Day 1 – WAML mtg and OA guests

-NRC investment report identifies FSMLs as some of the best investments.
-Coastal Acid. – WAML is poised for networking and cost sharing opportunities
-Connected chemical and biological measurements are lacking currently. (W. Coast hypoxia report, forthcoming)
-Seeking NSF funding, and perhaps NOAA OA as targets for proposal

Steve Weisberg
Challenges/costs – instrumentation, training, compatible data, commonality of purpose: must be science questions that require a network
Need to agree on:
- where,
- how to measure,
- how to couple bio and chem,
- How will this fit into other OA programs (IOOS, LTER, national reserve system) – enough value added and commonality with them to be useful, while not duplicating them.

OA is just one example through which to build a WAML network. WAML can be building networks around other topics as well in the future. (i.e. genomic observatories). This OA network is being watch by NAML as a potential example.

Jan Newton
Global to local scales – GOA-ON and IOOS
Global processes affect local systems differently. On top of local stressor inputs = variability higher in coastal waters, and extreme in estuaries.
Jiang L&O 2010, OA differences west vs east coast – what you learn elsewhere is not applicable at home.
- Widgits (infrastructure and sensors)
- Technical know how, human knowledge transfer
- Information access, data products and models
Coordination: Need to integrate widgits to feed local, regional, national and global scale models, and then analysis, then direct info to the public and decision-makers

-GOA-ON- document status of global OA and progress, impacts and ecosystem response, and model and forecast impacts going forward (download plan)
-met to discuss rationale, goals, design, measurements, data quality, etc
-data quality objectives = need both climate data (long term) and weather data (short term) from the program (SEE GUIDE)
-GOA-ON could adopt WAML guidances (also could welcome more partners?)

-IOOS is ‘end to end’ – widgits, data mgmt, modeling/analysis, products and services
-national integrated = national and non-national (private), 11 regional assns. which engage with local stakeholders
-IOOS Pac Region OA, see website

**power of the potential WAML network is the link to biological monitoring of impacts and experimentation.** This could be part of the network (i.e. pteropod sampling across sites, and processing at one location)

**see OST impact wheel for OA**

**see C-CAN sensor how to references guides as well**

WAML would be shore-based stations, rather than offshore... this is where the chemistry and the biology can marry. Shore based biology (i.e. shellfish, etc) at the marine labs and experimentation (and students, and ed $$) could complement the chemistry offshore with more in-depth analyses by putting WAML together with other networks and transects.

Burke Hales

OA is state-variable (T,S,P) and buffering dependent (ex. Med vs Arctic)

Measurable parameters for carbonate chemistry (Alk, Tco2, Pco2, pH) – use two

=conservative (alk, Tco2) and amplified (Pco2, pH)

=alk is mostly salinity determined regionally. Estimates via Pco2 not advised.

=BEST combo is one conservative and one amplified (*alk and pH) to constrain the carbonate chemistry

Must know uncertainty – can still be valuable to generate low quality data if known

Data quality levels:

Weather data: data to assess sensitivity for experiments, or look at local natural seasonal-tidal timescales. Likely attainable by most labs

Climate data: more sensitive, data good enough to resolve background shifts due to rising CO2 or climate change. Omega must be known to <0.02.

If you can do one of the amplified parameters (pCO2) well, alk is forgiving.

Live seawater! Unfiltered (sieved is fine), unstored, unpreserved – unmodified and fresh from the environment.

Frequency – must compensate for diel, tidal, etc.

– 3x tidal frequency ? (every 2 hours in OR/WA)

– diel signal decays as you move offshore

where to sample? – go to the marine labs first, oyster hatcheries and other willing players second

*Minimal – send samples to a reference lab (25-200 per analysis set)

*Less minimal – get good temp and salinity. Try to get good pH and build an alkalinity relationship using historical data (or alk titration system – doesn’t have to be that good)

*Best- get live water and good continuous temp and salinity. Get continuous Pco2, Tco2. Run CRMs. maintain a mooring with temp/sal sensors add Pco2, pH. Maintain a validation program (sample & ship, or sample & analyze & CRMs)
-buffers for seawater pH (salinity dependent scale)
cross-calibration exercises are good (send samples to other analyses/WAML sites)

Biological monitoring:
Should WAML agree on large-scale monitoring goals? Or let programs act locally on site-specific species of concern?
-Could you do it with a homogenous dataset on common species? Widely distributed populations – couple with connectivity up and downstream. Or instead look for signals in external forcing agents with different species (ex. PISCO tuffy sampling?)
... monitor parameters like settlement, timing, physiological change.
-WAML could develop studies where natural variability meets adaptive capacity.
-draw line between biological monitoring and experimentation?

Training:
-best practices guide online (Dickson training camps)
-marine labs maybe not as well suited? Dickson = discrete sample focus with ultra-high precision.
-facility/academia partnerships are helpful, esp when in proximity
-tried to establish ‘blue-ribbon’ facilities where regular camps could be held.

WAML – Individual States of OA Affairs
Cal Poly (Center for Coastal Studies) – no OA monitoring system, but highly likely to participate in WAML effort. =
- monitoring water quality w/ 2 obs staff with SCCOOS and CenCOOS, 5yrs
- industry partners (Cayucos and Morro Bay)
- weekly phytoplankton sampling HAB monitoring, monthly invert 4yrs
- recruitment, seasonal groundfish monitoring with fisheries, 10 yrs
- tomanek, oysters and OA proteomics/porcelain crabs and multi-stress
- ryan walter, physical drivers of OA oceanographics

Guam Marine Lab – not doing OA yet.
- chemical analyses of water quality
- physical oceanographic data on reefs
- profilers at sites around island, and new instruments pending (NOAA)
- community monitoring coral reefs (corals, algae, invert, fish), divsty/abun
- OA: tom schils studys imapcts on algal communities
- Richard randall’s collection of 30,000cotal = time series on calcification
- talking to Mote lab about interoceanic basin study OA on corals

Friday Harbor – OA monitoring funded but not enacted yet
- temp/salinity monitoring by Emily Carrington
- 80 ft cline: below that, water stays constant.
- Want to start shallow (30ft w/ flow cytometer to record plankton continuously) and deep monitoring programs (90ft that will include pH)
- planning to write grants to get expertise to handle the above data
- working with Smithsonian Inst. – want to do genomics/bio with chem
- mesocosms??

Hopkins Marine Lab – OA: 2 durafets in running seawater tanks
- alkalinity titrator, weekly
- water intake is going through the Monterey Aquarium’s sand filter
- continuous, uploaded onto the web
- lab can measure DIC, etc = not at high standards yet, but okay
- kelp forest array in the water?
- Other monitoring: long term intertidal/fish (PISCO), kelp, quadrats of shore, invasive monitoring
- OA: upwelling/O2/temp research on biology – grazing rates, physiology

Day 2 – WAML mtg (OA portion)

Bodega Marine Lab – LOTS of OA work
- OA mooring 1km offshore (curent, temp/sal, pH pCO2) – since 2009, website ocean obs. Node
- Seafet sensor in reserve intertidal, in place several years
- Bottle samples with both deployments to groundtruth each, datasets online (collected 1/week). Also bottle sample at the shore intake
- Tessa hill has burkeolater at hog island oyster co (online)
- Seafet and seafox at intake for oyster farm.
- Full time OA tech ($ OA research group) – 95% of time is processing the bottle samples. Spectrophotometric methods for analysis (weather quality) and titrators for alk (Dickson reference materials)
- Are intakes relative to offshore? BML can provide study
- Tomales bay intake – temp/sal are comparable to offshore, pH unkown
- Biological monitoring – SWAT team biodiversity survey (Raimondi)
- CA area of special biological sig (some studies)
- UC reserve tracks shorebirds, mammals, etc
- Brian/Tessa – lots of OA research inverts, collab with F&W (white abalone) to look at OA and hypocia on abalone dev. and genomics = pop level effects, hidden impacts, predator/prey and species interactions
- Hog island - sensors since 2012, temp/sal/pH/dissolved O2/CO2 (featured by mark bittman) – daily, seasonal, annual variability

Hawaii Lab – ‘Urban’ Lab
- NSF training program ATD in collab with Am Samoa and pac island community colleges = high broader impacts
- Active monitoring program across the pacific islands, incl water quality
- pH, dissolved O2 instrumentation available
- rob dunbar – ‘footlocker’ project for OA and genomics
- EPSCOR opportunities
- OA research – Maunalua Bay: genomics, transcriptomics, proteomics of corals growing at 7.8 pH (low), model shows no recruitment to bay, high residence time of water – locally adapted. (also Neko bay?)
- Mike Hatfield: recruitment – interest in pH and microbiome
- Buoy by NOAA/PMEL nearby with CO2 measurements

Humboldt Lab – no OA monitoring now
- area of special biological concern – Trinidad head
- SIO shore sampling program since 1970s
- CenCOOS data for Trinidad pier – lots of upwelling
- Trinidad line (PaCOOS Eric Yorkstead, NOAA fish) – 8yrs = biological and water quality samples
- MPA studies intertidal, PISCO, kelp forests, reef fishing, etc
- OA: Jeff Abell, chem oceanography (continental shelf and PaCOOS)
- Proposed to put a mooring buoy on Trinidad line (surface and bottom sensors)
- Eric Bjorkstedt (NOAA) with Scott Hamilton and Cheryl Logan – fisheries, hypoxia and pH, behavior, physiol and gene expression of temperate reef fish

Shannon Point – Erika McPhee
- experimental OA research: Brady Olsen lead PI = carbonate chemistry, phyto/zoo/microalgae
- air/sea gas exchange systems and control rooms
- eelgrass buffering and shallow conditions
- monitoring seawater intake – draw and store, not continuous sampling.
- Monthly CTD and water sampling with Ecology Dept
- Working to put mooring in Bellingham bay
- Talking to Deb Kelly (UW?) about cabled sensors for undergrad use, watching FHL to see how their moorings work first.

Moss Landing –
- 2 sensing systems: Monterey wharf with Monterey abalone company, and lab intake
- lab intake sits at deepwater intrusion site, so large water chem changes, includes pH durafet, DO temp/conductivity, turbidity, chlorophyll - online
- Monterey wharf: ysi, pH, conductivity, DO, chloro, turbidity, cyanobact. Planning to put CO2 sensors on as well
- Monitoring – pH for last 5 years, and seaweeds for 30 years
- 35 year record of rhodoliths in gulf of CA
- 40 year time series of inverts on shelf in Monterey Bay sub canyon
- OA: Scott Hamilton looking at seaweed physio, inverts, also rockfishes
- OA: Jason Smith, lab and field trials of sensors for pH

Tiburon Center – SF State
- CenCOOS pier sampling; ysi, weather station, pH T/S/DO – measures relatively deep water in bay
- Biological oceanography strength: phyto, food chains, genomics, living shoreline work
- NERR network measuring pH in estuary
- CO2 MAP buoy to be deployed this year
- Research vessel in the bay and estuary, potential asset
- Water quality analytical capacity
- Discrete sampling by labs since 2000: phyto, chlorophyll, nutrients
- Native oyster monitoring and restoration – recruitment, etc
- Eelgrass restoration and monitoring
- OA: stillman has CO2 system in lab, carpenter lab: phyto culture OA setup
- Wilkerdale lab measures DIC in estuary and wants to expand; cochlan lab has experimental multistressor lab set up.
- CenCOOS/NERR wants to add OA relevant sensors to stations – need $5

Gump Station (Moorea)
- lab has been in place since 1985
- deep seawater intake = live seawater
- cabled observatory – fiberoptic to hawaii. Hope to link to instruments cabled – currently French have wireless communication to sensors
- OA water quality monitoring via LTER – schitt and Holbrook (UCSB) and Edmands/Carpenter (CSUN)

OIMB
- raw seawater intake.
- Don’t do much monitoring, house full time NERR monitoring staff who do
- NERR stations in estuary, received water quality instruments - Sammi and a seafox from NOAA OA
- No oyster hatcheries associated, but doing native oyster restoration work
- No OA research, but do larval research
- 9 yrs light trap data on crap megalope, PISCO site nearby (cape arago?), and physical oceanography in estuary

MBARI – doing OA work
- funded by Packard foundation
- OA: experimentation (Jim Barry)
- OA instrumentation dev. – building small moorings off ano Nuevo
- Obs since 1987 (OA mid90s): (Station H3/M1) in Monterey Bay, monitoring patterns show seasonal spikes on CO2, and can link to biological changes as well (phyto community) – suggest communities have changed since mid-2000s. Have frozen samples for genomics 10yrs

Competition for 1-2 new LTER sites. Coastal marine
**All scientists meeting in CO next month.**
Mark Ohman
-CalCOFI shipboard measurements. Continuous underway pCO2 and pH measurements. (Proxy relationships based on these data, using temp and O2 – works best for sites below 15m without freshwater i.e. SoCal (Alin et al 2012)– can provide pH and omega) – CalCOFI lines run from SD up to Monterey
-Moorings – core of CA current CCE1, CCE2 pt. conception upwelling zone, Del Mar continental shelf mooring
-Spray gliders can use proxy relationship (since 2012)
-SIO pier = manual measurements of total alk and total DIC; automated measurements (SCCOOS); and dual plankton cameras.

Gretchen – SBC LTER
- land and ocean impacts on kelp forest
- OA: started with seafets 2013 at 3 LTER sites (arroyo quemado – CTD moored, Naples and Mohawk reefs)
- OA is very time intensive – note that for WAML network planning!
- Established Seafet program = pre deployment calibration, bottle samples, in house chemistry using Dickson SOPs
- New capacity – Tco2 = additional analyses
- Low pH can coincide with biological drivers (correspond with low temps in some places, high in others: san Miguel vis anacapa) – Lydia
- Emily/GH booklet on investments (GET THIS)
  o Time people money costs
  o Data management – they go to LTER database
  o Hidden costs, sensors go down and need fixing, need swappers
- Benefits/opportunities of WAML network
  o Data gap in nearshore ecosystems
  o Co-locating biology with sensors
  o Local partnerships (Agencies- parks/BOEM, industry, management)
  o Sustainability requires creative funding

George Waldbusser
- West Coast OA/Hypoxia science panel - Not monitoring program, just guidance
- See WA blue ribbon panel as well
- SOAMAN = oa monitoring network bi-coastal in 2011, for protecting shellfish hatcheries – rejected by USDA
- Biological monitoring with industry in places that have chemical monitoring in place (taylor shellfish, whiskey creek, etc) – be creative with biology (i.e. simple fluorescence industry can do to look at spat)

Marie Bundy
- National Estuarine Reserves (NERRS)– 28 around U.S., 5 on west coast
- Research/monitoring emphasis with state/fed partnership $
- Track: Abiotic (water quality & nutrients at 4 stations each, weather stations 1 per), biological (habitat, biodiversity), land use
- Big data! (swmprats.com = data discovery), and full datasets available at centralized data management (CDMO) portal. Biological data available at individual reserve sites?