Coastal Community Multi-disciplinary Modeling & Observation Network

Emanuele Di Lorenzo, Georgia Institute of Technology
Ellen Herbert, Ducks Unlimited
Huili Hao, University of North Carolina Wilmington

In a Nutshell

How does the temporal scale of change impact the response of coupled human-natural systems?

Given the complex feedbacks between natural phenomenon, human behavior, coastal ecosystems and infrastructure that occur on both short- and long-term time scales, we propose a hybrid hub/research initiative that aims at:

- Developing the data infrastructures and modeling framework that enable *monitoring, understanding, and forecasting* the **impacts of anthropogenic and physical drivers** on the **natural environment**, **built environment,** and **populations** at the coast.
- Establishing a set of synergistic people networks (e.g. stakeholders, scientists, and engineers) that will co-develop the knowledge and co-design the **tools for planning coastal resilience and economic development.**
- Quantify system feedbacks for both **long-term change and major events.**
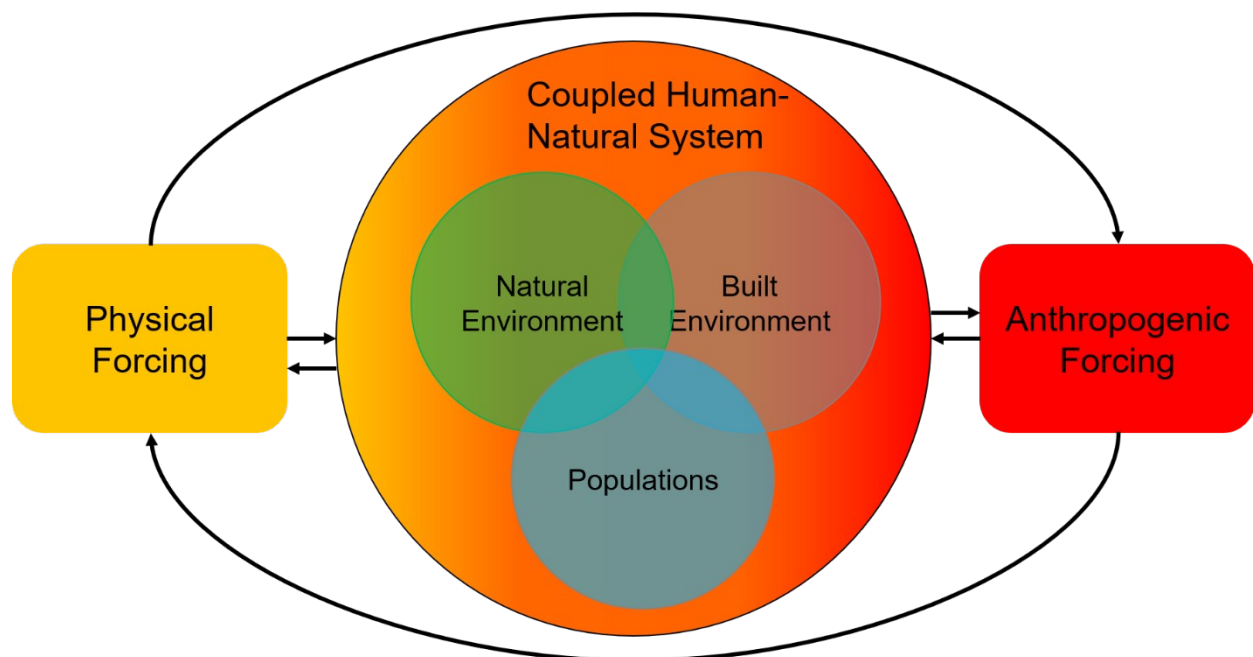
Specific Recommendations

A successful network will incorporate the key elements: a diverse set of people co-developing questions, observing platforms, modeling frameworks. More specifically, we envision:

1) Regional Diverse Stakeholder Networks that includes policy makers, regulators, decisions makers, local communities, planners, business owners and members of under-represented communities to interface with a knowledge network made of scientists and engineers with domain experts in the three key dimensions, environmental, human and infrastructure.

These networks will work together to co-develop and co-design the following elements:

2) Multi-Disciplinary Data Streams that resolve key processes for planning coastal resilience and economic development. These processes include the hydrological cycle, energy consumption and production, sea level and dynamics flooding, infrastructure development and maintenance. Using these data streams we will answer questions of how the co-evolution natural and built environments modify the impact of natural hazards and environmental changes, economic development and value, ecosystem services, business operations and types, social vulnerability. The observing network will multi-variate and will involve both professional and citizens in the deployment of instruments and retrieval of the data. Key to the network is to use low cost observational platform and sensors, with high spatial resolution coverage to enable "human-scale" understanding of processes that impact human (e.g. dynamics flooding, urban heating) and synergistic relationships with managers of existing data streams such as urban utilities.

3) Modeling & Predictions Framework that integrates the data sources from the environmental, human and infrastructure to reanalysis of historical coastal conditions, evaluation of real-time conditions, forecasting, and the evaluation of different social-economical-environmental scenarios. An example of an integrated modeling framework includes interfacing (1) regional earth system models that resolve the processes outlined above, (2) infrastructure performance evaluation modules, and (3) human indicator networks. The development of new "creative" integration approaches is a key component of the research capacity for **observing and modeling networks.**

The data, modeling and people networks will focus their research on planning coastal resilience and economic development in the face of climate and human drivers that act to force long-term changes that lead to sustained social-ecological-environmental changes in the community, as well as event/extremes that lead to emergency responses.

<mark>Impact/Value</mark>

Our research will quantify, understand and forecast risks in coupled human-natural systems driven by long-term change, extreme events and the interaction between long-term change and extreme events. This will encourage the planning of sustainable economic development (e.g. businesses, tourism) and enhance tools for community resilience such as:
- Scenario exploration
- Cost-Benefit
- Trade-offs
- Visual understanding of complex interactions)
- Include equity in proactive planning

Finally, the network and research framework will promote and iterative approach to co-development of research priorities and data-driven solutions.

Coastal communities are most vulnerable during **short-lived extreme weather events**, as evidenced by the devastating impacts of Hurricanes Florence, Harvey, Irma and Maria. These recent natural disasters illustrate the compound threats that coastal communities face as climate change and human development continue to exert pressures on coastal systems. Given that over 40% of Americans live in coastal counties with thriving economies and associated infrastructure, there is a critical need for developing observing and modeling networks that allow for community-based resilience planning and economic development. Moreover, recent events demonstrate that communities are **uniquely vulnerable to long-term drivers that slowly result in the degradation of their quality of life, ultimately leading to displacement** , such that resilience planning tools and resulting policies must explicitly incorporate the health and well-being of such residents (e.g. "resilience equity") in order to **effectively mitigate the effects of both incremental change in baseline condition and environmental extremes.**