Canadian Arctic Marine Science Plans

2020

Pacific Arctic Group Meeting

Arctic Science Summit Week 2020

Online

Bill Williams, Fisheries and Oceans Canada
CCGS Louis S. St-Laurent

JOIS - AON-BGOS
Chief Scientist: Bill Williams
Supported by: NSF, DFO
Collaborators: WHOI, JAMSTEC, TUMSAT, KIT ...
Provisionally 5 – 30 Sept, 2020 (25 days)
Kugluktuk - Canada Basin - Kugluktuk
27 participants
CTD/rosette profiles + biogeochemical sampling
Vertical net casts for zooplankton
XCTD casts
Underway measurements
Ice Observations (ship, ice and helicopter)
BGOS mooring recovery, possible redeployment
Deploy 4 Ice Tethered Profilers, 2 Seasonal Ice Mass Balance Buoys
Section along 150W

2004

2019
Depth (m) of Pacific Water (S=33.1)
Freshwater content

From Rick Krishfield
Total Fresh Water (m)

Change in FW from 2003:
- 55%
- 40%
Ocean acidification in the surface waters of the Beaufort Gyre

Zhang, Yamamoto-Kawai, Williams (2020) 10.1029/2019GL086421
Ocean acidification in the surface waters of the Beaufort Gyre

Zhang, Yamamoto-Kawai, Williams (2020) 10.1029/2019GL086421
CCGS Sir Wilfrid Laurier
7 days for science, 16 scientists, boarding in Victoria

- U-CTD & X-CTDs during transit
- CTD/Rosette, bongo net casts across the Gulf of Alaska.
- Underway seawater sensors and water sampling
- Deployment of 5 Argo floats
- On-board incubations to estimate primary productivity

After Dutch Harbor

- Benthic sampling using Van Veen grabs & Haps corer
- CTD & water sampling with the vertically towed bongos.
- Seabird and marine mammal observation
- On-board incubations to estimate primary productivity
- Continuous Plankton Recorder
- Mooring recovery

Victoria-Barrow
3-23 July (est.)
CCGS Sir Wilfrid Laurier (Arctic Leg 3)
Marine Hazards ... Ocean Monitoring
23 Sep – 5 Oct 2020

14 oceanographic moorings to be recovered, 14 to be deployed
Continuous near-surface temperature & salinity
1 oceanographic section, CTD only: DBO-8; 2 CPR tows, each 550 mi
Organic contaminants sampling – seawater
Seabed mapping by multi-beam sonar - opportunistic
Year-round data document marine climate: Norms, natural variation, extremes, progressive change

- **Sea ice**
  - Thickness, drift, hazardous features
- **Sea surface**
  - Storm waves, storm surge
- **Ocean current – surface to seabed**
  - Seawater pathways (e.g. nutrient delivery, pollutant dispersal), dangerous currents
- **Ocean water masses – temperature, salinity**
  - Identify properties, origins of seawater
- **Sediment in seawater**
  - Suspension, transport & deposition
- **Organic contaminants in seawater**
- **Biological enhancers**
  - Nutrient upwelling, zooplankton variation
- **Ambient sound**
  - Mammal’s vocalization, species presence, natural sound, seismic surveys, ship noise
F/V Frosti: 41m commercial fishing trawler
Canadian Beaufort Sea Marine Ecosystem Assessment (CBS-MEA)

Science in support of a changing Beaufort Sea ecosystem

DFO Leads: A. Majewski, A. Niemi, J. Reist and R. Young
Project approach

• Multidisciplinary science team consisting of DFO, University and Community partners

• Off-shore, ship-based sampling - physical, chemical and biological (bacteria to bowheads) data collection
  – Linked mooring program (Niemi)

• Real-time ecosystem integration

• Complementary nearshore/coastal work included in the study area
Water-column sampling

CTD-Rosette:

- Temperature, salinity, and other water properties will be measured to identify water mass habitats for fishes, plankton, and benthic invertebrates.
**Water-column sampling**

**Hydroacoustics:**
Ship-mounted hydroacoustics provide a picture of where the fish and plankton are in the water column.

**Mid-water nets:**
Mid-water trawls and plankton nets will identify the species that live within different water masses.
**Bottom sampling**

Box-core and beam trawl:
- Document bottom-type (e.g., mud vs. gravel) where fish and invertebrates are sampled
- Sample the communities of invertebrates (fish & MM food) living within the sediments and on the sea floor
Bottom sampling

Small beam trawl
- Catches small bodied fishes e.g., sculpins, lumpsuckers, snailfishes
- Extend coverage from CCGS Nahidik
- Allows comparisons with Alaskan data

Larger bottom trawl
- Catches a broad spectrum of species & sizes including larger, faster fishes.
  e.g., flatfishes, skates
2019 stations:

2020: 1 August – 11 September, stations TBD.
R/V Martin Bergmann
19-m coastal research vessel
6 scientists
Based in Cambridge Bay, NU
**R/V Martin Bergmann**

**THE LITTLE BOAT THAT DID**

- **Satellite Tracked Drifters**
- **Forward Sonar**
- **300 KHz ADCP**
- **500 KHz ADCP**
- **Underway Eco-Sampler**
- **Underway Sampler**
- **Sidescan**
- **Weather Obs**
- **Adrian’s Office**
- **600 m Winch**
- **A-Frame**

**Passive Acoustic Mooring**

**Acoustic Backscatter Mooring**

**Current Mooring**

**Bottom Camera**

**Bottom Dredge**

**Box Corer**

**Sediment Grab**

**Zooplankton Net**

**UCTD**

**Chl_a Chain**

**CTD Rosette**

**Adrian**

**Peter**

**Jason**

**Clyde**

**Darcey**

**Randy**

**Bill**

**Bodil**

**Seth**

**Kristina**

**Chris**

**Eddy**

**Eddy Carmack**

**Also:**

- **River Sampler**
- **Remote Weather Station**
- **Ancillary Fleet**
Kitikmeot Sea Science Study (K3S, since 2016)
To explore the physical and geochemical drivers of ecosystems in the Kitikmeot Sea.

Bill Williams, Bodil Bluhm, Kristina Brown, Eddy Carmack, Seth Danielson, Lina Rotermund, Brent Else, CJ Mundy
Overall estuarine freshwater - saltwater balance:

Inflowing freshwater from rivers mixes with inflowing deep salty water to make the shallow outflow:

<table>
<thead>
<tr>
<th></th>
<th>Salinity (g/kg)</th>
<th>Volume (km³/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep Inflow</td>
<td>29</td>
<td>256.25</td>
</tr>
<tr>
<td>Freshwater Inflow</td>
<td>0</td>
<td>41</td>
</tr>
<tr>
<td>Shallow Outflow</td>
<td>25</td>
<td>297.25</td>
</tr>
</tbody>
</table>

Residence time: 13 years

300km³/yr of inflow at 8 mmol/m³ of NO₃ = 2.7 gC/m²/yr
Components:
- Estuarine circulation
- Wind-driven flows
- Freshwater inflow
- Tidal dynamics
- Tidal mixing in narrow straits

Primary production
Geochemical tracers
Inorganic carbon cycles
Benthic ecology
2020 Kitikmeot Sea Science Study (August 2020)

Mooring deployments across the Kitikmeot Sea:

Bill Williams, Bodil Bluhm, Kristina Brown, Eddy Carmack, Seth Danielson, Lina Rotermund, Brent Else, CJ Mundy
The Barrow Strait Monitoring Program and Real-time ocean observatory

Clark Richards,
Bedford Institute of Oceanography

- Originally maintained from 1998 to 2011.
- Turned-around August 2019 for 2 years
- **Principle objective:** To quantify freshwater and volume transports into the NW Atlantic.
- Measurements of water properties, currents, and ice draft, passive acoustics.
DRAFT 2020 Amundsen Expedition Plan
Draft February 2020
Overview
114 days at sea
4 legs

Legend:
- Cruise Track Leg 1 AZOMP
- Cruise Track Leg 2a Coral Seep ROV, ArcticNet & Bio-Argo Floats
- Cruise Track Leg 2b ArcticNet & SN Techno
- Cruise Track Leg 3a ArcticNet & RadCARBBES
- Cruise Track Leg 3b PeCaBeau, ArcticNet, Gliders & SN
- Alternate Cruise Track Leg 3b (if time)
- Cruise Track Leg 4 KEBABB, ArcticNet & SN Qaanaaq
- Community/City
- CTD
- KEBABB Basic
- Nutrient
- AZOMP Bio
- AZOMP CTD
- Contaminants
- Basic
- DFO Benthic
- Full
- PeCaBeau
- Sentinel North
- Mooring
- ROV
- ArcticKelp
- Argo Float
- Bio-Argo Float
- Coring
- Glacier/Ice
- Glider
- River

St. Anthony NL 30 July
Kugluktuk 2 September
Cambridge Bay 24 September
Resolute Bay 27 August
Pond Inlet 19 August
Quebec City 3 July & 24 October
Data collection near coast:

- Seawater temperature, salinity, tracers of sea-ice melt water and velocity
- Nutrients, oxygen, carbon products (ocean acidification), microplastics
- Zooplankton, Phytoplankton, Microbes
- Signs of Fukushima spill

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>DBO Line</th>
<th>Distance from shore</th>
<th>Time within 50 nm of shore</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 Sep</td>
<td>Barrow Line</td>
<td>6</td>
<td>27 nm</td>
<td>14 hrs</td>
</tr>
</tbody>
</table>

Contact: Bill Williams Bill.Williams@dfo-mpo.gc.ca

Data and cruise reports available: https://www.whoi.edu/website/beaufortgyre/data