



Fisheries and Oceans
Canada

Pêches et Océans
Canada

Canadian Arctic Marine Science 2019

Pacific Arctic Group Meeting

October, 2019

Hangzhou, China

Bill Williams, Fisheries and Oceans Canada



Canada

Bering Strait on Sunday morning!



CCGS Louis S. St-Laurent



GEM Arctic 2019

CCGS Louis S. St-Laurent



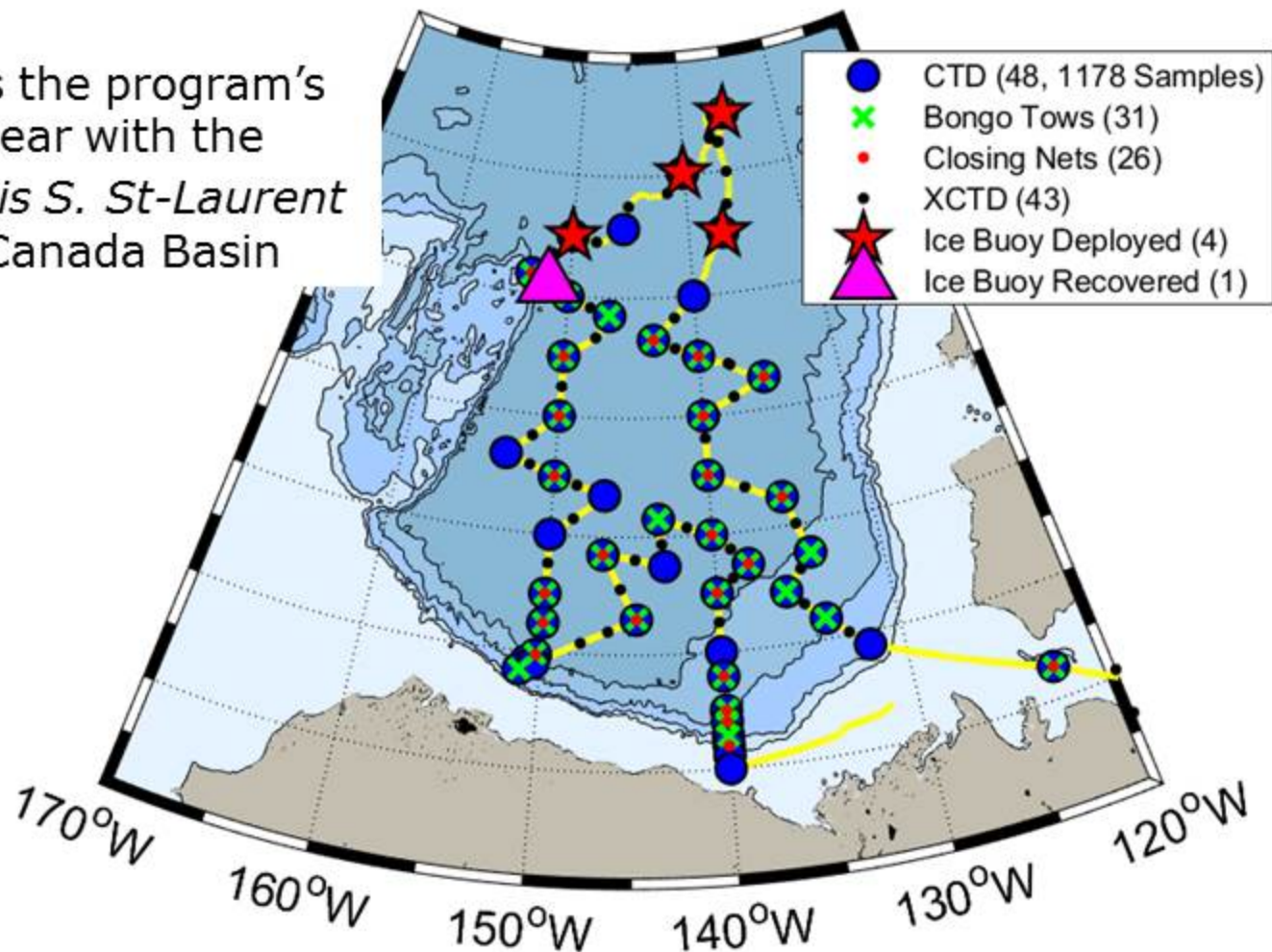
GEM Arctic 2019

CCGS *Louis S. St-Laurent*

JOIS - AON-BGOS

12 Sept – 04 Oct 2019

2019 was the program's
17th year with the
CCGS Louis S. St-Laurent
in the Canada Basin

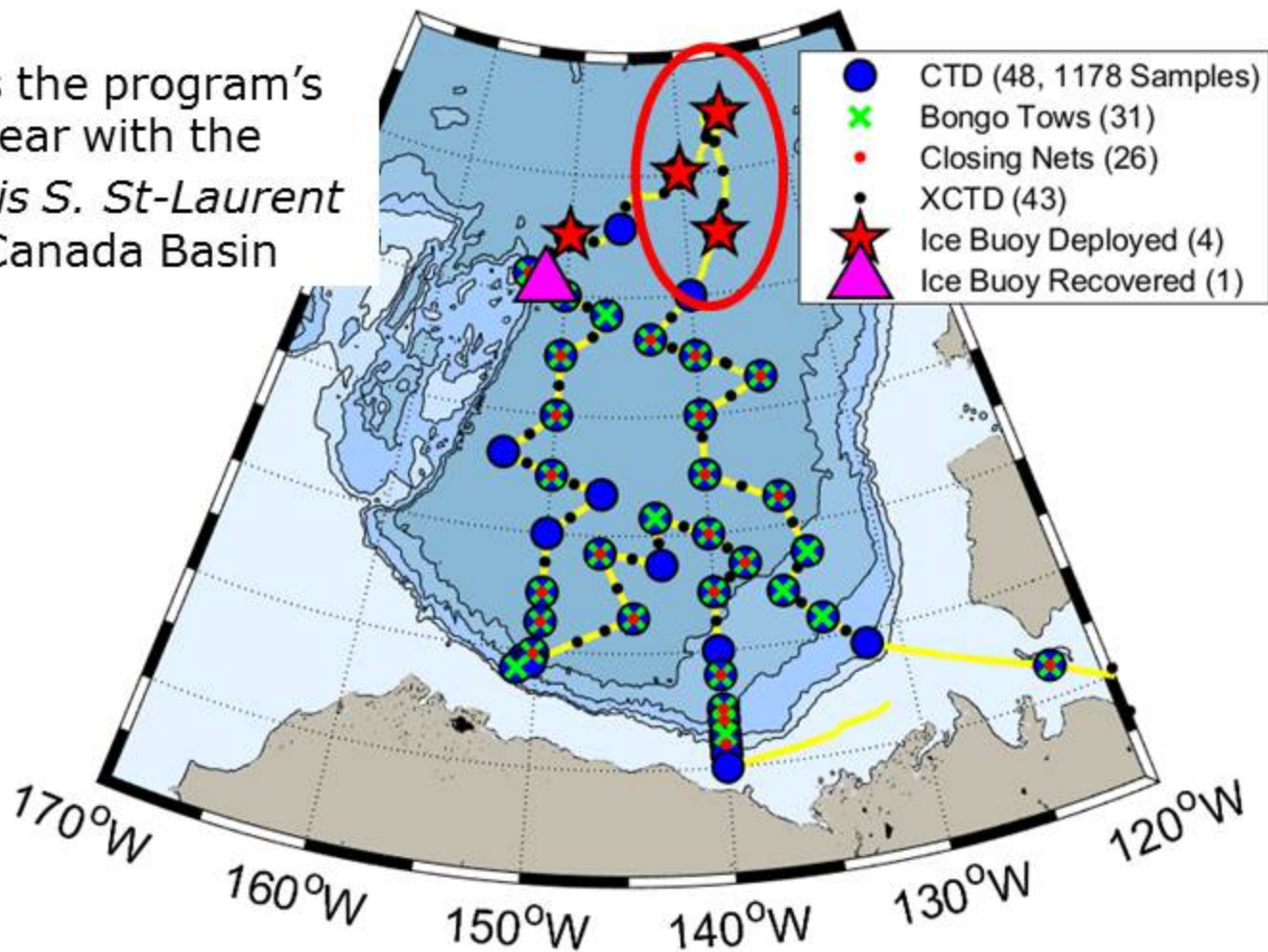


CCGS Louis S. St-Laurent

JOIS - AON-BGOS

12 Sept – 04 Oct 2019

2019 was the program's
17th year with the
CCGS Louis S. St-Laurent
in the Canada Basin



CCGS Louis S. St-Laurent



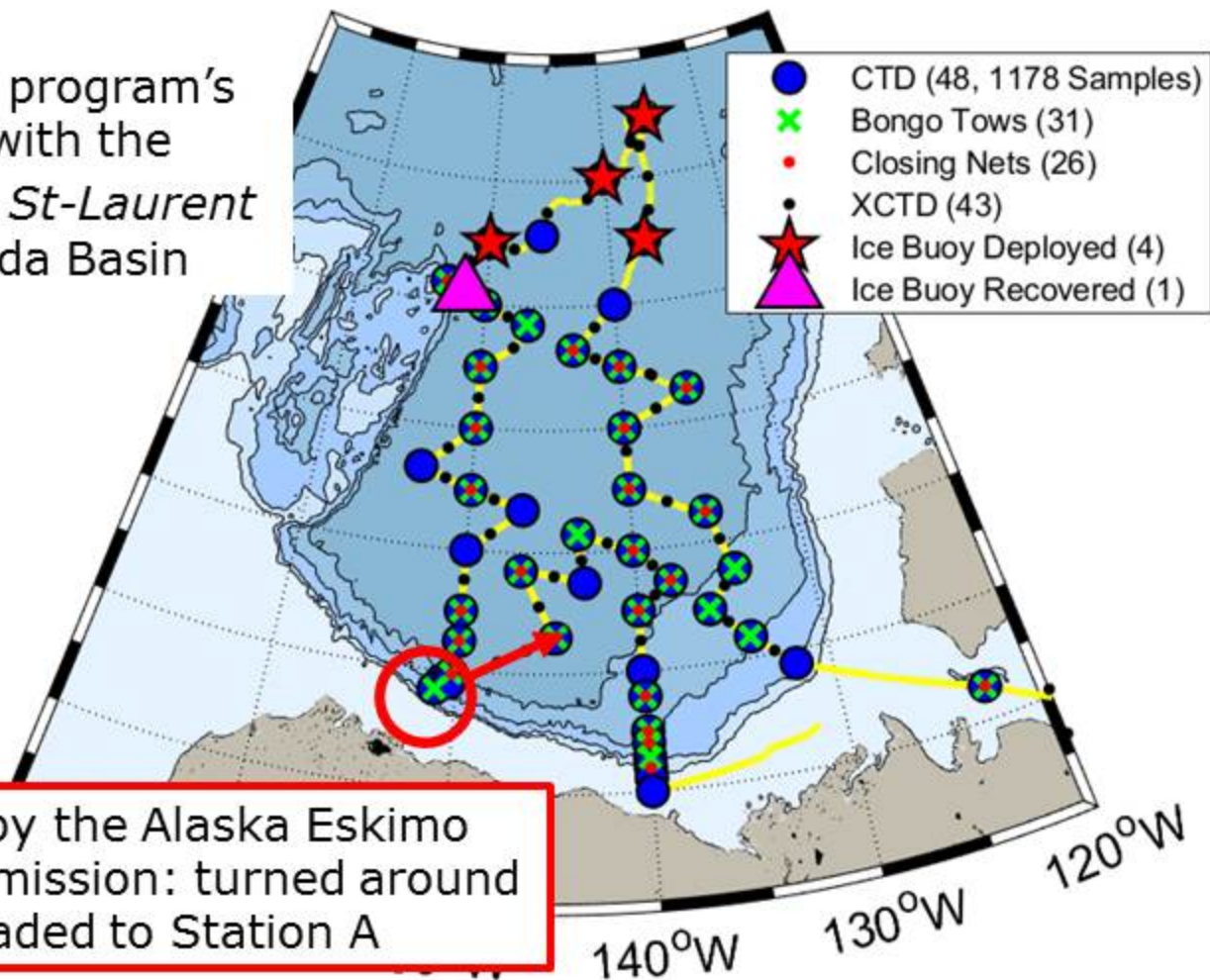
Large flows of level ice in the north.

CCGS *Louis S. St-Laurent*

JOIS - AON-BGOS

12 Sept – 04 Oct 2019

2019 was the program's
17th year with the
CCGS Louis S. St-Laurent
in the Canada Basin



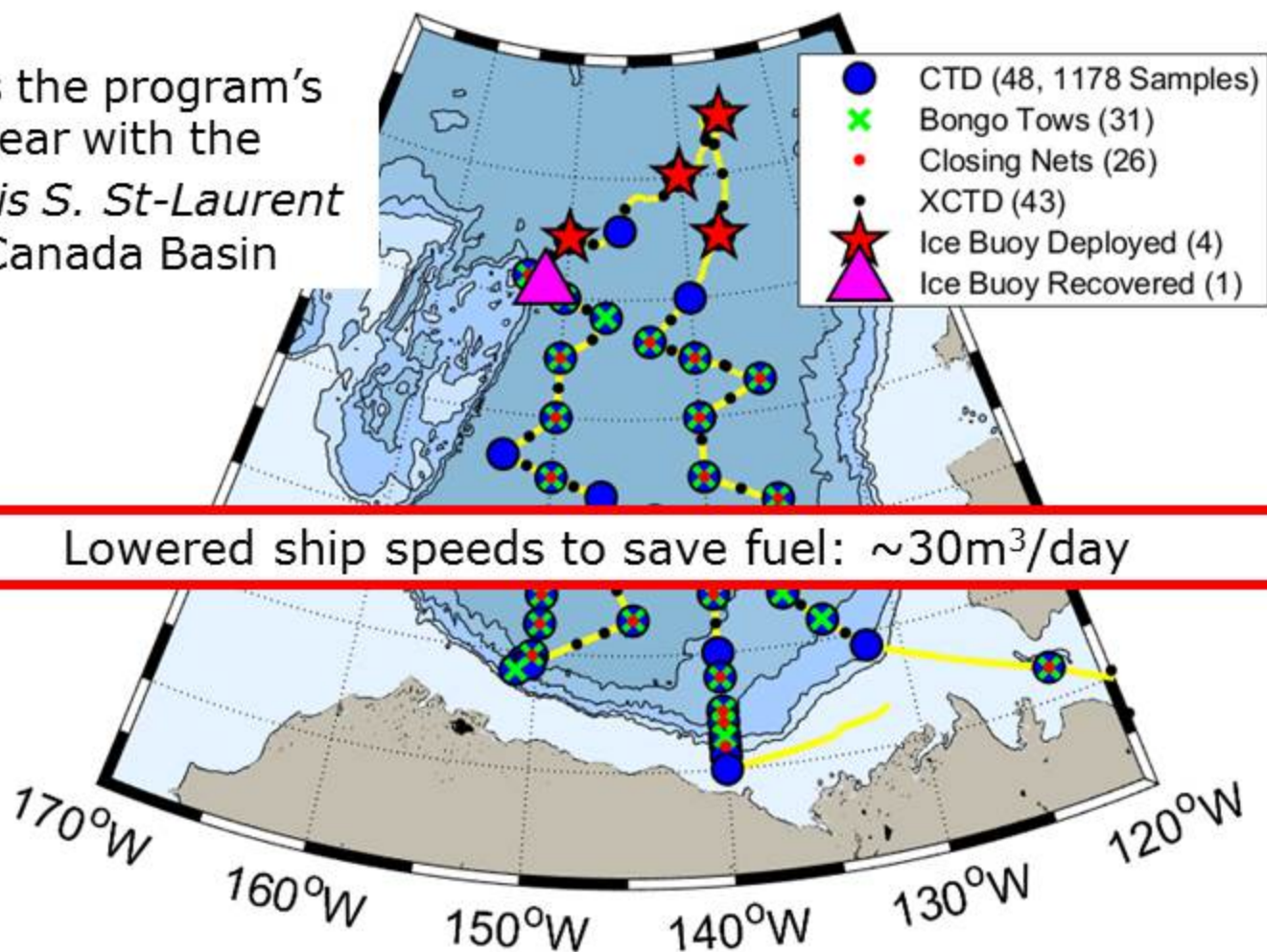
Contacted by the Alaska Eskimo
Whaling Commission: turned around
and headed to Station A

CCGS *Louis S. St-Laurent*

JOIS - AON-BGOS

12 Sept – 04 Oct 2019

2019 was the program's
17th year with the
CCGS Louis S. St-Laurent
in the Canada Basin





Joint Ocean Ice Studies & Beaufort Gyre Observation System 2019

CCGS Louis S. St-Laurent | September 10th – October 4th, 2019



Roy Lockyer (CCGS Louis S. St-Laurent)
 Alexander Fowler (CCGS Louis S. St-Laurent)
 Nicholas Houle (CCGS Louis S. St-Laurent)
 Alexandre Missi (CCGS Louis S. St-Laurent)
 Geoffrey Ellis (CCGS Louis S. St-Laurent)
 Ricardo Armasio (CCGS Louis S. St-Laurent)
 Gary Morgan (CCGS Louis S. St-Laurent)
 Vincent Mullett (CCGS Louis S. St-Laurent)
 David Pike (CCGS Louis S. St-Laurent)
 Taylor Marsh (CCGS Louis S. St-Laurent)
 Bradley Hillier (CCGS Louis S. St-Laurent)
 Daryl Tobin (CCGS Louis S. St-Laurent)
 Roger Carow (CCGS Louis S. St-Laurent)
 Jerome Sibley (CCGS Louis S. St-Laurent)
 Steven Krats (CCGS Louis S. St-Laurent)
 Albert Herbit (CCGS Louis S. St-Laurent)
 Anthony Walters (CCGS Louis S. St-Laurent)
 Guillaume Paradis (CCGS Louis S. St-Laurent)



Jeffrey Seitz (CCGS Louis S. St-Laurent)
 Stuart Maclean (CCGS Louis S. St-Laurent)
 David White (CCGS Louis S. St-Laurent)
 Paul Jenkins (CCGS Louis S. St-Laurent)
 Bradley Gillard (CCGS Louis S. St-Laurent)
 Travis Macdonald (CCGS Louis S. St-Laurent)
 Joseph Bryan (CCGS Louis S. St-Laurent)
 Donald Hillier (CCGS Louis S. St-Laurent)
 Brandon Baker (CCGS Louis S. St-Laurent)
 James Mayo (CCGS Louis S. St-Laurent)
 Kyle Spengler (CCGS Louis S. St-Laurent)
 Philip Rideout (CCGS Louis S. St-Laurent)
 Brendon Manger (CCGS Louis S. St-Laurent)
 Christopher Hudson (CCGS Louis S. St-Laurent)
 Steve Wickens (CCGS Louis S. St-Laurent)
 Anthony Engbers (CCGS Louis S. St-Laurent)
 Steven Tucker (CCGS Louis S. St-Laurent)
 Kelly Waters (CCGS Louis S. St-Laurent)



Peer Klattenhoff (CCGS Louis S. St-Laurent)
 Stephen Lloyd (CCGS Louis S. St-Laurent)
 Karen Seider (CCGS Louis S. St-Laurent)
 Raymond Lockyer (CCGS Louis S. St-Laurent)
 Cheryl Berger (CCGS Louis S. St-Laurent)
 Woodrow Compton (CCGS Louis S. St-Laurent)
 Lena Abbott (CCGS Louis S. St-Laurent)
 Kimberly Dusey (CCGS Louis S. St-Laurent)
 David Froggatt (CCGS Louis S. St-Laurent)
 John David (CCGS Louis S. St-Laurent)
 Cassandra Young (CCGS Louis S. St-Laurent)
 Gary Squires (CCGS Louis S. St-Laurent)
 Cory Simms (CCGS Louis S. St-Laurent)
 Raehene Kerrivan (CCGS Louis S. St-Laurent)
 Curtis Benjamin (CCGS Louis S. St-Laurent)
 Matthew Ackerman (CCGS Louis S. St-Laurent)
 Catherine Buschhaus (CCGS Louis S. St-Laurent)
 Jennifer Finlayson (CCGS Louis S. St-Laurent)

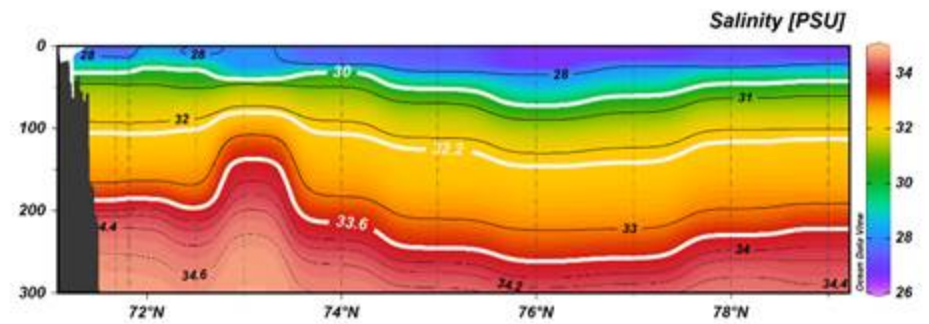
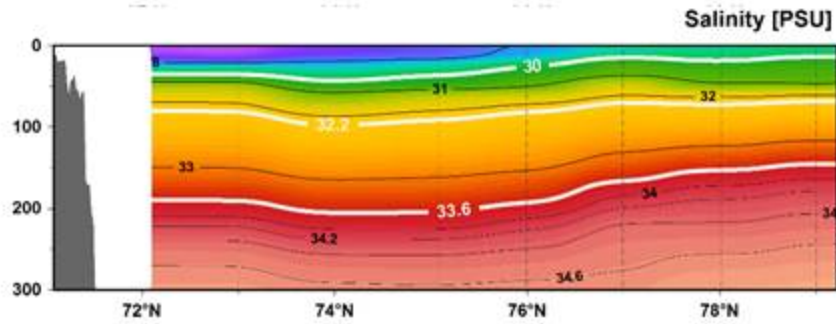
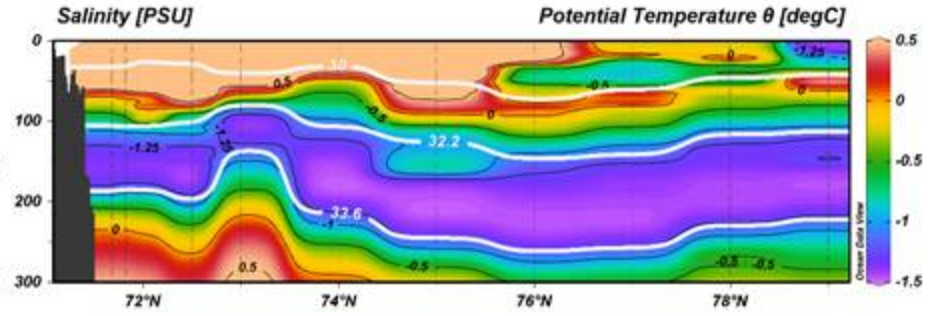
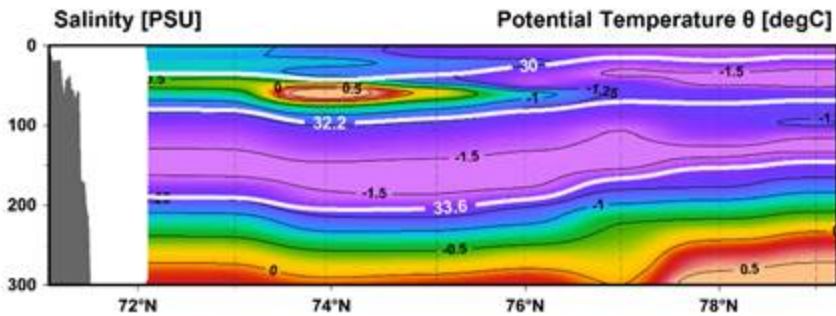
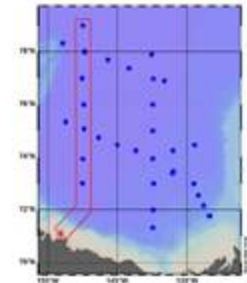


Sarah Zimmermann (CCGS Louis S. St-Laurent)
 Edmond Fok (CCGS Louis S. St-Laurent)
 Sarah-Ann Quinsal (CCGS Louis S. St-Laurent)
 Marty Develaar (CCGS Louis S. St-Laurent)
 Kenny Soozalava (CCGS Louis S. St-Laurent)
 Christopher Clark (CCGS Louis S. St-Laurent)
 Stephen Page (CCGS Louis S. St-Laurent)
 Peter Van Buren (CCGS Louis S. St-Laurent)
 Jeff O'Brien (CCGS Louis S. St-Laurent)
 Fred Marsh (CCGS Louis S. St-Laurent)
 Marshall Swartz (CCGS Louis S. St-Laurent)
 Jasmine Zhu (CCGS Louis S. St-Laurent)
 Cory Beatty (CCGS Louis S. St-Laurent)
 Michiyo Yamamoto-Kawai (CCGS Louis S. St-Laurent)
 Yuanxin "Kin" Zhang (CCGS Louis S. St-Laurent)
 "Seu" Masataka Seo (CCGS Louis S. St-Laurent)



Kazu Tateyama (CCGS Louis S. St-Laurent)
 Masahiro "Mash" Saito (CCGS Louis S. St-Laurent)
 Kohel Sato (CCGS Louis S. St-Laurent)
 Hiromi Kimura (CCGS Louis S. St-Laurent)
 Yurika Watanabe (CCGS Louis S. St-Laurent)
 Céline Guiguen (CCGS Louis S. St-Laurent)
 Nicolas Sylvestre (CCGS Louis S. St-Laurent)
 Thomas Grevesse (CCGS Louis S. St-Laurent)
 Loic Jacquemont (CCGS Louis S. St-Laurent)
 Bingkun Luo (CCGS Louis S. St-Laurent)
 Cassandra DeFrancesco (CCGS Louis S. St-Laurent)

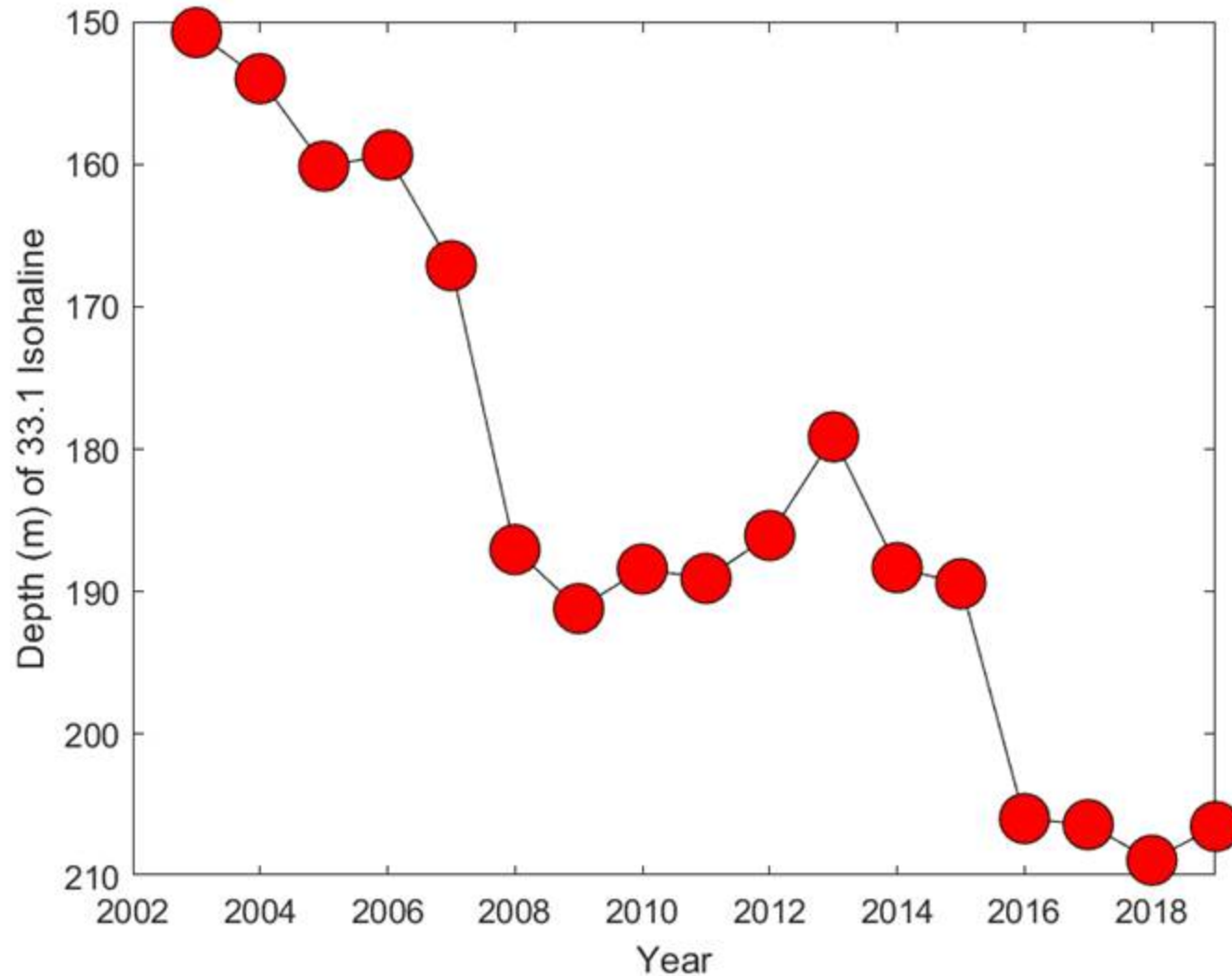
Section along 150W



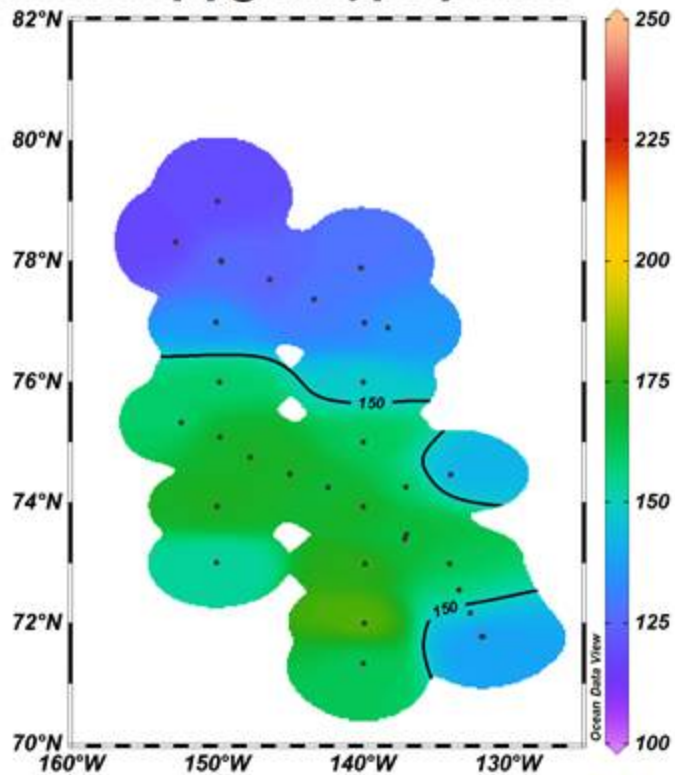
2004

2019

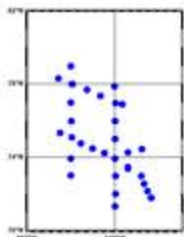
Depth (m) of Pacific Water (S=33.1)



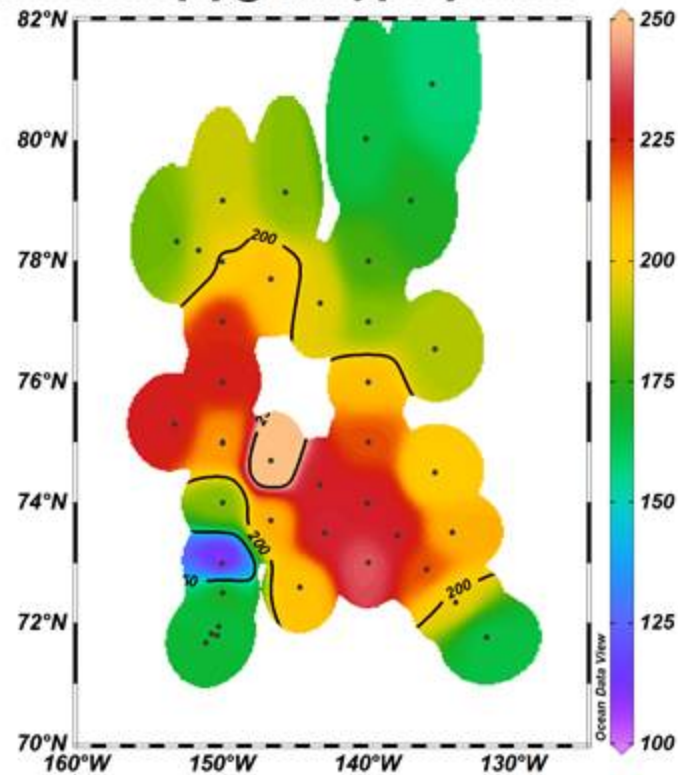
Depth from Pressure [m] @ Salinity [PSU]=33.1000



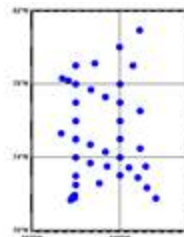
2004



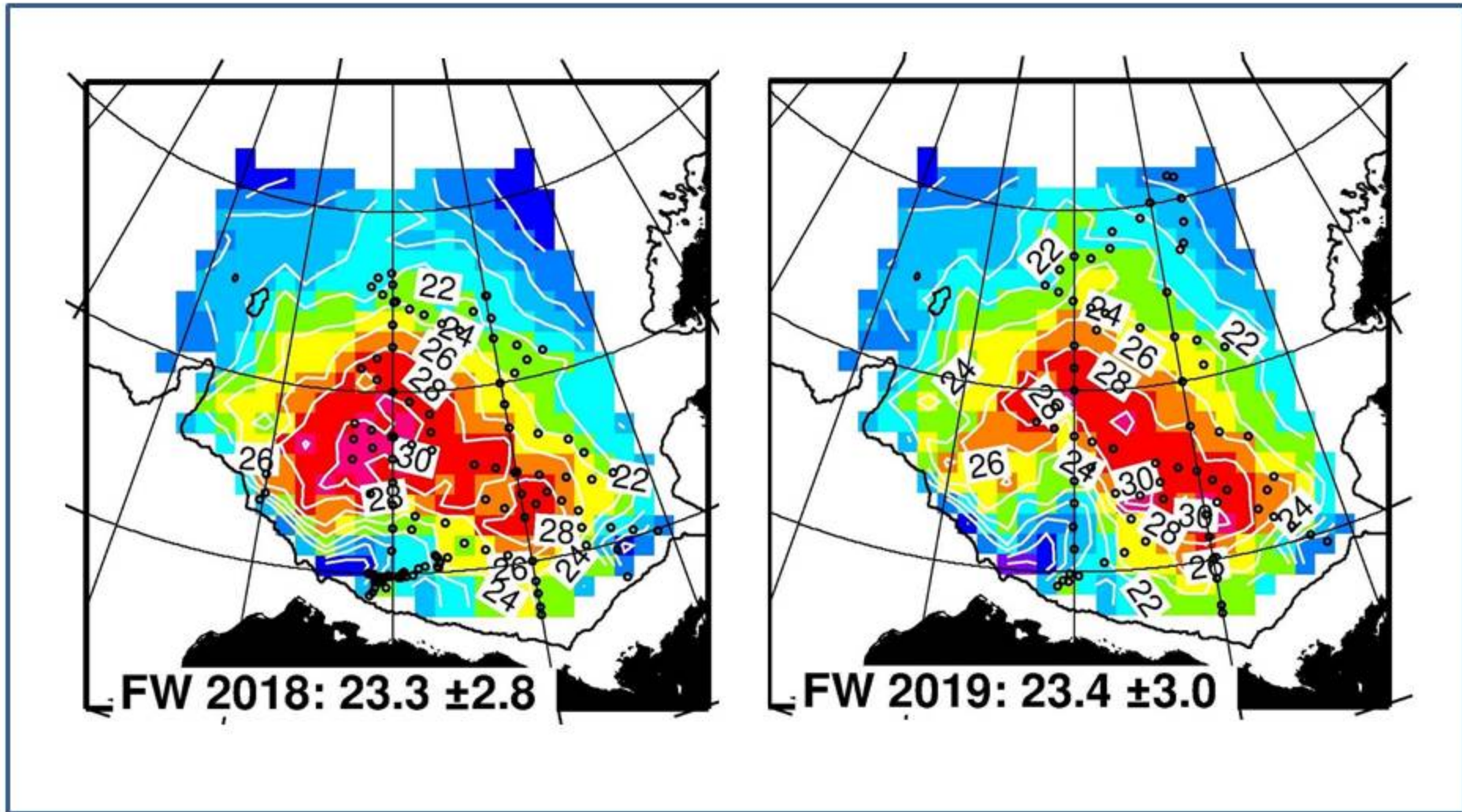
Depth from Pressure [m] @ Salinity [PSU]=33.1000



2019

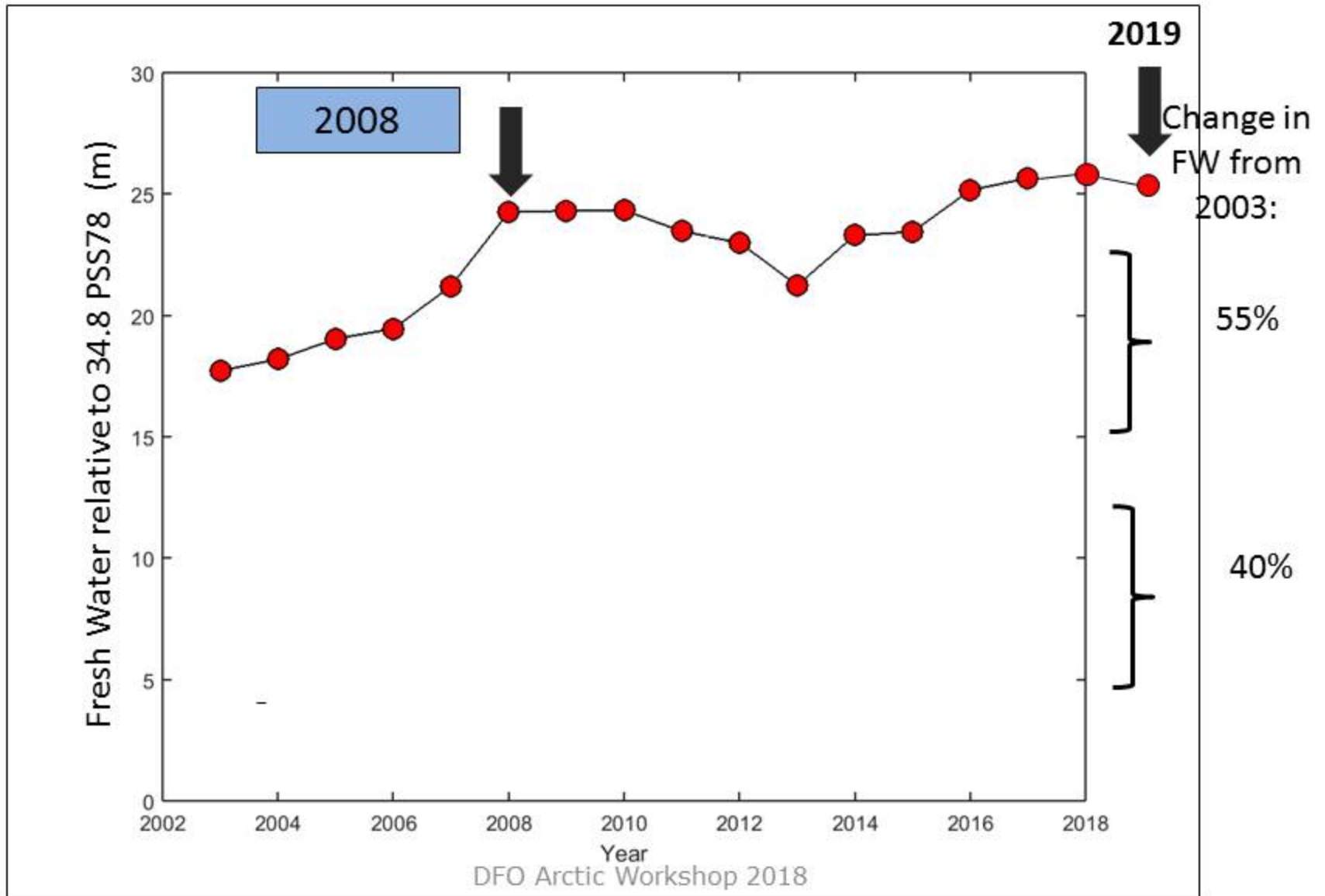


Freshwater content



From Rick Krishfield

Total Fresh Water (m)



CCGS Sir Wilfrid Laurier



Transit to the Arctic across the NE Pacific: C3O, DBO



6 days for science, 16 scientists

- U-CTDs during transit
- CTD/Rosette, ADCP, bongo net casts across the Gulf of Alaska.
- underway seawater sampling
- deployment of 5 Argo floats
- onboard incubations to estimate primary productivity

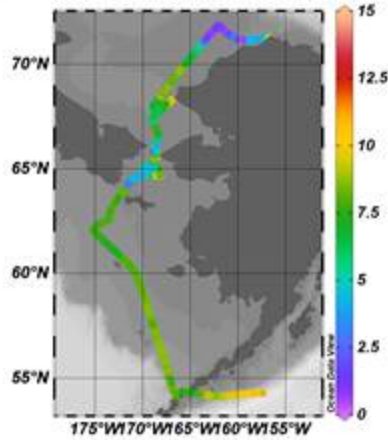
board 12 scientists in Dutch Harbor for DBO

- sediment sampling using VanVeen grabs & Happs corer
- CTD & water sampling with the rosette
- vertically towed bongos.
- seabird and marine mammal observation
- onboard incubations to estimate primary productivity
- **Addition of CPR!**

Underway data, 5m intake:

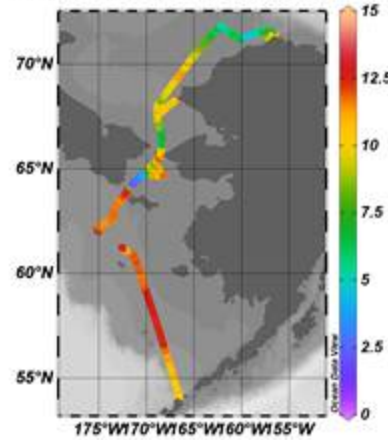
2018

Temperature, 2 [ITS-90, deg C]



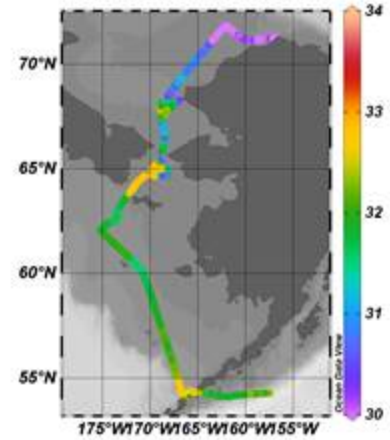
2019

Temperature, 2 [ITS-90, deg C]



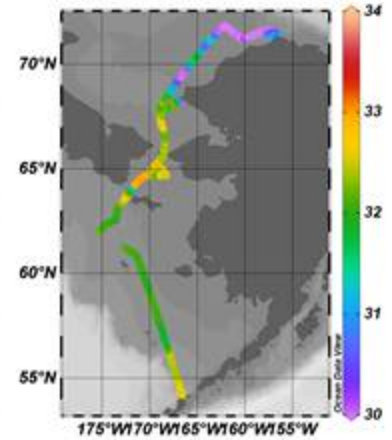
2018

Salinity, Practical [PSU]

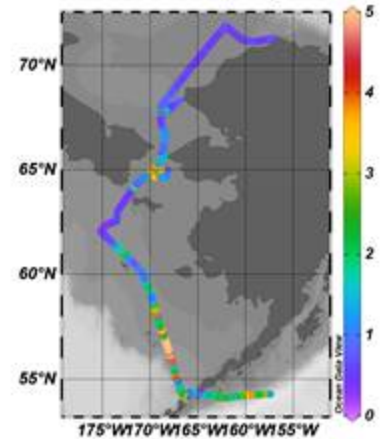


2019

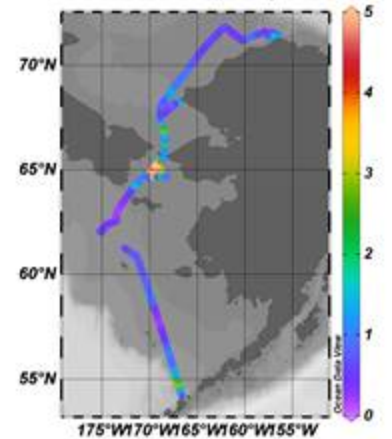
Salinity, Practical [PSU]



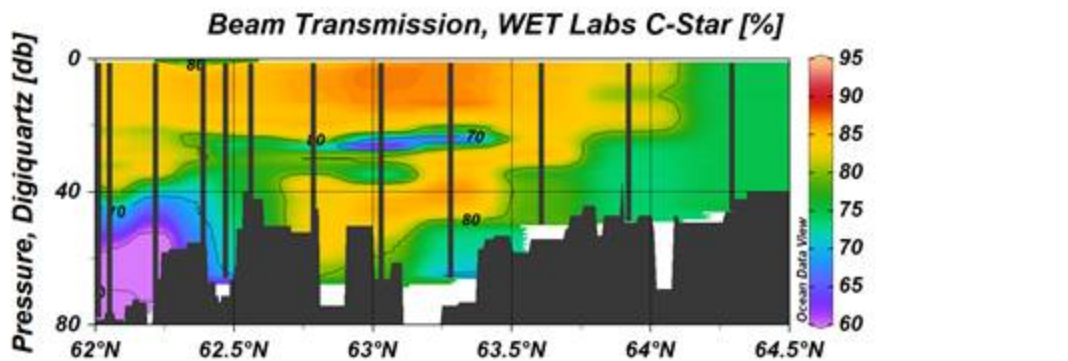
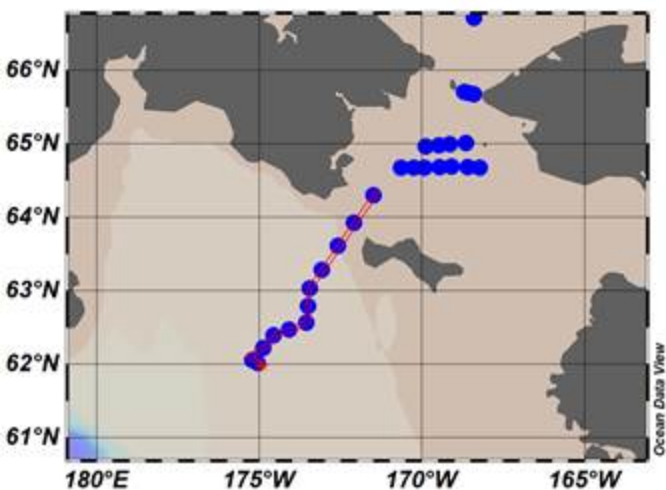
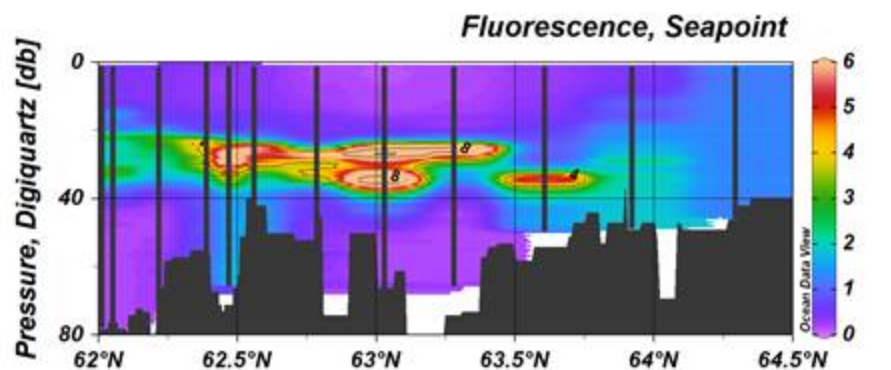
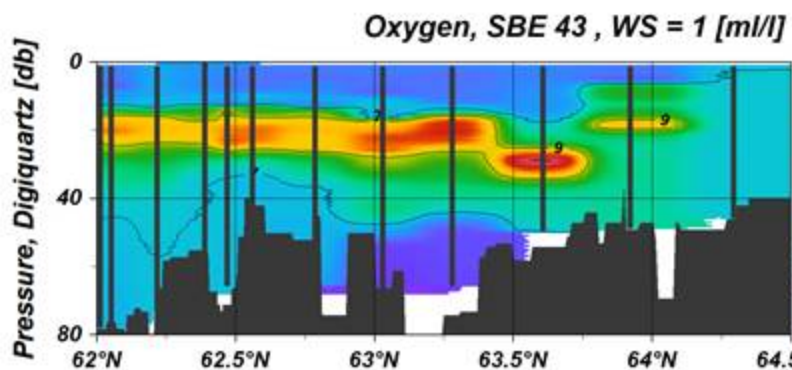
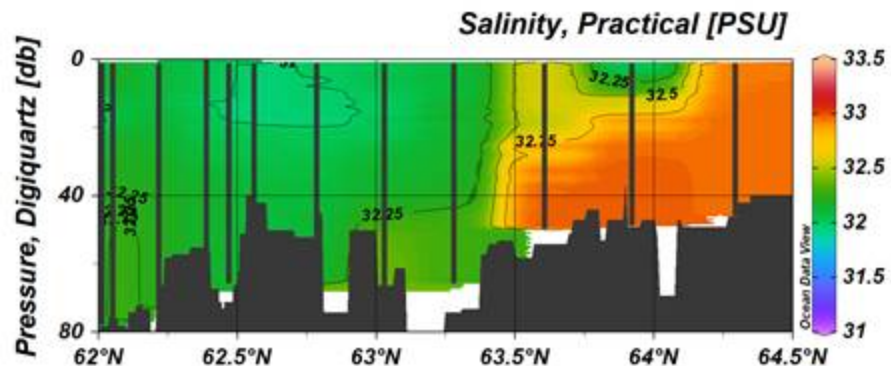
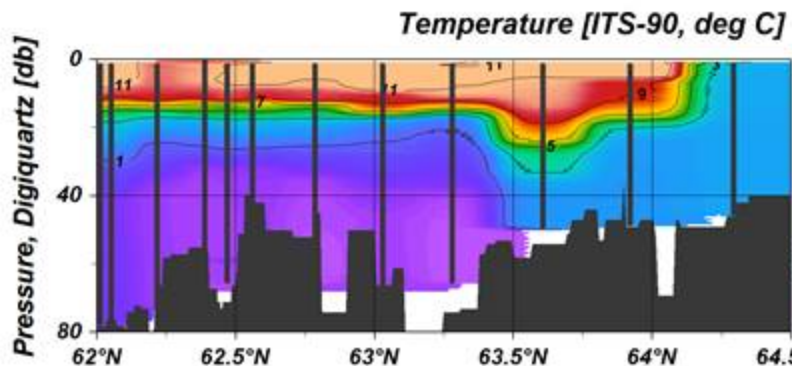
Fluorescence, Seapoint



Fluorescence, Seapoint

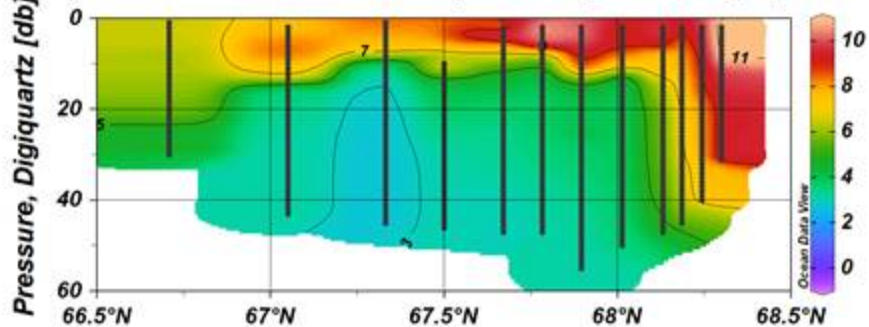


DBO 1

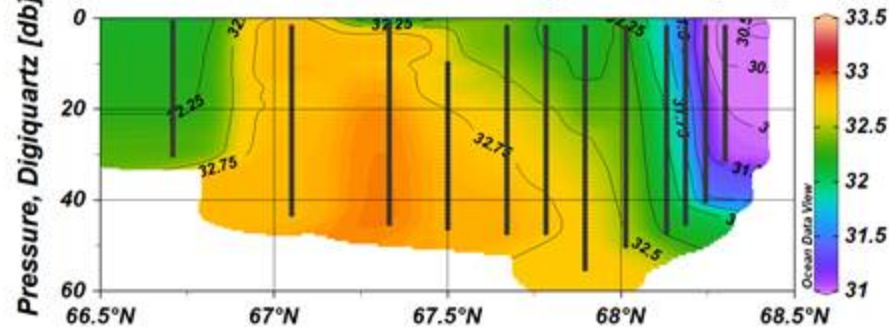


DBO3

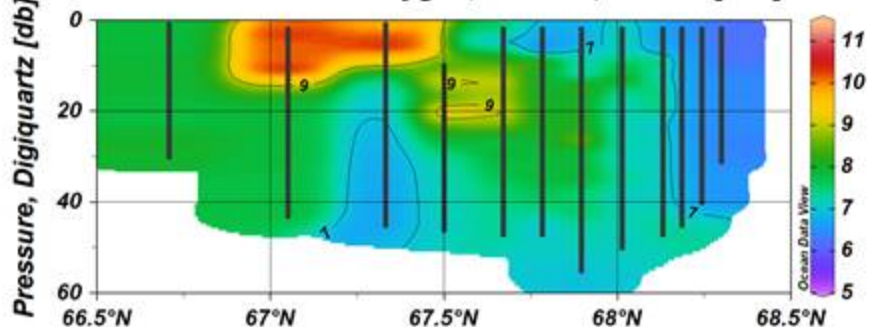
Temperature [ITS-90, deg C]



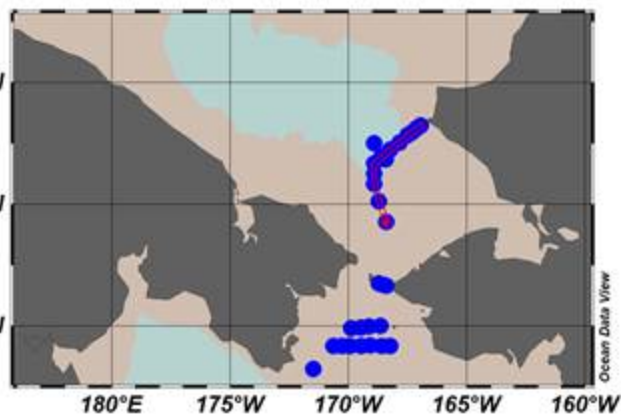
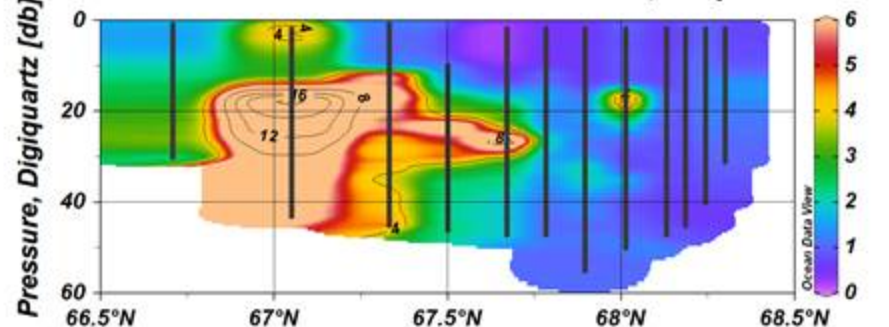
Salinity, Practical [PSU]



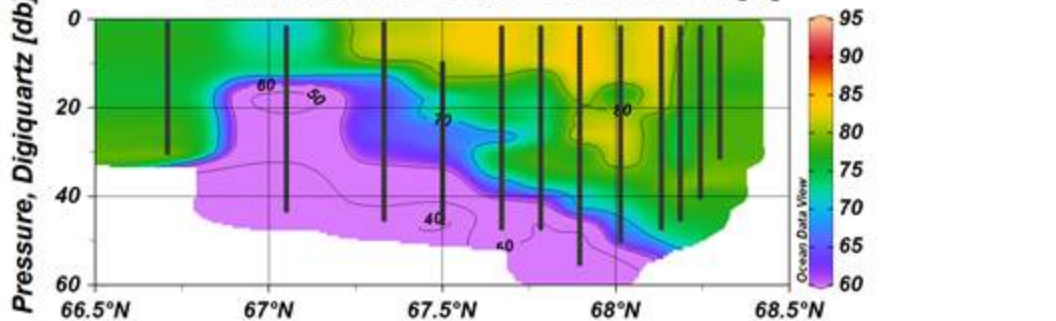
Oxygen, SBE 43, WS = 1 [ml/l]



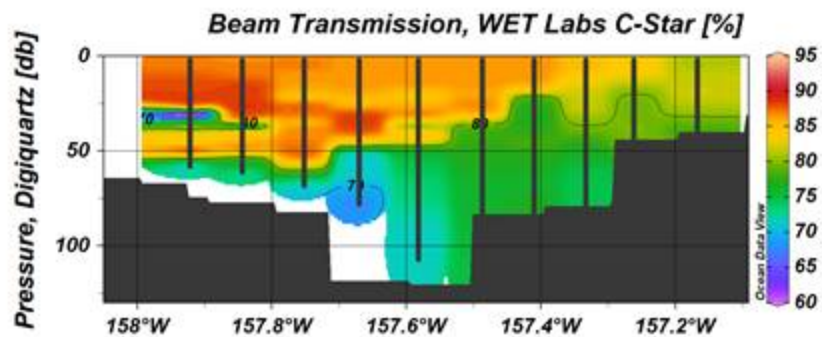
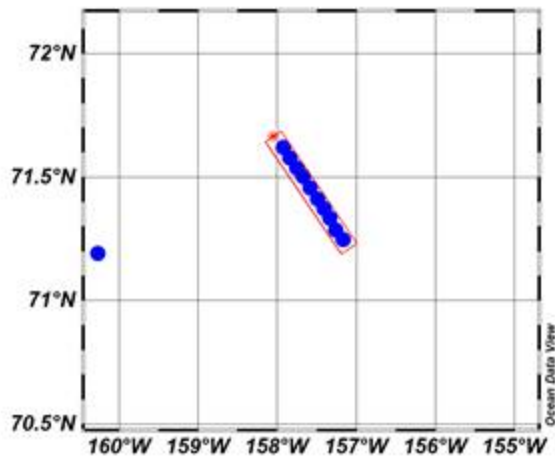
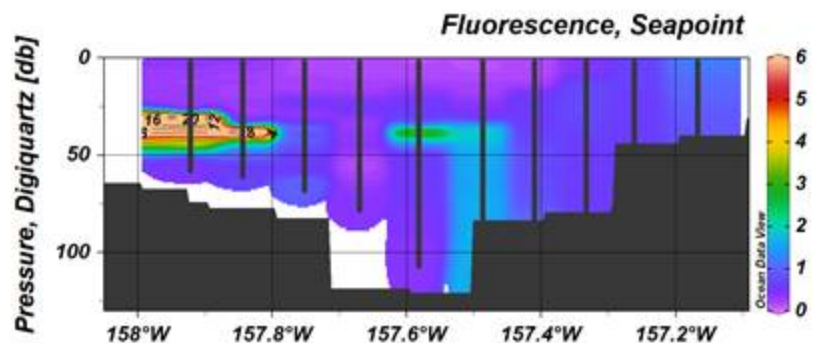
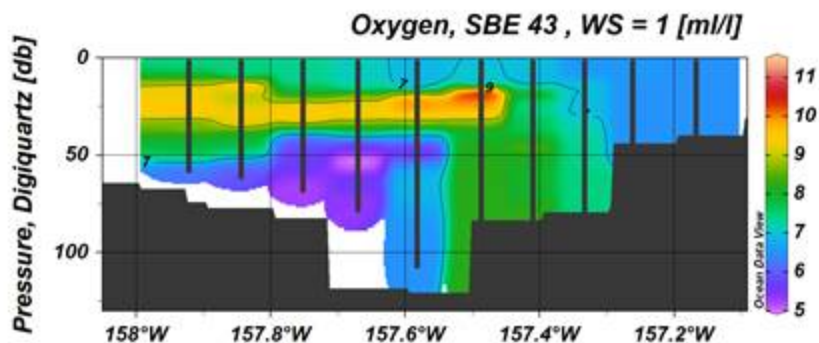
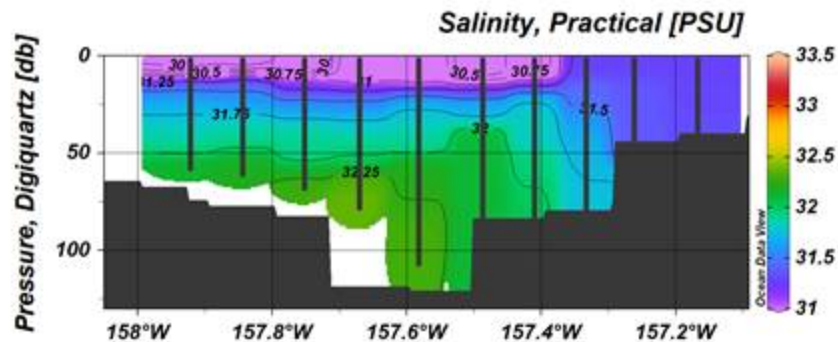
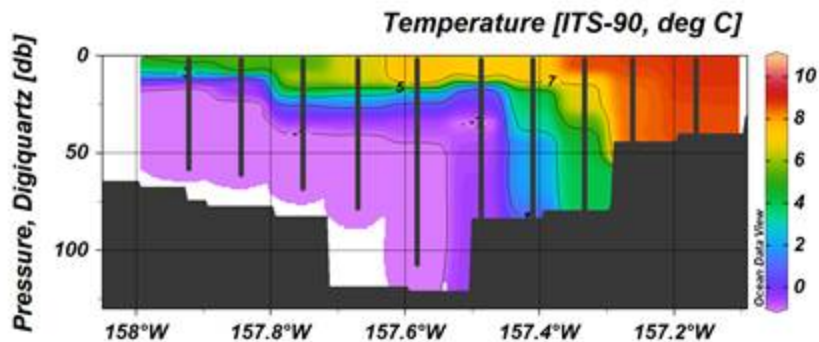
Fluorescence, Seapoint



Beam Transmission, WET Labs C-Star [%]



DBO5 – Barrow Canyon



CCGS Sir Wilfrid Laurier (Arctic Leg 3)

Marine Hazards ... Ocean Monitoring

25 Sep – 10 Oct 2019

21 oceanographic moorings to be recovered, 16 to be deployed

Continuous near-surface temperature & salinity

1 oceanographic section, CTD only: DBO-8; 2 CPR tows, each 550 mi

Organic contaminants sampling – air & seawater

Bottom mapping by multi-beam sonar - opportunistic



Chief Scientist

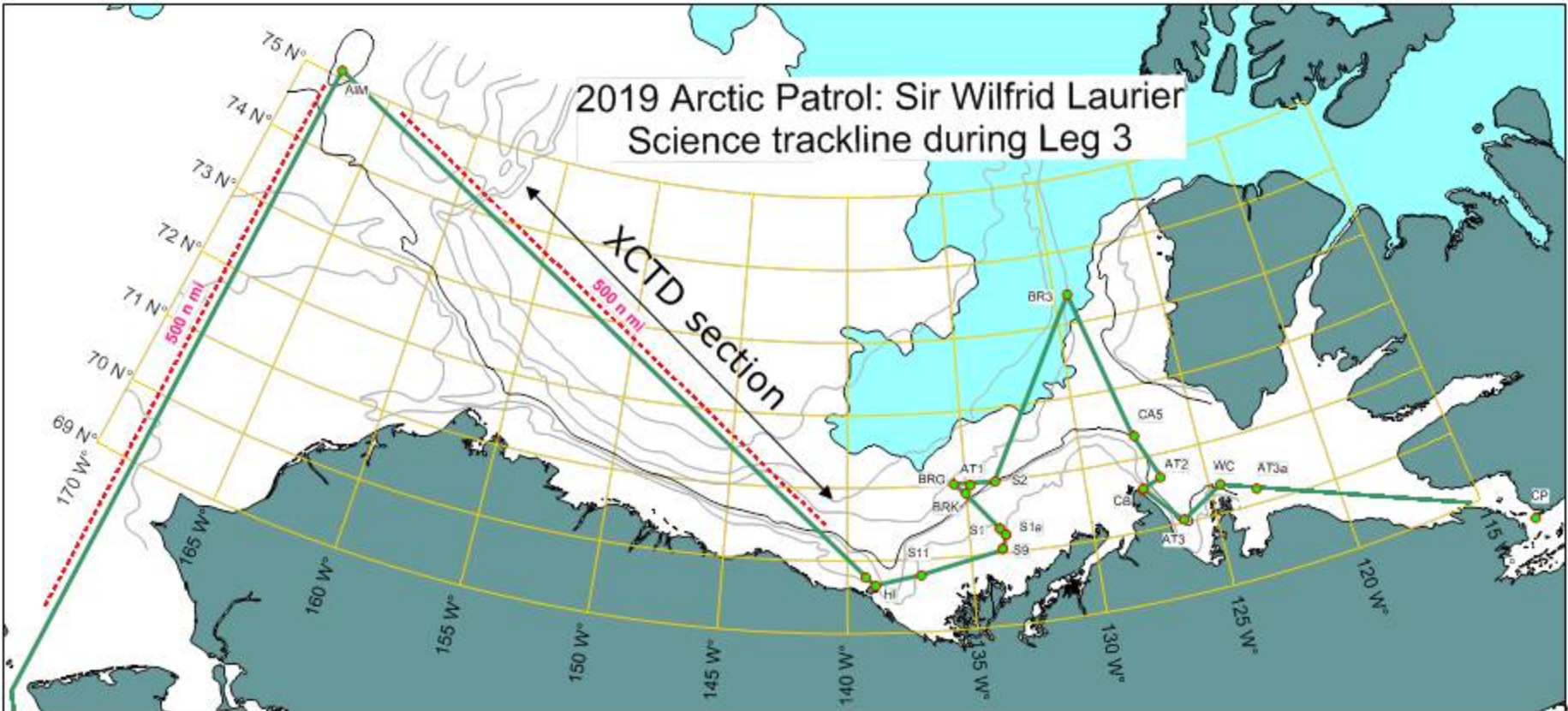
Humfrey Melling, DFO at IOS

Collaborators

ArcticNet, ASL Env Sci, ECCC,
CHS, NOAA, Stantec

Supported by

PERD, ASL, OPP



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



Banks Island, NT. (A. Niemi)

Project approach

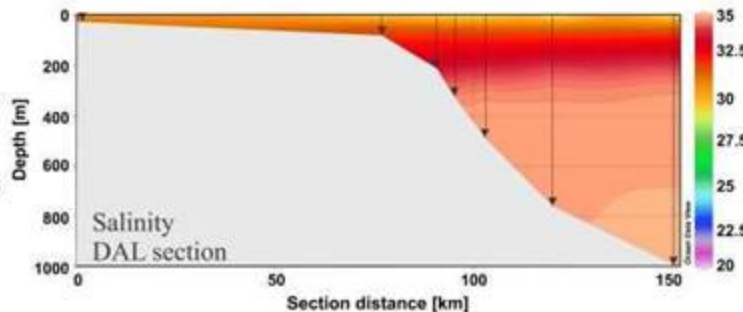
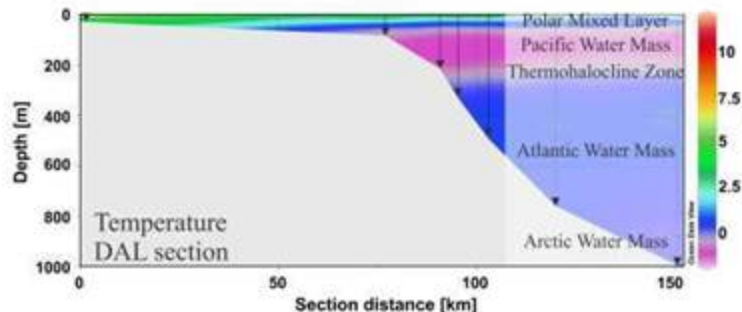
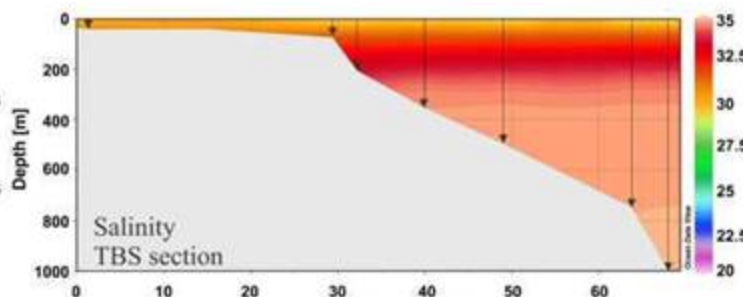
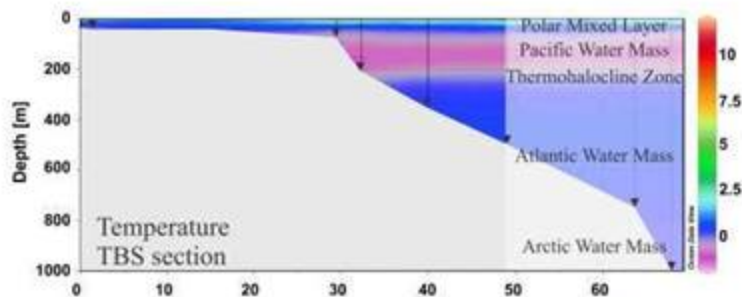
- Multidisciplinary science team consisting of DFO, University and Community partners
- Off-shore, ship-based sampling - physical, chemical and biological (bacteria to bowheads) data collection
 - Linked mooring program (Niemi)
- Real-time ecosystem integration
- Complementary nearshore/coastal work 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

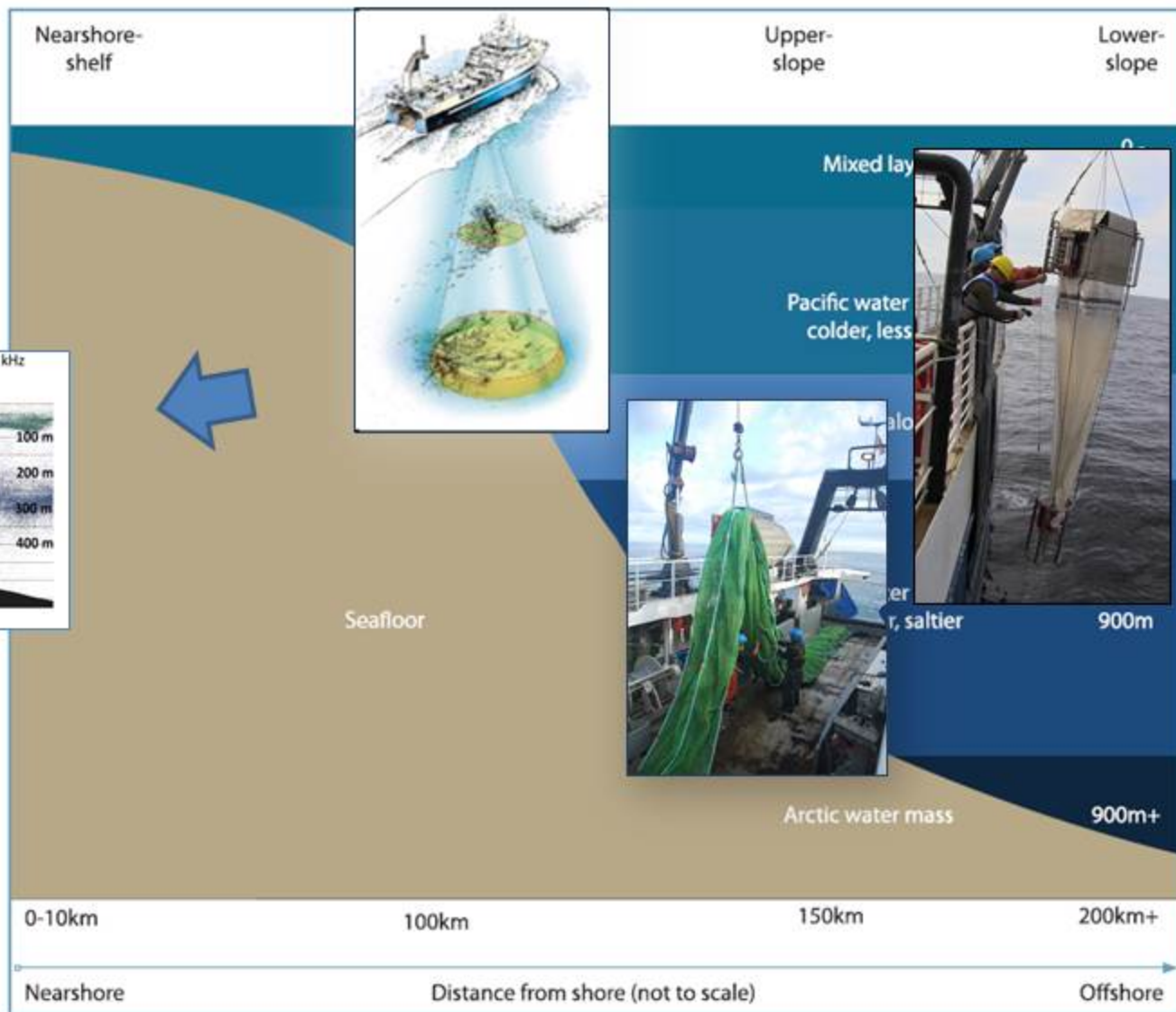
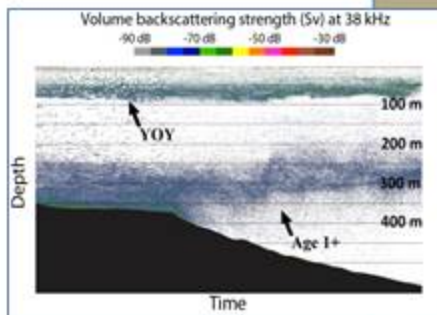


Water-column profiles of temperature and salinity on the CBS shelf and slope

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

Box Core



Invertebrates in the sediments



Bottom Trawling



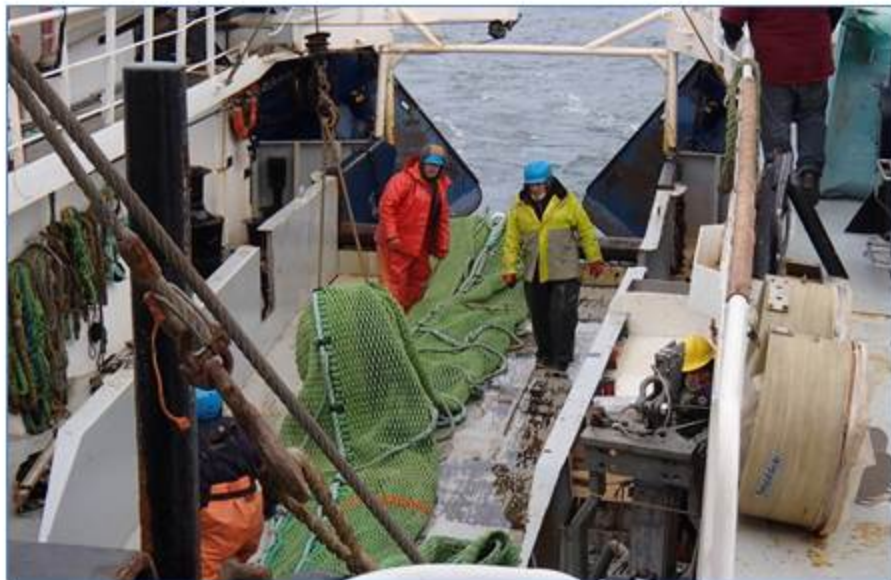
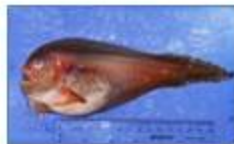
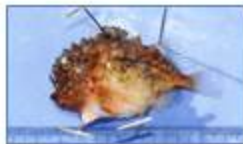
Invertebrates on/near bottom



Bottom sampling

Small beam trawl

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

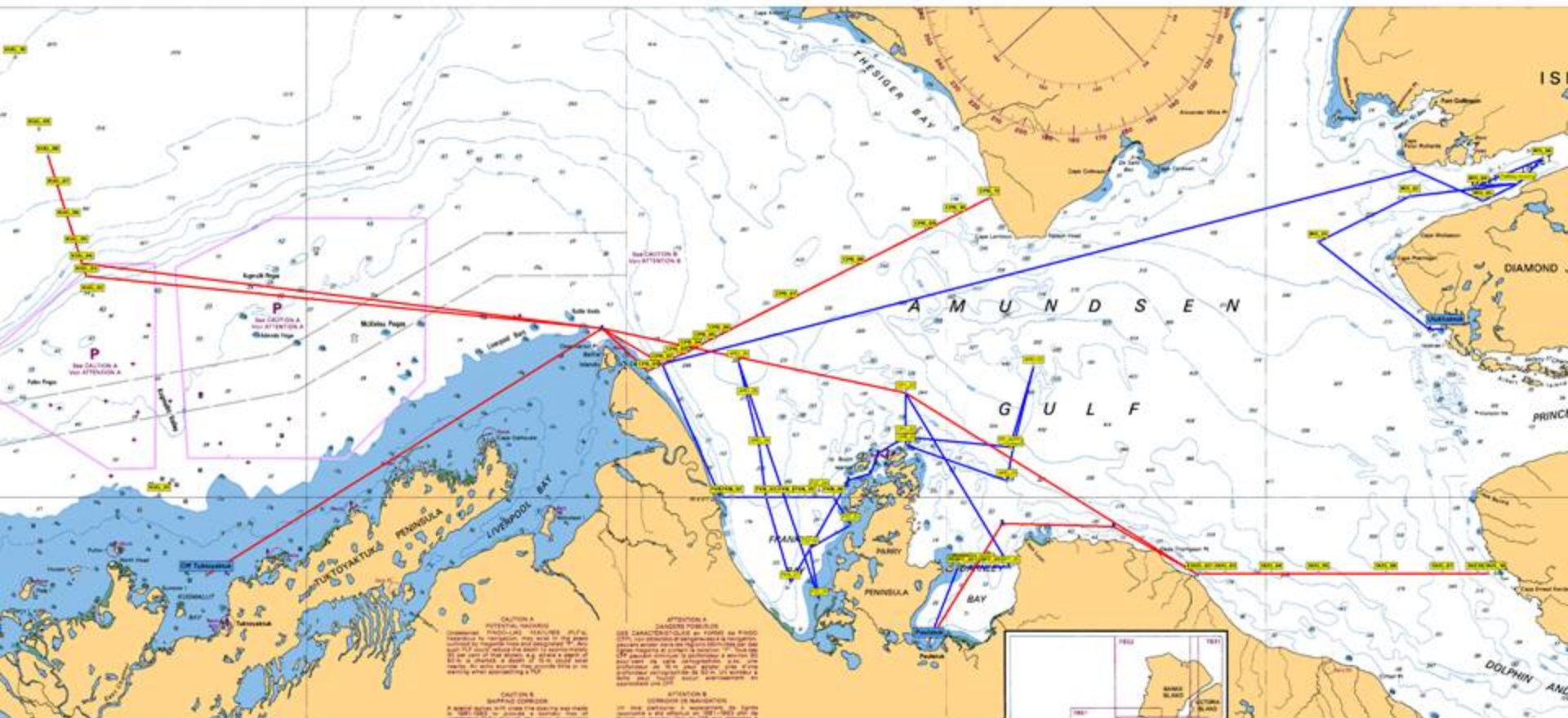


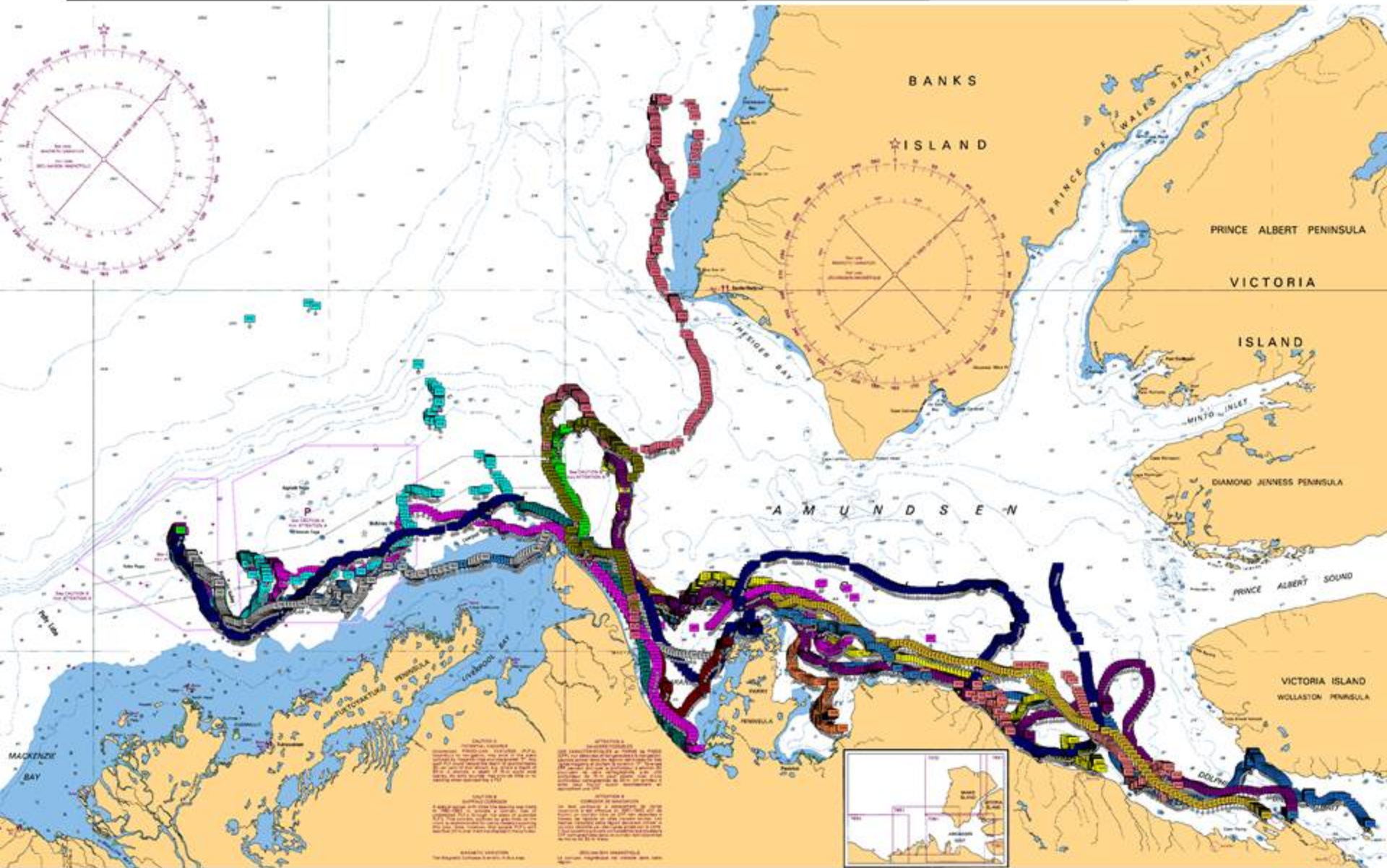
Larger bottom trawl

- Catches a broad spectrum of species & sizes including larger, faster fishes.

e.g., flatfishes, skates







R/V Martin Bergmann

19-m coastal research vessel

6 scientists

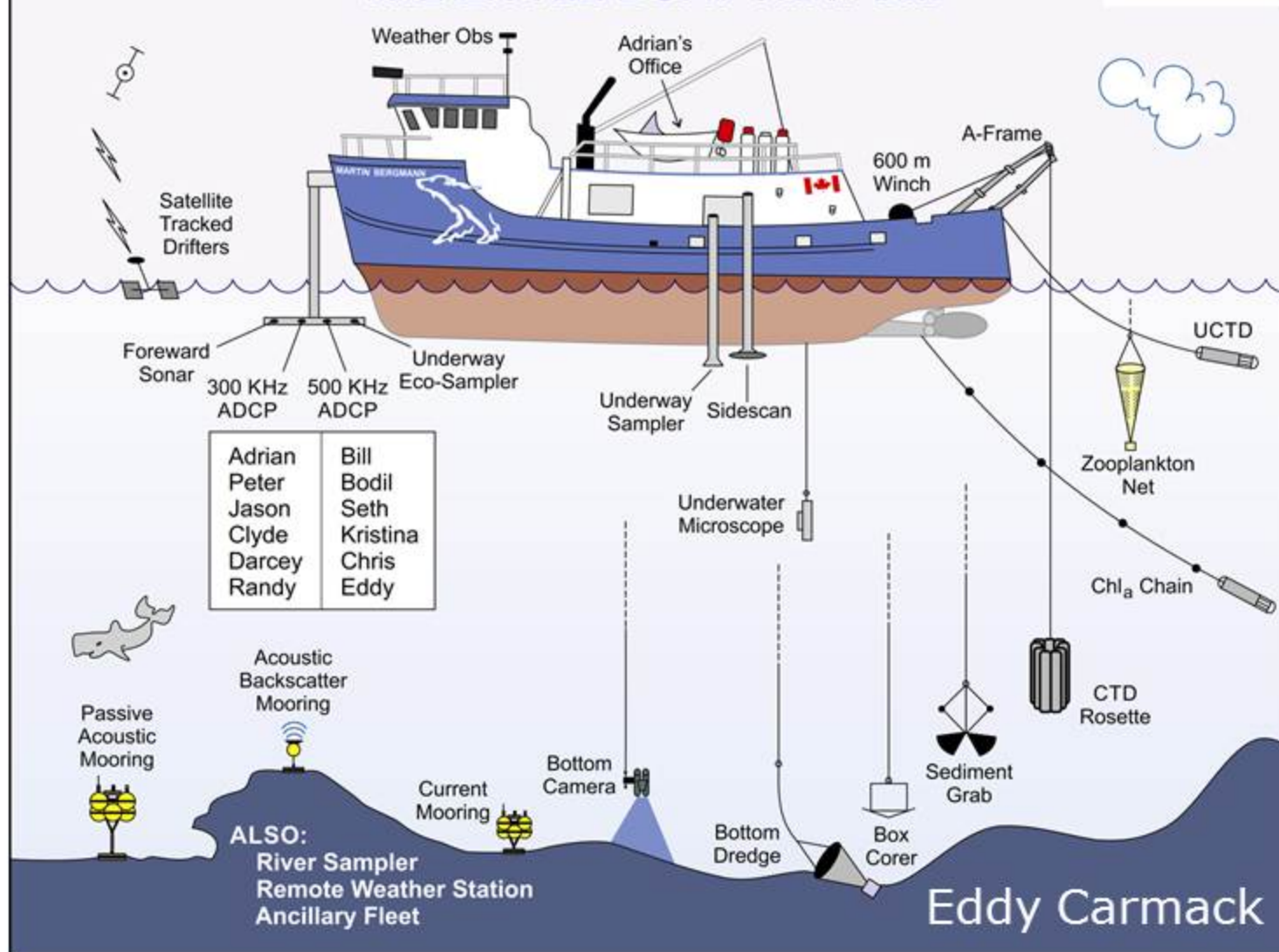
Based in Cambridge Bay, NU

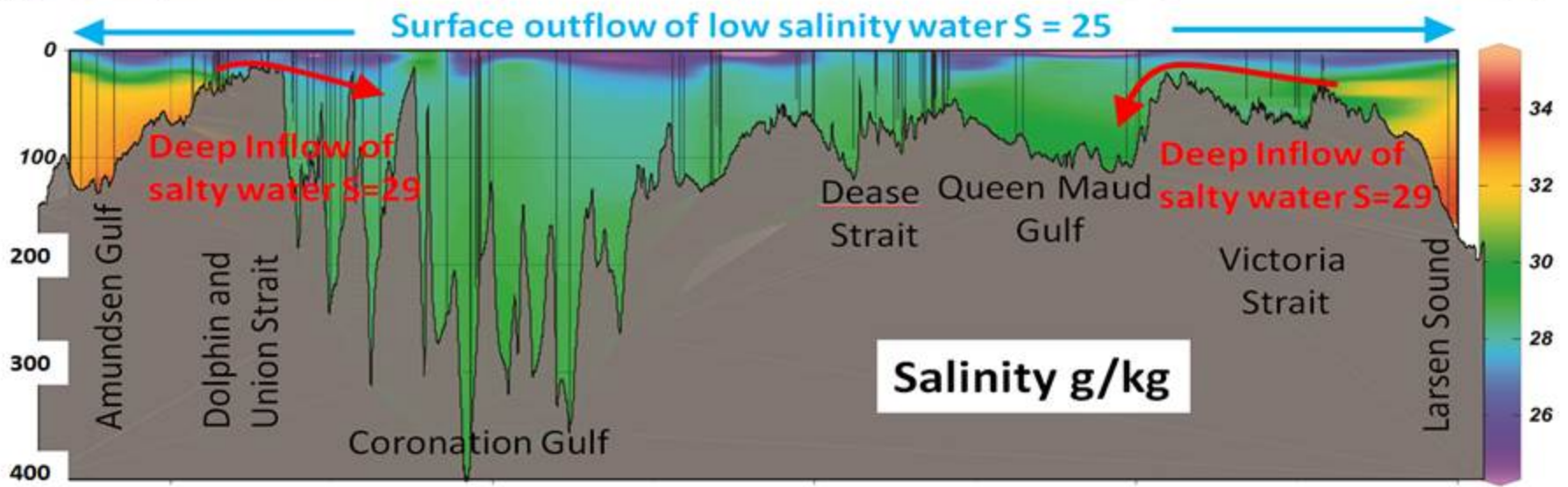
ARCTIC
RESEARCH
FOUNDATION



R/V *Martin Bergmann*

THE LITTLE BOAT THAT DID





Ecological Research & Monitoring in the Kitikmeot Sea

RV Martin Bergmann's home base is Cambridge Bay:

Operated by the non-profit Arctic Research Foundation

Northern anchorage permits immediate start when local ice clears in late July

Supports initiatives of DFO, ONC, OTN, Polar Knowledge Canada, UVic, UAF, UiT, MEOPAR

Ocean moorings:

Submerged instruments monitor ocean current, salinity, temperature, PAR, DO, acoustic backscatter, underwater sound, light. Year-round operation. (DFO, ARF, Polar Knowledge Canada)

Submerged listening stations track char during summer feeding at sea operated by Ocean Tracking Network (OTN)

Cabled observing station in Cambridge Bay:

Operated as a test-bed cabled observatory by Ocean Networks Canada (ONC)

Reference oceanographic transects:

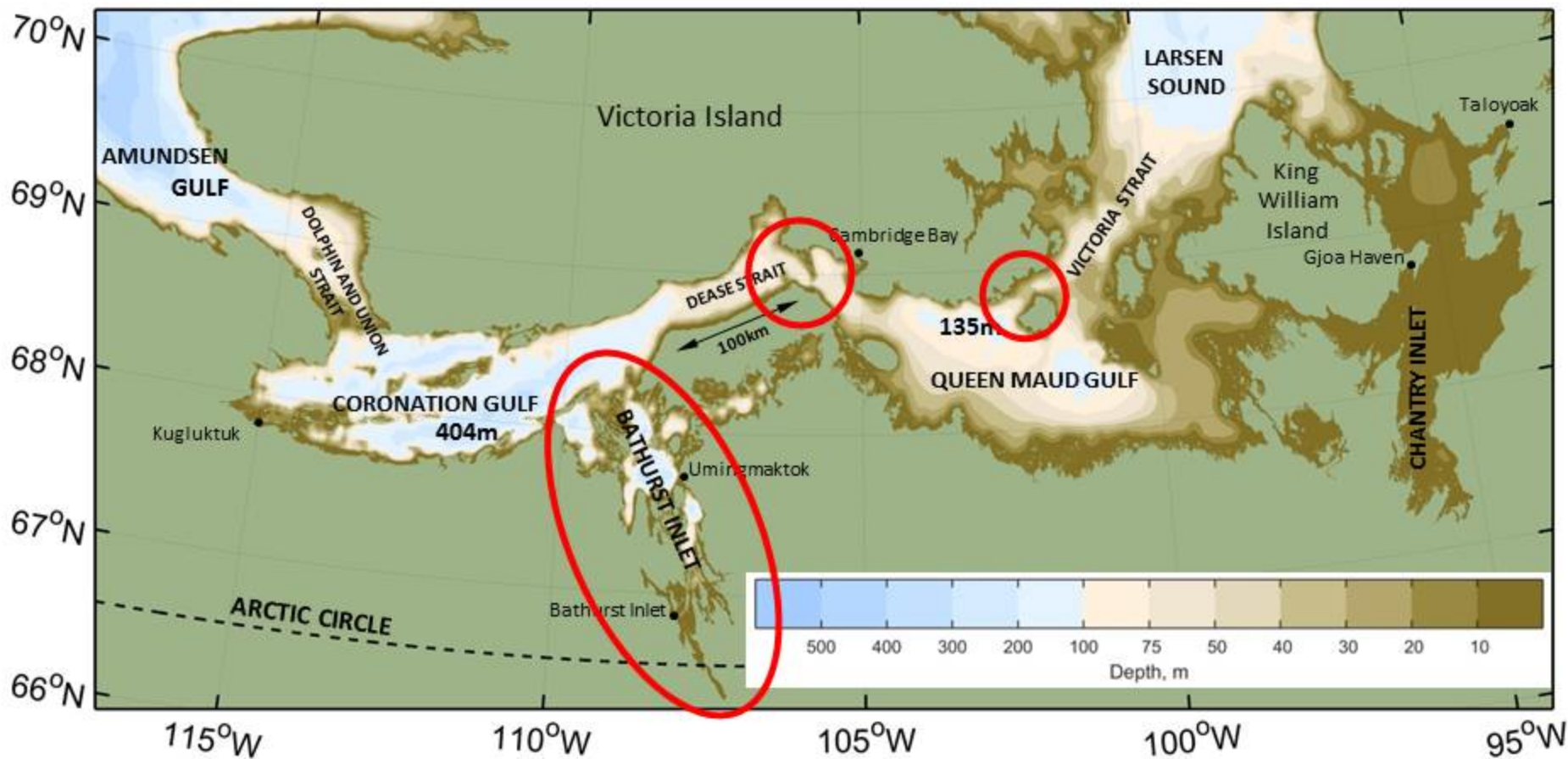
Temperature, salinity, fluorescence, DO, turbidity measured from *R/V Martin Bergmann* in August & from the ice surface in March by the Canadian Rangers (CROW)

Biological hotspots:

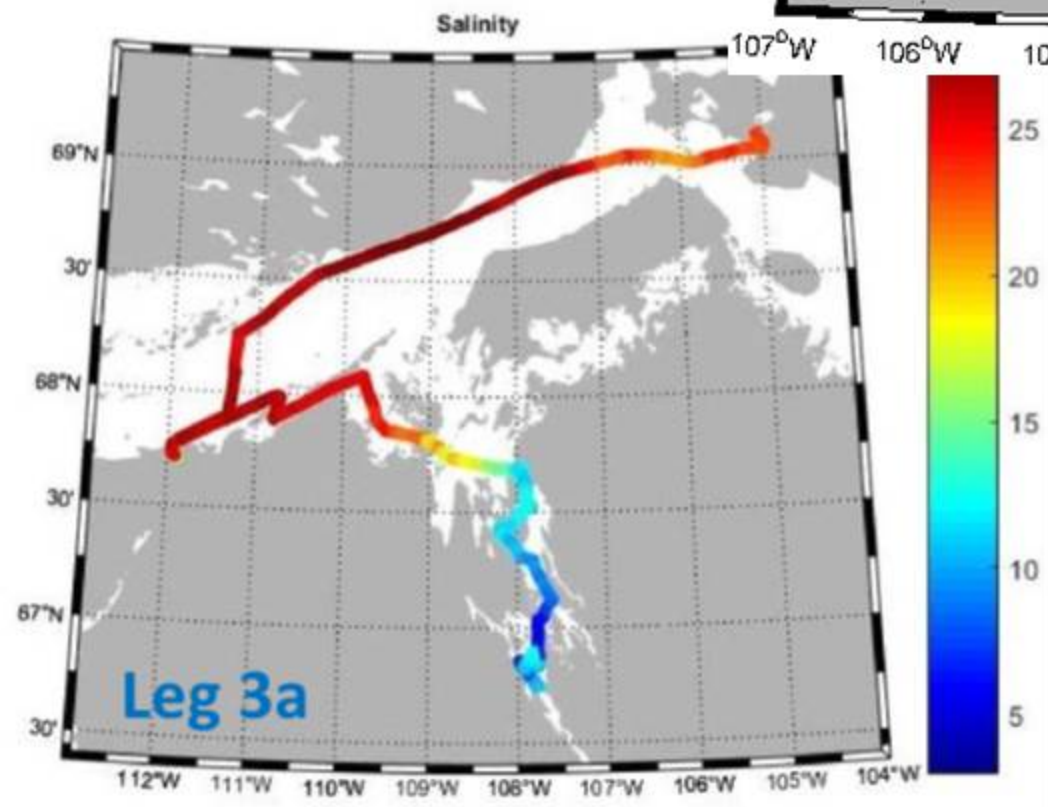
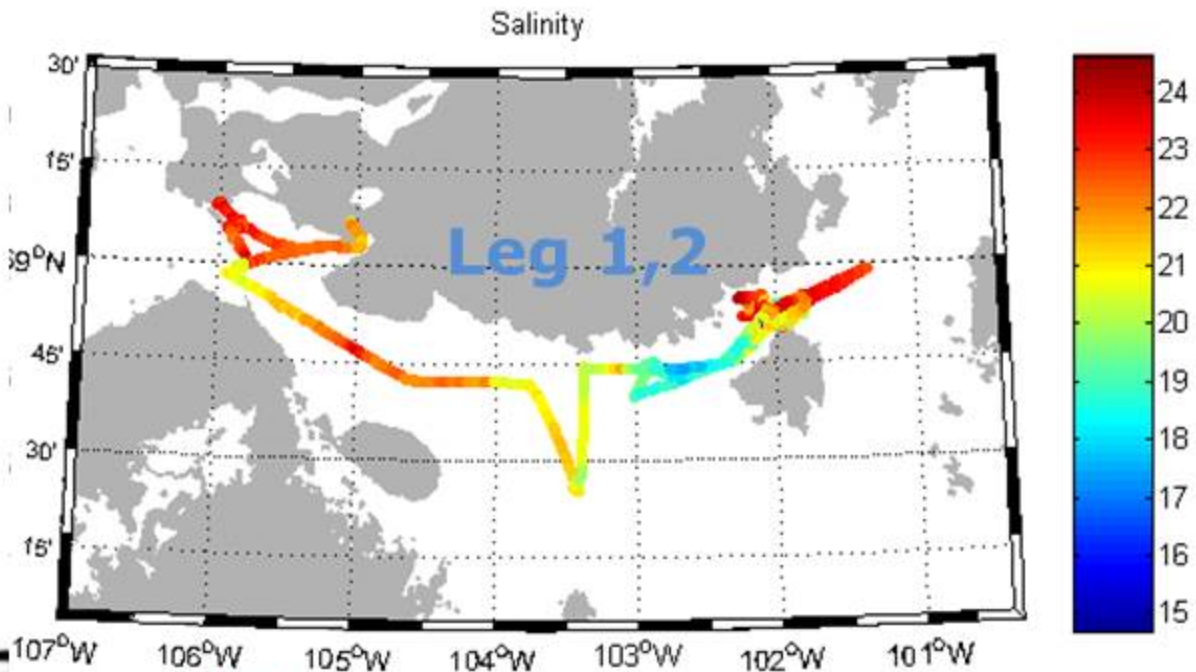
Search for areas where upwelling brings nutrient rich water into the photic zone – traditional knowledge & science working together

Kitikmeot Sea Science Study (K3S)

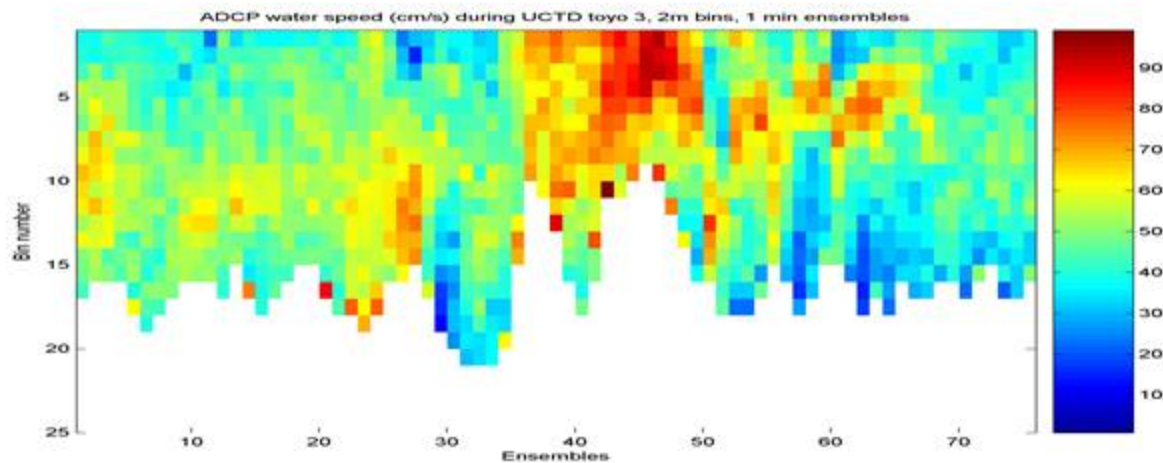
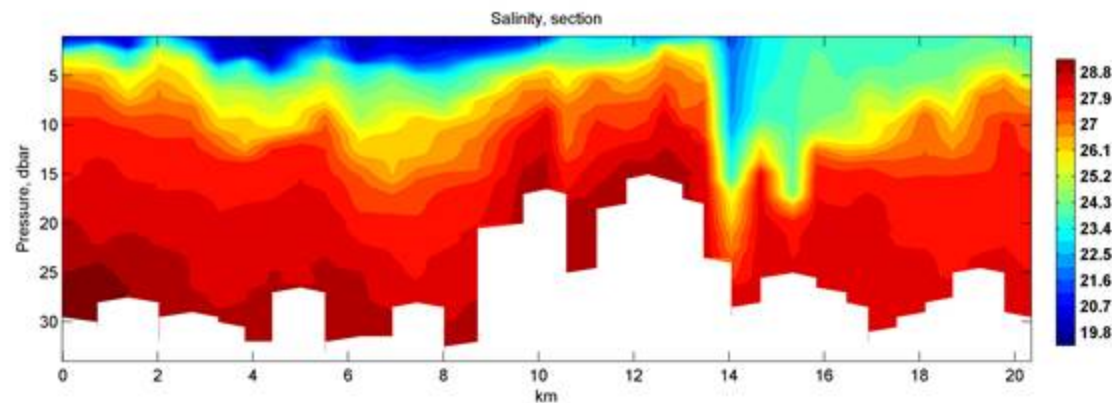
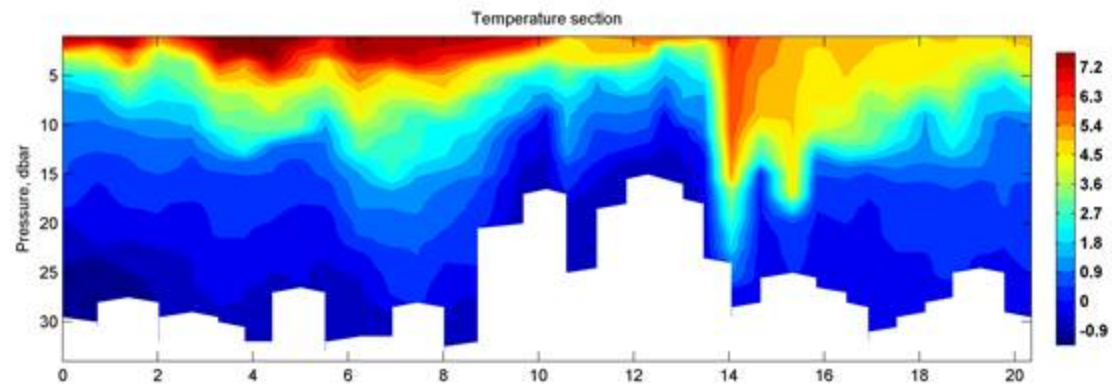
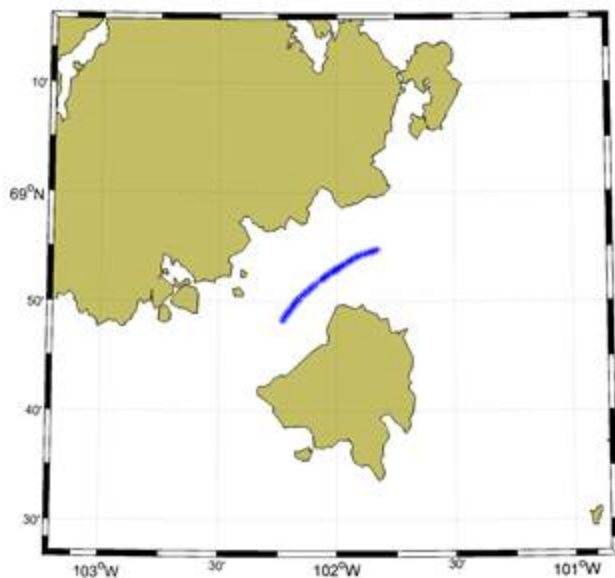
R/V Martin Bergmann
mid-August to mid-September 2019



Ship track and underway salinity



UCTD section in Icebreaker Channel



The Barrow Strait Monitoring Program and Real-time ocean observatory

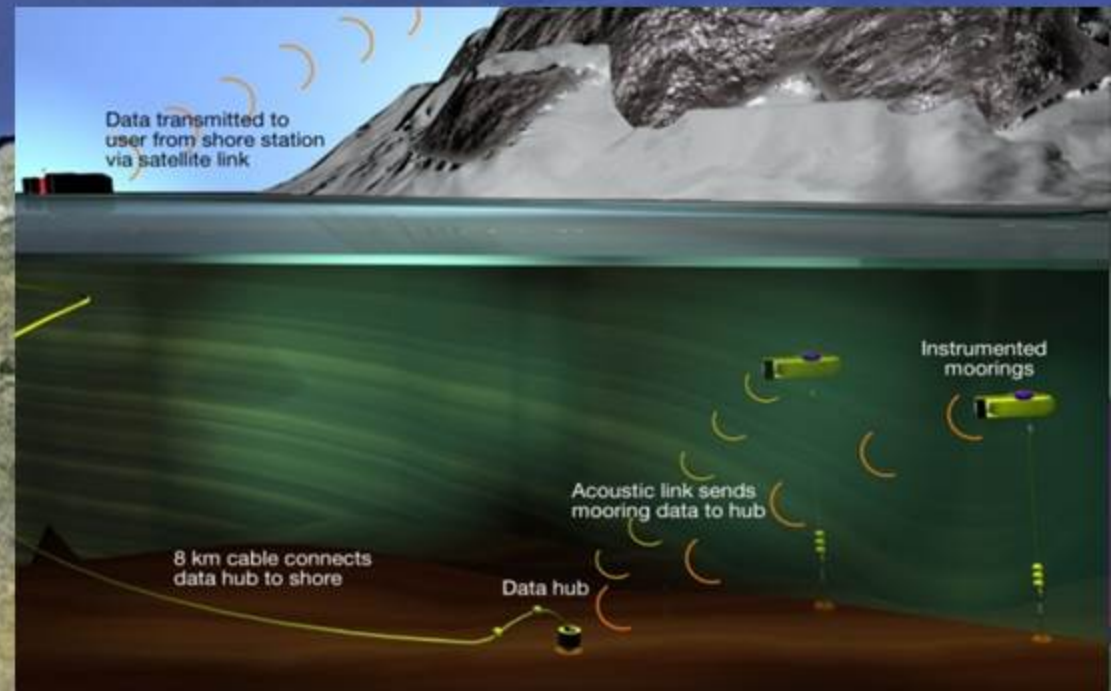
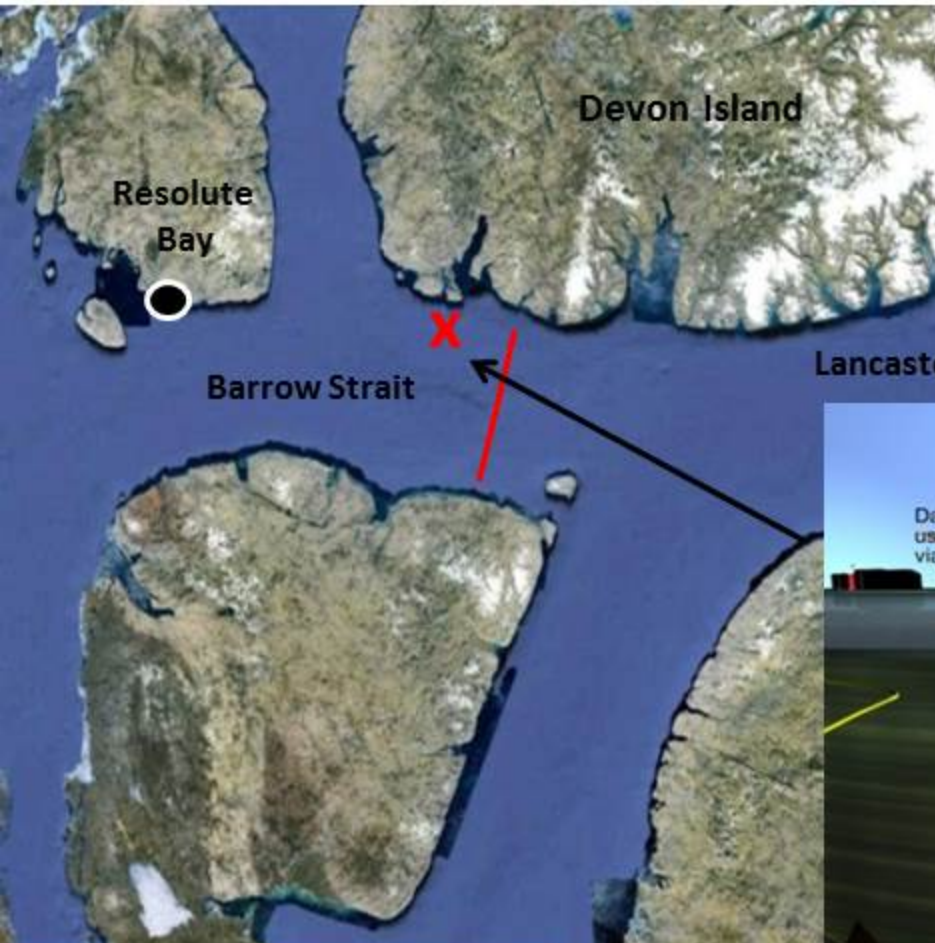
Clark Richards,
Bedford Institute of Oceanography



Fisheries and Oceans
Canada

Pêches et Océans
Canada

- Originally maintained from 1998 to 2011.
- **Re-deployed in August 2017.**
- **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.



NGCC • CCGS
AMUNDSEN

BRISE-GLACE DE RECHERCHE CANADIEN
CANADIAN RESEARCH ICEBREAKER

AMUNDSEN
SCIENCE 



2019 & 2020 Expedition Plans

29 April 2019

2019 Amundsen Expedition - Overview

Overview

Amundsen
104 days at sea
5 segments

Resolute Bay
15 August

Pond Inlet
26 July

Iqaluit
4 July

St. Anthony NL
23 June

Dartmouth NS
3-4 June

Quebec City

30 May & 10 September

Legend

- Cruise Track Leg 1a
- Cruise Track Leg 1b
- Cruise Track Leg 2a
- Cruise Track Leg 2b
- Cruise Track Leg 3
- Community
- AZOMP Bio
- AZOMP CTD
- AZOMP Float
- ISECOLD Benthic
- ISECOLD Full
- Lander
- Mooring
- Bio-Argo Float
- CTD
- Nutrient
- Basic
- BIOS Experiment
- Full
- KEBABB Basic
- Arctic Kelp Site
- Bongo Net
- Coring Site
- Multibeam Mapping Survey
- River Sampling Site

1100 km



2020 Amundsen Expedition - Overview





