

Kachemak Bay Research Reserve (KAC) NERR Water Quality Metadata
January – December 2016
Latest Update: 3/26/2018

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons

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2) Entry verification

Deployment data are uploaded from the YSI data logger to a Personal Computer (IBM compatible). Files are exported from EcoWatch in a comma-delimited format (.CDF), EcoWatch Lite in a comma separated file (CSV) or KOR Software in an Excel File (.XLS) and uploaded to the CDMO where they undergo automated primary QAQC; automated depth/level corrections for changes in barometric pressure (cDepth or cLevel parameters); and become part of the CDMO's online provisional database. All pre- and post-deployment data are removed from the file prior to upload. During primary QAQC, data are flagged if they are missing or out of sensor range. The edited file is then returned to the Reserve for secondary QAQC where it is opened in Microsoft Excel and processed using the CDMO's NERRQAQC Excel macro. The macro inserts station codes, creates metadata worksheets for flagged data and summary statistics, and graphs the data for review. It allows the user to apply QAQC flags and codes to the data, remove any overlapping deployment data, append files, and export the resulting data file for upload to the CDMO. Upload after secondary QAQC results in ingestion into the database as provisional plus data, recalculation of cDepth or cLevel parameters, and finally tertiary QAQC by the CDMO and assimilation into the CDMO's authoritative online database. Where deployment overlap occurs between files, the data produced by the newly calibrated sonde is generally accepted as being the most accurate. For more information on QAQC flags and codes, see Sections 11 and 12. Steve Baird was responsible for these tasks.

3) Research objectives

The YSI electronic data loggers are programmed to measure the water temperature, specific conductivity, dissolved oxygen, depth, pH, and turbidity conditions at 15-minute intervals. In Kachemak Bay, there are two permanent water quality monitoring stations (Homer and Seldovia), each having two data sondes. One site is located on the northeast side of the Bay at the end of the Homer Spit, and the other on the southwest side of the Bay in Seldovia. At each site, one data logger is suspended 1-meter below the surface ("Surface"), and one data logger is suspended 1-meter from the bottom ("Deep"). At both locations the surface sondes are horizontally within 100 meters of the deep sondes.

The circulation in Kachemak Bay is driven primarily by the 8-meter tidal flux. Regional circulation is characterized by generally cyclonic ocean currents in the Gulf of Alaska flowing

onto the shelf off of Cook Inlet. Nutrient rich bottom water is upwelled and mixed with surface water. These enriched waters may enter into Kachemak Bay, the inflow tending to stay along the southern shore flowing past the Seldovia instruments, while water flowing out of the bay stays along the Inner Bay and north shore, flowing past the Homer instruments. These trapped coastal flows separate the bay into two distinct ecosystems, and the instruments are positioned to reflect this distinction. Within each system there is vertical stratification of the water. The vertical placement of the sondes is designed to help elucidate the differences in circulation of the surface and deep waters.

As the inflowing water proceeds up the bay, fresh water runoff from the surrounding ice fields and watersheds dilute the salinity and increase the sediment load in the path of the Homer instruments. The in-flowing water, in the path of the Seldovia instruments, initially supports a marine system, while the northern out-flowing water of the Homer instruments is more estuarine. The Kachemak Bay water quality instruments capture this difference with deployments along the north and south shores. These data will be used to supplement studies on primary productivity, larval distribution, settlement, recruitment, growth rates, community dynamics, and biodiversity in the bay.

4) Research methods

Both telemetered instruments (“Deep”) are stationary and housed in ABS pipe mounted vertically on the ferry docks of Homer and Seldovia. The pipes are positioned to ensure that the sensors are approximately 1-meter above the bottom of the ocean floor (actual depth changes with respect to the tides). The surface sondes are attached to a buoy and a sonde guard that slides vertically on a cable to ensure that the sonde remains 1-meter below the surface as the tide is changing.

Calibration and deployment were performed monthly using methods outlined in the YSI Operations Manual. The following sensors are calibrated using standards purchased from YSI: pH (7 and 10), conductivity (50 mS/cm), and turbidity (126 NTU). Depth is calibrated using an offset that is calculated using the barometric pressure.

The Chlorophyll probe is calibrated at zero in DI water. QA/QC of this parameter is conducted by comparing sonde data to our monthly grab samples that are analyzed on a Turner 10-AU Spectrophotometer (see Nutrient data/metadata for 2016). Sonde data are accepted or rejected based on this comparison. The estimates of chlorophyll concentration produced by the YSI chlorophyll probe are meant to complement the more accurate results obtained by the monthly grab samples.

A Sutron Sat-Link2 transmitter was installed at the Homer Dolphin Deep station on 12/13/2005 and transmits data to the NOAA GOES satellite, NESDIS ID # 3B00077A WQ. A Sutron Sat-Link2 transmitter was installed at the Seldovia Deep station on 07/31/2007 and transmits data to the NOAA GOES satellite, NESDIS ID # 3B040240 WQ. The transmissions are scheduled hourly and contain four (4) data sets reflecting fifteen minute data sampling intervals. Upon receipt by the CDMO, the data undergoes the same automated primary QAQC process detailed in Section 2 above. The “real-time” telemetry data become part of the provisional dataset until undergoing secondary and tertiary QAQC and assimilation in the CDMO’s authoritative online database. Provisional and authoritative data are available at <http://cdmo.baruch.sc.edu>.

5) Site location and character

Kachemak Bay is located approximately 200 kilometers south of Anchorage on the western shore of the Kenai Peninsula. Kachemak Bay, at 59.6° N and 151.5° W, is a temperate regional fjord with hydrographic conditions unique among the NERR system estuaries. The tidal range of 8-meters is among the largest in the world, and salinity ranges from near zero at stream mouths to 33.3 PSU at the entrance to the inner Bay. The bay is 35 kilometers wide at its mouth and approximately 57 kilometers long. The head of Kachemak Bay is located to the northeast at the Fox River Flats, and the mouth lies to the southwest, along a line between Anchor Point and Point Pogibshi. The 6-kilometer long Homer Spit that extends into the Bay from the northern shoreline splits Kachemak Bay into inner and outer bays. The Kachemak Bay NERR encompasses both the inner and outer bays. Water flows between the inner and outer Bays through a narrow opening formed between the Spit and the southern shoreline. The Bay has an average depth of 41-meters, and a maximum of 169-meters. Fresh water introduced primarily by the Fox, Bradley, and Martin Rivers and Sheep Creek at the head of the Bay, flows along the northwest shore of the inner Bay.

The Homer YSI data logger site is located on the north side of Kachemak Bay at 59.60203°N 151.40877°W. The “deep” sonde is deployed at a depth 1 meter from the bottom, in water fluctuating between 7.5 and 16.8 meters. The “surface” data sonde is deployed at a nominal depth of 1 meter. The bottom habitat is predominantly sand. Pollutants in the area are from the excessive boat traffic at the entrance of the Homer harbor, and a nearby fish waste outfall line. Throughout the year, salinity has ranged from 20.5 to 32.4 ppt, as the instrument's location in the stratified water column is dependent on tide height, with a tidal range of 8.1 meters. It is predominately an estuarine environment during summer months when glacial runoff is highest, and during the winter months it reverts to a more marine-like system with glacial runoff at a minimum.

The Seldovia YSI data logger site is located on the south side of Kachemak Bay at 59.44097°N 151.72089°W, approximately 25 kilometers southwest of the Homer site. As with the Homer site, the data loggers are situated on the ferry terminal dock, with one instrument 1 meter below the surface, and one 1 meter above the bottom, in water fluctuating between 4.3 and 13.0 meters. The access to Seldovia is limited to boat or air, as the site is located off the highway system. The bottom habitat is predominantly sand. Pollutants in the area are minimal. Throughout the year, salinity has ranged from 25.0 to 33.9 ppt at this site with a tidal range of 8.0 meters.

SWMP Station Timeline

Station Code	SWMP Status	Station Name	Location	Active Dates	Reason Decommissioned	Notes
kach3wq	p	Homer Surface 3	59° 36' 7.38 N, 151° 24' 33.90 W	05/31/2012 12:15 -	NA	NA
kachdwq	P	Homer Dolphin Deep	59° 36' 7.24 N, 151° 24' 31.61 W	01/01/2003 00:00 -	NA	NA
kacsdwq	P	Seldovia Deep	59° 26' 27.56 N, 151° 43' 15.46 W	01/01/2004 00:00 -	NA	NA

kacsswq	P	Seldovia Surface	59° 26' 27.56 N, 151° 43' 15.46 W	01/01/2004 00:00 -	NA	NA
kacbcwq	P	Bear Cove	59° 42' 20.41 N, 151° 3' 33.84 W	06/18/2002 11:30 - 09/24/2003 17:30	Change in research questions and difficult access.	Site was seasonal, because access was too difficult in winter.
kacdwlwq	P	Homer Dolphin	59° 36' 7.24 N, 151° 24' 31.61 W	10/24/2002 10:00 - 12/31/2002 23:30	Just renamed to kachdwq.	Exact same site as kachdwq. Naming convention changed when installing paired surface-deep sondes.
kachowq	P	Homer	59° 36' 8.34 N, 151° 24' 36.00 W	07/12/2001 07:45 - 11/20/2002 12:30	On city dock. City built a newer dock surrounding old one.	1 meter off bottom, 62 meters from current kachdwq site. Data overlaps kacdlwq site in late 2002. Old mount destroyed by storm November 2002.
kachswq	P	Homer Dolphin Surface	59° 36' 7.24 N, 151° 24' 31.61 W	02/13/2004 09:30 - 11/28/2011 16:00	Sonde was getting destroyed by banging against pilings. Moved 35 meters.	Essential equivalent to kach3wq. Site was relocated to a safer location for the sonde in rough seas.
kacpgwq	P	Port Graham	59° 22' 13.91 N, 151° 53' 46.03 W	06/21/2002 10:00 - 09/24/2003 15:30	Change in research questions and difficult access.	Site was seasonal, because access was too difficult in winter.
kacsewq	P	Seldovia	59° 26' 27.56 N, 151° 43' 15.46 W	08/17/2001 15:15 - 12/31/2003 23:30	Just renamed to kacsdwq.	Exact same site as kacsdwq. Naming convention changed when installing paired surface-deep sondes.

6) Data collection period – Included in annual metadata document.

Monitoring at Homer Deep, Seldovia Deep, and Seldovia Surface was continuous throughout 2016. The Homer Surface site was sampled from 1/1/16 – 12/14/16, and was removed during the winter months when ice formed on the surface waters at this site. Deployment and retrieval dates and times for 2016 are listed below:

Homer Surface 3

Loc	Deploy Start Time	Retrieve End Time	Sonde	pH		DO	Turb	Cond	Chl	Notes
H3	12/22/2015 14:15	01/20/2016 14:30	6600EDS (Alpha)	6561		6150 ROX	6136	6560		
H3	01/22/2016 15:45	02/23/2016 13:30	6600EDS (Indigo)	6561		6150 ROX	6136	6560		
H3	02/23/2016 14:00	03/21/2016 13:30	6600EDS (Alpha)	6561		6150 ROX	6136	6560		
H3	03/21/2016 13:45	04/22/2016 14:30	6600EDS (Indigo)	6561		6150 ROX	6136	6560		
H3	04/22/2016 15:00	05/19/2016 13:15	6600EDS (Alpha)	6561		6150	6136	6560		
H3	05/19/2016 13:45	06/20/2016 10:15	6600EDS (Indigo)	6561		6150 ROX	6136	6560		
H3	06/20/2016 11:00	07/22/2016 10:15	6600EDS (Alpha)	6561		6150	6136	6560		
H3	07/22/2016 11:30	08/17/2016 13:30	EXO2 (Papa)	599702		599100-01	599101-01	599827	599103-01	
H3	08/17/2016 14:00	09/19/2016 14:45	EXO2 (Romeo)	599702		599100-01	599101-01	599827	599103-01	
H3	09/19/2016 15:15	10/07/2016 06:45	EXO2 (Quebec)	599702		599100-01	599101-01	599827	599103-01	
H3	10/13/2016 10:45	10/21/2016 12:15	EXO2 (Quebec)	599702		599100-01	599101-01	599827	599103-01	
H3	10/21/2016 12:30	11/16/2016 13:45	EXO2 (Sierra)	599702		599100-01	599101-01	599827	599103-01	
H3	11/16/2016 14:15	11/17/2016 14:00	EXO2 (Quebec)	599702		599100-01	599101-01	599827	599103-01	
H3	11/23/2016 10:15	12/14/2016 10:15	EXO2 (Romeo)	599702		599100-01	599101-01	599827	599103-01	

Homer Deep

Loc	Deploy Start Time	Retrieve End Time	Sonde	pH		DO	Turb	Con d	Chl	Notes
HD	12/22/2015 14:15	01/20/2016 14:30	6600EDS (Foxtrot)	6561		6150 ROX	6136	6560		
HD	01/20/2016 15:00	02/23/2016 13:30	6600EDS (Delta)	6561		6150 ROX	6136	6560		
HD	02/23/2016 14:00	03/21/2016 13:30	6600EDS (Foxtrot)	6561		6150 ROX	6136	6560		
HD	03/21/2016 13:45	04/22/2016 14:15	6600EDS (Golf)	6561		6150 ROX	6136	6560		
HD	04/22/2016 14:30	05/19/2016 12:45	6600EDS (Foxtrot)	6561		6150	6136	6560		
HD	05/19/2016 13:30	06/20/2016 10:00	6600EDS (Golf)	6561		6150 ROX	6136	6560		
HD	06/20/2016 10:45	07/22/2016 10:15	6600EDS (Foxtrot)	6561		6150	6136	6560		
HD	07/22/2016 11:00	08/17/2016 13:15	6600EDS (Indigo)	6561		6150 ROX	6136	6560		
HD	08/17/2016 13:45	09/19/2016 14:30	6600EDS (Delta)	6561		6150	6136	6560		
HD	09/19/2016 15:00	10/21/2016 12:00	6600EDS (Indigo)	6561		6150 ROX	6136	6560		
HD	10/21/2016 12:15	11/16/2016 13:45	6600EDS (Delta)	6561		6150	6136	6560		
HD	11/16/2016 14:00	12/14/2016 10:15	6600EDS (Indigo)	6561		6150 ROX	6136	6560		
HD	12/14/2016 10:45	01/18/2017 11:30	6600EDS (Delta)	6561		6150	6136	6560		

Seldovia Surface

Loc	Deploy Start Time	Retrieve End Time	Sonde	pH		DO	Turb	Cond	Chl	Notes
SS	12/18/2015 12:15	01/20/2016 11:30	6600V2 (Mike)	6589		6150 ROX	6136	6560	6025	
SS	01/20/2016 12:00	02/22/2016 11:30	6600EDS (Golf)	6561		6150 ROX	6136	6560		
SS	02/22/2016 12:00	03/21/2016 10:30	6600V2 (Mike)	6589		6150 ROX	6136	6560	6025	
SS	03/21/2016 11:00	04/21/2016 09:00	6600V2 (November)	6589		6150 ROX	6136	6560	6025	
SS	04/21/2016 09:30	05/17/2016 11:15	6600V2 (Lima)	6561		6150 ROX	6136	6560	6025	
SS	05/17/2016 11:45	06/16/2016 09:00	6600EDS (Delta)	6561		6150 ROX	6136	6560		
SS	06/16/2016 09:45	07/20/2016 10:00	6600V2 (Lima)	6561		6150 ROX	6136	6560	6025	
SS	07/20/2016 10:45	08/17/2016 09:15	EXO2 (Quebec)	599702		599100-01	599101-01	599827	599103-01	
SS	08/17/2016 09:45	09/14/2016 09:45	EXO2 (Sierra)	599702		599100-01	599101-01	599870-01	599103-01	
SS	09/14/2016 10:15	10/20/2016 11:00	EXO2 (Papa)	599702		599100-01	599101-01	599827	599103-01	
SS	10/20/2016 11:30	11/15/2016 11:30	EXO2 (Romeo)	599702		599100-01	599101-01	599827	599103-01	
SS	11/15/2016 12:00	12/13/2016 11:45	EXO2 (Papa)	599702		599100-01	599101-01	599827	599103-01	
SS	12/13/2016 12:15	01/17/2016 12:00	EXO2 (Quebec)	599702		599100-01	599101-01	599827	599103-01	

Seldovia Deep

Loc	Deploy Start Time	Retrieve End Time	Sonde	pH		DO	Turb	Cond	Chl	Notes
SD	12/18/2015 12:15	01/20/2016 11:30	6600V2 (Oscar)	6589		6150 ROX	6136	6560	6025	
SD	01/20/2016 12:00	02/22/2016 11:30	6600V2 (November)	6589		6150 ROX	6136	6560	6025	
SD	02/22/2016 12:15	03/21/2016 10:30	6600V2 (Lima)	6561		6150 ROX	6136	6560	6025	
SD	03/21/2016 11:15	04/21/2016 8:45	6600V2 (Oscar)	6589		6150 ROX	6136	6560	6025	
SD	04/21/2016 09:15	05/03/2016 09:30	6600V2 (Mike)	6589		6150	6136	6560	6025	
SD	05/03/2016 10:00	05/17/2016 11:15	6600V2 (November)	6589		6150	6136	6560	6025	
SD	05/17/2016 11:45	06/16/2016 09:00	6600V2 (Mike)	6589		6150	6136	6560	6025	
SD	06/16/2016 09:30	07/20/2016 10:00	6600V2 (Oscar)	6589		6150	6136	6560	6025	
SD	07/20/2016 10:45	08/17/2016 09:15	6600V2 (November)	6589		6150	6136	6560	6025	
SD	08/17/2016 09:45	09/14/2016 09:45	6600V2 (Oscar)	6589		6150 ROX	6136	6560	6025	
SD	09/14/2016 10:15	10/20/2016 11:00	6600V2 (November)	6589		6150	6136	6560	6025	
SD	10/20/2016 12:15	11/15/2016 11:45	6600V2 (Mike)	6561		6150	6136	6560	6025	
SD	11/15/2016 12:00	12/13/2016 11:45	6600V2 (November)	6561		6150	6136	6560	6025	
SD	12/13/2016 12:15	01/17/2017 12:00	6600V2 (Mike)	6561		6150	6136	6560	6025	

7) Distribution

NOAA retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The NERRS retains the right to be fully credited for having collected and process the data. Following academic courtesy standards, the NERR site where the data were collected should be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

Requested citation format:

NOAA National Estuarine Research Reserve System (NERRS). System-wide Monitoring Program. Data accessed from the NOAA NERRS Centralized Data Management Office website: <http://www.nerrsdata.org/>; accessed 12 October 2012.

Also include the following excerpt in the metadata which will address how and where the data can be obtained.

NERR water quality data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal Investigators and Contact Persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page www.nerrsdata.org. Data are available in comma delimited format.

8) Associated researchers and projects

The data are being combined with hydrographic survey data to examine water exchange between Kachemak Bay and Lower Cook Inlet. The sonde data provides the temporal context while the survey data provides the spatial information.

In addition, these data complement the other concurrent System-Wide Monitoring Program modules such as meteorological and nutrient data collection.

II. Physical Structure Descriptors

9) Sensor specifications

YSI 6600EDS data sonde:

Parameter: Temperature

Units: Celsius (C)

Sensor Type: Thermistor

Model#: 6560

Range: -5 to 50 C

Accuracy: +/- 0.15

Resolution: 0.01 C

Parameter: Conductivity

Units: milli-Siemens per cm (mS/cm)

Sensor Type: 4-electrode cell with autoranging

Model#: 6560

Range: 0 to 100 mS/cm

Accuracy: +/- 0.5% of reading + 0.001 mS/cm
Resolution: 0.001 mS/cm to 0.1 mS/cm (range dependant)

Parameter: Salinity
Units: parts per thousand (ppt)
Sensor Type: Calculated from conductivity and temperature
Range: 0 to 70 ppt
Accuracy: +/- 1.0% of reading pr 0.1 ppt, whichever is greater
Resolution: 0.01 ppt

Parameter: Dissolved Oxygen % saturation
Units: percent air saturation (%)
Sensor Type: Rapid Pulse - Clark type, polarographic
Model#: 6562
Range: 0 to 500% air saturation
Accuracy: 0-200% air saturation: +/- 2% of the reading or 2% air saturation, whichever is greater; 200 to 500% air saturation: +/- 6% of the reading
Resolution: 0.1% air saturation

or

Sensor Type: Optical probe w/ mechanical cleaning
Model#: 6150 ROX
Range: 0 to 500% air saturation
Accuracy: 0-200% air saturation: +/- 1% of the reading or 1% air saturation, whichever is greater 200-500% air saturation: +/- 15% or reading
Resolution: 0.1% air saturation

Parameter: Dissolved Oxygen mg/L (Calculated from % air saturation, temperature, and salinity)
Units: milligrams/Liter (mg/L)
Sensor Type: Rapid Pulse - Clark type, polarographic
Model#: 6562
Range: 0 to 50 mg/L
Accuracy: 0-20 mg/L: +/- 2% of the reading or 0.2 mg/L, whichever is greater
20 to 50 mg/L: +/- 6% of the reading
Resolution: 0.01 mg/L

or

Units: milligrams/Liter (mg/L)
Sensor Type: Optical probe w/ mechanical cleaning
Model#: 6150 ROX
Range: 0 to 50 mg/L
Accuracy: 0-20 mg/L: +/-0.1 mg/l or 1% of the reading, whichever is greater
20 to 50 mg/L: +/- 15% of the reading
Resolution: 0.01 mg/L

Parameter: Non-vented Level - Shallow (Depth)
Units: feet or meters (ft or m)
Sensor Type: Stainless steel strain gauge
Range: 0 to 30 ft (9.1 m)
Accuracy: +/- 0.06 ft (0.018 m)
Resolution: 0.001 ft (0.001 m)

Parameter: pH – bulb probe or EDS flat glass probe

Units: pH units

Sensor Type: Glass combination electrode

Model#: 6561 or 6561FG

Range: 0 to 14 units

Accuracy: +/- 0.2 units

Resolution: 0.01 units

Parameter: Turbidity

Units: nephelometric turbidity units (NTU)

Sensor Type: Optical, 90 degree scatter, with mechanical cleaning

Model#: 6136

Range: 0 to 1000 NTU

Accuracy: +/- 2% of reading or 0.3 NTU (whichever is greater)

Resolution: 0.1 NTU

Parameter: Chlorophyll Fluorescence

Units: micrograms/Liter

Sensor Type: Optical probe w/ mechanical cleaning

Model#: 6025

Range: 0 to 400 ug/Liter

Accuracy: Dependent on methodology

Resolution: 0.1 ug/L chl a, 0.1% FS

YSI EXO Sonde:

Parameter: Temperature

Units: Celsius (C)

Sensor Type: CT2 Probe, Thermistor

Model#: 599870

Range: -5 to 50 C

Accuracy: -5 to 35: +/- 0.01, 35 to 50: +/- .005

Resolution: 0.01 C

Parameter: Conductivity

Units: milli-Siemens per cm (mS/cm)

Sensor Type: CT2 Probe, 4-electrode cell with autoranging

Model#: 599870

Range: 0 to 200 mS/cm

Accuracy: 0 to 100: +/- 0.5% of reading or 0.001 mS/cm; 100 to 200: +/- 1% of reading

Resolution: 0.001 mS/cm to 0.1 mS/cm (range dependant)

Parameter: Salinity

Units: practical salinity units (psu)/parts per thousand (ppt)

Sensor Type: CT2 probe, Calculated from conductivity and temperature

Range: 0 to 70 psu

Accuracy: +/- 1.0% of reading pr 0.1 ppt, whichever is greater

Resolution: 0.01 psu

OR

Parameter: Temperature
Units: Celsius (C)
Sensor Type: Wiped probe; Thermistor
Model#: 599827
Range: -5 to 50 C
Accuracy: ± 0.2 C
Resolution: 0.001 C

Parameter: Conductivity
Units: milli-Siemens per cm (mS/cm)
Sensor Type: Wiped probe; 4-electrode cell with autoranging
Model#: 599827
Range: 0 to 100 mS/cm
Accuracy: $\pm 1\%$ of the reading or 0.002 mS/cm, whichever is greater
Resolution: 0.0001 to 0.01 mS/cm (range dependent)

Parameter: Salinity
Units: practical salinity units (psu)/parts per thousand (ppt)
Model#: 599827
Sensor Type: Wiped probe; Calculated from conductivity and temperature
Range: 0 to 70 ppt
Accuracy: $\pm 2\%$ of the reading or 0.2 ppt, whichever is greater
Resolution: 0.01 psu

Parameter: Dissolved Oxygen % saturation
Sensor Type: Optical probe w/ mechanical cleaning
Model#: 599100-01
Range: 0 to 500% air saturation
Accuracy: 0-200% air saturation: $\pm 1\%$ of the reading or 1% air saturation, whichever is greater 200-500%
air saturation: $\pm 5\%$ or reading
Resolution: 0.1% air saturation

Parameter: Dissolved Oxygen mg/L (Calculated from % air saturation, temperature, and salinity)
Units: milligrams/Liter (mg/L)
Sensor Type: Optical probe w/ mechanical cleaning
Model#: 599100-01
Range: 0 to 50 mg/L
Accuracy: 0-20 mg/L: ± 0.1 mg/l or 1% of the reading, whichever is greater
20 to 50 mg/L: $\pm 5\%$ of the reading
Resolution: 0.01 mg/L

Parameter: Non-vented Level - Shallow (Depth)
Units: feet or meters (ft or m)
Sensor Type: Stainless steel strain gauge
Range: 0 to 33 ft (10 m)
Accuracy: ± 0.013 ft (0.004 m)
Resolution: 0.001 ft (0.001 m)

Parameter: pH
Units: pH units
Sensor Type: Glass combination electrode
Model#: 599701(guarded) or 599702(wiped)
Range: 0 to 14 units

Accuracy: +/- 0.01 units within +/- 10° of calibration temperature, +/- 0.02 units for entire temperature range

Resolution: 0.01 units

Parameter: Turbidity

Units: formazin nephelometric units (FNU)

Sensor Type: Optical, 90 degree scatter

Model#: 599101-01

Range: 0 to 4000 FNU

Accuracy: 0 to 999 FNU: 0.3 FNU or +/-2% of reading (whichever is greater); 1000 to 4000 FNU +/-5% of reading

Resolution: 0 to 999 FNU: 0.01 FNU, 1000 to 4000 FNU: 0.1 FNU

Parameter: Chlorophyll

Units: micrograms/Liter

Sensor Type: Optical probe

Model#: 599102-01

Range: 0 to 400 ug/Liter

Accuracy: Dependent on methodology

Resolution: 0.1 ug/L chl a, 0.1% FS

The Kachemak Bay NERR deployed five 6600EDS V2-2 sondes, four 6600V2-4 sondes and four EXO 2 sondes in 2016. All sondes were deployed with Temperature/Conductivity, pH, turbidity, and ROX DO probes. The V2-4 sondes were deployed with the same probes as the 6600EDS V2-2 along with an optical chlorophyll probe.

Sensor specifications, continued (YSI 6600EDS V2-2 and 660 V2-4 data sondes):

Parameter	Units	Sensor Type	Model	Range	Accuracy	Resolution
Temperature	Celsius (C)	Thermistor	6560	-5 to 50 °C	+/-0.15 °C	0.01 °C
Conductivity	milli-Siemens per cm (mS/cm)	4-electrode cell with autoranging	6560	0 to 100 mS/cm	+/-0.5% of reading + 0.001 mS/cm	0.001 mS/cm to 0.1 mS/cm (range dependent)
Salinity	parts per thousand (ppt)	Calculated from conductivity and temperature		0 to 70 ppt	+/- 1.0% of reading or 0.1 ppt, whichever is greater	0.01 ppt
Dissolved Oxygen %	percent air saturation (%)	Rapid Pulse – Clark type, polarographic	6562	0 to 500 % air saturation	0-200 % air saturation, +/- 2 % of the reading or 2 % air saturation, whichever is greater; 200-500 % air saturation, +/- 6 % of the reading	0.1 % air saturation
Dissolved Oxygen mg/L	milligrams per Liter (mg/L); Calculated from % air saturation, temp and salinity	Rapid Pulse – Clark type, polarographic	6562	0 to 50 mg/L	0 to 20 mg/L, +/- 2 % of the reading or 0.2 mg/L, whichever is greater; 20 to 50 mg/L, +/- 6 % of the reading	0.01 mg/L
Dissolved Oxygen %	% Saturation	Optical probe w/ mechanical cleaning	6150 ROX	0 to 500% air saturation	0-200% air saturation: +/- 1% of the reading or 1% air saturation, whichever is greater; 200-500% air saturation: +/- 15% of reading	0.1% air saturation
Dissolved Oxygen mg/L	milligrams/Liter (mg/L)	Optical probe w/ mechanical cleaning	6150 ROX	0 to 50 mg/L	0-20 mg/L: +/-0.1 mg/l or 1% of the reading, whichever is greater; 20 to 50 mg/L: +/- 15% of the reading	0.01 mg/L
Depth	feet or meters (m)	Stainless steel strain gauge		0 to 30 ft (9.1 m)	+/- 0.06 ft (0.018 m)	0.001 ft (0.001 m)
pH	pH units	Glass combination electrode	6561 and 6561FG	0 to 14 units	+/- 0.2 units	0.01 units
Turbidity	nephelometric turbidity units (NTU)	Optical, 90 ° scatter, with mechanical cleaning	6136	0 to 1000 NTU	+/- 2 % reading or 0.3 NTU (whichever is greater)	0.1 NTU
Chlorophyll	micrograms/Liter (µg/L)	Optical probe w/ mechanical cleaning	6025	~0 to 400 µg/L 0 to 100 RFU	The accuracy of the in vivo measurement will be completely dependent on the method of calibration	0.1 µg/L Chl 0.1% RFU

Dissolved Oxygen Qualifier (Rapid Pulse / Clark type sensor):

The reliability of dissolved oxygen (DO) data collected with the rapid pulse / Clark type sensor after 96 hours post-deployment for non-EDS (Extended Deployment System) data sondes may be problematic due to fouling which forms on the DO probe membrane during some deployments (Wenner et al. 2001). Some Reserves utilize the YSI 6600 EDS data sondes, which increase DO accuracy and longevity by reducing the environmental effects of fouling. Optical DO probes have further improved data reliability. The user is therefore advised to consult the metadata for sensor type information and to exercise caution when utilizing rapid pulse / Clark type sensor DO data beyond the initial 96-hour time period. Potential drift is not always problematic for some uses of the data, i.e. periodicity analysis. It should also be noted that the amount of fouling is very site specific and that not all data are affected. If there are concerns about fouling impacts on DO data beyond any information documented in the metadata and/or QAQC flags/codes, please contact the Research Coordinator at the specific NERR site regarding site and seasonal variation in fouling of the DO sensor.

Depth Qualifier:

The NERR System-Wide Monitoring Program utilizes YSI data sondes that can be equipped with either vented or non-vented depth/level sensors. Readings for both vented and non-vented sensors are automatically compensated for water density change due to variations in temperature and salinity; but for all non-vented depth measurements, changes in atmospheric pressure between calibrations appear as changes in water depth. The error is equal to approximately 1.02 cm for every 1 millibar change in atmospheric pressure, and is eliminated for vented sensors because they are vented to the atmosphere throughout the deployment time interval.

Beginning in 2006, NERR SWMP standard calibration protocol calls for all non-vented depth sensors to read 0 meters at a (local) barometric pressure of 1013.25 mb (760 mm/hg). To achieve this, each site calibrates their depth sensor with a depth offset number, which is calculated using the actual atmospheric pressure at the time of calibration and the equation provided in the SWMP calibration sheet or digital calibration log. This offset procedure standardizes each depth calibration for the entire NERR System. If accurate atmospheric pressure data are available, non-vented sensor depth measurements at any NERR can be corrected.

In 2010, the CDMO began automatically correcting depth/level data for changes in barometric pressure as measured by the Reserve's associated meteorological station during data ingestion. These corrected depth/level data are reported as cDepth and cLevel, and are assigned QAQC flags and codes based on QAQC protocols. Please see sections 11 and 12 for QAQC flag and code definitions.

NOTE: older depth data cannot be corrected without verifying that the depth offset was in place and whether a vented or non-vented depth sensor was in use. No SWMP data prior to 2006 can be corrected using this method. The following equation is used for corrected depth/level data provided by the CDMO beginning in 2010:
$$((1013-BP)*0.0102)+Depth/Level = cDepth/cLevel.$$

Salinity Units Qualifier:

In 2013, EXO sondes were approved for SWMP use and began to be utilized by Reserves. While the 6600 series sondes report salinity in parts per thousand (ppt) units, the EXO sondes report

practical salinity units (psu). These units are essentially the same and for SWMP purposes are understood to be equivalent, however psu is considered the more appropriate designation. Moving forward the NERR System will assign psu salinity units for all data regardless of sonde type.

Turbidity Qualifier:

In 2013, EXO sondes were approved for SWMP use and began to be utilized by Reserves. While the 6600 series sondes report turbidity in nephelometric turbidity units (NTU), the EXO sondes use formazin nephelometric units (FNU). These units are essentially the same but indicate a difference in sensor methodology, for SWMP purposes they will be considered equivalent. Moving forward, the NERR System will use FNU/NTU as the designated units for all turbidity data regardless of sonde type. If turbidity units and sensor methodology are of concern, please see the Sensor Specifications portion of the metadata.

Chlorophyll Fluorescence Disclaimer:

YSI chlorophyll sensors (6025 or 599102-01) are designed to serve as a proxy for chlorophyll concentrations in the field for monitoring applications and complement traditional lab extraction methods; therefore, there are accuracy limitations associated with the data that are detailed in the YSI manual including interference from other fluorescent species, differences in calibration method, and effects of cell structure, particle size, organism type, temperature, and light on sensor measurements.

10) Coded variable definitions

File name definitions: Reserve/deployment site/file definition/year
(ex: kacsswq2016 = Kachemak Bay/Seldovia Surface/WaterQuality/2016).

Sampling station	Sampling site code	Station code
Homer Surface	H3	kach3wq
Homer Deep	HD	kachdwq
Seldovia Surface	SS	kacsswq
Seldovia Deep	SD	kacsdwq

11) QAQC flag definitions

QAQC flags provide documentation of the data and are applied to individual data points by insertion into the parameter's associated flag column (header preceded by an F_). During primary automated QAQC (performed by the CDMO), -5, -4, and -2 flags are applied automatically to indicate data that is missing and above or below sensor range. All remaining data are then flagged 0, passing initial QAQC checks. During secondary and tertiary QAQC 1, -3, and 5 flags may be used to note data as suspect, rejected due to QAQC, or corrected.

- 5 Outside High Sensor Range
- 4 Outside Low Sensor Range
- 3 Data Rejected due to QAQC
- 2 Missing Data
- 1 Optional SWMP Supported Parameter
- 0 Data Passed Initial QAQC Checks
- 1 Suspect Data
- 2 *Open - reserved for later flag*
- 3 Calculated data: non-vented depth/level sensor correction for changes in barometric pressure
- 4 Historical Data: Pre-Auto QAQC

5 Corrected Data

12) QAQC code definitions – This section details the secondary QAQC Code definitions used in combination with the flags above. Include the following excerpt:

QAQC codes are used in conjunction with QAQC flags to provide further documentation of the data and are also applied by insertion into the associated flag column. There are three (3) different code categories, general, sensor, and comment. General errors document general problems with the deployment or YSI datasonde, sensor errors are sensor specific, and comment codes are used to further document conditions or a problem with the data. Only one general or sensor error and one comment code can be applied to a particular data point, but some comment codes (marked with an * below) can be applied to the entire record in the F_Record column.

General Errors

GIC	No instrument deployed due to ice
GIM	Instrument malfunction
GIT	Instrument recording error; recovered telemetry data
GMC	No instrument deployed due to maintenance/calibration
GNF	Deployment tube clogged / no flow
GOW	Out of water event
GPF	Power failure / low battery
GQR	Data rejected due to QA/QC checks
GSM	See metadata

Corrected Depth/Level Data Codes

GCC	Calculated with data that were corrected during QA/QC
GCM	Calculated value could not be determined due to missing data
GCR	Calculated value could not be determined due to rejected data
GCS	Calculated value suspect due to questionable data
GCU	Calculated value could not be determined due to unavailable data

Sensor Errors

SBO	Blocked optic
SCF	Conductivity sensor failure
SCS	Chlorophyll spike
SDF	Depth port frozen
SDG	Suspect due to sensor diagnostics
SDO	DO suspect
SDP	DO membrane puncture
SIC	Incorrect calibration / contaminated standard
SNV	Negative value
SOW	Sensor out of water

SPC	Post calibration out of range
SQR	Data rejected due to QAQC checks
SSD	Sensor drift
SSM	Sensor malfunction
SSR	Sensor removed / not deployed
STF	Catastrophic temperature sensor failure
STS	Turbidity spike
SWM	Wiper malfunction / loss

Comments

CAB*	Algal bloom
CAF	Acceptable calibration/accuracy error of sensor
CAP	Depth sensor in water, affected by atmospheric pressure
CBF	Biofouling
CCU	Cause unknown
CDA*	DO hypoxia (<3 mg/L)
CDB*	Disturbed bottom
CDF	Data appear to fit conditions
CFK*	Fish kill
CIP*	Surface ice present at sample station
CLT*	Low tide
CMC*	In field maintenance/cleaning
CMD*	Mud in probe guard
CND	New deployment begins
CRE*	Significant rain event
CSM*	See metadata
CTS	Turbidity spike
CVT*	Possible vandalism/tampering
CWD*	Data collected at wrong depth
CWE*	Significant weather event

13) Post deployment information

Homer Surface (H3):

Site	Deploy Date	Sonde	SpCond (50 mS/cm)		DO (%)	pH (7)	pH (10)	Turb (0 NTU)	Turb (126 NTU)	Depth (m)	Chl (0)	Notes
H3	12/22/2015	Alpha	48.47		98.1	7.09	10.16	0.7	123.3	-0.306		
H3	01/19/2016	Indigo	48.34		95.9	6.98	9.92	0.4	126.3	-0.177		
H3	02/23/2016	Alpha	50.41		99.3	7.03	10.04	1.7	125.2	-0.167		
H3	03/21/2016	Indigo	49.38		97.1	7.02	10.05	0.5	123.5	-0.179		
H3	4/22/2016	Alpha			99.5	7.06	10.07	-0.2	134.0	-0.036		
H3	5/19/2016	Indigo	48.39		98.9	7.06	9.87	-1.3	120.1	0.026		
H3	6/20/2016	Alpha	48.48		97.7	7.02	10.06	0.4	121.9	-0.132		
H3	07/22/2016	Papa	50.46		99.2	7.09	10.13	1.69	125.5	0.072	7.73	
H3	08/17/2016	Romeo	50.09		101.9	7.05	10.12	5.66	127.2	-0.041		
H3	09/19/2016	Quebec	52.32		95.5	7.01	10.04	-1.52	124.9	0.029	0.06	
H3	10/13/2016	Quebec	50.06		101.4	7.05	10.06	2.41	121.02	-0.143	2.74	
H3	10/21/2016	Sierra	51.74		101.5	7.2	10.18	0.04	120.78	-0.037	0.09	
H3	11/16/2016	Quebec	50.06		103.6	6.79	6.73	0.1	119.6	-0.254	-0.09	
H3	11/23/2016	Romeo	49.46		100.0	7.1	10.23	4.44	124.8	0.087	-30.79	

Homer Deep (HD):

Site	Deploy Date	Sonde	SpCond (50 mS/cm)		DO (%)	pH (7)	pH (10)	Turb (0 NTU)	Turb (126 NTU)	Depth (m)	Chl (0)	Notes
HD	12/22/2015	Foxtrot	48.37		99.7	7.11	10.18	0.1	122.8	-0.308		
HD	01/20/2016	Delta	48.68		95.8	7.00	10.02	0.6	126.5	-0.197		
HD	02/23/2016	Foxtrot										
HD	03/21/2016	Golf	49.39		97.3	7.05	10.10	0.2	123.8	-0.177		
HD	04/22/2016	Foxtrot	49.12		98.4	7.04	10.04	-0.4	129.1	-0.036		
HD	05/19/2016	Golf	49.85		99.8	7.01	10.03	1.2	124.3	0.029		
HD	06/20/2016	Foxtrot	50.15		97.3	7.03	10.11	0.2	123.2	-0.127		
HD	07/22/2016	Indigo	50.26		99.2	7.03	10.05	0.3	120.4	0.078		
HD	08/17/2016	Delta	50.52		100.2	7.01	10.07	0.2	119.9	-0.03		
HD	09/19/2016	Indigo	50.59		97.5	6.7	9.73	0.2	125.3	-0.135		
HD	10/21/2016	Delta	51.95		100.4	7.05	10.07	0.7	141.7	-0.028		
HD	11/16/2016	Indigo	49.9		100.7	7.04	10.18	-0.1	119.3	0.102		
HD	12/14/2016	Delta	49.05		98.8	6.6	9.56	2.6	126.8	-0.271		

Seldovia Surface (SS):

Site	Deploy Date	Sonde	SpCond (50 mS/cm)		DO (%)	pH (7.02)	pH (10.06)	Turb (0 NTU)	Turb (126 NTU)	Depth (m)	Chl (0)	Notes
SS	12/18/2015	Mike	48.55		97.8	7.02	10.06	0.4	123.8	-0.311	-0.4	
SS	01/20/2016	Golf	47.97		98.9	7.02	10.01	0.1	123.3	-0.029		
SS	02/22/2016	Mike	51.3		99.6	7.00	10.04	-0.3	123.4	-0.156	0.7	
SS	03/21/2016	November	49.45		99.4	7.06	10.05	19.4	146.7	-0.157	2.4	
SS	4/21/2016	Lima	48.96		98.1	7.04	10.03	-0.5	125.1	-0.128	0.3	
SS	5/17/2016	Delta	49.74		99	7.12	10.13	0.3	127.4	-0.033		
SS	6/16/2016	Lima	49.27		99.1	7.12	10.09	-0.4	132.5	-0.0030	0.7	
SS	07/20/2016	Quebec	50.41		101.1	7.03	10.08	8.5	124.6 (124)	0.072	8.8	
SS	08/17/2016	Sierra	50.24		101.6	6.39	9.42	1.34	124.35 (124)	-0.118	0.28	
SS	09/14/2016	Papa	51.19		97.3	7.1	10.19	7.2	124.85 (124)	-0.145	6.04	
SS	10/20/2016	Romeo	50.41		99.9	7.13	10.1	1.79	125.35 (124)	0.034	-29.72	
SS	11/15/2016	Papa	50.29		100.4	7.07	10.07	6.56	122.2 (124)	0.066	-0.02	
SS	12/13/2016	Quebec	49.58		97.9	7.07	10.07	1.64	127.75 (124)	-0.266	-0.02	

Seldovia Deep (SD):

Site	Deploy Date	Sonde	SpCond (50 mS/cm)		DO (%)	pH (7.02)	pH (10.06)	Turb (0 NTU)	Turb (126 NTU)	Depth (m)	Chl (0)	Notes
SD	01/19/2016	November	48.17		99.4	6.98	9.96	-0.1	123.2	-0.018	0.3	
SD	02/22/2016	Lima	49.56		101.9	7.33	10.32	0.1	120.6	-0.155	562.8	
SD	03/21/2016	Oscar	47.48		99.9	7.07	10.07	0.2	124.8	-0.088	-0.1	
SD	4/21/2016	Mike	49.99		98.7	7.01	10	-0.2	125.1	-0.083	-0.1	
SD	5/3/2016	November	49.68		96.5	7.13	10.15	0.4	127.1	-0.129	0.3	
SD	5/17/2016	Mike	50.11		98.8	7.04	10.03	1.0	123.6	-0.03	0.1	
SD	6/16/2016	Oscar	49.48		99.7	6.58	9.51	1.0	122.2	0.002	0.2	
SD	07/20/2016	November	53.52		98.5	7.08	10.09	0.1	125.2	0.065	0.1	
SD	08/17/2016	Oscar	50.39		99.0	6.86	9.58	-0.1	127.4	-0.126	0.6	
SD	09/14/2016	November	50.71		98.5	30.06	30.01	-0.1	126.1	-0.142	0.0	
SD	10/20/2016	Mike	50.89		99.6	7.32	10.15	1.5	134.6	-0.029	1.8	
SD	11/15/2016	November	49.78		100.8	7.05	10.14	-1.9	114.4	0.093	0.9	
SD	12/13/2016	Mike	49.61		98.3	7.02	10.13	2.9	121.9	-0.266	0.4	

14) Other remarks/notes

Data are missing due to equipment or associated specific probes not being deployed, equipment failure, time of maintenance or calibration of equipment, or repair/replacement of a sampling station platform. Any NaNs in the dataset stand for “not a number” and are the result of low power, disconnected wires, or out of range readings. If additional information on missing data is needed, contact the Research Coordinator at the reserve submitting the data.

Seldovia Surface & Homer Surface sites move up and down on a cable. Sometimes the sonde gets hung-up on the cable, causing out of water events. <1.0 meter and >0.1 meter data are retained.

Chlorophyll fluorescence readings at Seldovia Surface were frequently anomalously high from April through September in 2016. Generally, these readings rarely exceed 30 micrograms per liter in Kachemak Bay, and data showing higher values should be used with caution.

At the 1/20/2016 sonde swap-out (at 14:45), we found the buoy had broken free of the Homer Surface 3 sonde, leaving the sonde lying on the bottom. Data from the time it sunk (in 2015) till it was discovered lying on the bottom were rejected. Repairs were made on 1.22.2016, and the sonde was re-deployed at 15:45.

On 1/29/2016 the Homer Deep sonde was pulled out of the water at 11:42, to make repairs on the deployment tube. The sonde was redeployed at 12:39. Data while the sonde was out of the water have been rejected.

Soon after deployment on 4/21/2016, the sonde at Seldovia Deep stopped transmitting data to the satellite. It was swapped for a different sonde on 5/3/16 at 09:40. The previously-deployed sonde was functioning properly, but the data cable connection was wet.

On 10/06/2016 sometime late in the day, the cable at the Homer Surface3 sonde broke, and the sonde floated free. It washed up on the beach and was retrieved on 10/10/2016. We redeployed it with a new cable on 10/13/2016.

On 11/17/2016 the Homer Surface3 sonde cable broke again. It was redeployed with a new cable on 11/23/2016 at 10:00.

On 12/14/2016 the Homer Surface3 sonde was removed for the remainder of the winter due to icing.