

## Thematic Hubs

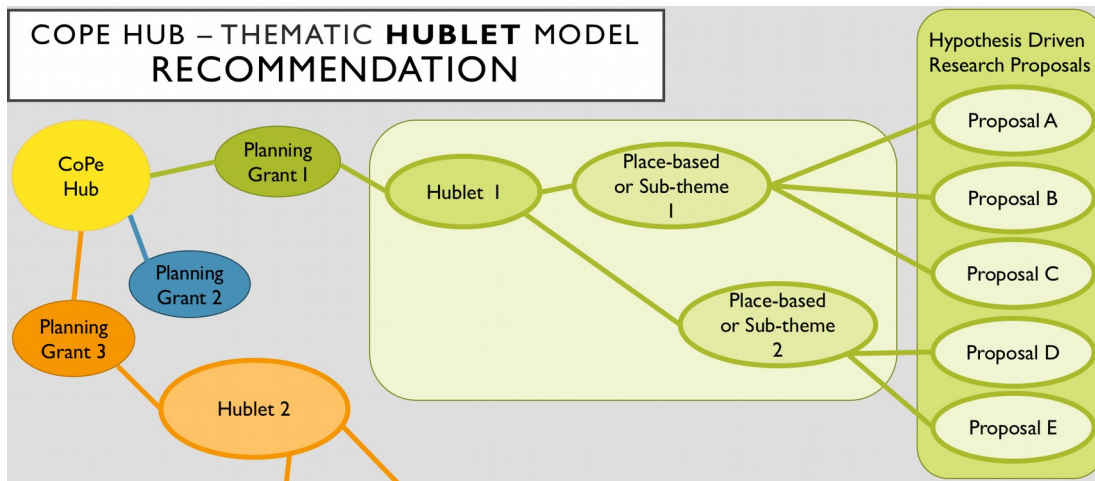
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### The Challenge and The Recommendation

The **big challenge** is to identify and address societal needs related to coastlines and people with a transdisciplinary, hypothesis-based research framework. The **solution** is:

- a virtual CoPe Hub that provides steering and oversight, organizational support, a data repository, community models, a forum for resource sharing, and coordination with national agency leadership, and
- thematic Hublets, each of which coordinates interactions between scientists, stakeholders, and decision makers to define societal needs, facilitates a convergent fundamental-research network, organizes and provides logistical support for cross-disciplinary studies, broadens community and national participation, enables educational opportunities, and translates research results to the broad community.

The CoPe Hub will host workshops including a broad group of scientists, agencies, NGOs, and industry to identify Hublet themes. The CoPe Hub steering committee (with limited term participants) will evaluate resulting proposals for one-year Hublet planning grants based on the critical societal needs. Hublet proposals will be evaluated on the breadth and depth of scientific interest spanning (and receiving buy-in from) at least 3 NSF directorates. The planning grants will provide support for the Hublet steering committee and interested participants to develop proposals for the activities, organization, and budget needed to address the Hublet goals. Successful Hublet proposals would be funded for 4 to 5 year terms, with the possibility of renewal for a second term.

Hublet activities might include supplying logistical support during coordinated regional or sub-theme studies (which could include colocated or distributed laboratory, field, numerical, and theoretical investigations), providing background observations for field or modeling studies (offshore wave data, bathymetry and topography, historical coastlines or vegetation information), hosting workshops to foster transdisciplinary

research or to integrate researchers and community members, enabling mini-sabbaticals, student exchanges, or colocation of scientific groups to nurture convergence (NRC 2014), funding educational activities (student fellowships, teacher opportunities, citizen science, research technician positions), and/or providing support and education to translate scientific results to communities and coastal managers. In addition, each Hublet will hold workshops to identify topics for place-based or sub-theme research studies.

After identifying a research topic, the Hublets will ask NSF to advertise RFPs for hypothesis-driven research, crossing at least one disciplinary boundary. With support from the Hublet, the team of scientists funded via these efforts would hone the integrated study, community involvement, and educational opportunities addressed within each topic. Hublet themes and activities will evolve as societal needs are addressed or change.

### **Reasoning for a Virtual Hub and Thematic Hublets**

The hub system will facilitate linkages between science, management, and community members, and provide support and facilitation for transdisciplinary research. The hub system also has clear benefits to scientists, agencies, and community members.

Thematic Hublets will enable societal concerns to be addressed, and at risk communities to be empowered. Impacts on coastal systems often have similarities across a range of regions. For example, Hurricanes Irene (2011), Sandy (2012), Matthew (2016), Harvey (2017), Irma (2017), Maria (2017), and Florence (2018) all caused damage owing to wind, rain and flooding, and waves and storm surge. Thus, we suggest theme-based Hublets to address the common processes and interactions during events, while also enabling place-based research studies that may integrate with local communities.

Theme-based Hublets also will enhance international exchange of information. Virtual Hubs and Hublets will ensure broad national participation (versus a fixed location or regional Hublet), while also enabling place-based or regional studies to entrain local communities. The proposed organization with evolving steering committees and frequent workshops will allow Hublet themes to be adaptable as needs change. Meanwhile, having an over-arching central Hub and steering committee will facilitate Hublet development, provide oversight and evaluation of Hublet progress, and enable a long-term framework.

The proposed convergent, integrative systems approach within each Hublet will generate rapid advances in understanding and predicting impacts on coastlines and people, leading to improved coastal management strategies. Coordinating research studies across a diverse group of scientists will nurture convergence. Working together to address common goals leads to deep relationships and will foster new collaborations and cross-discipline research ideas. Providing logistical support and background information for coordinated research provides benefit to scientists, entrains them into the Hub and Hublet approach with incentives through shared data and advancements from related disciplines. Transdisciplinary science workshops will ensure frequent face-to-face interactions, leading to development of a shared scientific language and fostering relationships developed during research studies. Incorporating agencies, NGOs, industry, and communities into the workshops will maintain the focus on societal needs, leverage other organization advancements and enabling relationships, and allow evolution of the Hublet science goals. Mini sabbaticals, student exchanges, and scientist colocation efforts allow intense scientific interactions spanning disciplines, and thus will further nurture convergence. Funding educational activities broadens participation from local communities, entrains a broader group, and ensures the next generation of

transdisciplinary scientists. Support for translating scientific results to community input will advance co-production of knowledge.

### **Hub System Value and Impact**

Coastal regions are vital to the national economy, coastal food production (Barange et al. 2018), security, commerce, and recreation. Worldwide, almost one billion people live at elevations within 10 m of present sea level. Long-term erosion threatens communities, infrastructure, ecosystems, and habitat (Elko et al. 2015). Major storms, sea level rise, tsunamis, earthquakes, and other natural events pose high risk to society and cause billions of dollars of damage. Degraded water quality impacts ecosystem and human health. For example, flooding from Hurricane Florence (2018) caused property damage of more than \$17 billion, and further losses to economic output. Flooding of coal production facilities and animal waste ponds resulted in extensive environmental damage to critical coastal ecosystems and fisheries. Contaminants introduced to the coastal aquifer may persist for decades. Ocean waves and surge caused erosion of protective dunes, overwash of low-lying areas, and damage to coastal infrastructure. Simulations suggest that the frequency of the most intense hurricanes and tropical storms may increase owing to climate change (Knutson et al. 2010, Emanuel 2013). In addition, accelerations in sea level rise (Sweet et al. 2017) may exacerbate storm impacts (Woodruff et al. 2013). It is critical to develop new methods and organizations to identify and address concerns associated with coastlines and people.

To rapidly advance understanding of the coastal system, including feedbacks and interactions between processes studied by a range of disciplines and to entrain coastal communities into solution decisions, it is necessary to have knowledge co-production from scientists, educators, stakeholders, and decision makers (Meadow et al. 2015). It also is critical to converge science disciplines to share knowledge and develop a shared language.

The CoPe Hub-Hublet system will leverage ongoing efforts by agencies to coordinate academic researchers, agencies, NGOs, and industry. By joining and expanding the coordination effort, the system also will leverage observations and research efforts made by these groups. The CoPe Hub-Hublet system will significantly advance translation of fundamental scientific advances to community members, and lead to improved communication by scientists and trust in the science enterprise by communities.

### **Summary**

Coastal areas are vital to the national economy, security, commerce, and recreation. By enabling convergence of research spanning geosciences, math and physical sciences, biology, engineering, economics, and social sciences the proposed effort will result in a better understanding of the process feedback relevant to coastlines and people. The hub system also will broaden participation and enhance educational opportunities, leading to a more involved and knowledgeable coastal population.

The CoPe Hub and Hublets will nurture convergence of research disciplines enabling rapid progress addressing critical societal needs. The CoPe Hub will act as a long-lasting oversight to ensure success, and to support, evaluate, and enhance Hublet performance. The evolving Hublet themes enable adaptation to changing needs and research progress. Together the Hub and Hublets will enhance co-production of knowledge by researchers, agencies, and communities that will address policy and economic needs.

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