

SOP 15: Five-Year Report (OC_L Creation) version 2

Beginning in 2012 and every five years thereafter, the Project Leader, with appropriate SEAN-funded external technical assistance, will undertake trend analyses and comparison of the monitoring program dataset to other regional datasets for the purpose of placing observed signals into broader temporal and regional contexts.

1 Five-Year Report Format and Content

The Five-Year Report will contain the following subsections and content:

1. **Introduction:** Overview of the monitoring program and its history
2. **Methods:** Summary of the sampling methodology
3. **Coverage:** Chart showing what stations were occupied in what months and years
4. **Results:** Analyses are driven mainly by observed features noted within the Glacier Bay dataset. The Five-Year Report will include the following four components:
 1. Analysis of spatial extent of observed anomalies
 2. Trend analysis
 3. Time series analysis
 4. Comparisons to other surface and profile data
5. **Discussion:** Summary of observations based on tables and figures presented in the Results section.

2 Content of Results Section (i): Analysis of Spatial Extent of Observed Anomalies

For the same reasons as for the Annual Data Report, Station 04 is given particular attention in the five-year data reports. The Five-Year Report should describe the extent to which Station 04 anomalies are representative of anomalies observed at the other core Glacier Bay stations (and other oceanographic stations in the larger region) through use of basic statistics: mean, standard deviation, and cross-correlation computations will suffice. This analysis will help place interpretation of the Station 04 results into a broader spatial context.

3 Content of Results Section (ii): Trend Analysis

The Five-Year Report will present monthly anomaly time series, which includes station-by-station plots of the *difference between observed and long-term mean monthly values*. This manipulation removes the mean annual signal (represented by the monthly climatology) from the time series and allows for straightforward interpretation of different signals. Examples of such analyses are available at the GAK1 time series web page: <http://www.ims.uaf.edu/gak1/> and in Figure SOP 15.1 below. Analyses will be performed at a selection of depth levels that provide a representative depiction of the water column. Employ the standard oceanographic depth levels of 0, 10, 20, 30, 40, 50, 75, 100, 150, 200, 250, and 300 m.

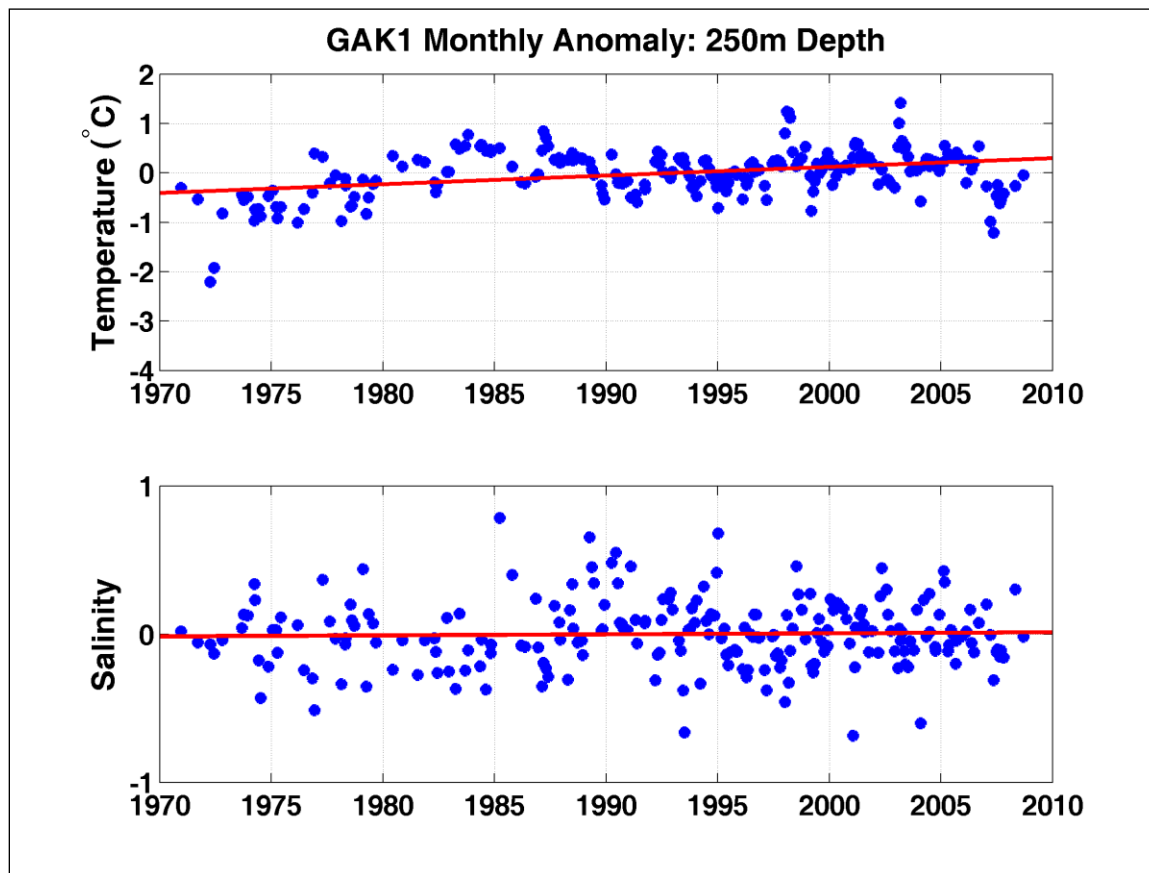


Figure SOP 15.1. Example anomaly plots of temperature (top) and salinity in PSU (bottom) along with the least-squares best fit linear trend (red) to each time series for oceanographic station GAK1. In these plots, the mean annual signal (monthly climatology) has been subtracted from the present month's measurements, resulting in a zero mean anomaly time series. The plots show that the mean 250 m temperature has increased by nearly 1 °C over the last 35 years, whereas the salinity has remained essentially unchanged. The most recent two years (2007 and 2008) show temperatures well below the long-term trend line, indicating a recent prolonged cold spell. Temperatures through most of the 1980s, however, were mostly higher than normal.

4 Content of Results Section (iii): Time Series Analysis

When the GLBA dataset is sufficiently long, spectral analysis techniques (e.g., Fourier analysis) will be appropriate for evaluating cyclic and quasi-cyclic phenomena. To ensure statistically robust interpretations, Fourier analysis requires a time series to be about 10 times the length of the period for the signal of interest. Thus, to well resolve the (approximately) three-year El Nino (Southern Oscillation Index) signal, a time series approaching 30 years will be required.

The GLBA oceanographic time series trends and anomalies should also be compared to other regional datasets collected in the northeastern Pacific. These comparisons should include investigations of regime shifts (e.g., step or state changes) and periodic or quasi-periodic phenomena.

Oceanographic data sets for comparison include (but are not necessarily limited to):

1. The GAK1 time series
2. Oceanographic measurements from the mouth of Resurrection Bay, Alaska. Dataset maintained by the University of Alaska: <http://www.ims.uaf.edu/gak1/>
3. The Line P and Ocean Station Papa time series
4. Oceanographic measurements from 50 N, 140 W. Dataset maintained by the Canadian Department of Fisheries and Ocean Sciences (DFO) at the Institute of Ocean Sciences (IOS): <http://www.pac.dfo-mpo.gc.ca/science/oceans/data-donnees/line-p/index-eng.html>.
5. Canadian “lighthouse” time series
6. Sea surface temperature and salinity measurements from lighthouses located along the Canadian Pacific coast. Dataset maintained by DFO-IOS: <http://www.pac.dfo-mpo.gc.ca/science/oceans/data-donnees/lighthouses-phares/index-eng.html>
7. National Data Buoy Center (NDBC) moorings and coastal station datasets: <http://www.ndbc.noaa.gov/>
8. Oceanographic and meteorological data sets located throughout Southeast Alaska

Companion plots of environmental and climate time series may be employed to help interpret the oceanographic findings within a broader context. Cross-correlation techniques can help identify possible linkages between the local Glacier Bay system and the companion time series.

Data sets for comparison include:

1. Local atmospheric variables:
 1. Wind, temperature, and precipitation datasets available from the National Climate Data Center (NCDC) www.ncdc.noaa.gov and the National Data Buoy Center (NDBC) www.ndbc.noaa.gov.
 2. The Bakun Upwelling index available from the Pacific Fisheries Environmental Laboratory: http://www.pfeg.noaa.gov/products/PFEL/modeled/indices/upwelling/NA/upwell_menu_NA.html
 3. Variables computed by atmospheric reanalysis models such as the National Center for Environmental Prediction/National Center for Atmospheric Research (NCEP/NCAR) reanalysis: <http://www.esrl.noaa.gov/psd/data/gridded/data.ncep.reanalysis.html>
1. Local sea level/tide stations:
 1. Data available from the NOAA Tides and Currents web page: <http://tidesandcurrents.noaa.gov/>
2. Local streamflow data:
 1. Dataset available from the United States Geological Survey: <http://waterdata.usgs.gov/ak/nwis/>
3. Large-scale climate system indices:
 1. Pacific Decadal Oscillation (PDO): <http://jisao.washington.edu/pdo/PDO.latest>
 2. Southern Oscillation Index: www.cgd.ucar.edu/cas/catalog/climind/index.html

3. North Pacific Index (NPI): www.cgd.ucar.edu/cas/catalog/limind/index.html
4. Pacific-North American Index (PNA): <http://jisao.washington.edu/data/pna/>

5 Content of Results Section (iv): Comparison of Glacier Bay Measurements to Other Surface and Profile Data

Evaluation of the Glacier Bay CTD data within a broader spatial context can be accomplished by using historical CTD casts from the greater Southeast Alaska region. Data can be downloaded from the NODC World Ocean Database (WOD) at <http://www.nodc.noaa.gov/access/index.html>. The plot shown in Figure SOP 15.2 is an example of using this WOD historical dataset. The WOD should be polled for each Five-Year Report to determine whether new casts for the region of interest have been incorporated. Transects that are coincident or nearly coincident with the timing of the Glacier Bay CTD transects should be focused on and will provide the greatest benefit for analysis.

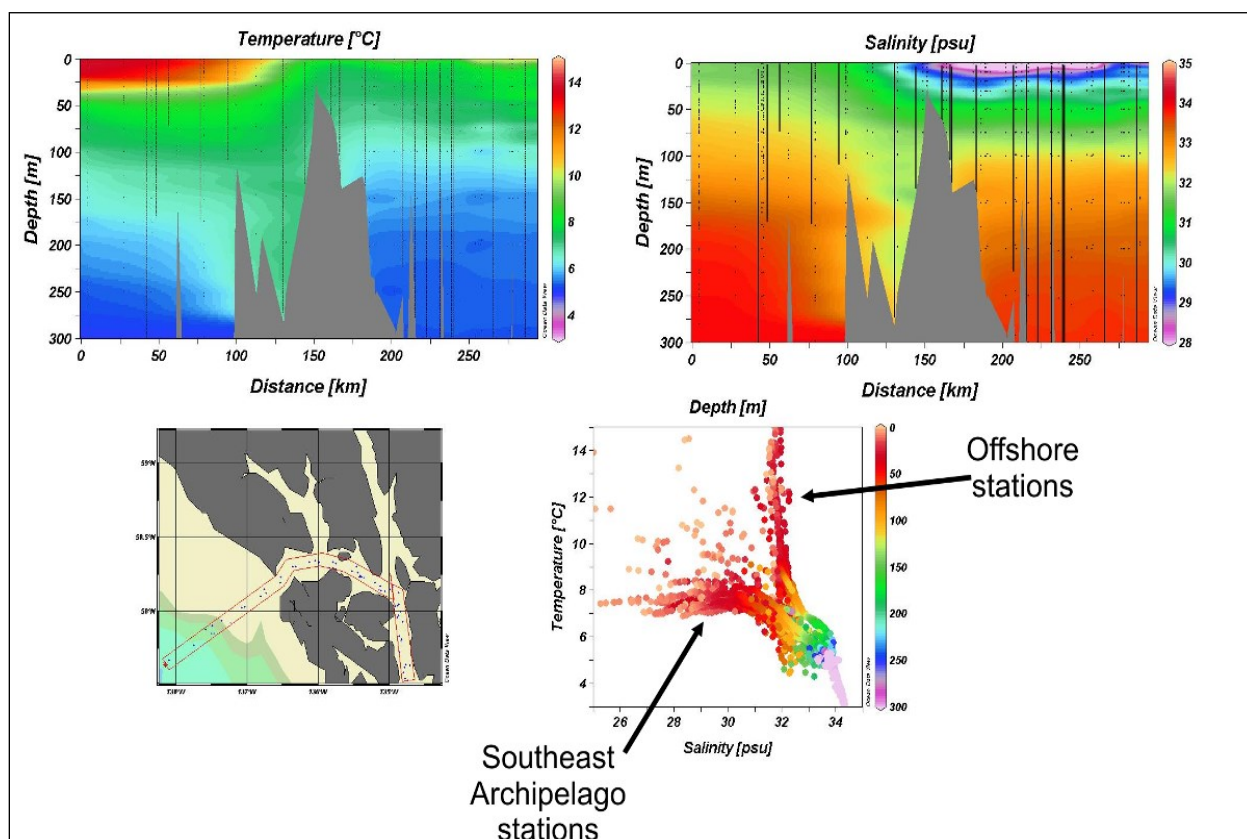


Figure SOP 15.2. Horizontal cross-sections (upper panels) and a temperature-salinity plot (lower right panel) employing historical CTD data from the NODC World Ocean Database, plotted with the Ocean Data View (ODV) software package. Station locations are plotted on the map in the lower left panel and span from the central Gulf of Alaska (located at 0 km on the left of the upper two panels) into Cross Sound (at approximately 110 km) to the mouth of Glacier Bay (at approximately 150 km), to the mouth of Lynn Canal (at approximately 220 km) and down into Chatham Strait. In this case, the data are averaged from between the months of August and October.

Other spatially explicit datasets that can lead to useful insight include satellite measurements of:

1. Sea surface temperature (advanced very high resolution radiometer satellite)
2. Winds
3. Sea surface elevation (from the Topex/Poseidon satellites)
4. Ocean color (SeaWifs and MODIS satellites)

These datasets can all be accessed online: <http://seawifs.gsfc.nasa.gov/> and http://podaac.jpl.nasa.gov/DATA_CATALOG/index.html. Useful datasets can also be retrieved directly from the AOOS data portal: <http://www.aos.org/>.

6 Validation and Submission of the Deliverable

The final version of OC_L is generated as a DOCX file by the Project Leader. It is passed to the Data Manager for processing as an NRTR by the NPS publications staff. Once the publications group approves the final product, the data manager creates a PDF file and performs the protocol-defined validation checks. Eventually the report is confirmed certified through the standard workflow described in Chapter 4. The Data Manager installs the final PDF in the auxiliary repository, creates a web link for it, updates the Deliverable Product Tracking grid, and forwards the final OC_L to NPS's IRMA Data Store.