GAW Report No. 225

WMO/UNEP
Dobson Data Quality Workshop

(Hradec Kralove, Czech Republic, 14-18 February 2011)



GLOBAL ATMOSPHERE WATCH

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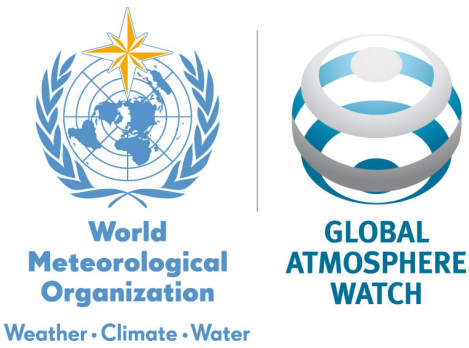
GAW Report No. 225

WMO/UNEP DOBSON DATA QUALITY WORKSHOP

(Hradec Kralove, Czech Republic, 14-18 February 2011)

Edited by

R.D. Evans, E. Hare, J. Staehelin. K. Vanicek and G. Braathen



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Group photo of participants at the Dobson Data Quality Workshop, Hradec Kralove, Czech Republic, 14-18 February 2011

Executive Summary

The Dobson Data Quality Workshop was the technological meeting of the Dobson total ozone data managers and experts from the central facilities of the Global Atmosphere Watch (GAW) Programme. The action was initiated by the recommendation of the 7th Ozone Research Managers Meeting that was held in Geneva, Switzerland, from 18-21 May 2008. The Scientific Advisory Group for Ozone (SAG-Ozone) of GAW provided expert guidance and the Solar and Ozone Observatory Hradec Kralove (SOO) of the Czech Hydrometeorological Institute (CHMI) took the responsibility for the local arrangements of the workshop that was held in the Conference Centre "Nové Adalbertinum" in Hradec Kralove, Czech Republic. Financial support was provided by the Ozone Secretariat of UNEP from the Vienna Convention Trust Fund and by the Ministry for the Environment of the Czech Republic. The World Meteorological Organization (WMO) assisted in the distribution of this support.

The main goals of the workshop were:

- To bring together managers of the archive datasets from the Dobson stations and provide guidance on how to re-evaluate and re-process important past datasets
- To collect the primary (0-level) Dobson datasets and calibration metadata from the stations to be saved in the World Ozone and Ultraviolet Data Center (WOUDC)
- To present the actual scientific themes and results on operation of the Dobson instruments and data quality assurance at the stations given by invited experts.

The agenda of the meeting was scheduled into morning scientific presentations and afternoon interviews of experts from the central GAW facilities (Regional Dobson Calibration Centers (RDCCs), WOUDC, satellite team) with the station data managers. The expert presentations were focused on the most relevant themes related to the Dobson observations and data evaluation - instrumental upgrades and automation, unified software tools, data re-processing case studies, evaluation of data quality by satellite observations, measurements in extreme conditions - Antarctic stations, comparison of Dobson and Brewer observations, implementation of new ozone cross-sections. The interviews covered discussions on calibrations and data analysis, the transfer of the digitized 0-level observation data and the calibration metadata (SL and HG lamp tests) from particular stations to the WOUDC database and consultations on application of the freeware tools for the Dobson data processing, quality control and international data transfer: The excursion to the SOO-JHK was also arranged.

The workshop was attended by 34 participants including 21 station data managers of 51 Dobson stations that represent about 70% of the currently active Dobson stations of the GAW network. About 70% of the stations contributing to the WOUDC were involved. Just after the meeting managers of 14 programmes responded by sending in Level-0 data to the WOUDC and 29 programmes have updated Level-1 data in the archive in the WOUDC. A unified template of the information of the individual stations was discussed and extended to be available for all stations in the network. The participants became knowledgeable of the problems in the earlier data, and methods of reprocessing using the freeware developed by the RDCCs.

To continue the activity the 8th Ozone Research Managers Meeting to be held in Geneva, Switzerland, from 2-4 May 2011 should call all Dobson stations to submit the level-0 observational and calibration data to the WOUDC as well as the level-1 analysis. The data managers and experts who are actually involved in the project should be encouraged and supported on the national and international levels to continue their contribution to the project. To further stress the importance it is recommended that WMO send a supportive letter to the Permanent Representatives (PRs) of the countries operating Dobson instruments. As a certain number of stations with long-term records or stations located in important regions were not present at the workshop, the templates will be sent to them with comments by the appropriate RDCCs. A recommendation is stated to arrange a second workshop in Toronto in conjunction with the Quadrennial Ozone symposium in 2012 to assess the progress of the project.

1. MOTIVATION AND BACKGROUND

Background

The monitoring of stratospheric ozone started in the earlier part of the 20th century concurrent with studies of the solar spectrum. The researches of Dr Gordon Dobson into atmospheric processes lead to his development of various specialized instruments. The double monochromator now named the Dobson spectrophotometer developed in the mid 1920s is still in use today. The instrument was predominantly used for monitoring total column ozone (TOC) in the second half of 20th century. The Dobson observations taken in the global network represent the dominant part of the historical records on the ozone layer, mainly in the period prior to satellite observations been implemented. The longest data record is from the Arosa station in Switzerland which dates from 1920s. Today, there are about 70 stations using this instrument to report TOC that are mostly operated at stations contributing to the Global Atmosphere Watch (GAW) Programme of the World Meteorological Organization (WMO) and to the Network for Detection of the Atmosphere Composition Change (NDACC). While there are stations that also report ozone concentrations with height (profiles) derived from observations of the Umkehr effects, this report is specific for the record of TOC.

The Dobson data series are used in key global studies on the condition of stratospheric ozone, for example in the quadrennial WMO UNEP Ozone Assessments prepared at the request of the parties to the Vienna Convention. The datasets provide information about long-term changes of the ozone layer, that are used in climate models, including those used in the Intergovernmental Panel on Climate Change reports.

For adequate evaluation of the effectiveness of the Montreal Protocol high quality column ozone measurements are very important, High quality ground-based measurements are also vital to control the quality of merged satellite series constructed from the individual satellite instruments being used for trend analysis of the ozone layer. Continued maintenance and calibration of instruments at the ground-based GAW and NDACC total ozone monitoring stations are the basic areas of the assistance provided by WMO. Recent analyses presented by the GAW Scientific Advisory Group for Ozone (SAG-O3) of WMO have shown that these activities also ought to include a better implementation of data quality procedures in the network and a thorough evaluation of past measurements. This concerns especially the Dobson total ozone observations. On the basis of this finding it was recommended at the 7th Meeting of the Ozone Research Managers of the Parties to the Vienna Convention, Geneva, 2008, that a technological workshop should be organized to bring together managers of the archive datasets and provide guidance on how to re-evaluate and reprocess some important past data records and to collect the primary (0-level) data and calibration metadata from the stations in the World Ozone and Ultraviolet Data Center (WOUDC).

At the request of WMO, the Solar and Ozone Observatory Hradec Kralove of the Czech Hydrometeorological Institute took responsibility for the organization of the workshop as its contribution to the activities of the Regional Dobson Calibration Centre (RDCC) – Europe. On the recommendation of the SAG-O3 any institution responsible for continuous TOC observation with the Dobson instrument was invited to nominate an expert responsible for processing of the Dobson observations and maintenance of the database of its station(s) to participate in the workshop. The

organizers expected that the digitized historical 0-level (primary) data, Standard (SL) and Mercury (HG) lamp test data of the Dobson instruments from participating stations would be available for the discussions concerning their quality and transferred to the WOUDC.

This data workshop was especially motivated by the following:

- The concern that there are periods in the data records of the reporting stations that could be improved. Vitali Fioletov 's paper "Performance of the ground-based total ozone network assessed using satellite data", published in the Journal of Geophysical Research in 2008 revealed some problems in the data records of a number of ground stations. About 25% of all stations having reported have some suspect periods, as defined by the criteria of the paper. Consider that the information as to the state of unperturbed stratosphere ozone prior to 1980 is almost entirely from the Dobson instrument, and that the instrument calibration scheme by intercomparison was not instituted until the mid 1970s. Some effort is needed to evaluate and improve the data prior to this period. This concern was reported to the WMO/GAW SAG-O3 meetings in 2007 and 2009.
- The concern is that with the "changing of the guard" – the pending retirement of many of the principle operators of the observing programmes within the community, the data, the readings from the instrument and the calibration records – could be lost.
- The concern that as the knowledge of both the instrument and the parameters used to convert the readings into TOC or profiles changes, the future need for a reprocessing the existing data increases. It is much easier to reprocess the complete dataset in one archive, rather than convince multiple organizations to reprocess with a new algorithm. The WOUDC in Toronto, Canada is the archive for Dobson data, but this archive is actually of Level 1 analysis, the result of the initial processing of the instrument readings by the operating organization. At this time, there is information in the archive from organizations that have ceased to exist.
- The need to improve quality of the existing datasets for use of the crucial ozone assessments of the recovery of stratospheric ozone.

2. PARTICIPANTS AND AGENDA

The workshop was held in the Conference Center "Nove Adalbertinum", in Hradec Kralove, Czech Republic from 14-18 February 2011. The scientific guidance of the action was provided by members of the SAG-Ozone and invited experts. The main financial support came from the Vienna Convention Trust Fund on Research and Systematic Observations managed by the Secretariat of the Montreal Protocol of UNEP. Local organization of the workshop was arranged by the Czech Hydrometeorological Institute under a substantial support of the Ministry for the Environment of the Czech Republic.

In total, 31 participants from 20 countries and several guests attended the workshop (see Annex A). The participating station managers and experts represented 50 stations of their home institutions. These represent about 70% of the currently active Dobson stations contributing to the WOUDC database.

The agenda of the meeting was scheduled into two main segments. In the mornings, scientific presentations on issues related to the reprocessing issues were given. On-demand presentations of national/regional ozone monitoring activities were also included in these sessions. In the afternoon interviews of experts from the GAW facilities (WDCC, RDCCs, WOUDC, SAG-O3) and of the satellite team with the station data managers were held.

The oral presentations covered the most relevant themes related to the Dobson observations and data evaluation:

- Instrumental technological upgrades
- Automation of Dobson observations
- Unified software tools for processing observations and data management
- Data re-evaluation and re-processing case studies
- Evaluation of quality ground total ozone observations by satellite measurements
- Operation of the instruments in extreme conditions – Antarctic stations
- Comparison of Dobson and Brewer observations
- Implementation of new ozone cross-sections

The presentations can be downloaded as PDF format files from the website of the workshop at: http://www.o3soft.eu/dobsonweb/welcome.html

The afternoon interviews were focused mainly on:

- Discussions concerning calibrations and data analysis – RDCC experts and satellite team with station data managers grouped by regions
- Digitized 0-level data and calibration metadata (SL and HG lamp tests) transfer by station data managers to the representative of the WOUDC
- Consultations on application of the freeware tools for the Dobson data processing quality control and international data transfer
- Preparation of the Report for the 8th Ozone Research Managers Meeting

The agenda and titles of particular presentations are given in Annex B.

3. APPROACH

The meeting brought together experts from the GAW facilities, users of Satellite and Dobson data and managers of Dobson stations with experience in re-evaluation and reprocessing a station's record with representatives of approximately 75% of the reporting stations in the data record. The approach was that of interviews of the reporting station data managers by the experts from the regional calibration centers guided by a checklist. The checklists were originally developed by the experts and are under evaluation, based on the results of the interviews.

The data users at the workshop played a very important role bringing the scientific expertise mainly from the Satellite and Ozone Assessment experts. Their presence at the interviews increased the knowledge of the programme managers of the importance of the measurements and they learned of the realities of the data in the archive.

The Interviewer asked the station manager questions regarding the history of the instrument use and calibrations, using the record as a guide. The object is to identify periods in the station record that would need reprocessing. A plan was then prepared for each station under the manager's control for any needed reprocessing.

An example of the template is displayed in Annex C.

4. RESULTS

During the workshop the following goals were achieved:

1. The template of the information of the individual stations was discussed and extended. An example of the template is displayed in Annex C. The data managers from the majority (51) of the currently active Dobson stations (ca. 70) attended the workshop. This represents about 70% of the capacity of the network.
2. Twenty-five scientific presentations were given by the SAG-Ozone members and by invited experts on particular themes related to the Dobson data quality control and evaluation of the data records.
3. The meeting did have the immediate result of presenting station representatives with periods in the data records of their stations requiring revaluation. This information was mainly obtained by investigation of the calibration metadata records and by comparison of the ground observations with satellite overpass data during the interviews of the stations representatives and the experts.
4. A plan was then prepared for each station under the manager's control for any needed reprocessing.
5. The template of the information of the individual stations was discussed and further extended by discussion of the participants. An example of the template that will be commonly applied by the participating stations and distributed by the WOUDC and RDCCs is displayed in Annex C. The template will be supplied to the stations that were not able to attend the workshop.
6. The stations representatives have been informed about the most recent upgrades of the freeware for processing and management of the Dobson observations that are now available from the GAW facilities (RDCC-Europe, CHMI and RDCC-Asia, Japan Meteorological Agency (JMA)). The experts from these facilities gave on-demand consultations about application of the software tools.

a. A plan was then prepared for each station under the manager's control for any needed reprocessing.

7. In the six weeks after the meeting, the managers of 14 programmes responded by sending in Level-0 data to the WOUDC archive, and 29 programmes have updated Level-1 data in the archive. All of the programme managers are knowledgeable of the problems in the earlier data, and are investigating methods of reprocessing. A more complete description of the data submitted is displayed in Annex D.

8. The participants were called by the WMO representative to submit total ozone observations in near-real-time into the Global Telecommunication System/WMO Information System (GTS/WIS) data transfer system using the CREX encoding rules developed under the WIS-WIGOS (WMO Integrated Global Observing System) Pilot Project.

5. RECOMMENDATIONS AND FUTURE ACTIVITIES

The participants agreed that the workshop was very useful for an efficient dialogue between representatives of the stations and data quality experts in order to improve the important Dobson record. Indeed, sometimes representatives were able to identify immediately a particular problem responsible for data quality problems of a record for some period. Unfortunately part of the invited station representatives with long-term records or stations located in important regions were not present, namely representatives stations from P.R. China, India and Kenya were not able to attend the workshop because of different problems. Though considerable progress was made in the workshop additional work is needed in future in order to make best use of available TOC data.

The participants agreed on the following recommendations:

1. The primary recommendation is for all stations to submit the level-0 observational and calibration data to the WOUDC as well as the level-1 analysis. The intention is that the data record of each station would be inspected and then corrected as needed. The extent (observational, calibration, instrument history, and data processing information) of the level-0 information and formats for the submission is still under development.
2. This reprocessing project and the deposition of the level-0 data into the WOUDC is time consuming and labour intensive, especially for the managers of the regional calibration centers. To impress on the people who are actually involved in this project of its interest and importance, the Ozone Research Managers are recommended to encourage and support their personnel in this project.
3. To further stress the importance of the project on the organizations involved, the WMO Secretariat is recommended to send a supportive letter to the Permanent Representative of the countries operating Dobson Ozone spectrophotometers.
4. A certain number of stations with long-term records or stations located in important regions were not present. The templates are to be evaluated and improved based on experiences from the interviews and sent to all Dobson stations not present at the workshop by the managers of the appropriate Regional Calibration Centers.
5. A recommendation is to arrange a second workshop in Toronto in conjunction with the Quadrennial Ozone symposium in 2012 to assess the progress of the project.
6. A recommendation is to incorporate data workshops in future intercomparison meetings.
7. A recommendation is to develop similar procedures for re-evaluation of older datasets for Brewer and DOAS (e.g. SAOZ) data with the appropriate responsible organizations. The Brewer network is already submitting level-0 data to the WOUDC.

6. ACKNOWLEDGEMENTS

The Scientific Steering committee wishes to express appreciation to the following organizations for the support of the workshop and the participants:

The Ozone Secretariat of the United Nations Environment Programme
The World Meteorological Organization – GAW Programme
Vienna Convention Trust Fund on Research and Systematic Observations

Plus, the Scientific Steering committee thanks the Czech Meteorological and Hydrological Institute and especially the staff of Solar and Ozone Observatory for their hospitality and assistance during the workshop.

ANNEX A

WMO/UNEP Dobson Data Quality Workshop
Hradec Kralove, Czech Republic, 14-18 February 2011

List of Participants

	Name	*Affiliation, Responsibilities*	*Country*	*Station*	*Representing Stations*	*E-mail*
1	Boulkelia, Lamine	Algerian Meteorological Service	Algeria	Tamanrasset	1	f.ounnar@meteo.dz l.boulkelia@yahoo.fr
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7	Evans, Robert D.	Earth System Research Laboratory: GMD, NOAA, WDCC, SAG-O3	USA	US Dobson network	15	Robert.D.Evans@noaa.gov
8	Fioletov, Vitali	Environment Canada, WOUDC	Canada	Invited expert		Vitali.Fioletov@ec.gc.ca

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Guests						
32	Hlaváček, Jiří	Ministry for the Environment of CR	Czech Republic	Dpt. Int. Relations		
33	Quasnitzov,á Klára	Ministry for the Environment of CR	Czech Republic	UNEP CR		
34	Borská, Jana	Ministry for the Environment of CR	Czech Republic	UNEP CR		

ANNEX B

WMO/UNEP Dobson Data Quality Workshop
Hradec Kralove, Czech Republic, 14-18 February 2011

Agenda

Monday, February 14

08:00-09:30	Registration
09:30-10:15	Opening the Workshop
-	Representatives of the, CHMI, Czech UNEP
	Head of the SC – scientific programme
	Head of the LOC – organization, local arrangements
10:00-10:30	Evans R.D.: Dobson spectrophotometer – "How Did We Get Here?", Subtitle. "Where To Next?"
10:30-11:00	Miyagawa K.: High quality data acquisition under Dobson automatic observation system installation
11:00-11:30	*Coffee break*
11:30-12:00	Koehler U.: 10 years of RDCC-Europe - an example of successful cooperation between MOHp and SOO-HK
12:00-12:30	Rhodes S.:: RDCC Australia - active stations, ICs, equipment
12:30-14:00	*Lunch break*
14:00-16:00	Interviews with the station managers
15:00	*Coffee break*

Tuesday, February 15

08:30-09:00	Evans R.D.: New developments in instrument characterization, and refinement of analysis
09:00-09:30	Vanicek K.: Homogenization of the Dobson total ozone data series from Hradec Kralove, Czech Republic
09:30-10:00	Rhodes S.: Re-evaluation efforts at current and past Australian Dobson stations
10:00-10:30	*Coffee break*
10:30-11:00	Labow G.: Results from the latest processing of TOMS & SBUV column ozone values
11:00-11:30	Fioletov V.: The performance of the ground-based total ozone network assessed using satellite data
11:30-12:00	Milinevsky G.: Ozone measurements by Dobson spectrophotometer in Kyiv-Goloseyev site, Ukraine
12:00-12:30	*Lunch break*
13:30-16:00	Interviews with the station managers + preparation of the Report
15:00	*Coffee break*

Wednesday, February 16

08:30-09:00	Hare E.: The World Ozone and UV Data Centre (WOUDC) – Long-term Archival of Total Column Ozone Measurements
09:00-09:30	Stanek M.: Freeware tools for processing of Dobson observations and DQ assessment
09:30-10:00	Staehelin J.: Total Ozone measurements: Absorption cross-sections and International Collaboration with SPARC
10:00-10:30	*Coffee break*
10:30-11:00	Vanicek K.: Assimilation of the Dobson and Brewer data series from Hradec Kralove, 1961-2010
11:00-11.30	Shanklin J.: Ozone observations from the Antarctic, and the discovery of the ozone hole
11:30-12:00	Sanchez R.: Overview of the Dobson Stations in Argentina
12:00-13:30	*Lunch break*
13:30-16:00	Excursion to the SOO + Preparation of the Report
15:00	*Coffee break*
19:00-21:00	*Joint dinner*

Thursday, February 17

08:30-09:00	Braathen G.: WMO's Global Atmosphere Watch, an overview
09:00-09:30	Fioletov V.: WMO/UNEP Ozone Assessment 2010: an overview and key findings
09:30-10:00	Vanicek K.: Contribution of the CHMI to the capacity building in the global Dobson network
10:00-10:30	*Coffee break*
10:30-11:00	Koide T.: Activities of RDCC-Asia and QA/SAC Japan conducted by JMA
11:00-11:30	Coetzee G.: Activities of the RDCC-Africa
11:30-11:45	Shanklin J. Computing Antarctic Ozone and the Antarctic Ozone and UV network
11:45-12:00	Janouch M.: Contribution of the Czech Republic to the detection of the stage of the Ozone layer of the Earth and solar UV radiation in Antarctica
12:00-13:30	*Lunch break*
13:30-16:00	Interviews with the station managers + Preparation of the Report
15:00	*Coffee break*

Friday, February 18

08:30-08:45	Sigurdsson A.: The Reykjavik total ozone series
08:45-09:00	Da Silva F.: Measurements with Dobson; Brewer and Ozone Sonde in Brazil
09:00-09:30	Summary of the interviews (Evans – WDCC; Hare - WOUDC)
09:30-10:00	Future activities and needs of the GAW Dobson infrastructure summaries by regions and facilities (Evans, Coetzee, Koide, Koehler, Rhodes, Sanchez, Hare)
10:00-10:30	*Coffee break*
10:30-11:30	Draft of the Report for the 8-ORM (Staehelin, Braathen)
11:30-12:00	Close the Workshop, adjourn

ANNEX C

WMO/UNEP Dobson Data Quality Workshop
Hradec Kralove, Czech Republic, 14-18 February 2011

Example Template

Station Identification				
		Name		Manila
		Agency Name		Philippine Atmospheric Geophysical and Astronomical Services Administration
		Address		PAGASA Weather Bureau Science Garden Complex Agham Road, Diliman, Quezon City 1100, Philippines
		Station Number		218
		Dobson Instrument S/N		90
		Latitude (deg)		14.645
		Longitude (deg)		121.045
		UTC offset time (hour)		8.0
		Surface Pressure (hPa)		1012.0
		Sea Level Height (m)		61.0
Period of Record (Periods in the station record based on instruments used)				
		Date		**Remarks**
		(Start)	**(End)**	
		12/6/1978	6/30/1990	Start of operation at Manila Observatory, Ateneo University
		7/1/1990	Present	Resumed operation at new site: PAGASA Science Garden Complex in Quezon City (14°38’ N / 121 °03’ E)
Intercomparison/Calibrations/Repair				
		Date		**Remarks**
		(Start)	**(End)**	
		1/1/1982	10/1/1982	General repair and calibration in Boulder, Colorado, USA
		6/1/1986	5/1/1987	Intercomparison held in Melbourne, Australia
		2/1/1996	3/1/1996	WMO Regional Comparison of the Dobson Spectrophotometer in Aerological Observatory, Tsukuba , Japan
		3/25/2004	3/31/2004	Repair and inspection by field survey
		3/6/2006	3/26/2006	WMO/GAW Regional Intercomparison and Calibration of Dobson Spectrophotometer for Asia, Tsukuba, Japan
		4/11/2010	4/26/2010	Calibration and inspection by QA/SAC field survey
Record of N-Table used				
		Date		**Remarks / File name**
		(Start)	**(End)**	
		1/1/1979	1/1/1982	?? Information would be available at Boulder
		10/1/1982		?? Information would available in Melbourne
		3/14/1996	3/31/2006	RTON9603.052
		4/1/2006	12/31/2007	RTON0603.052

		1/1/2008	4/22/2010	RTON1003.052
		4/23/2010	Present	RTON1004.052
Format				
		Date		**Remarks**
		(Start)	**(End)**	
		1/1/1979	3/31/1996	Paper form
		4/1/1996	Present	Electronic form
Plan: **The data from the period prior to 3/14/1996 should be digitized. The calibration centers in Boulder and Melbourne should be contacted for intercomparison information. With this information, the data prior to 3/14/1996 should be reprocessed and resubmitted to WOUDC, along with all existing Level-0 (12/6/1978 to present) data.**				

ANNEX D

WMO/UNEP Dobson Data Quality Workshop
Hradec Kralove, Czech Republic, 14-18 February 2011

Details of New Data Submissions in WOUDC

Data Arising from the Dobson Workshop, Hradec Kralove, CZ, 14-18 Feb. 2011										
					Prepared by E. W. Hare (WOUDC) - April 2011					
Agency Name	**Agency ID**	**Contact or PI**	**WMO Region**	**Dobson #**	**Last Known Platform**	**Date Range (Level 0)**	**Level 0 Data**	**Level 1 Data**	**Level 0 File types**	**Comments or issues**
Australian Bureau of Meteorology	**ABM**	Steve Rhodes	Australia & Oceana	Multiple	Multiple	Multiple	x	√	n/a	Level 1, processed data continue to be submitted on a regular basis
Armenian State Hydrometeorological and Monitoring Service	**AHMS**	Davit Melkonyan	Europe	D044	STN410 - Amberd, Armenia	2000-2011	X	√	n/a	Level 1, processed data continue to be submitted on a regular basis. **NOTE: a new, revised dataset following the meeting interviews has been deposited at the WOUDC**.
British Antarctic Survey	**BAS**	Jonathan Shanklin	Antarctica	D073	STN057 - Halley, Antarctica	1973-2011	√	√	ZOZy1y2.DAT (1)	Level 1 data are submitted sporadically in non-WOUDC format

British Antarctic Survey - Ukrainian Antarctic Institute	**BAS - UAI**	Jonathan Shanklin & Gennadi Milinevsky	Antarctica	D123	STN232 - Faraday/Vernadsky, Antarctica	1971-2010	√	√	FOZy1y2.DAT	Level 1 data are submitted sporadically in non-WOUDC format
British Antarctic Survey	**BAS**	Jonathan Shanklin	Antarctica	D103	STN211 King Edward Point, South Georgia and the South Sandwich Islands	1971-1982	√	√	MOZyy.DAT	Level 1 data are mature and were submitted in earlier years
British Antarctic Survey	**BAS**	Jonathan Shanklin	Antarctica	All	All	Various	√	√	General file types	
Czech Hydro Meteorological Institute	**CHMI-HK**	Karel Vaníček	Europe	D074	STN096 - Hradec Kralove, Czech Republic	1961-2011	**x**	√	n/a	Level 1, processed data continue to be submitted on a regular basis
Direcion nacional meteorológico Uruguay	**DNMUY**	Sergio Arizcorreta	South America	D134	STN343 - Salto, Uruguay	1997-2011	√	√	OZmmyy.iii, OZmmyy.PRN, Hgmmddyy, STDmmddyy, Umker_ddmmyy	Level 1 data have been submitted by SMNA (2000-2010) in the past, but a new agreement will now have DNMUY staff send the data directly. **Data from 2011 are now being submitted directly by DNMUY staff**.
German Weather Service	**DWD-MOHp**	Ulf Koehler	Europe	D104	STN099 - Hohenpeissenberg, Germany	1967-2011	**x**	√	n/a	Level 1, processed data continue to be submitted on a regular basis
German Weather Service	**DWD-MOL**	Andre Knöfel	Europe	D064/D071	STN050 - Potsdam (now STN174 - Lindenberg), Germany	1964-2003	**x**	**x**	n/a	No Level 1 data have been submitted recently. (since 2005 site transition)

Egyptian Meteorological Authority	**EMA**	Wafik M. Sharobiem	Africa	D059	STN409 - Hurghada, Egypt	2001-2010	**x**	√	n/a	Level 1, processed data continue to be submitted on a regular basis
Egyptian Meteorological Authority	**EMA**	Wafik M. Sharobiem	Africa	D069	STN245 - Aswan, Egypt	1984-2010	**x**	√	n/a	Level 1, processed data continue to be submitted on a regular basis
Egyptian Meteorological Authority	**EMA**	Wafik M. Sharobiem	Africa	D096	STN152 - Cairo, Egypt	1967-2010	**x**	√	n/a	Level 1, processed data continue to be submitted on a regular basis
Instituto de Meteorología de Cuba	**IMC**	Juan Carlos Pelaez	North & Central America	D067	STN311 - Havana, Cuba	2005-2011	**x**	√	n/a	Level 1 data recently submitted
Icelandic Meteorological Office	**IMO**	Arni Sigurdsson	Europe	D050	STN051 - Reykjavik, Iceland	1957-2009	**x & √**	√	Exported text versions of MS-Excel spreadsheet data	Level 0 data in non-standard format. Level 1 data are submitted sporadically
National Institute of Aerospace Science of Brazil	**INPE**	Francisco Raimundo Da Silva	South America	D093	STN219 - Natal, Brazil	1997-2010	√ **(partial)**	√	OZmmyy.iii, OZmmyy.PRN + various calibration and metadata files in MS-Excel format	Level 1 data are submitted sporadically (still some data missing)
National Institute of Aerospace Science of Brazil	**INPE**	Francisco Raimundo Da Silva	South America	D114	STN200 - Cachoeira Paulista, Brazil	2000-2010	√ **(partial)**	√	OZmmyy.iii, OZmmyy.PRN + various calibration and metadata files in MS-Excel format	Level 1 data are submitted sporadically (still some data missing)
Japan Meteorological Agency	**JMA**	Koji Miyagawa	Asia & Antarctica	Multiple	Multiple	2008-2010	√ **(partial)**	√	AL_yymm.iii	Level 1, processed data continue to be submitted on a regular basis

Kyiv National Taras Shevchenko University	**KNU**	Gennadi Milinevsky	Europe	D040	STN498 - Kyiv-Goloseyev, Ukraine	2010	x	√	n/a	Level 1 data have just begun submission and it is anticipated that these data will be submitted regularly
Meteorological and Hydrological National Service Peru	**MHNSP (SENAMHI)**	Esequiel Villegas Paredes	South America	D087	STN429 - Marcapomacocha, Peru	n/a	x	√ **(NOAA)**	n/a	Level 1 data have been submitted by NOAA (2000-2010) in the past, but a new agreement will have MHNSP staff now send the data directly. **An update document outlining this transition has been received from MHNSP staff.**
Meteorological Servcie of Canada	**MSC**	Vitali Fioletov	North America	D077	STN065 - Toronto, Canada	n/a	x	x	n/a	No data - the instrument is no longer in service
Meteorological Servcie of Philippines	**MSP**	Cherry Jane Cada	Asia	D052	STN216 - Manila, Philippines	n/a	√ **(partial)**	√	AL_yymm.iii All the lamp results	Level 1, processed data continue to be submitted on a regular basis
National Oceanic and Atmospheric Administration	**NOAA-CMDL**	Robert D. Evans	North America	Multiple	Multiple	Multiple	x	√	n/a	Level 1, processed data continue to be submitted on a regular basis
Regional Meteorological Directorate of Algeria	**RMDA**	Lamine Boulkelia	Africa	D011	STN002 - Tamanrasset, Algeria	1994-2010	√	√	Djjjyyyy.iii	Level 1, processed data continue to be submitted on a regular basis
South African Weather Service	**SAWS**	Gerrie Coetzee and Katlego Ncongwane	Africa	D089	STN265 - Irene, South Africa (formerly Pretoria)	1990-2010	x	√	n/a	Level 1, processed data continue to be submitted on a regular basis

South African Weather Service	**SAWS**	Gerrie Coetzee and Katlego Ncongwane	Africa	D132	STN340 - Springbok, South Africa	1995-2010	x	√	n/a	Level 1, processed data continue to be submitted on a regular basis
Servicio meteorológico nacional Argentina	**SMNA**	Ricardo Sanchez	South America	D097	STN091 - Buenos Aires, Argentina	1965-2010	√	√	OZmmyy.iii	Level 1, processed data continue to be submitted on a regular basis
Servicio meteorológico nacional Argentina	**SMNA**	Ricardo Sanchez	South America	D133	STN342 - Comodoro Rivadavia, Argentina	1995-2010	√	√	OZmmyy.iii	Level 1, processed data continue to be submitted on a regular basis
Servicio meteorológico nacional Argentina	**SMNA**	Ricardo Sanchez	South America	D131	STN339 - Ushuaia, Argentina	1994-2010	√	√	OZmmyy.iii	Level 1, processed data continue to be submitted on a regular basis
Servicio meteorológico nacional Argentina	**SMNA**	Ricardo Sanchez	South America	D099	STN233 - Marambio, Antarctica	1995-2010	√	√	OZmmyy.iii	Level 1, processed data continue to be submitted on a regular basis
Thailand Meteorological Department	**TMD**	Duanchai Uraiwan	Asia	D090	STN216 - Bangkok, Thailand	n/a	√ **(partial)**	√	AL_yymm.iii	Level 1, processed data continue to be submitted on a regular basis

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151. Report of the First CAS Working Group on Environmental Pollution and Atmospheric Chemistry (Geneva, Switzerland, 18-19 March 2003) (WMO TD No. 1181).

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