XBT Data Management and Quality Control in Japan (III)
Collection for Digital Traced Temperature Profile on Strip Chart

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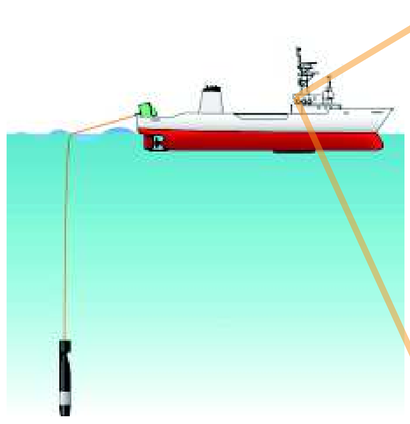
Abstract

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 (Tagged Image File Format) image file. The image file was imported by Adobe Illustrator and temperature profile on strip chart was traced and saved as DXF (Drawing Exchange Format) file. The DXF file was converted as a function of temperature and elapsed time from XBT probe launch by affine transformation and depth was calculated by manufacturer's fall rate equation. The traced temperature, however, was lower than visual reading temperature in existing database of Japan Oceanographic Data Center at deep layer. The result of all comparison also indicated the traced temperature was lower than the visual reading temperature at the deeper standard depths. 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 than 93% of the absolute of difference between traced temperature and visual reading temperature at the standard depths are within 0.1 degree Celsius. 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 (JMA), so nearly 2,600 profiles were replaced and the number of data remarkable increased in comparison with the existing database.



XBT measurement

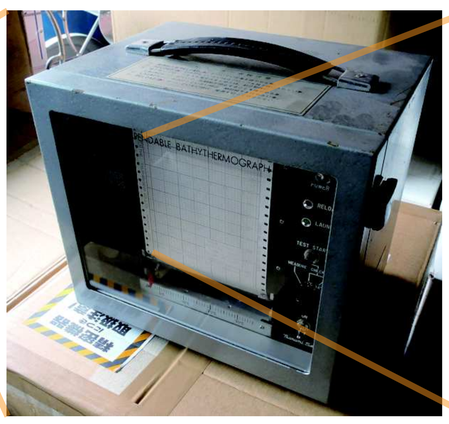
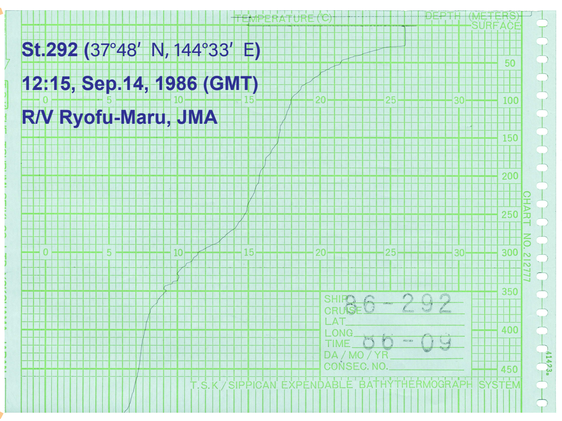
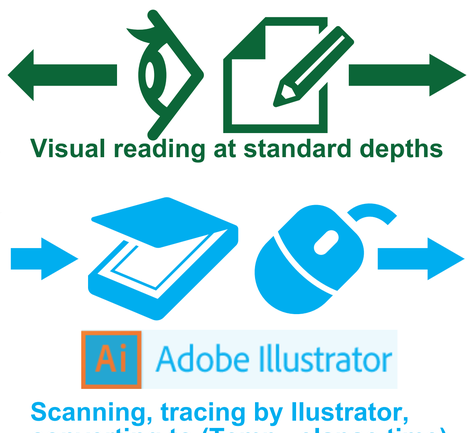
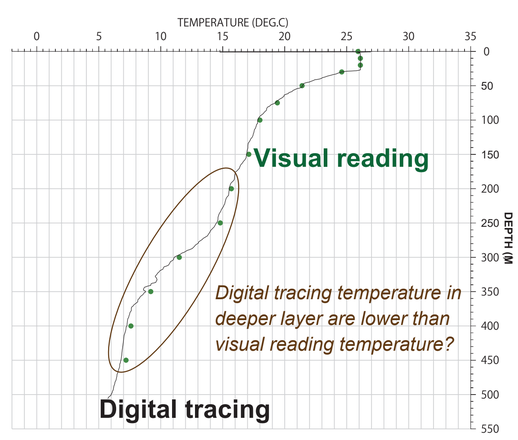


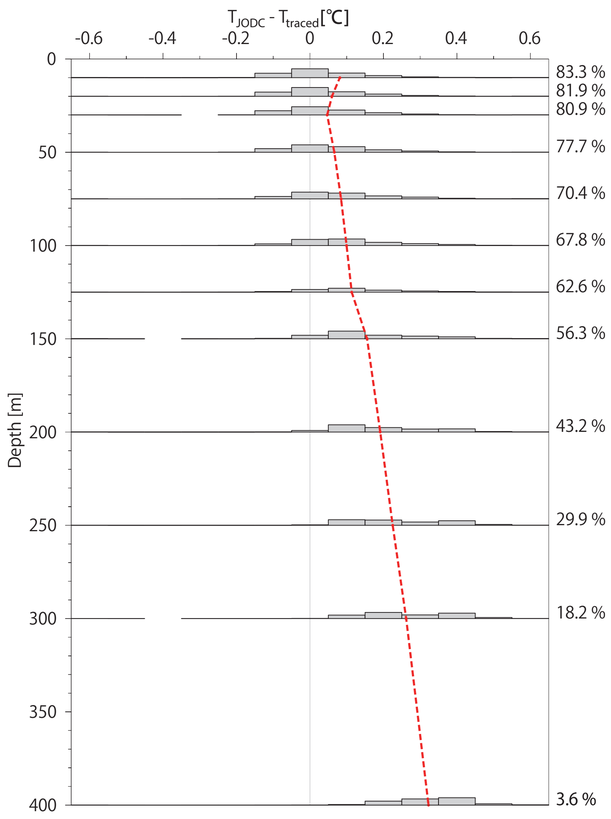
Chart Recorder (TSK MK-2A)



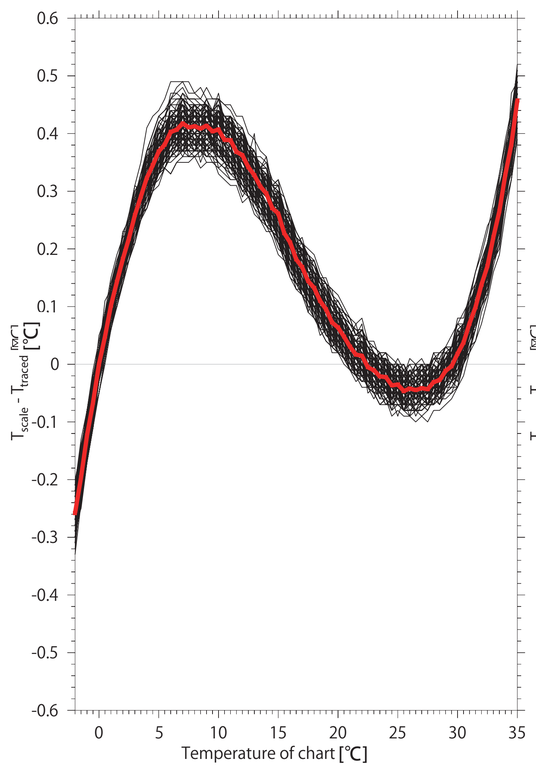
Strip Chart (TSK/Sippican No.212777)



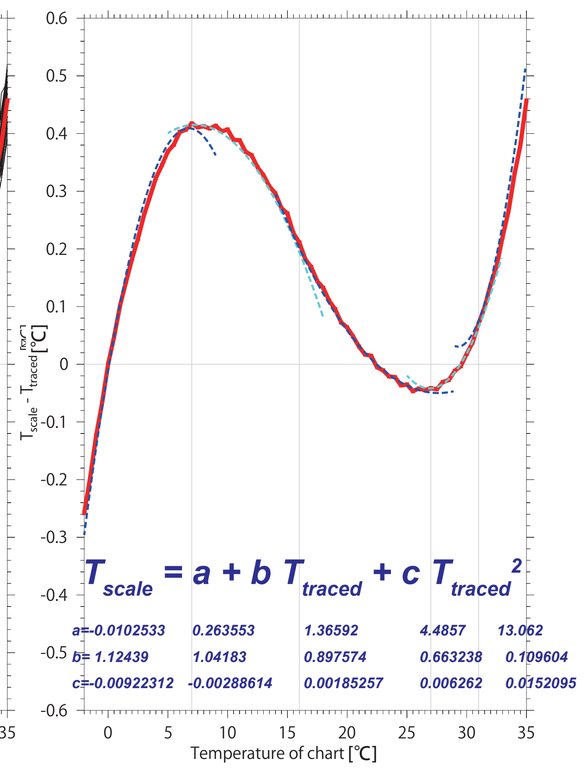




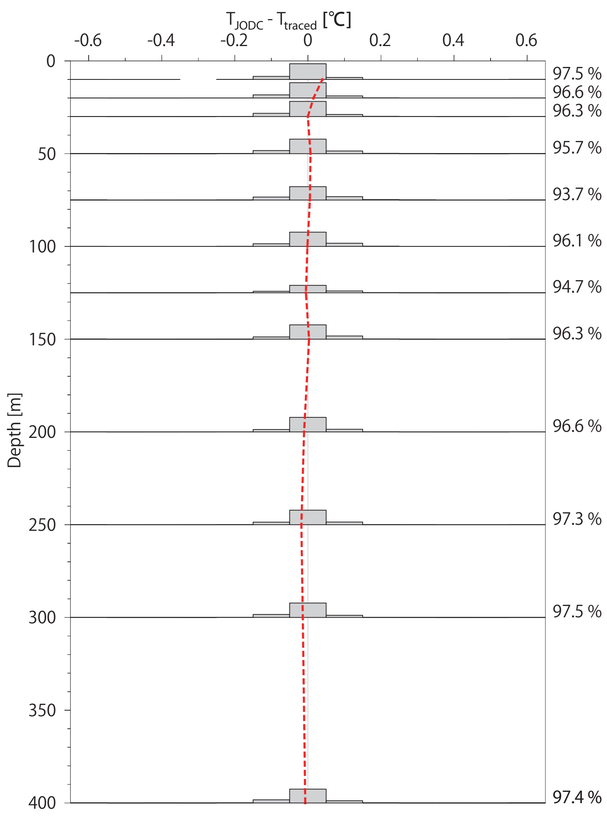
Histogram of temperature differences between visual reading (T_{JODC}) and traced (T_{traced}) at standard depths. Red line shows mean difference and axis label at right shows the ratio within ±0.1 degree Celsius. Note that JODC (Japan Oceanographic Data Center) means visual reading temperature data are stored in JODC.



Temperature differences between horizontal scale of strip chart (T_{scale}) and traced horizontal axis (T_{traced}) for 100 strip charts (black lines) and mean difference (red line).



Quadratic fuctions (blue lines) to mean temperature differece curve fitting (red line) in each five temperature domain
[< 7 | 7 - 16 | 16 - 27 | 27 - 31 | 31 <]



Same manner as leftmost figure but T_{traced} are corrected by quadratic functions shown in left figure.

Acknowledgments

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References

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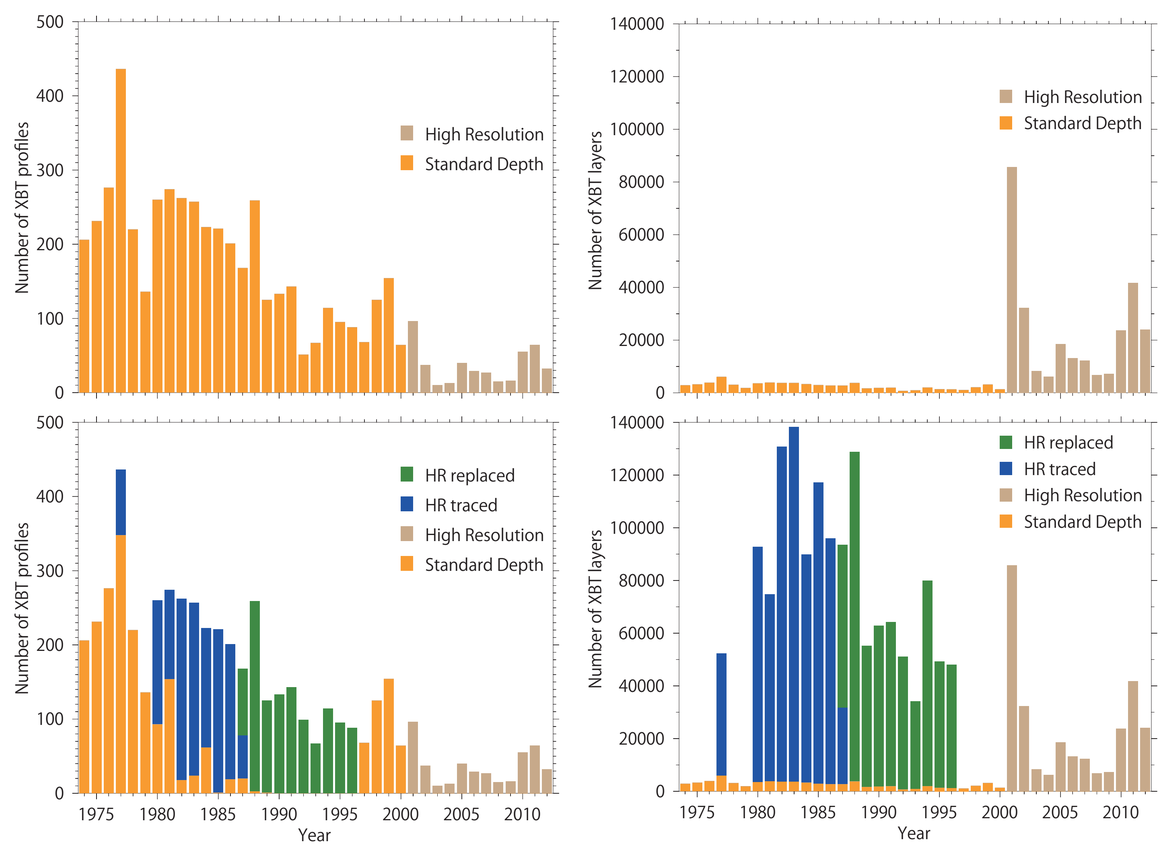
Kizu S., H. Yoritaka and K. Hanawa: A New Fall Rate Equation for T-5 Expendable Bathythermograph (XBT) by TSK, J. Oceanogr., 61, No.1, 115-121, 2005.



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 JODC 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 found by this study.