PROPOSAL SIGNATURE FORM

THIS FORM MUST BE SIGNED BY THE PROPOSED PRINCIPAL INVESTIGATOR AND SUBMITTED ALONG WITH THE PROPOSAL. If the proposal has more than one investigator, this form must be signed by at least one of the investigators, and that investigator will ensure that Trustee Council requirements are followed. Proposals will not be reviewed until this signed form is received by the Trustee Council Office.

By submission of this proposal, I agree to abide by the Trustee Council's data policy (*Trustee Council Data Policy**, adopted July 9, 2002) and reporting requirements *(Procedures for the Preparation and Distribution of Reports***, adopted July 9, 2002).

PROJECT TITLE: **LONG-TERM OCEANOGRAPHIC MONITORING OF THE ALASKA COASTAL CURRENT**

Printed Name of PI: **Thomas Weingartner**

Signature of PI: [signature] Date 8/1/06

* **www.evostc.state.ak.us/Policies/data.htm**

** **www.evostc.state.ak.us/Policies/Downloadables/reportguidelines.pdf**

Trustee Council Use Only Project No. 070340 Date Received: _________

FY07 INVITATION
PROPOSAL SUMMARY PAGE

Project Title: LONG-TERM OCEANOGRAPHIC MONITORING OF THE ALASKA COASTAL CURRENT

Project Period: 1 October 2006 to 30 September 2009

Proposer(s): **Thomas Weingartner**, University of Alaska Fairbanks, PO Box 757220, Fairbanks, Alaska 99775, weingart@ims.uaf.edu

Study Location: Hydrographic Station GAK 1, Entrance to Resurrection Bay,

Abstract: This program continues a 36-year time series of temperature and salinity measurements at hydrographic station GAK 1. The data set, which began in 1970, now consists of monthly CTDs and a mooring with 6 temperature/conductivity recorders throughout the water column, a fluorometer and nitrate sensor at 20 m depth and a nitrate sensor at 150 m depth. The project monitors five important Alaska Coastal Current ecosystem parameters and to quantify and understand interannual and longer period variability in:

1. Temperature and salinity throughout the 250 m deep water column,
2. Near surface stratification,
3. Near and subsurface nitrate supply on the inner shelf,
4. Fluorescence as an index of phytoplankton biomass, and
5. Atmosphere-ocean heat fluxes.

In aggregate these variables are basic descriptors of the Alaska Coastal Current, an important habitat and migratory corridor for organisms inhabiting the northern Gulf of Alaska, including Prince William Sound.

EVOS Funding Requested: (including 9%GA)
FY 07 $ 128.2 K
FY 08 $ 131.3 K
FY 09 $ 129.5 K
TOTAL: $ 389.0 K

Non-EVOS Funds to be used: FY07 $ 0

TOTAL: $356 K (without 9% ADFG GA)

Date: 4 August 2006

I. NEED FOR THE PROJECT

A. Statement of Problem

The Alaska Coastal Current (ACC) is an important component of the Gulf of Alaska marine environment. This narrow (~40 km), swift, year-round flow is maintained by the integrated forcing of winds and terrestrial freshwater discharge. Both the winds and the discharge vary seasonally (Figure 1), although not in-phase with one another: discharge is a maximum in fall and the westward (downwelling-favorable) winds are strongest in winter. The runoff contribution to the shelf is massive (~24000 $m^3 s^{-1}$; or 20% > than the Mississippi River discharge) and, in combination with the winds, affects shelf dynamics, stratification, and nutrient loads. These principal drivers of this shelf ecosystem also vary substantially at interannual and longer time scales (*Stabeno et al*., 2004; *Royer*, 2005; *Weingartner et al.*, 2005), although these variations are not well-correlated with large scale climate indices, such as the Pacific Decadal Oscillation (*Mantua et al*., 1997).

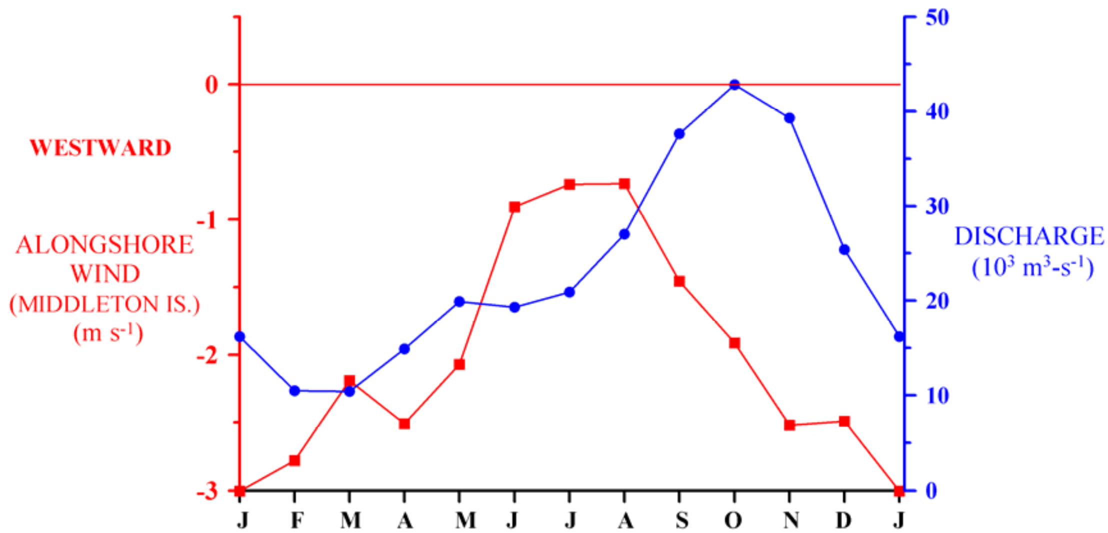

Figure 1. The mean monthly values of integrated coastal freshwater discharge (following Royer, 1982) and alongshore wind speed (computed from Middleton Island (see Figure 3 for the location of this island).

Approximately ~2/3 of the along-shelf (baroclinic) transport is carried within the ACC making it the most prominent circulation feature of the Gulf of Alaska shelf. The ACC originates on the British Columbian shelf (*Royer*, 1998), flows northward through the passages of Southeast Alaska, thence westward along Alaska's south coast, before entering the Bering Sea through Unimak Pass in the western Gulf of Alaska (*Schumacher et al., 1980; Stabeno et al.*, 2002; *Weingartner et al*., 2005) (Figure 2). It thus spans an alongshore distance of ~2500 km making it one of the longest coastal currents in the global ocean.

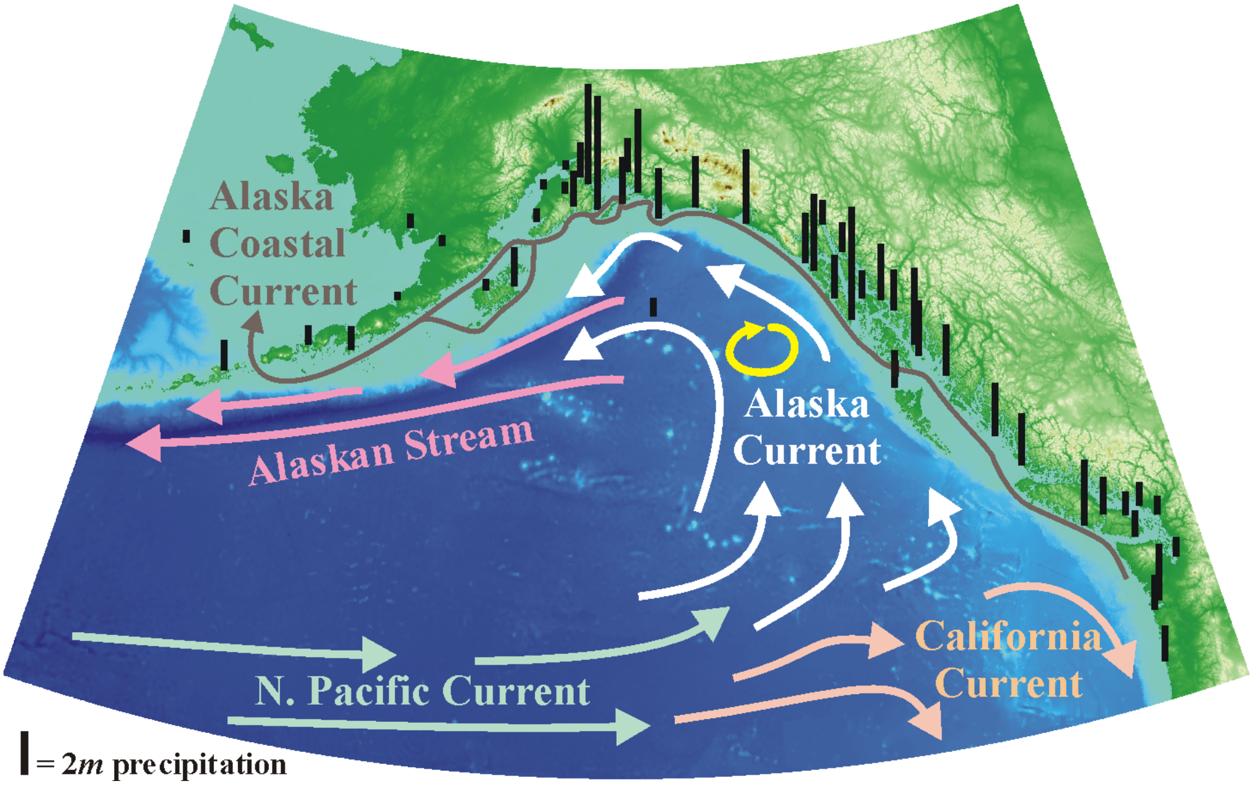

Figure 2. Schematic of the circulation of the Northeast Pacific and Gulf of Alaska. The vertical bars are the mean annual precipitation amounts at selected National Weather Service coastal sites and in the interior of the Gulf of Alaska (*Baumgartner and Reichel*; 1975).

The ACC flows through Prince William Sound (Figure 3; *Royer et al*., 1990; *Niebauer et al.*, 1994; *Vaughan et al*., 2001) and, is a source of heat, salt, and nutrients to the sound and its adjacent bays (*Gay et al.*, 2001). Indeed, *Niebauer et al.* (1994) estimate that the ACC replenishes the upper 100 m of Prince William Sound 2 – 3 times per year at least. In addition, the ACC carries sound waters back onto the shelf and it regulates exchange between the outer shelf and the fjords and bays along the coast, including Cook Inlet. Hence, the ACC affects environmental conditions for numerous nearshore Gulf of Alaska habitats. All of these attributes suggest that the ACC is an important ocean pathway by which climate signals, dissolved and suspended materials, contaminants, and organisms are advected around the gulf and into the Bering Sea. The current is also an important habitat and migratory corridor for a variety of marine organisms, in particular for juvenile salmon leaving the natal streams of Prince William Sound for the shelf and basin (*Boldt*, 2001). Since much of the circulation within the sound is associated with the ACC, this current is likely a crucial advective pathway for various herring life stages (*Norcross et al.*, 2001) implying that these fish also use the current as both a migratory path and a habitat during various stages of their life history.

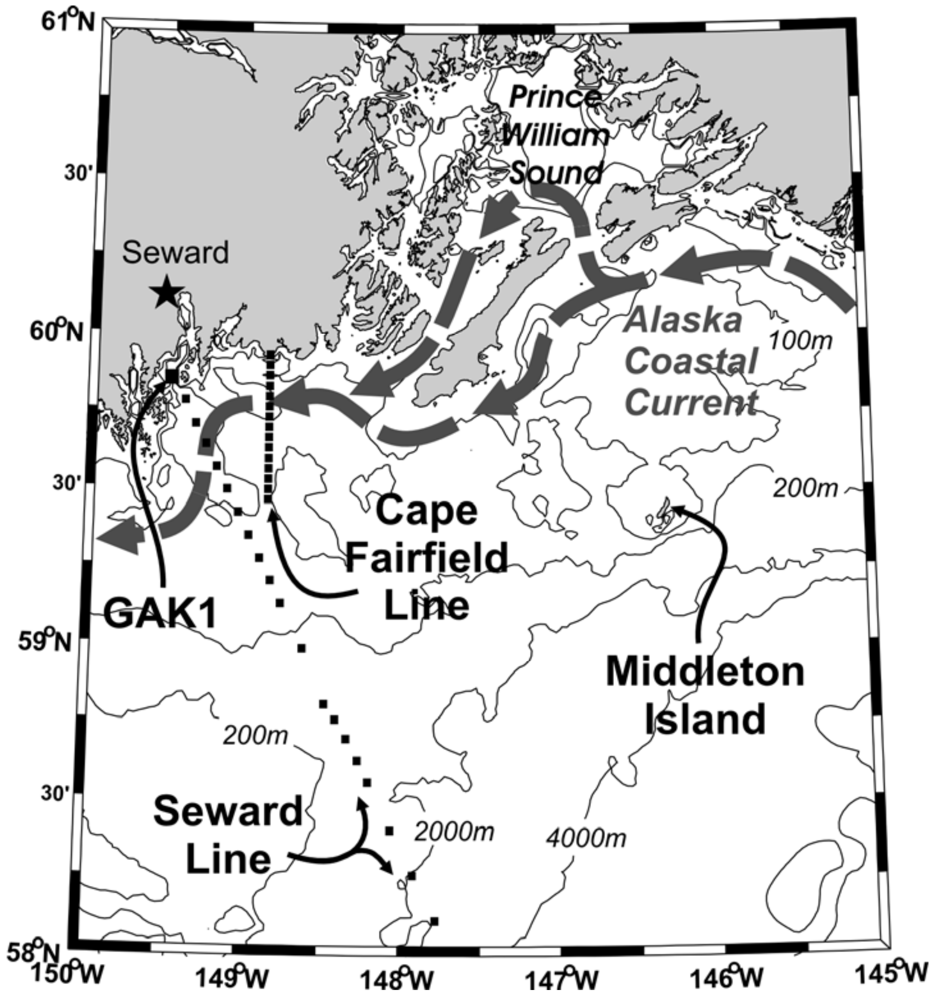

Figure 3. Schematic of the circulation of the Alaska Coastal Current in Prince William Sound and the adjacent Gulf of Alaska shelf. The Cape Fairfield and Seward lines were CTD transects sampled throughout the Global Ocean Ecosystem Dynamics (GLOBEC) Program (1997- 2004) used to characterize shelf properties and biological production. The Cape Fairfield transect was a high resolution CTD transect through the Alaska Coastal Current used to calibrate transport at GAK 1 (*Weingartner et al*., 2005).

Variability in the marine environment must be quantified and its causes understood in order to comprehend and predict the response of the Gulf of Alaska marine ecosystem to natural or human related causes. Ocean temperatures, salinities, nutrients, and phytoplankton blooms are easily monitored and fundamental properties of the ecosystem that affect upper trophic level variability. We propose to maintain at GAK 1: 1) the 36-year time series of temperature and salinity measurements, 2) monitoring phytoplankton bloom characteristics begun in 2005, and 3) continuous nutrient near-surface and deep nutrient time series measurements begun in spring 2006. GAK 1 lies within the Alaska Coastal Current (ACC) on the northern Gulf of Alaska shelf downstream of Prince William Sound and upstream of Cook Inlet (Figure 2) and thus was in the path of the 1989 Exxon Valdez Oil Spill (*Royer et al.*, 1990). Opportunistic sampling commenced at this station in 1970 and since November 1997, the EVOSTC has supported systematic sampling of temperature and salinity at GAK 1. The sampling includes monthly conductivity-temperature versus depth (CTD) measurements (begun in 1970) and hourly temperature and conductivity measurements from a mooring consisting of six instruments distributed throughout the water column at GAK1. This station is *the only station* in the Gulf of Alaska that measures salinity and it is *the only station* measuring temperature and salinity throughout the water column. *Weingartner et al.* (2003). *Weingartner et al*., (2005) and *Royer* (2005) give a more complete description and analysis of the data collected thus far. Important findings derived from GAK 1 under EVOSTC support include:

1. The anomalous summer 1997 warming (~1-2^{o}C above normal) was due to anomalously low summer cloud cover and wind speeds and was confined to the upper 40 m of the ocean.

2. The El Niño-induced warming (~2^{o}C above normal) in winter 1998 occurred over the entire 250 m depth of the shelf, and was accompanied by unusually fresh shelf waters and above normal ACC transport. Stratification occurred early and might have induced an earlier than normal spring bloom. These anomalies provide a glimpse of what may be the norm if future climate change entails warmer and wetter winters in the Gulf of Alaska. Earlier stratification might induce an earlier spring bloom in the sound and the ACC thereby resulting in a timing mismatch between the bloom and zooplankton feeding

3. Several factors were responsible for these anomalies: 1) coastal Alaska discharge [computed following *Royer* (1982)] was above average in fall 1997 and winter 1998, 2) Pacific Northwest river discharges were above average during summer and fall 1997, and 3) coastal downwelling around the Northeast Pacific was stronger than normal from summer through winter. In aggregate these factors decreased nearshore salinities and strengthened ACC alongshore transport. The simultaneous occurrence of all of these anomalies is unusual; 1997-98 was the only year since 1970 (the start of the GAK 1 record) in which all of these anomalies coincided.

4. Most of the discharge appears to be transported within the upper 75 m of the water column and within ~40 km of the coast.

5. There are statistically significant relationships between monthly anomalies of GAK 1 salinity and/or dynamic height and anomalies of ACC mass and freshwater transport. These results could be applied to resource management issues, for evaluating numerical model performance, and for retrospective ecosystem studies. For example, *Coyle* (2005) suggests that variations in ACC alongshore transport in late winter/spring affects zooplankton dispersal and recruitment processes.

6. Coastal discharge can hindcast ACC transports using the precipitation record assembled by Royer (1982) that begins in 1930 for the Gulf of Alaska. We extended Royer's runoff time series from 1930 to 1900 based upon correlations between anomalies of runoff and atmospheric sea level pressure difference between Seward and Ketchikan (ΔSLP_{KS}). We find that winter ΔSLP_{KS} anomalies are correlated with the winter Pacific Decadal

Oscillation (PDO) anomalies. Minimum discharge occurred from 1900-1910 and maximum discharge in the 1930s. Coastal discharge and coastal salinities suggest a decrease in freshwater discharge in the Gulf of Alaska from the late 1950s through the mid-1970s. Discharge increased from the mid-70s through the early-80s, coincident with the regime shift of the 1970s and with the PDO (*Mantua et al.*, 1997; *Overland et al*., 1999). These findings add to suggestions of a freshening across the North Pacific Ocean basin since the 1970s (*Wong et al.,* 1999).

7. The mooring has provided a platform for other scientists, for example in 2001-02 we placed prototype halibut tags, developed by USGS-BRD scientists, onto the GAK 1 mooring for testing. These tags are now routinely used to study halibut migrations.

8. The GAK1 monthly time series has underscored the large interannual and interdecadal variability of the northern Gulf of Alaska. With the inception of the moored time series, shorter period variations, reflecting important dynamical transitions, are being detected and quantified. The in-month variance of the moored data is generally less than the monthly variance computed from the historical monthly CTD sampling and the integral time scales are longer than 1 month. Both results suggesting that temporal aliasing associated with the monthly CTD sampling has not been a significant problem.

9. *Royer* (2005) documented a 30 year warming and freshening trend in the upper 100 m of the Gulf of Alaska shelf that implies an increase in ACC transport (Weingartner et al., 2005) and an increase in upper layer stratification (*Royer et al*., submitted), which could influence biological production.

10. The general warming and freshening in the northern Gulf of Alaska might have led to the outbreak of *Vibrio parahaemolyticus* reported in Prince William Sound (*Royer et al.,* submitted). The freshening surface layer appears to retain summer heat thereby allowing these organisms (which causes gastroenteritis in humans) to flourish. More frequent similar occurrences are predicted if the present trends in upper ocean salinity and temperature continue.

11. We have determined that the ACC is a principal source of freshwater for the Bering Sea shelf and thereby influences biological processes on both this shelf and the Chukchi Sea through Bering Strait (*Weingartner et al*., 2005; *Aagaard et al*., in press). These results imply that the GAK 1 monitoring effort has implications for other important Alaskan marine ecosystems.

GAK 1 data has also supported efforts to assess the recovery of marine species and services affected by the oil spill, which underscored the need to understand natural climate variability and its influence on the recovery of species injured by the oil spill (*Purcell et al.,* 1999; *Piatt and Irons*, 1999; *Duffy*, 1999; *Anderson et al.*, 1999). Many of our past results were obtained in conjunction with data collected under the auspices of the NSF-NOAA funded Northeast Pacific Coastal Gulf of Alaska GLOBEC (Global Ocean Ecosystem Dynamics) program, which seeks to understand how climate variability affects marine ecosystems. GLOBEC field sampling is now over but that program provided essential data that helped establish the usefulness of GAK 1 at both regional and broader scales. In addition, many of the biological data sets collected under the auspices of the GLOBEC (1998 – 2004) program represented the first systematic and year-round biological sampling for nutrients, phytoplankton, and zooplankton conducted on this shelf. The interpretation of these data sets continues and we anticipate that GAK 1 data will be used in retrospective and predictive studies to address prior biological variability in this ecosystem using ecosystem models.

B. Relevance to 1994 Restoration Plan Goals and Scientific Priorities

The ACC is an important focus habitat of EVOSTC for it links Prince William Sound and continental shelf marine habitats. Terrestrial runoff from around the Gulf of Alaska affects ACC dynamics and its nutrient and sediment load although oceanic processes substantially modify these influxes. The ACC transmits these signals to many of the nearshore habitats around the gulf. We propose to monitor temperature, salinity, nitrate, and phytoplankton (chlorophyll fluorescence) bloom properties at GAK 1 in the ACC. These variables are inexpensively monitored and useful indices of ecosystem variability, when gathered over a long time period. Salinity primarily controls density gradients, which affects circulation and vertical mixing. Temperature influences stratification and affects the metabolic rates of marine organisms. Nitrate is a critical macronutrient that supports phytoplankton production and hence production at higher trophic levels. Fluorescence provides an index of phytoplankton biomass and indicates the frequency and magnitude of blooms. Interannual variations in any of these parameters could promote changes in biological production at higher trophic levels. The data and results proposed herein will provide the long-term temporal context of the natural variability of the ACC and, by extension, Prince William Sound. The data are thus essential in understanding how species affected by the oil spill are recovering, since this recovery occurs in an environment with large natural variety that could also affect recovery.

II. PROJECT DESIGN

A. Objectives

The over-arching goal of this program is to provide a high quality, cost-effective, long-term data that are simple measures of the variability of the Gulf of Alaska marine environment. A part of this goal involves providing the data to numerous stakeholders, including scientists, resource managers, fishers, climatologists, and the public. We propose to monitor five important ACC ecosystem parameters in order to quantify and understand interannual and longer period variations:

1. Temperature and salinity throughout the water column,
2. Near surface stratification since this affects phytoplankton bloom dynamics,
3. Near and subsurface nitrate supply on the inner shelf, since this important nutrient affects phytoplankton production,
4. Indices of phytoplankton biomass, since this is an index of primary production, and
5. Middleton Island atmosphere-ocean heat fluxes, since these fluxes primarily control upper ocean temperatures and might be related to broader scale climatological indices.

B. Procedural and Scientific Methods

As in the past, the objectives will be met by monthly CTD measurements and year-long, continuous measurements from a subsurface mooring with temperature and conductivity (T/C) recorders placed at nominal depths of 20, 50, 100, 150, 200, and 250 m. A (Wetlabs, Inc.) fluorometer is included at 20 m, to determine timing and duration of the spring and summer blooms. GLOBEC measurements show that the spring bloom extends from the surface to at least 20 m depth, but by early summer, the chlorophyll maximum is at ~20 m depth (*Childers et al*., 2005). The fluorometer emits an illuminated beam of light (at 470 nm) that stimulates chlorophyll in the beam path. The absorbed light excites the chlorophyll molecules, which emit light (fluoresce) at a 695 nm. The emitted light is detected by the fluorometer and the intensity of the fluorescence is proportional to chlorophyll biomass. (We emphasize that this chlorophyll measurement is only a relative measure of chlorophyll concentration. Absolute values would require systematic water sample measurements over time and additional laboratory analyses to convert the fluorometer data to absolute chlorophyll concentrations. We believe that this extra effort and cost is not essential to our particular goals.) We also include two ISUS (*In Situ* Ultraviolet Sensor) sensors at 20 m and 150 m depth. These instruments optically determine nitrate based on the nitrate UV-absorption spectrum. This spectrum is unique for nitrate and it is resolved by the 256-channel ISUS spectrometer and interpreted by an algorithm developed by the Monterey Bay Aquarium Research Institute. The 20 m ISUS is within the euphotic zone and complements the fluorometer data. The 150 m ISUS will gauge the annual re-supply of nitrate to this shelf (and also Prince William Sound) through the annual exchange between deep shelf and slope waters (*Royer*, 1975; *Weingartner et al.*, 2005). The deep inflow of nitrate is mixed to the surface in winter and is thereby available to phytoplankton at the onset of the spring bloom. These comparatively new sensors appear to provide sufficiently reliable data ($\pm$ 2 μM) for a whole year [*Whitledge*, 2006]. The ISUS sensors are provided at no cost to this project because they were provided (and will be maintained) with support from the Alaska Ocean Observing System.

The moored instruments and monthly CTD sampling schemes are complementary; one provides high vertical resolution at monthly time scales and the other provides high temporal resolution, but at coarser vertical spacing. The monthly CTDs provide redundancy in the event an instrument fails on the mooring. The GAK 1 monthly temperature and salinity are statistically significant predictors of monthly anomalies of the alongshelf baroclinic transport in the ACC (for from November – August; *Weingartner et al.* [2005]) so ACC transport anomalies are monitored indirectly from the GAK 1 data.

The moored T/C recorders are Microcats (at depths greater than 20 m) and a SeaCat (at 20 m depth to incorporate the fluorometer) are manufactured by Seabird, Inc. Seabird performs pre- and post-calibrations upon which we determine sensor drift (typically ~0.01^{o}C -yr^{-1} and ~0.03, or better, Practical Salinity Unit yr^{-1}). The monthly CTD casts are collected from a chartered fishing vessel resident in Seward using a portable CTD (Seabird SBE-25). The SBE 25 has an accuracy ~0.01 or better for salinity and .005^{o}C for temperature. Bio-fouling will gradually degrade the signal quality of the fluorometer so we strive to deploy the mooring in March or early April (depending upon weather) in order to minimize fouling potential prior to the spring bloom in April or May. Temperature and salinity data are sampled at 15-minute intervals except at 20 m depth where power supply considerations for the fluorometer and ISUS dictate hourly sampling. Example time series of the temperature and salinity data are shown in Figure 4 and Figure 5.

C. Data Analysis and Statistical Methods

The temperature and salinity data analyses are straightforward. We will compute standard statistical estimates for each month and depth and compare these with historical data since the thrust of this effort is to quantify interannual variability. We will also incorporate Royer's (1982) discharge time series (provided courtesy of Royer through no cost to this project) and air-sea heat fluxes derived from Middleton Island data (which begins in 1948) in our analyses of salinity and temperature variability. We have generated the historical heat flux calculations through 2001 (with support from GLOBEC) and these are shown in Figure 6. The results show that winter heat losses (from the ocean to the atmosphere) are more variable both interannually and at longer periods than summer heat gains. For example, the figure indicates that winter heat loss has decreased by nearly 20% since the mid-1970s and this change is reflected in the warming at GAK 1 since that time (*Royer*, 2005). The winter heat loss affects upper ocean temperatures (75 – 100 m) in early spring when many young larvae are emerging to feed. On the other hand summer heat gains appear to be relatively consistent from year to year because this is primarily a function of cloud cover. *Royer et al*. (2006) contend that summer surface temperatures over the shelf and in Prince William Sound are primarily a function of the stratification. They suggest that stronger stratification traps heat in the surface layer and elevates surface temperatures, whereas weaker stratification allows the solar energy to diffuse to greater depths. Within the ACC, stratification is primarily a function of the vertical salinity gradients that we will measure at GAK 1. We note however, that the winter air-sea heat fluxes are valid for the outer shelf because Middleton Island air temperatures and winds are generally more moderate in winter than those within Prince William Sound. We will quantify heat flux differences between several of the meteorological buoys in Prince William Sound and Middleton Island as part of this project. Relationships between Prince William Sound and Middleton Island heat fluxes will be determined from linear regressions to re-construct a historical time series of Prince William Sound heat fluxes and sea surface temperatures. We note that these regressions might be poor in places, where glacial meltwater influences the surface temperatures. Where statistical agreement is achieved could be useful to scientists wanting surface temperatures to use in retrospective biological studies that involve periods before the installation of meteorological buoys in Prince William Sound. We will also quantify spring and summer phytoplankton blooms in relation to changes in stratification, runoff, and winds. Stratification estimates will be made from the 3 uppermost instruments and the monthly CTD surveys. To determine the number of blooms and bloom duration we will determine the duration of a bloom peak and the number of peaks observed in spring and summer from the fluorometer. This approach is subjective because a bloom event will be defined with reference to a base line which will likely drift over time because of bio-fouling. Nevertheless,

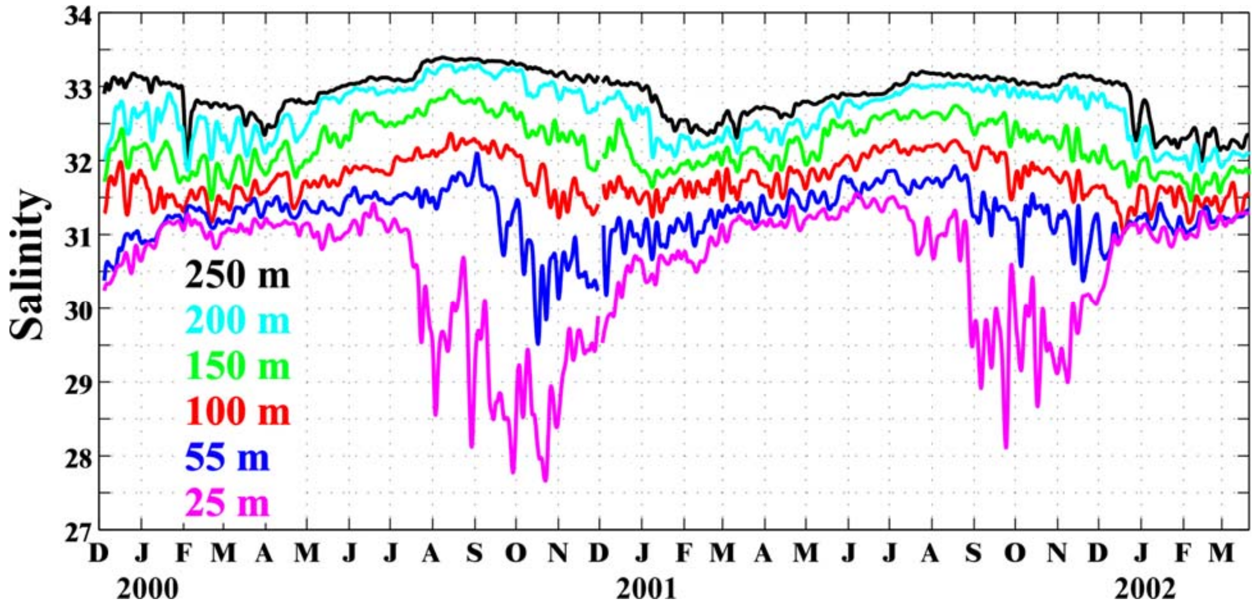

Figure 4. Time series of quarter-hourly salinity collected at various depths by the moored instruments at station GAK 1.

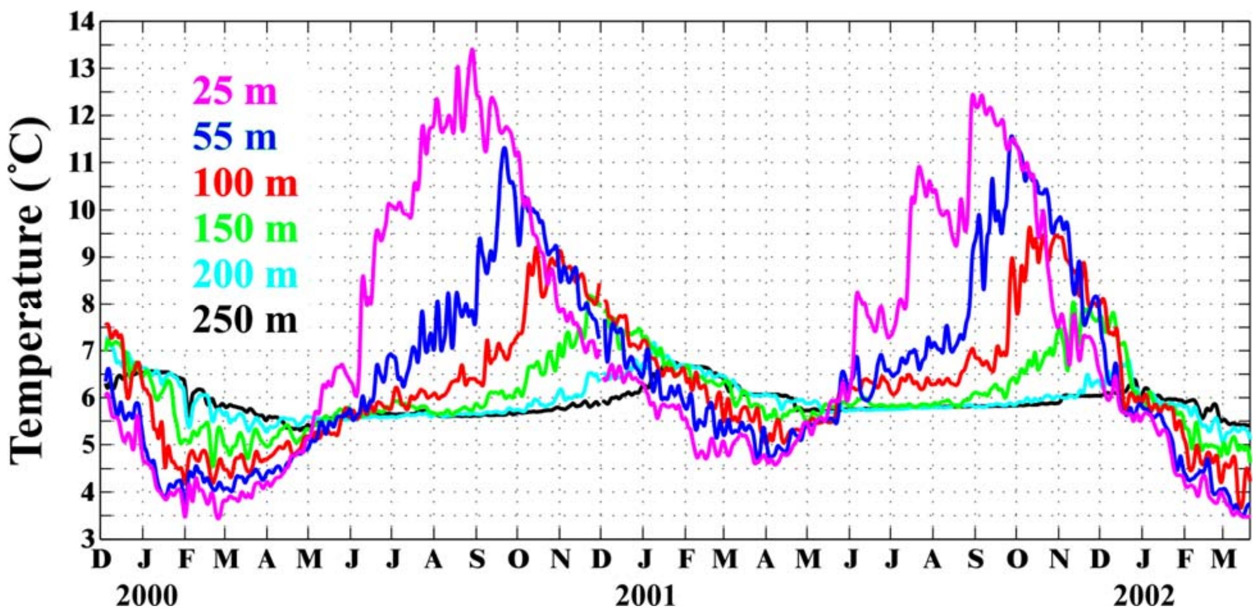

Figure 5. Time series of quarter-hourly temperature (bottom) collected at various depths by the moored instruments at station GAK 1.

the approach will be useful in qualitatively descriptions proposed here and should be quite reliable for describing year-to-year variability in the spring bloom, which is our primary emphasis. GLOBEC measurements, as well as those by *Eslinger et al.* (2001) from Prince William Sound, indicate that the timing of the spring bloom varies considerably from year-to-year and often by several weeks. *Weingartner et al*. (2003) show that the onset of the spring

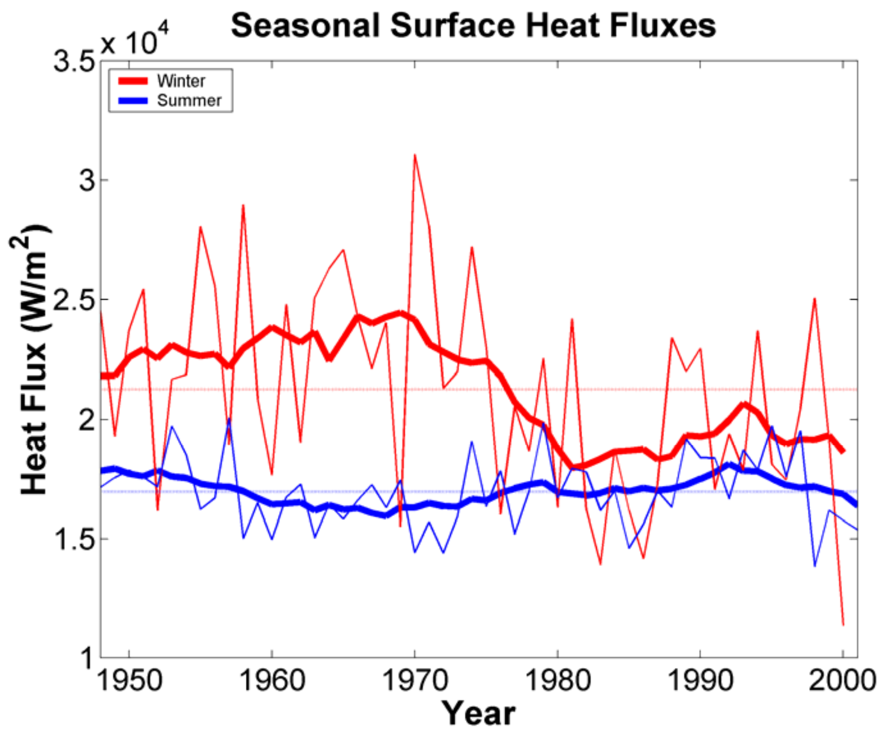

Figure 6. Annual cumulative heat loss in winter (red) and heat gain in summer (blue) from 1950 – 2001.

bloom on the Gulf of Alaska shelf is tied to the quantity and phasing of winter and early spring runoff because freshwater is the principal stratifying agent in the ACC in these seasons. Climate model predictions for this region (Intergovernmental Panel on Climate Change [*IPCC*, 2001]) and the GAK 1 time series show (*Royer*, 2005; *Royer et al*., 2006) that winters are becoming warmer and wetter over the Gulf. This suggests that the onset of the spring bloom will occur earlier in the year (*Weingartner et al*., 2003; *Weingartner et al*., 2005) as stratification develops earlier. Such changes could alter the lower trophic structures in the Gulf of Alaska and/or create a mismatch in timing between the phytoplankton bloom and zooplankton hatch. Regardless of the mechanism, such changes could have substantial consequences for higher trophic components.

D. DESCRIPTION OF STUDY AREA

The fieldwork will be conducted at Station GAK1 at the mouth of Resurrection Bay (Figure 3). The station is at ~59° 51'N, 149° 28'W, and is located on the inner edge of the ACC midway between Prince William Sound and Cook Inlet in approximately 265 m water depth. Because much of the ACC flows through the sound (*Niebauer et al.*, 1994), GAK 1 characterizes salinity and temperature properties of Prince William Sound waters.

E. COORDINATION AND COLLABORATION WITH OTHER EFFORTS

All data sets will be available on the GAK 1 website (http://www.ims.uaf.edu/gak1/). The GAK 1 data will be particularly valuable to the scientists involved with herring projects in Prince William Sound (we are aware that B. Norcross and S. Gay are submitting proposals to conduct some of these studies) and they have expressed interest in the GAK 1 data set. As discussed above this project is being supplemented by the Alaska Ocean Observing System (AOOS), which is providing the ISUS nitrate samplers (with each sampler costing $30,000). We are also communicating with the Pacific Ocean Shelf Tracking (POST) program (A. Seitz) and have offered to incorporate their acoustic beacon on the GAK 1 mooring. This is easily accomplished for it entails no significant change to the existing GAK 1 mooring design.

III. SCHEDULE

A. Project Milestones

Objective 1. Updated in annual report and on website and to be made available by March-April following the year that the mooring is recovered.

Objective 2. Updated in annual report and on website and to be made available by March-April following the year the mooring is recovered.

Objective 3. Updated in annual report and on website and to be made available by March-April following the year the mooring is recovered.

Objective 4. Updated in annual report and on website and to be made available by March-April following the year the mooring is recovered.

Objective 5. Updated in annual report and on website and to be made available two years after the end of the calendar year (owing to delays associated with attaining and processing the Middleton Island data sets from the National Weather Service).

B. Measurable Project Tasks for FY 07 through FY09 (October 1, 2006 – August 31, 2009)

Fiscal Year 2007

FY 07, 1st quarter (October 1, 2006 – December 31, 2006)
- Oct., Nov., Dec.: Monthly CTD surveys; begin acquiring, archiving, and processing Middleton Island and Prince William Sound buoy data.

FY 07, 2nd quarter (January 1, 2007 – March 31, 2007)
- January 20 - 25: Attend Alaska Marine Science Symposium
- Jan., Feb., Mar.: Monthly CTD surveys, recover and re-deploy GAK 1 mooring. Conduct post-calibrations of instruments.

FY 07, 3rd quarter (April 1, 2007 – June 30, 2007)
- Apr. May, June: Monthly CTD surveys. Complete post-calibration on mooring instruments, process mooring and CTD data.

FY 07, 4th quarter (July 1, 2007 – September 30, 2007)
- Jul., Aug., Sept.: Monthly CTD surveys, update heat fluxes. Submit annual report.

Fiscal Year 2008

FY 08, 1st quarter (October 1, 2007 – December 31, 2007)
- Oct., Nov., Dec.: As in FY 07, 1st quarter

FY 08, 2nd quarter (January 1, 2008 – March 31, 2008)
- Jan., Feb., Mar.: As in FY 07, 2nd quarter

FY 08, 3rd quarter (April 1, 2008 – June 30, 2008)

Apr. May, June: As in FY 07, 3rd quarter
FY 08, 4th quarter (July 1, 2008 – September 30, 2008)
Jul., Aug., Sept.: As in FY 07, 4th quarter.

Fiscal Year 2009

FY 09, 1st quarter (October 1, 2008 – December 31, 2008)
Oct., Nov., Dec: As in FY 07, 1st quarter.
FY 09, 2nd quarter (January 1, 2009 – March 31, 2009)
Jan., Feb., Mar.: As in FY 07, 2nd quarter.
FY 09, 3rd quarter (April 1, 2009 – June 30, 2009)
Apr. May, June: As in FY 07, 3rd quarter.
FY 09, 4th quarter (July 1, 2009 – September 30, 2009)
Jul., Aug., Sept.: As in FY 07, 4th quarter. Submit final report.

IV. RESPONSIVENESS TO KEY TRUSTEE COUNCIL STRATEGIES

A. COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

There is no traditional ecological knowledge component in this program. Data sharing with interested users is achieved through our website, which provides information on project history, and prior results.

B. Resource Management Applications

This project monitors fundamental parameters that characterize the variable physical, nutrient, and chlorophyll conditions of the Gulf of Alaska shelf and especially the ACC and thus has potential applications to the management of a variety of marine resources. These data are presently being used in an Alaska Sea Grant funded project to assess the Kodiak Island King Crab recruitment processes (G. Kruse, PI). We add that we were originally invited by the EVOSTC to submit proposals to maintain GAK 1 at the beginning of restoration and recovery efforts in the late 1990s. The continuation of this effort was also urged by representatives of USGS-BRD, ADF&G, NOAA-NMFS, and several public community stakeholders during the establishment of the Gulf Ecosystem Monitoring Program. Over the years we have fielded numerous requests for data (or questions pertaining to it) from scientists, commercial and charter fishermen, and economic advisors to the seafood processing industry. (The latter were primarily interested in climate change issues that could influence investment strategies.)

PUBLICATIONS AND REPORTS

Data and results will be provided via Internet as mentioned and presented at the annual Alaska Marine Science Symposium. We anticipate that Dr. T. Royer will also make annual presentations to PICES on the environmental status of the Gulf of Alaska, which will include the GAK 1 data. Funding for the PICES presentations is covered under separate grants to Dr. Royer.

CURRICULUM VITA FOR THE PRINCIPAL INVESTIGATOR

THOMAS J. WEINGARTNER

EDUCATION

Ph.D. Physical Oceanography, 1990, North Carolina State University
M.S. Physical Oceanography, 1980, University of Alaska
B.S. Biology, 1974, Cornell University

MEMBERSHIPS

American Geophysical Union; American Meteorological Society

PUBLIC SERVICE

Member, Prince William Sound Science Center Advisory Committee
Guest Co-Editor, Deep-Sea Research Special Issue on Northeast Pacific GLOBEC Program
Member, Organizing Committee, 2005 Gordon Conference on Coastal Oceanography
Past Member, Science and Technology Advisory Committee, Gulf Ecosystem Monitoring Program, 2002 – 2004
Member, Fall 2004 NSF's Physical Oceanography Review Panel
Past Member, GLOBEC Northeast Pacific Executive Committee, 2000 - 2003
Past Member, Science Steering Committee, NSF - Arctic System Science-Ocean Atmosphere Ice Interaction (OAII) Shelf-Basin Interaction Project (2/98 - 2/03).
Past Member, Science Steering Committee, NSF - ARCSS-OAII Shelf-Basin Interactions (1995 -2002)
Past Member, UNOLS Fleet Improvement Committee (1994 – 1998)

PROFESSIONAL EXPERIENCE

Associate Professor; Institute of Marine Science, School of Fisheries and Ocean Sciences, U. of Alaska Fairbanks, Alaska; 6/99 - present
Assistant Professor; Institute of Marine Science, School of Fisheries and Ocean Sciences, U. of Alaska Fairbanks, Alaska; 11/93 - 1999
Research Associate; Institute of Marine Science, School of Fisheries and Ocean Sciences, U. of Alaska Fairbanks, Alaska; 9/91 - 10/93
Postdoctoral Student; Institute of Marine Science, School of Fisheries and Ocean Sciences, U. of Alaska Fairbanks, Alaska; 7/88 - 8/91
Graduate Research Assistant; Department of Marine, Earth and Atmospheric Sciences, North Carolina State U.; Raleigh, North Carolina; and Department of Marine Science, U. of South Florida; St. Petersburg, Florida; 8/84 - 10/88

PROFESSIONAL INTERESTS

Physical oceanography of the Arctic and North Pacific Ocean and the adjacent shelves, biophysical linkages in oceanography.

FIVE MOST RELEVANT PUBLICATIONS

Weingartner, T.J., S. Danielson, and T. C. Royer, Freshwater Variability and Predictability in the Alaska Coastal Current *Deep-Sea Research*, 52: 169 – 192, 2005.

Weingartner, T. Physical and Geological Oceanography: Coastal Boundaries and Coastal and Ocean Circulation (Chap. 4, p. 35 - 48), IN: The Gulf of Alaska: Biology and Oceanography, edited by P. Mundy, University of Alaska Sea Grant (Ak-SG-05-01), 214 p., 2005.

Weingartner, T.J., K. Coyle, B. Finney, R. Hopcroft, T. Whitledge, R. Brodeur, M. Dagg, E. Farley, D. Haidvogel, L. Haldorson, A. Hermann, S. Hinckley, J. Napp, P. Stabeno, T. Kline C. Lee, E. Lessard, T. Royer, S. Strom, The Northeast Pacific GLOBEC Program: Coastal Gulf of Alaska, submitted to *Oceanography*

Niebauer, H. J., T. C. Royer, and T. J. Weingartner, 1994. Circulation of Prince William Sound, Alaska, Journal of Geophysical. Research 99, 14,113 - 14126.

Royer, T. C., J. Vermisch, T. J. Weingartner, H. J. Niebauer, and R. D. Muench. 1990. Ocean circulation influence on the *Exxon Valdez* oil spill. *The Oceanography Society* 3:3-10.

FIVE ADDITIONAL PUBLICATIONS

Aagaard, K., T. J. Weingartner, T. J. Danielson, S. L., Woodgate, R. A., Johnson, G. C., Whitledge, T. E. What controls flow and salinity in Bering Strait? (in press, *Geophys. Res. Lett*.)

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Danielson, S. L., K. Aagaard, T. Weingartner, S. Martin, D. Quadfasel, J. Meincke, The St. Lawrence polynya and the Bering shelf circulation: New observations and a model comparison. A year in the St. Lawrence polynya *(in press J. Geophys. Res*., 2006)

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Okkonen, S., Weingartner, T.J., S. Danielson, D. L. Musgrave, and G. M. Schmidt, Satellite and hydrographic observations of eddy-induced shelf-slope exchange in the northwestern Gulf of Alaska *J. Geophys. Res*. 108: 15 –1, 15 –10, 2003.

SCIENTIFIC COLLABORATIONS WITHIN PAST 48 MONTHS:

K. Aagaard (U. Washington), E. Carmack (Institute of Ocean Sciences), L. Cooper (U. Tenn.), K. Dunton (U. Texas, Port Aransas), J. Grebmeier (U. Tenn.), M. Goni (Oregon State U.), A. Hermann (NOAA-PMEL), S. Martin (U. Washington), B. Moran (U. Rhode Island), R. Pickart (Woods Hole), D. Quadfasel (U.Hamburg), T. Royer (Old Dominion), P. Stabeno (NOAA-PMEL), W. Williams (Institute of Ocean Sciences), P. Winsor (Woods Hole), R. Woodgate (U. Washington).

OTHER KEY PERSONNEL

Mr. Seth Danielson is a physical oceanographer who has worked in both the GLOBEC and EVOS-supported GAK 1 projects for several years. He has the responsibility for data processing, analyses, and maintenance of the project web page and will be intimately involved in preparing the final report and presentations at the annual meeting. Mr. David Leech is the Seward based mooring and marine technician responsible for the design and deployment of the mooring and maintenance of the instruments. He will also conduct the monthly CTD sampling from the chartered vessels. Danielson and Leech are both employees of the University of Alaska's Institute of Marine Science.

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Aagaard, K., T. J. Weingartner, T. J. Danielson, S. L., Woodgate, R. A., Johnson, G. C., Whitledge, T. E. What controls flow and salinity in Bering Strait? (in press, *Geophys. Res. Lett*.)

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Data Management and Quality Assurance/Quality Control (QA/QC) Statement

1. Study Design

The sampling types include monthly CTD casts and quarter hourly temperature and salinity measurements from Microcats (at 50, 100, 150, 200, and 250 m) and hourly measurements from the Seacat at 20 m depth. The fieldwork will be conducted at Station GAK1 at the mouth of Resurrection Bay and is based out of Seward, Alaska. The station is at ~59.85^{o}N, 149.47^{o}W. GAK 1 is located on the inner edge of the ACC midway between Prince William Sound and Cook Inlet in approximately 265 m water depth. Examples of statistical analyses to be used are monthly means and standard deviations with these compared with historical data using Student's t-tests, power spectra, auto- and cross-correlations, and linear regressions. (See pages 6 – 9 of the project plan)

2. Acceptable data criteria

This is discussed in section 6 below.

3. Data characteristics

The data consist of time series from the mooring and monthly profiles of temperature and salinity (as described in item 1). The data to be collected are physical measurements and consist of: temperature, salinity, and fluorescence and a time stamp. AOOS is sponsoring the collection of the nitrate data from the ISUS instruments. (See pages 6-9 of the project plan)

4. Algorithms

The Seabird manuals for the Microcats and Seacats are available from the manufacturer and provide descriptions on how the sensor voltages are converted to physical units. We compute density and depth using the International Equation of State of Seawater based on Matlab software routines encoded for this purpose and used throughout the oceanographic community.

5. Physical samples.

Not applicable to this project.

6. Calibration procedures.

We insure data quality with the temperature-conductivity recorders (Microcats, Seacat, and SBE-25 CTD) in several ways. First, the instruments are on an annual calibration schedule and the calibration history is maintained at IMS and as Seabird. Second, prior to deployment of the moorings we operate each instrument in a well-mixed seawater bath in Seward for two days. The purpose of this pre-deployment test is to check that each instrument's clock and pre-set sampling period is correct and that all instruments are recording the same temperature and salinity. This is not a calibration, only a check to make sure that each instrument is recording the same values of temperature and salinity. Third, post-recovery processing screens the data for erroneous spikes (that might have resulted from temporary clogging of the conductivity cell for example. (The fluorescence measurements are relative only and therefore not calibrated as discussed on pages 6-9 of the project plan.). Meteorological data from Middleton Island and various buoys are calibrated by NOAA (National Data Buoy Center and National Weather Service).

University of Alaska Fairbanks Budget Justification
PJ 070340 Request = $389.K
FY 07 = $128.2K; FY 08 = $131.3K; FY 09 = $129.5K

According to the EVOS instructions, the EVOS budget line items included were rounded for submission. All line items discussed here are given in detail in the attached budget document.

Salary support*: $175.8 K*
Dr. Thomas Weingartner is the project PI and is responsible for project management. He will devote 0.5 months/yr to the project ($5.1K, $5.4K, $5.6K). Mr. Seth Danielson is a physical oceanographer who has worked on both the GLOBEC and EVOSTC GAK 1 projects since 1997. He is responsible for data processing, analyses, archiving and maintenance of the project web page. He requires 3 months/yr of support ($27.3K, $28.8K, $30K). Mr. David Leech is the Seward based mooring and marine technician responsible for the design, fabrication, deployment and recovery of the mooring and maintenance and calibration correspondence for the instruments. He also conducts the monthly CTD sampling. He will spend 1.75 months on the project with 14 days/yr at university mandated overtime pay while he is at sea for the CTD and mooring work ($23.6K, $24.2K, $25.8K). One month of this time will be spent in the design and fabrication of the mooring and this time is included in the equipment category of the budget. All members of this research team are affiliated with the University of Alaska.

Benefits:
Staff benefits are applied according to UAF's benefit rates for FY07, negotiated with the Office of Naval Research (ONR). A copy of the rate proposal is available at: http://www.alaska.edu/ controller /cost-analysis/cost_reports.html.

Travel: *$9.6K*
Funds are requested for one person to travel (round-trip Fairbanks – Anchorage) with two days per diem for attending the annual Alaska Marine Science Symposium meeting ($.8K each year). Two round-trips are also requested for Danielson to travel to Seward and conduct two of the monthly CTD casts while Leech is in the field for other projects ($2.4K each year).

Services: *$80.1 K*
The service request includes funds for annual instrument calibrations (5 Microcats, 1 Seacat, and 1 SBE-25) plus the shipping of the instruments to and from Seabird in Seattle ($4.7K each year). Additional funds are needed to cover the costs for twelve days on the charter fishing vessel for twelve of the monthly CTD sampling periods ($18K per year). The mooring recovery and deployment is performed from a larger vessel at a rate of $2000/day ($4K per year). We have budgeted for an extra day for the mooring work in the event that problems arise in mooring recovery/deployment operations.

Supplies: *$.9 K*
Funds are requested for computer supplies (printer and software license maintenance fees, etc.).

Equipment: *$30 K*
Equipment includes the design and fabrication of the mooring (which involves 1 month of Leech's time in each year of the project) and mooring hardware (batteries, vanes, anchors, line, shackles etc.) and an Oceanetic Measurement Ltd emergency satellite locator beacon. (The beacons are installed on the subsurface float and transmit a signal in the event that the mooring is prematurely released or inadvertently pulled to the surface by a vessel.) In addition, we request funds to purchase one new Microcat (with pressure) in Year 1 and another in Year 2 to replace two of our aging units.

In-kind contributions:
The ISUS nitrate analyzers and the technician responsible for these is covered by a grant from the Alaska Ocean Observing System (AOOS) to Dr. Terry Whitledge of the Institute of Marine Science, University of Alaska.

Indirect Costs: $92.6K ($60.5K = UAF)($32.1 = EVOS G&A)
Facilities and Administrative (F&A) Costs are negotiated with the Trustee Council and are calculated at 25% of the Total Direct Costs (TDC). TDC includes Total Direct Costs minus subcontracts in excess of $25,000 and equipment. Regarding subcontracts, the indirect rate is 25% of the first $25,000 of each subcontract, plus 5% of each subcontract's cost in excess of $25,000 and less than $250,000, plus 2% of each subcontract's cost in excess of $250,000. A copy of the agreement is available at: http://www.alaska.edu/ controller/cost-analysis/negotiated_agreements.html. To cover costs through the Trustee Council's general administration (GA), an additional 9% indirect is added to the budget to be paid to Alaska Department of Fish and Game per RFP instructions.

FY 2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2006 - September 30, 2007

Budget Category:	Authorized FY 2006	Proposed FY 2007	Proposed FY 2008	Proposed FY 2009	Project Total
Personnel		$56.0	$58.4	$61.4	$175.8
Travel		$3.2	$3.2	$3.2	$9.6
Contractual		$26.7	$26.7	$26.7	$80.1
Commodities		$0.3	$0.3	$0.3	$0.9
Equipment		$11.8	$11.8	$6.4	$30.0
Subtotal	$0.0	$98.0	$100.4	$98.0	$296.4
Equipment Exclusions		$19.7	$19.9	$14.7	$54.3
UAF Indirect (25%)		$19.6	$20.1	$20.8	$60.5
Modified Subtotal		$117.6	$120.5	$118.8	$356.9
ADFG GA (9%)		$10.6	$10.8	$10.7	$32.1
Project Total	$0.0	$128.2	$131.3	$129.5	$389.0
Full-time Equivalents (FTE)		0.4	0.4	0.4	
Other Resources					

Dollar amounts are shown in thousands of dollars.

Comments:
This budget is a correction version with a detailed budget added for each year of the project.

FY07

Received 8/4/06

Project Number: 070340
Project Title: Long-Term Oceanographic Monitoring of the Alaska Coastal Current
Name: Weingartner

FY 2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2006 - September 30, 2007

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 2007
Weingartner, Thomas			0.5	10.2		5.1
Leech, David			1.8	7.9	9.4	23.6
Danielson, Seth			3.0	9.1		27.3
	Subtotal		5.3	27.2	9.4	
					Personnel Total	$56.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2007
RT Fairbanks to Anchorage	0.4	1	2	0.2	0.8
RT Fairbanks to Seward	0.4	2	8	0.2	2.4
				Travel Total	$3.2

FY07

Prepared:

Project Number: 070340
Project Title: Long-Term Oceanographic Monitoring of the Alaska Coastal Current
Name: Weingartner

Contractual Costs:	Proposed
Description	FY 2007
vessel charter for CTDs (12 1-day trips @$1500/day)	18.0
vessel charter for moorings (12-day trips @$2000/day)	4.0
Microcat and SeaCat calibrations (5 @ $375; 1 @ $475)	2.4
SBE-25 calibration	1.5
shipping (RT Seward - Seattle SeaBird for calibration)	0.8
Contractual Total	$26.7

Commodities Costs:	Proposed
Description	FY 2007
Computer supplies and licenses	0.3
Commodities Total	$0.3

FY07

Received 8/4/06

Project Number: 070340
Project Title: Long-Term Oceanographic Monitoring of the Alaska Coastal Current
Name: Weingartner

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2007
SeaBird 37SMP Microcat with pressure			5.4
mooring fabrication supplies			6.4
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$11.8

Existing Equipment Usage:	Number	
Description	of Units	

FY07

Prepared:

Project Number: 070340
Project Title: Long-Term Oceanographic Monitoring of the Alaska Coastal Current
Name: Weingartner

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 2008
Weingartner, Thomas			0.5	10.8		5.4
Leech, David			1.8	8.0	9.8	24.2
Danielson, Seth			3.0	9.6		28.8
	Subtotal		5.3	28.4	9.8	
					Personnel Total	$58.4

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2008
RT Fairbanks to Anchorage	0.4	1	2	0.2	0.8
RT Fairbanks to Seward	0.4	2	8	0.2	2.4
				Travel Total	$3.2

FY08

Received 8/4/06

Project Number: 070340
Project Title: Long-Term Oceanographic Monitoring of the Alaska Coastal Current
Name: Weingartner

Contractual Costs:	Proposed
Description	FY 2008
vessel charter for CTDs (12 1-day trips @$1500/day)	18.0
vessel charter for moorings (12-day trips @$2000/day)	4.0
Microcat and SeaCat calibrations (5 @ $375; 1 @ $475)	2.4
SBE-25 calibration	1.5
shipping (RT Seward - Seattle SeaBird for calibration)	0.8
Contractual Total	$26.7

Commodities Costs:	Proposed
Description	FY 2008
Computer supplies and licenses	0.3
Commodities Total	$0.3

FY08

Received 8/4/06

Project Number: 070340
Project Title: Long-Term Oceanographic Monitoring of the Alaska Coastal Current
Name: Weingartner

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2008
SeaBird 37SMP Microcat with pressure			5.4
mooring fabrication supplies			6.4
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$11.8

Existing Equipment Usage:	Number	
Description	of Units	

FY08

Received 8/4/06

Project Number: 070340
Project Title: Long-Term Oceanographic Monitoring of the Alaska Coastal Current
Name: Weingartner

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 2009
Weingartner, Thomas			0.5	11.2		5.6
Leech, David			1.8	8.5	10.5	25.8
Danielson, Seth			3.0	10.0		30.0
	Subtotal		5.3	29.7	10.5	
					Personnel Total	$61.4

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2009
RT Fairbanks to Anchorage	0.4	1	2	0.2	0.8
RT Fairbanks to Seward	0.4	2	8	0.2	2.4
				Travel Total	$3.2

FY09

Received 8/4/06

Project Number: 070340
Project Title: Long-Term Oceanographic Monitoring of the Alaska Coastal Current
Name: Weingartner

Contractual Costs:	Proposed
Description	FY 2009
vessel charter for CTDs (12 1-day trips @$1500/day)	18.0
vessel charter for moorings (12-day trips @$2000/day)	4.0
Microcat and SeaCat calibrations (5 @ $375; 1 @ $475)	2.4
SBE-25 calibration	1.5
shipping (RT Seward - Seattle SeaBird for calibration)	0.8
Contractual Total	$26.7

Commodities Costs:	Proposed
Description	FY 2009
Computer supplies and licenses	0.3
Commodities Total	$0.3

FY09

Received 8/4/06

Project Number: 070340
Project Title: Long-Term Oceanographic Monitoring of the Alaska Coastal Current
Name: Weingartner

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2009
SeaBird 37SMP Microcat with pressure			0.0
mooring fabrication supplies			6.4
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$6.4

Existing Equipment Usage:	Number	
Description	of Units	

FY09

Received 8/4/06

Project Number: 070340
Project Title: Long-Term Oceanographic Monitoring of the Alaska Coastal Current
Name: Weingartner

Long Term Monioring in the Alaska Coastal Current

Metadata:

- Identification Information
- Spatial Data Organization Information
- Distribution Information
- Metadata Reference Information

Identification_Information:
  Citation:
    Citation_Information:
      Originator: Thomas Weingartner
      Publication_Date: 20060728
      Title: Long Term Monioring in the Alaska Coastal Current
      Edition: 1
      Geospatial_Data_Presentation_Form: atlas
      Publication_Information:
        Publication_Place: Fairbanks, Alaska
        Publisher: Thomas Weingartner
      Online_Linkage: <http://www.ims.uaf.edu/gak1/>
  Description:
    Abstract:
      Temperature, salinity, fluorescence and nitrate time series on the Gulf of Alaska shelf 59 50.7N, 149 28W Resurrection Bay through monthly CTDs and moored measurements
    Purpose:
      Monitor long-term variability in the Alaska Coastal Current's properties
  Time_Period_of_Content:
    Time_Period_Information:
      Range_of_Dates/Times:
        Beginning_Date: 1970-6-6
        Ending_Date: present
    Currentness_Reference: to present
  Status:
    Progress: In work
    Maintenance_and_Update_Frequency: Annually
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: 150
      East_Bounding_Coordinate: 148
      North_Bounding_Coordinate: 60
      South_Bounding_Coordinate: 59
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: oceanographic data
      Theme_Keyword: oceans

Place:
Place_Keyword_Thesaurus: Standard
Place_Keyword: Gulf of Alaska
Temporal:
Temporal_Keyword_Thesaurus: Standard
Temporal_Keyword: 1970 - present
Access_Constraints: none
Use_Constraints: none

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Point

Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Thomas J. Weingartner
Contact_Organization: Institute of Marine Science
Contact_Address:
Address_Type: Mailing and Physical Address
Address:
Institute of Marine Science University of Alaska
City: Fairbanks
State_or_Province: Alaska
Postal_Code: 99775
Country: USA
Contact_Voice_Telephone: 907-474-7993
Contact_Facsimile_Telephone: 907-474-7204
Contact_Electronic_Mail_Address: weingart@ims.uaf.edu
Resource_Description:
Oceanographic data: temperature, salinity, fluourescence, nitrate
Distribution_Liability: none

Metadata_Reference_Information:
Metadata_Date: 20060728
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Thomas J. Weingartner
Contact_Organization: Institute of Marine Science
Contact_Address:
Address_Type: Mailing and Physical Address
Address:
Institute of Marine Science University of Alaska
City: Fairbanks
State_or_Province: Alaska
Postal_Code: 99775
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Contact_Voice_Telephone: 907-474-7993
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Contact_Electronic_Mail_Address: weingart@ims.uaf.edu
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

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