Breakout session by Technical Systems – Seafloor

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Goal of Session – Focus on the technical assets and how they will help you answer critical questions.
Task for Session - List research topics/themes relevant to these technical systems that OOI and other observing assets can facilitate that you could not do before. What technologies are needed for the future?

We focused on Axial Seamount and to a lesser extent Hydrate Ridge – Research topics/themes covered yesterday so we chose not to duplicate.

Need more nodes (original science plan) – cable around caldera
- Geodesy – need more observations to constrain models
- Bigger seismic network to cover the north caldera
  - Combine with hydroacoustic monitoring using OOI and ONC data

Expand to hydrothermal field on base – Dependable vent field – 60 m chimneys

Water column
- HPIES
- Hydrothermal mooring
  - similar to shallow mooring
  - deep profiler not as reliable
  - thermistor strings
  - Endeavour style mooring
- AUV – spatial map of caldera and water column, megaplumes

More chemical/physical sensors in hydrothermal systems.
- Suite of 5 instruments (all working) in International District – replicate for reliability
- Expand to other fields

Drilling – discussed yesterday but potentially important

Crawler at Ashes for temperature, chemistry and video (like Wally)

COVIS – black smoker fluid flow and diffuse flow temperature fluctuations over 10 x 80 m area

Temperature
- More high-T probes so not dependent on 1 that broke
- More low-T temperature sensors – daisy chain or optical communications to limit use of ports

Fiber optic distributed temperature sensor – 20 km of fiber with temperature every 10 m – 0.1°C resolution – 200°C max

Adaptive sampling, PI controlled sampling – write proposals for specific activities

Better models of subsurface hydrothermal flow and chemistry

Hydrate Ridge

Hydrate ridge – currently 2 flow meters, photo mosaics, osmo-sampler and mass spec. Need to think creatively how to improve estimates of heat and chemical fluxes.

AUV identified at early meetingy as highest priority at hydrate ridge
- mow the lawn water column surveys at different levels
- fluxes
- photomosaic centimeter deformation
- 3-D time series of seafloor

Hydrophone array to localize vents (methane bubbles) over hydrate ridge.

75 kHz ADCP – need to expand such measurements

Both

More hydrophones to track marine mammals
- large (km) and small (10's m) aperture array
- Co-locate camera for nearby animals

Diffuse flux from camera observations.

Photogrammetry
- Sub centimeter resolution virtual model of hydrothermal vents over time from video from ROV or crawler if you know where it is – Combine with water column from COVIS
- Structured light system – camera with two lasers – 1 mm resolution

Technical Systems: Water Column and Gliders
List research topics/themes relevant to these technical systems that OOI and other observing assets can facilitate that you could not do before. What technologies are needed for the future?

Main Research Topics/Themes:
Mixing in the coastal systems and deep-ocean; implications for energy flow and nutrient fluxes; the importance of episodic events and winter conditions (unmeasured!)

- Episodic events; profilers (getting to near surface is important even (particularly) during storms)
- Intense productivity events; profilers
- Microstructure measurements; high frequency dopplers; turbulent fluxes of nutrients, momentum
- Mixing and surface waves; sediment transport; surface wave measurements?
- Large scale high frequency circulation form HPIES and bottom pressure; data assimilative models; OSSEs extend reach into north pacific
- Energy flow through the ocean; how is the deep ocean mixed? Episodic mixing events in the deep ocean; deep profilers on the slope and the axial ridge; for the future we need a fast profiler; more battery life
- Barotropic flows; space and time scales; deep profiler, hpies, bottom pressure, and E/M transport
- Winter conditions in coastal ocean; transitions, productivity and export; 25 m mooring and full cross shelf array; needs 150 m

Structure: mesoscale, submesoscale and finescale; open ocean and coastal; implications for productivity, transport on these scales and ultimately the fate of organic material

- Resolving the mesoscale and submesoscale structures, from gliders and flanking moorings; build a climatology of this
- Thin layers Cabled array shallow profilers; timing to all profile in synch
- Small scale behavior of animals; hard to get resolution that matches physical measurements; glider ADCP backscatter and bio-acoustics on the moored
- Vertical structure in coastal settings for hypoxia and strat; endurance array; inshore offshore differences
- Measuring/modeling currents and waves, nearshore within 50 m depth; for use by fishermen
- Respiration; carbon export; cross-shelf arrays; **turbulence**; gliders

Go deeper, get beyond biooptical biomass; get community structure and productivity rates

- Move beyond optical measurements for plankton biomass and get rates; habs
- More zooplankton sampling; cameras on profiler; distribution and community structure; identify what's out there
- HABs; sediments
- Particle sizes/distribution and export LISST

Other:

- Swarms of broadband satellites in low earth orbit my offer opportunities for comms and cloud computing

- Real time control systems for assets to do adaptive sampling; profilers

Key Systems/Tech:
Profilers; Gliders; full coastal arrays (with everything working

What systems aren't working?

Cabled
Deep profilers are not currently working, redeploy next year a spare set

Papa (Global)
Gliders are having failures (too many). Turn around times for glider repair are 6-9 months (too long)

Surface piercing profiler was removed

Endurance
Cabled Surface piercing profiler was replaced with an uncabled CSPP

Gliders are having same problems as global, only average two deployed at a time…

Surface Measurements:

List Research relevant to Surface measurements that OOI and other observing assets can facilitate that you could not do before.

- This was a very small group. A very interesting part of working with surface obs is the water column response. So separating surface and subsurface/"water column" breaks up communities. *Small group, but Big Thoughts!*
- Merging satellite and OOI data will be able to see global scale forcing and full ocean response. Problem: Cloudy regions leads to many gaps in satellite data.
- Gas exchange and air-sea fluxes allow studies of air-sea interaction and carbon cycle studies. OOI and NOAA are providing **sustained longterm obs** important since seasonal cycle and synoptic events relate and interannual variable large (blob). Can capture extreme events.
- Dust events, volcano eruptions, etc.. Lead to **episodic event** that may affect longterm conditions.

Research continued

- Airsea fluxes are calculated at all met stations in OOI. Newer algorithms may have some new state variables such as waves. **Need to compare and contrast fluxes between coastal and open ocean, fetch limited and large swell regions, upwelling and downwelling regions,…** These fluxes can accumulate in water column, and affect fluxes at later times.

- Coastal upwelling brings high nutrient, high pCO2 and low O2 waters to the surface which directly affects air-sea fluxes, and impacts various trophic levels (pH affects larvae, O2 affects fish etc.). The mechanisms of transport are poorly understood, as are efficiencies of cross-shelf transport. **How will this change in the future?**

What technologies are needed for future?

- **Need Underway Shipboard** thermosalinograph and underway CO2+BGC, ADCP from OOI maintenance cruises, Line P, and regular NOAA cruises.
- **WA coastal radar (CODAR)** is a gap. Every other region in US and Canada has them, but not WA.
- **Direct measurement of fluxes** are needed. At this point only 'OR Shelf buoy' has direct fluxes. Would like direct fluxes at Station P.
- Problem: Mixed layer observed with surface mooring, but only at discrete depths and only physical obs, not BGC. Argo turns off at 10m. Only Endourance has surface piercing profiles (measure CTD, DO, velocity, nitrate, UV spectral irradiance, …). Profiling gliders at Papa turn probably before surface (5-10m) and only pierce surface when make call. In wintertime this is well within the mixed layer, though won't be able to resolve diel cycle.
- **Need more detailed measurements of ocean surface boundary layer** (dissipation from ADV or microstructure probes, bubbles from acoustic or optical obs, dissolved N2, better mixed layer representation, …

What technologies are needed for future? Cont…

- Would be nice to think of network of Environmental Sampling Processor (such as being developed by MBARI).
- Would be great to have **Autonomous in situ water sampling and imaging:** HABS, iron, nutrients, fish larvae, zooplankton? Could this be done by an AUV (waveglider, drone, saildrone, …)?