

BUFR Basic:

Self-descriptive table driven form

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Topics covered

- What is BUFR/PrepBUFR
- BUFR message layout
- Self-descriptive table driven concept
- BUFR table descriptor
- BUFR Table B

What is BUFR/PrepBUFR

- **B**inary **U**niversal **F**orm for the **R**epresentation of meteorological data (BUFR)
 - BUFR is a “self-descriptive” table driven code form
 - The form and content of the data contained within a BUFR message are described within the BUFR message itself
 - BUFR is one of the code forms WMO recommends for the representation and exchange of observational data
 - BUFR/PrepBUFR is the only data format accepted by GSI for observation data ingesting
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- **PrepBUFR is the NCEP term for “prepared” or QC’ d data in BUFR format (NCEP convention/standard)**
 - **PrepBUFR file is still a BUFR file**

BUFR Message Layouts

CONTINUOUS BINARY STREAM						
Section 0		Section 1	Section 2	Section 3	Section 4	Section 5
Section Number	Name	Contents				
0	Indicator Section	"BUFR", length of message, BUFR edition number				
1	Identification Section	Length of section, identification of the message				
2	Optional Section	Length of section and any additional items for local use by data processing centers				
3	Data Description Section	Length of section, number of data subsets, data category flag, data compression flag, and a collection of data descriptors which define the form and content of individual data elements				
4	Data Section	Length of section and binary data				
5	End Section	"7777"				

In a BUFR message, section 3 contains a sequence of data **descriptors**, which describe the **type** of data contained in the section 4 and the **order** in which data appear in the section 4.

Self-descriptive Table Driven Concept

CONTINUOUS BINARY STREAM						
Section 0		Section 1	Section 2	Section 3	Section 4	Section 5
Section Number	Name	Contents				
3	Data Description Section	Length of section, number of data subsets, data category flag, data compression flag, and a collection of data descriptors which define the form and content of individual data elements				
4	Data Section	Length of section and binary data				

Section 3 (Data Description)

Section 4 (Data)

012245

Descriptor (pointer)

101

BUFR message

Class 12 - Temperature

TABLE REFERENCE			TABLE ELEMENT NAME	WMO BUFR Table B			
F	X	Y		UNIT	SCALE	REFERENCE VALUE	DATA WIDTH (Bits)
0	12	001	Temperature/dry-bulb temperature	K	1	0	12
0	12	002	Wet-bulb temperature	K	1	0	12
0	12	245	Temperature	C	1	-2732	14

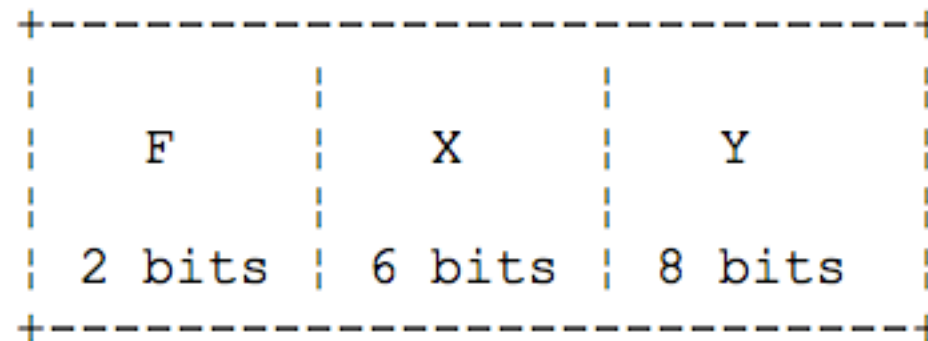
WMO BUFR Table B

- BUFR Tables (More details in Lecture 4)
 - content definition tables (Table A, B, C, D)
 - code tables and flag tables
- **Table B**
 - how to encode/decode individual elements in BUFR

Class 12 - Temperature

TABLE REFERENCE			TABLE ELEMENT NAME	BUFR			
				UNIT	SCALE	REFERENC E VALUE	DATA WIDTH (Bits)
F	X	Y					
0	12	001	Temperature/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

BUFR Descriptor



- BUFR descriptor: a set of 16 bits divided into 3 parts: F, X, and Y
 - F denotes the type of descriptor.
 - F = 0 → Element descriptor (Table B entry)
 - F = 1 → Replication operator
 - F = 2 → Operator descriptor (Table C entry)
 - F = 3 → Sequence descriptor (Table D entry)
 - X (6 bits: 00-63) indicates the class or category of descriptor.
 - Y (8 bits: range from 00-255) indicates the entry within a class X.

BUFR Descriptor: example

Section 3 (Data Description)

012245

Descriptor (pointer)

Section 4 (Data)

101

BUFR message

Class 12 - Temperature

TABLE REFERENCE			TABLE ELEMENT NAME	BUFR			
F	X	Y		UNIT	SCALE	REFERENCE VALUE	DATA WIDTH (Bits)
0	12	001	Temperature/dry-bulb temperature	K	1	0	12
0	12	002	Wet-bulb temperature	K	1	0	12
0	12	245	Temperature	C	1	-2732	14

- 1) F = 0 : table B
- 2) X = 12 : class 12 (temperature)
- 3) Y = 245 : NCEP defined temperature

245 entry in the class 12 (temperature class) of BUFR table B is NCEP defined temperature entry

Decode BUFR file: example

Section 3 (Data Description)

012245

Descriptor (pointer)

Section 4 (Data)

101

BUFR message

Class 12 - Temperature

TABLE REFERENCE			TABLE ELEMENT NAME	WMO BUFR Table B			
F	X	Y		UNIT	SCALE	REFERENCE VALUE	DATA WIDTH (Bits)
0	12	001	Temperature/dry-bulb temperature	K	1	0	12
0	12	002	Wet-bulb temperature	K	1	0	12
0	12	245	Temperature	C	1	-2732	14

Decoding Steps:

- 1) read data descriptor (012245) and data (101) into memory
- 2) find the REFERENCE, BIT and UNITS associated with descriptor 012245 in the predefined table
- 3) decode the data value 101 based on the information in this table as temperature observation 10.1 °C.

Important Notes

- This talk is only to understand BUFR self-descriptive table driven form
- It is very hard for general users to use the concepts in this talk to process BUFR files
- General users should process BUFR file based upon functions provided in BUFR library (for example BUFRLIB from NCEP)
- A simple and straight forward method for encoding and decoding is found in Lecture 3

Questions?

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