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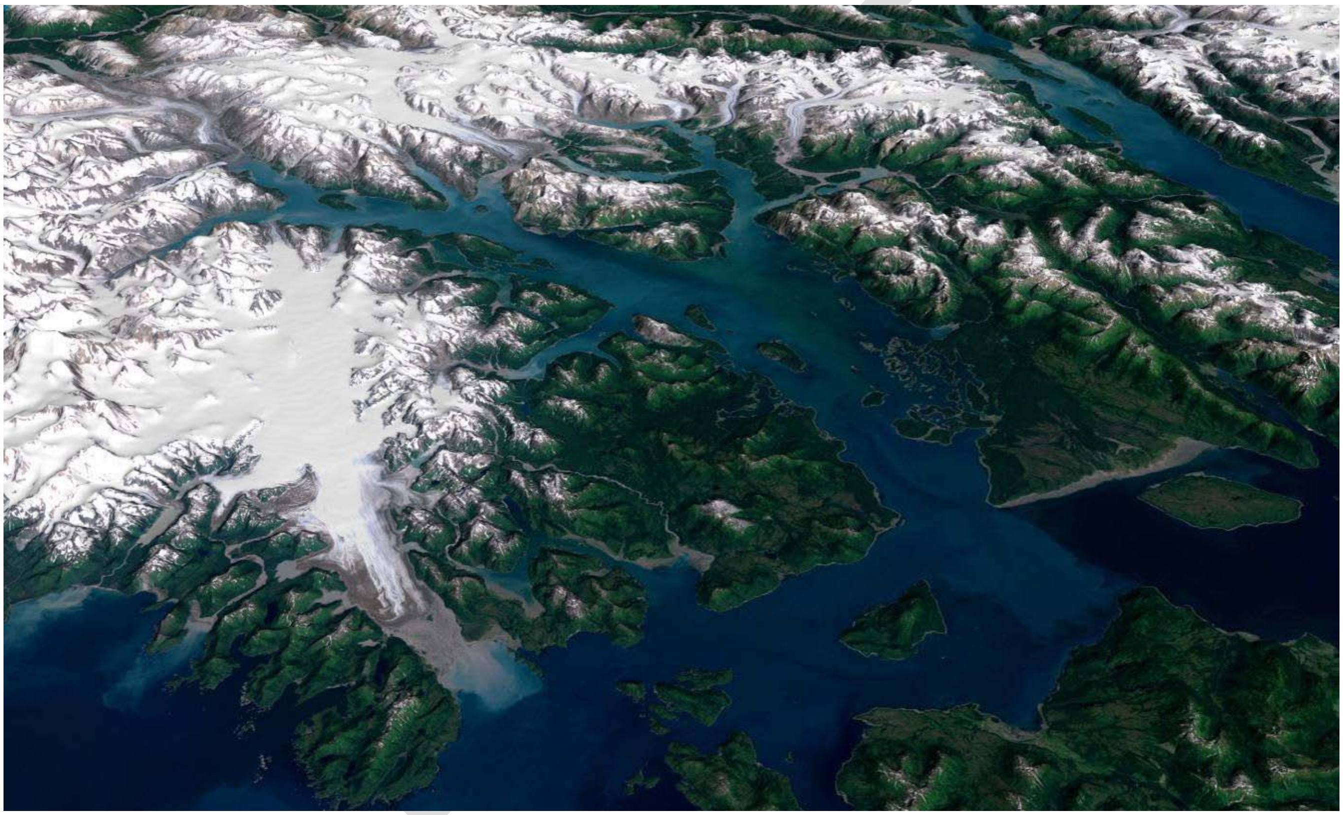
Glacier Bay National Park and Preserve Oceanographic Monitoring Protocol OC–2009.1

Natural Resource Report NPS/SEAN/NRR—2009/XXX



ON THE COVER
Aerial view of Glacier Bay National Park and Preserve.
Image courtesy of NASA's Visible Earth archive. Landsat data and USGS NED data coregistration provided by the Landsat Project Science Office at NASA's Goddard Space Flight Center. The image is a visualization created by merging imagery from the Landsat 7 satellite's Enhanced Thematic Mapper Plus (ETM+) instrument with elevation data from the USGS National Elevation Dataset (NED).

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Abstract

Initiated in 1993, the Glacier Bay hydrographic survey archives represent one of the longest running oceanographic datasets in Alaskan waters. This document describes the field methods and data handling procedures required to ensure an uninterrupted and consistent sampling program in the future collection, quality assurance and archiving procedures. The dataset will enable future analyses to better interpret observed changes in the physical environment and better understand how the marine physical environment impacts the abundant marine life found within Glacier Bay.

Nine field surveys are scheduled for each year: two comprehensive surveys in mid-winter and mid-summer with occupation of all standard stations and seven monthly surveys between March and October with occupations of representative core stations. Water column profiles of the following parameters constitute the measurements for all surveys: water temperature, salinity, photosynthetically active radiation (PAR), optical backscatterance (OBS – turbidity), dissolved oxygen, and chlorophyll-a fluorescence (proxy for phytoplankton concentration, an index of phytoplankton standing stock).

Acknowledgements

The authors would like to extend their deepest appreciation to all of the people who have been responsible for carrying the Glacier Bay oceanographic sampling to the point it is at today – a robust 16 year time series. Oceanographic time series of this extent and quality are rare anywhere and particularly rare in Alaskan waters. The science field crews, vessel operators, and principal investigators all have dedicated untold time and resources toward creating this dataset and these efforts have resulted in what will be an enduring legacy through the implementation of this oceanographic monitoring program. We thank the authors of Hooge et al. (2003) for providing a sound foundation for the subsequent generation of this protocol. We thank our collaborators and reviewers who provided valuable and defining input to the process that led to the sample design selection, the final protocol document, and implementation of the program. In particular, Lisa Etherington, Mayumi Arimitsu, David Hill and Tom Weingartner all provided valuable insights and comments.

1.0 Background and Objectives

1.1 Protocol Synopsis

This protocol is an update of and supersedes the Hooge et al. (2003) *Fjord Oceanography Handbook.* The National Park Service (NPS) Southeast Alaska Network (SEAN) entered into an agreement with the University of Alaska Fairbanks (UAF) to cooperatively update and revise Hooge et al. (2003), following NPS standards for protocol content as described in Oakley et al. (2003). Some relevant material herein remains unchanged from Hooge et al. (2003), including the majority of the fundamental data processing algorithm settings. Significant changes and additions have been made to the protocol for the sampling design and for visualization, reporting, and archiving data. Much of sections *1.2* and *1.3* are reproduced from the executive summary of Eckert et al. (2006), "Assessment of coastal water resources and watershed conditions at Glacier Bay National Park and Preserve, Alaska." Readers are encouraged to consult this original source for references and more detailed background information.

The body of this protocol is structured to provide an overall description of steps, processes, and staff responsibilities for conducting the monitoring program. Standard Operating Procedures (SOPs) provide detailed, step-wise procedures for conducting each step or process. SOPs are referenced in each section, as appropriate.

This protocol was designed for application to Glacier Bay proper. Throughout this document, we use "GLBA" to refer to the entirety of the NPS administrative unit of Glacier Bay National Park and Preserve, and "Glacier Bay" to refer to Glacier Bay proper.

1.2 History of Glacier Bay National Park and Preserve

GLBA is located in northern Southeast Alaska and is bordered by the Gulf of Alaska to the west, Icy Strait to the south, Tongass National Forest to the west and northwest, Tatshenshini-Alsek Provincial Park (Canada) to the north, and Tongass National Forest to the northeast (Figure 1). GLBA encompasses marine areas along the outer coast, Cross Sound, Icy Strait, Glacier Bay proper, and smaller bays including Dundas Bay, Lituya Bay, Torch Bay and Dry Bay. Multiple sills, embayments, tidewater glaciers, islands and other topographic features characterize Glacier Bay's complex bathymetry. Glacier Bay has mixed semi-diurnal tides and a large tidal range, averaging 3.7 m (12 ft) near the mouth to greater than 4.2 m (14 ft) at the heads.

On February 26, 1925, President Calvin Coolidge created Glacier Bay National Monument to preserve the majestic beauty and scientific opportunities. The area of the Monument doubled in size in 1936, and the boundaries were modified in 1955, excluding Gustavus and the east side of Excursion Inlet. Gold mining was permitted from 1936 until 1976. Glacier Bay became a National Park through the Alaska National Interest Lands Conservation Act (ANILCA) of 1980, which extended the park boundary to the Alsek River and Dry Bay for a total area of over 1.33 million ha (3.28 million acres) including 23,426 ha (57,884 acre) in the preserve. GLBA was designated an

International Biosphere Reserve in 1986 and a World Heritage Site in 1992. In 2005, the National Park Service won a Supreme Court case filed by the State of Alaska, resulting in NPS jurisdiction over submerged lands and tidelands within GLBA boundaries. This decision made GLBA one of the few protected areas in the world that includes submerged marine habitat within its jurisdiction. Bartlett Cove is the single major site of terrestrial human presence in GLBA and the only location in the park that is human-occupied year-round.

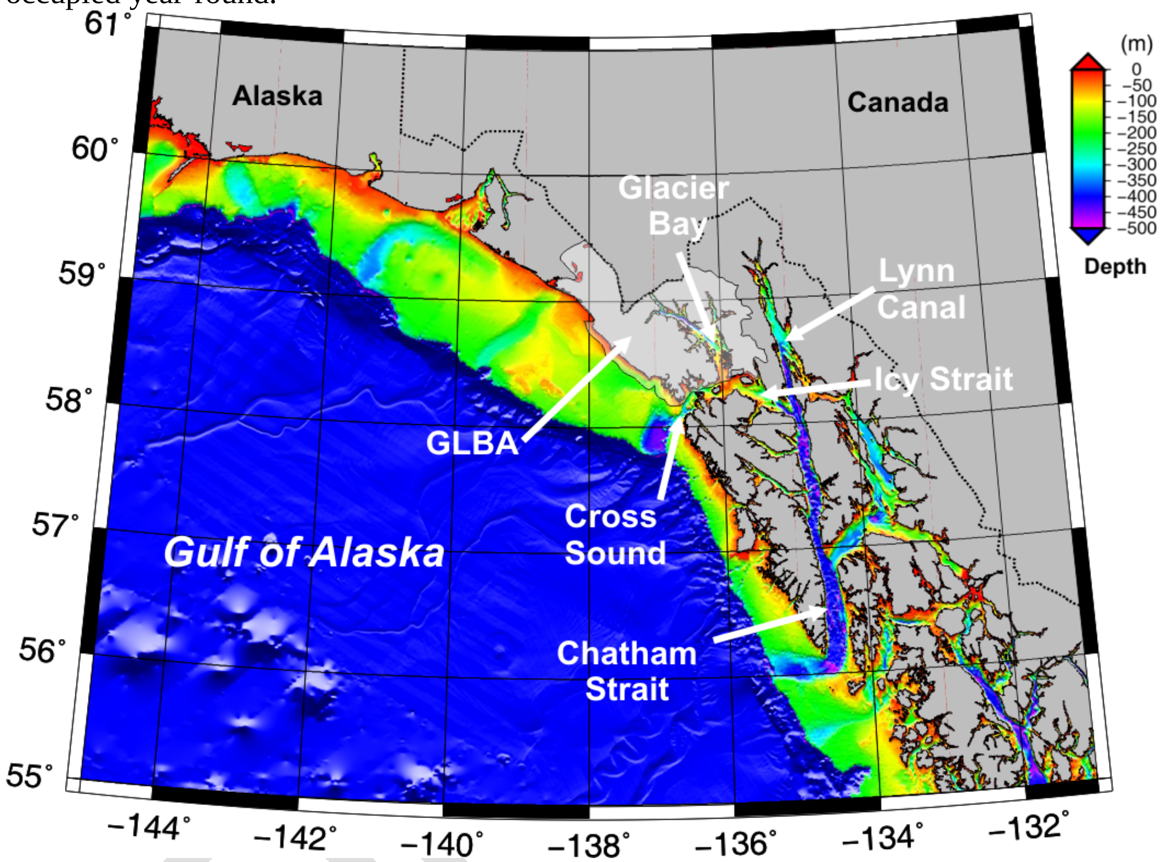

Figure 1.1. Map of the northeast Gulf of Alaska locating Glacier Bay and GLBA (light shading) with respect to the nearby major bodies of water. Color shading represents the bathymetric topography, with depths of greater than 500m colored dark blue. The entrance to Glacier Bay resides at the crest of a shallow sill (~50m) in Icy Strait, separating northern Chatham Strait from Cross Sound.

1.3 Biophysical Setting

GLBA is well known as a natural laboratory, and starting with John Muir and William S. Cooper, classic studies of ecological succession began in the late 1800s and early 1900s. Vegetation changes along the gradient of glacier recession are well-documented and are textbook examples of ecological succession. In streams, the successional development of plant and animal communities is closely connected with the growth and maturation of adjacent terrestrial plant communities. Stream invertebrates colonize streams after dissolved organic carbon inputs by colonizing stream bank vegetation reach adequate levels. As plant succession continues, woody debris may accumulate in streams, providing shelter for fish and promoting colonization by anadromous salmonids.

Glaciers have been carving the park for more than seven million years, and today approximately 27 percent (356,136 ha [880,000 acres]) of GLBA is covered by glacial ice. In 1794, Captain George Vancouver documented that Glacier Bay was only 5 miles long due to a massive glacier occupying the bay with its terminus located just south of Sitakaday Narrows. At that time, this large glacier, which is now called the Grand Pacific Glacier, measured more than 1,200 m (4,000 ft) thick, 32 km (20 mi) wide, and more than 161 km (100 mi) long. By 1916, the Grand Pacific Glacier had retreated 100 km (60 mi) to the present Tarr Inlet. This dramatic glacial retreat provides an outstanding opportunity to study glacial retreat, ecological succession, the effects of climate change, and other physical and biological dynamics of the area. Glacial retreat has caused and is continuing to cause tremendous physical changes to GLBA, and as a result, its freshwater and marine ecosystems are dynamic and challenging to understand.

Climate in fall, winter, and spring is dominated by the strong Aleutian Low in the northern Gulf of Alaska and by weak high pressure systems in the summer. As a result, GLBA experiences a wet and moderate marine climate. Records from the only NOAA weather station located within GLBA, at Bartlett Cove, has records going back to 1966 and shows an average temperature of 4.9ºC (40.9ºF), average rainfall of 92 cm (36 in), and average snowfall of 132 cm (52 in). July is the warmest month with an average temperature of 12.8ºC (55 ºF), and the coolest conditions occur in January, when the average temperature is -2.8ºC (27 ºF). Given the geographic and topographic heterogeneity within GLBA, data from this weather station does not represent the diversity of conditions within GLBA.

Biological marine resources include a rich diversity and high abundance of marine mammals, including humpback whales (*Megaptera novaeangliae*), killer whales (*Orcinus orca*), harbor seals (*Phoca vitulina*), Steller sea lions (*Eumetopias jubatus*), sea otters (*Enhydra lutris*), harbor porpoises (*Phocoena phocoena*), minke whales (*Balaenoptera acutorostrata*), and rarely Dall's porpoises (*Phocoenoides dalli*). Humpback whale monitoring in Glacier Bay proper, begun in the mid-1980s, indicates an increasing population. Harbor seals, however, have undergone a drastic decline of over 75% from 1992-2008, at an average annual rate of approximately 10%. Sea otters have undergone a dramatic increase since they began recolonizing Glacier Bay in 1993, with approximately 2,800 individuals recorded in 2006.

Fish and bird diversity in GLBA are very high. Glacier Bay is an important nursery area for fishes and is probably a spawning location for many species. Glacier Bay provides important habitat for many marine birds, with species composition shifting from predominantly seabirds in the summer to predominantly waterfowl in the winter. Some species of marine birds have been declining in Glacier Bay, including Kittlitz's and marbled murrelets, which have been declining throughout Alaska. Glacier Bay supports the largest breeding-season population of Kittlitz's murrelets in the world. Marine invertebrate resources are diverse and abundant and include Tanner (*Chionoecetes bairdi*), Dungeness (*Cancer magister*), and king crabs (*Paralithodes* spp.).

Petroleum spills present a clear environmental risk to coastal water resources in GLBA. Currently, Geographic Response Strategies (GRS), which are spill response plans tailored by ADEC and other agencies, protect specific sensitive areas from oil impacts following a spill. Specific areas within the park for which GRS exist include Point Carolus, Bartlett Cove, Berg Bay, Hugh Miller Inlet, North Beardslee Island, South Marble Island, and Sandy Cove. In 2007, SEAN initiated a marine contaminants monitoring program (using blue mussel tissue assays) to track long-term trends and to maintain a moving baseline that would be exceptionally valuable in the event of an acute local impact (e.g., a vessel grounding or spill).

Climate change is an important natural resource issue for national parks in Alaska, and recent research suggests that changes in climate may dramatically impact water resources in Alaskan parks. Striking effects of climate change on hydrologic resources in Alaska include changes in the extent of permafrost and glaciers and the timing of annual sea ice onset and retreat. A direct result of increased glacier melt is an increase in coastal runoff, and an alteration of coastal sediment discharge. Both inputs can have downstream consequences for the marine ecosystem. Possible effects include increased levels of stratification (with implications for phytoplankton growth timing and magnitude) and increased cross-frontal density gradients (with implications for along-shore transport and cross-frontal mixing processes). The Intergovernmental Panel on Climate Change reports (e.g., IPCC [2007]) predicts high probabilities of increased global mean temperatures over the coming decades. The cryosphere is known to be sensitive to fluctuations in temperature; many ice fields in Alaska are now experiencing net ablation and many tidewater glaciers are retreating. Currently, glaciers in coastal GLBA are thinning at rates as high as 4 m (13 ft) per year and glacial retreat over the last two centuries has moved the leading edge of the tidewater glaciers in Glacier Bay up the fjord more than 100km. Glacial systems are dynamic balances between accumulation and ablation; continued glacial retreat as well as possible periods of glacial advance will modify both the terrestrial and marine environments and ecosystems in the future.

1.4 Purpose of Oceanographic Sampling

Oceanographic measurements collected on the hydrographic survey enable a “bottom-up” perspective of ecosystem relationships. Physical measurements include temperature, salinity, light, oxygen and suspended sediment. These measurements characterize the environment that directly impacts both lower trophic (e.g. phytoplankton) and upper trophic (e.g. crabs, fishes, marine mammals and birds) organisms through their influence on metabolic rates, ability to support carbon fixation through production of chlorophyll, or the propensity for organisms to be retained within/exported from the euphotic layer. Fluorescence measurements provide an index of the phytoplankton standing stock, which in turn forms the food base for primary consumers (zooplankton) and the subsequent cascade of carbon through trophic levels to apex predators (e.g. fishes, marine mammals and birds). Thus, observations made within this monitoring program form a foundation upon which other (e.g., habitat, population) aspects of the marine ecosystem within Glacier Bay can be evaluated.

1.5 Overview of Prior Oceanographic Sampling

Since 1992, the NPS and the US Geological Survey (USGS) have conducted CTD (conductivity-temperature-depth) monitoring of physical conditions, including temperature, salinity, turbidity, photosynthetically active radiation (PAR), and *in situ* fluorometric measurements at 24 stations distributed throughout the Bay. Annual data reports, peer review publications, and program evaluations that describe these measurements are listed in the Reference section of this document. Data from these and other field efforts are archived locally at the SEAN oceanography web page (http://science.nature.nps.gov/im/units/sean/).

This oceanographic monitoring program has revealed salinity values ranging from less than 10 to greater than 32 with least saline waters found in narrow surface lenses near tidewater glaciers, and the most saline waters at deep depths and in the lower Bay. Density fluctuations are primarily driven by salinity, which is the driving dynamic parameter for most coastal Alaskan waters. Sea water temperatures range from -1 to 15 ºC (30 to 59 ºF), with the coldest temperatures found at the heads of the two arms in late winter and the warmest waters observed in surface stratified waters during summer. Light penetration is reduced by sedimentation resulting from glacial runoff and by increases in phytoplankton biomass. The factors driving reductions in light penetration are important to understand because the amount of light available impacts phytoplankton production. Zooplankton surveys indicate rich productivity in a variety of locations within Glacier Bay, particularly in upper inlets with and without tidewater glaciers and near river and stream outlets.

1.6 Rationale for Selecting This Resource to Monitor

GLBA is quintessentially a marine park. Along with weather, glaciers, and landform, the ocean waters drive the park's ecosystems and dominate the dynamics of many biological communities, from primary producers to apex predators. A number of the SEAN Vital Signs applicable to GLBA (e.g., Marine Predators, Intertidal Invertebrate Communities, Kittlitz's Murrelets) are themselves directly or indirectly influenced by oceanography. By monitoring select parameters, managers can detect oceanographic changes that are likely to influence the condition of many resources throughout the park and region. Oceanographic monitoring is important to understanding the Southeast Alaska marine system, the linkage between atmospheric and oceanic systems, and the implications of climate change in high-latitude systems.

Standard oceanographic data are universally recognized among marine scientists as essential to understanding how ocean waters influence associated biology communities in a "bottom-up" fashion. Along with water column stability and nutrient availability, the availability of light drives primary productivity which then controls the dynamics of secondary productivity and indeed the entire marine trophic web.

Eckert et al. (2006) identified four factors that could contribute to impairment of GLBA marine water resources: contaminants, harmful algal blooms, invasive aquatic species, and climate change. Biological populations will respond to impacts realized, and the oceanographic monitoring program will enable us to better understand and/or mitigate resultant changes and effects. Within GLBA, nearly all other resource and research issues are entirely or partly related to the marine ecosystem. Therefore, a better understanding of the many interconnected subsystems comprised by GLBA is dependent upon improved knowledge of underlying oceanographic processes.

1.7 Measurable Objectives

The adopted objectives for the GLBA oceanographic monitoring program were refined through lengthy discussion during the 2006 Program Evaluation (Etherington 2006). These objectives are:

1) To provide a dataset on physical oceanographic conditions in Glacier Bay (salinity, temperature, stratification, photosynthetically available radiation [PAR], optical backscatterance [OBS, turbidity] that can be used to better understand seasonal and interannual changes in the estuarine dynamics of Glacier Bay and the greater southeast Alaska oceanographic system.

2) To provide a baseline oceanographic dataset (salinity, temperature, stratification, photosynthetically available radiation [PAR], optical backscatterance [OBS, turbidity], dissolved oxygen, and chlorophyll *a* fluorescence) that can be used by biologists to understand spatial and temporal variation in the abundance patterns of a variety of organisms including zooplankton, marine invertebrates, fishes, mammals and seabirds of Glacier Bay.

2.0 Sampling Design

Between 1992 and 2008, oceanographic sampling was targeted at the majority of 24 stations on a nominally quarterly basis. In designing the selected sampling scheme, we worked to incorporate results from prior monitoring program reviews (see *Section 8.2*) and evaluations of our proposed modifications so that the selected program maintains coherence with past sampling and also forms the basis for the strongest possible sampling program from this point forward. We took the 10 to 100-year view: in ten years, this dataset will span a quarter century and the bulk of observations will still be from collections made prior to 2009. In 100 years, however, collections made prior to 2009 will comprise fewer than 15% of the total observations. To gain maximum utility, we have strived for a balance between continuity between samples taken before and after 2009 and what we feel is the most useful dataset in the long run.

We were fortunate to have this considerable data set and several corresponding analyses to inform our development of a long-term protocol. In considering existing data, we found that past quarterly sampling adequately resolved inter-annual signals, but was not of sufficient resolution to permit characterization of seasonal signals. Achieving both scales of resolution are inherent to meeting our specified monitoring objectives.

This SEAN protocol, therefore, modifies the sampling design to achieve a balance between spatial and temporal resolution: semi-annual sampling at the "full" complement of 23 stations and monthly sampling from October to March at 7 "core" stations. Samples are taken in the months of March, April, May, June, July, August, September, October and once in mid-winter (December or January), see Figure 2.1.

Water column CTD profiles include direct measurements of pressure, temperature, conductivity, fluorescence and optical backscatterance. Derived values from these measurements include depth, salinity, density, chlorophyll-a concentration and turbidity.

2.1 Rationale for Selecting This Sampling Design Over Others

The selected sampling design achieves moderate spatial resolution of the selected parameters at the "full" complement of 23 stations (Figure 2) so that annual and longer timescale signals can be resolved at all historical CTD stations. Also, monthly sampling (but with coarser spatial resolution) is achieved at the "core" 7 stations during the spring, summer and fall seasons when the ecosystem undergoes its largest dynamical range excursions and the physical properties exhibit their largest temporal and spatial gradients. This design, therefore, achieves a balance between an intensive spatial sampling at two times per year to resolve annual signals and an intensive temporal sampling at a smaller suite of stations to resolve seasonal signals. This spatial/temporal balance addresses logistical, weather and budget realities associated with limited numbers of ship days, labor, and funds that the NPS can dedicate to this particular sampling effort and sustain over the long-term.

The protocol requires three days of ship time each in July and mid-winter, and two days each for cruises monthly during March-June and August-October. This reduction in the number days necessary to complete most cruises requires a smaller window of good

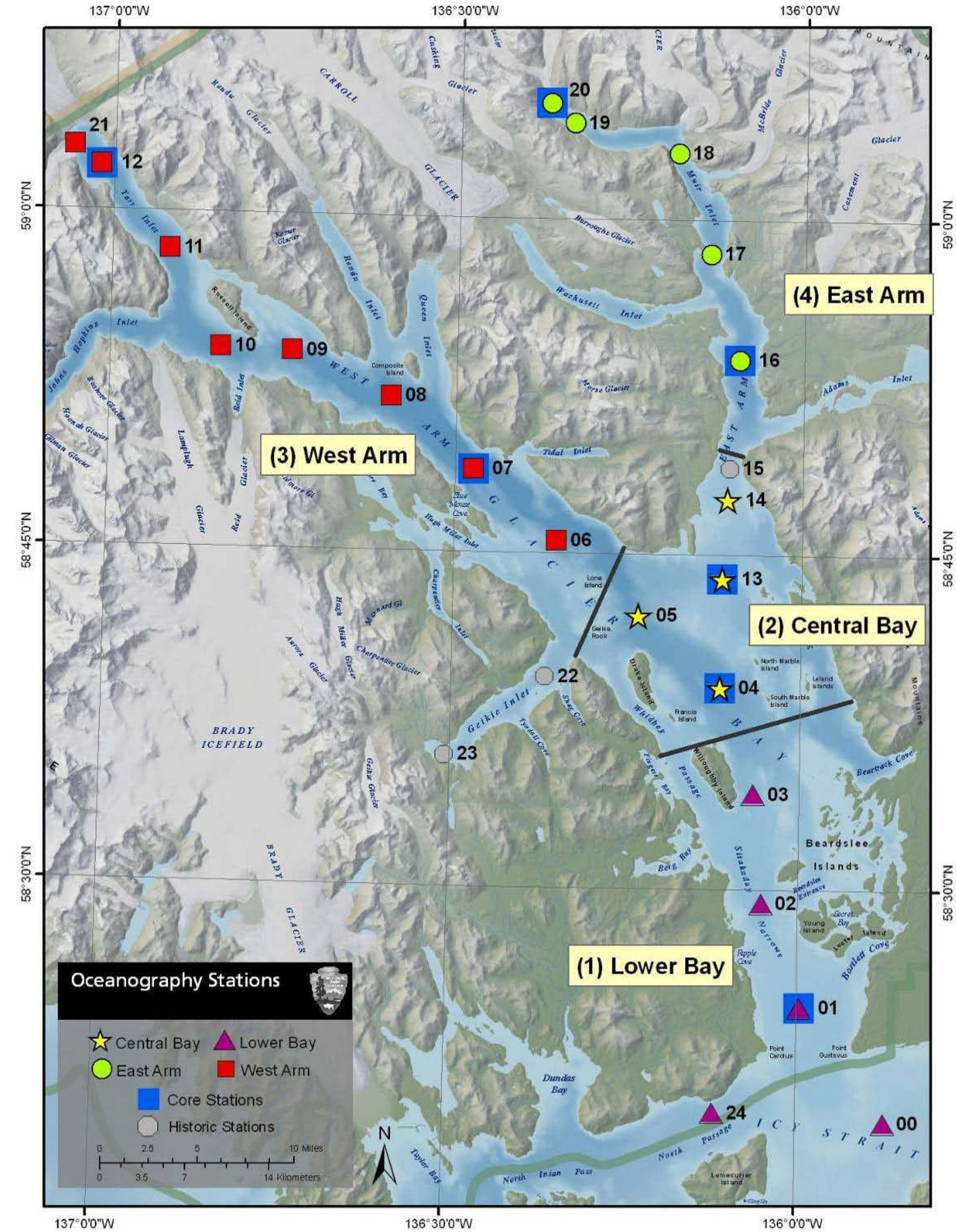

Figure 2.1. Oceanographic sampling station locations in Glacier Bay, Alaska. Stations comprised by the "core" station set are shown on a blue square background. Stations 00-14, 16-21 and 24 comprise the "full" station set. Stations 00-23 were historically sampled.

weather to complete the minimum sampling and will result in a more complete dataset. By staging adequate fuel on-board, it is possible that some of the monthly sampling field trips may be achieved with only one day of field work, thereby potentially reducing the total number of ship days per year.

In addition to the selected design, three alternative designs were considered. The following subsections (2.1.1 – 2.1.3) presents brief summaries of these alternative designs; Appendix E provides an overview of the protocol development focus group meeting that led to selection of the sampling design.

2.1.1 Alternative Design 1: Quarterly Sampling at Historical Station Locations

Alternative Design 1 represented a continuation of the 23 historic stations on a quarterly basis. Although this option would maintain the highest degree of continuity between historical and future efforts, this design was not attractive because it would not be able to resolve seasonal signals and thus would not fulfill the program objectives stated in Section 1.3.

2.1.2 Alternative Design 2: Oceanographic Moorings

We considered subsurface taut-wire oceanographic moorings in Alternative 2. Advantages of a monitoring program built upon mooring technology include high frequency temporal sampling (~1 hour, year-round) and the need of only one ship day per year for mooring servicing. Disadvantages include potential loss of an entire years worth of data if the mooring should catastrophically fail; inability to reliably sample the uppermost 10m of the water column, where many important physical and biological processes take place; problems associated with biofouling, which can degrade measurement accuracy; the considerable initial outlay of funds to purchase all needed equipment is considerable (estimated at $50,000-$100,000 per mooring, depending on configuration). The single most important disadvantage is that a mooring system would yield lower-resolution spatial sampling (both in the horizontal and vertical dimensions), thereby precluding achievement of our monitoring objectives. For these reasons, we determined that this alternative was not an acceptable replacement for the existing monitoring program. A mooring would be a very useful addition if additional funds become available, to add a high frequency temporal sampling.

2.1.3 Alternative Design 3: Incorporation of Ocean Acidification Measurements

Due to the recognized risk of ocean acidification to marine ecosystems, we also considered monitoring the carbonate cycle as part of the hydrographic cruises. A number of factors made this effort unrealistic at the present time. Primary among them is that for purposes of measuring ocean pH, the commercially available pH probes for deployment with a CTD do not achieve the required resolution; they achieve an accuracy of about 0.1 whereas 0.001-0.01 is required in an ocean acidification study. To achieve the required accuracy, water column samples must be obtained and processed in an analytical laboratory. For the purposes of this monitoring program, the costs and additional effort are impractical; however SEAN and GLBA will work to identify external funding sources and partnerships that would allow us to add this important component to our selected design.

2.2 Site Selection

The “full” station set includes stations 00-14, 16-21 and 24; see Figure 2.1 for a map of station locations and the delineation of stations into the four primary domains. Appendix A provides geographic coordinates of the stations. Station 24 (North Passage) is now being added in response to recommendations of the 2006 Program Evaluation (Etherington 2006) and comments made by reviewers of the proposed protocol modification. Specifically, the 2006 Program Evaluation identified the most important candidate for an additional station as “one west of the Bay mouth in deeper water NW of Lemesuier Island” (Etherington 2006:10). The location for Station 24 was chosen to coincide with the deepest point in the passage cross-section and within a reasonable distance to the mouth to Glacier Bay so that vessel transit time to the station is not impractical. The full station set comprises the majority of the historically sampled CTD stations from the years 1992-2008. Stations 22 and 23 in Geikie Inlet were not included within this program because Etherington (2006) recommended their elimination. Station 15 was sampled historically, but was dropped from the program in 2005 after confirmation of a high degree of redundancy of that station with Station 14.

The “core” station set includes stations 01, 04, 07, 12, 13, 16 and 20. These stations are chosen to achieve one (Lower Bay) or two (all other domains) representative samples in each of the primary oceanographic domains at a higher temporal sample rate during the spring, summer, and fall months.

In aggregate, previously published annual reports, peer-reviewed journal articles and program reviews (see Reference section below) form the basis for the selection of the core and full stations sets. The core stations are selected to capture one or two samples within each of four oceanographic domains within Glacier Bay. These domains (Lower Bay, Central Bay, West Arm, East Arm) reflect different - though not independent - biophysical settings that give each domain its own characteristics. These domains are not exhaustive of all possible marine settings within Glacier Bay, but they do represent a wide variety of the major habitat types. Etherington et al. (2007) address the breakout of stations and show that variability within domains is generally small compared to variability across domains.

Station 12 (rather than 21) was selected for inclusion within the core station set because the historical database contains more occupations of Station 12 and in months of thick ice cover, Station 12 is more reliably accessible. Stations 12 and 20 add considerable time to the field work due to the long transits required to access the stations, but due to the proximity of these stations to the fjord heads, they are situated within habitat types not found farther down the fjords. These stations are important to help keep attention upon the shallow buoyant ice melt/coastal runoff plume observed at the head of each fjord and the associated biological responses (e.g., Kittlitz’s Murrelets habitat and those documented in Etherington et al. [2007]).

2.3 Sampling Frequency and Replication

Sampling includes vertical CTD profiles at

1) the “full” station set twice per year: July and mid-winter (December or January)

2) the “core” station set in March, April, May, June, August, September, and October

One vertical profile is required at each of the sample sites. The CTD samples at a rate of 2 measurements per second. These raw scans are subsequently averaged into 1-m bins. At a typical lowering rate of 1 m/s, this achieves approximately 2 samples per 1 m average depth level in the final data file. This final data product thus achieves a medium-resolution depiction of all variables throughout the measured water column.

2.4 Level of Change Detectable for the Amount/Type of Sampling Being Instituted

Monthly sampling of the core station set between March and October will allow resolution of seasonal fluctuations during the period of times that exhibit the greatest biological production and the physical system is typically undergoing its most rapid thermal and fresh water fluctuations.

Semi-annual sampling of the full station dataset will achieve a higher resolution depiction on an annual basis at the highest feasible spatial resolution. This dataset will be appropriate for evaluating interannual variability associated with climate-scale processes such as the El-Nino Southern Oscillation (ENSO) cycle, the Pacific Decadal Oscillation (PDO), or the North Pacific Index (NPI).

The sample design does not resolve sub-monthly time scales, include the fortnightly (2 week), synoptic (2-6 day), tidal (12-24 hour), or supertidal (< 12 hr) signals. Tidal fluctuations are regular and predictable, however, and measurements can be interpreted with respect to the tidal phase and amplitude of the major constituents.

3.0 Hydrographic Survey

The field work component of this monitoring program results directly in the long-term dataset that is needed in order to form robust assessments about the state of the Glacier Bay system. This dataset will enable NPS the ability to observe, assess, and understand changes (both natural and anthropogenic).

Looking ahead to the generation of Annual Data Reports (SOP 14) and 5-Year Reports (SOP 15), steps taken during the survey will assist in the generation of these documents. In particular, entries made in the "Comments" and "Notes" sections on the CTD station Field Log will assist the Project Leader in assembling the cruise operations summary for the reports. Selected photographs of unusual (or even typical) events and conditions can also be incorporated into the reports.

3.1 Field Season Preparations and Equipment Setup

Instrumentation at the start of the sampling year (December/January cruise) should be in good working order, having been previously calibrated at the manufacturer in the time since the previous (October) cruise. A test cast off the dock in Bartlett Cove and subsequent data download and inspection will ensure proper equipment functionality and setup before heading out to the sampling stations. Instructions for assembling equipment required for the survey are given in SOP 4, section 1, with the following subsections:

SOP 4: ***1.0 Field Preparations***

- *Supplies to have on hand (see also Appendix C)*
- *Check computer to CTD communications*
- *Check battery voltage*
- *Memory check and clear*
- *Check date and time*
- *Test cast, download test data, verify*

3.2 Field Operations

Each survey is nominally scheduled to occur within the first full week of the designated month. Vessel availability, vessel operator availability, and weather forecasts all will influence the actual timing of each cruise.

Details of the at-sea portion of the sampling program and the order of operations are listed in SOP 4, section 2:

SOP 4: 2.0 Field Operations

- *Selection of sampling sequence*
- *Navigate to station*
- *Fill out CTD station log*
- *Initiate data logging*
- *Equilibrate the CTD just below the surface*
- *Lower CTD to target depth*
- *Haul CTD back to surface*

- *Terminate data logging*
- *Complete CTD station log*
- *Fresh water rinse*
- *Stow CTD for transit*

3.3 Post-cruise Operations

Post–cruise operations are detailed in SOP 4, section 3. Additional instructions detailing file download from the CTD are found in SOP 5. Instructions for file verification and plotting, done to ensure proper operation of the instrumentation and capture of data, are in SOP 7.

SOP 4: 3.0 Post-cruise Operations

- *Storage of the CTD and associated hardware*
- *Transfer data to network*
- *Data file verification and plotting*

Once the data have been archived on the network servers, initial data verification steps are taken to ensure proper operation of the instrumentation and capture of data.

Evaluation of post-season calibration results (SOP 9), creation of data deliverables (SOPs 6, 8, 10, 11, 12, 13, 16, and 17) and annual report generation (SOP 14) are performed using all cruises at the end of the sampling year after post-season calibrations have been received from Sea-Bird.

4.0 Data Handling, Analysis, and Reporting

This chapter describes the general approaches to generating, maintaining, and disseminating products of this monitoring protocol. Detailed procedures are provided in product-specific SOPs. Detailed product definitions may be found in Appendix J.

4.1 Overview of Information Architecture

Data in the oceanography program are managed according to the standard methods used by all SEAN programs, as described in the SEAN Data Management Plan (Johnson and Moynahan 2008). The model from which these methods were derived is illustrated in Figure 4.1.

Dissemination of all data is done electronically from SEAN and partner web sites. Certain reports are also published by NPS under the Natural Resource Technical Report (NRTR) and Natural Resource Report (NRR) series. No other dissemination methods are supported.

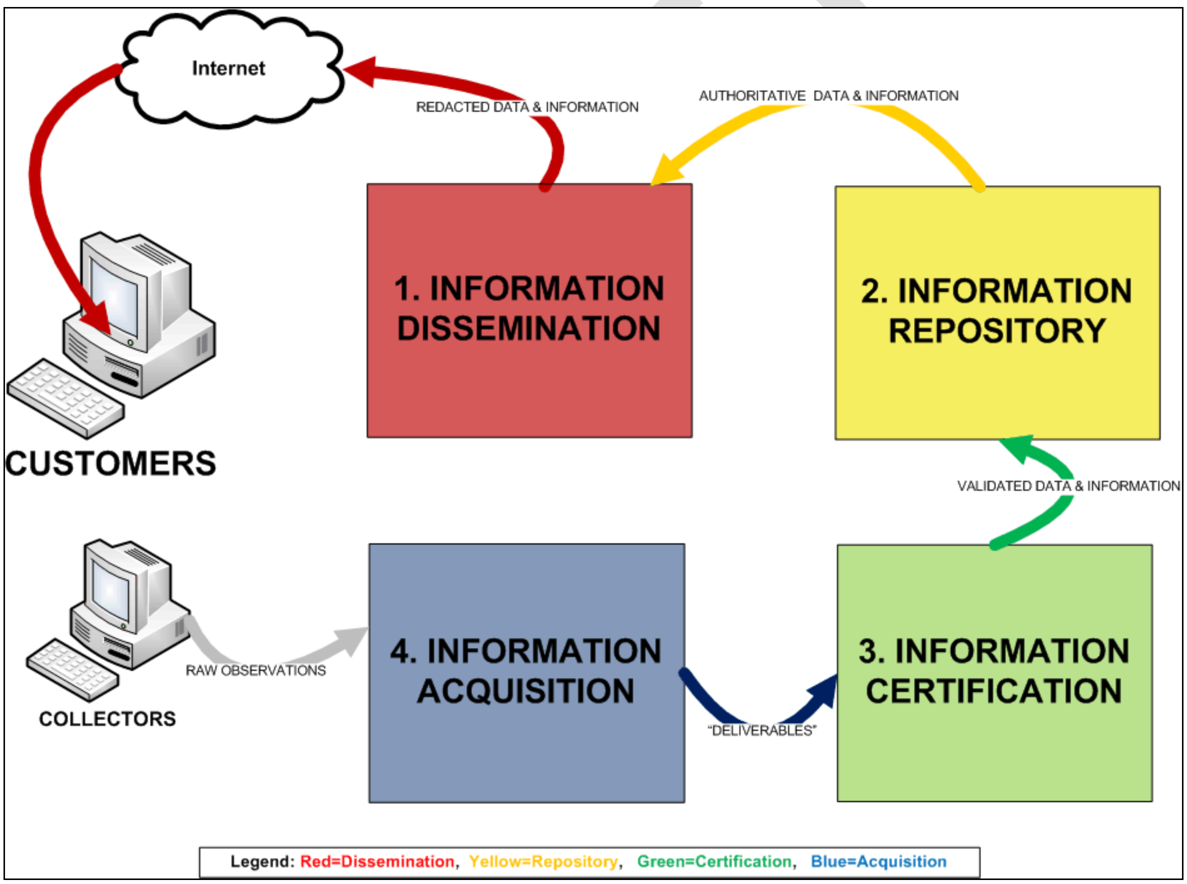

Figure 4.1. The SEAN Core Functional Model overview. Dissemination services (red) provide all deliverables to all customers using Internet web servers. Repositories (yellow) store the certified inventory and monitoring products called for in the protocols. Certification processes (green) assure repositories have the highest quality data and that sensitive items are restricted to authorized users. Data acquisition processes (blue) led by park staff and cooperators include a wide array of tasks, ranging from collecting raw data to producing reports on long-term trends.

4.2 Overview of Data Products

The oceanography program creates and maintains thirteen specific data products for customers, also referred to in this document as deliverables. Each deliverable is disseminated from SEAN and, in selected cases, partner web sites. The SEAN web site is the single authoritative source for these deliverables. In the event that an oceanography data product distributed by a partner ever diverges from the values disseminated by SEAN, the SEAN version should be used.

The deliverables are summarized in Table 4.1 and each deliverable is fully defined in Appendix J. Accompanying each definition is a data flow diagram illustrating where underlying data come from, what processes are applied to them, where they are stored, and who is responsible for managing each of them (Figures J.1 – J.13).

SOPs present the detailed, stepwise process for creating each deliverable. Table 4.1 includes a column referencing the appropriate SOP to use in building each one.

Table 4.1. The SEAN data deliverables provided by this monitoring program.

Deliverable Title	Description	Provided to Customers as	Frequency Produced	Responsibility	SOP
OC_A: CON calibration files	The collection of calibration files used to adjust raw CTD data to standard levels based on the particular sensitivity of each sensor in the instrument array.	Windows files in the proprietary "CON" format of vendor Sea-Bird Electronics.	Typically, once per year after the annual instrument calibration has been performed. May be done more frequently if CTD is recalibrated due to sensor failure.	Project Leader	3
OC_B: Raw HEX files	The collection of raw CTD data taken in one cast. One HEX file is created per cast. Values represent relative voltages or frequencies sampled from sensors.	Windows files in vendor's ASCII "HEX" format, wrapped into a single ZIP file.	One ZIP file per year.	Project Leader	6
OC_C: Processed CNV files	The collection of raw data processed against calibration factors, binned into one meter segments, and expressed in engineering units. One CNV file is created for each cast.	Windows files in vendor's ASCII "CNV" format, wrapped into a single ZIP file.	One ZIP file per year.	Project Leader	8
OC_D: Database additions	A single cumulative database of all certified OC_C data. Customers extract data onto their workstations after specifying filter parameters such as year, depth range, etc.	ASCII CSV files downloaded from web and saved onto local workstations.	Continuously available.	Data Manager	10
OC_E: AOOS data submission	The data in OC_D are delivered by SEAN to partner AOOS, who provide various visualization and reporting tools for working with it.	Various forms, as defined by partner.	Data are updated periodically from the SEAN database as they become certified; typically once per year.	Data Manager	16
OC_F: NODC data submission	The data in OC_D are delivered by SEAN to partner NODC, who combine them with other program data in their deep repository and redistribute them to researchers.	Various forms, as defined by partner.	Data are updated periodically from the SEAN database as they become certified; typically once per year.	Data Manager	17

Deliverable Title	Description	Provided to Customers as	Frequency Produced	Responsibility	SOP
OC_G: Calibration certificates	Scanned images of certificates provided by instrument servicers that document sensor sensitivity factors at the time of each calibration.	Individual PDF files, one for each certificate.	Typically, one per year per sensor after the annual instrument calibration has been performed. May be done more frequently if an individual sensor is recalibrated due to its being repaired or replaced.	Project Leader	2
OC_H: Field log sheets	Two-sided color scans of the original field log sheets	One PDF file containing one November – October year.	Once per year.	Project Leader	12
OC_I: Protocol	This protocol document, explaining the complete details of the monitoring program as currently implemented.	One PDF file.	As required.	Network Coordinator	18
OC_J: Data availability matrix	Data availability matrix documenting which data are available in the OC_D database by month and year.	One cumulative PDF file covering all years.	Typically once per year after certification of the latest OC_D.	Data Manager	13
OC_K: Annual data report	Annual report summarizing operations and data.	One PDF file.	Once per year after certification of the corresponding OC_D.	Project Leader	14
OC_L: Five-year report	Five-year analysis reviewing trends in the collected parameters	One PDF file.	Once every fifth year after completion of the most recent OC_K annual report.	Ecologist	15
OC_M: Data quality assignment	Data quality adjustment report used to flag database rows judged to be anomalous for various reasons.	Incorporated into the OC_D downloadable database.	Once per year after certification of the latest OC_D.	Project Leader	11

4.3 Dissemination: Accessing the Data Deliverables

In keeping with SEAN's data management policies, customers access all of the oceanographic program's deliverables directly from SEAN's public web site. The web site also contains useful ancillary information and references to relevant published and gray literature. Figure 4.2 illustrates main page content. Most example links in Figure 4.2 are top-level and refer to subordinate web pages that offer customers the ability to select information covering specific years or filtered by specific parameters. Subordinate pages also provide access to formal metadata in XML format for the specific deliverable type.

Figure 4.3 illustrates example content for a subordinate page, in this case one that may be used for deliverable OC_B (raw HEX files).

Figures 4.2 and 4.3 are intended to illustrate content only. The actual layout, graphics, and cosmetics used will follow the guidance of the national Inventory and Monitoring program. All SEAN web pages exhibit a consistent style.

While the dissemination services are publicly available to the world, the target audiences include NPS managers and resource specialists, and the broader scientific community.

Copies of certified cast data are distributed to the Alaska Ocean Observing System (AOOS) for further dissemination. The AOOS system is rapidly evolving, offers useful analysis tools, and serves an established audience. AOOS's current capabilities and features are documented at http://ak.aoos.org/aoos/index.html. SEAN does not control program data once AOOS assimilates it into their operations. Should discrepancies be found between AOOS and SEAN data, SEAN is the authoritative source.

Copies of final certified data are also distributed to National Oceanographic Data Center (NODC) for further dissemination. NODC is a branch of the National Oceanic and Atmospheric Administration (NOAA) that has served as an oceanographic data repository since 1961. The NODC archive is the largest collection of publicly accessible oceanographic data in the world (see http://www.nodc.noaa.gov/). SEAN does not control program data once NODC assimilates it into their operations, nor does SEAN manage NODC data's currency or update schedules. Should discrepancies be found between NODC and SEAN data, SEAN is the authoritative source.

Selected certified deliverables and their metadata are also distributed to NPS Data Store for further dissemination (http://science.nature.nps.gov/nrdata/). Should discrepancies be found between NPS Data Store deliverable copies and original SEAN web site products, SEAN is the authoritative source.

In the SEAN model, as depicted in Figure 4.1, a Project Leader is also a customer. When creating a product based on earlier deliverables (e.g., annual or 5-year reports), the Project Leader uses as source material the certified SEAN deliverables from the web; the Project Leader's local work files are not used. This process assures that deliverable creation processes only use authoritative data and, thereby, are reproducible. For example, OC_C (processed CNV files) is created using OC_B (raw HEX files) and OC_A (CON calibration files). To create OC_C, the leader first downloads the certified OC_B and OC_A deliverables to a local workstation. The Project Leader's locally retained files originally used in submitting OC_B and OC_A are ignored, as it is possible they could have become locally altered copies that diverge from certified products.

No deliverables of the oceanographic monitoring program are currently considered sensitive. Should a future policy revision make something sensitive, it will be sequestered at SEAN and will not be available for general dissemination. Questions regarding existence of sequestered products should be directed to the Data Manager through the "Contact Information" link of the web site.

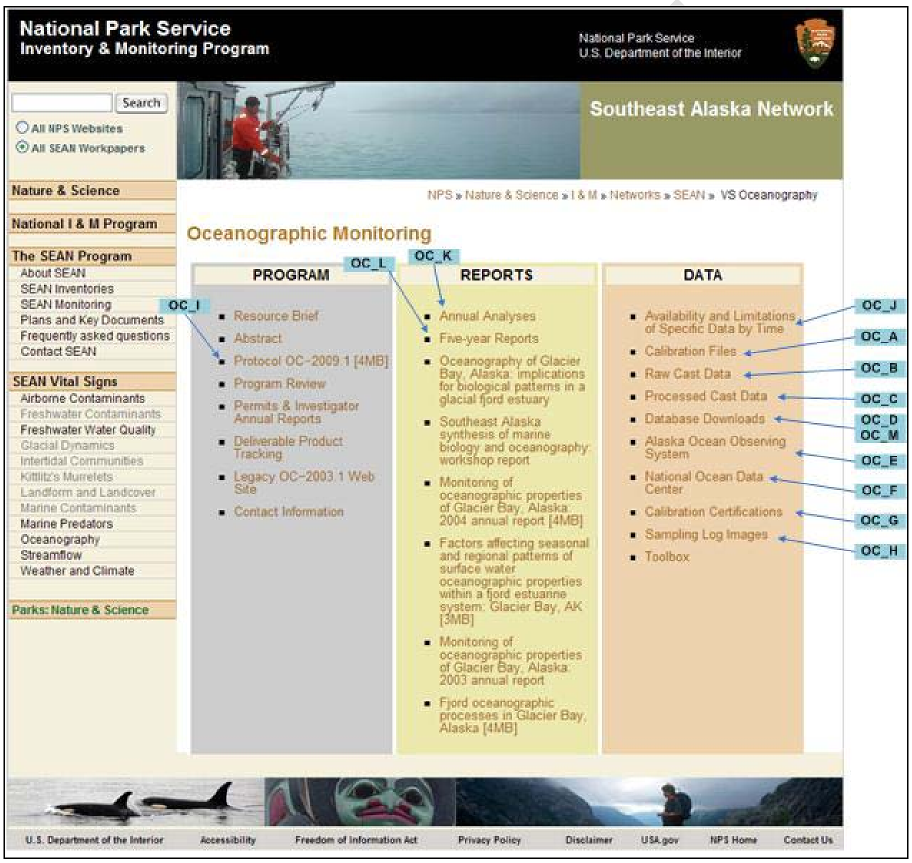

Figure 4.2 Deliverable references located on the oceanographic monitoring program's main page.

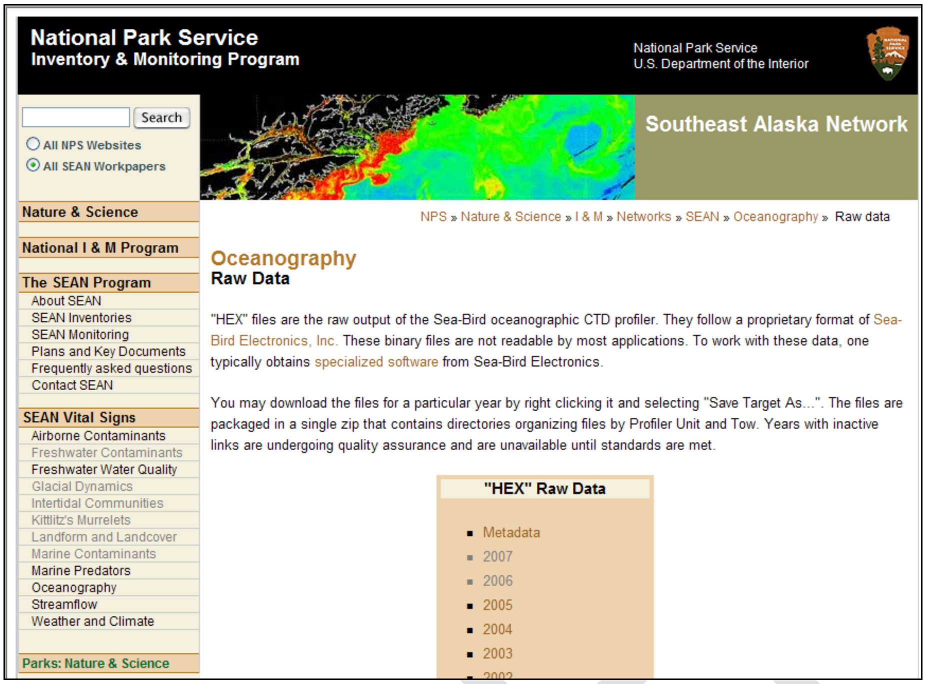

Figure 4.3 Example content for a deliverable's subordinate web page. This specific illustration is appropriate for deliverable OC_B (raw HEX files).

4.4 Repository: Data Archiving

Oceanographic program data are maintained in SEAN's Auxiliary Repository on equipment located in the SEAN office in Juneau, Alaska. Parts of the SEAN Data Management Plan detail the Juneau backup and restore mechanism (Johnson and Moynahan 2008: SOP 204 – Backup and Restore Routines; SOP 1101 - Network Archiving Process). That same document in Chapter 11 covers the philosophy of records management at SEAN.

Content of the Auxiliary Repository is also mirrored at the production web site and database facilities of the NPS Natural Resource Program Center (NRPC) in Fort Collins, Colorado, from which it is publicly disseminated. The NRPC uses enterprise-level business continuity processes to maintain their mirror of SEAN's repository.

Original copies of submissions to outside repositories (OC_E [AOOS] and OC_F [NODC]) are retained in a safekeeping area of the Juneau network. Doing so permits reconstruction of failed partner repositories. Similarly, NODC archives permit reconstruction of SEAN databases in the event of disaster.

4.5 Deliverable Validation and Certification

Each deliverable goes through rigorous validation processes to ensure it meets mandatory quality control criteria. After a submitted product meets all mandatory criteria, the originator reviews the final version and, if completely satisfied, certifies it. Once certified, the Data Manager installs it in the repository and ensures it is properly accessible from the dissemination web site.

The SEAN Data Management Plan describes the approach to validation and certification (Johnson and Moynahan 2008: Section 6.4 and SOP 601 – Procedures for Certifying Project Data).

This protocol explicitly defines in Appendix J the set of mandatory and optional validation criteria for every deliverable in the oceanographic monitoring program.

Certification requires orchestrating a set of tasks between the Project Leader and Data Manager (generically depicted in Figure 4.4). For each deliverable, these tasks are detailed in their respective SOPs. Specific interactions between Project Leader and Data Manager are graphically illustrated for each deliverable in the data flow diagrams in Appendix J.

4.6 Data Acquisition: Scheduling Deliverable Production

A set of prerequisites must be completed before most deliverables can be generated. That is, creating some deliverables may be dependent on prior certification of other deliverables, which, in turn, may have their own dependencies. Figure 4.5 illustrates the typical order used in creating the products. Besides formal deliverables, key intermediate processes are also noted in the proper sequence. Due to the numerous circumstances and exceptions one may encounter while operating the monitoring program, it may be necessary to revise the order of execution *ad hoc*. Figure 4.5 is only an example; the Project Leader may identify acceptable variations. Substantial permanent variations will be formalized in future protocol revisions (SOP 18).

4.7 Managing the Production Environment

In order for users of the Internet to have access to I&M products, the content is required to be housed on what are called "production" file servers, database servers, and web servers. These are currently physically housed in Ft. Collins, Colorado. Only fully-vetted, permanent items are allowed in the production environment. The SEAN maintains its own environments in order to prepare content for production. These are known as the Development, Test, and Staging environments. They reside on their own servers located at the SEAN offices.

The technical details to observe in preparing program data products and installing them in production are addressed in SOP 19.

4.8 Metadata Maintenance

The Data Manager is responsible for maintaining FGDC-compliant metadata for each tabular deliverable. SEAN stores metadata as XML files and serves them on the SEAN webpage, alongside the deliverables they describe. SEAN uses NPS Metadata Editor and the NPS_Basic_Edit stylesheet for basic entry. Where data fields exist, SEAN extends the basic metadata by providing the Entity_and_Attribute_Information section. Metadata considerations are further addressed in Chapter 8 of the SEAN Data Management Plan (Johnson and Moynahan 2008).

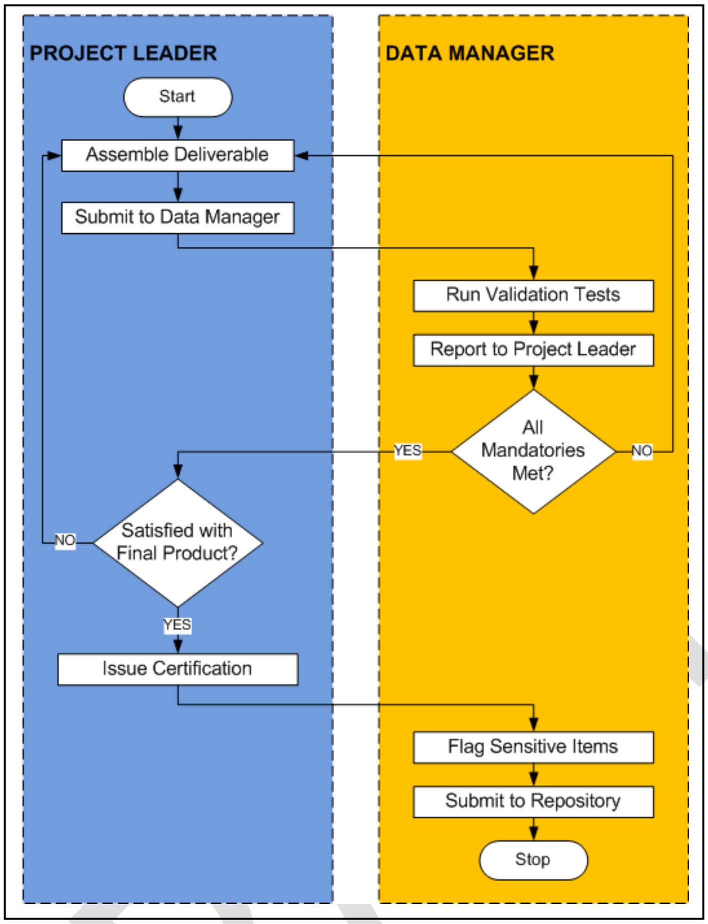

Figure 4.4 Sequence of tasks and staff responsibilities used in the SEAN certification process.

PRE-SEASON

Deliverable	Comment
OC_G: CTD calibration certificate images	Generally available as previous year's post-season
OC_A: CON calibration file	Generally available as previous year's post-season

IN-SEASON

Cruise 1…*n*

Day 1…*n*

Cast 1…*n*

- Fill in sample log sheet
- Have CTD collect readings

- Dump CTD to laptop files
- QA files visually
- Clear data from CTD

Post cruise

- Copy laptop files to network storage
- QA raw data by plotting
- File field log sheets for post-season use

POST-SEASON

Send CTD out for annual recalibration

Deliverable	Comment
OC_H: log sheet images	One PDF for whole season
OC_B: raw HEX files	One ZIP for whole season
OC_C: processed CNV files	One ZIP for whole season
OC_D: database rows	Generated from OC_C by Data Manager
OC_G': calibration certificate images	Available after CTD returns from annual calibration
OC_A': CON calibration file	Available after CTD returns from annual calibration
OC_M: data quality report	Applied to OC_D by Data Manager
OC_J: data availability matrix	OC_C must be certified before updating OC_J
OC_E: AOOS submission	Generated from OC_D by Data Manager
OC_F: NODC submission	Generated from OC_D by Data Manager
OC_K: annual report	Generated from OC_D by Project Leader
OC_L: 5-year report	Generated every fifth year from OC_D and outside sources
OC_I: revised protocol	No fixed schedule; implement at start of a season.

Figure 4.5. Typical sequence of deliverable production.

5.0 Personnel Requirements and Training

5.1 Roles and Responsibilities

Field efforts, comprising the hydrographic survey and undertaken by the Project Leader and Vessel Operator, are detailed in SOP 4. CTD care and maintenance, data download, data processing and plot generation are done by the Project Leader, following details given in SOPs 1 – 3 and 5 – 7. The validation process is the joint responsibility of the Project Leader and the Data Manager (SOPs 2 – 3, 6, 8, 10-18). The resulting certified deliverables are installed in the NPS repository archive, hooked into web dissemination links, and transmitted to external facilities (SOPs 16 – 17) by the Data Manager.

5.1.1 Project Leader (presently Lewis Sharman, Ecologist, GLBA):

- Work with the vessel operator to schedule and execute a safe cruise that accomplished all sampling requirements
- Initiate or discontinue sampling as dictated by weather conditions or the general safety of personnel and equipment
- Complete pre-cruise confirmation of the CTD instrumentation, power, memory, and configuration for proper operation
- Complete CTD Field Log at each station
- Deploy CTD at each station
- Ensure proper storage and maintenance of the CTD instrumentation and hardware
- Ensure CTD is sent to manufacturer for annual calibrations
- Verify proper data collection and overall quality at the end of each day's sampling, including entering CTD Field Log information into a station summary spreadsheet
- Plot vertical profiles at the end of each cruise to demonstrate data quality
- Process collected data files to 1-m averaged values
- Ensure post-season calibrations have been checked and applied if needed
- Complete and submit the data deliverables defined in Appendix J to the Data Manager
- Correct deliverables as needed to meet mandatory validation criteria
- Assemble metadata entries that document exceptions and notable observations recorded in field notes

5.1.2 Vessel Operator (varies; presently GLBA operators of the Capelin, Arete, Talus, and on occasion, Sharman and Moynahan on the Sigma-T or Boomer):

- Vessel operations, fueling, and maintenance
- Work with the Project Leader to schedule and execute a safe cruise that accomplishes all sampling requirements
- Initiate or discontinue sampling as dictated by weather conditions or the general safety of personnel and equipment
- Assist the Project Leader as needed to execute the CTD cast

5.1.3 Data Manager (presently Bill Johnson, SEAN):

- Validate quality of deliverables against formal criteria
- Build facilities to disseminate products over the web

- Maintain and disseminate metadata, create metadata files
- Track project progress and adherence to schedules
- Archive data at:
    - The NPS internal database
    - The regional AOOS database
    - The national NODC database
- Coordinate corrections so that AOOS and NODC continue to represent the best consistent project data

5.2 Qualifications

5.2.1 Project Leader:

- Knowledge of at-sea field sampling operations, protocol, and safety
- Familiarity with CTD instrumentation, data collection, and deployments
- Ability to download data file to a computer, process, plot, and evaluate profile quality
- Expertise in correcting errors detected in data deliverables
- Project management skills

5.2.2 Vessel Operator:

- Basic seamanship skills
- Small boat operations
- Small engine operation and maintenance
- Operation of marine communication and navigation electronics
- Use of marine hydraulics
- Local area knowledge

5.2.3 Data Manager:

- Expertise in database management
- Expertise in web programming
- Data processing, validation, reporting and archiving skills
- Project management skills

5.3 Training procedures

5.3.1 Project Leader:

- CTD operations and maintenance
- Field Log record-keeping procedures
- Post-cruise data quality check and visualization techniques
- Sea-Bird CTD data processing techniques

5.3.2 Vessel Operator:

- Department of the Interior Motorboat Operator Certification Course or appropriate USCG license
- Marine navigation
- Marine weather forecasting

5.3.3 Data Manager:

- Technical database management
- Technical web development
- CTD operations
- CTD data processing

6.0 Operational Requirements

6.1 Annual Workload and Field Schedule

The field season begins with the mid-winter cruise of December/January, having received a freshly calibrated instrument back from the manufacturer following the October cruise. Each field year thus may span two calendar years, beginning with a December or January cruise and ending with the October cruise. Approximately 19 field days each per year are required for a vessel operator and CTD operator to complete this sampling, distributed over the following schedule:

December/January: 3 days to sample stations 00-14, 16-21 and 24
March: 2 days to sample stations 01, 04, 07, 12, 13, 16, and 20
April: 2 days to sample stations 01, 04, 07, 12, 13, 16, and 20
May: 2 days to sample stations 01, 04, 07, 12, 13, 16, and 20
June: 2 days to sample stations 01, 04, 07, 12, 13, 16, and 20
July: 2 days to sample stations 00-14, 16-21 and 24 (feasible in good weather & extended daylight)
August: 2 days to sample stations 01, 04, 07, 12, 13, 16, and 20
September: 2 days to sample stations 01, 04, 07, 12, 13, 16, and 20
October: 2 days to sample stations 01, 04, 07, 12, 13, 16, and 20

The target date range of sampling for each cruise is the first full week of the sample month. This ensures buffer time when weather constraints prohibit sampling during the target week. Sampling all stations with less ship time could be accomplished by first examining ways to run a vessel with extra range or fuel storage on-board so that in months of long daylight and reduced station coverage (May, June and August), it might be possible to occupy all stations in one extended day for a savings of 3 ship days per year. Use of a vessel that can operate well in darkness or low light conditions would also allow all months from March to June and August to October to have one vessel day trimmed for a savings of up to 7 ship days per year.

In addition to the field efforts described above, approximately one-half person-day will be required to set up/stow sampling equipment before/after each cruise for a total of 9 days per year. Approximately one-half person-day per cruise is required for the CTD operator to download data, transfer data to the archive and make initial QC plots so that if instrumental problems are detected in the data, they can be corrected before the next field effort (4.5 days). Processing data takes place annually after manufacturer calibration results are received; this will require 5 days in December or January. Approximately two weeks time (ten days) are required to assemble the annual final report in January or February.

We strongly recommend development of full redundancy in capabilities for field sampling (CTD operation). Doing so would reduce the burden on any one individual and ensure operational continuity in the inevitable instance of Project Leader schedule conflict, absence, or turnover.

Data manager duties will require approximately 15 days per year.

In aggregate, personnel resources dedicated to this program include the following tasks and estimated time requirements:

Vessel operator	19 days per year
CTD operator	27 days per year
Data verification & processing	5-10 days per year
Annual report generation	10 days per year
5-year report generation	20 days every 5 years
Data management	15 days per year

6.2 Facility and Equipment Needs

- Vessel for conducting research equipped with
  - Fuel
  - GPS system
  - Depth sounder
  - Davit/boom and hydraulics for hauling line or equivalent
  - Survival suits
  - Float coats
  - Communications (satellite phone and marine radio)
  - Emergency beacon (EPIRB - Emergency Position Indicating Radio Beacons)
  - General emergency supplies on board the vessel
- Redundant CTD system with ancillary sensors and associated hardware and spares as described in *Section 6.3* below.
- Heated storage facility and shop area for CTD instrumentation, line, miscellaneous hardware and spares.
- Data processing and archive facilities
- Laptop computer

6.3 Startup Costs and Budget Considerations

The continued success of the program depends to a considerable extent upon certain direct support from GLBA. This support is principally in-kind (rather than outright funding) and takes the form of the following:

- Provision of a park vessel as oceanographic sampling platform, with operator (see section 5.1.2) and associated maintenance, fuel, etc. (approximately 19 days per year, see sections 6.1-2);
- Provision of a park employee (Project Leader, see section 5.1.1 and section 6.1) capable of conducting field surveys, maintaining the instruments/equipment, and downloading, processing, and periodically reporting out the data (approximately 50 days per year).
- Occasionally the Project Leader will require an assistant (in addition to the vessel operator) capable of assisting with the field surveys (estimated requirement 10 days per year). This assistant may be park or SEAN staff.

To ensure uninterrupted sampling, SEAN will need to procure a new set of instrumentation approximately every 10 years, with the first set to be purchased as soon as possible after implementation of this protocol (Spring 2009). In 2009, the cost of a complete CTD system with all ancillary sensors is approximately $25,000. A backup system will achieve multiple benefits: 1) allow annual recalibrations to take place without impeding field efforts if the calibration facility is not able to effect a rapid turn-around for any reason; 2) allow the sampling program to keep pace with state of the art instrumentation advances on an appropriate time scale; 3) allow SEAN to plan and budget for gradual instrumentation replacement over time and 4) provide instrumental redundancy in case of failure. Examples of failure include moderately common field problems (corroded connector pins, cracked conductivity cell or damaged interface cabling ancillary sensors) as well as uncommon problems (flooded pressure housing, battery leakage, or total instrumental loss due to lowering line failure).

Calibration costs of $2500/year are required to ensure overall reliability of the collected data. Funds (< $500/year) for miscellaneous operations and field supplies (see Appendix C) are also needed on an ongoing basis. `

Access to a dedicated vessel that is not dependent upon scheduling constraints of an operator from GLBA could allow the SEAN personnel to more efficiently plan and execute field work. Key considerations in deciding whether to acquire a dedicated vessel include: predictability of support from existing GLBA divisions and vessels (i.e., Resource Management and Law Enforcement Rangers), cost of acquisition, operation, and maintenance, and extent to which the vessel would be utilized by other Vital Signs that call for boat-based monitoring (e.g., Marine Predators, Kittlitz's murrelets, Marine Contaminants, Weather and Climate, Airborne Contaminants).

Depending on the expertise in-house at SEAN, both annual data reporting and the five-year summaries may benefit from contracting an external oceanographer to help in the analysis, presentation and interpretation of the collected dataset.

6.4 Protocol Revision Process

This protocol may be updated or revised as new knowledge, technologies, equipment, and methods become available. Revisions will balance the advantages of new techniques with possible disadvantages associated with disrupting data continuity.

All revisions require review for clarity and technical soundness. Small changes to the existing protocol documents — for example formatting, simple clarification of existing content, small changes in the task schedule or project budget, or general updates to information management handling SOPs—may be reviewed in-house by project cooperators and SEAN staff. Changes to data collection, analysis techniques, or sampling design will trigger an external peer review to be coordinated by the Alaska Region Inventory and Monitoring Coordinator.

The SEAN Network Coordinator will periodically poll the Project Leader and Data Manager on the need to initiate a protocol revision cycle. Every effort will be made to ensure that complete, certified protocol revisions are applied at the start of a new sampling year (i.e., after the October cruise and before the winter cruise). Exceptions include revisions that would remedy an identified safety deficiency or a significant issue of data quality or continuity of operations.

The protocol document is defined as data deliverable OC_I. Technical details of its construction are specified in SOP 18.

The protocol revision process will be cooperatively managed by the Project Leader, SEAN Network Coordinator, and SEAN Data Manager. In the course of a revision cycle, proposed revisions may originate from any of those three individuals. One of these three people shall agree to be "revision coordinator" and be responsible for the actual drafting of the document. Proposed contributions and internal tracked-change reviews will be resolved by the revision coordinator until consensus is reached on a final draft document. If an external peer review is required, the coordinator will resolve review comments in consultation with the other two participants.

A revised protocol must be given a new protocol identifier, using the form detailed in the SEAN Data Management Plan (Johnson and Moynahan 2008: SOP 602 – Version Control). The Project Leader will include a summary and justification of the revision in the first post-revision Annual Report, under an appropriately titled section. The new protocol will be disseminated and archived through standard SEAN practices and will be submitted to appropriate NPS repositories outside SEAN.

7.0 Oceanography of Glacier Bay: Other Considerations

The basic set of deliverable plots and data summaries outlined within the protocol for reporting and archive purposes will ensure attainment of the monitoring objectives, but as the Glacier Bay and the greater northeast Pacific ecosystems both change over time, new or different methods of analyzing and reporting the data will be developed. Technological advances will allow for more detailed measurements of more parameters. It is important that NPS maintain the observations currently specified within this protocol, but NPS should also remain open to future generation technologies that may improve measurement and description of the oceanographic ecosystem.

The monitoring program outlined herein has been designed to document oceanographic conditions from representative domains within Glacier Bay. This program provides a solid foundation for understanding the oceanographic environment, but there remain many gaps that need to be acknowledged and addressed if opportunities present themselves. For the physical fields, limited spatial and temporal coverage of selected parameters lead to incomplete snapshots of the physical system. While the ancillary sensors on the CTD make a cost-effective attempt to go beyond the basic physics, this oceanographic program is incomplete with respect to the lack of monitoring of chemical properties and the bacterial, phytoplankton, microzooplankton, and zooplankton communities.

GLBA and, more broadly, the NPS can help ameliorate these gaps by supporting process-oriented studies that focus on better describing the dynamics and community makeup of the portions of the ecosystem currently not sampled. Such studies would make the monitoring dataset collected under this protocol more valuable because these investigations would place the monitoring results within a more complete ecological context. Examples of such process studies include those outlined below.

Physics:

- Tides:
  - Twenty-four hour to one month tidal cycle hydrography and current studies at various locations along and across the bay will put stations into a high-resolution temporal frame of reference
- The nearshore environment:
  - Describe physical conditions and transport processes in biological “hot-spots” to better predict and understand regions of high biological densities and productivity
  - Freshwater dynamics studies, from coastal discharge to mixing processes, to help link terrestrial, glacial and marine processes
- Mooring deployments:
  - Provide descriptions of both low-frequency and high-frequency modes of system change, including tidal processes, deep water renewal and the phasing of system changes throughout the water column
- Oceanographic linkages:
  - Determine the level of connectivity and influence of waters outside Glacier Bay.
  - Determine relationships with oceanographic patterns on larger scales.

Chemistry:

- Nutrient budgets:

- Document the nutrient dynamics and nutrient transfer pathways within Glacier Bay in order to better understand this productive ecosystem
- Ocean acidification:
    - Glacier Bay as a high-latitude early-warning system for ocean acidification

Primary Production:

- Phytoplankton bloom dynamics:
    - Investigate spring bloom and episodic production events through the summer: to determine relative importance to overall productivity
    - Determine the role of tidal mixing in maintaining primary production.
    - Explore limitations to production through the summer and how they affect the phytoplankton community structure
    - Investigate role of tidewater glaciers in patterns of primary productivity and document changes as glaciers recede/advance

Secondary Production:

- Zooplankton communities:
    - Document the structure and dynamics of the dominant zooplankton communities that feed the fish and marine mammal populations
    - Investigate spatial and temporal abundance of meroplankton (larvae) of commercially and ecologically important species (e.g. crabs, clams, mussels)

8.0 References

8.1 References Cited and Publications Utilizing GLBA Oceanography Data

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Glacier Bay National Park and Preserve Oceanographic Monitoring Protocol

SOP 1: CTD Maintenance, Storage and Calibration

1. CTD maintenance, supplies and general handling procedures

1.1. General CTD Handling, Care, and Use Instructions
The Sea-Bird SBE-19 operators' manual (available on the SEAN and Sea-Bird websites) documents all recommended practices for cleaning the CTD, accessing the battery compartment, care and installation of O-rings, instrument operation, instrument setup and CTD-computer communications. The project leader will read and become comfortable with all aspects of the manual.

1.2. Supplies
On an ongoing basis, all field gear should be assessed and repaired or replaced as needed. Items that may need attention include but are not limited to CTD batteries, electrical silicone grease, Triton-X, the CTD lowering line, the computer-to-CTD interface cable, o-rings. A supply of KimWipes or other similar non abrasive lint-free wiping towel is necessary for proper o-ring handling.

2. Long-term storage

2.1 Instrument cleaning
Cleaning the CTD is important to maintain sensor viability and reduce the potential for the negative effects of biofouling and buildup of salt crystals on the sensors. Rinse the entire instrument with fresh water. For the WetLabs WETStar mini fluorometer, rinse thoroughly and air-dry the instrument after each experiment (the flow tube must be rinsed after each cast).

If a DO sensor is installed on this CTD, disconnect its tubing so it is not exposed to the following conductivity cell cleaning solution. Flush the conductivity cell with either a 1% solution of Triton X-100 or a 500-1000 ppm bleach solution. Use a syringe to wash the solution back and forth. Let the solution remain soaking for 2 minutes (bleach) or 60 minutes (Triton X-100). (Note: Triton X is a non-ionic biogenic detergent; be careful not to get the solution on your skin). Drain the cell and tubing. Thoroughly rinse the unit with clean water for 5 minutes; any residual salt crystals can damage the cell. Sea-Bird cautions not to use a brush or Q-tip to clean the flow tube on the conductivity cell, as this can alter the calibration or damage the sensor.

2.2 Storage
After the conductivity cell is thoroughly dry from its last cleaning, store by attaching a loop of Tygon tubing to seal the dry cell. If tubing is unavailable for some reason, let the Triton-X solution dry in the conductivity cell and do not rinse until the beginning of a cruise. If the cell is completely dry, it may be stored in freezing conditions.

3. Factory Calibrations

Immediately after each October cruise, send the entire CTD instrument to Sea-Bird Electronics for calibration of all sensors. Sea-Bird will ensure the third-party ancillary sensors are also calibrated at the originators factory and returned in a timely fashion. Sea-Bird shipping information is as follows. Be sure to get an RMA number from Sea-Bird before shipping the CTD to them. Include a completed Sea-Bird Service Request Form in the shipping crate. Ship the CTD via FedEx, and make sure the RMA number is written on the address label somewhere. Email the serial number of the instrument to Sea-Bird in advance.

SEA-BIRD ELECTRONICS, INC.
1808-136th Place NE
Bellevue, WA 98005, USA
Phone: (425) 643-9866
Fax: (425) 643-9554
E-mail: Seabird@seabird.com
Contacts: Mike Handewith, Dave Armstrong, Andy Heard

Sea-Bird's website also has return information at: www.seabird.com

Glacier Bay National Park and Preserve Oceanographic Monitoring Protocol

SOP 2: Calibration Certificates (OC_G Creation)

Summary

Two cases are possible. First, the sensor servicing company may have provided one or more paper certificates attesting to the calibration parameters determined on a particular date. In this case, the Project Leader must generate one PDF file for each document using a document scanner and appropriate software. Second, the sensor servicing company may have provided a CD or DVD already containing PDF files of the certificates.

Once the PDFs are available, they are copied to a park network drive, renamed following a consistent convention, and run through the validation / quality assurance iterations until certified and disseminated.

SOP 2 requires users to work in the internal NPS network under valid Active Directory accounts. Access questions should be directed to the Data Manager.

Detailed steps

1. Certificates on paper received

1. Project Leader tasks

1. Extract from packet only those forms that list sensor parameters and attest to their accuracy.
2. Scan each one into a separate PDF file using park scanner and associated software. Save on park network at \\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\yyyy\Certificate\ where yyyy is the year on the certificate, e.g., 2010.
3. Name each file with a reference to its local CTD number, followed by an underscore, followed by sensor type, followed by underscore, followed by the sensor serial number, followed by underscore, followed by calibration date as YYMM.
    1. *Local CTD number is 1, 2, etc. It is not the Sea-Bird serial number.*
    2. *Sensor types: TEM, CON, PAR, OBS, FLU, DOX, PRE.*
    3. *Sensor serial number may always be found inside the PDF.*
    4. *Example CTD#1 Fluorometer calibration certificate of March 2009 would be named 1_FLU_ WS3S-652P_0903.PDF.*
4. Submit these files via email attachment to the Data Manager for validation, specifying in the message body it is deliverable OC_G, as defined in protocol OC-2009.1. Multiple files are permitted in one submission email.

2. PDFs on CD received

1. Project Leader tasks

1. Copy each PDF that contains a certificate from the CD into \\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\yyyy\Certificate\ where yyyy is the year on the certificate, e.g., 2010.

2. Rename each file with a reference to its local CTD number, followed by an underscore, followed by sensor type, followed by underscore, followed by the sensor serial number, followed by underscore, followed by calibration date as YYMM.
    1. *Local CTD number is 1, 2, etc. It is not the Sea-Bird serial number.*
    2. *Sensor types: TEM, CON, PAR, OBS, FLU, DOX, PRE.*
    3. *Sensor serial number may always be found inside the PDF.*
    4. *Example CTD#2 Pressure strain gauge calibration certificate of February 2009 would be named 2_PRE_ 0436_0902.PDF.*
3. Submit these files via email attachment to the Data Manager for validation, specifying in the message body it is deliverable OC_G, as defined in protocol OC-2009.1. Multiple files are permitted in one submission email.

3. Regardless of whether paper or CD files

1. Data Manager tasks

1. On receipt of the submission, assign the next formal Submission Number to this file, as found in the master Submission_Log table.
    1. *Use the "Update Submission Log" web tool at http://165.83.57.239/0_submission_update.aspx .*
    2. *Complete Submission_Log details up through the Submission_Date column.*
        1. Due to the nature of this deliverable, there is no submission unit scope. The filename is sufficient to distinguish it.
2. Save the file in the staging area for validation
    1. *Be sure the filename matches the required form listed above.*
    2. *The staging location is INPGLBAFS03\DATA:\SEAN_Data\Staging\OC\OC_G .*
3. Validate the submission according to current criteria.
4. Record validation summary data in the Submission_Log.
    1. *Set status code to V if mandatory validation passed.*
    2. *Set status code to F if mandatory validation failed*
5. If submission fails mandatory criteria, reply with a "failure email" that includes:
    1. *The submission number assigned*
    2. *The deliverable ID*
    3. *The protocol ID*
    4. *Documentation listing all the specific mandatory criteria failed*
6. If submission passes mandatory criteria, reply with a "success email" that includes:
    1. *The submission number assigned*
    2. *The deliverable ID*
    3. *The protocol ID*
    4. *Documentation listing any specific optional criteria failed*
    5. *Request to certify deliverable as complete*

2. Project Leader tasks

1. On receipt of a failure email:
    1. *Rescan the PDF to ensure it is in the proper format OR contact the vendor to obtain a valid PDF with proper parameters.*
    2. *Restart the process from the beginning.*
2. On receipt of a success email, review any failed optional criteria:
    1. *If these are acceptable:*
        1. Reply with a "certification email" stating the deliverable is certified and may be disseminated.

2. *If these are unacceptable:*
    1. Reply with a "withdrawal email", stating the deliverable is withdrawn.
    2. Take remedial action to obtain a corrected deliverable.
    3. Restart the process from the beginning.

3. Data Manager tasks

1. On receipt of a withdrawal email:
    1. *Mark the withdrawal in the Submission_Log's Status column using the web tool.*
    2. *Clean submission files out of staging area.*
    3. *Terminate the process.*
2. On receipt of a certification email:
    1. *Verify no sensitive information is in the deliverable. Products containing sensitive information cannot be disseminated. (Sensitivity is highly unlikely for this deliverable.)*
    2. *Copy the submitted file to test environment at AUXREP\OC\OC_G\ .*
    3. *Propagate from test to production environment.*
    4. *Verify deliverable is accessible from production web site.*
    5. *Mark the certification in the Status column in Submission_Log using the web tool.*
    6. *Clean submission files out of staging area.*
    7. *Update the deliverable tracking spreadsheet with the date of completion for OC_G.*
    8. *Terminate the process.*
3. Update the scope of the formal metadata so it includes this new date range.

Glacier Bay National Park and Preserve Oceanographic Monitoring Protocol

SOP 3: CON Calibration files (OC_A Creation)

Summary

OC_A is built in one of two ways, depending on circumstances. Case 1 occurs when the Project Leader receives a vendor-supplied CD containing a CON file, typically after the annual recalibration. In this case, the CON file is submitted to the Data Manager for the validation / quality assurance process and is eventually certified.

Case 2 occurs when a single detector undergoes calibration (or initial installation). The detector is shipped with paper documentation that must be used along with vendor software to create a new CON file. The new file undergoes standard validation and certification.

SOP 3 requires users to work in the internal NPS network under valid Active Directory accounts. Access questions should be directed to the Data Manager.

Detailed steps

1. **Case 1: Full calibration file set is received**
   1. ***Project Leader tasks***
      1. Receive CD supplied by vendor with recalibrated CTD.
      2. Copy the "con" file from CD to \\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\yyyy\CON_calibration, where yyyy is the year of calibration, e.g., 2009. The file will be named on the CD using the format YYMM.CON, where Y stands for year and M is month. In order to distinguish this calibration from those of any other CTDs employed, the filename must be changed. Rename the local copy to the form C_YYMM.CON, where C stands for CTD number. For example, a calibration file from March 2005 for CTD #1 would be called 1_0503.CON.
      3. Submit the file via email attachment to the Data Manager for validation, specifying in the message body it is deliverable OC_A, as defined in protocol OC-2009.1.
   2. ***Data Manager tasks***
      1. On receipt of the submission, assign the next formal Submission Number to this file, as found in the master Submission_Log table.
         1. *Use the "Update Submission Log" web tool at http://165.83.57.239/0_submission_update.aspx .*
         2. *Complete Submission_Log details up through the Submission_Date column.*
            1. Due to the nature of this deliverable, there is no submission unit scope. The filename is sufficient to distinguish it.
      2. Save the file in the staging area for validation, ensuring its name meets the standards defined in Appendix J.
      3. . Validate the submission according to current criteria.
         1. *Criteria are minimal because this deliverable's form is proprietary to the CTD vendor.*

        2. *Record validation summary data in the Submission_Log using the web tool.*
    4. If submission fails mandatory criteria, reply to the original submission with a "failure email" that includes:
        1. *The submission number assigned*
        2. *The deliverable ID*
        3. *The protocol ID*
        4. *Documentation listing all the specific mandatory criteria failed*
    5. If submission passes mandatory criteria, reply to the original submission with a "success email" that includes:
        1. *The submission number assigned*
        2. *The deliverable ID*
        3. *The protocol ID*
        4. *Documentation listing any specific optional criteria failed*
        5. *Request to certify deliverable as complete*

3. ***Project Leader tasks***
    1. On receipt of failure email:
        1. *Contact the vendor to obtain a valid con file.*
        2. *Restart the process from the beginning.*
    2. On receipt of a success email, review any failed optional criteria:
        1. *If these are acceptable, reply with a "certification email" stating the deliverable is certified and may be disseminated.*
        2. *If these are unacceptable:*
            1. Reply with a "withdrawal email" stating the deliverable is withdrawn.
            2. Take remedial action to obtain a corrected deliverable.
            3. Restart the process from the beginning.

4. ***Data Manager tasks***
    1. On receipt of a withdrawal email:
        1. *Mark the withdrawal in the Submission_Log's Status column using the web tool.*
        2. *Terminate the process.*
    2. On receipt of a certification email:
        1. *Verify no sensitive information is in the deliverable. Products containing sensitive information cannot be disseminated.*
        2. *Copy the submitted file to test environment as AUXREP\OC\OC_A\yyyy\ where yyyy is the numeric year the vendor created the file.*
        3. *Propagate from test to production environment*
        4. *Verify deliverable is accessible from production web site.*
        5. *Mark the certification in the Status column in Submission_Log using the web tool.*
        6. *Update the deliverable tracking spreadsheet with the date of completion for OC_A.*
        7. *Terminate the process.*
    3. Update the scope of the formal metadata so it includes this addition.

2. Case 2: Paper addendum to calibration is received

1. Project Leader tasks

1. Receive revised calibration parameters on paper or email.
2. Make a new copy of the CON file that directly preceded this recalibration effort. Calibration files are located on \\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\yyyy\CON_calibration\ where

yyyy is the year of calibration, e.g., 2009. Name the file C_YYMMx.CON where ‘x’ is a letter used to distinguish this latest update from its predecessor. Begin the sequence with ‘a’ and use sequential letters for additional updates. For example, the first revision to calibration file 1_0903.CON would be 1_0903a.CON. The next revision (which must be based on 1_0903a.CON) would be 1_0903b.CON.

3. Using the Sea-Bird program SBEDataProc.exe, revise the calibration parameters in the new CON file. Be careful to exactly enter the new information, while not changing items that define other aspects of the CTD. Errors in the CON file will produce erroneous results in the other deliverables; and the fact that results are defective may not be obvious.
    1. *Start the SBEDataProc.exe program. It should be on the Project Leader’s computer under the “Start” button.*
    2. *Select Configure from the top menu. On the dropdown menu, click on “SBE 19 Seacat CTD.” A Windows form will appear on screen.*
    3. *Press the OPEN button on the form. Navigate to the new copy of the CON file made in the preceding step. Open it. The Windows form will now list the sensors defined in the latest CON file.*
    4. *Double click the name of the first sensor to adjust. A dialog box will be displayed showing the latest calibration entry for that particular sensor. Each sensor takes different types of values. The calibration document should have values that match the dialog box entries for a particular sensor.*
    5. *Revise the screen entries so they match the document.*
    6. *Press the OK button when the sensor has been fully defined.*
    7. *Back on the Windows form, press the SAVE button to permanently write the new information to the CON file.*
    8. *If there are additional sensor calibrations to enter, go back to the section on double-clicking the sensor name on the form.*
    9. *When done, press the EXIT button and then close the SBEDataProc application.*
4. Submit the new file via email attachment to the Data Manager for validation, specifying in the message body it is deliverable OC_A, as defined in protocol OC-2009.1.

2. *Data Manager tasks*

1. On receipt of the submission, assign the next formal Submission Number to this file, as found in the master Submission_Log table.
    1. *Use the “Update Submission Log” web tool at http://165.83.57.239/0_submission_update.aspx .*
    2. *Complete Submission_Log details up through the Submission_Date column.*
        1. Due to the nature of this deliverable, there is no submission unit scope. The filename is sufficient to distinguish it.
2. Save the file in the staging area for validation, ensuring its name meets the standards defined in Appendix J.
3. . Validate the submission according to current criteria.
    1. *Criteria are minimal because this deliverable’s form is proprietary to the CTD vendor.*
    2. *Record validation summary data in the Submission_Log using the web tool.*
        1. Set status code to V if mandatory validation passed.
        2. Set status code to F if mandatory validation failed

4. If submission fails mandatory criteria, reply with a “failure email” that includes:
    1. *The submission number assigned*
    2. *The deliverable ID*
    3. *The protocol ID*
    4. *Documentation listing all the specific mandatory criteria failed*
5. If submission passes mandatory criteria, reply with a “success email” that includes:
    1. *The submission number assigned*
    2. *The deliverable ID*
    3. *The protocol ID*
    4. *Documentation listing any specific optional criteria failed*
    5. *Request to certify deliverable as complete*

3. Project Leader tasks

1. On receipt of a failure email:
    1. *Re-edit the file so it is correct OR contact the vendor to obtain proper parameters.*
    2. *Restart the process from the beginning.*
2. On receipt of a success email, review any failed optional criteria:
    1. *If these are acceptable:*
        1. Reply with a “certification email” stating the deliverable is certified and may be disseminated.
        2. Remember to generate a PDF of the CTD document and build a new deliverable OC_G – CTD Calibration Certificates.
    2. *If these are unacceptable:*
        1. Reply with a “withdrawal email”, stating the deliverable is withdrawn.
        2. Take remedial action to obtain a corrected deliverable.
        3. Restart the process from the beginning.

4. Data Manager tasks

1. On receipt of a withdrawal email:
    1. *Mark the withdrawal in the Submission_Log’s Status column using http://165.83.57.239/0_submission_update.aspx.*
    2. *Terminate the process.*
2. On receipt of a certification email:
    1. *Verify no sensitive information is in the deliverable. Products containing sensitive information cannot be disseminated.*
    2. *Copy the submitted file to test environment as AUXREP\OC\OC_A\.*
    3. *Propagate from test to production environment.*
    4. *Verify deliverable is accessible from production web site.*
    5. *Mark the certification in the Status column in Submission_Log using http://165.83.57.239/0_submission_update.aspx.*
    6. *Update the deliverable tracking spreadsheet with the date of completion for OC_A.*
3. Update the scope of the formal metadata so it includes this new date range.

Glacier Bay National Park and Preserve Oceanographic Monitoring Protocol

SOP 4: Hydrographic Survey

1. Field Preparations

1.1. Supplies to have on hand
Assemble CTD and general field gear (see Appendix C), lowering line and hardware, distilled water jugs for rinsing CTD, field logs, GPS and spares kit. Appendix C also outlines equipment needed to complete oceanographic surveys. Use the CTD's wooden box for transportation, particularly on unpaved roads in a car. Vibrations due to transportation result in broken connections or sensors. Please treat the instrument carefully (it is very expensive!). After the instrument is loaded onto the vessel, be sure to secure the end of the ground line to the CTD using 2 metal carabiners and the other end to the vessel. The CTD communications, battery, memory and date/time checks can be done on board at the dock or in a lab.

1.2. Check computer to CTD communications
Before deployment of the CTD in the field, check the "status" of the instrument using the Seasoft software module ***seaterm.exe***. A test CTD cast off the dock in Bartlett Cove would help to verify proper CTD operation. See details of communication and operation in SOP 2 and/or the SBE-19 operator's manual for help.

1.3. Check battery voltage
Check battery status within the SeaTerm program. If the **Vmain** is less than **10V**, replace the 9 D-cell batteries.

1.4. Memory check and clear
Ensure that the CTD memory is empty (info was cleared after the last cruise) In the SeaTerm window, press **F3** or click on the **Connect** button. The display should read >10V Vmain for the 9 alkaline D-Cell batteries and cleared memory (nsamples = 0, memory = 0). To clear memory, enter the **InitLog** command in SeaTerm.

1.5. Check date and time
Next, check to see that the time and date are current for ***GMT time***. Note that GMT is either 8 or 9 hours away from Alaska Local time depending on whether or not Daylight Savings is in effect (8 hours when DST is in effect and 9 hours when it is not). If the CTD is not synchronized to GMT, enter the **ST** command in SeaTerm. The program will prompt you to type in the correct date, then the correct time. Synchronizing your watch with CTD time can help avoid mistakes when entering information in the Field Log. It is important that GMT time be employed so that future analyses can accurately relate the timing of the tidal signal to the timing of the CTD cast. Tidal analyses are carried out with respect to GMT, so avoiding the use of local time will help avoid errors introduced by switching in and out of Daylight Savings.

1.6. Soak the dry conductivity cell

When removed from dry storage, the conductivity cell needs to soak before being deployed. Fill the cell with a 0.1% Triton X-100 for at least one hour. When ready to use, drain the Triton X-100 solution; there is no need to rinse the cell. Do not allow Triton X-100 to flow through to any dissolved oxygen sensor, which may be adversely effected.

1.7. Test cast off the Bartlett Cove dock, download test data and verify proper operation

If the operating status of the CTD is uncertain, particularly if the CTD is newly set up or batteries have been replaced, it is a good idea to perform a test cast before heading to the field to ensure proper CTD operation before beginning valuable ship time. Data can be downloaded and viewed as described in *Section 3.5.3.*

3. 2. Field Operations

2.1. Selection of sampling sequence

The vessel operator and project leader will work together to determine the order with which to occupy stations. Consideration for personnel, vessel and equipment safety should be taken into account when assessing weather conditions and the short-term forecast. It is desirable to occupy stations south of Station 04 on the incoming tide, but it is more important that all target stations are occupied.

2.2. Navigate to station

The vessel operator will navigate to each station in turn using GPS navigation and ensure that the CTD cast is initiated within 500 m of the nominal station location.

2.3. Fill out CTD station log

See Appendix B for a copy of the log form. See Appendix A for a listing of the nominal station locations and depths. At the start of a new Field Log form, fill out the top header information, including:

1. Vessel name
2. Cruise identifier
3. The CTD number employed (CTD number is local to the NPS SEAN system and defined in Appendix F; as of 2009, the CTD in current use is #2).
4. The Data Dump Number (sequential number for download. Check previous data dump log for current number to use, see also Appendix B).
5. The names of observers responsible for conducting the CTD cast.

At the beginning of the CTD cast, record on the Field Log form:

1. The sequential cast number (1, 2, 3, 4…)
2. The station name (01, 04, 07, …)
3. The latitude and longitude of the cast location, using decimal degrees in WGS 84 Alaska datum (Or mark a waypoint on the GPS and record the waypoint number in the logbook. See section 2.9, below.)
4. The waypoint number for future reference on the cruise.

5. The station date and time. Record time as GMT date and time; note there are different offsets for Alaska Standard Time (add 9 hours) and Alaska Daylight Savings Time (add 8 hours).
6. The bottom depth as measured by the fathometer.
7. The target depth for the CTD (i.e., the amount of line to pay out).
8. Comments documenting any item of note associated with this cast. Use extra room on the bottom or the back of the Field Log form if needed.

2.4. Initiate data logging

Slide the magnetic switch to the "ON" position. Record the time "on" in the field notebook. See Figure SOP1.1 for details of the CTD sensor layout and on/off switch location.

2.5. Equilibrate the CTD just below the surface

Lower the CTD into the water, just below the surface, to equilibrate for a minimum of two minutes. Employ a stopwatch with timer alarm to ensure a full 120 second soak period is observed. This equilibration time will allow 45 seconds for the pump to turn on, provide time for the instrument to adjust to ambient temperature and for the conductivity cell to flush. Also, it allows the data processing program the ability to remove the first 90 seconds of data collected, resulting in improved measurements over the uppermost few meters of the water column.

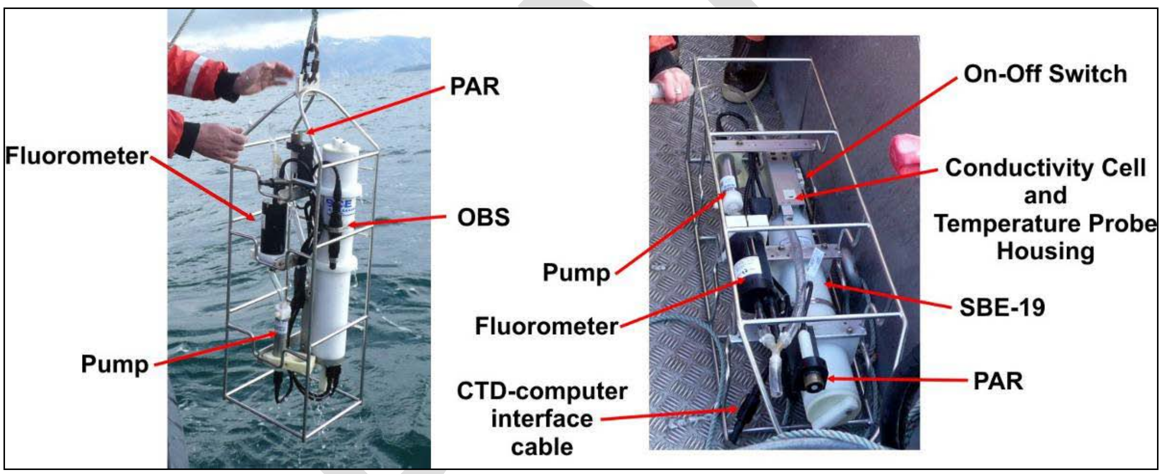

Figure SOP1.1. Location of SBE-19 CTD sensors and on/off switch.

2.6. Lower CTD to target depth

Lower the CTD at a speed of approximately **one m/s** (meter per second) using 3/8" nylon, 3-braid line marked at 10-meter intervals (timed as 10 meters per 10 seconds). Blue tape markers indicate 10-m intervals, red tape indicates 50-m intervals, and green tape indicates 100-m intervals. The instrument should be dropped no more than 90% of the depth at the station and never more than the **maximum depth of 600 m**. The CTD is usually dropped to no more than 550 m as a safety precaution.

2.7. Haul CTD back to surface

Retrieve the CTD with a power block/davit or a long-line drum. Note that data are collected by the CTD on both the down- and up-casts; however, the up-cast data are not typically used for analysis (down-cast data are more accurate because the sensors are receiving and measuring a nearly-undisturbed water column on the way down) — so there is no need to go slowly on the way up. Be careful, however, as the instrument nears the surface, and be sure to control the power block so the CTD is not jerked up out of the water and into the davit block or against the side of the boat. Be careful when bringing CTD back onto boat.

2.8. Terminate data logging
Turn the instrument off with the magnetic switch.

2.9. Complete CTD station log
Record any irregularities about the cast on the data sheet. Include comments about such events as, e.g., the magnetic switch arriving at the surface in the "off" position, forcing a duplication of that station's cast. If you marked a GPS waypoint for the cast's location, enter the coordinates onto the data sheet now to prevent loss of the waypoint when others use the GPS later.

2.10. Fresh water rinse
Rinse entire instrument with distilled water, poured from jug or by using a squire bottle. In particular, make sure to douse all of the optical sensors with the fresh water. Rinse the irradiance meter with distilled water and replace the cover. Flush the conductivity cell with syringe of Triton-X solution (preferred) or distilled fresh water. Syringe and Tygon tubing should be left attached to cell to avoid drying out between usages.

2.11. Stow CTD for transit
With air temperatures greater than 5 ºC above freezing, the CTD may remain on deck. In freezing and near-freezing conditions, bring the CTD into the cabin between stations and during transit to avoid freezing and breaking the conductivity cell.

2.12. Data Download
At the end of the day, download the CTD cast data to a local computer according to SOP 5, which includes basic quality assurance steps.

3. Post-cruise operations

3.1. Storage of the CTD and associated hardware and spares
Stow CTD until next field effort. For long-term storage procedures, see SOP 1.

For overnight short-term storage, the CTD may be left on board the survey vessel. Bring the CTD into the cabin to avoid freezing and breaking the conductivity cell.

3.2. Data Transfer to Network
After each cruise, transfer data to network according to details of SOP 5.

3.3. Plot Data
Once cruise data has been transferred to the network, plot each cast for QA purposes using SOP 7.

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SOP 5: CTD Data Download and Transfer to Network

Summary

During a cruise, typically at the end of each day, the contents of the CTD are downloaded to a laptop computer and given quality assurance tests. The CTD memory is then erased to make room for additional data.

At the end of each cruise, the laptop files are copied to the park's network file server. These files are the basis for many other deliverables.

This process is the responsibility of the Project Leader.

Detailed steps

1. **Before a cruise**
    1. ***Ensure the laptop has working copies of SEATERM software.***
        1. If not found on laptop, seek Data Manager's assistance.
    2. ***Ensure the serial data cable is packed for the field.***
    3. ***If this is the first cruise of the year, create a "c:\oceanography\yyyy\Downloaded HEX files\" folder on the laptop to hold the season's cruise data, where yyyy is the 4-digit year.***
    4. ***Create a subdirectory for this cruise as "c:\oceanography\yyyy\Downloaded HEX files\\yymm\" where yy is the 2-digit year, and mm the 2-digit month.***
    5. ***Determine the starting dump number for the cruise by incrementing the last dump number used by the OC survey program.***
        1. It may be found on the most recently completed survey field log sheet.

    <u>Only one sequential dump number is maintained, regardless of how many CTDs are employed at various times</u>.

2. **For each cruise day**
    1. ***Capture casts using the method described in SOP 1.***
    2. ***Retrieve daily data from CTD.***
        1. Connect laptop serial port to CTD using special cable.
        2. Invoke SEATERM software.
        3. Be sure SEATERM is set to download one specified cast at a time.
        4. Press "connect" software icon.
            1. *If it doesn't connect, take remedial action such as tightening cables and replacing batteries.*
            2. *If it does connect, the number of casts and the record numbers for each cast will be displayed.*

        1. Complete a CTD Download Checklist from the displayed information; for date, use the local date transferred rather than the GMT collection date.
        2. If no processing is done on the CTD for 90 seconds, the connection is dropped to conserve battery power.
    5. Invoke a transfer using the “upload” button.
    6. Specify the next cast to save, as tracked on the checklist.
    7. You will be prompted for “header” information.
        1. *Enter it from the correct row of the field log sheet.*
        2. *Be mindful of the 90-second disconnect timeout.*
    8. Specify the destination file on the laptop as c:\oceanography\yyyy \Downloaded HEX files \yymm\yymm_C_dddd_cc.hex, where yy is year of cast, mm is month of cast, C is local ctd number, dddd is dump number, and cc is cast number. Zero fill any name component to ensure the filename is exactly 18 characters.
    9. Watch screen progress to be sure the correct sample numbers are reflected for that cast.
        1. *If the wrong records appear listed, delete the file using Windows explorer and redo the download.*
    10. Mark the completed download on the paper checklist.
    11. Repeat for each cast until the list is completely checked off.
3. ***Visually check basic quality of each HEX file.***
    1. Locate each downloaded file with Windows explorer and open it in NOTEPAD.
    2. The cast number should match the log sheet entry and the filename – this is VERY IMPORTANT.
    3. The header text should match the corresponding log sheet values.
    4. Beyond the header, every line should be exactly the same length – visually scan down to the end for short or long lines. (The exact number of characters in the data line varies by the number and type of sensors on the CTD at the time it is used.)
4. ***If any file does not meet the QA requirements, then delete it with Windows explorer and recreate it with SEATERM.***
    1. A file cannot be deleted if it is still open in NOTEPAD – close the file.
    2. The new file must go through this QA as well.
    3. If a second attempt at downloading the cast also results in data lines not exactly 24 character:
        1. *Use the notepad session to delete the invalid lines.*
        2. *Save the file and close NOTEPAD.*
        3. *Add a comment to the field log sheet specifying the number of invalid rows deleted due to length errors.*
        4. *If, from a particular point in time, files begin exhibiting consistent short or long lines, this suggests the CTD is faulty and must be serviced immediately.*
5. ***Back up the hex files in laptop folder “yymm” to a USB thumb drive.***
    1. Plug in thumb drive and wait for it to be recognized.
    2. Use Windows Explorer to copy files.
    3. Use the “Safely remove hardware” function in the system tray to ensure the copy is complete.
    4. Physically remove the drive
6. ***Clear data from CTD.***
    1. Verify that all casts have been downloaded to the laptop and backed p on the USB drive.

      2. Using SEATERM, press the "Init Log" button; this permanently erases the CTD memory.
   7. ***Disconnect.***
      1. Exit the SEATERM program.
      2. Disconnect the cable from CTD and laptop.
      3. Cap the CTD data socket.

3. **At end of each cruise:**
   1. ***Copy the HEX files from laptop to network server folder at \\nps\akrdfs\GLBA\Science\ Data\Oceanography\Data\yyyy\HEX_raw\ where 'yyyy' is the survey year.***
      1. Files for a particular year are comingled and are not segregated by cruise.
      2. Subsequent data processing will fail unless this specific folder holds all files for the season.
   2. ***Store log sheets in an annual paper file kept by the Project Leader.***
      1. They will be required post-season to generate OC_H field log images.
      2. They will also be required before the next cruise to determine the next starting dump number.

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SOP 6: Raw HEX files (OC_B Creation)

Summary

During the survey year cruises are made. At the end of each cruise day, data from each cast recorded on the CTD must be moved to a laptop computer file. The files undergo basic quality assurance. When the laptop files are complete, the CTD memory is erased to make room for the next day's collection.

At the end of each cruise, the laptop files are copied to the park's network file server.

At the end of each season, the network file copies are zipped into one file for the year. The Project Leader submits the one file to the Data Manager as OC_B. Validation / quality assurance iterations are performed until the Project Leader is satisfied the data are as accurate and complete as is practical. The Project Leader certifies the deliverable and the Data Manager arranges for repository and dissemination.

SOP 6 requires users to work in the internal NPS network under valid Active Directory accounts. Access questions should be directed to the Data Manager.

Detailed steps

1. **In-season component**
    1. ***Project Leader tasks***
        1. During the field season, the oceanographic survey procedures described in SOP 4 must be successfully performed. They provide the required basis for performing this SOP.
2. **Post-season component**
    1. ***Project Leader tasks***
        1. Verify all of the year's cruises are present as hex files are in \\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\yyyy\HEX_raw\ .
            1. *If any hex files are missing and cannot be located, this should be marked on the original field log sheet before it is scanned and preserved. The information will be needed when building the OC_M quality assessment and OC_K annual report at the end of the cruise season.*
        2. Zip all the hex files in into a single file stored in the same folder.
            1. *Bring up the HEX_raw folder in Windows explorer*
                1. Select all files.
                    1. Left click one of the HEX files to select it.
                    2. Press Control-A to select the remaining.
                    3. If any non-HEX files were in the folder, deselect them by holding down the control key and left clicking each one.
            2. *Create a single ZIP file containing all HEX files using WinZip*

        1. In Windows explorer, right click one of the selected files and hold right button until a menu appears – this may take awhile, be patient.
        2. From the menu that appears, point to WinZip.
            1. If WinZip is not on the menu, contact IT support for help.
        3. On the sub-menu that appears, select "Add to Zip File…"
        4. On the "Add" dialog box that appears, append the final product's filename to the existing path.
            1. The default path shown should be the folder containing the HEX files.
            2. Name the archive file HEX_yyyy_a.zip .
                1. *'yyyy' is the calendar year.*
                2. *Sequence letter 'a' is A for first attempt, B for second, etc.*
                3. *For example, the third attempt at creating a valid 2011 OC_B deliverable would use filename HEX_2011_C.ZIP.*
        5. Press the "Add" button and the new file will be created from all selected HEX files.
    3. *Submit the deliverable file via email notification to the Data Manager for validation.*
        1. Specify in the message body it is deliverable OC_B, as defined in protocol OC-2009.1.
        2. Specify the fully qualified filename that the ZIP resides in.
        3. Do not attach the ZIP file to the email, as it may be too large to be delivered.
                1. *Do not alter the deliverable file after the submission email has been sent; that could break the validation process.*

2. ***Data Manager tasks***
    1. On receipt of the submission, assign the next formal Submission Number to this file using the "Update Submission Log" web tool at http://165.83.57.239/0_submission_update.aspx.
    2. Complete Submission_Log details up through the Submission_Date column.
    3. Copy the file into the staging area for validation at \\inpglbafs03\data\SEAN_Data\Staging\OC\OC_B.
        1. *Put it in its own subdirectory whose name is the same as the submission number.*
        2. *Ensure its name meets the standards defined in Appendix J.*
    4. Unzip the file into its component HEX files in the staging area.
    5. Invoke validation of the HEX files according to current criteria by using the web program at http://165.83.57.239/OC_DM_validate_OCB.aspx.
        1. *Validation summary results automatically are recorded in the Submission_Log.*
    6. If submission fails mandatory criteria, reply with a "failure email" that includes:
        1. *The submission number assigned*
        2. *The deliverable ID*
        3. *The protocol ID*
        4. *A specific list of all the mandatory criteria failed*
            1. Copy and paste the "findings" panel of OC_DM_validate_OCB.aspx into the email message.
            2. Alternatively, attach the "findings.htm" file that was automatically created in the staging subdirectory.
    7. If submission passes mandatory criteria, reply with a "success email" that includes:
        1. *The submission number assigned*
        2. *The deliverable ID*
        3. *The protocol ID*
        4. *Documentation listing any specific optional criteria failed*

        5. *Request to certify deliverable as complete*

3. ***Project Leader tasks***
    1. On receipt of a failure email:
        1. *Make corrections so the deliverable meets mandatory criteria.*
            1. Print out the findings from the email if desired for ready reference.
            2. It may be convenient to have the scanned field log forms (OC_H) accessible in order to help resolve exceptions.
            3. Edit each original file using WordPad.
                1. Be aware these are the original source records and editing must be done with care to avoid introducing new errors.
                2. When a file is corrected, save it on top of the existing file.
        2. *In case of accident, files may be restored to original state by obtaining copy of previous submission from Data Manager*
        3. *Restart the process from the beginning of the post-season component process.*
    2. On receipt of a success email, review any failed optional criteria:
        1. *If these are acceptable:*
            1. Reply with a “certification email” stating the deliverable is certified and may be disseminated.
        2. *If these are unacceptable:*
            1. Reply with a “withdrawal email”, stating the deliverable is withdrawn.
            2. Take remedial action to obtain a corrected deliverable.
            3. Restart the process from the beginning.
4. ***Data Manager tasks***
    1. On receipt of a withdrawal email:
        1. *Mark the withdrawal in the Submission_Log’s Status column using the web tool.*
        2. *Terminate the process.*
    2. On receipt of a certification email:
        1. *If sensitive information is in the unzipped deliverable:*
            1. Products containing sensitive information cannot be disseminated.
            2. Mark the Submission_Log’s Status column as Sensitive using the web tool.
            3. Copy the submitted single zip file to test environment as AUXREP\OC\OC_B\SENSITIVE\ HEX_yyyy.zip (no version letter in name).
        2. *If NO sensitive information is in the unzipped deliverable:*
            1. Copy the submitted single zip file to test environment at AUXREP\OC\OC_B\ HEX_yyyy.zip.
            2. Create web page links to the new file.
            3. Mark the certification status and date in Submission_Log using the web tool.
        3. *Propagate from test to production environment.*
        4. *Verify non-sensitive deliverable is accessible from production web site.*
        5. *Update the annual deliverable tracking spreadsheet with the date of completion for OC_B.*
        6. *RETAIN the individual files from the staging area.*
            1. This will serve as the original CTD file backup.
            2. The original CTD files on the park server are typically directly edited in the validation process, so the staging backup is necessary.
    3. Using NPS Metadata Editor software, update the scope of the formal metadata so it includes this new date range.

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SOP 7: Post-Cruise Quality Assurance: Raw Data Plots

Summary

When cruise data become available on the park network after completion of SOP 5, the performance of the CTD is reviewed by generating a set of profile plots from the HEX files. Sea-Bird SBEDataproc software is used. Due to the number of parameters recorded, each cast requires two JPEG file plots in order to display all values.

By performing this immediately after each cruise, the leader can detect faulty performance in one or more individual sensors in time to complete repairs before the next cruise. (This quality check does not, however, replace the visual file inspections performed in SOP5. Incorrect length data lines detected in SOP5 indicate defects in the CTD hardware, firmware, and/or configuration.)

This process is the responsibility of the Project Leader. The plots are intermediate products local to the park and are not a formal SEAN deliverable. They are, however, required so the Project Leader may create the OC_M data quality evaluation deliverable at season's end.

Note: before executing this procedure, it may be helpful to review Appendix H regarding standard directory structures and Appendix I regarding Sea-Bird software layout.

SOP 7 requires users to work in the internal NPS network under valid Active Directory accounts. Access questions should be directed to the Data Manager.

Detailed steps

1. **Be aware of limitations inherent in software.**
    1. ***This process may be performed at the park or at any location physically connected to the NPS network.***
        1. If executed outside the immediate park, it may take a great deal of time to complete.
        2. Be aware execution from outside could slow Internet response to all park staff.
    2. ***The workstation used must have special SBEDATAPROC software and custom scripts installed.***
        1. If not found on desktop, seek Data Manager's assistance.
        2. The custom scripts are required to automate a set of complex data processing steps.
    3. ***The software may present message boxes and halt until the operator issues commands to continue.***
        1. Sometimes these messages do not appear in the foreground of the desktop, but are hidden behind other windows.
        2. To limit hidden windows, it is advisable not to work with other software, such as web browsers, while this process is being performed.
    4. ***The vendor software does not permit rigorous exception recovery.***
        1. The applications may fail due to a number of circumstances.

2. Familiarity with the Sea-Bird data processing applications will aid in diagnosing and overcoming problems.
3. The authoritative manual may be found at http://www.seabird.com/pdf_documents/manuals/SBEDataProcessing_7.18c.pdf.
4. The Data Manager is available to assist in resolving software issues.

2. Generate plots from all HEX files

1. Be sure there are no empty HEX files in the directory, which will halt the automated processing.

1. Use Windows Explorer to find any files that are too small to contain data points.
   Navigate to \\nps\akrdfs\glba\science\data\oceanography\data*yyyyhex_raw*, where *yyyy* is the year of interest.**
   Locate any file whose size is 2KB or smaller.
2. Open each small file with NOTEPAD.EXE or similar program to verify whether rows of hex data follow the line containing *END*.
3. For each file with no data, use Windows Explorer to rename it by appending a ".bad" extension, which will remove it from the processing path. (E.g., rename a file called 0903_1_0178_00.hex to 0903_1_0178_00.hex.bad.

2. Invoke the automation scripts by double-clicking the provided desktop icon or, if no icon is available, double-clicking its BAT file in Windows explorer.

1. Each CTD has its own version of the script. For example, CTD #1 uses C:\Program Files\Sea-Bird\#1HEX_Plot.bat. CTD #5 uses C:\Program Files\Sea-Bird\#5HEX_Plot.bat.
2. Details of program configuration are provided in Appendix I.

3. A "DOS command window" will appear and prompt the user for parameters.

1. Provide the 4-digit year in response to the prompt.
2. Enter the name of the calibration file to use.
   1. *Generally, this is the file most current at the beginning of the survey year.*
   2. *Enter the filename and extension only.*
      1. For example, 1_0436a.con
      2. Do not attempt to specify any directory information. The locations of calibration files for each year are pre-defined.
3. The process may appear unresponsive, with no visible indication of activity, but it is running. Be patient.

4. A Windows dialog box will appear titled "Data Conversion"

1. It shows parameters used and provides the status of file processing.
2. As long as file processing progress is shown, nothing should be touched in the dialog box.
3. Message boxes indicating errors in a particular file may appear.
   1. *The messages are terse but do explain the nature of problems.*
   2. *Generally, they can be dismissed by pressing the OK button.*
   3. *If presented a message box asking "Do you want to process the next file?", one may generally press YES.*
      1. A few defective files should not be grounds for cancelling all plots.
   4. *If presented with the message "Output file already exists," click on the "Yes to all" button.*
4. It will be over when the dialog box disappears.

5. ***Nothing will appear for awhile, but the first set of plots, the "A" group, is being assembled.***
   1. Once the software has looked at every file for the year, it may display a message box warning of errors in certain files.
      1. *Errored files will not be plotted.*
      2. *Press the OK button on the message box to continue.*
      3. *Be aware this box may be hidden beneath other Windows, and that processing will not resume until OK is pressed.*
   2. A Windows form titled "Sea Plot" will eventually appear.
      1. *It should display a progress bar as it plots each file.*
      2. *One may monitor the creation of JPG plot files by watching the …yyyy\plot\hex\ directory as illustrated:*

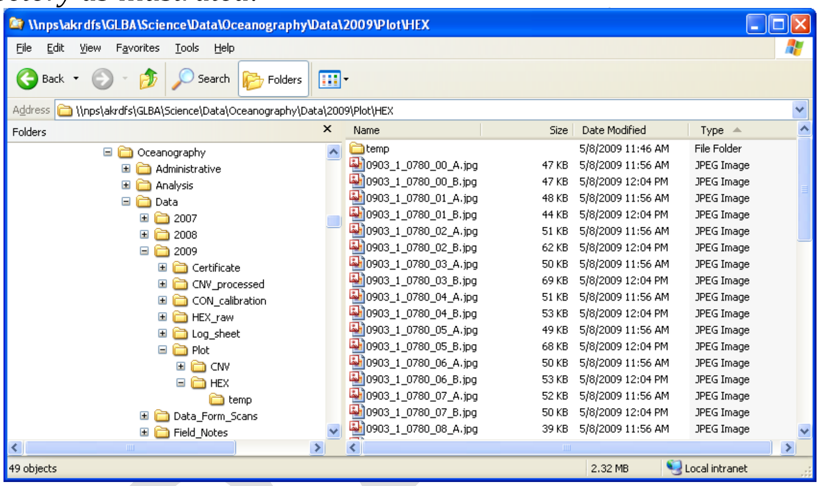

Figure SOP7.1. Using Windows Explorer to monitor plotting progress.

      3. *When complete, the software may display a temporary plot viewing window, which should be dismissed.*
      4. *Once the A plot files are complete, the dialog box will disappear.*
6. ***Nothing will appear for awhile, but the second set of plots, the "B" group, is being assembled.***
   1. The considerations and actions are the same as those in the previous step.
   2. After the B plots complete the original command box should automatically disappear as well. If it doesn't, type EXIT in that box.
7. ***The plots should be reviewed for indications of problems.***
   1. They may typically be viewed in Windows explorer by double-clicking. The application that pops up showing the first file typically supports scrolling through the other files in the directory. Figure SOP7.2 illustrates this.
   2. The plot files follow the same file naming convention as the HEX files, but have an _A or _B appended, indicating which parameter set they show.
   3. Missing plot files are usually the result of damaged HEX files – which should be investigated.
   4. Erratic plots of only one parameter suggest a faulty sensor in need of correction.
      1. *However, outlier values only at the top of the cast are to be expected, as the CTD may start recording before being fully submerged and acclimated.*

5. Erratic plots of multiple parameters, if they are repeated from a particular time forward, suggest a systemic CTD failure. See Figure SOP7.3.

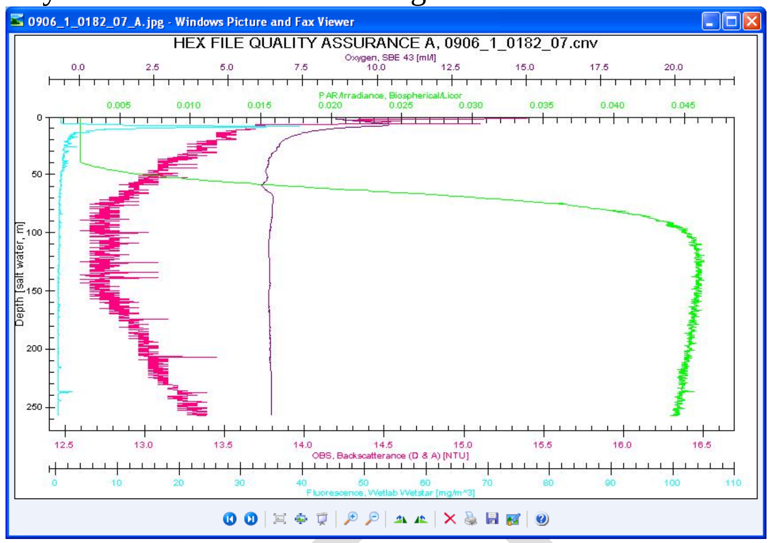

Figure SOP7.2. Example plot illustrating typical values in Hex files.

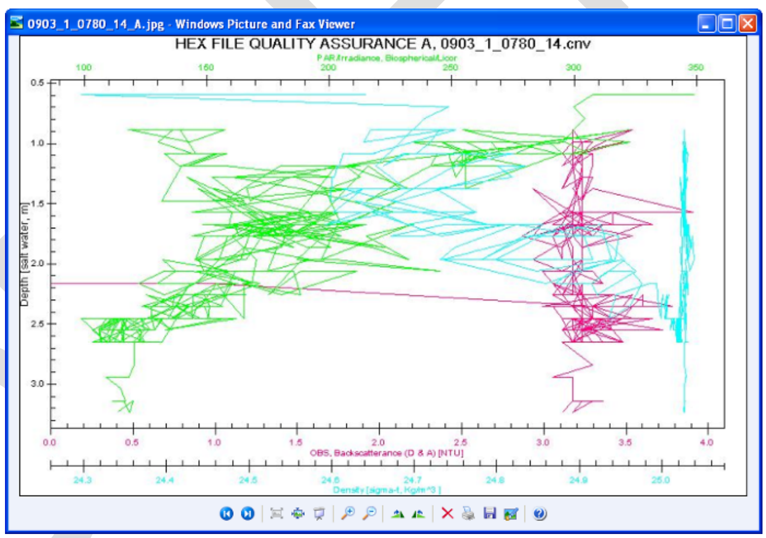

Figure SOP7.3. Hex plot illustrating CTD failure due to multiple sensor faults.

3. Retain the plot files for year end.

1. ***They will be required for determining data quality when deliverable OC_M is built at the end of the year.***
2. ***If accidentally deleted, they will be recreated the next time this process is run. The automated process always plots all files for the year.***
3. ***The …yyyy/PLOT/HEX/TEMP directory is used to store intermediate CNV files integral to this process. These files are not to be used for any other purpose as they are not managed. They may be deleted whenever desired.***

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SOP 8: Processed CNV files (OC_C Creation)

Summary

At the end of the survey year, the certified HEX files along with the latest CON file are retrieved from SEAN and copied to the park file server. Sea-Bird SBEDataproc software is executed under script control, creating the CNV files.

Once created, the individual CNV files are zipped into one file for the year. The Project Leader submits the one file to the Data Manager as OC_C. Validation / quality assurance iterations are performed until the Project Leader is satisfied the data are as accurate and complete as is practical. The Project Leader certifies the deliverable and the Data Manager arranges for repository, dissemination, and metadata update.

Two profile plots of each fully processed CNV file are also generated by SBEDataproc script. The plots are retained by the Project Leader for later creation of deliverable OC_M - Data Evaluation.

Note: before executing this procedure, it may be helpful to review protocol Appendix H regarding standard directory structures and Appendix I regarding Sea-Bird software layout.

SOP 8 requires users to work in the internal NPS network under valid Active Directory accounts. Access questions should be directed to the Data Manager.

Detailed steps

1. **Project Leader tasks**
    1. ***Obtain the latest certified HEX files.***
        1. Delete all data files in \\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\yyyy\HEX_raw\ .
        2. Download the certified OC_B deliverable from web site http://science.nature.nps.gov/im/units/sean/OC_Main.aspx to file server directory \\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\yyyy\HEX_raw\ .
        3. Unzip its files using Windows explorer
            1. *Double-click the downloaded zip file.*
            2. *A pane showing all the HEX files will open – select them with the mouse and drag to the main folder of \\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\yyyy\HEX_raw\ .*
            3. *It could take awhile to extract the typical number of files.*
    2. ***Obtain the most recent certified CON file for the season.***
        1. Delete all files in \\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\yyyy\CON_Calibration\ .

2. Download the most recent certified OC_A deliverable for the year to \\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\yyyy\CON_Calibration\ .

3. ***Using Windows Explorer, create a folder for the CNV output at \\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\yyyy\CNV_processed where yyyy is the year surveyed.***
   1. Within that folder, create a subdirectory named “temp”.
   2. If the CNV_Processed folder already exists from an earlier attempt, delete all its existing files, including those in the temp directory, using Windows Explorer.
4. ***Use SBEDataProc to generate one CNV file from each HEX file.***
   1. Be aware of inherent software limitations as detailed in SOP 7.
   2. The final output CNV files will be directed to \\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\yyyy\CNV_processed\.
      1. *The file will be named yymm_C_dddd_cc_suffix.CNV*
         1. yy is year, mm is month, C is CTD#, dddd is dump#, and cc is cast number.
         2. Suffix refers to a set of single letters separated by underscores that get generated as a byproduct of the software process. A typical suffix is “c_f_a_m_l_d_b”.
   3. Invoke the automation scripts by double-clicking the provided desktop icon or, if no icon is available, double-clicking this entry in Windows explorer: C:\Program Files\Sea-Bird\CNV_Create.bat. A “DOS command box” will appear.
   4. Invoke the automation scripts by double-clicking the provided desktop icon or, if no icon is available, double-clicking its BAT file in Windows explorer.
      1. *Each CTD has its own version of the script. For example, CTD #1 uses C:\Program Files\Sea-Bird\#1CNV_Create.bat. CTD #5 uses C:\Program Files\Sea-Bird\#5CNV_Create.bat.*
      2. *Details of program configuration are provided in Appendix I.*
   5. A “DOS command window” will appear and prompt the user for parameters.
      1. *Provide the 4-digit year in response to the prompt.*
      2. *Enter the name of the calibration file to use.*
         1. Generally, this is the file most current at the beginning of the survey year.
         2. Enter the filename and extension only.
            1. For example, 1_0436a.con
            2. Do not attempt to specify any directory information. The locations of calibration files for each year are pre-defined.
   6. While nothing may appear to be happening, processes are starting in the background. Each one may take several minutes to appear on the screen. Be patient.
   7. A Windows dialog box will appear titled “Data Conversion”
      1. *It shows parameters used and provides the status of file processing.*
      2. *As long as file processing progress is shown, nothing should be touched in the dialog box.*
      3. *Message boxes indicating errors in a particular file may appear.*
         1. The messages are terse but do explain the nature of problems.
         2. Generally, they can be dismissed by pressing the OK button.
         3. If presented a message box asking “Do you want to process the next file?”, one may generally press YES.
            1. A few defective files should not be grounds for cancelling the deliverable.
      4. *This subprocess will be over when the “Data Conversion” dialog box disappears.*

8. Dialog boxes will similarly appear and disappear as the following additional processes execute: Filter, Align CTD, Cell Thermal Mass, Loop Edit, Derive, Bin Average, Sea Plot ‘A’ series, Sea Plot ‘B’ series.
   1. *Note and dismiss any warning messages as they appear.*
   2. *Errors serious enough to halt the process are possible.*
      1. Appendix I provides details helpful in diagnosis.
      2. The latest Sea-Bird software manual may explain how to recover.
      3. The Data Manager may be able to assist.
9. Once the whole process completes, several sets of files will be created.
   1. *\\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\yyyy\CNV_processed\ will contain the final CNV files to be used in assembling OC_C.*
   2. *\\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\yyyy\Plot\CNV\ will contain a pair of plots for each cast.*
      1. These are based on the fully processed CNV files.
      2. They should be similar but not identical to the QA plots in the …\Plot\HEX\ subdirectory.
   3. *\\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\yyyy\CNV_processed\temp\ will contain the intermediate files left by each subprocess.*
      1. These are left behind for diagnostic purposes.
      2. They are not to be reported to SEAN.
      3. They should be deleted once OC_C is successfully certified.

5. ***Zip all the CNV files in \\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\yyyy\CNV_processed\ into a single file stored in the same folder.***
   1. Bring up the CNV_processed folder in Windows explorer
   2. Select all files.
      1. *Left click one of the CNV files to select it.*
      2. *Press Control-A to select the remaining.*
      3. *If any files other than types CNV were in the folder, deselect them by holding down the control key and left clicking each one. Be certain to deselect the “temp” directory.*
   3. Create a single ZIP file containing all final CNV files using WinZip or similar software
      1. *In Windows explorer, right click one of the selected files.*
      2. *From the menu that appears, point to WinZip.*
         1. If WinZip is not on the menu, contact IT support for help.
      3. *On the sub-menu that appears, select “Add to Zip File…”*
      4. *On the “Add” dialog box that appears, add the final product’s filename to the existing path.*
         1. The default path shown should be the folder containing the CNV files.
         2. Name the archive file CNV_yyyy_a.zip .
            1. ‘yyyy’ is the calendar year.
            2. Sequence letter ‘a’ is A for first attempt, B for second, etc.
            3. For example, the second attempt at creating a valid 2012 OC_C deliverable would use filename CNV_2012_B.ZIP.
      5. *Press the “Add” button and the new file will be created from all selected files.*
   4. Submit the deliverable file via email notification to the Data Manager for validation.
         1. Specify in the message body it is deliverable OC_C, as defined in protocol OC-2009.1.

        2. Specify the fully qualified filename that the ZIP resides in.
        3. Do not attach the ZIP file to the email, as it may be too large to be delivered.
        4. Do not alter the deliverable file after the submission email has been sent; that could break the validation process.

2. **Data Manager tasks**
    1. ***On receipt of the submission, assign the next formal Submission Number to this file, as found in the master Submission_Log table.***
        1. Use the "Update Submission Log" web tool at http://165.83.57.239/0_submission_update.aspx .
        2. Complete Submission_Log details up through the Submission_Date column.
            1. *The submission status must be P for pending.*
    2. ***Network copy the file into the staging area for validation at \\inpglbafs03\data\SEAN_Data\Staging\OC\OC_C.***
    3. ***Ensure its name meets the standards defined in Appendix J.***
        1. Put it in its own subdirectory whose name is the same as the submission number.
    4. ***Unzip the file into its component CNV files in the staging area.***
    5. ***Invoke validation of the CNV files according to current criteria by using the web program at http://165.83.57.239/OC_DM_validate_OCC.aspx.***
        1. Select the pending OC_C submission from among those shown.
        2. Validation summary results automatically are recorded in the Submission_Log.
    6. ***If submission fails mandatory criteria, reply with a "failure email" that includes:***
        1. The submission number assigned
        2. The deliverable ID
        3. The protocol ID
        4. A specific list of all the mandatory criteria failed
            1. *Copy and paste the "findings" panel of OC_DM_validate_OCC.aspx into the email message.*
            2. *Alternatively, attach the "findings.htm" file that was automatically created in the staging subdirectory.*
    7. ***If submission passes mandatory criteria, reply with a "success email" that includes:***
        1. The submission number assigned
        2. The deliverable ID
        3. The protocol ID
        4. Documentation listing any specific optional criteria failed
        5. Request to certify deliverable as complete

3. **Project Leader tasks**
    1. ***On receipt of a failure email:***
        1. Make corrections so the deliverable meets mandatory criteria.
        2. Restart the process from the beginning of the post-season component section.
    2. ***On receipt of a success email, review any failed optional criteria:***
        1. If these are acceptable:
            1. *Reply with a "certification email" stating the deliverable is certified and may be disseminated.*
            2. *Delete the obsolete intermediate files contained in …\CNV_Processed\temp\.*
        2. If these are unacceptable:
            1. *Reply with a "withdrawal email", stating the deliverable is withdrawn.*

2. *Take remedial action to obtain a corrected deliverable.*
3. *Restart the process from the beginning.*

4. Data Manager tasks

1. ***On receipt of a withdrawal email:***
    1. Mark the withdrawal in the Submission_Log's Status column using the web tool.
    2. Terminate the process.
2. ***On receipt of a certification email:***
    1. If sensitive information is in the unzipped deliverable:
        1. *Products containing sensitive information cannot be disseminated.*
        2. *Mark the Submission_Log's Status column as Sensitive using the web tool.*
        3. *Copy the submitted single zip file to test environment as AUXREP\OC\OC_C\SENSITIVE\ CNV_yyyy.zip (no version letter in name).*
    2. If NO sensitive information is in the unzipped deliverable:
        1. *Copy the submitted single zip file to test environment at AUXREP\OC\OC_C\ CNV_yyyy.zip.*
        2. *Create web page links to the new file.*
        3. *Mark the certification in the Status column in Submission_Log using the web tool.*
    3. Propagate from test to production environment.
    4. Verify any non-sensitive deliverable is accessible from production web site.
    5. Update the annual deliverable tracking spreadsheet with the date of completion for OC_C.
    6. Do not delete the individual CNV files from the staging area. They will be immediately needed for generating OC_D.
3. ***Update the scope of the formal metadata so it includes the new date coverage.***

Glacier Bay National Park and Preserve Oceanographic Monitoring Protocol

SOP 9: Post-Season Quality Assurance: Calibration Evaluation

After the October cruise, the CTD is returned to Sea-Bird for calibration of the sensors. If multiple CTDs were employed during the season, all must undergo calibration. All sensors on a CTD are to be calibrated. Because no water samples are taken for mid-season calibrations of the conductivity, fluorometers or OBS sensors, the annual calibrations provide the only means for the program to independently assess sensor operations. The "Temperature Calibration Report" and "Conductivity Calibration Report" will detail sensor drift between the current and previous instrument calibrations. Use the "As Received" calibration values for purposes of determining drift during the period of instrument use.

For Glacier Bay measurements, which describe a dynamic coastal domain, sufficient accuracy of temperature (ºC) and salinity (PSU) data are achieved at the 0.01 and 0.03 levels respectively; however typical measurements will perform better than this, on the order of 0.002-0.005 for the temperature measurements and 0.01-0.02 for the salinity measurements. Water samples are not taken during the Glacier Bay cruises, so the monitoring program has only limited ability to assess and correct deviant readings. After the calibration sheets have been inspected, a data quality flag will be assigned (see OC_M) to each CTD cast, according to the criteria listed below.

1.0 Temperature sensor drift

Sea-Bird specifies typical drift of the temperature probes to be less than 0.002 ºC per year. Presuming no major problems are noted with the temperature sensor, no calibration adjustments to the temperature measurements should ever be required. Check the "drift since last cal" value and ensure this value is below 0.01 ºC.

If the sensor offset is greater than 0.01, the cause of this should be determined through examination of the comments on the calibration report and/or in consultation with Sea-Bird. For offsets less than or equal to 0.01 ºC, the data quality flag should be marked as "Good." For offsets between 0.01 ºC and 0.02 ºC, the data quality flag should be set to "Questionable" and for offset greater than 0.02 ºC, the data quality flag should be set to "Bad". In the rare case where the temperature calibration indicates a total drift of more than 0.01 ºC, the cause of such a large offset are to be documented in the comments field of OC_M.

2.0 Conductivity sensor drift

Particular care must be taken when assessing the conductivity calibration values, because drift and complete cell failure can be caused by many different sources. Biofouling of the conductivity cell causes measurable changes in accuracy; a crack in the glass cell can cause partial (minimal) or near complete sensor failure. Typical drift of a conductivity cell with one year between calibrations should be in the range of 0.001-0.0025 PSU/month.

If the calibration report indicates a total conductivity cell drift of greater than 0.03 (≈0.0025 PSU/month for a year-long calibration cycle), then document this large drift in the metadata notes and adjust the data quality flag accordingly. The data quality flag is marked as "Good" if the total conductivity cell offset is less than or equal to 0.03 PSU. The data quality flag is marked as "Questionable" if the total offset is between 0.03 and 0.1 PSU and the data quality flag is marked as "Bad" if the total offset is greater than or equal to 0.1 PSU.

For the purposes of the GLBA program, no post-calibration salinity adjustments are made. Without *in-situ* water samples, it is generally not possible to determine when the offset (of even if only one) was generated or if the offset occurred as a slowly drifting change in sensor characteristics. Researchers who would care to make the assumption that the drift occurred linearly with time can access the archived calibration sheets and spread the drift evenly (in time), as detailed in *Sea-Bird Application Note #31*, which can be downloaded from the Sea-Bird web site.

In the rare case where the salinity calibrations exhibit a total drift of more than 0.1 PSU, the cause of such a large drift is probably catastrophic sensor failure and the Sea-Bird sensor calibration report may note some significant problem; this is to be noted in the comments field of OC_M. If no single event stands out as the likely cause of failure, none of the salinity data should be certified as "Good." If a likely cause for failure can be identified, the Project Manager will have the option of 1) certifying only data collected before this point in time with a "Questionable" data quality flag and data collected after this point in time with a "Bad" data quality flag set *or* 2) denoting all data collected as "Bad". Employing comparisons of measurements collected in previous years along with measurements collected in the year of sensor failure can help diagnose when such a failure may have taken place. The deepest measurements in the water column would be most appropriate for such comparisons because the dynamic range of salinity values is smaller away from the surface waters.

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SOP 10: Database Additions (OC_D Creation)

Summary
Immediately after certification of an OC_C submission, the individual CNV validation files are still available in the staging area. Data in these files are loaded into the test database, deleting anything previously submitted for the stated year. Once that is done successfully, the process is repeated for the production database. Certification is attested by the Data Manager, on the basis of the Project Leader's OC_C certification.

All steps are performed by the Data Manager.

Detailed steps

1. **Data Manager tasks**
   1. ***Upon certification of OC_C, verify the year's unzipped CNV file set is still complete in the staging area.***
   2. ***OC_C has already been validated and needs no further quality control measures.***
   3. ***If the OC_C deliverable for the submission unit was marked sensitive in its Submission_Log entry:***
      1. Create a Submission_Log entry for this OC_D using the web tool, marking the status as sensitive.
      2. Update the annual deliverable tracking spreadsheet with the date of completion for OC_D.
      3. Propagate only the tracking spreadsheet to production.
      4. The process is complete.
   4. ***Otherwise use web application http://165.83.57.239/OC_DM_create_OC_D.aspx to create and validate the OC_D***
      1. Indicate to the program which certified OC_C submission from the offered choices to use as the basis for the OC_D.
      2. The submission log entry will be automatically created and updated as progress is made.
      3. The OC_C components are revalidated
         1. *If a mandatory criterion is violated, the OC_D will not be created and the process ends.*
         2. *Failure suggests a previously undetected flaw in the predecessor OC_C and, possibly, OC_B components: this must be investigated and corrected before an O_D can be created.*
      4. If this submission unit has previously been stored in the database, then the new data will totally replace the older submission
         1. *The web application will only erase/replace the earlier data if the operator confirms this with the "overwrite" button on the screen.*
         2. *Should loading of the new data fail later in the process, any erased prior data will remain erased. Remedial action will be needed to recreate it.*

5. When complete, the web application updates the submission status.
    1. *If it is not Certified, check the screen execution log to determine the nature of the problem, correct the issue, and resubmit.*

5. Using SQL Server management studio, update the production database rows and submission log entry for the submission unit from the staging server.

6. Update the annual deliverable tracking spreadsheet with the date of completion for OC_D.

7. Update the scope of the formal metadata so it includes the new date range.

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SOP 11: Data Quality Assignment (OC_M Creation)

Summary

At the end of the survey year, a review is done to determine if recalibration data indicate sensor errors over the season are significant. The original log sheet images are reviewed for annotations regarding exceptions. The HEX and CNV profile plots are reviewed both separately and jointly for data errors.

The Project Leader notes questionable and unusable casts for the year on the data quality report spreadsheets. The Data Manager, after validating the spreadsheet forms, updates appropriate columns in the cumulate database to reflect exceptions to quality.

Detailed steps

1. **Project Leader tasks**
    1. ***Obtain a blank Data Quality Report form from the "toolbox" link on the SEAN web site.***
        1. Its form is an XLSX spreadsheet.
        2. Ensure there are nine tabs, one for each cruise of the year.
        3. Head the top of each form with cruise-specific information.
        4. Record results of the following analyses on the appropriate sheet.
            1. *Use the order shown.*
            2. *If a cast/station is marked BAD at a point in the process for any reason, no further quality review for that cast is performed.*
            3. *If a cast/station is marked QUESTIONABLE, review continues in order to determine if it should be further marked down to BAD.*
    2. ***Review the latest certified calibration certificates.***
        1. Examine the certified images on the SEAN website of the pre- and post-season calibration documents (deliverable OC_G).
        2. Following the guidance in SOP 9, note any data quality exceptions on the data quality report sheets.
        3. The scope of this finding may cover the entire season if a serious drift was present.
    3. ***Review all certified field log sheet images for the year on the web site (deliverable OC_H).***
        1. Individual cast exceptions may be noted in the COMMENTS field.
        2. Overall cruise exceptions and problems may be noted in the NOTES field.
        3. Be sure to check the backside image of each sheet for further details.
        4. Mark technically flawed casts as BAD on the quality spreadsheet.
            1. *Use the codes listed at the bottom of the sheet, which follow the standard used by the Ocean Data View system.*
            2. *Include a brief explanatory comment. Each comment will be embedded in the historic database to guide future researchers when they select data to work with.*

    5. Mark/comment casts as questionable if one or two sensors appear faulty for some or all of a cast.
        1. *It isn't possible to provide a quality rating at the CTD/dump/cast/individual-sensor level, so any problem has to be recorded for the cast as a whole.*
4. ***Review the HEX profile plots made for individual casts made for QA purposes during the season (SOP 7).***
    1. Mark/comment as questionable casts having one or two improbable plot lines.
    2. Mark/comment as bad casts displaying three or more improbable plot lines.
5. ***Review the CNV profile plots made for individual casts made for QA purposes during the season (SOP 8).***
    1. Mark/comment as bad casts for which nothing is plotted
        1. *The data processing tasks discard observations that are widely outside acceptable limits – in a seriously failed cast it is possible all points get deleted.*
    2. Compare CNV post-season plots against HEX in-season plots.
        1. *If strong discrepancies appear, investigate possible causes.*
        2. *The nature and degree of discrepancies may widely vary.*
        3. *The Project Leader's judgment, following currently accepted practices in the field, will determine whether to mark casts as questionable or bad.*
6. ***Submit the deliverable file via email attachment to the Data Manager for validation.***
7. ***Specify in the message body it is deliverable OC_M, as defined in protocol OC-2009.1.***

2. Data Manager tasks

1. ***On receipt of the submission, assign the next formal Submission Number to this file, as found in the master Submission_Log table.***
    1. Use the "Update Submission Log" web tool at http://165.83.57.239/0_submission_update.aspx .
    2. Complete Submission_Log details up through the Submission_Date column.
2. ***Copy the file into the staging area for validation at \\inpglbafs03\data\SEAN_Data\Staging\OC\OC_M.***
    1. Ensure its name meets the standards defined in Appendix J.
3. ***Validate the XLSX file according to current criteria.***
4. ***Record validation summary data in the Submission_Log using the web tool.***
5. ***If submission fails mandatory criteria, reply with a "failure email" that includes:***
    1. The submission number assigned
    2. The deliverable ID
    3. The protocol ID
    4. Documentation listing all the specific mandatory criteria failed
6. ***If submission passes mandatory criteria, reply with a "success email" that includes:***
    1. The submission number assigned
    2. The deliverable ID
    3. The protocol ID
    4. Documentation listing any specific optional criteria failed
    5. Request to certify deliverable as complete

3. Project Leader tasks

1. ***On receipt of a failure email:***
    1. Make corrections so the deliverable meets mandatory criteria.

    2. Make another submission with the corrected deliverable candidate.
2. ***On receipt of a success email, review any failed optional criteria:***
    1. If these are acceptable:
        1. *Reply with a "certification email" stating the deliverable is certified and may be disseminated.*
    2. If these are unacceptable:
        1. *Reply with a "withdrawal email", stating the deliverable is withdrawn.*
        2. *Take remedial action to obtain a corrected deliverable.*
        3. *Restart the process from the beginning.*

4. Data Manager tasks

1. ***On receipt of a withdrawal email:***
    1. Mark the withdrawal in the Submission_Log's Status column with the web tool.
    2. Terminate the process.
2. ***On receipt of a certification email:***
    1. Due to the nature of these data NO sensitive information is in the deliverable.
    2. Copy the submitted single spreadsheet file to test environment at AUXREP\OC\OC_M\yyyy.XLSX.
    3. Create web page links to the new file.
    4. Update the test database contents.
        1. *Use the OC_M update tool on the Data Management web site at http://165.83.57.239/OC_DM_update_OCM.aspx .*
    5. Mark the certification in the Status column in Submission_Log using the web tool
    6. Propagate from test to production environment.
3. ***Update the annual deliverable tracking spreadsheet with the date of completion for OC_M.***
4. ***Update the scope of the formal metadata so it includes the new date coverage.***

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SOP 12: Field Log Sheets (OC_H Creation)

Summary

The complete set of paper field log sheets that have been accumulating over the survey year are collected. They are double-side scanned into a single PDF for the year. The PDF is submitted through the validation / quality assurance iterations until certified.

SOP 12 requires users to work in the internal NPS network under valid Active Directory accounts. Access questions should be directed to the Data Manager.

Detailed steps

1. **Project Leader tasks**
    1. ***Retrieve from paper files the field log sheets that have been recorded during the survey season.***
    2. ***Arrange them in dump number order.***
    3. ***Verify the set is complete. The dump number should continuously increment with no gaps. If a sheet is discovered missing for a dump, insert a page of paper in the stack listing the dump number and stating "No Field Log Sheet."***
    4. ***Scan the entire packet into a single PDF file using park scanner and associated software.***
        1. Be sure the scanner is set for 2-sided scanning, or be prepared to duplex them by hand.
        2. Save the PDF on park network at \\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\yyyy\Field_Log_Sheets\ where **yyyy** is the survey year covered, *e.g.*, **2011.** Name the file LOG_yyyy.PDF, once again substituting the year for **yyyy**.
    5. ***Submit the single PDF file via email attachment to the Data Manager for validation, specifying in the message body it is deliverable OC_H, for year*** *yyyy*, ***as defined in protocol OC-2009.1.***
2. **Data Manager tasks**
    1. ***On receipt of the submission, assign the next formal Submission Number to this file, as found in the master Submission_Log table.***
        1. Use the "Update Submission Log" web tool at http://165.83.57.239/0_submission_update.aspx .
        2. Complete Submission_Log details up through the Submission_Date column.
    2. ***Save the file into the staging area for validation at \\inpglbafs03\data\SEAN_Data\Staging\OC\OC_H.***
    3. ***Validate the submission according to current criteria.***
    4. ***Record validation summary data in the Submission_Log using the web tool.***
    5. ***If submission fails mandatory criteria, reply with a "failure email" that includes:***
        1. The submission number assigned
        2. The deliverable ID

    3. The protocol ID
    4. Documentation listing all the specific mandatory criteria failed
  6. ***If submission passes mandatory criteria, reply with a "success email" that includes:***
    1. The submission number assigned
    2. The deliverable ID
    3. The protocol ID
    4. Documentation listing any specific optional criteria failed
    5. Request to certify deliverable as complete

3. Project Leader tasks

1. ***On receipt of a failure email:***
    1. Review the paper stack is in order.
    2. Rescan the PDF to ensure it is in the proper form.
    3. Resubmit
    4. If failure cannot be resolved, email the Data Manager that the submission is withdrawn.
2. ***On receipt of a success email, review any failed optional criteria:***
    1. If these are acceptable:
        1. *Reply with a "certification email" stating the deliverable is certified and may be disseminated.*
    2. If these are unacceptable:
        1. *Reply with a "withdrawal email", stating the deliverable is withdrawn.*
        2. *Take remedial action to obtain a corrected deliverable.*
        3. *Restart the process from the beginning.*

4. Data Manager tasks

1. ***On receipt of a withdrawal email:***
    1. Mark the withdrawal in the Submission_Log's Status column using the web tool.
    2. Terminate the process.
2. ***On receipt of a certification email:***
    1. Verify no sensitive information is in the deliverable. Products containing sensitive information cannot be disseminated. (Sensitivity is highly unlikely for this deliverable.)
    2. Copy the submitted file to test environment at AUXREP\OC\OC_H\ .
    3. Propagate from test to production environment.
    4. Verify deliverable is accessible from production web site.
    5. Mark the certification in the Status column in Submission_Log using the web tool.
    6. Update the deliverable tracking spreadsheet with the date of completion for OC_H.
3. ***Update the scope of the formal metadata so it includes this new date range.***

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SOP 13: Data Availability Matrix (OC_J Creation)

Summary

Once the OC_D database update has been certified for the year, this must be publicly documented in OC_J. The Data Manager retrieves the most recent OC_J version as an Excel spreadsheet. A database query is executed for the year to show by month by CTD the presence of readings for salinity, PAR, OBS, fluorometry and DO. The spreadsheet is updated to reflect this and saved. A PDF is made of the new spreadsheet. It is installed in the repository for dissemination.

All tasks are performed by the Data Manager.

Detailed steps

1. **Retrieve the latest Excel spreadsheet version of deliverable OC_J from AUXREP\OC\OC_J\current.xls.**
2. **Resave it as AUXREP\OC\OC_J\yyyymmdd.xls.**
    1. ***Filename is date of creation, (i.e., today).***
    2. ***yyyy is 4-digit year.***
    3. ***mm is 2-digit month with leading zero if needed.***
    4. ***dd is 2-digit day with leading zero if needed.***
3. **Query the detailed database for a count of parameters recorded over the scope of deliverable OC_D, grouped by year, month, CTD, and sensor type.**
    1. ***Open a SQL data query tool such as Microsoft SQL Server Management Studio.***
    2. ***Execute the query stored in K:\SEAN_Data\Staging\OC\OC_J\OC_J-basis.sql.***
    3. ***Update yyyymmdd.xls cell icons so they reflect the scope of data found by the query.***
    4. ***If this is the first deliverable reported for the latest survey year, an additional row must be added to the sheet and populated. If it is the result of a resubmission / recertification to the original OC_D, then the original row should be directly altered.***
4. **Exhaustively compare results against one year prior.**
    1. ***Any changes to the CTD capabilities should be reflected.***
    2. ***If expected changes do not appear, suspend the process until the nature of the fault is determined and remediation steps are identified and performed.***
5. **Spot check older sheet cells against the comprehensive database query.**
    1. ***Exhaustive comparison is not required because these are not likely to change.***
    2. ***If the query does not appear consistent with the existing history, investigate cause to determine whether it is the result of normal operations or of an error.***
    3. ***If the result appears caused by a failure that requires remediation, then launch an ad hoc effort to repair damage.***

6. **If no inconsistencies were detected above, update the sheet to reflect new values.**

7. **Save the new components of OC_J.**
   1. ***Resave the updated yyyymmdd.xls.***
   2. ***Also save yyyymmdd.xls as a PDF file named yyyymmdd.pdf.***
   3. ***Copy yyyymmdd.xls over file current.xls, which will be the basis for the next deliverable cycle.***
   4. ***Copy yyyymmdd.pdf over file current.pdf, which is the information disseminated by the main web site.***

8. **Verify the new OC_J is being properly served by the web site.**

9. **Update the deliverable tracking spreadsheet with the date of completion for this OC_J.**

Glacier Bay National Park and Preserve Oceanographic Monitoring Protocol

SOP 14: Annual Data Report (OC_K Creation)

The annual report will summarize the field efforts of the previous sampling year, provide graphical and tabular summaries of collected data and place these data within historical context so that unusual observations can be identified. The sampling year ends after the October cruise, so the final certified data will not be available until after the instrument returns from the Sea-Bird calibration facility, typically in November or early December. The December oceanographic cruise will take place in December or January; the Annual Data Report will normally be generated in January or February.

Because water column samples of phytoplankton, oxygen and suspended sediment load are not taken and analyzed, the ancillary data sensors cannot be quantitatively compared on an inter-cruise or inter-annual basis. For example, different phytoplankton species have different responses as measured by the fluorometers. Thus, even on a single cruise, data are not directly comparable because phytoplankton communities within a fjord near the glacier may well have different makeup from communities more closely connected to the Gulf of Alaska. Nonetheless, it is important to examine these data (on a relative scale) in order to note possible changes in the character of these parameters over time.

1.0 Annual Report Format and Content:

The Annual Data Report will contain the following subsections and content:

1. **Introduction:** Overview of the monitoring program and its history; personnel involved.
2. **Methods:** Summary of the sampling methodology, timing of field work.
3. **Synopsis of operations:** Overview of the year; what went well; what problems cropped up; what needs particular attention in the coming year. Summary of observation comments and notes recorded on the Field Log sheets.
4. **Coverage:** Chart showing what stations were occupied in what months
5. **Results:**
    i. *Tables summarizing basic measurement and statistics*. Provide the mean, maximum, minimum and standard deviation of designated parameters in the upper 50m of the water column from all cruises (for each core station). Parameters will include: temperature, salinity, density, vertical density gradient, fluorescence, oxygen, OBS and PAR. (See example in Section 2.0 following.)
    ii. *Analysis of Station 04 with respect to historical data*. Vertical profile plots or tables of the temperature and salinity measurements from Station 04 in all cruises along with historical mean and +/- one standard deviation.
    iii. *Horizontal cross-sections*. Horizontal cross-sections of temperature, salinity, density, fluorescence, oxygen, and OBS from the July and December cruises, extending from Icy Strait to the head of the West Arm.

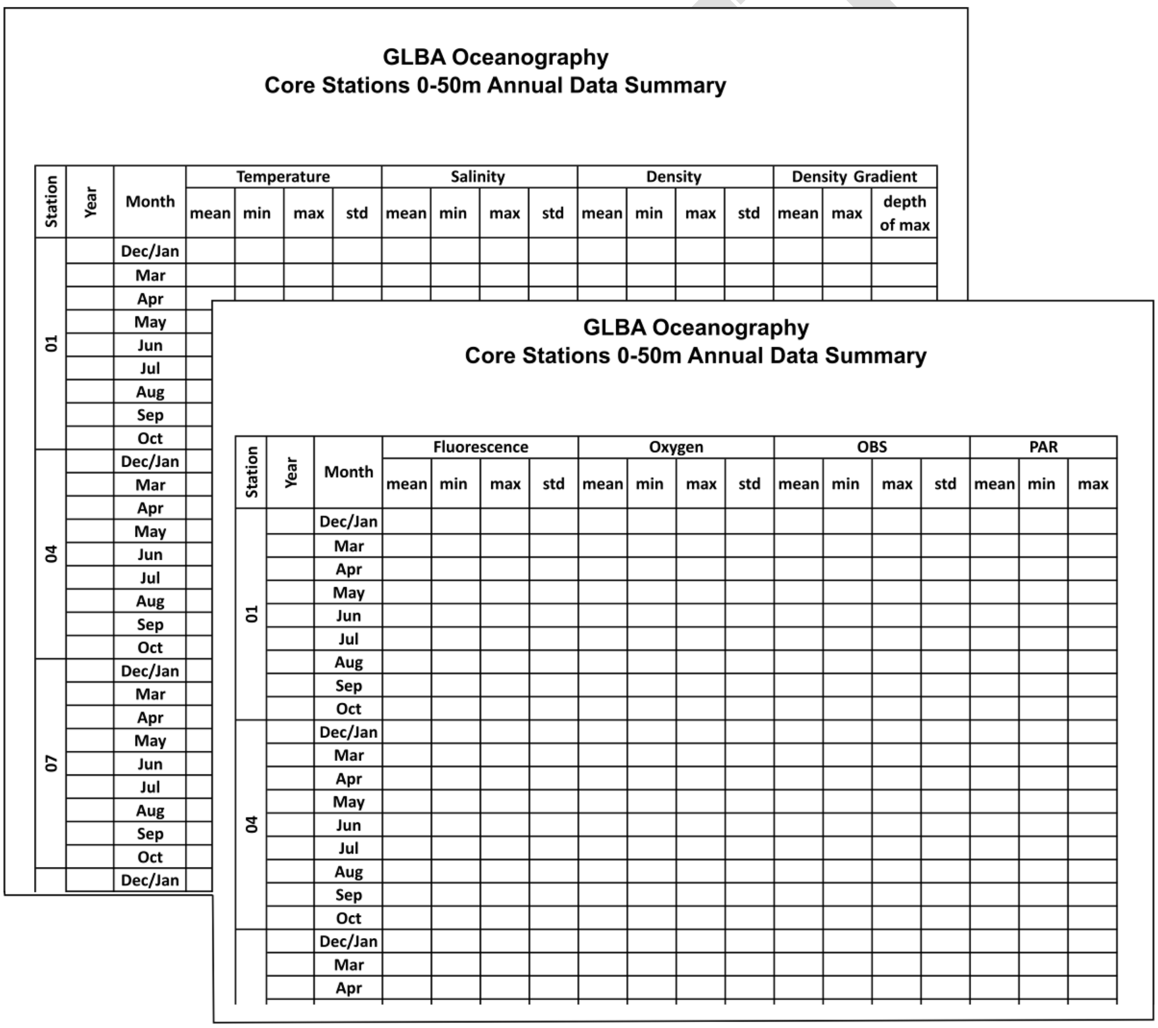
6. **Discussion:** Summary of observations based on tables and figures presented in the Results section. Note in particular anomalous conditions that persist through multiple sampling periods, multiple years and/or across domains.

2.0 Content of Results Section (i): Tables summarizing basic measurements and associated statistics:

In order to assess the measurements made within each cruise, standard statistical summary tables (Table SOP14.1) and/or plots will be created by the Project Leader with help from the Data Manager in accessing values stored within the database.

These tables will be useful to other researchers conducting marine related studies in the park: such data tables can be incorporated directly into their analyses and the Annual Data Report will provide sufficient context for interpretation of these measurements.

Table SOP14.1. Example data summary tables for reporting the basic measurement and statistics collected at the core station set.



GLBA Oceanography
Core Stations 0-50m Annual Data Summary

Station	Year	Month	Temperature				Salinity				Density				Density Gradient		
			mean	min	max	std	mean	min	max	std	mean	min	max	std	mean	max	depth of max
01		Dec/Jan															
		Mar															
		Apr															
		May															
		Jun															
		Jul															
		Aug															
		Sep															
		Oct															
04		Dec/Jan															
		Mar															
		Apr															
		May															
		Jun															
		Jul															
		Aug															
		Sep															
		Oct															
07		Dec/Jan															
		Mar															
		Apr															
		May															
		Jun															
		Jul															
		Aug															
		Sep															
		Oct															
		Dec/Jan															

GLBA Oceanography
Core Stations 0-50m Annual Data Summary

Station	Year	Month	Fluorescence				Oxygen				OBS				PAR		
			mean	min	max	std	mean	min	max	std	mean	min	max	std	mean	min	max
01		Dec/Jan															
		Mar															
		Apr															
		May															
		Jun															
		Jul															
		Aug															
		Sep															
		Oct															
04		Dec/Jan															
		Mar															
		Apr															
		May															
		Jun															
		Jul															
		Aug															
		Sep															
		Oct															
		Dec/Jan															
		Mar															
		Apr															

Rows of each table will describe each field effort conducted through the year and at each core station. Columns of the data tables will contain the 0-50m depth level mean, maximum, minimum and standard deviation for all of the following parameters: Temperature, Salinity, Density (Sigma_t), Vertical density gradient, Fluorescence, Oxygen, OBS, and PAR. Exceptions to the reported statistics are for 1) the density gradient parameter, which requires reporting of the mean, maximum and depth of maximum only and 2) the PAR measurement, which requires the mean, minimum and maximum values only. Table SOP14.1 shows example table setups for reporting these statistics.

The 0-50 m depth level captures the portion of the water column where the majority of primary production, macronutrient utilization, phytoplankton standing stock, thermal stratification and low-salinity lenses all occur. Thus, summarizing this portion of the water column will provide a broad perspective on the physical, chemical and phytoplankton components of the system.

3.0 Content of Results Section (ii): Analysis of Station 04 with respect to historical data

Using data from Station 04 only, vertical profiles (temperature vs. depth and salinity vs. depth) are to be plotted along with the climatologic mean profile in order to assess the relation of the current data to the long-term mean (Figure SOP14.1). The data should also be tabulated so that the values shown in the plots are easily accessible to managers and other researchers (Table SOP14.2). Station 04 is selected for this analysis because it represents a deep station inside the main sill of the fjord and with close connection (proximity) to the West Arm, East Arm and Lower Bay domains.

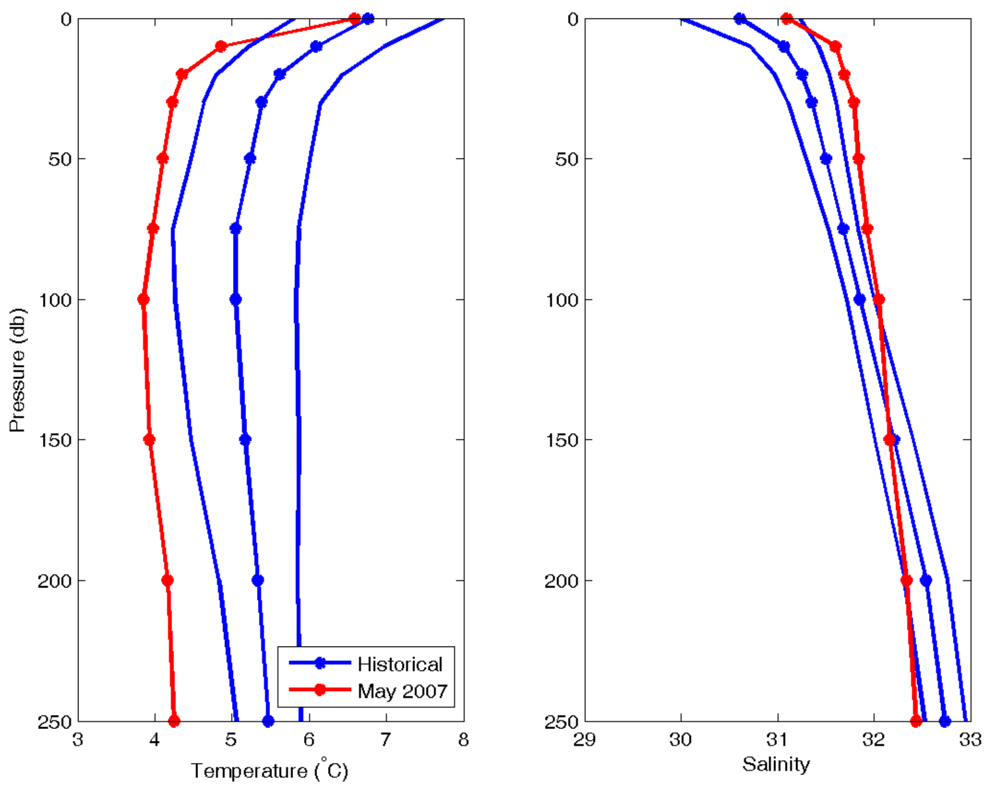


Figure SOP14.1. Example vertical profiles of temperature (left) and salinity (right) shown along with historical data. Data is taken from oceanographic station GAK1 in the northern Gulf of Alaska near Resurrection Bay. Plotted are the current data (May 2007, red with dots) and historical mean values (blue, with dots) along with +/- bounds of 1 standard deviation to either side of the historical mean (blue, without dots). Only a subset of the full vertical profile has been employed here: the 0, 10, 20, 30, 50, 75, 100, 150, 200 and 250 m depth levels. From this plot, we see that waters in May 2007 are anomalously cold over nearly the whole water column whereas the waters are anomalously salty between 10 and 100m depth and anomalously fresh at 250m depth.

Error bounds of one standard deviation plotted to either side of the climatology will allow the profile of interest to be assessed as to whether or not the monthly values' deviations (from climatology) are considered "normal" or "anomalous." An anomalous year is defined as one with observations that fall beyond one standard deviation of the mean of all measurements. Therefore, by definition of 1 standard deviation and the assumption of a normal distribution, 68% of all years will be considered "normal" and 32% will be considered "anomalous." Anomalous measurements are to be noted in the discussion section of the report. Observations that fall outside of two standard deviations (~95% of normally distributed observations) represent very unusual occurrences and deserve particular attention within the annual report.

Table SOP14.2. Example data table: tablature display of the same data presented in Figure SOP14.1. To help draw attention to anomalous measurements, observations made in May 2007 that lie outside one standard deviation of the long term mean have been emphasized in bold italic type.

	Station GAK1 Temperature				**Station GAK1 Salinity**			
Depth	**1972-2008 May Mean**	**Mean - 1 Standard Deviation**	**May 2007**	**Mean + 1 Standard Deviation**	**1972-2008 May Mean**	**Mean - 1 Standard Deviation**	**May 2007**	**Mean + 1 Standard Deviation**
0	6.69	5.66	6.59	7.72	30.63	30.02	31.10	31.24
10	6.03	5.10	***4.86***	6.95	31.08	30.73	***31.60***	31.43
20	5.56	4.73	***4.36***	6.40	31.25	30.98	***31.69***	31.53
30	5.35	4.58	***4.23***	6.12	31.36	31.11	***31.79***	31.60
50	5.20	4.42	***4.10***	5.98	31.49	31.29	***31.84***	31.70
75	5.01	4.18	***3.97***	5.83	31.67	31.52	***31.93***	31.83
100	5.01	4.23	***3.85***	5.80	31.85	31.71	***32.05***	31.99
150	5.15	4.46	***3.93***	5.84	32.20	32.00	32.16	32.40
200	5.33	4.82	***4.17***	5.83	32.54	32.32	32.34	32.76
250	5.46	5.05	***4.25***	5.87	32.75	32.53	***32.44***	32.96

These tables and vertical profile plots are to be generated at a select subset, the "standard oceanographic" depths: 0, 10, 20, 30, 40, 50, 75, 100, 150, 200, 250, 300, 400, and 500 m depth levels.

4.0 Content of Results Section (iii): Horizontal cross-sections

Horizontal cross-section plots can be generated with the ODV software. An ASCII data table provided by the Data Manager that contains the full "flattened" dataset can be imported directly into ODV. Parameters to plot include temperature, salinity, fluorescence, oxygen and OBS. An example of a horizontal cross-section figure along Glacier Bay is presented in Figure SOP14.2.

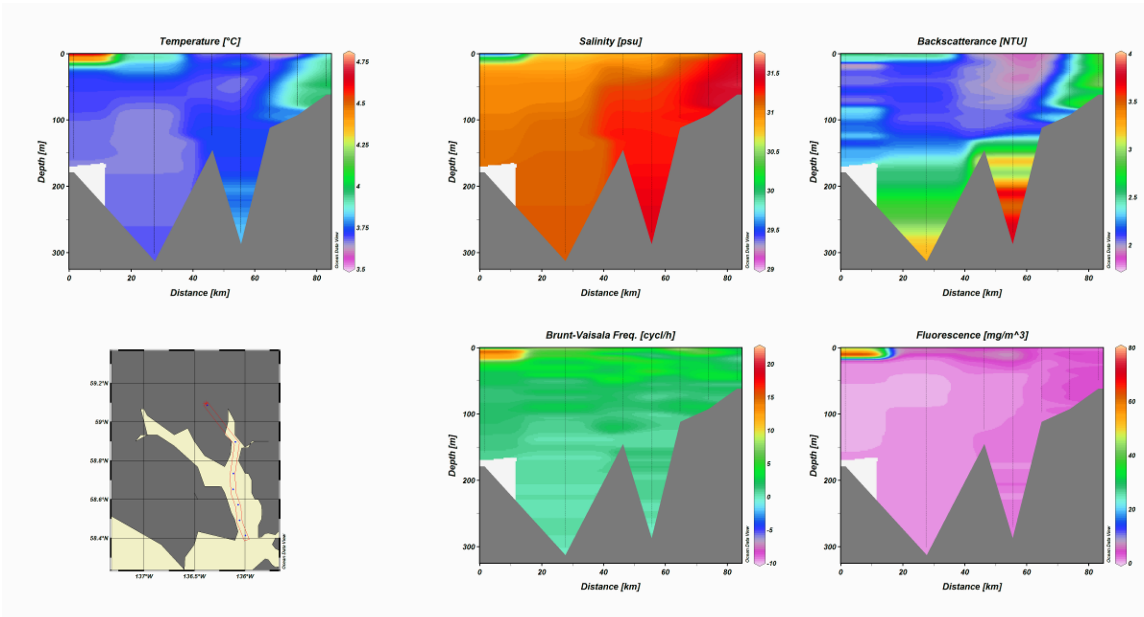


Figure SOP14.2. Example horizontal cross-section using Glacier Bay CTD data collected in April 2009. Station locations are plotted with blue dots in the map in the lower left-hand corner, the transect is outlined in red. On the contour plots, the fjord head is oriented to the left and the station at the mouth of Glacier Bay is on the right hand side.

These figures provide a visual depiction of the data collected with the highest spatial resolution and features within the figures will lend themselves to discussion of biophysical processes that are important to the marine ecosystem.

5.0 Validation and submission of the deliverable

The final version of OC_K is generated as a PDF file by the Project Leader. It is passed to the Data Manager for the defined validation checks and eventually is confirmed certified through the workflow used for all deliverable certifications. 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_K to NPS's NRInfo Portal (formerly NPS Data Store).

Glacier Bay National Park and Preserve Oceanographic Monitoring Protocol

SOP 15: 5-Year Report (OC_L Creation)

Beginning in 2012 and every 5 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.

1.0 5-Year Report Format and Content:

The 5-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 5-year report will include at the following four components:
    i. Analysis of spatial extent of observed anomalies
    ii. Trend analysis
    iii. Time series analysis
    iv. Comparisons to other surface and profile data
5. **Discussion:** Summary of observations based on tables and figures presented in the Results section.

2.0 Content of Results Section (i): Analysis of spatial extent of observed anomalies

For the same reasons as for the annual report, Station 04 is given particular attention in the annual data reports. Show in the 5-year report to what extent Station 04 anomalies are representative of anomalies observed at the other core stations. This analysis will help place interpretation of the Station 04 results into a broader spatial context.

3.0 Content of Results Section (ii): Trend analysis

The 5-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: www.ims.uaf.edu/gak1 and in Figure SOP15.1 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: the 0, 10, 20, 30, 40, 50, 75, 100, 150, 200, 250 and 300 m depth levels.

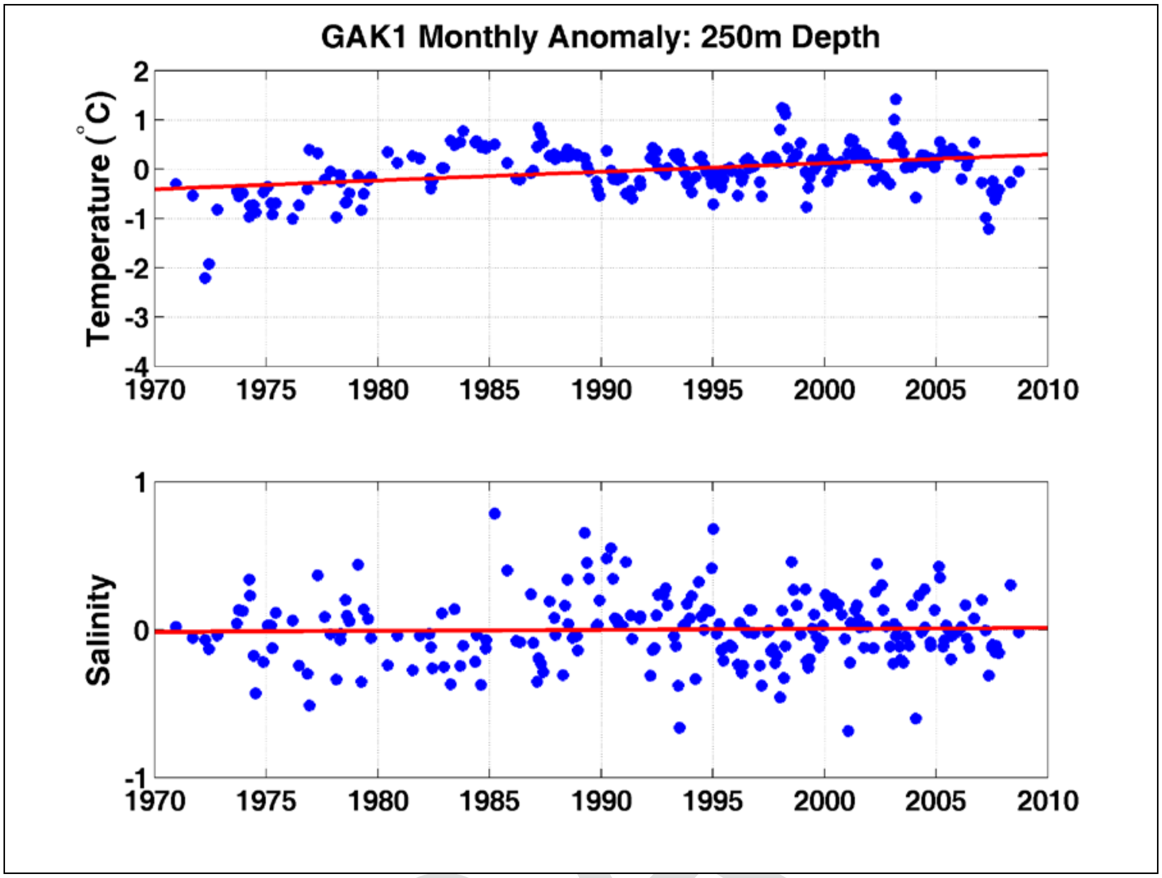


Figure SOP15.1. Example anomaly plots of temperature (top) and salinity (bottom) along with the least-squares best fit linear trend (red) to each time series for oceanographic station GAK1. In these plots, the mean annual signal (monthly climatology) has been subtracted from the present month's measurements, resulting in a zero mean anomaly time series. The plots show that the mean 250m temperature has increased by nearly 1 ºC over the last 35 years whereas the salinity has remained essentially unchanged. The most recent two years (2007 & 2008) show temperatures well below the long-term trend line, indicated a recent prolonged cold spell. Temperatures through most of the 1980s, however, were mostly higher than normal.

4.0 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) 3-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 data sets collected in the northeast 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

Oceanographic measurements from the mouth of Resurrection Bay, Alaska. Dataset maintained by the University of Alaska – www.ims.uaf.edu/gak1/.

2) The Line P and Ocean Station PAPA time series

Oceanographic measurements from 50N, 140W. Dataset maintained by the Canadian Department of Fisheries and Ocean Sciences (DFO) at the Institute of Ocean Sciences (IOS). www-sci.pac.dfo-mpo.gc.ca/osap/projects/linepdata/default_e.htm

3) Canadian "lighthouse" time series

Sea surface temperature and salinity measurements from lighthouses located along the Canadian Pacific coast. Dataset maintained by DFO-IOS. www-sci.pac.dfo-mpo.gc.ca/osap/data/default_e.htm

4) National Data Buoy Center (NDBC) moorings and coastal station datasets

Oceanographic and meteorologic data sets located throughout Southeast Alaska. www.ndbc.noaa.gov/.

Companion plots of environmental and climate time series can 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

Wind, temperature and precipitation datasets available from the National Climate Data Center (NCDC; www.ncdc.noaa.gov and the NDBC www.ndbc.noaa.gov)

2) Local streamflow data

Dataset available from the United States Geological Survey (http://waterdata.usgs.gov/ak/nwis/)

3) Large-scale climate system indices

Pacific Decadal Oscillation (PDO,http://jisao.washington.edu/pdo/PDO.latest),
Southern Oscillation Index (www.cgd.ucar.edu/cas/catalog/climind/index.html)
North Pacific Index (NPI, www.cgd.ucar.edu/cas/catalog/climind/index.html)
Pacific-North American Index (PNA, http://jisao.washington.edu/data/pna/).

5.0 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 utilizing historical CTD casts from the greater Southeast Alaska region. Data can be downloaded from the NODC World Ocean Database (WOD), (www.nodc.noaa.gov/) and the AOOS-AMIS database (www.aoos.org/). The plot shown in Figure SOP 15.2 is an example of using this WOD historical dataset. The WOD should be polled for each 5-year report to determine if 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.

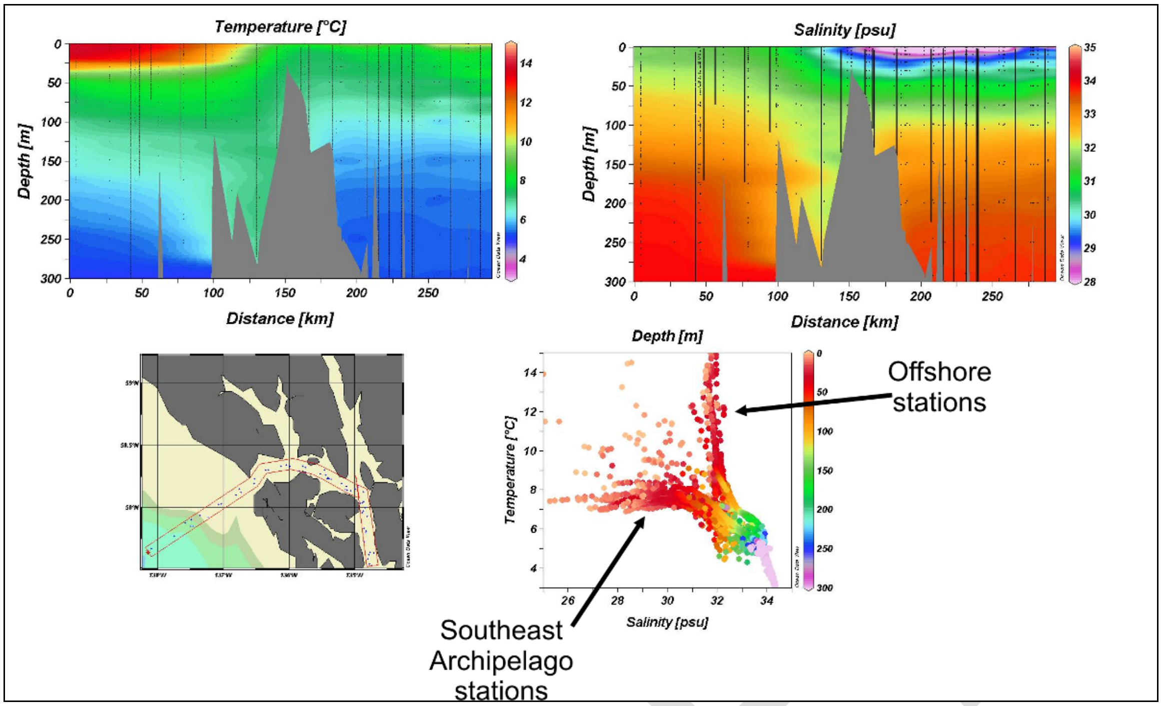


Figure SOP15.2. Horizontal cross-sections (upper panels) and a T-S plot (lower right panel) employing historical CTD data from the NODC World Ocean Database, plotted with the Ocean Data View (ODV) software package. Station locations are plotted on the map in the lower left panel and span from the central 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 150km), to the mouth of Lynn Canal (at approximately 220 km) and down into Chatham Strait. In this case, the data is averaged from between the months of August and October.

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

- Sea Surface Temperature (Advanced Very High Resolution Radiometer satellite)
- Winds (from the QuikSCAT satellite)
- Sea Surface Elevation (from the Topex/Poseidon satellites)
- 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). Most of these datasets can also be retrieved directly from the AOOS data server.

6.0 Validation and submission of the deliverable

The final version of OC_L is generated as a PDF file by the Project Leader. It is passed to the Data Manager for the defined validation checks and eventually is confirmed certified through the workflow used for all deliverable certifications. 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 NRInfo Portal (formerly NPS Data Store).

SOP 16: AOOS Data Submission (OC_E Creation)

Summary

At the end of each season, once the OC_D database updates have been certified, the year's data are submitted to the Alaska Ocean Observing System for secondary archiving and dissemination.

The step-by-step details of this process were not fully defined as of publication of this protocol. They will be documented in the next version.

Glacier Bay National Park and Preserve Oceanographic Monitoring Protocol

SOP 17: NODC Data Submission (OC_F Creation)

Summary

At the end of each season, once the OC_D database updates have been certified, the year's data are submitted to the National Oceanographic Data Center for secondary archiving and dissemination. This same submission will also be forwarded to the NRInfo Portal.

The step-by-step details of this process were not fully defined as of publication of this protocol. They will be documented in the next version.

Glacier Bay National Park and Preserve Oceanographic Monitoring Protocol

SOP 18: Protocol Revision (OC_I Creation)

Summary

Periodically, material changes must be made to the protocol to take advantage of new technologies, equipment, and methods. Changes may also be made to correct significant errors in the document.

The Network Coordinator, Project Leader, and Data Manager jointly build a list of desired changes. They review the issues, accept some or all of them by consensus, and draft new language to affect the accepted changes. One person shall be chosen to coordinate the new document and be responsible for the new draft. Changes to key items will trigger an external review of the draft document.

After satisfying both internal and external reviewers, the updated protocol will go through formal validation and certification by the Network Coordinator and Data Manager. The certified protocol will be widely disseminated.

Detailed steps

1. **Network Coordinator (NC) tasks**
    1. ***Periodically poll Project Leader (PL) and Data Manager (DM) on the need for a protocol revision cycle.***
    2. ***Schedule a revision cycle when called for by consensus.***
    3. ***Obtain a new formal protocol ID number from Data Manager.***
        1. Method for assigning a protocol ID is formally set in SEAN's Data Management Plan SOP-602 Version Control.
        2. A new ID is required for each revision because all data collected are tagged with the specific protocol they were created under: the mechanism is rigid.
    4. ***Solicit agenda of issues to address.***
    5. ***Initiate kick-off meeting.***
2. **NC, PL, and DM tasks**
    1. ***Prepare issues lists.***
    2. ***Agree on overall scope of revision.***
        1. "Minor" will have internal review.
        2. "Major" will have peer review.
    3. ***Agree on a "coordinator" who is responsible for managing assembly of the revised document.***
    4. ***Obtain the most recent Word version of the current protocol from the DM to serve as the basis for the new document.***
        1. The original DOCX file is copied to an editable destination file.
        2. The document is set for tracked changes.

   3. A global search and replace is done to change all existing references to the protocol ID to the new designator.
   4. The DM provides a link allowing access of the DOCX file by the three team members through a browser.
   5. The actual final product will be made available on the web only as read-only PDF in order to minimize the chance of multiple conflicting documents being built.
5. ***Draft possible revisions.***
   1. Each team member should take responsibility for sections within their realm of expertise.
   2. If a particular section needs to be addressed to meet multiple needs, it should be worked on serially.
      1. *Get team agreement on the order of attack for issues.*
      2. *Assign person to do first revision covering first issue.*
      3. *Obtain consensus on the first revision.*
      4. *Assign person to do second revision covering second issue, etc.*

3. “Coordinator” tasks

1. ***Assemble revision drafts into a coherent document.***
2. ***Maintain a document change table in the SOP document to track internal versioning.***
3. ***Distribute to NC, PL, and DM for internal review.***
4. ***Update document to satisfy internal review.***
5. ***Obtain consensus of NC, PL, and DM.***
6. ***Format the document.***
7. ***If scope is major, coordinate external review.***
   1. Pass document to Regional I&M Coordinator for consideration.
   2. Distribute resulting review comments to NC, PL, and DM.
   3. Revise protocol in light of review comments.
   4. Coordinate revisions among team.
8. ***Assemble document.***
9. ***Obtain final team approval.***
10. ***Format document as a Natural Resource Report (NRR).***
    1. Coordinate technical/formatting NRR review
    2. Obtain a “TIC” document number from NRPC.
    3. Make final technical revisions.
11. ***Notify team of completion.***

4. Network Coordinator tasks

1. ***Generate a PDF file off the original Word document.***
2. ***Submit both the PDF and DOCX files via email attachment to the Data Manager for validation.***
   1. Specify in the message body it is deliverable OC_I, as defined in protocol OC_2009.1.

5. Data Manager tasks

1. ***On receipt of the submission, assign the next formal Submission Number to this file, as found in the master Submission_Log table.***
   1. Use the “Update Submission Log” web tool at http://165.83.57.239/0_submission_update.aspx .
   2. Complete Submission_Log details up through the Submission_Date column.

2. ***Save the attached file into the staging area for validation at \\inpglbafs03\data\SEAN_Data\Staging\OC\OC_I.***
3. ***Validate the two files according to current criteria.***
4. ***Record validation summary data in the Submission_Log using the web tool.***
5. ***If submission fails mandatory criteria, reply with a "failure email" that includes:***
    1. The submission number assigned
    2. The deliverable ID
    3. The protocol ID
    4. Documentation listing all the specific mandatory criteria failed
6. ***If submission passes mandatory criteria, reply with a "success email" that includes:***
    1. The submission number assigned
    2. The deliverable ID
    3. The protocol ID
    4. Documentation listing any specific optional criteria failed
    5. Request to certify deliverable as complete

6. Network Coordinator tasks

1. ***On receipt of a failure email:***
    1. Make corrections so the deliverable meets mandatory criteria.
    2. Make another submission with the corrected deliverable candidate.
2. ***On receipt of a success email, review any failed optional criteria:***
    1. If these are acceptable to NC, PL, and DM:
        1. *Reply with a "certification email" stating the deliverable is certified and may be disseminated.*
    2. If these are unacceptable:
        1. *Reply with a "withdrawal email", stating the deliverable is withdrawn.*
        2. *Take remedial action to obtain a corrected deliverable.*
        3. *Restart the process from the beginning.*

7. Data Manager tasks

1. On receipt of a withdrawal email:
2. Mark the withdrawal in the Submission_Log's Status column using the web tool.
3. Terminate the process.

2. ***On receipt of a certification email:***
    1. Due to the nature of these data NO sensitive information is in the deliverable.
    2. Copy the two submitted files to test environment at AUXREP\OC\OC_N\.
        1. *Name them <protocol_ID>.PDF and <protocol_ID>.DOCX.*
    3. Create web page link to the new PDF but not the .DOCX, which remains hidden.
    4. Retire the old protocol so it becomes accessible from the Historical Protocol link.
    5. Mark the certification in the Status column in Submission_Log using the web tool.
    6. Propagate from test to production environment.
    7. Update the annual deliverable tracking spreadsheet showing date of completion for OC_I.
        1. *Record in the tracking spreadsheet for the year reflected in the protocol_ID, which may not be the current year.*
        2. *An entirely new row will need to be added to the sheet, as this is not a scheduled deliverable already accounted for.*

3. **Submit the final document to NatureBib.**
4. **Update the I&M protocol database to reference the new protocol.**
5. ***Revise web sites to accommodate any altered information structure set in the new protocol.***
6. ***Update the scope of the formal metadata so it includes the new date and versioning information.***

Glacier Bay National Park and Preserve Oceanographic Monitoring Protocol

SOP 19: Managing the Production Environment

Summary

In order for most SEAN deliverables to be disseminated to the public, they must be installed in the NPS production environment at I&M in Ft. Collins, Colorado. Certain of the deliverables must also be installed in production repositories, such as the NODC and the NPS Data Store. In order for this production content to be generated, various steps must be performed in SEAN's staging environment. Once content is built and verified in the staging environment, it gets copied to production for permanent storage and dissemination.

Most of the detailed SOPs in this protocol end with a reference to propagating the final deliverable into production. This is an implicit reference to this SOP. Not all deliverables are handled in the exact same manner, so methods for installing them into production vary.

1.0 Schematic of the Environments

Figure SOP 19.1 illustrates the major components in the SEAN staging and WASO production environments. (References are also made to SEAN's development and test environments. Details of their operation are not germane to moving deliverables from staging to production, and will not be discussed here.)

2.0 Components of the Environments

Major components of the staging environment include the Staging Directory, the Data Management Web Server, the Staging Database, and the Master Auxiliary Repository. The staging directory is a folder on SEAN's local file server used to collect submitted productions and feed them into validation and certification processes. The data management web server is an internal-only website holding applications used to: validate some deliverables; create certain deliverables; report information used as the basis for other deliverables; and actively track the status of all deliverables in process. The staging database is a SQL database used to hold the OC_D product and the status tables. The master auxiliary repository is a set of folders and files housed on the local SEAN file server. It contains all certified deliverables except for OC_D, which can only live on a database server.

The production environment consists of the Production Database, the Replica Auxiliary Repository, and the Production Web Server. The production database houses all final OC_D data. The replica auxiliary repository is a mirror of the staging auxiliary repository. (This is done because NPS security technicians do not permit the production environment to directly access the staging auxiliary repository.) The production web server houses the public dissemination point. It draws content from the other two components.

Three additional production environments, which receive copies of certain items from the auxiliary repository, are AOOS, NODC, and the NPS Data Store. Delivering content to these repositories is SEAN's only role and responsibility in their management.

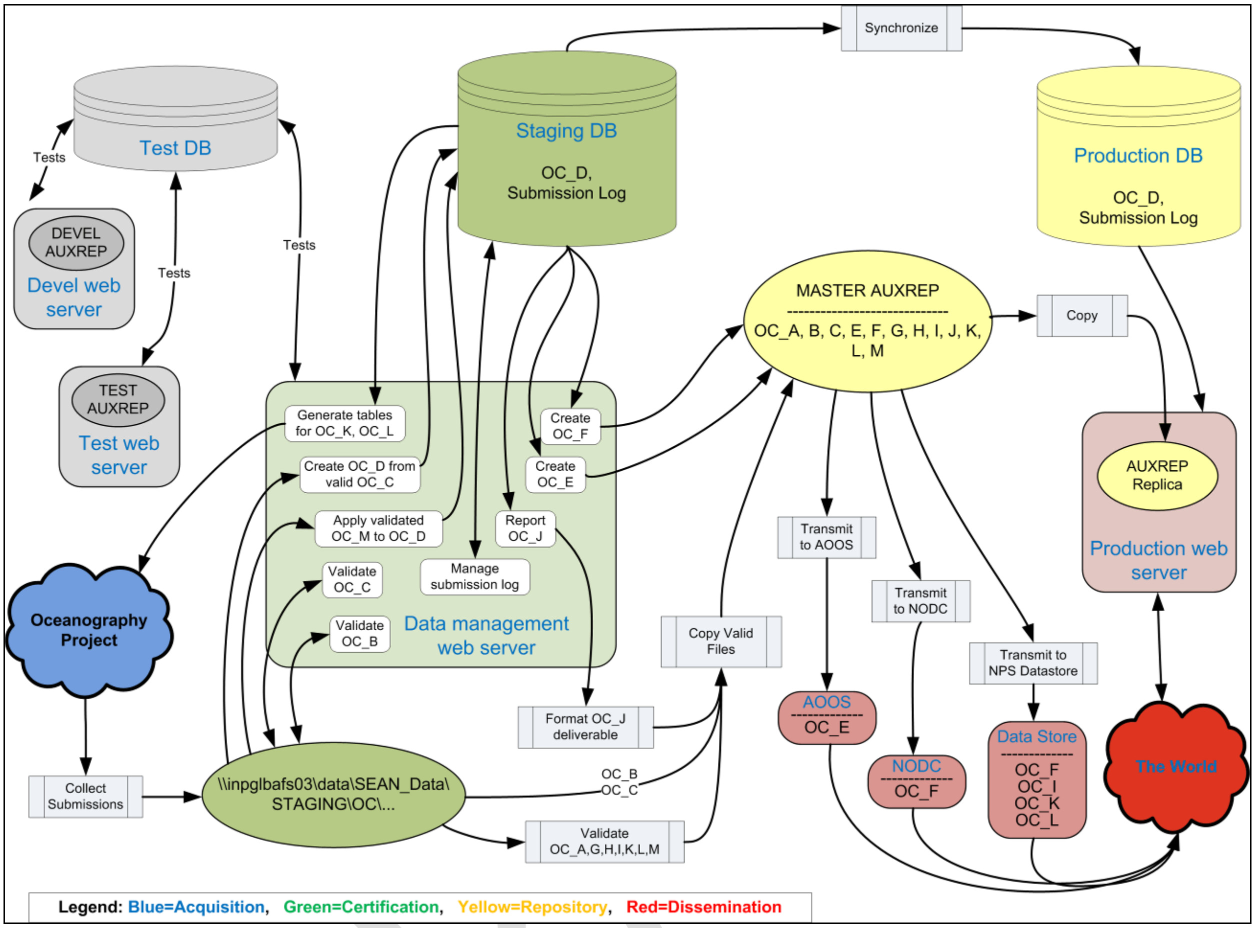


Figure SOP19.1. Components of the staging and production environments are illustrated in schematic form. Coloring indicates the functional realm of each component, as defined in the SEAN data management plan. Rectangles depict the data management tasks required to move a product from one component to the next. Internal functions provided by the data management web server related to oceanography are also listed.

3.0 Management Tasks to Perform

Figure SOP19.1 shows in rectangles specific tasks needed to move a deliverable from the submission-to-staging through the production-dissemination states. These are primarily data copying steps achieved either by file transfer or by SQL database synchronization. No attempt will be made to detail specific commands and IT processes to accomplish these particular tasks. They are inherently complex and are dependent on the current complement of equipment components, software versions, security policies, and NRDC operating procedures. Most of the tasks are also performed on the order of only once per year. Data management staff is expected to determine the best method to use at each particular invocation.

The data management web site also supports a number of necessary tasks required in accomplishing the staging to production process. These are depicted in Figure SOP19.1 as lozenges within the data management web server object. Their use is covered in the various SOPs covering detailed production of data deliverables.

Appendix A: Oceanographic Station Locations

A.1 Currently sampled stations

Core stations are highlighted in bold type.

Station	Latitude (WGS84)	Longitude (WGS84)	Description	Nominal Depth (m)
00	58.326735	-135.875108	Icy Strait	53
01	**58.412562**	**-135.99511**	**Mouth of Glacier Bay**	**62**
02	58.490056	-136.05178	Sitakaday Narrows	93
03	58.571715	-136.065116	SE of Willoughby Island	112
04	**58.650872**	**-136.115113**	**N of Drake I. and N of Marble I.**	**288**
05	58.704199	-136.233473	Between N Drake and SW Tlingit PT	366
06	58.759193	-136.341762	E of Hugh Miller Inlet	288
07	**58.8111687**	**-136.474331**	**N of Blue Mouse, W of Tidal Inlet**	**435**
08	58.865018	-136.593433	S of Rendu Inlet	426
09	58.897515	-136.736769	SE of Russell Island	377
10	58.899179	-136.840103	N of Reid Inlet	361
11	58.972079	-136.916778	Tarr Inlet	338
12	**59.033341**	**-137.018446**	**Head of Tarr Inlet**	**288**
13	**58.73253**	**-136.113453**	**SE of Tlingit PT, NW of Sturgess**	**146**
14	58.79169	-136.108456	Muir Sill	81
16	**58.895845**	**-136.093461**	**E of Hunter Cove**	**313**
17	58.975001	-136.136797	E of Westdahl Pt	212
18	59.0500003	-136.18513	S of Riggs, NW of McBride	214
19	59.07168	-136.336789	Muir Inlet	225
20	**59.086017**	**-136.370953**	**Head of Muir Inlet**	**179**
21	59.047695	-137.057739	Marjorie/Grand Pacific	195
24	58.333333	-136.116667	North Passage	150

A.2 Historical stations not currently sampled

Station	Latitude (WGS84)	Longitude (WGS84)	Description	Nominal Depth (m)
15	58.815021	-136.105123	W of Muir Pt.	116
22	58.657692	-136.36543	Entrance to Geikie	155
23	58.598125	-136.506455	Head of Geikie	66

Appendix B: Standard Form Templates

Electronic copies of all templates are available at the following web site: http://science.nature.nps.gov/im/units/sean/OC_Main.aspx.

B.1 Field Log Form

Oceanographic Survey Field Log
Glacier Bay National Park and Preserve

Vessel: ________________________ **Cruise:** ________________________________ **Page** ___/___

CTD #: ____ **Data Dump #** _________ **Observer(s):** ____

Cast #	Station	Latitude (ºN)	Longitude (ºW)	Waypt.	GMT Date (YYYY/MM/DD)	GMT Time (HH:MM)	Fathometer Depth (m)	Target Depth (m)	Comments
		___.______	-____.______		____/___/__	___:___			
		___.______	-____.______		____/___/__	___:___			
		___.______	-____.______		____/___/__	___:___			
		___.______	-____.______		____/___/__	___:___			
		___.______	-____.______		____/___/__	___:___			
		___.______	-____.______		____/___/__	___:___			
		___.______	-____.______		____/___/__	___:___			
		___.______	-____.______		____/___/__	___:___			
		___.______	-____.______		____/___/__	___:___			
		___.______	-____.______		____/___/__	___:___			

Notes:

B.2 CTD Download Checklist

Oceanographic Survey CTD Download Checklist
Glacier Bay National Park and Preserve

Date: ____________________ **CTD #:** _____ **Data Dump #** _________

Cast #	Starting record	Ending record	File name	Down-loaded ✓	Visual Inspection ✓
				☐	☐
				☐	☐
				☐	☐
				☐	☐
				☐	☐
				☐	☐
				☐	☐
				☐	☐
				☐	☐
				☐	☐
				☐	☐
				☐	☐
				☐	☐
				☐	☐

File name is 18 characters of the form **yymm_C_dddd_cc.HEX** where:
yy is year, **mm** is month, **C** is CTD#, **dddd** is dump#, **cc** is cast#
(use leading zeroes where necessary to meet length requirements)

B.3 Data Quality Report

Oceanographic Survey Data Quality Report
Glacier Bay National Park and Preserve

CTD #: ____ **Data Dump #** ________ **Starting Date:** _________________

Station#	Quality Code	Comment
All Stations in Dump		

- OR -

00		
01		
02		
03		
04		
05		
06		
07		
08		
09		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		

Data quality codes are:

0 - good
1 - unknown
2 - questionable
8 - bad

as defined for Ocean Data View at http://odv.awi.de/fileadmin/user_upload/odv/misc/ODV4_QualityFlagSets.pdf.

SEAN Deliverable OC_M

Appendix C: Oceanographic Survey Equipment List

C.1 Research Vessel and support equipment

- R/V Capelin, Arete (Lewis)
- Power Block/Davit (on boat)
- Hydraulics (on boat)

C.2 CTD sampling equipment

- SEACAT SBE 19-03 Conductivity-Temperature-Depth (CTD) Recorder
- Ground line (marked every 10m) and plastic tub
- 2 stainless steel locking carabineers (on CTD)
- CTD equipment box
    - Distilled water squirt bottle
    - Triton –X* detergent and squirt bottle with diluted solution and MSDS
    - Silicone Grease (Dow Corning 4 Electrical Insulating Compound)
    - Rubbing Alcohol and Q-Tips (for cleaning conductivity cell and data cable pins)
    - Lint-free cloth and lint-free papers (KimWipes)
    - Data Cable, including RS232 to DB9 connector
    - Copy of protocol
    - Spare pens and pencils
    - Paper towels
    - Spare Batteries
        - 9 D-cell batteries (per CTD)
        - 12 AA-cell batteries (4 per GPS, 8 per PLGR)
- Distilled Water (1gallon)
- Portable Computer
- Empty USB flash memory drive for data backups
- Office Box (containing general office equipment)
- GPS unit and manual (Be sure to download station locations into GPS before use.)
- Extra power/antenna cables and external antennas
- Stopwatch with timer alarm

* Triton X-100 is non-ionic detergent, which is used as a 1% percent solution in distilled water. One source is VWR Scientific Products in Seattle, WA at 800-932-5000, or www.vwrsp.com.

C.3 Manuals and documentation

- Seacat SBE 19-03, SeaSave, SeaPlot and SBEDataProcessing operating manuals
- GPS operating manual
- Last CTD dump
- Waterproof field notebook with blank Rite-in-the-rain or Duracopy paper
- Oceanography notebook (contains protocol, station locations, maintenance info, etc.)
- CTD datasheets copied onto waterproof paper

C.4 General field gear

- Rite-in-the-Rain waterproof or DuraCopy plastic paper
- Several black Ultra Fine Point Sharpie pens and/or pencils.
- Personal Flotation Devices (one per person on board)
- Immersion (survival) suits (one per person on board)
- Handheld (waterproof) radio with ParkNet frequencies and extra radio batteries
- Groceries – order beforehand
- Rain gear
- Waterproof gloves (insulated ideal)
- Waterproof boots
- Binoculars
- Personal gear
- Topographical map and nautical charts of Glacier Bay
- Digital camera

C.5 Computer equipment and software

- On-board Windows Laptop with appropriate ports for connection to CTD
- SeaTerm.exe CTD data acquisition software
- WordPad, Notepad, or other text editor software
- Storage media for data backup (e.g., recordable compact disc; thumb drive)

Appendix D: List of Acronyms

Acronym	Definition
AOOS	Alaska Ocean Observing System
CTD	Conductivity-temperature-depth instrument for recording oceanographic parameters
GLBA	Glacier Bay National Park and Preserve
GMT	Greenwich mean time
GPS	Global positioning system
NOAA	National Oceanic and Atmospheric Administration
NODC	National Oceanographic Data Center
NRPC	Natural Resource Program Center
OBS	Optical backscatterance, a measure of turbidity
ODV	Ocean Data View, visualization software
PAR	Photosynthetically active radiation
QA	Quality assurance
SEAN	Southeast Alaska Network of NPS Inventory & Monitoring Division
SOP	Standard operating procedure
USGS	United States Geological Survey

Appendix E: Summary of 2009 Protocol Development Working Group Discussion

The following paragraphs summarize a February 2009 discussion of the SEAN oceanography monitoring program, held at the Glacier Bay Field Office at Indian Point in Juneau. We worked to incorporate results from prior monitoring program reviews (see *Section 8.2*) and evaluations of our proposed modifications so that the selected program maintains coherence with past sampling and also forms the basis for the strongest possible sampling program from this point forward. The group tried to take the 10 to 100-year view: in ten years, this dataset will span a quarter century and the bulk of the holdings will still be from collections made prior to 2009. In 100 years, however, collections made prior to 2009 will comprise fewer than 15% of the total observations. To gain maximum utility, we have strived for a balance between continuity between samples taken before and after 2009 and what we feel is the most useful dataset in the long run.

A number of researchers with past and present interest in Glacier Bay oceanography (including Lisa Etherington, Mayumi Arimitsu, and David Hill) were sent this summary and solicited for feedback. Overall response to the recommended changes was positive, though we did make some adjustments to the protocol based on this feedback. Most important, one new station in North Passage was added for sampling with the full station set in July and mid-winter.

E.1 Proposed Modifications to the Glacier Bay Oceanographic Monitoring Protocol

The Southeast Alaska Network (SEAN) of the National Park Service (NPS) has committed to long-term continuation of oceanographic monitoring within Glacier Bay proper. NPS entered into a cooperative agreement with the University of Alaska Fairbanks (UAF) to review and update the GLBA monitoring protocol (Hooge et al. 2003), including program objectives, rationale, field methods, schedules for calibrating instruments and sensor replacement, data processing and archiving procedures, metadata and data formats, and recommended data summaries. The historical database contains 16 consecutive years of sampling (1993-2008), primarily carried out by United States Geological Survey (USGS) personnel. To date, sampling has resulted in a number of annual reports and peer-reviewed publications that provide considerable detail summarizing the various domains, their mean annual cycles, and the monthly variability across and within domains.

The 2006 Glacier Bay Oceanographic Program Evaluation Report (Etherington 2006) is based on a 2005 Glacier Bay Oceanographic Program Review Workshop attended by a number of NPS, USGS and NOAA personnel. The workshop attendees refined the objectives of the monitoring program as follows:

1) To provide a dataset on physical oceanographic conditions in Glacier Bay (salinity, temperature, stratification, photosynthetically available radiation (PAR), optical backscatterance (OBS, turbidity) that can be used to understand seasonal and interannual *changes in the estuarine dynamics of Glacier Bay as well as the Southeast Alaska oceanographic system.*

2) To provide a baseline oceanographic dataset (salinity, temperature, stratification, photosynthetically available radiation (PAR), optical backscatterance (OBS, turbidity), and chlorophyll a fluorescence) that can be used by a variety of biologists to understand spatial and temporal variation in the abundance patterns of a variety of organisms.

These objectives remain in place today. **At the outset of the SEAN protocol development process, the initial NPS proposal was to *continue with sampling historic CTD stations numbers 00-21[1] within GLBA on a quarterly basis (March, July, October and December)*.**

On February 4, 2009, a focus group (Brendan Moynahan, Lewis Sharman, Bill Johnson, Yumi Arimitsu, Lisa Etherington (by phone), Ginny Eckert and Seth Danielson) discussed the background behind the present GLBA dataset, monitoring objectives, rationale, and ways we might modify the present sampling design to ensure the monitoring dataset best fulfills the objectives stated above and other anticipated needs of user groups. The group recognized the rare luxury of having adequate historical data to critically consider modifications. Much discussion revolved around the realization that the proposed quarterly sampling resolves annual cycles but not seasonal; in order to ensure the resolution of seasonal fluctuations, it is necessary to increase the temporal rate of sampling.

The group agreed that more frequent temporal sampling would be greatly beneficial, particularly during the spring, summer, and fall months when most other user groups are in GLBA and when both the physical and biological systems undergo their greatest annual changes. Applying results from Etherington et al. (2007), which summarized spatial/temporal variability patterns within GLBA and found that adjacent stations are highly correlated, we concluded that a reduced set of monitoring stations representative of the four primary domains (Lower Bay, Central Bay, West Arm, and East Arm) could reduce the number of days at sea from 3-4 days to 2 days per cruise, yet still capture the bulk of the oceanographic spatially-dependant signals. We discussed many alternatives that, though appealing, do not fit within the available budget (e.g., maintaining long-term oceanographic moorings). While a single station within each of the four primary domains would capture the majority of the spatial variability, the data set would be significantly improved by inclusion of stations near the head of each arm (i.e., in Tarr and Muir inlets) and at Station 13 in the Central Bay (which USGS identified as exhibiting unique biophysical characteristics).

We therefore propose modifications to the present sampling scheme: 1) Occupy all standard CTD stations (#'s 00-21) once in July and once in mid-winter (December or January as conditions permit) and 2) occupy Stations 01, 04, 07, 12, 13, 16, and 20 on a monthly basis from March to June and August to October. This scheme resulted from lengthy discussion over the cost-benefit balance between spatial and temporal resolution and the number of ship days available per year. This effort ensures two samples in each domain except for the Lower Bay, where strong tidal currents lead to enhanced mixing and reduced gradients. Additional benefits

1 Under any sampling scheme, present stations 22 and 23 (both in Geikie Inlet), would be discontinued per recommendations of the 2006 oceanography program review.

from the proposed sampling scheme include 1) fewer consecutive days of good weather are required to complete most months sampling and 2) this scheme will eventually lead to robust monthly climatologies for select stations in all major oceanographic domains in 9 calendar months and climatologies at all stations near the extremes of both summer and winter (July and December/January).

Sampling per the revised scheme would begin in April 2009. The draft protocol will be delivered to NPS on April 1, 2009. It will undergo internal and external peer review and will be finalized by May 1, 2009.

Appendix F: CTD Instruments Employed in Program

Deliverables associated with instrument calibration details are specific to each individual CTD. The filenames for these deliverables have a CTD# embedded in them. The following table identifies the individual physical device associated with each CTD#.

Table F.1. CTD instruments employed in the program.

CTD#	Model	Serial #	Started Service	Ended Service
1	Sea-Bird SBE19-03	193353-0436	4/1994	-
2	Sea-Bird SBE19-03	194652-0775	7/1993	1/2005
3	Sea-Bird SBE 19	819	6/1999	7/2000
4	Sea-Bird SBE 25	43	5/1994	7/2000
5	Sea-Bird SBE19-plus V2	19P55083-6353	2/2010	-

Appendix G: Data file standard header

The header strings, illustrated in Figure G.1, are required to be defined to the SeaTerm program on any computer used to download CTD data into HEX files. The strings must be one to one matches of the characters in the illustration. Mandatory validation of HEX and CNV files will always fail unless this exact header is defined.

This header is normally maintained on Windows computers in the file C:\WINDOWS\SeaTerm.ini .

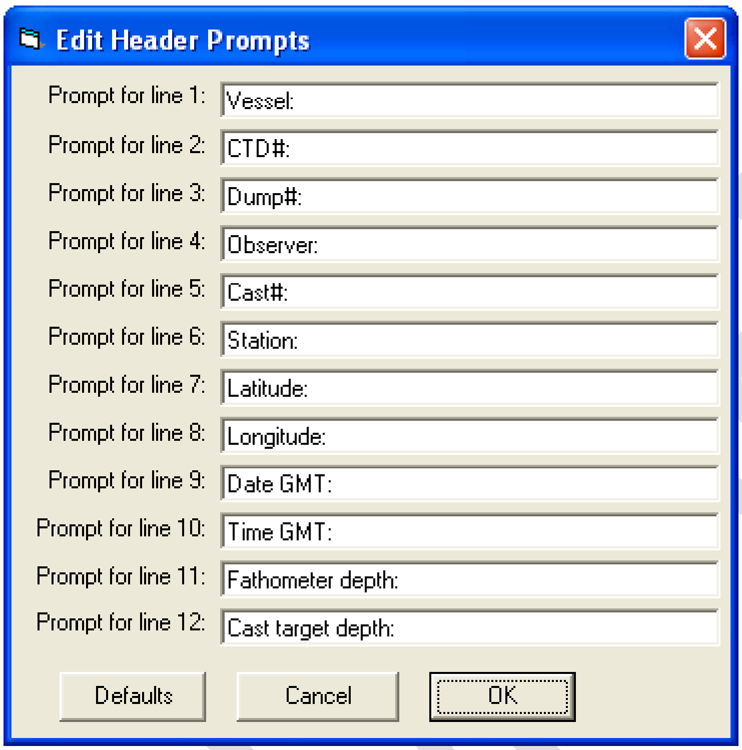


Figure G.1. Required header prompts to be used with SeaTerm software.

Appendix H: Typical Computer Directory Structures

Operating this program requires using a field laptop, a networked park computer, and the SEAN auxiliary repository. The data are normally stored in standard structures.

1.0 Laptop used to capture shipboard data from CTD.

Responsible person: Project Leader.

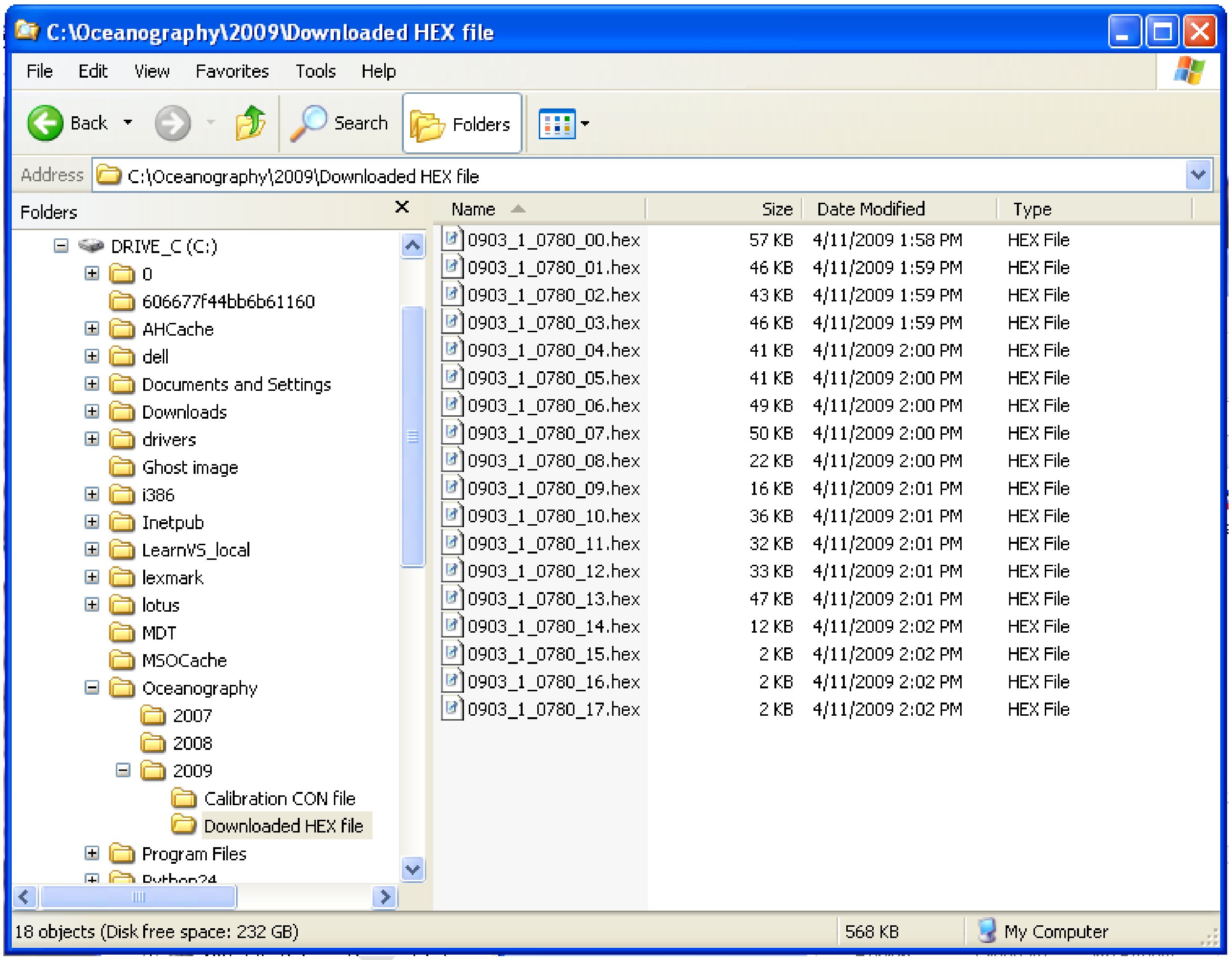


Figure H.1. Standard directory structure for field laptops used in data capture.

2.0 GLBA network file server used for building deliverables.
Responsible person: Project Leader.

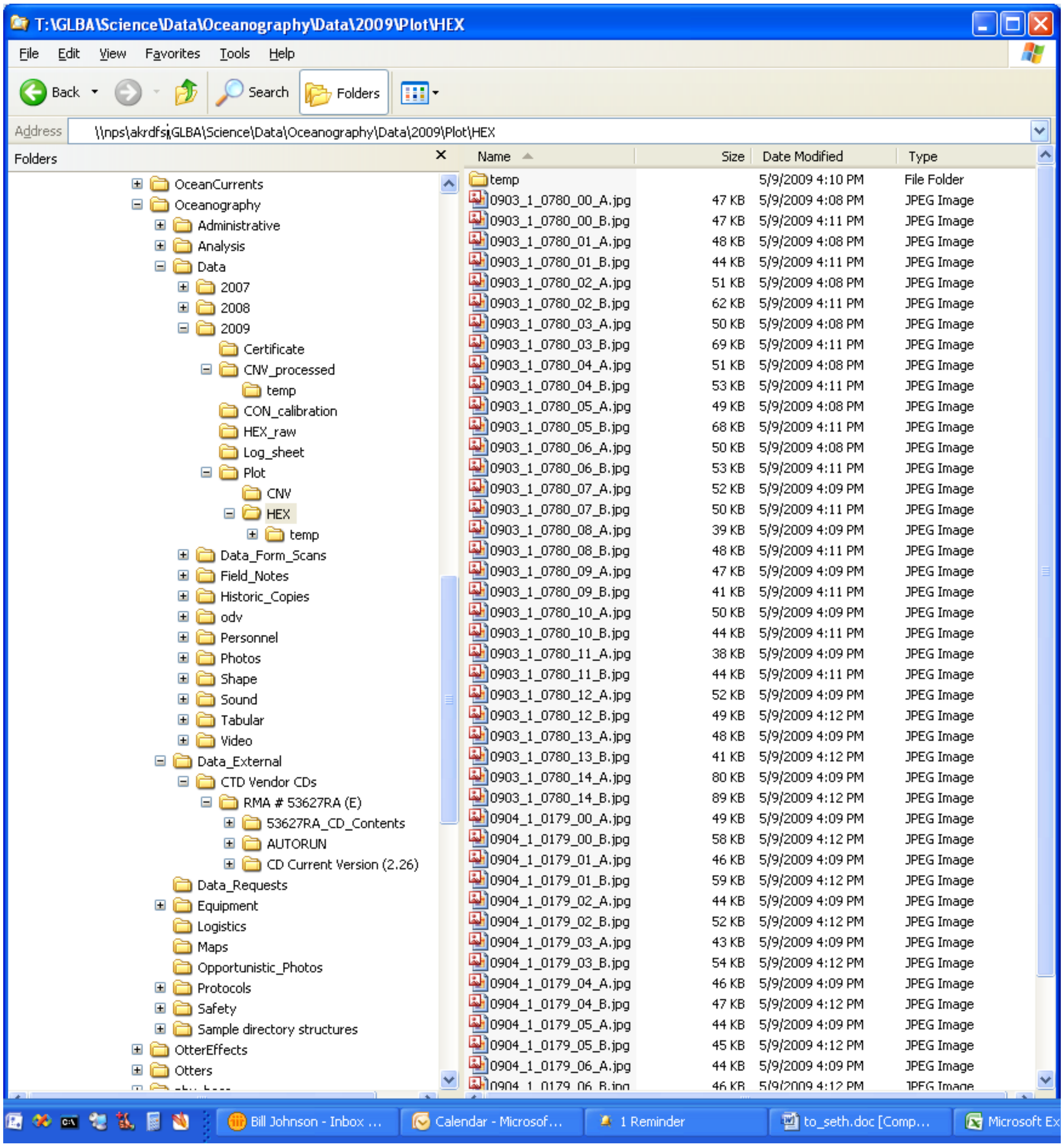


Figure H.2. Standard directory structure for park network file server.

3.0 SEAN auxiliary repository.

Responsible person: Data Manager.

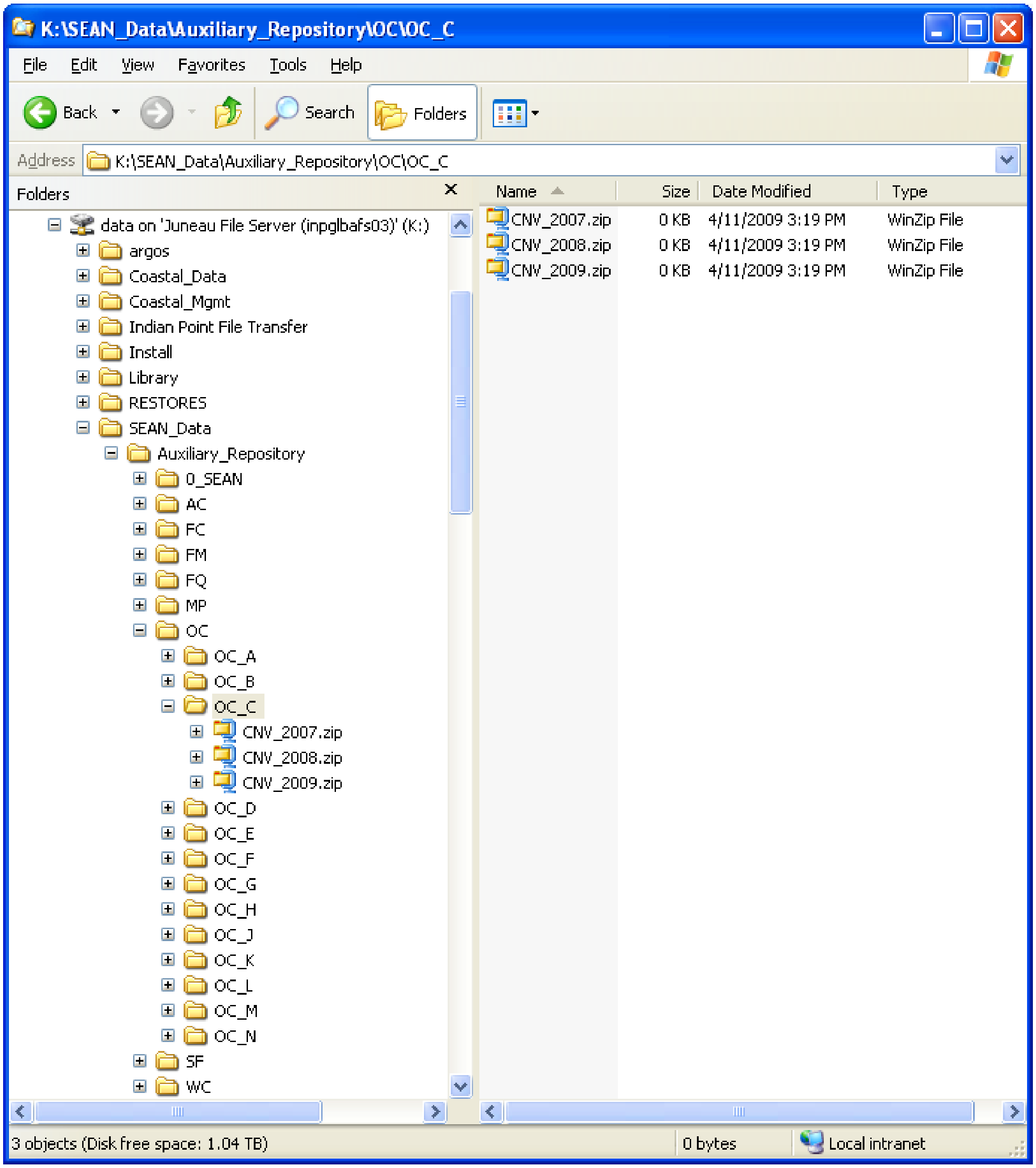


Figure H.3. Standard directory structure for oceanography section of SEAN auxiliary repository.

Appendix I: Sea-Bird Software Detailed Configuration

A software layout has been designed that supports the specific operations described in certain SOPs. An understanding of it may be helpful in troubleshooting processing exceptions.

Sea-Bird SeaTerm software must be available on the Project Leader's laptop for unloading the CTD. Sea-Bird SBEDataProcessing-Win32 needs to be available on the park network in order to perform post-cruise QA as well as to create deliverable OC_C.

1.0 SeaTerm on the laptop

Sea-Bird software is provided on annual calibration CDs. It is also available as a download described at http://www.seabird.com/software/FTPsiteinfo.htm . The product to install is in the Seasoft-Win32 package. Installation is straightforward, but local administrator rights are required, so IT support may need to assist. The installation puts all software in C:\Program Files\Sea-Bird\ . Our laptop requires only SeaTerm software (NOT SeaTermV2 software). The additional software products that are installed will not be used on the laptop.

All data reside in C:\Oceanography. Each year is given its own directory. A CON directory holds the current calibration file. A HEX directory holds all the cast data downloaded from the CTD. This is illustrated in Appendix H.

2.0 SBEDataProcessing accessible on the park network

Sea-Bird software must be installed, as described above, where the Project Leader may use it when connected to the park network. It is possible to use the laptop, but this is not desirable since that could result in accidental storage of the data files on the laptop instead of on the secure, backed up network. If terminal server is employed by the Project Leader, the IT staff will need to do the installation. There are a number of programs in the SBEDataProcessing suite, all of which must be accessible.

The manual named SEASOFT-Win32: SBE Data Processing is also available on the same web site as the software. It explains the details of processing that are briefly outlined below.

Several additional files must be added to C:\Program Files\Sea-Bird\ to support the automation the SOPs rely on. The file names are illustrated in Figure I.1. Those names referencing HEX are used to support the regular QA described in SOP 7. Those referencing CNV are needed to generate OC_C in SOP 8 and OC_M in SOP 11.

The following documentation references generic filenames such as "HEX_Plot_A.psa." In actuality, files are CTD specific so they may accommodate unique sensor configurations among the various devices. They bear names like "#5_HEX_Plot_A.psa" for use with CTD #5 and "#1_HEX_Plot_A.psa" for use with CTD #1.

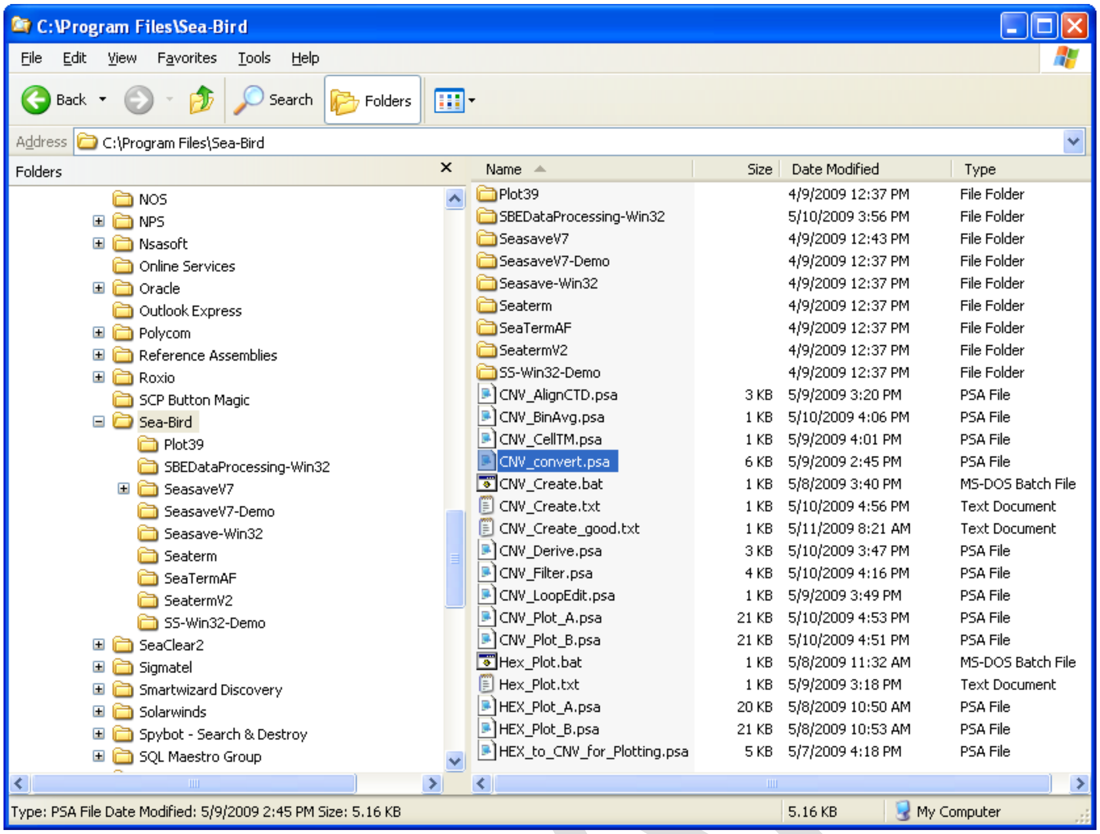
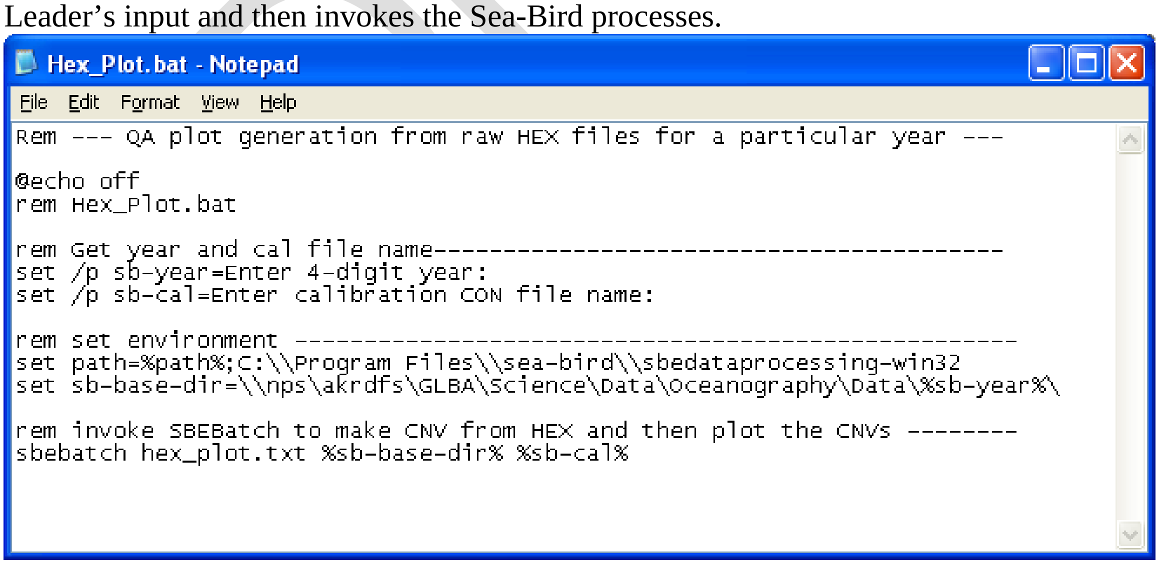


Figure I.1. Layout of Sea-Bird software directory showing special files created to support SOPs 7, 8, and 11.

3.0 SOP 7 HEX plot software

Hex_Plot.bat drives the process. A shortcut on the user's desktop would be helpful, as this is performed after every cruise. It collects the year and calibration file name from the Project Leader's input and then invokes the Sea-Bird processes.



```
Hex_Plot.bat - Notepad
File Edit Format View Help
Rem --- QA plot generation from raw HEX files for a particular year ---

@echo off
rem Hex_Plot.bat

rem Get year and cal file name------------------------------------------
set /p sb-year=Enter 4-digit year:
set /p sb-cal=Enter calibration CON file name:

rem set environment -----------------------------------------------------
set path=%path%;C:\\Program Files\\sea-bird\\sbedataprocessing-win32
set sb-base-dir=\\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\%sb-year%\

rem invoke SBEBatch to make CNV from HEX and then plot the CNVs --------
sbebatch hex_plot.txt %sb-base-dir% %sb-cal%
```

Figure I.2. "HEX_Plot.bat" - batch program that generates HEX quality assurance plots for a particular year.

The batch file then invokes synchronous operation of all the needed Sea-Bird software processes using the SBEBATCH.EXE program. The instructions for running the processes are in file Hex_Plot.txt. It does three tasks, one for each line in Figure I.3. First all HEX files are converted to basic CNV files and stored in a "temp" directory – as per specifications set in "HEX_to_CNV_for_plotting.psa". Second, for each CNV file "temp", the set of A parameters is plotted according to "HEX_Plot_A.psa". Third, a profile plot is also generated showing the B parameters according to "HEX_Plot_B.psa".. Two plots are required due to the large number of parameters recorded by the CTD.

Hex_Plot.txt - Notepad

```
datcnv /i%1hex_raw\*.hex /o%1plot\hex\temp /c%1con_calibration\%2 /pHEX_to_CNV_for_Plotting.psa /s
seaplot /i%1plot\hex\temp\*.cnv /o%1plot\hex /pHEX_Plot_A.psa /s
seaplot /i%1plot\hex\temp\*.cnv /o%1plot\hex /pHEX_Plot_B.psa /s
```

Figure I.3. File "Hex_Plot.txt" contains instructions for sequencing the data processing sub-processes to generate profile plots based on HEX files.

4.0 SOP 8 CNV file creation

Once a year the Project Leader uses "CNV_Create.bat" (Figure I.4) to run this operation automatically. It may be performed repeatedly until the resulting deliverables are acceptable.

CNV_Create.bat - Notepad

```
Rem --- Build fully-processed CNV files from raw HEX files for a particular year ---

@echo off
rem CNV_Create.bat

rem Get year and cal file name-----------------------------------------
set /p sb-year=Enter 4-digit year:
set /p sb-cal=Enter calibration CON file name:

rem set environment -----------------------------------------------------
set path=%path%;C:\\Program Files\\sea-bird\\sbedataprocessing-win32
set sb-base-dir=\\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\%sb-year%\

rem invoke SBEBatch to make CNV from HEX and then plot the CNVs --------
sbebatch CNV_Create.txt %sb-base-dir% %sb-cal%
```

Figure I.4. "CNV_Create.bat" file contents.

The batch file invokes synchronous operation of all the needed Sea-Bird software processes. The instructions performed are in file "CNV_Create.txt", Figure I.5. Each task uses its own ".psa" file to specify options to use in certain processing steps.

CNV_Create.txt - Notepad

```
Datcnv /i%1hex_raw\*.hex /o%1CNV_Processed\temp /c%1CON_calibration\%2 /pCNV_Convert.psa /s /a_C
Filter /i%1CNV_Processed\temp\*_C.cnv /o%1CNV_Processed\temp /pCNV_Filter.psa /s /a_F
Alignctd /i%1CNV_Processed\temp\*_F.cnv /o%1CNV_Processed\temp /pCNV_AlignCTD.psa /s /a_A
CellTM /i%1CNV_Processed\temp\*_A.cnv /o%1CNV_Processed\temp /pCNV_CellTM.psa /s /a_M
Loopedit /i%1CNV_Processed\temp\*_M.cnv /o%1CNV_Processed\temp /pCNV_LoopEdit.psa /s /a_L
Derive /i%1CNV_Processed\temp\*_L.cnv /o%1CNV_Processed\temp /c%1CON_calibration\%2 /pCNV_Derive.psa /s /a_D
Binavg /i%1CNV_Processed\temp\*_D.cnv /o%1CNV_Processed /pCNV_Binavg.psa /s /a_B
Seaplot /i%1CNV_Processed\*.cnv /o%1plot\cnv /pCNV_Plot_A.psa /s
Seaplot /i%1CNV_Processed\*.cnv /o%1plot\cnv /pCNV_Plot_B.psa /s
```

Figure I.5. Sequence of processes to run in order to produce final CNV files as well as associated profile plots.

First the raw HEX files are pulled from folder ..\HEX_Raw\ and converted into basic CNV files, as adjusted by the named calibration file. This, and subsequent, CNV files are stored in the ..\CNV_Processed\temp\ folder. The original filename has a "_c" suffixed to it to indicate the file was the result on data conversion.

Second the "_c" files are run through a filter to smooth the pressure, temperature, and conductivity readings. The resulting files are suffixed further with "_f" and written to the temp folder.

Next the "_f" files are aligned so that temperature and conductivity coincide with the pressure. These go into temp as "_a" files.

Then the "_a" files have conductivity cell thermal mass effects removed from the measured conductivity. The resulting temp files are suffixed "_m".

The "_m" files then have readings during pressure slowdowns and reversals (typically the result ship heave) flagged as bad. The output is suffixed "_L".

Using measured pressure, temperature, and conductivity, the "_L" files have calculated on them sigma-t, salt water depth, and salinity. The resulting files are marked "_d".

Finally, the "_d" files have their values averaged into 1-meter bins. The final "_b" files are stored directly in ..\CNV_Processed\. They are NOT written to ..\CNV_Processed\temp\.

The "_b" files are the basis for the two sets of post-processing profile plots. Plots are stored in the ..\Plot\CNV\ folder. There is an A suffixed to the filename of the first profile plots, and B to the second set. A pair of plots is required for each cast due to the number of parameters measured by the CTD.

The final CNV files begin with a preamble that documents the particular data processing steps that were performed to generate the values in the file. Figure I.6 illustrates a typical preamble.

```
* Sea-Bird SBE19 Data File:
* FileName = C:\Oceanography\2009\Downloaded HEX file\0907_1_0184_03.hex
* Software Version 1.59
* Temperature SN = 0436
* Conductivity SN = 0436
* System UpLoad Time = Jul 16 2009 15:04:02
** Vessel:Sigma-t
** CTD#:1
** Dump#:0184
** Observer:Sharman
** Cast#:03
** Station:10
** Latitude:58.89903
** Longitude:-136.83978
** Date GMT:2009/07/16
** Time GMT:19:42
```

```
** Fathometer depth:361
** Cast target depth:330
** Moderate line angle.
* ds
* SEACAT PROFILER V2.1e  SN 0436   07/16/09  23:02:22.158
* pressure sensor: serial no = 2852184,  range = 870 psia,  tc = -24
* clk = 32767.703   iop = 135   vmain = 9.9   vlith = 5.2
* ncasts = 6   samples = 9970   free = 11687   lwait = 0 msec
* sample rate = 1 scan every 0.5 seconds
* minimum raw conductivity frequency for pump turn on = 3000 hertz
* pump delay = 45 seconds
* battery cutoff = 7.2 volts
* number of voltages sampled = 4
* S>
* dh
* cast 3  07/16  19:42:07   samples 5897 to 7557  stop = switch off
* S>
# nquan = 12
# nvalues = 319
# units = specified
# name 0 = wetStar: Fluorescence, Wetlab Wetstar [mg/m^3]
# name 1 = obs: OBS, Backscatterance (D & A) [NTU]
# name 2 = par: PAR/Irradiance, Biospherical/Licor
# name 3 = t090C: Temperature [ITS-90, deg C]
# name 4 = prSM: Pressure, Strain Gauge [db]
# name 5 = c0S/m: Conductivity [S/m]
# name 6 = sbeox0V: Oxygen Voltage, SBE 43
# name 7 = sigma-t00: Density [sigma-t, Kg/m^3 ]
# name 8 = sal00: Salinity [PSU]
# name 9 = depSM: Depth [salt water, m], lat = 58.5
# name 10 = sbeox0ML/L: Oxygen, SBE 43 [ml/l], WS = 2
# name 11 = flag: flag
# span 0 =     0.3639,    16.3122
# span 1 =    13.7855,    23.6942
# span 2 = 3.3050e-02, 1.5638e+02
# span 3 =     3.7964,     7.0704
# span 4 =      1.009,    322.248
# span 5 =   1.597253,   3.115554
# span 6 =     2.6009,     3.5767
# span 7 =    11.4476,    24.9448
# span 8 =    14.6693,    31.4214
# span 9 =      1.000,    319.000
# span 10 =    5.78148,    8.49310
# span 11 = 0.0000e+00, 0.0000e+00
# interval = meters: 1
# start_time = Jul 16 2009 19:42:07
# bad_flag = -9.990e-29
# sensor 0 = Frequency 0  temperature, 0436, 03-Mar-09
# sensor 1 = Frequency 1  conductivity, 436, 03-Mar-09, cpcor = -9.5700e-
08
# sensor 2 = Extrnl Volt  0  irradiance (PAR), primary, 6011, 26-Feb-09
# sensor 3 = Extrnl Volt  1  backscatterance, primary, 1591, 08-Mar-09
# sensor 4 = Extrnl Volt  2  WET Labs, WETStar fluorometer, WS3S-0652P,
10-Mar-09
# sensor 5 = Extrnl Volt  3  Oxygen, SBE, primary, 1628, 07-Apr-09p
# sensor 6 = Pressure Voltage, 195991, 27-Feb-09
# datcnv_date = Jan 13 2010 16:46:36, 7.18c
```

```
# datcnv_in =
\\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\2009\hex_raw\0907_1_0184
_03.hex
\\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\2009\CON_calibration\1_0
903.con
# datcnv_skipover = 180
# datcnv_ox_hysteresis_correction = yes
# filter_date = Jan 13 2010 16:50:23, 7.18c
# filter_in =
\\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\2009\CNV_Processed\temp\
0907_1_0184_03_c.cnv
# filter_low_pass_tc_A = 0.500
# filter_low_pass_tc_B = 1.000
# filter_low_pass_A_vars = t090C c0S/m
# filter_low_pass_B_vars = prSM
# alignctd_date = Jan 13 2010 16:54:17, 7.18c
# alignctd_in =
\\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\2009\CNV_Processed\temp\
0907_1_0184_03_c_f.cnv
# alignctd_adv = t090C 0.500, sbeox0V 5.500
# celltm_date = Jan 13 2010 16:58:41, 7.18c
# celltm_in =
\\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\2009\CNV_Processed\temp\
0907_1_0184_03_c_f_a.cnv
# celltm_alpha = 0.0400, 0.0000
# celltm_tau = 8.0000, 0.0000
# celltm_temp_sensor_use_for_cond = primary,
# loopedit_date = Jan 13 2010 17:03:11, 7.18c
# loopedit_in =
\\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\2009\CNV_Processed\temp\
0907_1_0184_03_c_f_a_m.cnv
# loopedit_minVelocity = 0.100
# loopedit_surfaceSoak: do not remove
# loopedit_excl_bad_scans = yes
# Derive_date = Jan 13 2010 17:08:35, 7.18c
# Derive_in =
\\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\2009\CNV_Processed\temp\
0907_1_0184_03_c_f_a_m_l.cnv
\\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\TEST\CON_calibration\1_0
436.con
# derive_time_window_docdt = seconds: 2
# derive_ox_tau_correction = yes
# binavg_date = Jan 13 2010 17:14:32, 7.18c
# binavg_in =
\\nps\akrdfs\GLBA\Science\Data\Oceanography\Data\2009\CNV_Processed\temp\
0907_1_0184_03_c_f_a_m_l_d.cnv
# binavg_bintype = meters
# binavg_binsize = 1
# binavg_excl_bad_scans = yes
# binavg_skipover = 0
# binavg_surface_bin = yes, min = 0.200, max = 0.800, value = 0.000
# file_type = ascii
*END*
```

Figure I.6. Example of a documentary preamble stored at the head of all CNV files.

Appendix J: Deliverable Definitions

Deliverables are the data and information products that are validated, certified, archived, and disseminated through the Southeast Alaska Network. Scientific deliverables are typically built by the Project Leader and submitted to the Data Manager. A few technical deliverables, which are of an information-management rather than scientific nature, are built by the Data Manager. Regardless of the source, every deliverable is formally validated by the Data Manager and certified by the originator before it is made available.

In order to carry out these processes, it is necessary to define in full detail the content, nature, and domain of each deliverable. Complete definitions also support subsequent interpretation of the products by removing ambiguity.

Appendix J defines every deliverable supported by the SEAN oceanographic program. It follows policies set in the SEAN Data Management Plan (Johnson and Moynahan 2008: SOP 302 – Data Management Considerations in Protocol Development). Using that method, the top level description of a deliverable is explained using a single form named either A, B, C, or D. The specific form used for a particular deliverable depends on the nature of the deliverable's contents. Deliverables of a tabular type are further defined with a form X, where the structure of the table is described. Each individual attribute (i.e., column, field) of a table is then defined in detail using a form Y. Using this set of six forms, all data and information involved in the SEAN oceanographic program (and other SEAN programs) are consistently, precisely, and fully defined.

Each deliverable is also documented with a data flow diagram. These explain exactly where underlying data come from, what processes are applied to them, where they are stored, and who is responsible for managing each of them.

Appendix J Contents

J.1 OC_A: CON Calibration Files

Purpose of deliverable: CTD sensors are periodically calibrated. The unit as a whole is generally calibrated annually, though special circumstances may cause individual sensors to be recalibrated and reported *ad hoc*. Calibration results in a report for each sensor that provides numeric factors used to adjust actual field readings to a standardized level. A full CTD calibration typically results in the vendor providing a "CON" computer file covering multiple sensors. When ad hoc calibration of just one particular sensor is performed, results are typically provided on paper. These paper factors must then be added to the latest CON file using proprietary software. The ultimate deliverable, a calibration file, is used by subsequent processes to normalize field data. Providing this deliverable allows customers to generate processed "CNV" data from raw readings, replicate our program results, and investigate new methods of processing raw CTD data.

Frequency produced: A new calibration file must be created after the result of any sensor recalibration is reported to the Project Leader. Note there are different process steps for handling a file provided for the CTD than there are for handling a paper report on an individual sensor.

Prerequisites: Validation cannot be performed until the corresponding OC_G calibration certificate images have been certified.

Data flow:

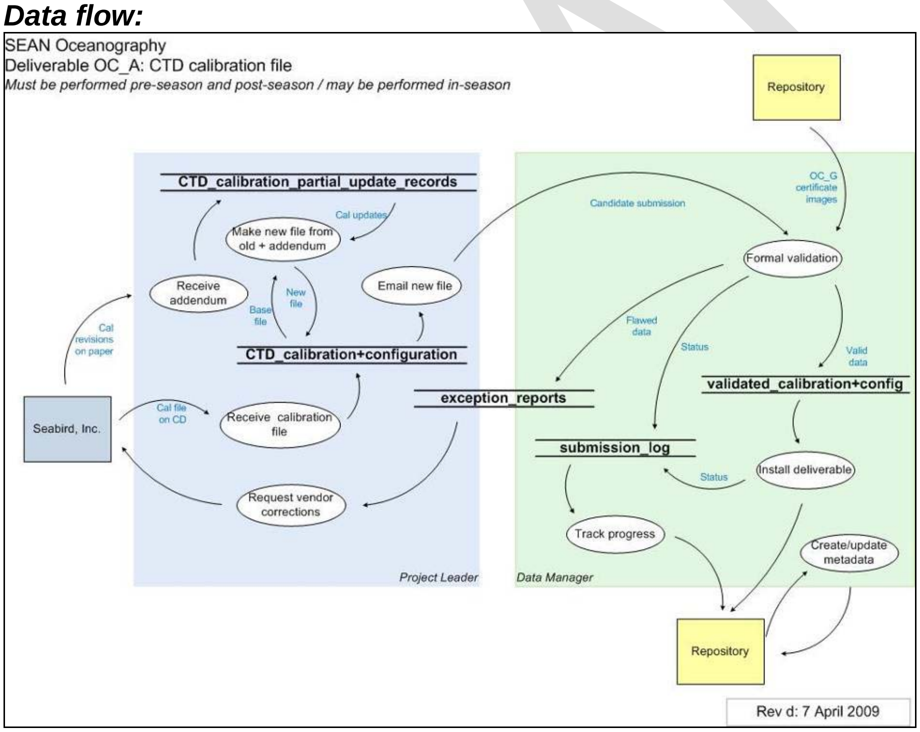


Figure J.1. Data flow required to generate deliverable OC_A – CON file.

Deliverable definition forms:

Form C: Non-Tabular Data Deliverable

Vital Sign: OC Oceanography	*Deliverable ID:* OC_A	*Deliverable Title:* CON calibration files
File format: CON	*Associated software and version*: SBEDataProc 7.18	*Revision Date / protocol version:* 04-07-2009 / OC_2009.1
Expected frequency: 1/ctd/year	*Likely dissemination partners:* None – served by SEAN	*Submission unit:* Year+CTD#

What purpose does this deliverable serve?

Documents the calibration parameters for all sensors on the CTD. Needed to convert raw HEX data into binned engineering-unit CNV data (using the SBEDataProc program).

Summary of content:

This file uses a proprietary format. Each type of sensor requires different kinds and numbers of calibration parameters. The file contains a section for each sensor, as identified by sensor serial number. Within each section are the particular parameters appropriate to that sensor. There is also a general CTD configuration section that defines such items as the number of channels installed.

Mandatory validation criteria:

1. Must be able to be opened, updated, and resaved using the Config function of SBEDataProc 7.18 or later.
2. Values must match those in corresponding OC_G images from the same time period.

Optional validation criteria:

- None -

Deliverable ID of any other SEAN data products required to create this product:

OC_G CTD calibrations certificate images

Description and source of any outside data required to create this product:

Periodic calibration is managed by Sea-Bird Electronics, typically at the end of each season. They supply a new CON file after each service event. Some sensors may be revised during the season. In this case, documentation is provided to permit the Project Leader to update the latest CON file at the park.

J.2 OC_B: Raw HEX Files

Purpose of deliverable: CTD devices collect sensor data in memory, grouped by cast. These raw "hex" data are downloaded from the CTD into ASCII files containing header information and hexadecimal representations of sensor voltages/frequencies taken at a preset time interval. Each cast is recorded in one and only one hex file. Typically, OC_B hex files are later processed into advanced products that are binned by depth with voltages converted to appropriate engineering units (see deliverable OC_C). However, the raw OC_B deliverables are made available to the community in order to support custom analyses that require raw sensor data.

Frequency produced: Hex data are produced for every cast, as delineated by the cycling of the CTD's on/off switch. The data are unloaded into hex files at the end of each cruise day. Hex files are accumulated during the season. OC_B is created at the end of each season by packaging all component hex files into a single deliverable.

Prerequisites: Production of this deliverable is dependent on capturing the daily CTD data stream into intermediate hex files throughout the season. The final deliverable, itself, is created post-season from the saved in-season data files.

Data flow:

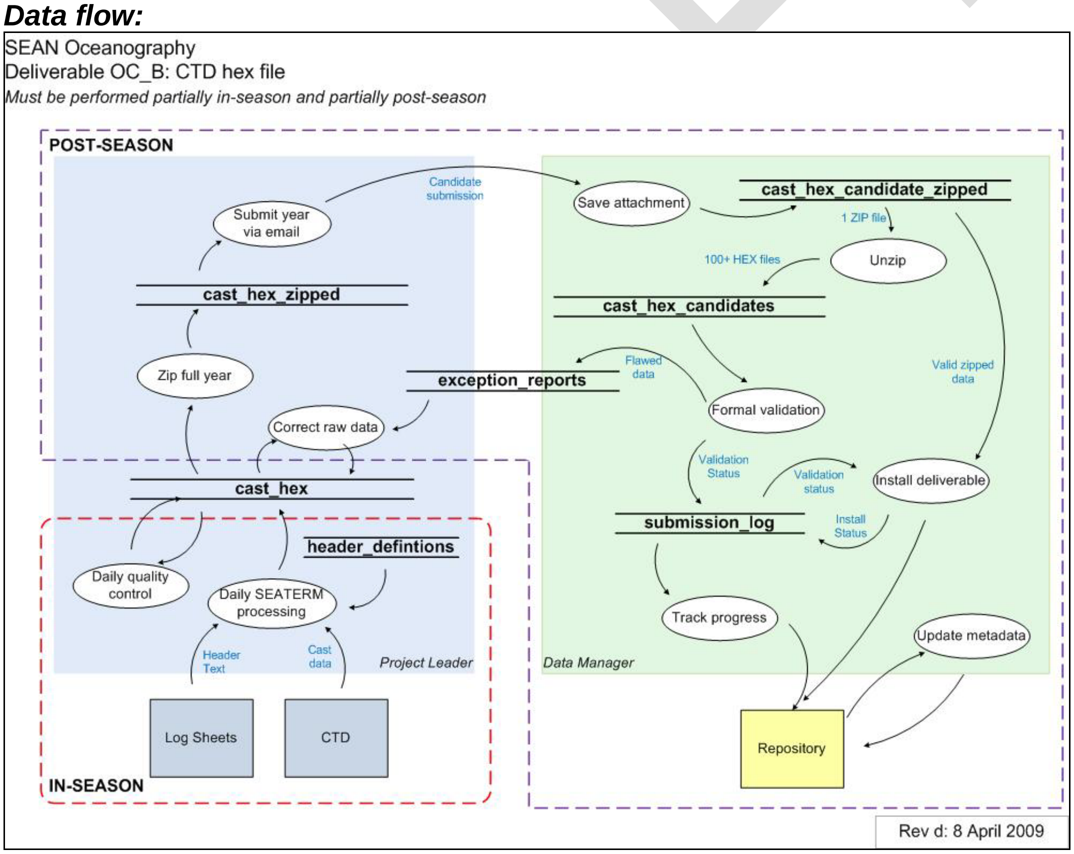


Figure J.2. Data flow required to generate deliverable OC_B – HEX files.

Deliverable definition forms:

Form D: Tabular Data Deliverable

Vital Sign: OC Oceanography	*Deliverable ID:* OC_B	*Deliverable Title:* Raw HEX files
File format: ZIP	*Associated software and version*: PKUNZIP, WINRAR, etc.	*Revision Date / protocol version:* 04-08-2009 / 2009.1
Expected frequency: 1 zip holding about 120 hex files/year	*Likely dissemination partners:* None – served by SEAN	*Submission unit:* YEAR
What purpose does this deliverable serve? Provides raw CTD "hex" data as the basis for customer analyses.		
Identifiers of relations that compose the tabular deliverable ("Relations" are tables or files that provide information which may be represented in a grid format. Each relation listed must be fully defined in its own accompanying Form X.): HEX_yyyy.ZIP is a zip archive of individual cast files named "yymm_C_dddd_cc.hex", where yy is year of cast, mm is month of cast, C is local ctd number, dddd is dump number, and cc is cast number. Leading zeroes are used to make every filename exactly 18 characters. The cast files are treated as a relation for data management purposes.		
Deliverable ID of any other SEAN data products required to create this product: - None -		
Description and source of any outside data required to create this product: Individual cast data from CTD downloads. Field log sheets recording cast particulars. SeaTerm.ini program configuration file containing the header prompt definitions in explained in Appendix G.		

Form X: Relation Definition

Vital Sign: OC Oceanography	*Relation identifier:* yymm_C_dddd_cc.hex	*Used by deliverable ID:* OC_B
Revision date / protocol version: 04-08-2009 / 2009.1	*Type of relation:* ☐ Database table ☒ Data file	*Estimated rows:* 1,200
Primary key for this relation: - none -		
Purpose: Oceanographic cast raw "hex" data downloaded from CTD.		
Identifiers of attributes defined over this relation ("Attributes" are columns of the grid. Each attribute must be defined in an accompanying Form Y.): LINE		
Mandatory validation criteria involving multiple attributes: - none -		
Optional validation criteria involving multiple attributes: - none -		

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* LINE	*Used by deliverable ID:* OC_B
Revision date / protocol version: 04-08-2009 / 2009.1	*Default report heading:* -none-	*Relation (from Form X):* yymm_C_dddd_cc.hex
Purpose: One proprietary data line from the CTD device during a cast.		

Data type:	varchar()
Maximum length	200
Required:	no
Measurement units:	n/a
Format:	Character string
Foreign key to (relation+attribute):	n/a
Case:	Upper only
Mandatory validation rules for this attribute (in order of application):	1. Null LINE is always valid. 2. LINE having first character of ‘*’ is always valid. 3. LINE must be composed of characters from the set {A-Z} + {0-9}. Lower case is not permitted. 4. Every LINE in the file, other than those beginning with ‘*”, must be exactly the same number of characters long. For example, all must be 24 characters in a particular file. 5. Within the relation as a whole, each of the following strings must be present in at least one LINE beginning ‘**’: ‘Vessel:’, ‘CTD#:’, ‘Dump#:’, ‘Observer:’, ‘Cast#:’, ‘Station:’, ‘Latitude:’, ‘Longitude:’, ‘Date GMT:’, ‘Time GMT:’, ‘Fathometer depth:’, ‘Cast target depth:’
Optional validation rules for this attribute:	• Count the number of lines following the delimiter line ‘*END*’. This should match the number of samples determined by parsing the line beginning ‘* cast’ and locating starting and ending record number.

J.3 OC_C: Processed CNV Files

Purpose of deliverable: CNV files show the recorded parameters for each cast in a manner useful for analysis. Each CNV is derived from a HEX file, but differs in three ways. First, the CNV data shows one row for every meter of depth; while HEX data typically show multiple rows for every meter, as HEX readings are taken at periodic times instead of periodic depths. Second, CNV values have been normalized using the calibration factors. Third, CNV values are in terms of engineering units instead of voltage/frequency levels.

Frequency produced: OC_C is created at the end of each season by generating a CNV file for each HEX file and then packaging all CNV files into a single deliverable.

Prerequisites: Production of this deliverable is dependent on having certified OC_A and OC_B products for the season.

Data flow:

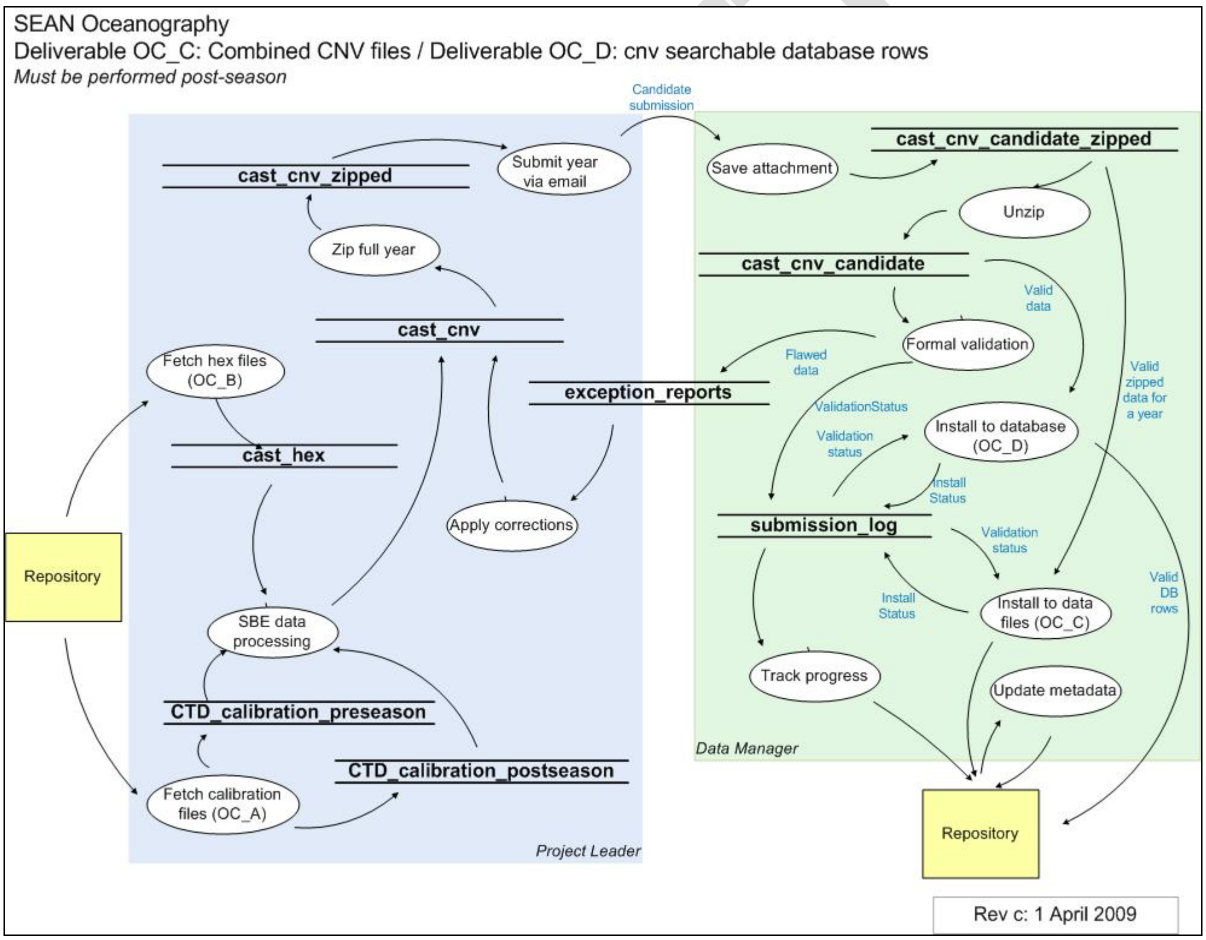


Figure J.3. Data flow required to generate deliverable OC_C – CNV files.

Deliverable definition forms:

Form D: Tabular Data Deliverable

<table>
<tr><td>Vital Sign:
OC Oceanography</td><td>Deliverable ID:
OC_C</td><td>Deliverable Title:
Processed CNV files</td></tr>
<tr><td>File format:
ZIP</td><td>Associated software and version:
PKUNZIP, WINRAR, etc.</td><td>Revision Date / protocol version:
04-09-2009 / 2009.1</td></tr>
<tr><td>Expected frequency:
1 zip holding about 120 hex files/year</td><td>Likely dissemination partners:
None – served by SEAN</td><td>Submission unit:
YEAR</td></tr>
<tr><td colspan="3">What purpose does this deliverable serve?
Provides binned, calibrated CNV data for customer analyses.</td></tr>
<tr><td colspan="3">Identifiers of relations that compose the tabular deliverable (“Relations” are tables or files that provide information which may be represented in a grid format. Each relation listed must be fully defined in its own accompanying Form X.):
CNV_yyyy.ZIP is a zip archive of individual cast files named “yymm_C_dddd_cc.cnv”, where yy is year of cast, mm is month of cast, C is local ctd number, dddd is dump number, and cc is cast number. Leading zeroes are used to make every filename exactly 18 characters. The CNV files are considered a relation for purposes of data management.</td></tr>
<tr><td colspan="3">Deliverable ID of any other SEAN data products required to create this product:
OC_A and OC_B</td></tr>
<tr><td colspan="3">Description and source of any outside data required to create this product:
- none -</td></tr>
</table>

Form X: Relation Definition

Vital Sign:	*Relation identifier:*	*Used by deliverable ID:*
OC Oceanography	yymm_C_dddd_cc.cnv	OC_C
Revision date / protocol version: 04-09-2009 / 2009.1	*Type of relation:* ○ Database table ◉ Data file	*Estimated rows:* 180

Primary key for this relation:

- none -

Purpose:

Oceanographic cast CNV data for customer analysis. The file consists of a preamble defining parameters involved in the cast such as station and dump number. This is followed by a second preamble that documents the processing performed to create this cast data. The final section is a grid of attributes with each row representing a meter in the downcast.

Identifiers of attributes defined over this relation (“Attributes” are columns of the grid. Each attribute must be defined in an accompanying Form Y.):

PRESSURE	FLUORESCENCE
DEPTH	OBS
TEMPERATURE	OXYGEN
CONDUCTIVITY	PAR
SALINITY	SBE_DATA_FLAG
SIGMA_T	

Mandatory validation criteria involving multiple attributes:

Any record whose first character is either ‘*’ or ‘#’ is preamble data that is always valid, no validation of individual attributes applies to such rows.

Within the relation as a whole, each of the following strings must be present in at least one row beginning with the ‘*’ character:

‘Vessel:’, ‘CTD#:’, ‘Dump#:’, ‘Observer:’, ‘Cast#:’, ‘Station:’, ‘Latitude:’, ‘Longitude:’, ‘Date GMT:’, ‘Time GMT:’, ‘Fathometer depth:’, ‘Cast target depth:’

Optional validation criteria involving multiple attributes:

- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* PRESSURE	*Used by deliverable ID:* OC_C
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* Pressure (dbar)	*Relation (from Form X):* yymm_C_dddd_cc.cnv
Purpose: Pressure in decibars.		

Data type:	real
Maximum length	8
Required:	yes
Measurement units:	Decibars
Format:	9999.9999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between 0 and 9999.9999
Optional validation rules for this attribute:	Should be between 1 and 800

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* DEPTH	*Used by deliverable ID:* OC_C
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* Depth (m)	*Relation (from Form X):* yymm_C_dddd_cc.cnv
Purpose: Depth in meters.		

Data type:	integer
Maximum length	4
Required:	yes
Measurement units:	meters
Format:	9999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be an integer. 2. Must be between 0 and 9999. 3. Must be unique within a file.
Optional validation rules for this attribute:	• Should be between 0 and 800.

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* TEMPERATURE	*Used by deliverable ID:* OC_C
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* Temperature (C)	*Relation (from Form X):* yymm_C_dddd_cc.cnv
Purpose: Temperature in Celsius.		

Data type:	real
Maximum length	6
Required:	no
Measurement units:	Degrees C
Format:	99.9999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between -5.0 and 20.0. 3. Special allowed case of SBE error flag value: -9.990e-29.
Optional validation rules for this attribute:	• Should be between 0.0 and 20.0

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* CONDUCTIVITY	*Used by deliverable ID:* OC_C
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* Conductivity (S/m)	*Relation (from Form X):* yymm_C_dddd_cc.cnv

Purpose: Conductivity in Siemens per meter.

Data type:	real
Maximum length	8
Required:	no
Measurement units:	Siemens/meter
Format:	9.999999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between 0.0 and 10.0. 3. Special allowed case of SBE error flag value: -9.990e-29.
Optional validation rules for this attribute:	Should be between 0.0 and 5.0.

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* SALINITY	*Used by deliverable ID:* OC_C
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* Salinity (PSU)	*Relation (from Form X):* yymm_C_dddd_cc.cnv
Purpose: Salinity in practical salinity units.		

Data type:	real
Maximum length	6
Required:	yes
Measurement units:	PSU
Format:	99.999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between 0.0 and 40.0. 3. Special allowed case of SBE error flag value: -9.990e-29.
Optional validation rules for this attribute:	• Should be between 0.0 and 34.0.

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* SIGMA_T	*Used by deliverable ID:* OC_C
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* Density (kg/m^3)	*Relation (from Form X):* yymm_C_dddd_cc.cnv
Purpose: Density differential in kg/m^3.		

Data type:	real
Maximum length	7
Required:	no
Measurement units:	kg/m^3
Format:	99.999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between 0.0 and 30.0. 3. Special allowed case of SBE error flag value: -9.990e-29.
Optional validation rules for this attribute:	• Should be between 15.0 and 27.0.

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* FLUORESCENCE	*Used by deliverable ID:* OC_C
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* Fluorescence (mg/m**3)	*Relation (from Form X):* yymm_C_dddd_cc.cnv
Purpose: Fluorescence.		

Data type:	real
Maximum length	6
Required:	no
Measurement units:	mg/m³
Format:	99.999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between 0.0 and 99.999. 3. Special allowed case of SBE error flag value: -9.990e-29.
Optional validation rules for this attribute:	• Should be between 0.0 and 70.0.

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* OBS	*Used by deliverable ID:* OC_C
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* Backscatterance (in NTU)	*Relation (from Form X):* yymm_C_dddd_cc.cnv
Purpose: Turbidity detected by OBS backscatter sensor.		

Data type:	real
Maximum length	7
Required:	no
Measurement units:	NTU
Format:	999.999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between 0.0 and 800.0. 3. Special allowed case of SBE error flag value: -9.990e-29.
Optional validation rules for this attribute:	• Should be between 0.0 and 500.0.

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* OXYGEN	*Used by deliverable ID:* OC_C
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* Dissolved Oxygen (ml/l)	*Relation (from Form X):* yymm_C_dddd_cc.cnv
Purpose: Dissolved oxygen content.		

Data type:	real
Maximum length	6
Required:	no
Measurement units:	ml/l
Format:	99.999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between 0.0 and 20.0. 3. Special allowed case of SBE error flag value: -9.990e-29.
Optional validation rules for this attribute:	• Should be between 2.0 and 14.0.

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* PAR	*Used by deliverable ID:* OC_C
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* PAR (uE/m^2 * sec)	*Relation (from Form X):* yymm_C_dddd_cc.cnv
Purpose: Photosynthetically active radiation.		

Data type:	real
Maximum length	8
Required:	no
Measurement units:	µEinsteins/m²·sec
Format:	9999.999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between 0.0 and 3000.0. 3. Special allowed case of SBE error flag value: -9.990e-29.
Optional validation rules for this attribute:	• Should be between 0.0 and 1600.0.

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* SBE_DATA_FLAG	*Used by deliverable ID:* OC_C
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* DP Quality	*Relation (from Form X):* yymm_C_dddd_cc.cnv

Purpose:
Indicates bins with suspect data due to pressure slowdown or reversal as drop progresses. Set appropriately by SBE data processing “loopedit” function. A non-zero value indicates suspect data, which will not be loaded into the OC_D database.

Data type:	real
Maximum length	9
Required:	no
Measurement units:	n/a
Format:	n/a
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	-none-
Optional validation rules for this attribute:	

J.4 OC_D: Database Additions

Purpose of deliverable: Working with large groups of OC_C processed CNV files can be cumbersome and difficult. An oceanography database is maintained that contains all the CNV values for all surveys done in the program. Through the web, the database may be queried to produce a single file on the customer's workstation containing final data, filtered to meet the customer's exact area of interest. Deliverable OC_D is an incremental update used to revise the cumulative database.

Frequency produced: OC_D is generated at the end of each season directly after certification of OC_C processed CNV files. It is created from OC_C's intermediate validation files.

Prerequisites: Production of this deliverable is dependent on having a certified OC_C product for the year.

Data flow:

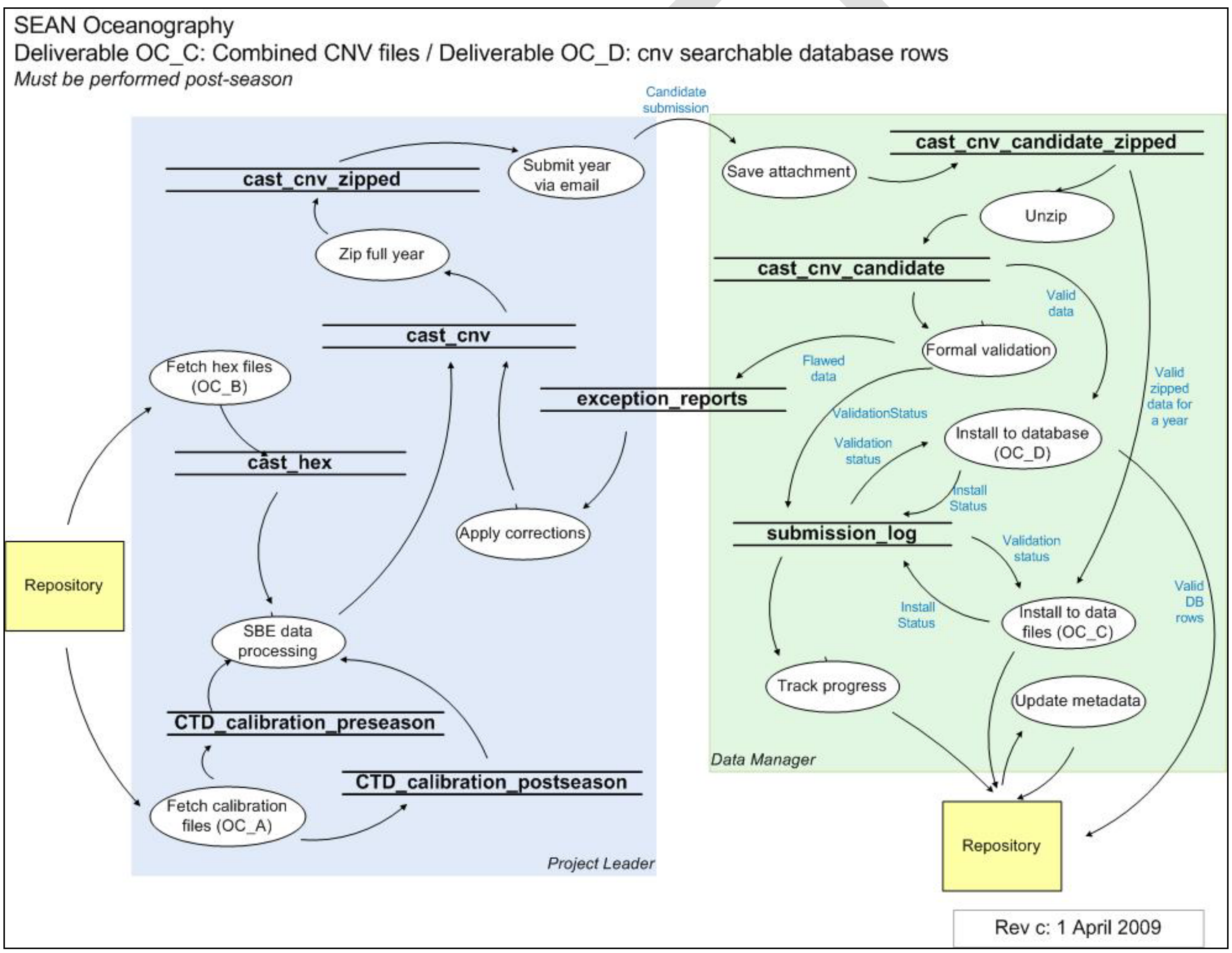


Figure J.4. Data flow required to generate deliverable OC_D – database additions.

Deliverable definition forms:

Form D: Tabular Data Deliverable

<table>
<tr><td>Vital Sign:
OC Oceanography</td><td>Deliverable ID:
OC_D</td><td>Deliverable Title:
Searchable database rows</td></tr>
<tr><td>File format:
n/a</td><td>Associated software and version:
n/a</td><td>Revision Date / protocol version:
04-10-2009 / 2009.1</td></tr>
<tr><td>Expected frequency:
1 submission/year</td><td>Likely dissemination partners:
None – served by SEAN</td><td>Submission unit:
YEAR</td></tr>
<tr><td colspan="3">What purpose does this deliverable serve?
Provides binned, calibrated CNV data filtered by parameters directly to customer workstations. This is basically deliverable OC_C recast in database structure. Sensor data in the source CNV file that have negative values (typically due to faulty sensor or SBE data error flag) are treated as NULL in the database.</td></tr>
<tr><td colspan="3">Identifiers of relations that compose the tabular deliverable (“Relations” are tables or files that provide information which may be represented in a grid format. Each relation listed must be fully defined in its own accompanying Form X.):
tbl_oc_cast</td></tr>
<tr><td colspan="3">Deliverable ID of any other SEAN data products required to create this product:
OC_C</td></tr>
<tr><td colspan="3">Description and source of any outside data required to create this product:
- none -</td></tr>
</table>

Form X: Relation Definition

Vital Sign: OC Oceanography	*Relation identifier:* tbl_oc_cast	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Type of relation:* Database Table	*Estimated rows:* 300,000+

Primary key for this relation:

ctd + dump + cast + depth

Purpose:

Oceanographic calibrated cast data binned to 1 meter buckets and expressed in engineering units, to serve as a basis for customer analysis. The table appears totally denormalized to facilitate web downloading and direct use by Excel and MS Access.

Identifiers of attributes defined over this relation ("Attributes" are columns of the grid. Each attribute must be defined in an accompanying Form Y.):

CTD	CONDUCTIVITY
DUMP	SALINITY
OBSERVER	SIGMA_T
CAST	FLUORESCENCE
VESSEL	OBS
STATION	OXYGEN
LATITUDE	PAR
LOGITUDE	SBE_DATA_FLAG
DATE_GMT	COMMENTS
TIME_GMT	DATA_QUALITY
FATHOMETER_DEPTH	QUALITY_COMMENT
TARGET_DEPTH	TIME_STAMP
PRESSURE	PROTOCOL_ID
DEPTH	USERID
TEMPERATURE	SUBMISSION_NUMBER
	CRUISE_YEAR

Mandatory validation criteria involving multiple attributes:

- none -

Optional validation criteria involving multiple attributes:

- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* CTD	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* CTD#	*Relation (from Form X):* tbl_oc_cast

Purpose:
Local identification of the CTD device. Initially, units 1 and 2 were defined.

Data type:	Varchar(1)
Maximum length	1
Required:	yes
Measurement units:	n/a
Format:	9
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be between 1 and 9.
Optional validation rules for this attribute:	- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* DUMP	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* DUMP#	*Relation (from Form X):* tbl_oc_cast
Purpose: The sequential number that is incremented each time any CTD memory is cleared. It tracks distinct uses of the CTD to gather a set of consecutive casts.		

Data type:	Varchar(4)
Maximum length	4
Required:	yes
Measurement units:	n/a
Format:	0000
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must represent a whole number, zero filled.
Optional validation rules for this attribute:	- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* OBSERVER	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* OBSERVER	*Relation (from Form X):* tbl_oc_cast
Purpose: The last names of those making the cast.		

Data type:	Varchar(50)
Maximum length	50
Required:	no
Measurement units:	n/a
Format:	n/a
Foreign key to (relation+attribute):	n/a
Case:	any
Mandatory validation rules for this attribute (in order of application):	- none -
Optional validation rules for this attribute:	- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* CAST	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* Cast#	*Relation (from Form X):* tbl_oc_cast

Purpose:
Sequential cast number within a particular dump. Casts are integers beginning with zero. They are generated by the CTDs themselves. Because of memory limits in existing equipment, it is rare CAST will ever exceed 15.

Cast is part of the primary key, making its representation critical. If its value is below 10, it must be stored only as two digits, employing a leading zero if needed..

Data type:	Varchar(2)
Maximum length	2
Required:	yes
Measurement units:	n/a
Format:	n0
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must represent an integer between 0 and 99.
Optional validation rules for this attribute:	• should be between 0 and 15

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* VESSEL	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* Vessel	*Relation (from Form X):* tbl_oc_cast
Purpose: Name of the vessel used to conduct the survey.		

Data type:	Varchar(24)
Maximum length	24
Required:	no
Measurement units:	n/a
Format:	n/a
Foreign key to (relation+attribute):	n/a
Case:	Proper
Mandatory validation rules for this attribute (in order of application):	- none -
Optional validation rules for this attribute:	- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* STATION	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* Station	*Relation (from Form X):* tbl_oc_cast

Purpose:
Identification number for a unique sampling location. Over time station numbers may be retired. The numbers are never recycled. Stations are always exactly two digits in length, using a leading zero if needed to meet that constraint.

Data type:	Varchar(2)
Maximum length	2
Required:	yes
Measurement units:	n/a
Format:	00
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must represent a zero-filled integer between 00 and 24.
Optional validation rules for this attribute:	- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* LATITUDE	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* Latitude	*Relation (from Form X):* tbl_oc_cast
Purpose: Decimal latitude in WGS84 datum.		

Data type:	real
Maximum length	8
Required:	no
Measurement units:	degrees
Format:	99.99999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between 58.0 and 61.0.
Optional validation rules for this attribute:	- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* LONGITUDE	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* Longitude	*Relation (from Form X):* tbl_oc_cast
Purpose: Decimal longitude using the WGS84 datum.		

Data type:	real
Maximum length	10
Required:	no
Measurement units:	n/a
Format:	-999.99999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between -135.0 and -142.0.
Optional validation rules for this attribute:	- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* DATE_GMT	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* Date	*Relation (from Form X):* tbl_oc_cast
Purpose: Date the cast was taken; in the GMT time zone.		

Data type:	date
Maximum length	n/a
Required:	no
Measurement units:	n/a
Format:	n/a
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a valid a date. 2. Must not be a date beyond the current one at point of validation. 3. Must not be a date before 1992.
Optional validation rules for this attribute:	- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* TIME_GMT	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* Time	*Relation (from Form X):* tbl_oc_cast
Purpose: Time cast was initiated, in Greenwich Mean Time.		

Data type:	time
Maximum length	n/a
Required:	no
Measurement units:	n/a
Format:	n/a
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must resolve to a valid time.
Optional validation rules for this attribute:	- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* FATHOMETER_DEPTH	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* Bottom (m)	*Relation (from Form X):* tbl_oc_cast
Purpose: Depth to the sea floor of this station in meters, expressed as a positive integer.		

Data type:	integer
Maximum length	4
Required:	no
Measurement units:	meters
Format:	9999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be an integer between 0 and 9999.
Optional validation rules for this attribute:	- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* PRESSURE	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* Pressure (dbar)	*Relation (from Form X):* tbl_oc_cast
Purpose: Pressure in decibars.		

Data type:	real
Maximum length	8
Required:	no
Measurement units:	Decibars
Format:	9999.999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between 1 and 9999.999.
Optional validation rules for this attribute:	Should be between 1 and 800

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* DEPTH	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* Depth (m)	*Relation (from Form X):* tbl_oc_cast
Purpose: Depth of this bin in meters, expressed as a positive integer.		

Data type:	integer
Maximum length	4
Required:	yes
Measurement units:	meters
Format:	9999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be an integer. 2. Must be between 0 and 9999.
Optional validation rules for this attribute:	• Should be less than 800.

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* TEMPERATURE	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* Temperature (C)	*Relation (from Form X):* tbl_oc_cast
Purpose: Water temperature in degrees Celsius.		

Data type:	Real
Maximum length	6
Required:	no
Measurement units:	Degrees C
Format:	99.999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between -5.0 and 20.0.
Optional validation rules for this attribute:	• Should be between 0.0 and 20.0

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* CONDUCTIVITY	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* Conductivity (S/m)	*Relation (from Form X):* tbl_oc_cast
Purpose: Conductivity in Siemens per meter.		

Data type:	real
Maximum length	8
Required:	no
Measurement units:	Siemens/meter
Format:	9.999999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between 0.0 and 10.0.
Optional validation rules for this attribute:	Should be between 0.0 and 5.0.

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* SALINITY	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* Salinity (PSU)	*Relation (from Form X):* tbl_oc_cast
Purpose: Salinity in practical salinity units.		

Data type:	real
Maximum length	6
Required:	no
Measurement units:	PSU
Format:	99.999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between 0.0 and 40.0.
Optional validation rules for this attribute:	• Should be between 0.0 and 34.0.

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* SIGMA_T	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* Density (kg/m³)	*Relation (from Form X):* tbl_oc_cast
Purpose: Density differential in kg/m³.		

Data type:	real
Maximum length	7
Required:	no
Measurement units:	kg/m³
Format:	nn.nnn
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between 0.0 and 30.0
Optional validation rules for this attribute:	• Should be between 15.0 and 27.0.

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* FLUORESCENCE	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* Fluorescence (mg/m³)	*Relation (from Form X):* tbl_oc_cast
Purpose: Fluorescence. Negative values may be recorded when sensor is disconnected.		

Data type:	real
Maximum length	6
Required:	no
Measurement units:	mg/m³
Format:	99.999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must not exceed 100.0.
Optional validation rules for this attribute:	• Should be between 0.0 and 70.0.

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* OBS	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* Backscatterance (NTU)	*Relation (from Form X):* tbl_oc_cast
Purpose: Turbidity detected by OBS backscatter sensor.		

Data type:	real
Maximum length	7
Required:	no
Measurement units:	NTU
Format:	999.999
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between 0.0 and 800.0.
Optional validation rules for this attribute:	• Should be between 0.0 and 500.0.

Form Y: Attribute Definition

<table>
<tr><td>Vital Sign:
OC Oceanography</td><td colspan="2">Attribute identifier:
OXYGEN</td><td>Used by deliverable ID:
OC_D</td></tr>
<tr><td>Revision date / protocol version:
04-09-2009 / 2009.1</td><td colspan="2">Default report heading:
Dissolved Oxygen (ml/l)</td><td>Relation (from Form X):
tbl_oc_cast</td></tr>
<tr><td colspan="4">Purpose:
Dissolved oxygen content. Negative values may appear when CTD is used without the DO sensor connected.</td></tr>
<tr><td colspan="2" align="right">Data type:</td><td colspan="2">real</td></tr>
<tr><td colspan="2" align="right">Maximum length</td><td colspan="2">6</td></tr>
<tr><td colspan="2" align="right">Required:</td><td colspan="2">no</td></tr>
<tr><td colspan="2" align="right">Measurement units:</td><td colspan="2">ml/l</td></tr>
<tr><td colspan="2" align="right">Format:</td><td colspan="2">nn.nnn</td></tr>
<tr><td colspan="2" align="right">Foreign key to (relation+attribute):</td><td colspan="2">n/a</td></tr>
<tr><td colspan="2" align="right">Case:</td><td colspan="2">n/a</td></tr>
<tr><td colspan="2" align="right">Mandatory validation rules for this attribute (in order of application):</td><td colspan="2">1. Must be a real number.
2. Must not exceed 20.0.</td></tr>
<tr><td colspan="2" align="right">Optional validation rules for this attribute:</td><td colspan="2">• Should be between 2.0 and 14.0.</td></tr>
</table>

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* PAR	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-09-2009 / 2009.1	*Default report heading:* PAR (uE/m^2 * sec)	*Relation (from Form X):* tbl_oc_cast
Purpose: Photosynthetically active radiation.		

Data type:	real
Maximum length	8
Required:	no
Measurement units:	µEinsteins/m²·sec
Format:	nnnn.nnn
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be a real number. 2. Must be between 0.0 and 3000.0.
Optional validation rules for this attribute:	• Should be between 0.0 and 1600.0.

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* SBE_DATA_FLAG	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* DP Error Flag	*Relation (from Form X):* tbl_oc_cast
Purpose: Indicates bins with suspect data due to pressure slowdown or reversal as the cast progresses. A non-zero value indicates suspect data.		

Data type:	real
Maximum length	9
Required:	no
Measurement units:	n/a
Format:	n/a
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	- none -
Optional validation rules for this attribute:	

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* COMMENTS	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* Comments	*Relation (from Form X):* tbl_oc_cast
Purpose: Recorded comments regarding circumstances of this particular cast.		

Data type:	Varchar(128)
Maximum length	128
Required:	no
Measurement units:	n/a
Format:	n/a
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	- none -
Optional validation rules for this attribute:	- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* DATA_QUALITY	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* Data Quality	*Relation (from Form X):* tbl_oc_cast

Purpose:
Indicator of the quality of the observation, for determining whether to include it in analyses. The Ocean Data View coding system is observed. This is not recorded in the database during OC_D processing. Instead, it is entered upon subsequent certification of deliverable OC_M: Data Quality.

Data type:	Varchar(1)
Maximum length	1
Required:	no
Measurement units:	n/a
Format:	n/a
Foreign key to (relation+attribute):	tbl_data_quality
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. If present, must match 0, 1, 4, or 8.
Optional validation rules for this attribute:	- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* DATA_QUALITY_COMMENT	*Used by deliverable ID:* OC_D
Revision date / protocol version: 05-12-2009 / 2009.1	*Default report heading:* Quality Comment	*Relation (from Form X):* tbl_oc_cast
Purpose: Explanation of why data quality was not considered "good." Source is certified OC_M spreadsheet for a particular year.		

Data type:	Varchar(128)
Maximum length	128
Required:	no
Measurement units:	n/a
Format:	n/a
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	- none -
Optional validation rules for this attribute:	- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* TIME_STAMP	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* Last Updated	*Relation (from Form X):* tbl_oc_cast
Purpose: The date and time this row was most recently inserted or updated in the table. It is used for auditing purposes.		

Data type:	datetime
Maximum length	n/a
Required:	yes
Measurement units:	n/a
Format:	n/a
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	- none -
Optional validation rules for this attribute:	- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* PROTOCOL_ID	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* Protocol	*Relation (from Form X):* tbl_oc_cast
Purpose: The formal version of the protocol under which this row was created.		

Data type:	Varchar(10)
Maximum length	10
Required:	yes
Measurement units:	n/a
Format:	n/a
Foreign key to (relation+attribute):	Tbl_protocol
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must match a protocol in tbl_protocol.
Optional validation rules for this attribute:	- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* USERID	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* Updated by	*Relation (from Form X):* tbl_oc_cast

Purpose:
The login name used to authorize the process that created/updated this row in the cumulative database. It is restricted to those userids stored in the database table called tbl_submitter. It is used for auditing purposes.

Data type:	Varchar(20)
Maximum length	20
Required:	yes
Measurement units:	n/a
Format:	n/a
Foreign key to (relation+attribute):	tbl_submitter
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must match a protocol in tbl_submitter.
Optional validation rules for this attribute:	- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* SUBMISSION_NUMBER	*Used by deliverable ID:* OC_D
Revision date / protocol version: 04-10-2009 / 2009.1	*Default report heading:* Submission#	*Relation (from Form X):* tbl_oc_cast
Purpose: The submission number used to transmit to the network the files from which this particular row came. It is used for several data management purposes, including auditing.		

Data type:	int
Maximum length	n/a
Required:	yes
Measurement units:	n/a
Format:	n/a
Foreign key to (relation+attribute):	tbl_submission_log
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must match a submission_number in tbl_submission_number.
Optional validation rules for this attribute:	- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* CRUISE_YEAR	*Used by deliverable ID:* OC_D
Revision date / protocol version: 12-30-2009 / 2009.1	*Default report heading:* Cruise Year	*Relation (from Form X):* tbl_oc_cast
Purpose: Cruises are aggregated by year defined as the period December through November. For example, casts made in December 2008 and those from April 2009 are all in cruise year 2009. Casts made in October 2008 are in cruise year 2008. Cruise year is derived from DATE_GMT.		

Data type:	Varchar(4)
Maximum length	4
Required:	yes
Measurement units:	n/a
Format:	0000
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must represent an integer between 1993 and the current year.
Optional validation rules for this attribute:	- none -

J.5 OC_E: AOOS Repository Submission

Purpose of deliverable: Copies of final certified detailed data are delivered to the Alaska Ocean Observing System (AOOS) for further dissemination. Their web system offers useful analysis tools and serves an established audience.

Frequency produced: This is generally created once per field season. In the event incorrect data appear in the AOOS system, OC_E may be recreated to make it whole.

Prerequisites: Production of this deliverable is built using the certified OC_D database for a particular year.

Data flow:

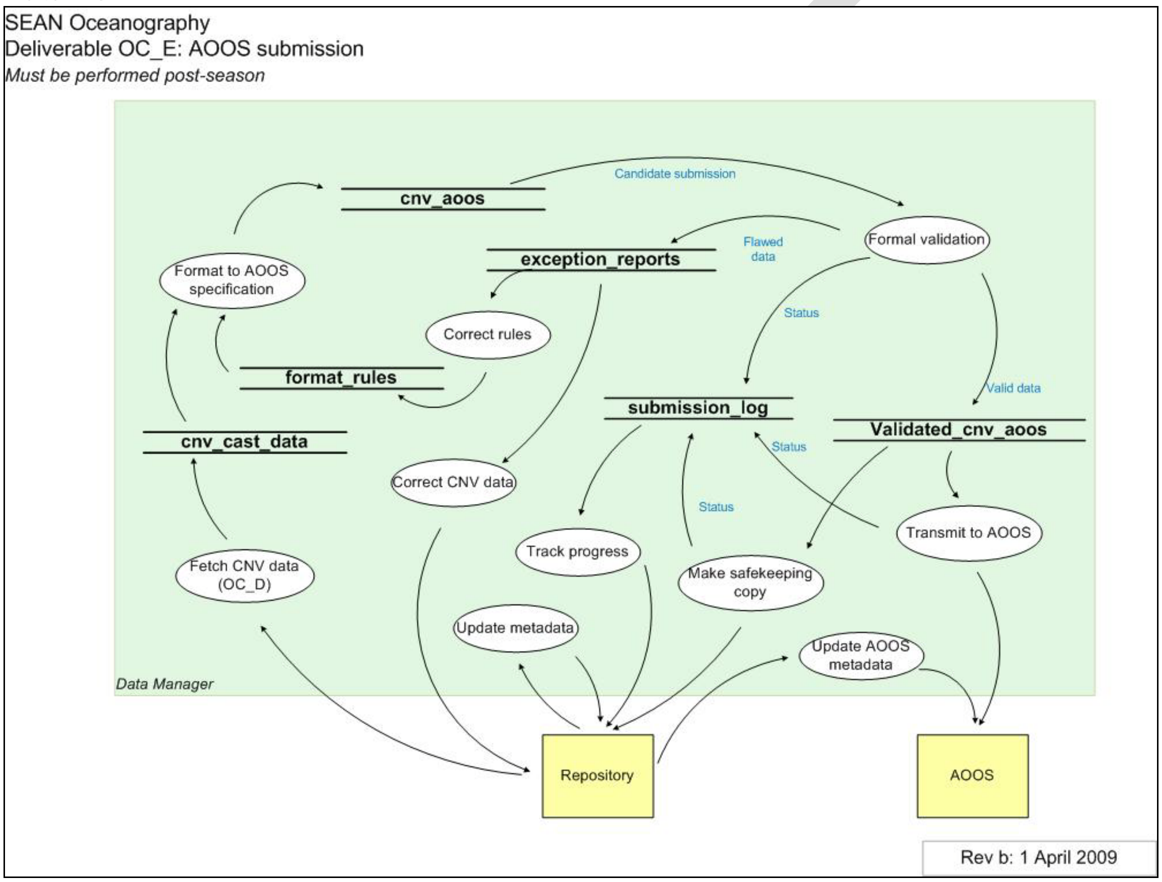


Figure J.5. Data flow required to generate deliverable OC_E – AOOS submission.

Deliverable definition forms:

Form D: Tabular Data Deliverable

Vital Sign: OC Oceanography	*Deliverable ID:* OC_E	*Deliverable Title:* AOOS submission
File format: CSV for data XML for metadata	*Associated software and version*: Custom for data Metavist 5.0 for metadata	*Revision Date / protocol version:* 05-04-2009 / 2009.1
Expected frequency: Once per year	*Likely dissemination partners:* AOOS	*Submission unit:* YEAR
What purpose does this deliverable serve? Populates secondary repository.		
Identifiers of relations that compose the tabular deliverable ("Relations" are tables or files that provide information which may be represented in a grid format. Each relation listed must be fully defined in its own accompanying Form X.): AOOS_yyyy.CSV where 'yyyy' is the four-digit year represented.		
Deliverable ID of any other SEAN data products required to create this product: OC_D		
Description and source of any outside data required to create this product: Format rules must be supplied by AOOS as a basis for generating the CSV..		

Form X: Relation Definition

Vital Sign:	*Relation identifier:*	*Used by deliverable ID:*
OC Oceanography	AOOS_yyyy.CSV	OC_E
Revision date / protocol version: 05-04-2009 / 2009.1	*Type of relation:* Windows file	*Estimated rows:* 20,000

Primary key for this relation:

- none -

Purpose:

Oceanographic calibrated cast data binned to 1 meter buckets, expressed in engineering units.

Identifiers of attributes defined over this relation (“Attributes” are columns of the grid. Each attribute must be defined in an accompanying Form Y.):

CTD	TEMPERATURE
DUMP	CONDUCTIVITY
CAST	SALINITY
VESSEL	SIGMA_T
STATION	FLUORESCENCE
LATITUDE	OBS
LOGITUDE	OXYGEN
DATE_GMT	PAR
TIME_GMT	SBE_DATA_FLAG
FATHOMETER_DEPTH	COMMENTS
PRESSURE	DATA_QUALITY
DEPTH	PROTOCOL_ID
	CRUISE_YEAR

Mandatory validation criteria involving multiple attributes:

- none -

Optional validation criteria involving multiple attributes:

- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:*	*Used by deliverable ID:* OC_E
Revision date / protocol version: 2009.1	*Default report heading:*	*Relation (from Form X):* AOOS_yyyy.CSV
Purpose: All attributes used for OC_E are copies of those with the same name from OC_D. Refer to the definition of deliverable OC_D for details.		

Data type:	
Maximum length	
Required:	
Measurement units:	
Format:	
Foreign key to (relation+attribute):	
Case:	
Mandatory validation rules for this attribute (in order of application):	
Optional validation rules for this attribute:	

J.6 OC_F: NODC Repository Submission

Purpose of deliverable: Copies of final certified detailed data are delivered to the National Oceanographic Data Center (NODC) for further dissemination. This repository is accessed by the worldwide research community to obtain detailed data. Its excellent archive also serves as backup in case SEAN experiences a disaster.

Frequency produced: This is generally created once per field season. In the event incorrect data appear in the NODC system, OC_F may be recreated to make it whole.

Prerequisites: Production of this deliverable is built using the certified OC_D database for a particular year.

Data flow:

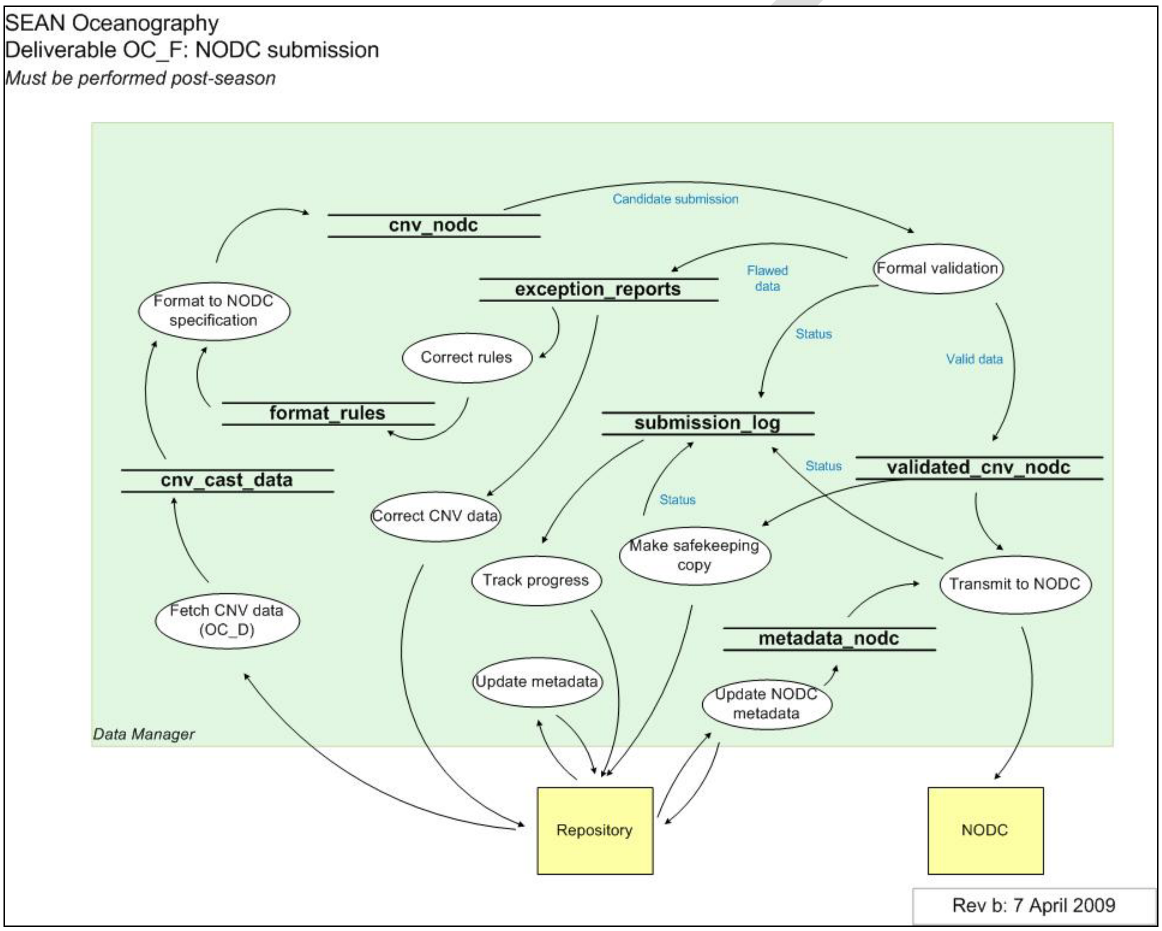


Figure J.6. Data flow required to generate deliverable OC_F – NODC submission.

Deliverable definition forms:

Form D: Tabular Data Deliverable

Vital Sign: OC Oceanography	*Deliverable ID:* OC_F	*Deliverable Title:* NODC submission
File format: CSV for data XML for metadata	*Associated software and version*: Custom for data Metavist 5.0 for metadata	*Revision Date / protocol version:* 05-04-2009 / 2009.1
Expected frequency: Once per year	*Likely dissemination partners:* NODC/NOAA	*Submission unit:* YEAR
What purpose does this deliverable serve? Populates secondary repository.		
Identifiers of relations that compose the tabular deliverable ("Relations" are tables or files that provide information which may be represented in a grid format. Each relation listed must be fully defined in its own accompanying Form X.): NODC_yyyy.CSV where 'yyyy' is the four-digit year represented.		
Deliverable ID of any other SEAN data products required to create this product: OC_D		
Description and source of any outside data required to create this product: Format rules must be negotiated developed in consultation with NODC as a basis for generating the CSV.		

Form X: Relation Definition

Vital Sign: OC Oceanography	*Relation identifier:* NODC_yyyy.CSV	*Used by deliverable ID:* OC_F
Revision date / protocol version: 05-04-2009 / 2009.1	*Type of relation:* Windows file	*Estimated rows:* 20,000

Primary key for this relation:

- none -

Purpose:

Oceanographic calibrated cast data binned to 1 meter buckets, expressed in engineering units.

Identifiers of attributes defined over this relation (“Attributes” are columns of the grid. Each attribute must be defined in an accompanying Form Y.):

CTD	TEMPERATURE
DUMP	CONDUCTIVITY
CAST	SALINITY
VESSEL	SIGMA_T
STATION	FLUORESCENCE
LATITUDE	OBS
LOGITUDE	OXYGEN
DATE_GMT	PAR
TIME_GMT	SBE_DATA_FLAG
FATHOMETER_DEPTH	COMMENTS
PRESSURE	DATA_QUALITY
DEPTH	PROTOCOL_ID
	CRUISE_YEAR

Mandatory validation criteria involving multiple attributes:

- none -

Optional validation criteria involving multiple attributes:

- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:*	*Used by deliverable ID:* OC_F
Revision date / protocol version: 2009.1	*Default report heading:*	*Relation (from Form X):* NODC_yyyy.CSV
Purpose: All attributes used for OC_F are copies of those with the same name from OC_D. Refer to the definition of deliverable OC_D for details.		

Data type:	
Maximum length	
Required:	
Measurement units:	
Format:	
Foreign key to (relation+attribute):	
Case:	
Mandatory validation rules for this attribute (in order of application):	
Optional validation rules for this attribute:	

J.7 OC_G: Calibration Certificate Images

Purpose of deliverable: CTD sensors are periodically calibrated. The whole unit is generally calibrated annually, though special circumstances may cause individual sensors to be recalibrated and reported *ad hoc*. When a unit is returned to the Project Leader from calibration, it is accompanied by certificates specifying the latest calibration parameter values and attesting to their accuracy. Researchers need to find these in order to verify accurate calibration figures have been properly applied to other oceanographic data products.

Frequency produced: Whenever the result of any sensor recalibration is reported to the Project Leader. Certificates may be provided as paper forms, which must be scanned into PDFs. They may also be supplied as PDF files on CD, which may be used directly.

Prerequisites: None.

Data flow:

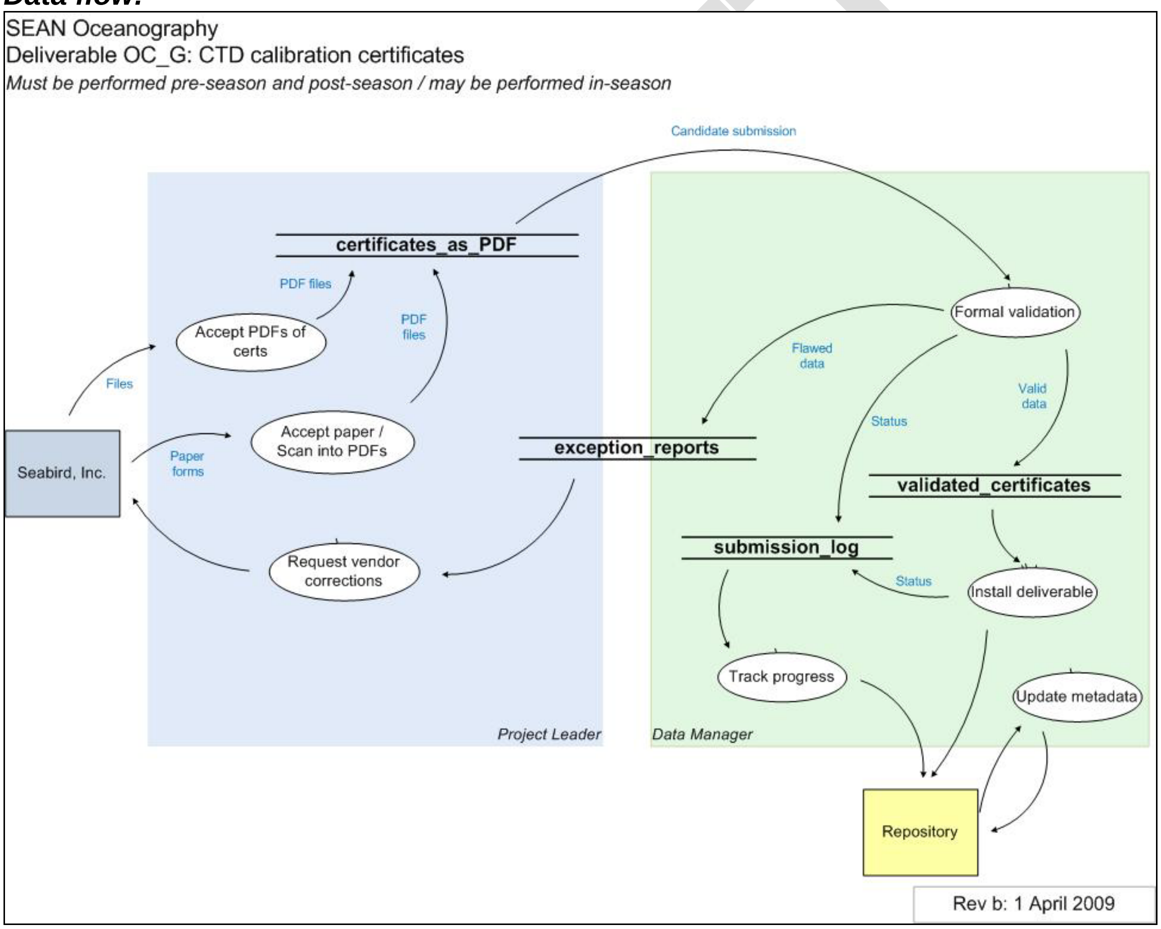


Figure J.7. Data flow required to generate deliverable OC_G – calibration certificate images.

Deliverable definition forms:

Form C: Non-Tabular Data Deliverable

Vital Sign: OC Oceanography	*Deliverable ID:* OC_G	*Deliverable Title:* Calibration certificate images
File format: PDF	*Associated software and version*: Adobe Acrobat 9 pro	*Revision Date / protocol version:* 04-07-2009 / OC_2009.1
Expected frequency: 5/ctd/year	*Likely dissemination partners:* None – served by SEAN	*Submission unit:* CTD# + Sensor s/n + Year + Month
What purpose does this deliverable serve? Documents the calibration parameters for all sensors on the CTD. Needed to validate revisions to OC_A calibration CON files.		
Summary of content: Scanned images of calibration certificates saved as PDFs. Certificates are provided by CTD and sensor vendors after periodic recalibration and after obtaining new sensors.		
Mandatory validation criteria: 1. Must successfully open using Adobe Reader 7.0 or greater. 2. Filename must conform to submission unit pattern described in detailed steps in SOP 2		
Optional validation criteria: - None -		
Deliverable ID of any other SEAN data products required to create this product: - None -		
Description and source of any outside data required to create this product: Paper and/or PDF calibration certificates from manufacturers.		

J.8 OC_H: Field Log Sheet Images

Purpose of deliverable: These are scanned images of the original sampling log sheets used to record the header information for each cast of a cruise. They are made available to allow discovery and correction of erroneous header information in OC_B hex files. Notes on the images may also be viewed to explain exceptional data encountered in other products derived from OC_B. Both front and back of each form are recorded, unless completely blank.

Frequency produced: These should be created annually, typically after completion of the field season.

Prerequisites: Availability of the complete set of log sheets for the survey year.

Data flow:

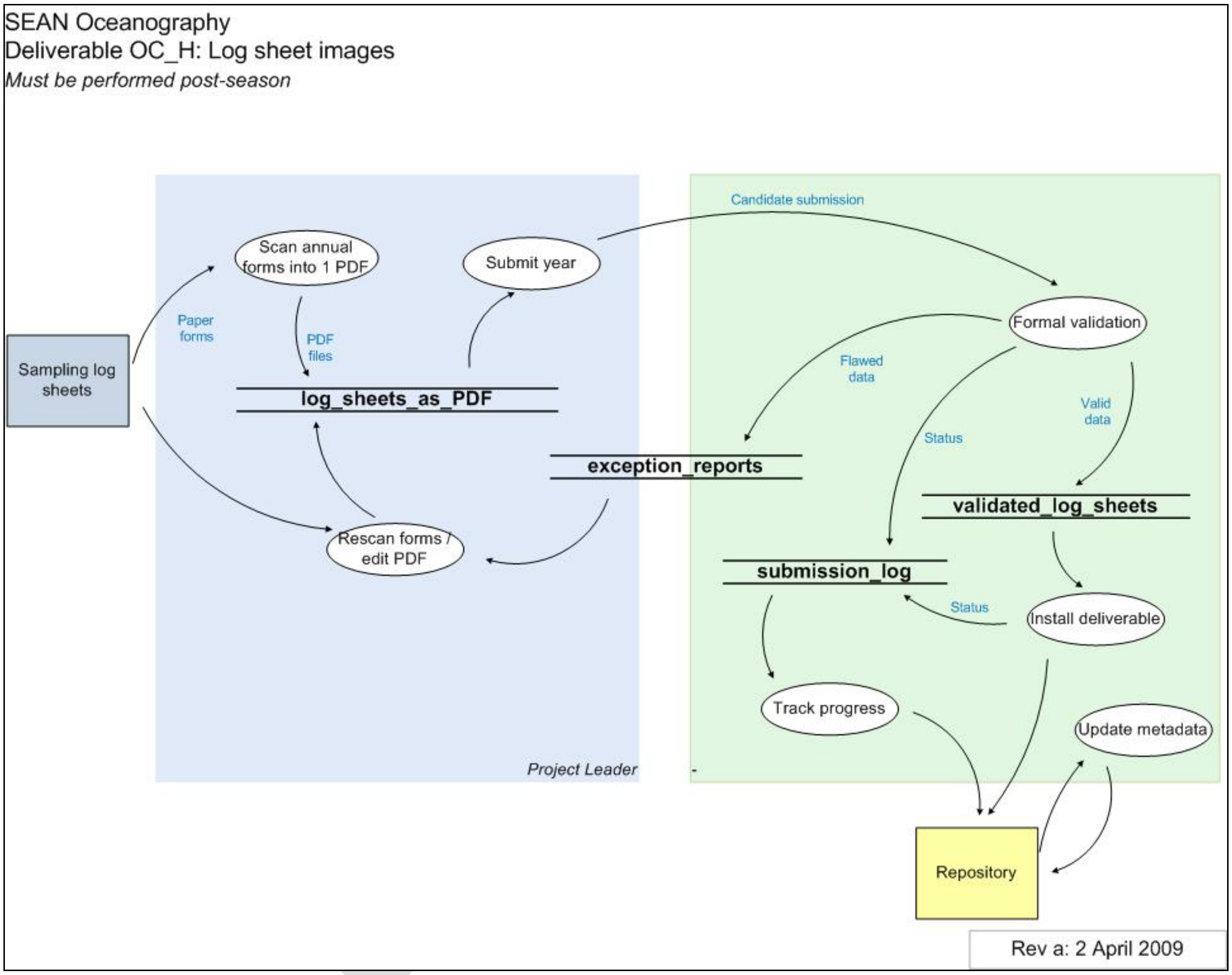


Figure J.8. Data flow required to generate deliverable OC_H – field log sheet images.

Deliverable definition forms:

Form C: Non-Tabular Data Deliverable

Vital Sign: OC Oceanography	*Deliverable ID:* OC_H	*Deliverable Title:* Log sheet images
File format: PDF	*Associated software and version*: Adobe Acrobat 9 pro	*Revision Date / protocol version:* 04-07-2009 / OC_2009.1
Expected frequency: 20/year	*Likely dissemination partners:* None – served by SEAN	*Submission unit:* Year
What purpose does this deliverable serve? Source documents may be used for researching data errors and individual exceptions.		
Summary of content: Scanned images of field log sheets.		
Mandatory validation criteria: 1. Must successfully open using Adobe Reader 7.0 or greater. 2. Filename must conform to submission unit pattern described in detailed steps.		
Optional validation criteria: - None -		
Deliverable ID of any other SEAN data products required to create this product - None -		
Description and source of any outside data required to create this product: Paper log sheets from field crews.		

J.9 OC_I: Protocol

Purpose of deliverable: The protocol document defines in detail the technical methodology employed in the SEAN oceanography program.

Frequency produced: Created as needed, using the processes in SOP 18.

Prerequisites: Protocol deliverables are always created from the most-recent DOCX form of the latest OC_I protocol document.

Data flow:

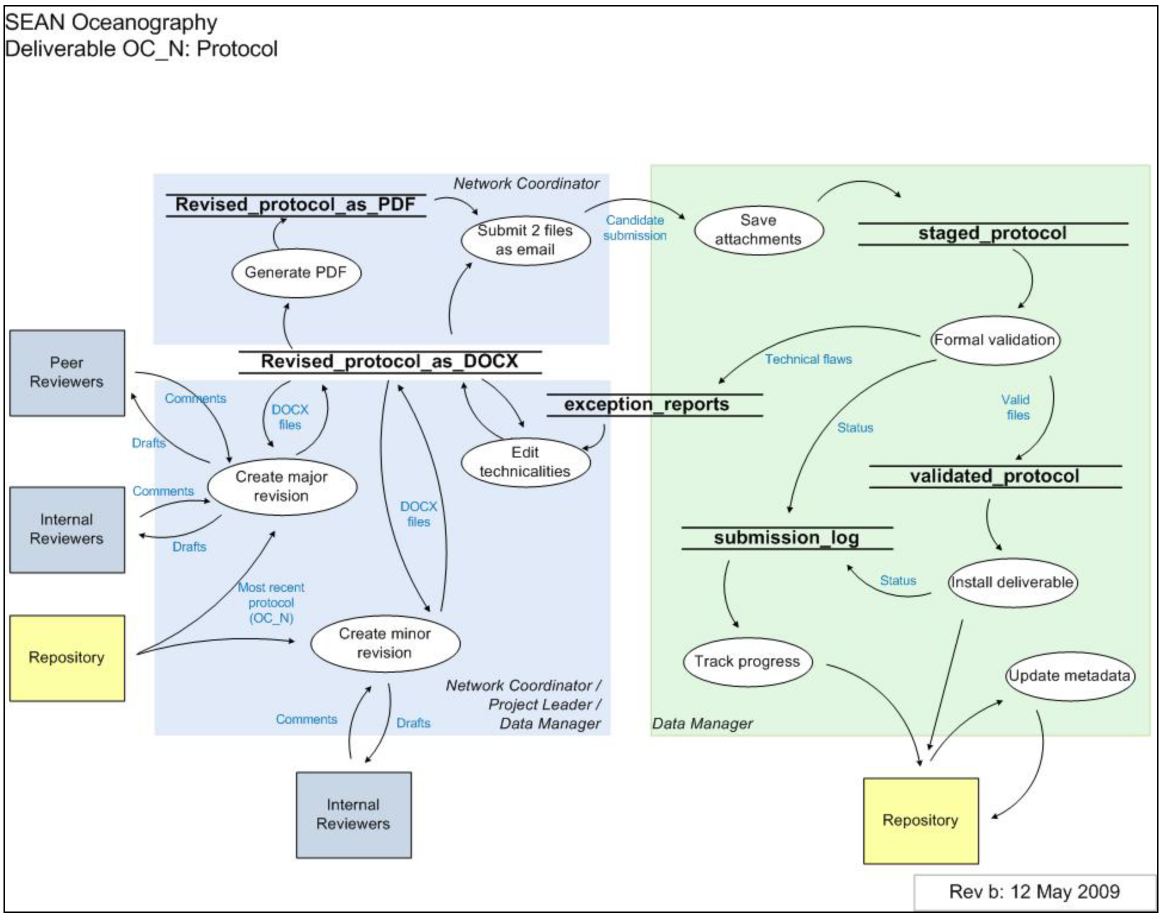


Figure J.9. Data flow required to generate deliverable OC_I – protocol.

Deliverable definition forms:

Form A: Non-Tabular Information Deliverable

<table>
<tr><td>Vital Sign:
OC Oceanography</td><td>Deliverable ID:
OC_I</td><td>Deliverable Title:
Protocol</td></tr>
<tr><td>File format:
DOCX and PDF</td><td>Associated software and version:
Word 2007 + Adobe Acrobat 9 pro</td><td>Revision Date / protocol version:
05-12-2009 / OC_2009.1</td></tr>
<tr><td>Expected frequency:
unknown</td><td>Likely dissemination partners:
None – served by SEAN</td><td>Submission unit:
Single unit to supplant the existing OC_I.</td></tr>
<tr><td colspan="3">What purpose does this deliverable serve?
Defines the technical methodology employed in the SEAN oceanography program.</td></tr>
<tr><td colspan="3">Summary of content:
Narrative, detailed appendices, standard operating procedures for conducting program. A PDF copy is kept for dissemination purposes. A DOCX copy is kept as the basis for the next version update.</td></tr>
<tr><td colspan="3">Mandatory validation criteria:
1. PDF must successfully open using Adobe Reader 7.0 or greater.
2. DOCX must successfully open using Microsoft Word 2007.
3. Must consistently reference a correct version number, as defined in SEAN Data Management Plan (Johnson and Moynahan 2008: SOP 602 – Version Control).</td></tr>
<tr><td colspan="3">Optional validation criteria:
- None -</td></tr>
<tr><td colspan="3">Deliverable ID of any other SEAN data products required to create this product
Prior OC_I.</td></tr>
<tr><td colspan="3">Description and source of any outside data required to create this product:
No specific sources can be named in advance. Editors will have to draw on a number of areas of technical expertise and guidance to complete this deliverable.</td></tr>
</table>

J.10 OC_J: Data Availability Matrix

Purpose of deliverable: Researchers need to be informed of the availability of specific data by month and year. Specific data collected varies depending on factors such as the type of detectors installed at the time, weather conditions, and field circumstances. The availability depicted here is derived from the presence of time and type entries existing in the database based in deliverable OC_D database additions. “Type” granularity refers to the type of physical parameter measured: temperature, PAR, etc. If the data management procedures are strictly observed, then the matrix will inherently reflect availability of OC_D’s precursors: OC_A, OC_B, OC_C, and OC_G.

Frequency produced: This must always be performed directly after completing a deliverable OC_D database additions, which is normally done annually. The actual deliverable disseminated for OC_J is a PDF file. However, an Excel spreadsheet is also part of this deliverable, though not served on the web site. The spreadsheet serves as the source for the PDF and the basis for the next update.

Prerequisites: OC_D database additions.

Data flow:

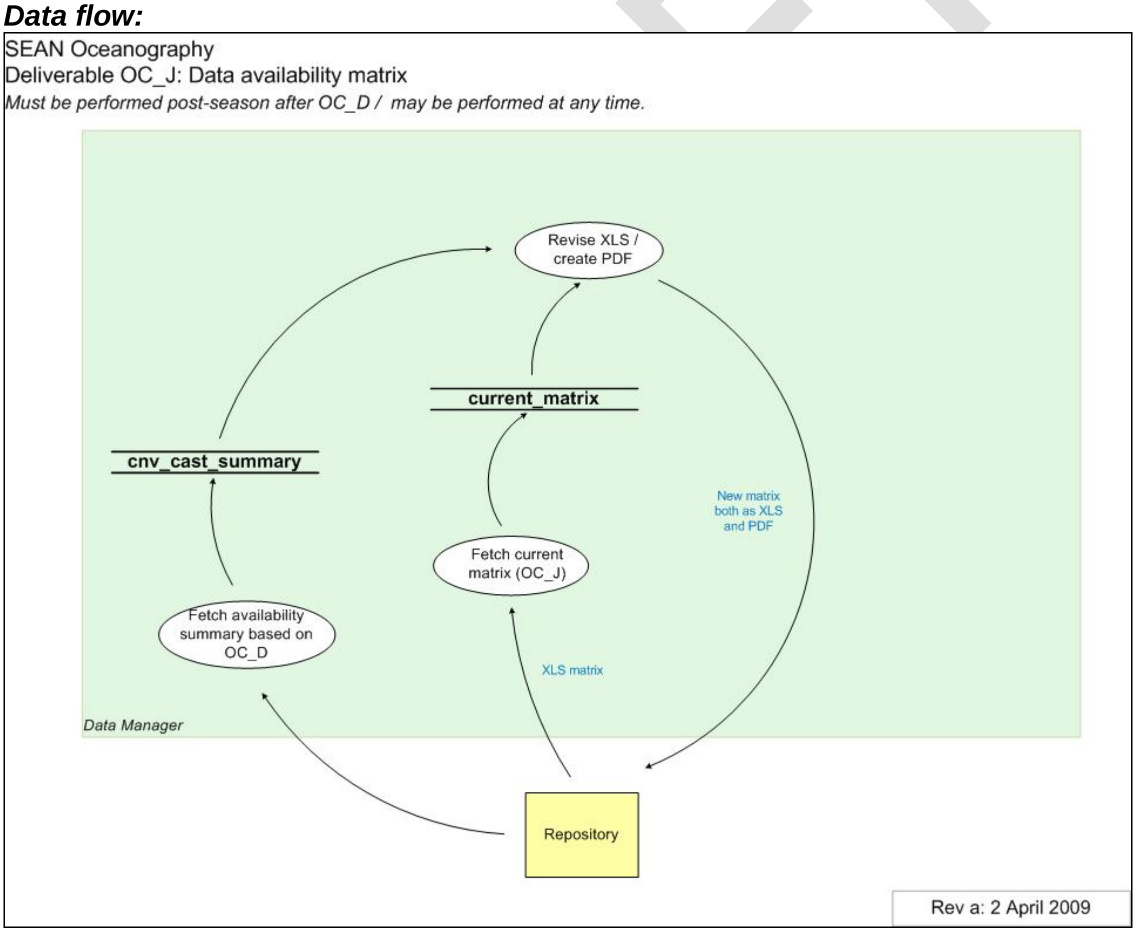


Figure J.10. Data flow required to generate deliverable OC_J – data availability matrix.

Deliverable definition forms:

Form A: Non-Tabular Information Deliverable

Vital Sign: OC Oceanography	*Deliverable ID:* OC_J	*Deliverable Title:* Data availability matrix
File format: .XLS and .PDF	*Associated software and version*: Excel 2008 and Adobe Acrobat 9	*Revision Date / protocol version:* 10-19-2009 / 2009.1
Expected frequency: 1/year	*Likely dissemination partners* None – served by SEAN	*Submission unit:* None: does not get merged into a time series

What purpose does this deliverable serve?
Explains to customers the availability of time and type entries existing in deliverable OC_D and its precursors. "Time" granularity is year/month. "Type" granularity refers to the kind of physical parameter measured: temperature, PAR, etc.

Summary of content:
A PDF rendering of an Excel spreadsheet similar in form and content to the following:

	January					February					March					April				
	O2	SAL	PAR	OBS	FLU	O2	SAL	PAR	OBS	FLU	O2	SAL	PAR	OBS	flr	O2	SAL	PAR	OBS	FLU
2005		√	√	√	√							√	√	√	√					
2004												√	√	√	√					
2003							√	√	√	√							√	√	√	√
2002		√	√	√	√							√	√	√	√		√	√	√	√
2001							√	√	√	√		√	√	√	√		√	√	√	√
2000		√	√	√	√							√	√	√	√					
1999												√	√		√					
1998							√			√										
1997																				
1996													√		√					
1995																				
1994		√	√														√			
1993																				

	May					June					July					August				
	O2	SAL	PAR	OBS	FLU	O2	SAL	PAR	OBS	FLU	O2	SAL	PAR	OBS	FLU	O2	SAL	PAR	OBS	FLU
2005							√	√	√	√		√	√	√	√					
2004							√	√	√	√		√	√	√	√					
2003							√	√	√	√		√	√	√	√		√		√	√
2002												√	√	√	√		√		√	√
2001												√	√	√	√					
2000		√	√	√	√		√	√		√		√	√	√	√		√	√	√	√
1999							√	√		√		√	√		√		√	√	√	√
1998							√	√		√										
1997		√			√							√			√					
1996								√		√										
1995																				
1994		√	√		√							√	√		√		√	√		√
1993												√					√			

	September					October					November					December				
	O2	SAL	PAR	OBS	FLU	O2	SAL	PAR	OBS	FLU	O2	SAL	PAR	OBS	FLU	O2	SAL	PAR	OBS	FLU
2005							√	√	√	√										
2004							√	√	√	√										
2003							√		√	√							√		√	√
2002							√	√	√	√										
2001							√	√	√	√										
2000		√	√	√	√												√	√	√	√
1999							√	√	√	√										
1998							√	√		√							√	√		√
1997												√			√					
1996		√			√		√			√										
1995								√		√			√		√					
1994																				
1993		√					√					√	√				√	√		

Dissolved oxygen available √
Salinity/density available √
PAR available √
OBS available √
Fluorescence available √

Mandatory validation criteria:

1. Spreadsheet must be able to be opened with full functionality using Microsoft Excel 2008 or more recent version.
2. PDF must be able to be opened and properly rendered under Adobe Reader 9.

Optional validation criteria:
- None -

Deliverable ID of any other SEAN data products prerequisite to this product:
OC_D database update.

Description and source of any outside data required to create this product:
- None -

J.11 OC_K: Annual Report

Purpose of deliverable: This is a report that summarizes the operations and outcomes of a season. Content includes station coverage, tables and plots illustrating current conditions, operation exceptions, and notification of any changes to the protocol. The content is appropriate for its audience of management as well as the public.

Frequency produced: These are typically created annually, after completion of each field season.

Prerequisites: Certified database deliverable OC_D for the season. Certified data quality evaluation OC_M for the season. The OC_M data quality evaluation is typically not available until after the CTD returns from annual factory calibration with new calibration factors.

Data flow:

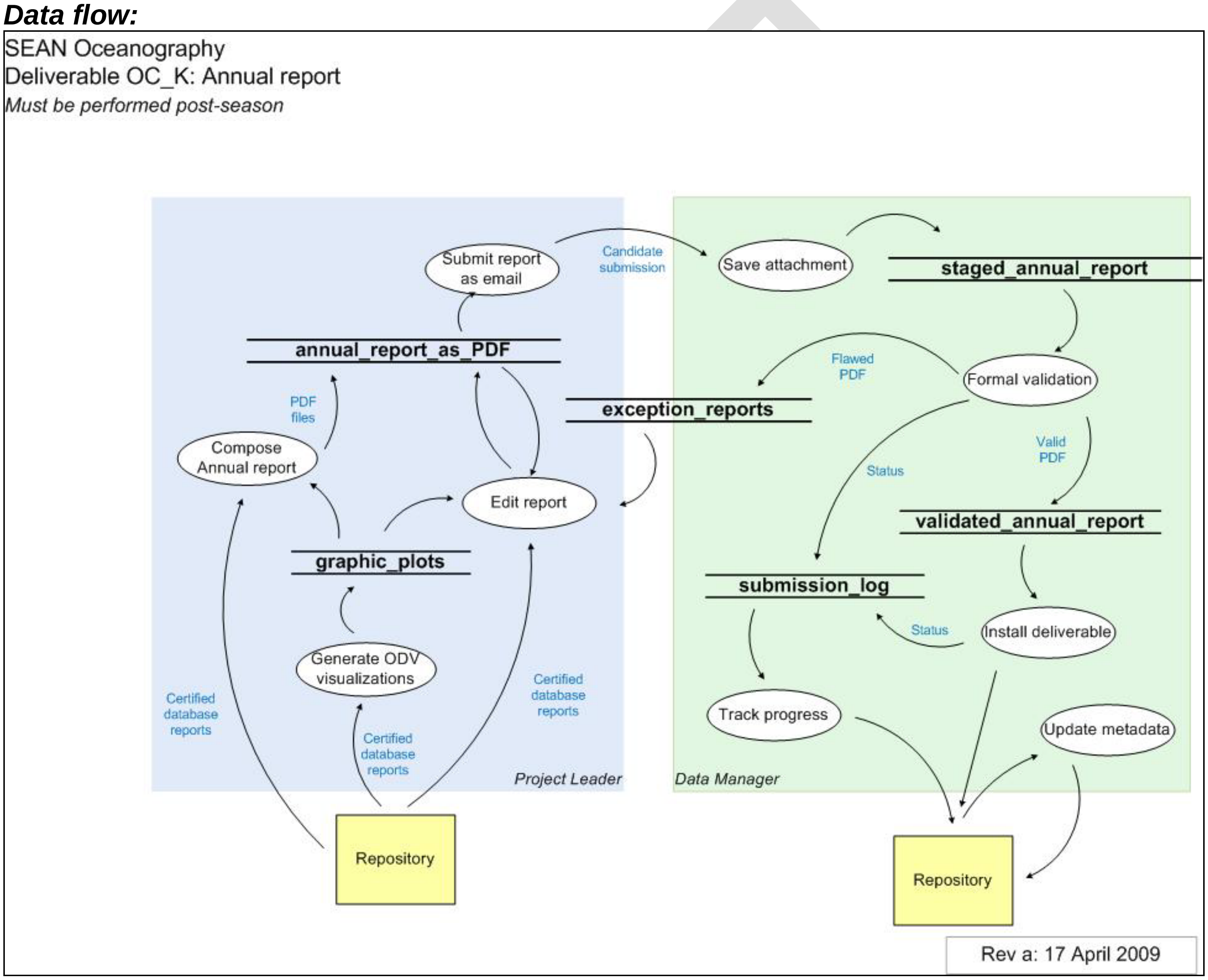


Figure J.11. Data flow required to generate deliverable OC_K – annual report

Deliverable definition forms:

Form A: Non-Tabular Information Deliverable

<table>
<tr><td>Vital Sign:
OC Oceanography</td><td>Deliverable ID:
OC_K</td><td>Deliverable Title:
Annual report</td></tr>
<tr><td>File format:
PDF</td><td>Associated software and version:
Adobe Acrobat 9 pro</td><td>Revision Date / protocol version:
04-17-2009 / OC_2009.1</td></tr>
<tr><td>Expected frequency:
1/year</td><td>Likely dissemination partners:
None – served by SEAN</td><td>Submission unit:
Year</td></tr>
<tr><td colspan="3">What purpose does this deliverable serve?
Summarizes the operations and outcomes of a season to inform managers and the public as well as professional oceanographers.</td></tr>
<tr><td colspan="3">Summary of content:
Synopsis of operations, temporal/spatial coverage for this season, representative data tables, representative vertical profile plots, representative data visualizations, discussion summarizing observations.</td></tr>
<tr><td colspan="3">Mandatory validation criteria:
1. Must successfully open using Adobe Reader 7.0 or greater.</td></tr>
<tr><td colspan="3">Optional validation criteria:
- None -</td></tr>
<tr><td colspan="3">Deliverable ID of any other SEAN data products required to create this product
OC_D CNV database rows. OC_M data quality evaluation.</td></tr>
<tr><td colspan="3">Description and source of any outside data required to create this product:
- None -</td></tr>
</table>

J.12 OC_L: Five-Year Report

Purpose of deliverable: This report discusses trends that are evident from the historic data series. It does not cover operations, which is done in the annual report. The content is appropriate for an audience of management and the public, as well as scientists.

Frequency produced: These are created every five years, typically sometime after completion of the OC_K annual report for the most recent season.

Prerequisites: Certified database deliverable OC_D database additions for all seasons in the scope. Certified data quality report OC_M for all seasons in the scope.

Data flow:

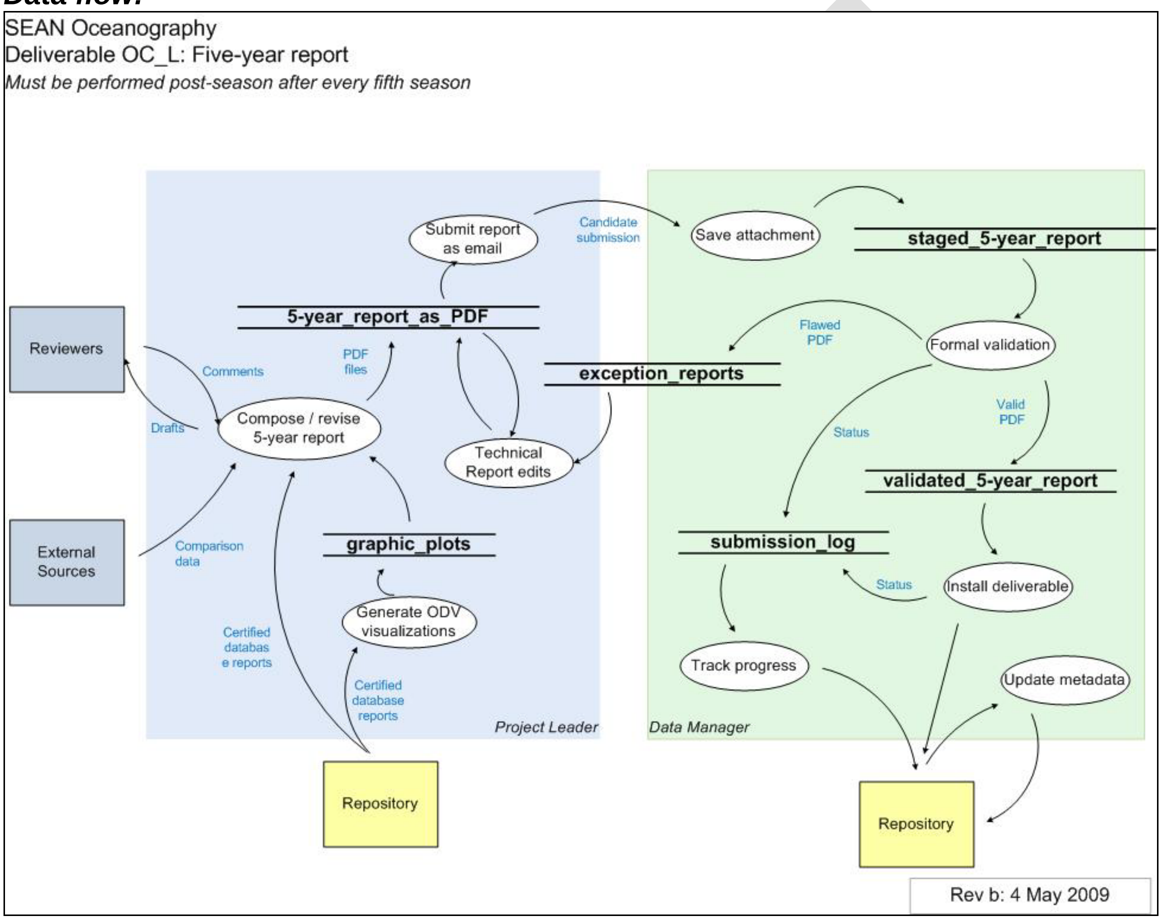


Figure J.12. Data flow required to generate deliverable OC_L – five-year report.

Deliverable definition forms:

Form A: Non-Tabular Information Deliverable

<table>
<tr><td>Vital Sign:
OC Oceanography</td><td>Deliverable ID:
OC_L</td><td>Deliverable Title:
Five-year report</td></tr>
<tr><td>File format:
PDF</td><td>Associated software and version:
Adobe Acrobat 9 pro</td><td>Revision Date / protocol version:
04-17-2009 / OC_2009.1</td></tr>
<tr><td>Expected frequency:
1 every 5 years</td><td>Likely dissemination partners:
None – served by SEAN</td><td>Submission unit:
5-year contiguous set of survey years</td></tr>
<tr><td colspan="3">What purpose does this deliverable serve?
Analysis of physical oceanographic trends for each station is provided to inform customers and facilitate decision making. Time series analysis for evaluating cyclic phenomena is also presented.</td></tr>
<tr><td colspan="3">Summary of content:
Introduction, methods, coverage, results, and discussion.</td></tr>
<tr><td colspan="3">Mandatory validation criteria:
1. Must successfully open using Adobe Reader 7.0 or greater.</td></tr>
<tr><td colspan="3">Optional validation criteria:
- None -</td></tr>
<tr><td colspan="3">Deliverable ID of any other SEAN data products required to create this product
OC_D CNV database rows and OC_M data quality evaluation for the years covered must be certified before this report may be composed.</td></tr>
<tr><td colspan="3">Description and source of any outside data required to create this product:
Oceanographic time series useful for comparison include GAK1, Line P and Ocean Station PAPA, Canadian “lighthouse, and National Data Buoy Center moorings and coastal stations. Cross correlation analysis uses climate data from NCDC and NDBC, streamflow from USGS, and large-scale climate system indices such as those available from http://jisao.washington.edu and http://www.cgd.ucar.edu/cas/catalog/climind.</td></tr>
</table>

J.13 OC_M: Data Quality Evaluation

Purpose of deliverable: This form identifies the quality of data taken during each cast of the season. Once certified it is not disseminated as a stand-alone data product. Instead, the values in OC_M are applied to columns in the cumulative database originally populated by OC_D.

Frequency produced: OC_M may be created piecemeal in season with one spreadsheet per CTD + Dump. However, due to prerequisite scheduling, OC_M is submitted and certified once per year.

Prerequisites: Certified database deliverable OC_D database additions, original AND post-season calibration reports OC_G, quality-assurance plots generated for both HEX and CNV files by Project Leader (not a deliverable).

Data flow:

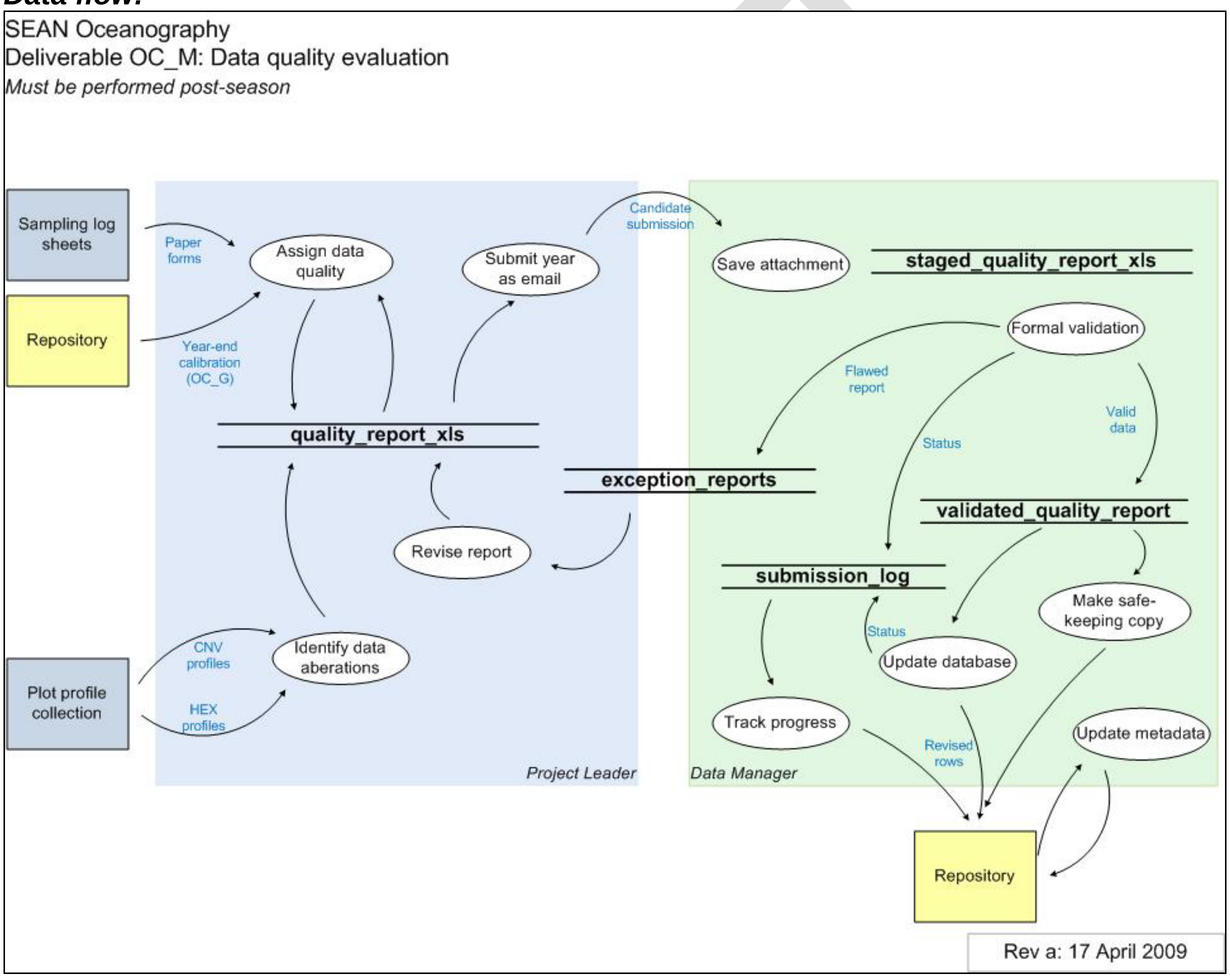


Figure J.13. Data flow required to generate deliverable OC_M – data quality evaluation.

Deliverable definition forms:

Form D: Tabular Data Deliverable

Vital Sign: OC Oceanography	*Deliverable ID:* OC_M	*Deliverable Title:* Data quality report
File format: XLS	*Associated software and version*: Excel 2007	*Revision Date / protocol version:* 05-01-2009 / 2009.1
Expected frequency: 20/year	*Likely dissemination partners:* None – served by SEAN	*Submission unit:* CTD# + dump#
What purpose does this deliverable serve? Provides data quality column values for cumulative database.		
Identifiers of relations that compose the tabular deliverable ("Relations" are tables or files that provide information which may be represented in a grid format. Each relation listed must be fully defined in its own accompanying Form X.): OC_M_C_dddd.XLS, where "C" is the CTD unit number and "dddd" is the dump number.		
Deliverable ID of any other SEAN data products required to create this product: OC_D, OC_G		
Description and source of any outside data required to create this product: - None -		

Form X: Relation Definition

Vital Sign: OC Oceanography	*Relation identifier:* OC_M_C_dddd.XLS	*Used by deliverable ID:* OC_M
Revision date / protocol version: 05-01-2009 / 2009.1	*Type of relation:* File	*Estimated rows:* 25

Primary key for this relation:

ctd + dump

Purpose:

Roster of casts made during a dump cycle of a particular CTD, with data quality exceptions identified.

Identifiers of attributes defined over this relation (“Attributes” are columns of the grid. Each attribute must be defined in an accompanying Form Y.):

CTD
DUMP
CAST
QUALITY_CODE
COMMENT

Mandatory validation criteria involving multiple attributes:

If COMMENT is not null, then QUALITY_CODE must not be null.

Optional validation criteria involving multiple attributes:

- none -

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* CTD	*Used by deliverable ID:* OC_M
Revision date / protocol version: 05-01-2009 / 2009.1	*Default report heading:* CTD#	*Relation (from Form X):* OC_M_C_dddd.XLS
Purpose: Local identification of the CTD device. Initially, units 1 and 2 were defined.		

Data type:	Varchar(10)
Maximum length	1
Required:	yes
Measurement units:	n/a
Format:	9
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must be between 1 and 9.
Optional validation rules for this attribute:	• Should be between 1 and 3.

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* DUMP	*Used by deliverable ID:* OC_M
Revision date / protocol version: 05-01-2009 / 2009.1	*Default report heading:* Dump#	*Relation (from Form X):* OC_M_C_dddd.XLS
Purpose: The sequential dump number covered by this data.		

Data type:	Varchar(4)
Maximum length	4
Required:	yes
Measurement units:	n/a
Format:	0009
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must represent an integer between 1 and 9999.
Optional validation rules for this attribute:	

Form Y: Attribute Definition

Vital Sign:	*Attribute identifier:*	*Used by deliverable ID:*
OC Oceanography	CAST	OC_D
Revision date / protocol version:	*Default report heading:*	*Relation (from Form X):*
05-01-2009 / 2009.1	CAST#	OC_M_C_dddd.XLS

Purpose:
Sequential cast number within a particular dump. Casts are integers beginning with zero. They are generated by the CTDs themselves. Because of memory limits in existing equipment, it is rare CAST will ever exceed 15.

Data type:	Varchar(2)
Maximum length	2
Required:	yes
Measurement units:	n/a
Format:	00
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must represent an integer between 0 and 99.
Optional validation rules for this attribute:	• should be between 0 and 15

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* QUALITY_CODE	*Used by deliverable ID:* OC_M
Revision date / protocol version: 05-01-2009 / 2009.1	*Default report heading:* Quality	*Relation (from Form X):* OC_M_C_dddd.XLS
Purpose: The numeric quality code used to flag individual casts. Codes used are those defined natively to Ocean Data View software. 0=good, 1=unknown, 2=questionable, 8=bad.		

Data type:	Varchar(1)
Maximum length	1
Required:	no
Measurement units:	n/a
Format:	9
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	1. Must represent an integer between 0 and 9.
Optional validation rules for this attribute:	• should be one of {0, 1, 2, 8}

Form Y: Attribute Definition

Vital Sign: OC Oceanography	*Attribute identifier:* COMMENT	*Used by deliverable ID:* OC_M
Revision date / protocol version: 05-01-2009 / 2009.1	*Default report heading:* Quality Comment	*Relation (from Form X):* OC_M_C_dddd.XLS

Purpose:
A brief explanation of why the quality was assigned. If COMMENT is entered, then QUALITY_CODE must not be null.

Data type:	Varchar(128)
Maximum length	128
Required:	no
Measurement units:	n/a
Format:	n/a
Foreign key to (relation+attribute):	n/a
Case:	n/a
Mandatory validation rules for this attribute (in order of application):	- None -
Optional validation rules for this attribute:	- None -

National Park Service
U.S. Department of the Interior

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NPS XXXXXX, December 2009