

SimCenter Community Roundtable
“Advancing Hurricane Regional Simulation:
A Community Discussion of Challenges & Opportunities”
September 27, 2024

This SimCenter Community Roundtable meeting was organized by the **Working Group on Regional Simulation of Hurricanes**. This session convened leaders in hurricane regional simulation to share lightning talks on some of the latest developments from their initiatives and then engage in a wider discussion with attendees on key challenges and opportunities to further advance the state-of-the-art.

Host: Tracy Kijewski-Correa, University of Notre Dame

Presentations and Key Ideas

1. **“AI-Empowered Hurricane Engineering: A Modeler’s Perspective”**

Presenter: Teng Wu, University at Buffalo

A stochastic framework called BuCH was used to simulate wind, rain, and storm surge hazards from hurricanes. The framework leveraged multiple machine learning surrogates and rulesets to perform its simulations.

2. **“AI and CFD in High-Fidelity Vulnerability Modeling”**

Presenter: Seymour Spence, University of Michigan.

Presented a framework that used BRAILS to predict the built environment in an area, then coupled the geometry of this environment with CFD simulations and a Monte Carlo-based damage estimation approach to predict wind- and debris-induced damages to light-frame wooden buildings.

3. **“Multidisciplinary Community Resilience Modeling with IN-CORE”**

Presenter: Kooshan Amini, Rice University.

This presentation showcased the capabilities of IN-CORE through their Galveston testbed. The hazard input was created using ADCIRC+SWAN. A computable general equilibrium (CGE) model and a population dislocation model were used to quantify socioeconomic effects.

4. **“Florida Public Loss Model”**

Presenters: Jean-Paul Pinelli, Florida Institute of Technology & Kurt Gurley, University of Florida

A presentation of the Florida Public Loss Model. Some recent advances include component-based modeling for building interiors and contents, simulating recovery times, and including inland floods and tree hazards.

5. **“Coastal Hazards, Equity, Economic Prosperity and Resilience Hub”**

Presenter: Rachel Davidson, University of Delaware

The CHEER Hub was presented, where the STARR tool converts damage and loss results into recommendations for policies, insurers, and households. The tool simulates loss as time dependent.

6. **“Leveraging StEER Network for Improving Regional Simulation of Hurricanes”**

Presenter: David Roueche, Auburn University

Presentation of the StEER network and its WiSPD dataset, highlighting their use for fragility descriptions.

7. **“Obtaining Asset Inventories for Natural Hazards Applications”**

Presenter: Barbaros Cetiner, UC Berkeley and SimCenter

This presentation demonstrated SimCenter’s BRAILS package for generating inventories of the built environment.

Discussion Highlights

- The ability of current machine learning surrogates to accurately simulate hurricane-borne wind, storm, and rainfall patterns is limited. A potential solution could be to correct low-fidelity models through calibration with high-fidelity data or rulesets.
- The optimal fidelity necessary for wind and surge hazard models, in light of uncertainties later in the loss modeling chain, has yet to be established.
- The role of wind-driven rain in hurricane damage still needs to be better understood.
- The growing availability of experimental and field data presents numerous opportunities for developing and validating new models and frameworks.
- Accurately simulating interdependencies between individual components of the built environment continues to be a challenge.
- Hazard models for convective storms and tree falls have yet to make their way into damage and loss assessment.
- Current loss models do not quantify the evolution of hazard exposure resulting from climate changes and population shifts.
- Changes in vulnerability, such as the aging of building structures, have also not yet been accounted for in loss studies.
- Damage processes for building interiors and contents require further development.
- Accurately assessing the cost-effectiveness of various mitigation strategies remains a challenge.
- A better understanding of multi-hazard damage sequences is needed for effective multi-hazard modeling.
- Estimating building retrofit costs is complex and needs further refinements.
- Software that incorporates community-scale flood mitigation (e.g., levees, seawalls) are needed.
- StEER's WiSPD dataset can be used for validating wind-induced damage models.

More Information

Additional SimCenter Community Roundtable meetings can be found at <https://simcenter.designsafe-ci.org/collaborate/scr/>.