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Introduction

Traditional Alphanumeric Codes (TAC) have been in use for over 50 years to transmit data from radiosondes, buoys, and surface land stations across the Global Telecommunications System (GTS). In 2003, the World Meteorological Organization (WMO) approved the use of Binary Universal Form for the Representation of Data (BUFR) format for transmitting meteorological data across the world. The WMO mandated TAC-formatted reports for conventional data to end distribution over the GTS in November 2014; however, most nations continue to transmit both BUFR- and TAC-formatted data.

The BUFR format has many advantages over the older TAC format, such as its self-describing nature, compact size, expandability for adding new variables and increasing precision, and its backwards compatibility. The parallel distribution of both TAC- and BUFR-formatted data has highlighted problems in the way that the new BUFR data is encoded and transmitted, as well as highlighting needed updates to the master station lists that provide location metadata for the TAC format. This work focuses on issues in the distribution of surface data (SYNOP) and BUOY reports)—for issues in radiosonde data, see Poster #1174.

Current Status

The current BUFR and TAC coverage for land, buoy, and ship reports is shown in the two figures below. These two figures are a snapshot of the data available at 00Z 01 December 2016. Several countries have already discontinued their TAC SYNOP feeds, including the United Kingdom, Spain, and Germany. Other countries have not begun to disseminate BUFR formatted data, such as Peru, Ecuador, Iran, and several of the former Soviet Republics. Most buoy and ship data is now only transmitted in BUFR.



















Dealing with Disappearing Surface Data: The Migration to BUFR and the Discontinuation of Text SYNOP and BUOY Reports Dan Tyndall¹, Pat Pauley¹, Chris Atkinson^{2,3}, Blake Sorenson^{2,4}, Justin Reeves⁵, Cary McGregor⁵, Randy Pauley⁵, and Greg Hoisington⁵

Discrepancies between TAC and BUFR Elevations - 00Z 01 December 2016



Metadata Errors

One of the advantages the BUFR format has over the TAC format is the ability to include positional metadata with the meteorological data. The parallel distribution of data has revealed issues in the BUFR metadata, as well as needed updates to the master station lists that supply metadata for TAC observations. The two figures above on the left highlight discrepancies in location (top) and elevation (bottom) between the BUFR source and the FNMOC master station list for land stations reporting at 00Z 01 December 2016 over North America. This comparisor between the metadata highlighted several issues with the FNMOC master station list for station identifiers that had been reused by Canada which were identified by the large discrepancies between latitudes, longitudes, and elevations, as well as additional confirmation with the Meteorological Service of Canada. The large figures on the left show the same discrepancies between position and elevation metadata, but over the entire world and after the FNMOC master station list was updated with the corrections for the reused Canadian identifiers. Some of the remaining discrepancies are caused by incorrect signs on latitude or longitude, such as Shemya, Alaska (70414); Seychelles (63980); and Troll, Antarctica (60662). There are other discrepancies that will need to be analyzed further with the origiating country. The planned strategy within the Navy's data assimilation systems will be to continue to use the FNMOC master station list metadata (adding updates as necessary) for large discrepancies with BUFR metadata (as is currently done for BUFR radiosonde data). Currently, the Navy only assimilates BUFR buoy surface data and assumes the metadata is accurate.

The two rightmost panels above depict stations that have identifier issues. Several stations in South America and east of Australia (shown as diamonds in the figures) have been transmitting BUFR reports with null station identifiers, causing the FNMOC processing software to assign a fictitious identifier of 00001. Additionally, BUFR buoy reports are being converted back to the TAC format and retransmitted through the GTS, but with missing station identifiers (as shown by the cyan triangles in the figures). This issue has gotten worse through December 2016 (bottom panel), as the amount of reports with missing identifiers has increased. Efforts are being made to find the source of these problematic reports.

NCO Retransmitted Observations - 00Z 01 December 2016



Retransmitted Data

NCEP Central Operations (NCO) Silver Springs (formerly NOAA Telecommunications Operations Center) have been rebroadcasting BUFR messages in the TAC format, including messages that do not originate from the United States. While this is helpful for centers that have not been able to dedicate resources to decode the new format, it has also caused some inadvertent problems, such as many duplicated reports, reports with large metadata errors, confusion over the point of contact for these reports, and concealing when country chooses to discontinue its TAC feed. For example, the discontinuation of TAC data from Germany was unnoticed until the creation of this poster.

The figure on the left shows rebroadcasted data from NCO at 00Z 01 December 2016. Colors and markers indicate unique bulletin headers for each message (which are not labeled here). These retransmitted reports are from stations across the world, but are re-encoded in Washington, DC.









Unique BUFR Buoy Data

The utilization of BUFR has changed the format of identifiers for buoys. The original buoy identifiers were five-digit numbers; new identifiers are now seven digits long. Buoys that originally had a five-digit identifier now have two extra zeros in the third and fourth position (e.g., 32316 would become 3200316 in BUFR). These extra digits have added additional station identifiers; buoys in which the third and fourth digits are not zeros are now being utilized in the Navy's data assimilation systems. These buoys are depicted as green triangles in the figure above.



FNMOC Data Loss Mitigation Strategy

Several countries have ceased their transmission of TAC data, including the United Kingdom, Germany, and Portugal. New Zealand originally discontinued their TAC data feed. but later reactivated it. The figure above shows stations for which FNMOC is converting data to SYNOP format; magenta squares denote locations in which METAR reports are being converted to SYNOP, orange stars denote locations in which BUFR reports are being converted to SYNOP.



Concluding Remarks

Surface data has an important role in the Navy's data assimilation systems, as demonstrated by the above figure depicting forecast system observation impact. Verification of both meteorological data and metadata from the new format is essential as the BUFR migration continues. Up-to-date information on the migration can the ECMWF wiki: be found online on http://software.ecmwf.int/wiki/display/TCBUF/.