XBT Data Management and Quality Control in Japan (III)

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We reassembled historical expendable bathythermograph (XBT) data in order to improve an ocean subsurface temperature database. Over 4,000 strip charts by XBT chart recorder in the 1980's were collected from Japan Meteorological Agency and Japan Coast Guard, and digitized and stored by image scanner as TIFF format image file (left panel in Figure 1). The image file was imported by Adobe Illustrator and temperature profile on strip chart was traced and saved as DXF format file. The DXF file was converted as a function of temperature and elaped time from XBT probe launch by affine transformation and depth was calculated by manufacture's fall rate equation. The traced temperature, howerver, was lower than visual reading temperature in existing database of Japan Oceanographic Data Center at deep layer (right panel in Figure 1). The result of all comparison also indicated the traced temperature was lower than the visual reading temperature at the deeper standard depths (left panel in Figure 2). We recognized that it is caused by non-linear temperature scale of strip chart. Unfortunately the specification of strip chart was undocumented so that we investigated the temperature scale, i.e., horizontal axis of strip chart by the same way as temperature tracing, and then we determined approximate functions for traced temperature. After correction, more thant 93% of the absolute of difference between traced temperature and visual reading temperature at the standard depths are within 0.1 degree Celsius (right panel in Figure2). It is clarify that the traced temperature profile can be replaced with existing database. The depth of traced temperature was finally calculated by new fall rate equation by Hanawa *et al.* (1995) for T-6 and by Kizu *et al.* (2005) for T-5, and those profile have high vertical resolution at 1m intervals as the same as output by recently digital converter. In addition we found the vertically high resolution data by digital converter in 1990's by R/V Ryofu-Maru of Japan Meteorological Agency, so nearly 2,600 profiles were replaced (left panels in Figure 3) and the number of data remarkable increased in comparison with the existing database (right panels in Figure 3).

References

Hanawa, K., P.Raul, Rick Baily, A.Sy, and M.Szabados: A new depth-time equation for Sippican or TSK T-7, T-6 and T-4 expendable bathythermographs (XBT), Deep Sea Res., Part I, 42, 1423-1451, doi:10.1016/0967-0637(95)97154-Z, 1995.

Kizu S., H. Yoritaka and K. Hanawa: A New Fall Rate Equation for T-5 Expendable Bathythermograph (XBT) by TSK, J. Oceanogr., 61, No.1, 115-121, 2005.

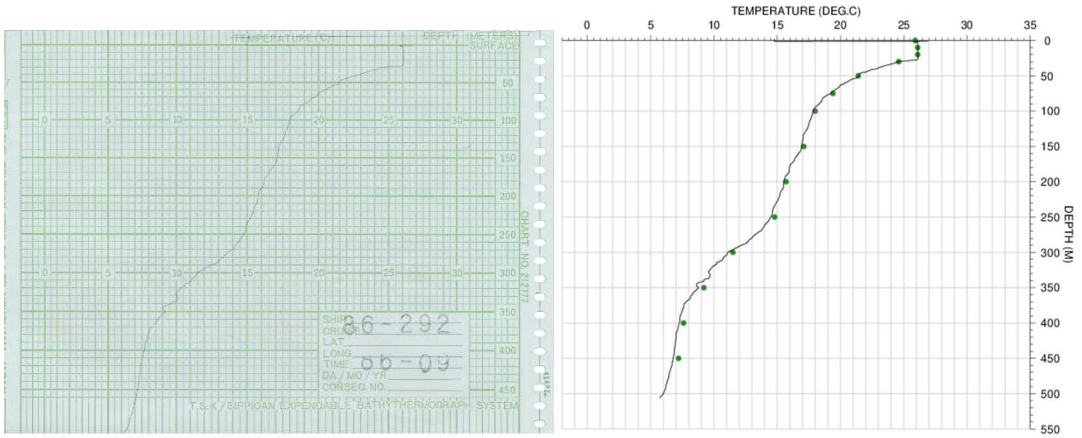

Figure 1: Examples of XBT strp chart by R/V Ryofu-Maru of Japan Meteologocal Agency (left panel), and traced temperature profile (black line in right panel) and visual reading temperature at the standard depths (green circle in right panel).

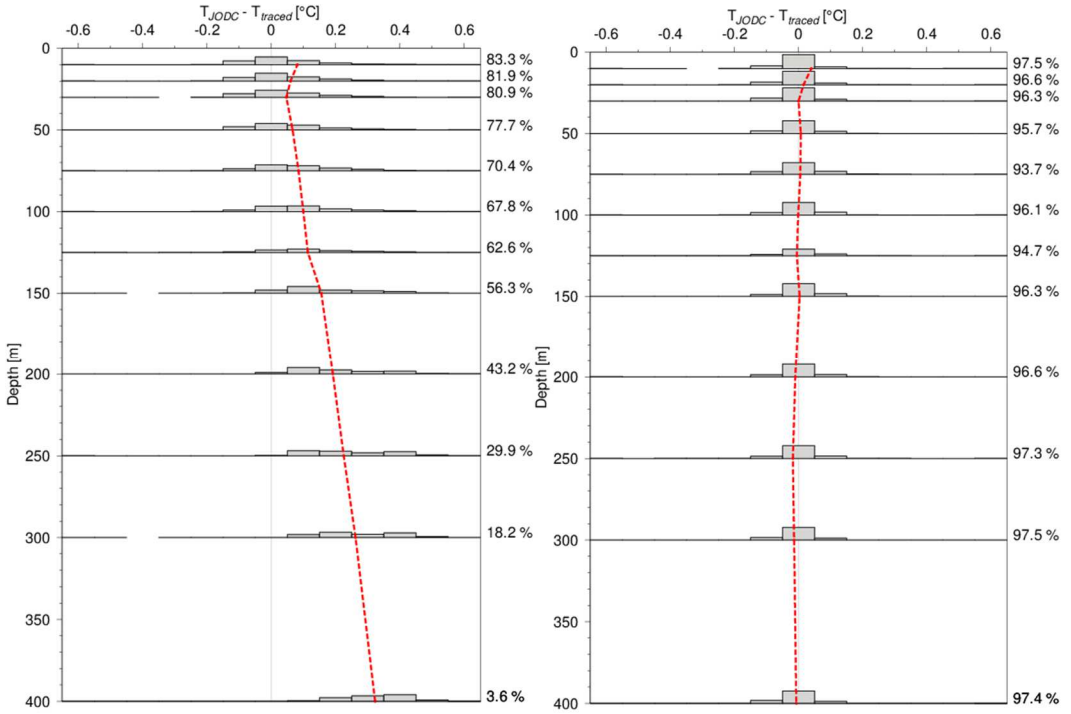

Figure 2: Histogram of differences of visual reading temperature and tracing temperature at the standard depths. Left panel show a result by tracing temperature using affine transformation only, and right panel show the after collection by determined approximate functions in this study. Red line shows mean of differences and label at right vertical axis shows a ratio of absolute differences within 0.1 degreee Celcius.

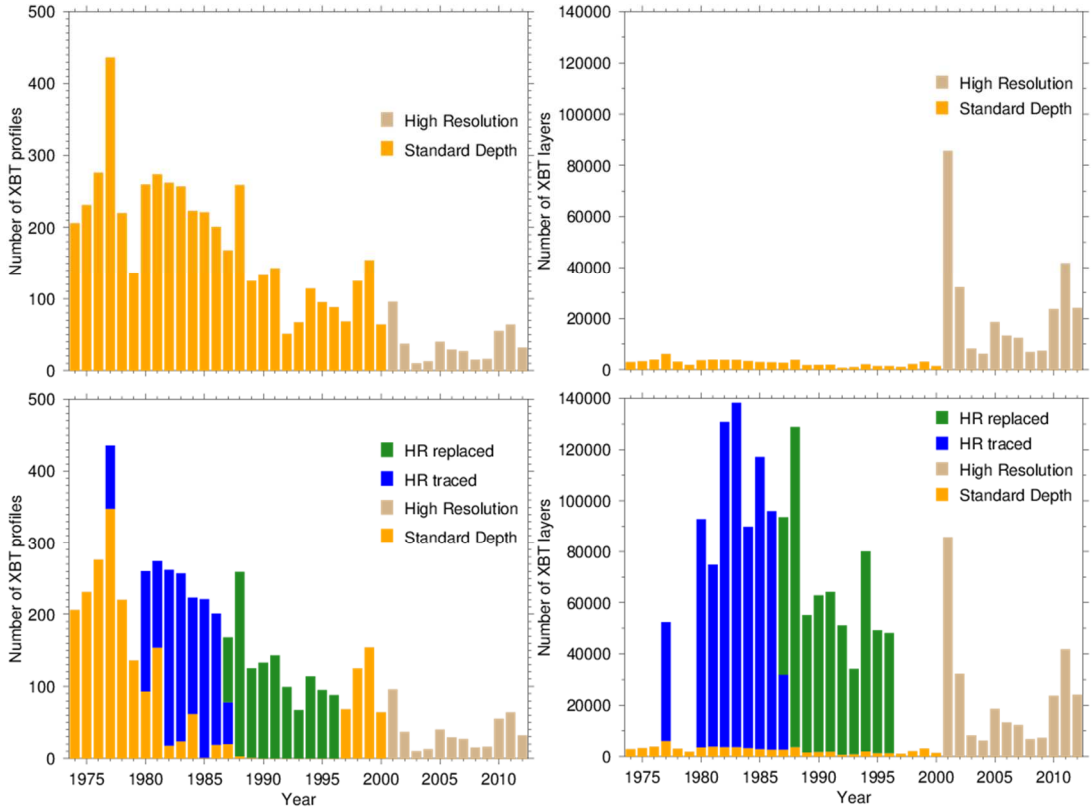

Figure 3: Annual changes of the number of XBT profiles (left panels) and XBT layers (right panels) by R/V Ryofu-Maru. Upper panels shows existing database of Japan Oceanographic Data Center and lower panels show the new one in this study. Blue indicates traced data and grean indicates replaced with high resolution data by digital converter which were funded by this study.