Observational Approaches to Benthic Dynamics

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www.neptunecanada.ca, www.venus.uvic.ca, www.oceannetworks.ca

NEPTUNE Canada
Transforming Ocean Science

VENUS

projects of

OCEAN NETWORKS CANADA
A University of Victoria Initiative

The Limitations of Observatories for Studies of Benthic Dynamics

- Epifauna versus infauna
- Space versus time

Satellites = Not so interesting for benthic studies

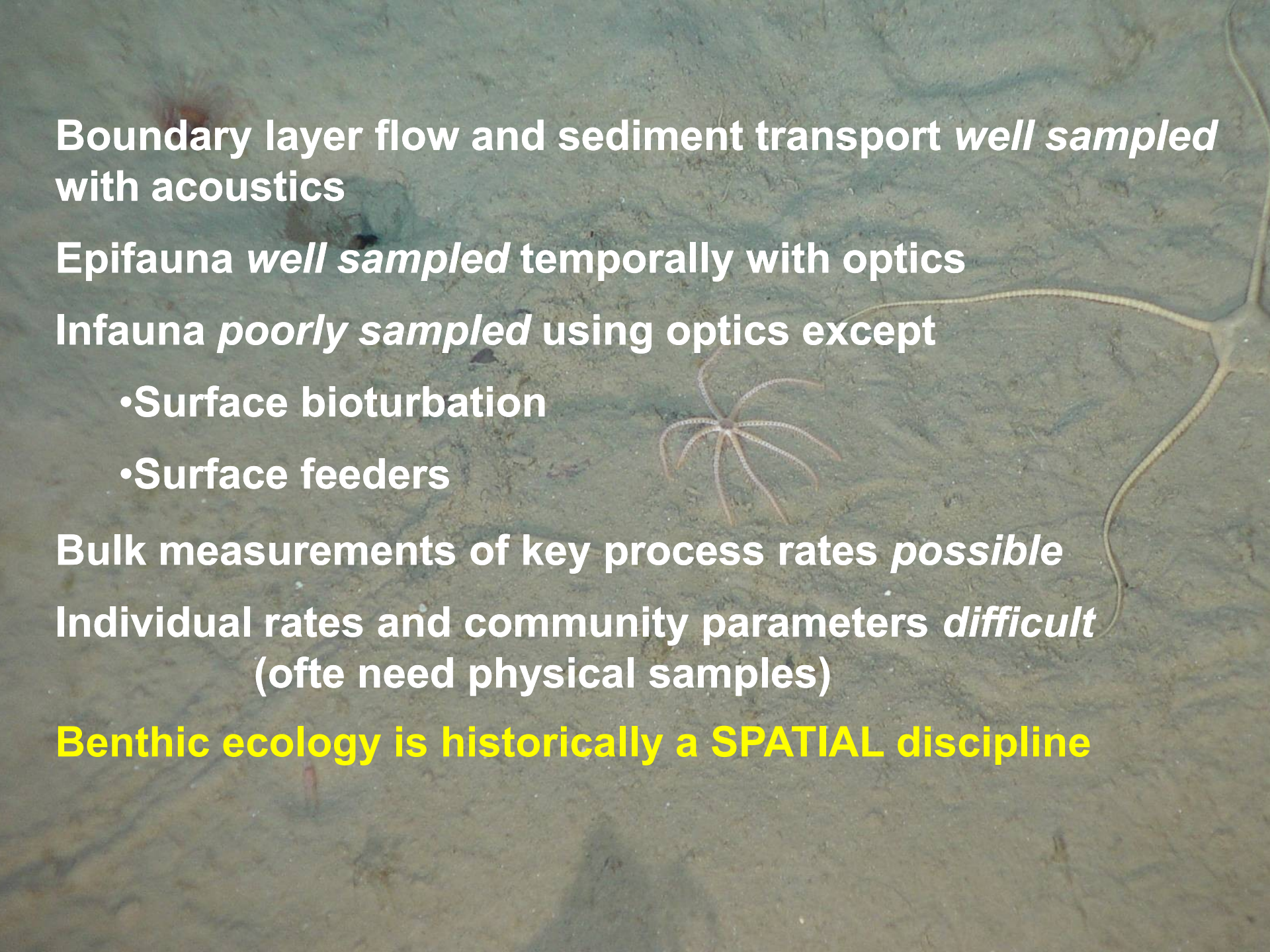
Observatories = Interesting for benthic studies

Observatories + Ships = REALLY interesting benthic studies

Potential Questions

- **Recruitment** response to events
(tidal, seasonal, storm, tectonic, venting, regime shift)
- **Feeding/behavioral** response to events
(phytoplankton flux, currents, predators)
- **Respiration/growth** response to events
- **Ecosystem services/functions**
  - Carbon sequestration
  - Pollutant breakdown
  - Nutrient regeneration
  - Secondary production
  - Biogenic habitat

} Deep sea is largest habitat on Earth!



Boundary layer flow and sediment transport *well sampled* with acoustics

Epifauna *well sampled* temporally with optics

Infauna *poorly sampled* using optics except

- Surface bioturbation
- Surface feeders

Bulk measurements of key process rates *possible*

Individual rates and community parameters *difficult* (ofte need physical samples)

Benthic ecology is historically a SPATIAL discipline

•Epifaunal dynamics in field of view
•Growth
•Recruitment
•Behaviour
Limited spatial coverage, unless AUVs added

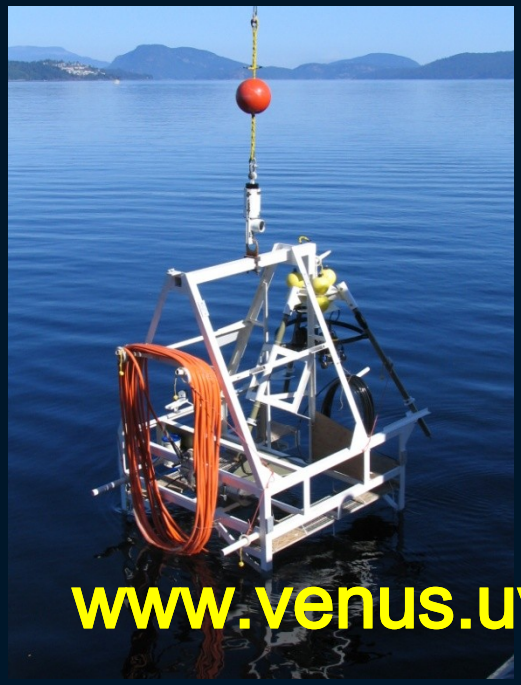
Observatories = superb temporal resolution
Ship/ROV/submersible = superb spatial resolution

VICTORIA EXPERIMENTAL NETWORK UNDER THE SEA

A seafloor cabled laboratory at the University of Victoria

VENUS is located in two places:

- Strait of Georgia
- Saanich Inlet



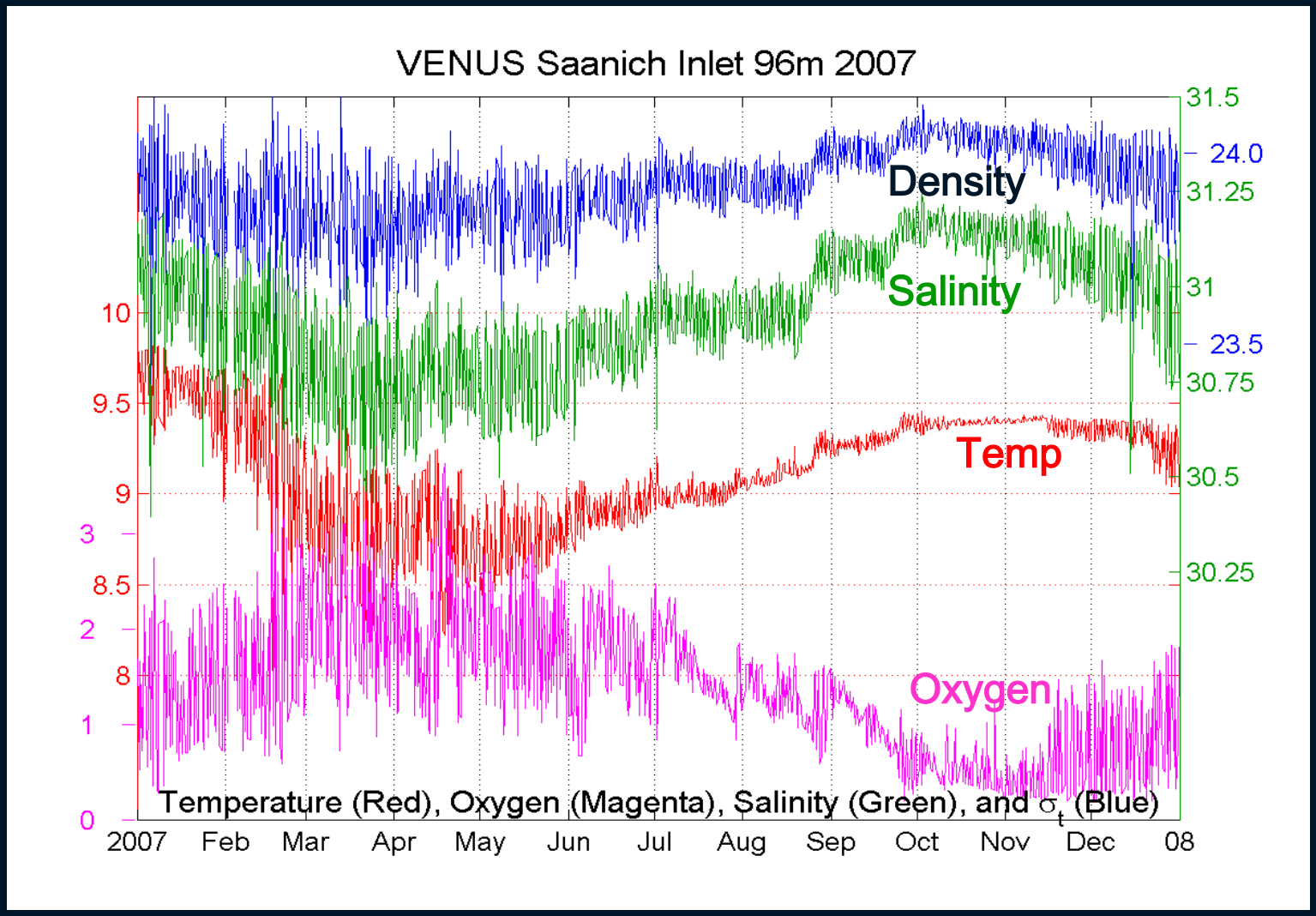
To date, 25 instruments are connected via a subsean node
Data are available to all:

www.venus.uvic.ca

VENUS
Victoria Experimental Network Under the Sea
The Ocean Online, Real-time, Anytime

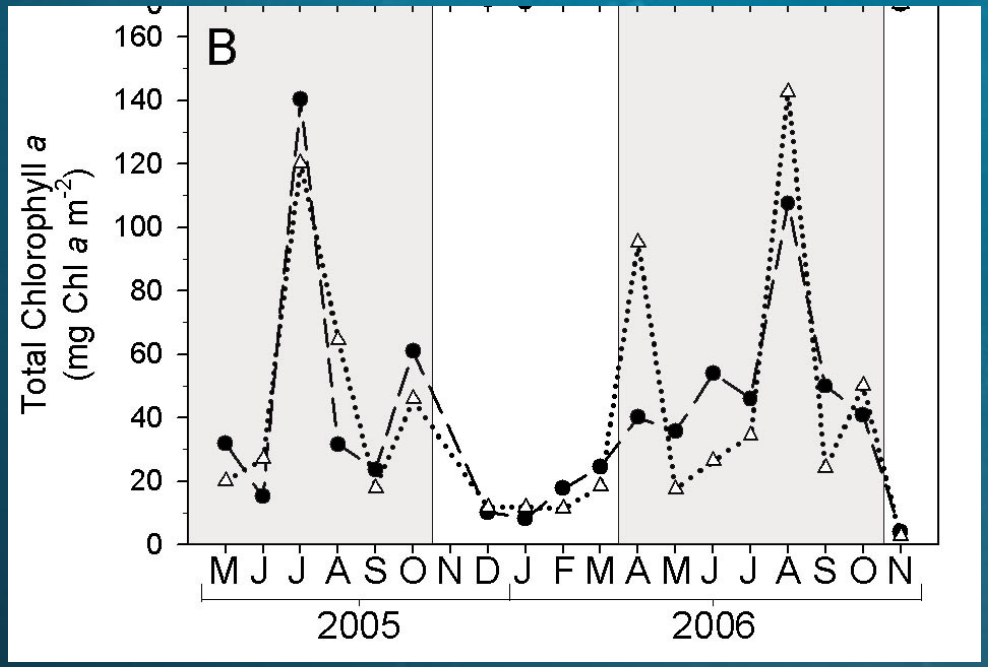
Saanich Inlet, British Columbia

A Year of Data from Saanich (oxygen in ml/l)



A PRODUCTIVE ECOSYSTEM!!

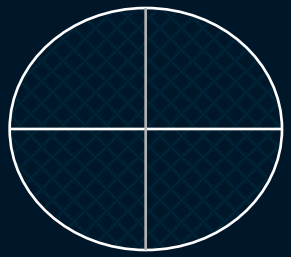
Large spring blooms of diatoms



Damian Grundle (2007)

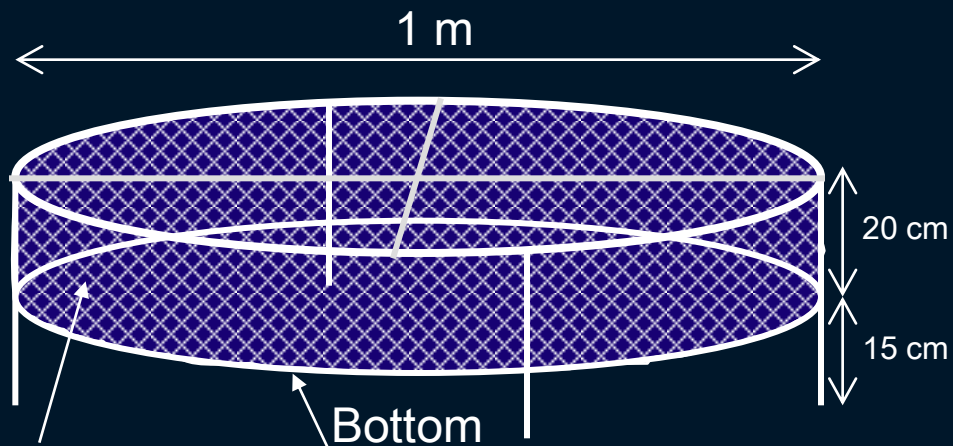
- Densest aggregations on the coast
- Concentrate on top of the oxycline
- Euphausiids, copepods, amphipod, jellies and chaetognaths
- Seasonal herring

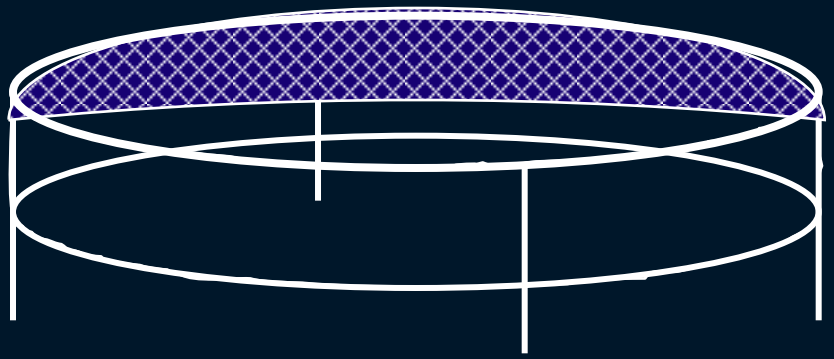
Exclusion Cages

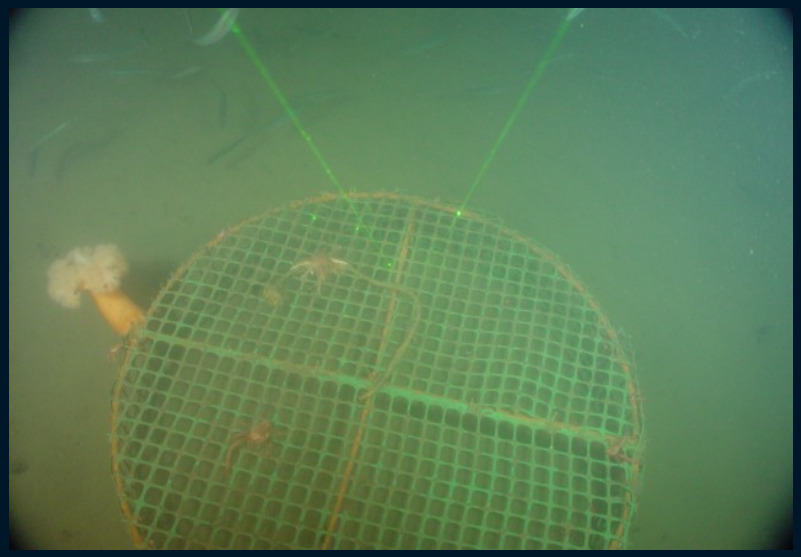


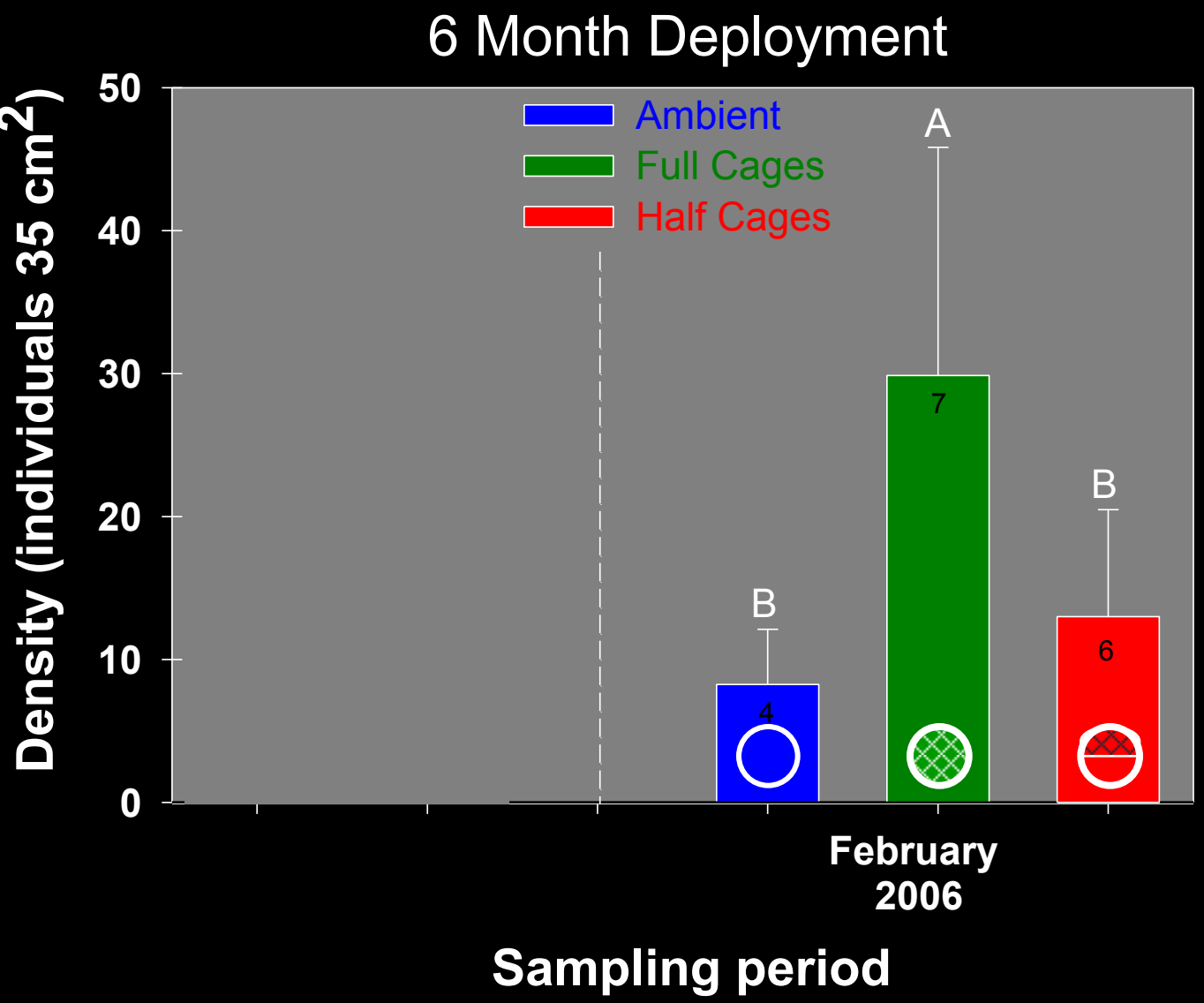
Top View

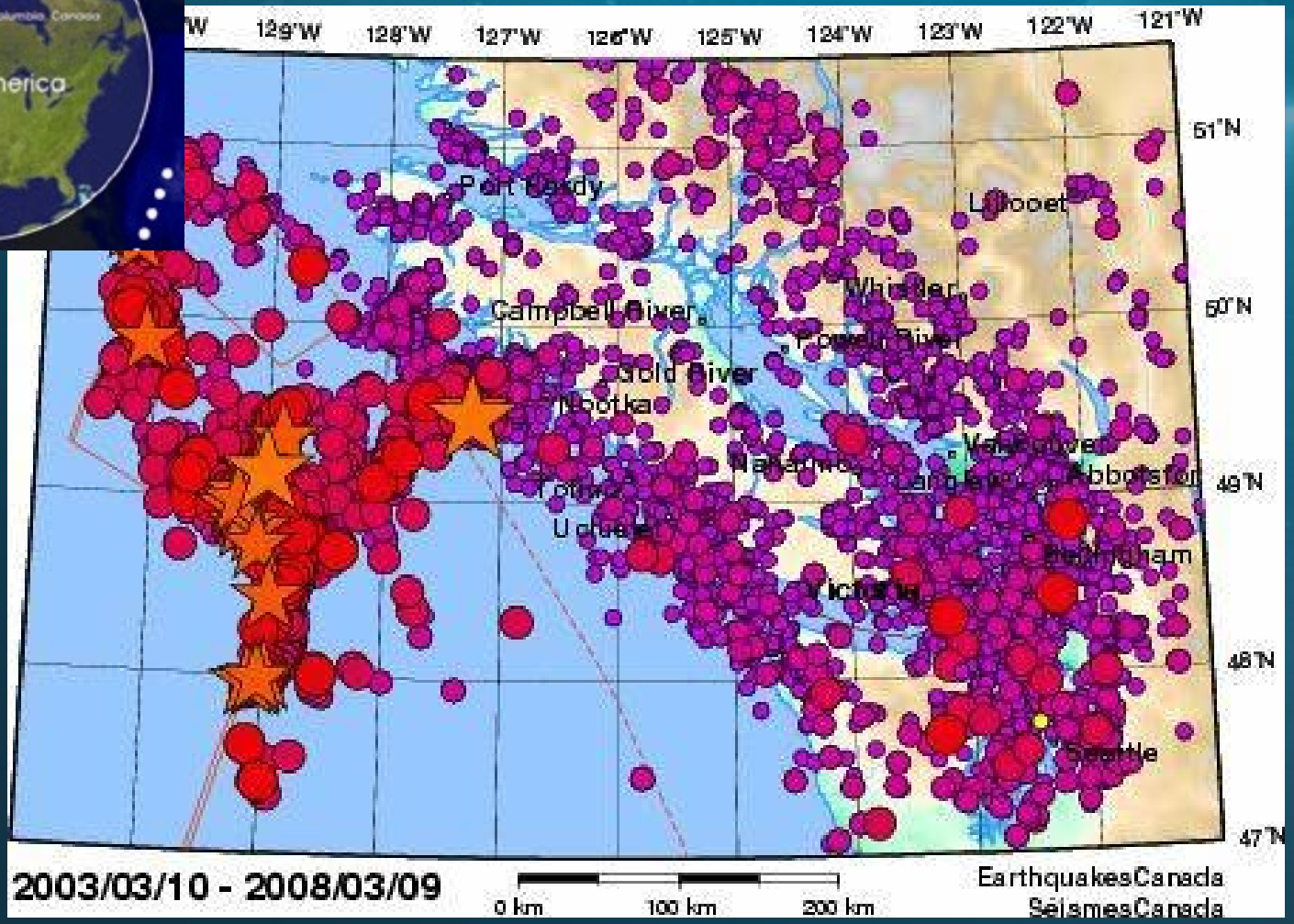
Side View








6 Month Deployment
Ambient
Full Cages
Half Cages
Density (individuals 35 cm2)
50
40
30
20
10
0
A
B
B
7
6
4
February
2006
Sampling period



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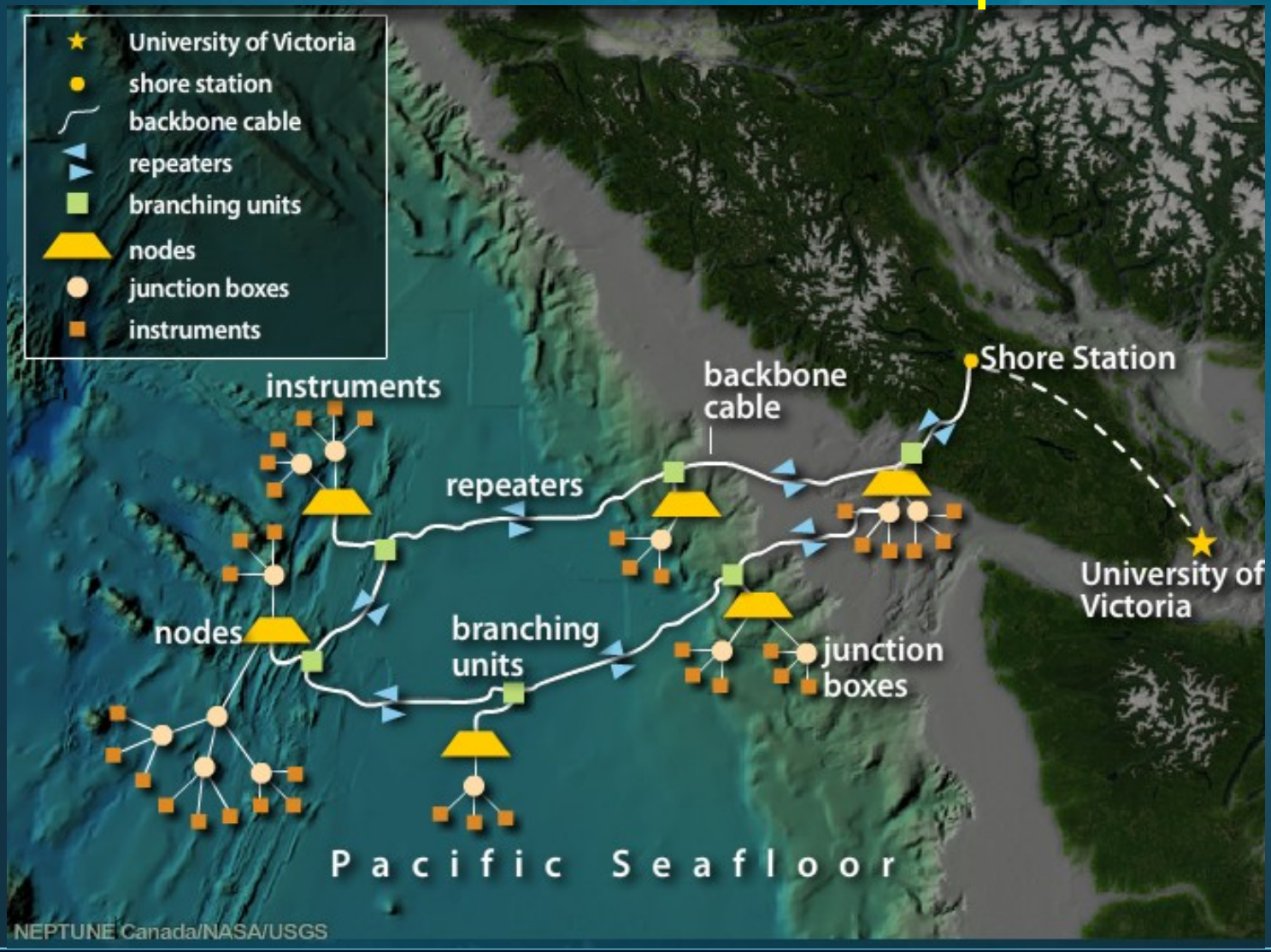
Power and internet to the deep sea



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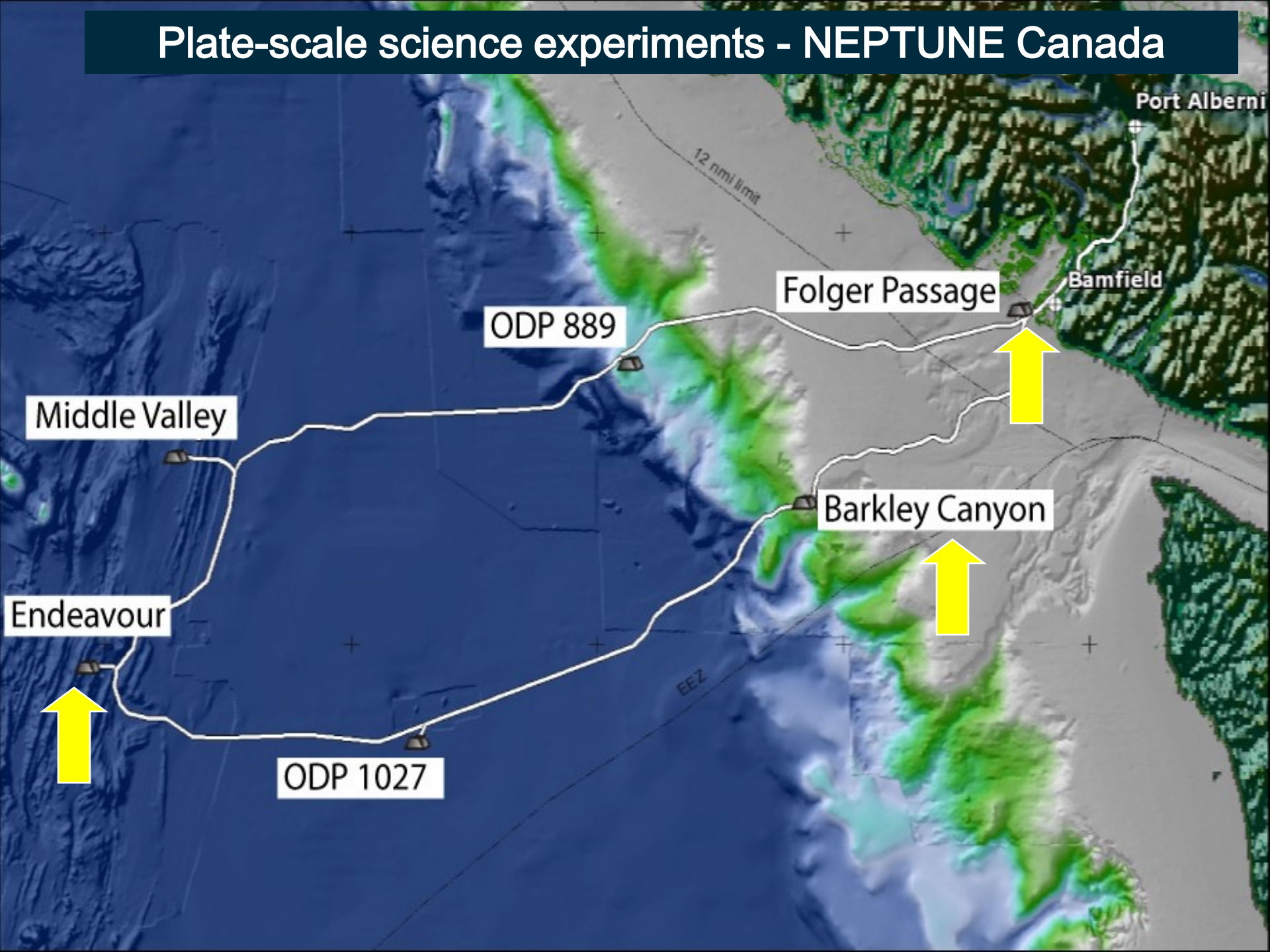
Plate-scale science experiments - NEPTUNE Canada
Port Alberni
12 nmi limit
Bamfield
Folger Passage
ODP 889
Middle Valley
Barkley Canyon
Endeavour
EEZ
ODP 1027

RV Atlantis

RV Thomas G. Thompson

ROPOS/ROCLS

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Node deployment July-August

Instrument deployment: 19 August- 20 Sept.

Key New Infrastructure Components

400V DC➔48/24/15V DC

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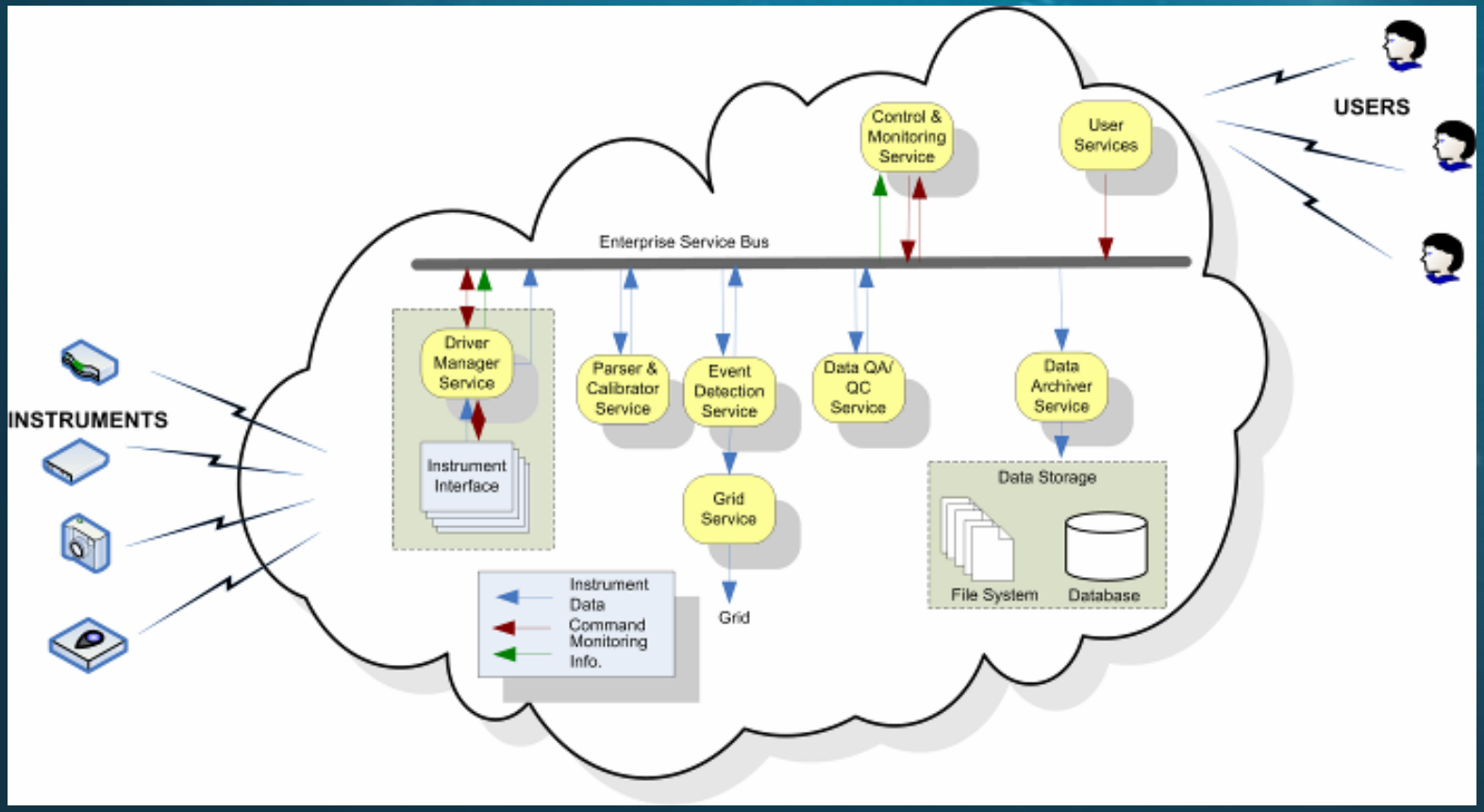
Data Management and Archiving System (DMAS)



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Science Research Themes

- Plate tectonic processes and earthquake dynamics
- Dynamic processes of fluid fluxes and gas hydrates in the sea bed
- Regional ocean/climate dynamics and effects on marine biota
- Deep-sea ecosystem dynamics
- Engineering and computational research

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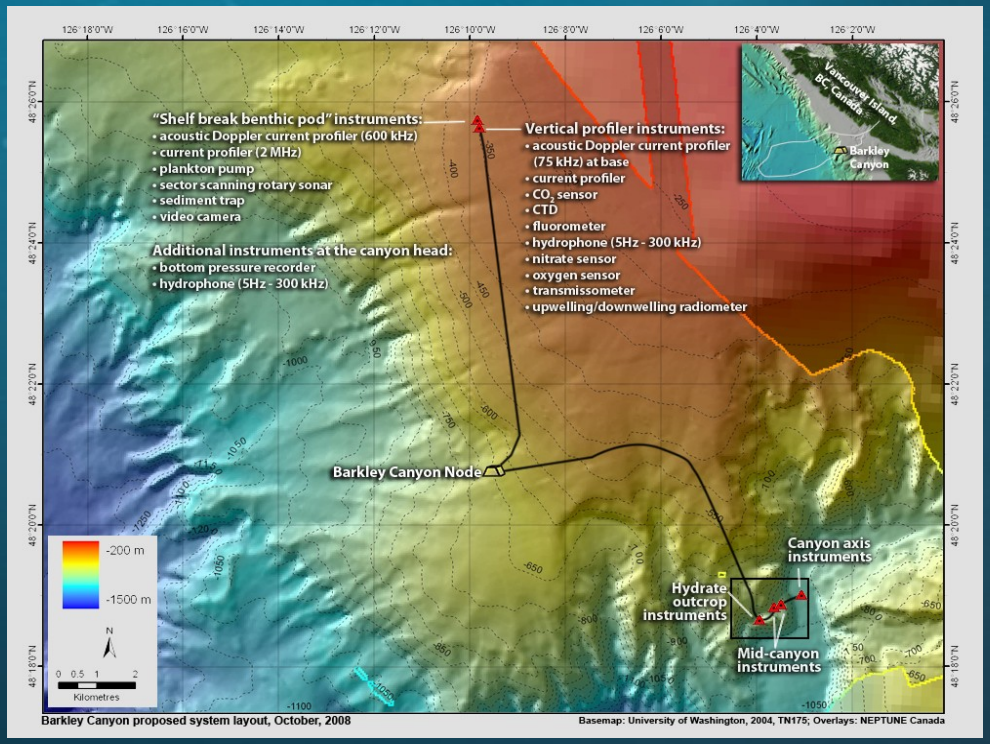
BIOPHYSICAL LINKAGES

Biophysical Linkages Underlying Variability in Coastal Ocean Processes off the west coast of Vancouver Island



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Vertical Profiler System (VPS) for NEPTUNE CANADA

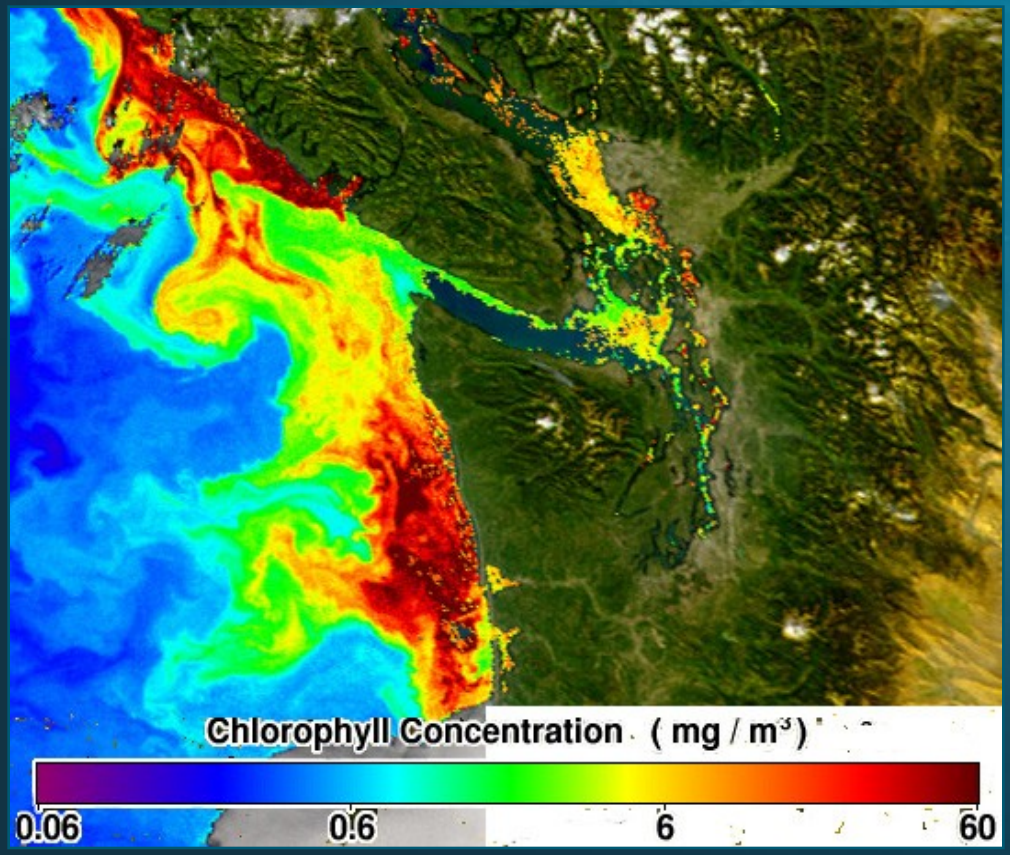
Instrument Package

Layout of Sensors

Platform

ngk ocean

Ocean dynamics



- CTD
- Oxygen sensor
- Fluorometer
- Transmissometer
- Nitrate sensor
- CO_2 sensor
- Upwelling/downwelling radiometer
- Broadband hydrophone
- ADCP
- Bottom pressure sensor

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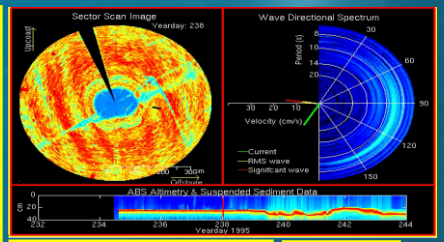
DISTURBANCE IN DEEP-SEA ECOSYSTEMS

- Acoustic Doppler Profiler
- Rotary SONAR
- Multi-Beam SONAR
- CTD
- Microbial package
- Sediment trap
- Plankton pump
- Fluorometer
- Hydrophone
- Video cameras
- High resolution still camera



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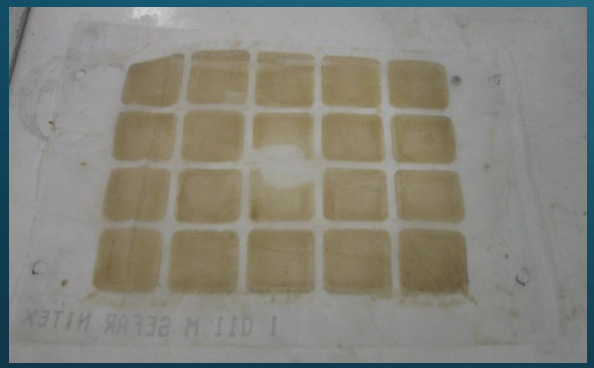
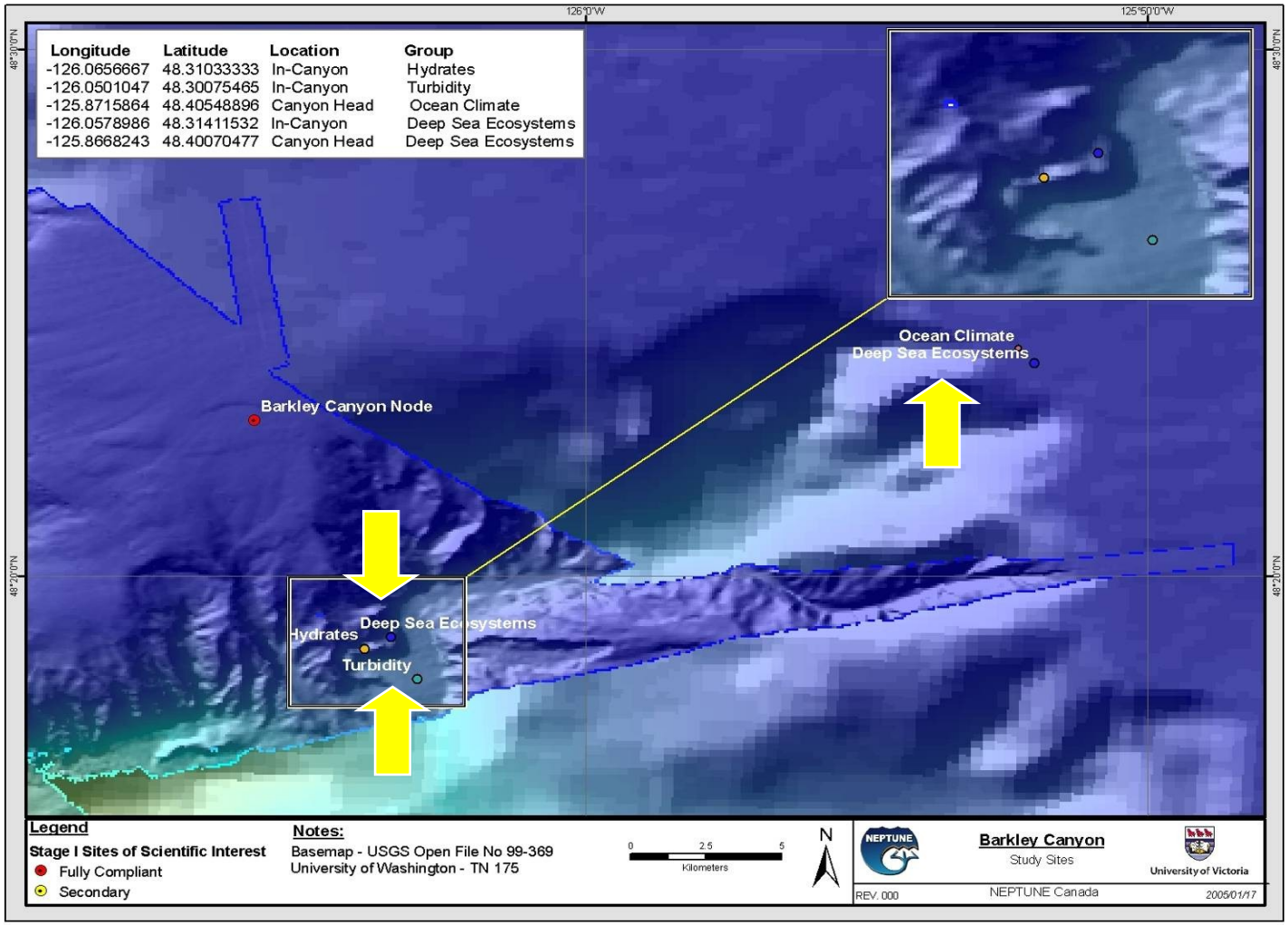
Benthos, boundary layers, sediment transport

Plankton Pump

- High volume pump
- Concentration mechanism
- Multiple samples
- Scheduled and event triggered





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The project will address:

- *How does material flux (quality and quantity) through canyon systems relate to boundary layer flow on daily, seasonal, long-term (e.g. climate change) and event-driven (e.g. slumping) time scales?*
- *How does flux of organic material (quality, quantity, mean & variance) through canyon systems influence faunal response? (community structure, spawning, bioturbation) of benthos, hyperbenthos, larvae, and microbes on multiple time scales…slumps to regime shifts)?*

Observatory data provide a superb environmental data set but we still need a physical sample for sedimentary fauna

Principal investigators: Paul Snelgrove & Anna Metaxas

Co-investigators: Phillippe Archambault, Brian Bornhold, Grant Ferris, Alex Hay, Kim Juniper, Verena Tunnicliffe

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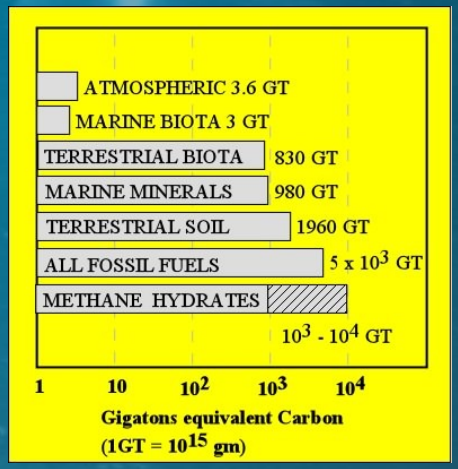
BARKLEY CANYON HYDRATES

- Temperature Probes
- Geochemical sensors
- Digital cameras
- 4C seismo-acoustic array

- Remotely operated crawler
  - CTD
  - methane sensor
  - Schlieren optic system
  - 6 oxygen micro profilers
  - benthic flow simulation chamber
  - pan/tilt/zoom webcam
  - video system (gas bubbles)



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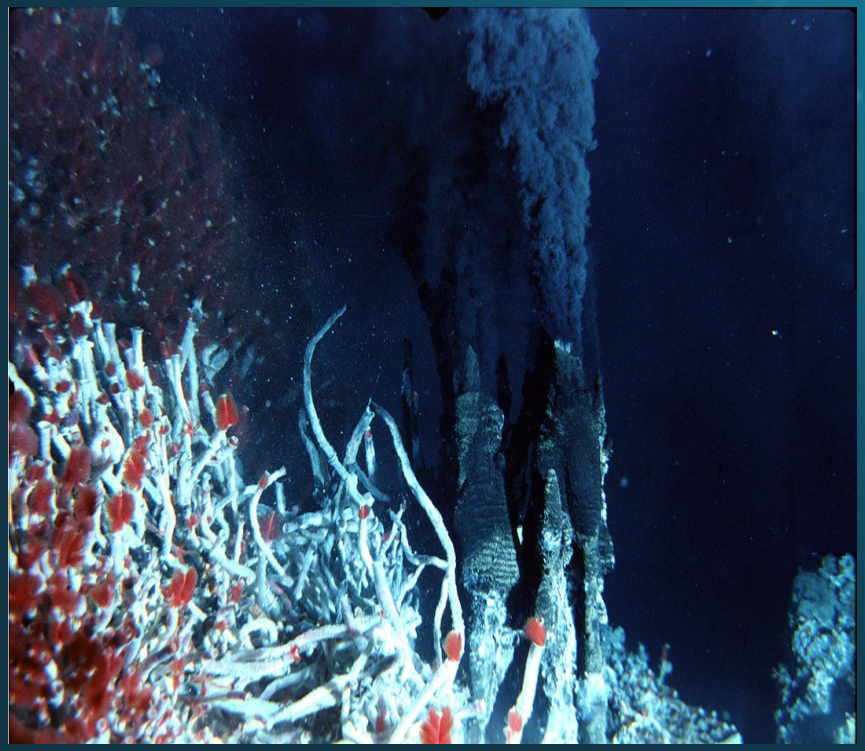
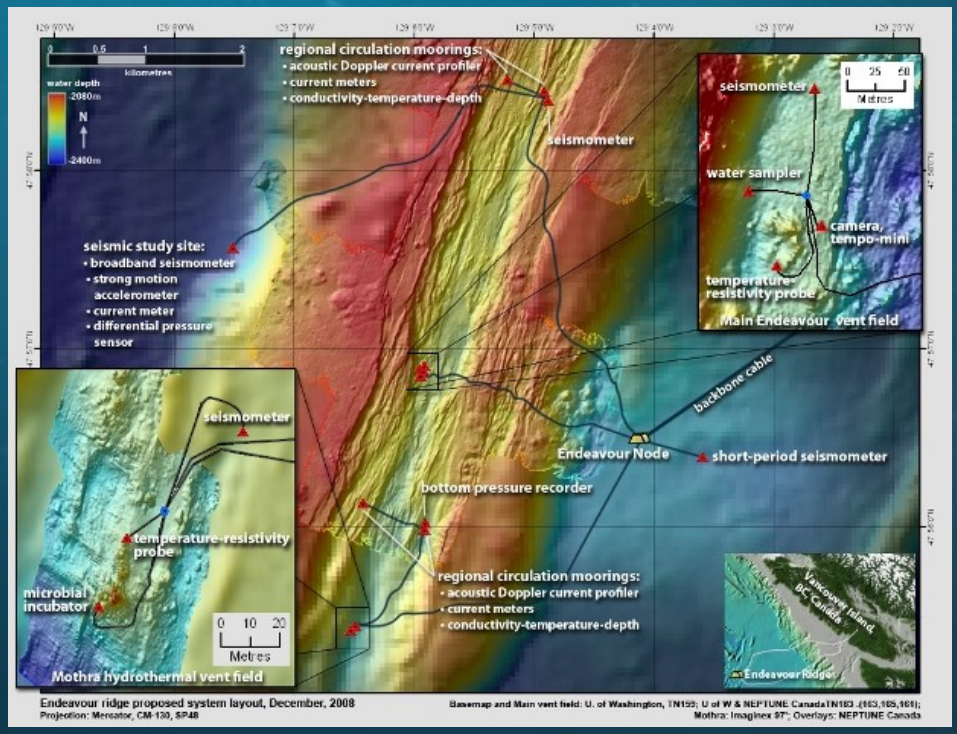
Tethered Crawler

Jacobs Univ., Bremen,Germany

MONITORING THE ENDEAVOUR – MIDDLE VALLEY HYDROTHERMAL SYSTEMS:

Integrated heat and mass fluxes and the response of biogeochemical & physical processes to perturbations





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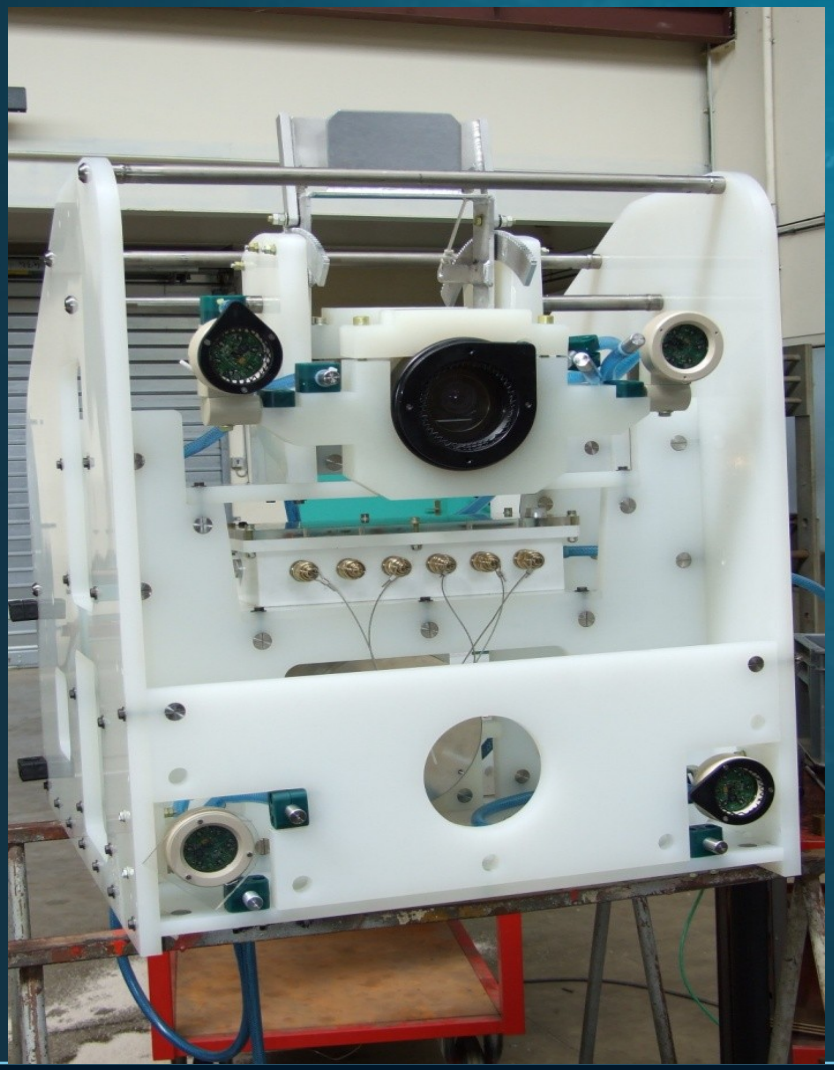
TEMPO-mini



- Designed by Ifremer (France)
- An instrument module designed for study of hydrothermal vent communities
- Video, temperature, oxygen, and iron sensors
- Coordinated antifouling system

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An invitation to interact…

- … in scientific experiments and/or instrument development and commercial deployment on the NEPTUNE Canada observatory in or after 2009: crbarnes@uvic.ca or neptune@uvic.ca
- Visit our updated website: www.neptunecanada.ca
- Also visit:
  www.venus.uvic.ca
  www.oceannetworks.ca
  www.oceanleadership.org

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Conclusions:

- Observatories provide excellent data frameworks for benthic dynamic studies

- For many questions, need spatial coverage (e.g. AUVs) but optics an acoustics can address some needs.

- For some questions, particularly those involving sedimentary fauna, still need physical samples, which require ships periodically

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Many thanks….

Canadian Foundation for Innovation

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- Verena Tunnicliffe
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- ROPOS Team
- Crew of CCGS Tully
- Jonathon Rose (UVic)
- Mike Kelly (MUN)
- Brenda Oake (MUN)
- Damian Grundle (UVic)
- Gitai Yahel (Ruppin Academic Center, Israel)

NSERC CRSNG