

# *Smart Oceans North* : Community-based cabled ocean observatories



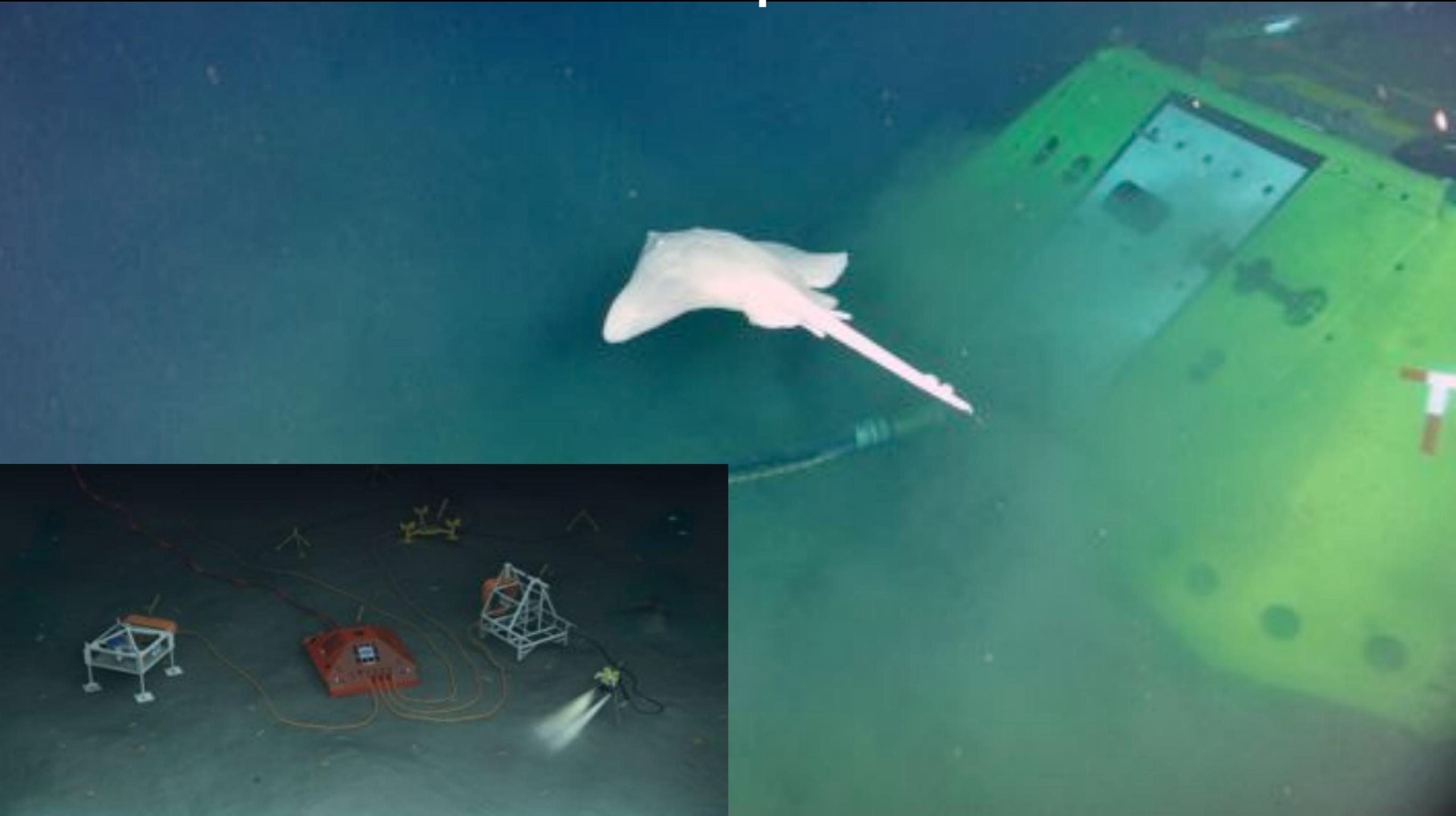
S. Kim Juniper  
Ocean Networks Canada  
University of Victoria

# Ocean Networks Canada cabled ocean observatories

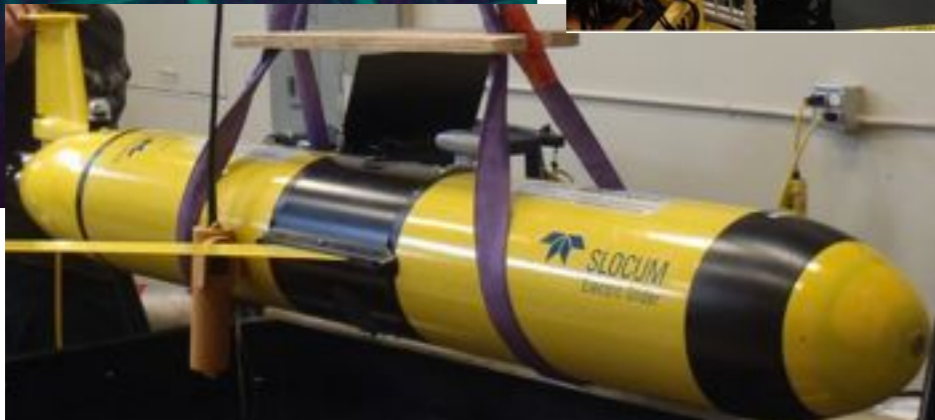
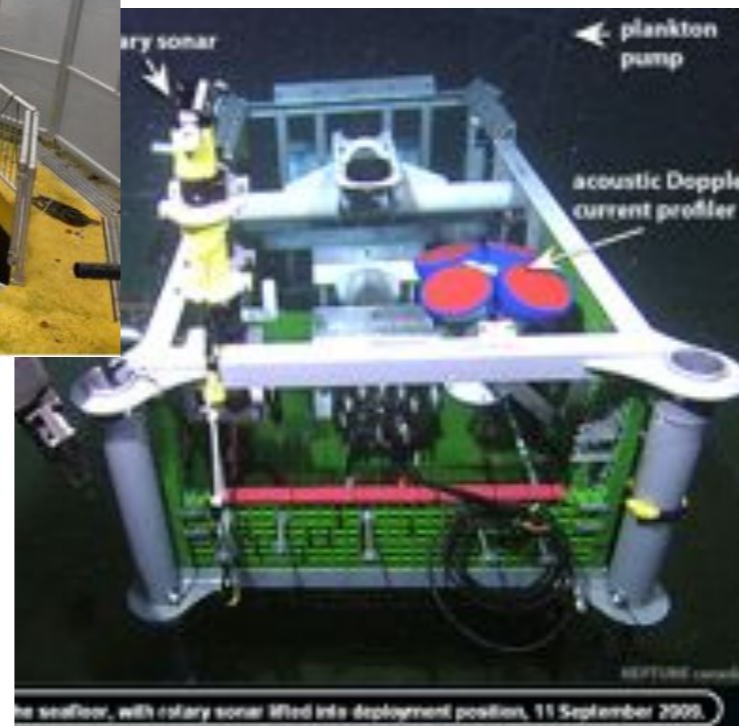
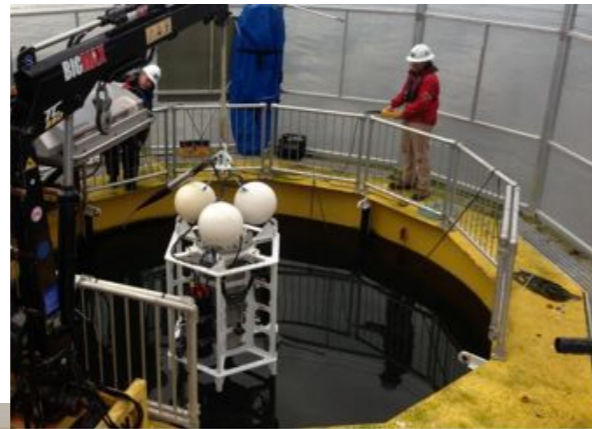
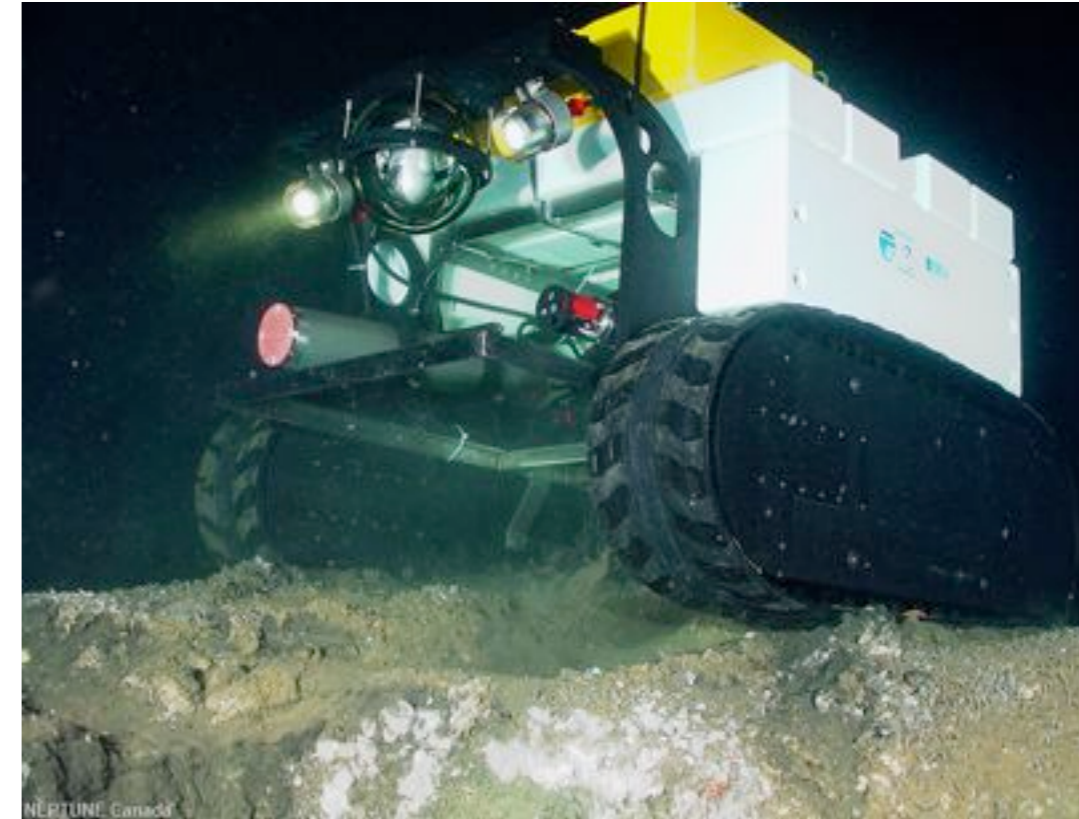
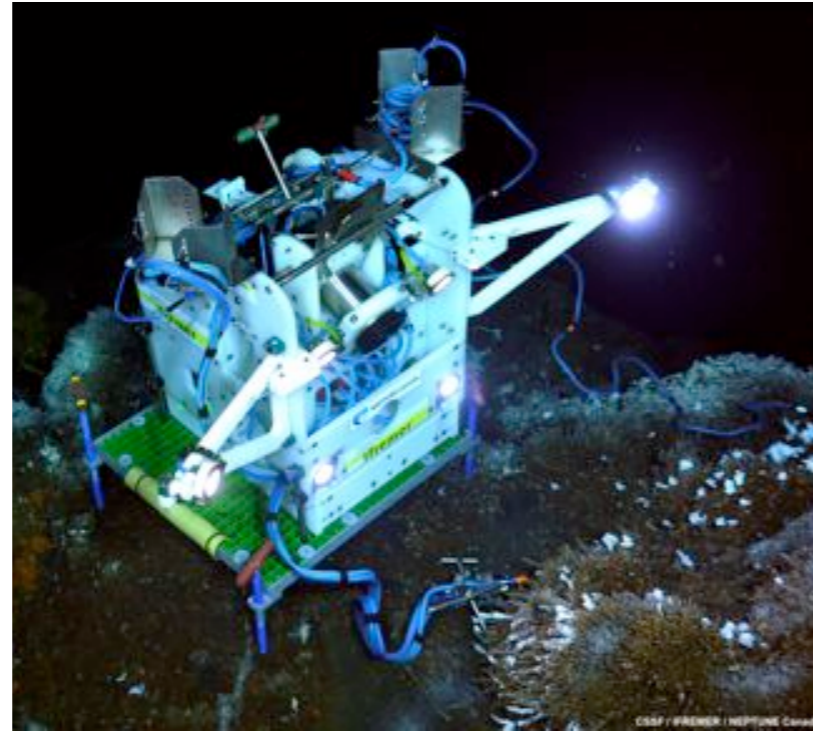
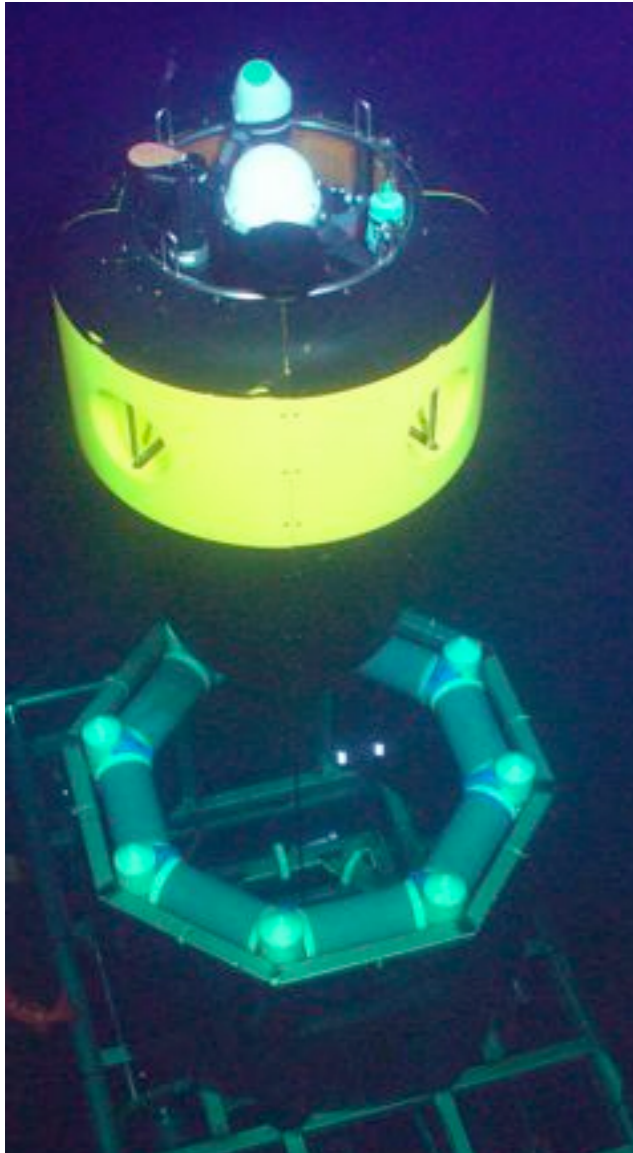
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# 8 seafloor nodes in NE Pacific & Salish Sea provide power and communications to instrument platforms



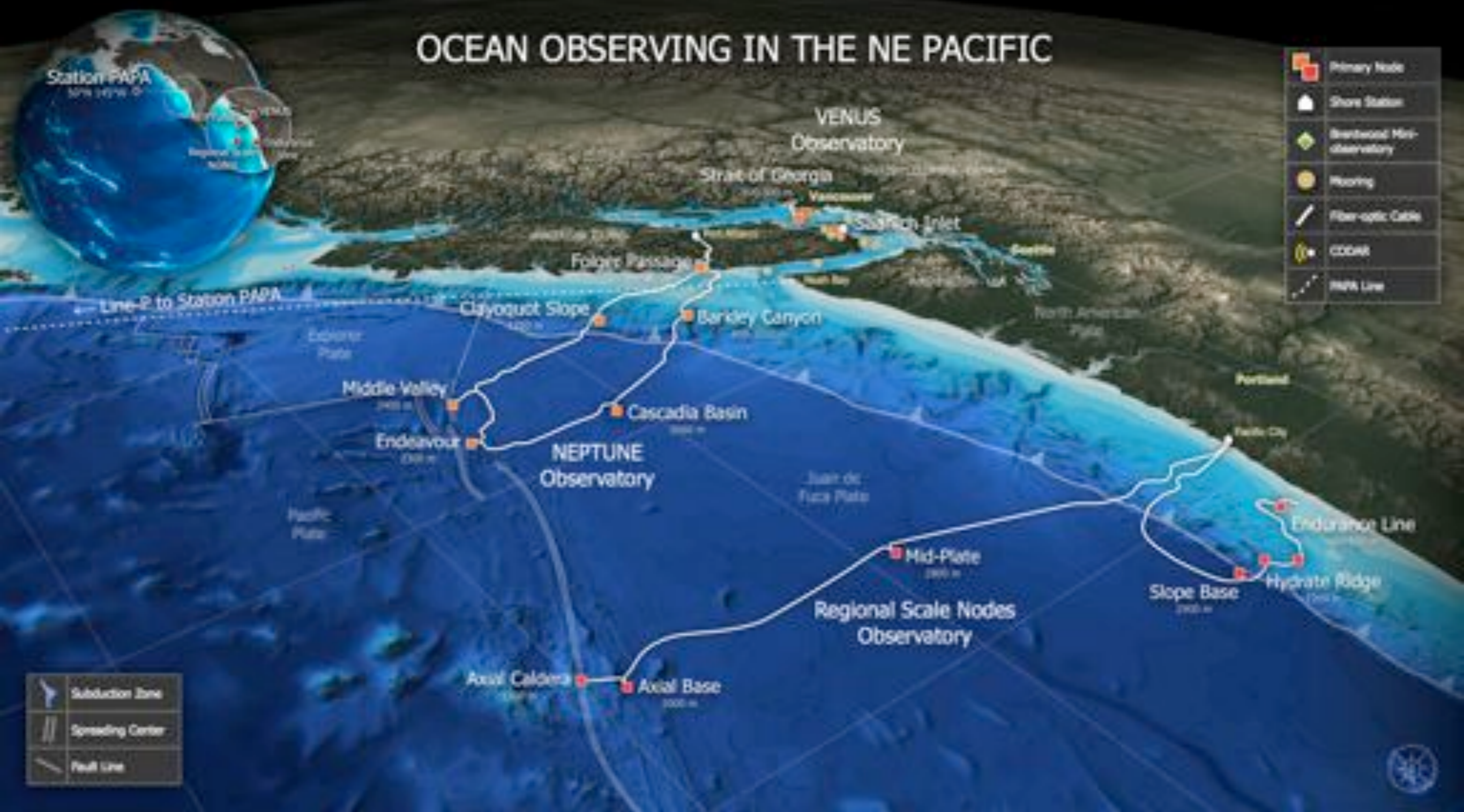
# Multi-instrument platforms and stand-alone instruments



the seafloor, with rotary sonar lifted into deployment position, 11 September 2009.

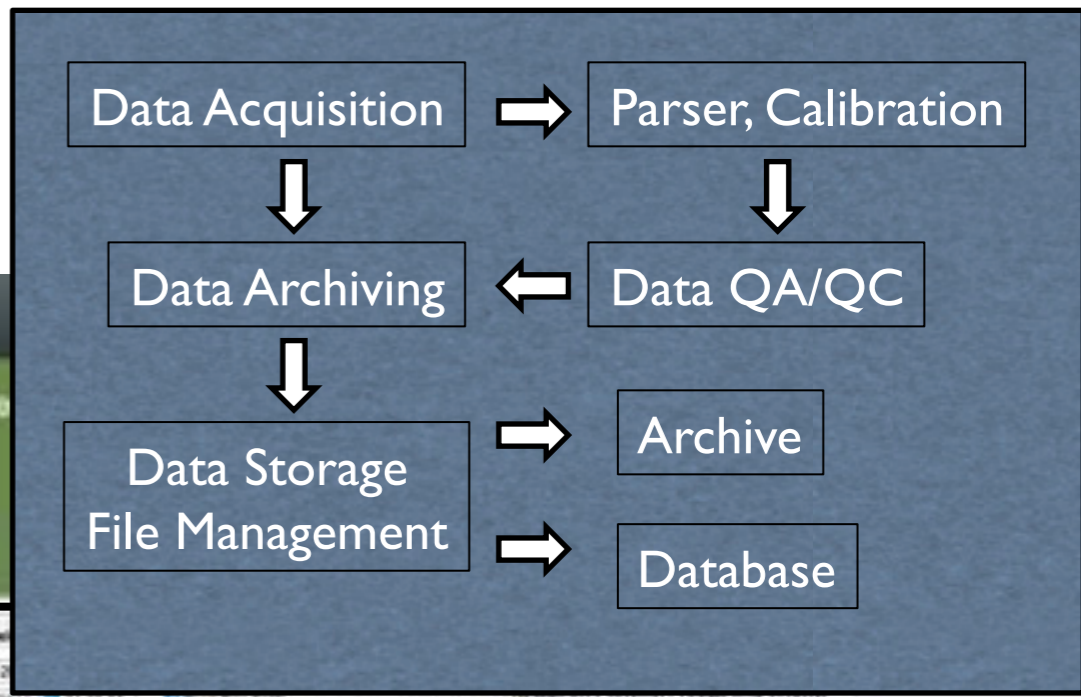
Barkley Canyon Bottom Pressure Recorder (BPR) with differential pressure gauge and platform

# OCEAN OBSERVING IN THE NE PACIFIC



# Data Access and Data Tools

- all sensor data and imagery archived
- online graphical previews of scalar data
- viewers for ADCP and hydrophone data in development
- online viewing of annotated, archived video
- web services delivery of data
- downloads of all data



Seatube

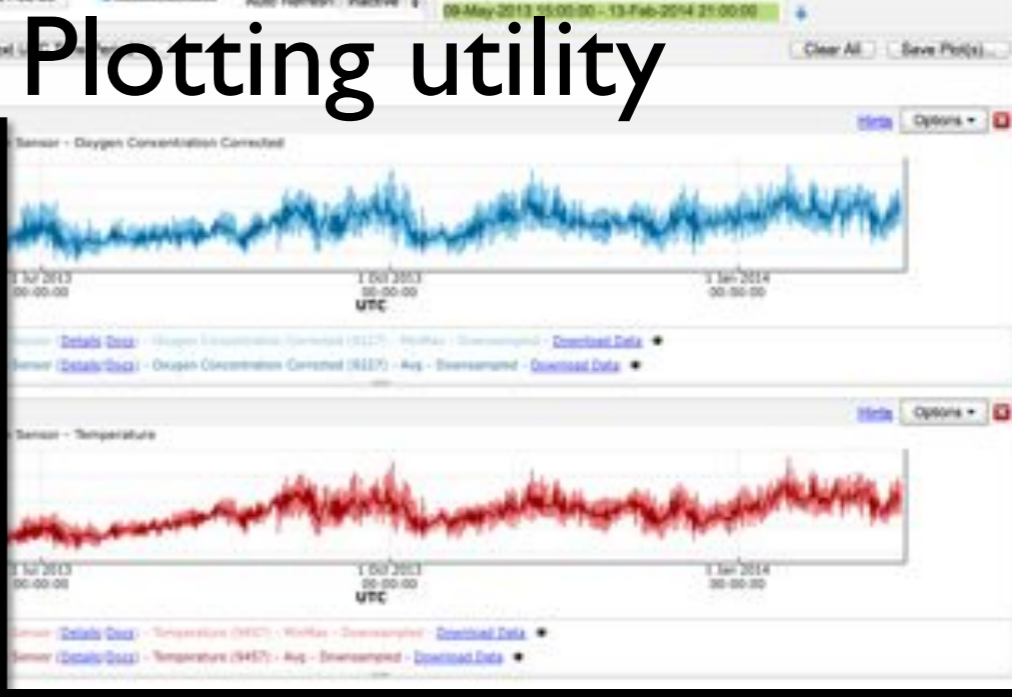
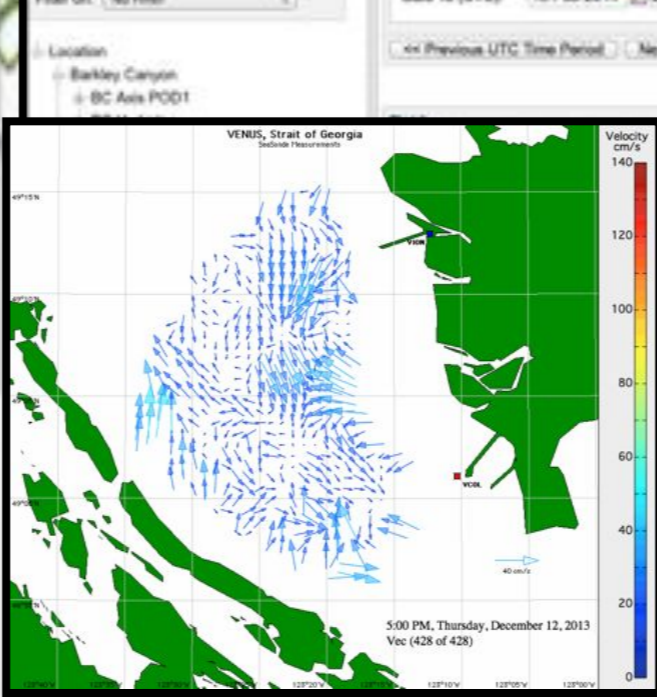
Start Date (UTC)	End Date (UTC)	Comment	Img	Latitude	Longitude	Depth	Origin	Action
25-Jun-2012 19:30:21	25-Jun-2012 19:30:21	confirmation received that the connection of BPR is good		48.42731	-126.17494	393.02	WLS	
25-Jun-2012 19:32:54	25-Jun-2012 19:32:54	diver site		48.42743	-126.17454	393.06	WLS	
25-Jun-2012 19:33:07	25-Jun-2012 19:33:07	VPS in sight		48.42743	-126.17454	392.96	WLS	
25-Jun-2012 19:34:16	25-Jun-2012 19:34:16	VPS		48.42743	-126.17454	392.96	WLS	
25-Jun-2012 19:37:45	25-Jun-2012 19:37:45	one side of the VPS		48.42738	-126.17412	393.18	WLS	
25-Jun-2012 19:38:02	25-Jun-2012 19:38:02	ECHOSounder custom star in front of VPS		48.42741	-126.17407	393.06	WLS	
25-Jun-2012 19:38:11	25-Jun-2012 19:38:11	DGC: Please add comment [Focal Length=1] [F-Stop=4] [Exposure time=0.01] [ISO Equivalent=200]		48.42741	-126.17408	393.81	WLS	
25-Jun-2012 19:39:36	25-Jun-2012 19:39:36	CANDARAN: sea anemone		48.42741	-126.17408	393.88	WLS	
25-Jun-2012 19:39:49	25-Jun-2012 19:39:49	DGC: Please add comment [Focal Length=4.2] [F-Stop=4] [Exposure time=0.01] [ISO Equivalent=200]		48.42741	-126.17408	394.03	WLS	
25-Jun-2012 19:40:14	25-Jun-2012 19:40:14	DGC: Please add comment [Focal Length=4.2] [F-Stop=4] [Exposure time=0.01] [ISO Equivalent=200]		48.42741	-126.17408	393.97	WLS	

Time Period Selection

Sort by: Location

Filter on: No filter

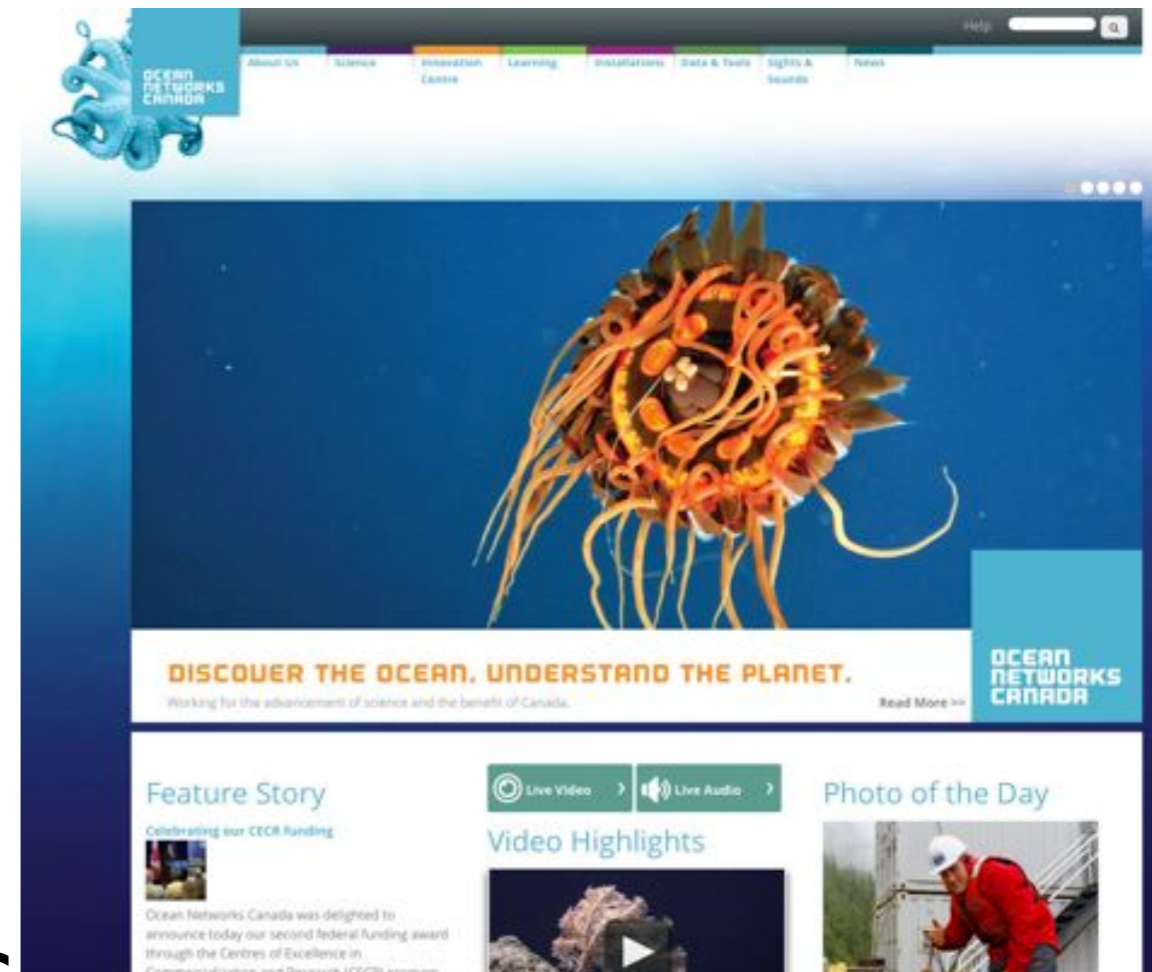
Location: Barkley Canyon, BC Axis POD1



# 2012-2013 statistics

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- Web site visits
  - 275 000 individuals
  - 180 countries
- 8000 users accessed data archive
- 21 500 data downloads
- 45 peer-reviewed articles
- 3 crowd sourcing campaigns

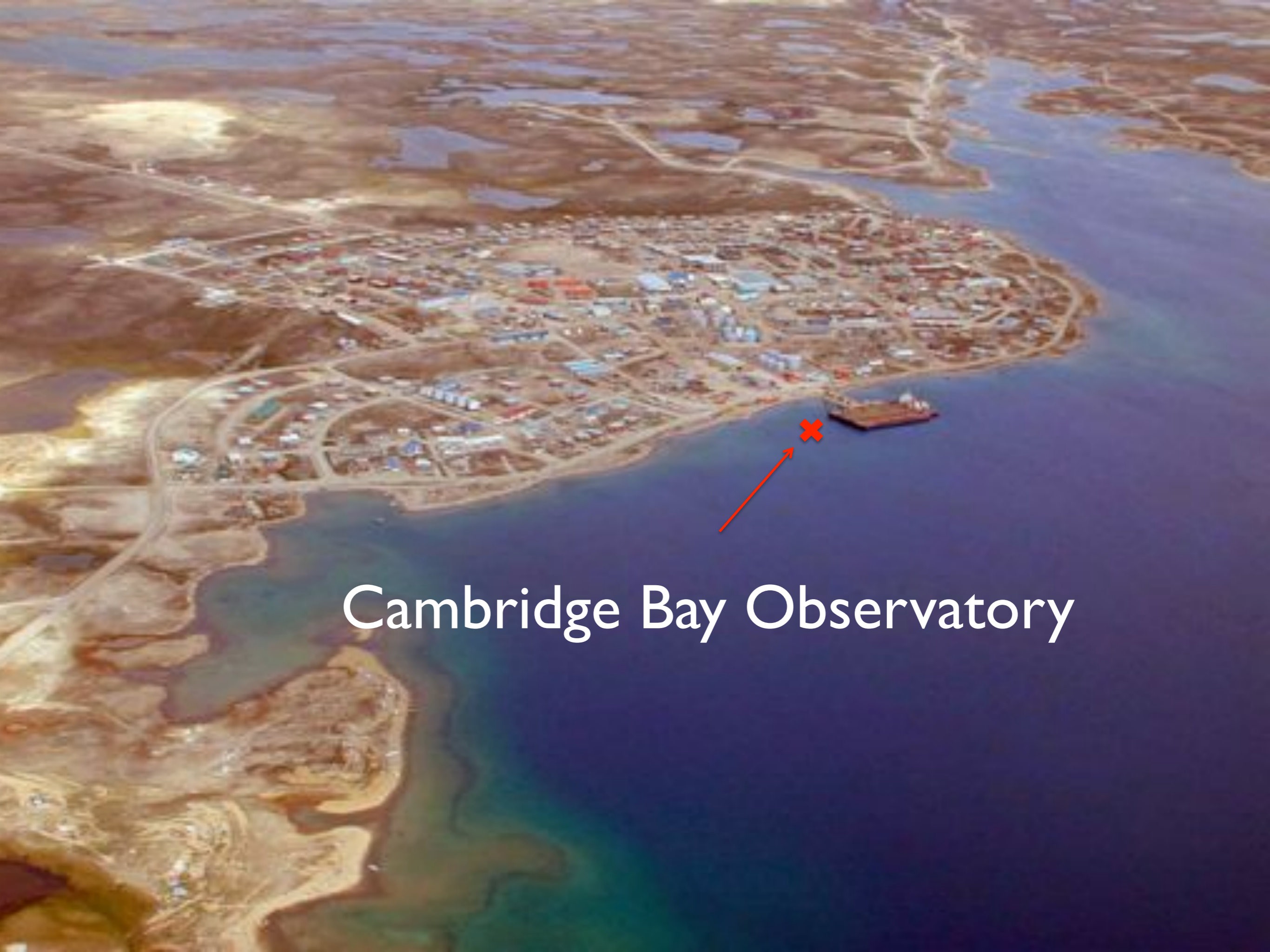


# Cambridge Bay Observatory

A miniature cabled  
ocean observatory  
for science and  
outreach







Cambridge Bay Observatory

# Cambridge Bay mini-Observatory



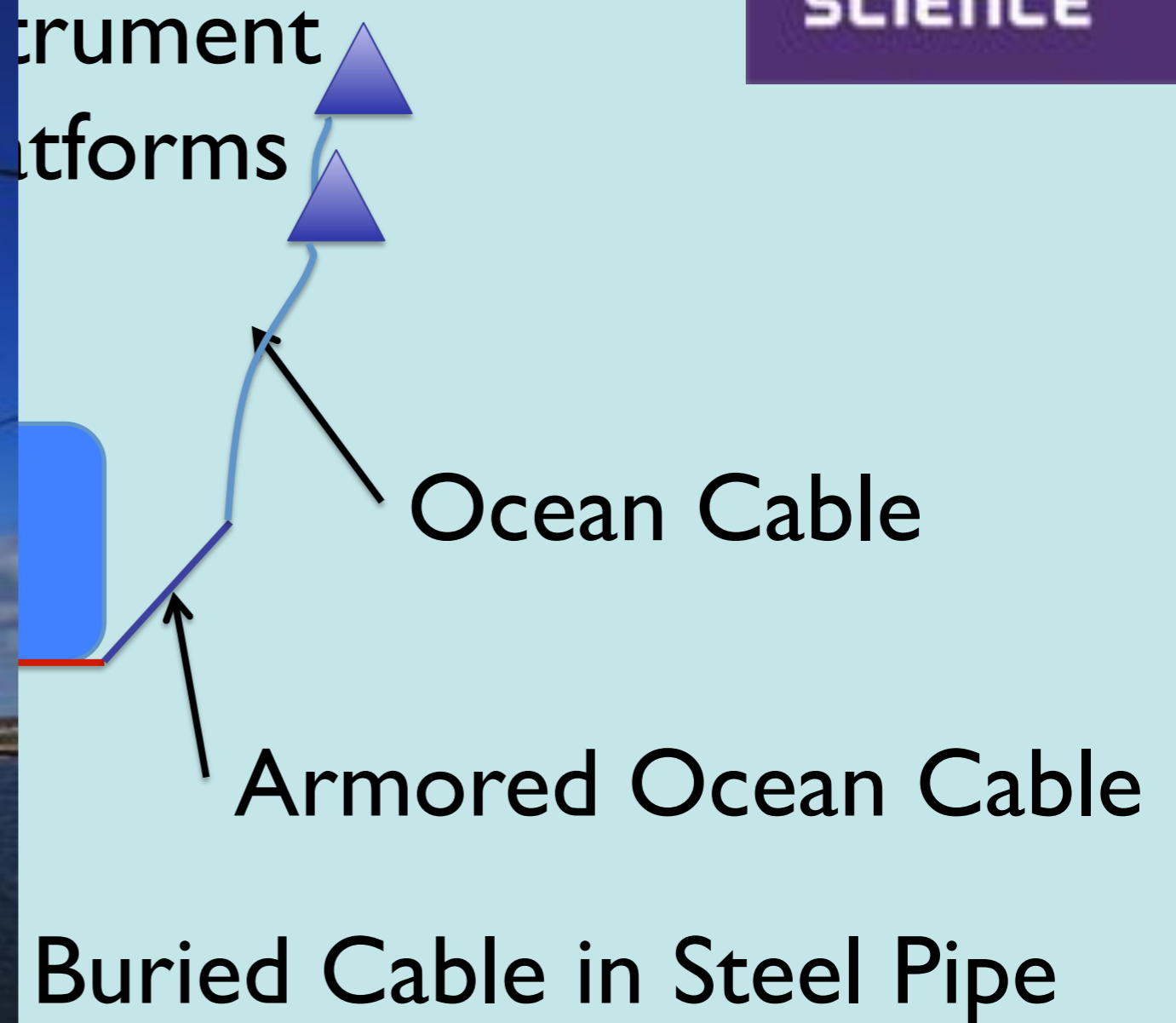
Instrument  
Platforms



Ocean Cable

Armored Ocean Cable

Buried Cable in Steel Pipe



# Local Network Overview

Nunavut Government Building

Shore Station



Wireless  
Link



Data logging  
and distribution

School and Cultural Centre



2-way  
satellite  
link

UVic



# Satellite Data Transmission to ONC Data Centre at UVic

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Real Time - CTD, ice  
thickness, weather data

Hourly - image packets,  
hydrophone data



# Mini-observatory instrument package



## SeaBird Water Quality Monitor

1. Sea-Bird CTD
2. Wet-Labs chlorophyll fluorometer, turbidity, and DO<sub>2</sub> sensors
3. Bleach Injection System (BLIS)



# The first 18 months of data

## Arctic Observatory Plotting Utility

Cambridge Bay and Peel Sound

Logged in as Kim Juniper | Profile | Help | Logout

Data Search Code Runner Plotting Utility SeaTube Digital Fishers Cameras More Tools

Instruments Saved Plots Help

Sort by: Location

Filter on: No Filter

Location

Peel Sound

Cambridge Bay

Dock

CTD

Ice Profiler

Meteorological Station

Air Temperature

Barometric Pressure

Barometric Trend

Battery Voltage

Internal Humidity

Internal Temperature

Rainfall Rate

Relative Humidity

USB 10 (UTC) 13-DEC-2012 4:17:00 Reset Time Fields Auto Refresh: inactive

01-Oct-2012 00:00:00 - 13-Dec-2012 19:50:00

12-Oct-2012 00:00:00 - 13-Dec-2012 19:50:00

12-Oct-2012 17:13:34 - 13-Dec-2012 22:17:06

12-Oct-2012 17:13:34 - 13-Dec-2012 22:17:06

<< Previous UTC Time Period Next UTC Time Period >>

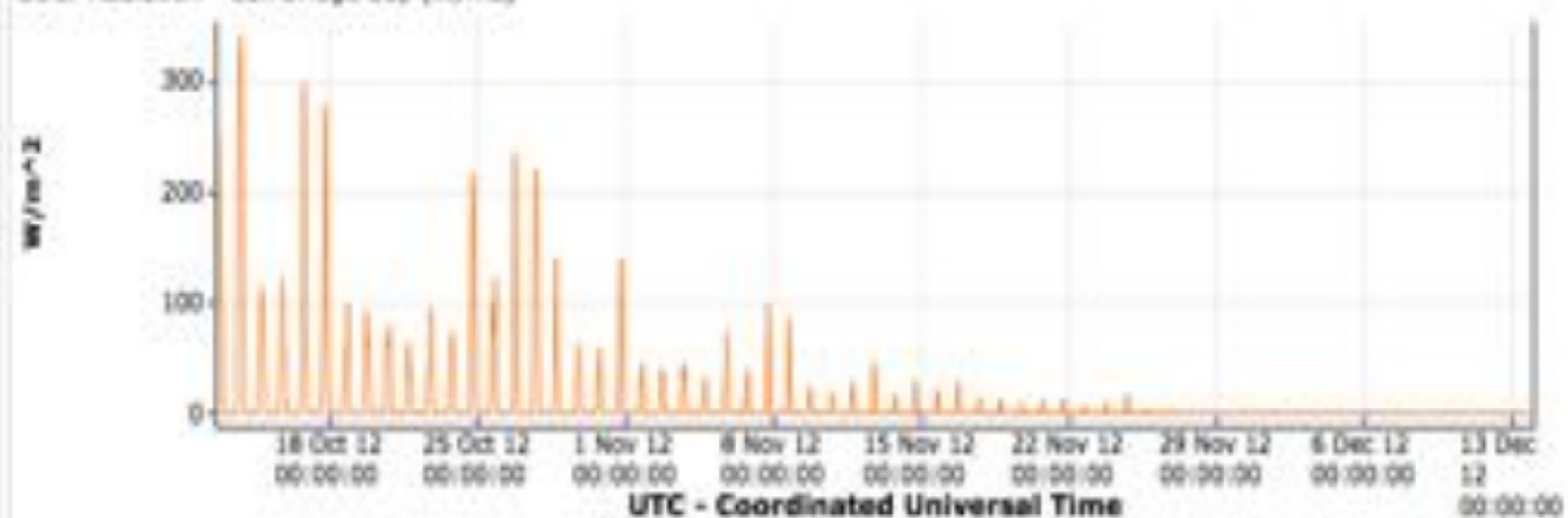
Clear All

Save Plot(s)...

Plot 2

Plot 2: Legend

Solar Radiation - Cambridge Bay (W/m<sup>2</sup>)



# Data downloads

Step 1. Choose Data Source

Step 2. Select Data Product

Step 3. View Cart (0 items)

Data Search Help

Sort by: Location

Filter on: No Filter

Location

Peel Sound

Cambridge Bay

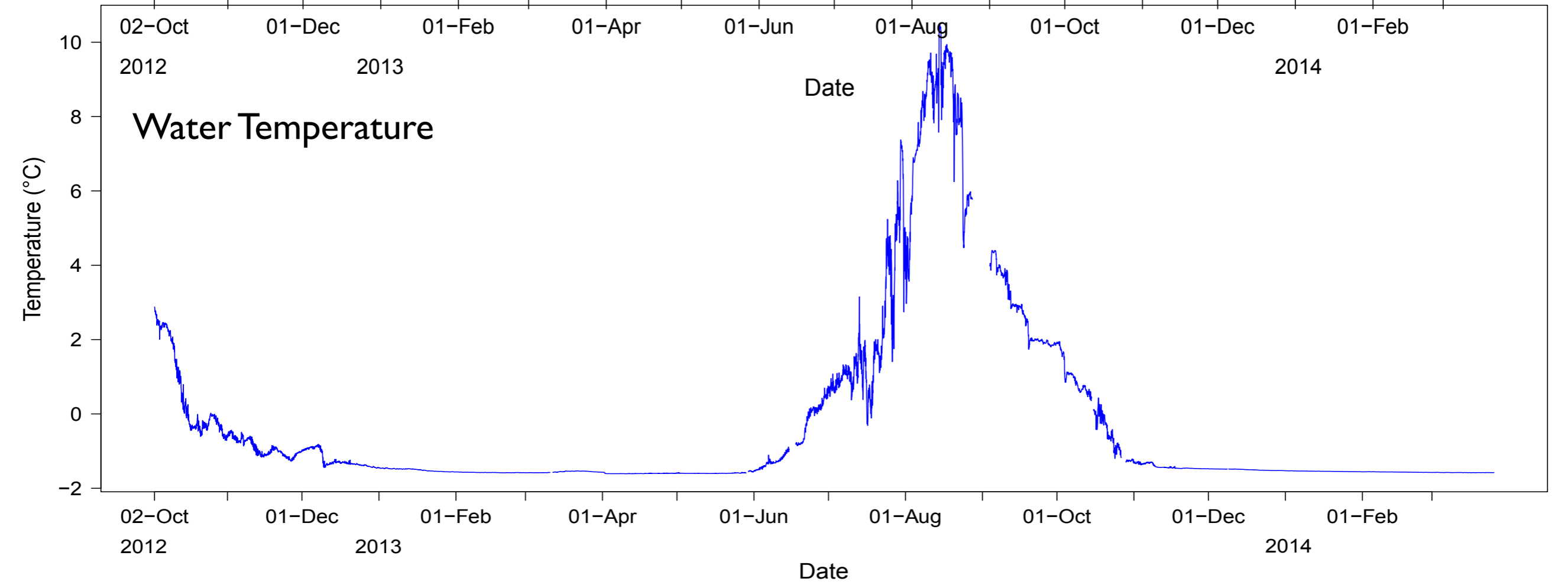
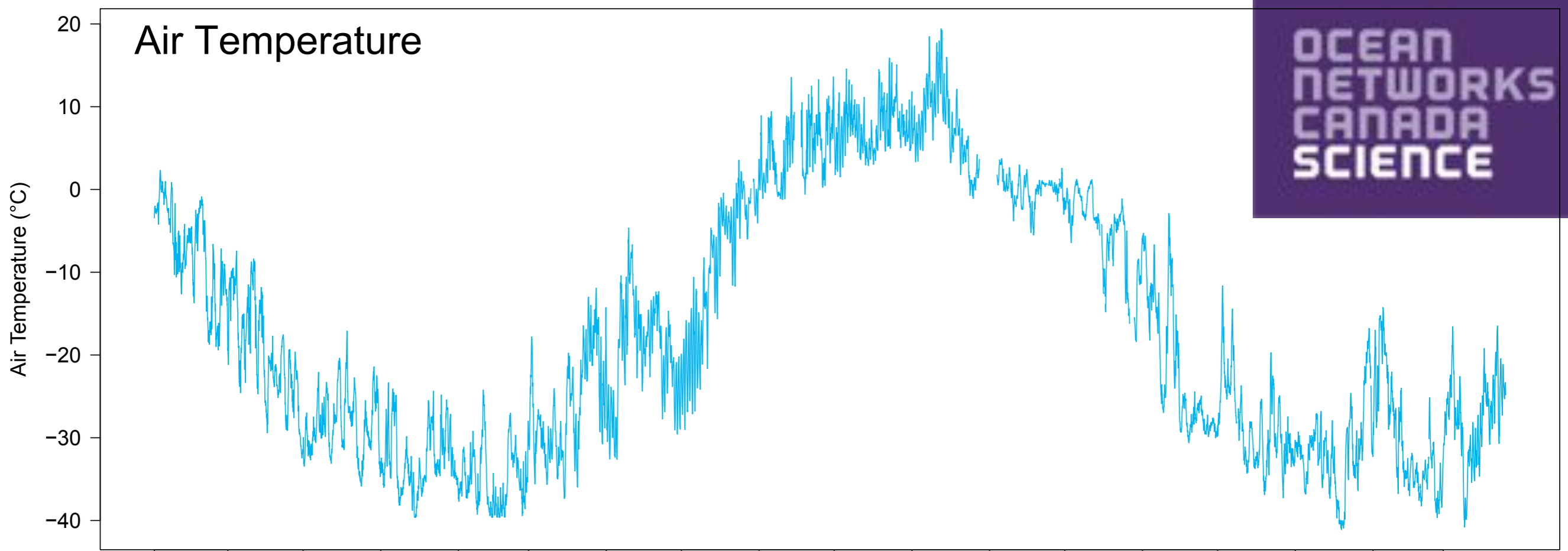
Dock

CTD

Ice Profiler

Meteorological Station







# ASL Shallow Water Ice Profiler (SWIP)

## Ice Draft Calculations

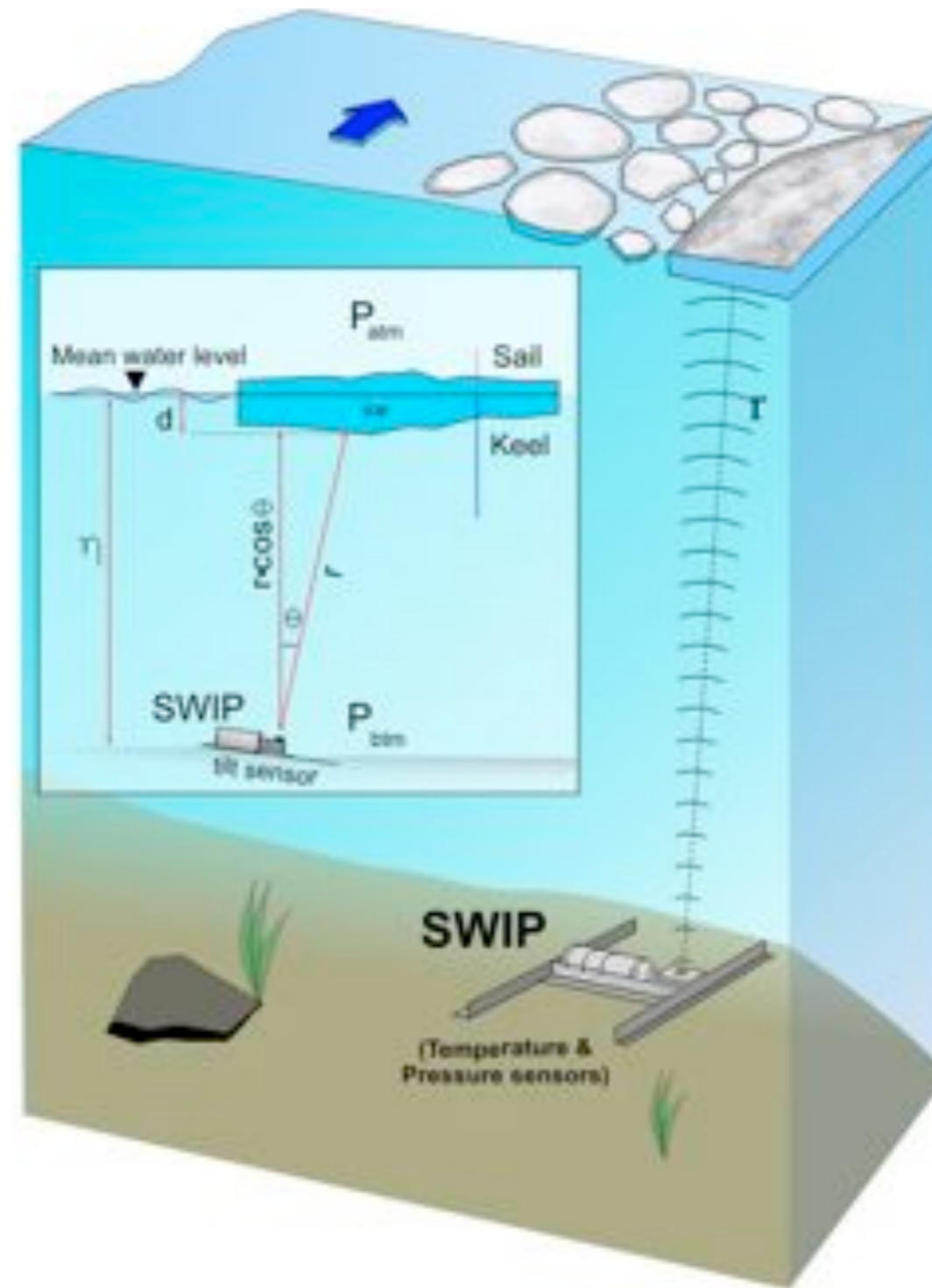
$$\eta = \frac{(P_{\text{btm}} - P_{\text{atm}})}{\rho g} \quad (\text{water level})$$

$$d = \eta - \beta \cdot r \cdot \cos \theta \quad (\text{ice draft})$$

$\beta$  = function of C (speed of sound)

Determined from:

- bottom temperature
- CTD
- Open water events

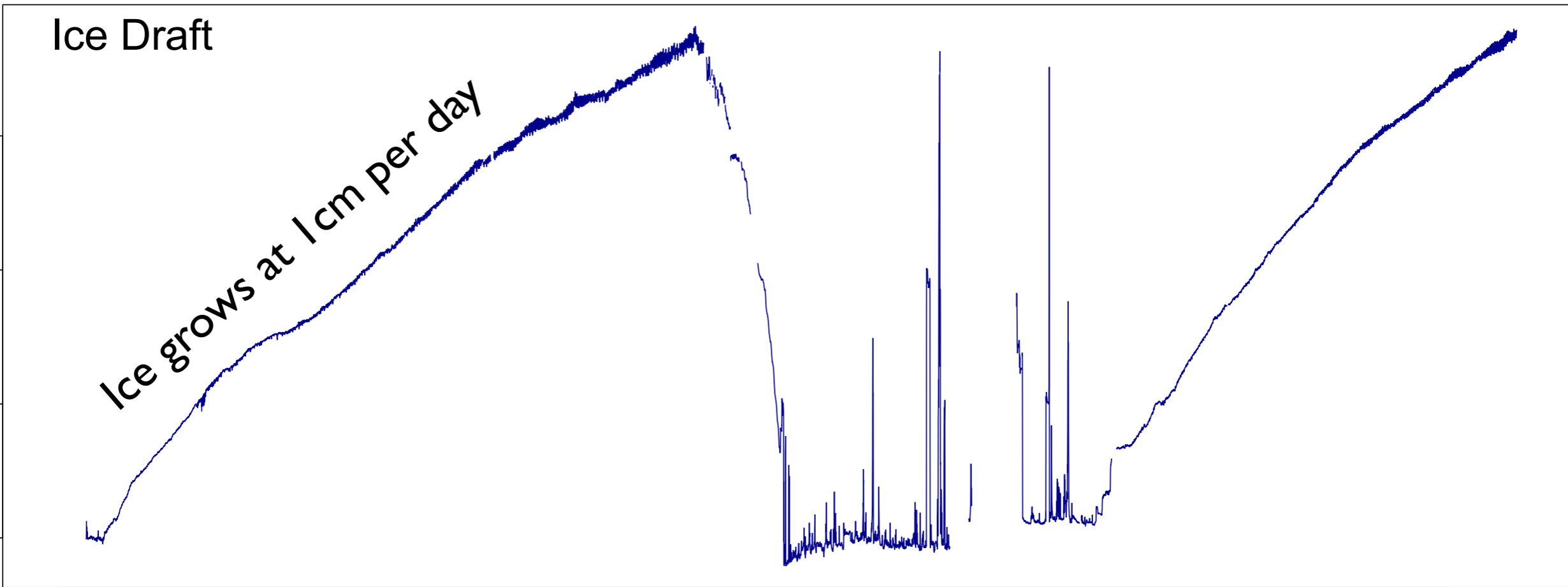


# Ice Draft

Ice Draft Corrected (m)

Ice grows at 1cm per day

1.5  
1.0  
0.5  
0.0

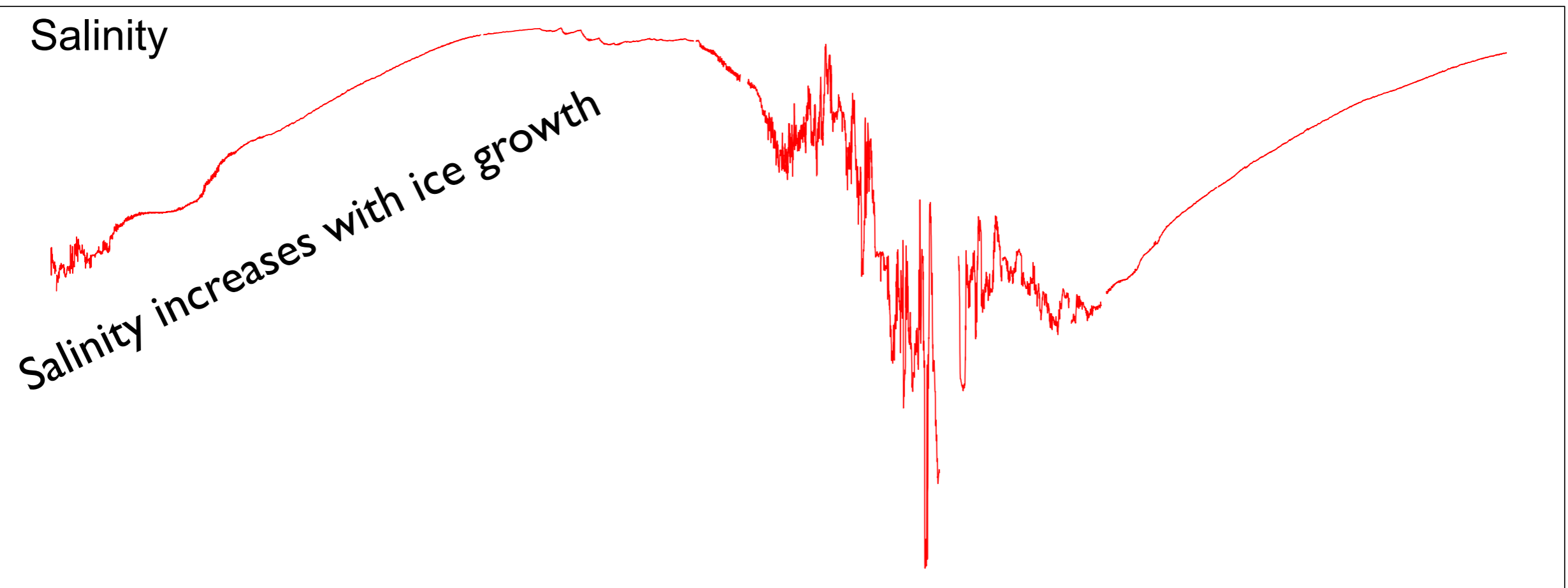


# Salinity

Salinity (psu)

Salinity increases with ice growth

29  
28  
27  
26  
25  
24

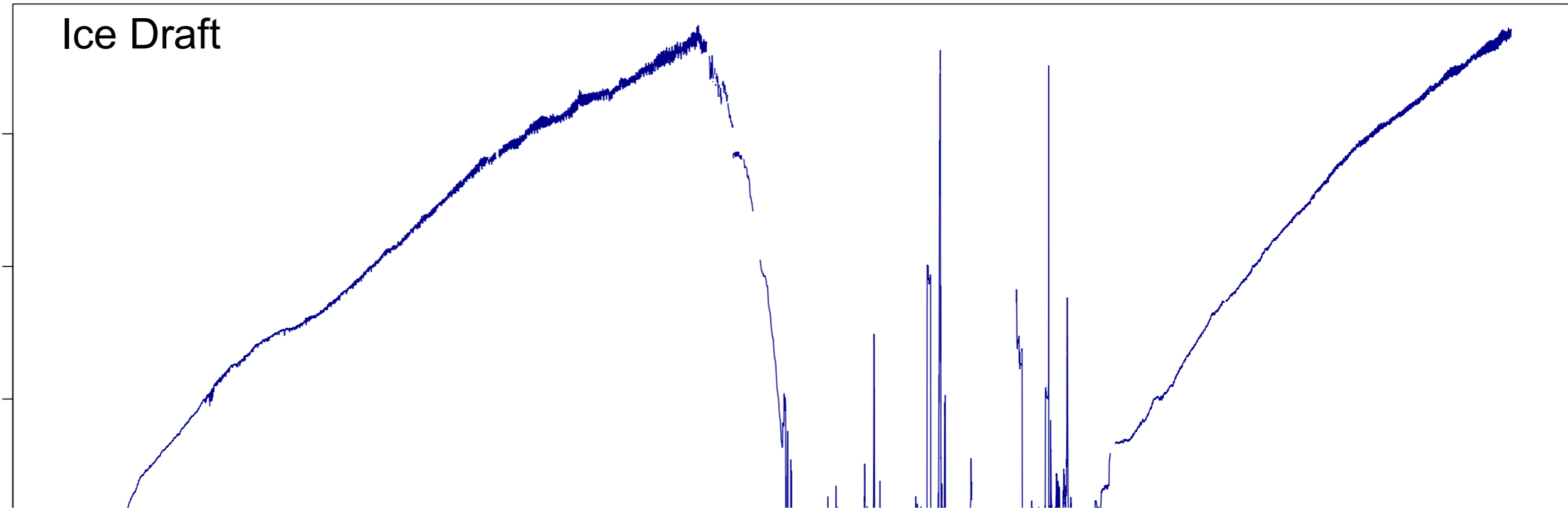


02-Oct 01-Dec 01-Feb 01-Apr 01-Jun 01-Aug 01-Oct 01-Dec 01-Feb

# Ice Draft

Ice Draft Corrected (m)

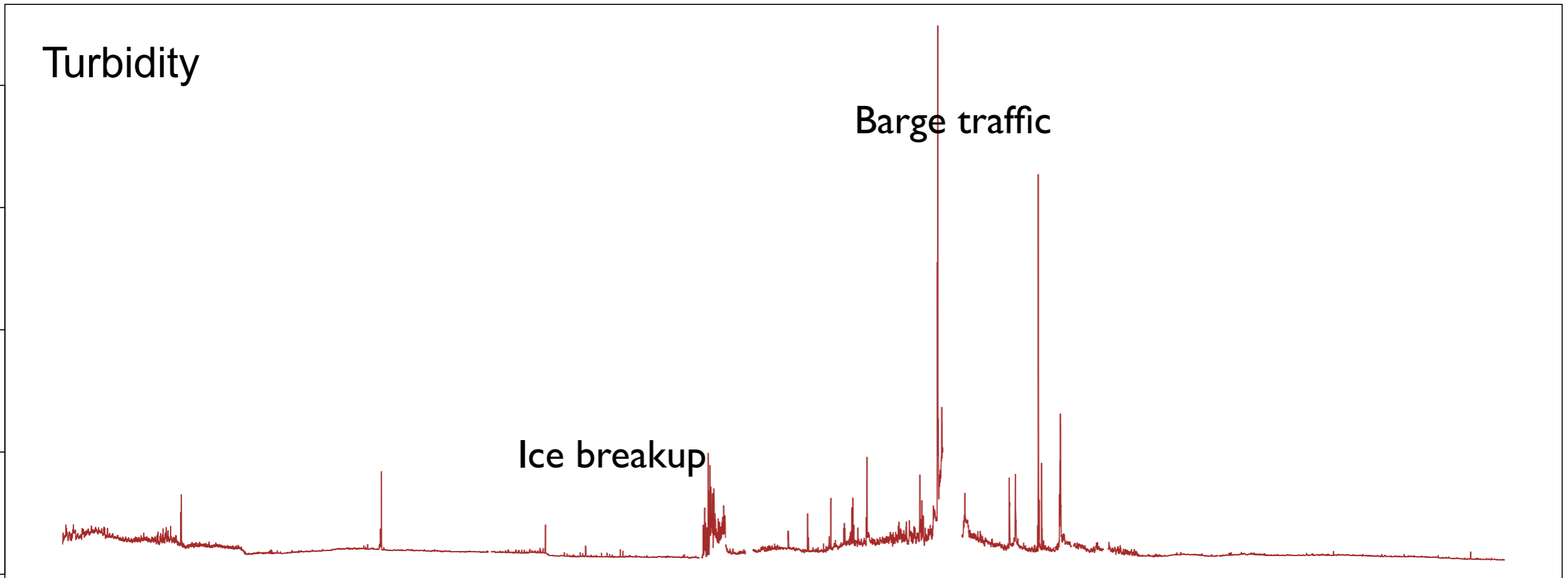
1.5  
1.0  
0.5



# Turbidity

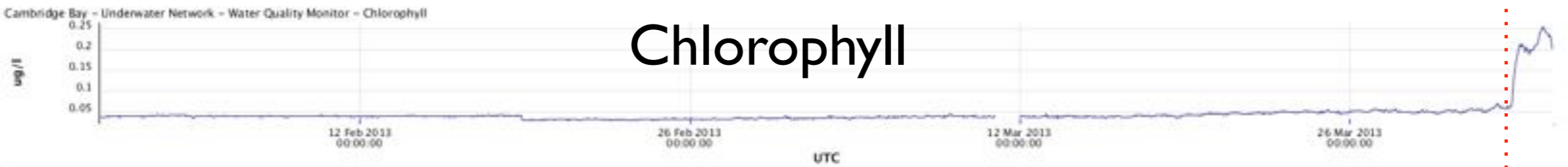
Turbidity (NTU)

8  
6  
4  
2  
0



# Under-ice phytoplankton bloom?

- rapid increase in chlorophyll and dissolved oxygen concentration on April 1-2, 2013



Cambridge Bay - Underwater Network - Water Quality Monitor - Chlorophyll  
Cambridge Bay - Underwater Network - Water Quality Monitor - Chlorophyll (3510) - Avg - Downsampled



Cambridge Bay - Underwater Network - Water Quality Monitor - Oxygen  
Cambridge Bay - Underwater Network - Water Quality Monitor - Oxygen (3508) - Avg - Downsampled

# Ocean Presence HD Video Camera

- remote control pan, zoom and tilt
- programmed sweeps



# Accessing video imagery


Arctic Observatory SeaTube Pro  
Cambridge Bay and Peel Sound

Data Search | Code Runner | Plotting Utility | SeaTube | Digital Fishers | Cameras | Projects | More | Tools

Videos | Playlists

Available Resolutions: Medium

- Cruises
- Location
  - Cambridge Bay
    - Shore Station
    - Underwater Network
      - 2012
      - 2013
        - January
        - February
        - March
        - April
        - May
        - June
        - July
        - August
        - September
        - October
        - November
        - December
          - 01
          - 02
          - 03
          - 04
          - 05
          - 06
          - 07
          - 08
          - 09
          - 10



00:53 05:23 1x 20

Dive Log Entries | My Annotations

Start Date (UTC)	End Date (UTC)	Comment	Img	Lat
00:00:02				
02:00:02				
04:00:03				
06:00:03				

# Anemones on seafloor

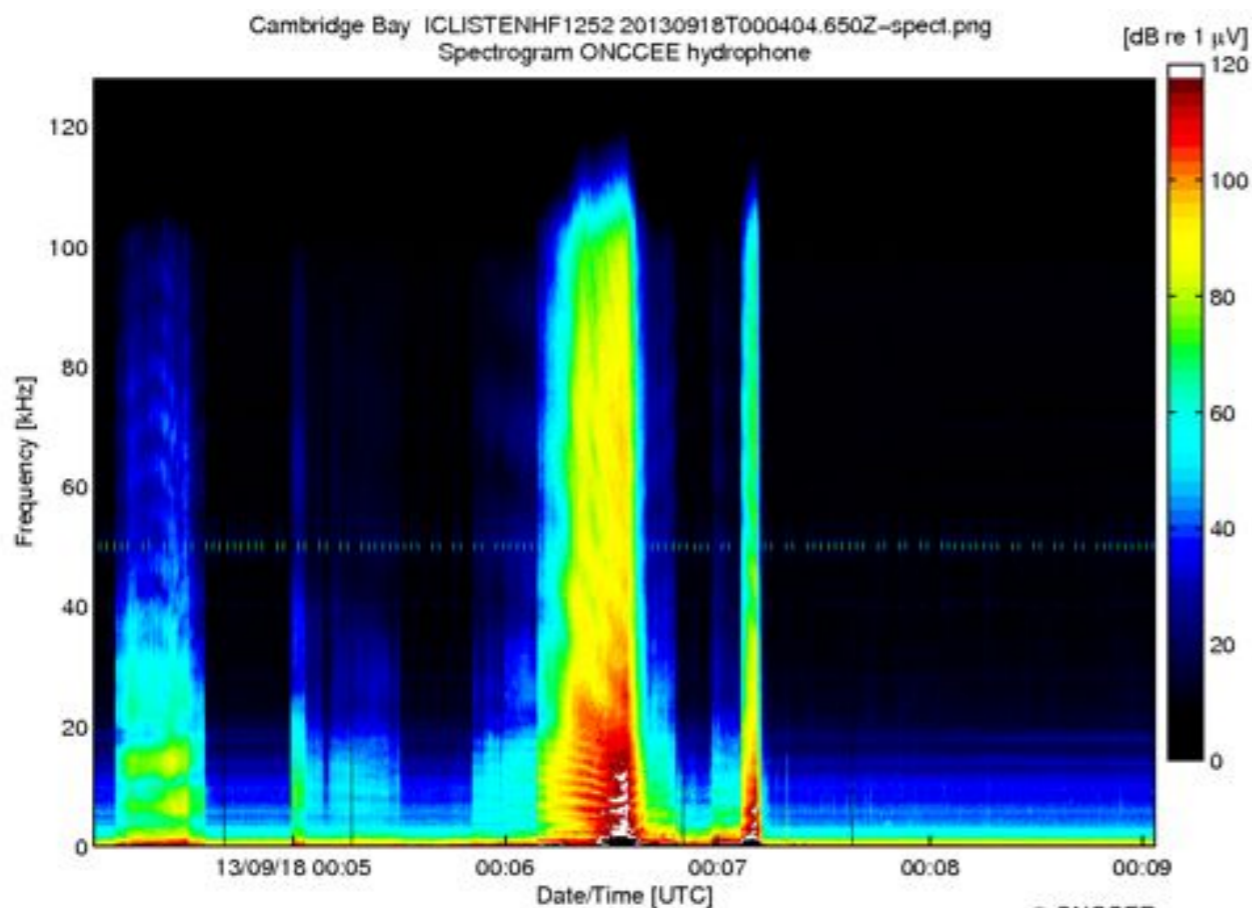
13 December 2012

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SCIENCE



# IC Listen High Frequency Hydrophone

- continuous recording of underwater sound





# Acoustic Fish Tag Receiver

**Tag detected  
yesterday  
- arctic char project**

*3/26/2014 12:00:31 AM*

*450094,643,2014-03-25*

*23:59:23,A69-1601,65303,*

*#E0*



# Community-based research infrastructure

- Free and open data policy
- Education and outreach opportunities
- Communities and independent scientists can access all data



# Smart Oceans North

- potential community based observatory locations

## Current and proposed

- Cambridge Bay
  - field testing of CO<sub>2</sub> sensor in late 2014
- Churchill
- Hudson Strait
- SE Hudson Bay (Kuujjarapik)
- Lake Melville
  - field test of mercury sensor in 2015

## New ideas

- Rupert Estuary (Waskaganish)
  - Continuous, real-time monitoring of salinity, turbidity, ice thickness, fish migration.