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Eau, Terre et Environnement

ARCTICNET 2007-2008 MCLANE MOORED PROFILER DATA -
QUALITY CONTROL REPORT

By

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ABSTRACT

This report is a summary of the quality control process applied to the McLane Moored Profiler (MMP) data recorded between October 2007 and July 2008 during the Circumpolar Flaw Lead program. During this period, two MMP moorings funded by ArcticNet were deployed in the southern Beaufort Sea from the CCGS Amundsen. This report summarizes the problems encountered during data analysis and the corrections applied or suggested. The following text should be consulted prior to using the MMP data.

RÉSUMÉ

Ce rapport résume le processus de contrôle de qualité effectué sur les données recueillies par les profileurs de type McLane Moored Profiler (MMP) déployés entre octobre 2007 et juillet 2008 lors du programme «Circumpolar Flaw Lead». Au cours de cette période, deux mouillages MMP financés par ArcticNet furent déployés au sud de la mer de Beaufort par le NGCC Amundsen. Ce rapport résume les problèmes rencontrés au cours de l'analyse des données et les corrections appliquées ou suggérées. Ce texte doit être consulté avant toute utilisation des données de ces appareils MMP.

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INTRODUCTION

The ArcticNet network was created in 2004 to assess the effects of ongoing warming and modernization on Canadian Arctic ecosystems, economies and societies. An important part of the ArcticNet program includes the monitoring and study of biological, chemical and physical components of the coastal Canadian Arctic seas. Between 2007 and 2008, six ArcticNet moorings were deployed in the Beaufort Sea (Figure 1). In this report, we will look at two of these moorings, which were equipped with McLane Moored Profilers (MMP) (McLane Research Laboratories, 2008): CA05MMP-07 and CA16MMP-07. For more information on the other moorings, please consult Boisvert et al. (2011) and Rail and Gratton (2010).

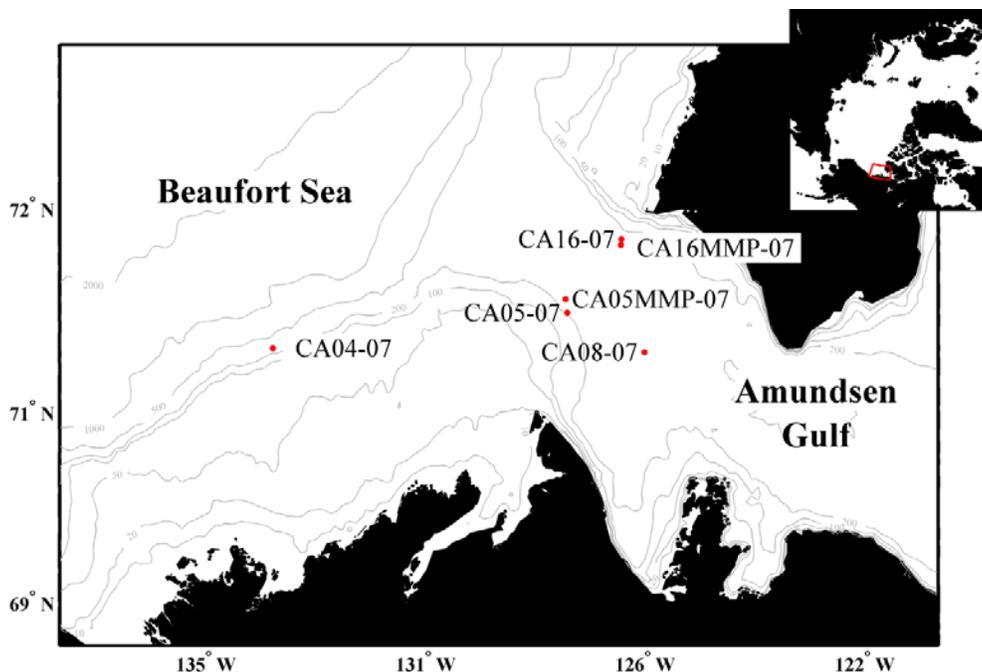


FIGURE 1. Moorings deployed in Southern Beaufort Sea in fall 2007.

Moorings CA05MMP-07 and CA16MMP-07 were deployed in Beaufort Sea from the CCGS Amundsen in October 2007. Both moorings were recovered in July 2008. Each mooring was equipped with a MMP, which is an instrument capable of completing autonomously time-series profiles of the water column by traveling vertically along the mooring line (Figure 2). Each MMP was equipped with a SBE 52-MP and a Seapoint Chlorophyll Fluorometer (SCF), which are used respectively to measure Conductivity, Temperature and Depth (pressure), and fluorescence. The characteristics of each instrument are provided in Table 1.

Quality control was only performed on conductivity-temperature data by following the ArcticNet Mooring's Data Quality Control protocol (Guillot, 2003). Fluorescence data quality control was not performed.

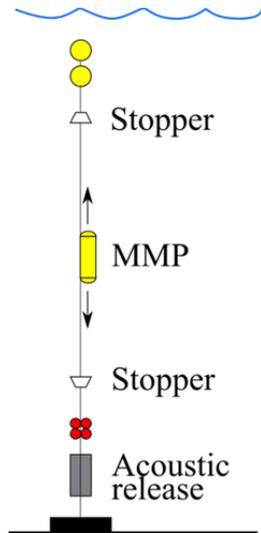


FIGURE 2. A typical MMP mooring line.

TABLE 1. Summary of ArcticNet 2007-2008 MMP mooring data characteristics.

Mooring	Water depth	Position	Instrument	Serial No	Instr. Depth (m)	Date of first reliable data	Date of last reliable data	T (°C)	Cond (mS/cm)	Press (dbar)	Spd (m/s)	Dir (true)	Turb (FTU)	Oxy (uM)	Chl	pH	Comments
CA05MMP-07	233	71°24.1966' N 127°38.1112' W	MMP	12138-05	40 - 120	2007-10-23 04:00	2008-07-24 11:00										3670 profiles
CA16MMP-07	355	70° 45.699' N 136° 0.503' W	MMP	12138-03	30 - 190	2007-10-22 01:12	2008-07-23 00:01										3301 profiles

Color code	
	Available data
	No data

METHODS

The quality control process included a validation of the metadata, the calibration coefficients, the instrument depth and clock, and the comparison of the mooring data with Rosette CTD data recorded around the same time. Missing and questionable data mentioned in this report were replaced with NaNs (i.e., not-a-number). A summary of the moorings' characteristics is found in Table 1.

Calibration coefficients validation

All the instruments deployed were calibrated by their respective companies prior to the expeditions. The probes' specifications: range, resolution and accuracy can be found in Appendix 1. The temperature calibration was done for a temperature range from +1 to +32°C. As the water temperature in the Arctic Ocean is generally below 0°C, the calibration range should be modified in the future. For this reason, the data recorded by the SBE 52-MP must be handled with care.

Data processing

All MMP binary data were first converted to physical units with the help of the software « UnPacker.exe » provided by McLane Research Laboratories. Subsequently, using Matlab[®], all the data from the same profile were combined and the time of the first measurement of a profile was assigned to the rest of the profile. Next, each profile was averaged every 1 dbar. Finally, salinity was computed from the CTD data with the routine « SW_SALT.M » of the Sea Water Matlab library (CSIRO, 1994).

Date and time validation

The dates and times validation process was carried out by comparing the time of the first and last profiles of the MMPs with the GPS time recorded in the mooring logbook when the moorings were deployed and recovered. In addition, an inspection of the time interval between each profiles has been completed to confirm the profiling frequency.

Data validation: visual inspection (plots) and data comparison

Each variable was plotted on many separate figures for a visual inspection. Mooring salinity and temperature data were compared with data from a Seabird 911+ CTD lowered from the ship after every mooring deployment and before every mooring recovery. The CTD cast used were obtained within a 15 km radius from the mooring location. The CTD probes were calibrated frequently and are, therefore, considered reliable. The list of the CTD casts used for the data comparison can be found in Appendix 3.

RESULTS

1. Mooring CA05MMP-07 (MMP #12138-05)

A total of 3670 profiles were recorded by this MMP between October 23, 2007, and July 24, 2008. The time of the first and the last profiles completed by the MMP are in agreement with the deployment and recovery time of the mooring line. This gives us no reason to suspect that there has been a major drift in the instrument's clock. No correction is recommended.

The pressure probe appears to have worked properly since the recorded values are consistent with the mooring design as well as with the other physical parameters recorded by the instrument. In addition, the probe recorded a pressure inferior to 1 dbar when the instrument was on the ship's deck after the recovery. No correction is recommended. As presented on figure 3, the vast majority of the profiles were completed between 40 and 130 dbar. However, there were a few times when the profiler went below 130 dbar and, in some occasions, had some difficulties reaching depths above 60 dbar.

Most of the profiles were two hour apart except for a few occasions (~400) when the interval was 15 minutes (figure 3). This might be related to the initial settings of the instrument.

The temperature and the salinity recorded by the profiler were similar to the data recorded by CTD. No correction is recommended. A list of the CTD casts used for validation and the actual comparisons are presented in Appendices 2 and 3, respectively.

Figure 4 presents contours of the CA05MMP-07 salinity and temperature profiles for the complete sampling season.

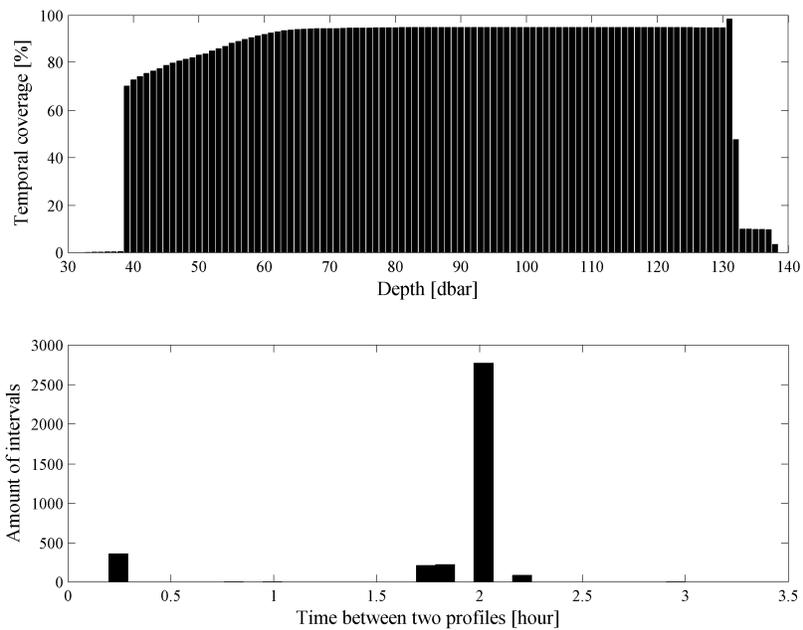


FIGURE 3. CA05MMP-07 MMP data statistics. (Top) The height of the black bars represent the proportion of the profiles that sampled the corresponding depth along the x-axis. (Bottom) Histogram of the period between two successive profiles.

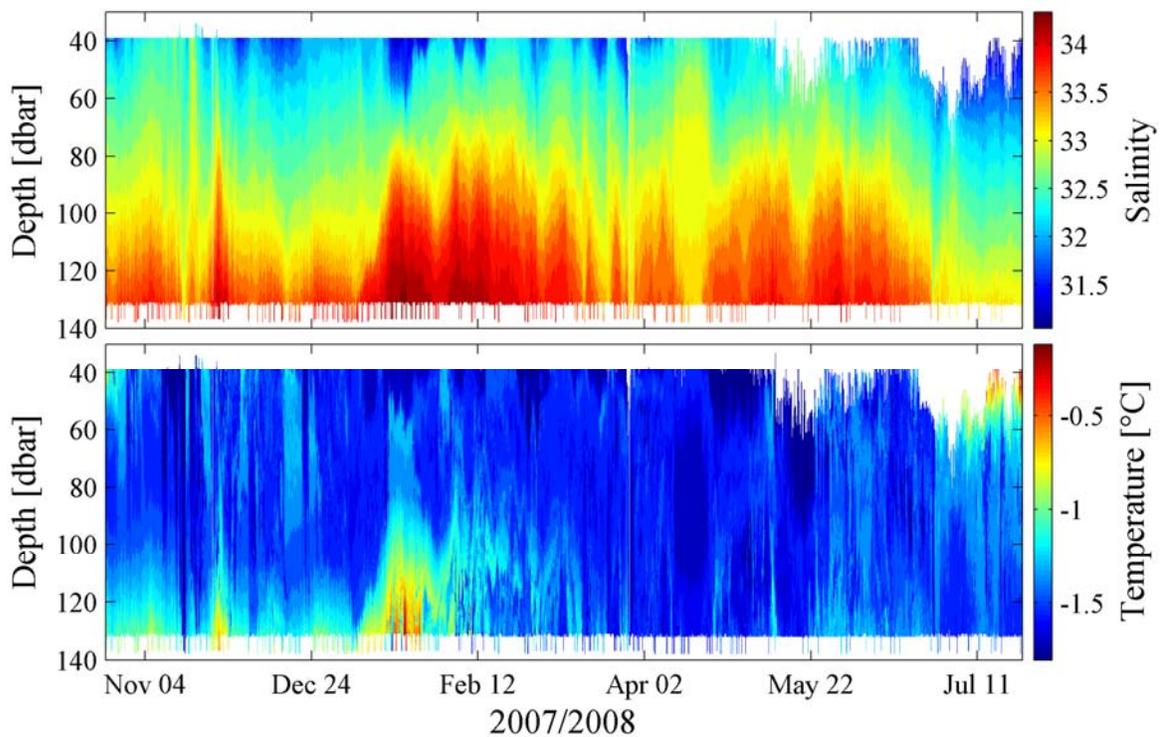


FIGURE 4. CA05MMP-07 MMP complete data set.

2. Mooring CA16MMP-07 (MMP #12138-03)

A total of 3301 profiles were recorded by the second MMP between October 22, 2007, and July 23, 2008. The time of the first and the last profiles completed by the MMP are in agreement with the deployment and recovery time of the mooring line. This gives no reason to suspect that there has been a major drift in the instrument's clock. No correction is recommended.

The pressure probe appears to have worked properly since the recorded values are consistent with the mooring design as well as with the other physical parameters recorded by the instrument. In addition, the probe recorded a pressure inferior to 1 dbar when the instrument was on the ship's deck after the recovery. As presented on figure 5, the vast majority of the profiles were completed between 40 and 190 dbar. However, there were a few times when the profilers had some difficulties reaching depths above 50 dbar (figure 6).

Most profiles were two hours apart except a few occasions when the interval was of four hours (figure 5). This suggests that some profiles are missing.

The temperature and the salinity recorded by the profiler were similar to the data recorded by CTD. No correction is recommended. A list of the CTD casts used for validation and the actual comparisons are presented in Appendices 2 and 3, respectively.

Figure 6 presents contours of the CA16MMP-07 salinity and temperature profiles for the complete sampling season.

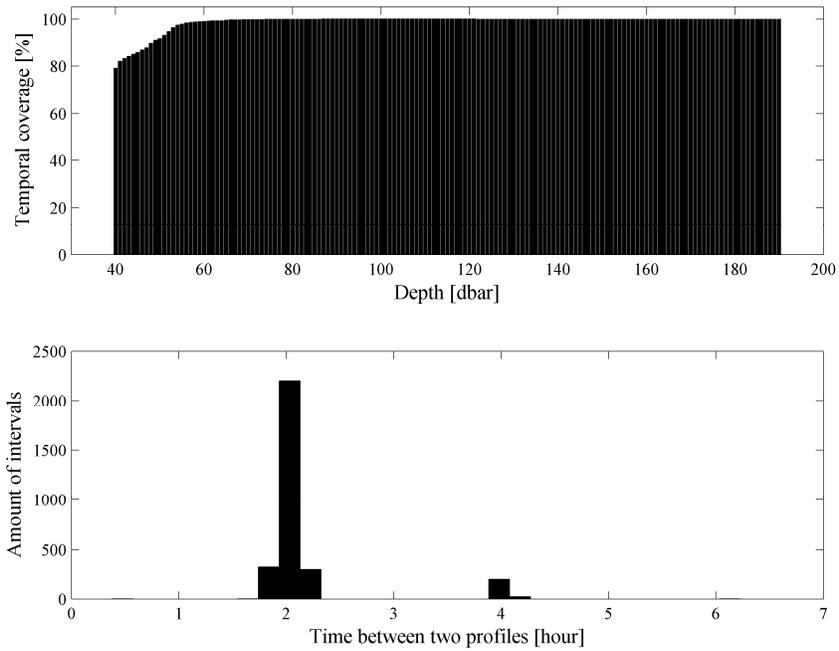


FIGURE 5. CA16MMP-07 MMP data statistics. (Top) The height of the black bars represents the proportion of the profiles that sampled the corresponding depth. (Bottom) Histogram of the period between two successive profiles.

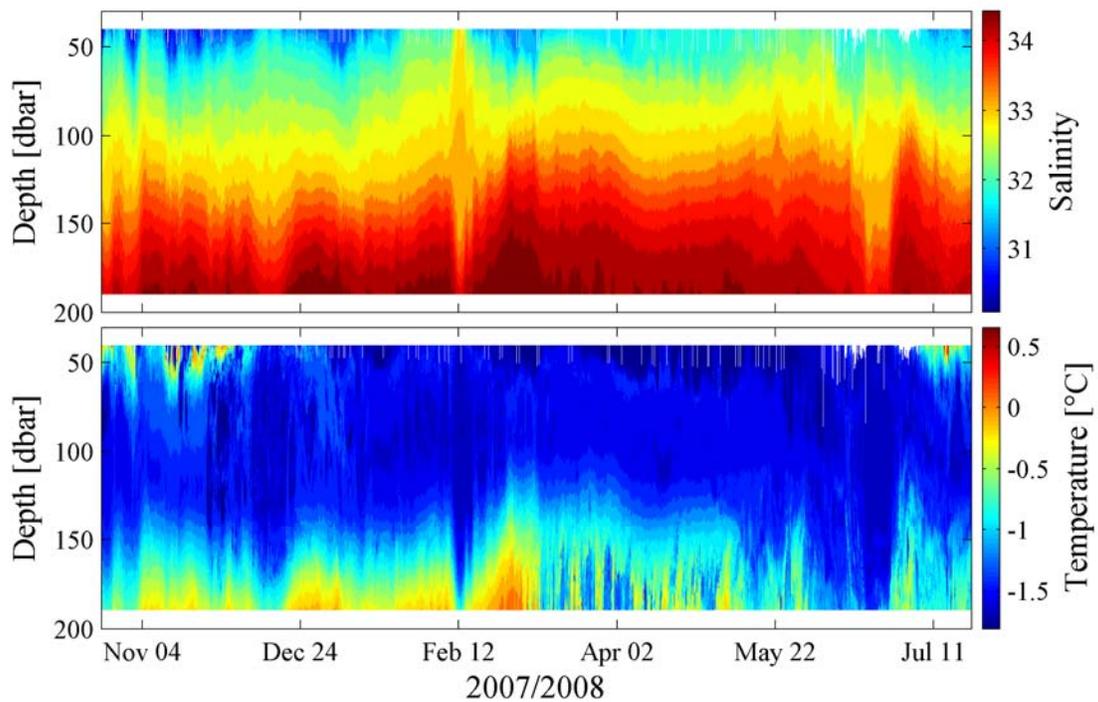


FIGURE 6. CA16MMP-07 MMP complete data set

SUMMARY

The ArcticNet 2007-2008 mooring deployment in the Canadian Arctic included six mooring lines for a total of 52 instruments, which were all recovered. This report addressed the quality control of the data from the two McLane Moored Profilers. The quality control of the other instruments is described in another quality control report (Boivert et al., 2011).

The data quality control process of the MMP data included metadata, calibration coefficients, depth and time validation, and the comparison of mooring data with Rosette-CTD data recorded around the same time.

All of the MMP data appear reliable and no correction is recommended. Most calibrations seemed adequate after comparison with the SBE-911 CTD mounted on the NGCC Amundsen rosette. However, it is important to mention that the temperature calibration for all the SBE 52-MP sensors was performed within an inappropriate range (+1 to +32°C) and the temperature data should be used with caution.

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- McLane Research Laboratories, 2008. McLane Moored Profiler User Manual, East Falmouth, USA, 389 pp.
- Rail M.E. and Y. Gratton. 2011. Distribution of Temperature and Salinity in the Canadian Arctic Archipelago during the 2007 and 2008 ARCTICNET Sampling Expeditions. Report No R0001243, INRS-ETE, Québec (Qc): vii + 65 pp.

APPENDIX 1: Instrument specifications.

SBE 52-MP	Range	Resolution	Accuracy
Temperature	-5 to +35 °C	0.001°C	0.002°C
Conductivity	0 to 9 S m ⁻¹	0.00005 S m ⁻¹	0.0003 S m ⁻¹
Pressure	0 to 600 m	0.001% of Range	0.1% of Range

APPENDIX 2: CTD casts used to validate the MMP salinity and temperature data.

Mooring instruments		CTD cast numbers							
CA05MMP-07	Instrument	MMP # 12138-03	0706070	0706071	0804133	0804134	0804142	0804143	0804144
	Day of 2007	296; 571	296	296	556	556	557	557	557
	Latitude [°N]	71.7534	71.281	71.3108	71.421	71.3604	71.2942	71.2907	71.2884
	Longitude [°E]	-126.5055	-127.5422	-127.6239	-127.3637	-127.5571	-127.7654	-127.7575	-127.7568
CA16MMP-07	Instrument	MMP # 12138-05	0706062	0706134	0707017	0707018	0708072	0708073	0804126
	Day of 2007	296; 570	295	307	327	327	377	377	555
	Latitude [°N]	71.7534	71.7555	71.7061	71.7395	71.727	71.7214	71.7252	71.6988
	Longitude [°E]	-126.5055	-126.5083	-126.1309	-126.6475	-126.7185	-126.2188	-126.2278	-126.4832

CTD cast numbers (continued)								
0804145	0804146	0805023						
557	557	572						
71.29	71.2843	71.4225						
-127.7665	-127.7504	-127.366						
0804127	0804128	0804129	0804147	0805014	0805015	0805016	0805017	0805018
556	556	556	558	570	570	570	570	570
71.7019	71.6947	71.7057	71.7027	71.7932	71.7459	71.7067	71.7006	71.6939
-126.4935	-126.4948	-126.4877	-126.1237	-126.4863	-126.4773	-126.6253	-126.6166	-126.6002

APPENDIX 3: CTD profile comparisons.

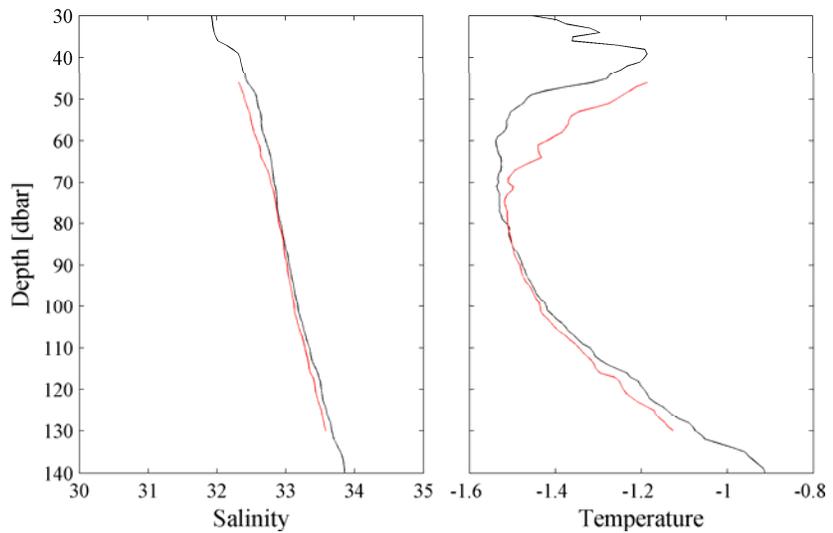
1. CA05MMP-07

CA05MMP-07
Position : 71.4033°N, -127.6352°E
Profile time : 23-Oct-2007, 04:00

ARCTICNET & CFL 0706 Station 408
CTD east number : 0706070
Position : 71.281°N, -127.5422°E
Profile time : 22-Oct,2007, 18:02
Depth : 198 m

Distance between the two profiles :
14 km

Time interval between the two profiles :
9:58 hours

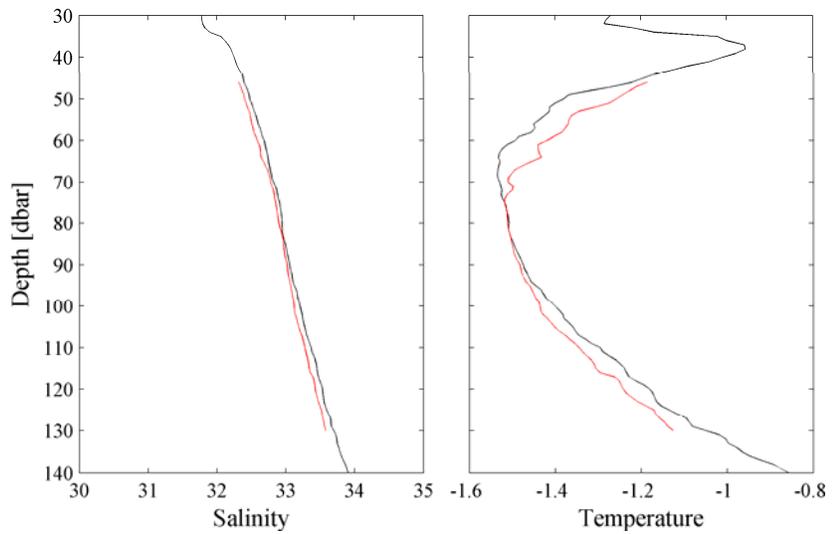


CA05MMP-07
Position : 71.4033°N, -127.6352°E
Profile time : 23-Oct-2007, 04:00

ARCTICNET & CFL 0706 Station 408
CTD east number : 0706071
Position : 71.3108°N, -127.6239°E
Profile time : 22-Oct,2007, 22:18
Depth : 193 m

Distance between the two profiles :
10 km

Time interval between the two profiles :
5:42 hours

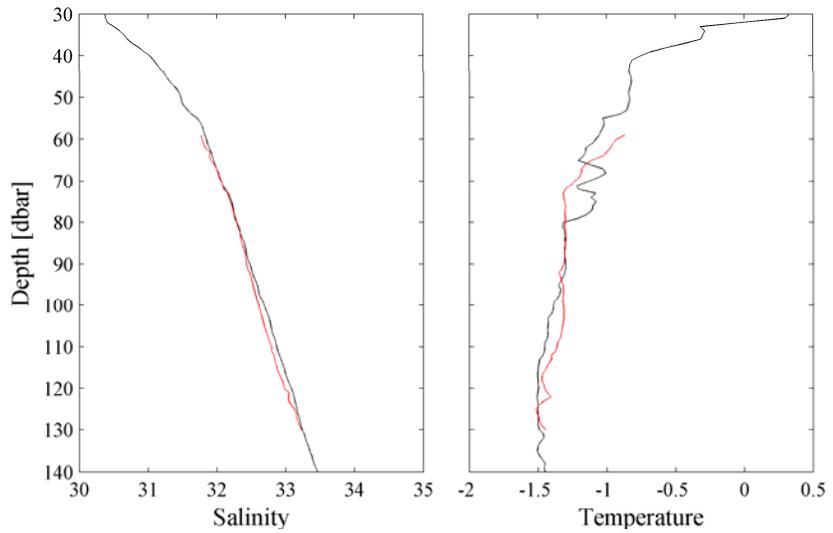


CA05MMP-07
 Position : 71.4033°N, -127.6352°E
 Profile time : 09-Jul-2008, 07:00

CFL 0804 Station 414
 CTD cast number : 0804133
 Position : 71.421°N, -127.3637°E
 Profile time : 09-Jul-2008, 07:08
 Depth : 305 m

Distance between the two profiles :
 10 km

Time interval between the two profiles :
 0.8 hours

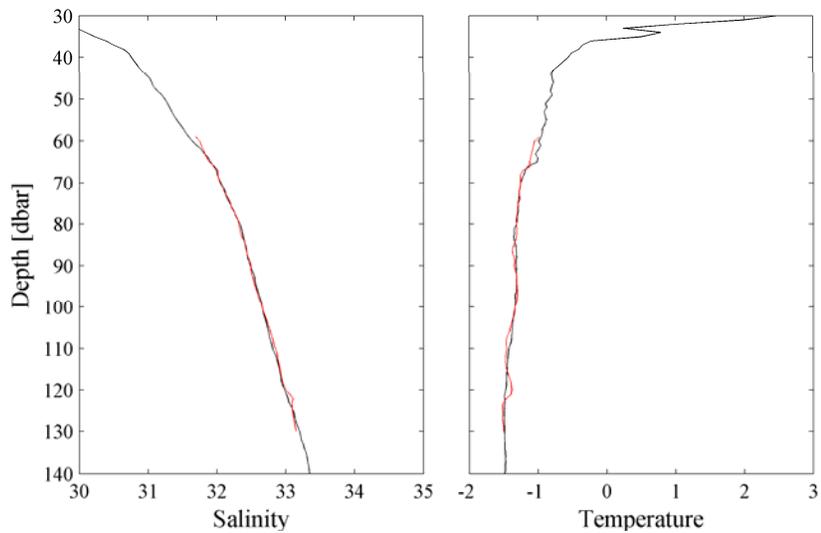


CA05MMP-07
 Position : 71.4033°N, -127.6352°E
 Profile time : 09-Jul-2008, 09:00

CFL 0804 Station 415
 CTD cast number : 0804134
 Position : 71.3604°N, -127.5571°E
 Profile time : 09-Jul-2008, 09:00
 Depth : 238 m

Distance between the two profiles :
 6 km

Time interval between the two profiles :
 0.1 hours

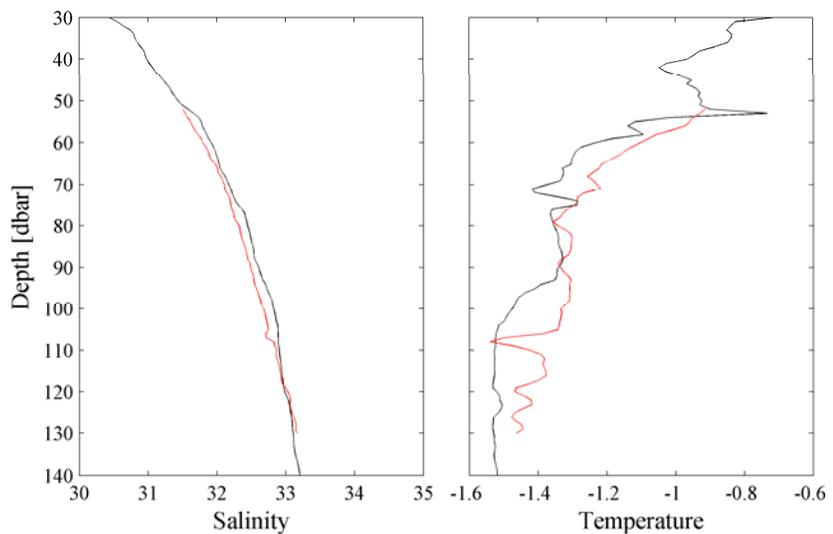


CA05MMP-07
 Position : 71.4033°N, -127.6352°E
 Profile time : 10-Jul-2008, 01:00

CFL 0804 Station 416
 CTD cast number : 0804142
 Position : 71.2942°N, -127.7654°E
 Profile time : 10-Jul-2008, 00:43
 Depth : 158 m

Distance between the two profiles :
 13 km

Time interval between the two profiles :
 0.18 hours

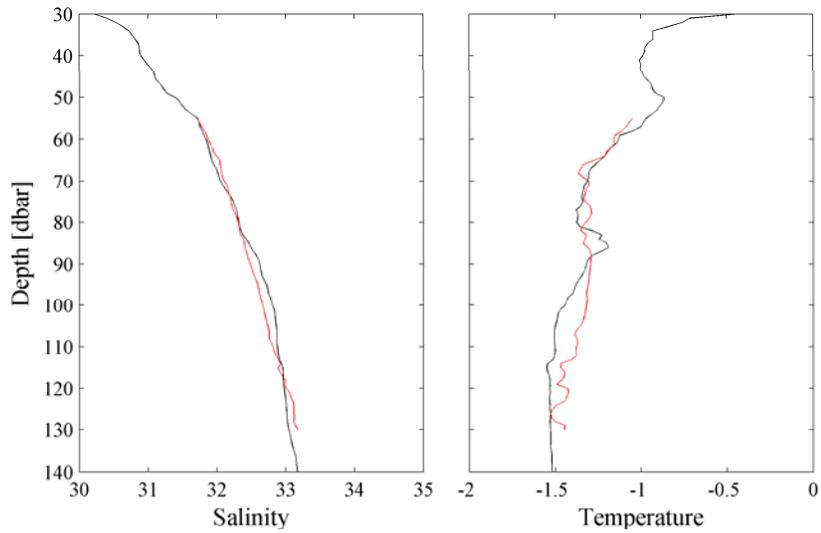


CA05MMP-07
Position : 71.4033°N, -127.6352°E
Profile time : 10-Jul-2008, 03:00

CFL 0804 Station 416
CTD cast number : 0804143
Position : 71.2907°N, -127.7575°E
Profile time : 10-Jul-2008, 03:48
Depth : 163 m

Distance between the two profiles :
13 km

Time interval between the two profiles :
0:49 hours

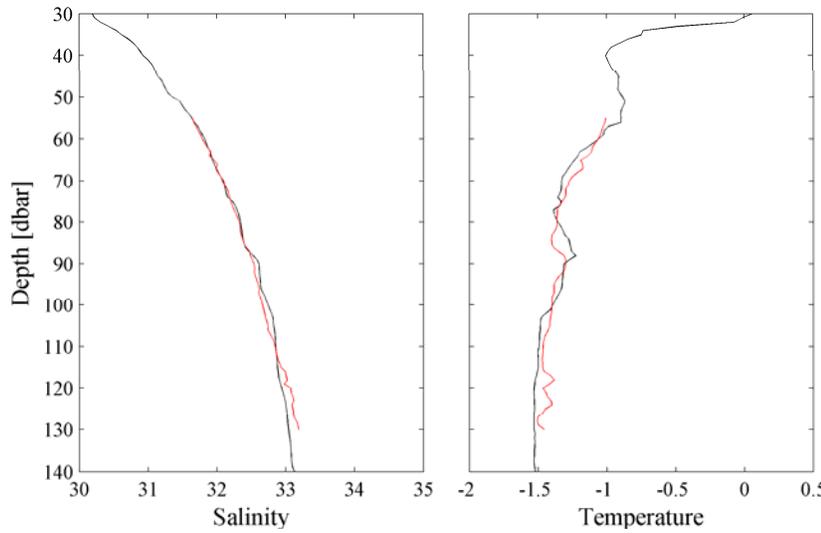


CA05MMP-07
Position : 71.4033°N, -127.6352°E
Profile time : 10-Jul-2008, 05:00

CFL 0804 Station 416
CTD cast number : 0804144
Position : 71.2884°N, -127.7568°E
Profile time : 10-Jul-2008, 05:50
Depth : 160 m

Distance between the two profiles :
13 km

Time interval between the two profiles :
0:49 hours

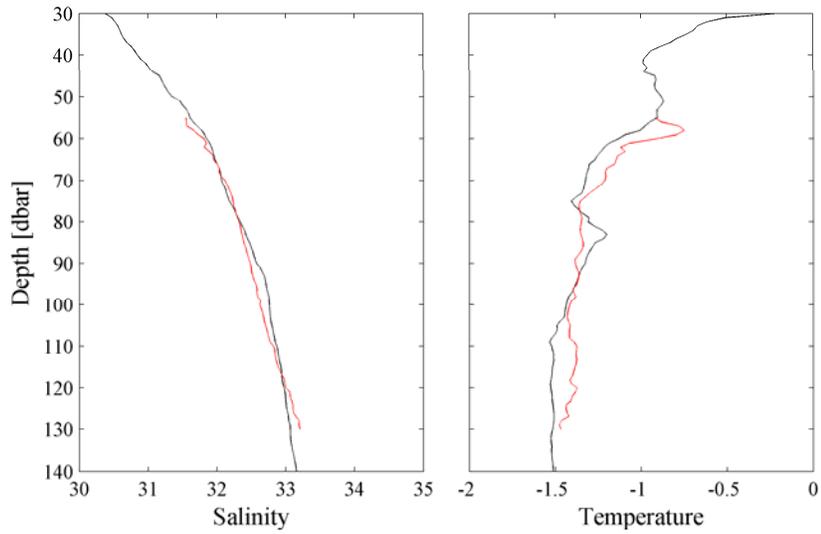


CA05MMP-07
Position : 71.4033°N, -127.6352°E
Profile time : 10-Jul-2008, 11:00

CFL 0804 Station 416
CTD cast number : 0804145
Position : 71.29°N, -127.7665°E
Profile time : 10-Jul-2008, 08:04
Depth : 156 m

Distance between the two profiles :
13 km

Time interval between the two profiles :
2:56 hours

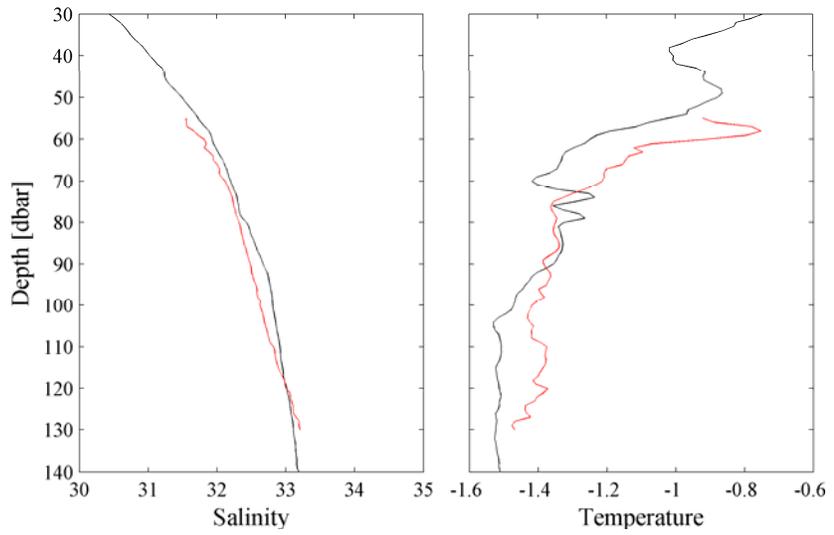


CA05MMP-07
Position : 71.4033°N, -127.6352°E
Profile time : 10-Jul-2008, 11:00

CFL 0804 Station 416
CTD cast number : 0804146
Position : 71.2843°N, -127.7504°E
Profile time : 10-Jul-2008, 11:48
Depth : 160 m

Distance between the two profiles :
14 km

Time interval between the two profiles :
0:48 hours

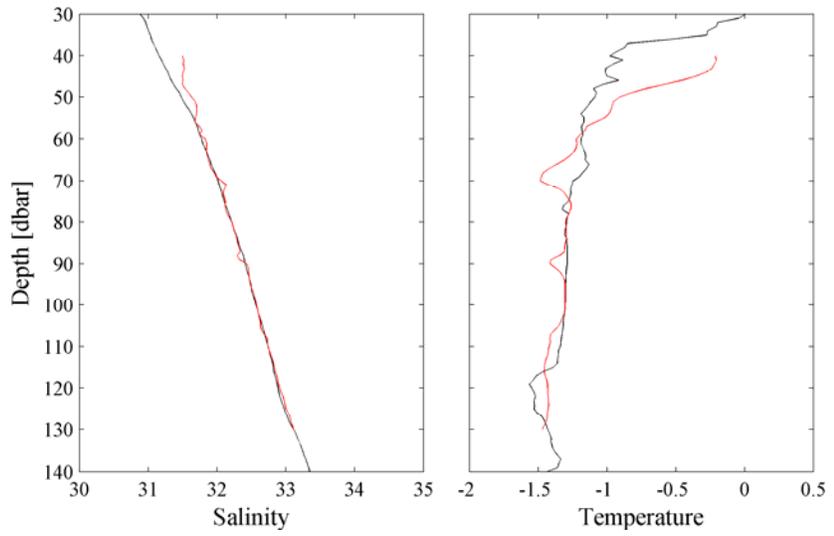


CA05MMP-07
Position : 71.4033°N, -127.6352°E
Profile time : 24-Jul-2008, 11:00

CFL 0805 Station 414-10a
CTD cast number : 0805023
Position : 71.4225°N, -127.366°E
Profile time : 24-Jul-2008, 21:28
Depth : 305 m

Distance between the two profiles :
10 km

Time interval between the two profiles :
10:27 hours



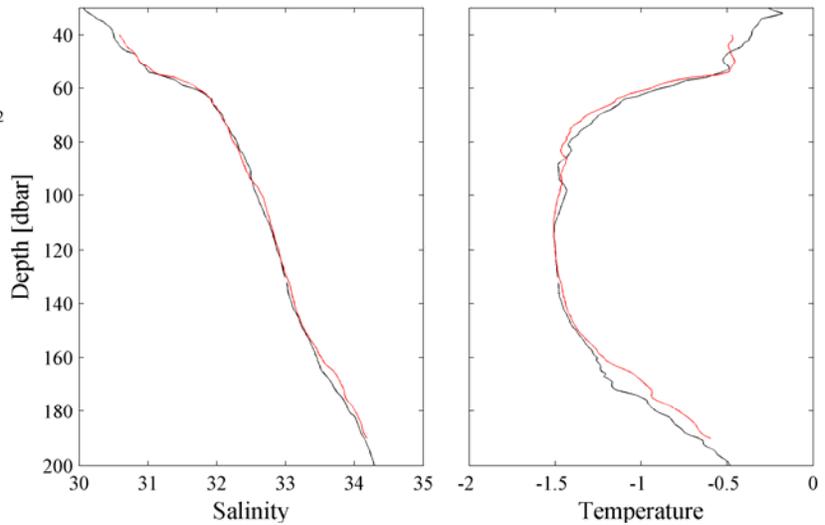
2. CA16MMP-07

CA16MMP-07
 Position : 71.7534°N, -126.5055°E
 Profile time : 22-Oct-2007, 02:00

ARCTICNET & CFL 0706 Station MW-2
 CTD cast number : 0706062
 Position : 71.7555°N, -126.5083°E
 Profile time : 21-Oct,2007, 19:01
 Depth : 364 m

Distance between the two profiles :
 0 km

Time interval between the two profiles :
 6:59 hours

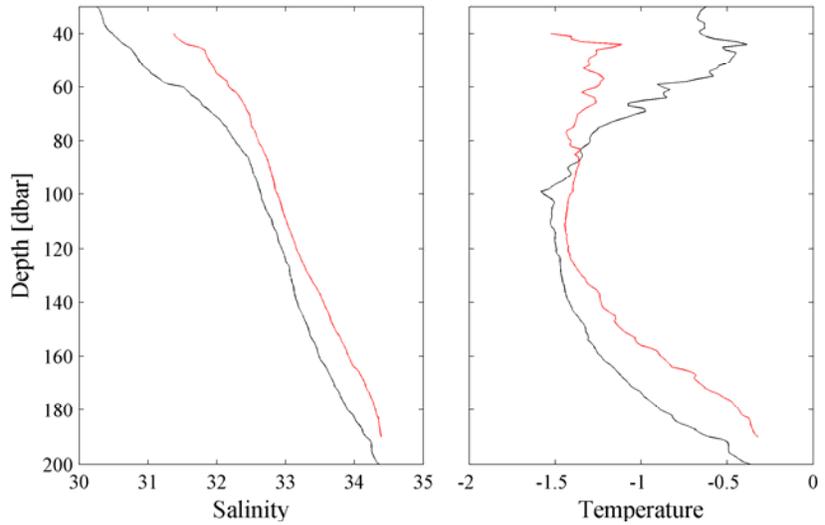


CA16MMP-07
 Position : 71.7534°N, -126.5055°E
 Profile time : 03-Nov-2007, 12:00

ARCTICNET & CFL 0706 Station 1900
 CTD cast number : 0706134
 Position : 71.7061°N, -126.1309°E
 Profile time : 03-Nov,2007, 11:09
 Depth : 230 m

Distance between the two profiles :
 14 km

Time interval between the two profiles :
 0:50 hours

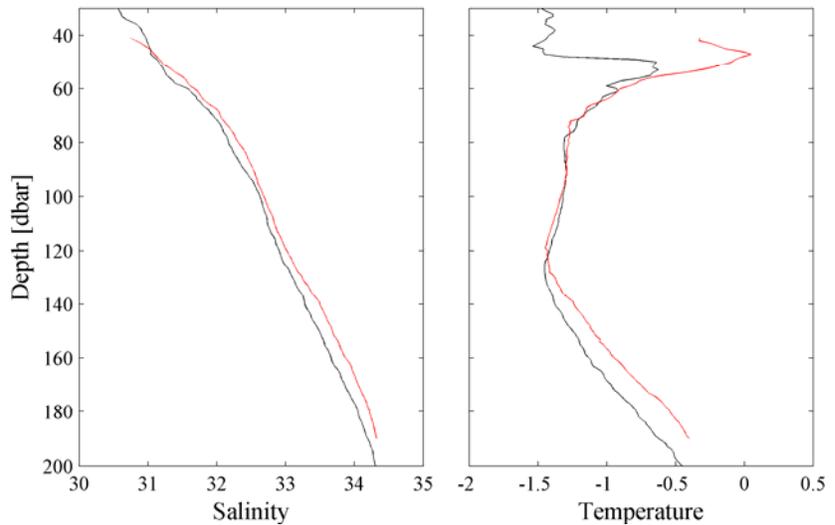


CA16MMP-07
 Position : 71.7534°N, -126.5055°E
 Profile time : 22-Nov-2007, 22:00

CFL 0707 Station 437
 CTD cast number : 0707017
 Position : 71.7395°N, -126.6475°E
 Profile time : 22-Nov,2007, 21:33
 Depth : 420 m

Distance between the two profiles :
 5 km

Time interval between the two profiles :
 0:26 hours

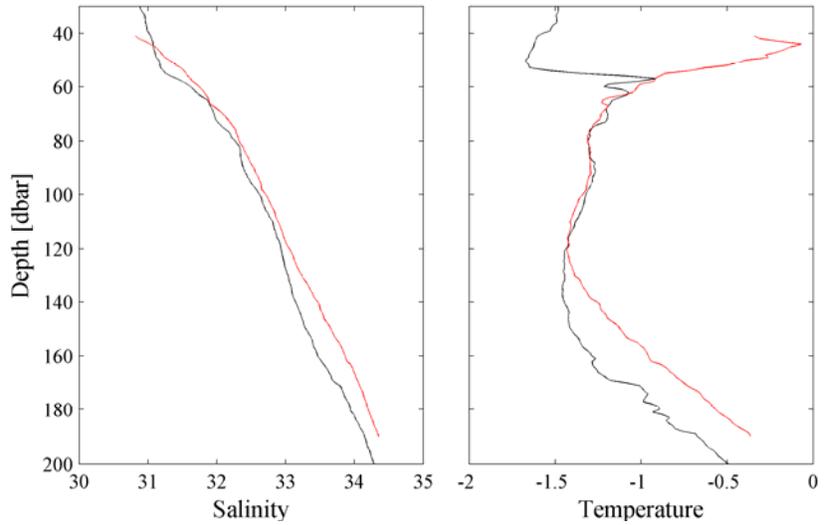


CA16MMP-07
Position : 71.7534°N, -126.5055°E
Profile time : 23-Nov-2007, 02:00

CFL 0707 Station 437
CTD cast number : 0707018
Position : 71.727°N, -126.7185°E
Profile time : 23-Nov-2007, 01:21
Depth : 443 m

Distance between the two profiles :
8 km

Time interval between the two profiles :
0:38 hours

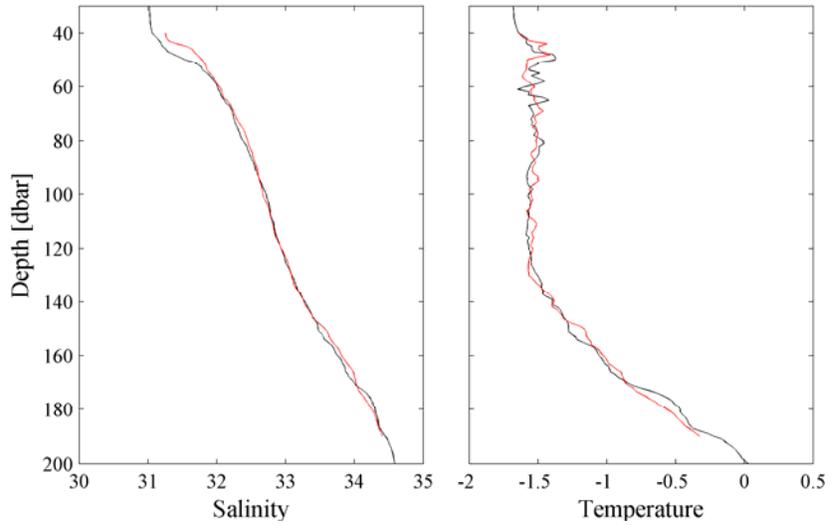
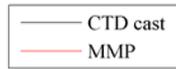


CA16MMP-07
Position : 71.7534°N, -126.5055°E
Profile time : 11-Jan-2008, 14:00

CFL 0708 Station 2008-14D
CTD cast number : 0708072
Position : 71.7214°N, -126.2188°E
Profile time : 11-Jan-2008, 14:09
Depth : 235 m

Distance between the two profiles :
11 km

Time interval between the two profiles :
0:10 hours

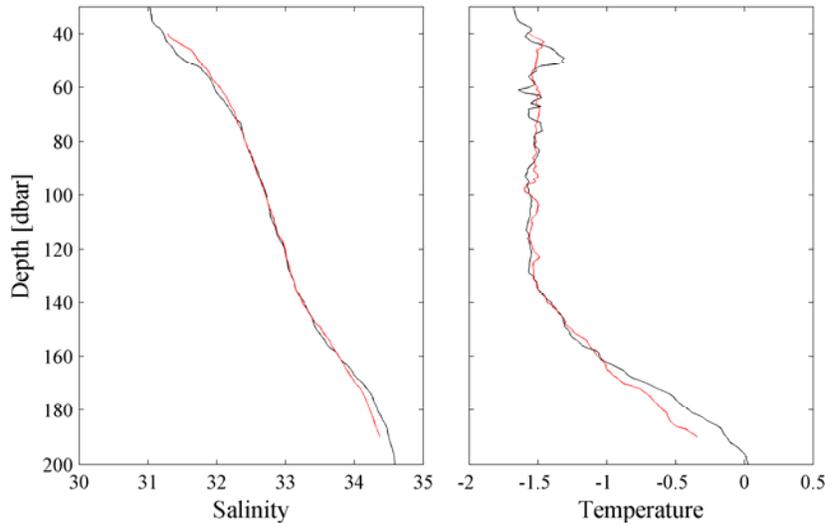


CA16MMP-07
Position : 71.7534°N, -126.5055°E
Profile time : 11-Jan-2008, 18:00

CFL 0708 Station 2008-14D
CTD cast number : 0708073
Position : 71.7252°N, -126.2278°E
Profile time : 11-Jan-2008, 17:34
Depth : 243 m

Distance between the two profiles :
10 km

Time interval between the two profiles :
0:26 hours

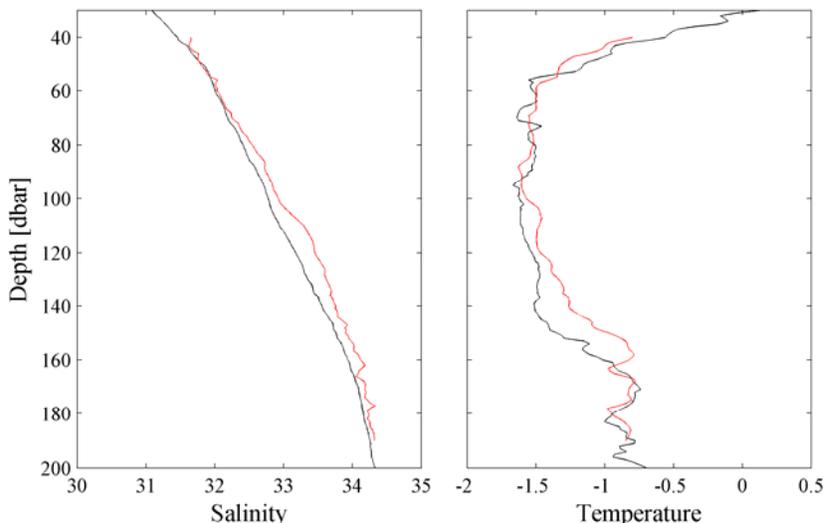


CA16MMP-07
Position : 71.7534°N, -126.5055°E
Profile time : 08-Jul-2008, 10:00

CFL 0804 Station 410
CTD cast number : 0804126
Position : 71.6988°N, -126.4832°E
Profile time : 08-Jul-2008, 09:13
Depth : 400 m

Distance between the two profiles :
6 km

Time interval between the two profiles :
0:46 hours

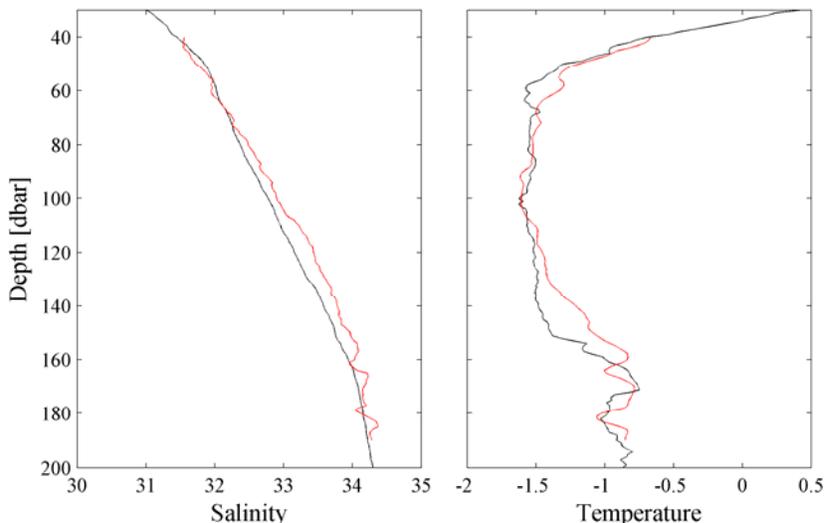


CA16MMP-07
Position : 71.7534°N, -126.5055°E
Profile time : 08-Jul-2008, 12:00

CFL 0804 Station 410
CTD cast number : 0804127
Position : 71.7019°N, -126.4935°E
Profile time : 08-Jul-2008, 12:48
Depth : 410 m

Distance between the two profiles :
6 km

Time interval between the two profiles :
0:48 hours

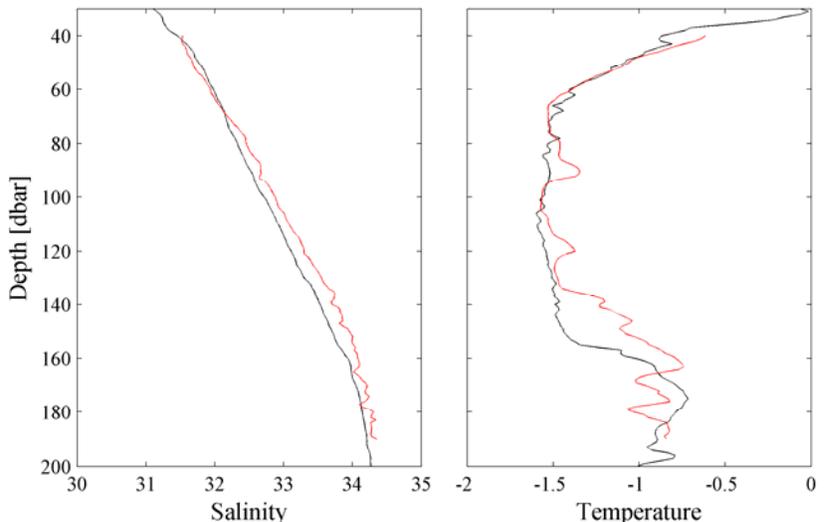


CA16MMP-07
Position : 71.7534°N, -126.5055°E
Profile time : 08-Jul-2008, 16:00

CFL 0804 Station 410
CTD cast number : 0804128
Position : 71.6947°N, -126.4948°E
Profile time : 08-Jul-2008, 15:25
Depth : 412 m

Distance between the two profiles :
7 km

Time interval between the two profiles :
0:35 hours

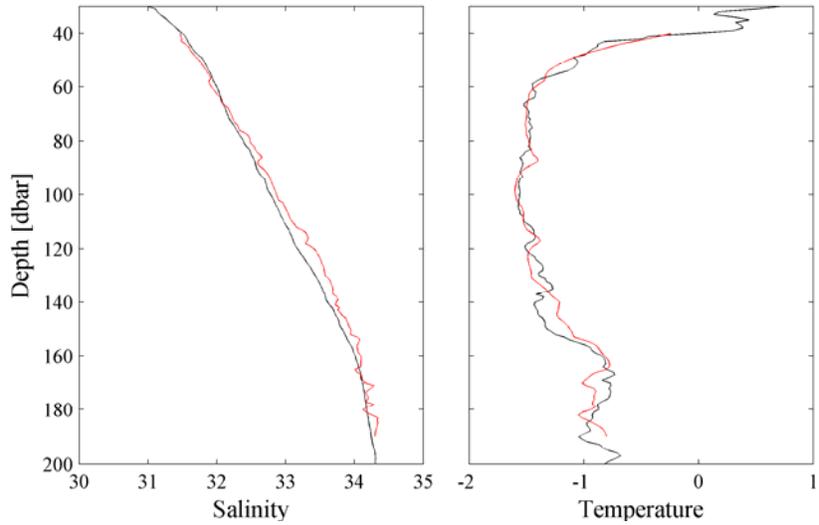


CA16MMP-07
 Position : 71.7534°N, -126.5055°E
 Profile time : 08-Jul-2008, 20:00

CFL 0804 Station 410
 CTD cast number : 0804129
 Position : 71.7057°N, -126.4877°E
 Profile time : 08-Jul-2008, 19:03
 Depth : 395 m

Distance between the two profiles :
 5 km

Time interval between the two profiles :
 0:57 hours

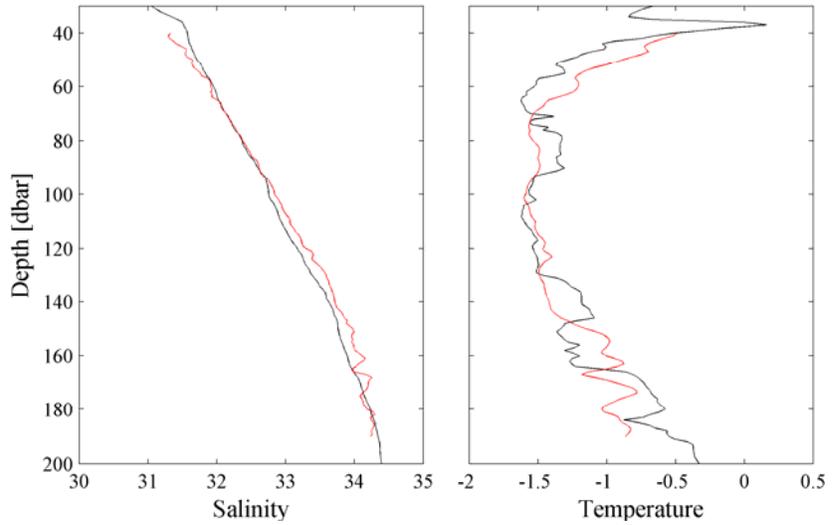


CA16MMP-07
 Position : 71.7534°N, -126.5055°E
 Profile time : 10-Jul-2008, 22:00

CFL 0804 Station 1900
 CTD cast number : 0804147
 Position : 71.7027°N, -126.1237°E
 Profile time : 10-Jul-2008, 21:39
 Depth : 236 m

Distance between the two profiles :
 14 km

Time interval between the two profiles :
 0:21 hours

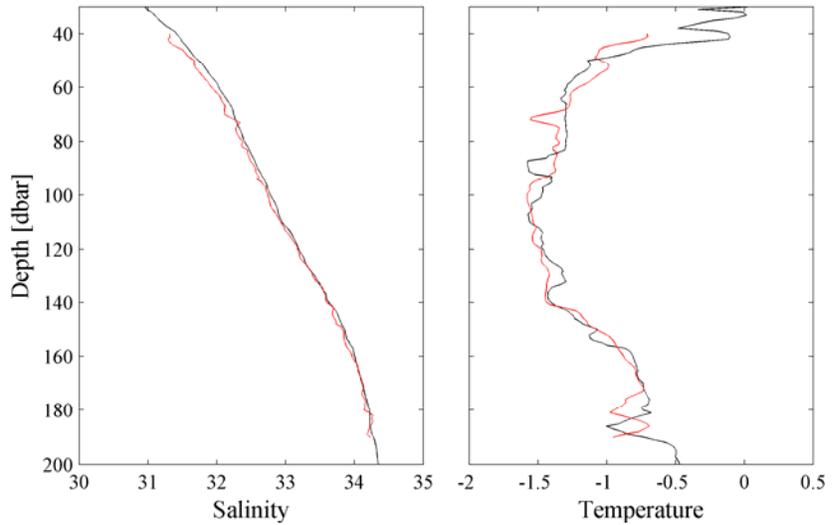


CA16MMP-07
 Position : 71.7534°N, -126.5055°E
 Profile time : 22-Jul-2008, 20:00

CFL 0805 Station CA16-07
 CTD cast number : 0805014
 Position : 71.7932°N, -126.4863°E
 Profile time : 22-Jul-2008, 20:17
 Depth : 297 m

Distance between the two profiles :
 4 km

Time interval between the two profiles :
 0:17 hours

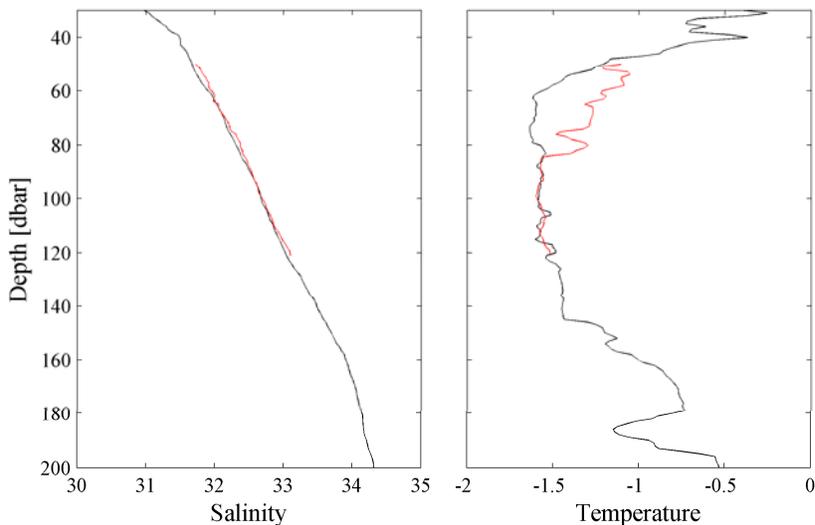


CA16MMP-07
Position : 71.7534°N, -126.5055°E
Profile time : 23-Jul-2008, 00:00

CFL 0805 Station CA16MMP-07
CTD cast number : 0805015
Position : 71.7459°N, -126.4773°E
Profile time : 23-Jul-2008, 01:39
Depth : 351 m

Distance between the two profiles :
1 km

Time interval between the two profiles :
1:39 hours

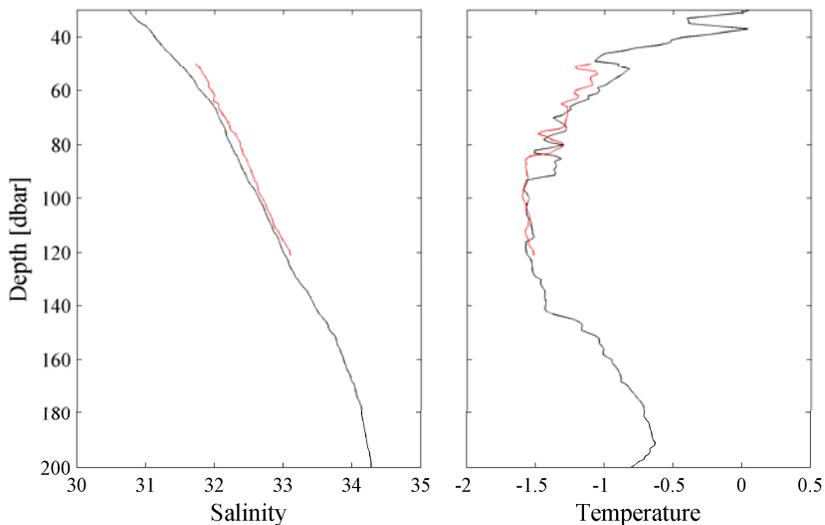


CA16MMP-07
Position : 71.7534°N, -126.5055°E
Profile time : 23-Jul-2008, 00:00

CFL 0805 Station 437
CTD cast number : 0805016
Position : 71.7067°N, -126.6253°E
Profile time : 23-Jul-2008, 05:42
Depth : 438 m

Distance between the two profiles :
7 km

Time interval between the two profiles :
5:41 hours

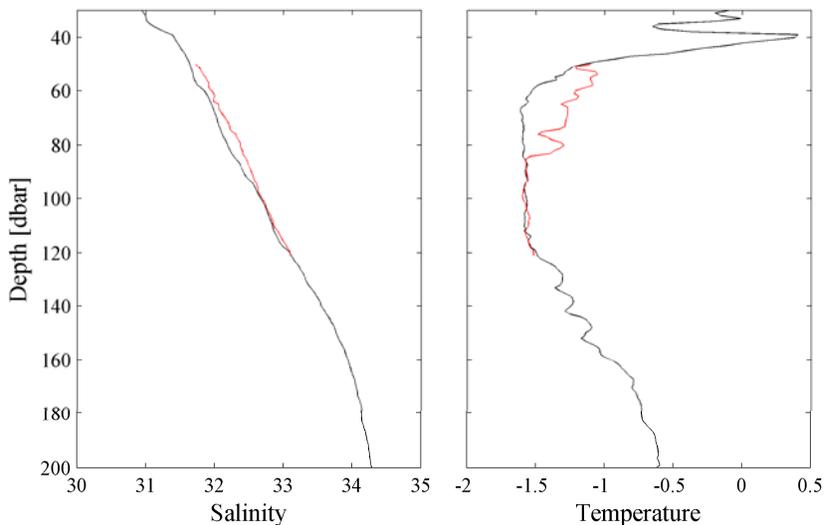


CA16MMP-07
Position : 71.7534°N, -126.5055°E
Profile time : 23-Jul-2008, 00:00

CFL 0805 Station 437
CTD cast number : 0805017
Position : 71.7006°N, -126.6166°E
Profile time : 23-Jul-2008, 08:32
Depth : 440 m

Distance between the two profiles :
7 km

Time interval between the two profiles :
8.32 hours



CA16MMP-07
Position : 71.7534°N, -126.5055°E
Profile time : 23-Jul-2008, 00:00

CFL 0805 Station 437
CTD cast number : 0805018
Position : 71.6939°N, -126.6002°E
Profile time : 23-Jul-2008, 10:23
Depth : 441 m

Distance between the two profiles :
7 km

Time interval between the two profiles :
10.23 hours

