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| WORLD METEOROLOGICAL ORGANIZATION  COMMISSION FOR BASIC SYSTEMS  -----------------------------  FOURTH MEETING OF  INTER-PROGRAMME EXPERT TEAM ON DATA REPRESENTATION MAINTENANCE AND MONITORING  GENEVA, SWITZERLAND, 30 MAY - 3 JUNE 2016 |  | IPET-DRMM-IV / Doc. 3.2 (11)  (26. 5. 2016)  -------------------------  ITEM 3.2  ENGLISH ONLY |

BUFR & CREX

Development of a LIDAR & Ceilometer Table D Sequence

*Submitted by*

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**Summary and Purpose of Document**

As part of the COST action ES0702 EG-CLIMET <http://www.eg-climet.org> , a special working group was formed to look at the “Harmonisation of European automatic Lidar and Ceilometer Network, Calibrations , recording formats and archiving protocols”. As part of these activities it was agreed that a common BUFR template should be agreed upon for this data. After an extensive review the following Table D sequence has been agreed upon by the LIDAR community.

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**ACTION PROPOSED**

The meeting is requested to review the proposal and if in agreement grant

validation status to the proposed D sequence.

**ANNEXES:**

1. B descriptors proposed as part of the D sequence development.
2. Additional information concerning the data.

**DISCUSSIONS**

The sequence outlined in this proposal has been developed in parallel with the proposal previously submitted by the UK Met Office and MetEO Swiss to IPET-DRMM I (Tokyo 2013) for a “**BUFR template for radar wind profiler**”. As such the two sequences utilise the same sequence of descriptors in the header section.

In developing the sequence a number of new descriptors have been proposed which are listed in annex 1.

**PROPOSAL**

The meeting is requested to review and pass the proposed D sequence and Table B descriptors to validation status.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **LIDAR Sequence** | | | | |
| **TABLE**  **REFERENCE** | **TABLE**  **REFERENCE** | **TABLE**  **REFERENCE** | **TABLE**  **REFERENCES** | **ELEMENT NAME** |
| **F X Y** | **F X Y** | **F X Y** | **F X Y** |
| **Header Section** | | | | |
| **3 09 023** |  |  |  |  |
|  | 0 01 001 |  |  | WMO Block Number |
|  | 0 01 002 |  |  | WMO Station Number |
|  | 0 05 001 |  |  | Latitude (High Accuracy) |
|  | 0 06 001 |  |  | Longitude (High Accuracy) |
|  | 0 07 001 |  |  | Height Of Station |
|  | 3 01 014 |  |  | Time Period |
|  |  | 1 02 002 |  | Replication of 2 descriptors (3 01 011 & 3 01 012) twice [[1]](#footnote-1) |
|  |  | 3 01 011 |  |  |
|  |  |  | 0 04 001 | Year |
|  |  |  | 0 04 002 | Month |
|  |  |  | 0 04 003 | Day |
|  |  | 3 01 012 |  |  |
|  |  |  | 0 04 004 | Hour |
|  |  |  | 0 04 005 | Minute |
|  | 0 02 003 |  |  | Type of measuring equipment used [[2]](#footnote-2) |
|  | **Cloud data section** | | | |
|  | 3 02 004 |  |  | ***General Cloud Information*** |
|  |  | 0 20 010 |  | Cloud cover (total) |
|  |  | 0 08 002 |  | Vertical significance (surface observations) |
|  |  | 0 20 011 |  | Cloud amount |
|  |  | 0 20 013 |  | Height of base of cloud |
|  |  | 0 20 012 |  | Cloud Type |
|  |  | 0 20 012 |  | Cloud Type |
|  |  | 0 20 012 |  | Cloud Type |
|  | 3 02 005 |  |  | ***Cloud Layer*** |
|  |  | 0 08 002 |  | Vertical significance (surface observations) |
|  |  | 0 20 011 |  | Cloud amount |
|  |  | 0 20 012 |  | Cloud Type |
|  |  | 0 20 013 |  | Height of base of cloud |
|  | **Backscatter data section** | | | |
|  | 1 14 000 |  |  | Delayed replication of 14 descriptors |
|  | 0 31 000 |  |  | Delayed replication Factor |
|  |  | 0 07 007 |  | Height |
|  | 3 01 022 | 0 05 001 |  | Latitude High Accuracy |
|  |  | 0 06 001 |  | Longitude High Accuracy |
|  | 1 xx 000 |  |  | Delayed replication dependent on number of wavelength measurements present in the data.(note d) |
|  | 0 31 000 |  |  | Delayed replication Factor - – if applicable (see note d) |
|  | 0 02 121 |  |  | Mean Frequency |
|  | 0 15 063 |  |  | Attenuated Backscatter |
|  | 0 15 064 |  |  | Uncertainty in Attenuated Backscatter |
|  | 0 15 065 |  |  | Particle Backscatter Coefficient |
|  | 0 15 066 |  |  | Uncertainty in Particle Backscatter Coefficient |
|  | 0 15 067 |  |  | Particle Extinction Coefficient |
|  | 0 15 068 |  |  | Uncertainty in Particle Extinction Coefficient |
|  | 0 15 069 |  |  | Particle LIDAR Ratio |
|  | 0 15 070 |  |  | Uncertainty in LIDAR Ratio |
|  | 0 15 071 |  |  | Particle Depolarization Ratio |
|  | 0 15 072 |  |  | Uncertainty in Depolarization Ratio |
|  | 0 33 002 |  |  | Quality Information |
|  | 0 10 071 |  |  | Vertical Resolution |
|  | 0 27 079 |  |  | Horizontal Width of sampled volume. |

**NOTES**

**Note a**

We have a requirement for coding instruments operating at wavelengths between the following ranges;

100nm for UV Lidar’s to 30m for VHF radars\* (see RWP Template)

This corresponds to a range of between the following when measured in Hz

1e+7 – 1e+16

We intend to make use of the existing descriptor 0 02 121 and use modifiers to obtain the desired range.

\*We must also consider the ceilometers/lidar instruments as we plan to use a common header sequence – details in a separate proposal.

**Note b**  We would like to request that a footnote is added indicating that the station height should recoded as ‘Above Mean Sea level’.

**Note c** – Should this be part of “Class 27 Non-coordinate location’?

**Note d** – The replication is included to allow for instruments with multiple wavelengths – for most instruments only one wavelength is reported, in which case this should be set to ‘missing’ (ie. No additional replication is required).

**Note e** – Following on from the overall Table D sequences proposed for RWP Wind and RASS data. Alternatively could we have a standard sequence for the header (as this will be the same for Wind profiler/RASS and LIDAR/Ceilometer messages and then issue separate Table D references for the data parts?

**Annexe 1 B descriptors proposed as part of the D sequence development.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **BUFR** | | | | **CREX** | | |
| **TABLE**  **REFERENCE** |  |  |  |  | **DATA** |  |  | **DATA** |
| **ELEMENT NAME** | **UNIT** | **SCALE** | **REFERENCE** | **WIDTH** | **UNIT** | **SCALE** | **WIDTH** |
| **F\* X   Y** |  |  |  | **VALUE** | **(Bits)** |  |  | **(Characters)** |
| 0 15 063 | Attenuated Backscatter | m‑1.Sr‑1 | 8 | 0 | 20 | m‑1.Sr‑1 | 0 | 6 |
| 0 15 064 | Uncertainty in Attenuated Backscatter | m‑1.Sr‑1 | 8 | 0 | 20 | m‑1.Sr‑1 | 0 | 6 |
| 0 15 065 | Particle Backscatter Coefficient | m‑1.Sr‑1 | 8 | 0 | 20 | m‑1.Sr‑1 | 0 | 6 |
| 0 15 066 | Uncertainty in Particle Backscatter Coefficient | m‑1.Sr‑1 | 8 | 0 | 20 | m‑1.Sr‑1 | 0 | 6 |
| 0 15 067 | Particle Extinction Coefficient | m‑1 | 8 | 0 | 20 | m‑1.Sr‑1 | 0 | 6 |
| 0 15 068 | Uncertainty in Particle Extinction Coefficient | m‑1 | 8 | 0 | 20 | m‑1.Sr‑1 | 0 | 6 |
| 0 15 069 | Particle LIDAR Ratio | Sr | 2 | 0 | 14 | Sr | 0 | 4 |
| 0 15 070 | Uncertainty in LIDAR Ratio | Sr | 2 | 0 | 14 | Sr | 0 | 4 |
| 0 15 071 | Particle Depolarization Ratio | % | 2 | 0 | 14 | % | 0 | 4 |
| 0 15 072 | Uncertainty in Depolarization Ratio | % | 2 | 0 | 14 | % | 0 | 4 |
| 0 27 079 | Horizontal Width of sampled volume. | m | 0 | 0 | 18 | m | 0 | 6 |
| 0 10 071 | Vertical resolution | m | 0 | 0 | 14 | m | 0 | 4 |

**ANNEX – ADDITIONAL INFORMATION**

**New Codes for 0 02 003 descriptor**

Code tables:

To represent in a slightly more specific way the different observation methods, the following entries are suggested to be added to code table 0 02 003:

|  |  |
| --- | --- |
| 10 | Doppler radar wind profiler |
| 11 | Doppler lidar wind profiler |
| 12 | Backscatter lidar |
| 13 | Spaced antenna wind profiler |

Comments taken from previous proposal document may be useful when discussing the template.

**2.3 Cloud data section**

Clouds shall be reported in the same way as in the SYNOP messages (Table D sequence 3 02 035 for basic synoptic instantaneous data). Sequence 3 02 004 accommodates the general cloud information reporting total cloud cover and total cloud amount as well as the lowest cloud base observed. Individual cloud layers shall be reported with sequence 3 02 005 which can be repeated as many times as necessary.

The descriptor 0 08 002 for “Vertical significance” refers a code table of which the relevant entries are shown below. To report the general cloud information the vertical significance is set to 5 or 20.

the lowest cloud base (ceiling) or no clouds, respectively. The vertical significance of the individual cloud layers is set to 20 – 24.

Since the cloud type cannot be determined automatically with lidars the descriptor 0 20 012 for cloud type is set to 63 (missing value).

The descriptor 0 20 011 refers to a code table of which the relevant entries are shown below. In case of missing values the value is set to 15.

***2.4 Backscatter data section***

Backscatter data are provided mainly by research Lidars but more and more also by state-of-the art ceilometers. Optical parameters of aerosols can be derived from backscatter and extinction data that are an important information for the estimation of volcanic ash concentration or of the boundary layer height.

Backscatter data are reported as a function of emitted and received wavelength/frequency. In order to host backscatter data at several wavelengths in one file, two additional replications are used.

**2.4.1 Vertical coordinate**

The vertical coordinate is height and it refers to height above sea level.

**2.4.2 Latitude/Longitude**

Latitude and longitude are reported as a function of altitude to give full flexibility for data location. With this the template follows the developments being made in radiosounding where the measurement is no longer considered a vertical profile but a trajectory.

**2.4.3 Uncertainty**

For the definition of the measurement uncertainty it is referred to the CIMO guide [], chapter 1:

“Non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used.”

Uncertainty is an important parameter for a proper use of the measurement. For remote sensing, uncertainty is not constant, but changes generally as a function of altitude and as a function of the meteorological conditions. It is hence important and required to report uncertainty as a function of altitude.

Measurement uncertainty can be inferred by identifying and quantifying sources of uncertainty in the measurement process and by propagating them through the data reduction process. Alternatively, the uncertainty can be estimated from intercomparisons with reference measurements.

**2.4.4 Missing Data**

Missing data should be reported following the BUFR convention:

“The convention for representing missing data for compressed data within the binary Data section shall be to set the corresponding increments to fields of all ones.”

**2.4.5 Vertical resolution**

To properly characterize the data, the vertical resolution is reported as a function of altitude. Vertical averaging may be applied in higher parts of the profile to improve signal to noise ratio.

**2.4.6 Horizontal width of sampled volume**

This parameter characterized the horizontal extent of the volume, in which measurements are being done in order to be reduced to a single vertical profile. For scanning instruments, this is the diameter of the cone which has been scanned. For strictly vertically pointing instruments, this is the diameter of the cone defined by the beam divergence.

The horizontal width of the sampled volume gives some qualitative information on the representativeness of the measurement.

**2.4.7 Quality flag**

The value of the QF depends on the algorithm used and is different from system to system. The value of the QF for the data user depends on how the QF is set. A harmonized QF could be provided by a centralized QC.

|  |  |
| --- | --- |
| *Table 1: Code table 0 22 002.* 0 | Data not suspect |
| 1 | Data suspect |
| 2 | Reserved |
| 3 | Quality information not given |

**2.4.8 Aerosol parameters**

For definitions of the aerosol parameters included in the BUFR template, the reader is referred to the E-PROFIL ALC glossary which can be found on the EUMETNET portal.

1. Note this is a change to the original proposal [↑](#footnote-ref-1)
2. Code table 0 02 003 will be extended to accommodate extra metadata parameters. [↑](#footnote-ref-2)