

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

2006

Introduction:

The European RDCC-E 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 2006 with the organization and realization of one regular campaign with four instruments from June 18 to July 1 at MOHp (D103, D104, D113, D118) towards the reference D064 and one extra campaign for three Swiss Dobsons with special optical work from July 10 to 21 (D051, D062, D101 towards the reference D074). The Lindenberg (MOL) Dobson No. 071 (formerly Potsdam) was checked in September 2006 due to some uncertainties in the comparison with the local Brewer.

In total 7 European Dobsons got a regular maintenance service and were calibrated towards the European reference instruments D064 (MOHP) and D074 (SOO-HK), respectively. One instrument - the Dobson No. 103 from the **British Antarctic Survey (BAS)** - was undergone a complete refurbishment (replacement of the old fashioned electronics by the new US type with the MOHp-modification, optical and mechanical work).

The MOHp reference D064 participated in the SAUNA (**Sodankylä Total Column Ozone Intercomparison**) international campaign for total ozone column measuring instruments at the Arctic Research Centre (ARC) of the Finnish Meteorological Institute (FMI) in Sodankylä from March 20 to April 14, 2006. More than 20 scientists and technicians from 8 countries participated with 11 ground based instruments (Dobson, Brewer, SAOZ, DOAS + Ozone sonde and LIDAR) in the SAUNA. 13 Satellite-borne instruments on 8 platforms formed the “space-part” of this campaign. The regular, biannual calibration of the European secondary standard D064 against the world standard D065 was subsequently carried out at Hohenpeissenberg from April 18 to 27, 2006.

The Microtops No. 3128 instrument, calibrated and maintained in 2005 after ten years of continuous operation at MOHp, showed good agreement with the spectrometers. As the traveling Microtops No. 3785 was not ordered for a calibration check its doubtful calibration (too low values by several percent) was not improved.

Spare parts supply of the Dobson community, mentioned in the former RDCC-E reports as one of the urgent tasks, is no longer a serious problem. A lot of various new spare parts (new special microammeters, shutter motors, SL- and HG-power supplies, electronic thermometers etc.) are available now at MOHp and can be ordered if needed. Again several pairs of old mirrors with scratched and contaminated surfaces were recoated and are available for replacement. The production of new wedges (tracks and slides) in the

own workshop at the MOHP has begun and contact with a company for the production of the wedge plates has been established.

The excellent “Dobson – Brewer co-operation” was continued during 2006. Members of expert groups met several times during international meetings (e.g. at the WMO/GAW SAG for Ozone and IGACO Ozone meetings at Athens, Greece; unfortunately the NDACC meeting at the Observatoire Haute Provence in France could not be attended by U. Köhler due to the 225th anniversary celebration at the MOHP at the same time). Status Quo and future Dobson activities were discussed by experts of DAHC during the SAG Ozone meeting. New discussions about the accuracy of total ozone data measured from ground station instruments and from space were raised due to the observed differences between Dobson, Brewer and satellite borne instruments. Especially the new TOMS data algorithm Vs. 8 versus Brewer data provides worse agreement than Vs. 7. The implementation of new sets of ozone absorption coefficients is now in discussion. Comparisons of the long term Dobson and Brewer records from Hohenpeißenberg and Hradec Králové with the latest satellite data sets TOMS-V8 and GOME-WFDOAS revealed some very interesting features. Some of them have been reached under the EC funded project CANDIDOZ, (2002-2005). The results confirm the importance of measuring the thickness of the ozone layer with different and totally independent instruments simultaneously at well-maintained GAW stations. Therefore, the validation activities of the current and planned satellite missions will continue at both DAHC-E observatories.

Training courses organized by SOO-HK in cooperation with WMO for operators of Dobson spectrophotometers from GAW ozone stations located outside RA-VI. are continued. This long-term educational programme represents the contribution of the RDCC-E to the Capacity Building on monitoring of the ozone layer in developing countries.

Taking into account the above activities realized in 2006 the MOHP and SOO-HK have again confirmed, that they are able to meet the demands on maintenance the high quality calibration level in the expanded Dobson network in Europe and also assist in the field of Capacity Building in other regions. The Quality Assessment/Quality Control (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 on a long term basis and will contribute to realization the ozone monitoring goals anchored in the GAW Strategic Plan. **Attachment 2** (updated) proves the benefit of the Dobson calibration system for the data quality.

The following sections give a description of the offered services, the work done in 2006 including results achieved and the activities planned for 2007. The outlook will outline further intentions in the near future.

Offered Services:

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

- Maintenance/provision of absolutely calibrated regional reference instruments (D064 at MOHP, D074 at SOO-HK), being regularly compared with standard instruments of the WDCC (NOAA/GMD Boulder, Colorado). These comparisons (as done in June 2002, February/March 2004 and April 2006) 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 calibration campaigns at MOHP, until 2003 2 – 3 campaigns per year (each 2 – 3 instruments). From 2004 onwards only one campaign per year will be held at Hohenpeißenberg (up to 5 instruments which need intensive service). Well maintained Dobsons with minor problems will be gathered once per 4-5 years in larger campaigns (10 instruments in the maximum) organized either at El Arenosillo (Spain) or Arosa (Switzerland) and assisted by RDCC specialists from MOHP and SOO-HK. The reason is that the Hohen-

peißenberg facility does not allow to handle more than 5 instruments during one IC. The first larger campaign at El Arenosillo will be held in September 2007 (MOHp, SOO-HK).

- Refurbishment of Dobsons being out of operation and/or spectrophotometers that are equipped with old components (e.g. installation of new electronics – the US style modified by MOHp etc.), supply of spare parts. New sources for some special parts (e.g. sun director produced by a Czech workshop, providers of new type of a small and stable SL-power supply, improved and therefore more stable HG-lamps incl. power supply, wedge plates with appropriate transmission gradient, a modern shutter-motor and a microampere meters) have been found or are under investigation. The mechanical parts of the wedge (tracks and slides can now be produced in the MOHp workshop (mainly MOHp with support of SOO-HK).
- Service for the European Dobson stations, technical/scientific support additional to the regular inter-comparisons (MOHp, SOO-HK) including the 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).
- Upgrade and implementation of the new Dobson Standard Operating Procedures in co-operation with WDCC Boulder, WMO and Dobson Ad-Hoc Committee (MOHp, SOO-HK).
- Thorough and continuous analyses/control of data quality, support/advice in data re-evaluations, comparisons with other instruments (e.g. other Dobsons, Brewers). Detection/explanation/quantifying of principal differences between particular types of instruments including validation of satellite observations in close co-operation with the **Dobson Ad-Hoc Committee (DAHC)**, the **Brewer Ad-Hoc Committee (BAHC)** of GAW and . the **WMO SAG (Scientific Advisory Group) Ozone** - U. Köhler and K. Vanicek as the members. (MOHp, SOO-HK)
- Education and training of Dobson operators for the regular operation, standard tests and maintenance of instruments and unified data processing both for the RA-VI and stations located in developing countries including newly established stations with re-located instruments 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, two new improved versions are planned to be produced. Thus two units will be available for other calibration centres (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 (MOHp).
 - 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).

- Stock with selected pieces of spare parts (New US-type electronics, SL- and HG-power supplies, phototubes, microammperemeters, mechanical wedge parts, optical components etc.) (MOHp).

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 2006:

The RDCC-E MOHp/SOO-HK performed the following activities at various areas in 2006, partly in close co-operation with the WDCC and other RDCC's and GAW facilities - responsibilities are given in brackets (**MOHp** = Meteorological Observatory Hohenpeißenberg; **SOO-HK** = Solar and Ozone Observatory Hradec Králové; **WDCC** = World Dobson Calibration Center at NOAA, Boulder):

- Maintenance and provision of two regional reference Dobson instruments No. 064 (MOHp) and No. 074 (SOO-HK); in April 2006 D064 was intercompared and calibrated with the world standard D065 from Boulder.
- Technical and scientific organization, performance and evaluation of one regular Dobson intercomparisons held at the RDCC-E Hohenpeißenberg: MOHp2006 with the D103 (UK-BAS), D104 (Germany), D113 (Italy) and D118 (Greece) from June 18 to July 1. Additionally one extra campaign was arranged for the Swiss D051, D062 and D101 at Arosa, Switzerland. Results of these campaigns are given in **Attachment 1**: Both panels show the difference between the N-values ("raw data") of standard instrument D064/D074 and the Dobsons to be calibrated. Left panel before adjustment during the initial calibration, right panel after adjustment during the final calibration. 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) (MOHp, SOO-HK).
- Check of calibration of the Lindenberg (MOL) Dobson D071 in September 2006.
- The Microtops filter ozonometer No. 3785 for in-situ calibration checks of Dobsons at stations was not used for this purpose in 2006. Currently the calibration level of these instruments continues to be not correct again, as the ozone values have been low by more than 2% in comparison with the spectrometer. In addition the Microtops instrument No. 3128 kept its calibration level rather stable after complete repair and calibration service at Solar Light during July and August 2005 (MOHp).
- Regular calibration services of the Brewer B010 (MOHp) were carried out by IOS (Martin Stanek for Ken Lamb, Toronto) in May 2006.
- The complete refurbishment (replacement of electronics, optical alignment) of the BAS Dobson D103 was finished in 2006 and this instrument then participated in the MOHp2006-IC in June (MOHp). Now all four BAS Dobsons have been completely overhauled and calibrated.
- Participation and presentation of contributions on activities of RDCC-E at international meetings and campaigns:
 - SAUNA campaign at ARC-FMI Sodankylä from March 20 to April 14 (MOHp).
 - The meeting of the WMO/GAW Scientific Advisory Group for Ozone (SAG-Ozone) and IGACO Ozone Workshop, Athens, Greece, May 14 – 19, 2006 incl. DAHC-discussions of the current state of the Dobson network, future developments e.g. re-location of unused Dobsons to other or new GAW stations, problems at various stations with instrumentation, operation, evaluation of data records and co-operation between Dobson and Brewer groups in the RA-VI, updating of the Dobson Standard Operation Procedures SOP's (MOHp, SOO-HK).

- The ICCED - Co-operation of Meteorological Observatories in Central Europe - the Working Group Meeting, Lindenberg, Germany, 23-25.01.2006 (SOO-HK).
- Contribution to the drafts of the User Guidance Instructions UGI and Data Quality Objectives DQO, which are initiated by the WMO SAG for Ozone (MOHp, SOO-HK).
- Contribution of experts of the RDCC-R to preparation of the Chapter 16 - "Measurement of Ozone" in the new edition of the CIMO Guide (Guide to Meteorological Instruments and Methods of Observation, 7-th Edition, WMO/CIMO/-No. 8, World Meteorological Organization, Geneva, Switzerland, 2006).
- Supervision of the new Dobson station in Armenia, monitoring of the produced data and test results (MOHp).
- Transfer of the D035 (UK) to the new station Marion Island (South Africa).
- Continuation of the discussion and possible decisions about the further deployment of unused Dobsons (new candidates for a transfer to new stations are instruments from Hungary D120, Italy D046, Belgium D040, Norway D008 and D014) in the frame of WMO/DAHC (WDCC, MOHp, SOO-HK).
- Technical check/adjustment of D049 (former Bordeaux) and upgrade of the software package at the observatory Midi-Pyrenees, France, March 2006, (SOO-HK).
- Training of two Dobson observers from the regional GAW station Nairobi, Kenya, September 2006. Unfortunately, the capacity building project sponsored by the Czech Government expired in 2006 and thus the future training activities can be held only if external funds are available. (SOO-HK).
- Expert assistance to the intercomparison of Dobson instruments from selected Asian stations at RDCC-Asia, Tsukuba, Japan, March 2006. This mission was an example of the partnership between RDCCc and it also resulted in the partial re-evaluation of the Dobson data series from the Bangkok station that is to be published as a WMO report and will serve as the pilot study to similar re-evaluations now being initiated by the SAG-Ozone. (SOO-HK).
- Further development and improvement of the semi-automated wedge calibration unit (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 with the following URL: <http://www.chmi.cz/meteo/ozon/dobsonweb/welcome.htm>. (SOO-HK).
- 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, wedge tracks and slides) (MOHp, SOO-HK).
- Beginning of the arrangement of next Dobson-campaigns to be held at MOHp and El Arenosillo in 2007 (MOHp, SOO-HK).
- Planning of the technical support during the RBCC-campaign at El Arenosillo in September 2007 and comparison with Dobsons (MOHp).
- Investigation of relation between Dobson, Brewer and recent satellite data sets from collocated measurements performed at MOHp and SOO-HK and their presentation (e.g. Vanicek K. 2006: Differences between ground Dobson, Brewer and satellite TOMS-8 and GOME-WFDOAS total ozone observa-

tions at Hradec Kralove, Czech. Atmos. Chem. Phys. Discuss., 6,5839–5865, 2006) (MOHp. SOO-HK).

- A more detailed investigation of the comparison between MOHp D104/BR010 and the latest TOMS Version 8 was done and confirmed the findings of worse agreement at least for the Hohenpeissenberg data. A discussion started about new sets of absorption coefficients for both ground based and satellite-borne instruments. It was proposed to organize absolute calibrations for both types of spectrometer at Izaña at the same time and to measure the slit functions of Dobsons in the laboratory.
- Expert consultations provided to the newly established Regional Brewer Calibration Centre of RA-VI at Izana, Spain (SOO-HK).
- Contribution of the RDCC-E to the building up the joint GAW/IGACO infrastructure in the area of total ozone observations.

The following staff was responsible for the realization of the above 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)
Jiří Pokorný, technician (SOO-HK)
Bert Dömling, technician (MOHp)
Ferdinand Strommer, technician (MOHp)
Alois Stögbauer, workshop (MOHp)
Johannes Eding, electrical workshop (MOHp)

The below listed colleagues participated in the MOHp2006-IC campaign (in alphabetical order):

Mr. Ioannis Christodoulakis, Dobson operator (University of Athens, Greece)
Mrs. Catherine Moore, Dobson operator (BAS, United Kingdom)
Mr. Emanuele Vuerich, scientist (Italian Airforce Meteorological Service, RESMA Vigna di Valle, Italy)

In Arosa the following colleagues organized and carried out the Arosa2006-IC (in alphabetical order):

Mr. Rudi Burren, station head (LKO Arosa, Switzerland)
Mrs. Bea Meister, Dobson operator (LKO Arosa, Switzerland)
Mrs. Maude Neininger, Dobson operator (LKO Arosa, Switzerland)
Mr. Herbert Schill, scientist (LKO Arosa, Switzerland)
Dr. Rene Stuebi, scientist (Payerne, Switzerland)

Plans for 2007:

The following list gives an overview about the intended activities to be performed in 2007:

- Technical and scientific preparation, organization, performance and evaluation of two Dobson inter-comparisons :
 - **MOHp2007**, tentatively from June 10 to 23. Expected participants are 4 or maximal 5 instruments: from Sweden/Norrköping (D030, Weine Josefsson), Italy (D047 and D048, Emanuele Vuerich), Iceland (D050, Arni Sigurdsson) and Russia (D107, Valery Dorokhov) (MOHp).
 - **El Arenosillo 2007**: tentatively from September 2 to 15: Expected participants are from Portugal (D013, Ana-Marisa Delgado), UK (D041, David Moore), France (D049, Philippe Recaud), Spain (D120, Jose Manuel Vilaplana) and Romania (D121, Constantin Rada).
- Maintenance of the D064 as the primary and the D074 as the secondary regional reference spectrophotometers
- Complete refurbishment (at least installation of new US-type electronics), optical alignment and calibration of D050 from Iceland at Hohenpeißenberg (MOHp) and calibration during MOHp2007.
- At least beginning of refurbishment of D046 (Italy) and possible calibration during the MOHp-2008, if finished until then (MOHp).
- Continuation of the discussion and possible decisions about the further deployment of unused Dobsons (candidates for a transfer to new stations are instruments from Hungary D120, Italy D046, Belgium D040, Norway D008 and D014) in the frame of WMO/DAHC. All need an overhaul and calibration service before (WDCC, MOHp, SOO-HK).
- Hosting of the sub-regional intercomparison of Brewer spectrophotometers (Czech, Hungary, Poland and Slovakia) accompanied by the simultaneous comparative total ozone observations taken with the regional Dobson secondary reference D074 in May 2007 (SOO-HK)
- Expert assistance to the Dobson and Brewer intercomparisons at ElArenosillo, Spain, September 2007 - according to requests of the scientific committee (SOO-HK).
- Presentation of particular RDCC-E activities at:
 - The meeting of the WMO/GAW Scientific Advisory Group for Ozone (SAG-Ozone) and the corresponding Pre-SAG-Meeting of the Technical Panel at Puerto de la Cruz (Tenerife), April 22 - 29, 2007 incl. a DAHC-discussions of the current state of the Dobson network, future developments e.g. relocation of unused Dobsons to other or new GAW stations, problems at various stations with instrumentation, operation, evaluation of data records and co-operation between Dobson and Brewer groups in the RA-VI, updating of the Dobson Standard Operation Procedures SOP's (MOHp, SOO-HK).
 - The WMO-GAW/NDACC meeting at Geneva in October 2007 (MOHp).
 - The NDACC (former NDSC) Steering Committee Meeting, Hawaii, November 2007 (MOHp).
- The instruction for the application procedure "Dobson Relocation" is under preparation (MOHp, SOO-HK)
- Continuous updating of the Dobson Web Pages with the aim to get comments of visitors and to announce actual events related to the GAW Dobson network; designing and creating a RDCC-E-Web Page at the MOHp-server as a supplement to the Czech web site (SOO-HK, MOHp).

- 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 Kenya and monitoring of the produced data, to ensure the demanded data quality within the global Dobson network (MOHp, SOO-HK).
- Continuation of detailed investigations Dobson-Brewer-satellite and Dobson-SAOZ total ozone measurements exploiting the data of the SAUNA-campaign and of long term series of stations with well-known high data quality. Presentation of the results at appropriate meetings (e.g. NDACC SC meeting) (MOHp)..
- Support of Dobson and Brewer stations with medium or long term records with the data examination and possibly necessary re-processing according the findings and recommendations of the WMO SAG Ozone and the Technical Panel group. In this context the use of the homogenized satellite data records to determine doubtful total ozone records of ground based instruments (breaks, biases, stealthy deterioration) will be a very helpful tool (MOHp, SOO-HK).
- Participation of experts in national/international events on celebration of the 20-th anniversary of the Montreal Protocol including presentation of scientific outputs (MOHp, SOO-HK).

Further Outlook:

The financial problems in the past years in most of the countries engaged in the ozone monitoring and research have not been improved yet. Thus following two particular problems, already mentioned in the previous Annual Reports, are still on the agenda:

- 1) The continuation of long-term records of total ozone measured with Dobsons is questioned in some institutions.
- 2) The realization of the fundamental requirement of the global Dobson calibration system - the regular absolute calibrations of the standard instruments (at least each two/three years) - is currently very difficult. Efforts to raise funding from satellite agencies have not been successful yet, but new promising negotiations are ongoing.

Number of unused Dobsons available for a possible relocation is still increasing. Some of these instruments have already found new locations. The discussion of the future operation of the remaining instruments will be continued in the WMO/DAHC and WMO SAG for Ozone. Decisions will be made in a close coordination with the lending countries/institutions and the candidates for new Dobson stations. The financial aspects of these transfers could partly be solved by the support of WMO/AREP and MP Trust Fund. There is, however, the need to provide enough financial resources for this trust fund. At the recent WMO SAG Ozone at Tenerife, 2007 meeting a recommendation was stated, that “the WMO Secretariat asks all GAW country contacts to approach their respective foreign ministries asking for donations to the Vienna convention Trust Fund for Ozone Research and systematic observations. To assist the country contacts, the WMO will draft a letter template that can be used.”

The refurbishment and standardization of the instruments from the GAW network continues to remain an important goal for the coming years. The replacement of the large variety of old electronics by the new US-type with MOHp-modification etc. should continue. Each Dobson designated for relocation should be undergone such a renewal. The costs for this activity can partly be covered by the official RDCC-E-budget of the German Weather Service DWD depending on the financial situation of the operating institution/country. Though the development project of the Czech Government on the Capacity Building expired in 2006 limited funds are still available from the budget of the CHMI that allow the SOO-HK experts to continue participation of the Observatory in the duties and activities of the RDCC-E.

The Staehelin's 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 still a good guidance how to handle the parallel Dobson and Brewer data series created at a considerable number of stations. On the initiative of the WMO SAG for Ozone two papers will be published to improve public information about the quality of measurements of the total ozone column (TOC) by Dobson and Brewer and the available data sets. These publications are:

- User Guidance Indicators UGI for the TOC data of Dobson & Brewer in the WOUDC/Toronto (Hare).
- Data Quality Objectives DQO of TOC-measurements by Dobson & Brewer (Staehelin, Evans, Köhler, McElroy, Vaníček).

Detailed results of the comparison Hohenpeissenberg and Hradec Králové Dobson/Brewer data with TOMS and other satellite instruments - processed with the latest algorithms Version 8 - confirm the need of a certain number of selected high quality stations, where parallel operation of both types of spectrophotometers are continued (s. **Attachment 3**). Comparison between the overpass data Hohenpeissenberg of Nimbus 7 Vs. 7 and Vs. 8 revealed, that something happened in the satellite data record during the winter months December, January and February (s. **Attachment 4**). Similarly, comparison of the overpass total ozone observations taken with the OMI instruments towards the ground (Dobson and Brewer) measurements shows remarkably different results if processed by the TOMS and KNMI-DOAS algorithms. This phenomenon needs to be further investigated by means of the high-quality ground data sets. Thus, it is again confirmed, that these kind of reference stations are the fundament for continuous reliable validation of satellite data measured especially with the new generation of instruments, which will be one of the key activities of the two branches of the GAW total ozone monitoring network with synergetic effects. Further investigations of the principal differences between Dobson and Brewer data series are still very important in this context. The implementation of the findings related to the different temperature dependences of the Dobson and Brewer absorption coefficients in a potential data correction gave encouraging results (s. **Attachment 5**). In addition the issues of the determination and introduction of new sets of absorption coefficients for the various types of instruments and the laboratory measurements of slit functions (e.g. of the reference Dobsons) are getting more and more importance.

Absolute Calibration after Langley at Izaña simultaneously for the reference Brewer and Dobson is planned to be organized in 2007 under potential funding from a third party.

The modified calibration scheme with only one campaign per year at MOHp has been applied during the past 2 years and has turned out to be practicable and without any obvious negative effect on the calibration quality of the European. This new concept with a combination of annual small MOHp-campaigns for labour-intensive instruments and a quadrennial medium size intercomparison for Dobsons with less demand on repair service has already reduced the amount of necessary work significantly. The first "bigger" campaign in El Arenosillo (INTA, Spain) is scheduled for September 2007. All the above mentioned activities follow the general goal – the implementation of the current ground GAW ozone monitoring infrastructure as an efficient part of the IGACO system.

Hohenpeissenberg, June 2007

Hradec Králové, June 2007

(Ulf Köhler)

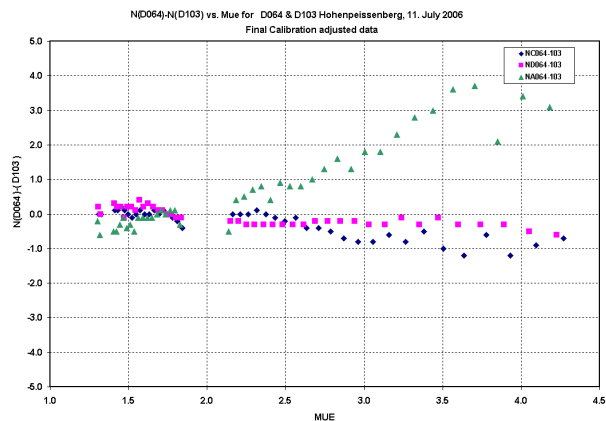
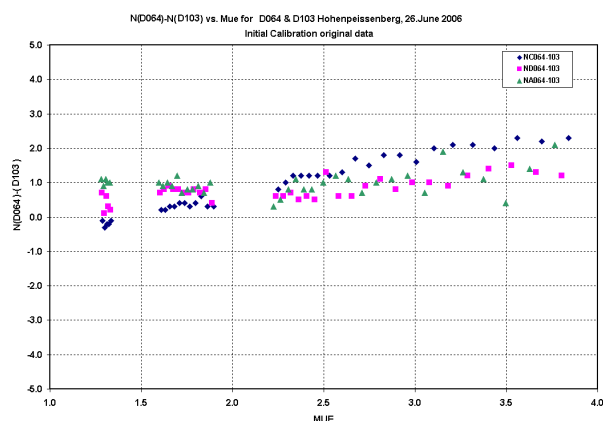
(Dr. Karel Vaníček)

Attachments:

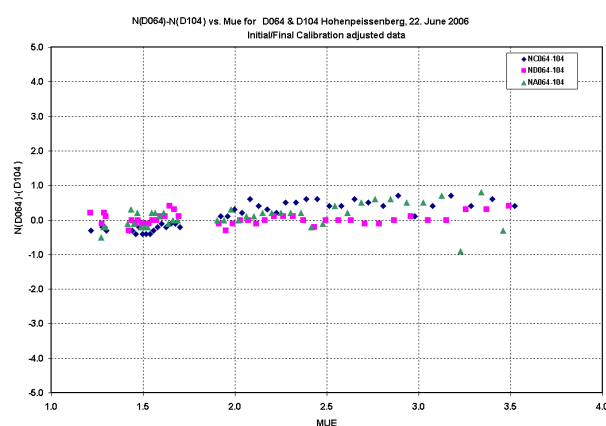
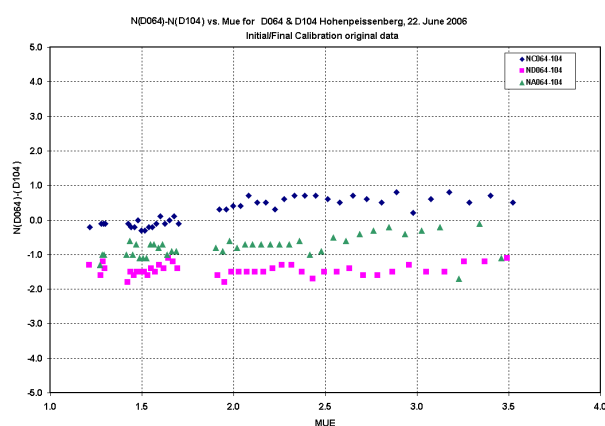
1. Summary graphs of the Dobson calibrations MOHp2006 and Arosa2006: Initial calibrations of the various instruments on the left hand, final calibrations normally on the right hand; shown are the differences of the raw data between standard Dobson and instruments under calibration in the three used wavelength pairs (3 pages).
2. Updated summary of the success of Dobson calibrations in the past decades.
3. Updated relative differences (monthly means) between D104 and the VS7- and the latest VS8-data evaluations for the various satellite instruments.
4. Comparison TOMS NIMBUS 7 - satellite instruments Vs 7 and Vs. 8.
5. Relative differences (monthly means) between D104 and BR010 (MOHp) original data and with applied temperature- and mue-corrections (a) & between D074 and BR098 (SOO-HK) original data and applied temperature- and SO2-corrections (b).
6. Actual table of all operational European Dobson stations incl. calibration state and schedule (1 page) for 2006/07.

Attachment 1: Graphs of the Calibration Results at Hohenpeissenberg and Arosa

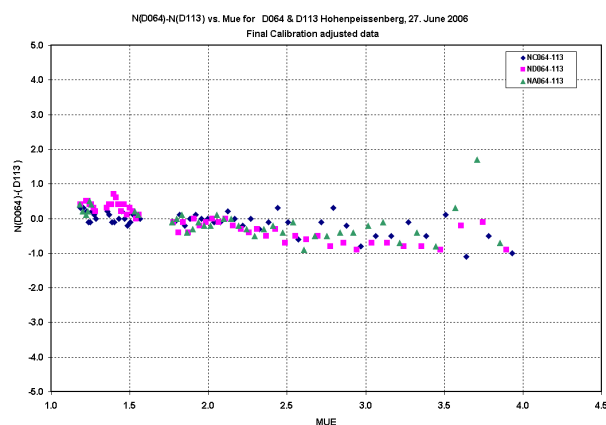
D103 (Antarctica, BAS – UK), final calibration after complete refurbishment:



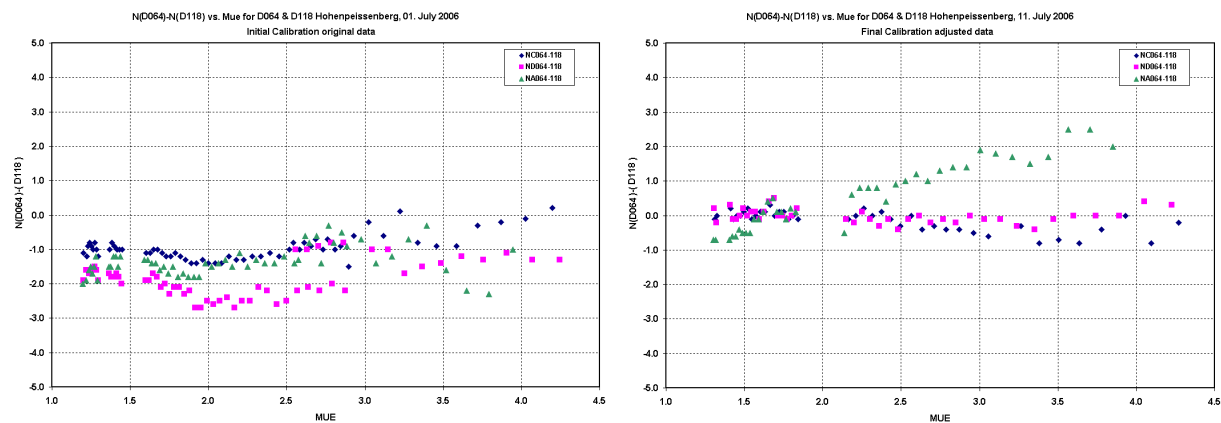
D104 (Hohenpeissenberg, Germany), as no optical work was necessary, initial and final calibration on one day:



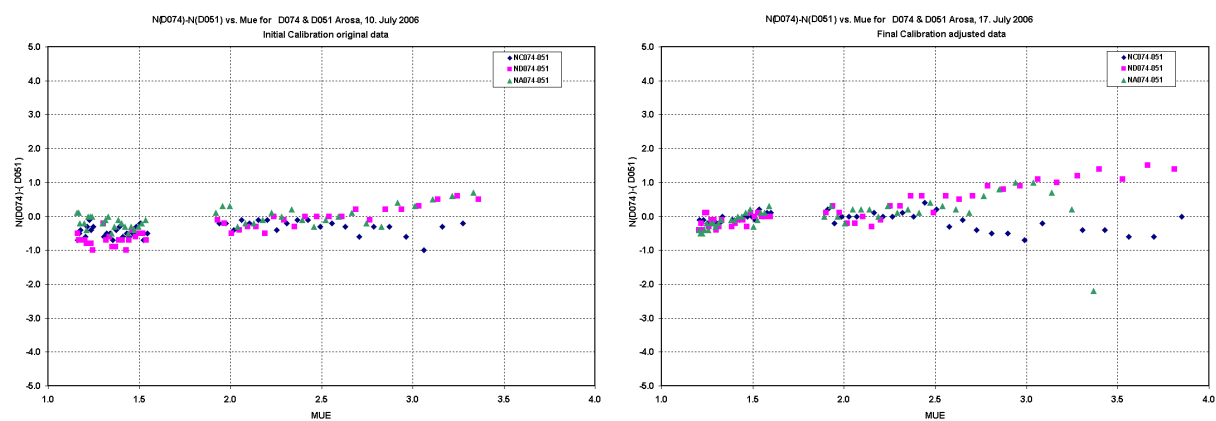
D113 (Vigna di Valle, Italy), as function after arrival was not good, instrument was not undergone an initial calibration before intense maintenance work:



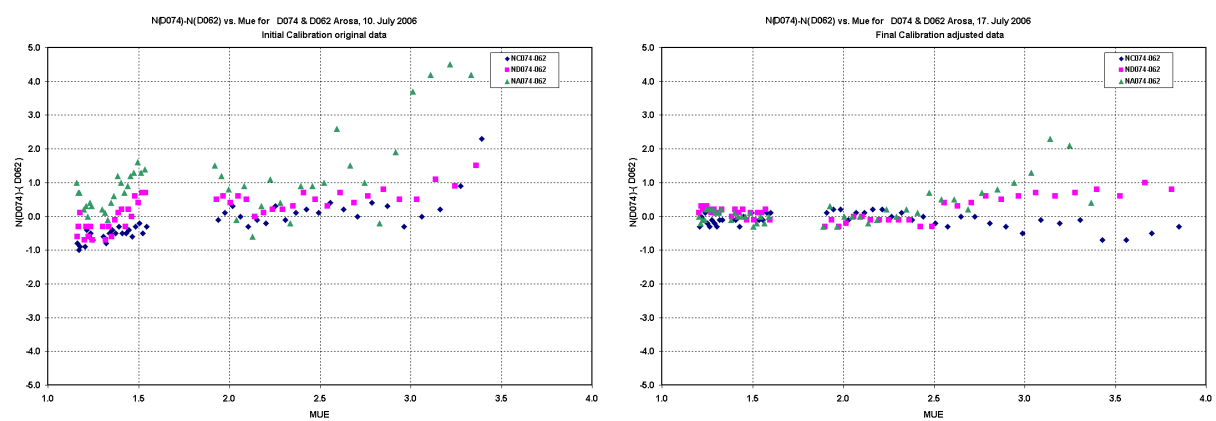
D118 (Athens, Greece) - regular calibration (last IC in 1997)



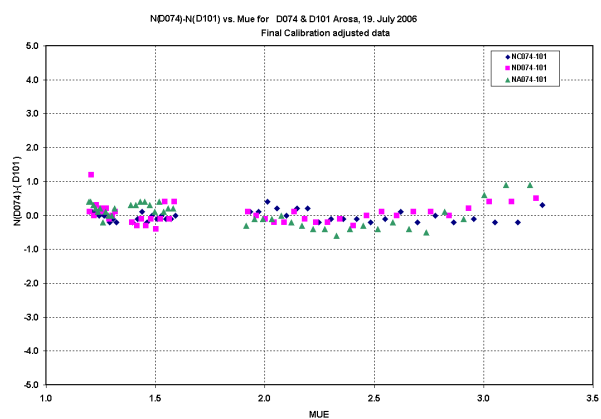
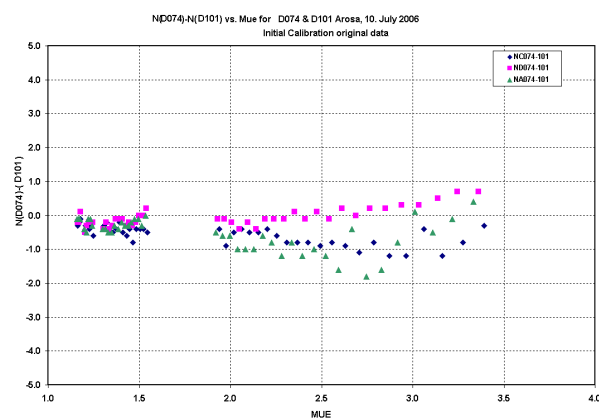
D051 (Arosa, Switzerland) - regular calibration (last IC in 2003)



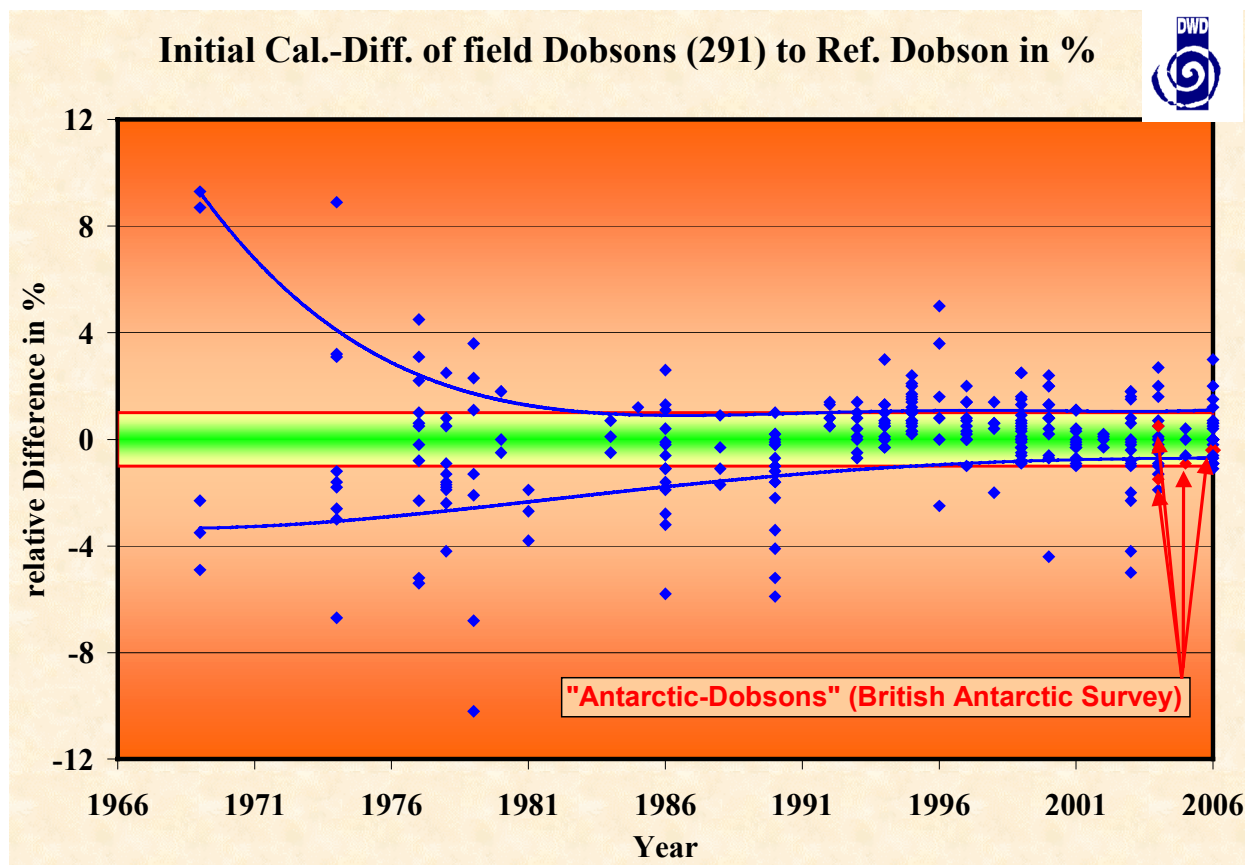
D062 (Arosa, Switzerland) - regular calibration (last IC in 2003)



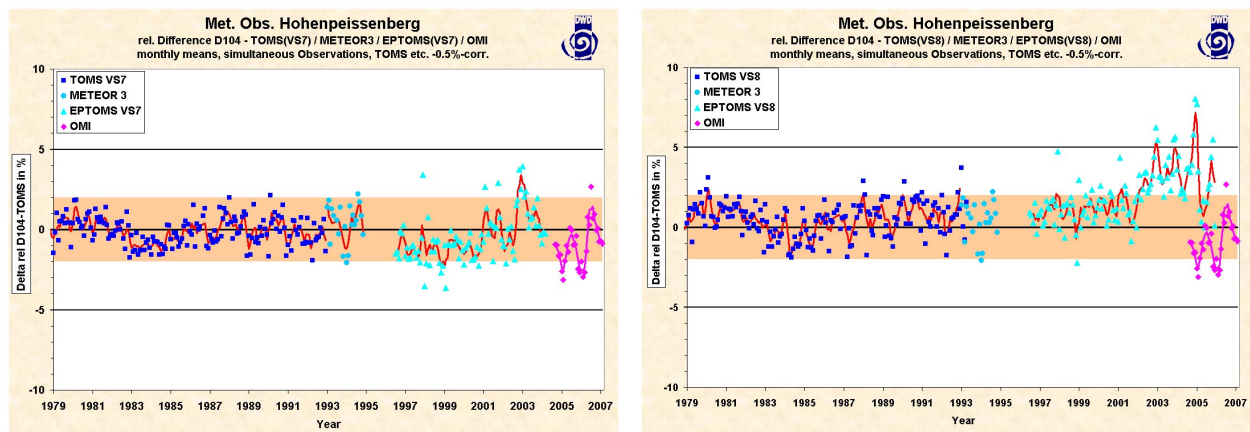
D101 (Arosa, Switzerland) - regular calibration (last IC in 2003)



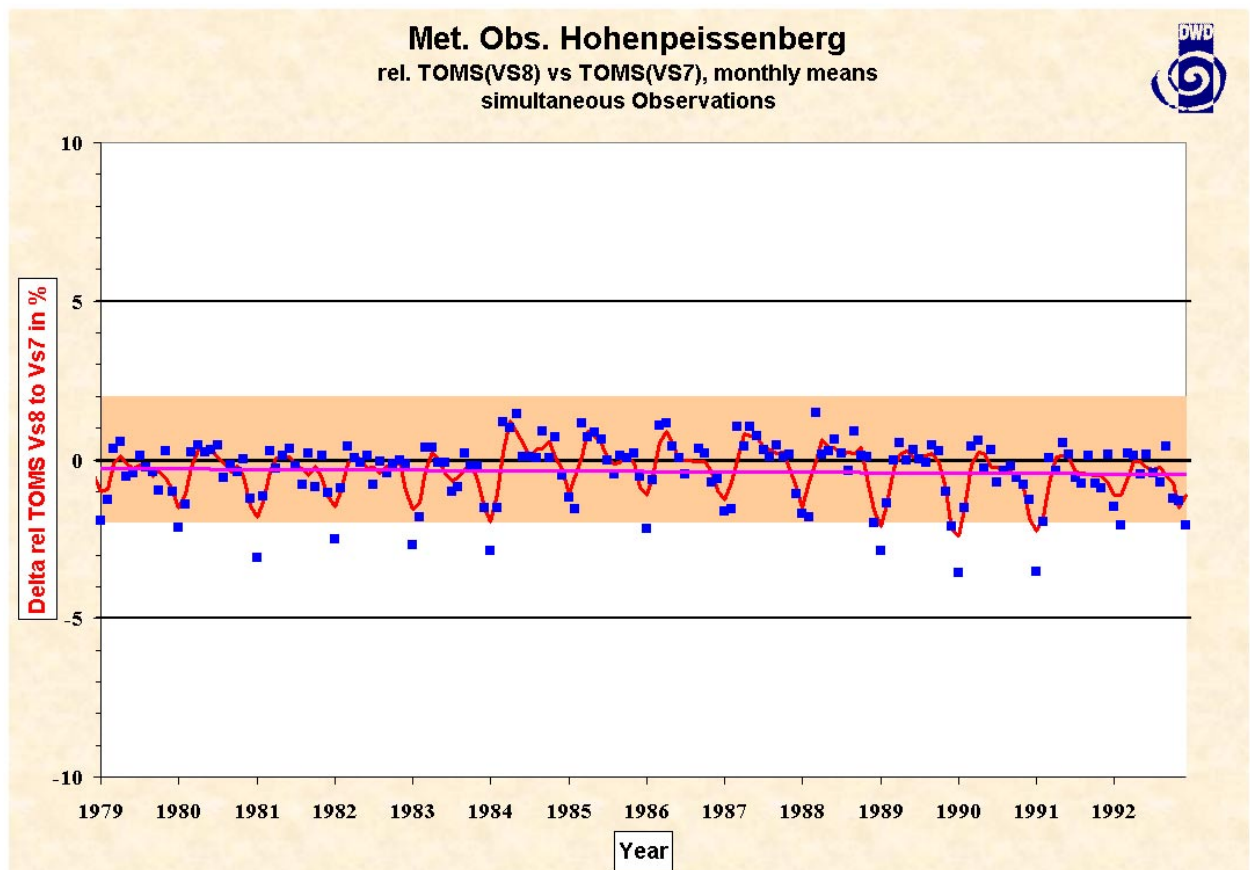
Attachment 2: Dobson calibration success



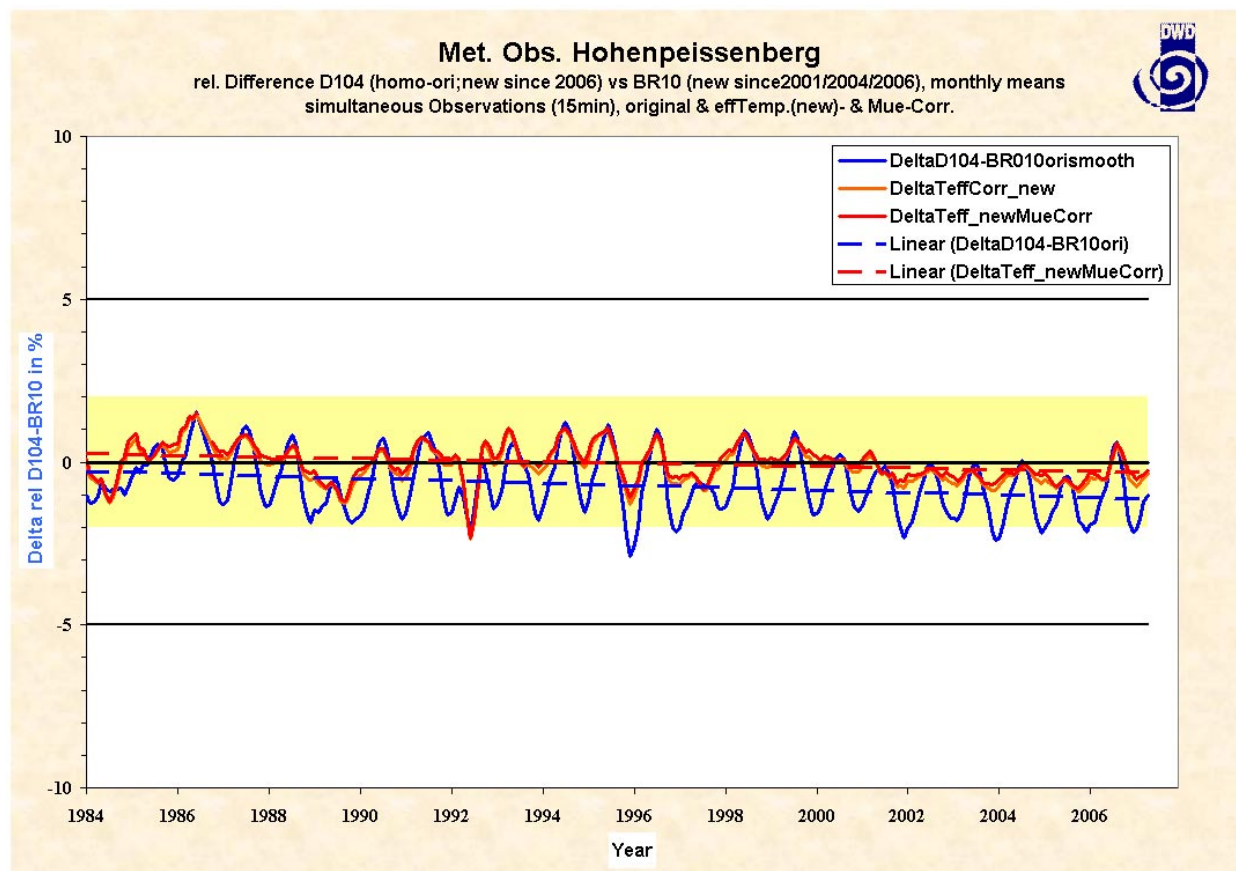
Attachment 3: Comparison D104 with various satellite instruments Vs 7 (left panel) & Vs. 8 (right panel), updated



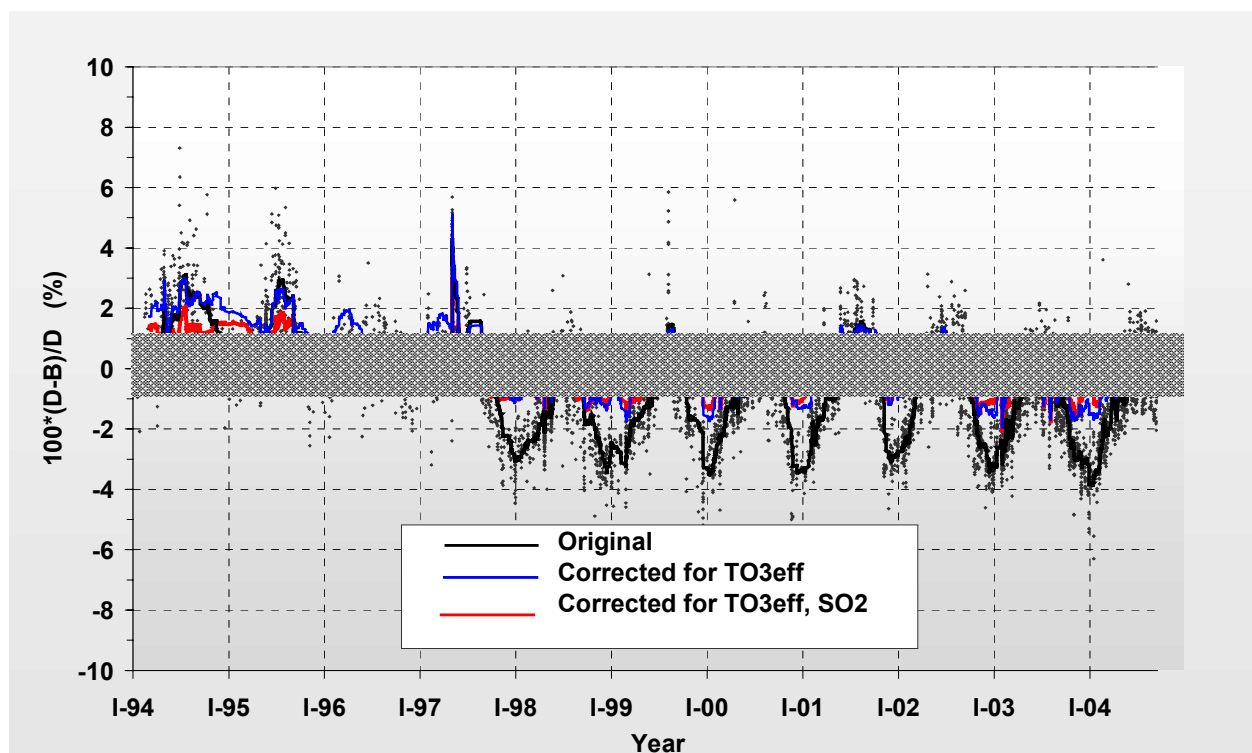
Attachment 4: Comparison TOMS NIMBUS 7 - satellite instruments Vs 7 and Vs. 8



Attachment 5a: Updated comparison D104 with BR010, blue curve smoothed original data, orange curve with temperature correction, red curve additional with mue-correction (differences in calculation of SZA)



Attachment 5b: Comparison D074 with B098, Hradec Králové, 1994-2004 before and after correction of Dobson data for TOeff and total SO2



Attachment 6: Table of State and Schedule for the European Dobsons 2006/07

Summary of European Dobson Stations							
No.	Dobson-No.	Country	Location	Last Cal.	L. Cal. Location	Next Cal.	N.Cal. Location
2	D013	Portugal	Lisbon	2004	MOHp	2007	El Arenos.
6	D030	Sweden	Vindeln	6/2001	MOHp	2007	El Arenos.
8	D032	UK	Lerwick	05/2004	MOHp	2007	El Arenos.
16	D049	France	Campistrous,	07/2002	MOHp	2007	El Arenos.
40	D120	Spain	El Arenosillo	6-7/03	MOHp	2007	El Arenos.
41	D121	Romania	Bucharest	7/2001	MOHp	2007	El Arenos.
14	D047	Italy	Vigna di Valle	5/2003	MOHp	2007	MOHp
15	D048	Italy	Sestola	07/2003	Arosa	2007	MOHp
17	D050	Iceland	Reykjavik	7-8/1995	Arosa	2007	MOHp
29	D085	France	Haute Provence	7/03	Arosa	2007	MOHp
22	D064	Germany	Hohenpeissenberg	4/2006	MOHp	2008	?
11	D041	UK	Camborne, Lerwick	6-7/03 5/04	MOHp	2008	MOHp
12	D044	Armenia	Nor Amberd	07/2004	MOHp	2008	MOHp
27	D074	Czech	Hradec Kralove	6/2005	MOHp	2008	MOHp
30	D092	Denmark/Greenland	Thule	5/7/2004	MOHp	2008	MOHp
35	D107	Russia	Moscow	5-6/03	MOHp	2008	MOHp
25	D071	Germany	Lindenberg	9/2006	MOHp	2009	MOHp
28	D084	Poland	Belsk	6/2005	MOHp	2009	MOHp
36	D108	Russia	Voeikovo	6/2005	MOHp	2009	MOHp
18	D051	Switzerland	Arosa	7/2006	Arosa	2010	Arosa
21	D062	Switzerland	Arosa	7/2006	Arosa	2010	Arosa
32	D101	Switzerland	Arosa	7/2006	Arosa	2010	Arosa
26	D073	UK	Cambridge	6-7/2004	MOHp	2010	MOHp
34	D104	Germany	Hohenpeissenberg	6-7/2006	MOHp	2010	MOHp
38	D113	Italy	Cagliari Elmas	6/2006	MOHp	2010	MOHp
39	D118	Greece	Athens	6-7/2006	MOHp	2010	MOHp
42	D123	UK	Cambridge	6-7/04	MOHp	2010	MOHp
7	D031	UK (Ukraine)	Vernadsky	9/2005	MOHp	2011	MOHp
33	D103	UK	Halley	6-7/2006	MOHp	2012	MOHp
1	D008	Norway	Ny Alesund			?	?
23	D066	Italy	S. Pietro Capofiume	1993	Hradec	?	?
13	D046	Italy	Brindisi	?	?	?	refurbishm.
3	D014	Norway	Tromsø	5/1998	Oslo	?	relocation?
10	D040	Belgium	Uccle	5-6/00	MOHp	?	relocation?
19	D056	Norway	Harestua	7/99	Arosa	?	relocation?
37	D110	Hungary	Budapest-Lorinc	7-8/1995	Arosa	?	relocation?
4	D015	Botswana	Maun	2-3/2004	Dahab	?	SA
5	D018	Kenia	Nairobi	04/2005	MOHp	?	SA
9	D035	SA	Marian Island	5/04	MOHp	?	SA
20	D059	Egypt	Harghada	2-3/2004	Dahab	?	SA
24	D069	Egypt	Aswan	2-3/2004	Dahab	?	SA
31	D096	Egypt	Cairo	2-3/2004	Dahab	?	SA

Description:

Next Calibration

Calibration in 2 years

Calibration next year

Calibration recently

Status unknown/not operational

Calibration no longer at MOHp