

Temperature vertical profile measurements by the ROV/UWTV

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(1) Objectives

The objective of this measurements is to collect vertical profiles of temperature at the drilling site C0002 and C0024 during the D/V Chikyu IODP Expedition 358. Obtained temperature profiles will be used to examine temporal changes in steric height at the fixed observation point for half a year.

(2) Instruments and methods

Temperature vertical profiles were measured by a temperature and pressure (TD) logger (Duet T.D. deep [serial no. 95974], RBR Ltd., Ottawa, Canada) at a sampling rate of 1 Hz. The TD logger was attached to the Remotely Operated Vehicle (ROV) or the Underwater Television Camera System (UWTV) on the D/V Chikyu. About 70 round-trip measurements (140 temperature profiles) between sea surface and close to the sea floor were conducted at site C0002 (33.3012 N, 136.6369 E, 1939 m, October 13, 2018 – March 1, 2019) by the ROV, and one round-trip measurement (2 temperature profiles) was conducted at site C0024 (33.0346 N, 136.7906 E, 3842 m, March 5-6, 2019) by the UWTV.

To estimate temporal changes in steric height at the drilling site, salinity profiles were estimated from measured temperature by using climatological temperature-salinity relationships according to a method of Uchida and Imawaki (2008). The temperature-salinity relationship for the coastal cold water region north of the Kuroshio axis was applied to the temperature profiles, since the drilling sites were in the coastal side of the Kuroshio large meander.

(3) Results

To evaluate quality of the TD logger data, in situ comparison with the shipboard CTD data (SBE 9plus CTD system, Sea-Bird Scientific, Bellevue, Washington, USA) was conducted in the R/V Mirai cruise (MR19-01). Pressure and temperature were measured by the TD logger at a sampling rate of 1 Hz and were compared with the pressure and temperature measured by the SBE 9plus CTD (Figure 1). Since the SBE 9plus temperature data was not calibrated in situ according to a method of Uchida et al., 2015), viscous heating effect (+0.5 mK, Uchida et al., 2007) on the SBE 9plus temperature sensor was subtracted from the SBE 9plus temperature data. For pressure comparison, temperature hysteresis of the SBE 9plus pressure sensor was relatively large, therefore, the data obtained during

the down cast was used for the evaluation. For temperature comparison, variability of the temperature difference was quite large for shallow depths due to large vertical gradient of temperature, therefore, the data obtained for depths deeper than 2000 dbar was used for the evaluation. Linear fit coefficients were as follows:

$$P_{TD} - P_{9plus} = -1.393 + 0.0009106 P_{9plus}$$

$$T_{TD} - T_{9plus} = -0.0016 + 4.5201e-7 P_{9plus}$$

From these results, accuracy of the pressure and temperature data measured by the TD logger is expected to be 1.4 dbar and 1.6 mK, respectively.

Time series of the temperature profiles and steric height between 0 and 1900 dbar are shown in Figure 2.

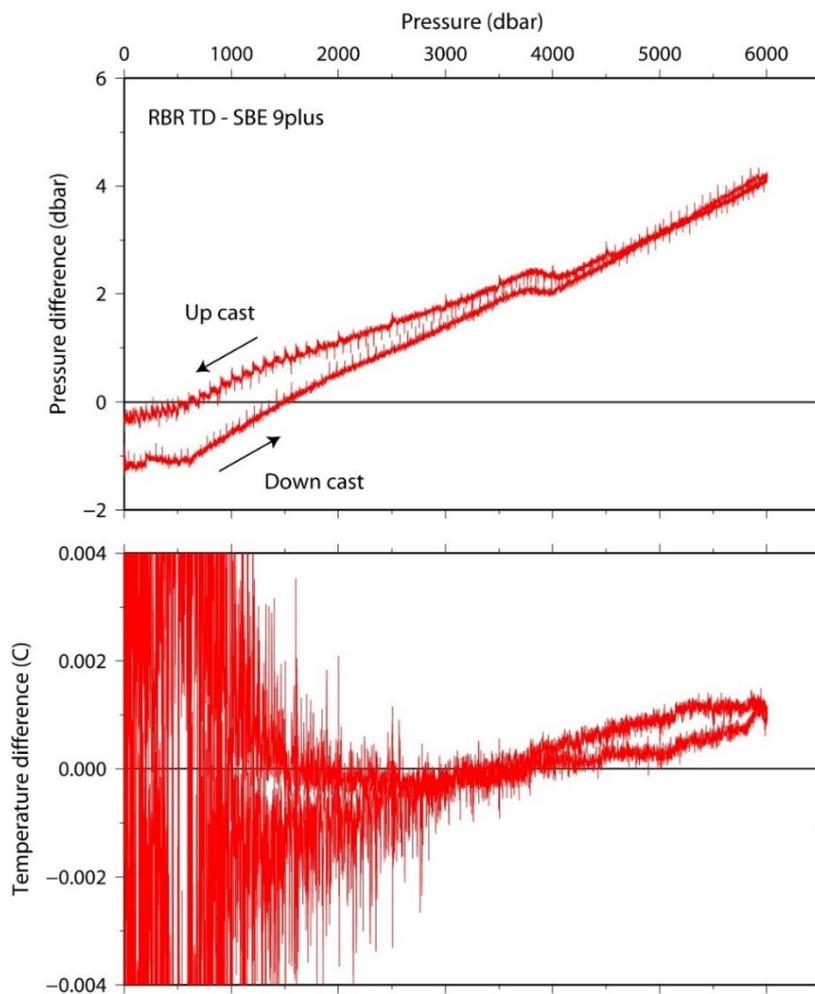


Figure 1. Difference between the TD logger and the SBE 9plus CTD data. Upper panel shows the pressure difference (TD – SBE 9plus) and lower panel shows the temperature difference (TD – SBE 9plus).

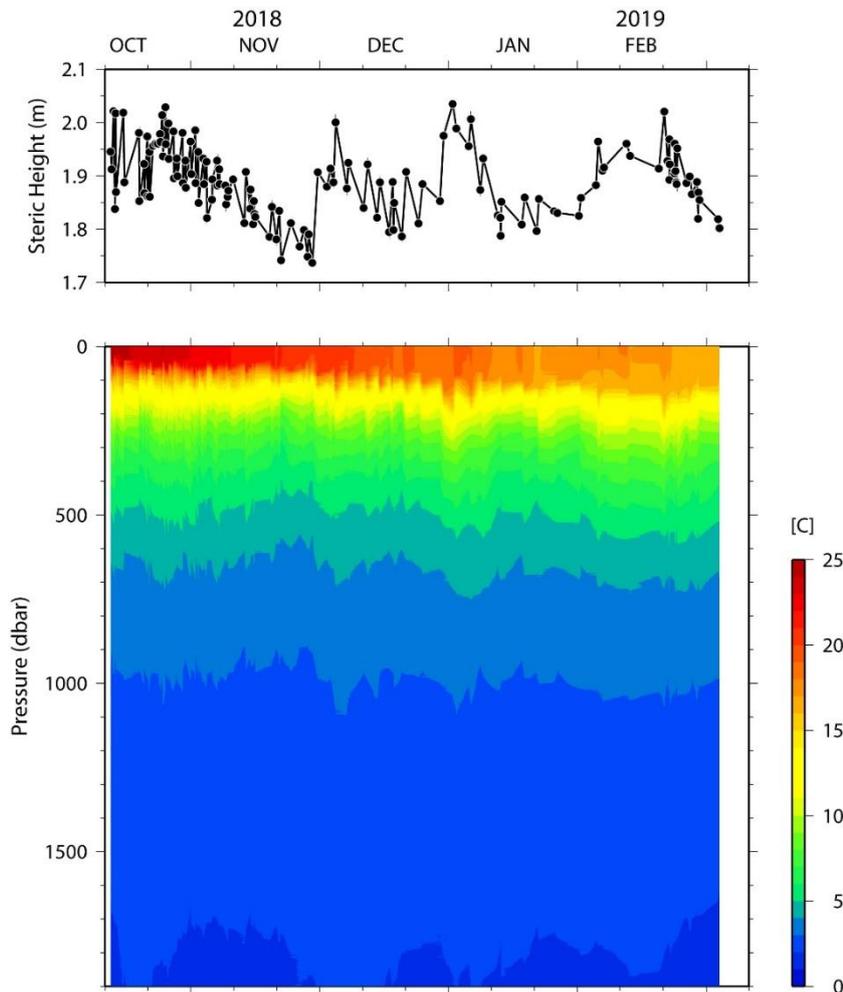


Figure 2. Time series of the temperature profiles (lower panel) and steric height between 0 and 1900 dbar (upper panel).

(4) Data archive

These obtained data will be submitted to JAMSTEC Data Management Group (DMG).

(5) References

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