Candidate Recommendation

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ORIGINAL BIG IDEAS:
12: **Storm resilience testbed**: physical, ecosystem, and social scientists team with local stakeholders to forecast coastal change and flooding, improve storm-readiness, make observations pre-, during-, and post-storm, then learn from the results and prepare for the next event!
26: **What:** Water! Hurricane Harvey and Florence have shown the importance of cascading hazards related to water: the interactions between flash flooding, river flooding, storm surge and currents and waves.
How: Intensive modeling and data collection before, during, and after coastal storm events. I would propose that the hub could participate in a field campaign (similar to what is done in NASA and NOAA) during the hurricane season so that resources could be concentrated in affected areas. The big difference would be that NSF would care about the social impacts and vulnerable populations. High resolution data collection is key, e.g., deployable radar, small disposable buoys in flooded areas, and community data collectors (photos, surveys, etc)
Who: Combining resources with other agencies, multi-institutional, real community engagement, and citizen science

Title: Coasts and People (CoPe) Storm Resilience Testbed

Our idea in a nutshell:

Motivation: We lack a fundamental understanding of how coastal storms drive physical, biological, and social processes that threaten coastal communities.
Goal: to identify pathways toward greater resilience to coastal storms
Approach: physical, ecosystem, and social scientists team with local stakeholders in several geographic centers to learn from past storm events, perform intensive rapid-response studies of upcoming storms, and develop a testbed for simulating future storm event scenarios to guide community action.

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)

Structure: Locate the testbed in several geographic centers that are positioned to access different community types (population density, wealth, culture), coastlines (built, sandy, rocky, marsh, permafrost), and storm types (extratropical and tropical cyclones). We would encourage centers to be located in university/public/private campuses or community spaces

to foster community-building and rapid-response operations. Researchers located across the US would be affiliated with the center that best aligns with their geographic location and topical focus. Communication between centers and with partner agencies at the coast would be achieved with shared online resources (such as Zoom) and quarterly meetings.

Participation: The centers would draw social and physical/biological researchers, decision makers, and public and private partners into community spaces to co-produce knowledge. Decision makers and public and private partners would be integrated in design of research efforts and scenario analysis. Community members would be engaged through developing existing relationships established by local partners, involvement in data collection (photos, surveys), public talks/workshops lead by the centers (e.g., town hall style forums, engagement with secondary schools), and communication through their respective networks and media outlets.

Actions: Combine long-term monitoring and resiliency model development with intensive field campaigns focused around storm events, analysis of historical analogs, collaborating with ongoing research and community engagement efforts across a broad coastal geographical region. Specific tasks include:

- Gather data from past storms in the geological, historical, political, socio-economic and instrumental record
    - Environmental data: water quality, wind, waves, inundation, precipitation, land use/cover, soils, ecosystems
    - Social data: information about social capital and ties, modes of governance, plans for disaster response and emergency preparedness, damage, and community ‘stories’ to help get a physical and social baseline for response
- Intensive data collection during the project period and in the event of a coastal storm
    - Partner with others (e.g., USGS, NOAA, and community science) to collect observations in a range of locations as a pre-storm baseline
    - Create a repository for the collection of atmospheric, hydrologic, water quality, biological, administrative, economic, and social data before, during, and after specific storm events
    - Social and natural conditions in the pre-storm environment and the post-storm disaster landscape
    - High resolution data collection and sharing will be a key requirement, e.g., deployable radar, small disposable buoys in flooded areas, and community data collectors (photos, surveys, etc)
- Analyzing the biological, physical, ecological, social and economic effects of past and current storm observations and linking with socio-economic outcomes, policy and program evaluation, and management decisions
- Development of simulation testbed to assess storm-driven coastal hazards and human actions/decisions scenarios
    - Determine the social and economic impact of historic storms and assess the impact of a similar storm striking again given given physical changes (e.g. sea level) and socioeconomic/population changes
    - Use the social and economic data and forecasted storm hazards to simulate social and economic conditions in the future
    - Explore different environmental factors and management actions (sea level and storm intensity changes, changing land-use/land-cover, coastal

engineering structures and living shoreline approaches) and assess their social and economic impacts and their impacts on resilience (program evaluation methods)

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?

The CoPe Storm Resilience Testbed would improve resilience of vulnerable coastal populations with a range of population densities, built and unbuilt coasts, and storm exposure. The testbed would deepen our understanding of why some coastal communities recover more quickly (or demonstrate greater resilience) to storm events than other communities.

Interdisciplinary with broad participation: CoPe's focus on integrating the human and physical science aspects of the coastal response to storms, with broad participation of local communities, NGO's, political agencies, universities, and industry would provide a new transformative perspective. The centers would act as "living labs" building on ongoing efforts in the region to develop coastal resilience, and stakeholders would participate to help define specific goals and objectives and gain access to the latest science to guide decision making.

Structure: Approaches and solutions tailored to needs across different geographies and cross-fertilization of knowledge, including comparisons of resiliency. Answer why some coastal communities recover more quickly (or demonstrate greater resilience) to storm events than other communities. This would require a research effort to obtain long-term physical and social data in historically vulnerable communities and if the opportunity arises, similar intensive data collection pre-event, during the event, and in post-event recovery. Data collection pre-event might focus on physical and ecological indicators; socio-economic characteristics; local government indicators of social and economic conditions (e.g. geocoded data on crime, building permits, code violations and blight, abandoned housing). The program would contribute resources and staff to oversee a data repository for both past and current storm events, reaching out to those involved in research campaigns funded by NSF, NOAA, USGS, and data collection networks such as the Community Collaborative Rain, Hail and Snow Network.

Participation: Communication across observational scientists, modelers/forecasters, social scientists, decision makers, community members. This project offers the scope to incorporate community-engaged and participatory research methods, particularly with respect to intensive data collection and analysis before, during, and after storm events. Collaborating stakeholders could include state and local governments (particularly environmental quality, public safety, emergency management, planning, transportation, and public works units) and nonprofit organizations (particularly disaster response, healthcare, faith-based, and community and economic development organizations).

Actions: Rich repository of biophysical and socio-economic data for identification of analogs, setting baselines, testing models, constructing realistic scenarios to test responses, establishing community histories, pooling research data from multiple disciplines to facilitate

collaboration.

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?

The structure of the testbed centers, partnerships with agencies and communities, and long-term funding would provide the stability and resources needed to collect intensive pre-, during-, and post-storm social and environmental data and develop a testbed framework as a research and a decision-making tool. Similar to focused efforts in weather-forecasting that have dramatically improved the accuracy of prediction of storm tracks and character several days in the future, CoPe could support a program that could transform understanding and predictability of the social and environmental response to storms. This would be supported by historic observations, new observations during storm events, and simulation frameworks. Specifically, we use observations to build accurate model forecasts of cascading storm hazards (erosion, flooding, loss/damage to infrastructure). Then, we can consider and assess alternative actions to reduce vulnerability in the future. For example, with rising sea levels and more frequent flooding of low lying areas, we could promote policies that shift development to locations that are less likely to be flooded in the coming decades. With aging infrastructure not designed to handle today's population and land use demands as well as worsening storm conditions, we need a dedicated center to guide planning for future construction, expansion of existing protective systems, and protective actions that individuals should take to reduce loss of life and property.

A significant body of evidence has emerged in recent years that suggests socially and economically disadvantaged communities are particularly vulnerable to losses from coastal storms. In turn, such vulnerability reinforces those already facing economic disadvantage. Van Zandt *et al.'s* (2012) study of the effects of Hurricane Ike on Galveston in 2008, for instance, found that disadvantaged neighborhoods were disproportionately located in areas that were more prone to flooding; residents in these neighborhoods slower to evacuate; and suffered greater losses as a proportion of pre-storm property values than more advantaged communities. To the extent sea level rise, coastal erosion, and storm frequency and intensity increase over time (IPCC 2015), we might expect the most vulnerable members of coastal communities to bear an even greater share of the costs.

The explicit integration of science and policy in the decision making process would lead to better natural resource management outcomes and coastal resilience. This is evidenced in literature on *structured decision making*, a strategy that considers scientific predictions, uncertainty, and societal values. (https://www.usgs.gov/centers/pwrc/science/structured-decision-making)
In addition, use of interdisciplinary research approaches (physical, biological, social) and local community knowledge has the potential to be transformative.