|  |  |  |
| --- | --- | --- |
| WORLD METEOROLOGICAL ORGANIZATIONCOMMISSION FOR BASIC SYSTEMS-----------------------------FOURTH MEETING OF INTER-PROGRAMME EXPERT TEAM ONDATA REPRESENTATION MAINTENANCE AND MONITORINGGENEVA, SWITZERLAND, 30 MAY - 3 JUNE 2016 |  | IPET-DRMM-IV / Doc. 3.2 (10)(25. 5. 2016)-------------------------ITEM 3.2ENGLISH ONLY |

BUFR AND CREX

**Revised note for encoding geographic coordinates in BUFR
and new element descriptors for encoding coordinate reference systems and fixed reference mean sea level**

*Submitted by Daniel Lee, Sibylle Krebber (DWD), Alexander Kats (Russian Federation)*

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Summary and Purpose of Document**

A main advantage of BUFR is the inclusion of coordinates with weather messages. However, coordinates can only be interpreted with surety when the coordinate reference system is known. This document proposes new Table B descriptors for encoding coordinate reference systems and fixed reference mean sea level in BUFR and a note for FM 94-BUFR for reducing ambiguity. The proposal of encoding geographic coordinates in BUFR was discussed at IPET-DRMM III last year and some changes were proposed and agreed.

Meanwhile the new BUFR descriptors were validated.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**ACTION PROPOSED**

The meeting is invited to consider the revised note for inclusion in the Manual on Codes, WMO No. 306, Volume I.2. and to approve the proposed new descriptor for the next fast track 2016-II.

**ANNEXES:**

 1. Validation report of Radar data descriptors (including coordinate reference system and fixed reference mean sea level)

**DISCUSSIONS**

BUFR allows users to encode coordinates describing where observations were made. However, there is currently no way of encoding the coordinate system in which these coordinates should be interpreted. This allows messages to be encoded with latitude/longitude coordinates which may or may not be understood as the encoding user intended, because the reference coordinate system, and in particular its prime meridian, are left to the user's interpretation.

Typically, latitude/longitude coordinate systems use the equator, defined by the obliquity of the ecliptic, as the latitudinal origin, north and east directions defined by the earth's rotational axis and the generally accepted IERS Reference Meridian, which is close to, but not identical with, the prime meridian at Greenwich which was used until earth-based surveying was largely superseded by satellite-based cartography. This is, however, neither guaranteed nor is it always the case. Historically, easting coordinates based on different easting origins have led to confusion in different circumstances. Although the latitudinal origin is easily defined based on the earth's rotational characteristics, the longitudinal origin is a matter of arbitrary definition, creating the need for the definition and maintenance by an external authority.

Because such external authorities are not referenced in BUFR tables, the coordinates are ambiguous. Even if it is assumed that the prime meridian at Greenwich is used, this meridian is defined in several coordinate systems with differences of more than 100 meters at most latitudes. In addition to these traditional uncertainties that occur when working with coordinates determined from the earth's surface, satellite data sometimes use exotic coordinate systems which cannot be properly interpreted using traditional, geostationary coordinate systems.

Normally it is a fairly safe assumption that latitude/longitude coordinates should be interpreted using the WGS84 geodetic system, in which the longitudinal origin is clearly defined. This is the case when the data is encoded according to the specifications in the CIMO Guide. However, tragic experience has shown that not all stations report in a fully CIMO-compliant manner. Without absolute surety that they do so and without a specification of the coordinate reference system, any coordinates are, in truth, ambiguous, even if the interpretation is often serendipitously correct. The remaining ambiguity should be reduced in order to ensure a consistent interpretation of encoded coordinates.

**PROPOSAL**

The following revised note is proposed for FM 94-BUFR:

1. Position can only be unambiguously interpreted if the coordinate reference system and, if required, fixed reference mean sea level, to which it is attributed, is known. If these are not specified it is assumed that the position shall be interpreted with respect to WGS84 geodetic system and Earth Geodetic Model EGM96.

Add new BUFR Table B descriptors and Code tables:

**Class 01 – BUFR/CREX Identification**

|  |  |  |  |
| --- | --- | --- | --- |
| **TABLE****REFERENCE** |  | **BUFR** | **CREX** |
| **F** | **X** | **Y** | **ELEMENT NAME** | **UNIT** | **SCALE** | **REFERENCE VALUE** | **DATA****WIDTH****(Bits)** | **UNIT** | **SCALE** | **DATA****WIDTH****(Char)** |
| 0 | 01 | 150 | Coordinate reference system | Code table | 0 | 0 | 16 | Code table | 0 | 5 |
| 0  | 01 | 151 | Fixed mean sea level reference datum | Code table | 0 | 0 | 12 | Code table | 0 | 4 |

**Code tables:**

**0 01 150   Coordinate reference system**

| Code figure |  |
| --- | --- |
| 0 | WGS84, as used by ICAO since 1998 |
| 1 | ETRS89, as defined by EPSG::4258  |
| 2 | NAD83, as defined by EPSG::4269 |
| 3 | DHDN, as defined by EPSG::4314 |
| 4 | Ellipsoidal datum using the International Reference Meridian maintained by the International Earth Rotation and Reference Systems Service (IERS) (see Note 2) |
| 5 - 65534 | Reserved |
| 65535 | Missing value |

Notes

1. EPSG is a dataset of coordinate system and coordinate system transformations, originally produced and maintained by the European Petroleum Survey Group. Now it is maintained by the Geodesy Subcommittee of the International Association of Oil and Gas Producers Geomatics Committee.
2. If this coordinate reference system is specified, the semi-major and semi-minor axes must be specified (e.g. descriptors 0 01 152 and 0 01 153).

**0 01 151**Fixed mean sea level reference datum

| Code figure |  |
| --- | --- |
| 0 |  Earth Gravitational Model 1996 |
| 1 |  Baltic height system 1977 |
| 2-4094 |  Reserved |
| 4095 |  Missing value |