OCEAN NETWORKS CANADA

THE ROLE OF OCEAN OBSERVATORIES IN CLIMATE CHANGE MONITORING, MULTI-HAZARD EARLY WARNING AND DISASTER RISK REDUCTION

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CANADIAN INFRASTRUCTURE & PARTNERS
Grise Fiord
To Cape Herschel, CFS Alert & Thule Research Station
Arctic Research Station
Resolute
Gascoyne Inlet
Clyde River
Pond Inlet
Qikiqtarjuaq
Arctic Drifter Buoys
Coastal Community Ocean Observers Program
Greenland Institute of Natural Resources
Canadian Ranger Ocean Watch Program
Cambridge Bay
Existing installation
Funded installation
Potential installation
Existing Mobile Asset
Potential Mobile Asset
Industry Partner
Science Partner
Data Centre
Ship-based Observing
Data Transfer Line
Fibre-optic Cable
Line Papa
Prince Rupert
Kitamaat Village
Churchill
SmartBay
Campbell River
Defence Research Hydrophone Experiment
Salish Sea Marine Survival Program
Tofino
NEPTUNE
University of Victoria
VENUS
Defence Research & Development Canada CODARs
FORCE
Neutrino Observatory
Mill Bay
OTN/DFO Halifax Line
Great Lakes
University of Waterloo
PACIFIC OCEAN
ATLANTIC OCEAN


SOUTHERN BRITISH COLUMBIA INFRASTRUCTURE
VENUS Observatory
NEPTUNE Observatory
Endeavour
Cascadia Basin
Middle Valley
VANCOUVER ISLAND
WASHINGTON - USA
PACIFIC OCEAN
Explorer Plate
Juan de Fuca Plate
Pacific Plate

OCEAN NETWOKS USERS AND DATA VOLUME

1. Canada
2. United States
3. Ucraine
4. Russia
5. China
6. UK
7. France
8. Germany
9. Spain
10. India

- **850**+ km seafloor backbone cables
- **400** instruments containing **over 5000** sensors online 24/7/365
- **500**+ TB of data archived in over **26 million** files
- **280** GB of data collected and **35** GB distributed per day

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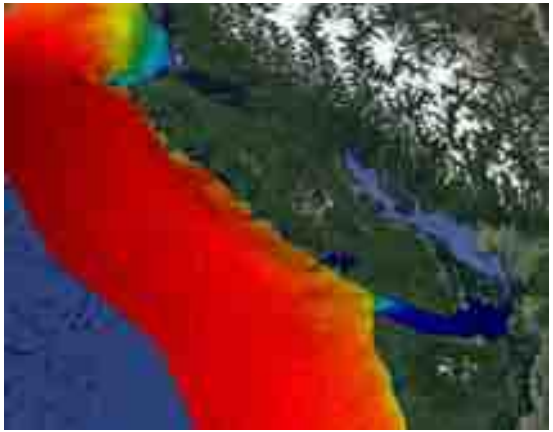
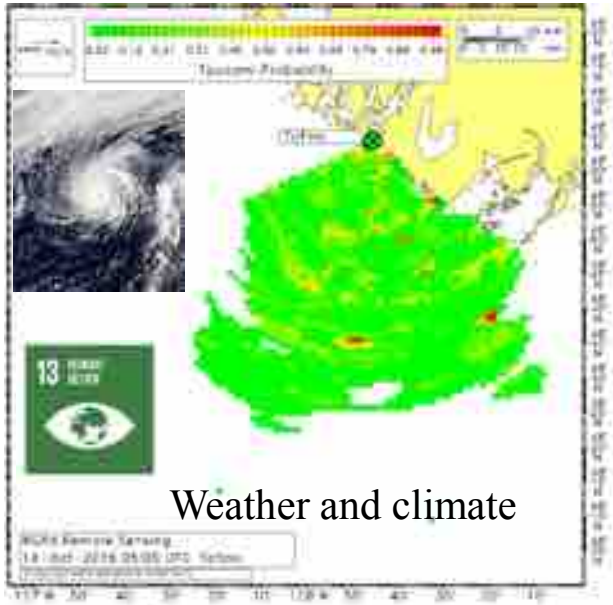
CLIMATE CHANGE STUDIES

THE IMPORTANCE OF THE OCEAN

Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development

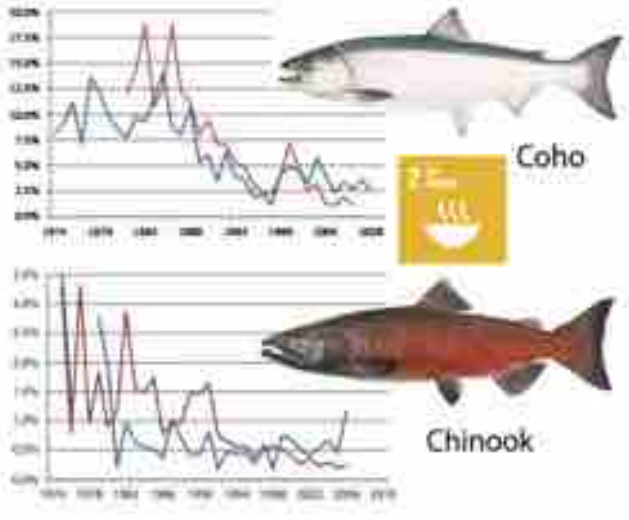


Energy
Employment



Weather and climate

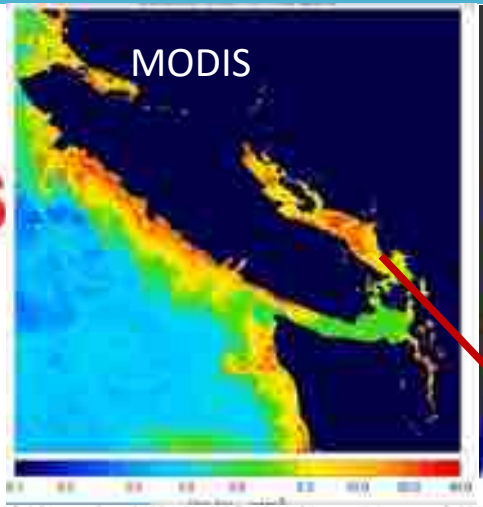
Terrestrial ecosystems influencer

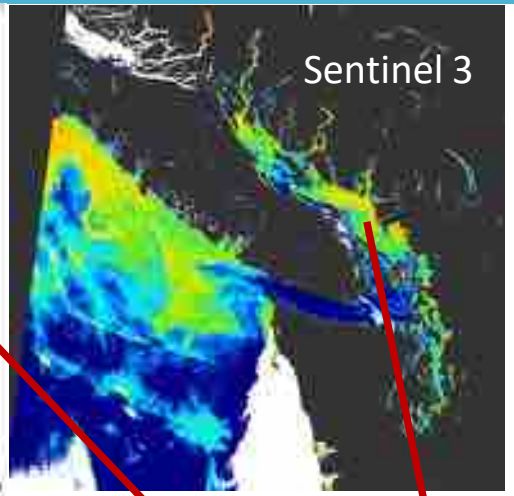


Food sustainability
Sustainable industry and innovation

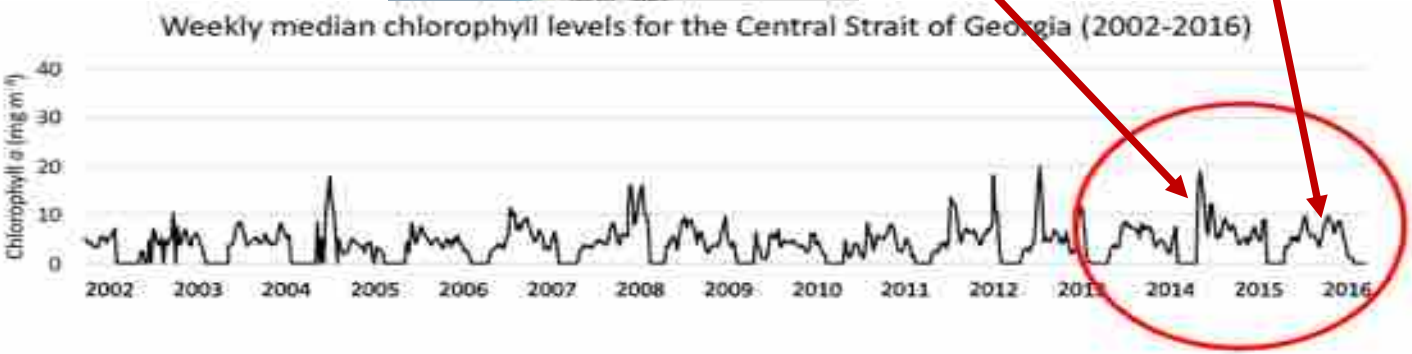
Economic importance

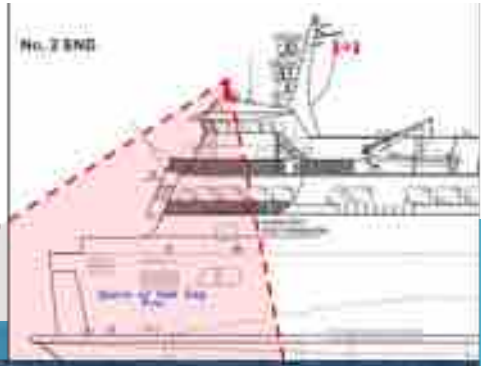
FOCOS





(Ferry Ocean Colour Observation System)





Slide courtesy of Dr. Maycira Costa

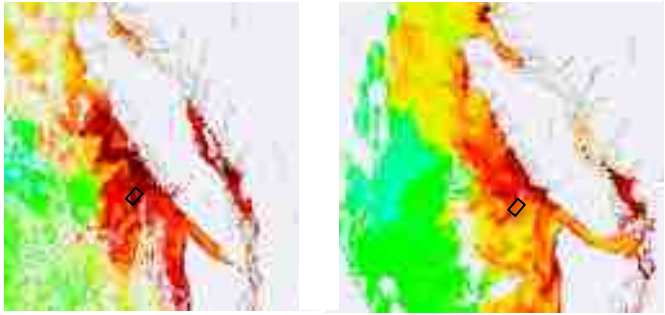
THE OCEANIC BIOLOGICAL PUMP: CARBON TRANSPORT STUDIES

(Thomsen et al., 2017)

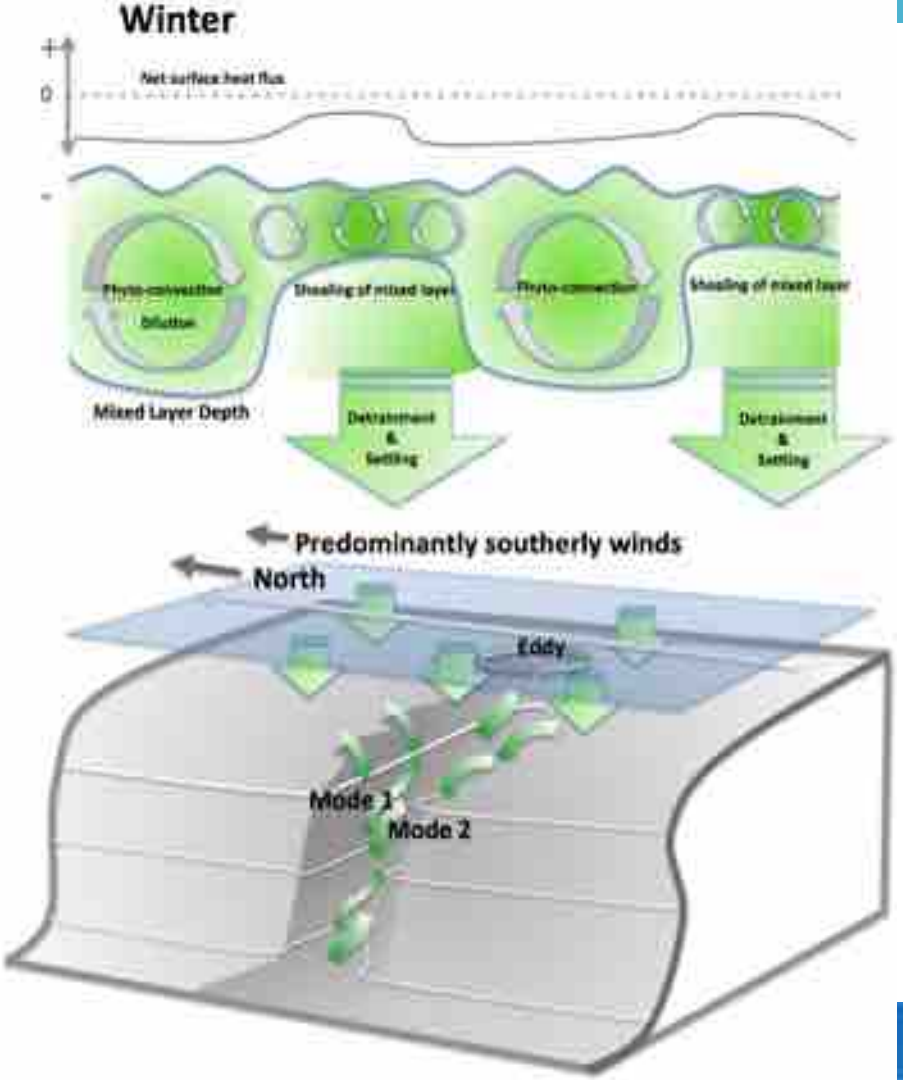
Data set (time-series):

- Nov 2011 – Jun 2012 (7 months)
- MODIS daily composite images
- Internet Operated Vehicle (‘Wally’) – CTD, Fluorometry, turbidity, video camera
- Photo mosaics – benthic abundance and activity

MODIS Satellite data



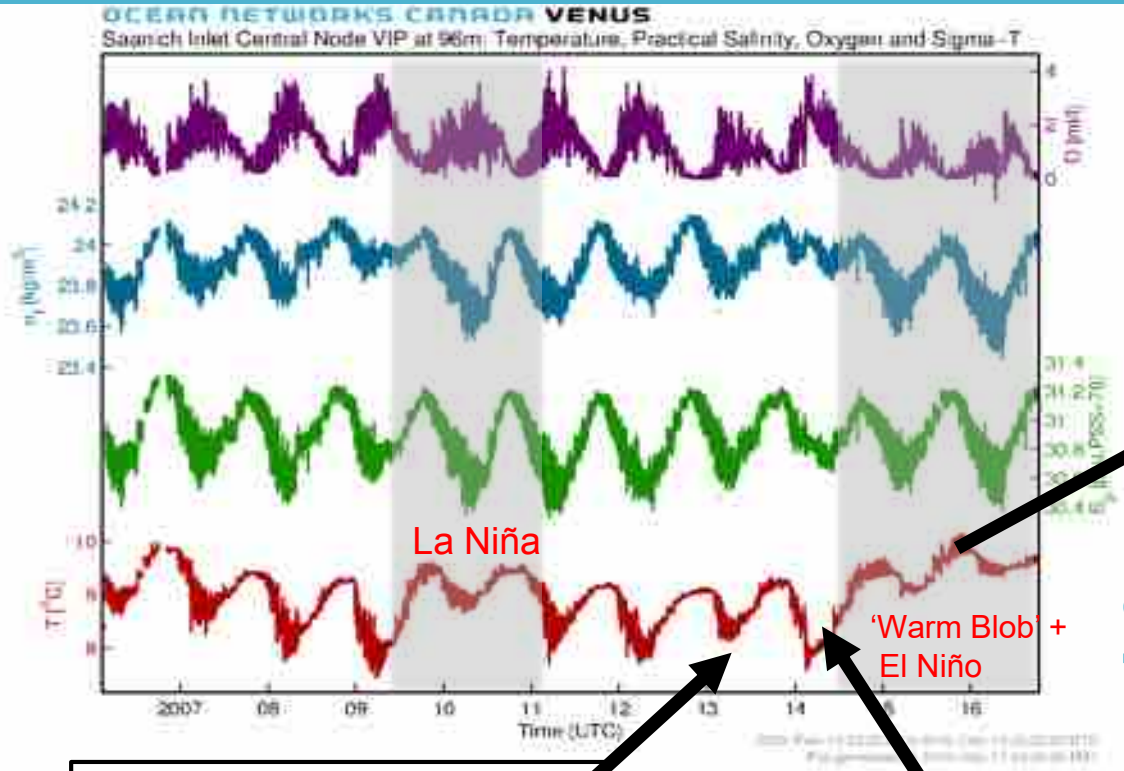
OCEAN NETWORKS CANADA

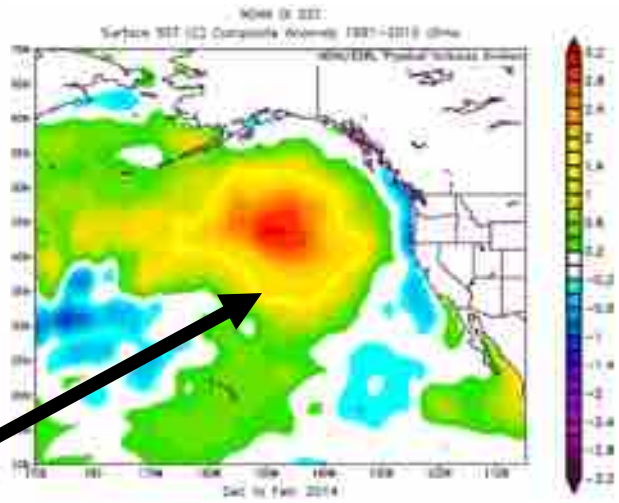


THE OCEANIC BIOLOGICAL PUMP: CARBON TRANSPORT STUDIES

(Thomsen et al., 2017

- Transfer of CO_2 to Particulate Organic Carbon
- Exported carbon from winter blooms arrived with a 1-3 days lag at the seafloor;
- Comparable chlorophyll signals at BBL to spring conditions;
- Significant response by benthic megafauna: increase in abundance and activity: feeding and movement





OCEAN MONITORING: THE WARM BLOB CASE

Weak 2013/2014 downwelling evident on shelf at 97 m

'Normal' downwelling in 2014/2015 …but very warm (+1.7 C): "Blob" moves inshore

Slide courtesy of Dr. Peter Chandler

ARCTIC OBSERVATORY

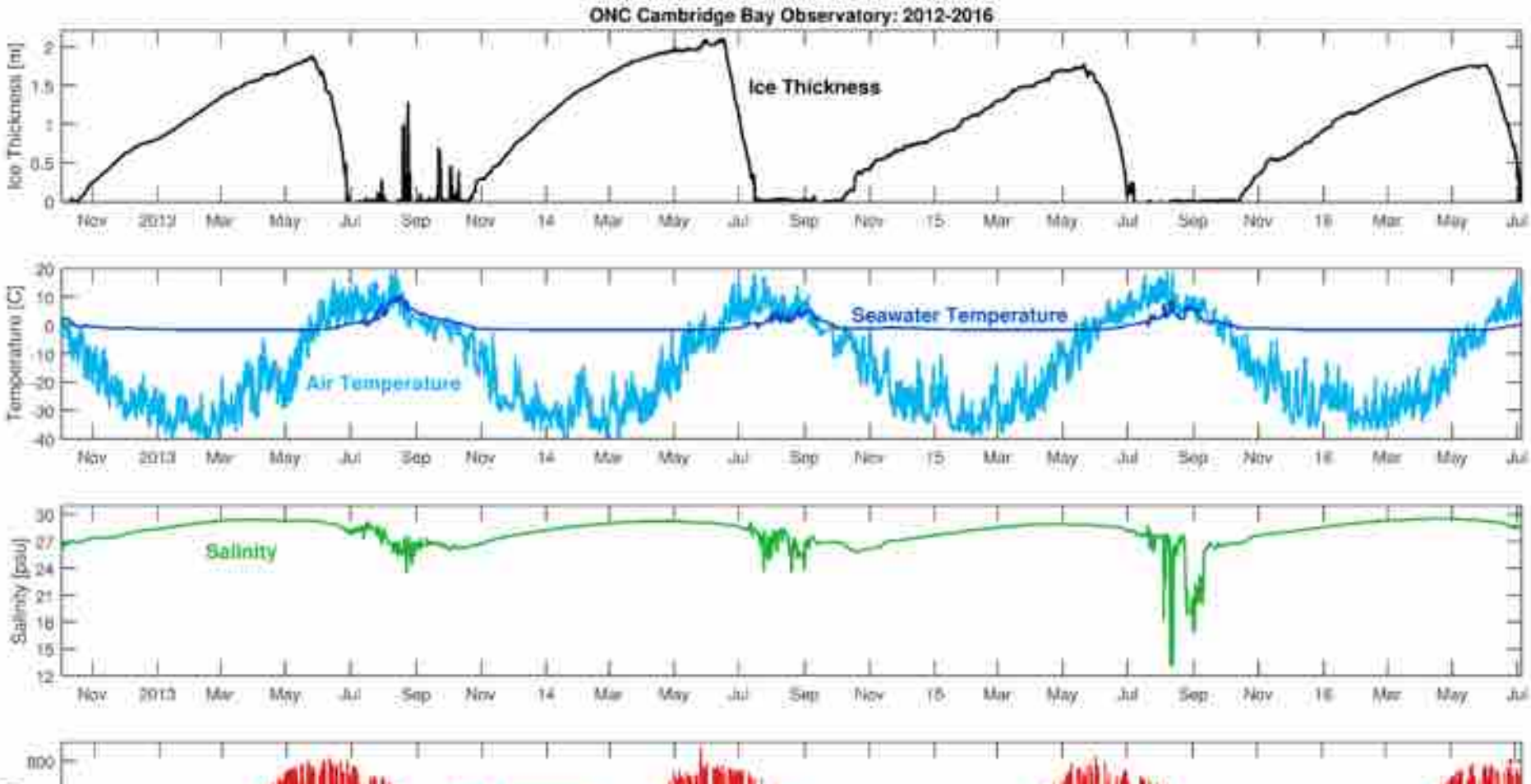
CAMBRIDGE BAY OBSERVATORY

- Operational since 2012
- 250m electrical cable
- 100Mbit data
- 200W power
- 13 sensors
- Satellite com backhaul

Major research themes

- Arctic climate change
- Ice behavior
- Marine mammal behavior
- Testbed for Arctic sensor technologies

CAMBRIDGE BAY COMUNITY OBSERVATORY

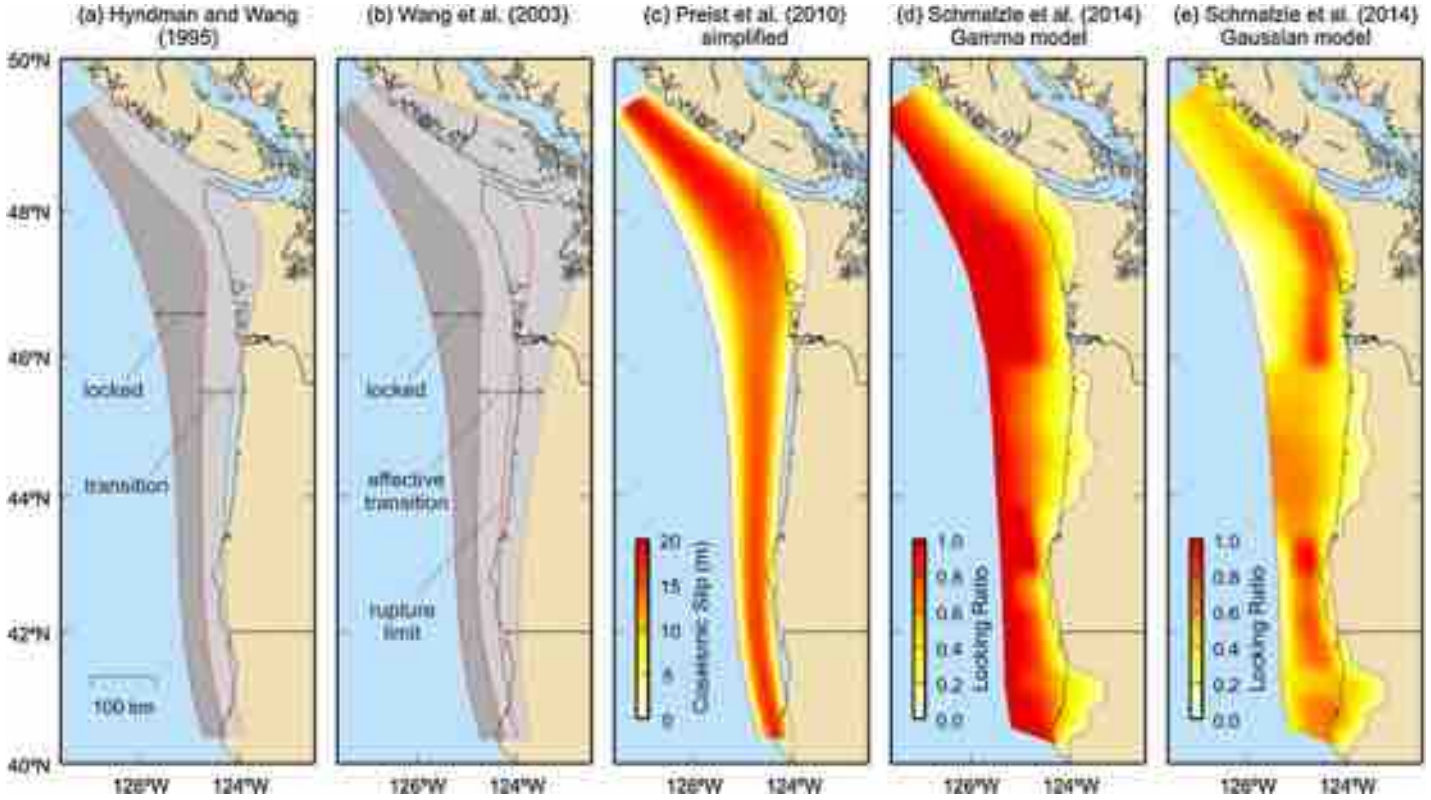


OCEAN NETWORKS CANADA

MULTI-HAZARD EARLY WARNING AND DISASTER RISK REDUCTION

GEODESY STUDIES

Northern Cascadia Subduction Zone Observatory

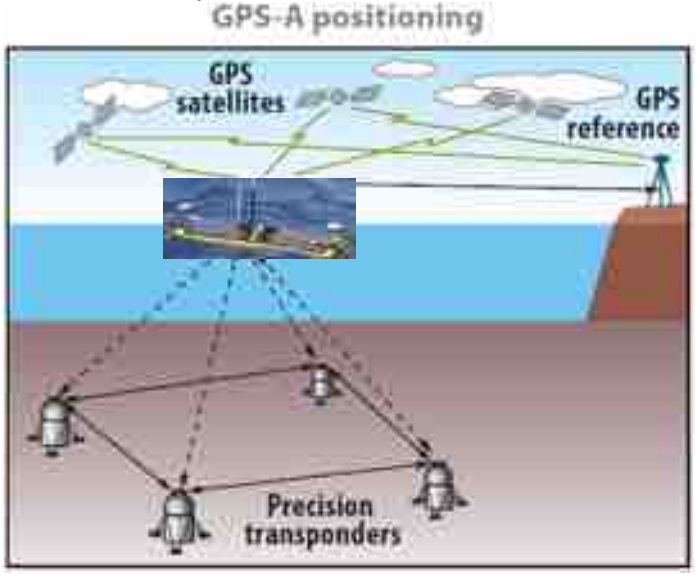


(Wang and Tréhu, 2016)

GPS measurements on land do not provide sufficient constraints for offshore locking pattern!

GEODESY STUDIES

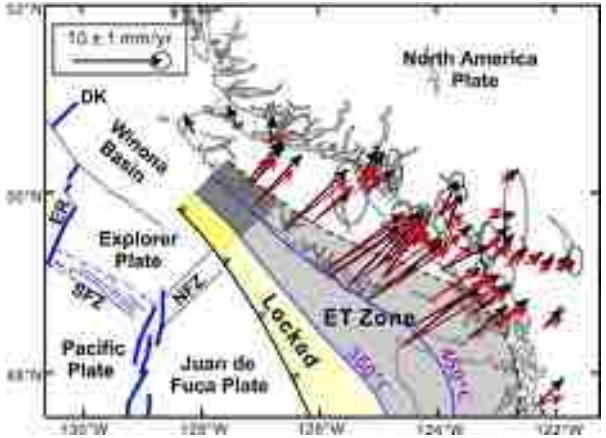
Northern Cascadia Subduction Zone Observatory



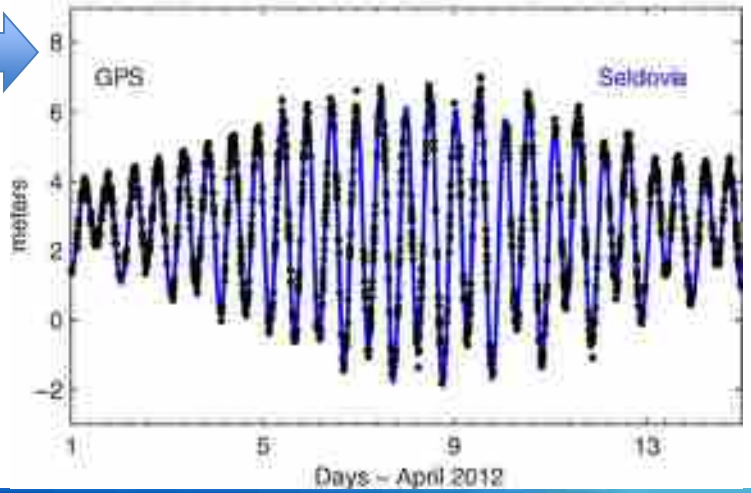
GPS-Acoustic method can determine the position of transponders on the seafloor.

OCEAN NETWORKS CANADA

A SINERGY EXAMPLE: GNSS MULTIPURPOSE



Implications for seismic and tsunami hazards: Black arrows, observed GNSS site velocities; red arrows, model predicted site velocities



Sea-level estimates from GPS and tide gauge data (Larson et al., 2013)

Tsunami detection? Low maintenance cost versus tidal gauges (Hoeberechts et al., 2015)

AN OCEAN WISHLIST FOR THE SATELLITE COMMUNITY

- Keep providing the **color of the ocean imagery and SST**
- **Digital Elevation Models (DEM)** with high resolution, intertidal coverage and a well referenced tidal datum to be combined with bathymetry
- More coverage in the North for **GNSS data**
- Keep providing **imagery in real time from disaster zones**
- Detailed **weather air pressure** data for meteorological tsunami modeling
- **Better integration of ocean and satellite data** in particular for element cycles
- Low-earth-orbit systems for **cellular communications**, cheap, highly available high-bandwidth communication solutions resistant to disruption by disasters.
- **Easy access to free data**
- **Access to other data** under agreement - MOU?

WHAT IS YOUR WISHLIST FOR THE OCEAN COMMUNITY?


THANK YOU!
Ocean Networks Canada is funded by the Canada Foundation for Innovation, Government of Canada, University of Victoria, Government of British Columbia, CANARIE, and IBM Canada.
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OceanNetworksCanada
visit: oceannetworks.ca

OCEAN NETWORKS CANADA

THANK YOU!

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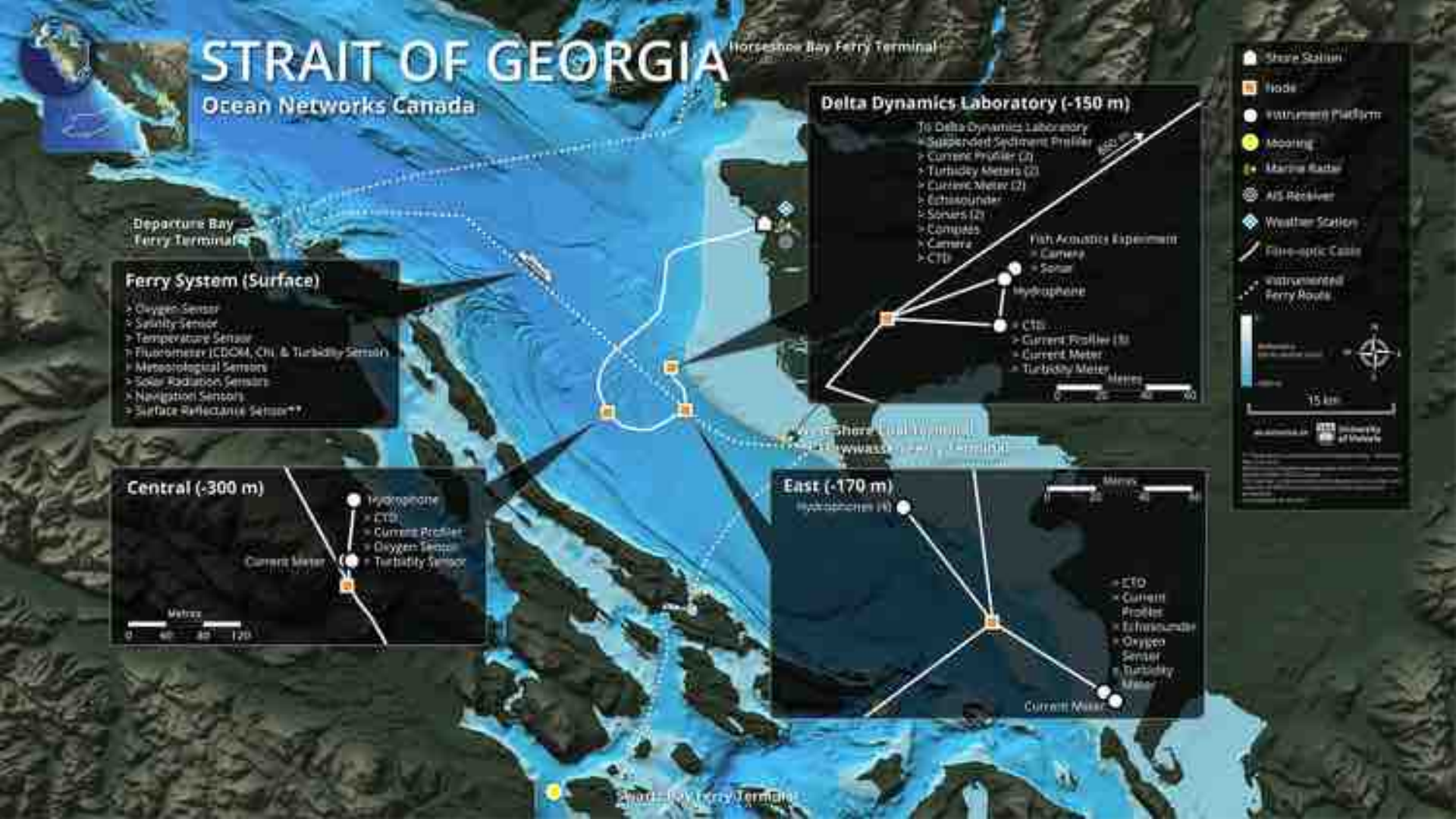
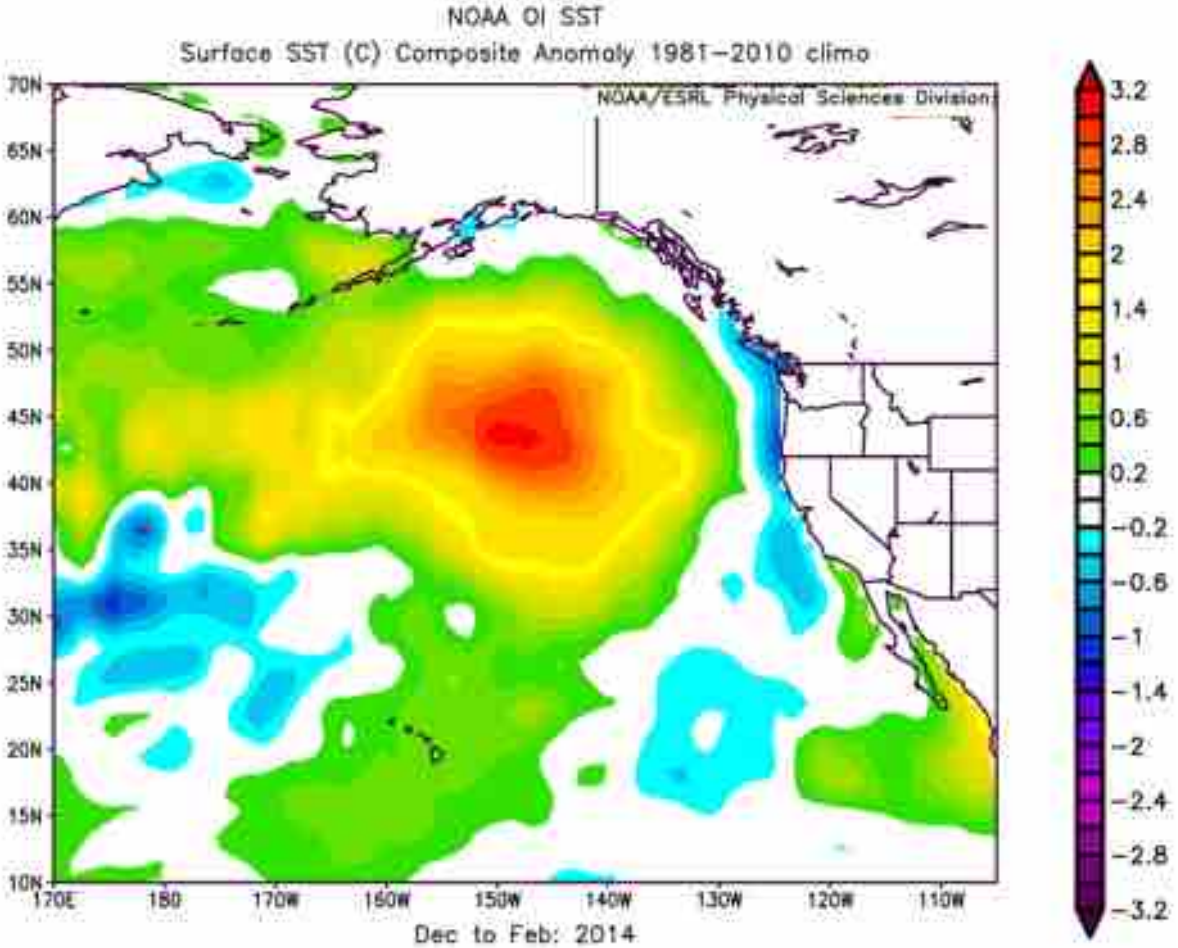

STRAIT OF GEORGIA
Ocean Networks Canada
Horseshoe Bay Ferry Terminal
Departure Bay Ferry Terminal
Ferry System (Surface)
> Oxygen Sensor
> Salinity Sensor
> Temperature Sensor
> Fluorometer (CDOM, Chl, & Turbidity Sensor)
> Meteorological Sensors
> Solar Radiation Sensors
> Navigation Sensors
> Surface Reflectance Sensor**
Delta Dynamics Laboratory (-150 m)
To Delta Dynamics Laboratory
> Suspended Sediment Profiler
> Current Profiler (2)
> Turbidity Meters (2)
> Current Meter (2)
> Echosounder
> Sonars (2)
> Compass
> Camera
> CTD
Fish Acoustics Experiment
> Camera
> Sonar
Hydrophone
> CTD
> Current Profiler (3)
> Current Meter
> Turbidity Meter
Metres
0 20 40 60
Central (-300 m)
Hydrophone
> CTD
> Current Profiler
> Oxygen Sensor
> Turbidity Sensor
Current Meter
Metres
0 40 80 120
East (-170 m)
Hydrophones (4)
Metres
0 20 40 60
> CTD
> Current Profiler
> Echosounder
> Oxygen Sensor
> Turbidity Meter
Current Meter
Shore Station
Node
Instrument Platform
Mooring
Marine Radar
AIS Receiver
Weather Station
Fibre-optic Cable
Instrumented Ferry Route
15 km
University of Victoria

SMART OCEAN SYSTEMS™

Smart Ocean Systems™ are designed to detect, analyze and alert about natural hazards and anthropogenic events

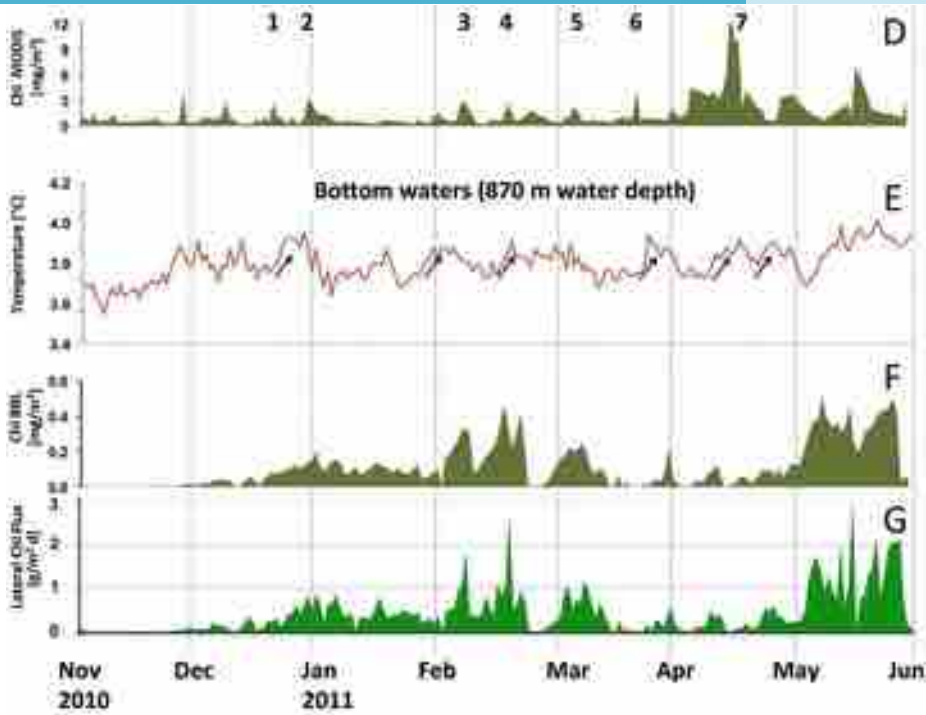


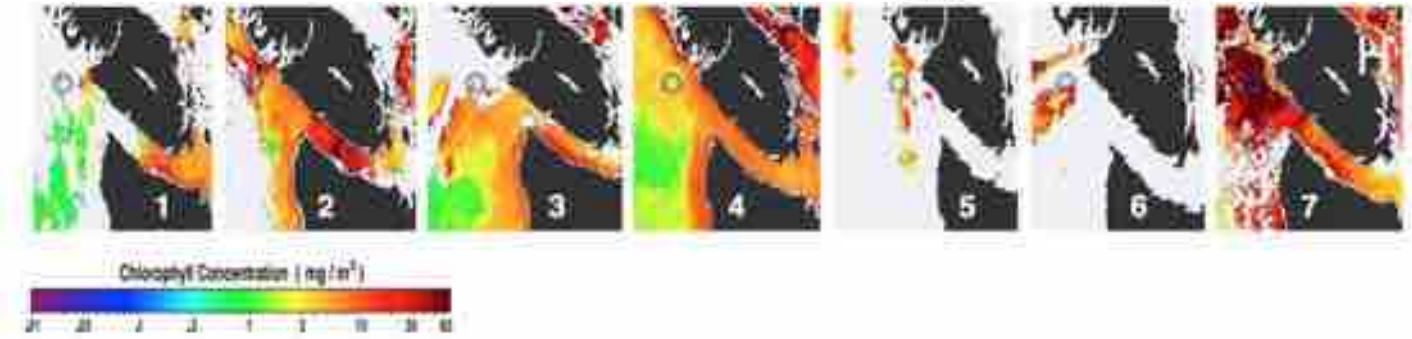
THE WARM BLOB

From early 2014 through late 2015 an intense Sea Surface Temperature anomaly was detected in the North East Pacific (figure shows three month average SST)

THE OCEANIC BIOLOGICAL PUMP: CARBON TRANSPORT STUDIES

(Thomsen et al., 2017: Scientific Reports,)





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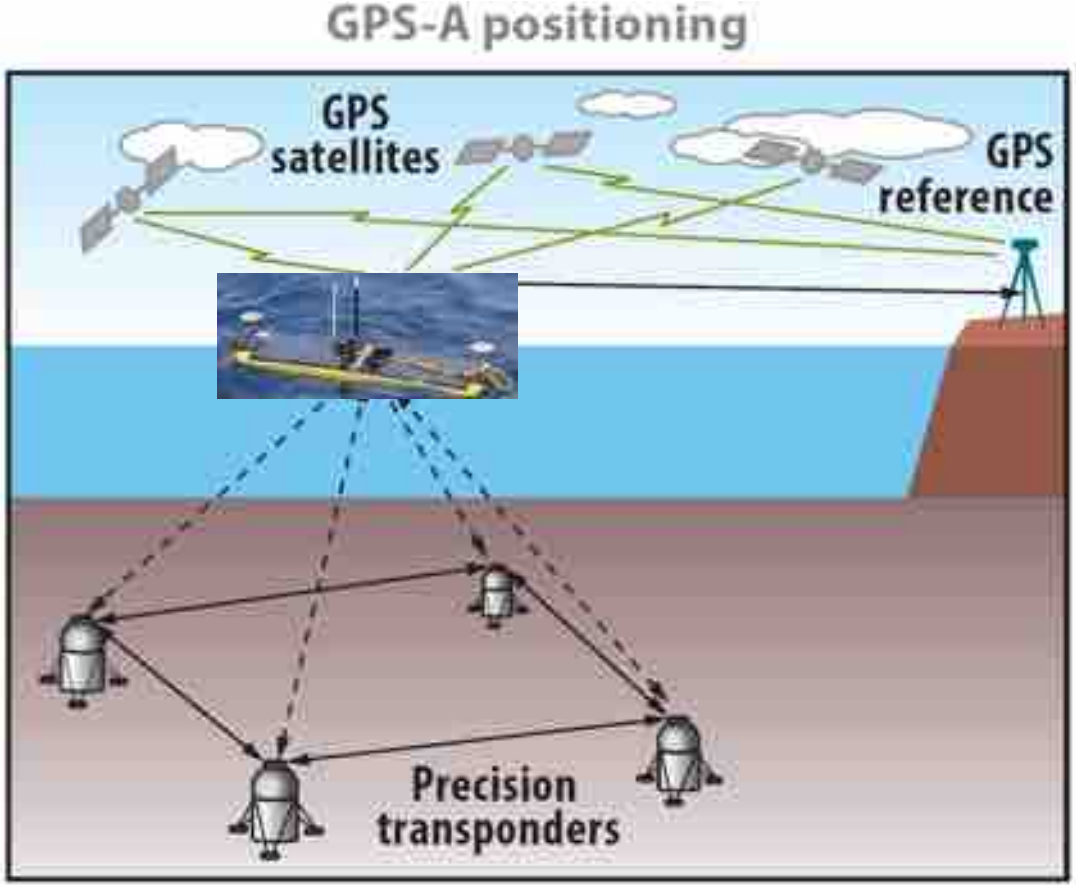

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