The WMO table driven codes: The 21st century universal observation codes

Luis Kornblueh

Max-Planck-Institut für Meteorologie

Unified meteorological observation data handling:

- **BUFR** - **B**inary **U**niversal **F**orm for the **R**epresenation of meteorological data

- BUFR allows packing, quality flags and associated values.

- **CREX** - **C**haracter form for the **R**epresenation and **EX**change of data

- CREX permits simple readability.

The main features of these codes are self-description, flexibility and expandability.

Contents

- The advantages of Table Driven Codes versus traditional Alphanumeric Codes are demonstrated.

- The principles of the structure of the codes are developed.

- Specific and Common features of BUFR and CREX are explained.

- BUFR is in operational use since 1988. It is used for satellite, aircraft and wind profiler observations, and for archiving of all types of observational data.

- CREX is operational since May 2000. CREX is already used for the exchange of ozone data, radiological data, hydrological data, tide gauge data and soil temperature data.

- BUFR should always be used to exchange observations internationally.

- CREX should be used only if binary transmission is not possible.

How does BUFR looks like?

BUFR	
SECTION 0	Indicator Section
SECTION 1	Identification Section
SECTION 2	(Optional Section)
SECTION 3	Data Description Section
SECTION 4	Data Section
SECTION 5	End Section

Sections 0 and 1 in BUFR are short sections, which identify a message.
Section 2 in BUFR is a optional section that can be used to transmit any information or parameters for national/special purpose.

In BUFR the parameters are simply listed as required by the user of the codes (the data producer). The datum are laid out one after the other. An item (the data value of a parameter to be transmitted in a report) will be translated in a set of bits in BUFR. CREX is the image in characters of BUFR bit fields.

When there is a requirement for transmission of new parameters or new data types, new elements are simply added to the WMO BUFR and CREX Tables (to be agreed by WMO).

Table driven codes can transmit an infinity of information. There is total flexibility. Definition of new **codes** as such is no more necessary. Expansion of tables is sufficient.

Tables define how the parameters (the elements) shall be coded as data items in a BUFR message (i.e. units, size, scale). The Tables defining BUFR coding are the Tables A, B, C, and D.

A BUFR tables

table reference	element name	unit	scale	reference value	data bits
0 12 001	dry-bulb temperature	K	1	0	12
0 12 002	wet-bulb temperature	K	1	0	12
0 12 003	dew-point temperature	K	1	0	12
0 12 004	dry-bulb temperature at 2 m	K	1	0	12
0 12 005	wet-bulb temperature at 2 m	K	1	0	12
0 12 006	dew-point temperature at 2 m	K	1	0	12
0 12 007	virtual temperature	K	1	0	12
0 12 011	maximum temperature, at height and over periode specifi ed	K	1	0	12
0 12 012	minimum temperature, at height and over periode specifi ed	K	1	0	12

Requirements for the usage

- Definition of tables

- Agreement of the Tables with WMO tables or initiative to regulate with WMO.

- Conversion library from raw data to BUFR

- Encoding/decoding knowledge on the observers and users side.

- self description

- flexibility

- expandability

- condensation (packing), quality flags, associated values for BUFR

- simple readability for CREX

BUFR and CREX can be easily expanded to satisfy all observational requirements, without deviating from WMO recommendations, even to answer national needs for specific domestic data exchange, as it is presently the case in many Countries.