DISCOVER THE OCEAN. UNDERSTAND THE PLANET.

FROM THE OCEAN DEPTHS TO A COMPUTER NEAR YOU: CURRENT STATUS, PLANS AND DATA MANAGEMENT AT ONC

OCEAN NETWORKS CANADA

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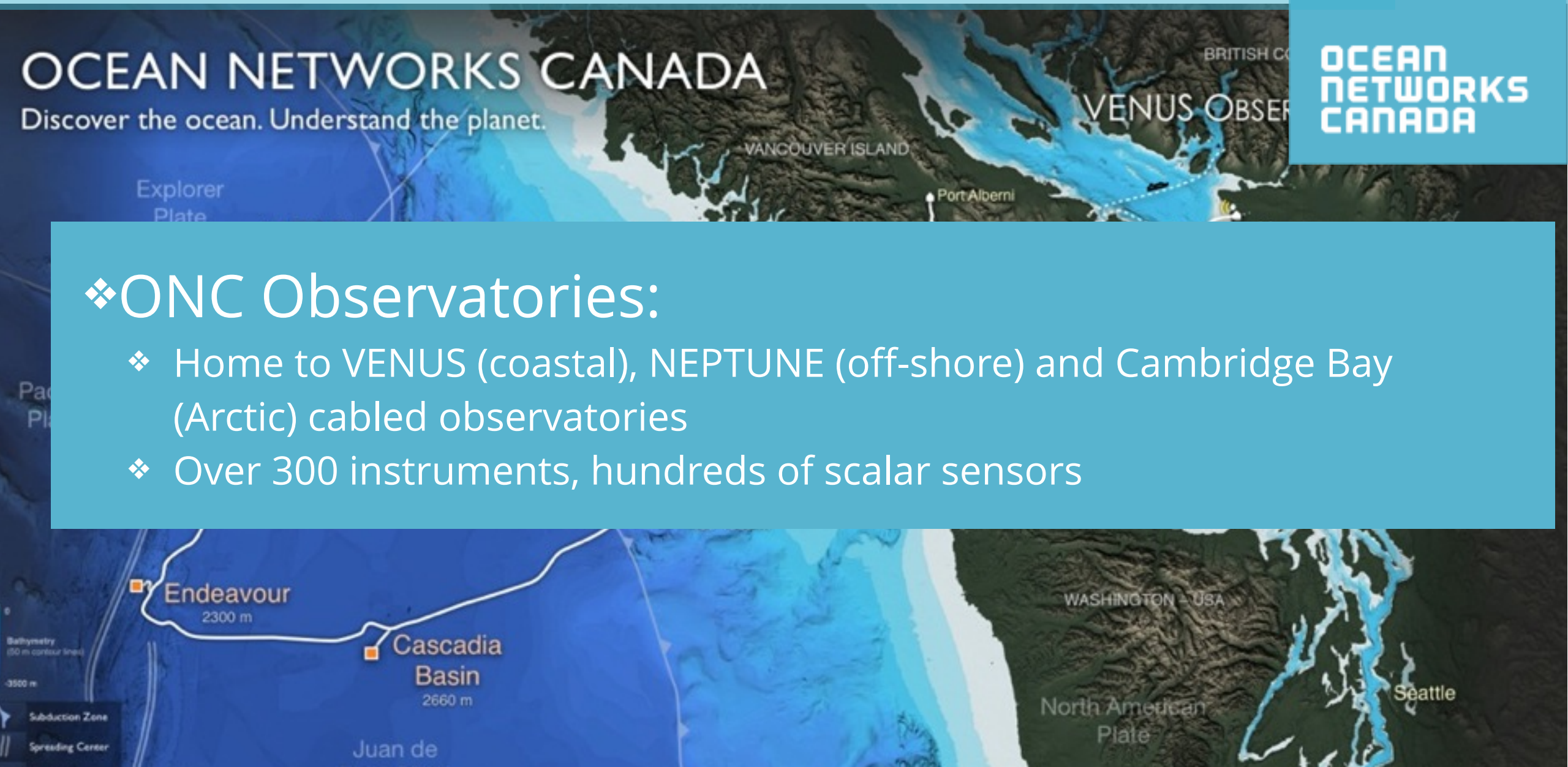
AN INITIATIVE OF University of Victoria



OCEAN NETWORKS CANADA

- ONC Observatories:
  - Home to VENUS (coastal), NEPTUNE (off-shore) and Cambridge Bay (Arctic) cabled observatories
  - Over 300 instruments, hundreds of scalar sensors

Ocean Networks Canada installations and data sources in the Canadian Arctic. Download this map.

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FUNDING STRUCTURE

- Ocean Networks Canada is a “Major Science Infrastructure” in Canada
- Operating funds come from the CFI (40%) in 5-year chunks
- Other sources of funding that include more federal sources and commercial revenue through our Innovation Centre.

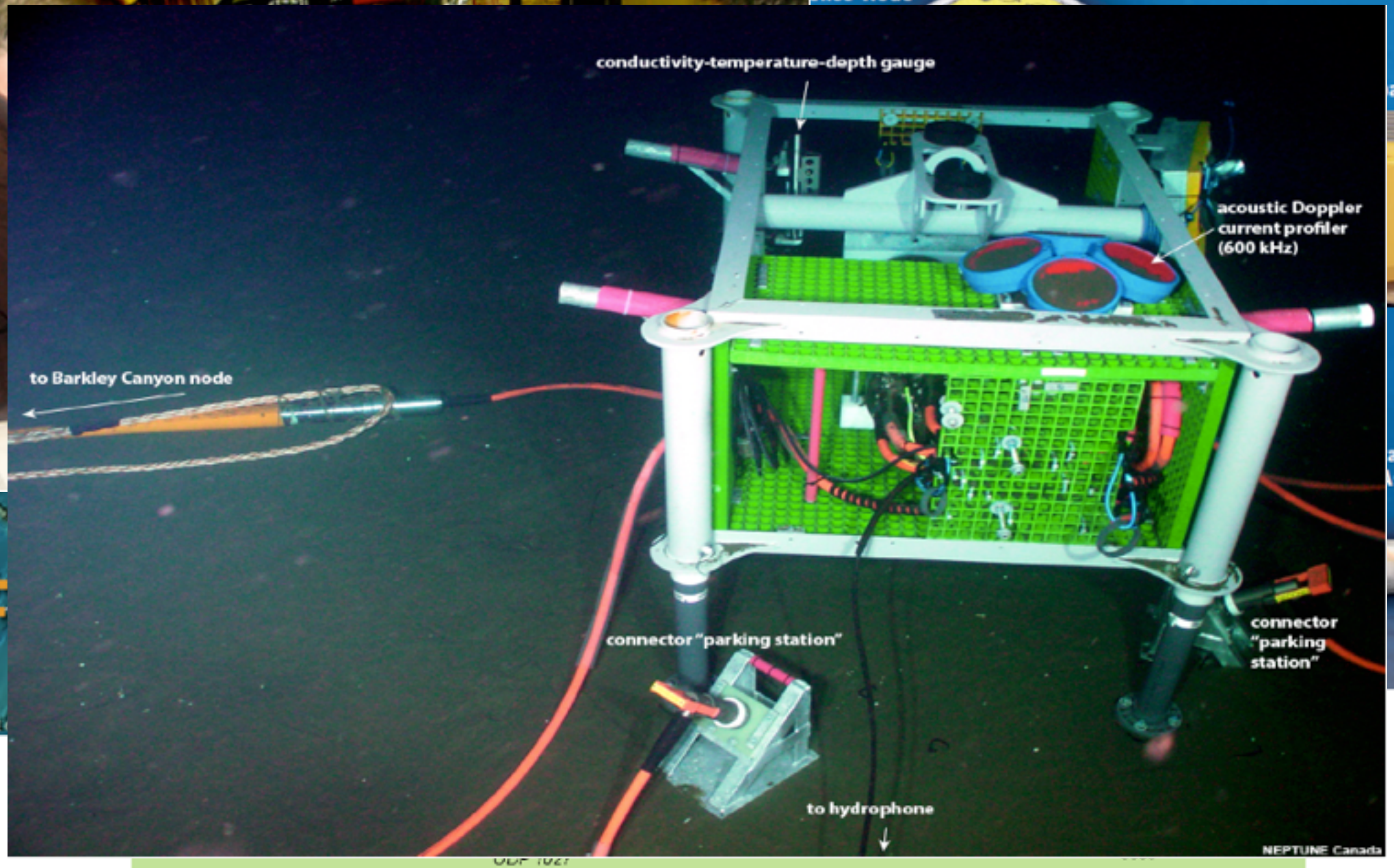
OCEAN NETWORKS CANADA

SCIENCE

OCEAN NETWORKS CANADA

ONC'S OBSERVATORIES

- First significant foray of Ocean Sciences into the area of "Big Science"
- A Facility serving many different ocean science disciplines
- Unlimited in scope, size and geographical location
- Endless instrumental capabilities


conductivity-temperature-depth gauge
acoustic Doppler current profiler (600 kHz)
to Barkley Canyon node
connector "parking station"
connector "parking station"
to hydrophone
NEPTUNE Canada

TYPES OF DATA

- The whole gamut…
  - Sensors producing single numbers from time to time
  - Sensors producing n-dimensional matrices
  - Sensors producing streams of data at high sampling rates (seismometers, hydrophones, cameras, …)

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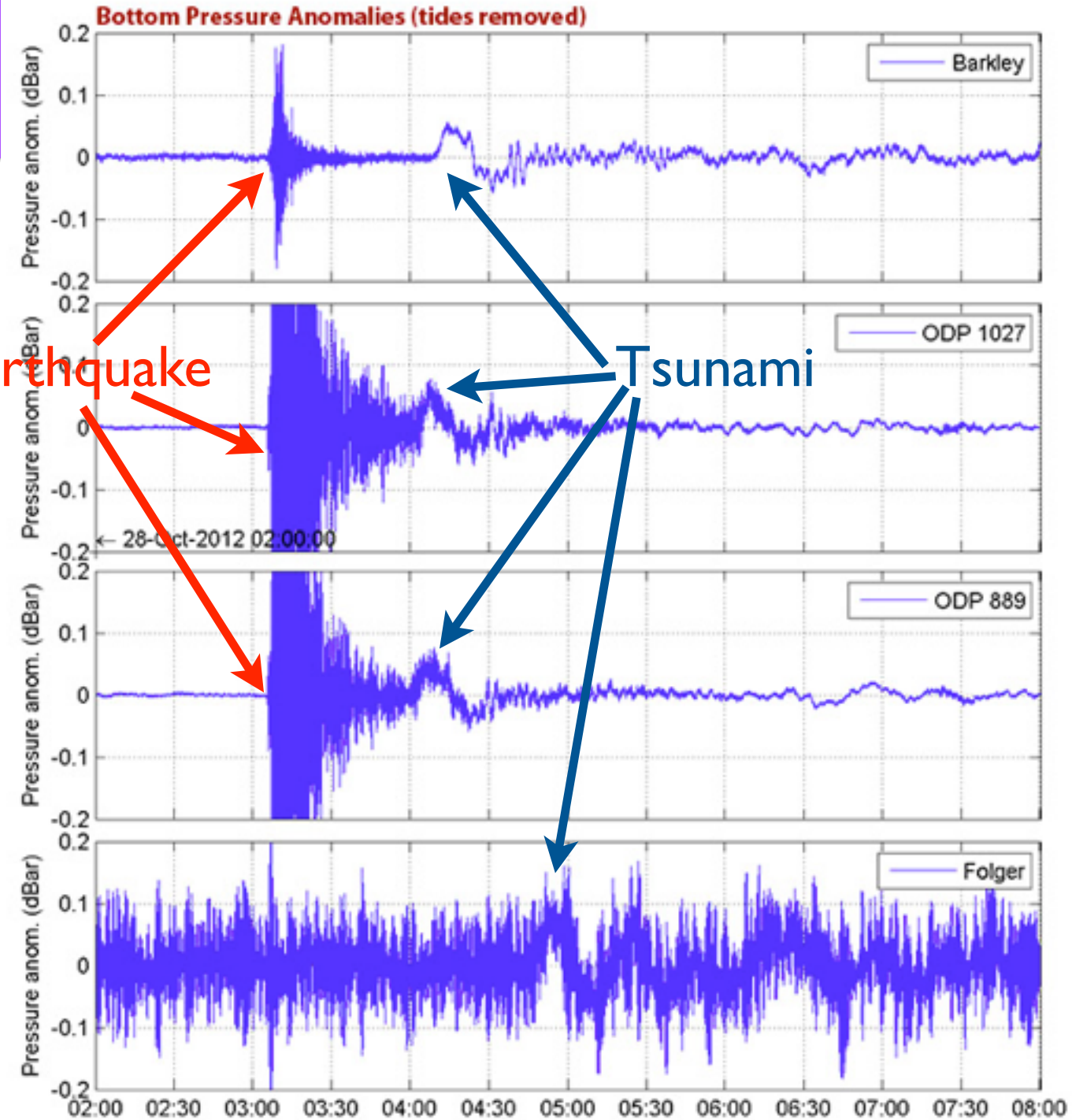
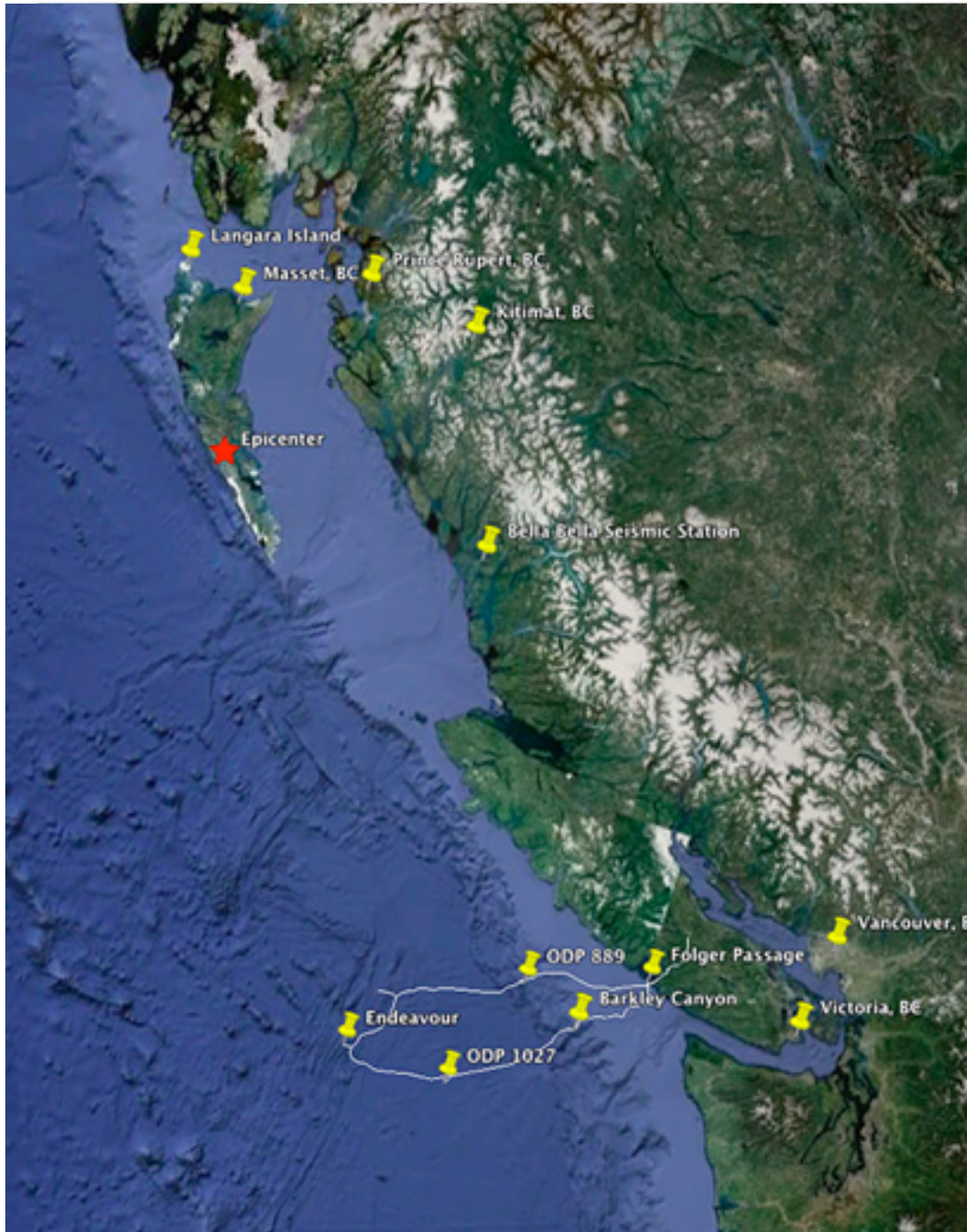
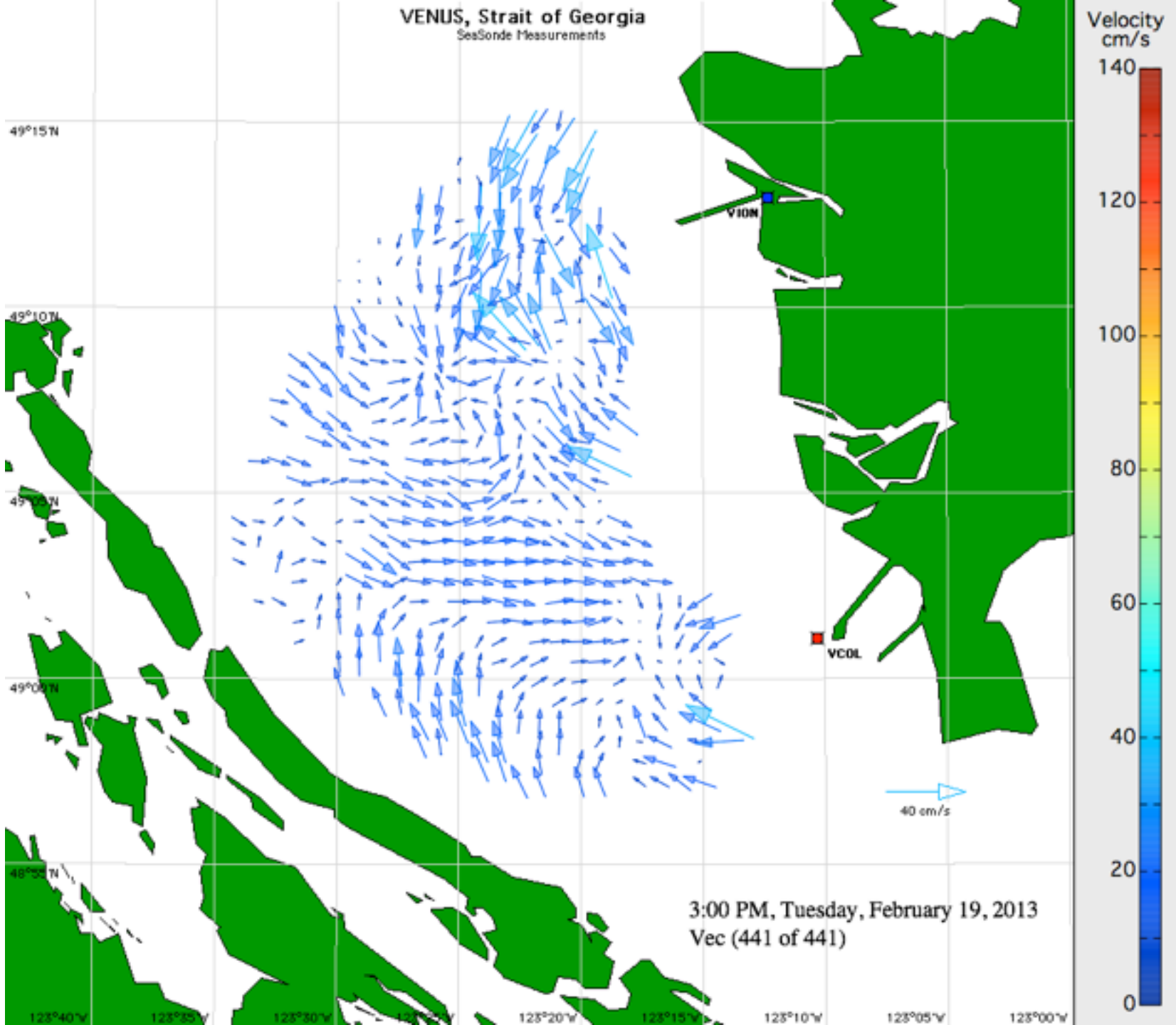


Earthquake

Tsunami




VENUS, Strait of Georgia
SeaSonde Measurements
Velocity cm/s
140
120
100
80
60
40
20
0
49°15'N
49°10'N
49°05'N
49°00'N
48°55'N
VION
VCOL
40 cm/s
3:00 PM, Tuesday, February 19, 2013
Vec (441 of 441)
123°40'W
123°35'W
123°30'W
123°25'W
123°20'W
123°15'W
123°10'W
123°05'W
123°00'W

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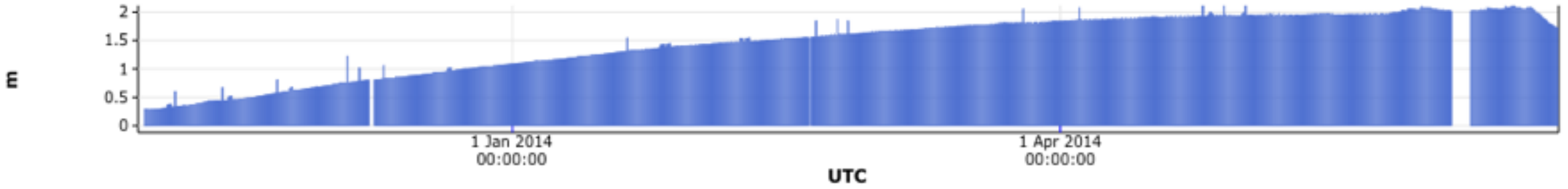
Plot 1 Hints Options

Cambridge Bay - Dock - Ice Profiler - Ice Draft Corrected



ASL Shallow Water Ice Profiler 53029 (Details|Docs) - Ice Draft Corrected (3937) - Clean - Avg - Downsampled - Download Data

Plot 7 Hints Options

Cambridge Bay - Dock - Water Quality Monitor - Temperature

WETLabs Water Quality Monitor 196 (Details|Docs) - Temperature (7751) - Clean - MinMax - Downsampled - Download Data

WETLabs Water Quality Monitor 196 (Details|Docs) - Temperature (7751) - Clean - Avg - Downsampled - Download Data

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END USERS

- Scientists
- Emergency responders, operators of large facilities
- the Public (crowdsourcing)

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LEARNING & ENGAGEMENT

OCEAN NETWORKS CANADA

LEARNING & ENGAGEMENT

- **Learning & Engagement team**
  - **Formal Learning**
    - K-12, Undergraduate engagement, Ship2Shore program
  - **Informal Learning**
    - Museums & Aquaria, Public displays
  - **Engagement**
    - Indigenous community relations, Public events

OCEAN NETWORKS CANADA INNOVATION

INNOVATION CENTRE

OCEAN NETWORKS CANADA INNOVATION

INNOVATION CENTRE

- Support of instruments manufacturers (long term instrument tests on ONC observatories)
- Commercialization of technology and expertise
- Smart Oceans Systems™ (geohazards early warning, sea state indices, marine mamma — ship interactions mitigation)

OCEAN NETWORKS CANADA INNOVATION

DIGITAL INFRASTRUCTURE

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DIGITAL INFRASTRUCTURE

- ONC's Digital Infrastructure has demonstrated:
  - Ability to acquire data in quasi real time from hundreds of sensors, online or not
  - Have the ability to quality-control, archive and be the steward for the data
  - Make data available to many users, both professional and the public
  - Derive data products autonomously

OCEAN NETWORKS CANADA INNOVATION

ONC DI REQUIREMENTS

- Extend the Internet under the Ocean
- Capture data from *many* different types of sensors (1D->5D data)
- Interact with underwater instrumentation (e.g., cameras)
- Provide precision time
- Keep data + metadata for 25 years
- Provide search, visualization, data products to many users
- Allow for X-correlation between data from various sensors
- Detect and react to events

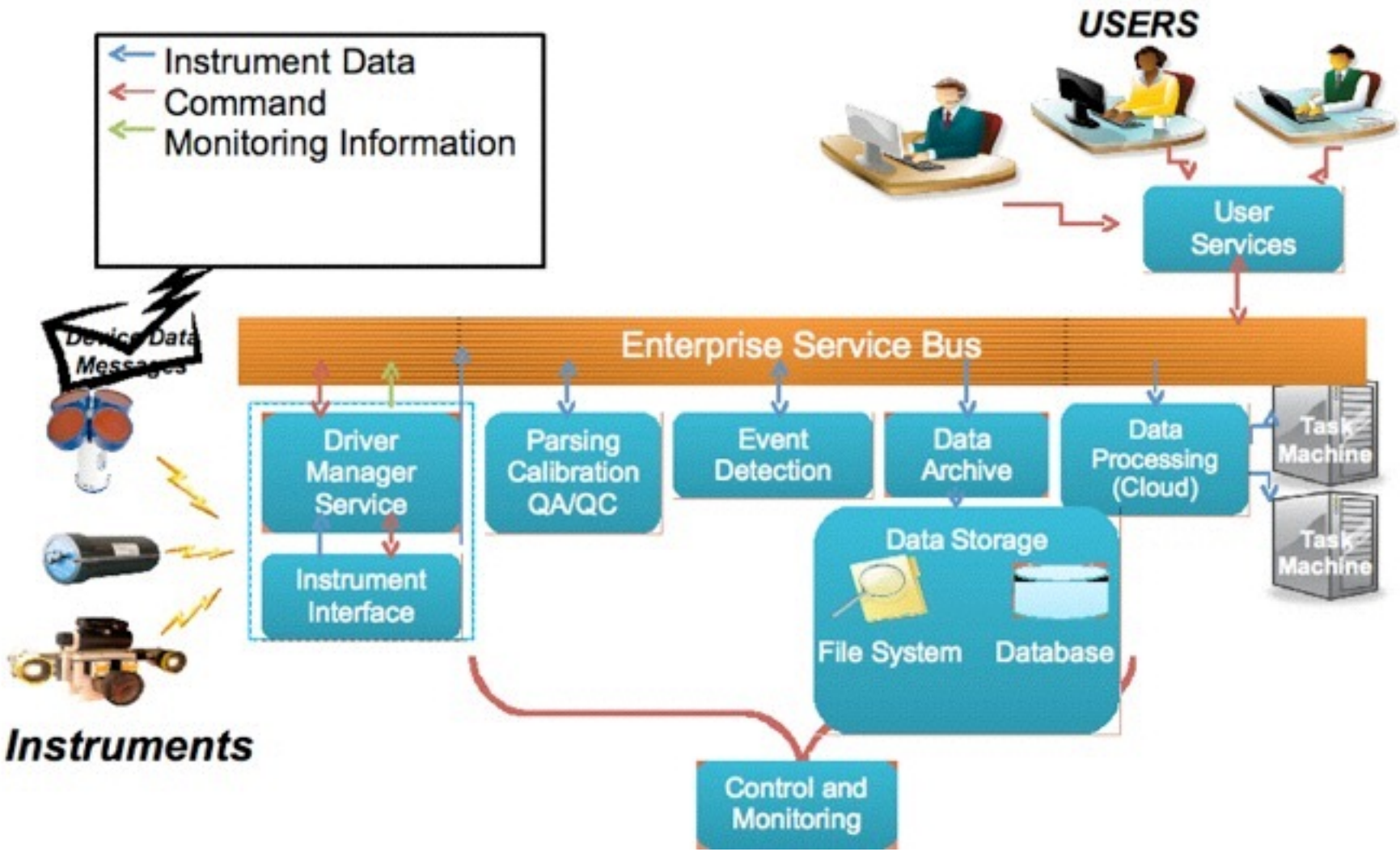
OCEAN NETWORKS CANADA INNOVATION

DI PRINCIPLES

- Built a system based on integrated data stewardship
  - "Drivers" to talk to instruments from various origins/manufacturers
  - Metadata collected before, during and after instrument deployment
  - Data stored on disks in multiple locations
  - Data access providing different data products for different user needs

OCEANS 2.0

OCEAN NETWORKS CANADA INNOVATION



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WET PLANT

IP

NODE 1

RS232

NODE 2

JUNCTION BOX

SHORE STATION

BUFFERING

- Buffering
- Routing
- Instrument Commanding

OPERATION CENTRE

FILE STORAGE

Data-base

CANARIE LINKS

UVIC

U of S

- Database
- File Storage
- Web Server
- Firewall
- Resource Scheduling

SCIENTISTS

PUBLIC

- Web
- Web Services
- Forms
- SQL
- Smart Phone Applications
- Streaming Video & Sound

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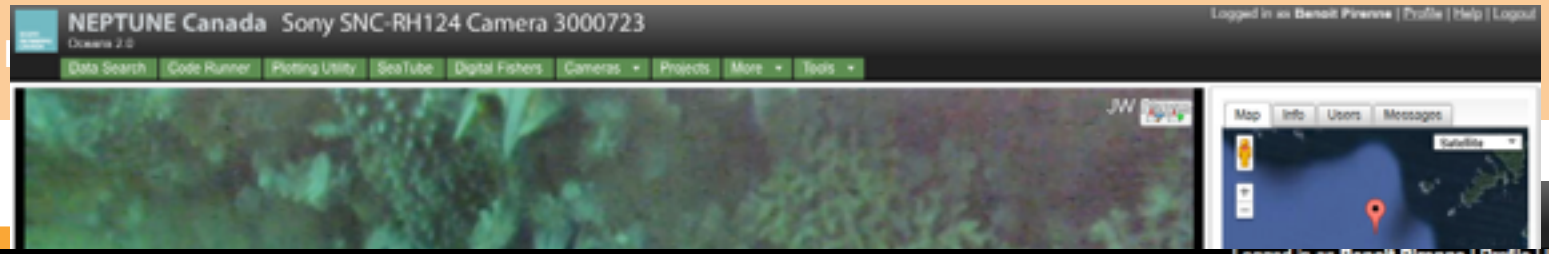

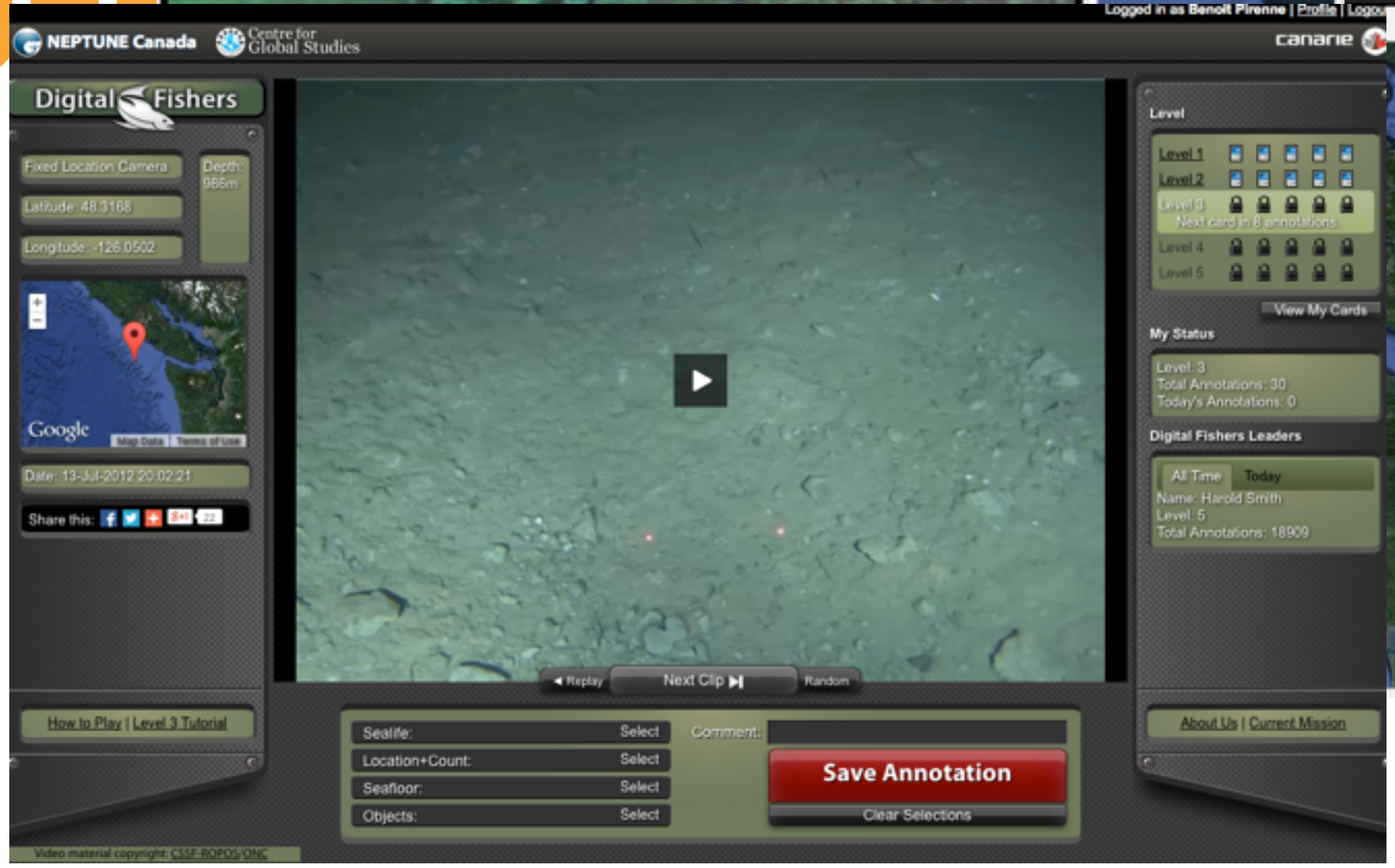

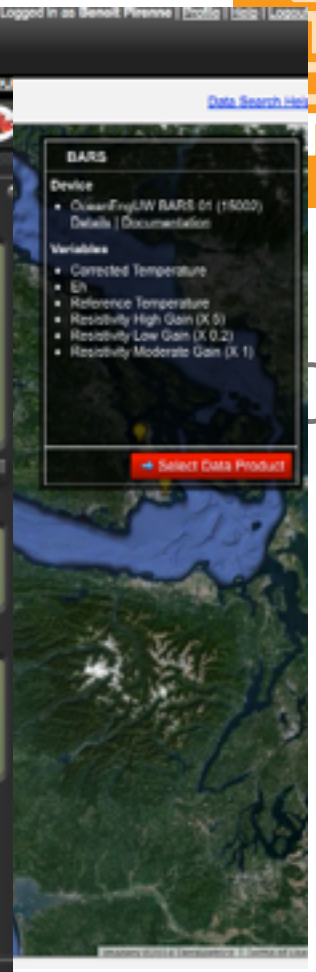

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ONC DI STRUCTURE

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SOFTWARE DEV & QC (20)

- Polyvalent IT staff

SYSTEMS & OPS (5)

- On call
- Network, systems management
- Redundancy management
- Support software management

DATA STEWARDSHIP (4)

- Data QA/QC
- Data annotation
- Overall metadata quality
- User support
- GIS

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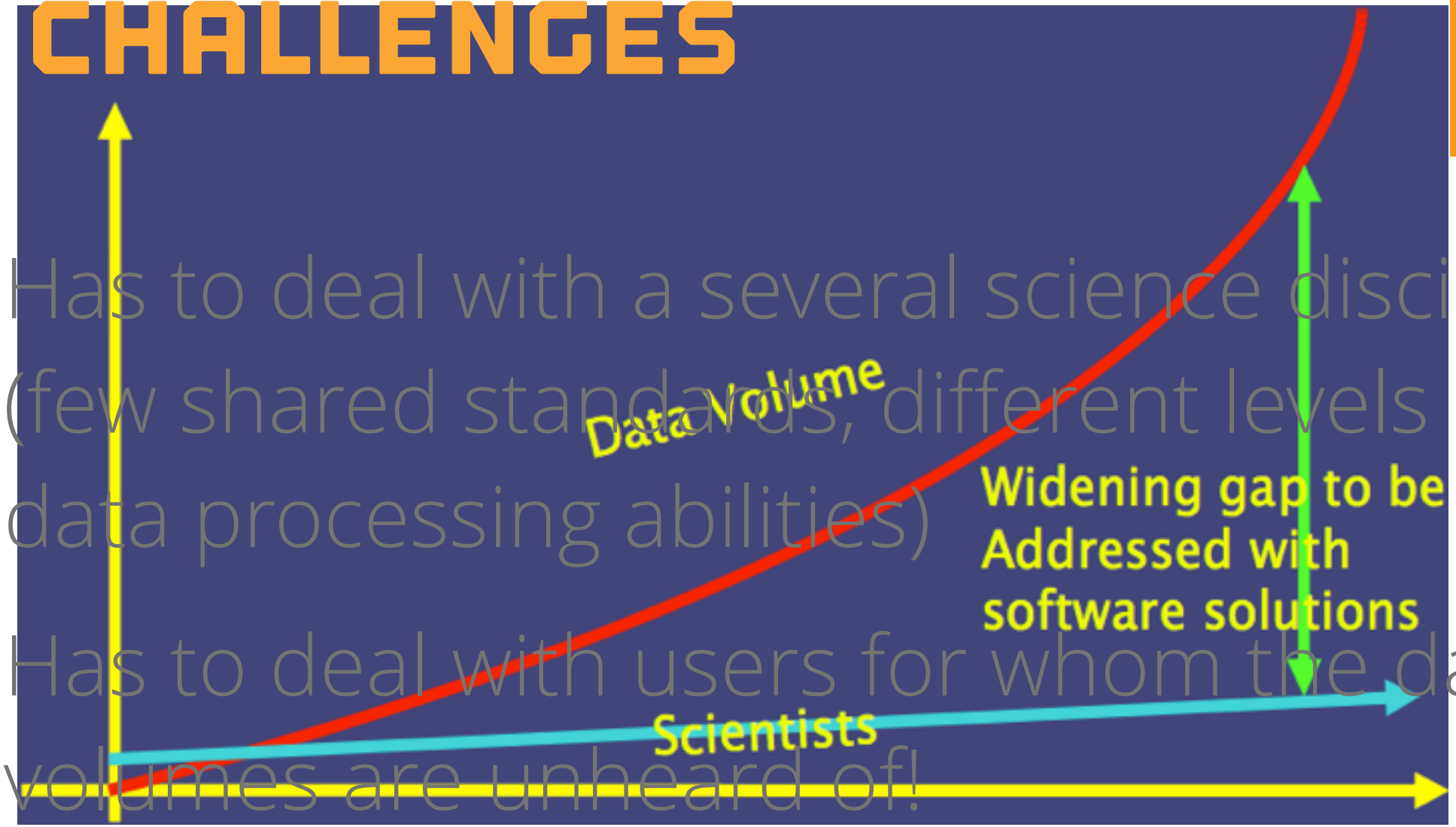
DI CHALLENGES



- Has to deal with a several science disciplines (few shared standards, different levels of data processing abilities)
- Has to deal with users for whom the data volumes are unheard of!

DISCOVER THE OCEAN. UNDERSTAND THE PLANET.

OCEAN NETWORKS CANADA INNOVATION

SMART OCEANS SYSTEMS™

OCEAN INFO DEMAND

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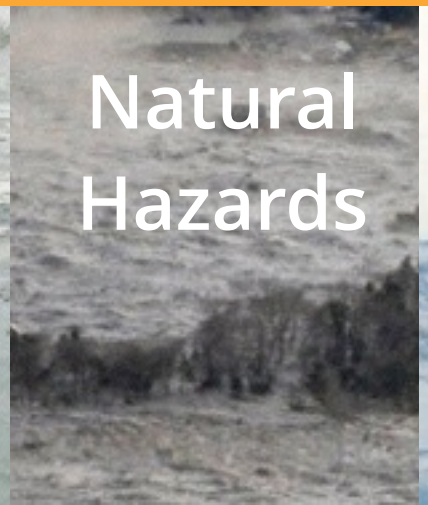
Respond to a demand for ***Smart Ocean Systems*** that can continuously ***monitor***, ***detect***, and ***respond*** to natural and man-made events



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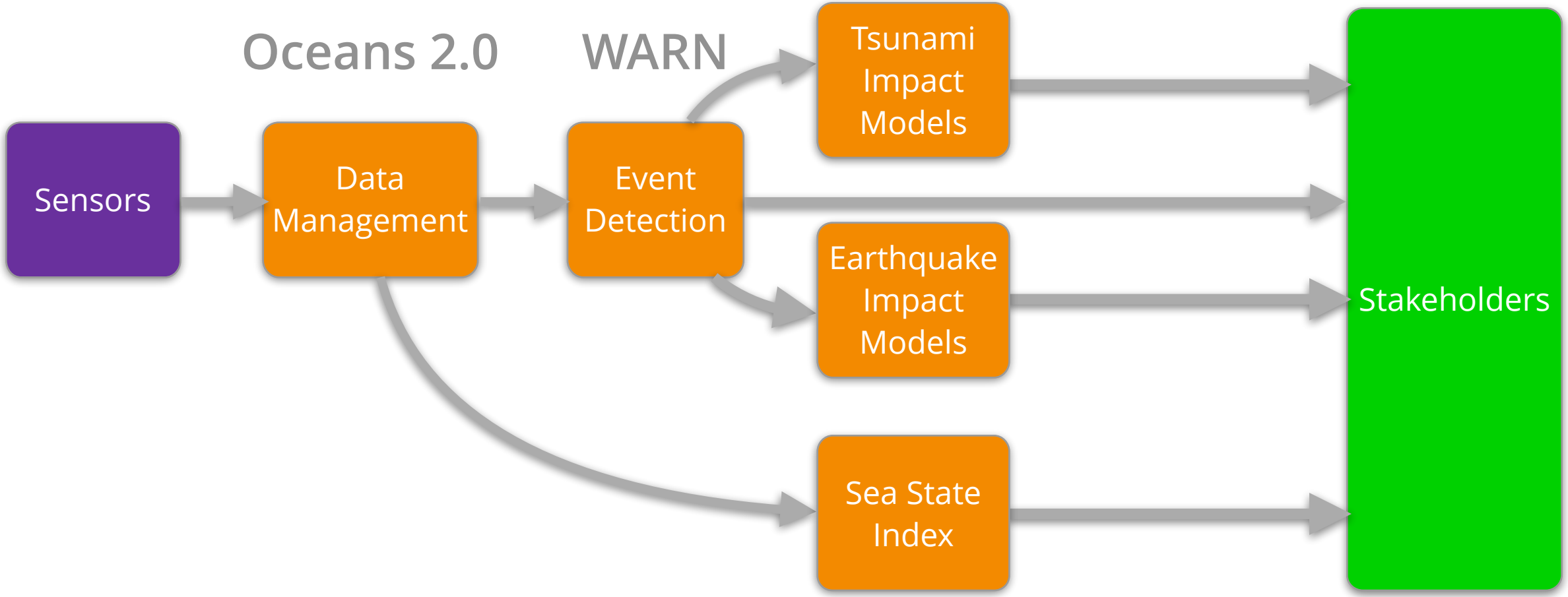
SMART OCEAN SYSTEMS™

Localized Forecasts



INTERNATIONAL LINKAGES

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- Include the US Ocean Observatory Initiative
- Other groups worldwide interested in getting ONC to help them setup their own system
- Use of interoperability approaches to provide data to both user communities
  - OGC for simple sensors
  - OpenDAP for multi-dimensional data

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COOPERATIONS WITH EU INSTITUTIONS

- Visiting scientist/engineer exchanges (2009-10, 2013 & 2014)
- Cooperation agreements (**Ifremer**, **EMSO** — 2013, **SmartBay Galway** — 2008, **UK National Oceanography Centre** — 2011, **PLOCAN**, Spain — 2012, …)
- Organization of joint workshops

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PARTNERSHIPS WITH EU INSTITUTIONS: INSTRUMENTATION

Instrument assembly
on the NEPTUNE observatory:
Ifremer, Brest

Vehicle operational since 2010
on the NEPTUNE observatory:
Jacobs University, Bremen

PARTNERSHIPS WITH EU INDUSTRY

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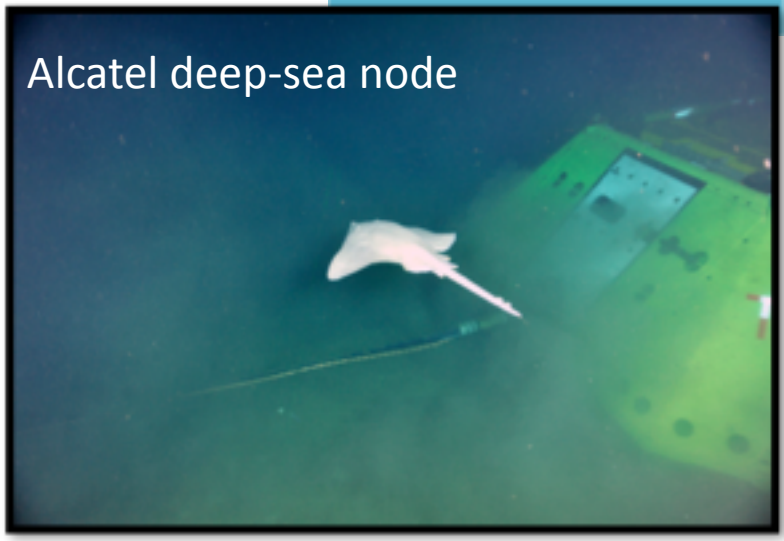
- Alcatel-Lucent (France/UK)
  - NEPTUNE Backbone cable and node technology
- NORTEK A/S (Norway) – active acoustics
- MacArtney A/S (Denmark) – Buoy Profiler System
- Unisense (Denmark) – chemical sensors



DATA INTEROPERABILITY

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- Interoperability efforts with Pangaea (Alfred Wegener Institute and MARUM — 2009)
- ONC's Oceans 2.0 is using Open Geospatial Consortium (OGC)'s Sensor Web Enablement approach (using 52° North Initiative for Geospatial Open Source Software GmbH)

SCIENCE INTERACTIONS

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- ONC has active scientists in many EU countries (EU countries heavily represented in our top users)
- Scientific collaboration programmes ongoing (e.g., automatic video analysis)

PLANS GOING FORWARD

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- More collaborations with EU institutions
  - Building on opportunities of Horizon 2020 and the Galway Agreement
- Increased focus on the Arctic
- Expanding Smart Oceans Systems™ to contribute to Canadian priorities
- Using ONC's Oceans 2.0 data management system as an integrator
  - Bringing together data from more diverse sources
  - Delivering value-added products to a broader group of users (international science, industry and gov't)