

Form Rev. 9.14.17

1. Project Number:

17120114-I

2. Project Title:

Long-term Monitoring of Oceanographic Conditions in the Alaska Coastal Current from Hydrographic Station GAK-1

3. Principal Investigator(s) Names:

Seth Danielson, University of Alaska Fairbanks
Thomas Weingartner, University of Alaska Fairbanks

4. Time Period Covered by the Report:

February 1, 2017-January 31, 2018 (Year 6)

5. Date of Report:

March 2018

6. Project Website (if applicable):www.gulfwatchalaska.orgwww.ims.uaf.edu/gak1/**7. Summary of Work Performed:**

The project sampling objectives were accomplished with conductivity, temperature, and depth instruments (CTDs) in nearly all months and a successful annual recovery and re-deployment of the GAK-1 mooring in March 2017. Nominally monthly CTD casts were done from the *R/V Little Dipper*, *R/V Sikuliaq*, *M/V Dora*, and *M/V Acorn*. As noted in the FY18 work plan, we have been working to replace our Seward-based coastal research vessel, the *R/V Little Dipper*, which has serviced the GAK-1 CTD monthly profiles since the 1980s. In July 2017, the *Little Dipper* suffered an engine failure. Since July we have repaired the engine and subsequently sold the vessel and are actively seeking a replacement. We have identified funding sources for a replacement vessel and hope to have a bid package out for a replacement vessel in the coming weeks, with a delivery date by early 2019. In the meantime, we charter local vessels to conduct the monthly sampling.

Data from the 2016-2017 mooring is shown in Fig. 1 and record-length anomaly time series for GAK-1 are shown in Fig. 2 along with the best fit linear trend line. Statistics of the trend analysis are provided in Table 1. The analysis shows that the surface waters are warming faster than waters near the seafloor. The surface is freshening and the waters near the seafloor have an opposite trend but the latter is not significantly different than zero. These trends show that the water column is progressively stratifying over time.

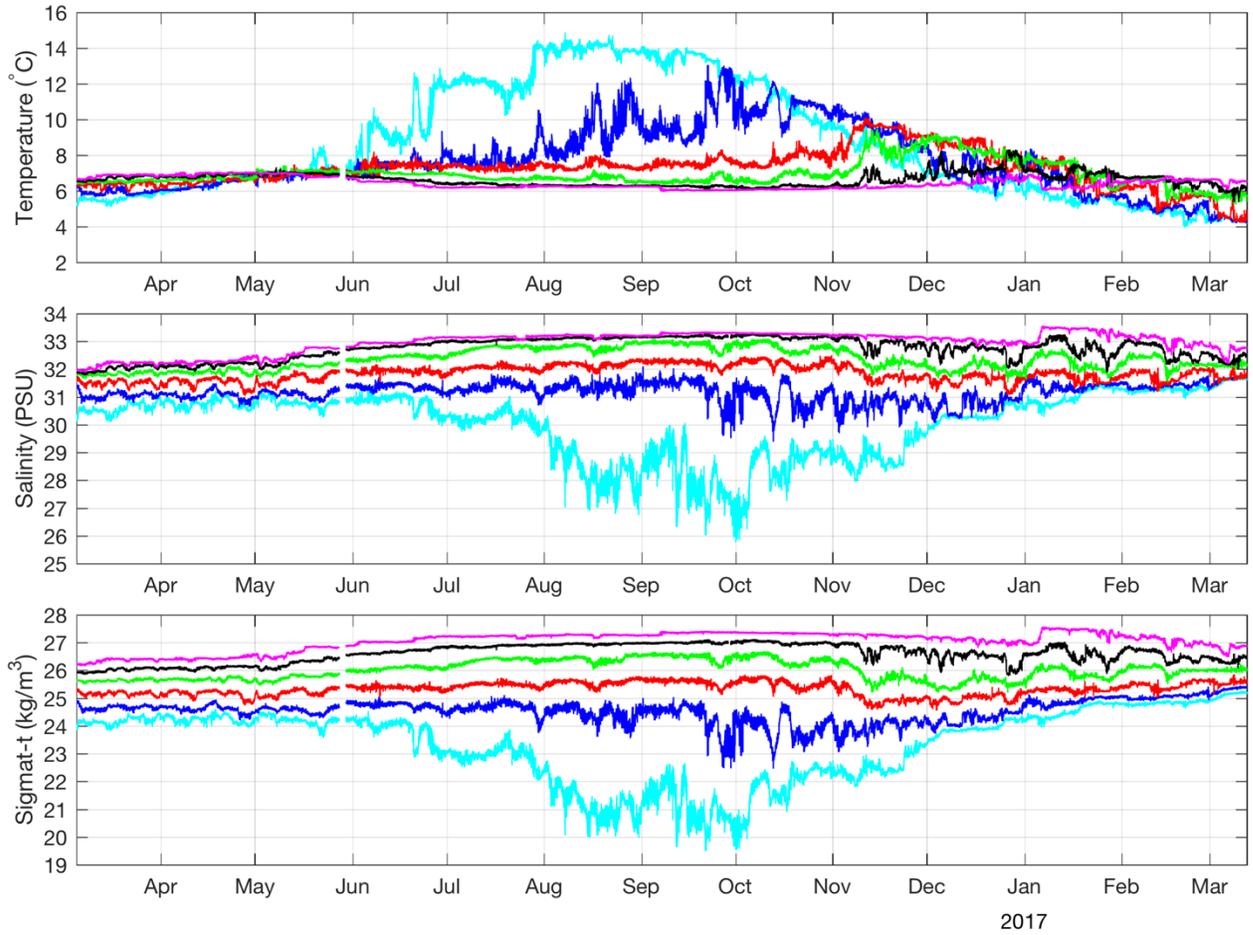


Figure 1. Time series of the 2016-2017 GAK-1 mooring records. Colors denote the nominal depth of each instrument from shallow (cyan, 20 m) to deep (magenta, 250 m).

Table 1. Statistics of the temperature and salinity trends observed at GAK-1 over December 1970 to January 2018. Slope is given as change of parameter per decade. C.I. is the 95% confidence interval on the slope.

Parameter	Depth Range	N	Slope (decade ⁻¹)	Slope C.I. (decade ⁻¹)	r ²	p
Temperature	0-50	393	0.24	0.07	0.12	0.00
Temperature	200-250	391	0.15	0.04	0.14	0.00
Salinity	0-50	393	-0.08	0.03	0.05	0.00
Salinity	200-250	391	0.02	0.02	0.01	0.07

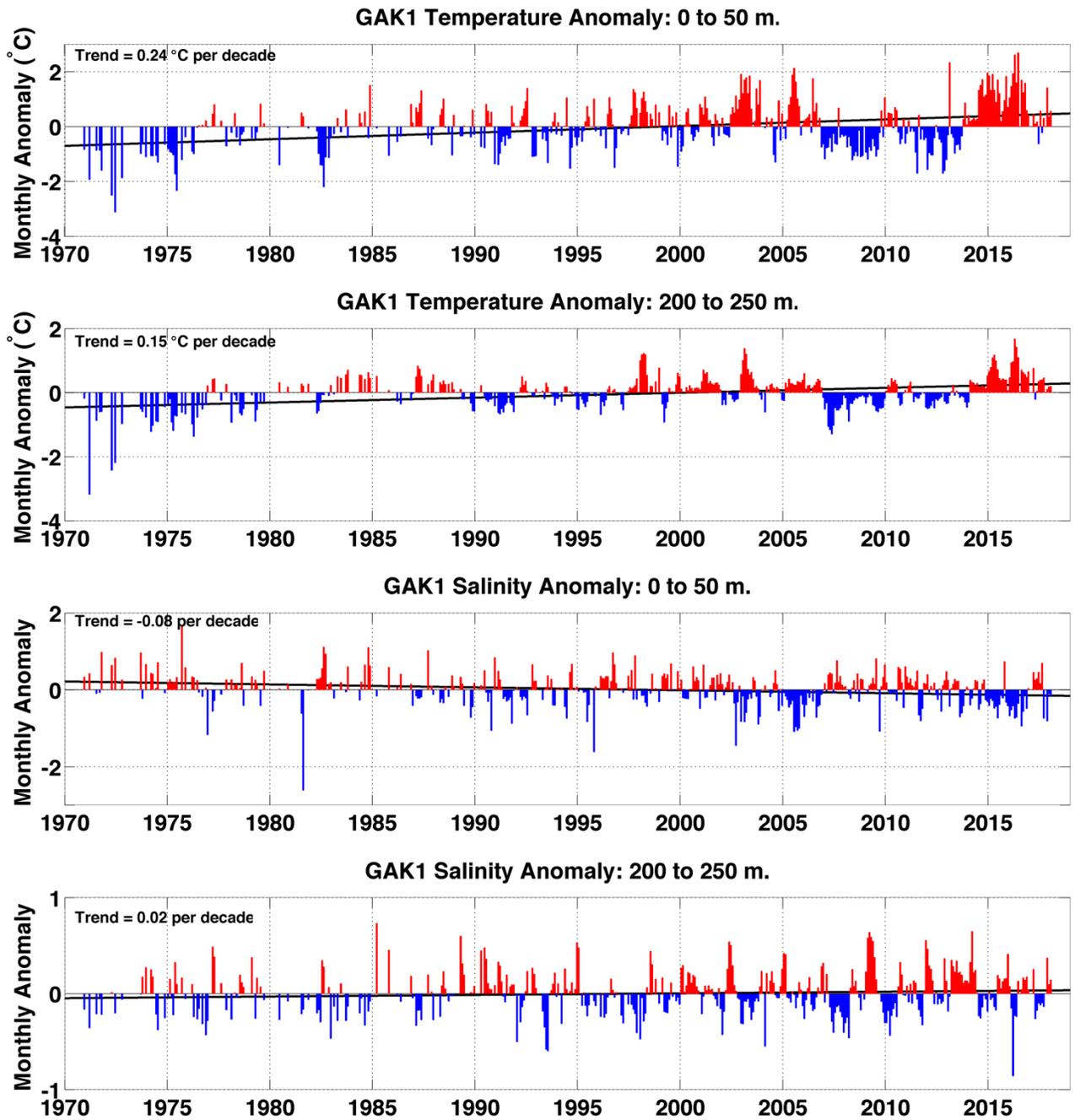


Figure 2. Record-length temperature and salinity monthly anomalies for near-surface (0-50m) and near-seafloor (200-250m) depth ranges. Positive anomalies are shown in red, negative anomalies are in blue. The linear trend line is shown in black and the trend slope is shown at the upper left-hand side of each panel.

8. Coordination/Collaboration:

A. Projects Within a Trustee Council-funded program

1. Within the Program

GAK-1 project personnel are working in partnership with Gulf Watch Alaska personnel from the program office (projects 17120114-A and B), the nearshore ecosystems component (project 17120114-H), Prince William Sound oceanography (project 17120114-G), and Lower Cook Inlet/Kachemak Bay oceanographic (project 17120114-J) projects in a coordinated cross-component effort to examine spatial and temporal regimes of variability and coherence in water and air temperatures across the Gulf Watch Alaska study region. The analyses will integrate existing Gulf Watch Alaska data along with ancillary National Oceanographic and Atmospheric Administration (NOAA) Center for Operational Oceanographic Products and Services (CO-OPS), remotely sensed satellite, and NOAA-National Data Buoy Center datasets. The focus of the analysis seeks a better understanding of the connections between the intertidal zone (nearshore ecosystems) and the coastal waters offshore (environmental drivers).

GAK-1 and the Seward Line (project 17120114-L) monitoring projects are closely partnering to increase the sampling effort at station GAK-1. In 2018 we added collections of nutrients, chlorophyll a, and zooplankton net tows to the GAK-1 sampling while on site for the CTD profiles.

2. Across Programs

a. Herring Research and Monitoring

None to report.

b. Data Management

We are coordinating with the Data Management team to upload data to the Research Workspace and make it available on the Gulf of Alaska data portal and review metadata and update for accuracy.

c. Lingering Oil

None to report.

B. Projects not Within a Trustee Council-funded program

None.

C. With Trustee or Management Agencies

The GAK-1 project is working in partnership with the new National Science Foundation-funded long-term ecological research (LTER) program to increase the inter-disciplinary, temporal and spatial coverage of high-resolution continuous data collections in the northern Gulf of Alaska. The infrastructure of the LTER project represented a leverage opportunity to increase our mooring-based monitoring on the mid to outer shelf. Along with other matching funds from the LTER program, University of Alaska Fairbanks, and the Alaska Ocean Observing System, we applied for major infrastructure funding from the M.J. Murdock Charitable Trust in 2017 and were awarded over \$350,000 (project total of over \$700,000) to build out an “Ecosystem Observatory” mooring on the northern Gulf of Alaska shelf. This offers us the ability to take a significant step forward in the year-round monitoring of many physical, chemical, and

biological factors. We anticipate that these year-round measurements will provide much-needed information during the many months of the year during which the Seward Line sampling cannot afford to collect in situ samples.

The GAK-1 project contributes data annually to NOAA's Ecosystem Considerations Reports. Full reports may be found at the following link:

<https://access.afsc.noaa.gov/reem/ecoweb/Index.php>

Danielson completed a re-analysis of the National Park Service (NPS) Glacier Bay oceanographic monitoring data and included in the (draft) report is a section that compares thermal and haline signals between station GAK-1 and Glacier Bay.

9. Information and Data Transfer:

A. Publications Produced During the Reporting Period

Batten, S.D., Raitsos, D.E., **Danielson, S.**, Hopcroft, R., Coyle, K., and McQuatters-Gollop, A. 2017. Interannual variability in lower trophic levels on the Alaskan Shelf. Deep Sea Research Part II. DOI: <http://dx.doi.org/10.1016/j.dsr2.2017.04.023>

Danielson, S. L. *In review*. Glacier Bay Oceanographic Monitoring Program Analysis of Observations, 1993-2016. Natural Resource Technical Report NPS/XXXX/NRTR—20XX/XXX. National Park Service, Fort Collins, Colorado.

Weingartner, T. J. and S. L. Danielson. 2018. Long-term monitoring of oceanographic conditions in the Alaska Coastal Current from hydrographic station GAK1 over 1970-2016. *Exxon Valdez Oil Spill Restoration Project Final Report (Restoration Project 16120114-P)*. Exxon Valdez Oil Spill Trustee Council, Anchorage, Alaska.

Recent publications using GAK1 data

Kohan, M.L., Mueter, F.J., Orsi, J.A., and McPhee, M.V. 2017. Variation in size, condition, and abundance of juvenile chum salmon (*Oncorhynchus keta*) in relation to marine factors in Southeast Alaska. Deep Sea Research Part II. DOI: <https://doi.org/10.1016/j.dsr2.2017.09.005>

Helser, T., Kastle, C., Crowell, A., Ushikubo, T., Orland, I.J., Kozdon, R., and Valley, J.W. 2017. A 200-year archaeozoological record of Pacific cod (*Gadus macrocephalus*) life history as revealed through ion microprobe oxygen isotope ratios in otoliths. *Journal of Archaeological Science: Reports*

Zador, S.G., Holsman, K. K., Aydin, K. Y., and Gaichas, S. K. 2017. Ecosystem considerations in Alaska: the value of qualitative assessments, *ICES Journal of Marine Science*, Volume 74, Issue 1, 1 January 2017, Pages 421–430. <https://doi.org/10.1093/icesjms/fsw144>.

B. Dates and Locations of any Conference or Workshop Presentations where EVOSTC-funded Work was Presented

UAF-IMS seminar: Marine heatwaves in the North Pacific and Arctic, 2013-2017, Fairbanks AK, 22 November 2017. **Oral Presentation.**

UAF Site Review: Northern Gulf of Alaska Marine Ecosystem Monitoring, M.J. Murdock Charitable Trust, 10 August 2017. **Oral Presentation.**

C. Data and/or Information Products Developed During the Reporting Period, if Applicable

We submitted a status update to NOAA's annual report *Ecosystem Considerations – Status of the Gulf of Alaska Marine Ecosystem* and to PICES's *North Pacific Ecosystems Status Report*. We continue to update the GAK-1 homepage list of citations that employ the GAK-1 dataset.

Danielson, S. 2017. Data contributed to the NOAA Ecosystem Considerations Report 2017 for the Gulf of Alaska region. Full reports may be found at the following link: <https://access.afsc.noaa.gov/reem/ecoweb/Index.php>.

Danielson, S. L., and T. J. Weingartner. 2017. GAK1 Mooring Timeseries data, Seward, AK, from the GAK1 project, 2012-2016, Gulf Watch Alaska Environmental Drivers Component. Dataset. Exxon Valdez Oil Spill Trustee Council Long-Term Monitoring program. Research Workspace. <https://doi.org/10.24431/rw1k18>.

Danielson, S. L., and T. J. Weingartner. 2017. CTD profile time series data from the GAK1 project, 2012-2016, Gulf Watch Alaska Environmental Drivers Component. Dataset. Exxon Valdez Oil Spill Trustee Council Long-Term Monitoring program. Research Workspace. <https://doi.org/10.24431/rw1k1b>.

D. Data Sets and Associated Metadata that have been Uploaded to the Program's Data Portal

GAK-1 mooring and CTD datasets to be updated online and on the Research Workspace on schedule.

10. Response to EVOSTC Review, Recommendations and Comments:

Science Panel Comments and Responses on Revised FY17-21 Proposal, September 2016

In September 2016, the Science Panel had no specific comments.

Science Panel Comments and Responses on FY18 Work Plans, September 2017

In September 2017, the Science Panel commented: This is an important long-term data collection project that needs to continue. The Panel supports the research and welcomes the news of the Long-Term Ecological Research (National Science Foundation) funding awarded to the PIs, which will insure the stability of gathering long-term data while expanding the scope of the project. PIs are using graduate students productively.

PI response: Thank you for the comments.

11. Budget:

Please see provided program workbook.

Personnel spending is below anticipated because the NOAA grant was established in late April, which was later than anticipated. The anticipated FY17 equipment purchase was delayed until FY18 to take advantage of matching funds from the M.J. Murdock Charitable Trust. Contractual

expenditures are higher than anticipated because a more expensive vessel was chartered after the *M/V Little Dipper* had engine troubles; this expenditure will continue to be higher until a replacement vessel is available.