Ocean Research Project, CTD summary and processing report, West Greenland 2016

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Introduction

From June to September 2016, Nicole Trenholm and Matt Rutherford of the Ocean Research Project (www.oceanresearchproject.org) operated their vessel the R/V Ault along the coast of western Greenland, collecting CTD (conductivity/temperature/depth) profiles and bathymetry data. The following report gives an overview of the CTD data and the processing performed to produce the final files.

RBR Concerto CTD

The CTD used to collect profiles throughout the expedition was an RBR[1] *Concerto* CTD (serial number 60130), shown in Figure 1. The RBR*Concerto* CTD sampled each of conductivity, temperature, and pressure at a rate of 4 Hz, and was lowered manually at a speed of about 1 m/s. The maximum rated depth of the CTD was 740 dbar, though the instrument was tested to 1000 dbar and the pressure sensor calibrated over this range. The RBR conductivity cell is an inductive cell, and is unpumped.

Pre and post cruise calibration certificates are provided separate to this report. Temperature and conductivity calibration evaluated after the cruise (November 2016) were found to be within $0.002°C$ and 0.003 mS/cm and no corrections for drift were required. It was discovered during the post-cruise calibration that the pressure channel was missing one of the required coefficients for temperature correction (x1 coefficient), which could affect the measured pressures when in cold water (Igor Shkvorets RBR, personal communication). It was determined that the best course of action was to use the x1 coefficient from the post-cruise calibration (x1=0.00018922), as examination of the values of coefficient from previous calibrations was similar and no sign of drift was evident. Pressure values were re-calculated from the raw data using the updated calibration coefficients.

Cast locations

Figure 2 shows a plot of the study region and individual CTD cast locations. Note that most of the CTD stations were within Inglefield fjord, as part of the detailed bathymetric mapping done during the 2016 field program.

A closer look at the CTD stations within the fjord, overlayed with the publically available NOAA bathymetry (1 minute resolution), shows the distribution of casts within the fjord and close to the glacier face. The color of the points indicates the discrepancy between the maximum depth of the CTD and the NOAA bathymetry, with red colors indicating a CTD profile that went deeper than the bathymetry product by the specified amount. Note that many of the CTD casts, especially those close to the glacier face, are several hundred meters deeper than the known bathymetry.

[1] http://www.rbr-global.com

Figure 1: RBR Concerto CTD

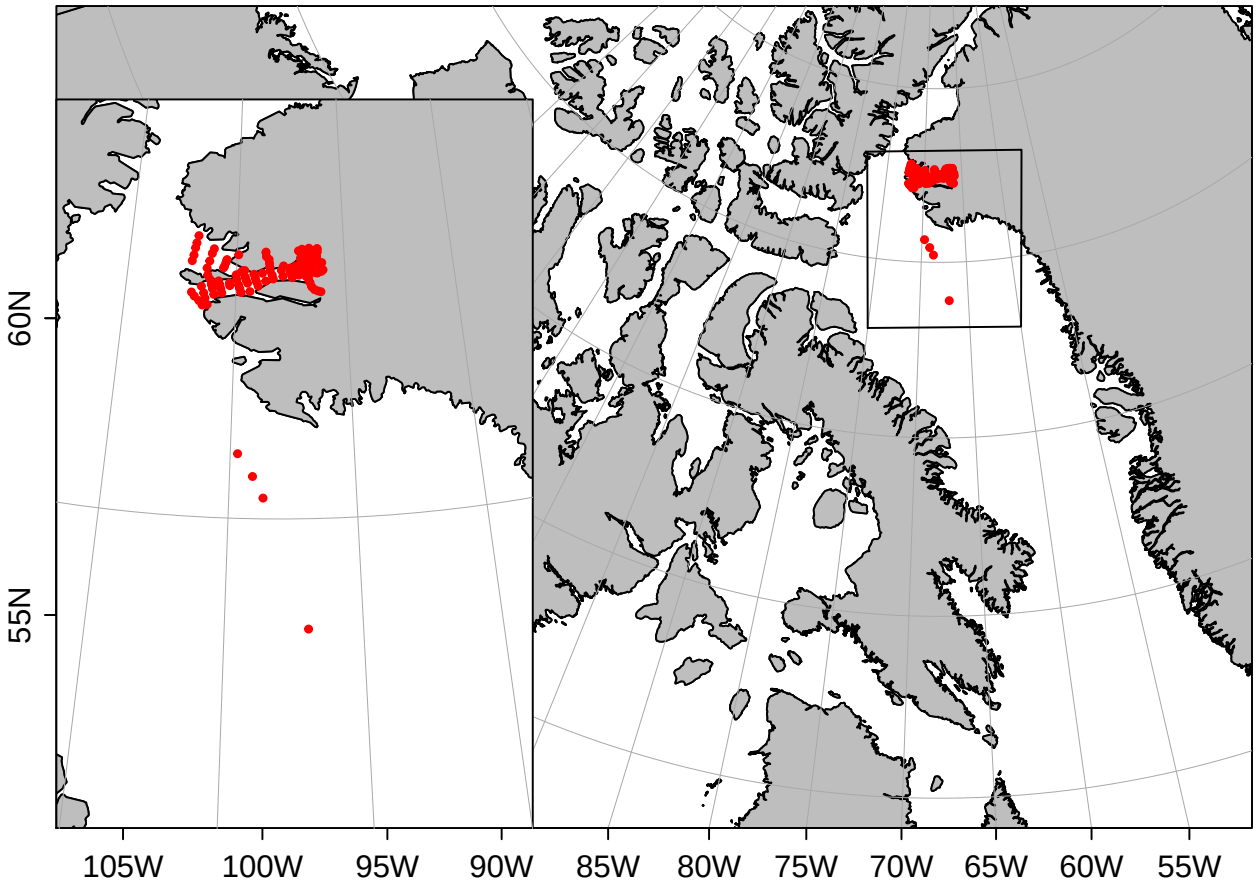

Figure 2: Map of CTD locations.

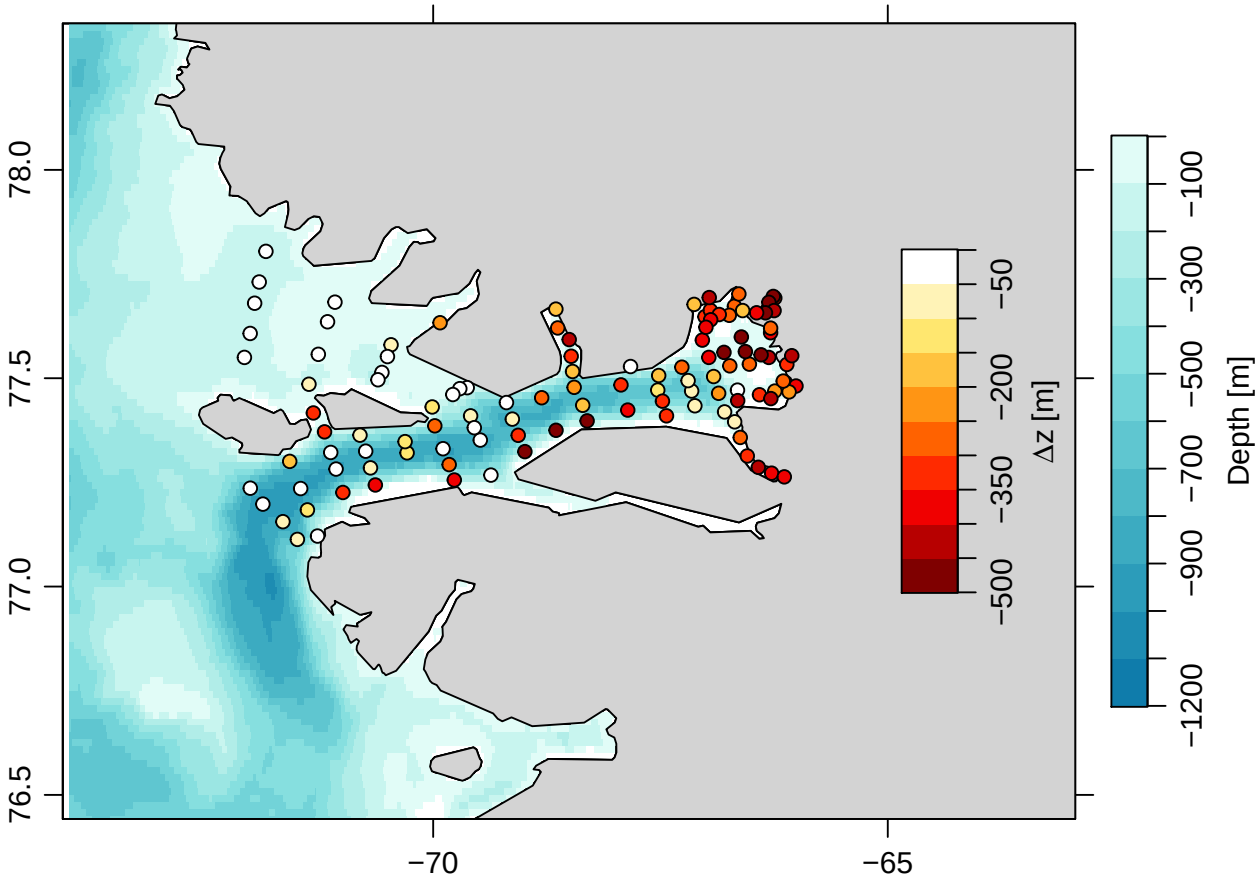

Figure 3: Detailed map of Inglefield fjord, with NOAA 1 minute resolution bathymetry, showing station location and the depth difference between the bathymetry and the maximum depth ofthe CTD cast.

CTD data processing

Processing of the CTD data was performed using the `oce` package[2] in the R language[3]. Raw time series data from the RSK files were read into R to create standard `ctd` objects, with salinity calculated according to the Practical Salinity Scale (e.g. PSS-78). The profiles were trimmed for downcast only, and near-surface values (e.g. pressure less than 1 dbar) were removed. Conductivity was lagged by one scan for better CT alignment, and then salinity and temperature were smoothed with a 5-point moving average filter. The profiles were then bin averaged to pressure bins 2 dbar wide, using a boxcar window with a width of 3 dbar. The final data were exported to both a NetCDF format and CSV (comma separated values) files.

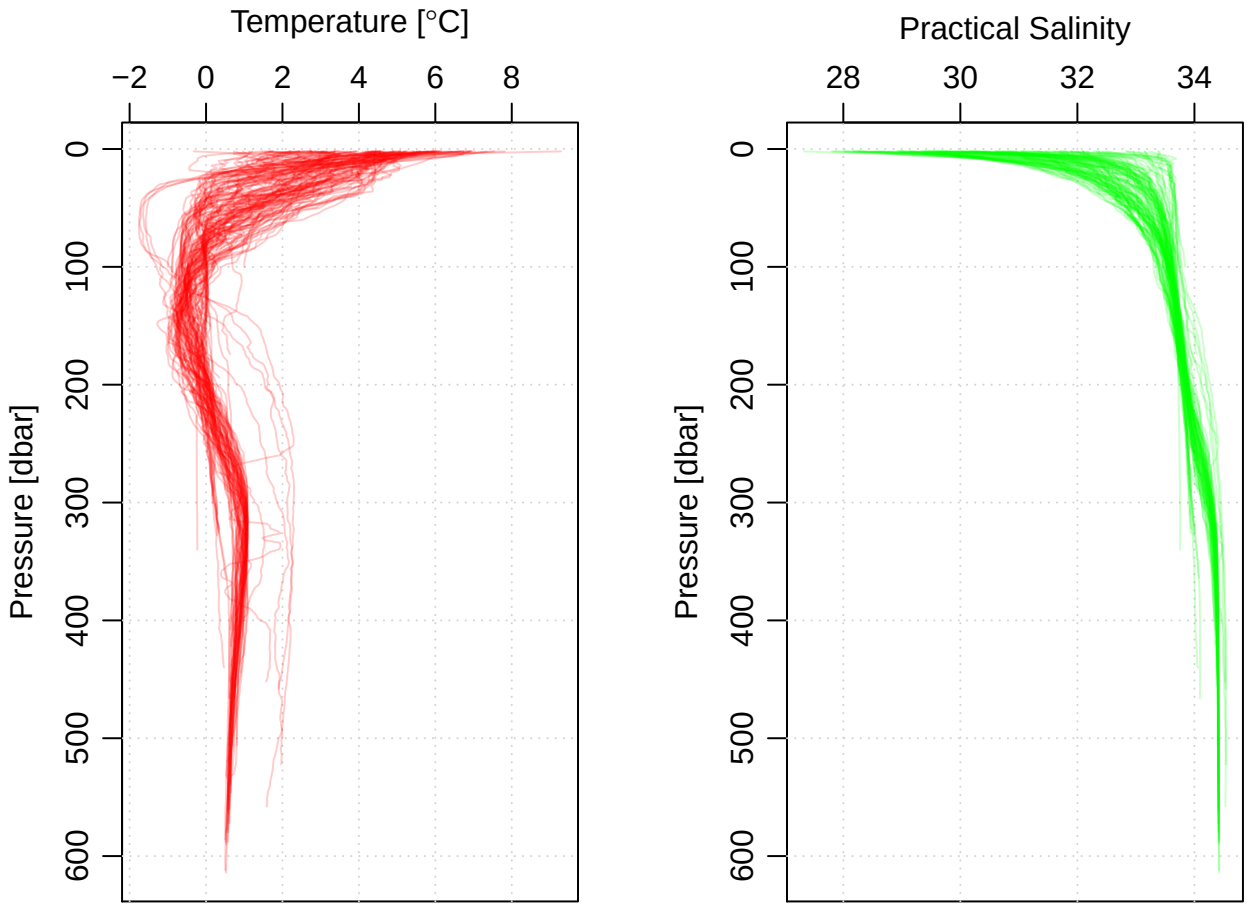

Figure 4: Summary of temperature and salinity profiles.

A summary of all temperature and salinity profiles is shown in Figure 4, and a summary of the processed TS properties from all profiles is shown in Figure 5.

Sound velocity profiles

The processed CTD data was used to produce profiles of water column sound velocity, using the TEOS-10 algorithm[4] provided by the `gsw` package in R[5]. Individual sound speed profiles were saved to the CTD profiles for later incorporation into the bathymetric data processing.

[2] http://dankelley.github.io/oce
[3] http://www.r-project.org
[4] http://teos-10.org/
[5] http://teos-10.github.io/GSW-R/index.html

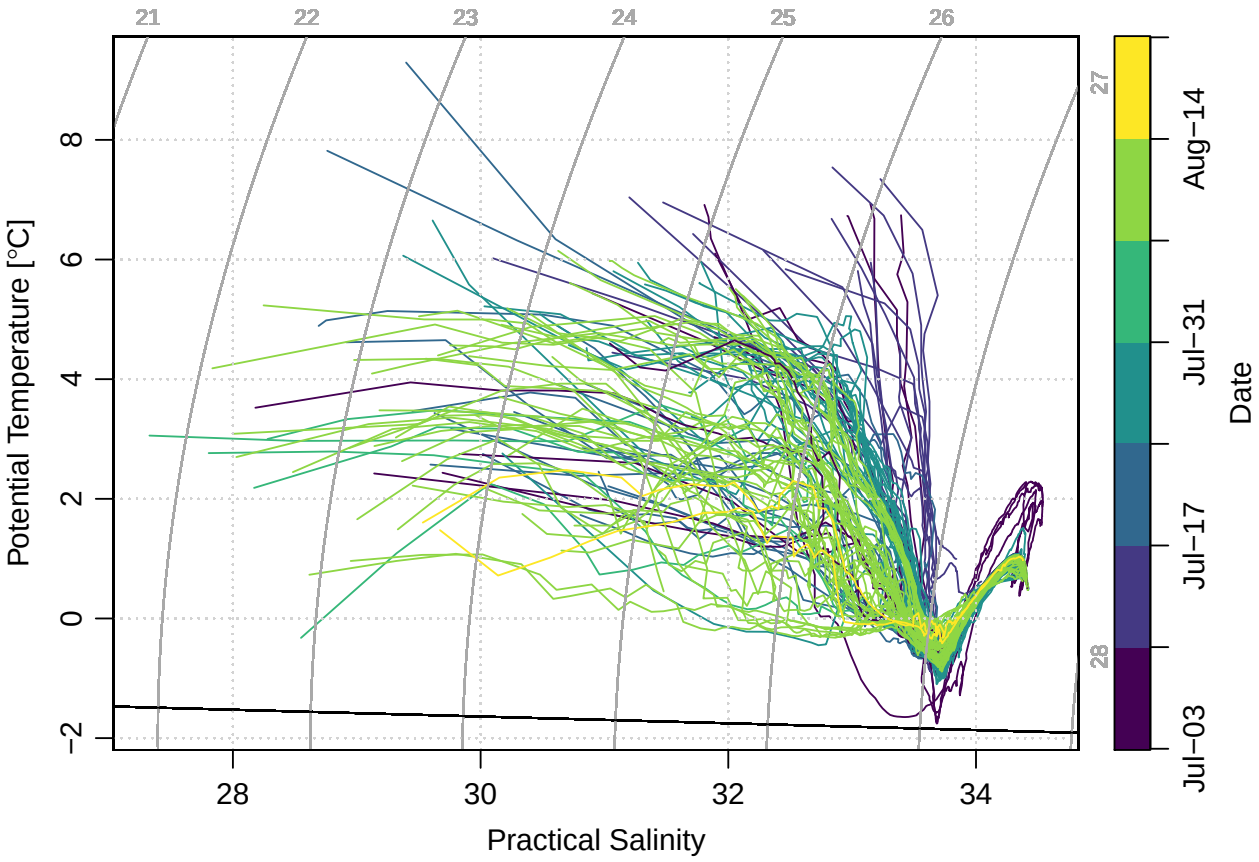

Figure 5: Summary of TS properties

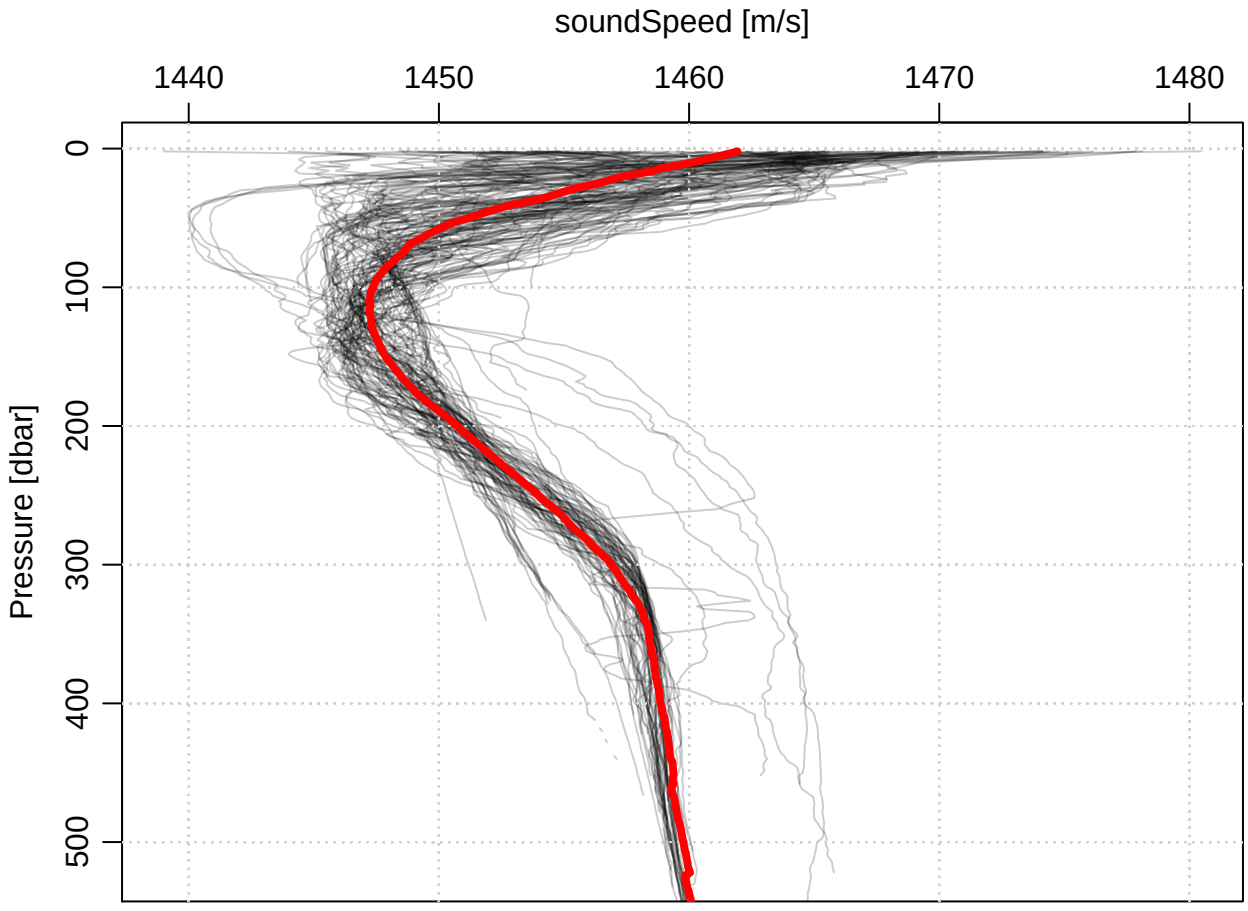

Figure 6: Sound speed profiles calculated from CTD casts. The average sound speed profile for all casts is indicated by the red line.