WORLD METEOROLOGICAL ORGANIZATION
GLOBAL ATMOSPHERE WATCH

Data Reporting Manual of the World Data Centre for Surface Ozone ($WDCSO_3$)

$WDCSO_3$ No. 1
(revision 1)

Prepared by

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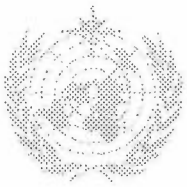
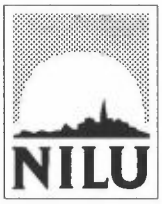
December 1998





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Data Reporting Manual of the World Data Centre for Surface Ozone ($WDCSO_3$)

$WDCSO_3$ No. 1

(revision 1)

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Table of Contents

1. Introduction

The Global Atmosphere Watch (GAW) is a World Meteorological Organization (WMO) programme devoted to the investigation and monitoring of changes in the chemical composition and ensuing physical characteristics of the globe's atmosphere. The purpose and objective of GAW is to provide quality data, scientific assessments, and other information on the atmospheric composition and related physical characteristics of the globe's background atmosphere. This concerted effort is required to improve understanding of the atmosphere and its interactions with the oceans and the biosphere, with the aim of predicting the future states of the earth-atmosphere system.

GAW was established in 1989 as a co-ordinated system of networks of observing stations, some of which began systematic data collection in the 1950's (i.e. Global Ozone Observing System – GO_3OS), and includes associated facilities and infrastructure encompassing measurement and related scientific assessment activities. The GAW programme is an integral part of the Global Climate Observing System (GCOS) consisting of global stations located at remote pristine locations and regional stations for characterising the regional environmental quality away from direct pollution sources. The overall role of GAW is to supply basic information of known quality indicative of the atmospheric environment. The measurement programme includes: greenhouse gases, ozone (surface, total, and profile), radiation (including UV-B) and optical depth, precipitation chemistry, chemical and physical properties of aerosols, reactive gases, radionuclides, and other related meteorological parameters (World Meteorological Organization, 1993). National and international policy decisions affecting the environment in the 21st century will thus relay heavily on the scientific data gathered through GAW. In particular, the measurements made within the context of GAW will be essential to the understanding of:

- The relationship between changing atmospheric composition and changes of regional and global climate.
- The impact of changes in climate and other aspects of the Earth system on the chemical composition of the atmosphere.
- The long-range atmospheric transport and deposition of potentially harmful substances.
- The natural cycling of chemical elements in the global atmosphere/ocean/biosphere system and anthropogenic impacts thereon.

In conjunction with the GAW, there are also established WMO World Data Centres for ozone and UV-B radiation (WOUDC, Toronto, Canada), precipitation chemistry (Albany, New York, USA), greenhouse and all atmospheric gases except ozone (WDCGG, Tokyo, Japan), and aerosols (WDCA, Ispra, Italy). A concept of Quality Assurance/Science Activity Centres serves as a crucial link between the individual sampling sites - where the parameters are measured - and the ultimate data

depositories (Data Centres) where the quality-assured data are archived and distributed.

The Norwegian Institute for Air Research (NILU) was awarded by the 49th session of the WMO Executive Council the privilege of hosting the new WMO World Data Centre for Surface Ozone ($WDCSO_3$). The objective of the $WDCSO_3$ at NILU is to provide the facilities to electronically store and maintain quality surface ozone data from the GAW network of monitoring stations and other background stations, produce yearly reports on the state of surface ozone data within the GAW network, and provide comprehensive surface ozone information to all WMO members, interested scientists and the general public as a whole.

To enhance the surface ozone information stored at the $WDCSO_3$, the submitted surface ozone data will be complemented by detailed auxiliary information in the form of meteorological data, instrument status, and also surface UV-radiation, NO_x, and VOCs measurements, if available. This data reporting manual describes the file format for submission, the primary and secondary, and is written in the context of the *Quality Assurance Project Plan (QAPjP) for Continuous Ground Based Ozone Measurements*, where the Standard Operating Procedure (SOP) for UV photometry type ozone instruments are described in detail (World Meteorological Organization 1997). Data submitted to the $WDCSO_3$ are expected to have ensued from the QAPjP SOP measurement guidelines.

2. $WDCSO_3$ Data Reporting Format

The file format for surface ozone measurements submitted to the $WDCSO_3$ archive consists of two *sections*: a header and a data structure. The parameters to be reported, their units, their value ranges, and format are described in detail in this section. Examples are given for the header and the measurement data.

2.1 The File Header

The header, which is to be included with each file submitted to the $WDCSO_3$ archive, must contain the following 27 records. ***Each record within the header must contain one (1) piece of information per line, and must be in the following order:***

1. *File type*
2. *WMO-GAW station identification number*
3. *Start of measurement date*
4. *End of measurement date*
5. *File creation date*
6. *File version*
7. *Station name*
8. *Country*
9. *Station latitude*
10. *Station longitude*
11. *Station elevation*
12. *Contact person*
13. *Contact person's e-mail address*
14. *Contact person's telephone number*
15. *Contact person's fax number*
16. *Instrument type used for the surface ozone measurements*
17. *Instrument serial number*
18. *Instrument calibration (audit) date*
19. *Instrument detection limit*
20. *Instrument time resolution*
21. *Air intake system*
22. *Air intake system location*
23. *UV surface radiation measurement type*
24. *Type of NO_x measurement*
25. *Species measured in NO_x*
26. *VOC measurement instrumentation*
27. *Type of VOCs measured*

NOTE: No line in the header is to remain empty (see section 2.5 for missing parameter codes). A $WDCSO_3$ file header must consist of 27 lines.

2.1.1 File Type

The file type, *it must be:*

```
WDCSO3 - Surface Ozone
```

2.1.2 WMO-GAW Station Identification Number

The reporting station's identification number common to all WMO-GAW World Data Centres.

Format: **DDDDDD**

for example `87349`

NOTE: The World Meteorological Organization will assign and maintain the WMO-GAW identification numbers for all GAW stations. The new GAW station ID will be a variation on the existing 6 digit WMO World Weather Watch (WWW) identification numbers. Implementation of the GAW station identification by WMO is expected in 1999.

2.1.3 Start of Measurement Date

The beginning of the surface ozone measurements reported in this file.

Format: **YYYYMMDD**

for example October 1, 1996 `19961001`

2.1.4 End of Measurement Date

The end of the surface ozone measurements reported in this file.

Format: **YYYYMMDD**

for example October 31, 1996 `19961031`

2.1.5 File Creation Date

The file's creation date.

Format: **YYYYMMDD**

for example `19971103`

2.1.6 File Version

The file version or revision.

Format: **maximum 80 characters**

for example:

```
Version 1.1, VOCs added to the existing ozone record
```

NOTE: Detailed information on the version or revision is required at the time of submission of the data sets.

2.1.7 Station Name

The official station name reporting data.
Format: **maximum 80 characters**

for example: `Ny-Aalesund`

2.1.8 Country

The country where the station is located or the country the station is associated with.
Format: **maximum 80 characters**

for example for Ny-Aalesund: `Norway`

2.1.9 Station Latitude

The station's meridional coordinate given in °North.
Units: [°] (degree)
Range: **-90**° to **90**°
Format: **±dd.d**

for the Northern Hemisphere (+) `+82.7`
and
for the Southern Hemisphere (-) `-63.1`

2.1.10 Station Longitude

The station's longitude given in °East.
Units: [°] (degree)
Range: **-180**° to **180**°
Format: **±ddd.d**

for eastern longitudes (+) `+112.2`
and
for western longitudes (-) `-93.7`

2.1.11 Station Elevation

The station's elevation above mean sea level (m.a.s.l.)

Units **[m]** (meters)
Format: **±dddd**

for example `474`

2.1.12 Contact Person

The name of the person responsible for the consistency of the station's data.

Format: ***maximum 80 characters***

for example `Bojan R. Bojkov`

2.1.13 Contact Person's E-mail Address

The contact person's E-mail address.

Format: ***maximum 80 characters***

for example `bojan.bojkov@nilu.no`

2.1.14 Contact Person's Telephone Number

The contact person's telephone number.

Format: **(country code) + telephone number**

for example `(47) 63 89 8000`

2.1.15 Contact Person's Telefax Number

The contact person's telefax number.

Format: **(country code) + telefax number**

for example `(47) 63 89 8050`

2.1.16 Instrument Type Used for the Surface Ozone Measurements

The surface ozone measuring instrument type and description.

Format: ***maximum 80 characters***

for example `UV-photometer model Teco 49`

2.1.17 Instrument Serial Number

The instrument's serial number **corresponding to 2.1.16**.
Format: ***maximum 80 characters***

for example `asc976753v`

NOTE: If there is an instrument change, multiple files should be submitted to the WDCSO$_3$.

2.1.18 Instrument Calibration (Audit) Date

The last calibration date or audit date.
Format: **YYYYMMDD**

for example September 23, 1996 `19960923`

2.1.19 Instrument Detection Limit

The surface ozone instrument's 3σ detection limit.
Units: **[ppb]** (parts per billion)
Format: **dd.d**

for example `0.5`

2.1.20 Instrument Time Resolution

The surface ozone measurement instrument's sampling time resolution.
Units: **[s]** (seconds)
Format: **dd**
for example `10`

2.1.21 Air Intake System

The instrument air intake instrumentation or description of the air inlet system used for the surface ozone measurements.
Format: ***maximum 80 characters***

for example

```
TEFLON tubing-1cm diameter, air residence time 10[s]
```

2.1.22 Air Intake System Location

The air intake system location or description of the air sampling location.

Format: ***maximum 80 characters***

for example `top of 3m mast`

2.1.23 UV Surface Radiation Measurement Type

Description of the UV surface radiation measurement and instrument type.

Format: ***maximum 80 characters***

for example `J(NO2) radiometer`

or

for example `Eppley pyranometer`

2.1.24 Type of NO_x Measurement

Description of the NO_x measurement technique.

Format: ***maximum 80 characters***

for example `chemiluminescence`

2.1.25 Species Measured in NO_x

The species measured by the instrumentation in **2.1.24**.

Format: ***maximum 80 characters***

for example `NO and NO2`

2.1.26 VOC Measurement Instrumentation

The VOC measuring instrument type.

Format: ***maximum 80 characters***

for example `GC-FID, can sampling`

2.1.27 Type of VOCs Measured

Description of the VOCs measured by the instrumentation in **2.1.26** (which group of VOCs).

Format: ***maximum 80 characters***

for example `C3-C8 grouped`

2.2 FILE HEADER EXAMPLE

This is a fictional example for a file header for a revised submission on November 3, 1997 (version 1.1, VOCs added to the existing ozone record already submitted) for measurements made during October 1996 at the GAW station Ny-Aalesund, Norway. The latitude is 78.9°N, the longitude is 11.9°E, and the measurement site is 474 [m.a.s.l.]. The instrument is a TECO 49 (serial no. asc976753v) with a 3σ resolution of 0.5 [ppb], a time resolution of 10 [s] and a sampling manifold located on a 3 [m] pole. The last instrument audit was performed on September 23, 1996. In addition, UV surface radiation is measured using a J(NO_2) radiometer, NO and NO_2 are measured using chemiluminescence, and C3-C8 VOCs (can sampling) are analysed using GC-FID. There is no WMO-GAW station ID available at this time (missing data code ZZZZZZZZZZ *is assigned, see section 2.5).*

The file header will be:

```
WDCSO3 - Surface Ozone
ZZZZZZZZZZ
19961001
19961031
19971103
Version 1.1, VOCs added to the existing ozone record
Ny-Aalesund
Norway
+78.9
+11.9
474
Bojan Bojkov
bojan.bojkov@nilu.no
(47) 63 89 8000
(47) 63 89 8050
UV-photometer model TECO 49
asc976753v
19960923
0.5
10
TEFLON tubing-1 cm diameter, 10 seconds residence
Top of 3m pole
J(NO2) radiometer
Chemiluminescence
NO and NO2
GC-FID, can sampling
C3-C8 grouped
```

2.3 MEASUREMENT DATA

The second part of the file format is the measurement data. The data is to be submitted in tabular form. Each line, representing one record, must include the date, the time, the ozone measurement, and ozone measurement status flag, the pressure, the temperature, the humidity, and the wind information. *Each record must be tabulated as follows:*

1. *Measurement date*
2. *Measurement time (UTC)*
3. *Surface ozone 10 or 15-minute average*
4. *Surface ozone 10 or 15-minute standard deviation*
5. *Surface ozone measurement status flag*
6. *Surface ozone 10^{th} or 15^{th} minute measurement*
7. *Surface pressure average*
8. *Surface temperature average*
9. *Relative humidity average at the surface*
10. *Surface wind speed 10 or 15-minute average*
11. *Surface wind speed 10 or 15-minute standard deviation*
12. *Surface wind direction 10 or 15-minute average*
13. *Surface wind direction 10 or 15-minute standard deviation*
14. *Cloud cover (as per meteorological observation)*
15. *Weather Condition (as per meteorological observation)*
16. *Total precipitation*
17. ***Surface radiation (if available)***
18. ***NO_x (if available)***
19. ***Volatile Organic Compounds (VOCs) (if available)***

NOTE: Use 10 or 15 minute averages only. If 10-minute averages are used, include the 10^{th} minute measurement in the record and likewise for 15-minute average values.

2.3.1 Measurement Date

The date of measurement.

Format: **YYYYMMDD**

for example 19971012

2.3.2 Measurement Time (UTC)

The time of measurement (UTC: universal time coordinate).

Range: **0001 to 2400**
Format: **HHMM**

for example 2215

2.3.3 Surface Ozone Average

The **10 or 15-minute** surface ozone average.

Units: **[ppb]** (parts per billion)
Format: **ddd.d**

for example 22.3

2.3.4 Surface Ozone Standard Deviation

The **10 or 15-minute** surface ozone standard deviation **corresponding to 2.3.3**.

Units: **[ppb]** (parts per billion)
Format: **ddd.d**

for example 1.3

2.3.5 Surface Ozone Measurement Status Flag

Each **10 or 15-minute** average surface ozone value in **2.3.3** must have one of the following flags.

- 0 Good ozone measurements
- 1 Revised ozone measurements
- -1 Uncertain ozone measurements
- 33 Instrument intercomparison
- 55 Instrument maintenance
- 77 Zero-air and span checks of the instrument
- -999 No ozone measurements available

2.3.6 Surface Ozone Sample Measurement

The **10th or 15th minute** surface ozone measurement (instantaneous measurement).

Units: **[ppb]** (parts per billion)
Format: **ddd.d**

for example 23.7

2.3.7 Surface Pressure Average

The **10 or 15-minute** average surface pressure corresponding to the ozone value in **2.3.3**.

Units: **[hPa]**

Format: **ddd.d**

for example 976.3

2.3.8 Surface Temperature Average

The **10 or 15-minute** average surface temperature corresponding to the ozone value in **2.3.3**.

Units: **[°C]**
Format: **±ddd.d**

for example +22.3

2.3.9 Relative Humidity Average at the Surface

The **10 or 15-minute** average relative humidity at the surface corresponding to the ozone value in **2.3.3**.

Units: **[%]**
Format: **ddd**
for example 88

2.3.10 Surface Wind Speed Average

The **10 or 15-minute** average surface wind speed corresponding to the ozone value in **2.3.3**.

Units: **[m/s]** (meters per second)
Format: **ddd**

for example 6.3

2.3.11 Surface Wind Speed Standard Deviation

The **10 or 15-minute** standard deviation of surface wind speed corresponding to the ozone value in **2.3.3**.

Units: **[m/s]** (meters per second)
Format: **ddd.d**

for example 0.3

2.3.12 Average Surface Wind Direction

The **10 or 15-minute** average surface wind direction corresponding to the ozone value in **2.3.3**.

Units: **[°]** (degree)

Range: **0° to 360°**
Format: **ddd**

for example 157

2.3.13 Standard Deviation Surface Wind Direction

The **10 or 15-minute** standard deviation of surface wind direction corresponding to the ozone value in **2.3.3**.

Units: [°] (degrees)
Format: **ddd**

for example 8.3

2.3.14 Cloud Cover

The cloud amount must be reported in *octas* as available from **standard meteorological observations**:

- 0 Clear sky
- 1-4 Scattered clouds
- 5-7 Broken
- 8 Overcast

- -999 No cloud information available

NOTE: For further information see WMO No 306 (1988).

2.3.15 Weather Condition

The local weather conditions as available from **standard meteorological observations**:

- 0 No event
- 111 Smog or Smoke
- 222 Haze, Sandstorm or Duststorm
- 333 Fog or Mist
- 444 Rain, Rainshower or Drizzle
- 555 Thunderstorms
- 666 Snow

- -999 No weather information available

2.3.16 Total Precipitation

The **10 or 15-minute** total precipitation corresponding to the ozone value in **2.3.3**, or **as per standard meteorological observation**.

Units: **[L/m^2]**
Format: **dd.d**

2.3.17 Surface Radiation

The **10 or 15-minute** average surface radiation measurement (if available) corresponding to the ozone value in **2.3.3**.

Units: **[W/m^2]**
Format: **ddd.d**

for example 22.3

2.3.18 NO_x

The NO_x measurements (if available) corresponding to the ozone value in **2.3.3**.

Units: **[ppb]** (part per billion)
Format: **ddd.d**

for example 78.0

2.3.19 Volatile Organic Compounds (VOCs)

The Volatile Organic Compounds measurement (VOCs, if available) corresponding to the ozone value in **2.3.3**.

Units: **[ppb]** (parts per billion)
Format: **ddd.d**

for example 43.3

2.4 MEASUREMENT DATA EXAMPLE

This is an example of measurement data in the described format:

19970201	2315	30.0	1.0	0	29.0	955.4	29.3	52	1.3	0.3	24	12	4	-999	0.0	-999	-999	-999
19970201	2330	28.0	1.0	0	29.0	955.4	28.5	54	1.9	0.5	9	14	4	-999	0.0	-999	-999	-999
19970201	2345	29.0	1.0	0	30.0	956.5	27.8	54	1.6	2.8	221	61	4	-999	0.0	-999	-999	-999
19970201	2400	31.0	0.5	0	31.0	958.8	23.3	62	6.4	1.8	199	22	4	-999	0.0	-999	-999	-999
19970202	15	31.0	1.0	0	30.0	959.5	22.5	63	6.1	2.0	187	21	4	-999	0.0	-999	-999	-999
19970202	30	30.0	1.0	0	30.0	960.3	21.3	67	5.9	1.8	196	24	4	-999	0.0	-999	-999	-999
19970202	45	30.0	1.0	0	29.0	959.9	20.7	67	5.6	1.8	176	24	4	-999	0.0	-999	-999	-999
19970202	100	29.0	2.0	0	30.0	962.0	19.1	80	5.4	1.4	211	18	4	-999	0.3	-999	-999	-999
19970202	115	29.0	2.0	0	30.0	961.9	17.8	86	5.1	1.4	199	23	4	-999	0.0	-999	-999	-999
19970202	130	27.0	1.0	0	25.0	962.9	18.4	81	5.2	1.4	214	18	4	-999	0.0	-999	-999	-999
19970202	145	26.0	2.0	0	25.0	963.9	18.7	80	5.5	1.3	216	16	-999	-999	0.0	-999	-999	-999

2.5 MISSING DATA

If any parameter is missing in the header or in a data record, the missing parameter must have one of the following values:

in the header (10 "z's"): ZZZZZZZZZZ

and

in the data table: -999

2.6 AVERAGE OR ARITHMETIC MEAN

The average or arithmetic mean to be used for the reported data is defined as follows:

For a given set of n values, X_1, X_2, X_3, . . ., X_n ,the average is their sum divided by n, the number of values in the set. It is denoted by $\overline{X}$ and may be expressed as

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

For example, if you have four surface ozone measurements and their values are 36, 39, 42 and 43 [ppb] respectively, their average is

$$\overline{X} = \frac{36+39+42+43}{4} = \frac{160}{4} = 40[\text{ppb}]$$

2.7 STANDARD DEVIATION

The standard deviation s of the mean $\overline{X}$ is the most used measure of the spread in the data, and is the positive square root of the variance.

$$s = \sqrt{\frac{\sum_{i=1}^{n} (X_i - \overline{X})^2}{n-1}}$$

For the four ozone measurements in **section 2.6 above**, the average $\overline{X}$ is 40[ppb], the standard deviation s is

$$s = \sqrt{\frac{(36-40)^2 + (39-40)^2 + (42-40)^2 + (43-40)^2}{4-1}} = \sqrt{\frac{30}{3}} = 3.16[\text{ppb}]$$

3. Reporting of Data to the $WDCSO_3$

3.1 Frequency of Data Submission

Reporting stations are to submit the current month of data at the end of every month (12 times a year). If there are revised data, due to calibrations, etc, they should be submitted as soon as available to the $WDCSO_3$ archive.

NOTE: All files must follow the format described in this document. NO other formats will be accepted with the exception of historical data (see 3.3).

3.2 Quality control of File format

It is recommended that each file $WDCSO_3$ file format be checked before submission to the $WDCSO_3$ archive. A $WDCSO_3$ programme (DOS executable) will be made available to the data originators (through ftp and WWW) to check the file format.

3.3 Historical data

Historical data will be accepted and stored at the $WDCSO_3$. Data dated before 1999 will be accepted in any format.

NOTE: For practical reasons, it is preferable for the historical data to be compliant to the $WDCSO_3$ format.

4. Methods of Data Submission to the $WDCSO_3$

Submissions of the surface ozone data to the $WDCSO_3$ archive are possible in the following manner:

1. E-mail the data to **wdcso3@nilu.no**

2. Send by anonymous ftp the data to **ftp.nilu.no**
(*login:* anonymous, *password*: 'your e-mail address')

   for example for user smith@institute.org

   ```
   login:      anonymous
   password:   smith@institute.org
   ```

NOTE: The submission of data through anonymous ftp site will be operational in early 1999.

3. Mail the data on a floppy disk(s) to:

   $WDCSO_3$
   c/o
   Dr. B. R. Bojkov
   Norwegian Institute for Air Research
   P.O. Box 100
   N-2007 Kjeller, NORWAY

REMINDER: Due to the amount of data generated in one month of instrument operation, no files will be accepted into the archive in a format other than the format described in this manual.

5. Access to the WDCSO$_3$ Archive

The WDCSO$_3$ archive is fully accessible through the World Wide Web (WWW):

http://www.nilu.no/wdcso3.html

All files of surface ozone observations will also be available through the ftp site:

ftp.nilu.no

NOTE: The retrieval of data through anonymous ftp site will be operational in early 1999.

6. Questions and Inquiries to the $WDCSO_3$

Questions or inquiries concerning data submissions, availability, etc, are to be directed:

1. by E-mail to:

   wdcso3@nilu.no

2. by mail to:

   $WDCSO_3$
   c/o
   Dr. B. R. Bojkov
   Norwegian Institute for Air Research
   P.O. Box 100
   N-2007 Kjeller, NORWAY

News, frequently asked questions (FAQ), and updates for the quality control programmes, will be available on the $WDCSO_3$ World Wide Web (WWW) site:

http://www.nilu.no/wdcso3.html

7. Revisions

September 1998

Original WDCSO$_3$ No. 1 data reporting manual.

December 1998 (WDCSO$_3$ No.1, Revision 1)

1. Addition of *file type*, *file version*, and *WMO-GAW station identification number* and rearrangement of header sequence in section **2.1**.
2. Addition of *weather conditions* to the measurement data as section **2.3.15**, subsequent shift of sections **2.3.15-2.3.18**.
3. Additional ozone status flags added in **2.3.5**.
4. Specified *average* surface pressure temperature and relative humidity corresponding to the average surface ozone measurement (**2.3.7-2.3.9**).
5. Corrected the range of measurement time in **2.3.2** to 0001-2400 instead of 0000-2359.
6. Corrected wind direction range in **2.3.12** to 0-360 instead of 0-359.
7. In **2.3.15**, total precipitation instead of average precipitation.
8. Minor clarifications in **2.1.6** and **2.3.6**.

8. Acknowledgements

I wish to thank the anonymous reviewers for their input to this data submission protocol. I am especially grateful to Mrs. Roxanna Villan of the *Observatorio Geofisico y Meteorologico Pilar*, Pilar, Argentina, on her practical suggestions. This project is financially supported by NILU (E-97097).

9. References

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CH-1212 Geneva 2 SWITZERLAND

ABSTRACT:

NORWEGIAN TITLE:

KEYWORDS:		
Surface Ozone	World Data Centre	File Format

ABSTRACT (in Norwegian):

* *Classification*
- *A Unclassified (can be ordered from NILU)*
- *B Restricted distribution*
- *C Classified (not to be distributed)*