

**Envisioning Coastal Hubs:  
Identifying Climate Driven Stressors to Inform Coastal Systems Responses & Adaptation  
NSF CoPe Scoping Session - San Diego (2018)**

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### **Introduction**

This paper proposes an innovative research hub as part of the Coastlines and People (CoPe) initiative led by the National Science Foundation (NSF). Specific recommendations, anticipated impact and value, and defined reasoning and supporting evidence are detailed below. The recommendations produced are based off collective ideas formulated during the NSF sponsored CoPe Scoping Session held September 26-28, 2018 in San Diego, CA.

### **Specific Recommendations**

What if a CoPe research hub could link diverse stakeholders together to use cutting edge basic science to identify climate-driven stressors and develop products that can inform coastal systems responses & adaptation? The following framework would allow a CoPe research hub to serve as a platform for accomplishing this mission. This working group has identified six key components to the CoPe research hub framework, and these components are described in detail below.

#### *Early identification & continuous engagement with stakeholders to identify coastal issues*

Early identification & continuous engagement with stakeholders is key to identifying coastal issues. Stakeholders may include academics, scientists, policy and decision makers, non-governmental organizations, industry, and community members. The goal of including a diverse array of stakeholders into the CoPe research hub framework is to allow local voices to be heard, to identify and prioritize important coastal problems affecting the local/regional community, and to understand how research can be tailored to more effectively provide and inform coastal adaptation and mitigation solutions. Additionally, multiple stakeholders foster co-creation and sharing of knowledge.

#### *Climate-driven stressors alone or synergistic with local stressors*

This CoPe research hub specifically focuses on climate-driven stressors. Climate-driven stressors can cause direct or indirect impacts and may include combinations of long-term multiple stressors in combination with short-term episodic events. Climate change-induced stressors may include but are not limited to sea level rise, ocean acidification, warming air temperature, warming water, drought, and increased storm frequency, intensity and/or duration. Because correlations are not sufficient for making solid conclusions, developing experiments and models that address mechanistic processes will improve understanding and prediction of its causality and potential non-linearities.

The scientists funded through the hub could connect this observation to a range shift related to changes in sea surface temperature as well as to the local stressor of heavy metal pollution. Research conducted by the hub scientists would then characterize these synergistic stressors, explore the mechanisms behind any observed impacts to fish communities, and report back on an adaptive solution to the community stakeholders.

### *Standardization criteria for research conducted through the CoPe research hub*

In order to more effectively conduct research that delivers results to the community, this CoPe research hub has defined criteria of the methods that must be included in research. The CoPe research hub will also serve as a resource to facilitate matching research needs with scientific experts to ensure scientific expertise to address complex research questions. Scientists from different organizations may be required to collaborate to ensure all research needs are met. The four specific criteria required of research conducted through the CoPe research hub are 1) Leverage existing long-term datasets as available; 2) Collect data to characterize human and/or natural systems; 3) Include mechanistic experiments to determine drivers; and 4) Use modeling to delineate mechanistic processes and forecast trends.

### *Required integration of observations, experiments and models of coastal processes and human responses to the changes*

This includes developing models that integrate habitat suitability and resiliency in response to climate change and sea level rise, and provides input for socio-economics models. In a bottom-up approach, these models can consider impacts to the natural ecosystems and human communities that rely on these coastal systems by identifying ecosystem services and dynamic management goals, such as establishment of revised water quality criteria. Producing valuable habitat suitability indices can identify climate change related hotspots and refugia, as well as develop indicators species that can be utilized to provide an indication of long-term declining habitat loss and how this loss impacts human behavior and adaptation.

### *Required contributions to adaptations and mitigation*

In the face of climate change impacts, communities are looking for adaptation solutions to maintain and enhance sustainability of vulnerable coastal economic sectors including aquaculture, and fisheries. This will include ocean and coastline mitigation solution, such as seagrass or kelp cultivation for reducing cumulative stressor impact, that can be developed into new industries for economic development and sustainability of food security.

### *Iterative stakeholder engagement process*

The CoPe research hub understands that coastal systems, both natural and human, are dynamic. The CoPe research hub shall use iterative processes to fine-tune and update research as necessary in order to continue providing adaptation and mitigation solutions to the community.

## **Impact and Value**

Identifying impacts of climate stressors on coastal systems and adaptation strategies tailored to developing sustainability and resilience of different coastal ecosystems, communities, and coastal industries (e.g., fisheries, aquaculture). The integration of a modeling approach allows forecasting and predicting of reduced habitat suitability, identification of coastal hotspots of stressors/vulnerability as well as ecological refugia and MPAs, all related to future risks within the biological-social domain. In addition, the hub will provide science-driven adaptation and mitigation options that will help coastal ecosystems, engineering and infrastructure solutions, and communities to adapt to long-term climate related changes and episodic climate hazards. By using a collaborative approach, the hub will advance science while addressing stakeholder concerns and needs, including community outreach, resiliency and equity issues. The continuous engagement of multiple stakeholders further promotes co-creation of knowledge, knowledge sharing, and tech-transfer, and facilitates science-policy transfer of research outcomes.

### **Reasoning and Supporting Evidence**

An increase in climate-based stressors, including long-term changes such as temperature changes, ocean acidification, sea level rise, as well as episodic coastal hazards like hurricanes, are adding pressure to coastal and estuarine food webs and ecosystems that are already affected by a range of anthropogenic stressors (e.g., coastal pollution, nitrification, etc), and affect the well-being of coastal communities. The paleo records, long-term trends and variability extremes in the coastal systems, indicate current decline of habitat suitability and potential for social vulnerability. This calls for an interdisciplinary scientific approach for increasing mechanistic understanding of climate driven impacts on these systems, and identifying science-driven adaptation and mitigation measures that account for dynamic interactions between human and ecological systems. The complexity also requires a high-risk/high-reward research and high pay-off approach that is driven by innovation. In addition, there is a need for a more standardized approach for studying coastal systems to foster repeatability and transferability of findings. The hub will also fill the critical need for a platform that allows for long-term, iterative engagement of multiple stakeholders that work in collaborative efforts to find solutions for complex coastal systems issues.

### **Conclusion and Next Steps**

The proposed CoPe coastal hub provides a framework for actionable science and the development of innovative solutions for habitats and communities that are impacted by complex climate related stressors. The hub is also unique in that it provides a platform for community involvement and feedback. Next steps would involve developing funding mechanisms for the program, refining the hub framework, and implementing the fully developed hub in a coastal region.