Can We Build Useful Models of Future Risk from Natural Hazards?

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Aerial view of the Limpopo River, Mozambique, from 2000. In March of that year, floodwaters rushed through communities, damaging the country's infrastructure
TSGT C. Humphries

By Albert J. Kettner, Irina Overeem, and Gregory Tucker 10 September 2018

Natural hazards cause thousands of deaths and inflict tremendous societal damage every year. The database of the United Nations Office for Disaster Risk Reductio (https://www.unisdr.org/) shows that the United States alone experienced 212 disasters between 2005 and 2014, worth $443 billion in damage. Worldwide over that sar 700,000 people were killed, and 1.7 billion people were affected by disasters. As a priority for action, the United Nations Sendai Framework (https://www.unisdr.org/we/coordinate/sendai-framework) urged a fundamental switch from merely responding to disasters after the fact to a proactive strategy of planning a resilience to reduce vulnerability to disasters before they occur.

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Computational modeling (https://eos.org/research-spotlights/researchers-roll-clouds-into-climate-modeling) provides an essential tool to better understand the fundamental surfa

processes causing natural hazards and their effects (https://eos.org/project-updates/seismic-hazard-assessment-honing-the-debate-testing-the-models) on Earth's surface change, esp where observations might fall short. As such, Earth surface models can contribute to quantitative preevent (https://eos.org/articles/how-forecasting-models-are-changing-the-w fires) risk assessments. Yet such assessments are appropriate only if models capture the important physical processes (https://eos.org/project-updates/how-landslides-become and are tested and well vetted—as well as usable and proven to be accurate.

To further explore and promote model-driven risk assessments, the Community Surface Dynamics Modeling System (CSDMS (https://csdms.colorado.edu/wiki/Main_Page organized a workshop. An international interdisciplinary group of over 130 scientists met to assess the state of knowledge in natural hazard modeling for risk assess focusing on building a next-generation cyberinfrastructure and a community for modeling and analysis practices.

Four major topics emerged from this meeting:

The first was the need to better integrate extreme events in Earth surface modeling. Low-probability, high-magnitude events often dictate landscape form and have potential to reset the directionality for long-term change. However, models might not run on spatial or temporal scales that capture such a hazard.
Human actions can trigger or magnify natural hazards in an evolving landscape.
Cyberinfrastructure to better integrate multiple models and data is required. For example, cascading natural hazards are common. Although many single-hazard mo almost none are capable of integrating across hazards, which is a necessity to truly assess risk. Coupling frameworks can accommodate for this.
Interdisciplinary research is necessary. Modeling the evolution of landscapes for risk assessment requires incorporating human dynamics. Human actions can trigg magnify natural hazards in an evolving landscape. There is value, therefore, in having the human factor integrated or coupled to environmental models.
Developing strategies for model testing, model validation, and model benchmarking against natural disasters as they happen and, with the recent explosion in remo data acquisition, rapidly afterward would provide insight into model uncertainty and to what extent models can be implemented in applied sciences.

Workshop information and presentations are available at the workshop's website (https://csdms.colorado.edu/wiki/CSDMS_meeting_2018). Scientific advances in model-dri assessments will be published in a special issue of the open access journal *Natural Hazards and Earth System Sciences (https://www.natural-hazards-and-earth-system-sc* The special issue is titled "Advances in Computational Modelling of Natural Hazards and Geohazards (https://www.natural-hazards-and-earth-system-sciences.net/special_issues/schedule.html#17)." Submissions are welcome until 1 March 2019.

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