EUMETNET
EUROPEAN METEOROLOGICAL SERVICES NETWORK

E-PROFILE

BUFR Specification for Active Ground Based Remote Sensing Profiler Data

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1.1		Alexander Haefele	Feedback from Myles and Volker incorporated and variants removed
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1.3	04.06.2013	Alexander Haefele	Implementation of comments from S. Klink and replacment of E-WINPROF by E-PROFILE.

Table of Content

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KAPITEL 1 Introduction

A radar wind profilers (RWP) is a radar device to measure the vertical profile of the three wind vector components. RWP's work in three frequency bands around 50, 400 and 1000 MHz, to cover an altitude range up to 30, 16 and 5 km, respectively.

Many countries are running a RWP network for assimilation in numerical weather prediction models (NWP). In Europe, the national networks are integrated into a common network in the frame of the EUMETNET programme E-PROFILE (former E-WINPROF). It contains around 30 RWP's on the European continent. Recently, E-PROFILE started the monitoring of the Canadian network of 9 RWP's. Data are encoded in BUFR messages and distributed via the Global Telecommunication System (GTS) and collected by the network hub, where system and data quality monitoring is performed.

Other important networks are: National Oceanic and Atmospheric Administration, NOAA, 35 stations; Japan Meteorological Agency, JMA, 31 stations; China Meteorological Administration, CMA, over 300 stations; Bureau of Meteorology (Australia), 6 stations.

Most of the data from these networks are exchanged via the GTS encoded as BUFR messages. Unfortunately all these networks are using different implementations of BUFR, which makes data exchange difficult and favors wrong use of the data (Semple, 2005). Hence, there is a need to harmonize the use of BUFR for RWP's. This need has also been recognized by the WMO and in the joint meeting of ET-ORS and ET-SBRSO an action has been formulated: "A small team should be formed to review the situation and identify and articulate the issues and how to suggest a way forward."

In the frame of E-PROFILE a small team has been formed to review the different BUFR templates for RWP's, to identify differences and to suggest a new BUFR template to be used by all RWP networks. A questionnaire has been distributed to the user community to collect feedback on data usage. Feedback has been received from DWD, Meteo France, Meteo AM, JMA and BoM. In this report the findings of this review are presented and a new BUFR template is proposed, based on the review and the feedback from the RWP and data user community.

Other technologies than RWP like Doppler and backscatter lidars for wind and aerosol measurements as well as SODAR and RASS for wind and virtual temperature measurements, are already or will be operated in networks in the coming years. It is therefore timely to include these instruments in this discussion. As it becomes increasingly difficult to derive a specific BUFR template for each and every instrument, it is attempted to focus on standardised products (e.g. measured and derived atmospheric parameters) rather than on specific measurement systems. For example, the remote sensing of the wind vector is currently possible with three different active methods using radio waves (radar), laser light (lidar) and sound waves (sodar). However, it would make little sense from a user perspective to have three different BUFR templates for the same derived product "wind vector". The proposed template therefore attempts a paradigm shift in that respect and proposes parameter oriented templates that can be used for several active remote sensing instruments.

The document is structures as follows: Chapter 2 presents a review of existing BUFR templates for radar wind profilers. The general header section for active remote sensing profiling measurements and

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the replication section for RWP, RASS, LIDAR and SODAR are described in Chapter 3. A detailed presentation of the reviewed RWP BUFR templates is given in Annex A.

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KAPITEL 2 Review of existing BUFR Templates for Radar Wind Profilers

2.1 RWP BUFR template comparison

Five different BUFR templates have been reviewed, namely those of COST-76 (E-PROFILE), NOAA, Canada and JMA. These templates are decoded and presented in the annex. The Bureau of Meteorology (Australia) is using the COST-76 template and CMA did not yet select a BUFR template. The following table summarizes which descriptors are used in which template.

For detailed information on the BUFR format the reader is referred to WMO publications (WMO, 2010)

Data Field	Element Name	Descriptor	COST-76	NOAA	CANADA	JMA	Comments
	WMO BLOCK NUMBER	0 01 001	Y	Y	Y	Y	
	WMO STATION NUMBER	0 01 002	Y	Y	Y	Y	
	TYPE OF STATION	0 02 001	Y	Y	N	N	
	YEAR	0 04 001	Y	Y	Y	Y	
	MONTH	0 04 002	Y	Y	Y	Y	
	DAY	0 04 003	Y	Y	Y	Y	
	HOUR	0 04 004	Y	Y	Y	Y	
	MINUTE	0 04 005	Y	Y	Y	Y	
	LATITUDE (COARSE ACCURACY)	0 05 002	Y	Y	N	Y	
	LONGITUDE (COARSE ACCURACY)	0 06 002	Y	Y	N	Y	
	LATITUDE (HIGH ACCURACY)	0 05 001	N	N	Y	N	
	LONGITUDE (HIGH ACCURACY)	0 06 001	N	N	Y	N	

	HEIGHT OF STATION	0 07 001	Y	Y	Y	Y	
	SHORT STATION OR SITE NAME	0 01 018	N	Y	N	N	
	TYPE OF MEASURING EQUIPMENT USED	0 02 003	Y	Y	Y	Y	
	TYPE OF ANTENNA	0 02 101	Y	N	N	N	
	3 DB BEAM WIDTH	0 02 106	Y	N	N	N	
	MEAN FREQUENCY	0 02 121	Y	Y	N	N	
	RANGE-GATE LENGTH	0 25 001	Y	N	N	N	
	MEAN SPEED ESTIMATION	0 25 020	Y	N	N	N	
	WIND COMPUTATION ENHANCEMENT	0 25 021	Y	N	N	N	
	TIME SIGNIFICANCE	0 08 021	Y	Y	N	Y	
	TIME PERIOD OR DISPLACEMENT	0 04 025	Y	Y	N	Y	

Data Field	Element Name	Descriptor	COST-76	NOAA	CANADA	JMA	Comments
	HEIGHT	0 07 007	Y	N	Y	Y	
	HEIGHT ABOVE STATION	0 07 006	N	Y	N	N	
	ADDITIONAL FIELD SIGNIFICANCE	0 31 001	Y	N	N	N	
	WIND PROFILER QUALITY CONTROL TEST RESULTS	0 25 034	N	Y	N	N	
	QUALITY INFORMATION	0 33 002	N	N	Y	Y	
	WIND DIRECTION	0 11 001	Y	Y	Y	N	
	WIND SPEED	0 11 002	Y	Y	Y	N	
	STANDARD DEVIATION OF HORIZONTAL WIND SPEED	0 11 050	N	Y	N	N	
	STANDARD DEVIATION OF VERTICAL WIND SPEED	0 11 051	N	Y	N	N	

W-COMPONENT	0 11 006	Y	Y	Y	Y	
U-COMPONENT	0 11 003	N	N	N	Y	
V-COMPONENT	0 11 004	N	N	N	Y	
SIGNAL TO NOISE RATIO	0 21 030	Y	N	N	Y	

2.2 Discussion

2.2.1 Information on Station

The descriptor TYPE OF STATION distinguishes between “automatic”, “ manned” and “hybrid” and it’s being used in two out of four templates.

In three out of four templates the course latitude and longitude information is used. These descriptors have an accuracy of 0.01 degree, which corresponds approximately to 1 km. In the Canadian template the high accuracy descriptors are used for latitude and longitude, which have a precision of 10^{-5} degrees, which corresponds approximately to 1 m.

A short station or site name is used only in the NOAA template.

2.2.2 Time

In all templates the time is reported with a precision of minutes. Three out of four templates contain the descriptor TIME SIGNIFICANCE and TIME PERIOD OR DISPLCACEMENT. Former refers to a code table and code figure 2 is widely used, which translates to “Time averaged”, meaning that the reported measurements are averages over time. A note says: “*Time averaged* indicates that values are continuously averaged over a period of time”. Latter is reported in minutes and refers to the duration of the averaging period.

From the BUFR tables it is not clear whether the time stamp is at the beginning, the center or at the end of the averaging period and whether the reported time period is before, after or centered with respect to the time stamp.

2.2.3 Information on the instrument

TYPE OF MEASURING EQUIPMENT is used in all templates. It refers to a code table which gives some information on the instrumentation used. Most data centers use code figure 6, which translates to “Wind profiler”. This is not very precise and it does not allow to distinguish between radar and lidar wind profilers, for example.

The COST-76 template provides a maximum of information on the instrument and its configuration: antenna type, 3 dB beam width, mean frequency (=operating frequency) and range-gate length are specified. The range gate length is an indication for the vertical resolution. NOAA provides the mean frequency and Canada and JMA do not contain any information on the instrument and configuration.

The descriptor WIND COMPUTATION ENHANCEMENT refers to different pulse coding's and is only reported in the COST-76 template.

MEAN SPEED ESTIMATION, contained only in the COST-76 template, refers to a code table, that gives information on the estimation of the wind speed. However, the exact meaning of this piece of information is not clear.

2.2.4 Vertical coordinate

Three out of four templates use HEIGHT as vertical coordinate. The BUFR tables do not say clearly, which reference level should be used for this descriptor. The NOAA template uses HEIGHT ABOVE STATION and is the most precise in this respect.

2.2.5 Data and quality flag

Wind is reported in speed, direction and w-component by COST-76, NOAA and Canada. The JMA template uses u-,v- and w-component. The standard deviation of horizontal/vertical wind speed is reported only in the NOAA template.

All templates contain a quality flag, however each template uses its own implementation.

Signal to noise ratio is reported in two out of four templates.

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KAPITEL 3 A New general purpose BUFR Template for active ground based remote sensing profilers

3.1 Purpose of this Template

The proposed template is a “product message”, that contains only the essential information needed for a proper use of the remote sensing data in numerical weather prediction. It is user oriented, clear and well defined, not leaving room for interpretation. Complementary information on hard- and software configuration and system performance for network monitoring as well as additional parameters like signal-to-noise ratio and raw data will be exchanged in a “raw data message”. The definition of a raw data BUFR template is beyond scope of this document. Other formats than BUFR might be more suitable for the storage of raw data, e.g. netCDF

The proposed template is based on the review of all templates for RWP that were known to be currently in use and accessible to the authors. The proposed template consists of a header part that is generic for active ground based remote sensing data and a replication (data) part that is specific for the measured quantity, e.g. wind, virtual temperature, backscatter and extinction.

Where possible existing code sequences have been adopted, new and modified descriptors are detailed below with the full BUFR template .

3.2 Header section

Data Field	Element Name	Descriptor	Table B Scale	Table B Ref.	Table B Width	Units	Comments
1	WMO BLOCK NUMBER	0 01 001	0	0	7	Numeric	
2	WMO STATION NUMBER	0 01 002	0	0	10	Numeric	
3	LATITUDE (HIGH ACCURACY)	0 05 001	5	-9000000	25	Degree	1
4	LONGITUDE (HIGH ACCURACY)	0 06 001	5	-18000000	26	Degree	1
5	HEIGHT OF STATION	0 07 001	0	-400	15	m	
6	TIME PERIOD	3 01 014					Table D
7	TYPE OF MEASURING EQUIPMENT USED	0 02 003	0	0	4	Code Table	

3.3 Comments on the header section

3.3.1 Information on Station

It is suggested to use the high accuracy indicators for latitude and longitude owing to a precision of approximately 1 m.

The type of station and short station or site name are not considered essential and are omitted.

3.3.2 Time

The use of the descriptors *time significance* and *time period or displacement* left space for misinterpretation. Furthermore, feedback from data users shows that reporting start and end time or the middle of the observation interval is preferred. It is hence proposed to define the observation period by reporting the start and end time using the table D sequence *time period* specified below:

TABLE REFERENCE F X Y	*TABLE REFERENCES*	*ELEMENT NAME*
3 01 014	1 02 002	Replication of 2 descriptors 2 times
	3 01 011	Year, Month, Day
	3 01 012	Hour, Minute
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

3.3.3 Meta data

Beside the standard meta data connected to location and geometry, only a minimum of metadata are included in the template. Nevertheless, the operator is encouraged to record all the metadata needed for a full characterization of the data. These may be used for reprocessing of the data or for climatological analyses. A convenient solution to archive and make accessible more exhaustive meta data could be a centralized meta data base. Such a proposition has been submitted to the WIGOS task team of metadata (ICG-WIGOS/TT-WMD-1).

Type of measuring equipment used: This information is not needed for data interpretation, but may be helpful to understand certain characteristics of the measurements. We propose to extend the code table 0 02 003 as follows:

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

3.4 *Wind data replication section (for RWP, Doppler lidar, SODAR)*

Data Field	Element Name	Descriptor	Table B Scale	Table B Ref.	Table B Width	Units	Comments
1	HEIGHT	0 07 007	0	-1000	17	m	
2	LATITUDE (HIGH ACCURACY)	0 05 001	5	-9000000	25	Degree	
3	LONGITUDE (HIGH ACCURACY)	0 06 001	5	-18000000	26	Degree	
4	U-COMPONENT	0 11 003	1	-4096	13	ms^{-1}	
5	UNCERTAINTY IN U-COMPONENT	Tbd	-1	0	10	ms^{-1}	NEW
6	V-COMPONENT	0 11 004	1	-4096	13	ms^{-1}	
7	UNCERTAINTY IN V-COMPONENT	Tbd	-1	0	10	ms^{-1}	NEW
8	QUALITY INFORMATION	0 33 002	0	0	2	Code table	
9	W-COMPONENT	0 11 006	2	-4096	13	ms^{-1}	
10	UNCERTAINTY IN W-COMPONENT	Tbd	-2	0	10	ms^{-1}	NEW
11	QUALITY INFORMATION	0 33 002	0	0	2	Code table	
12	VERTICAL RESOLUTION	Tbd	0	0	14	m	NEW
13	HORIZ. WIDTH OF SAMPLED VOLUME	Tbd	-1	0	20	m	NEW

3.5 Comments on the wind data replication section

3.5.1 Vertical coordinate

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

3.5.2 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.

3.5.3 Wind data from RWP, Doppler lidar and SODAR

Wind data are reported as wind components. An error estimate is given for each wind component for each height level. Uncertainty in *u,v* and *w* are new descriptors.

3.5.4 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.

3.5.5 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.”

3.5.6 Vertical resolution

To properly characterize the data, the vertical resolution is reported as a function of altitude. This is important if one day low and high mode are combined to a composite profile on the data processing level and the vertical resolution changes as a function of height. No information on horizontal

resolution is foreseen, since profiler data generally can be considered a point measurement in the horizontal plane.

3.5.7 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 beam swinging instruments, this is the diameter of the cone defined by the oblique beams. 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 representativness of the measurement.

3.5.8 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.

A quality flag is proposed because it has been used in all revised RWP templates and because it has been considered useful or even necessary by the data users. Further it makes the template more flexible to respond to changing requirements in the future. An individual quality flag is given for the horizontal wind components and for the vertical wind component and it refers to the last reported data. The values of the quality flag are given by the following code/flag table:

Table 1: Code table 0 22 002.

0	Data not suspect
1	Data suspect
2	Reserved
3	Quality information not given

3.5.9 High/low mode

Information on high and low mode is not provided anymore for the following reasons:

- This information is implicitly provided through the vertical resolution.
- High and low mode is relative and there is no general definition. It is better to think in high and low resolution data.
- High and low mode does not apply to all active remote sensing data.

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3.6 Temperature data replication section (RASS)

The Radio Acoustic Sounding System is an extension of a radar wind profiler for profiling of virtual temperature in the boundary layer.

Data Field	Element Name	Descriptor	Table B Scale	Table B Ref.	Table B Width	Units	Comments
1	HEIGHT	0 07 007	0	-1000	17	m	
2	LATITUDE (HIGH ACCURACY)	0 05 001	5	-9000000	25	Degree	1
3	LONGITUDE (HIGH ACCURACY)	0 06 001	5	-18000000	26	Degree	1
4	VIRTUAL TEMPERATURE	0 12 007	1	0	12	K	
5	UNCERTAINTY IN VIRTUAL TEMPERATURE	Tbd	-1	0	10	K	NEW
6	QUALITY INFORMATION	0 33 002	0	0	2	Code table	
7	W-COMPONENT	0 11 006	2	-4096	13	ms^{-1}	
8	UNCERTAINTY IN W-COMPONENT	Tbd	-2	0	10	ms^{-1}	NEW
9	QUALITY INFORMATION	0 33 002	0	0	2	Code table	
10	VERTICAL RESOLUTION	Tbd	0	0	14	m	NEW
11	HORIZ. WIDTH OF SAMPLED VOLUME	Tbd	-1	0	20	m	NEW

For comments see 3.5.

3.7 Backscatter data replication section (backscatter lidar)

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 which 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.

Data Field	Element Name	Descriptor	Table B Scale	Table B Ref.	Table B Width	Units	Comments
1	HEIGHT	0 07 007	0	-1000	17	m	
2	LATITUDE (HIGH ACCURACY)	0 05 001	5	-9000000	25	Degree	1
3	LONGITUDE (HIGH ACCURACY)	0 06 001	5	-18000000	26	Degree	1
4	DELAYED REPLICATION						
5	WAVELENGTH	TBD	TBD	TBD	TBD	M	
6	POLARITY	TBD	TBD	TBD	TBD		
7	DELAYED REPLICATION						
8	ATTENUATED BACKSCATTER	Tbd	Tbd	Tbd	Tbd	$m^{-1}sr^{-1}$	NEW
9	UNCERTAINTY IN ATTENUATED BACKSCATTER	Tbd	-1	0	10	$m^{-1}sr^{-1}$	NEW
10	BACKSCATTER COEFFICIENT	TBD	TBD	TBD	TBD	$m^{-1}sr^{-1}$	NEW
11	UNCERTAINTY IN BACKSCATTER COEFFICIENT	TBD	TBD	TBD	TBD	$m^{-1}sr^{-1}$	NEW
12	EXTINCTION COEFFICIENT	TBD	TBD	TBD	TBD	m^{-1}	NEW
13	UNCERTAINTY IN EXTINCTION COEFFICIENT	TBD	TBD	TBD	TBD	m^{-1}	NEW
14	QUALITY INFORMATION	0 33 002	0	0	2	Code table	
15	VERTICAL RESOLUTION	Tbd	Tbd	Tbd	Tbd	m	NEW
16	HORIZ. WIDTH OF SAMPLED VOLUME	Tbd	Tbd	Tbd	Tbd	m	NEW

KAPITEL 4 Summary of new descriptors and code tables

4.1 New Descriptors

Data Field	Element Name	Descriptor	Table B Scale	Table B Ref.	Table B Width	Units	Example Value
	UNCERTAINTY IN U-COMPONENT	Tbd	-1	0	10	ms^{-1}	2.5m/s
	UNCERTAINTY IN V-COMPONENT	Tbd	-1	0	10	ms^{-1}	2.5m/s
	UNCERTAINTY IN W-COMPONENT	Tbd	-2	0	10	ms^{-1}	0.55m/s
	VERTICAL RESOLUTION	Tbd	0	0	14	m	250m
	HORIZ. WIDTH OF SAMPLED VOLUME	Tbd	-1	0	20	m	12500.5m
	UNCERTAINTY IN VIRTUAL TEMPERATURE	Tbd	-1	0	10	K	1.5
	ATTENUATED BACKSCATTER	Tbd	-1	0	10	m-1sr-1	2.5
	UNCERTAINTY IN ATTENUATED BACKSCATTER	Tbd	Tbd	Tbd	Tbd	m-1sr-1	NEW
	BACKSCATTER COEFFICIENT	TBD	TBD	TBD	TBD	m-1sr-1	NEW
	UNCERTAINTY IN BACKSCATTER COEFFICIENT	TBD	TBD	TBD	TBD	m-1sr-1	NEW
	EXTINCTION COEFFICIENT	TBD	TBD	TBD	TBD	m-1	NEW
	UNCERTAINTY IN EXTINCTION COEFFICIENT	TBD	TBD	TBD	TBD	m-1	NEW

WAVELENGTH	TBD	TBD	TBD	TBD	m	NEW
POLARITY	TBD	TBD	TBD	TBD	TBD	NEW

4.2 New code tables

New entries for code table 0 02 003:

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

References

COST. (2001). *COST-76 Final Report: Development of VHF-UHF Wind Profilers and Profilers and Vertical Sounders for Use in European Observing Systems.* Luxenbourg: European Commission.

Semple, A. (2005). *Forecast Error Investigation 12th October 2003:Assimilation of Contaminated Wind Profiler Data into the Global Model, Forecasting Research Technical Report No. 465.* Exeter: Met Office.

WMO. (2010). *Manual on Codes.* Geneva: WMO.

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KAPITEL 5 ANNEX A

Only the descriptors of the data description section (BUFR section 3) are presented, BUFR sections 0 to 2 are general and well defined and section 4 follows the definitions of section 3. The data description section is split into an integral part (blue table) and a replication part (green table), which contains the profile.

5.1 The COST-76 Template

More information on this template can be found in (COST, 2001)

Data Field	Element Name	Descriptor	Table B Scale	Table B Ref.	Table B Width	Units	Comments
1	WMO BLOCK NUMBER	0 01 001	0	0	7	Numeric	
2	WMO STATION NUMBER	0 01 002	0	0	10	Numeric	
3	TYPE OF STATION	0 02 001	0	0	2	Code Table	
4	YEAR	0 04 001	0	0	12	Day	
5	MONTH	0 04 002	0	0	4	Hour	
6	DAY	0 04 003	0	0	6	Minute	
7	HOUR	0 04 004	0	0	5	Hour	
8	MINUTE	0 04 005	0	0	6	Minute	
9	LATITUDE (COARSE ACCURACY)	0 05 002	2	-9000	15	Degree	
10	LONGITUDE (COARSE ACCURACY)	0 06 002	2	-18000	16	Degree	
11	HEIGHT OF STATION	0 07 001	0	-400	15	m	
12	TYPE OF MEASURING EQUIPMENT USED	0 02 003	0	0	4	Code Table	
13	TYPE OF ANTENNA	0 02 101	0	0	4	Code Table	

14	3 DB BEAM WIDTH	0 02 106	1	0	6	Degree	
15	MEAN FREQUENCY	0 02 121	-8	0	7	Hz	
16	RANGE-GATE LENGTH	0 25 001	-1	0	6	m	
17	MEAN SPEED ESTIMATION	0 25 020	0	0	2	Code Table	
18	WIND COMPUTATION ENHANCEMENT	0 25 021	0	0	8	Flag Table	1
19	TIME SIGNIFICANCE	0 08 021	0	0	5	Code Table	
20	TIME PERIOD OR DISPLACEMENT	0 04 025	0	-2048	12	Minute	

Data Field	Element Name	Descriptor	Table B Scale	Table B Ref.	Table B Width	Units	Comments
21	HEIGHT	0 07 007	0	-1000	17	m	
22	ADDITIONAL FIELD SIGNIFICANCE	0 31 001					2
23	WIND DIRECTION	0 11 001	0	0	9	Degree true	
24	WIND SPEED	0 11 002	1	0	12	ms^{-1}	
25	ADDITIONAL FIELD SIGNIFICANCE	0 31 001					2
26	W-COMPONENT	0 11 006	2	-4096	13	ms^{-1}	
27	SIGNAL TO NOISE RATIO	0 21 030	0	-32	8	dB	

Comments:

1. Here, information on pulse coding can be given.
2. The ADDITIONAL FIELD SIGNIFICANCE descriptor is used as a quality flag.

5.2 The NOAA Template

Data Field	Element Name	Descriptor	Table B Scale	Table B Ref.	Table B Width	Units	Comments

1	WMO BLOCK NUMBER	0 01 001	0	0	7	Numeric	
2	WMO STATION NUMBER	0 01 002	0	0	10	Numeric	
3	TYPE OF STATION	0 02 001	0	0	2	Code Table	
4	YEAR	0 04 001	0	0	12	Day	
5	MONTH	0 04 002	0	0	4	Hour	
6	DAY	0 04 003	0	0	6	Minute	
7	HOUR	0 04 004	0	0	5	Hour	
8	MINUTE	0 04 005	0	0	6	Minute	
9	LATITUDE (COARSE ACCURACY)	0 05 002	2	-9000	15	Degree	1
10	LONGITUDE (COARSE ACCURACY)	0 06 002	2	-18000	16	Degree	1
11	HEIGHT OF STATION	0 07 001	0	-400	15	m	
12	SHORT STATION OR SITE NAME	0 01 018	0	0	40	CCITT IA5	
13	TYPE OF MEASURING EQUIPMENT USED	0 02 003	0	0	4	Code Table	
14	MEAN FREQUENCY	0 02 121	-8	0	7	Hz	
15	TIME SIGNIFICANCE	0 08 021	0	0	5	Code Table	
16	TIME PERIOD OR DISPLACEMENT	0 04 025	0	-2048	12	Minute	

Data Field	Element Name	Descriptor	Table B Scale	Table B Ref.	Table B Width	Units	Comments
17	HEIGHT ABOVE STATION	0 07 006	0	0	15	m	
18	WIND PROFILER QUALITY CONTROL TEST RESULTS	0 25 034	0	0	4	Flag Table	
19	WIND DIRECTION	0 11 001	0	0	9	Degree true	
20	WIND SPEED	0 11 002	1	0	12	ms^{-1}	

21	STANDARD DEVIATION OF HORIZONTAL WIND SPEED	0 11 050	1	0	12	ms^{-1}
22	W-COMPONENT	0 11 006	2	-4096	13	ms^{-1}
23	STANDARD DEVIATION OF VERTICAL WIND SPEED	0 11 051	1	0	8	ms^{-1}

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5.3 The Canadian Template

Data Field	Element Name	Descriptor	Table B Scale	Table B Ref.	Table B Width	Units	Comments
1	WMO BLOCK NUMBER	0 01 001	0	0	7	Numeric	
2	WMO STATION NUMBER	0 01 002	0	0	10	Numeric	
3	YEAR	0 04 001	0	0	12	Day	
4	MONTH	0 04 002	0	0	4	Hour	
5	DAY	0 04 003	0	0	6	Minute	
6	HOUR	0 04 004	0	0	5	Hour	
7	MINUTE	0 04 005	0	0	6	Minute	
8	LATITUDE (HIGH ACCURACY)	0 05 001	5	-9000000	25	Degree	1
9	LONGITUDE (HIGH ACCURACY)	0 06 001	5	-18000000	26	Degree	1
10	HEIGHT OF STATION	0 07 001	0	-400	15	m	
11	TYPE OF MEASURING EQUIPMENT USED	0 02 003	0	0	4	Code Table	

Data Field	Element Name	Descriptor	Table B Scale	Table B Ref.	Table B Width	Units	Comments
11	HEIGHT	0 07 007	0	-1000	17	m	
12	WIND DIRECTION	0 11 001	0	0	9	Degree true	
13	WIND SPEED	0 11 002	1	0	12	ms^{-1}	
14	QUALITY INFORMATION	0 33 002	0	0	2	Code Table	
15	W-COMPONENT	0 11 006	2	-4096	13	ms^{-1}	

16	QUALITY INFORMATION	0 33 002	0	0	2	Code Table	

5.4 The JMA Template

Data Field	Element Name	Descriptor	Table B Scale	Table B Ref.	Table B Width	Units	Comments
1	WMO BLOCK NUMBER	0 01 001	0	0	7	Numeric	
2	WMO STATION NUMBER	0 01 002	0	0	10	Numeric	
3	LATITUDE (HIGH ACCURACY)	0 05 001	5	-9000000	25	Degree	1
4	LONGITUDE (HIGH ACCURACY)	0 06 001	5	-18000000	26	Degree	1
5	HEIGHT OF STATION	0 07 001	0	-400	15	m	
6	TYPE OF MEASURING EQUIPMENT USED	0 02 003	0	0	4	Code Table	
7	YEAR	0 04 001	0	0	12	Day	
8	MONTH	0 04 002	0	0	4	Hour	
9	DAY	0 04 003	0	0	6	Minute	
10	HOUR	0 04 004	0	0	5	Hour	
11	MINUTE	0 04 005	0	0	6	Minute	
12	TIME SIGNIFICANCE	0 08 021	0	0	5	Code Table	
13	TIME PERIOD OR DISPLACEMENT	0 04 025	0	-2048	12	Minute	

Data Field	Element Name	Descriptor	Table B Scale	Table B Ref.	Table B Width	Units	Comments
14	HEIGHT	0 07 007	0	-1000	17	m	
15	QUALITY INFORMATION	0 33 002	0	0	2	Code Table	

16	U-COMPONENT	0 11 003	1	-4096	13	ms^{-1}
17	V-COMPONENT	0 11 004	1	-4096	13	ms^{-1}
18	W-COMPONENT	0 11 006	2	-4096	13	ms^{-1}
19	SIGNAL TO NOISE RATIO	0 21 030	0	-32	8	dB

5.5 The CMA Template

This template has not been available at the time of writing.

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