OPPORTUNITY #1: PHOENIX, AZ

TITLE AND NAMES OF SUPERVISORS:
“Assessment and Comparison of U.S. Design Storm Standards and Their Implications on Urban System Vulnerability to Extreme Events”

Primary Supervisors: Dr. Samuel Markolf, Dr. Mikhail Chester, and Dr. Thaddeus Miller

ABSTRACT:
Design storm standards (e.g. 100-year storms) are critical factors in determining how well our infrastructure and urban systems are able to withstand and maintain functionality during extreme weather events. However, little is known about how these design criteria are established, how consistent they are across time and locations, or whether they take into account the multitude of factors that can contribute system disruptions. This opacity was highlighted during Hurricane Harvey in 2017, when over 50% of the estimated flooding in Harris County, Texas occurred in areas designated as ‘minimal flood hazard’ (i.e., less than a 0.2% annual chance of flood). Thus, through a combination of literature review and geographic and systems analysis, this work seeks to answer the following question(s):

• How does land use change contribute to urban storm water runoff and flooding, and to what extent is land use change and location of critical infrastructure incorporated in the establishment design storm criteria?
  o What is the current design storm criteria in each U.S. UREx city?
  o How have these criteria been developed and changed over time – especially in the context of climate change and land use change?
  o How similar are the criteria across different locations?

Ultimately, this work has the potential to provide valuable insights into knowledge gaps and best practices that exist within current design storm criteria. Given the relative inflexibility and long-lasting nature of many infrastructure systems (and the design criteria to which they are built) these insights may prove invaluable in better adapting our urban and infrastructure systems to the rapid environmental and sociological changes they are likely to experience in the coming decades.

More information about our research, the Chester Lab, and the Infrastructure Resilience Lab can be found at the following links:
http://chester.faculty.asu.edu/research.php
https://cesem.engineering.asu.edu/resilience/
https://sustainability.asu.edu/person/samuel-markolf/
https://sustainability.asu.edu/person/thaddeus-miller/
**RELEVANCE TO UREx SRN MISSION, OBJECTIVES, AND RESEARCH:**
The proposed work aligns well with the City Comparisons WG’s objective of analyzing the capacity of each cities’ infrastructure to withstand extreme weather events. Additionally, this work would be a nice addition and complement to ongoing work within the Relates to ongoing efforts in SETS and City Comparisons, and builds on on-going efforts within Knowledge Systems Innovation Task Force – Dr. Chester gave a December 2017 KSI webinar related to design storm criteria in Phoenix, and Dr. Miller is currently leading the development of a paper titled ‘Designing for Tomorrow’s Storms: Adapting Institutional Knowledge Systems to Address Climate Change’. Similarly, design storm criteria are inherently SETS issues in that they merge institutional (social) and technological factors in the context of local ecosystems and climate. Finally, the information gathered from this work has the potential to be very informative in decision-making efforts and conversations with UREx SRN’s City Practitioners.

**REU’S RESPONSIBILITIES AND SKILLS TO BE ACQUIRED:**
The REU will be responsible for collecting and summarizing literature and policy documents related to land use change and design storms in urban areas; performing high level data analysis using Excel or other statistical software; using ArcGIS (of other geographic processing tools such as Google Earth Engine; carefully documenting his/her process and keeping files/data organized; meeting regularly with supervisors to discuss progress/challenges/concerns; and presented final results in written and poster/oral form at the conclusion of the experience.

The REU will gain skills in formulating and pursuing research questions, developing literature reviews, processing and analyzing data using Excel or R (or equivalent), analyzing geospatial data with ArcGIS (or equivalent), collaborating within an interdisciplinary team, developing a scientific poster or talk, and presenting research methods and findings to a diverse audience.