in Riga, May 2002.

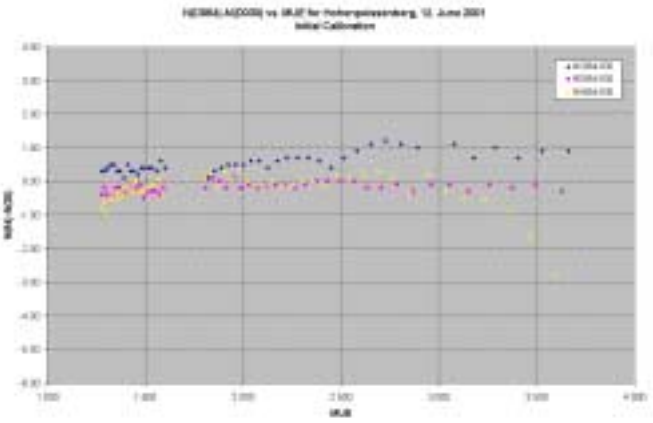
Despite all this negative developments there is currently no indication, that the fulfilment of the RDCC-tasks at MOHp/SOO-HK is generally at risk. New strategies have to be found to manage the tight money to guarantee the data quality of the European and the global Dobson network as well in the future. Since 2001 contribution of SOO-HK to RDCC activities is supported by the Project No.205/01/0003 of the Grant Agency of the Czech Republic.

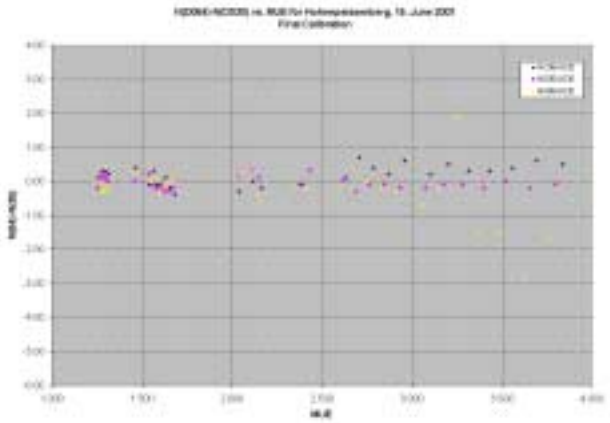
Hohenpeißenberg, January 2002 Hradec Králové, January 2002

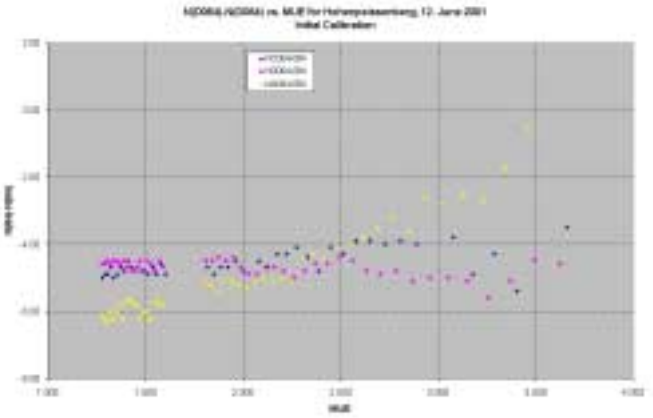
(Ulf Köhler) (Dr. Karel Vaníček)

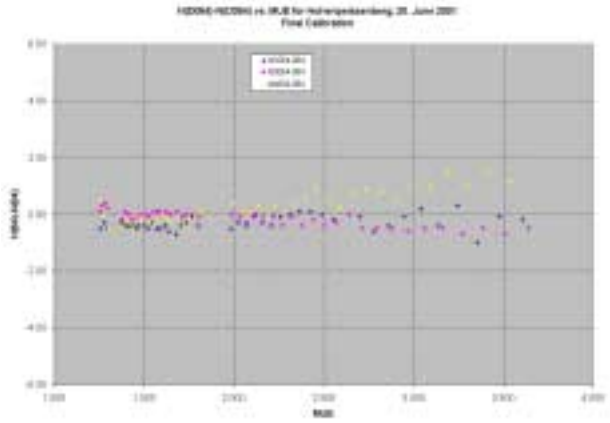
Attachments:
1. Summary graph of the Dobson calibrations (2 pages): Initial calibrations of the various instruments on the left hand, final calibrations on the right hand; shown are the differences of the raw data between standard Dobson and instruments under calibration in the three used wavelength pairs.
2. Comparison of the Russian filter instrument M124 (No.315) with the Hohenpeissenberg spectrometer Dobson No.064 and Brewer No.010.
3. Actual table of all operational European Dobson stations incl. calibration state and schedule (1 page).

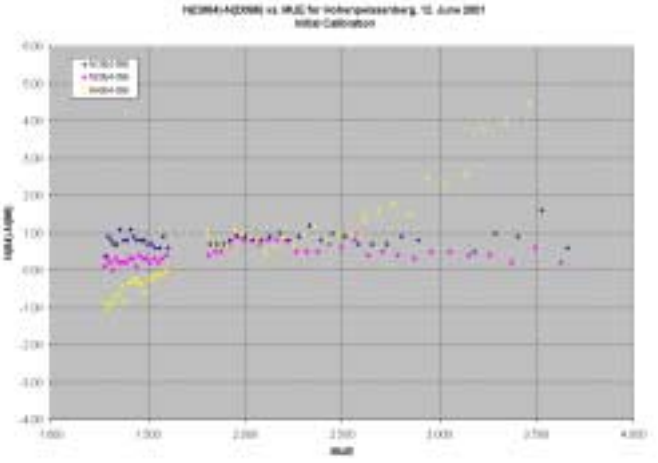
Attachment 1: Graphs of the Calibration Results

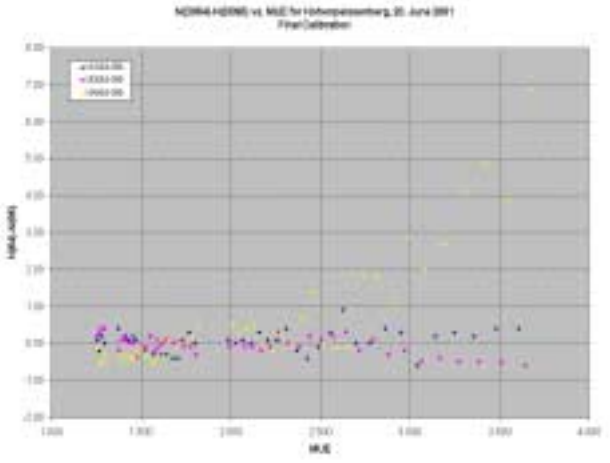


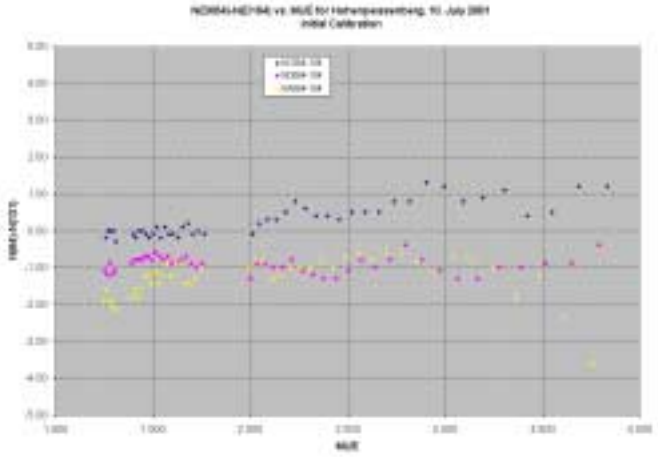


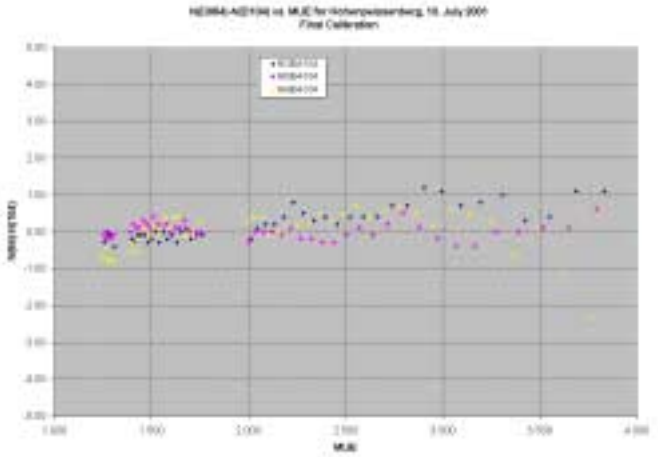


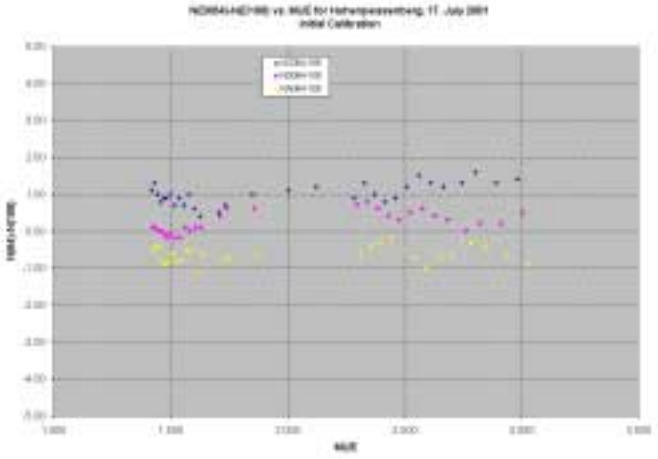


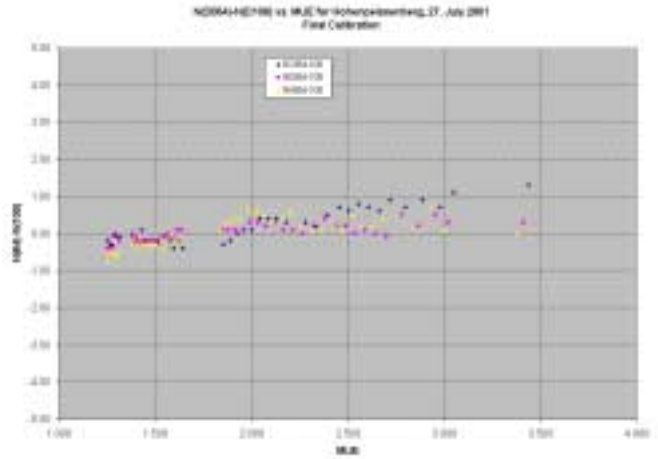


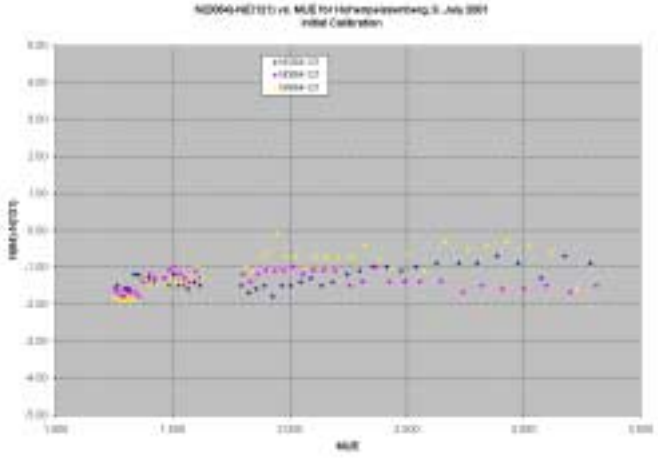


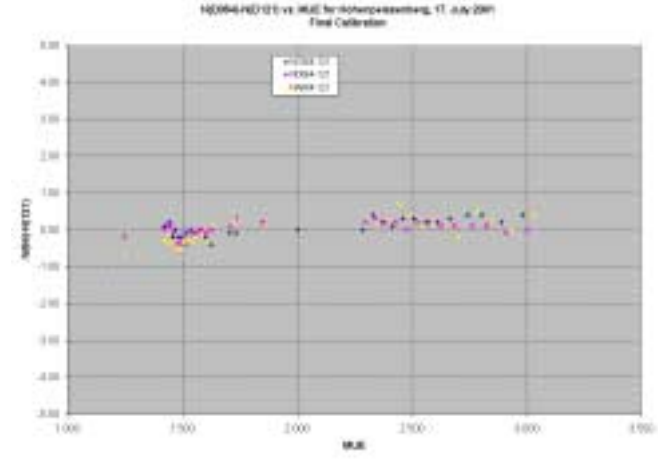




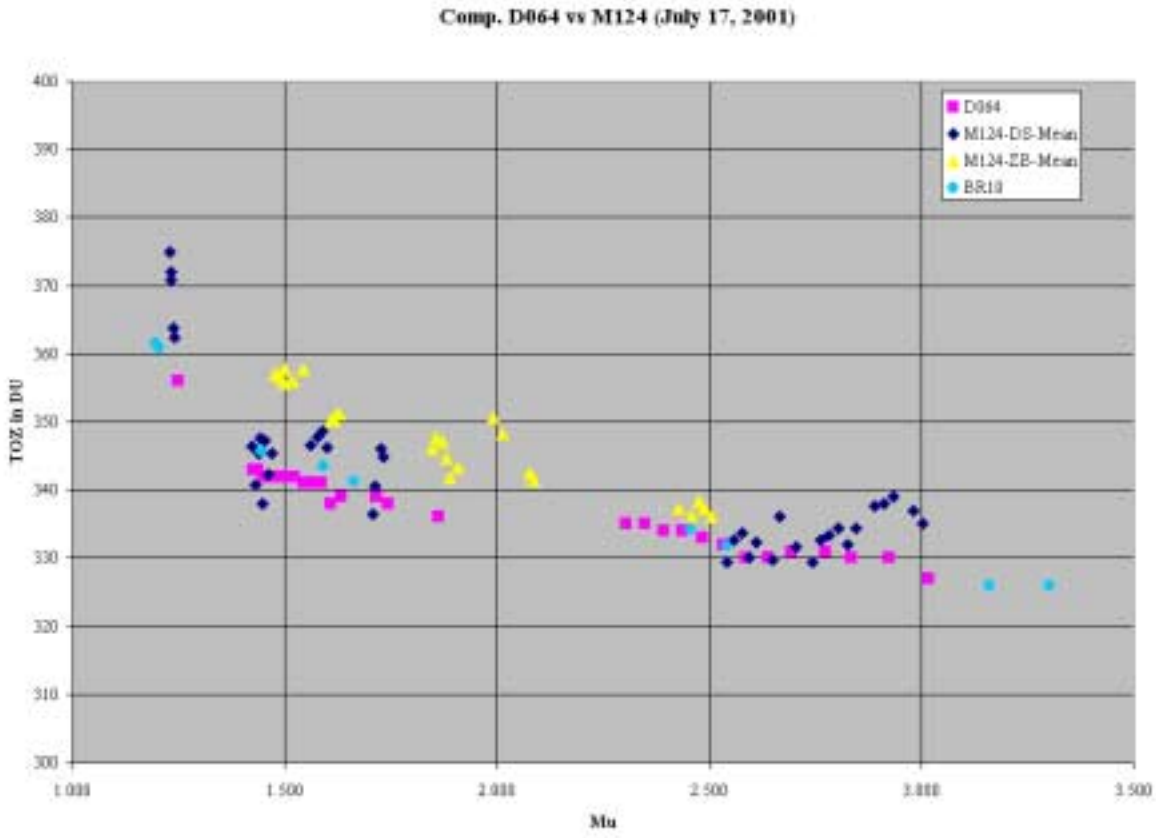








Attachment 2: Graphs of the Comparison M124 (No. 315) with D064 and BR010



Attachement 3: Table of State and Schedule for the European Dobsons

Summary of European Dobson Stations							
No.	Dobson-No.	Country	Location	Last Cal.	L. Cal. Location	Next Cal.	N.Cal. Location
1	D008	Norway	Ny Alesund			2002	MOHp
2	D013	Portugal	Lisbon	7-9/2000	MOHp	2004	MOHp
3	D014	Norway	Tromsö	5/1998	Oslo	?	?
4	D015	Switzerland	Arosa	8/78	Arosa		
5	D030	Sweden	Vindeln	6/2001	MOHp	2005	MOHp
6	D031	UK (Ukraine)	Vernadsky	?	?		
7	D032	UK	Lerwick	5-6/00	MOHp	2004	MOHp
8	D035	UK	Camborne	5-6/00	MOHp	2004	MOHp
9	D040	Belgium	Uccle	5-6/00	MOHp	2004	MOHp
10	D041	UK	Camborne	7/99	Arosa	2003	MOHp
11	D044	Armenia	Nor Amberd	8/2000	MOHp	2004	MOHp
12	D046	Italy	Brindisi	?	?	?	?
13	D047	Italy	Vigna di Valle	?	?	2002	MOHp
14	D048	Italy	Sestola	7/99	Arosa	2003	Arosa?
15	D049	France	Observatoire De Bordeaux, Floirac	7/99	Arosa	2002	MOHp
16	D050	Iceland	Reykjavik			2003	MOHp
17	D051	Switzerland	Arosa	?	?	2003	Arosa?
18	D056	Norway	Oslo	7/99	Arosa	2003	MOHp
19	D059	Egypt	Harghada	6-8/2000	MOHp	2004	MOHp
20	D062	Switzerland	Arosa	7/99	Arosa	2003	Arosa?
21	D064	Germany	Hohenpeissenberg	ref.instr.	-	2002	Boulder
22	D066	Italy	S. Pietro Capofiume	?	?		
23	D069	Egypt	Aswan	7/99	Arosa	2003	MOHp
24	D071	Germany	Potsdam	8/2000	MOHp	2004	MOHp
25	D073	UK	?	?	?		
26	D074	Czech	Hradec Kralove	7/99	Arosa	2002	MOHp
27	D084	Poland	Belsk	6/2001	MOHp	2005	MOHp
28	D085	France	Haute Provence	7/99	Arosa	2003	MOHp
29	D092	Denmark/Greenland	Thule			2003	MOHp
30	D096	Egypt	Cairo	6/2001	MOHp	2005	MOHp
31	D101	Switzerland	Arosa	7/99	Arosa	2003	Arosa?
32	D103	UK	Halley	?	?		
33	D104	Germany	Hohenpeissenberg	7/2001	MOHp	2005	MOHp
34	D107	Russia	Moscow	7/1999	Arosa	2003	MOHp
35	D108	Russia	Voeikovo	7/2001	MOHp	2005	MOHp
36	D110	Hungary	Budapest-Lorinc			?	?
37	D118	Greece	Athens	7-8/97	Kalavryta	2002	MOHp
38	D120	Spain	El Arenosillo	7/99	Arosa	2003	MOHp
39	D121	Romania	Bucharest	7/2001	MOHp	2005	MOHp
40	D123	UK	?	?	?		

Description:

Next Calibration

Calibration in 2 years

Calibration next year

Calibration recently

Status unknown/not operational