A Vision for CoPe HUBs

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HUB Vision and Goals
Through the CoPe HUB network, NSF-funded science on the interdisciplinary, complex, emerging and ongoing issues relating to coastlines and people will create a nexus for knowledge building and sharing amongst a diverse community stakeholders (Figure-1) . The HUBs will facilitate enduring connectivity of emerging and existing interdisciplinary research and stakeholder networks to address coastal challenges. The HUBs' goals are:
1. Produce Actionable Science
2. Build Trust and Capacity Across Generations
3. Enable More Efficient Research and Stakeholder Engagement and;
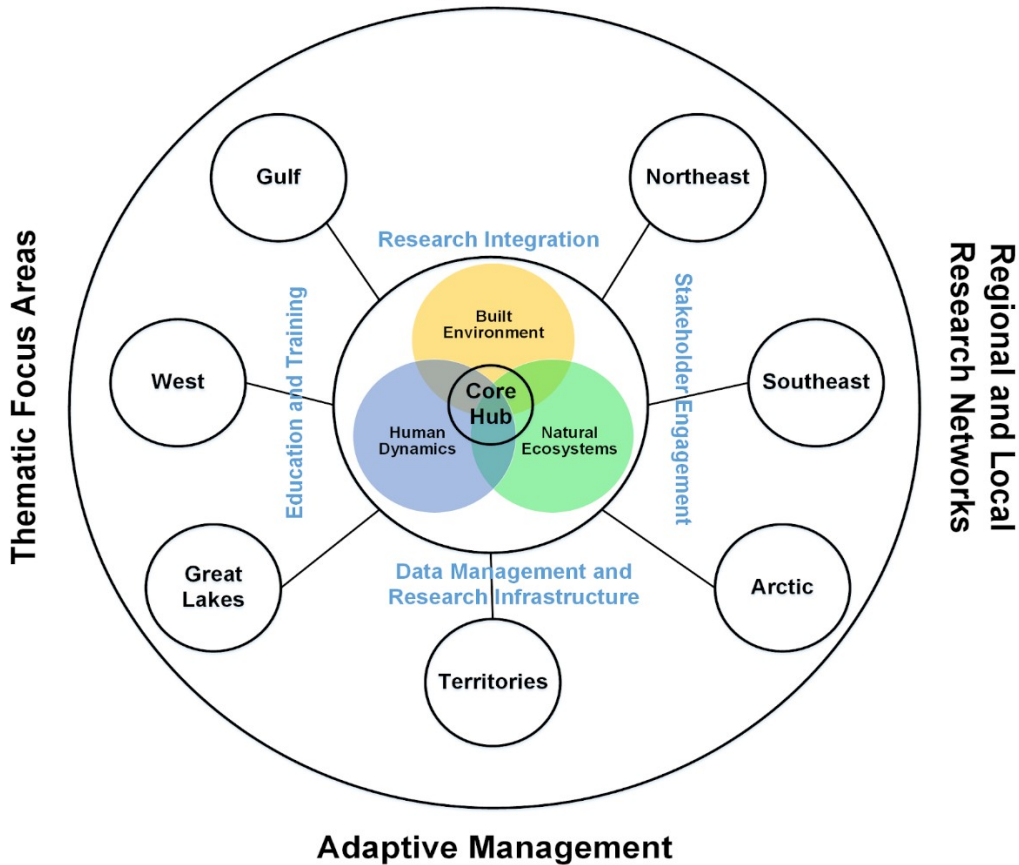4. Develop a Sustainable, Effective Pipeline for CoPe Science

Figure 1- Vision for CoPe HUB

Functions of CoPe HUBs

Research Integration (Convergence)
One of the key functions of the HUBs is to enable convergence of interdisciplinary research at the nexus of Natural Ecosystems, Built Environment, and Human Dynamics. According to the NSF's 10 Big Ideas report, "convergence research" is essential to address vexing societal challenges (including as Coastlines and People) that requires deep integration

across disciplines. Through engagement of researchers, practitioners, students, and stakeholders from various disciplines, the HUBs will address coastal challenges. The HUBs promote convergence of research at three levels: (1) interdisciplinary research components through a system-of-systems approach; (2) fundamental research with actions and decisions of stakeholders, as well community needs and values; feedback from stakeholders and communities would inform basic research questions; and (3) network of researchers and stakeholders across different coastal regions. At the heart of such interdisciplinary integration is the deep engagement of stakeholders to inform problem definition and solution development.

Stakeholder Engagement

In order to have truly actionable science, establish trust, and build capacity, CoPe HUBs should establish a robust stakeholder engagement strategy. Experts in stakeholder engagement from across disciplines should be consulted regionally to develop this strategy. We envision physical regional HUBs engaging with local communities, elected officials, agencies, students of all ages, researchers, and businesses. To reach a broader audience, enable data sharing, and broadcast education, citizen science, and training opportunities, a strong virtual/online presence is critical. Where possible, CoPe HUBs should work to elevate and progress existing initiatives. Established research centers, relevant programs such as NOAA's SeaGrant, and robust local initiatives should be consulted throughout HUB establishment and remain engaged in HUB activities to encourage research convergence. The close involvement of stakeholders would enable effective translation of fundamental research to decisions and actions by stakeholders. In fact, stakeholders become members of the research team in the HUBs.

The benefits of robust stakeholder engagement are numerous. First and foremost, allowing for multidirectional sharing of knowledge amongst researchers and the community will help establish productive relationships between the HUBs and communities. Listening and hearing stakeholder lived experiences, concerns, and priorities can inform the research initiatives of HUBs and result in more basic science with immediate, actionable applications. Allowing scientists a platform to engage with stakeholders regularly and share personal, science-themed experiences with stakeholders may break down the ivory-tower stigma common in these initiatives. Ultimately, HUB engagement efforts should build capacity. Through extensive engagement and education and training initiatives, described below, HUB researchers will be better equipped to share their science, communities will have the resources and capacity to use science to solve local problems, and HUBs will be fueled by a sustainable pipeline of researchers attuned to the criticality of interdisciplinary work in coastal environments.

Education and Training

One of the major functions of CoPe HUBs is to provide a sustainable educational platform to support actionable science. This requires distillation of science so that is can be implemented. Additionally, this necessitates maximizing community engagement to ensure community needs are being reflected in the research. The goal is to institutionalize a framework that can support and advocate for sustainable, informed dialogues among multiple stakeholders. Three components of this framework are:

(1) Capacity building - The first goal is to build capacity through various educational opportunities. The idea is to target the hub community at various levels. It may include establishing HUB fellow programs, mid-career professional development workshops, citizen science programs, holding annual conferences, and introducing various opportunities to engage students of different ages including K-12, undergrad, grad through curriculum development, innovative pedagogies such as service learning, internship, and annual competitions. Further, through a robust virtual/online presence, webinars, podcasts, GIS portals, and others will expand capacity building opportunities.

(2) Facilitating communication of science - Unlike the first goal, the second is mainly targeting researchers. The objective is to provide researchers with various opportunities to maximize their impact. This is accomplished through science communication training.

(3) Serving as a communication conduit - HUB is envisioned to serve as conduit to maintain dialogue between researchers and the broader community to ensure effectiveness.

Data Management and Research Infrastructure

Both an online and virtual presence for stakeholders will be utilized as the primary mechanism of integrating the information coming into and out of the HUB from all the stakeholders - this includes everything from scientific data to surveys conducted with stakeholders to town halls and any and all other activities. Data manager(s) will apply best practices so that stakeholders across different HUBs will be able to share and add to any dataset a HUB is collecting. While individual regional HUBs may not be computing powerhouses (e.g., to run models, bioinformatics, etc), they will act as nodes to connect their community of stakeholders to the relevant resources which will allow them to do so. Much like LTERs, the model we propose will allow both measured data and data analysis to be shared across stakeholders.

Research infrastructure is both expensive to purchase and maintain. HUBs will create mechanisms to allow HUB stakeholders to participate in the development and sharing of research infrastructure, its long-term use and sharing of the data outputs. Good examples of these exist already with ocean and the Great Lakes' observatories. In addition, universities and industry could come together to share research infrastructures so there is both a broad base of users, QA/QC such that the data collected is both available to a larger community but also collected in such a way that more people can use it. Examples of this include everything from buoy data of coastal hydrological phenomenon to pollutant analysis (e.g., HAB toxins, oils, others). The research infrastructure model proposed will lead to efficiencies by reducing individual needs to stakeholder needs and sharing. Further, it creates an efficient mechanism for rapid response to events. Stakeholders no longer have to establish a response from ground zero but can rely on a community of stakeholders to contribute to the overall outcome.

Attributes of Core and Regional Hubs

Focus on Place-based and Temporally Relevant Issues

This HUB framework would include dedicated regional centers located in existing partner institutions (university research centers, SeaGrant, LTERs, etc.) and would provide coverage and expertise in regionally pertinent coastal issues and priorities. This framework allows for different HUBs to focus on the most significant regional issues while following the basic HUB format and incorporating local expertise and existing professional networks. The research, training, and support functions of the regional HUBs would encourage long-term projects and initiatives while maintaining the flexibility to nimbly respond to episodic short-term needs through the rapid mobilization of new research and funding, or "surge capacity." The HUBs would have access to streamlined and expedited funding to apply towards these issues.

Focus on Thematic Research Areas

The HUB has a multifaceted thematic structure which would include the following: 1) Natural Ecosystem, 2) Human Dynamics, 3) Built Environment. Natural ecosystem would include natural processes which would include sea-level rise, climate change and etc. whereas Human Dynamics is focused primarily on evaluating the anthropological impacts. Built Environment will capture the issues related to infrastructure and their interdependencies. Even though each of these themes has distinct characteristics, the core HUB will advance science by

working at the nexus where each these key areas intersect to better mimic the reality of complex coastal challenges.

Integrate Regional and Local Research Networks

Various research networks are already addressing pressing and emergent challenges in coastal areas. These research networks include researchers and practitioners from different universities, SeaGrant offices, and other organizations. However, these research networks are fragmented and, largely, exist in isolation. An important role of Regional HUBs would be to improve the mechanisms of enduring connectivity in the local and regional research networks to enhance the development of actionable science for coastal communities. For example, many coastal areas are dealing with sea-level rise impacts and several research networks across the nation are addressing these issues. The HUBs can improve coordination and integration in the existing research networks and also enable the creation of new networks and connections for knowledge sharing, data and model integration, and capacity building for coastal communities. The core hub will be responsible for integration and coordination amongst external organizations and between regional hubs to create efficiencies.

Implement Adaptive Management

By definition, a HUB working on the Natural Ecosystems, Built Environment, and Human Dynamics, creates a nexus of stakeholder effort which will need to be flexible and sufficiently agile to plan both for long-term success but at the same time have a team which can respond to time-sensitive needs of the community (e.g., hurricane, HAB bloom, other). This HUB will implement an adaptive management strategy which will allow ongoing iterative reviews of goals, timelines, implementation, success, failures in order to adapt to the needs of the stakeholders. An intentional approach to making decisions and adjusting in response to new information and change will allow the HUB the flexibility to respond to the diverse needs of regional HUBs and stakeholders while advancing the goals of CoPe.

While this governance structure will be responsible for developing convergence among across the research integration, data management and research infrastructure, education and training and stakeholder engagement efforts, it will have to evolve as regional and core HUB priorities advance. As part of developing a successful adaptive management program, core HUB fellows will engage with stakeholders during annual meetings to survey and define the current program status and then recalibrate, as needed, to continue towards building to the goals/nexus of the program. This iterative process will create a leadership model in which knowledge and information can be continuously shared between the management team and stakeholders.

Hub Governance

The HUB would be managed by a core integration staff who would coordinate inter-HUB activities, provide data management and research infrastructure services for all HUBs, conduct performance assessments of HUB actions, and track all adaptive management processes. The core staff would also define the structure and role of funding, proposal requirements, and give the final approval on the selection of research topics.

Staffing for this core HUB would consist of 2-10 people housed together in a central location. An advisory board comprised of individuals from each HUB (researcher and local stakeholders included), NSF staff, and select outside participants would provide feedback on HUB activities and help direct future efforts. The role of NSF in this governance model would be to ensure the successful integration of HUB activities into the NSF model and providing guidance on priorities and funding cycles. Reliable, long-term funding is critical to HUB success.