Regional Calibration Centers for Dobson and Brewer in Europe – A joint venture for highest quality in monitoring the ozone layer

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

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esa obseruing the earth European Space Agency

Introduction (History and Current Status):

The European branch of the Global Ozone Monitoring Network operates two Regional Calibration Centers for the two different types of used spectrophotometers. The RDCC-E for Dobsons has been located at the Meteorological Observatory Hohenpeissenberg (Germany) since 1999, the RBCC-E for Brewers at the Izana Observatory on Tenerife (Spain) since 2003. Both centers take care of the maintenance of the calibration level and correct function of the corresponding spectrometers in the European network.

A new ESA project, the *CEOS Intercalibration of Ground-Based Spectrometers and Lidars*, was initiated in 2009 to support these investigations and to improve the ground-based data base for trend analyses and validation of data obtained by satellite born instruments.

Several campaigns were organized at various locations under extremely different atmospheric conditions. The results of these normal Dobson and Brewer intercomparisons and special absolute calibrations after the Langley method and of special investigations of instrumental properties will be shown as well as the improvements of new procedures in calibration and observations.

Regional Dobson Calibration Center for Europe:

First international Dobson intercomparison and calibration campaigns were organized in the 60ties, when problems with the stability of the calibration level had been realized. First only sporadic campaigns took place, but after the final formation of the Dobson calibration system of 1 World Dobson Calibration Center WDCC at NOAA, Boulder, USA) and 5 Regional Dobson Calibration Centers (RDCC's in the different WMO Regional Associations, RDCC-E at Hohenpeissenberg) regular Dobson intercomparisons were organized to maintain and calibrate each operational Dobson at least every four years according the WMO regulations.

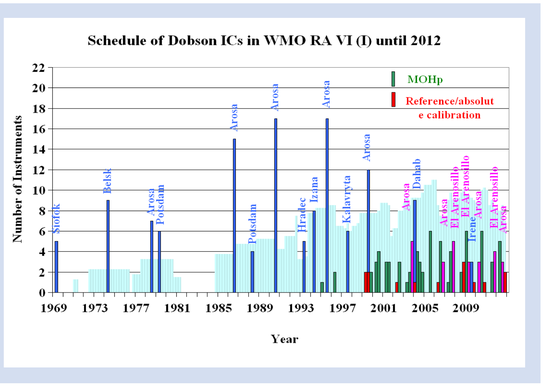


Figure 1: Calibration campaigns and number of calibrated Dobson

The regional standard Dobson No. 064 has been calibrated 6 times versus the primary standards since 1999. 2 absolute calibrations after the Langley method were performed in 2008 and 2010. Figure 2 shows the history of these calibrations and confirms the stability of the very good calibration level of this secondary standard Dobson.

Figure 1 shows the number of calibrations, the hosting locations and the number of treated Dobsons since the end of the 1960ties. When the RDCC-E at Hohenpeissenberg started in 1999, the European mode to calibrate a large number of Dobsons about every four years was replaced by annual campaigns with not more than 4 to 5 instruments. This reduces the big stress during the „huge" campaigns, but not the calibration frequency. More time could be spent for each instrument.

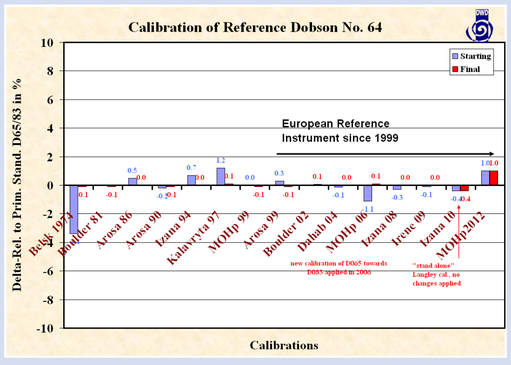


Figure 2: History of the calibration level of the European Regional Standard Dobson No. 64

Regional Brewer Calibration Center for Europe:

In November 2003 the WMO/GAW Regional Brewer Calibration Centre for RA-VI region (RBCC-E) was established at the Observatory Izaña of INM, Canary Islands (IZO). RBCC-E owns a full calibration and reference-maintenance equipment of three Brewer spectroradiometers (IZO Triad): Regional Primary Reference (BR 157), Regional Secondary Reference (BR 185) and Regional Travelling Reference (BR 183) which can be transported to calibration campaigns outside IZO. An optical laboratory is available for indoor calibrations as well as testing equipment to be transported to the campaigns.
IZO is located in subtropical region (28ºN) on top of the Izaña Mountain (2370 m.a.s.l.) with clear sky and small ozone variability. This allows routine absolute calibrations of the references similar to the MLO site on Hawaii. The IZO Triad is linked to the Environment Canada (EC) Triad by yearly calibrations towards the travelling reference BR 017. Though the IZO Triad is routinely calibrated by the Langley method their absolute calibration is not used to define a new scale. The EC Triad is respected as the official bearer of the GAW Brewer international scale. However, the establishment of the IZO Triad allows implementation of a self-sufficient European Brewer calibration system that respects the world scale but works as an independent GAW infrastructure. Recently because of doubts about the support of the world triad by EC , the WMO SAG Ozone authorizes at the meeting of 2011, that the RBCC-E transfers its own calibration based on Langley at Izaña Station.

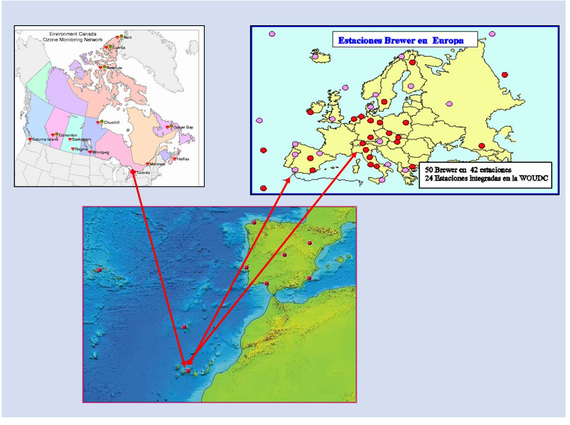


Figure 3: RBCC-E Brewer Calibration dissemination

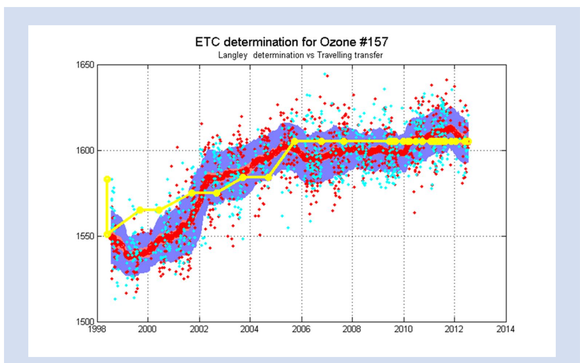
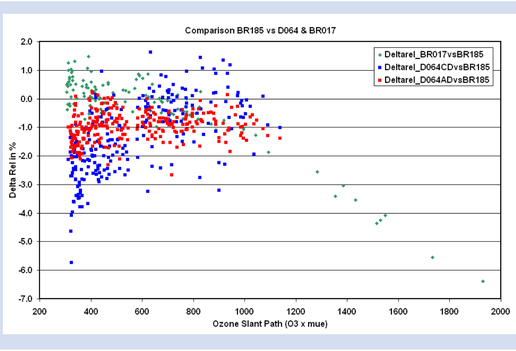


Figure 4: Long term 1998-2012 comparsion of Langley calibration a (red line) and ETC trarnsfered by the IOS travelling instrument 17

Results of various campaigns at different locations (sea level – high altitude – clear/hazy sky – high/low O3)

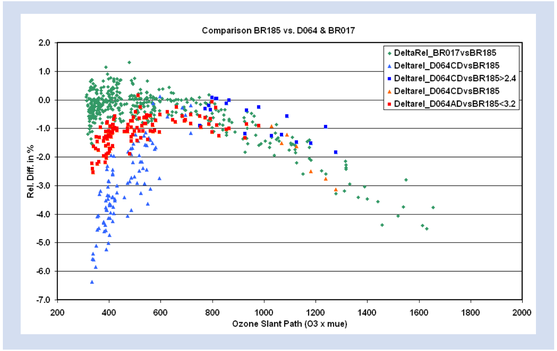
Izaña 2010:

The single BR017 is comparable to BR185 until OSP of 800, than drops. D064-AD TOC is about 1% lower than BR185, the CD TOC is lower at high sun (Mue < 2.4). Large differences occur at extremely high/low sun.



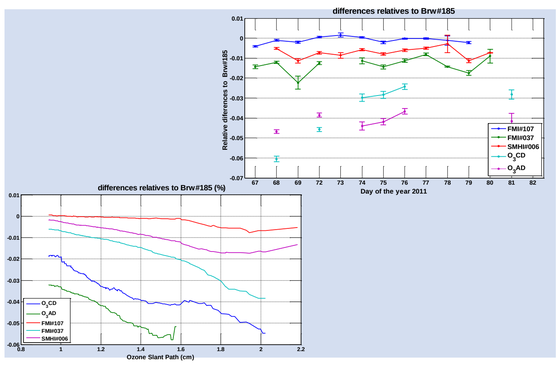
El Areno 2011:

BR017 average is about 1% lower than BR185 and agrees very well with D064-AD TOC at low sun. D064-AD at Mue < 3.2 and -CD at Mue > 2.4 is about 1% lower than BR185. Large differences occur at extremely high/low sun.



Soda 2011:

The Sodankylä campaign performed under high ozone slant path conditions shows an Dobson underestimation of 3% (CD) and 4% (AD). whereas the single Brewers underestimate by approx. 1% whereas the double Brewer agree.



Arosa 2012:

The arosa comparison,

Figure caption

Summary: The differences between the reference Dobson No. 064 and the reference Brewer No. 185 at four locations under various atmospheric conditions show the basic difference in their calibration levels of about 1% and in addition the effects of atmospheric parameters (effective ozone temperature), data processing algorithms (use of different heights of the ozone layer) and larger stray light sensitive (larger field of view) of the Dobson, which leads to differences up to 3-4%. The single Brewer No. 017 behaves similar to Dobson No. 064 and drops at OSP around 800 to 1000 compared to the double Brewer No. 185. An application of correct effective temperature of the ozone layer and correct Mue-calculation in the Brewer algorithm will surely improve the agreement.

DWD - 7/2010

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