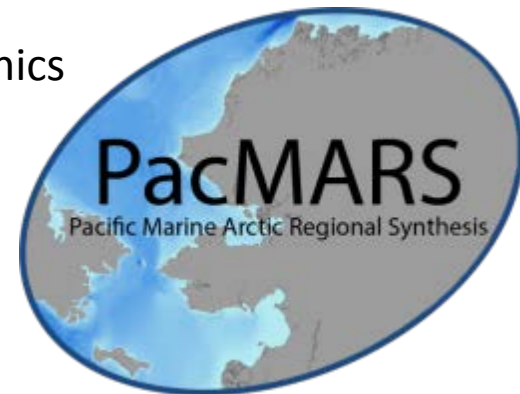


Thanks to Bodil Bluhm, Ken Dunton and Tom Weingartner for graphics



# Pacific Marine Arctic Regional Synthesis Themes 1, 2 & 6: Physics, Hydrography and Contaminants

L. Cooper, J. Trefry, S. Okkonen

University of Maryland Center for  
Environmental Science, Florida Institute of  
Technology, University of Alaska Fairbanks



PacMARS-SOAR Open Workshop: January 20, 2013



# Themes

## **Theme 1. Ice cover – primary production relationships, currents, winds, bathymetry**

- 1a. Will warmer water temperatures and reduced ice cover result in an increase in primary production in Arctic seas, and if so, how will this affect the sequestration of carbon, ocean acidification and food web dynamics?
- 1b. What is the connectivity to local/regional biogeochemistry and physical oceanography for the Chukchi and Beaufort Sea food web?

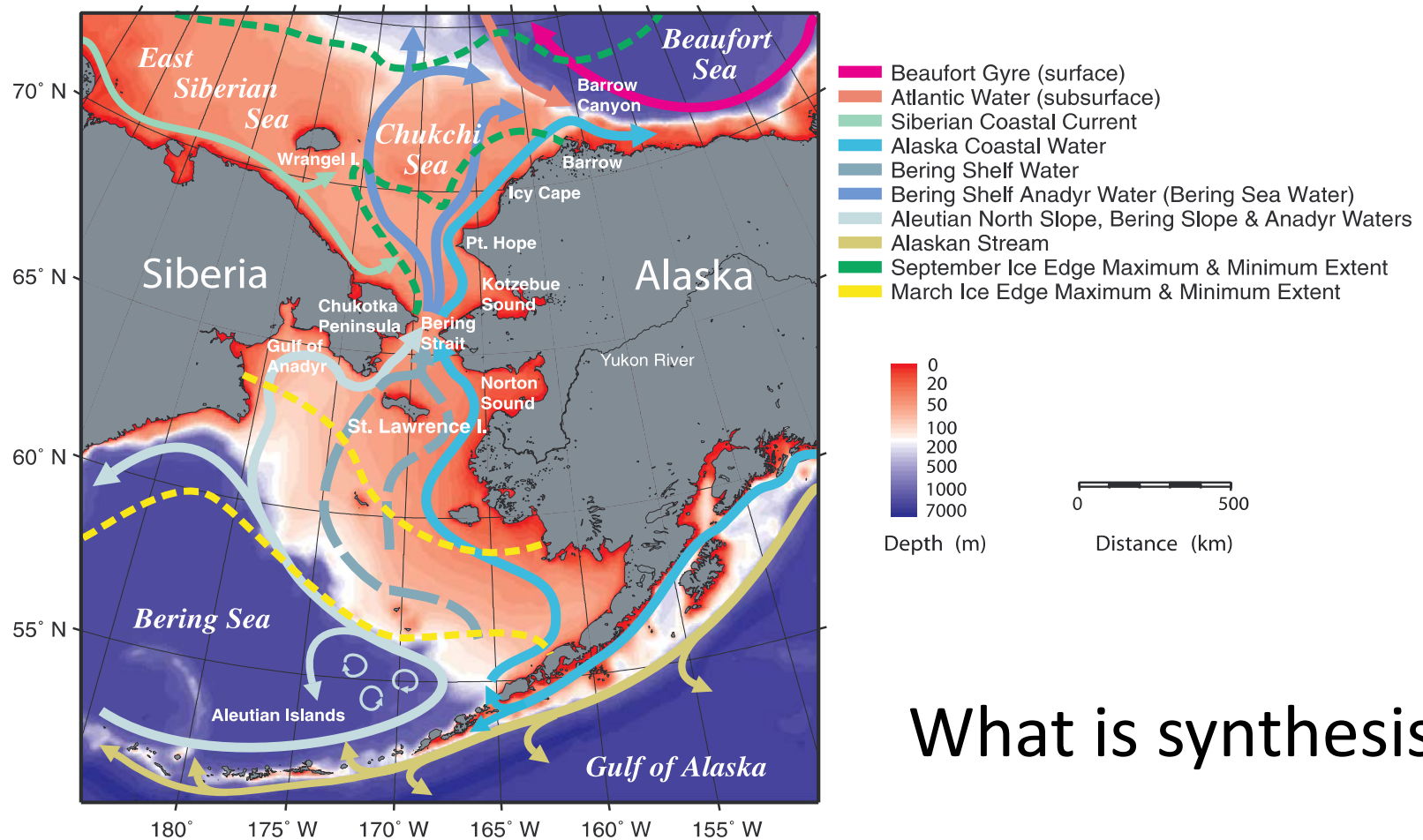
## **Theme 2: Phenology of biological production cycles in relation to physical environment**

- 2a. How will a changing climate affect the timing, magnitude, and duration of production cycles?
- 2b. Will changes likely result in successful colonization and replacement of arctic endemics by subarctic populations/species?

## **Theme 6: Chemical contaminants in sediment and biota**

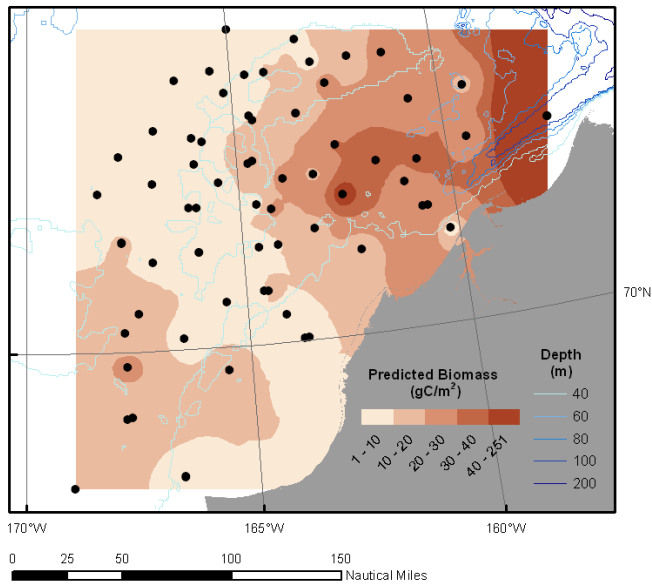
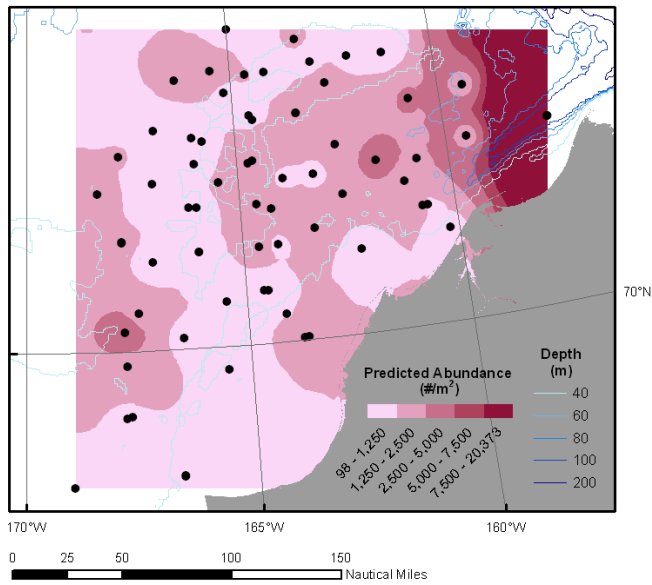
- 6a. What are the levels of chemical contaminants in sediments and seawater and how do they move through the food chain?
- 6b. Are there any potential impacts of varying contaminant burdens in sediment and prey on high trophic organisms, including humans?





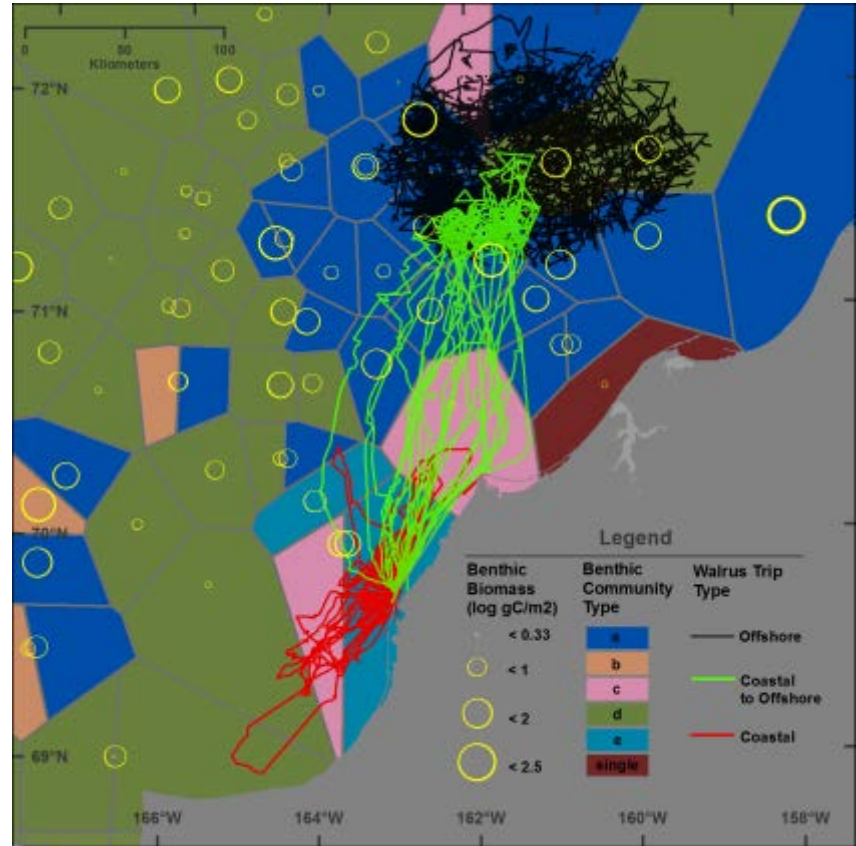
## What is synthesis?

rom map provided by Tom Weingartner and Seth Danielson, University of Alaska Fairbanks).



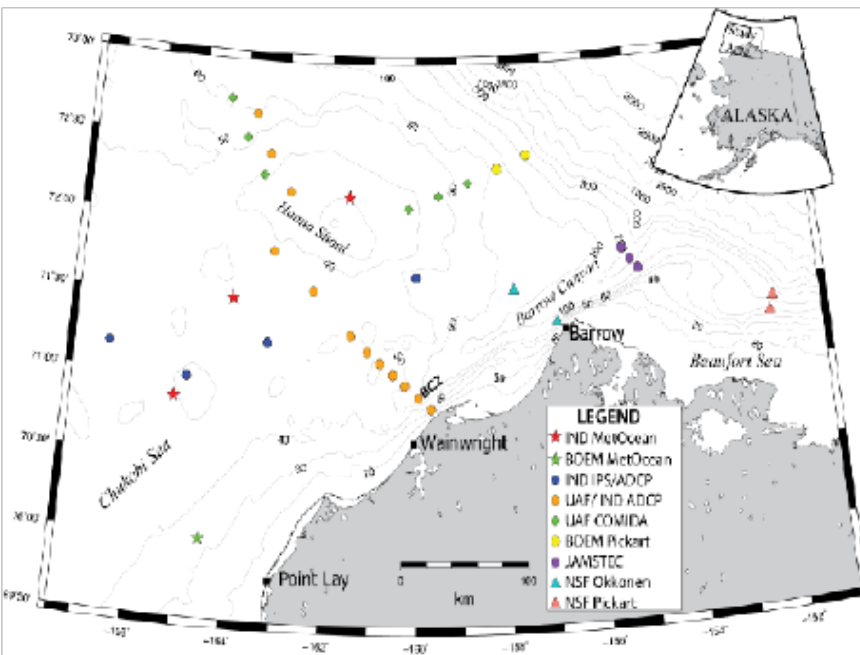
# Three Chukchi Sea cruises: 2008-2010

USGS Data Thanks to Tony Fischbach and Chad Jay

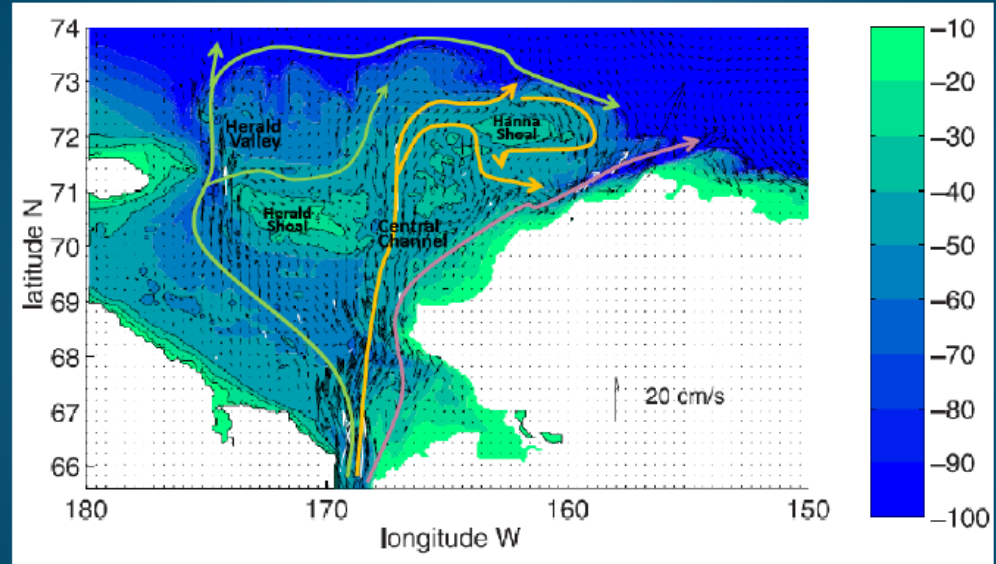


Example: interannual comparison benthic prey base and walrus movement via tracking (Jay, Fischbach and Grebmeier)

# 2012 Mooring Deployments for BOEM-COMIDA



## CHUKCHI WATER CURRENT STRUCTURE AT 27.5 m DEPTH



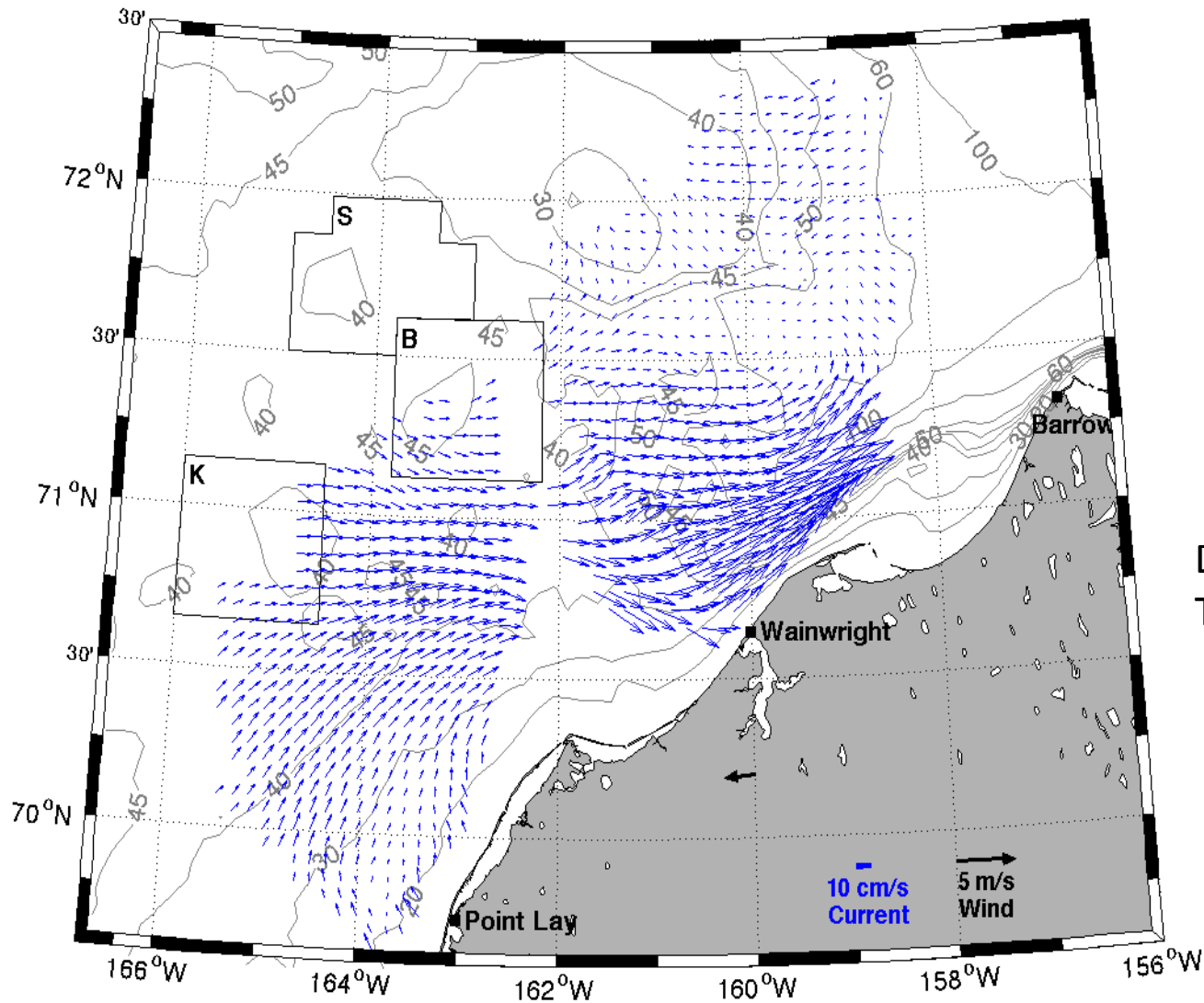
Annual mean horizontal velocity at 27.5 m depth as a function of bottom topography. Net flows denoted by colored arrows. From Spall (2007) and Weingartner (pers. comm)

Thanks to Tom Weingartner and Ken Dunton for graphics



# MEAN FLOW WHEN ACC IS NORTHEASTWARD

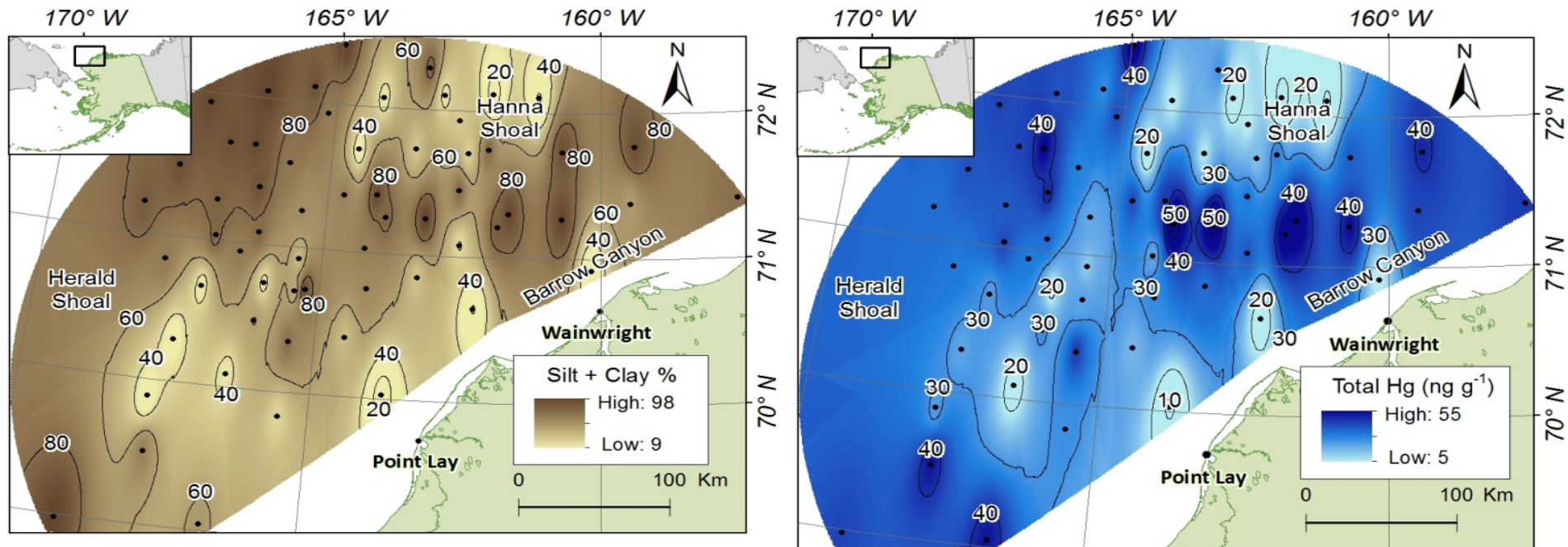
## Coastal Radars: 2008 – 2011



August – October  
hourly  
6km resolution  
~100 – 150 km range  
(Available)

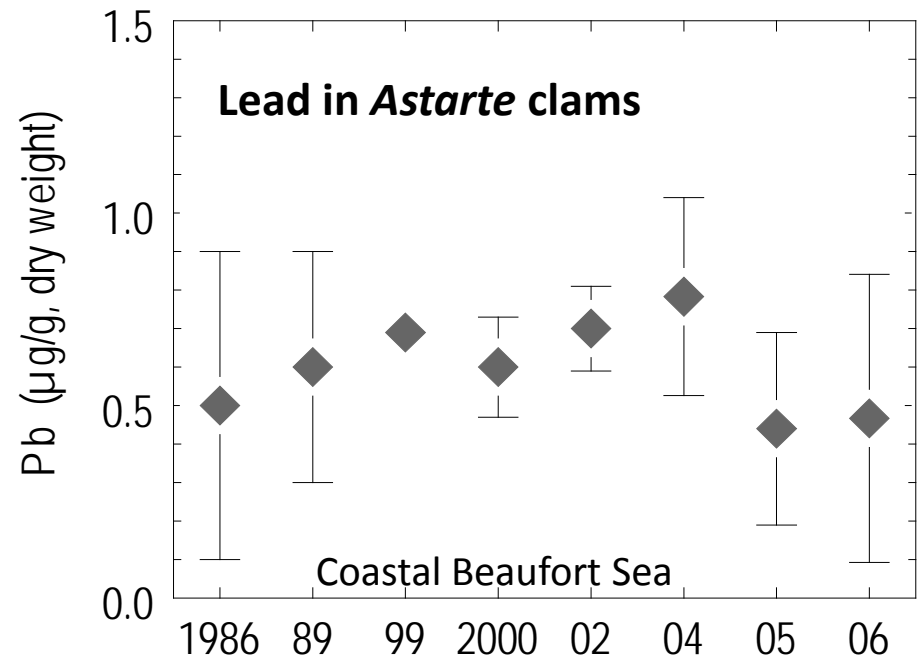
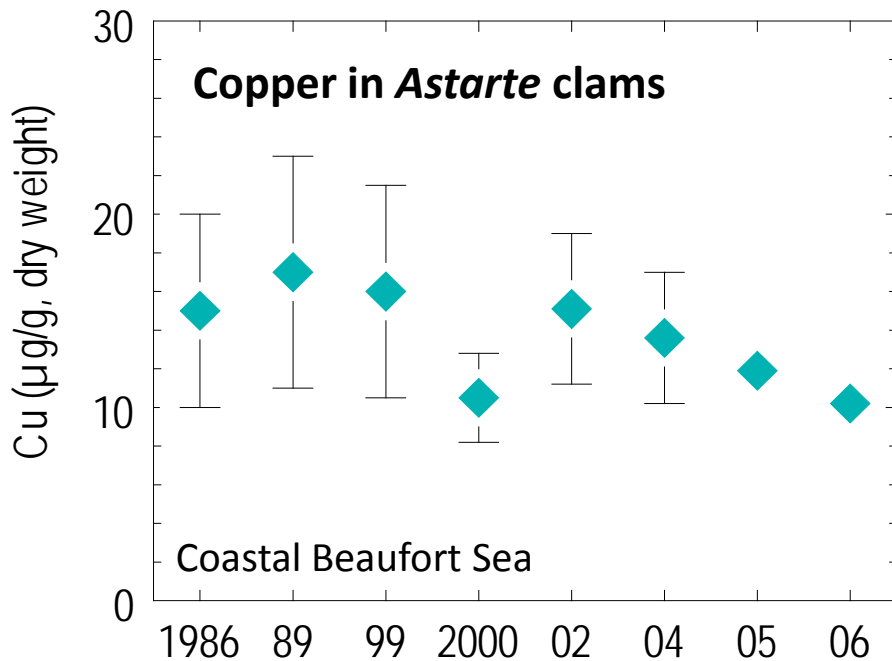
Data courtesy of  
Tom Weingartner

# Synthesis data for contaminants in sediments will be displayed in GIS format



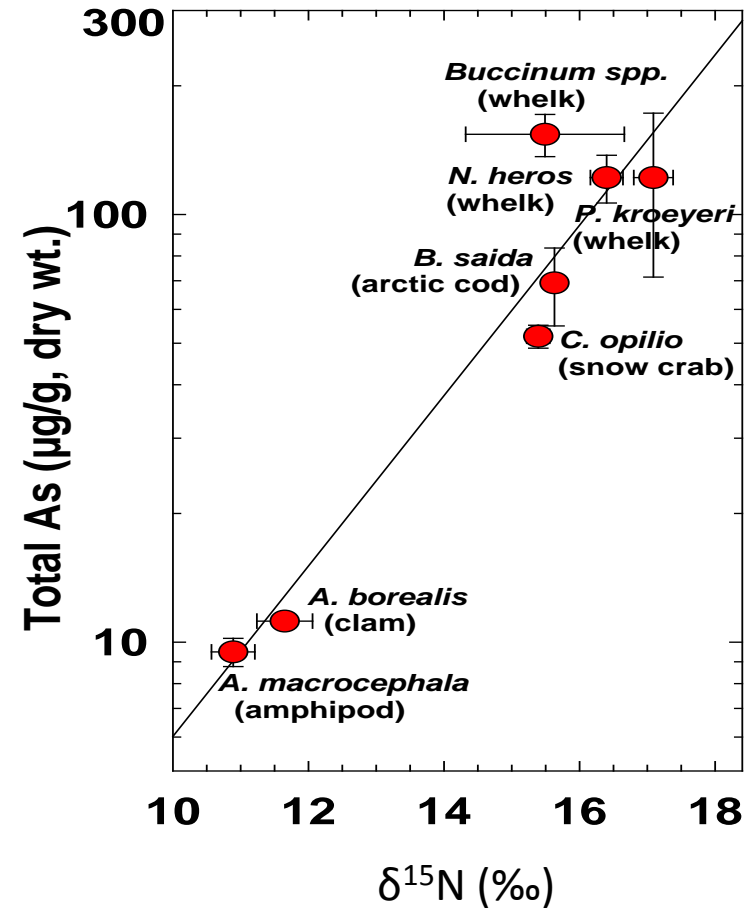
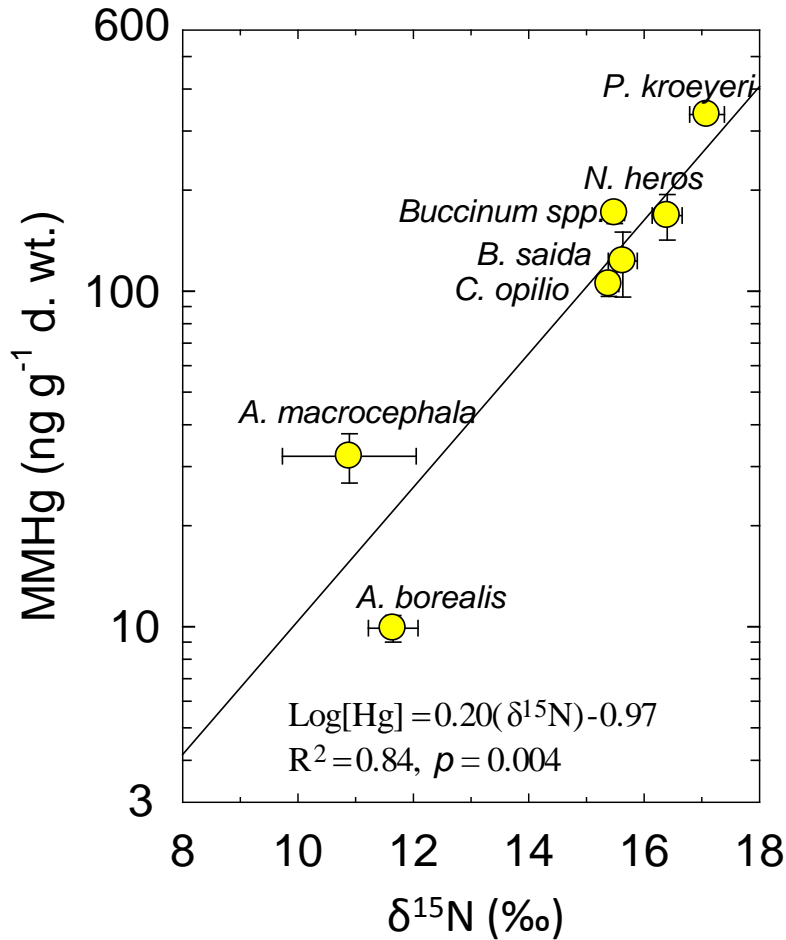
**Location and sediment grain size will be used as key variables for describing contaminant distribution and identifying data gaps**

# Synthesis data for contaminants in biota will be based on collection date and location and will displayed on graphs and maps.

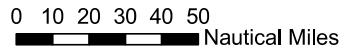
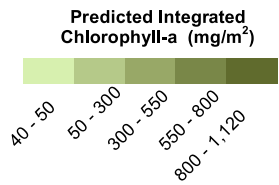
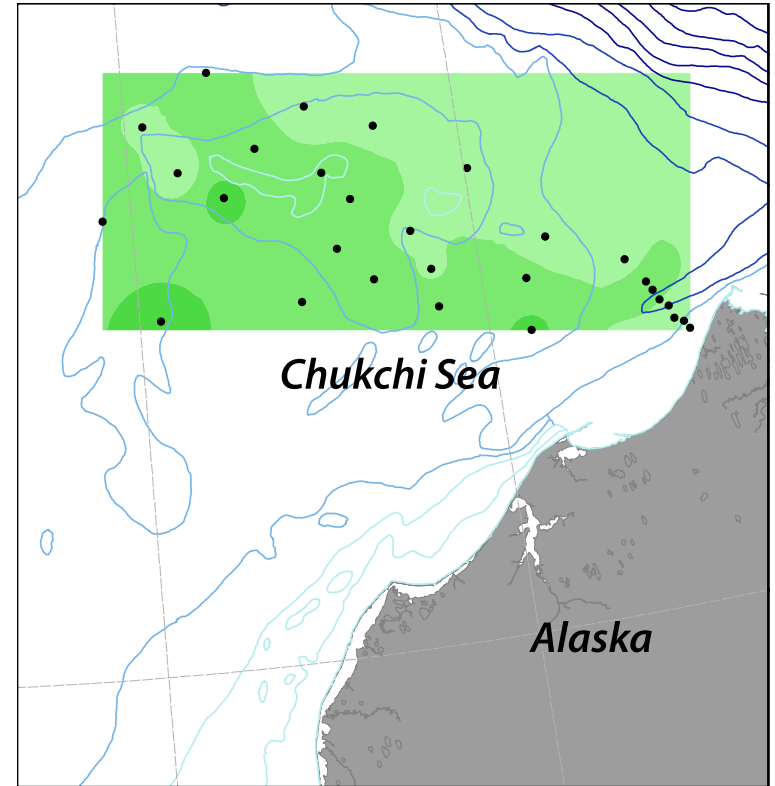
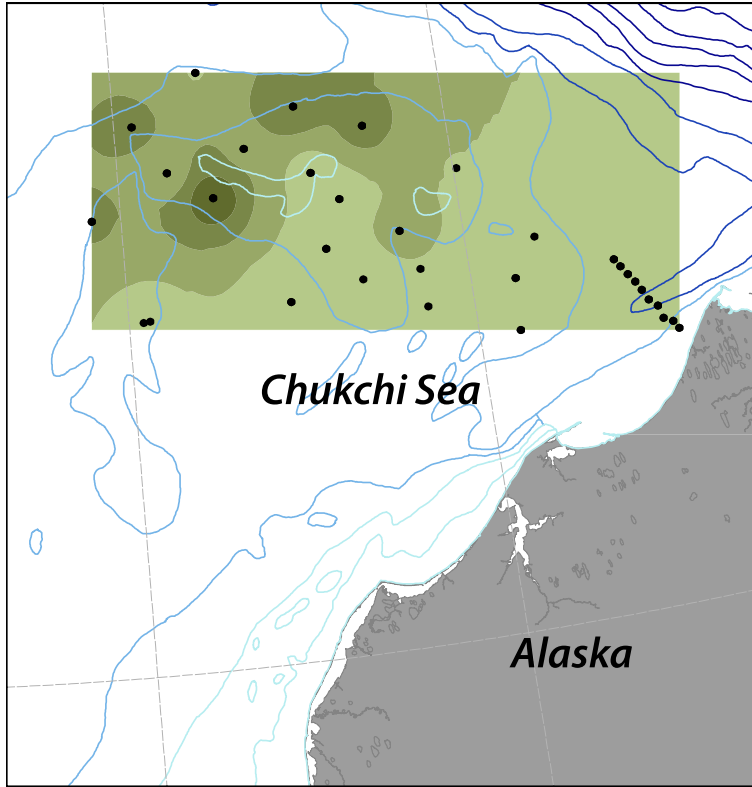




# Synthesis for biota also will include food web bioaccumulation and biomagnification.

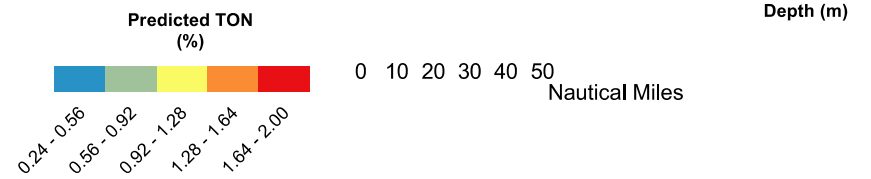
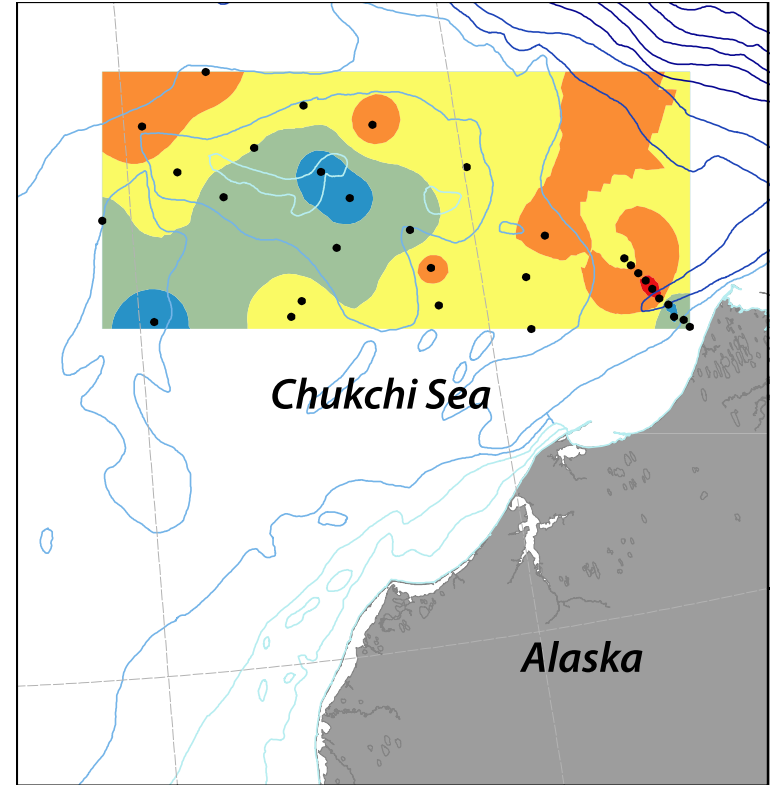
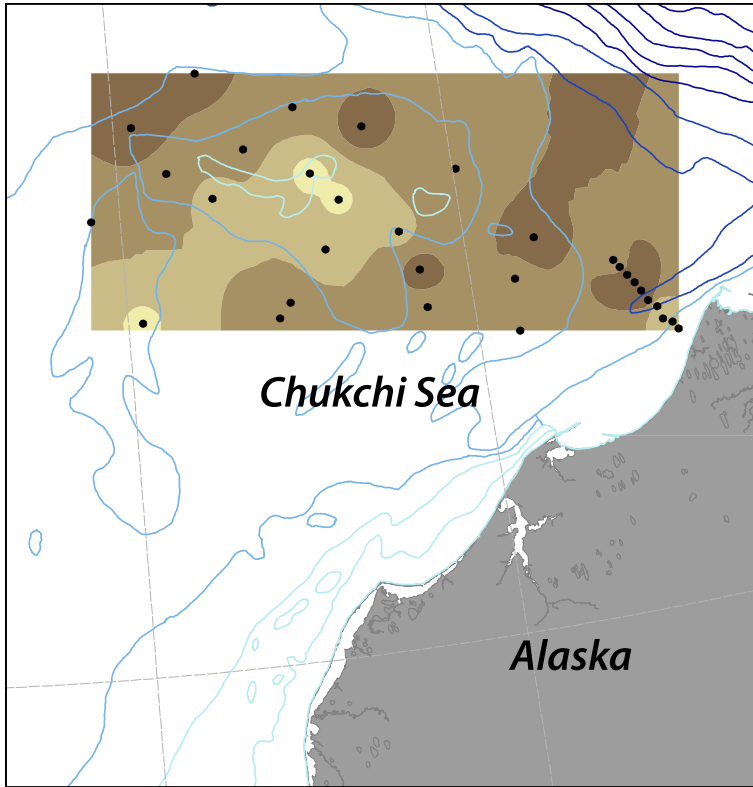


HLY1201



HLY1201

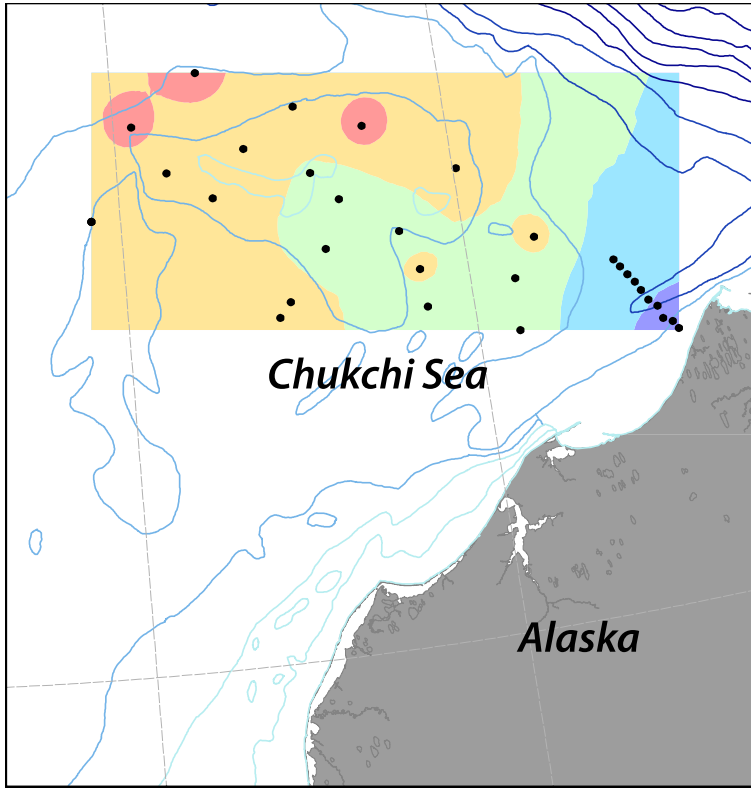
HLY1201



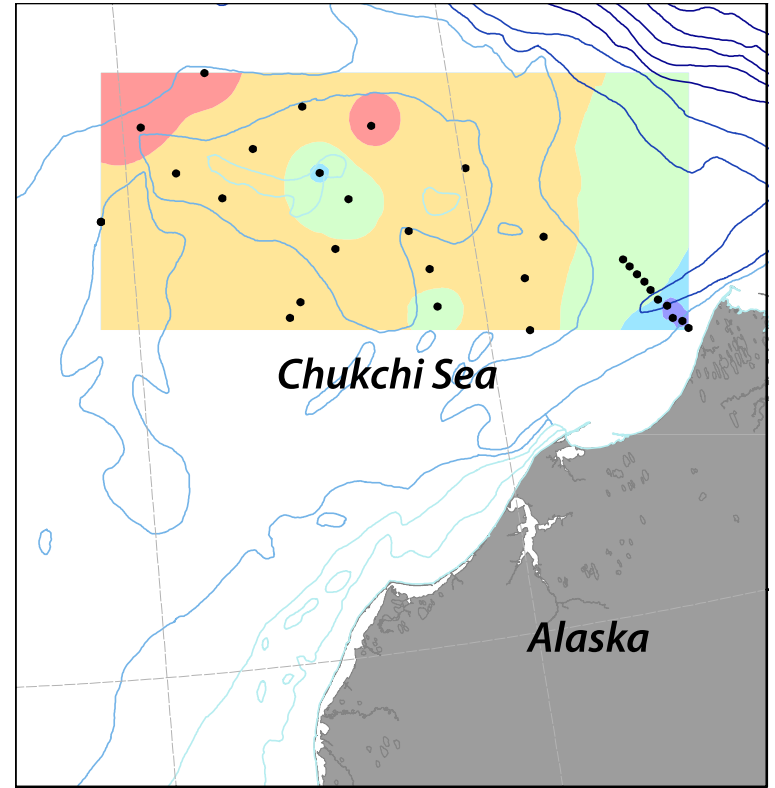
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HLY1201



HLY1201



Data / Project	Description / Long Title	Theme (s)	Link	Evaluation Status & Investigators / Institution / Point of Contact
ANAMIDA	Beaufort Sea BOEM studies, 2004-2007	1-4,6	<a href="http://www.duxbury.battelle.org/cANIMIDA/home/index.cfm">http://www.duxbury.battelle.org/cANIMIDA/home/index.cfm</a>	Trefry is lead, Dunton also
AKMAP	Alaska Monitoring and Assessment Program	1-6	<a href="http://www.dec.state.ak.us/water/wqsar/monitoring/AKMAP.htm">http://www.dec.state.ak.us/water/wqsar/monitoring/AKMAP.htm</a>	We will coordinate when able with Doug Dasher and others
AHDR	Arctic Human Development Report	5	<a href="http://www.svs.is/AHDR/">http://www.svs.is/AHDR/</a>	On-going; Yamin-Pasternak
ANWAP	Arctic Nuclear Waste Assessment Program	1-6	<a href="http://www.nsidc.co">http://www.nsidc.co</a>	Cooper, some data already archived
	Alaska Department of Fish and Game Subsistence Division Publications Searchable Database	4,5,6	<a href="http://www.adfg.alaska.gov/sf/publications/">http://www.adfg.alaska.gov/sf/publications/</a>	Sue Moore is going to help with contacts. Yamin-Pasternak annotating Technical Papers for the coastal settlements in the PacMARS region
AON	Arctic Observing Network and the Advanced Cooperative Arctic Data and Information Service	1-4,6	<a href="http://www.aoncadis.org/">http://www.aoncadis.org/</a>	CBL, UAF, EOL, URI, WHOI are all funded investigators via NSF
AOOS	Alaska Ocean Observing System Arctic Assets	1-6	<a href="http://data.aoos.org/maps/arctic_assets/">http://data.aoos.org/maps/arctic_assets/</a>	McCammon is involved as a collaborator
ArcOD	Species presence or abundance, biomass, benthos, zooplankton, fish, ice	1-4,6	<a href="http://www.arcdiv.org">www.arcdiv.org</a> , <a href="http://www.iobis.org">www.iobis.org</a>	Bluhm, Ashjian, Dunton all are involved
Arctic Biodiversity Assessment	Arctic Biodiversity Assessment	2	<a href="http://www.caff.is/aba">http://www.caff.is/aba</a>	Bluhm involved in writing of two chapters
Arctic EIS	Arctic Integrated Ecosystem Survey 2012-2013 project, funded by BOEM  Surface and bottom trawls ArcEIS	2,3,4,5,6	<a href="http://www.commerce.state.ak.us/dca/planning/cciap/ArcticEcosystemIntegratedSurvey.htm">http://www.commerce.state.ak.us/dca/planning/cciap/ArcticEcosystemIntegratedSurvey.htm</a>	UAF funded investigators will coordinate with:  Franz Mueter Bob Lauth Mike Sigler
Arctic ERMA	ERMA (Environmental Response Management Application)	1-6	<a href="http://response.restoration.noaa.gov/maps-and-spatial-data/environmental-response-management-application-application-erma/arctic-erma.html">http://response.restoration.noaa.gov/maps-and-spatial-data/environmental-response-management-application-application-erma/arctic-erma.html</a>	Large general effort, several PacMARS investigators likely to take advantage of this



Identify relevant data sets and evaluate them

Now a table (“Appendix 1”)

Convert to an annotated narrative

Living document- currently 11 pages





# C3O (Canada's Three Oceans) Data Sets



Sir Wilfrid Laurier cruises,  
July 1998-July 2012 and beyond  
(to 2017)

CTD-nutrients-O-18-chlorophyll-  
benthic data—grain size, C/N,  
sediment chlorophyll and biological  
community analysis

# 2006 Sir Wilfrid Laurier water column data

no	no	no	no	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no	yes	no	no
Pressure	Temperature	Salinity	Fluorescence	Transmittance	StdDev_Press	StdDev_Temp	StdDev_Sal	StdDev_Fluor	StdDev_Trans	StdDev_Term	StdDev_Cond	StdDev_Salraw	StdDev_Sal	StdDev_Salraw	StdDev_Sal	StdDev_Salraw	StdDev_Sal
215.975	6.3444	3.3886	34.0012	1.28	0.17	0.1	0.0003	0	0.0003								36.8
150.174	6.9658	3.4318	33.8964	1.82	0.135	0.2	0.0069	0.0004	0.0004								33.1
124.03	7.006	3.4307	33.8588	1.675	0.225	0.2	0.0088	0.0003	0.0003								34.4
99.29	7.2913	3.4452	33.7488	1.859	0.059	0.3	0.0162	0.0006	0.0104								39.2
78.816	7.5537	3.4528	33.5885	2.022	0.17	0.5	0.0102	0.0003	0.0058								32.7
48.349	7.9976	3.4527	33.1735	2.328	0.427	42.2	0.0082	0.0001	0.0086								21.8
24.005	9.4151	3.4533	31.8884	3.354	1.448	41.3	0.0618	0.0005	0.0501								26.9
19.402	9.8763	3.4636	31.7645	3.589	2.411	39.8	0.1057	0.0005	0.0283								20.5
14.183	10.0749	3.4914	31.6997	4.006	2.954	37.5	0.0521	0.0005	0.0288								23.3
8.83	10.2376	3.4926	31.5701	4.38	2.548	36.2	0.0902	0.0009	0.0409								24.4
4.027	10.4009	3.499	31.4942	4.644	2.708	35.1	0.0409	0.0006	0.011								22.7
0.286	10.5086	3.508	31.492	4.981	2.136	35	0.0046	0.0004	0.001								23.2
85.294	6.9957	3.4318	33.8984	1.579	0.146	40.6	0.0013	0.0001	0.0005								29.7
74.996	7.0174	3.4326	33.8954	1.574	0.144	40.4	0.0045	0.0002	0.0015								29.8
49.104	7.6834	3.4487	33.4311	1.975	0.192	45.2	0.1638	0.0016	0.139								28.7
39.433	8.2098	3.4535	32.9862	2.819	0.23	49.5	0.0614	0.0006	0.0797								25.3
29.123	8.7499	3.4613	32.5709	3.538	0.19	50.7	0.0569	0.0007	0.0528								19.3
19.847	9.7119	3.5112	32.2179	4.461	0.998	46.6	0.391	0.0044	0.1035								9.5
9.188	12.9603	3.7469	31.7121	7.741	10	8.1	0.3771	0.0272	0.0751								5
0.705	13.8593	3.8043	31.6744	7.394	13.91	1.5	0.0454	0.0041	0.013								1
999.709	3.4961	3.204	34.9903	0.238	0.098	49	0.0008	0.0001	0.0004								43.3
974.269	3.5426	3.2064	34.3832	0.24	0.097	48.2	0.004	0.0002	0.0014								43.2
499.014	4.9188	3.2854	34.1055	0.606	0.095	49.5	0.0047	0.0002	0.0031								40.5
299.365	6.0088	3.3595	33.9702	1.46	0.086	50.4	0.0046	0.0004	0.0019								35
200.43	6.9082	3.43	33.909	2.453	0.097	50.4	0.0304	0.0028	0.0023								32
150.457	7.4447	3.469	33.8328	2.647	0.097	6.4	0.0303	0.0016	0.0119								29.6
109.717	7.5269	3.4856	33.5641	3.057	0.132	51.2	0.0061	0.001	0.0156								27.3
74.895	8.2967	3.4239	32.5762	5.256	0.459	51.3	0.0673	0.01	0.0441								10.1
49.436	9.1498	3.4842	32.4345	6.291	1.451	49.1	0.0884	0.0075	0.0055								8
24.509	11.4352	3.6409	31.9919	6.392	8.956	30.1	0.16	0.0132	0.0178								5.1
10.168	13.4933	3.8418	32.1573	6.311	2.998	31.6	0.0447	0.0041	0.0078								4.2
0.031	13.5456	3.8487	32.1826	6.233	1.461	27.2	0.0013	0.0001	0.0007								0
997.581	3.3152	3.1876	34.3847	0.263	0.097	43.9	0.0006	0	0.0004								34.384
750.836	3.8664	3.2174	34.2899	0.236	0.099	44.2	0.0009	0.0001	0.0006								0.0007
500.272	4.5683	3.2536	34.1179	0.578	0.094	45.4	0.014	0.0011	0.0019								43.1
300.677	5.5173	3.318	33.9941	1.31	0.092	46.5	0.008	0.0006	0.0022								41.4
200.197	6.2708	3.3781	33.9072	2.152	0.087	47	0.0098	0.0007	0.0024								38.2
150.578	6.8363	3.4063	33.7427	2.952	0.091	48.8	0.0141	0.0008	0.0023								31.8
100.137	7.6848	3.3703	33.1321	4.317	0.143	48.1	0.0099	0.0005	0.0048								29.8
74.179	7.5517	3.3644	32.6361	5.575	0.134	48.2	0.0169	0.0008	0.0096								21.8
50.729	8.1947	3.4003	32.4314	6.021	0.624	47.7	0.0476	0.0032	0.0119								14.7
24.574	11.6205	3.6719	32.1317	6.216	5.762	35.9	0.5041	0.0789	0.0466								14.9
9.39	13.8246	3.8794	32.2288	6.326	4.222	31.4	0.1369	0.0131	0.0203								11.4
1.295	14.3643	3.9334	32.2789	6.307	1.897	30	0.0149	0.0014	0.0044								0.8
997.812	3.2753	3.1827	34.3677	0.255	0.098	44.8	0.0004	0	0.0003								0.4
750.706	3.7626	3.2053	34.2551	0.312	0.099	45	0.0041	0.0002	0.0013								0.2

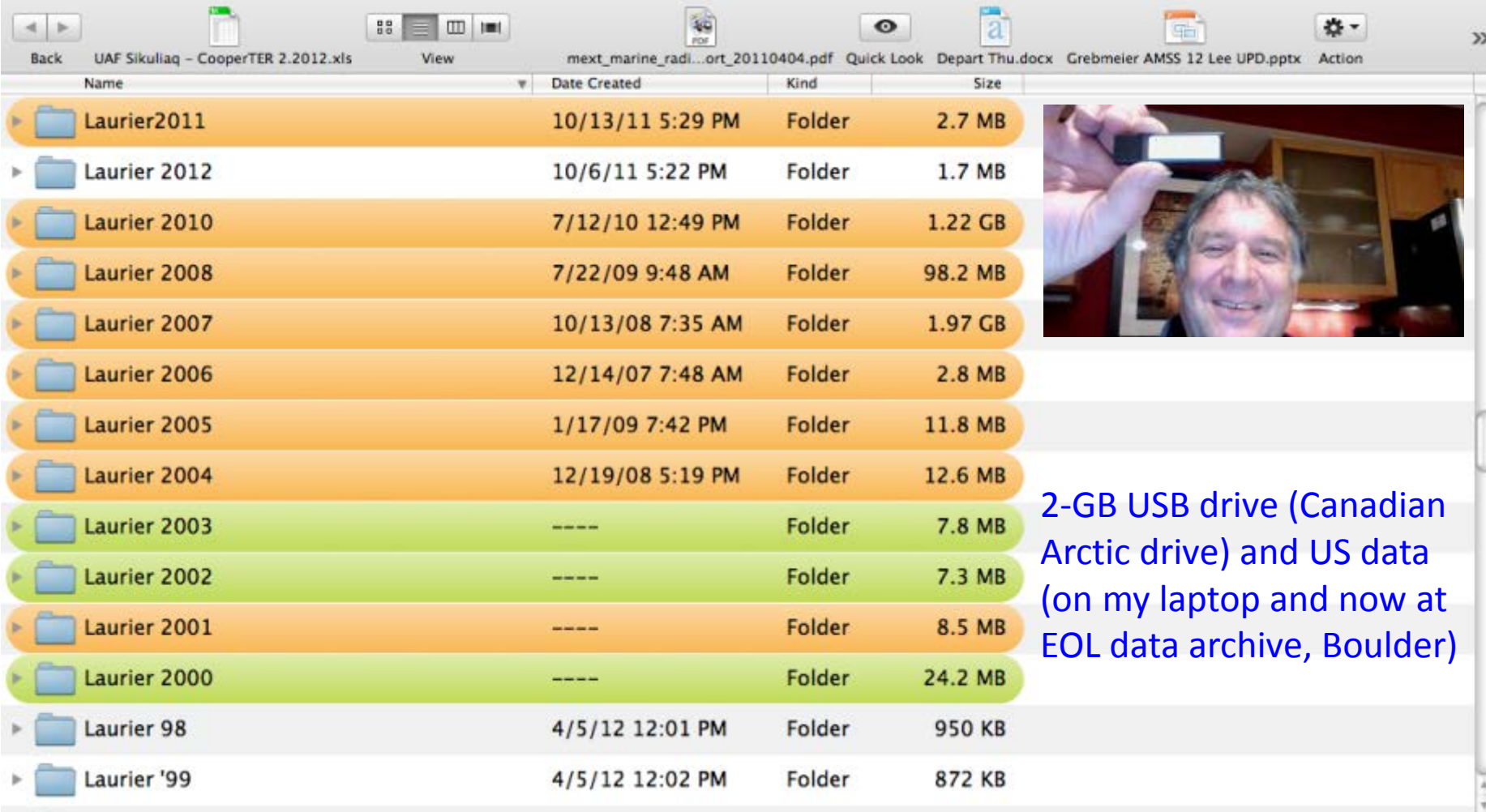


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# Current efforts

## (Still) Cleaning up incomplete data sets



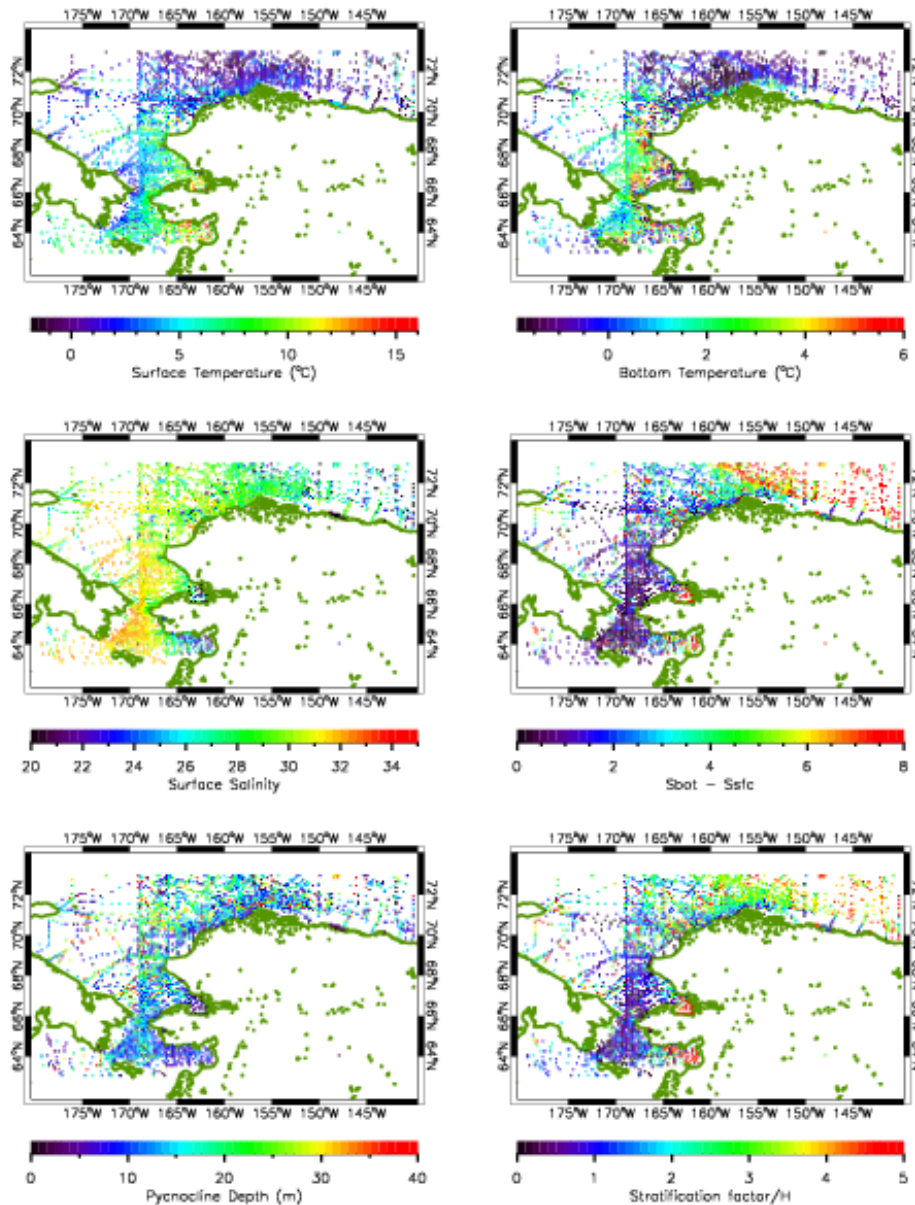
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Laurier2011	10/13/11 5:29 PM	Folder	2.7 MB
Laurier 2012	10/6/11 5:22 PM	Folder	1.7 MB
Laurier 2010	7/12/10 12:49 PM	Folder	1.22 GB
Laurier 2008	7/22/09 9:48 AM	Folder	98.2 MB
Laurier 2007	10/13/08 7:35 AM	Folder	1.97 GB
Laurier 2006	12/14/07 7:48 AM	Folder	2.8 MB
Laurier 2005	1/17/09 7:42 PM	Folder	11.8 MB
Laurier 2004	12/19/08 5:19 PM	Folder	12.6 MB
Laurier 2003	----	Folder	7.8 MB
Laurier 2002	----	Folder	7.3 MB
Laurier 2001	----	Folder	8.5 MB
Laurier 2000	----	Folder	24.2 MB
Laurier 98	4/5/12 12:01 PM	Folder	950 KB
Laurier '99	4/5/12 12:02 PM	Folder	872 KB

2-GB USB drive (Canadian Arctic drive) and US data (on my laptop and now at EOL data archive, Boulder)

# Possible Synthesis Expectations

- Cruise every July, very similar timing each year
  - Have chlorophyll concentrations and total inventories changed?
  - Need to assess water mass position (via nutrients?)
  - Tie-in with current and future DBO



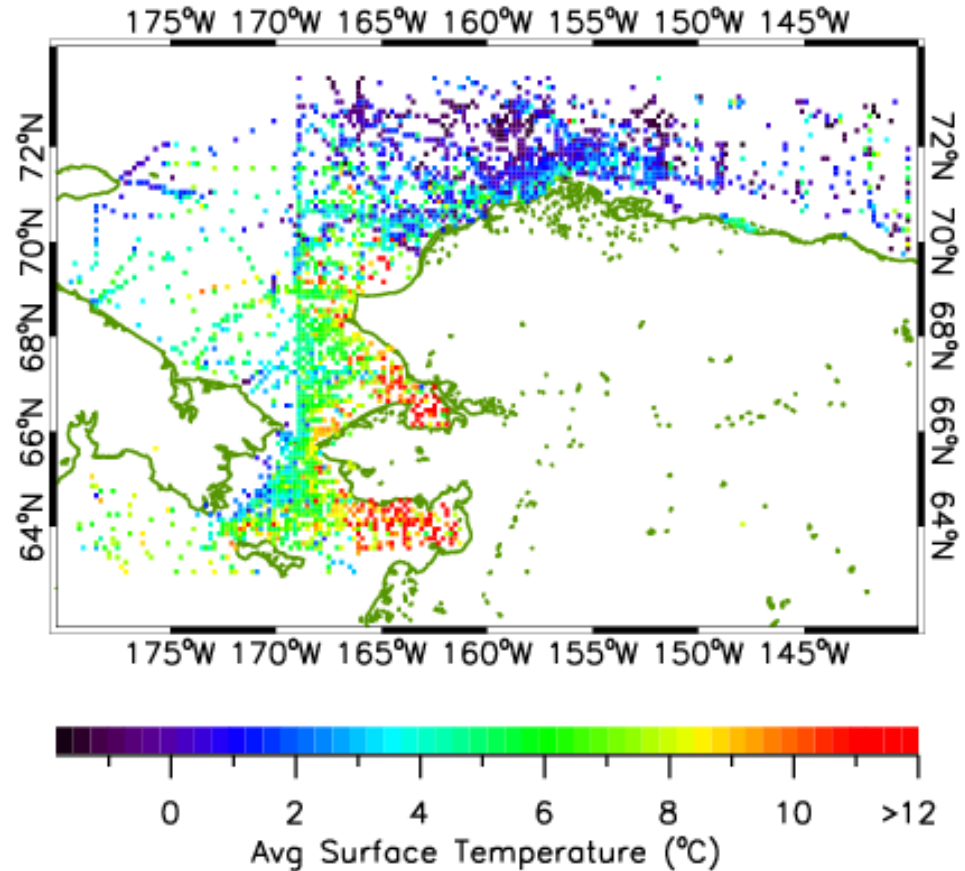
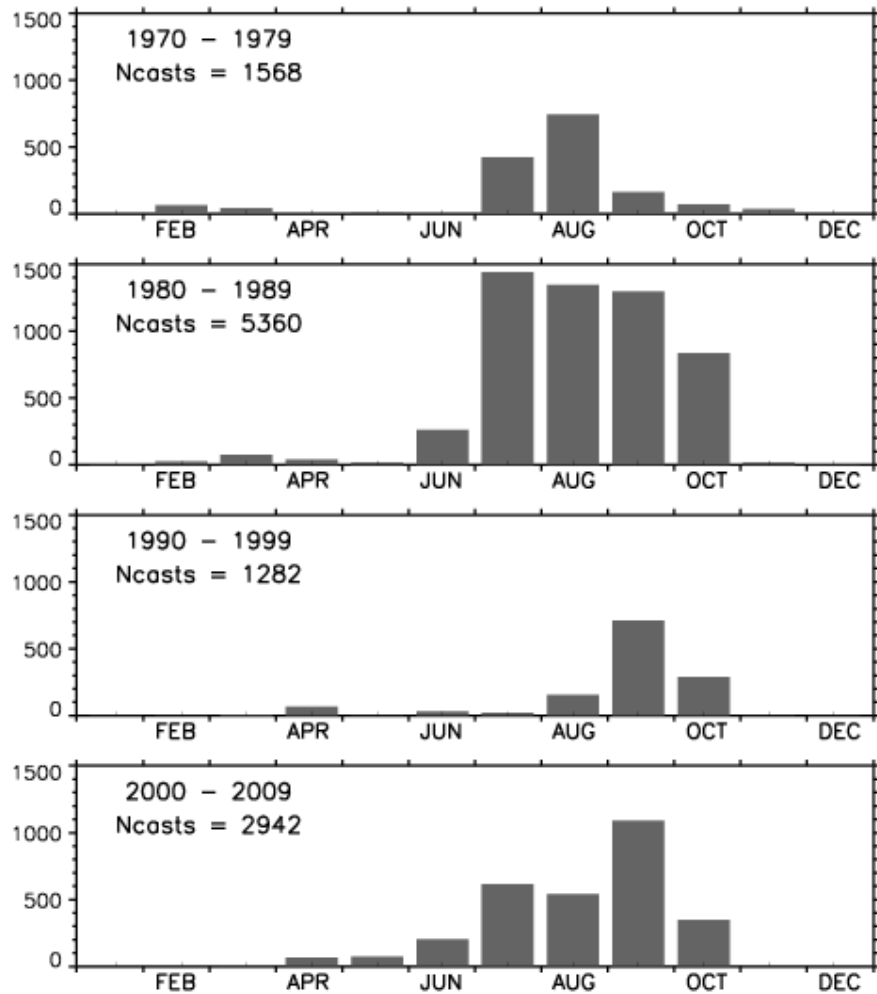


## Extracted Data from each CTD Cast

- Data/Cruise ID
- Stn/Cast #
- YY MM DD
- HH MM
- Lat
- Lon
- Depth
- $T_{sfc}$
- $T_{deep}$
- $T_{max}$
- $Z_{sfc}$
- $Z_{deep}$
- $Z_{Tmax}$
- $S_{sfc}$
- $S_{deep}$
- $S_{Tmax}$
- BV
- $Z_{BV}$
- Stratification



# CTD spatio-temporal distribution



Awaiting CTD data from Chukchi lease area

# Synthesis of Contaminants in Sediments and Biota

## 1. Assimilate available data sets for the following chemical contaminants:

Metals: Hg (including MeHg), Cd, As, Pb, Cu, Pb, Zn, ...  
Polycyclic Aromatic Hydrocarbons (PAH)  
Polychlorinated Biphenyls (PCBs)  
Pesticides? (DDT, chlordane)?

## 2. Synthesis paper for Hg (MeHg), Cd, and PCBs (or PAH) in sediments and biota (from plankton to marine mammals and birds) from the perspective of sources of the contaminant and pathways for delivery of those contaminants to target organisms.

Source → Pathway → Target

# Synthesis paper will focus on three contaminants of concern

**Hg (MeHg), Cd, and PCBs (or PAH)**

**in sediments and biota (plankton to marine mammals and birds)**

**from the perspective of sources of the contaminant and pathways for delivery of that contaminant to target organisms.**

**For example: Hg from atmospheric and coastal sources  
Cd from deep ocean water and riverine sources  
PCBs from atmospheric and some coastal sources  
PAH from atmospheric, fossil fuel and coastal sources**

**Knowledge gained from focusing on pathways may then be applied to other contaminants.**



# Summary

**Introduction to PacMARS themes**

**What is synthesis?  
(Via Examples)**

**How will we get it done?  
(Approaches)**

**Examples of Possible End-Products**

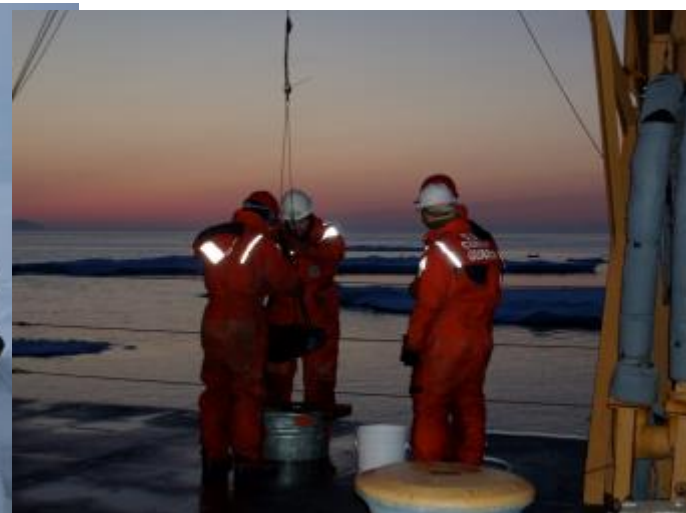


# To Come

**Outreach to Local Communities**

**Action by Agency Stakeholders**

**Future Field Research Efforts**



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