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QA Summary of Surveillance Cruise 2009195-010-006

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1. Scope

This internal document describes the details on the QA assessment of shipboard seabird profiles, manual lab measurements, and bridge data collected in **Lake Winnipeg** on the **2009195-010-006 Research Consortium Cruise**. A total of **57** stations were visited that commenced on **2009-07-14** and ended on **2009-08-02**. The QA officer assessed the quality of the shipboard data and prepared it for the principle investigator on **2021-04-30**.

2. Terms and Definitions

Cast	The act of collecting one depth-profile with a sonde onboard a research ship.
Cruise	A trip travelled through a body of water by ship where depth-profiles are collected at pre-arranged stations. Cruise Numbers have become more descriptive, based on the year and the first Julian Day of the cruise, the lake identifier, and the vessel identifier. For example, 2016130-010-006 indicates that on May 9, 2016, a Lake Winnipeg (lake 010) cruise was conducted onboard the Namao (vessel 006).
CSN	Consecutive Station Number
Depth-profile	A quantitative analysis of a section of a body of water representing distinctive water quality characteristics with respect to depth.
DO	Dissolved oxygen
Erroneous (data)	Data points that measure outside the expected instrumental range, or values considered globally impossible, which are typically observed as single spikes in the data
Headerline	Information in a data file located in the lines preceding the data columns. File, station, and instrument information (including calibration coefficients) are found here.
OIC	Officer In Charge
PSN	Permanent Station Number
QA	Quality Assurance
QAS	Quality Assurance Annual Summary
QAO	Quality Assurance Officer
Q'd file	Data file that has been assessed by a quality assurance officer.

RFUB	Relative Fluorescence Units blank subtracted. Units for chlorophyll are in these units in the processed data files, unless quantified concentrations are made available, in which they will be corrected.
SB (or SBE or WQP)	SeaBird Water Quality Profiler; four-channel profiling sonde. Raw output include .hex, .xmlcon, and .hdr for each profile. Processed "raw" file has a .cnv file extension. Fully processed and QC'd files that include the calibration coefficients for the optical sensors as well as the DO corrections have the extension .xls (4 Hz) and _DepthAvg.xls (depth-averaged in 0.5 m increments). Sensors include: depth (m), temperature (°C), specific conductance (µS/cm), dissolved oxygen (mg/l and %saturation), turbidity (NTU), chlorophyll (RFUB), and descent rate (m/s). The raw .cnv data files have the optical sensors (turbidity and chlorophyll) output in voltage, although the raw output file may state otherwise. The coefficients for the two optical sensors are input into the .xmlcon file for each SeaBird. The raw output .cnv files contain the calculated RFU values rather than the voltages. These calculated values are calibrated to best-approximated concentration units, if in-situ measurements are available. Surface PAR and underwater PAR data now available ($\mu\text{Em}^{-2}\text{s}^{-1}$). Underwater PAR data is not corrected to surface PAR.
Shipboard	Pertaining to activities performed and equipment used on board a research vessel.
Station	A pre-set location within a body of water classified with a unique number and identified by its GPS location.
Suspicious (data)	Data points that do not follow the expected trend (based on historical and statistical reasoning). However, this does not necessarily imply that the data is false.
WQA	Water Quality Assurance
WQAS	Water Quality QA Summary

3. QA Assessment

3.1. Stations Analyzed

Table 3-1. Seabird profile stations assessed by QA

FILENAME	STATION
2009195-006_2_001_01.mat	2
2009195-010-006_3B_002_01.mat	3B
2009195-010-006_3C_003_01.mat	3C
2009195-010-006_5_018_01.mat	5
2009195-010-006_6_017_01.mat	6
2009195-010-006_7_016_01.mat	7
2009195-010-006_10A_020_01.mat	10A
2009195-010-006_10S_019_01.mat	10S
2009195-010-006_12B_023_01.mat	12B
2009195-010-006_13B_026_01.mat	13B
2009195-010-006_16S(W14)_031_01.mat	16S(W14)
2009195-010-006_19_036_01.mat	19
2009195-010-006_21_038_01.mat	21
2009195-010-006_22_041_01.mat	22
2009195-010-006_23B_040_01.mat	23B
2009195-010-006_23S_047_01.mat	23S
2009195-010-006_26S_044_01.mat	26S
2009195-010-006_28_046_01.mat	28
2009195-010-006_31_043_01.mat	31
2009195-010-006_33_042_01.mat	33
2009195-010-006_34S_049_01.mat	34S
2009195-010-006_36S_006_01.mat	36S
2009195-010-006_37S_013_01.mat	37S
2009195-010-006_39_048_01.mat	39
2009195-010-006_43S_052_01.mat	43S
2009195-010-006_44S_025_01.mat	44S
2009195-010-006_45_051_01.mat	45
2009195-010-006_46S_022_01.mat	46S
2009195-010-006_49S_024_01.mat	49S
2009195-010-006_53_032_01.mat	53
2009195-010-006_54_057_01.mat	54
2009195-010-006_55_030_01.mat	55
2009195-010-006_56_028_01.mat	56
2009195-010-006_57B_004_01.mat	57B

2009195-010-006_58S_005_01.mat	58S
2009195-010-006_59_012_01.mat	59
2009195-010-006_60_011_01.mat	60
2009195-010-006_60B_008_01.mat	60B
2009195-010-006_60C_010_01.mat	60C
2009195-010-006_62_007_01.mat	62
2009195-010-006_64_053_01.mat	64
2009195-010-006_65_054_01.mat	65
2009195-010-006_68_055_01.mat	68
2009195-010-006_69_056_01.mat	69
2009195-010-006_W1_039_01.mat	W1
2009195-010-006_W2_045_01.mat	W2
2009195-010-006_W3_037_01.mat	W3
2009195-010-006_W4_050_01.mat	W4
2009195-010-006_W5(18)_035_01.mat	W5(18)
2009195-010-006_W6_034_01.mat	W6
2009195-010-006_W7_033_01.mat	W7
2009195-010-006_W8_029_01.mat	W8
2009195-010-006_W9_021_01.mat	W9
2009195-010-006_W10_014_01.mat	W10
2009195-010-006_W11_015_01.mat	W11
2009195-010-006_W12_009_01.mat	W12
2009195-010-006_W13(14)_027_01.mat	W13(14)

3.2 Changes/Corrections/Comments

Seabird Profile information/flags:

- Seabird 5116 was used for all profiles.
- The default SOC for SBE 5116 (0.4692) was used for every profile. This calculation should be taken into consideration for further DO analyses. Detailed information on the calculation of new SOC values can be made available upon request.
- Default coefficients were used to process the data. Data appeared to fall out of normal range for historic Namao cruises.
- No NMEA latitude, longitude, or time available. GPS coordinates used instead.
- No system UTC available. System upload time converted to UTC used instead.
- Default coefficients for chlorophyll were used to process data.

Updated Chlorophyll Coefficients

- `<SerialNumber>2100476</SerialNumber>`
- `<A0>0.00000000</A0>`
- `<A1>1.00000000</A1>`
- `<A2>0.00000000</A2>`
- `<A3>0.00000000</A3>`

- Default coefficients for Turbidity were used to process data.

Updated Turbidity Coefficients

- `<SerialNumber>2100458</SerialNumber>`
- `<A0>0.00000000</A0>`
- `<A1>180.00000000</A1>`
- `<A2>0.00000000</A2>`
- `<A3>0.00000000</A3>`

- New PAR coefficients were calculated and used to process data. Detailed information on the calculation of new PAR Coefficients can be made available upon request.

Updated PAR Coefficients

- `SerialNumber>70113</SerialNumber>`
- `<CalibrationDate>03/03/09</CalibrationDate>`
- `<M>1.00000000</M>`
- `0.00000000`
- `<CalibrationConstant>8547008547.00000000</CalibrationConstant>`
- `<Multiplier>1.00000000</Multiplier>`
- `<Offset>-0.11881899</Offset>`

- Filenames, PSN, latitudes, and longitudes were added or corrected in the files where necessary using the 2009 Namao Field Log.
- PSN 34S had two casts taken. The first cast for PSN 34S was noted as too shallow, the cast was added in a separate folder labelled 'PSN 34S first cast (too shallow)'.
- PSN W1 had two casts taken. The second cast for PSN W1 was processed and added to a folder labelled 'PSN W1 second cast'.
- PSN W13(14) had two casts taken. The second cast for PSN W13(14) was processed and added to a folder labelled 'PSN W13(14) second cast'.
- No surface PAR available for 2009.

5. Corrective Action

The calibration coefficients for the four optical sensors (Turbidity and Chlorophyll) are in the SeaBird .xmlcon files, using the User Polynomial option. Table 5.1 below lists the voltages, and user polynomial identifiers for each parameter.

Table 5-1. Informative list of the voltages associated with the optical parameters attached to the SeaBird 19+ SN. 5116.

Probe	A/D Voltage Channel in .xmlcon file	SeaSaveV2 Display	SBEDataProcessing – Win32
Turbidity (T)	3	User Polynomial, 2	Upoly 1, Turner Cyclops Turbidity (NTU)
Chlorophyll (C)	1	User Polynomial	Upoly 0, Turner Chlorophyll (RFU)

Post-processing of the raw .hex files from the SeaBird are primarily done using the SBE Data Processing software (SeaBird Data Processing Version 7.23.2, SeaBird Electronics 2014). The following steps are taken:

1. Data Conversion – Parameters independent of temperature and those not requiring filtration and correction with rate of descent are collected here (Scan Count, Pressure (db), Temperature (°C), Conductivity ($\mu\text{S}/\text{cm}$), Oxygen raw (V), Turbidity (NTU), Chlorophyll (RFU), PAR/Irradiance).
2. Filter – Low pass filter A is set to 1 for pressure. Low pass filter B is set to 0.5 (for sampling at 2 Hz) for temperature and conductivity.
3. Align CTD – Advance values are set to 0.5 for Temperature, 0.1 for Conductivity and 4 for Oxygen, raw.
4. Loop Edit – Minimum speed is set to 0.01 m/s. Percent of Mean Speed is set to 10% with a window size of 300. Surface Soak is removed at a depth of 1m. Min/Max soak depths are 0.5 m and 2 m respectively.
5. Derive – Parameters dependent on temperature and influenced by the rate of decent are derived here (Depth (m), Specific Conductance ($\mu\text{S}/\text{cm}$), Oxygen (mg/l), Oxygen (%saturation)).
6. Bin Average – Depth, interpolated is selected with a bin size of 0.5. The data flagged in the Loop Edit step are not used in the interpolation.

To correct the voltage readings from the Turner probes, MilliQ is used as a reference, in the dark, to “zero” the sensors and formazin at 126 NTU is used as the second standard for turbidity. These values are collected once at the start of the field season and are used to correct each optical sensor to RFUB units (and NTU for turbidity). At the end of the field season, a check will be done again to verify minimal drift in each sensor. Any necessary corrections will be made at that time, assuming linear drift.

The profiling protocol is to submerge the Seabird at 3m (to ensure the top of the plumbing is submerged) and hold for 400 scan counts. The Seabird is then brought up to approximately 1m or to the minimum depth where the Y-tubing is not exposed at the water surface. It is to be held there for 100 scan counts, and then profiled at 10% speed through the water column. Once the Seabird has completed its profile, it

is to be raised from the bottom for 20 scan counts. Recording can now be stopped and the Seabird brought back up to the surface. Dissolved oxygen check protocols and Seabird cleaning protocols have been made available onboard the Namao.

To avoid inadvertently repeating cruise numbers, or going out in the field without a pre-defined cruise number, an updated nomenclature will ensure duplicates are impossible and the number can be easily determined anytime of the year. See Research Support Cruise Numbers 2016 document for a list of lake and ship reference numbers.

YYYYJDN-LLL-SSS

YYYYJDN – Seven digit cruise start date

LLL – Three digit lake number

SSS – Three digit ship/small boat number

6. References

DePalma, S., 2010. Quality assurance procedures for shipboard depth-dependent profiled data. Document RS-10-002, Environment Canada, Canada Centre for Inland Waters, Burlington, ON.