

## 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)

2002

### *Introduction:*

The European RDCC at the Meteorological Observatory Hohenpeissenberg (MOHp)/Solar and Ozone Observatory Hradec Králové (SOO-HK) continued its regular work (service and calibration of operational Dobsons in the European network) in 2002 with one international Dobson intercomparison in July (**MOHp2002**). In total 3 instruments got a maintenance service and were calibrated towards the MOHp reference instrument Dobson No. 064. One of these instruments (Italian Dobson No. 047) had been out of operation for a number of years and needed an entire refurbishment. Additionally the Regional Standard of MOHp was calibrated towards the Primary Standard Dobson No. 083 at the World Dobson Laboratory at NOAA/Boulder (USA) during a two weeks campaign in June. This calibration was transferred to the second Regional Standard D074 from SOO-HK during the MOHp2002-campaign. The function of SOO-HK as a training centre for Dobson operators was continued successfully.

Due to the Boulder-campaign (limited time frame) and some problems of originally designated participants (lack of funding or schedule problems) only three instruments plus the reference instrument got a calibration in 2002. One of the missing instruments (Dobson No. 008 from Ny Alesund, Spitsbergen, Norway) was checked with the MOHp Microtops filter instrument No. 3785 on site. The calibration of this filter instrument was examined and improved during the campaign in Boulder. Despite this small number of instruments it has again been proved, 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 Quality Assessment/Quality Control (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 provision of the Dobson community with spare parts as one of the urgent problems has been approached successfully. The complete Dobson stock of Beck/Ealing (with a lot of old, but some useful spare parts) incl. construction drawings and parts' list was transferred to MOHp. First contacts with companies (e.g. for the production of mirrors or sund directors) have been tied.

The issue "Dobson-Brewer competition" and possible replacement of Dobsons with all the subsequent problems for long term records was again a very important item. First discussions could be conducted during the calibration campaign in Boulder between U. Köhler, B. Evans and K. Vanicek. The draft of a relevant paper was finished by Johannes Stähelin (ETH, Switzerland) under the assistance of several concerned experts. U. Köhler as scientific head of the RDCC at MOHp was unfortunately not able to participate in the Brewer

workshop in Toronto in September, to meet the involved people for further discussion. An investigation of differences between Dobson and Brewer observations has been included into research works performed at SOO-HK under the project CANDIDOZ of the European Commission that started in March 2002. A complex re-construction of calibration histories of the Dobson D074 and Brewer B098 spectrophotometers from SOO-HK has been completed under the project GA-CR NO. 205/01/0003: "Development of Technologies for the European Regional Ozone Calibration Center" supported by the Grant Agency of the Czech Republic in 2002.

The following sections give a description of the offered services, the work done in 2002 and the activities planned for 2003. 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 (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 etc.), provision of spare parts (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:
  - 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 (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 2002:***

The European RDCC MOHp/SOO-HK performed the following activities at various locations in 2002:

- Maintenance and provision of the two regional reference Dobson instruments No. 064 (MOHp) and 074 (SOO-HK).
- Calibration of D064 after replacement of mirrors and optical alignment with the 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. The graphs in attachment No.1 shows the good agreement of the standard instruments and the Microtops as well after this re-calibration. Calibration of the second European standard D074 during the regular MOHp2002-campaign (MOHp, SOO-HK).
- Provision of a well calibrated Microtops filter ozonometer for in-situ calibration checks of Dobsons at their stations, here Dobson No. 008 at Ny Alesund (Spitsbergen, Norway) in July and August (MOHp).
- Technical and scientific organization, performance and evaluation of one Dobson intercomparisons MOHp2002 at MOHp with the D047 (Italy), D049 (France) and D74 (Czech Republic) from July 14 to July 27 (MOHp2002). Complete refurbishment of the Italian D047, having been out of operation for several years, before the campaign. The graphs in attachment No.2 give a good impression of the success of the calibrations (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).
- 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 2 Dobson observers from Argentina and Uruguay at SOO-HK (18.-31.06.2002) 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 of Dr. Vanicek in the Brewer workshop in Toronto in September 2002 - presentation on a basic needs for a closer co-operation between Dobson and Brewer calibration infrastructures, mainly in the RA-VI region (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 and inventory of the complete Dobson stock and construction drawings of the former manufacturer Ealing Company to Hohenpeissenberg in January), final upgrading of the facilities like the optical laboratory by purchasement of corresponding accessories, construction of two sun directors as spares for RDCC (MOHp, SOO-HK).
- 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 2002 and at the meeting of the Scientific Advisory Group for Ozone of WMO/GAW in Toronto, September 2002 (MOHp, SOO-HK).
- Publication of a detailed report on the campaigns in 2000 and 2001 as WMO/GAW report No. 145 and also on the Dobson Web Page of SOO-HK (URL see above) (MOHp, SOO-HK).
- Beginning of the preparations for the next Dobson-campaigns held in MOHp and Arosa in 2003 (MOHp).
- 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 of calibration constants of the Dobson D074 and Brewer B098 spectrophotometer operated at SOO-HK in the period 1961-2002 and preparation of a relevant report (SOO-HK).
- Beginning 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 (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 Vaniček, head of the SOO-HK  
 Dr. Wolfgang Steinbrecht, scientist (MOHp)  
 Ing. Martin Stanek, engineer (SOO-HK)  
 Ing. Fritz Schönenborn, electronic engineer (MOHp)  
 Jiří Pokorný, technician (SOO-HK)  
 Bert Dömling, technician (MOHp)  
 Ferdinand Strommer, technician (MOHp)  
 Alois Stögbauer, workshop (MOHp)

### ***Plans for 2003:***

The following list gives an overview about the intended activities in 2003:

- Technical and scientific preparation, organization, performance and evaluation of three Dobson inter-comparison, two at MOHp, one at Arosa, with support from SOO-HK, participation of Martin Stanek during MOHp2003-1 and Arosa 2003 (MOHp, SOO-HK):
  - MOHp2003-1, tentatively from June 1 to June 14.  
Possible participants are 2 instruments: from Russia (D107, Valery Dorokhov) and Greece (D118, Costas Varotsos), additionally two Italian instruments (D046 and D113), which are currently out of operation, are intended to be refurbished and included in the calibrations. The proposed instruments D008/D056 (Norway, Arne Dahlback), D050 (Iceland, Bardi Thor kelsson) and D092 (Denmark/Greenland, Paul Eriksen) have again to be shifted to 2004 due to timing problems (see table in attachment) (MOHp, SOO-HK).
  - MOHp2003-2, tentatively from June 29 (22) to July 12.  
Possible participants are 2 instruments: from UK (D041, David Moore) and Spain (D120, Jose Vilaplana). The instrument from UK will get the new US-type electronic. The proposed Egyptian D069 has been shifted to 2004, as it is planned to combine the calibration of at least two of the three Egyptian Dobson from financial reasons. It is in consideration to organize one intercomparison in Egypt, possibly in co-operation with the African RDCC South-Africa.
  - Arosa 2003, tentatively from July 20 to August 2.  
Possible participants are 5 instruments: the three Swiss instruments D051, D062 and D101 (Rene Stübi, Herbert Schill), from Italy (D48, Francesco Denile) and from France (D085, Marie-Renee De Backer-Barilly).
- DAHC-Meeting in the second week of the Arosa2003-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).
- Presentation of the latest activities and outputs of RDCC-E at the annual meeting of WMO SAG-Ozone, Prague, October 2003
- 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 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.
- Continuation of the scientific investigation of the principal differences between Dobson and Brewer by means of a spectral radiation model of the Ludwig-Maximilians University Munich (STAR) and under the EC project CANDIDOZ. 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 "Dobson - Brewer competition"-issue and for validation of satellite total ozone observations - mainly from GOME and SCIAMACHY missions of ESA.

### ***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. Two particular problems have already been mentioned in the 2001-report:

- 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 Staehelin et al.-paper about "Comparison of total ozone measurements of Dobson and Brewer spectrophotometers and recommended transfer functions", initiated by an agreement of the DAHC-members, will be a good guidance how to handle the parallel existing of Dobson and Brewer at a considerable number of stations and a possible transition from one instrument to the another. Karel Vanicek and Emilio Cuevas prepared a paper about a possible regional Brewer calibration system, which is designed to achieve a calibration quality of the European Brewers similar to that in the Dobson network. This activity shows that there is still some work to do before the Brewer data will have reached the quality of the long-term Dobson records. Hence the statement in the RDCC-Report 2001 is still valid:

The unreflecting and inconsiderate replacement of Dobsons by Brewers is 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 and how the strategic plan for creation of an integrated ground-based and satellite ozone monitoring system can be realized, as specified in the WMO/GAW Report No. 140 (WMO TD No.1046, Geneva, 2001).

Some possible developments and/or proposals, arising during the past months, might be good steps to guarantee the future of the high-quality Dobson network despite of all financial problems of countries and institutions. The considered WMO trust fund for the global Dobson observation and calibration network could overcome the problems how to fund the necessary activities like International Dobson Intercomparisons, in particular with participants from developing countries or countries with transition economies, or the absolute calibration campaigns for the reference instruments. This trust fund in combination with new strategies (e.g. pooling of appropriate Dobsons for on-site calibrations like the Arosa2003-campaign or the considered Egyptian campaign in 2004) will enable to reduce the expenditures of money and manpower. The co-operation between MOHp and SOO-HK within the scope of RDCC - RA VI is a good example, how successful the distribution of work and expenses on more than one shoulder and the use of synergy effects can work.

Hohenpeißenberg, February 2003

Hradec Králové, February 2003

(Ulf Köhler)

(Dr. Karel Vaniček)

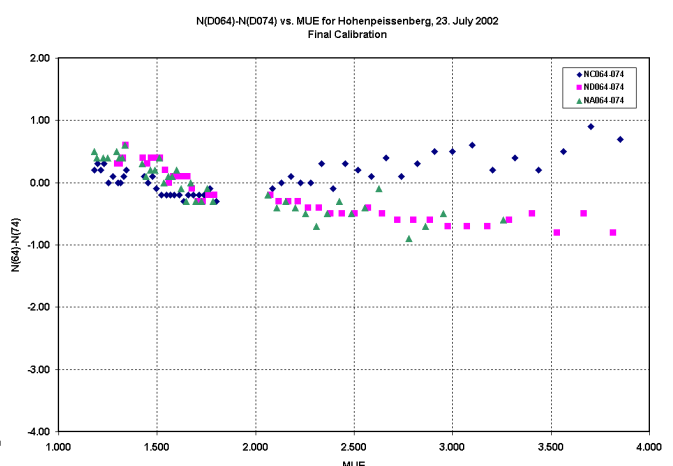
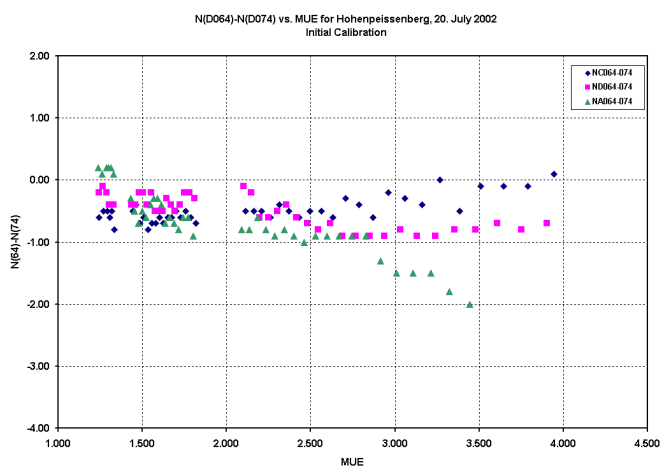
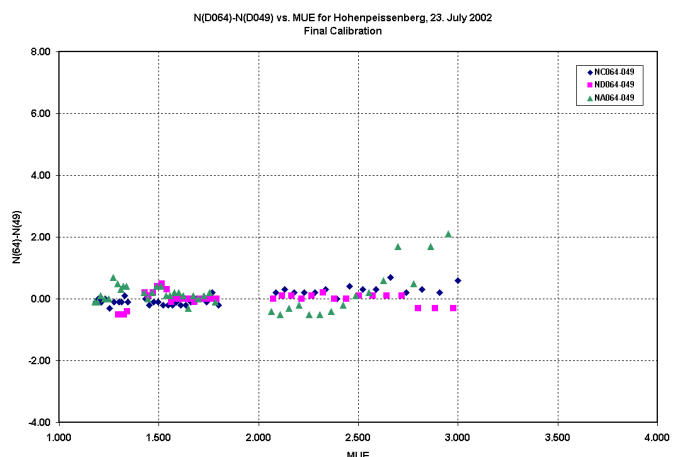
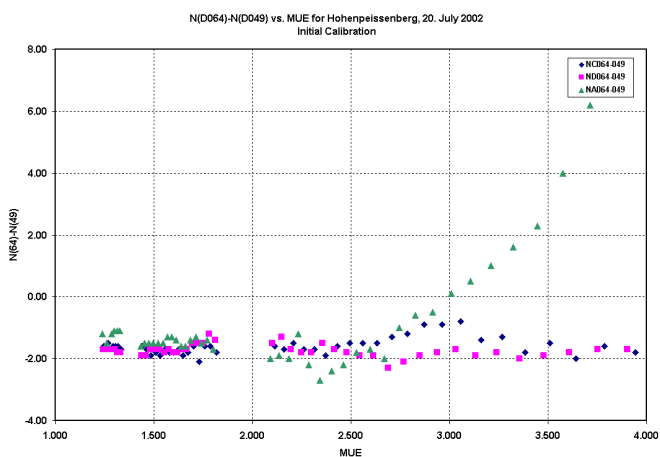
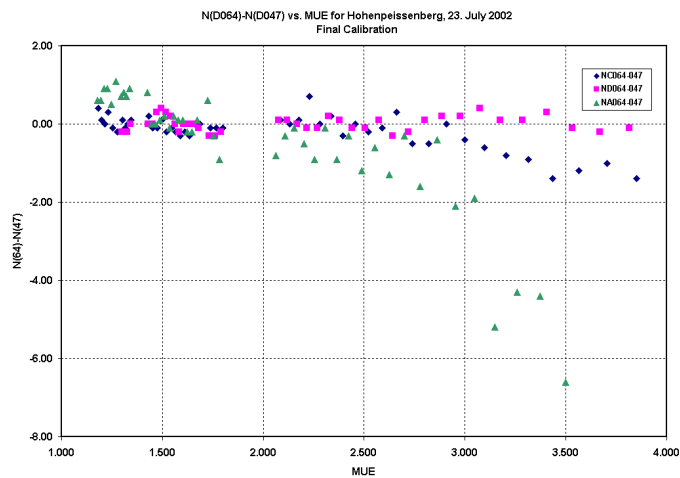
Attachments:

1. Summary graphs of the Dobson calibrations (1 page): 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. Actual table of all operational European Dobson stations incl. calibration state and schedule (1 page).

## Attachment 1: Graphs of the Calibration Results

As the Dobson No. 047 has been out of operation during the past years, no initial calibration exists. After all electrical, mechanical and optical work only a final calibration was performed.

Below are the graphs for the French (D049) and the Czech (D074) Dobson, left panel initial and right panel final calibration.





Attachement 2: 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
10	D041	UK	Camborne	7/99	Arosa	2003	MOHp
12	D046	Italy	Brindisi	?	?	2003	MOHp?
14	D048	Italy	Sestola	7/99	Arosa	2003	Arosa
17	D051	Switzerland	Arosa	?	?	2003	Arosa
20	D062	Switzerland	Arosa	7/99	Arosa	2003	Arosa
28	D085	France	Haute Provence	7-8/95	Arosa	2003	Arosa
31	D101	Switzerland	Arosa	7/99	Arosa	2003	Arosa
34	D107	Russia	Moscow	7/1999	Arosa	2003	MOHp
37	D113	Italy	Cagliari/Elmas			2003	MOHp?
38	D118	Greece	Athens	7-8/97	Kalavryta	2003	MOHp
39	D120	Spain	El Arenosillo	7/99	Arosa	2003	MOHp
1	D008	Norway	Ny Alesund			2004	MOHp
2	D013	Portugal	Lisbon	8/2000	MOHp	2004	MOHp
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
11	D044	Armenia	Nor Amberd	8/2000	MOHp	2004	MOHp
16	D050	Iceland	Reykjavik			2004	MOHp
18	D056	Norway	Oslo	7/99	Arosa	2004	MOHp
19	D059	Egypt	Harghada	6-8/2000	MOHp	2004	Egypt?
21	D064	Germany	Hohenpeissenberg	6/2002	Boulder	2004	Boulder
23	D069	Egypt	Aswan	7/99	Arosa	2004	Egypt?
24	D071	Germany	Potsdam	8/2000	MOHp	2004	MOHp
26	D074	Czech	Hradec Kralove	7/2002	MOHp	2004	MOHp
29	D092	Denmark/Gree	Thule			2004	MOHp
30	D096	Egypt	Cairo	6/2001	MOHp	2004	Egypt?
5	D030	Sweden	Vindeln	6/2001	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
3	D014	Norway	Tromsø	5/1998	Oslo	?	?
36	D110	Hungary	Budapest-Lorinc			?	?
4	D015	Switzerland	Arosa	8/78	Arosa		
6	D031	UK (Ukraine)	Vernadsky	?	?		
22	D066	Italy	S. Pietro Capofiume	?	?		
25	D073	UK	?	?	?		
32	D103	UK	Halley	?	?		
41	D123	UK	?	?	?		
<b>Description:</b>							
<b>Next Calibration</b>				<b>Calibration in 2 years</b>			
<b>Calibration next year</b>				<b>Calibration recently</b>			
<b>Status unknown/not operational</b>							