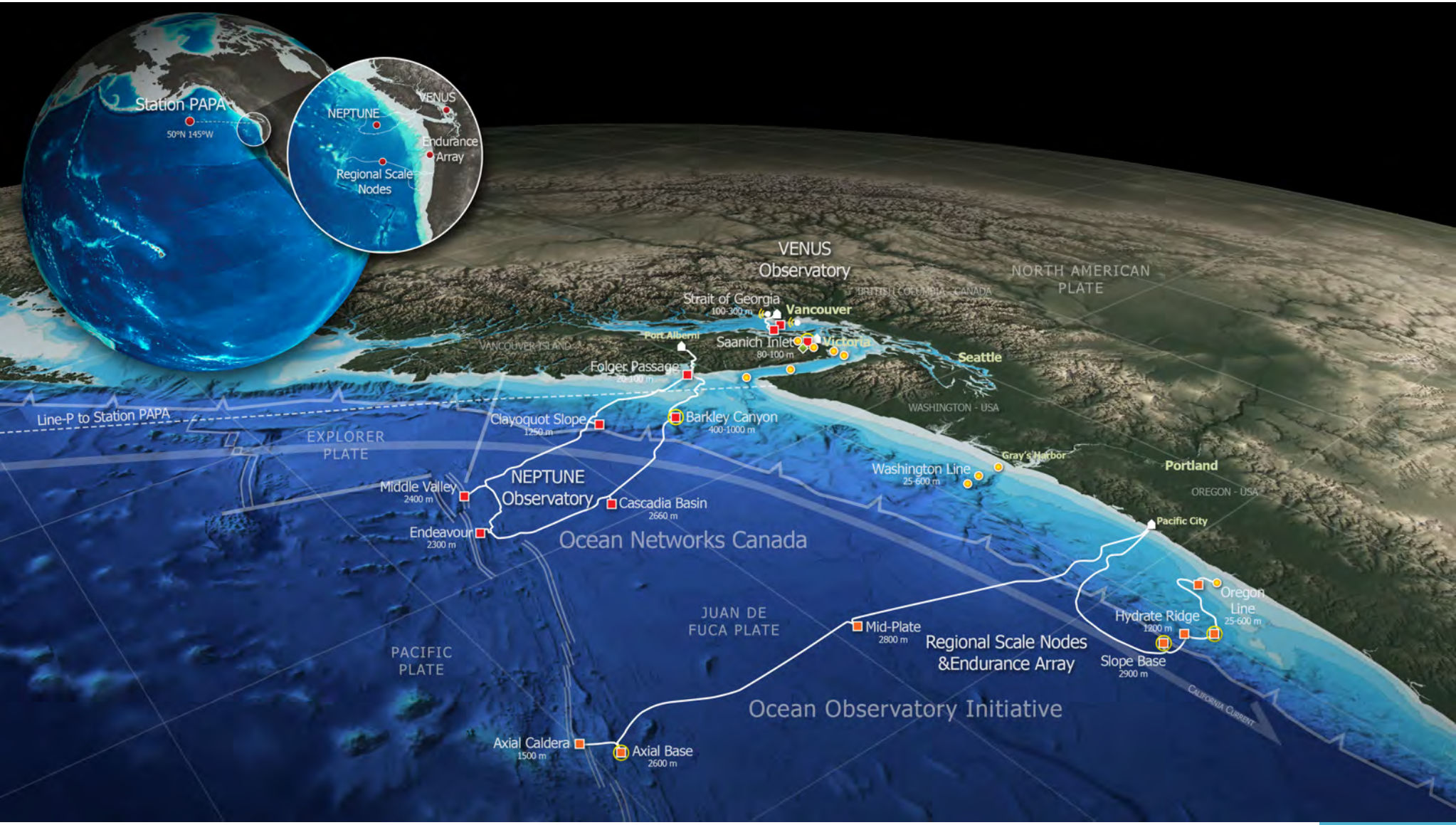
OCEAN NETWORKS CANADA

Ten years of observatory science
Building Canada's smart ocean systems

Richard Dewey, Kim Juniper, Kate Moran | Sept 28, 2016

Ocean networks Canada:

Building and Operating Canada's Ocean Observatory Systems



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The breadth of science themes

Four over-arching science *themes*:

- Understanding Climate Change
- Life in the Northeast Pacific and Salish Sea
- Seafloor, Ocean, and Atmosphere Linkages
- Seafloor in Motion

The breadth of science disciplines

Coastal to Mid-Ocean Ridges & the Arctic

- Benthic Ecology
- Circulation Dynamics
- Microbial Dynamics
- Sediment Dynamics
- Vent Ecology
- Methane and Hydrates
- Tsunamis and Waves
- HF Radar/Surface
- Biogeochemical Cycles
- Plankton Dynamics
- Mammal Vocalizations
- Vent Dynamics
- Engineering Testbed
- Bole Holes and CORKS
- Mobile Systems
- Data Mining and Modelling

9 Cabled Observatory “Nodes”, 4 - 12 platforms/Node

12 shore stations/sites, including Arctic and Atlantic

200+ different instrument types (1000+ sensors)

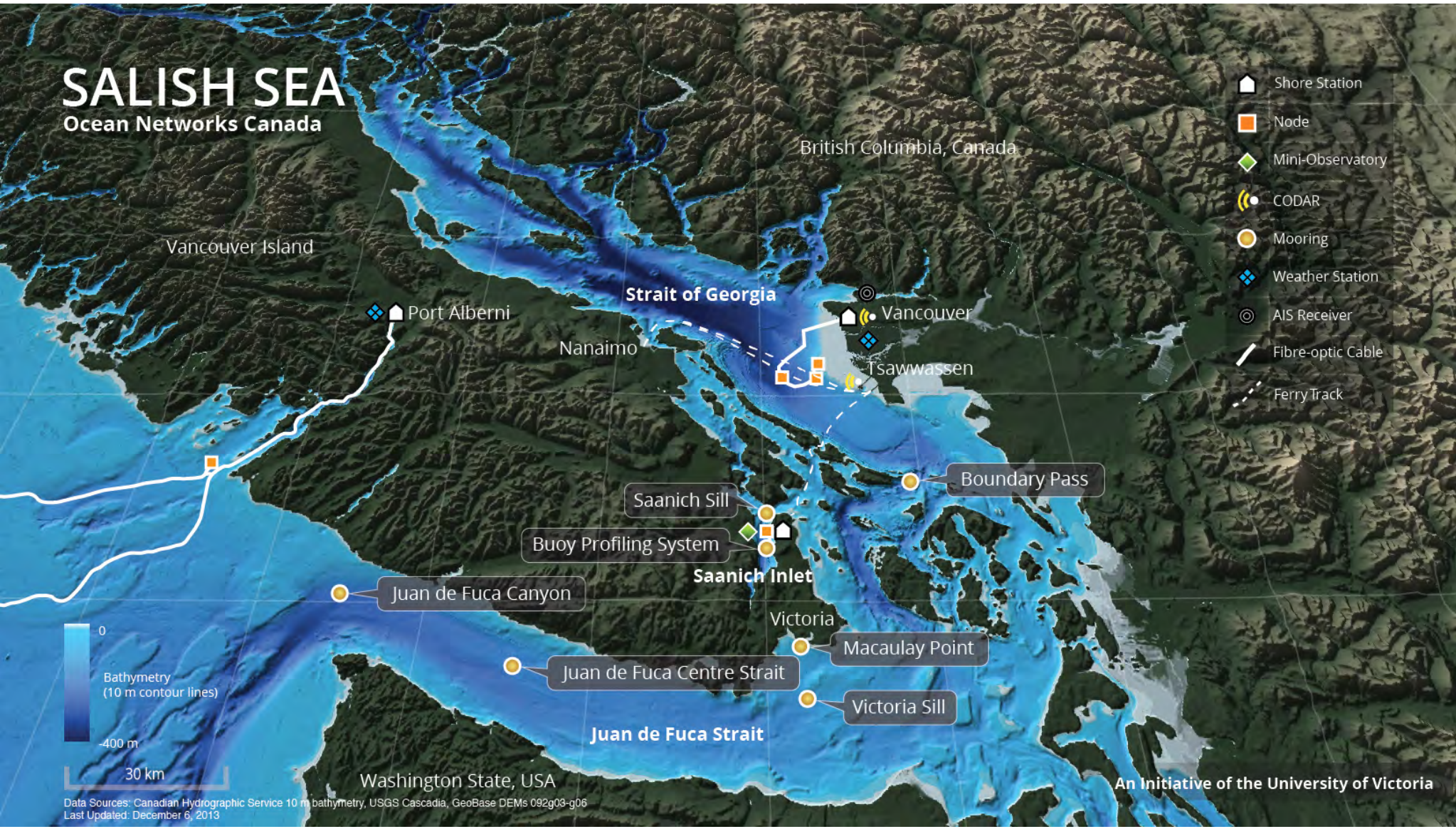
300+ active researchers and students, 10,000+ Reg. Users

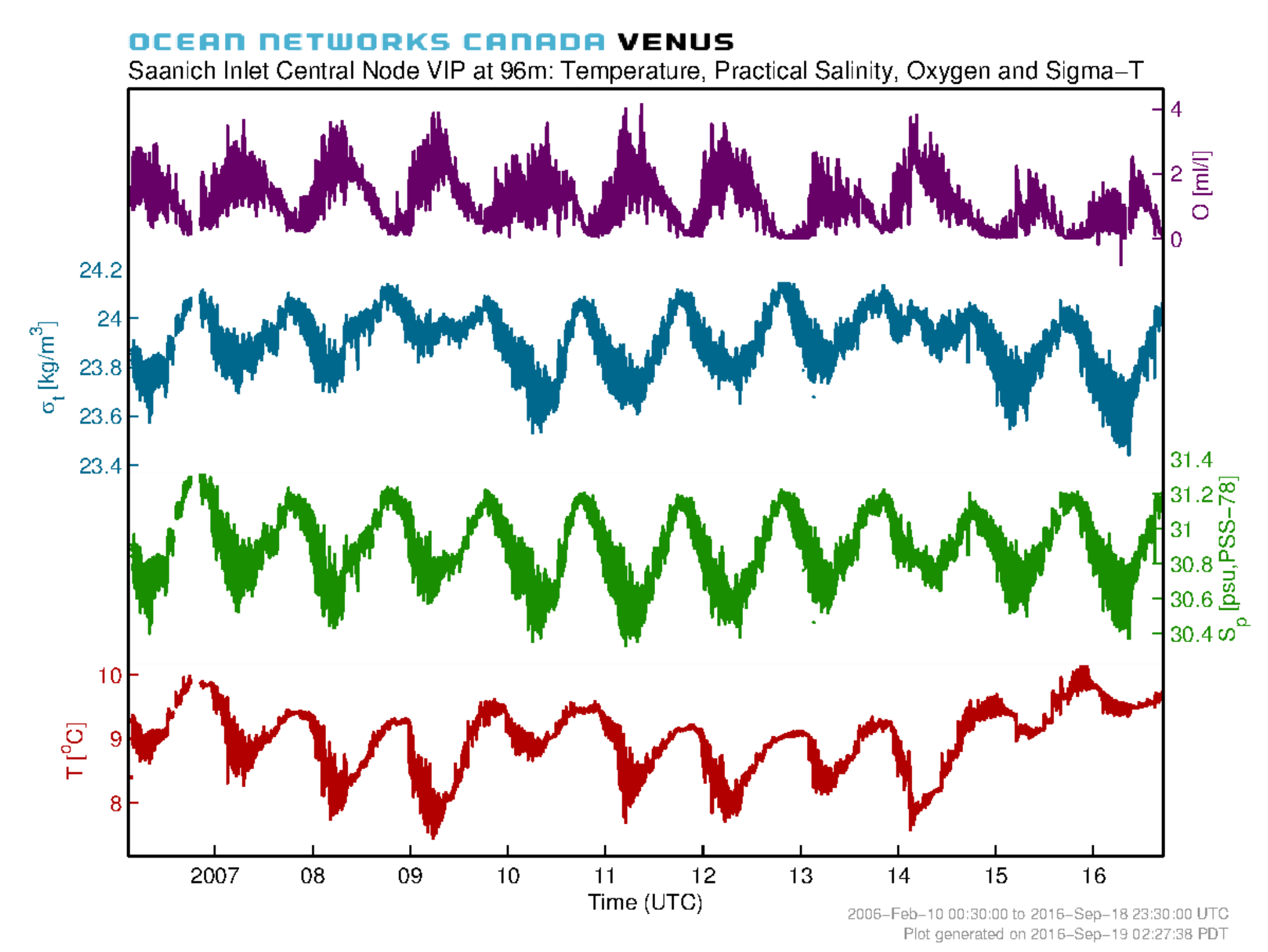
~400 GB/day → 120 TB/year → 1PB

Essential observatory Measures and activities

- Core Water Properties: T, S, P, Density, pH and Chl
- Acoustics: Hydrophones, Dopplers, Sonars
- Cameras: Stills, Videos, 3D, Low-light, Acoustic
- Gases: Total Gas Pressure, O_2, Methane, pCO_2
- Optics: Transmissivity, Back-scatter, particle counters
- Sediments: Piezometers, cores, traps
- Radar: WERA, CODAR, WaMOS
- Meteorological: Weather Stations
- Other: Physical Samples, AIS, Satellite
- Engineering Testbed and Sensor Development
- Computer Science, Modelling, Community Science

→ **Benefits to Canada: Smart Ocean Systems™**


SALISH SEA
Ocean Networks Canada
British Columbia, Canada
Vancouver Island
Strait of Georgia
Port Alberni
Nanaimo
Vancouver
Tsawwassen
Shore Station
Node
Mini-Observatory
CODAR
Mooring
Weather Station
AIS Receiver
Fibre-optic Cable
Ferry Track
Boundary Pass
Saanich Sill
Buoy Profiling System
Saanich Inlet
Juan de Fuca Canyon
Victoria
Macaulay Point
Juan de Fuca Centre Strait
Victoria Sill
Juan de Fuca Strait
0
Bathymetry
(10 m contour lines)
-400 m
30 km
Washington State, USA
An Initiative of the University of Victoria
Data Sources: Canadian Hydrographic Service 10 m bathymetry, USGS Cascadia, GeoBase DEMs 092g03-g06
Last Updated: December 6, 2013

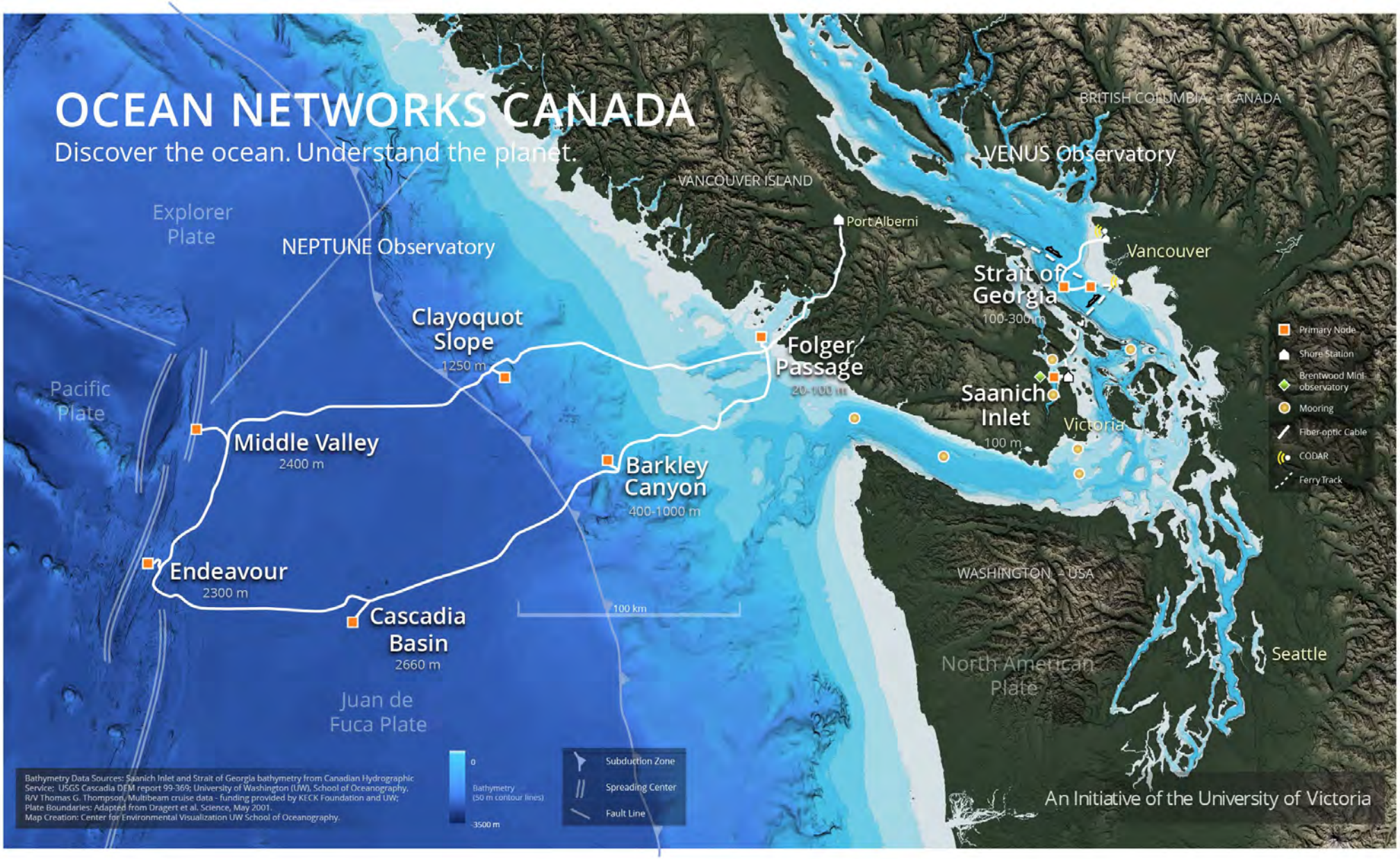

OCEAN NETWORKS CANADA VENUS
Saanich Inlet Central Node VIP at 96m: Temperature, Practical Salinity, Oxygen and Sigma−T
O [ml/l]
4
2
0
σt [kg/m3]
24.2
24
23.8
23.6
23.4
Sp [psu,PSS−78]
31.4
31.2
31
30.8
30.6
30.4
T [°C]
10
9
8
2007
08
09
10
11
12
13
14
15
16
Time (UTC)
2006−Feb−10 00:30:00 to 2016−Sep−18 23:30:00 UTC
Plot generated on 2016−Sep−19 02:27:38 PDT

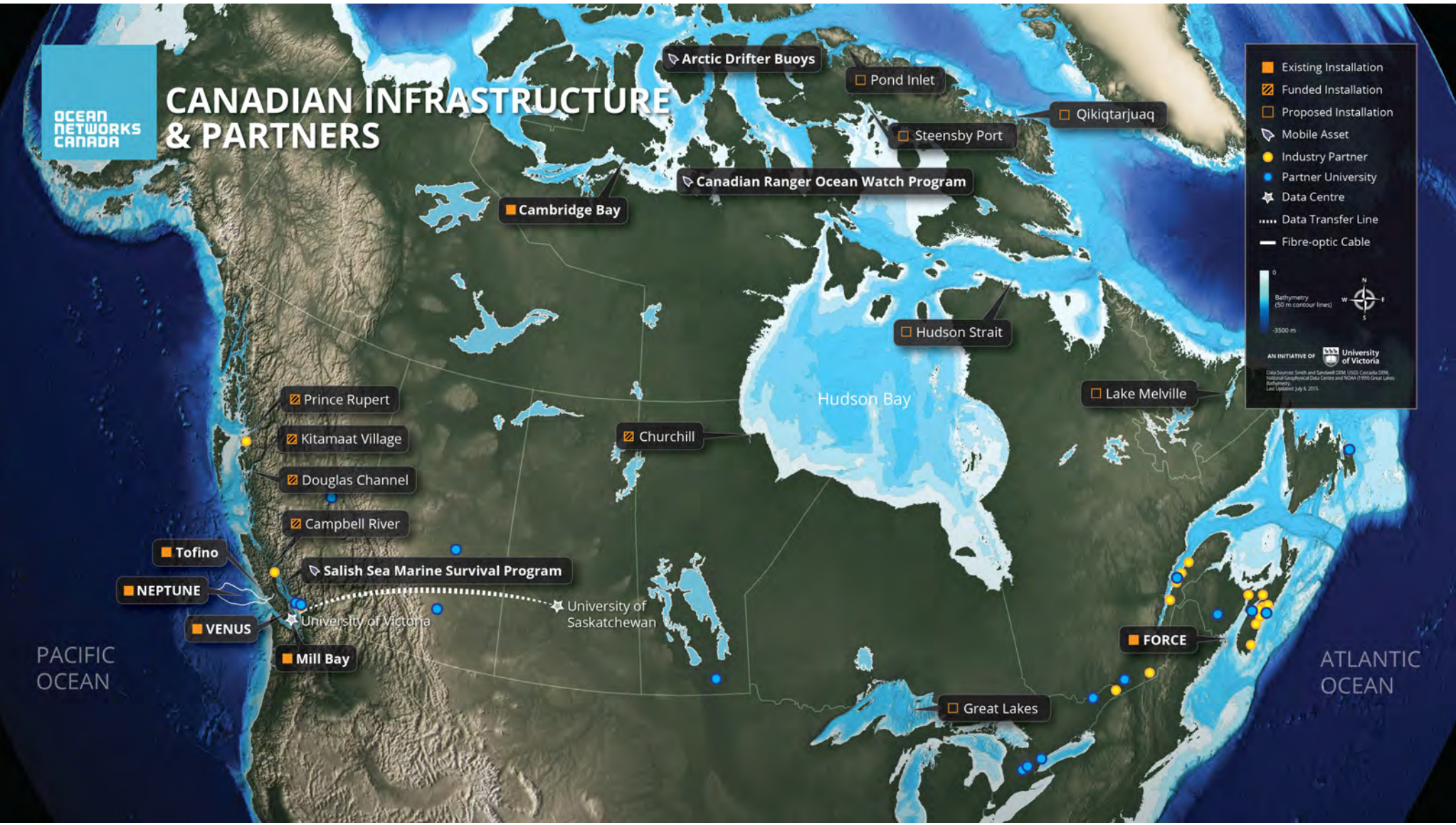
Euphausia pacifica
(~1cm)

2D profile data into 3D Data Cube

160 Million Profiles

Mei Sato, 2013 & 2014


OCEAN NETWORKS CANADA
Discover the ocean. Understand the planet.
BRITISH COLUMBIA - CANADA
VENUS Observatory
VANCOUVER ISLAND
Port Alberni
Explorer Plate
NEPTUNE Observatory
Vancouver
Strait of Georgia
100-300 m
Clayoquot Slope
1250 m
Folger Passage
20-100 m
Pacific Plate
Saanich Inlet
100 m
Victoria
Middle Valley
2400 m
Barkley Canyon
400-1000 m
Endeavour
2300 m
WASHINGTON - USA
100 km
Cascadia Basin
2660 m
Seattle
North American Plate
Juan de Fuca Plate
Primary Node
Shore Station
Brentwood Mini-observatory
Mooring
Fiber-optic Cable
CODAR
Ferry Track
Subduction Zone
Spreading Center
Fault Line
0
Bathymetry (50 m contour lines)
-3500 m
Bathymetry Data Sources: Saanich Inlet and Strait of Georgia bathymetry from Canadian Hydrographic Service; USGS Cascadia DEM report 99-369; University of Washington (UW), School of Oceanography, R/V Thomas G. Thompson, Multibeam cruise data - funding provided by KECK Foundation and UW;
Plate Boundaries: Adapted from Dragert et al. Science, May 2001.
Map Creation: Center for Environmental Visualization UW School of Oceanography.
An Initiative of the University of Victoria

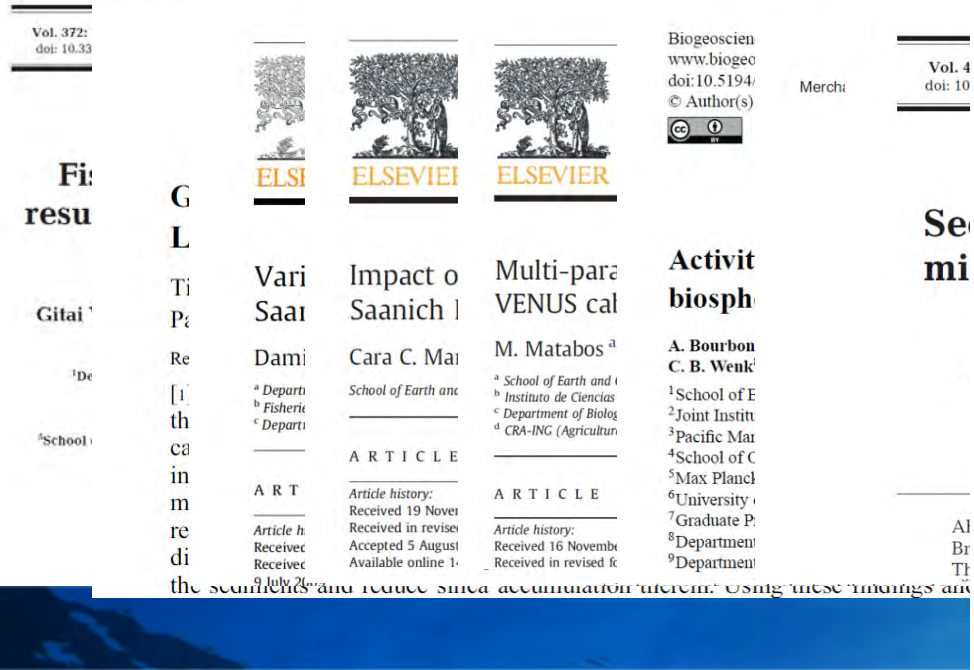

OCEAN NETWORKS CANADA
CANADIAN INFRASTRUCTURE & PARTNERS
Arctic Drifter Buoys
Pond Inlet
Qikiqtarjuaq
Steensby Port
Canadian Ranger Ocean Watch Program
Cambridge Bay
Hudson Strait
Hudson Bay
Lake Melville
Prince Rupert
Kitamaat Village
Douglas Channel
Campbell River
Churchill
Tofino
NEPTUNE
Salish Sea Marine Survival Program
VENUS
University of Victoria
University of Saskatchewan
Mill Bay
FORCE
Great Lakes
PACIFIC OCEAN
ATLANTIC OCEAN
Existing Installation
Funded Installation
Proposed Installation
Mobile Asset
Industry Partner
Partner University
Data Centre
Data Transfer Line
Fibre-optic Cable
Bathymetry (50 m contour lines)
-3500 m
AN INITIATIVE OF
University of Victoria

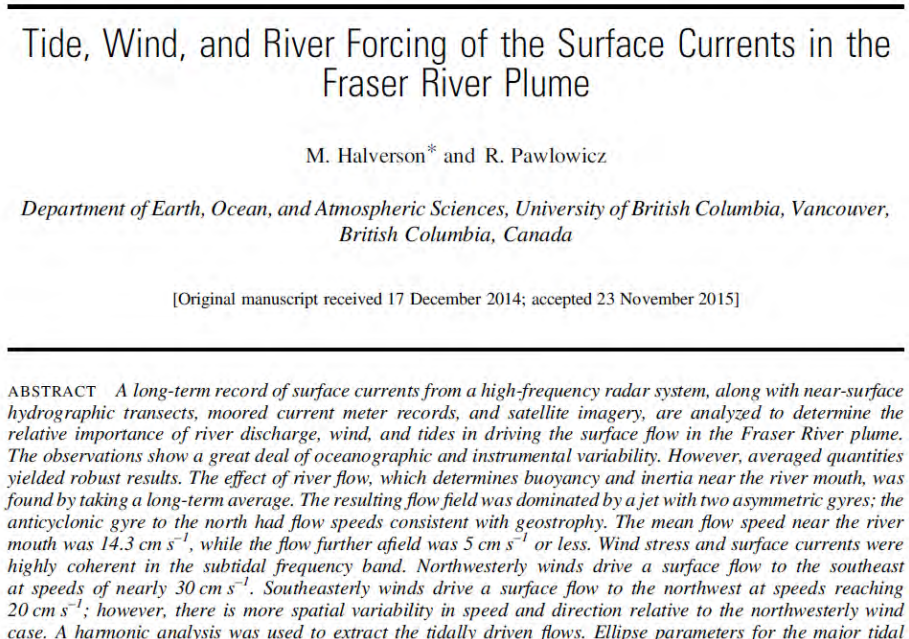
The science achievements

Key Metrics: Papers, Theses, and Presentations

- Over 160 publications, after a slow start, picking up
- Over 2 dozen M.Sc. and Ph.D. theses – use existing data
- Over 480 scientific and technical presentations at national and international conferences and symposia

Geophysics - 29% Ecology - 25% Ocean Dynamics - 19%
Eng. & Modelling – 10% Interdisciplinary – 7% Policy – 5%
Biogeochemistry – 5%





Tide, Wind, and River Forcing of the Surface Currents in the Fraser River Plume

M. Halverson* and R. Pawlowicz

Department of Earth, Ocean, and Atmospheric Sciences, University of British Columbia, Vancouver, British Columbia, Canada

[Original manuscript received 17 December 2014; accepted 23 November 2015]

ABSTRACT *A long-term record of surface currents from a high-frequency radar system, along with near-surface hydrographic transects, moored current meter records, and satellite imagery, are analyzed to determine the relative importance of river discharge, wind, and tides in driving the surface flow in the Fraser River plume. The observations show a great deal of oceanographic and instrumental variability. However, averaged quantities yielded robust results. The effect of river flow, which determines buoyancy and inertia near the river mouth, was found by taking a long-term average. The resulting flow field was dominated by a jet with two asymmetric gyres; the anticyclonic gyre to the north had flow speeds consistent with geostrophy. The mean flow speed near the river mouth was 14.3 cm s^{-1}, while the flow further afield was 5 cm s^{-1} or less. Wind stress and surface currents were highly coherent in the subtidal frequency band. Northwesterly winds drive a surface flow to the southeast at speeds of nearly 30 cm s^{-1}. Southeasterly winds drive a surface flow to the northwest at speeds reaching 20 cm s^{-1}; however, there is more spatial variability in speed and direction relative to the northwesterly wind case. A harmonic analysis was used to extract the tidally driven flows. Ellipse parameters for the major tidal*

Data Access through *Oceans 2.0*

Oceans 2.0 Demonstration & Reception (food and drinks): Here in the Hotel Today at 5:15 PM Astoria Room

Sponsored by:

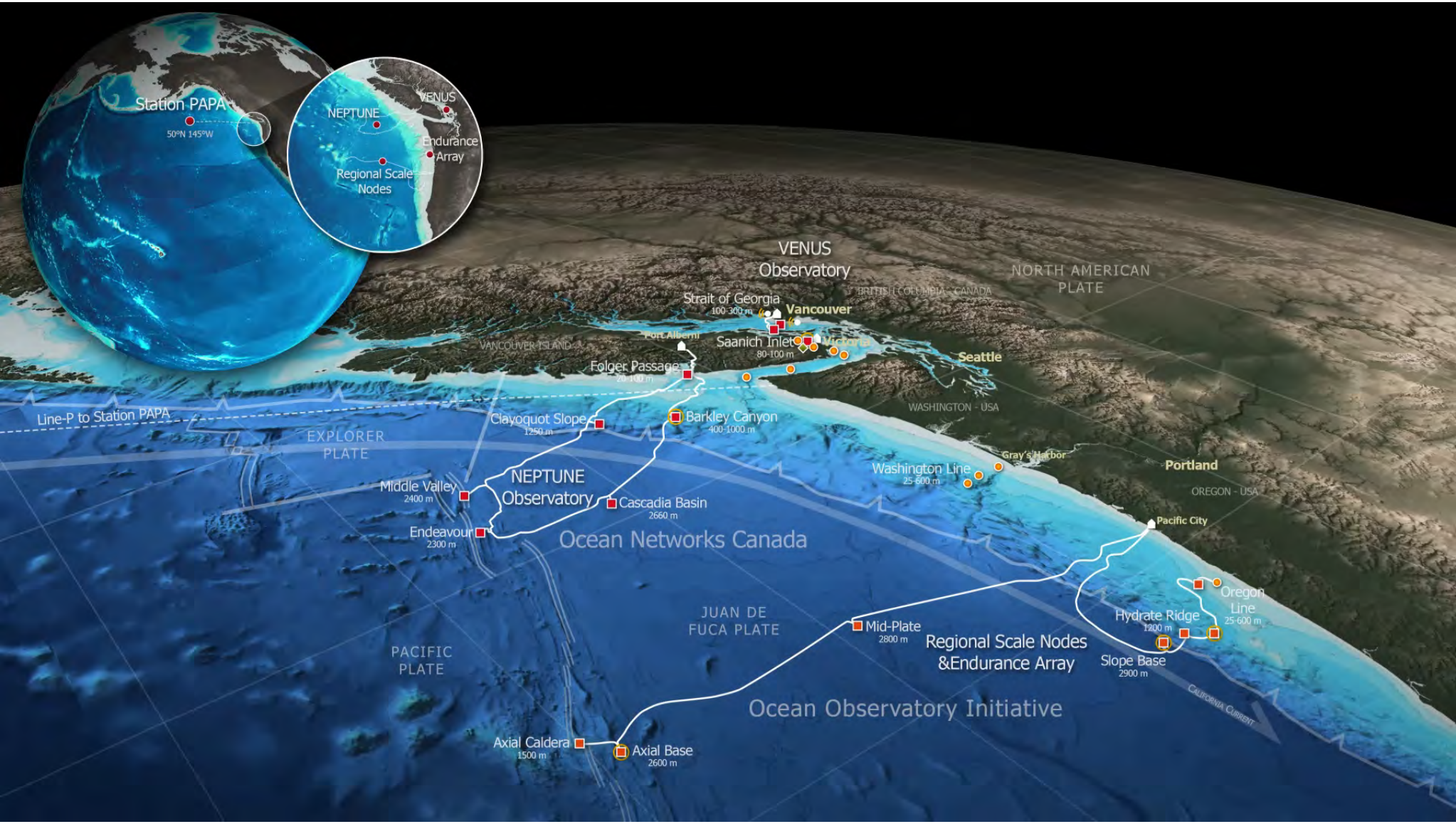
TELEDYNE MARINE

Everywhereyoulook™

Onc: Summary and conclusions

1) We have realized the vision: wide, deep, and on-line.
2) We continue to bring innovative and new systems on-line.
3) On-going lessons:
   a) Keep it simple, have spares and hot-swaps ready: long un-interrupted time-series is a core measure of success
   b) Easy data access (*Oceans 2.0*), while ensuring data quality!
      i. It is a continuous effort (every day!)
      ii. Calibrate, validate, improve S/N, and document
   c) Balance: core observations, successes, and innovation
   d) Integration across systems: ONC ← → OOI

A Northeast Pacific Network of Networks



Interoperability: A Network of Networks

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THANK YOU!

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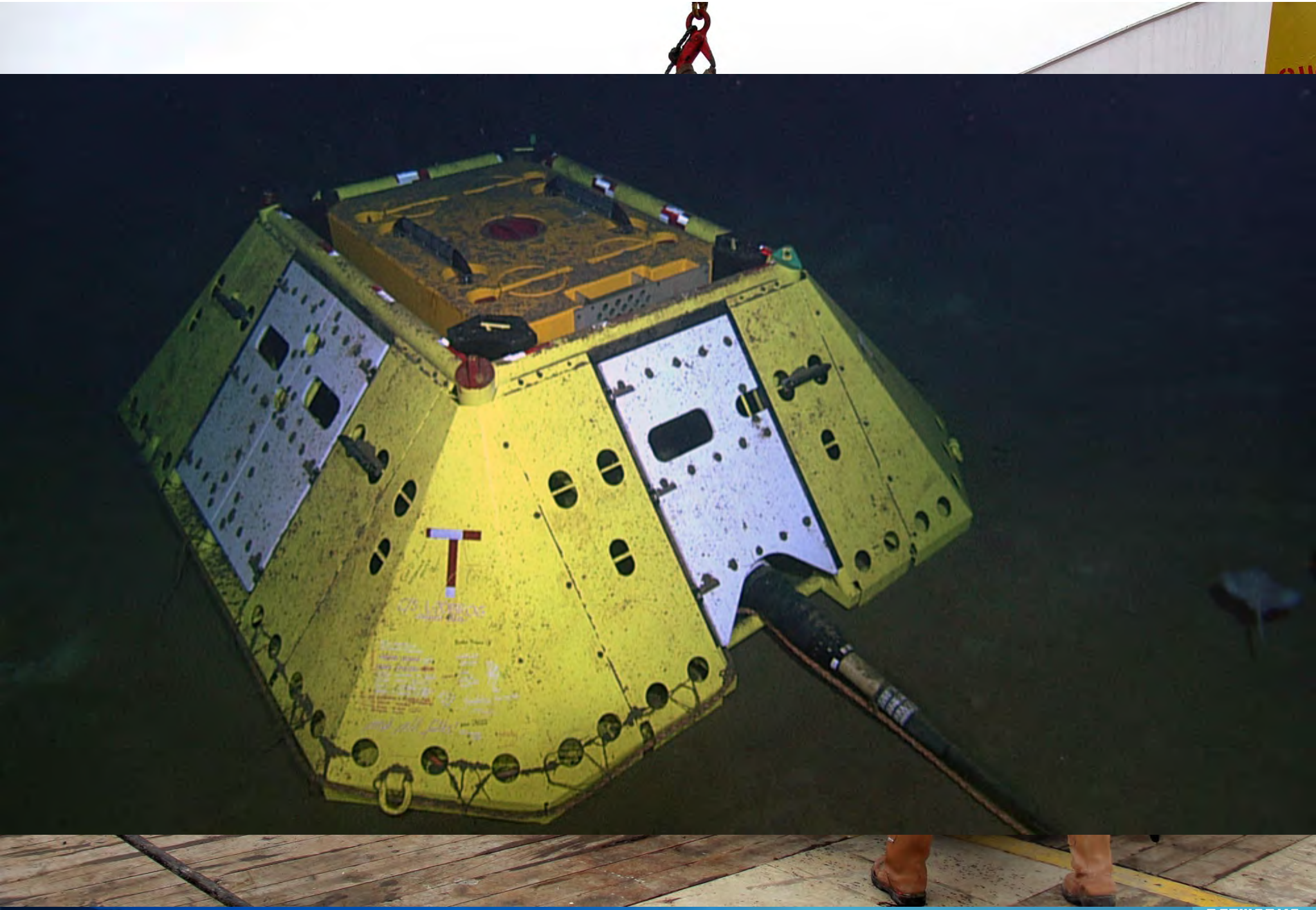
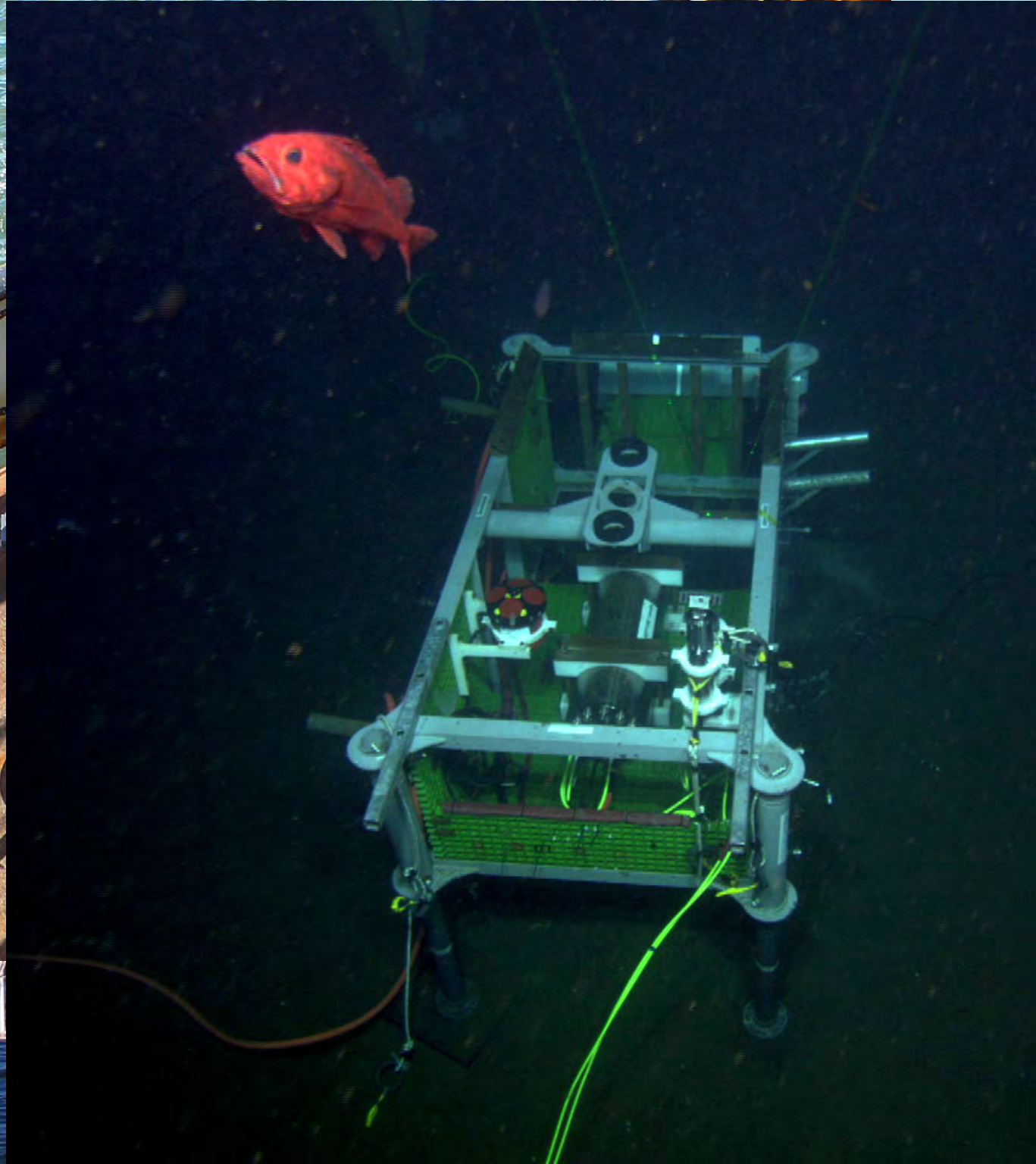
Ocean Networks Canada enhances life on Earth by providing knowledge and leadership that deliver solutions for science, society, and industry.







3D Grasshopper camera array before installation, August 2010

NEPTUNE Canada

After recovery to ship, August 2011

NEPTUNE Canada


TILUS