



IMOS Ship of Opportunity (SOOP) Expendable Bathythermograph (XBT) realtime data delivery

CSIRO Oceans and Atmosphere Climate Science Centre manage the collection of IMOS XBT SOOP data for three XBT transects. The data collected during these voyages is transmitted in real time (within an hour) back to CSIRO, then onto the Australian Bureau of Meteorology (BOM) and to the Global Transmission System (GTS), enabling near-realtime sharing of the data with meteorological agencies globally. The data collection system used by the CSIRO is the Turo Quoll and the associated Turo software.

Using Turo software, the realtime data is transmitted back to CSIRO using the Iridium SBD (Short Burst Data) network. The temperature data points are not identical to the delayed-mode, full resolution data (which is quality controlled and shared 2+ weeks after collection). This document describes the method of transforming the full resolution data into ship-to-shore transmitted temperature and depth data, and the process to deliver realtime data to the GTS and the Australian Ocean Data Network (AODN).

Packing of data for Iridium SBD delivery in realtime

The format of the ship-to-shore SBD messages is in a compressed version of the BUFR (Binary Universal Format for Data Representation) template TM315004. Due to the size of the profiles, it isn't feasible to transmit the full resolution data using the Iridium SBD format devised by Turo. To overcome the size limitations, the temperature data is decimated first. The algorithm used is the Douglas Peucker algorithm which was originally devised for cartography. This algorithm decimates the data such that every point is within a given tolerance of the original data. The tolerance used in the process is 5mdeg C which provides a good compromise between accurately representing the original data and providing a reasonable dataset length for transmission. The length of the dataset transmitted is not fixed and could potentially be quite large.

To further reduce the data size, section 4 of the compressed BUFR message is packed with only the data index of the decimated data (11bits) and temperature (13 bits). To convert the data index back into depth, the depth fall rate equation (a and b coefficients specific to the probe type) and sampling rate (in time) are extracted from the packed data and depth calculated.

Iridium transmission from ship to shore

Full details of the Iridium SBD transmission process are available in Turo (2008) and Turo (2011). To access these documents, contact Turo at www.turo.com.au.

Briefly, the transmission process uses the Iridium satellite system, sending data in SBD mode. Data is sent in packets, each up to 8000 bytes, divided into 335 byte parcels. Each parcel has a 5 byte header. Each parcel has a sequence number starting at 1. The SBD packets are delivered via email as an attachment and require sorting and unpacking. Depending on

the settings used in the Turo software, the format of the transmitted data is different, and the user should refer to Turo (2011) for full details.

Transmission of BUFR data to the GTS and AODN

After receipt of the data at CSIRO, the SBD attachments are converted into the full BUFR format (template TM315004) for distribution on the GTS. The start and end index of all suspect data (identified with the QC routines implemented in the Turo software) is stored in the SBD messages followed by the packed decimated temperature data. A Python application is provided to convert the packed data back into a full length BUFR message. The Python code to complete the conversion is available from Turo or by contacting CSIRO. The full BUFR messages are then delivered to the BOM for insertion on the GTS. They are also delivered to the AODN where they are available in netCDF format under the *IMOS-SOOP Expendable Bathythermographs (XBT) Research Group – XBT real-time data* collection.

<https://portal.aodn.org.au/search?uuid=35234913-aa3c-48ec-b9a4-77f822f66ef8>

References

Turo, 2008. *Devil XBT Iridium Transmission*. Turo Technology PTY LTD.

Turo, 2011. *Devil XBT Data Formats*. Turo Technology PTY LTD.

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For further information

Oceans and Atmosphere

Rebecca Cowley

+61 3 6232 5446

Rebecca.Cowley@csiro.au