ADAPTABLE COASTAL CITIES

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We propose that the National Science Foundation (NSF) focuses on the concept of "adaptable coastal cities (ACC)" as part of the CoPe "hub." The primary focus in the ACC initiative will be developing adaptive solutions to the critical challenges of natural and built coastal environments in response to and in anticipation to climate change.

IDEA IN A NUTSHELL

Coastal cities are facing increasing threat from flooding and erosions as a result of high tides, sea level rise and storm surge. The current city form, in terms of infrastructure and building structure, are inadequate and obsolete to respond and adapt to coastal hazards. We need to plan, design and develop new types of cities (e.g., floatable cities) and retrofit existing cities so that the cities are adaptable and resilient to ever changing coastal conditions.

Adaptable coastal cities mean that city infrastructure and building structures have the capacity to adapt to sea level rise and storm surge and to mitigate damages from wind, flood, rising sea level and other coastal hazards. Research is needed to come up with innovative and cost-effective technologies and methodologies to retrofit the existing infrastructure and elevate existing buildings and roads, and to provide new design guidance and building codes to develop new infrastructure and buildings.

RECOMMENDATIONS

1. Evolve design codes for the built environment to safely withstand coastal hazards (e.g., coastal flooding, hurricane wind, ***flood hydrostatic, hydrodynamic, and both wave and debris impact loads***). See Figures 1, 2 and 3 for examples of coastal impacts.

2. Develop innovative and cost-effective structural ***retrofitting*** methods to strengthen the built environment under environmental and socio-economic considerations.

3. Mainstream adaptation planning and design principles in the comprehensive planning process.

4. Formulate methods and procedures to enhance social and human resilience.

5. Explore efficient and equitable financing and resource allocation.

6. Broaden community engagement in the design and decision-making process of adaptable city planning and design.

Figure 1. Flood causing detachment of house footing

Figure 2. Floating house

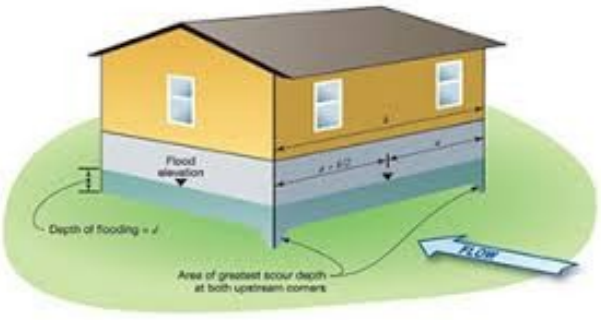

Figure 3. Flood loading on a house

EXPECTED IMPACT

The outcomes of this effort will lead to the development of cost-effective, practical and sustainable adaptation measures for coastal natural and built environments. The broad goals are to prevent degradation of public health, property, culture, ecology, and the quality of life in vulnerable coastal communities. Specific impacts include:

- Reduced property losses and minimal health impacts

- Innovative engineering solutions for complex coastal community adaptability
    - sustainable development with least impact on the ecology
    - sustainable and flood-resistant materials for newer constructions
    - resilient critical infrastructures
- Maximizing useful life of critical assets with minimal investment
    - cost-effective retrofits
    - temporary structures to strengthen critical infrastructure and add redundancy
- Critical assessment of grey vs. green infrastructures
    - right balance between the both
- Practical and acceptable regulatory/public policies
    - through engagement of public and other stakeholders
    - willingness to take on risk and pay in an equitable manner
    - enforceable design codes on private and public built environment
- Novel insurance schemes for equitable risk sharing
- Preservation of culture for displaced communities from vulnerable areas
- Modular buildings for adaptive retrofits and potential relocations
- Innovative critical infrastructure service delivery for floatable cities
- Multi-disciplinary focus for sensible and broader impacts
- Multi-disciplinary research training and workforce development

REASONING OR SUPPORTING EVIDENCE

Thermal expansion of water and melting of glaciers caused by global warming has resulted in a sea level rise (SLR) of approximately 1.7mm/year over the last century and over 3.2 mm/year in the last few decades (NOAA, 2014). This accelerated SLR combined with frequent storm surge events is already devastating the low-lying coastal regions of the southeastern U.S. The fact that some of the fastest growing metro areas in the U.S. are located along the coasts highlights the increased vulnerability of those populations to growing climate change impacts and the need for collaborative, long-term adaptation planning, innovative and cost-effective technologies, and comprehensive approaches and methodologies.

NOAA. (2014). Sea Level Rise and Nuisance Flood Frequency Changes around the United States, NOAA Technical Report NOS CO-OPS 073.