Lower Columbia Estuary Partnership

Troubleshooting errors in water surface elevation and Temperature Data

Overview

Best Practices – A Quick Guide to Water Surface Elevation and Temperature Data Collection

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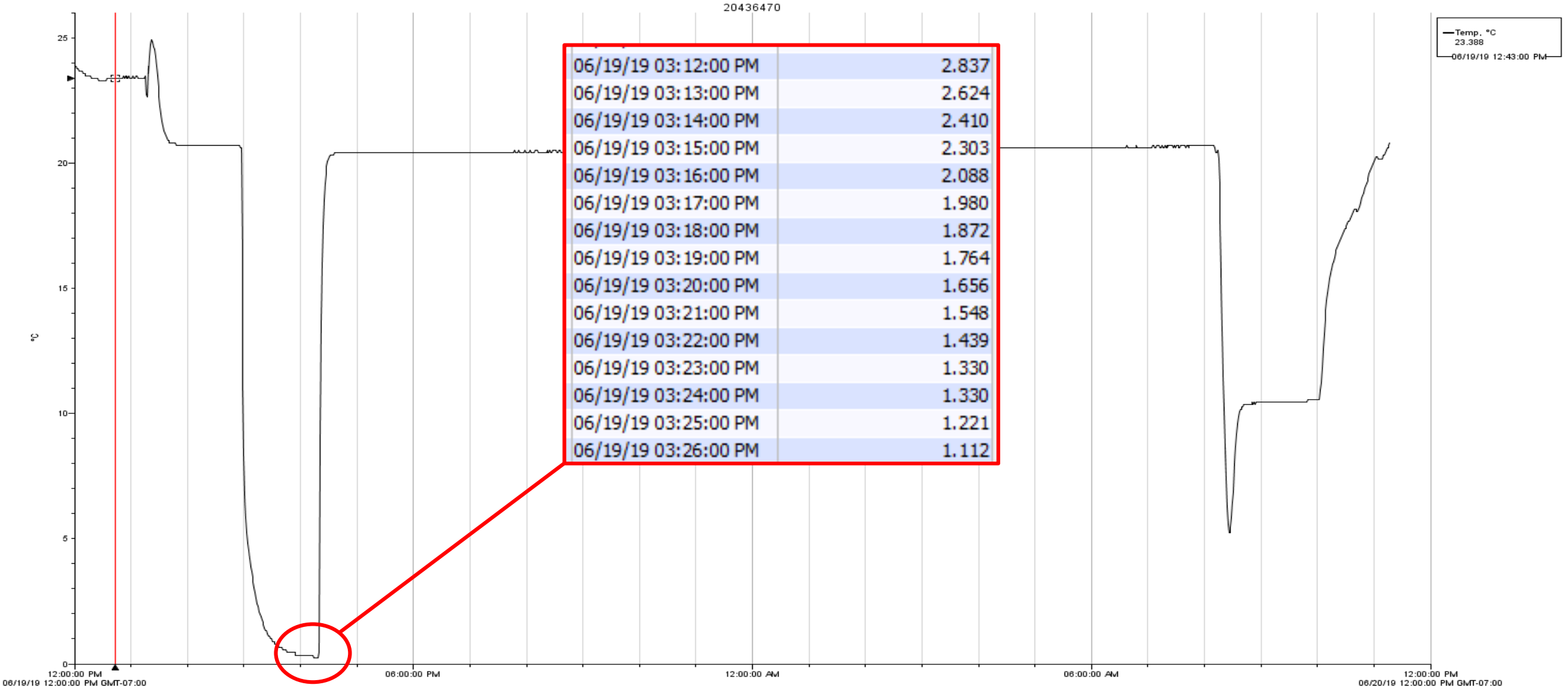
What are the problems?

Are these data any good? – Calibration Errors

0° C Bath:

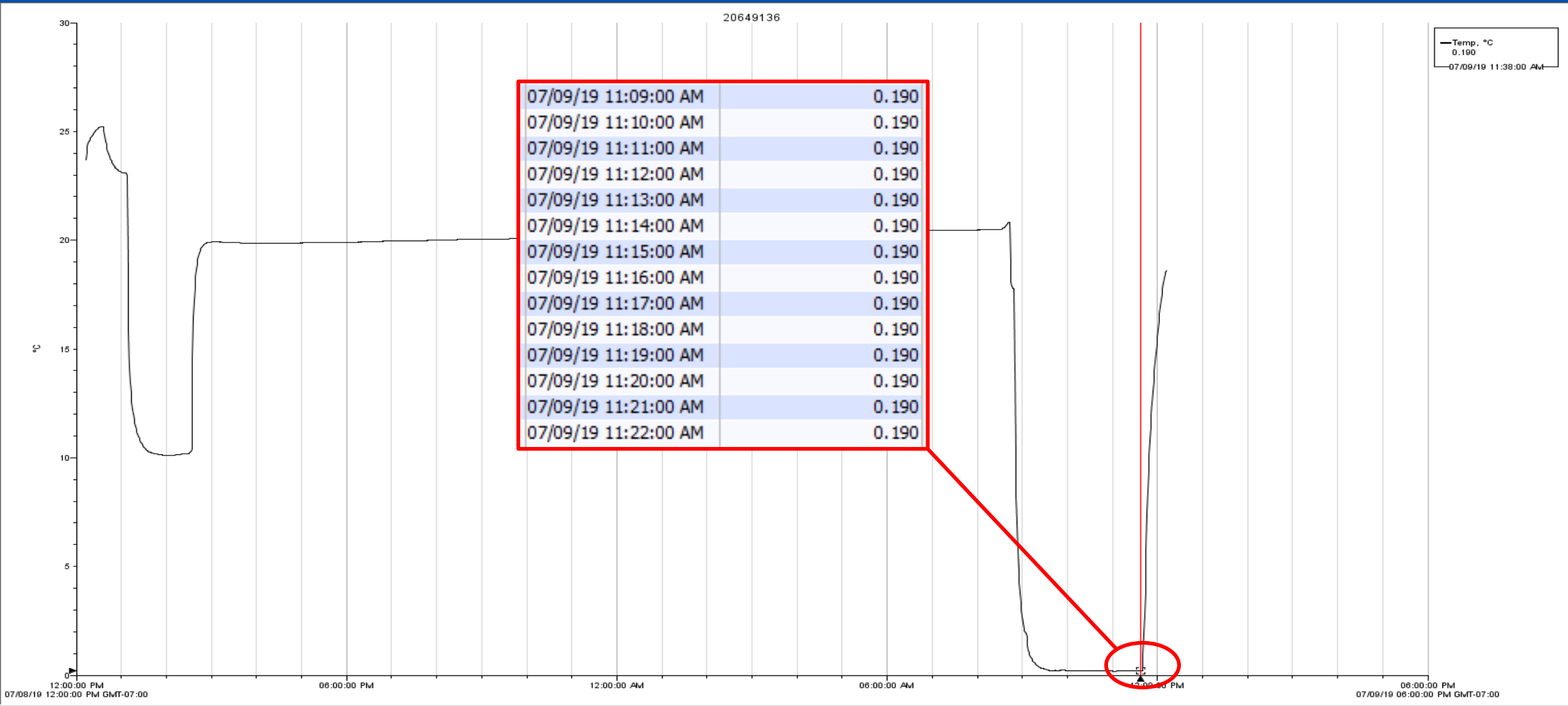
- Use a waterproof pump for best mixing
- Lay WSE sensors down flat, measure sensor depth
- Sink temperature loggers with weights
- Wait at least 10 – 20 minutes for loggers to stabilize
- Measure Temperature of the bath for at least 75 – 90 minutes **to get 10 consecutive minutes of the same temperature**

Prior to using water pump



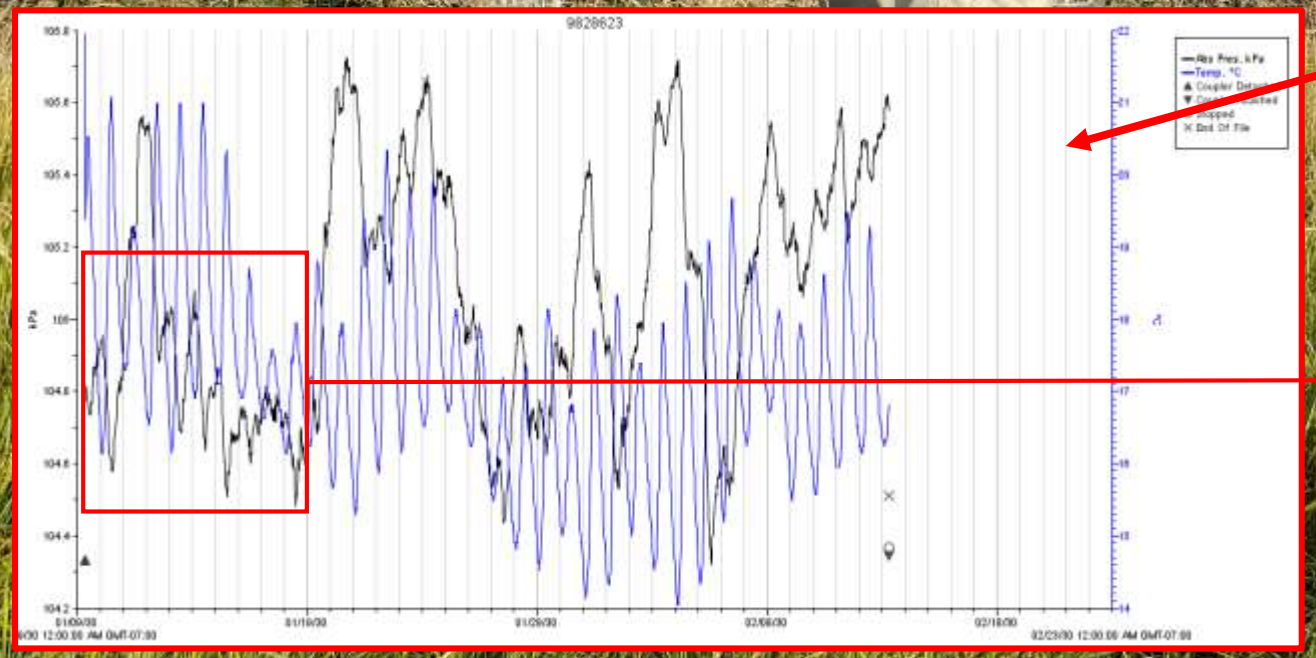
06/19/19 03:12:00 PM	2.837
06/19/19 03:13:00 PM	2.624
06/19/19 03:14:00 PM	2.410
06/19/19 03:15:00 PM	2.303
06/19/19 03:16:00 PM	2.088
06/19/19 03:17:00 PM	1.980
06/19/19 03:18:00 PM	1.872
06/19/19 03:19:00 PM	1.764
06/19/19 03:20:00 PM	1.656
06/19/19 03:21:00 PM	1.548
06/19/19 03:22:00 PM	1.439
06/19/19 03:23:00 PM	1.330
06/19/19 03:24:00 PM	1.330
06/19/19 03:25:00 PM	1.221
06/19/19 03:26:00 PM	1.112

After using water pump



07/09/19 11:09:00 AM	0.190
07/09/19 11:10:00 AM	0.190
07/09/19 11:11:00 AM	0.190
07/09/19 11:12:00 AM	0.190
07/09/19 11:13:00 AM	0.190
07/09/19 11:14:00 AM	0.190
07/09/19 11:15:00 AM	0.190
07/09/19 11:16:00 AM	0.190
07/09/19 11:17:00 AM	0.190
07/09/19 11:18:00 AM	0.190
07/09/19 11:19:00 AM	0.190
07/09/19 11:20:00 AM	0.190
07/09/19 11:21:00 AM	0.190
07/09/19 11:22:00 AM	0.190

Are these data any good? – Data transfer Errors



- Failing Loggers
  - Temperature shocks
  - Biofouling
  - False fails
- Incorrect dates and times on files transferred onto the Shuttle

Time, GMT-07:00	Abs Pres, kPa	Temp, °C
01/09/30 09:00:00 AM	104.773	21.951
01/09/30 09:30:00 AM	104.816	19.377
01/09/30 10:00:00 AM	104.808	19.758
01/09/30 10:30:00 AM	104.798	20.043
01/09/30 11:00:00 AM	104.788	20.329
01/09/30 11:30:00 AM	104.776	20.519
01/09/30 12:00:00 PM	104.745	20.519
01/09/30 12:30:00 PM	104.744	20.424
01/09/30 01:00:00 PM	104.742	20.329
01/09/30 01:30:00 PM	104.738	20.138
01/09/30 02:00:00 PM	104.735	19.948
01/09/30 02:30:00 PM	104.745	19.662
01/09/30 03:00:00 PM	104.741	19.472

So you got the data

Water depth above sensor = D – ((A+B2)-C)

4. Calculating movement of data logger housing during deployment
   - Compare measurements A, B1, B2 and the RTK elevations pre and post deployment, if measurements are significantly different then the data logger housing has shifted and the WSE data may need to be corrected or not usable. Data correction can be done if the precise timing of data logger housing movement can be identified in the hydrologic data and then the new data logger elevation (collected upon retrieval) applied to all data after the shift occurred (See example Figure 5).

7. Post-processing and Analysis

Once the data logger has been retrieved from the site and post- deployment water depth measurements have been made (See 4.6) the data can be processed and used to evaluate the conditions on the site. Below are some tips for processing the data in HOBOware:

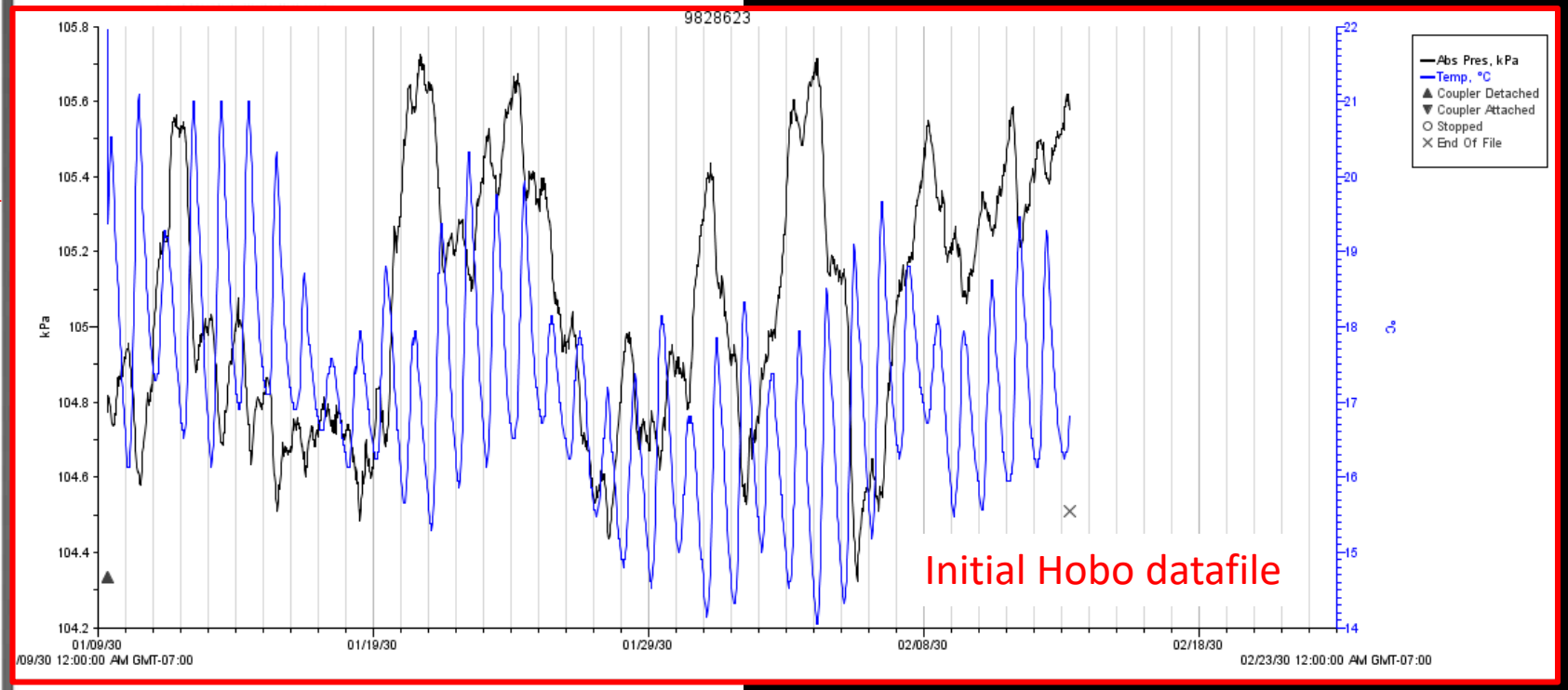
1. Understanding GMT and Correcting for Daylight Savings

It is best practice to always be aware of which time zone the data logger is collecting in. HOBOware does not automatically correct for daylight savings. Additionally, the data logger will be launched in whichever time zone your computer clock is in at the time of deployment unless it is adjusted manually. This means if you deploy your data logger in the summer (Daylight Savings Time) and then retrieve your data logger in the winter (Standard Time) your data will be read out in Daylight Savings Time, all time stamps after the fall time boundary (such as November 4 at 2 am) will be an hour off (one hour behind) because HOBOware does not adjust for shifts between Daylight Savings and Standard Time. This adjustment will need to be done manually in Excel, once exported from HOBOware. Correcting data for the end or beginning of daylight savings time can cause issues with time series data analysis because it involves deleting or duplicating a date and time when the data crosses a time boundary. Specifically, when daylight saving times begins clocks are moved forward one hour, meaning the 2 am date time on that day is deleted, while when daylight savings time ends the clocks go back one hour, meaning the 2 am time stamp is repeated. To avoid issues with duplicate and deleted time stamps data should be collected and stored in Standard Time, in the Pacific Time Zone this is GMT-8.

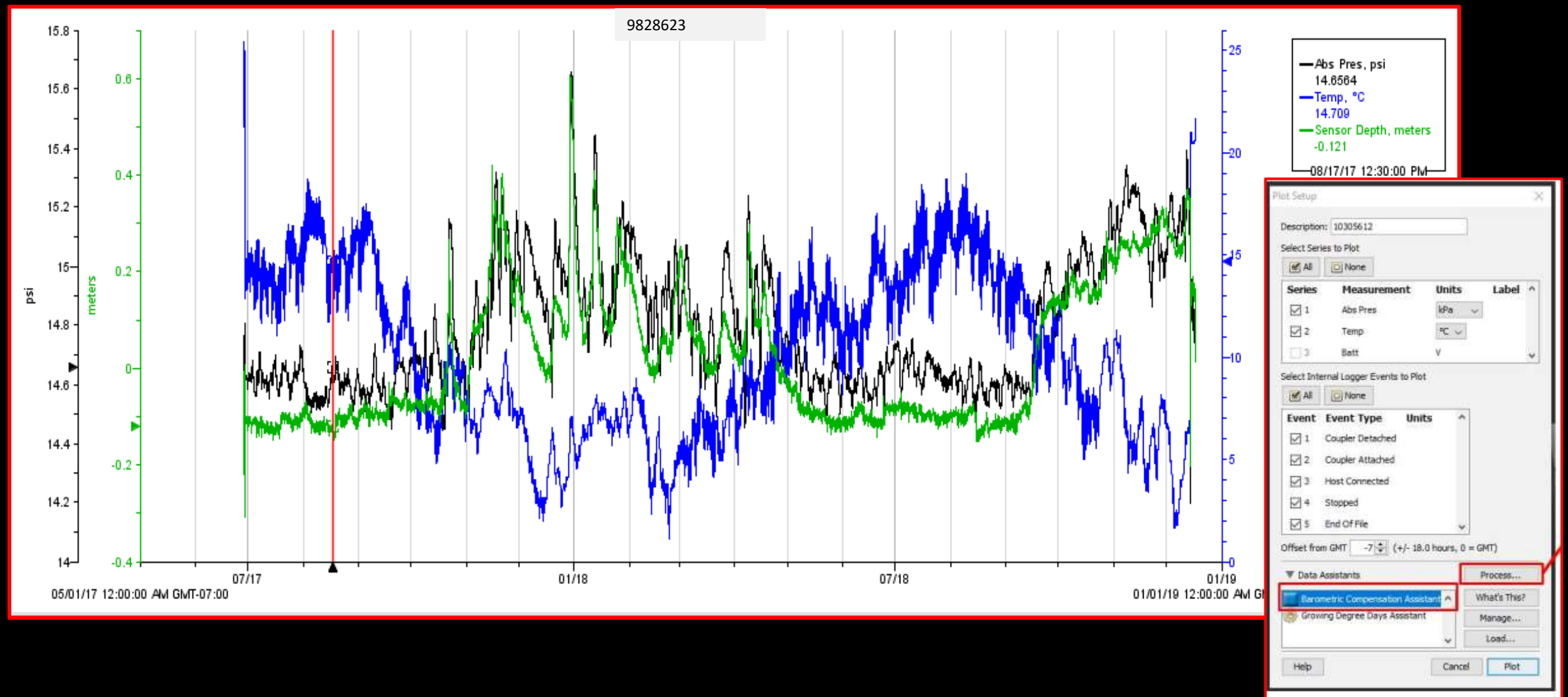
It is particularly important to understand how these shifts between daylight savings ending and beginning impact your date and time stamps when trying to compare your reference water levels and temperatures collected to your data logger data. For example is you are collecting all your data in Standard Time (i.e. GMT-8) you will need to make a small adjustment to your reference measurement date and time stamps collected during daylight savings time (i.e. Mar – Nov, see an annual daylight savings table for exact dates) so that the reference measurement time and dates match the loggers time and dates. To shift a daylight savings time stamp (i.e. GMT-7) to a standard time stamp (i.e. GMT-8) you only need to add one hour.

Lastly, understanding the time zone your data is collected in is critical for comparing time series data sets such as multiple loggers to one another or to a gage station, and when correcting your data with barometric data. It is essential to make sure all data sets are in the same time zone for meaningful analyses to be conducted.

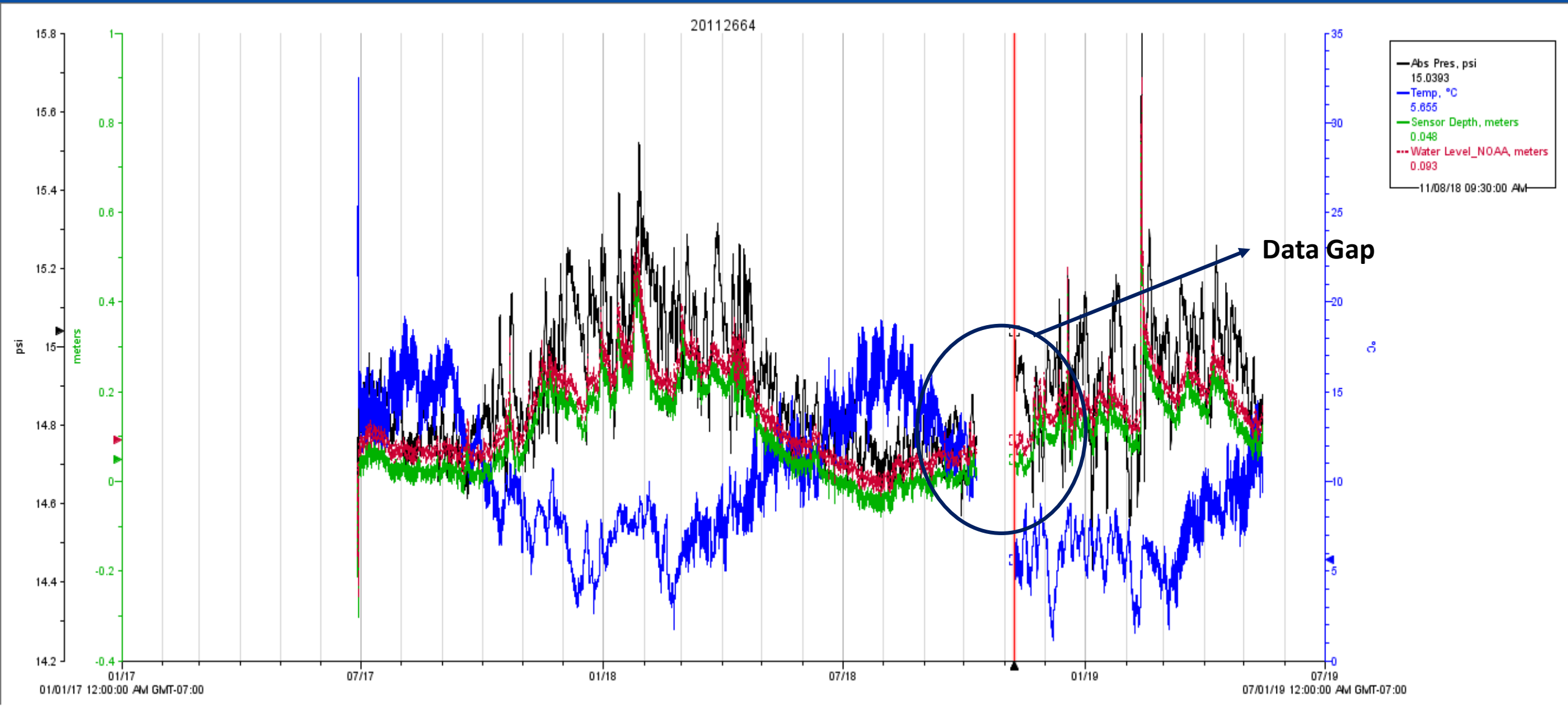
Best Practices - Quick Guide: Water Surface Elevation and Temperature Data Collection



After applying Barometric compensation assistant



Data Processing Errors: Data Gaps



Data Processing Errors: Due to Freezing temperatures

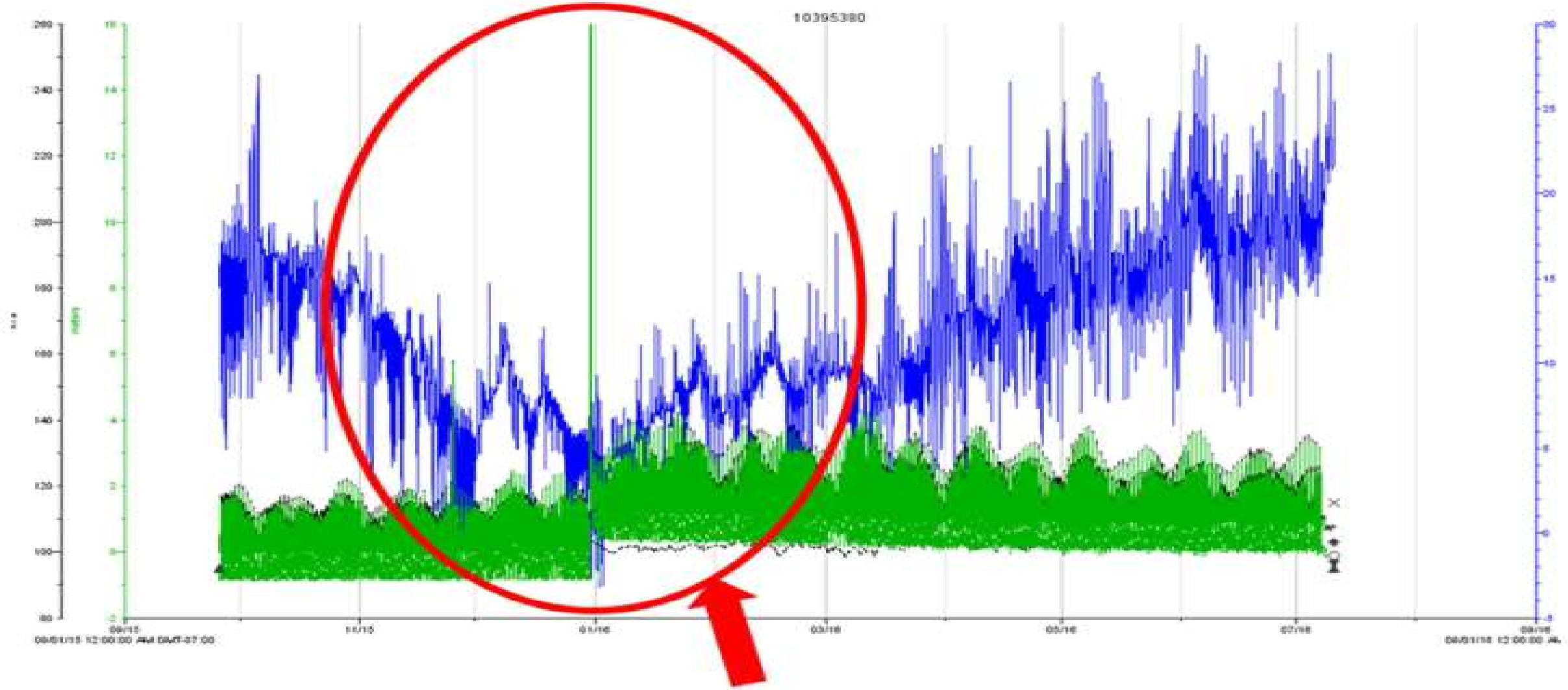


Figure 7. Error in data caused by a sensor freezing during deployment.

Let’s reduce those errors!

- Erase old data and always relaunch Hobo Shuttle
- QA/QC of loggers during calibrations
- Ensure loggers are set to the right logging intervals
- Swap loggers every six months
- Update hoboware pro regularly
- Ensure accurate field measurements: Water level, Temperature and RTK data
- Check deployed loggers and housing for algal growth and damages

Next Steps: Data Sharing – Creating a database

Site	Location	Date	Time (GMT - 7)	Removed/ Downloaded/ Placed	Serial Number	Logger Type	Collection Interval	TOC to Sensor-cord length (cm)	WSE to TOC (cm)	Water Level (cm)	TOC Elevation (m, NAVD88)	Sensor Elevation (m, NAVD88)	NIST Temp C	Conductivity (uS)
MCNA	MCNA1- N channel	6/24/2019	9:55	Placed	20149615	WSE/Temp	30	151	107.2	43.8	4.012	2.502	17.1	169.9
MCNA	MCNA2- N Wetland	12/13/2018	10:38	Removed	20149615	WSE/Temp	15	151	120.7	37.5	4.717	3.207	7.8	
MCNA	MCNA2- N Wetland	12/13/2018	10:38	Placed	20112945	WSE/Temp	30	151	120.7	37.5	4.717	3.207	7.8	
MCNA	MCNA2- N Wetland	6/24/2019	10:38	Removed	20112945	WSE/Temp	30	151	Dry	dry	4.717	3.207		
MCNA	MCNA2- N Wetland	6/24/2019	10:41	Placed	10563692	WSE/Temp	30	151	Dry	dry	4.717	3.207		
MCNA	MCNA3- S channel	12/13/2018	12:05	Removed	20358341	WSE/Temp	15	156	103	42.5	4.408	2.848	7.0	
MCNA	MCNA3- S channel	12/13/2018	12:05	Placed	20112940	WSE/Temp	30	156	103	42.5	4.408	2.848	7.0	
MCNA	MCNA3- S channel	12/13/2018	12:05	Placed	20112567	DO	30	142		42.5	4.245	2.825	7.0	
MCNA	MCNA3- S channel	6/24/2019	8:40	Removed	20112567	DO	30	142			4.245	2.825	17.5	185.4
MCNA	MCNA3- S channel	6/24/2019	8:40	Removed	20112940	WSE/Temp	30	156	78.5	77.5	4.408	2.848	17.5	185.4
MCNA	MCNA3- S channel	6/24/2019	8:50	Placed	20149616	WSE/Temp	30	156	78.5	77.5	4.408	2.848	17.5	185.4
MCNA	MCNA4- S wetland	12/13/2018	12:51	Removed	20358336	WSE/Temp	15	139	102	36	4.438	3.048	6.8	
MCNA	MCNA4- S wetland	12/13/2018	12:51	Placed	20112939	WSE/Temp	30	139	102	36	4.438	3.048	6.8	
MCNA	MCNA4- S wetland	12/13/2018	12:51	Placed	20112566	DO	30	143.5		36	4.598	3.163	6.8	
MCNA	MCNA4- S wetland	6/24/2019	9:16	Removed	20112939	WSE/Temp	30	139	78	61	4.438	3.048	15.8	271.3
MCNA	MCNA4- S wetland	6/24/2019	9:20	Placed	20112664	WSE/Temp	30	139	78	61	4.438	3.048	15.8	271.3
MCNA	MCNA4- S wetland	6/24/2019	9:16	Removed	20112566	DO	30	143.5			4.598	3.163	15.8	271.3
MCNA	MCNA5- Crabapple	12/13/2018	14:13	Removed	20149616	WSE/Temp	15	127.5	60.5	69	7.61	6.335	8.0	
MCNA	MCNA5- Crabapple	12/13/2018	14:13	Placed	10810155	WSE/Temp	30	127.5	60.5	69	7.65	6.375	8.0	
MCNA	MCNA5- Crabapple	1/29/2019	12:47	Placed	10330643	DO	30	146			7.998	6.538		
MCNA	MCNA5- Crabapple	6/24/2019	12:23	Removed	10330643	DO	30	146			7.998	6.538	13.6	249.4

Next Steps: Data Sharing – Creating user-friendly DETs

5_Measurement_DET

Paste atmospherically corrected and elevation corrected water level data into this form for upload into Oncor.

Water_Elevation_Instrument	Instrument_Deployment_Dat	Water_Measurement_Dat	Water_Temperature	Temperature_Sensor_Exposed	Water_Surface_Elevation	Instrument_Measurement_Notes	DB_Access
Hobo_9782045	3/12/2014 15:20	3/12/2014 15:20	11.24		1.4074	WSE Output converted to Meters	
Hobo_9782045	3/12/2014 15:20	3/12/2014 15:30	10.94		1.3473		
Hobo_9782045	3/12/2014 15:20	3/12/2014 15:40	10.94		1.2946		
Hobo_9782045	3/12/2014 15:20	3/12/2014 15:50	10.94		1.2378		
Hobo_9782045	3/12/2014 15:20	3/12/2014 16:00	10.94		1.1851		
Hobo_9782045	3/12/2014 15:20	3/12/2014 16:10	10.94		1.1355		
Hobo_9782045	3/12/2014 15:20	3/12/2014 16:20	10.94		1.0835		
Hobo_9782045	3/12/2014 15:20	3/12/2014 16:30	10.94		1.0314		
Hobo_9782045	3/12/2014 15:20	3/12/2014 16:40	10.94		0.9833		
Hobo_9782045	3/12/2014 15:20	3/12/2014 16:50	10.94		0.9387		
Hobo_9782045	3/12/2014 15:20	3/12/2014 17:00	10.85		0.8965		
Hobo_9782045	3/12/2014 15:20	3/12/2014 17:10	10.85		0.8510		
Hobo_9782045	3/12/2014 15:20	3/12/2014 17:20	10.85		0.8048		
Hobo_9782045	3/12/2014 15:20	3/12/2014 17:30	11.04		0.7645		
Hobo_9782045	3/12/2014 15:20	3/12/2014 17:40	11.04		0.7257		
Hobo_9782045	3/12/2014 15:20	3/12/2014 17:50	11.04		0.6894		
Hobo_9782045	3/12/2014 15:20	3/12/2014 18:00	11.04		0.6516		
Hobo_9782045	3/12/2014 15:20	3/12/2014 18:10	11.04		0.6169		
Hobo_9782045	3/12/2014 15:20	3/12/2014 18:20	11.04		0.5847		
Hobo_9782045	3/12/2014 15:20	3/12/2014 18:30	11.04		0.5530		
Hobo_9782045	3/12/2014 15:20	3/12/2014 18:40	11.04		0.5248		
Hobo_9782045	3/12/2014 15:20	3/12/2014 18:50	11.04		0.4997		
Hobo_9782045	3/12/2014 15:20	3/12/2014 19:00	11.04		0.4765		
Hobo_9782045	3/12/2014 15:20	3/12/2014 19:10	11.04		0.4560		
Hobo_9782045	3/12/2014 15:20	3/12/2014 19:20	11.04		0.4377		
Hobo_9782045	3/12/2014 15:20	3/12/2014 19:30	11.04		0.4225		

References

Continuous Water Level Data Collection and Management Using Onset HOBO® Data Loggers
Natural Resource Report NPS/NCBN/NRR—2017/1370
https://irma.nps.gov/DataStore/DownloadFile/563851

Oregon Plan for Salmon and Watersheds, Water Quality Monitoring Guidebook, Temperature Protocols Chapter 6:
http://docs.streamnetlibrary.org/Protocols/021.pdf

Washington Department of Ecology Quality Assurance Monitoring Plan: Continuous Monitoring for Oxygen, Temperature, pH, and Conductivity in Statewide Rivers and Streams
https://fortress.wa.gov/ecy/publications/summarypages/0903122.html

HOBOware User's Guide:
http://www.onsetcomp.com/support/manuals/12730-MANBHW-UG

HOBOware Pro Barometric Compensation Assistant User's Guide:
http://www.onsetcomp.com/files/manual_pdfs/Barometric-Compensation-AssistantUsers-Guide-10572.pdf

HOBO® U20 Water Level Logger Manual:
http://www.onsetcomp.com/files/manual_pdfs/12315-F-MAN-U20.pdf

Specifications for HOBO® U20 Water Level Loggers:
http://www.onsetcomp.com/files/datasheet/Onset%20HOBO%20U20%20Water%20Level%20Data%20Loggers.pdf

Specifications for HOBO® U20L Water Level Loggers:
http://www.onsetcomp.com/files/datasheet/Onset-HOBO-U20L-Water-Level-DataLogger-Series.pdf

US Geological Survey. 2012. Water level continuous standard operating procedures. Unpublished protocols. USGS, Western Ecological Research Center, San Francisco Bay Estuary Field Station, Vallejo, CA.
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