

## **2014 Bioness Data Processing Notes**

Last updated on 27 March 2015

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## 1. Introduction

The Canadian research icebreaker CCGS *Amundsen* is equipped with BIONESS (Bedford Institute of Oceanography Net and Environmental Sampling System). It is a multiple-net sampler for zooplankton and micronekton (pelagic animals 1-10 cm in length). It uses a new design concept, with nets arranged horizontally rather than vertically, as in earlier multiple-net samplers. The 9 one metre-square nets open sequentially and are towed from a ship at a speed of ~3 knots on a conductor cable that transmits and receives information. The sampler supports sensors for temperature, conductivity, depth, illumination, pitch, roll and net closure. During the down cast, no net is open. During the up cast, launchings of the nets are done consecutively.

Table 1: Instruments and probes

Instrument	Company	Unit	Serial number	Calibration date
Temperature	SeaBird	°C	19P32436-4433	2013-12-09
Conductivity	SeaBird	mS/cm	19P32436-4433	2013-12-09
Pressure	SeaBird	db	19P32436-4433	2013-12-09

Table 2: Recorded variables

Instrument	Company	Measurement	Specification	
SBE 19 Plus SEACAT Profiler	SeaBird	Temperature	Range (°C)	-5 to +32
			Initial Accuracy (°C)	0.005
			Resolution (°C)	0.0001
		Conductivity	Range (mS/cm)	0 to 90
			Initial Accuracy (mS/cm)	0.005
			Resolution (mS/cm)	0.001
		Pressure	Range (db)	0 to 7000
			Initial Accuracy (% f.s.)	0.1
			Resolution (db)	0.002

## **2. Processing protocol**

The following treatment steps were performed using the script:

Processing\_Amundsen\_Bioness.m developed in Matlab in Amundsen Science offices.

### **A: Data reading**

#### **A1: Read CTD rosette**

From processed Rosette data (files \*.int, see Rosette data processing report by the Amundsen Science technical team).

#### **A2: Read TSG data**

From processed TSG (Thermosalinograph) data processing (files \*.int, see TSG processing report – Amundsen technical team).

#### **A3: Read CTD Bioness Profile**

From Bioness raw data (files \*.DAT and \*.RAW)

#### **A4: Read Bioness net launch**

From Bioness raw data (\*.ECH files). This file gives the nets launching time.

### **B: Flag and Processing**

The processing steps in section B are sequentially applied on each cast of a given leg.

#### **B.1: Flag of out-of-range values**

For Pressure, Conductivity and Temperature values, this flag checks out of range values (See limits in section 3 “Processing characteristics”).

#### **B.2: Flag of spiking values**

For each measurement (Temperature, Conductivity), the flag checks spike values (See thresholds in section 3 “Processing characteristics”):

$|V2 - (V3 + V1) / 2| - |V1 - V3| / 2 > \text{threshold}$       Where V1, V2 and V3 are 3 consecutive values.

#### **B.3: Remove surface data**

All data above 2db depth pressure are removed.

#### **B.4: Processing of nets data**

For each net, the maximum depth for opening the net, the total opening duration and the total volume collected are calculated. The volume is calculated from the net surface ( $1\text{m}^2$ ), the horizontal distance (from the NAV vessel speed – see Readme file) and a net input flow ratio of 90% ( $100 \times \text{flow in} / \text{flow ext}$ ).

**Note:** ArcticNet and Amundsen Science are not responsible for water volume calculation. These values are only provided as general information.

#### **B.5: Low pass filter (SBE data processing toolbox)**

A Low pass filter is applied on the temperature and conductivity data. The time constant is fixed at 0.5s to keep the accuracy of the measures while allowing for further filtering on averaged bin performed in B.7.

#### **B.6: Align CTD filter (SBE data processing toolbox)**

The temperature and conductivity sensors don't have the same time response. The Align sensor filter aligns the data by time, relative to pressure. This ensures that calculations of salinity and other derived parameters are made using measurements from the same parcel of water. The best time offset correction is the following:

Temperature: + 0.20s

#### **B.7: Bin averaged filter (SBE data processing toolbox)**

The bin Average filter averages data, using averaging intervals based on the pressure range. The bin sizes are fixed at one meter.

#### **B.8: Calculation of the derived parameters**

These calculations use pressure, temperature, and conductivity to compute the following oceanographic parameters: salinity, density, freezing point and depth (sea water toolbox V3.2 documentation from CSIRO).

#### **B.9: CTD-Rosette co-localization**

Most of the time, Bioness deployments are performed during a station and there are always one or several CTD-Rosette casts done at one station. Therefore, comparisons are often made inside small time and distance intervals. Bioness casts are co-localized with CTD-Rosette casts, which are within 5 hours and 5.4 NM (Nautical Mile) away.

### **B.10: TSG co-localization**

Each cast beginning and ending are co-localised with TSG data.

### **B.11: Manual data check**

A graphic tool box allows the analyst to check, compare and flag the measurements by selecting values directly on screen for the following variables:

- Temperature profile: Bioness down cast, Bioness up cast, co-localized CTD-Rosette down cast, colocalized TSG and freezing point.
- Salinity profile: Bioness down cast, Bioness up cast, co-localized CTD-Rosette down cast and co-localized TSG.
- Density: Down and up cast
- $d(\text{density})/d(\text{pressure})$ : Down and up cast
- Open net number: Down and up cast

See annex 3.

## **C: Correction and Inter-comparison**

The processing steps in section C are applied on each leg.

### **C.1: Rosette inter-comparison**

Using the co-localization performed in B9, the differences between Bioness up cast and of the CTD-Rosette are calculated for temperature data and salinity data (below 40-meter depth) for each cast. Then, the median of the differences and the standard deviation are determined on all the legs. Final bias is determined by judgement of the analyst according to the number of comparisons and casts, and if the standard deviations is reasonable. Final bias is finally removed from the data (for temperature and/or salinity).

See plot annex 1

## **D: Output Data**

For each cast, two data files are created: one for the profile data (up cast only) and one for the net data (up cast only).

### **D.1: Profile data**

Data are saved in text format with the extension \*.int. One folder per leg and one file per cast are created.

Table 3: Profile data file format

Col	Content	Format	Units
1	Pressure	F10.2	db
2	Temperature	F10.2	deg C
3	Salinity	F10.2	psu
4	open net number	F10.2	Nb

NaN stands for: Not a Number. It indicates that no data was recorded or that the data was flagged and mistrusted.

For open net: number column 0 stands for: No net open.

### D.2: Data net

Data are saved in text format with the extension \*\_Net.int. One folder per leg and one file per cast are created

Table 4: Data net file format

Col	Content	Format	Units
1	Net	F5.0	nb
2	Open pressure	F10.2	db
3	Close pressure	F10.2	db
4	Total opening duration	F10.2	s
5	Total volume sampled	F10.2	m <sup>3</sup>
6	Temperature averaged	F10.2	deg C
7	Temperature standard deviation	F10.2	deg C
8	Salinity averaged	F10.2	psu
9	Salinity standard deviation	F10.2	psu

NaN stands for: Not a Number. It indicates that no data was recorded or that the data was flagged and mistrusted.

### 3. Processing characteristics

- Leg 1

Amundsen Bioness data processing

Amundsen\_2014001

Year: 2014

Leg: 1

Processing date: 12-Mar-2015

#### //////// Limits and Thresholds Settings //////////

B1: -10.00 db - Minimum pressure

B1: 7000.00 db - Maximum pressure

B1: -3.00 °C - Minimum temperature

B1: 30.00 °C - Maximum temperature

B1: 2.00 mS/cm - Minimum salinity

B1: 75.00 mS/cm - Maximum salinity

B2: 0.00 °C/m - Temperature limit spike

B2: 0.01 psu/m - Salinity limit spike

B5: 81.00 % - Net input flow ratio

#### //////// Processing //////////

----- Inter-comparison-----

C1: Bias applied on Salinity

Constant bias correction: 0.000 psu

C1: Bias applied on Temperature

Constant bias correction: 0.000 °C

#### ///// Cast List /////

Cast	File_name	Date	Hour
1	ArcticNet2014_St323_20140717.DAT	18-juil-14	01:33:29
2	ArcticNet2014_St305A_20140722.DAT	22-juil-14	23:46:42
3	ArcticNet2014_St115_20140731.DAT	31-juil-14	00:21:10
4	ArcticNet2014_st108_20140801.DAT	01-Aug-2014	02:45:43
5	ArcticNet2014_st101_20140802.DAT	02-Aug-2014	01:48:40
6	ArcticNet2014_stKEN1_20140803.DAT	03-Aug-2014	14:37:32
7	Arcticnet2014_st314_12082014.DAT	12-Aug-2014	15:11:33



○ Leg 2

Amundsen Bioness data processing

Amundsen\_2014002

Year: 2014

Leg: 2

Processing date: 12-Mar-2015

//////// Limits and Thresholds Settings //////////

B1: -10.00 db - Minimum pressure

B1: 7000.00 db - Maximum pressure

B1: -3.00 °C - Minimum temperature

B1: 30.00 °C - Maximum temperature

B1: 2.00 mS/cm - Minimum conductivity

B1: 75.00 mS/cm - Maximum conductivity

B2: 0.00 °C/m - Temperature limit spike (4Hz)

B2: 0.01 mS/cm - Conductivity limit spike (4Hz)

B6: 81.00 % - Net input flow ratio

//////// Processing //////////

----- Inter-comparison-----

C1: Bias applied on Salinity

Constant bias correction: 0.000 psu

C1: Bias applied on Temperature

Constant bias correction: 0.000 °C

///// Cast List /////

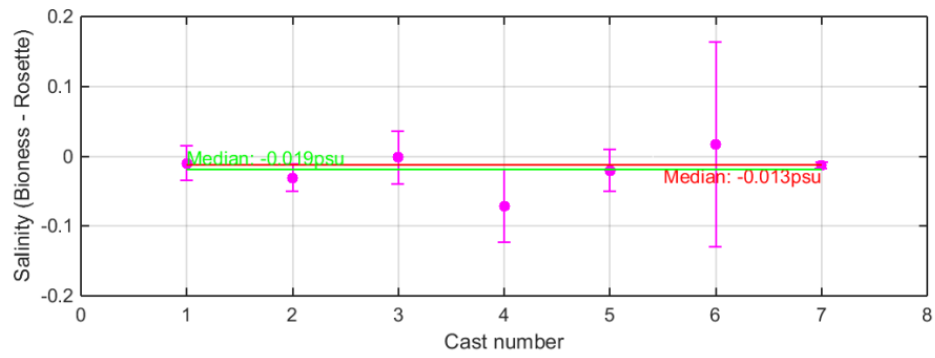
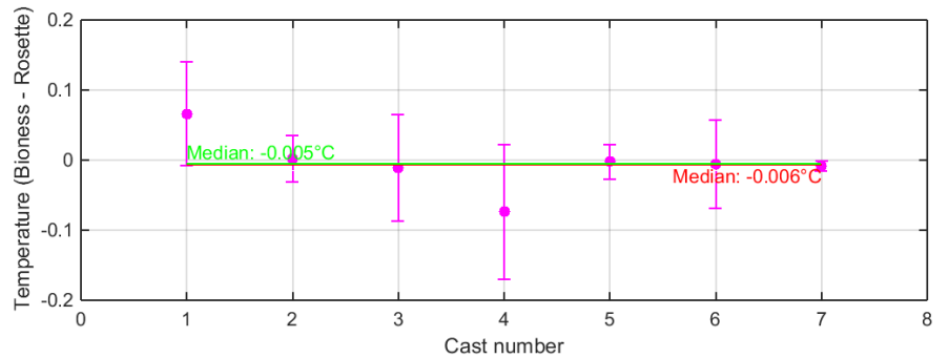
Cast	File_name	Date	Hour
1	ArcticNet2014_Stn408_20140820.DAT	20-Aug-2014	17:28:37
2	ArcticNet2014_Stn421_20140824.DAT	24-Aug-2014	07:48:47

#### **4. Data quality discussion**

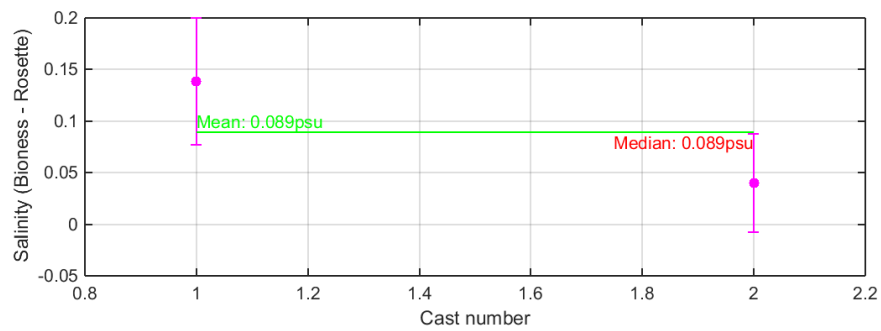
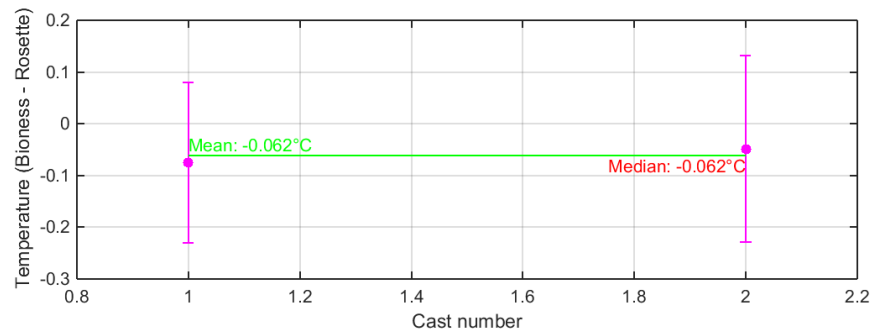
- Temperature uncertainty is in the order of 0.01°C or better. Inter-comparisons with the co-localised Rosette will provide some validation for the Bioness temperature data.
- Salinity uncertainty is in the order of 0.01psu (good Rosette inter-comparison) but can increase up to 0.03psu during high vertical gradient
- The calculation of the sampling volume of the nets is approximated. The Ratio, the tilt and the traveled distance are not exactly known. For example, the used traveled distance used in the calculation does not take into account cable winding. ArcticNet and Amundsen Science are not responsible for these calculations. Each user should verify the volume values.

## Annex 1: Inter-comparison plot

### ○ Leg 1

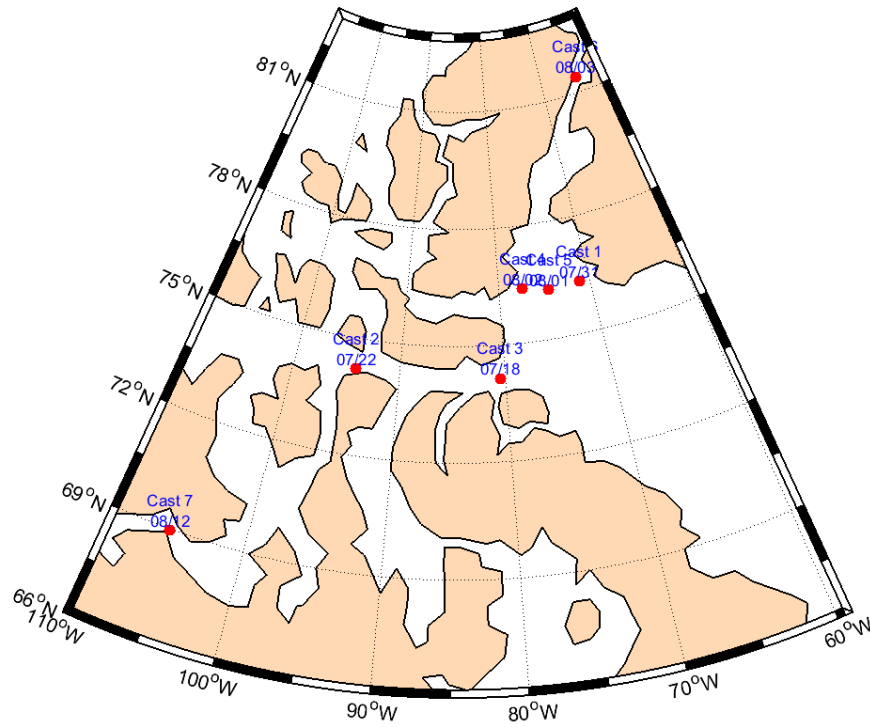


### ○ Leg 2

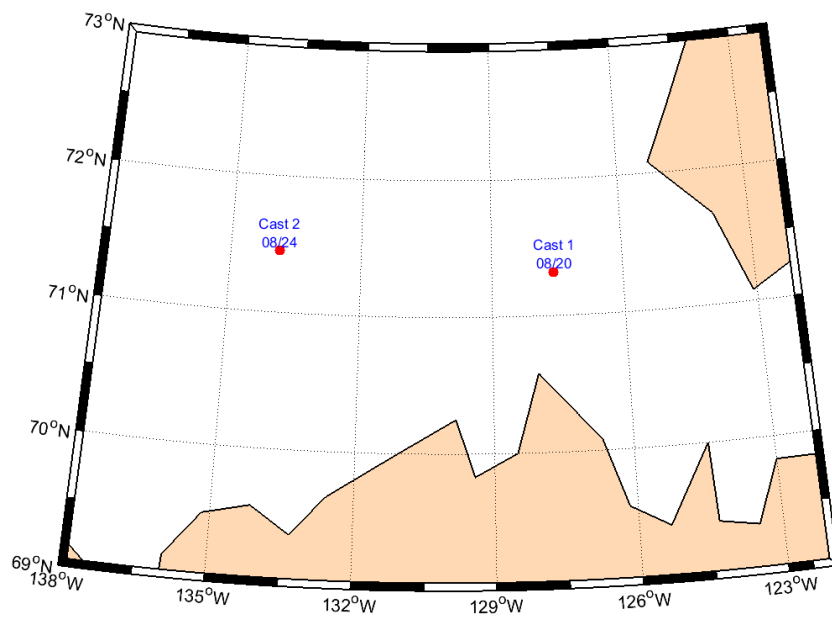


## Annex 2: Mapping

### ○ Leg 1



### ○ Leg 2



### Annex 3: Data visualizer

