**Reporting of daily climate extrema in BUFR**

**BUFR Template for once-per-month transmission of Daily climate observations**

A one year trial phase for once-per-month submission of CLIMAT messages containing daily climate observations was accepted by CCl-17 delegates in April 2017; reference Rec 5.1/2 (CCl-17).

For many measures of climate extremes, traditional CLIMAT messages containing summary of the month variables are insufficient. Additionally, daily summaries provided via SYNOP messages are insufficient because the data are incompatible with long historic daily series developed and made available by national meteorological services.

To fill this gap a template for dissemination of daily climate observations (transmitted once per month) in BUFR format; 3 07 074, is now available (Supplemental daily extreme temperature and precipitation values for monthly climate report).

Please note that this does not replace the existing CLIMAT BUFR templates.

This BUFR table provides the ability for National Meteorological and Hydrological Services (NMHSs) to provide 31 Daily observations for the following elements.

• Time of Observation for Temperature

• Daily Maximum Temperature

• Daily Minimum Temperature

• Daily Mean Temperature

• Time of Observation for Precipitation

• Total Daily Precipitation

• Depth of New Snowfall

• Depth of Total Snow on the Ground

Each of these observations should be taken at the observing time consistent with the climate reporting practices of the NMHS and reflect conditions over the previous 24-hour period. The climate convention varies from country to country so it is requested that each country retain its traditional observing practice in reporting daily climate summaries. For example, while the U.S. is local midnight, Australia is traditionally 0900 Local time, Canada has traditionally been 0600 UTC. These observations can be efficiently provided using the new BUFR template.

The BUFR Table D is defined as follows.

3 07 074 – Supplemental daily extreme temperature and precipitation values for monthly climate report

|  |  |  |
| --- | --- | --- |
| 3 01 001 | WMO block and station numbers |  |
| 0 04 001 | Year |  |
| 0 04 002 | Month |  |
| 3 01 021 | Latitude/longitude (high accuracy) |  |
| 0 07 030 | Height of station ground above mean sea level |  |
| 0 07 032 | Height of sensor above local ground (or deck of marine platform) |  |
| 1 12 000 | Delayed replication of 12 descriptors |  |
| 0 31 001 | Delayed descriptor replication factor  | Set to the number of days in the particular month for which data are being reported |
| 0 04 003 | Day |  |
| 0 04 004 | Hour |  |
| 0 04 024 | Time period or displacement | Typically set to -24 to denote the time to period beginning 24 hours prior to and ending at the specified time |
| 1 02 003 | Replicate 2 descriptors 3 times |  |
| 0 08 023 | First-order statistics | = 2 Daily maximum temperature,= 3 Daily minimum temperature,= 4 Daily average temperature |
| 0 12 101 | Temperature/air temperature |  |
| 0 08 023 | First-order statistics | Set to missing (cancel) |
| 0 04 004 | Hour |  |
| 0 04 024 | Time period or displacement |  |
| 0 13 060 | Total accumulated precipitation |  |
| 0 13 012 | Depth of fresh snow |  |
| 0 13 013 | Total snow depth |  |

Adhering to the BUFR template as described above, Members are asked to provide climate observations each month that are consistent with national climate databases for daily maximum temperature, daily minimum temperature, daily precipitation, total daily snowfall, daily snow depth, and the time of observation for temperature and precipitation.

Additional background information on the need for Daily climate observations is provided below.

##### Supporting information regarding the need for daily climate observations: Development of the principal measure of the state of the climate – the global temperature record - has extensively depended on monthly CLIMAT data provided by National Meteorological Services (NMSs). Over the last 20 years there has been a growing demand for indices and measures of the climate that also consider extremes (Jones et al. 2012). For many extreme measures, monthly CLIMAT data are insufficient and there is a need for a Daily CLIMAT message. This need is not just for timeliness, but principally for data that is compatible with long historic daily series developed and made available by NMHSs.

Attempts have been made to use SYNOP data for this purpose (e.g. by the European Climate Assessment and Dataset, ECA&D) but there are serious issues of incompatibility of SYNOP data with traditional methods of climate measurement within NMSs (see van den Besselaar et al., 2012). The most notable issue of incompatibility is associated with the way that daily maximum and minimum temperature are measured. Principally this is due to the fact that climate observations reflect the maximum and minimum temperatures measured over the previous 24-hour period, while daily summaries provided via SYNOP messages do not.

Daily summaries in SYNOP messages are based on measurements that occur between synoptic reporting times and often over a period less than 24-hours. For instance in Europe minimum temperatures are recorded over the first 12-hour period and maximum temperatures during the next 12-hour period. Measured in this way, the true daily minimum and maximum temperatures are often not reported because they occur outside those 12-hour periods. As a result SYNOP reports have been shown to significantly underestimate extremes. Minimum temperatures measured in this way are often higher than the true daily minimum temperature. Similarly, maximum temperatures reported via SYNOP messages are often lower than the true daily maximum temperature reported as 24-hour climate observation. Similar problems occur for precipitation. In other regions of the world SYNOP reporting practices can differ but problems remain. In the U.S., for example, the daily maximum and minimum temperature are reported during the 24-hour period ending at 00 UTC while a true climate observation is reported as a midnight-to-midnight local observation.

**References**

Jones, P.D., Lister, D.H., Osborn, T.J., Harpham, C., Salmon, M., Morice, C.P. 2012: Hemispheric and large-scale land surface air temperature variations: An extensive revision and an update to 2010. J. Geophys. Res. 117, D05127, doi:10.1029/2011JD017139.

van den Besselaar, E.J.M. Klein Tank, A.M.G, van der Schrier, G. and Jones, P.D., 2012: Synoptic messages to extend climate data records. Journal of Geophysical Research, 117, D07101, doi:10.1029/2011JD1688.