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World Meteorological Organization
Weather • Climate • Water
WMO/TD - No. 1552

GAW Report No. 193

Guidelines for Reporting Total Ozone Data in Near Real Time

WORLD METEOROLOGICAL ORGANIZATION
GLOBAL ATMOSPHERE WATCH

GUIDELINES FOR REPORTING

TOTAL OZONE DATA IN NEAR REAL TIME

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World Meteorological Organization
Weather • Climate • Water

WMO/TD-No. 1552
April 2011

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1. BACKGROUND

A WIS-WIGOS Pilot Project entitled “Improvement of Dissemination of Ozone (total column, profiles and surface) and Aerosol observations through the WIS” (GAW-IDOA) has been approved by EC-WG on WIGOS and WIS. This pilot project aims at improving the availability of ozone and Aerosol Optical Depth and surface Particulate Matter observations to the user community and prepares documentation to help other communities make their observing practices compatible [4].

2. TELECOMMUNICATION HEADERS FOR TOTAL OZONE DATA IN CREX

Total ozone data in CREX shall be distributed in messages with telecommunication headers $T_1T_2A_1A_2ii$, where **$T_1T_2A_1$ = KUL** (WMO No. 386 - Manual on the GTS, Table C7) and **A_2** (Table C3):

A_2	**Station location**
A	0˚ - 90˚W northern hemisphere
B	90˚W - 180˚ northern hemisphere
C	180˚ - 90˚E northern hemisphere
D	90˚E - 0˚ northern hemisphere
E	0˚ - 90˚W tropical belt
F	90˚W - 180˚ tropical belt
G	180˚ - 90˚E tropical belt
H	90˚E - 0˚ tropical belt
I	0˚ - 90˚W southern hemisphere
J	90˚W - 180˚ southern hemisphere
K	180˚ - 90˚E southern hemisphere
L	90˚E - 0˚ southern hemisphere

To meet the target of the Pilot Project, i.e. exchange of total ozone data in near real time, messages should be transmitted to the GTS/WIS within 15 minutes after the measurement is done (single observation data), or after the measurements of the day are completed (averaged observation data).

3. FM 95 - CREX

Total ozone data shall be encoded in CREX code form that is described in detail in the Manual on Codes, WMO-No. 306, Volume I.2, Part C
<http://www.wmo.int/pages/prog/www/WMOCodes.html>.

The presented guidance material aims at providing the essential part of information needed for reporting of total ozone data in CREX. An example of a CREX message containing Brewer averaged observation data is included for demonstration. CREX edition 2 is used in this example (CREX edition 1 may be used only up to the first Tuesday of November 2012).

KULD40 OKOH 161315
CREX++
T0002071500 A008002 P00089000 U00 S001 Y20110116 H0957 D07042++
11 649 Hradec Kralove 5018 01583 00285 2011 01 16 09
57 08 0184 001 98 00 00015 04 0316 09 0002 11 321++
7777

CREX
T0002071500

CREX master table	00
CREX edition number	02
CREX table version number	07
BUFR Master Table version number used	15
Version number of local table	00

		Data category		008
A008002		International data subcategory		002
P00089000		Originating centre (Common Code Table C-11)		00089
		Originating sub-centre (Common Code Table C-12)		000
U00		Update sequence number (00 for original and delayed messages; incremented for corrected messages)		00
S001		Number of subsets included in the report		001
Y20110116		Year		2011
		Month		01
		Day		16
H0957		Hour		09
		Minute		57
D07042	D01001			
	B01001	WMO block number		11
	B01002	WMO station number		649
	B01015	Station or site name (1)		Hradec Kralove^^^^^^
	D01024			
	B05002	Latitude (2) (3)	50.18 deg N	5018
	B06002	Longitude (2) (3)	15.83 deg E	01583
	B07001	Height of station *(above msl)*		00285
	D01011			
	B04001	Year (of ozone measurement)		2011
	B04002	Month (of ozone measurement)		01
	B04003	Day (of ozone measurement)		16
	D01012			
	B04004	Hour (of ozone measurement) (4)		09
	B04005	Minute (of ozone measurement) (4)		57
	B08021	Time significance = 8 = ensemble mean (5)		08
	B04025	Time period (in minutes)		0184
	D01070			
	B02143	Ozone instrument type		001
	B02142	Ozone instrument serial number (1)		98^^
	B02144	Light source type for Brewer spectrophotometer (6)		00
	D07031			
	B08022	Number of measurements		00015
	B08023	First order statistic = 4 = mean value		04
	B15001	Value (average) of ozone measurement		0316
	B08023	First order statistic = 9 = best estimate of std deviation		09
	B15001	Best estimate of std deviation of the ozone measurement		0002
	B08023	First order statistic = 11 = harmonic mean		11
	B15002	Harmonic mean of the air mass	3.21	321
7777				

Notes:

(1) Characters "^^^^^^" are used for visualization of the corresponding number of space characters.
(2) Latitude and longitude shall be reported in degrees with precision in hundredths of a degree.
(3) South latitude and west longitude shall be assigned negative values.
(4) Hour and minute specifies the time of the first measurement of the series.
(5) "Ensemble mean" indicates that a number of distinct values corresponding to a set of time locations are averaged.
(6) Ozone measurements of only one light source shall be selected, i.e. the best light source of the day.

4. CREX TEMPLATES FOR TOTAL OZONE DATA

The Expert Team on Data Representation and Codes developed CREX templates for ground-based total ozone measurements as in cooperation with GAW experts, in particular from Canada, the Czech Republic and Japan. These common sequence descriptors were recommended by the CBS Extraordinary Session in 1998 for operational use [3].

Table reference

D 07 041	Total ozone measurement from a Brewer ground-based spectrophotometer obtained from a single observation
D 07 042	Total ozone measurement from a Brewer ground-based spectrophotometer obtained from averaged observations
D 07 043	Total ozone measurement from a Dobson ground-based spectrophotometer obtained from a single observation
D 07 044	Total ozone measurement from a Dobson ground-based spectrophotometer obtained from averaged observations

D 07 041 - Total ozone measurement from a Brewer ground-based spectrophotometer obtained from a single observation

			Unit, scale, data width
D 01 001		**Station identification**	
	B 01 001	WMO block number	Numeric, 0, 2
	B 01 002	WMO station number	Numeric, 0, 3
B 01 015		Station or site name	Character, 0, 20
D 01 024		**Horizontal and vertical coordinates**	
	B 05 002	Latitude (coarse accuracy)	Degree, 2, 4
	B 06 002	Longitude (coarse accuracy)	Degree, 2, 5
	B 07 001	Height of station *(above msl)*	m, 0, 5
		Time identification	
D 01 011	B 04 001	Year (of ozone measurement)	Year, 0, 4
	B 04 002	Month (of ozone measurement)	Month, 0, 2
	B 04 003	Day (of ozone measurement)	Day, 0, 2
D 01 012	B 04 004	Hour (of ozone measurement)	Hour, 0, 2
	B 04 005	Minute (of ozone measurement)	Minute, 0, 2
D 01 070		**Ozone instrumentation – Brewer spectrophotometer**	
	B 02 143	Ozone instrument type	Code table, 0, 3
	B 02 142	Ozone instrument serial number or identifier	Character, 0, 4
	B 02 144	Light source type for Brewer spectrophotometer	Code table, 0, 2
D 07 030		**Ozone data – single observation**	
	B 15 001	Value of ozone measurement	DU, 0 , 4
	B 15 002	Value of air mass	Numeric, 2, 3

D 07 042 - Total ozone measurement from a Brewer ground-based spectrophotometer obtained from averaged observations

			Unit, scale, data width
D 01 001		**Station identification**	
	B 01 001	WMO block number	Numeric, 0, 2
	B 01 002	WMO station number	Numeric, 0, 3
B 01 015		Station or site name	Character, 0, 20

D 01 024		**Horizontal and vertical coordinates**	
	B 05 002	Latitude (coarse accuracy)	Degree, 2, 4
	B 06 002	Longitude (coarse accuracy)	Degree, 2, 5
	B 07 001	Height of station *(above msl)*	m, 0, 5
		Time identification	
D 01 011	B 04 001	Year (of ozone measurement)	Year, 0, 4
	B 04 002	Month (of ozone measurement)	Month, 0, 2
	B 04 003	Day (of ozone measurement)	Day, 0, 2
D 01 012	B 04 004	Hour (of ozone measurement)	Hour, 0, 2
	B 04 005	Minute (of ozone measurement)	Minute, 0, 2
B 08 021		Time significance (= 8 = ensemble mean)	Code table, 0, 2
B 04 025		Time period (for computation of the average)	Minute, 0, 4
D 01 070		**Ozone instrumentation – Brewer spectrophotometer**	
	B 02 143	Ozone instrument type	Code table, 0, 3
	B 02 142	Ozone instrument serial number or identifier	Character, 0, 4
	B 02 144	Light source type for Brewer spectrophotometer	Code table, 0, 2
D 07 031		**Ozone data – averaged observations**	
	B 08 022	Number of measurements	Numeric, 0, 5
	B 08 023	First order statistic (= 4 = mean value)	Code table, 0, 2
	B 15 001	Value (average) of ozone measurement	DU, 0 , 4
	B 08 023	First order statistic (= 9 = best estimate of std deviation)	Code table, 0, 2
	B 15 001	Best estimate of std deviation of the ozone measurement	DU, 0 , 4
	B 08 023	First order statistic (= 11 = harmonic mean)	Code table, 0, 2
	B 15 002	Air mass (harmonic mean of)	Numeric, 2, 3

Note: Hour and minute specifies the time of the first measurement of the series.

D 07 043 - Total ozone measurement from a Dobson ground-based spectrophotometer obtained from a single observation

			Unit, scale, data width
D 01 001		**Station identification**	
	B 01 001	WMO block number	Numeric, 0, 2
	B 01 002	WMO station number	Numeric, 0, 3
B 01 015		Station or site name	Character, 0, 20
D 01 024		**Horizontal and vertical coordinates**	
	B 05 002	Latitude (coarse accuracy)	Degree, 2, 4
	B 06 002	Longitude (coarse accuracy)	Degree, 2, 5
	B 07 001	Height of station *(above msl)*	m, 0, 5
		Time identification	
D 01 011	B 04 001	Year (of ozone measurement)	Year, 0, 4
	B 04 002	Month (of ozone measurement)	Month, 0, 2
	B 04 003	Day (of ozone measurement)	Day, 0, 2
D 01 012	B 04 004	Hour (of ozone measurement)	Hour, 0, 2
	B 04 005	Minute (of ozone measurement)	Minute, 0, 2
D 01 074		**Ozone instrumentation – Dobson spectrophotometer**	
	B 02 143	Ozone instrument type	Code table, 0, 3

	B 02 142	Ozone instrument serial number or identifier	Character, 0, 4
	B 02 145	Wave length setting for Dobson instruments	Code table, 0, 2
	B 02 146	Source conditions for Dobson instruments	Code table, 0, 2
D 07 030		**Ozone data – single observation**	
	B 15 001	Value of ozone measurement	DU, 0 , 4
	B 15 002	Value of air mass	Numeric, 2, 3

D 07 044 - Total ozone measurement from a Dobson ground-based spectrophotometer obtained from averaged observations

			Unit, scale, data width
D 01 001		**Station identification**	
	B 01 001	WMO block number	Numeric, 0, 2
	B 01 002	WMO station number	Numeric, 0, 3
B 01 015		Station or site name	Character, 0, 20
D 01 024		**Horizontal and vertical coordinates**	
	B 05 002	Latitude (coarse accuracy)	Degree, 2, 4
	B 06 002	Longitude (coarse accuracy)	Degree, 2, 5
	B 07 001	Height of station *(above msl)*	m, 0, 5
		Time identification	
D 01 011	B 04 001	Year (of ozone measurement)	Year, 0, 4
	B 04 002	Month (of ozone measurement)	Month, 0, 2
	B 04 003	Day (of ozone measurement)	Day, 0, 2
D 01 012	B 04 004	Hour (of ozone measurement)	Hour, 0, 2
	B 04 005	Minute (of ozone measurement)	Minute, 0, 2
B 08 021		Time significance (= 8 = ensemble mean)	Code table, 0, 2
B 04 025		Time period (for computation of the average)	Minute, 0, 4
D 01 074		**Ozone instrumentation – Dobson spectrophotometer**	
	B 02 143	Ozone instrument type	Code table, 0, 3
	B 02 142	Ozone instrument serial number or identifier	Character, 0, 4
	B 02 145	Wave length setting for Dobson instruments	Code table, 0, 2
	B 02 146	Source conditions for Dobson instruments	Code table, 0, 2
D 07 031		**Ozone data – averaged observations**	
	B 08 022	Number of measurements	Numeric, 0, 5
	B 08 023	First order statistic (= 4 = mean value)	Code table, 0, 2
	B 15 001	Value (average) of ozone measurement	DU, 0 , 4
	B 08 023	First order statistic (= 9 = best estimate of std deviation)	Code table, 0, 2
	B 15 001	Best estimate of std deviation of the ozone measurement	DU, 0 , 4
	B 08 023	First order statistic (= 11 = harmonic mean)	Code table, 0, 2
	B 15 002	Air mass (harmonic mean of)	Numeric, 2, 3

Note: Hour and minute specifies the time of the first measurement of the series.

5. CODE TABLES

The following Code tables are used for encoding of total ozone data: B 02 143 (Ozone instrument type), B 02 144 (Light source type for Brewer spectrophotometer), B 02 145 (Wave length setting for Dobson instruments) and B 02 146 (Source conditions for Dobson instruments).

0 02 143

Ozone instrument type

Code Figure	
0	Reserved
1	Brewer spectrophotometer
2	Caver Teichert
3	Dobson
4	Dobson (Japan)
5	Ehmet
6	Fecker telescope
7	Hoelper
8	Jodmeter
9	Filter Ozonometer M-83
10	Mast
11	Oxford
12	Paetzold
13	Regener
14	Reserved for future use
15	Vassy filter Ozonometer
16	Carbon iodide
17	Surface ozone bubler
18	Filter Ozonometer M-124
19	ECC sonde
20-126	Reserved
127	Missing value = /// in CREX

0 02 144

Light source type of Brewer spectrophotometer

Code figure	
0	Direct Sun
1	Direct Sun, attenuator #1
2	Direct Sun, attenuator #2
3	Focused Moon
4	Focused Sun
5	Focused Sun corrected with adjacent sky measurements
6	Zenith Sky
7-14	Reserved
15	Missing value = // in CREX

Note: Entries 1 and 2 should not be used.

0 02 145

Wave length setting for Dobson instruments

Code figure	
0	Wavelengths AD ordinary setting
1	Wavelengths BD ordinary setting
2	Wavelengths CD ordinary setting
3	Wavelengths CC' ordinary setting
4	Wavelengths AD focused image
5	Wavelengths BD focused image
6	Wavelengths CD focused image
7	Wavelengths CC' focused image
8-14	Reserved
15	Missing value = // in CREX

0 02 146

Source condition for Dobson instruments

Code figure	
0	on direct sun
1	on direct moon
2	on blue zenith sky
3	on zenith cloud (uniform stratified layer of small opacity)
4	on zenith cloud(uniform or moderately variable layer of medium opacity)
5	on zenith cloud (uniform or moderately variable layer of large opacity)
6	on zenith cloud (highly variable opacity, with or without precipitation)
7	on zenith cloud (fog)
8	On zenith haze
9	On direct sun through thin cloud, fog or haze
10-14	reserved
15	Missing value = // in CREX

6. SOFTWARE

CREX encoders for total ozone data were developed at the SOO HK (Czech Republic) and are available as freeware at: http://www.o3soft.eu/

- Programme “CX.RTN” is a subroutine to the Brewer operating software that reads Brewer data files and encodes CREX for both single and averaged observations.
- Programme “Dobson” enables operational calculation of total ozone. Versions 3.0 and above allow to produce ozone data in the WOUDC format and in the CREX code.

CREX encoders for total ozone data

Programme:	**CX.RTN**				
Member:	Czech Republic	**Centre:**	Czech Hydrometeorological Institute		
Description:	Brewer operating programme subroutine - CREX encoder for ozone data. Routine reads Brewer data files and encodes CREX, edition 2 for both single and averaged observations.				
Language:	GW-Basic	**Memory:**		**Disk:**	5 KB
Portability:	Easily portable to many OS	**Add. software:**	GWBasic	**Peripherals:**	Printer
Adaptability:	Adaptable by skilled users	**Input format:**			
Distribution:	http://www.o3soft.eu/	**Output format:**	CREX file, printed output		

Support:	Limited free technical support	**Doc:**	http://www.wmo.int/pages/prog/www/WMOCodes.html
Contact:	Martin Stanek	**Doc Lang:**	English
Address:	Solar and Ozone Observatory	**Tel:**	+420 49 52 60 352
	Hvezdarna 456	**Fax:**	+420 49 52 64 127
	500 08 Hradec Kralove	**E-mail:**	stanek@chmi.cz
	Czech Republic		
Remarks:	CX command can be used into schedules.		

Software-Categories	Hardware-Categories	Operating-System	Version
Decoding/Encoding WMO data forms	PC	Other	MS-DOS 3.3
Quality control			

Programme:	**DOBSON**				
Member:	Czech Republic	**Centre:**	Czech Hydrometeorological Institute		
Description:	PC software for Dobson total ozone data reduction. The programme enables operational calculation and backward recalculations of total ozone for selected wavelength pairs for DS, ZB, ZC and FM types of observations. The current version creates the new WOUDC data format and CREX, edition 2.				
Language:	Pascal 7.0	**Memory:**	500 KB	**Disk:**	1 MB
Portability:	Easily portable to many OS	**Add. software:**	None	**Peripherals:**	Printer
Adaptability:	Easily adaptable	**Input format:**			
Distribution:	http://www.o3soft.eu/	**Output format:**	CREX file, printed output, WMO character code		
Support:	Limited free technical support	**Doc:**	http://www.wmo.int/pages/prog/www/WMOCodes.html		
Contact:	Martin Stanek	**Doc Lang:**	English		
Address:	Solar and Ozone Observatory	**Tel:**	+420 49 52 60 352		
	Hvezdarna 456	**Fax:**	+420 49 52 64 127		
	500 08 Hradec Kralove	**E-mail:**	stanek@chmi.cz		
	Czech Republic				
Remarks:					

References

[1] Manual on the GTS, WMO-No. 386.

[2] Manual on Codes, WMO-No. 306, Volume I.2, Part C.

[3] Final Report, Commission for Basic Systems, Extraordinary Session, Karlsruhe, Germany, 1998.

[4] Braathen Geir: Report on WIGOS-WIS Pilot Project GAW-IDOA.

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1. Final Report of the Expert Meeting on the Operation of Integrated Monitoring Programmes, Geneva, 2 -5 September 1980.

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3. Report of the Expert Meeting on the Assessment of the Meteorological Aspects of the First Phase of EMEP, Shinfield Park, U.K., 30 March - 2 April 1981.

4. Summary Report on the Status of the WMO Background Air Pollution Monitoring Network as at April 1981.

5. Report of the WMO/UNEP/ICSU Meeting on Instruments, Standardization and Measurements Techniques for Atmospheric CO_2, Geneva, 8-11; September 1981.

6. Report of the Meeting of Experts on BAPMoN Station Operation, Geneva, 23–26 November 1981.

7. Fourth Analysis on Reference Precipitation Samples by the Participating World Meteorological Organization Laboratories by Robert L. Lampe and John C. Puzak, December 1981.

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9. An Assessment of BAPMoN Data Currently Available on the Concentration of CO_2 in the Atmosphere by M.R. Manning, February 1982.

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14. Effects of Sulphur Compounds and Other Pollutants on Visibility by Dr. R.F. Pueschel, April 1983.

15. Provisional Daily Atmospheric Carbon Dioxide Concentrations as Measured at BAPMoN Sites for the Year 1981, May 1983.

16. Report of the Expert Meeting on Quality Assurance in BAPMoN, Research Triangle Park, North Carolina, USA, 17-21 January 1983.

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20. Extended Abstracts of Papers to be Presented at the WMO Technical Conference on Observation and Measurement of Atmospheric Contaminants (TECOMAC), Vienna, 17-21 October 1983.

21. Fifth Analysis on Reference Precipitation Samples by the Participating World Meteorological Organization Laboratories by Robert L. Lampe and William J. Mitchell, November 1983.

22. Report of the Fifth Session of the WMO Executive Council Panel of Experts on Environmental Pollution, Garmisch-Partenkirchen, Federal Republic of Germany, 30 April - 4 May 1984 (WMO TD No. 10).

23. Provisional Daily Atmospheric Carbon Dioxide Concentrations as Measured at BAPMoN Sites for the Year 1982. November 1984 (WMO TD No. 12).

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46. Provisional Daily Atmospheric Carbon Dioxide Concentrations as Measured at BAPMoN Sites for the Year 1984. December 1986 (WMO TD No. 158).

47. Procedures and Methods for Integrated Global Background Monitoring of Environmental Pollution by F.Ya. Rovinsky, USSR and G.B. Wiersma, USA. August 1987 (WMO TD No. 178).

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118. Report of the International Workshops on Ozone Observation in Asia and the Pacific Region (IWOAP, IWOAP-II), (IWOAP, 27 February-26 March 1996 and IWOAP-II, 20 August-18 September 1996) (WMO TD No. 827).

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134. Guide on Sampling and Analysis Techniques for Chemical Constituents and Physical Properties in Air and Precipitation as Applied at Stations of the Global Atmosphere Watch. Carbon Dioxide (WMO TD No. 980).

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