EPE MARACOOS NEEDS ASSESSMENT WORKSHOP REPORT

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in Cooperation with

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1 Overview

The Mid Atlantic Regional Association Coastal Ocean Observing System (MARACOOS) sponsored a needs assessment workshop for scientists interested in teaching with data from the Integrated Ocean Observing System (IOOS). The meeting took place at Rutgers University's Institute of Marine & Coastal Sciences and involved four of the six PI MARACOOS scientists including Wendell Brown - University of Massachusetts, Carolyn Thoroughgood - University of Delaware, William Boicourt - University of Maryland, and Scott Glenn - Rutgers University. Janice McDonnell, Michael Mills, and Carrie Ferraro (Rutgers University) facilitated the meeting. Our objective was to develop model content that focuses on MARACOOS data products that could be used as assets to teach themes and concepts taught in an introduction to oceanography course (majors or non majors open for debate). This workshop was a "roll up your sleeves" hands on effort that resulted in draft lesson plans that can be refined and integrated with evolving EPE tools.

2 Workshop Schedule

The following agenda was developed for the needs assessment workshop.

July 30, 2012

10:00 am	Welcome and review goals and objective of workshop (Glenn)
10:30 am	Session 1: Determine concept(s) we want to explore. *Janice will lead a brainstorming activity helped triangulate a) broad themes and concepts we teach in oceanography 101, b) selection of a concept that is IOOS related/that data exists for that relates to oceanography 101, c) ideas for how IOOS data can improve understanding on topic of choice (explore where are student bottlenecks in learning and how IOOS data can help)*
11:30	Review progress
12:45 pm	Session 2: Review EPE data tools (Mills and McDonnell): *In this session we will review what EPE tools are being developed and apply what is relevant. Our objective is to sketch out tools/applications that will be critical to teach the topic/concept decided in Session 1.*
2:00 pm	Session 3: Develop Model Lesson(s). *Sketch out a storyboard that includes a) how will you engage the students in this topic (invitation and identification of the problem), b) exploration using IOOS data products and EPE tools, and c) making sense (how will be help students make meaning of the data – assistance with analysis and application of the data to the problem. Suggest working in teams of two to achieve this task.*
4:00 pm	Report out progress

July 31, 2012

9:00 am	Session 4: We will discuss the proposed OOI EPE Lesson Lab Builder template by reviewing the design sketches. We will solicit feedback on the design and implementation method using the *Plus/Delta Game.* Our goal is

to identify learning tool elements that need to be built into the tool. We will discuss learning theory in general (what does a good learning tool look like and how we incorporate visualization tools into learning). We will use a *Think Pair Share* – where participants will be encouraged to write down pluses and suggested changes on the worksheet – find another participant to share their ideas with – then share out as a team.

11:00 am Session 5: We will discuss how we will test and distribute our lesson(s) once they are completed. What is the extent of their distribution and use? How do we engage the undergraduate teaching community to collaborate and add lessons?

12:00 pm Lunch and wrap up - what are our next steps to complete what we have started here during this workshop.

3 Results

3.1 Sessions 1 and 3: Ocean Concepts

All of the participants teach undergraduates in a variety of contexts including non-major large classes. For example, Dr. Wendell Brown teaches 50 students in a college course for undergraduate oceanography majors while Dr. Scott Glenn teaches a majors and non-major combined course (50-75 students). The non-majors may take their course as their only science class. Each class may also have a mix from freshman to senior majors. There was discussion about developing lessons that are easily adaptable for more advanced courses.

Participants discussed two types of learning objectives for their courses including 1) basic skill building (e.g. learning metrics and how to draw contour lines); and 2) concept introduction (e.g. hurricanes and tsunamis).

The participants developed concept diagrams for three course topics for their classes. We used a brainstorming technique to develop collaborative concept diagrams of the content and skills needed to teach these topical themes. Below are the three theme outlines for undergraduate course development.

3.1.1 Example #1—Hurricanes

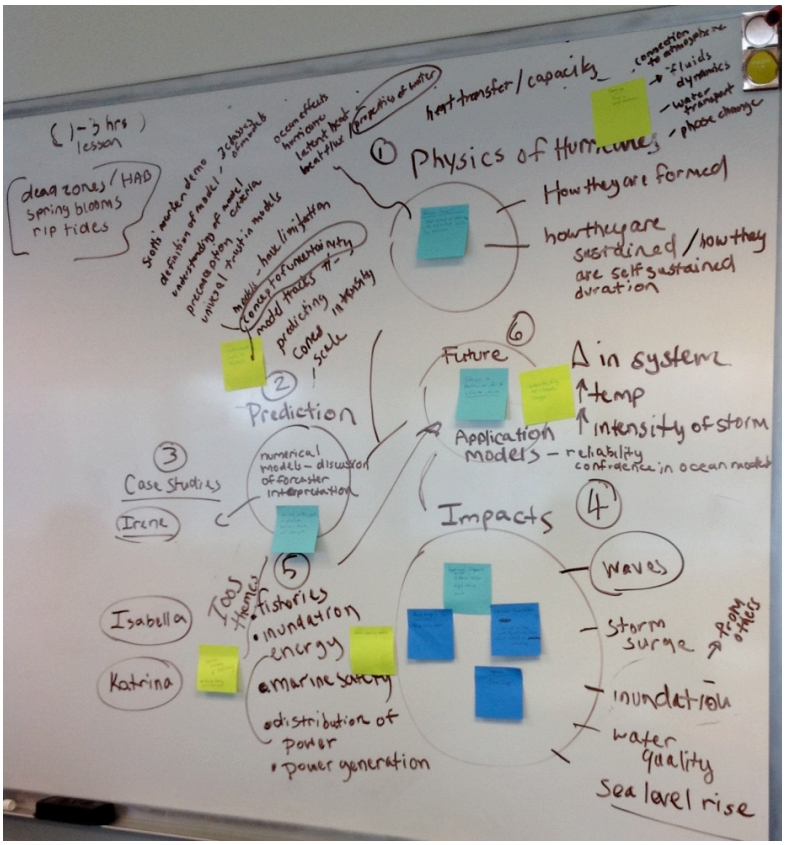
Reasons why a hurricane undergraduate lesson module would be useful:

- Great example of ocean/atmosphere interaction & models/uncertainty for building decision making skills in undergraduate students
- There are broad science concepts that relate to the hurricane theme
- MARACOOS data that applies to these themes

One of the participants' objectives was to identify the preconceptions that students have around hurricanes. The group estimated the lesson length would be 1 to 3 hours.

Hurricane concepts:

hurricane module for undergraduate.



1) Physics of hurricanes (how they are formed and sustained)

- How are they self-sustained, air/heat interaction (how the heat in the ocean sustains or does not sustain the hurricane)

- Included in this first phase of the lesson, this group would teach/cover heat capacity, heat transfer, and general properties of water.

2) Prediction (definition of models/ three classes of models), understanding of models, discussion of forecaster interpretation, intensity of storms, scale, probability or cone of landing, uncertainty, improvement of models over time.

3) Case studies of Isabella, Irene and Katrina to underscore the characteristics of hurricanes.

4) Impacts (storm surge, waves, water quality, inundation, sea level rise).

5) Preconceptions/Misconceptions students have about hurricane impacts include understanding fluid dynamics/wave movement, phase change, local vs. advective currents, marine safety & resiliency (decision-making and what to do), how the ocean affects the atmosphere, latent heat, properties of water, uncertainty/limits of models.

6) IOOS themes: fisheries, inundation, marine safety, distribution of power, power generation.

7) Future: relationship to changes in system like climate change, application of models.

Summary Hurricane Lesson Flow: Physics of the ocean, prediction, case studies, now you have the hurricane what are the impacts, how they impact the MARACOOS themes, future impacts and situations (climate change).

The format for the lesson module:

1. Lecture - physics, predicting cone intensity, case studies
2. Look at OOI/IOOS data for impacts section
3. Homework assignment(s) that clarify preconceptions and help learners reflect on decision-making/resiliency.

3.1.2 Example #2: Dead Zones

Driving question for the lesson module: Is the chance of a dead zone high or low?

Students will understand that:

- Blooms are determined by stratification of water and nutrients flow
- River flow causes stratification and delivers nutrients
- Storms can effect stratification of water and change bloom structure

The lesson will explore bloom formation, who and what is affected by dead zones, east verses west coast (upwelling on west coast – not the same on the east coast and the Gulf of Mexico, examples, predictors of blooms, and the impacts of blooms (what happens). The lessons will explore how a bloom forms (population explosion, phytoplankton needs for food & light).

Topics covered will include drivers of nutrient delivery, stratification, circulation, depth, temperature, nutrient supply, water clarity, mixing controlling bloom (formation/deformation), spring bloom crash (July to October) anoxia, nutrient delivery from rivers, atmosphere interactions/forcing, human induced (runoff), upwelling lead to algal blooms. Water becomes stratified and isolated the algal blooms causing it to die and decay.

Dead zone lesson (not azoic) – have animals in them and fish can swim a meter above the anoxic zone. The lesson module will assume knowledge of water properties and density. The lesson content flow will be:

- bloom formation: there are phytoplankton in the ocean that need light and nutrients
- drivers: nutrient delivery (rivers, atmosphere, human induced run off, municipal waste, coastal upwelling)
- blooms and isolation and dying plankton (stratification) - students can do delta t over delta z for density
- dead zone impacts, also including the idea that the habitat moves (chose glider track to explore satellite map)
- storms/fall bloom regime remix and reinvigorate phytoplankton
- have a matrix and ask the students to enter higher or lower for each variable. Look up the information and now discuss with your partner how will this impact the dead zone. Look at prior data (temp, spring runoff, chlorophyll, oxygen) and see what the conditions were in prior years that this occurred and then predict whether based upon current conditions, is the chance high or low?
- show the established scientific models for this issue and their strengths and flaws (I.e. those funded by NOAA, DEP or EPA)

Make a prediction in the spring course and then have them follow it over the summer. Then, give them a one credit special credit in the fall semester to blog and/ or report on what happened during the summer. Or MARACOOS can sponsor a competition to crowd source the best predictions.

Figure 2: Brainstorming diagram for a lesson module on dead zones.

3.1.3 Example #3: Inundation Lesson

This lesson would precede the hurricane lesson.

Driving question: Do you expect inundation risk to be high or low? When should we run for the hills? And/or where and when will we get high water?

Students will understand:

- How wind moves the water
- The difference between sea level rise and storm surge
- How waves are an important part of the damage
- How inundation gets at modeling (climate change) and assumptions behind projections
- The intersection with social sciences/parts of the world being impacted already (large societal issue & economics)
- Inundation models (Timing of high tide, phase at the time of the storm, beach slope, wind, rescue plans and marine safety, surge, waves)

This lesson module would be linked to Earth system and tides modules. Background information would need to be provided on:

- Sea level rise
- How sea level is rising (warming water & sinking of land)
- How sea level is determined
- Weather signal, temperature data from MARACOOS
- How storm surge is what is affecting us
- Tides/tidal prediction

Proposed Lesson flow:

1. Teach about storms (patterns; type of the storm is important- duration, timing, shape, track, intensity, and line winds; Coriolis for oceanography majors; weather map to understand wind for non-majors). This section will include case study examples of storms with MARACOOS and future OOI Pioneer data.
2. Discuss ocean response: surge and waves using time series data of winds. Students will track lower pressure, watch the response in the HF radar and the direction of the currents.
3. Next we will discuss tidal heights models and spatial distribution currents.
4. Other factors related to sea level rise including bathymetry/topography, local river flow, inverted barometer, seiches (water sloshing), sea level bulge cross section of a hurricane
5. Case studies and application. How are evacuation plans developed, when do you warn the public?

Student misconceptions/preconceptions include:

- How people react (response time);
- Pressure induced storm surge versus wind induced storm surge
- Separating the idea of sea level rise from tides, storms, and waves
- Managing and understanding combinations of when there are multiple forcings (understanding multiple drivers at the same time)
- Properties of water
- Factors contributing to sea level rise
- Inundation impacts beyond estuaries; other effects of inundation
- Integration of the http://oceanservice.noaa.gov/news/weeklynews/july12/stormsurge.html to help build this unit.

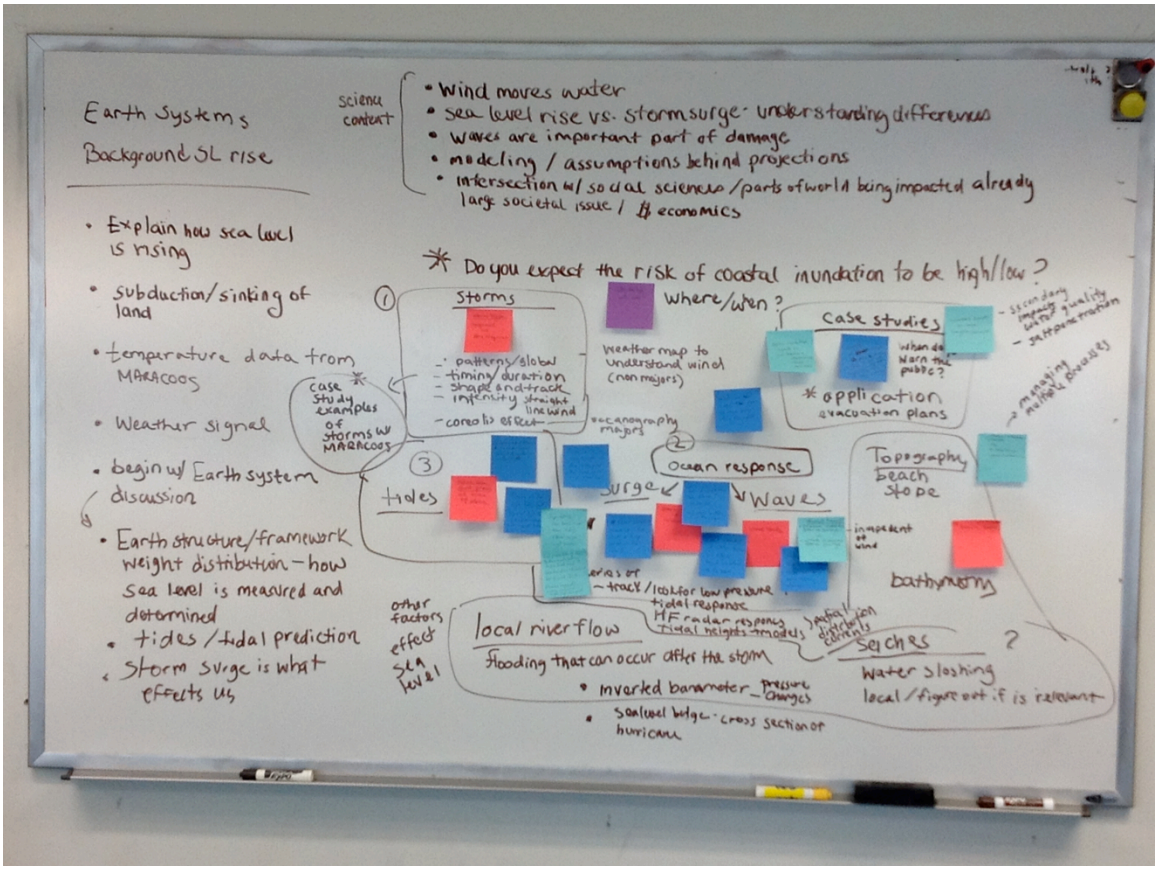


Figure 3: Brainstorm diagram for inundation unit.

3.2 Session 2, 4 & 5: OOI Data Tools and a Review of the Lab Lesson Builder

Q: How do we engage university faculty to use this LLB?

The participants recommended we include young professors – use to collaborate with the world. University expectations of faculty members are important. Participants asked how do we get to the next generation of scientists to promote these skills in their students? The university community does not value good teaching enough in the tenure process. But having said that, the Lesson Lab Builder (LLB) has the promise of having a community problem solved for the purpose of teaching with effective practices.

Faculty are interested in real time data but it is not easy to integrate into teaching. We need to figure out a way to continue to work on these problems and the ability to share things beyond PowerPoint. Graduate students want more experience communicating ocean science and experiences teaching undergraduates.

The participants recommended adding a human dimension to this work to increase the understanding of where science intersects with humans. The ultimate goal is to engage students in understanding coastal storms and inundation to improve decision making and awareness of warnings.

3.3 Workshop Action Items:

1) Look for Foundation/Agency to fund fully fleshing out the education lessons brainstormed in this workshop. MARACOOS will fund the hurricane unit for insertion into the LLB. We will actively seek funding for the other two modules.
2) OOI EPE will do usability testing on the hurricane unit to test the validity of the LLB.