AAIW: Preliminary XCTD Cruise Report

Antarctic Intermediate Water Formation in the Southeast Pacific

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1 AAIW XCTDs

During the Antarctic Intermediate Water (AAIW) winter cruise, dense underway profiling of upper ocean temperature and salinity was carried out with expendable conductivity-temperature-depth probes (XCTDs). The sampling at 15 to 20 km spacing supplemented the full-depth CTD stations that were spaced at approximately 50 km. Generally, three XCTDs were launched between CTD stations. Additionally, two intensive surveys were carried out in regions of deep mixed layers, steaming a diamond pattern centered on the main AAIW track, with dense XCTD sampling throughout and CTD stations at the corners. The first intensive survey began after CTD station 9 and ended with station 12 (Stations 8, 10, 6, and 11 are the corners). The second intensive survey began after CTD station 14 and ended with station 17 (Stations 14, 15, 12, and 16 are the corners). Surface drifters were deployed at the corners of the two diamond patterned intensive surveys.

1.1 Instrumentation

The XCTDs were digital TSK probes purchased from Sippican (Sippican, Inc.) and manufactured by TSK (The Tsurumi-Seiki Co.). The computer, deck unit, and launcher were supplied as standard ship's equipment on the Knorr. The deck unit was the Sippican MK-21 model.

1.2 Data acquisition

Data acquisition was on a pc computer with the Windows 2000 Professional operating system. (Minimum computer requirements for the Sippican software are a P3/700 with 64 MB of RAM, with W2000 or XP). Two copies of the data files were made; one on the pc hard disk and the second on either a networked drive or in a backup directory on the pc. The Sippican software versions were WinMK21 v2.1.2, MK21COEF v2.3.1, and MK21AL v2.5.1. The XCTD computer and the Sippican MK-21 deck unit were located in the computer rack in the main lab. The hand launcher and XCTDs were kept in the aft hangar, and the launches were staged from the hanger.

1.3 Launch Procedure

XCTD launching was a two person effort because the weather deck on the Knorr was secured while underway during most of the cruise, thus requiring two persons on deck and radio communication to the bridge. XCTD launch times were determined from the ETA time and range to station from the main ODF AAIW webpage. The bridge was notified via radio. One person opened the"New Launch" window of the MK-21 software while the second person went aft to load a new probe in the hand launcher. The software cycles through "Testing Probe", "Prepare to Launch", and "Launch Probe". If it is successful in reading the probe's EPROM, it will usually get through to the "Launch Probe" window. At this point both persons, in work vests and equipped with a handheld radio, would go out to launch the probe. There were four launch locations, and the choice was dictated by wind and seas. A permanent launch tube was located on the port side, just aft of the hangar. A second launch tube was tried in various locations; it was usually located on the rail on the port side of the fantail. The third location was the starboard side of the fantail, and a fourth was the starboard side immediately across from the aft hangar. The fall rate is approximately 200 m/min, and a cast typically took 5 mins. If a launch tube was used, both persons would come back inside and monitor the launch on the computer. If the probe was hand-launched, one person would watch from the hangar where they could also view the computer screen if they moved to the doorway into the main lab. The spent canister was retrieved after the launch. The data file was inspected and serial number (SN), time, latitude, and longitude were recorded to logsheets and reported to the bridge.

1.4 Problems encountered

We launched 399 probes and had a total of 342 good casts (defined as casts to depths of at least 800 m) with an overall success rate of 86%. The main reasons for XCTD failures were 1) XCTD wire contacting the ship, usually due to wind, 2) XCTD launch not recognized by the software (despite the fact that the EPROM was read ok and the SN displayed correctly in the “Launch Probe” window), 3) a false splash (the software starts recording when the probe is in air, but the computer operator has gone aft to launch and does not know to abort the cast), 4) loading a probe too early while the software is running (operator error - we did not know that the batteries in the probe run down in about 15 min if the program is active). The table at the end of this section summarizes the XCTD performance. Also note that some casts did not profile to maximum depth, usually for unknown reasons.

Part of our launch procedure initially was to wet the end of the probe with Jet-Dry, to improve adhesion and thus decrease spiking near the surface. This technique is used for analog XCTDs, but it may have been the cause of some of our early false splash failures with the digital probes. After communication with Sippican, we stopped using Jet-Dry; however, we still encountered false launches and other failures. The system was examined for wiring defects such as ground loops. The launcher cable appeared to be wired correctly, after testing with an ohm meter between the launcher and the Sippican connector box at the computer. However, the computer chassis, monitor, and Sippican deck unit were all independently grounded, and we were advised by Justine Afghan and Glenn Pezzoli that floating all but one ground was considered critical for the setup of the XCTD systems that they install on the high resolution XBT container ships. We floated the computer and deck unit ground, using a single ground in the connector box. However the monitor, the GPS, and other computers in the rack all had independent grounds which we were unable to change, and these could be a potential problem. Our success rate improved dramatically (from 75% to 90% or 95%) after we floated the ground on the computer chassis and deck unit, until the last week of the cruise when we had a string of failures (mostly undetected launches). A loose ground wire was found on the connector box between the computer and the launcher and reconnected, but that did not solve the problem. The source of the failure turned out to be a broken wire in the stress-relief section of the launcher cable, located where it entered the hand launcher. Other things that were tried at this time were 1) rebooting the computer, power cycling the deck unit, and restarting the software before every cast, 2) installing the software on a new computer outside of the rack, 3) turning off virus detection software, 4) disconnecting from GPS, and 5) disconnecting from the network. We had a Sippican digital test canister that did not detect the wiring problem, possibly because the wire ends still had intermittent contact. Continued testing by the Knorr's SSSG technician (Robbie Laird) indicated that the broken wire only had to make contact for an instant for the test canister to initiate a successful test cast. It is unknown whether the same is true for an actual XCTD cast.

XCTD Cast Statistics		
	No. of casts	Drop quality
Used probes	342	Good cast to depth $>$ 800 m
	10	Good cast to depth $<$ 800 m
	16	Bad or truncated cast due to wind or wire on deck
	17	Bad cast; failure to recognize launch
	9	Bad cast; reason unknown
	5	Bad cast; false splash
Unused probes	9	
Total	408	34 cases of 12

1.5 Data processing

The Sippican automated processing was the only processing that was applied. Two files exist for each cast: RDF (binary, raw) and EDF (ascii, edited by the Sippican autoprocessing). An example of a succession of good temperature casts to 1000 m is shown in Fig. 1.

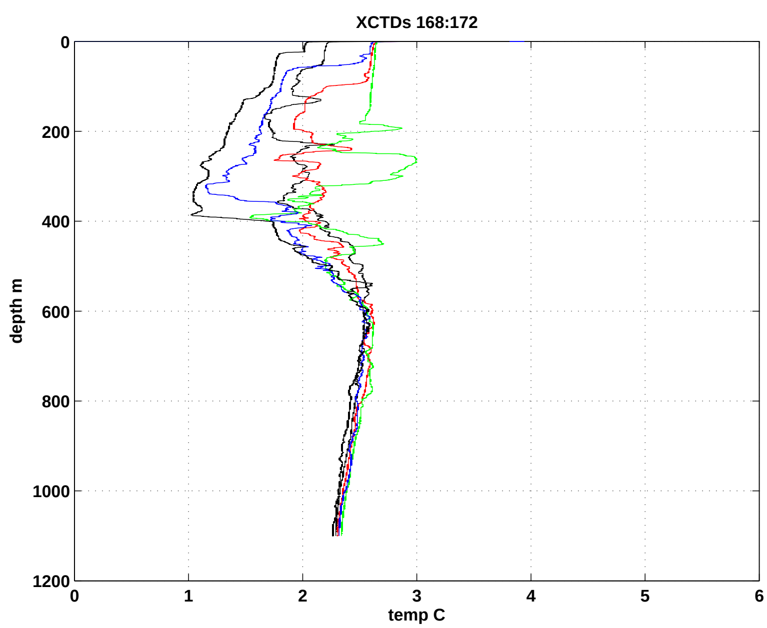

Figure 1: Sample of XCTD temperature profiles from casts 168 to 172

1.6 Recommendations

After diagnosing our final problem (broken wire in the launcher cable), we stopped the reboot/power cycle/restart routine, and we put the XCTD computer back on the network. We kept the virus software turned off, and we did not connect to the GPS. All of these things could potentially cause problems, but it is our assessment that they were probably not an issue in the Knorr setup. It is recommended to bring our own computer, cable, and launcher with a stable and tested version of the Sippican software installed. Then the science party has control with respect to: network, external inputs (GPS), grounding, and virus software. As long as time is accurate, the system does not need to be networked and does not need real-time GPS input.

Other recommendations for the summer cruise entail additional items to log for each cast that are helpful in assessing the quality of the cast and in diagnosing problems.

We suggest:

- Log whether spiking occurs in the profile and the maximum depth of the profile.
- Log the serial no. prior to deployment so that all probes get logged, even failures.
- Track the box number as well as serial no., in case the probe is part of a bad batch that needs to be reported to Sippican for a refund.
- Check whether the probes in a single box are all in sequence, again for tracking purposes.

1.7 Acknowledgements

Thanks to Justine Afghan and Glenn Pezzoli for advice during the AAIW winter cruise.