

Collaboration at the Chesapeake Bay (Bricks and Mortar approach)

Kevin Mcilhany
Physics, USNA

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Building a Lab – Why?

- A building is nice to have – but without collaboration it is pointless.
- The purpose of having a B&M lab is to physically bring people together on a *workday* time-scale.
- Once a clear definition of a group of similarly focused individuals is made, they are best served by continual **contact** with **themselves** and all of the **issues** surrounding **the goal**.
- Physical Presence.

NAS/NRC Report – May 2011

- Overall, it seems to be critical of the awareness of the CPB regarding management styles/issues.
- Recognition of the existence of a limited number of models associated with specific individuals. (modeling structure is vulnerable to personnel – single point failure modes).
- Currently, many models exist, yet only a small group of them are exercised by authorities (EPA/???)
- Genuine sense of urgency!
- Concerned about the ability to respond to outside criticism in a timely fashion (eg. LimnoTech)

NAS/NRC Report – May 2011 – cont.

- This will/should be costly (in the 10's millions to get started with millions in operating budget).
- Modeling flexibility
 - Having the ability to maintain a large monolithic model system + support and **RUN** multiple other models.
 - Fostering/maintain the decision making models/suites.
 - The ability to create (quickly) modeling tools to assist in decision making. (It may be a black box to some of the users, but it is **MADE** by the modelers).
 - Have the ability to explain TMDLs regularly to the public.
- Establish continuity for modeling the Chesapeake Bay.

NAS/NRC Report – May 2011 – cont.

- Needs a multi-prong approach of personnel on-site which can respond to:
 - Academics
 - Managers
 - Data Collection – Hardware
- Expansion of existing models
 - Time lag.
 - Incorporating new model techniques into existing structures.
 - Understanding Ensemble Modeling by the management.

B&M Lab + Collaboration

- Create a location which inspires collaboration.
- Create a structure that:
 - Maintains a governmental presence for the long term. (B&M Lab + personnel).
 - Houses outside academic collaborations (>1) simultaneously.
- Allows for collaboration on a daily basis.
- B&M Lab: 3 Divisions:
 - Sciences – in house + academic collabs
 - Programs – in house – liasons to ALL of the important agencies
 - Hardware – in house – technicians which allows flexibility between models + data taking.

B&M Lab + Collaborations

- Science Div
 - Have enough space at the B&M Lab to house larger collaborations:
 - House post-docs hired by the lab (2-3 yrs).
 - House outside post-docs (LTs) from academia (2-3 yrs)
 - House graduate students (1-3 years) from academia.
 - House temporary desks for visiting profs.
 - Allocate hardware space for data collection material.
 - House computers (cluster most likely).
 - House CAVE? (Like 3D IMAX)
 - Study model sensitivity coupled to land/water usage.
- Hydro – BioGeoChemical Model lives here.

B&M Lab + Collaborations

- Programs Div:
 - Create positions that are **liasons** between B&M and outside agencies.
 - Hire experienced program managers (possibly retired).
 - Need to have only one master.
 - Runs the models which are simple enough to be used by others (outside of lab).
 - Interfaces with the Science Div. to alter/create useful models.
 - Interfaces with the public to expose models. (CAVE)
 - Political folks. Need to be plugged into moving landscape.
 - Legal arm. Someone needs to be aware of the “line”.
 - Economics leg. Financial impact on States/Fed/Business.
- Watershed Model sits between Science and Programs.

B&M Lab – As an Institution

- Creating collaboration is great, but what exactly does this lab as an entity mean?
- What is its charter? What is tasked to actually do?
- Recommendation: stay away from regulation – just focus on modeling + tools + metrics
- To whom is the Lab management accountable to?
- What is the connection between the Lab and regulation? Is the final product of the lab an endorsed TMDL?
- Most likely, the Lab would be accountable to whatever funding agency is funding it.
- Should one agency fund this effort or allow for multiple (10+) agencies+outside funding?

B&M Lab – Central or Localized?

- Is the Lab designed to be a central authority on the Chesapeake or should it invite representation (thru personnel) from the full watershed?
- DOA - Designed to be Dead On Arrival.
- ** Recommend:
 - Lab Director + Deputy Dir.
 - Division Heads
 - Hire Lab-based post-docs (3-4).
 - Hire Technicians+workers (5-10).
 - Programs personnel will depend on the business model chosen.

B&M Lab – as a Physical Structure

- House Personnel.
- House Data.
- House Computing Cluster. (possibly get CSDMS locally operated).
- Dry-dock for implementing sensors on smaller craft.
- CAVE
- Small Auditorium (public presentation area) – possibly like Horn Point.
- *** Most important for day-to-day collaboration: The Lunchroom.
- The Big-Board – imagine a 30'x10' whiteboard.
- House historical data to demonstrate success+failure.

B&M Lab – as a Funded Structure

- Create a single (central) funded structure
- Allow for outside money to fund projects within the Lab. (localized)
- Recommend:
 - Fund the Lab as a permanent “line-item”.
 - Fund Collaborations (large-scale academic) via NSF/NOAA/???
 - Fund collaborations (small-scale stake-holders) from counties/states/business/gifts(scholars).

B&M Lab – Development

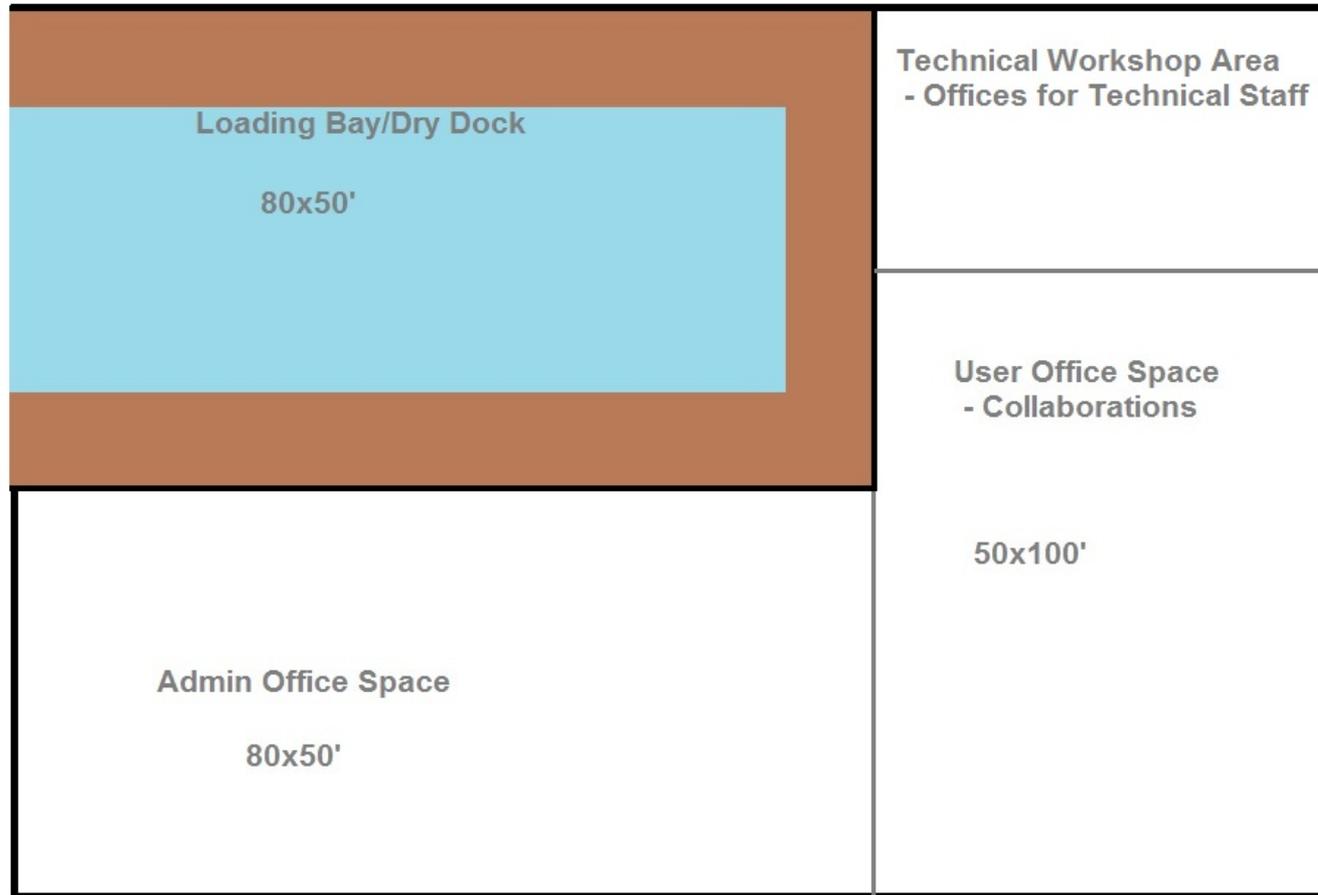
- “Give them a desk!” – As new projects come online, accommodate new personnel.
- Allow the charter to breathe.
- Provide the public with a permanent website to “see” what the health of the Bay means. Not just TMDLs.
- Keep up with the public interest of the Bay.
- Single point of contact for:
 - Agencies
 - Public
 - Academics – for better or worse

Collaborations – Academia

- Create two (preferably) larger collaborations which house post-docs (externally funded) at the Lab.
- Collaborations send graduate students to work at the lab during one phase of their PhD work.
- Creates – at the Lab - ~40-100 member collaborations semi-permanently housed at the Lab.
- Members educate themselves over the important issues.
- Regular talks given at the Lab by members over issues of the day.
- Collaborations educate managers.
- Managers educate collaborators.

Building Layout – Ground Floor

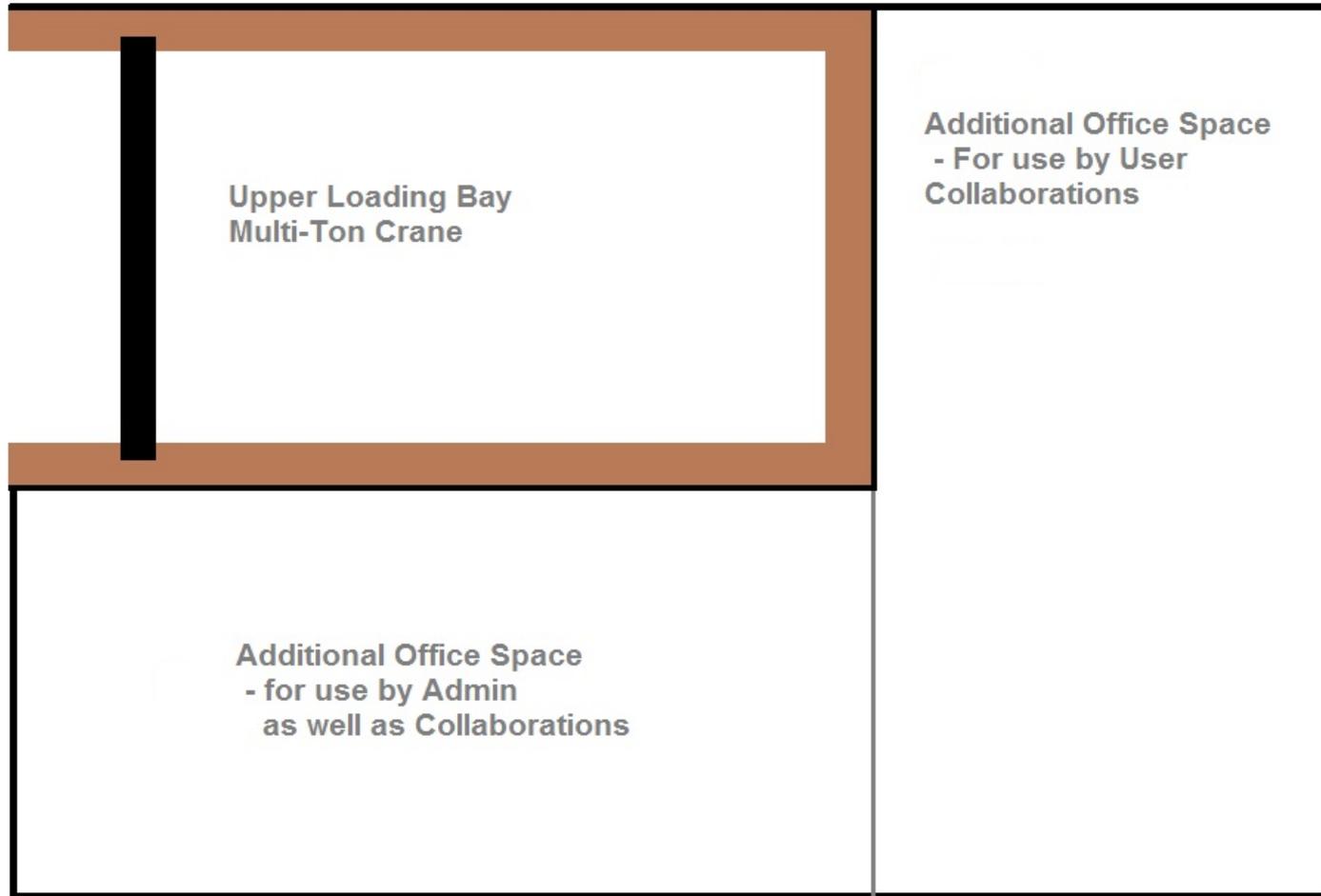
Proposed Chesapeake Lab Building Ground Floor



130x100'

Building Layout – Floor 2

Proposed Chesapeake Lab Building Second Floor Plan



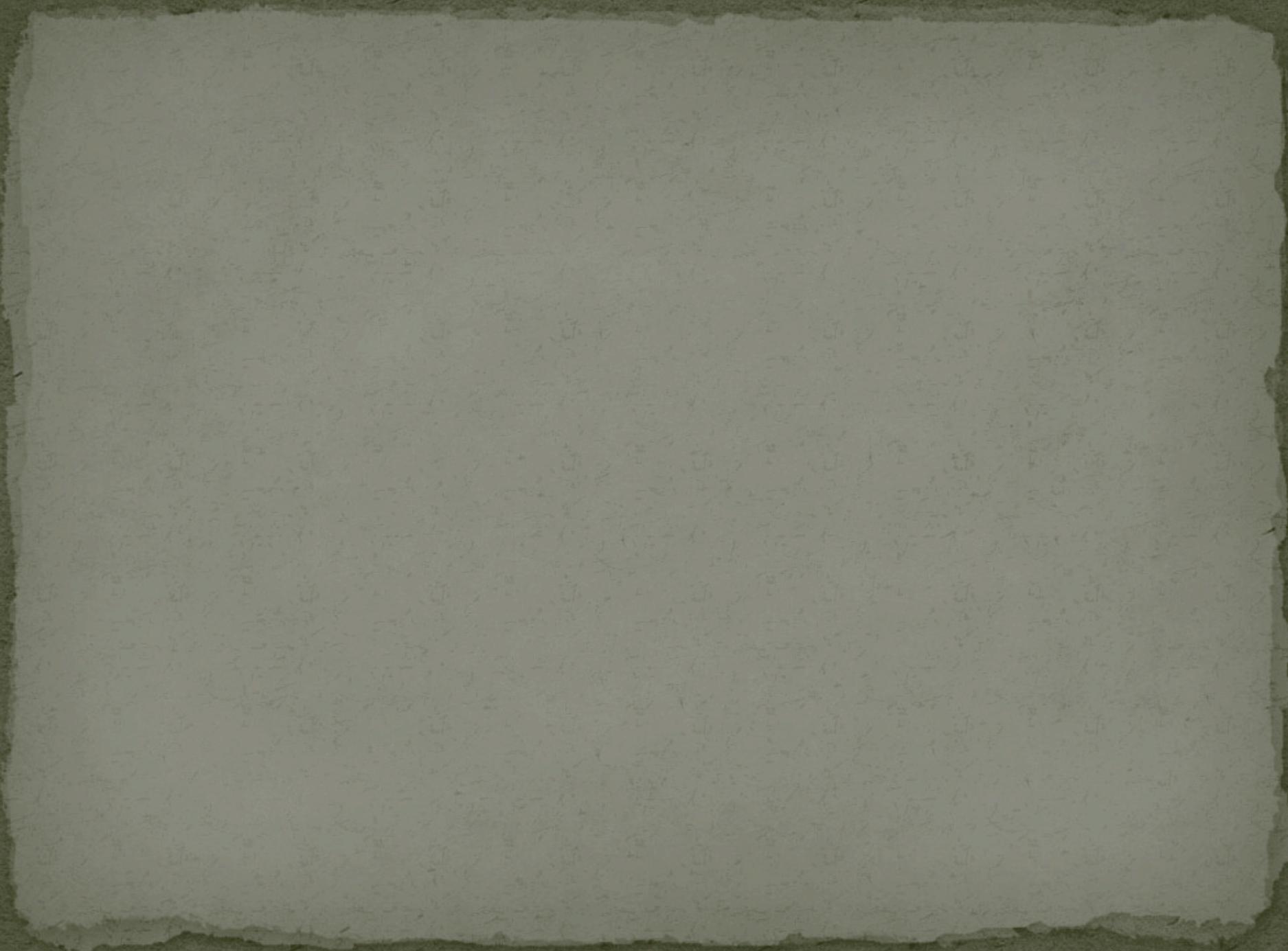
130x100'

Laboratory Costs - Personnel

Chesapeake Bay Lab											
Staff #	Staff #			Salary	Salary	Salary Total	Salary Total	Offices #	Office	Office S	
min	max	Position	Explanation	Min	Max	Min	Max	x	y	total	
1	1	Director		150	250	150	250	1	20	15	300
1	1	Deputy Director		100	180	100	180	1	15	15	225
3	3	Department Heads	Modeling, Sensors, Programs	100	150	300	450	3	12	15	540
1	1	Executive Administrator	HRD	60	80	60	80	1	12	12	144
1	1	Deputy Executive Administrator		50	70	50	70	1	12	12	144
3	3	Department Secretaries		50	60	150	180	3	15	15	675
5	7	Other Secretaries		40	50	200	350	1	20	20	400
10	15	Hardware Technical Staff		50	100	500	1500	2	20	15	600
3	3	Modelers		70	100	210	300	3	12	12	432
2	2	Program Assistants		70	100	140	200	2	12	12	288
						Salary	Salary				Size (sq
		Permanent Technical Staff				Min	Max				
		TOTALS				1860	3560				3748
4	5	Non-technical Staff	cleaning, security, services			200	200				225
3	5	Post-Docs	associates only with the Lab	60	80	180	400	3 upto 5			432 upto
								min			max
		Total Lab including ALL personnel				2240	4160	4405			4693

Collaboration Costs - Personnel

Chesapeake Bay Collaboration			(costs per year)		Total Costs			
3 year funding cycle			(includes travel)					
Member #	Member #	Position	Salary	Salary	One year	Three Years		
min	max		min	max	min	max	min	max
20	35	Professors	20	100	400	3500	1200	10500
20	30	Post-Docs	60	80	1200	2400	3600	7200
20	40	Graduate Students	20	30	400	1200	1200	3600
		One Time Cost						
		Hardware	1000	3000				
		Total Cost					Total Cost	
							min	max
							7000	24300



Observations:

- Working on fundamental particle physics requires large experiments (particles are relativistic)
- Data Sets are large (typically in terabytes TB)
- Computations are large – currently Tera-scale
- Signals are weak for the most interesting results
 - Finding the needle in the haystack problem
 - Requires knowledge of advanced techniques – neural networks, genetic algorithms, EOF, Bayesian stats...
- Modeling is required to understand results (Monte Carlo)
- Problems are well established and require 10+ years per collaboration
- High cost to operate – typically millions per experiment ranging up to a billion.

Modeling the Chesapeake Bay:

- Very complex problem – high # degrees of freedom
- Modeling is required to understand the problem
- Data sets from models are large (GB-TB)
- Problem is well established and requires years to model/understand results
- Small collaborations tackle this problem in many different ways simultaneously
- Funding is kept small for each group
- Only a few efforts to assemble larger collaborations

Reasons for Coming Together

- A larger collaboration will present results with a unified front to the public.
- Larger collaborations can vet results within the collaboration first before going public.
- Larger collaborations bring more ideas to the discussion and can be explored within a common framework.
- Larger collaborations can only operate with the blessing/backing of the government.
- More scientists = more credibility (?).
- Currently, no single agency is charged with creating a single picture of the Bay (Hind, Now and Forecasts)
 - EPA is closest – charged with environmental protection, TMDL
 - NOAA is next closest – charged with weather/hydrodynamic prediction

Big Science Model

- Nationally funded Laboratory system (bricks and mortar).
- Labs provide an infrastructure for collaborative science.
- Lab provides computational power – possibly a Cave.
- Labs provide more than real estate – support for public interfacing, legal support, long term presence (beyond a single collaboration).
- Collaborations meet/reside (partly) at the national lab.
- Funding is co-aligned: lab + collaboration - mostly

Laboratory Proposal

- Location: Chesapeake Bay shoreline – allows for hardware component
- Timeline:
 - break ground ~ 1-2 yrs
 - Purchase computers – 1 yr + continual upgrades
 - Lifetime – 30 yrs
- Personnel: approx. 40 FTE
- Cost to build: 3-5 mil + 10-20 mil + 3-5 mil = 16-30 million USD
- Cost to maintain: 2.5-4.5 million/yr (incl. utilities)
- Size:
 - 4400-4700 sqft. for personnel only.
 - 8000 sqft. including other features.

Collaborative Proposal (large)

- 1 – Spokesperson – 2 yr term
- 10-15 – Steering Committee – 2 or 4 yr terms (rotating) typically one member from each institution
- 1 – Constitution – to explain membership to collaboration and duties/responsibilities
- Per “group” or institution:
 - 1-3 Professors (1 PI)
 - 0-9 Postdocs
 - 0-9 Graduate Students
- This would form a collaboration from 40-100 members
- Cost: 3 yr terms – 7.0-24.6 million USD
- Suggests regulation thru Scientific Advisory Committees and Long Range Plans

Lab Features Possible

- Dry dock + Multi-ton crane
 - Allows for sensor development – linked to modeling input
 - Allows for sensor placement on buoys/small boats
 - Makes the lab a “complete” solution – modeling + data
- Cave –
 - 4π coverage – good resolution (diffraction limit)
 - 40'x40' size allows for a 20'x20' inside region for groups
 - Allows the Cave to be split into four individual Caves at the diffraction limit (10' to screen)
 - Requires ~200-300k for presentation computers

Operational Structure

- Once a week organizational meetings
 - Ops meeting
 - Group meetings (with virtual conferencing)
 - On the spot educational lectures within collaborations
- Once per 3-4 months Collaboration meetings
 - Forces progress to move along
 - Provides framework for graduate students and post-docs to present work/data
- Once per 2 years Scientific Advisory Committee meetings

Large Collaborations Operations

- Many senior members (professors + others) provide long range perspective
- Enhanced networking for jobs
- Enhanced opportunities for talks/conferences
- Spokesperson + co-Spokesperson on 2yr rotating schedule (always bringing someone online).
- Steering Committee is aligned to funding profiles (institutional) – decide publication protocols and speaker line-up, author list (order)

Large Scale Collaborations

- Develop a unified “toolset”
 - Metrics play a strong role in understanding model results
 - Statistical toolsets – complicated and understood by a smaller group
 - Lagrangian tools
 - Eulerian tools
- Confidence building in results
 - Use hindcasts to show how well a model works with minimal tuning
 - Maintain a database of forecast predictions and actual results
- Currently, no single agency is charged with creating a single picture of the Bay (Hind, Now and Forecasts)
 - EPA is closest – charged with environmental protection, TMDL
 - NOAA is next closest – charged with weather/hydrodynamic prediction

Large Collaborative New Features

- Working groups to focus on:
 - **Locations/types:**
 - Chesapeake Bay – main flow
 - Rivers/Contributaries
 - Inlets/ sub-Bays
 - Canal
 - Immediate Land interface
 - Total Watershed
 - Marsh land
 - **Biology:**
 - Algae
 - Hypoxia
 - **Chemistry:**
 - Reactive flows
 - Industrial runoff reactions
 - **Physics:**
 - Temperature dependence
 - Salinity/density
- Integrate each of these sub-groups into a complete picture

Other Advantages

- Collaboration is about PEOPLE. Builds community.
- More eyes on a problem = better de-bugging.
- Fun experiments can happen, eg. using a different grid on your models modules leads to discovery
- Currently, CBP + CCMP seems to come close to all of these goals.

Other Advantages – Programs Div.

- Programs division could work on extracting decision making tools from the larger modeling structure.
- Better understanding of ensemble averaging of models.
- Can directly educate other members of the community when needed, eg. Teaching lawyers the importance of a particular technique/result. Workshops for stakeholders.
- Branching out point of contact for any outsider to contact and follow up.
- When a lab is built, it supports business in the local community.
- Representatives actively defend the labs.
- Multi-scale models for multi-scale decision making.

Modeling Issues

- Grids
- Solvers
 - Spatial
 - Temporal
- Bio-complexity
- Coupling to Air/Climate models

- Can we talk about an “earth” model – from outer space to the core

Community Willpower

- What is preventing the Chesapeake Bay community from coming together?
 - Competition?
 - Tradition?
 - Irreconcilable Differences?
 - Personalities?
- What is still needed to move ahead?
 - If a white paper were written by 10+ institutions to form a large collaboration, who would be interested?
 - Agencies: NSF, NOAA, EPA, DHS/DITRA, military, NIH (health concerns), CDC, NCS(?)
- Are larger state interests preventing a federal collaboration?

Background

- Personal Info: Kevin McIlhany
 - High Energy Theorist – 1990-1993
 - Experimental Nuclear Physicist – 1993-2006
 - Computational Physicist/Fluid Dynamics – 2006-2012
- Collaborations:
 - Theory – 1-2 people at most
 - LSND – 30 physicists
 - HERMES – 300 physicists
 - BLAST – 50 physicists + 10 engineers –MIT-Bates*
 - Jefferson Lab experiments – Hall B/C - 200 physicists
 - Fluid Dynamics – 2-4 physicists

MIT Bates Laboratory

- Bates: Located 20 miles north of Boston.
- Ran beam on target for 30 years.
- Employed 50 FTEs during its tenure.



Reasons to Keep Collaborations Small

- Smaller groups can present multiple ideas to the community without requiring agreement.
- Funding agencies have more flexibility in splitting up a parcel of money.
- For groups that are successful, keep funding, otherwise cut (capitalism).
- Smaller groups tend to align with university labs, which can maintain funding locally.