Rethinking Failure: Engineering for Climate Extremes

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How does our built environment make society vulnerable to climate extremes such as flooding? What knowledge is required by engineering designers and risk managers to address the associated risks? How can engineering/scientific approaches be adapted to reduce vulnerability to weather and climate extremes? These were some of the key questions posed during a recent workshop at the National Center for Atmospheric Research, which was attended by climate scientists, civil engineering practitioners, and governmental departments. Engineering design encompasses a broad range of applications; to focus discussions, this workshop targeted the specific theme of water resources.

Engineered solutions to manage water resources have been developed empirically from observed extremes. In recent years, increases in population in vulnerable locations in combination with anthropogenic changes to the built and natural environment have all increased the risks posed to water infrastructure (storage and flood prevention) and to the reliability of the systems. The workshop explored whether traditional design approaches are sustainable or appropriate in a changing climate, and how historically defined empirical relationships engender lower resilience to catastrophic climate events, ultimately leading to failure.

The workshop comprised three sessions, each with two keynote presentations, followed by themed discussions in small groups and a plenary discussion:

- Today’s engineering solutions to climate variability and extremes
- Policy, economic, regulatory implications and constraints
- Where are we going?

The first session focused on critical vulnerabilities to climate extremes that are present today, finding that many systems may be more vulnerable to non-climate stresses (such as insufficient maintenance). Furthermore, failure is not a good word as it implies that the risks can be fully mitigated and hazards fully avoided. A better approach is to represent the risks associated with a range of protection measures, in combination with better communication across diverse vulnerability groups.

The second session centered around the notion of uncertainty in and between climate models, even though their output forms only part of the decision process in combination with land use and population changes *inter alia*. A sea change is required in the use of future climate information to empower decision makers to focus on the known hazards and vulnerabilities. This involves beginning with tractable options to manage hazard and risk, then introducing the climate scenarios at a later stage to facilitate more flexible adaptation strategies that encompass the uncertainty.
The final session considered the needs of the engineering community and how these can be supported by scientists, emphasizing the need to learn from existing technology, policies and practices rather than continuing to address each problem as a new challenge. Communication between scientists, users and the public could be improved by reframing the questions surrounding scientific knowledge to identify how that information will underpin decisions.

The organizers emphasize that this workshop aimed to instigate collaborations between engineers and scientists. It facilitated discussion on non-traditional approaches to address the risks posed by extreme events rather than providing a venue to present extant research. Further information is available from http://www.mmm.ucar.edu/events/2013_climateextremes/index.php