Candidate Recommendation

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Have 4 hubs (Alaska, East, West, and Gulf coast) tailored to their environmental & society challenges where staff is inviting nationwide interdisciplinary scientific domain scientists to: a) help better understand natural processes and b) integrate outcomes to other agencies, involved communities. As hub: a) have summer schools for involved local communities + agencies + students to have broad involvement, b) have resources for visiting scientists to use instruments (drones, boat time, instruments), and c) room where scenario modeling (futurecasts) can be done by anyone (so 'what if' questions can be addressed).

*Regionally-focused centers that support fundamental research on the *interactions* between multiple hazards (e.g., geological hazards, sea level change, ecosystem effects) that impact coastal communities over short-, intermediate- and long-term timescales, and link this with research on community planning and resilience.*

Regional hubs (North Atlantic, Mid-Atlantic, South Atlantic, Gulf of Mexico, Great Lakes, West Coast & Pacific) integrate applied research, extension, and science communications to assist communities and businesses with identifying information gaps and barriers that prevent implementation of mitigation and adaptation plans through co-production of knowledge and assisting with down-scaling data-sets as needed. These hubs would pull from existing institutions and groups to both staff the hubs and do the work. The point of the regional hubs is to encourage and provide a mechanism by which researchers from across disciplines, extension specialists, science communicators, and the private sector can work together... NOT build something totally new to compete with what other groups are doing separately. The hubs should instead bring groups working in resilience together and facilitate trans-disciplinary research and outreach. In this way, hopefully silos are more successfully broken down. And due to the partnerships created through the hubs, our professional community that is working in resilience can better facilitate the use of science and other information (legal, economic) at the community level to make decisions.

Specific existing groups to draw from include university-based research centers, the Sea Grant program, cooperative extension, groups based in communities, K-12 schools, community colleges, government agencies, etc. Each hub doesn't have to look the same though. They should be built according to regional needs and the organizations that are available and interested in participating. Private sector participation would be critical here as well.

What is your specific* recommendation?

(* Don't be abstract, general, or try to do too much in your recommendations. Try to be specific, actionable, stand alone)

Organized Hubs, termed "Regional Collaboratives" here after, will facilitate partnerships across institutions, agencies, and communities to provide applied research, outreach, and education support to coastal, island, and Great Lakes communities to help them build and maintain resilience across multiple time and space scales. Placement of Regional Collaboratives in diverse systems (e.g., urban, arctic, rural, etc.) will provide the ability to investigate local influences on coastal issues.

Regional Collaboratives provide:

(1) Contrasts in local conditions with which to compare understanding of coastal processes, change and resiliency across social, physical, and ecological settings;
(2) Opportunities to integrate research, extension, and science communication among diverse groups of stakeholders, thereby guiding the co-production of research that will more effectively mitigate long- and short-term coastal risks.

These regional collaboratives will integrate use-inspired research, extension, and science communications to assist researchers, communities, industry, and other stakeholders with

identifying information gaps and barriers that prevent implementation of mitigation and adaptation plans through the co-production of knowledge. Collaboratives will assist with acquiring and utilizing data-sets and models as needed to advance both fundamental understanding of coastal systems and the inclusion of stakeholder groups in the generation of science. The collaboratives will first work with communities and other stakeholder groups to identify regional problems and community goals for addressing local dimensions to these problems. Then, the collaboratives will continue working with communities and researchers to identify information gaps, support the coproduction of knowledge, and identify decision-support needs and implementation barriers. These regional collaboratives will achieve this vision by: (1) providing embedded facilitators with familiarity with synergistic programs and resources to build long-term relationships and trust among stakeholders; (2) facilitating dialogue between communities, academic institutions, government agencies and NGOs to enable projects; (3) work with community and stakeholder groups to identify needs for weather, climate, environmental, social and economic data/models and mainstream appropriate information into existing planning mechanisms; and (4) help communities identify and overcome funding and other barriers to implementation.

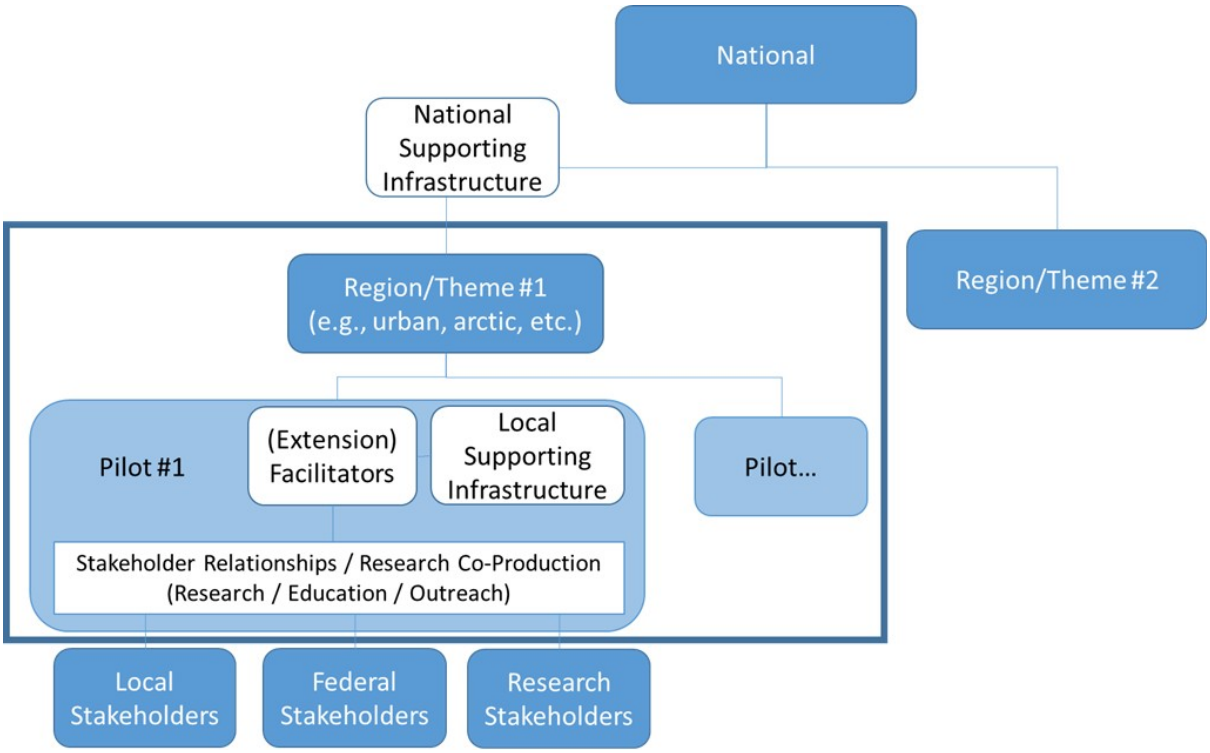

Figure 1. Regional collaboratives structure

Potential research questions that may be tackled via this approach:
Specific questions will vary from region to region, but overarching questions and themes can be addressed and shared via a connecting hub network setting.

a) <u>Understanding Coastal Systems</u>

- How do coastal hazards/processes align with where people will be impacted along the coast?
- How do efforts around urban planning and local scale sustainability intersect with coastal processes?
- How do the different parts of the coastal system interact, especially given the rapidly

changing landscape/human migration?
- Can we develop decision-relevant, verifiable ecosystem forecasts to predict key coastal phenomenon, much like we predict the weather? How can such forecasts be implemented to improve adaptive management of socio-environmental systems?
- What existing frameworks exist to advance systems-based thinking and decision-making in coastal communities? Do these existing frameworks need to be refined, or do we need a new approach?
- How do system level interactions help us understand coastal system resiliency? Can we use the telecoupling framework?
- How do coastal changes impact food, job, and national security?
- What are possible approaches for local/technical solutions that deal with man-made physical coastal and nearshore (estuarine) degradation (traditional hardening, dredging, destruction, redirection...). Change the paradigm from *continue as we always did* to what is a *smart and sustainable solution*. Find systems-wide solutions that integrate various factors rather than just repair one single issue.
- How do we take Ecosystem Service models and merge them with end-to-end Earth System Science Frameworks (Frameworks like: ESMF - https://www.earthsystemcog.org/projects/esmf/; or CSDMS - https://csdms.colorado.edu). Coupled numerical modules to fully explore the feedback between socioeconomics and the physical earth system to answer systems questions at the coastline? All of these require earth observations (either from space or on the ground), and these knowledge and data gaps need to be identified.
- How can both qualitative and quantitative perspectives be integrated so that all objectives important to stakeholders are included and the consequences of different actions can be assessed?
- What are the cross-cutting processes and linkages between human and natural systems that impact risk and resilience in coastal systems?
- Group 3 question = **How does coastal morphology change as a result of the interaction of sea level rise, subsidence, shoreline geodynamics, sediment supply, ecosystem dynamics, built environment and coastal hazards, and how do we best manage it for benefit of coastal population?**
    - Our regional hub idea provides a structural framework for approaching a question like this.
- What are the implications of multiple, cascading hazards on coastal ecosystems and communities? How does it affect future resilience?
    - Cascading hazards and changes in ecosystem health - has a multitude of connections to emerging pathogens and climate change impacting food security, changes in ecosystem function, and coastline impacts
    - The idea of “cascading hazards” could provide a link between multiple centers (e.g., an earthquake causes land-level change, how does this impact coastal morphology, flooding, ecosystems, etc.) -- You can see how this “regionally specific” research could affect thinking related to sea-level change in other locations

b) <u>Understanding the Approach to Multi-stakeholder Science</u>

- How do scientists engage communities identify the decisions they have to make?
- What modes of engagement with communities work (and what ones fail)? (especially to frame basic research questions)
- How can we improve available information from the global/regional level down to a granularity that local communities can use to make scientific based decisions?

- What are the best ways to engage diverse & underserved communities in inclusive/participatory/experiential science that serves their community?
- What are the public policy issues around integrated coastal management? What will best inform decision-making?
- How does responding to “slow-moving” coastal processes compare to ‘event scale’ processes from the community/policy perspective? Are there policy/management opportunities that build resilience to multiple kinds of coastal change?
- What are the public policy issues around integrated coastal management? What will best inform decision-making?
- What are participatory processes that allow for more sophisticated use of existing or new science in decision-making processes?
- Find out what existing “tools” do work for communities and build off those lessons learned (not all are useless)
- How does cooperation between multiple coastal stakeholders in defining science problems impact our understanding of and approach to performing basic science?

Why is it valuable?

Who does it impact? How? How will the world be better? Who are the stakeholders and who will you partner with to make it stronger?

- Communities need to be able to make science-driven decisions about coastal management, resources, future generations, etc.
- Develop resilience for now and in the future
- Huge wealth of networks and resources already exist that need to be knitted together to meet these ends without being competitive (maximize leveraging)
- Local scale processes (earthquakes, sea level rise, pollution) can be utilized as model engagement ‘systems’ where other regions can learn
- Communities will be better prepared for cascading hazards, e.g., hurricane then flooding, water contamination, landslides, etc.
- In terms of “who will you partner with” -- important to include academia, government agencies, industry, boundary organizations, community leaders/public representatives, resource managers etc.
- The multi-stressor/multi-hazard approach is powerful given the multiplicative problems generated by physical hazards such as hurricanes and the ensuing, cascading biological problems like water quality/pathogens/ harmful algal blooms resulting from subsequent runoff.

What’s the reasoning or supporting evidence behind it?

Evidence based, fact based, Takes into context current research (hasn’t already been tried and failed). How will you validate success? How is it grounded in existing scholarship? Why do this now, above all the other things we could do?

- Take into account existing professional networks and communities of practice - this recommendation is all about tapping into existing models and programs that already work.
- The ‘Why do this now part’: Communities have centered around coastal areas for various reasons. Given the concentration of society around the coast and changes

we face in future will make these regions more vulnerable if we don't anticipate on these changes. This has to be an interdisciplinary effort as the coastal zone is the area were various disciplines come together, calling for interdisciplinary research.
- Resources along coastlines and in small island nations are declining. Investment from the community is needed to gain knowledge and maintain environments to sustain those populations.
- If we decide to highlight cascading hazards as a possible research question to tie centers together - this Nature Comment just came out
- Coastal zones are one of the areas where environmental change is going to have the largest impact on human society.
- Global climate change is felt at the regional level, and solutions must be developed regionally with attention to community participation and knowledge. Approaches are modular and portable but require local/regional calibration and collaboration.
- For forecasting, this was recently published in PNAS on ecological forecasting (and Dietze is speaking at NSF today)
- Developing performance measures/metrics/indicators can help to evaluate outcomes of individual Regional Collaboratives, and if coordinated, can be developed and consistently tracked across Regional Collaboratives. Importantly, there will need to be process and outcome metrics that can redefine some of the ways we evaluate academic and intellectual contributions, especially for universities.
- 'Successful' examples of existing Regional Collaboratives are: NOAA RISAs, NSF-funded Climate Change Education Partnership projects, USGS Landscape Conservation Cooperative (LCC), Land & Ag-Extension Centers, NSF Critical Zone Observatories, (Parris et al, 2016); LTERs, Regional Ocean Observing Systems; Aquaria collectives (e.g. Monterey Bay Aquarium, Birch Aquarium, Baltimore), National Estuarine Research Reserves.

Additional Considerations:

Regional Collaboratives

- Regional Collaboratives -- specific places and specific problems -- focused regional center can help with ***building relationships***, trust, develop research that allows for connections that tie research to action
- Open centers with lightweight staff to facilitate interactions among local, state, federal stakeholders with external researchers where they define regional problems based on educating and soliciting community input
- Regional Collaboratives do in-reach to communities to listen to how communities frame wishes for the future
- Reach out to scientists to work on problems for weeks to months -- collaboration on specific regional problems that need to be tackled
    - Data gathering, research support, connect models
    - End product
    - Space for scientists and community members -- allow for collaboration and engagement on research products
- Connectivity between the Regional Collaboratives to allow for ways to share

knowledge and best practices
- Existing networks and databases from other agencies, e.g. NASA and IAIA, should auto populate (take advantage of open data and visualization tools / techniques) the Hub to ensure broad participation across disciplines. Categorizing and inventory of what tools are available across the agencies to avoid duplicated efforts.
- Identifying what communities want to protect can help with framing of the vision for the future
- Regional
    - similarities/differences in coastal challenges, processes, impacts, community values, community scale

Decision Support Processes and Tools

- Testable research that can help to understand what is context-specific vs. generalizable across Regional Collaboratives
- Prediction/Scenarios/Forecasting/What If -- decisions about the future, allow for people to explore the impacts of different decisions
- Decision-making: process and tools. Making decisions are about the future and the consequences of the decisions you need to make. What about this can we quantify to understand the consequences of the different paths we choose. We need exploration with communities about the future they want to move towards.

Communication / Engagement / Education

- Interface of research and engagement -- part of helping communities see where they may need to face decisions links to the broad extension mission, have dream for future and aren't sure how to get to the future that they wish to achieve
    - Need to recognize the value of boundary spanning organizations/people for translation, integration of research and practice
- Helping communities with values-based decision making by framing for relevance
- Identify the top line values or relevance that span regions and those that are regionally specific
- Communication problems are universal, so the hub concept could be the solution --- feedback with community
- Citizen science and engagement of community members in the data collection and research process (e.g., food security, ecosystem health)

Solutions / Actions

- Deliverables and outcomes must involve an iterative feedback loop with stakeholders
- The solution space should be effective and fulfilling

Topics

- Life Cycle and Debris Management
- Access to the recreational beach
- Property protection

Ideas for Hub Creation

- Smaller scale grants given to more regions to do 3 year scoping, co-production with communities, refine and develop collaboration, conduct multidisciplinary research with flexibility to refine given engagement
- National hub coordination and research -- coordination (similar to LTER, RISA or others) where there is collaboration across Regional Collaboratives and some shared

research questions that allow for collecting data and collaboratively answering questions about similarities and differences between regions for different topics