Argo BUFR enhancements

AST#16, Brest, France, March 2015

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WMO Policy

- In 2003 the 14th WMO Congress, supported the conclusions of the Commission for Basic Systems that Table-driven Code Forms (TDCF) are the solution to satisfy the demands of rapidly evolving science and technology, in view of their self-description, flexibility and expandability

- Advantages of TDCF over the Traditional Alphanumeric Codes

  - Can include quality flags, associated metadata and are highly compressed

  - The reliability of binary data transmission (BUFR) also provides for an increase in data quality/quantity received at meteorological centres, which would lead to the generation of better products

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Migration timetable

- Original timescale for the migration to TDCF was from 2002 (starting 2005 for marine data) to 2012
- However, this was slipped with the aim that all migrations would be completed by November 2014
- In September 2014 it was obvious that not all National Met Services would be ready for full transition by November 2014 and a decision was taken to extend the deadline until “the summer of 2015”
- However, Argo is in pretty good shape in terms of distributing data in BUFR (TM 3-15-003)

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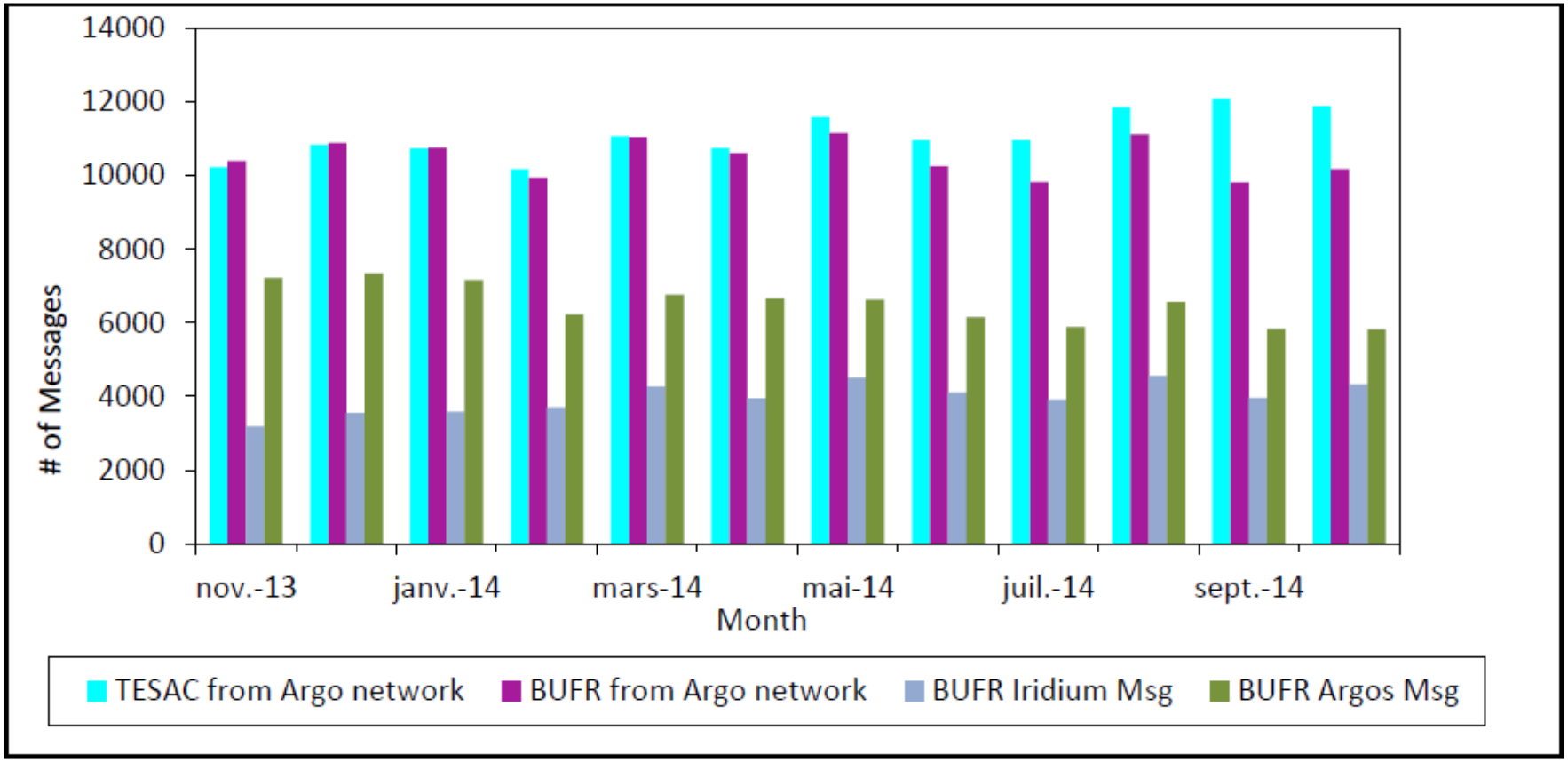
Status at ADMT#15



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Argo BUFR enhancements

- As the Argo NetCDF format develops to allow for the inclusion of additional profiles (e.g. un-pumped near-surface, bio-geochemical) it is important the Argo BUFR evolves to provide the same capability
- BUFR message has 6 sections
  - Section 0 – Indicator section
  - Section 1 – Identification section
  - Section 2 – Optional, so omitted for Argo
  - **Section 3 – Data description section**
  - **Section 4 – Data section**
  - Section 5 – End section

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Argo BUFR

- Section 3 gives the data descriptors, sequences or templates that define the data that follows in Section 4
  - 3-15-003: for the primary core-Argo CTD profile
  - This can be followed by additional sequences that define any additional data, e.g. 3-06-037 for dissolved oxygen profiles (already approved and so can be used on GTS)
  - Additional sequences for secondary temperature (3-06-017), temperature and salinity (3-06-018) are presently being validated by UKMO and MEDS
- The data then follows in section 4 as a continuous bit stream (padded at the end to ensure it is an integer number of octets/bytes in length)

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Progress on validation of supplementary sequences

- Both UKMO and MEDS have successfully encoded and decoded BUFR messages using the new sequences
- Have identified some modifications during the validation
  - To permit supplementary profiles with >255 levels
  - Recommend to modify code table 0-08-034 to map against the vertical sampling schemes defined for the Argo NetCDF (reference table 16)
- Next step is repeat the 2-way validation with both above changes implemented and document the results for approval by the WMO IPET-DRMM (expected to meet summer 2015)

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Reference Table 16

Code (STRING256) FORMAT → name: nominal measurement type [full description] [ ] indicates optional	N_PROF	Code Description
Primary sampling: averaged [description] or Primary sampling: discrete [description] or Primary sampling: mixed [description]	1	Primary CTD measurements and measurements from auxiliary sensors that are taken at the same pressure levels and with the same sampling method as the Primary CTD profile. For auxiliary sensor measurements it is not required that all pressure levels contain data.
Secondary sampling: averaged [description] or Secondary sampling: discrete [description] or Secondary sampling: mixed [description]	>1	Excluding "Primary sampling", this profile includes measurements that are taken at pressure levels different from the Primary CTD profile, or with sampling methods different from the Primary CTD profile. Measurements can be taken by the Primary CTD or by auxiliary sensors.
Near-surface sampling: averaged, pumped/unpumped [description] or Near-surface sampling: discrete, pumped/unpumped [description] or Near-surface sampling: mixed, pumped/unpumped [description]	>1	This profile includes near-surface measurements that are focused on the top 5dbar of the sea surface. (For the purpose of cross-calibration, this profile can extend deeper than the top 5dbar so as to overlap with the Primary sampling profile.) These measurements are taken at pressure levels different from the Primary CTD profile, or with sampling methods different from the Primary CTD profile. If the Primary sampling profile measures above 5dbar in the same manner as deeper data, there is no need to place the near-surface data here.
Bounce sampling: averaged [description] or Bounce sampling: discrete [description] or Bounce sampling: mixed [description]	>1	This scheme contains profiles that are collected on multiple rises/falls during a single cycle. The profiles are temporally offset from each other and/or the Primary sampling profile. They can be sampled with the Primary CTD or with auxiliary sensors.
Use the term 'averaged' if the data in the profile are pressure binned averages using multiple data measurements (pollings) from a sensor. Use the term 'discrete' if the data in the profile are from a single polling from a sensor. If both methods are used in the profile, use the term 'mixed'.		

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Modified code table 0-08-034 for supplementary profiles (given by 4 bits)

0 – secondary sampling: averaged

1 – secondary sampling: discrete

2 – secondary sampling: mixed

3 – near-surface sampling: averaged, pumped

4 – near-surface sampling: averaged, un-pumped

5 – near-surface sampling: discrete, pumped

6 – near-surface sampling: discrete, un-pumped

7 – near-surface sampling: mixed, pumped

8 – near-surface sampling: mixed, un-pumped

9 - 14 reserved

15 - missing

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Bio-geochemical variables

- A new BUFR class (41) has been agreed to allow for the specification of bio-geochemical variables, which are not presently included in the BUFR Master Table 0
- This will allow up to 255 bio-geochemical variables to specified (allowing a range of units and different precision as necessary)
  - Will enable profiles of various bio-geochemical variables: chlorophyll, CDOM, irradiance, backscattering etc. to be exchanged on GTS as required for use in future ecosystem prediction models

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