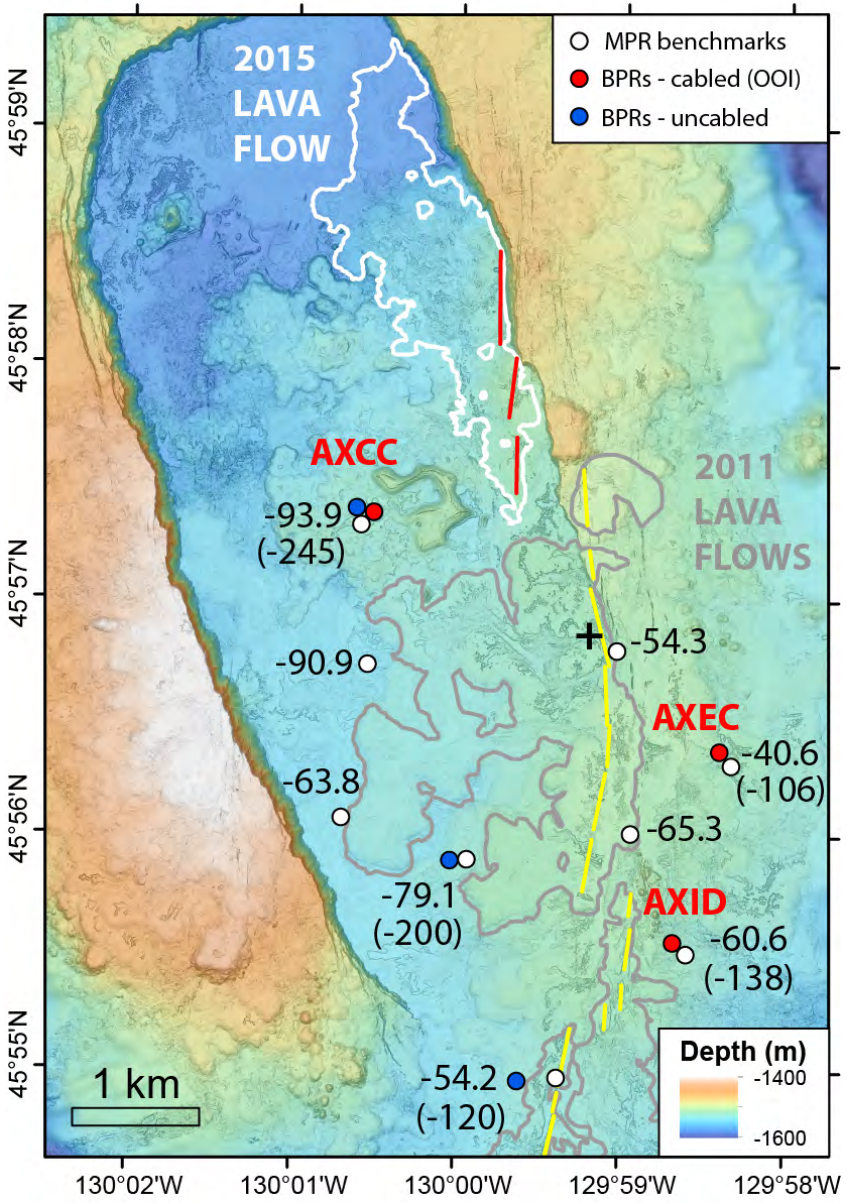
UNOLS OOI Community Workshop: Cabled, Endurance, Station Papa Arrays

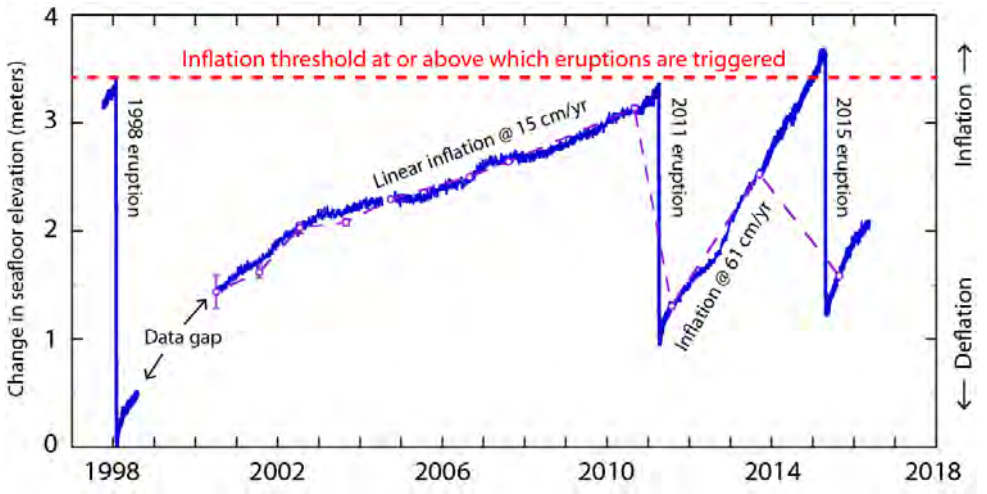
Participant Slides – Group 1

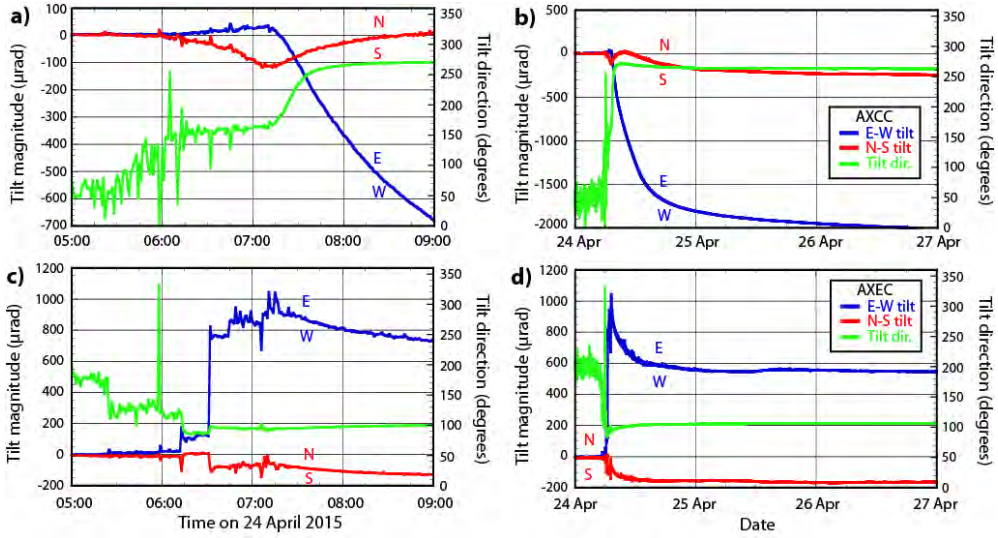
USE OF OOI CABLED ARRAY DATA FOR GROUND DEFORMATION STUDIES AT AXIAL SEAMOUNT

Bill Chadwick (Oregon State Univ.) and Scott Nooner (Univ. North Carolina, Wilmington)

Nooner, S. L., and W. W. Chadwick, Jr. (in press), Inflation-predictable behavior and co-eruption deformation captured by cabled instruments at Axial Seamount, Science







www.pmel.noaa.gov/ocs/Papa/

Ocean Climate Stations

Pacific Marine Environmental Laboratory

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Home | About Us | Research | Data | Technology | Publications | Media

Research

- Overview
- Kuroshio Extension Observatory
  - KEO Background
- Ocean Station Papa
  - Papa Background
  - Other Research at Papa
- Agulhas Return Current
  - ARC Background
- Air-Sea Fluxes

Related

Data Overview
It is the OCS project policy that timely, free, and unrestricted access shall

Moorings

Measurement Heig...
The tables below describe the nominal heights of meteorological measurements.

Ocean Station Papa

Current Anchor Position: 50° 3.3'N, 144° 52.4'W

Nominal Location: 50.1°N, 144.9°W

Mooring Type: Taut-Line

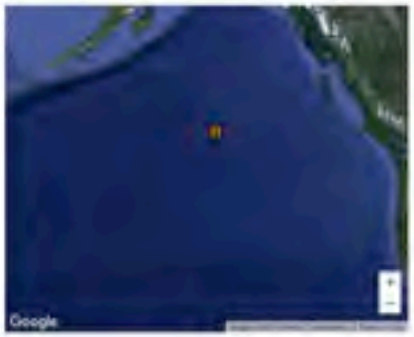
Scope: 0.965 (2015 -), 0.985 (2007 - 2014)

Watch Circle: 1.25km Radius

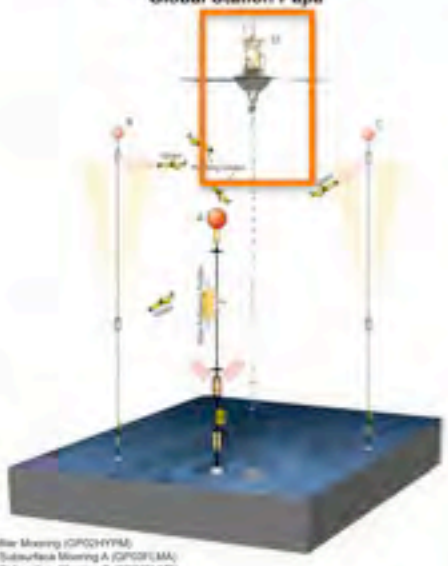
Avoidance Area: Ships working in the area are requested to observe an avoidance area of *at least 3NM radius (5.5km)* from the stated anchor position.

PMEL Metadata by Project

- Acoustic Monitoring Program
- Arctic Climate Dynamics
- Argo
- Atmospheric Chemistry
- Carbon Program:
  - Coastal and Regional
  - Moorings
  - Repeat Hydro
  - VOS
- EcoFOCI
- EOI:
  - MAPR
  - Cobb Hill Ridge
  - Chile Rise
  - Gastroseis Research
  - Lau Basin
  - Manaus Air
  - NE Pacific
  - Pacific Antarctic Ridge
- GTMBA
- NCTR
- Ocean Climate Stations
- Ocean Tracer
- Solomon Sea Glider

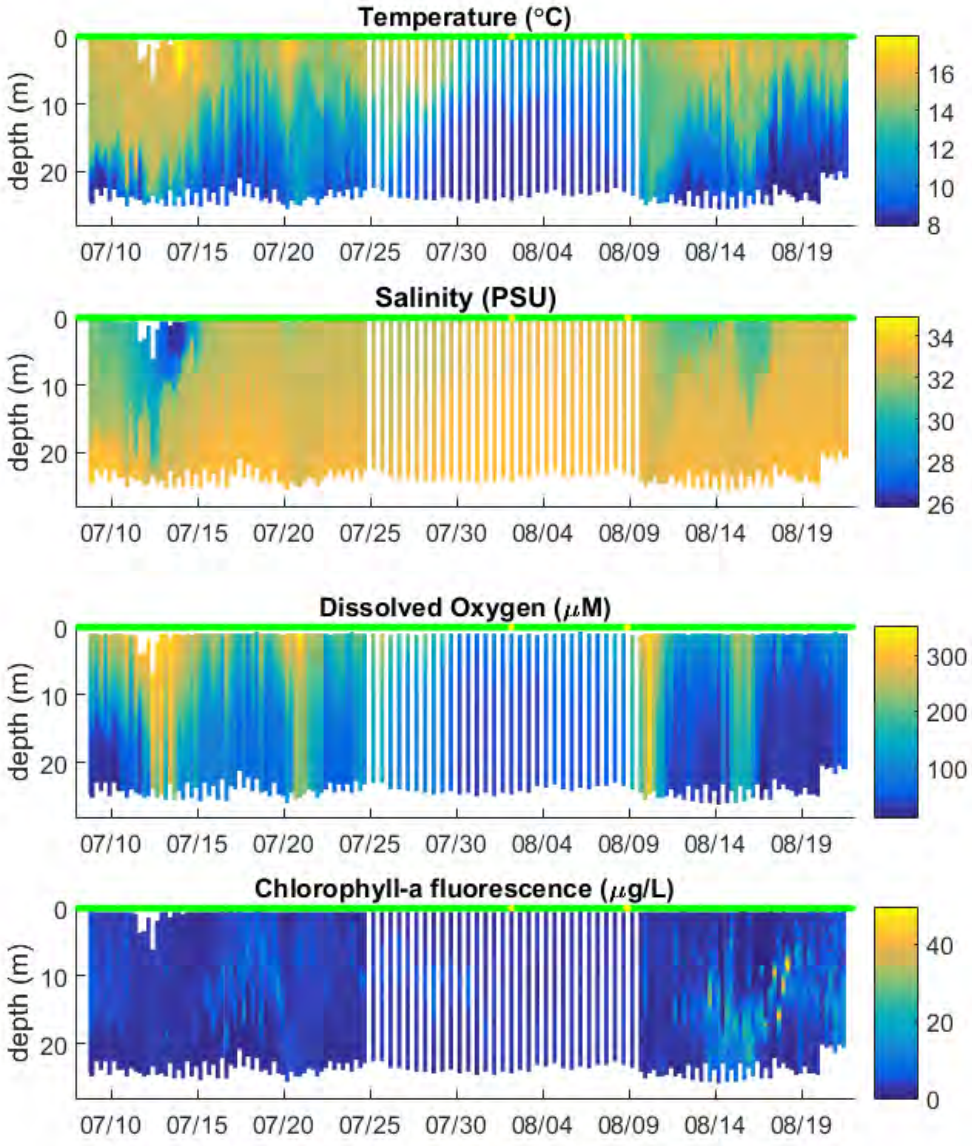


Global Station Papa

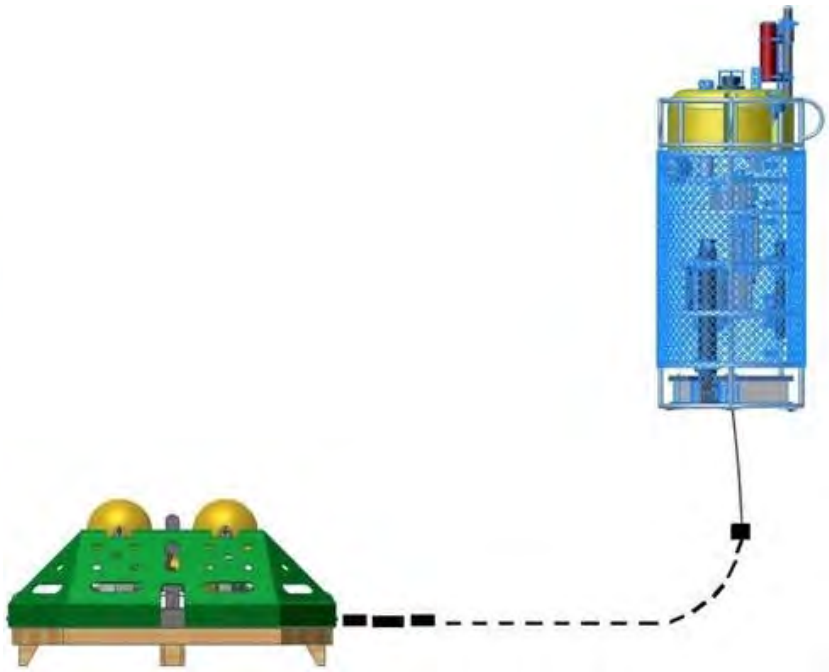


(A) Apex Profiler Mooring (GP02HYPM)
(B) Flanking Subsurface Mooring A (GP02FLMA)
(C) Flanking Subsurface Mooring B (GP02FLMB)
(D) NOAA PMEL Station Papa Surface Mooring
Mobile - Open Ocean Glider (GP05MOAS-GL)
Mobile - Global Profiling Glider (GP05MOAS-PG)

Time Series Analysis of Endurance Array Coastal Surface Piercing Profiler Data

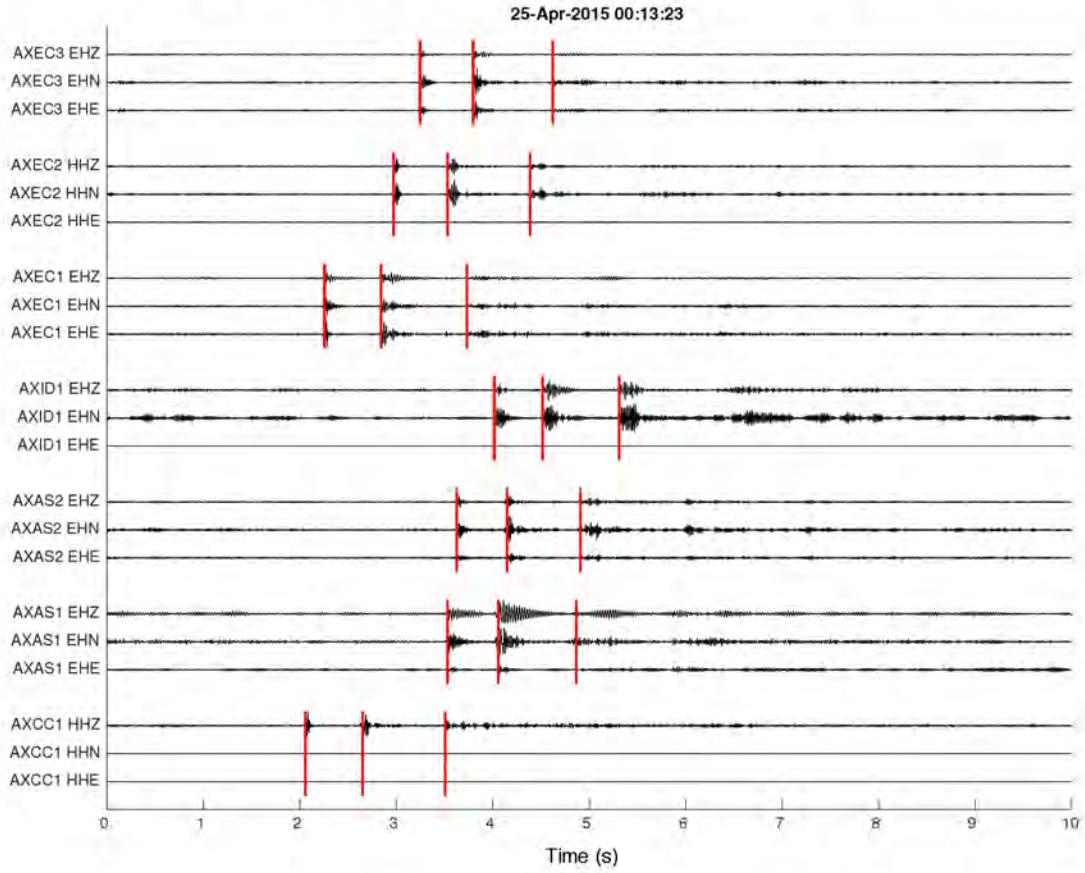


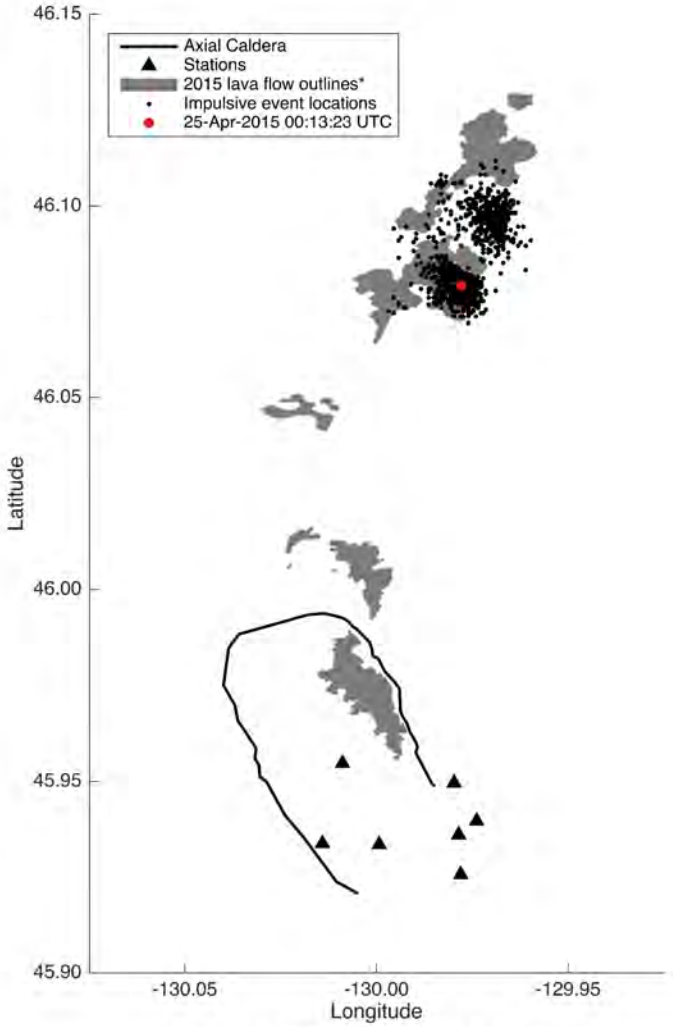
Jonathan Fram
Assistant Professor Senior Research
Oregon State University
jfram@ceaos.oregonstate.edu
Endurance Array Systems Engineer
Ocean Observatories Initiative



Charles Garcia – University of Washington

Locating impulsive events from Axial's eruption



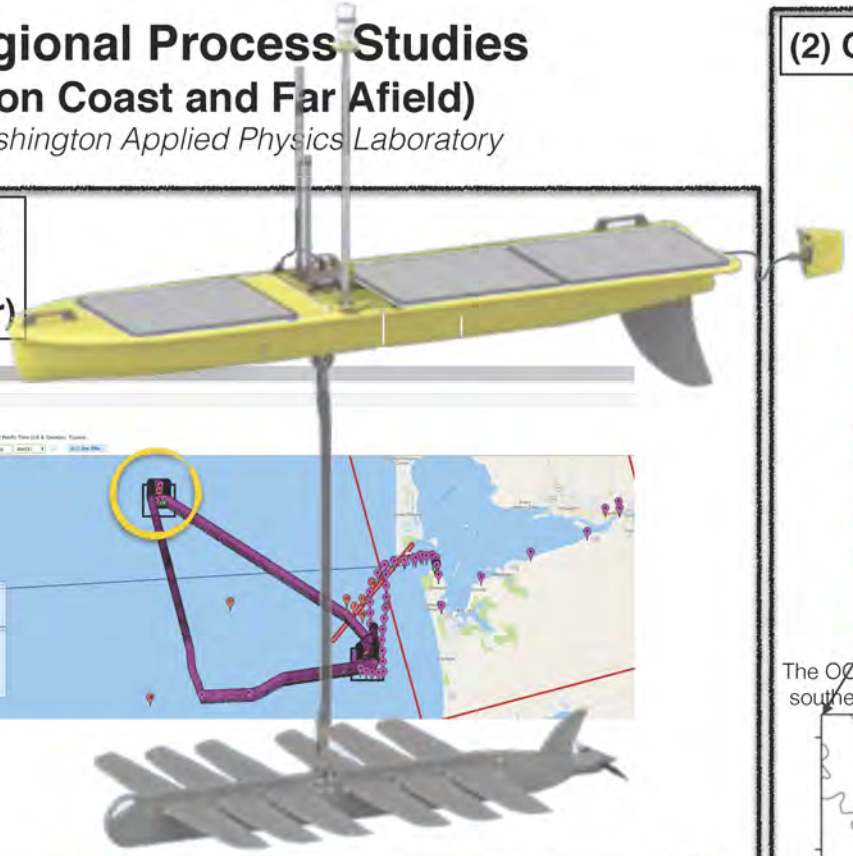


*Thanks to Bill Chadwick for lava flow outlines

OOI Synergy with Regional Process Studies
(both on the Washington Coast and Far Afield)

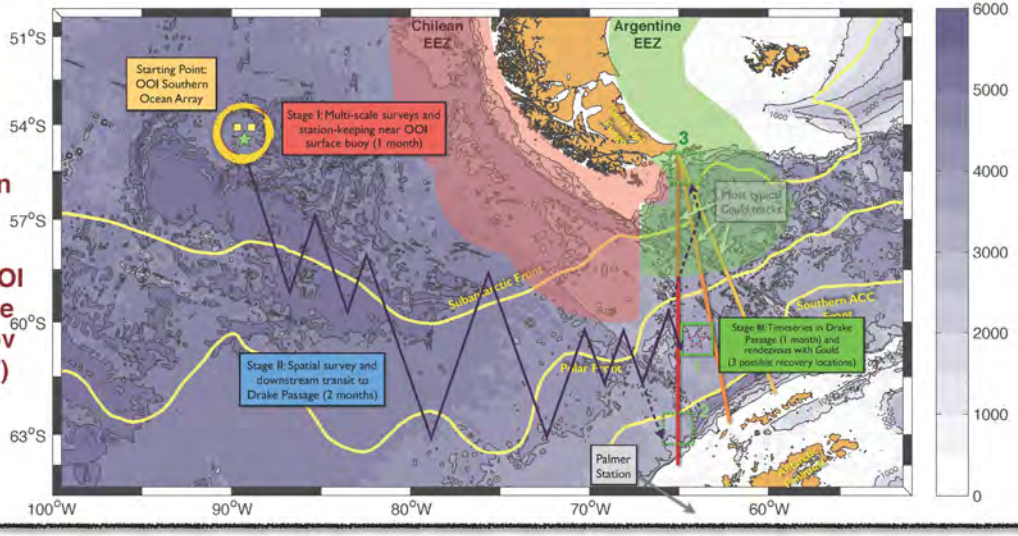
James B. Girton, University of Washington Applied Physics Laboratory

(1) Surface waves, currents, and air-sea fluxes from a mobile platform (Wave Glider)

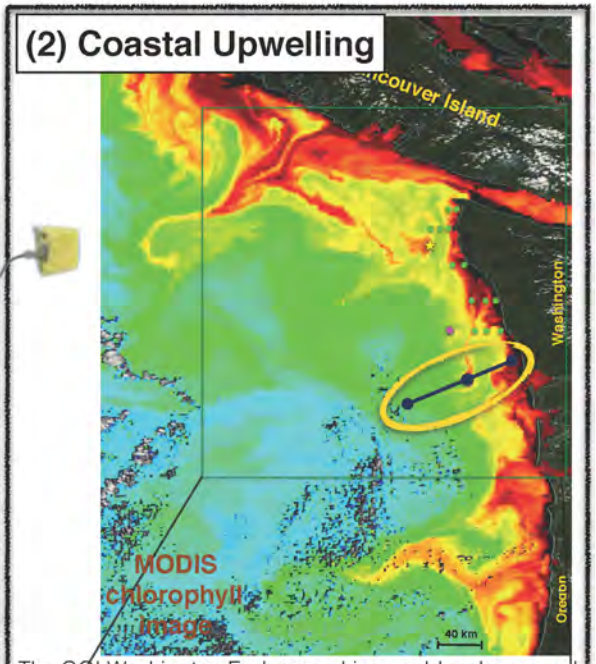


OOI WA Shelf mooring off Grays Harbor as a site for vehicle calibration/ validation (July 2016)

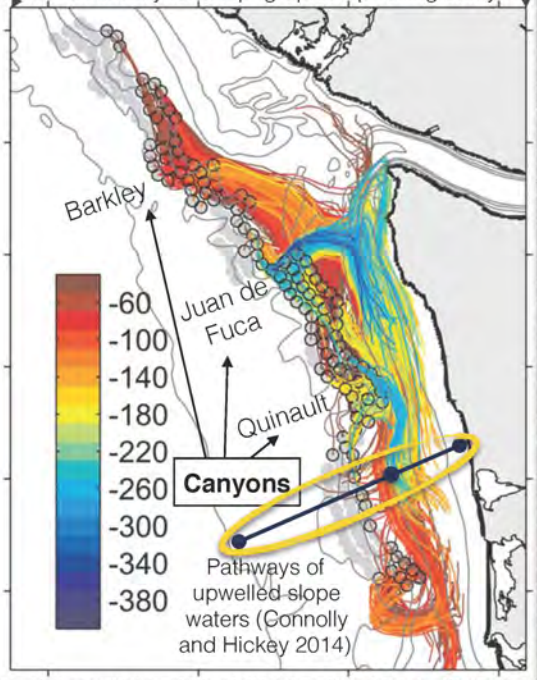
Southern Ocean wind-wave-current study will use OOI for cal/val before ACC survey (Nov 2016 - Apr 2017)



(2) Coastal Upwelling



The OOI Washington Endurance Line could make a good southern boundary for a topographic upwelling study…



Bruce Howe, University of Hawaii at Manoa
OOI Northeast Pacific Workshop, 27-29 September 2016, Portland, Oregon

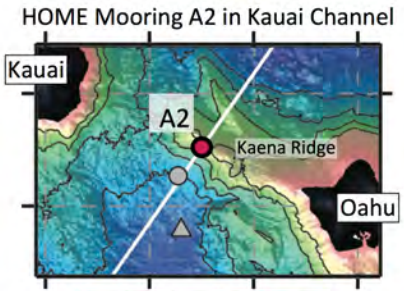
Current:

- Bottom pressure, HPIES, ocean circulation and climate
- Profiling mooring systems – capabilities and applicability to the ALOHA Cabled Observatory (ACO)
- Infrastructure – accuracy of timing;

Future:

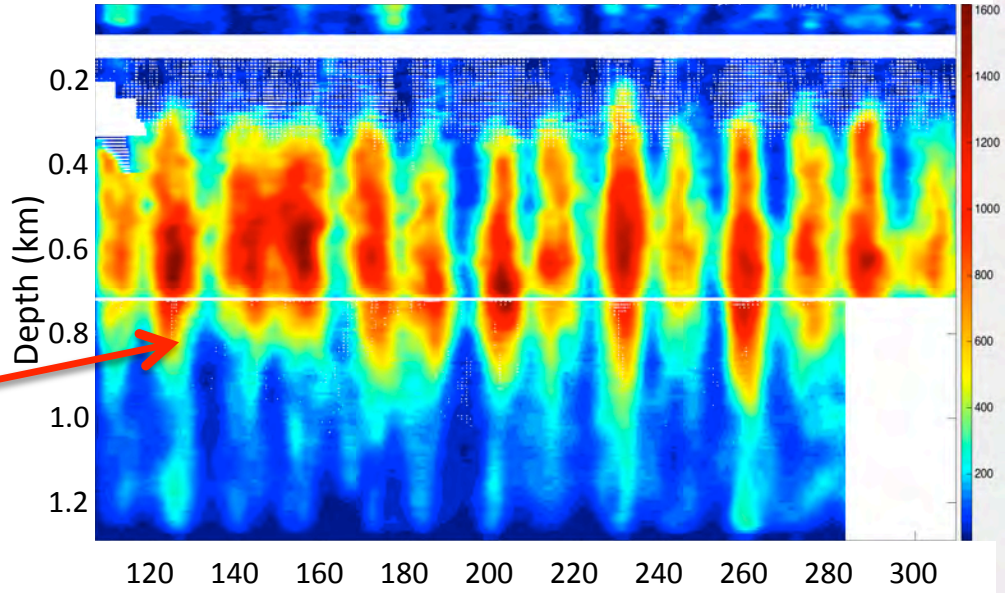
- long-range auv navigation; acoustic thermometry
- Basin scale RAFOS + ATOC
- Test bed for JTF SMART cable concept (trans-ocean bottom sensors)

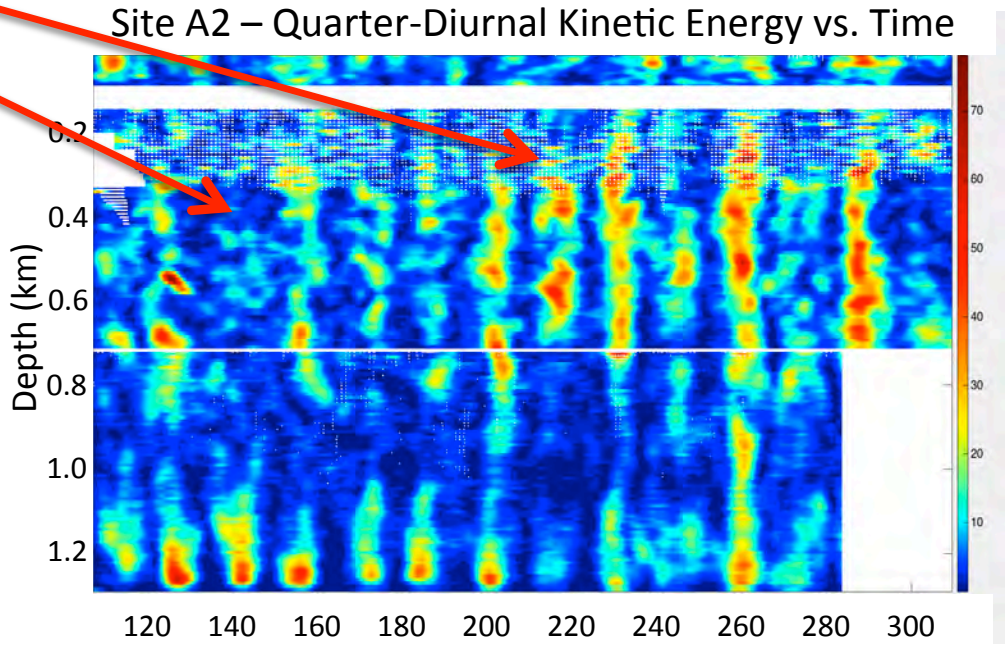
Luther
OOI Wrkshp
9/'16



Whither tidal energy?

- Into internal tides? …yes; like this beam
- Then what? … higher harmonics forced? …
  - like quarter-diurnal internal tides?
    - ✧ sometimes yes
    - ✧ sometimes not so much
- **Processes** are changing with time … why?
  - and, on longer timescales, too?
- This HOME dataset is inadequate.
  - Too Few T-S observations.
  - Too short – just 6 months here.
  - Imagine 6 yrs of profiler data!
- **Can't wait for QC'ed RCO profiler data!!!**





Ocean Engineering

- Improvements of existing hardware
- Design and deployment of new & unique instruments
- Extending the network
- AUVs, sensor networks, etc.

Computer Science/ Computer Vision

- Video analytics (esp. CamHD and CamDS)
- High-throughput / cloud computing
- "Big Data" analysis, visualization

- Roles, responsibilities and boundaries between OOI(CI) and users

Aaron Marburg
Applied Physics Laboratory, University of Washington
amarburg@apl.washington.edu

Craig McNeil at APL/UW

also VP of Pro-Oceanus Systems, Inc. (NS, Canada)

Interests: **Upper ocean process studies**

- air-sea CO_2 fluxes (wind, wave, bubble N_2/O_2)
- net ecosystem metabolism (O_2/CO_2)
- blooms (HABs, C_{org} flux)
- eddies, squirts, jets (impact on biogeochem)
- river plumes and sediment transport
- Langmuir circulation

Tools: **Sensors and Platforms**

- dissolved gas sensors (CO_2, N_2, O_2)
- 2 x REMUS 100 AUVs (Columbia River)
- Argo and MLF floats (hurricanes, OMZs)
- moorings (Arctic, OWS Papa)

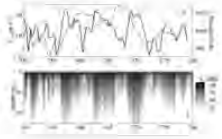
QC of data: CO_2 and N_2 (PSI)
O_2 (Aanderaa and SBE)

Interest in OOI - examples

Study 1: **Gas flux parameterization**
(waves?, fetch?, mixing?, surfactants?, OA?)

Data: CO_2, N_2, O_2 – time series and depth profiles
bubbles and LC – echosounders
winds and waves – buoys

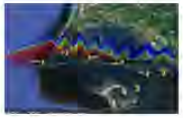
Assets: e.g, CE09OSSM, GP02HYPM



Study 2: **Shelf BioGeoChem, and River-to-Ocean transport**
(suspended sediments, nutrients)

Data: fluxes and budgets, eddy/plume tracking, marine optics, integration with remote sensing products and models

Assets: e.g., CE07SHSP, CE01ISSP, CE05MOAS-GL CE02SHSM

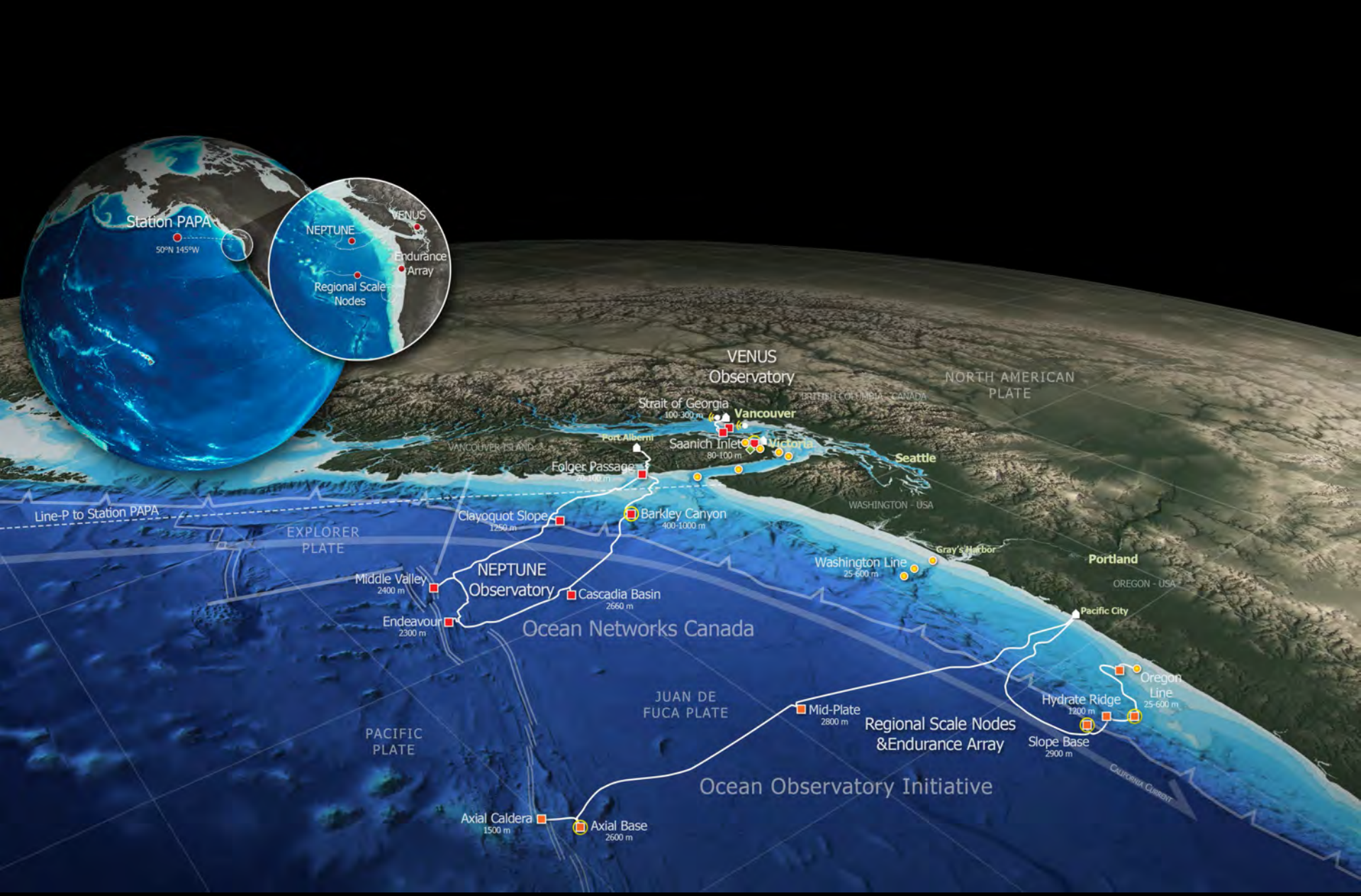


Cabled Array Operations
+
New Instrumentation

Eric McRae

Applied Physics Laboratory

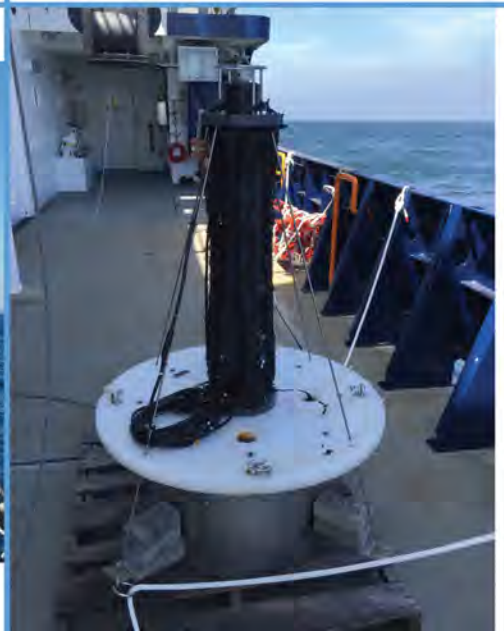
University of Washington



Steve Mihaly & Martin Scherwath

Clare Reimers
College of Earth, Ocean & Atmospheric Sciences
Oregon State University

PROJECT	Benthic Biogeochemical Exchange Dynamics on the Oregon Shelf	Sensors Powered by Benthic Microbial Fuel Cells Relaying Data to Autonomous Underwater Gateways
OOI SITES	Oregon Endurance Line *Shelf and Inshore Sites* (*25 and 80 m*)	Oregon Endurance Cabled Observatory *Slope Site (580 m)*
RESEARCH FOCUS	Eddy covariance; Seasonality of benthic O_2 & org-C fluxes; Shelf remineralization vs. export	Long-term observations of OMZ; Energy harvesting technology; Acoustic comms.

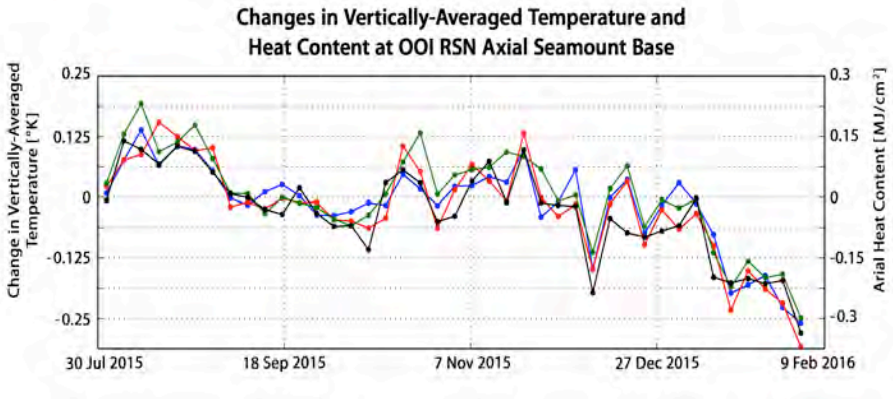


Tom Sanford APL-UW: HPIES on RSN
Horizontal Electric Field, Pressure and IES

What is HPIES?

H: Horizontal Electric field (HEF)
P: Bottom Pressure (BP)
IES: Inverted Echo Sounder (TT)

Changes in Ocean Heat Content As Observed with IES



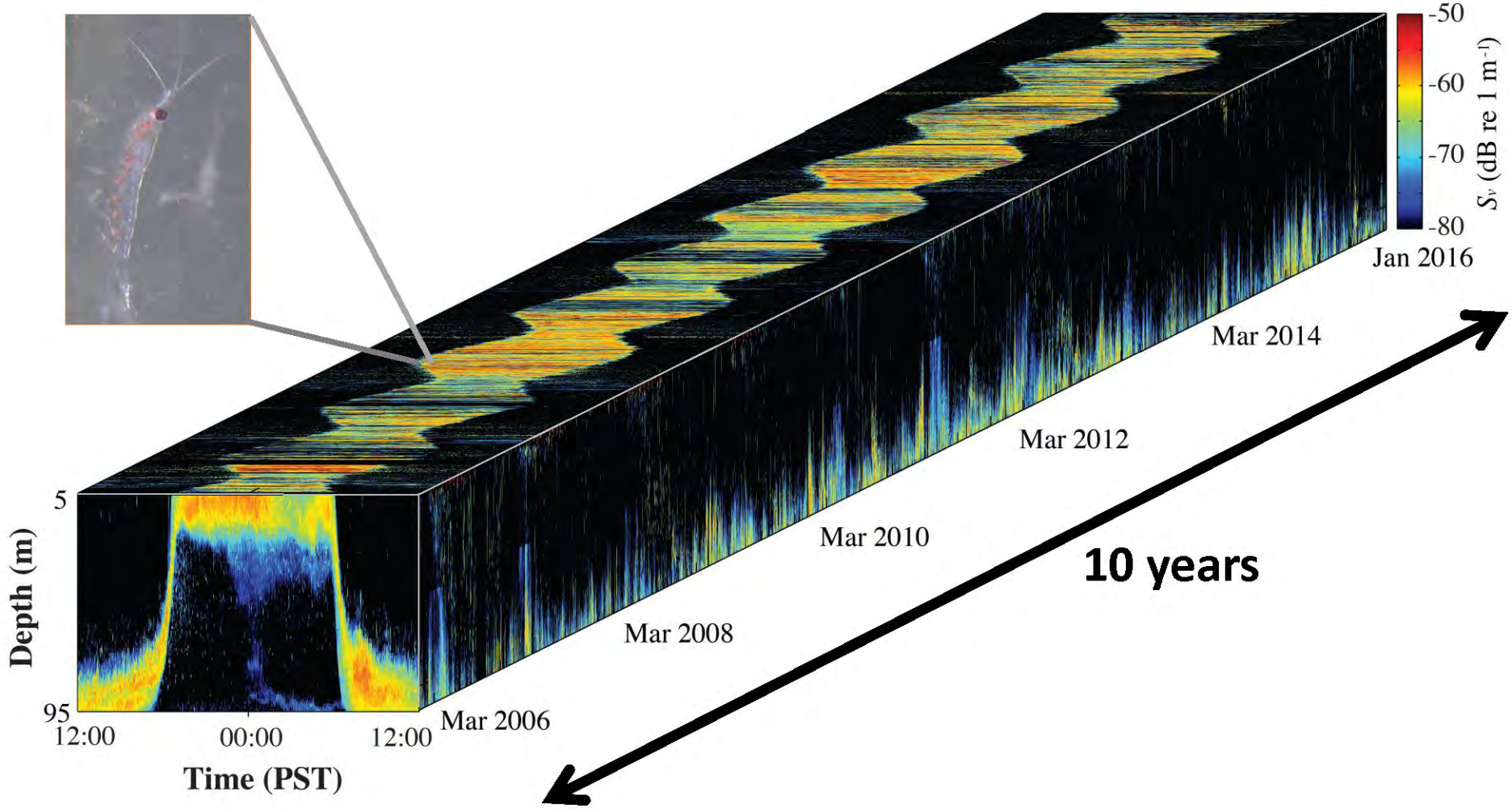
Scientific & Technological Objectives

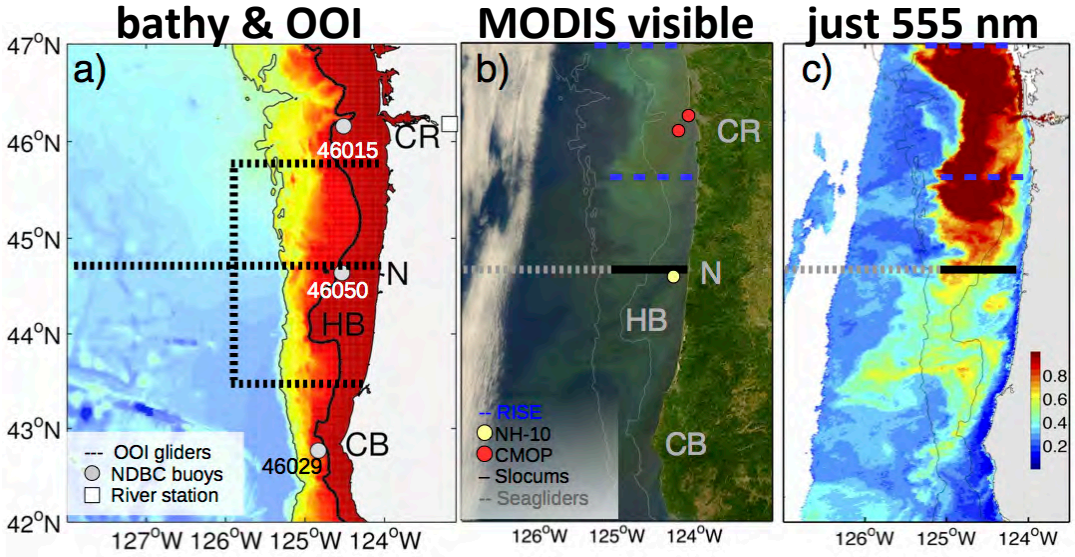
Using long-duration HPIES data alone or in combination with profiler data, we can ...

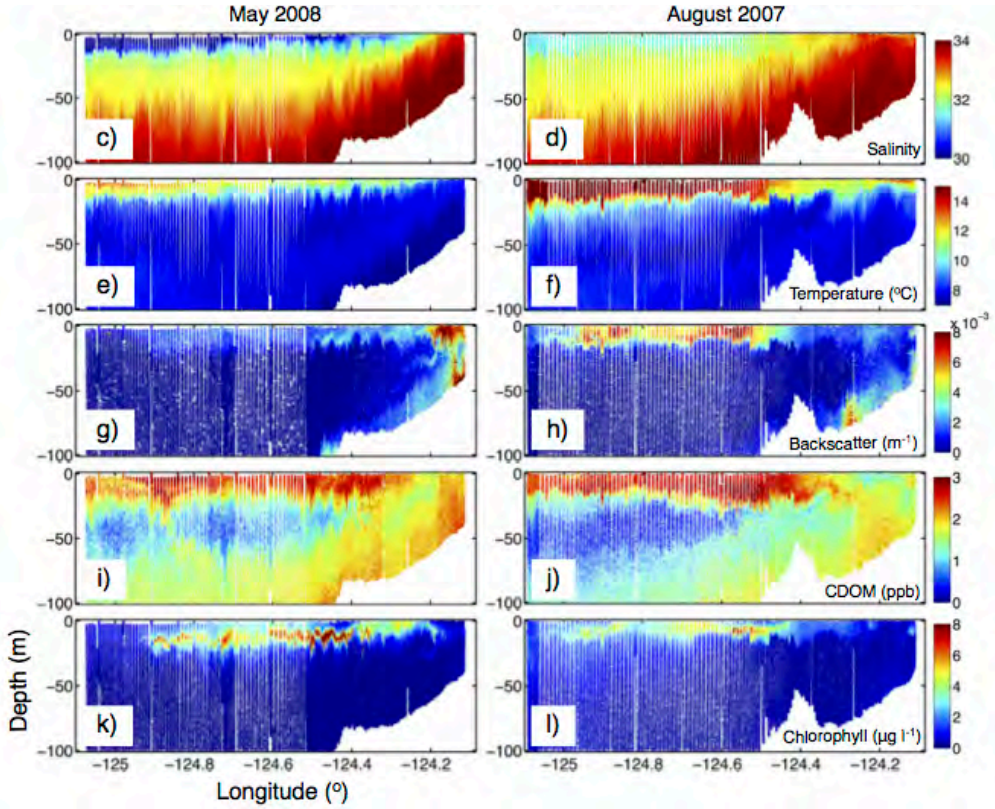
1. Create indices of climate change in the NE Pacific, all with high temporal resolution, such as:
   - Total water column heat content.
   - Heat content in various depth or mass classes.
     - Think: “Blob” structure, or PNIW character
   - Steric height versus mass change contributors to sea level variability.
   - Total volume, heat and freshwater transports, as well as transports in depth/density classes.
   - Many of these indices could also be established w/ profiler data at other OOI sites, providing contrast.
2. Explore phenomena that dominate sub-inertial deep ocean variability, such as atmospherically-forced
   - barotropic topographic waves, and
   - baroclinic mesoscale variability.
3. Observe electrical effects associated with seismic and venting events at Axial Seamount Base
4. Support expansion of HPIES on RSN and other submarine cables.
5. Detection of vent eddies & tsunamis w/ H, P & IES.

How does Upwelling Alter Animal Behavior?

Mei Sato (Oregon State University)







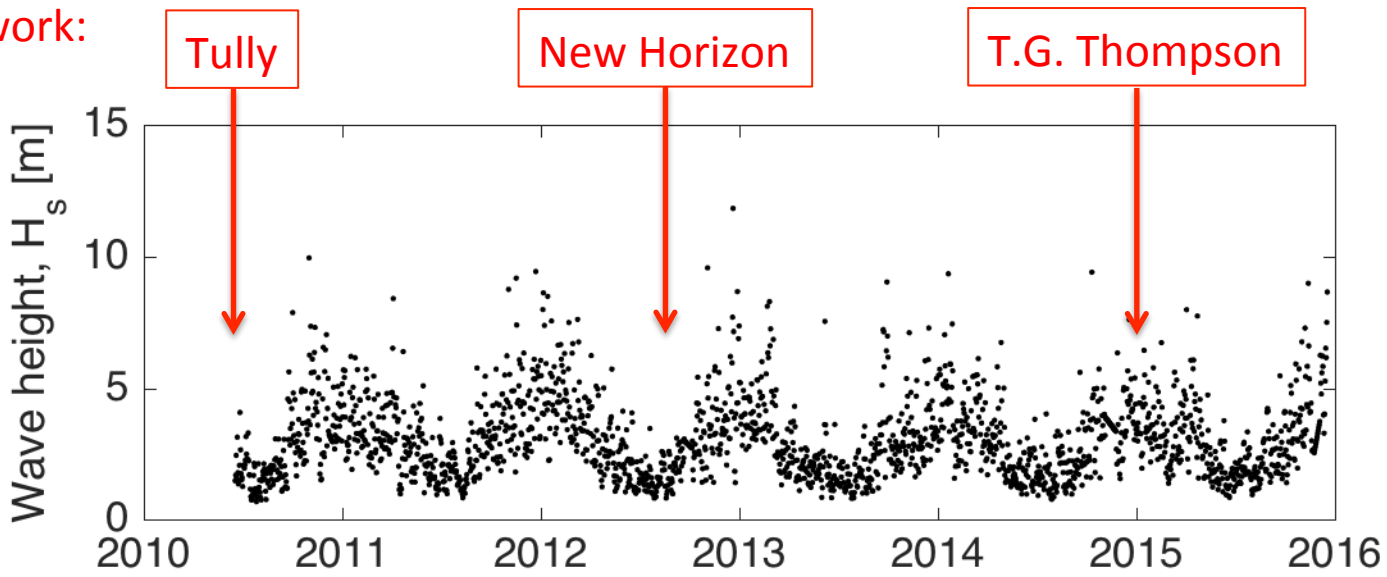
Fate of the Columbia River Plume

Kipp Shearman
Gonzalo Saldías
Oregon State University

- using a combination of satellite imagery and glider-based observations
- construct a satellite-based algorithm of Surface Salinity
- quantify the cross-shelf transport of freshwater
- use the OOI glider-lines to bound a volume for calculating salt budgets
- extend to other properties such as DOC

Surface waves at Station Papa

Mooring work:



Goals:

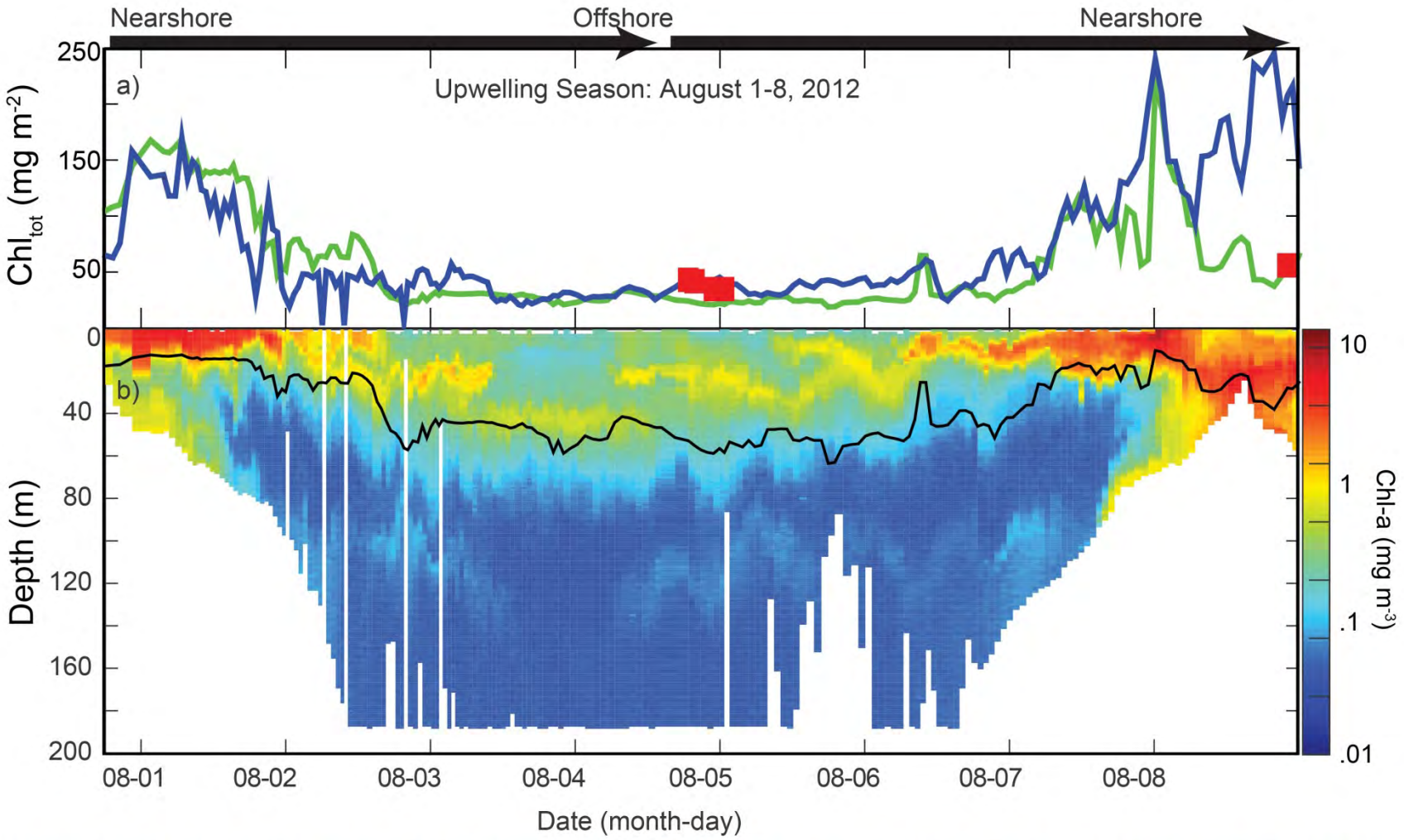
1. Understanding surface wave effects on upper ocean mixing
2. Continue long time series measurements at Station P (CDIP 166 / NBDC 46246)

Jim Thomson <jthomson@apl.uw.edu>

Phytoplankton Phenology and Productivity via

Coastal Endurance + gliders+ remote sensing

(A. White, Oregon State University)



Green – $\int CHL_{EUPHOTIC}$ based on surface chl (as satellites do)

Blue – quenching corrected $\int CHL_{EUPHOTIC}$ from glider

Red – MODIS

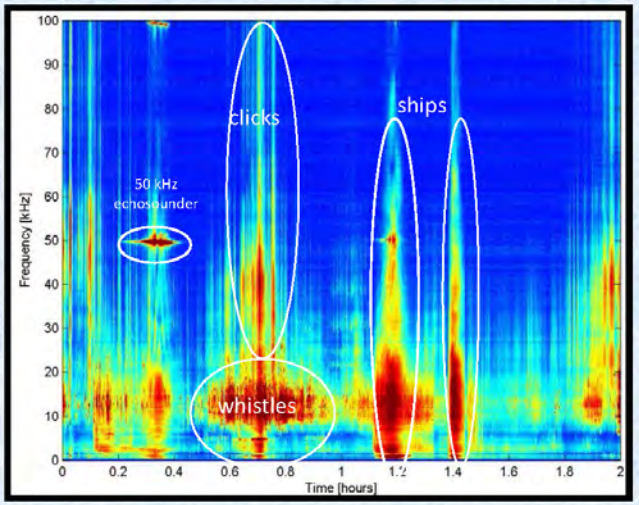
Sean Wiggins
Scripps Institution of Oceanography

UNOLS OOI Community Workshop:
Cabled, Endurance, and Station Papa
September 27-29, 2016

Research Ideas

A. Hydrophone Data Analysis Tool

- 6x icListen hydrophones (LF/HF) – Axial, Slope, Endurance Shelf/Offshore
- Sounds – marine mammals, ships, fish, weather, earthquakes
- Problem - download long duration large data sets impractical
  - e.g. 16-bit @ 200 kS/sec ~ 1 TB/month
- Solution – server-based remote analysis via Triton (MATLAB)
  - Analyst data evaluation and event logging
  - Automated detectors and classifiers
  - Detections and events saved to online database – Tethys
  - Download data subset for additional analysis

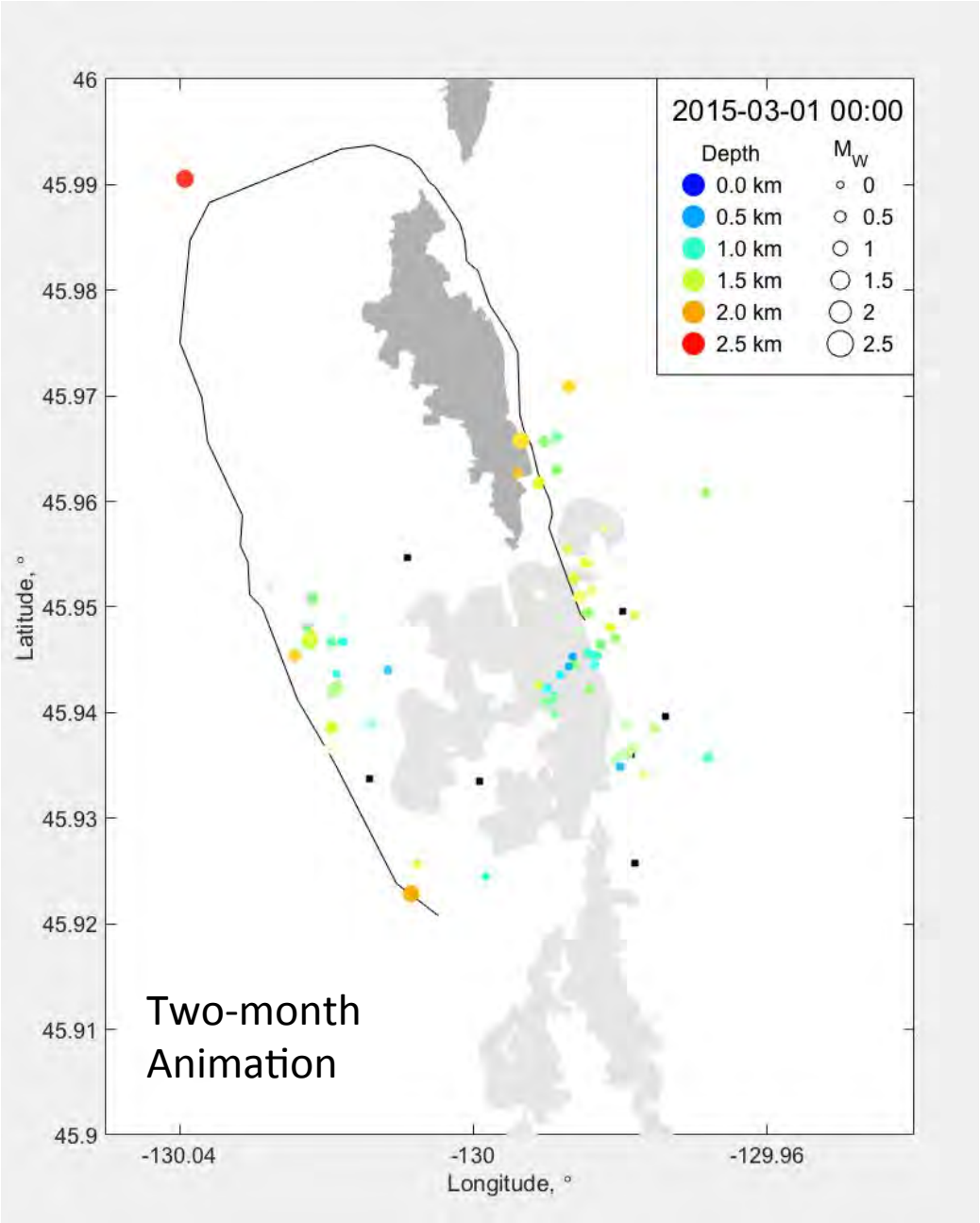


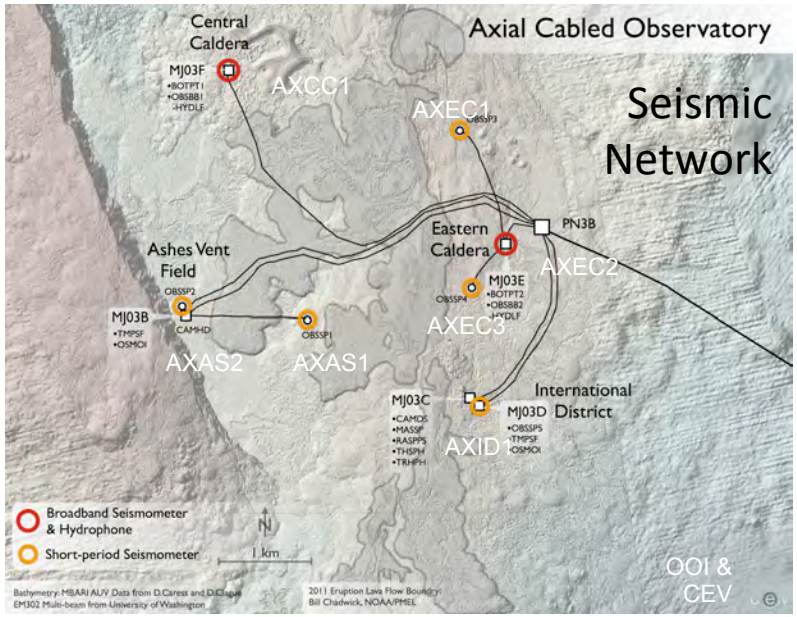
Triton software – Select Events/Files of Interest
http://cetus.ucsd.edu/technologies_Software.html

B. Methane Seep Monitoring

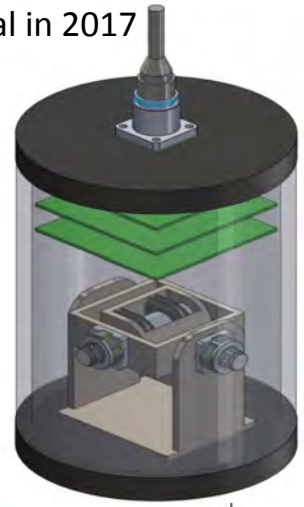
- Methane important greenhouse gas
- Southern Hydrate Ridge (SHR) OOI node near methane seeps
- Problem - Temporal and spatial variability of seafloor methane seep emissions poorly understood
- Solution - Continuous monitoring of seep emissions lead to better flux estimations
  - Use passive acoustic arrays to localize and characterize bubble sounds from vents
  - Use active acoustics (multibeam echosounders) to map seep water column plumes

Seismicity of Axial Seamount – William Wilcock





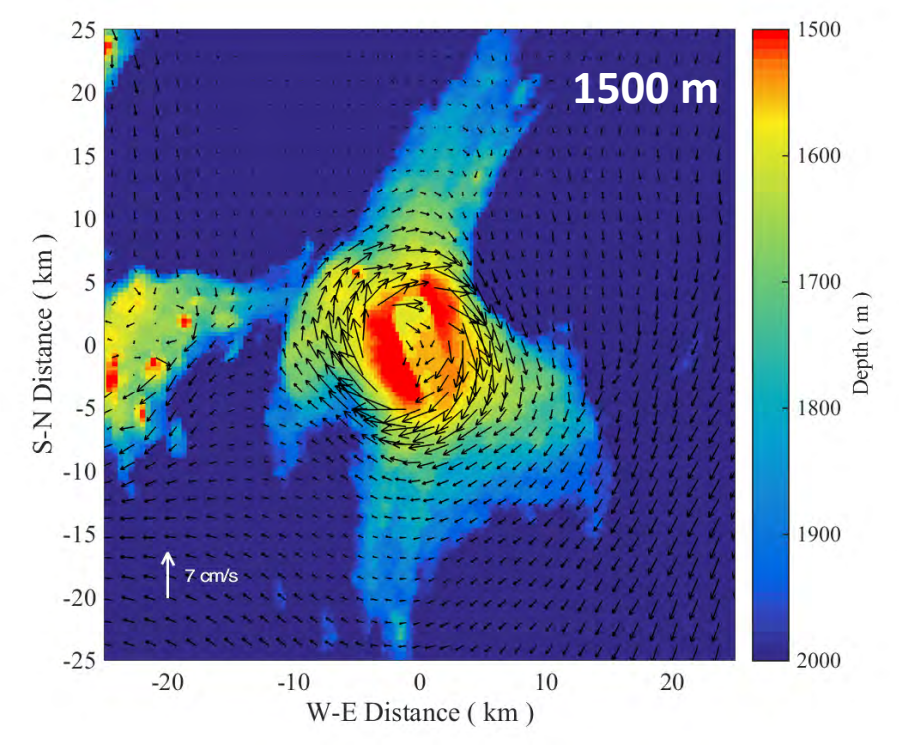
Flipping Tiltmeter coming to the OOI at Axial in 2017

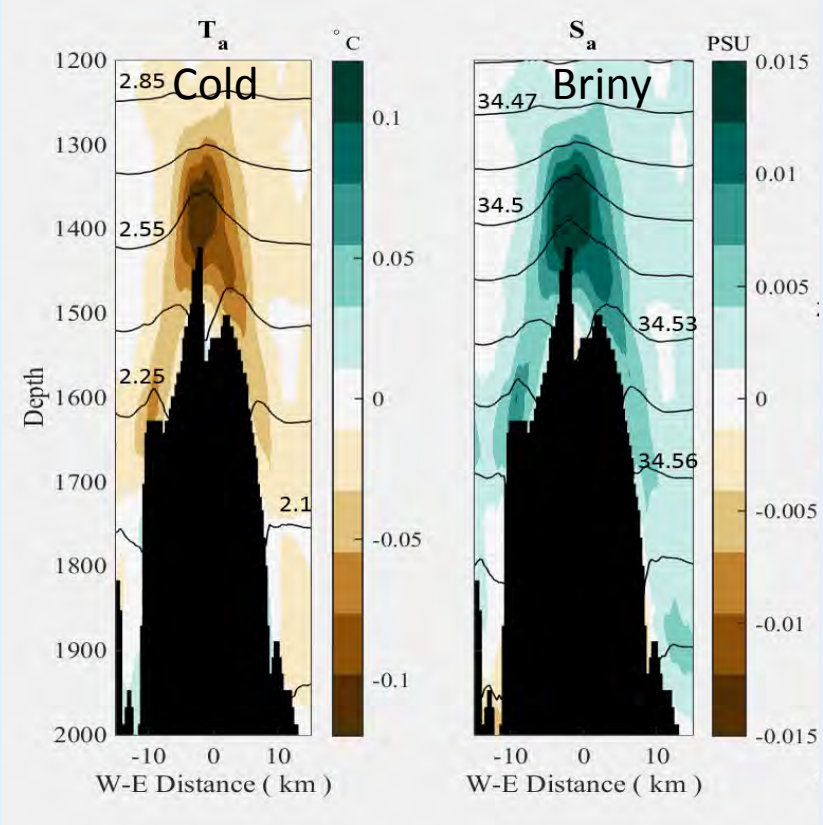


Daily Histogram

Numerical Study of Circulation, Hydrography, and Transport at Axial

Guangyu Xu, Postdoc Scholar, WHOI





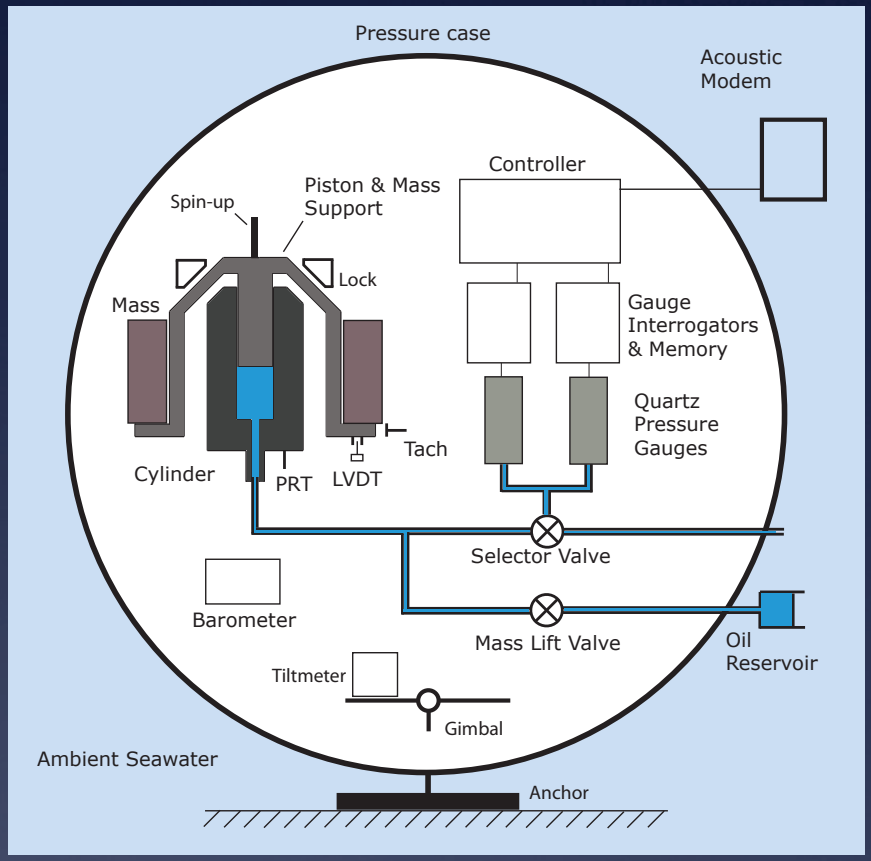
Physical oceanographic framework for Cabled Array data.

Using Cabled Array data (3-D single point current meter, ADCP) to constrain model.

Self Calibrating Pressure Recorder

Mark Zumberge and Glenn Sasagawa

- Because ambient seawater pressure is a proxy for depth, quartz pressure gauges are useful for **geodesy**
- However, pressure gauges **drift** at a rate of several cm per year: faster than many geodetic signals
- We have built a bottom pressure recorder which **calibrates itself** *in situ*
- We have proposed to attach it to the OOI cable on Axial Seamount



Automatically controlled valves inside the system periodically switch the quartz pressure gauges between seawater pressure and a calibration pressure derived from a piston gauge calibrator


UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM
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