



2020 Programming Bootcamp

Welcome & Introduction to SimCenter

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University of California at Berkeley



NSF award: CMMI 1612843

WELCOME

- This is an Intensive Bootcamp
- Cover a lot of Material (Breadth not Depth)
- Focus on Programming not Algorithms
- Intro to Programming for Civil Engineers Researchers by Civil Engineering Programmers/Researchers
- This year is different – no direct participant interaction

Collaborate

1. QUESTIONS & ANSWERS go to BOARD

The screenshot shows the homepage of the SimCenter Forum, which is a Simple Machines Forum (SMF) instance. The URL is <https://simcenter-messageboard.designsafe-ci.org.smf/index.php>. The page features a header with a welcome message for 'Hello fmk', a search bar, and a news banner stating 'SMF - Just Installed!'. Below the header, there's a navigation bar with links for Home, Help, Search, Admin, and Mod. The main content area displays several topic categories:

- SimCenter Training**:
 - Programming Bootcamp**: 1 Post, 1 Topic. Last post by pmackenz on Today at 01:41:28 PM.
- General**:
 - General Questions**: 0 Posts, 0 Topics.
 - Installation**: 16 Posts, 1 Topics. Last post by elihaddad on June 22, 2020, 08:22:05 PM.
- Research in Natural Hazards Engineering**:
 - Uncertainty Quantification (quoFEM)**: 25 Posts, 10 Topics. Last post by fmk on July 05, 2020, 01:53:22 AM.
 - Wind Engineering (WE-UQ)**: 24 Posts, 7 Topics. Last post by fmk on August 07, 2020, 07:49:19 PM.
 - Earthquake Engineering (EE-UQ)**: 38 Posts, 12 Topics. Last post by fmk on August 05, 2020, 05:42:50 AM.
 - Hydrodynamic Engineering (Hydro-UQ)**: 0 Posts, 0 Topics.

PRIZE To who answers the most (coveted SimCenter Mug)

2. Breakout Rooms

3. POLLING

FORMAT

- 45 min exercise review (9.15-10.00)
- 3 hours zoom presentation/hands on (10.00-1.00)
- Homework Assignments/Video Review (1 to 3 hours)

Material Covered

- Computer Architecture, Sequential & Parallel
- Python with exercises in web scraping and AI
- C/C++ with exercises in parallel programming
- DesignSafe TAPIS.

GOAL

- You walk away with an idea about how to Program
- You form relationship with other participants
- You walk away with some understanding about what SimCenter is doing so that you may contribute to research in natural hazards engineering

POLL

Where Are you From



2020 Programming Bootcamp

Introduction to SimCenter



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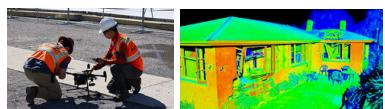
NSF NHERI Natural Hazards Engineering Research Infrastructure



NCO



7 Experimental facilities



2 Recon facilities



SimCenter NHERI

Center for Computational Modeling and Simulation

Cloud-enabled research applications Scalable to run on HPC with emphasis on UQ

Front-end

SimCenter Research Applications



M PE

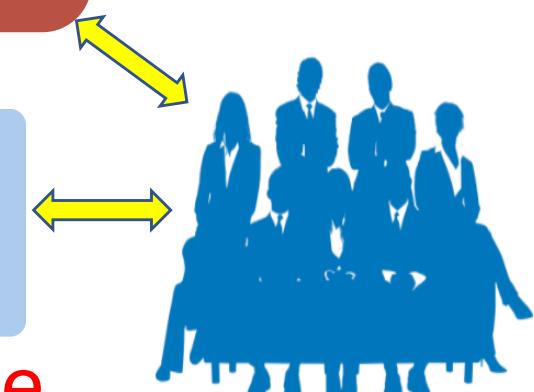


EE
UQ



3

We are a Virtual EF producing Software



**Researchers
Industry
Government Agencies**

SimCenter Goal

“To **transform** the nation’s ability to understand and mitigate adverse effects of natural hazards on the built environment **through advanced computational simulation**”

Grounded in the present
Five year focus
Twenty year vision

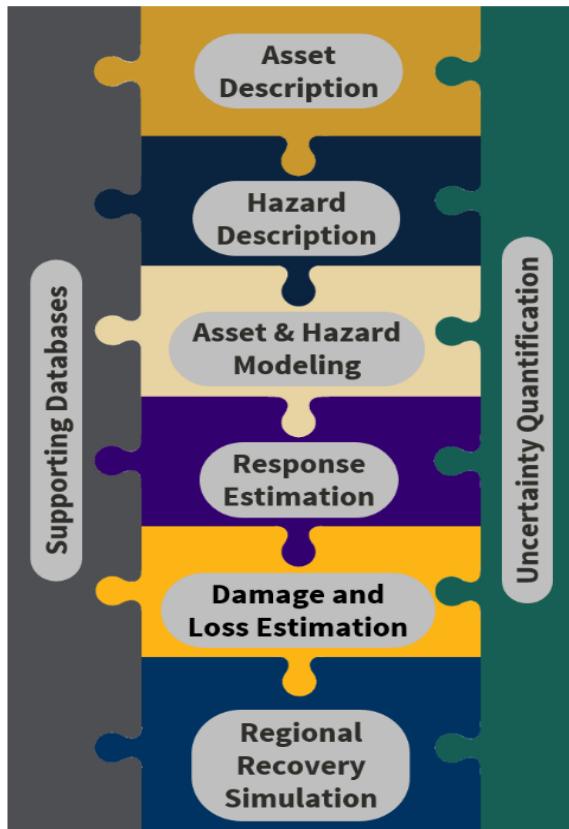
SimCenter Mandate from NSF

To produce Extensible Software that Researchers in Natural Hazards Engineering can use in their Research

- Develop an **open-source computational framework** for **building scientific workflow systems** to support decision-making to enhance community resilience to natural hazards **in the face of uncertainty**;
- **Design a framework** that is sufficiently **flexible, extensible, and scalable** so that any component of it can be enhanced to improve the analysis and thereby better meet the needs of the community;
- **Seed the framework** with enough **data** and **interfaces to existing simulation tools** so that it can be employed in the near-term;
- **Release tools/applications built using this framework** that meets the computational needs of researchers in natural hazards engineering;
- **Provide an ecosystem** that fosters collaboration between scientists, engineers, urban planners, public officials, and others who seek to improve community resilience to natural hazards.

Scientific Workflow Systems??

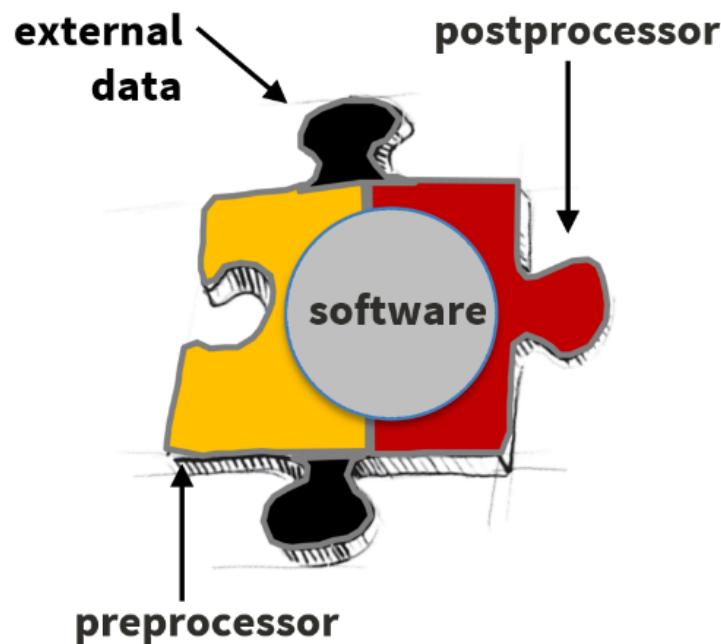
Scientific Workflow System: An application that allows users to build, launch, and monitor **scientific workflow**.



Scientific Workflow: A scientific workflow is an **automated workflow of applications** in which multiple applications are invoked following a **workflow description** with applications started and data being passed between the applications by **workflow management software** that runs the **workflow**.

We are not Starting From Scratch

there exists a lot of existing software
& online services providing data

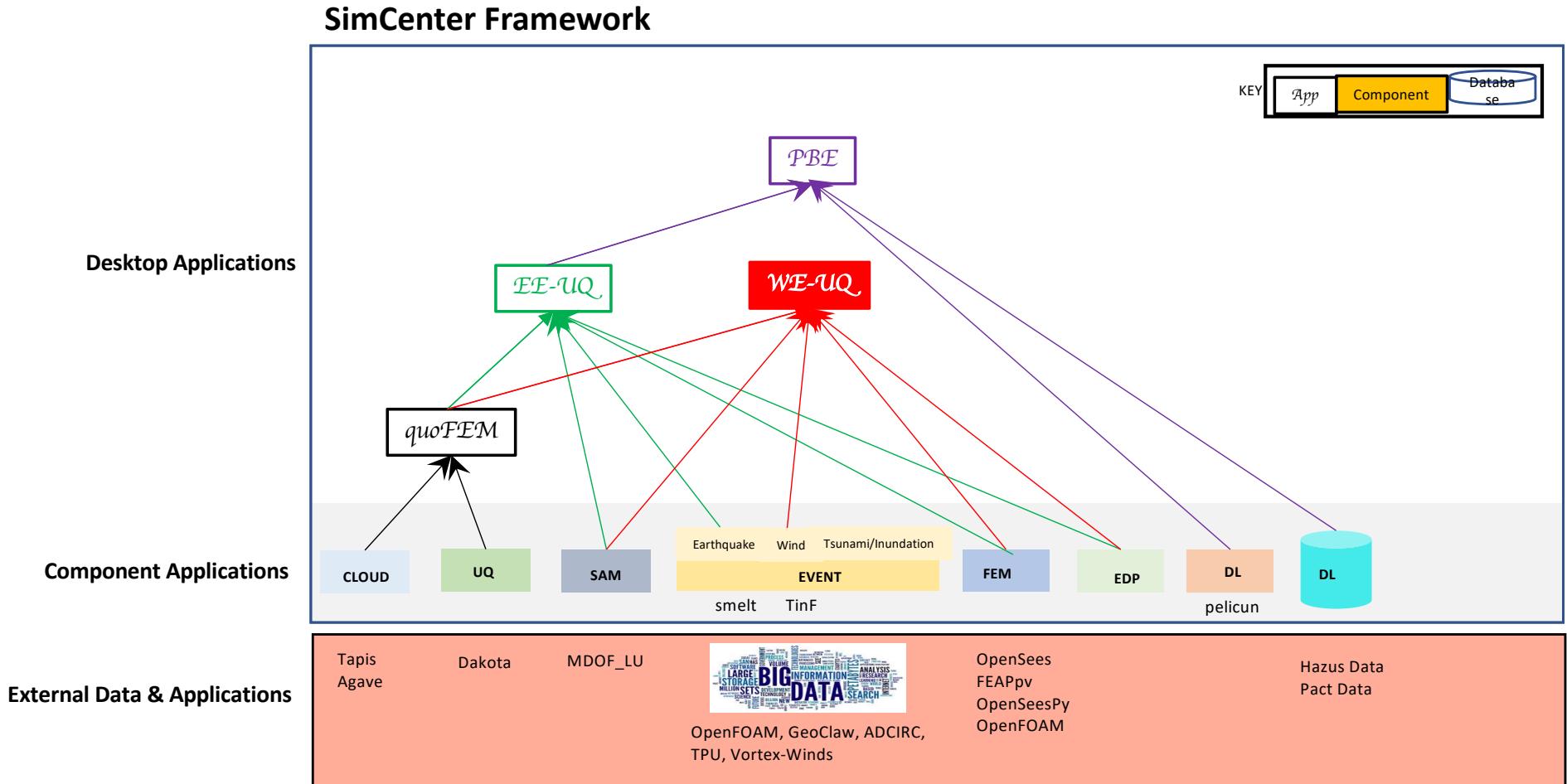


Our Tools Execute Workflows

These Workflows Produce UQ

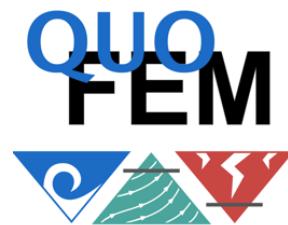
i.e. for each output response they produce information on the response and some measure on the uncertainty in the computed response, e.g. mean and std. dev

Software Design



SimCenter Research Applications

Available Now for Building Level Response Characterization





Wind Engineering with UQ

Quantifies uncertainty in **building response** when building subjected to a Wind Event by performing multiple linear or nonlinear time history analysis

Application:

- **Inputs:** Building information, structural modeling, wind event & inputs for UQ
- **Outputs:** UQ of building response

Release Dates:

Version 1.0 (2018) CFD Bluff Body

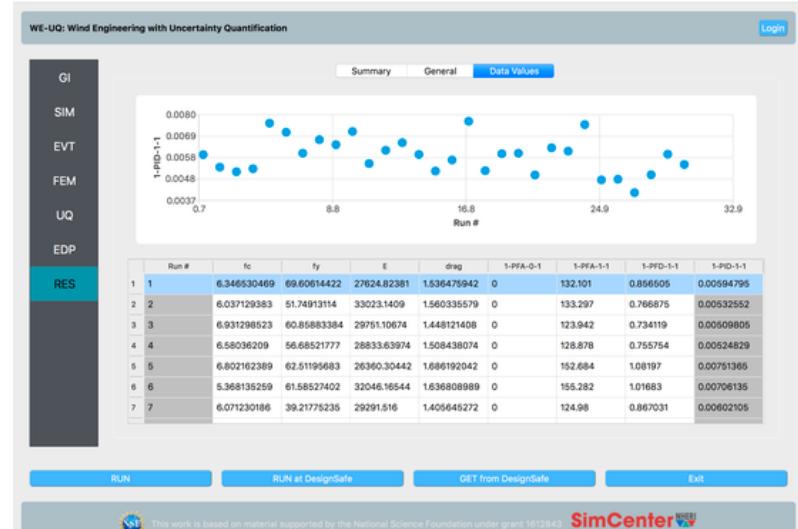
Version 2.0 (2019) Sampling, Stochastic Loading, Wind Tunnel & Online Datasets

V 3.0 (2020) coupled FEM-CFD, more datasets, Sensitivity, Reliability

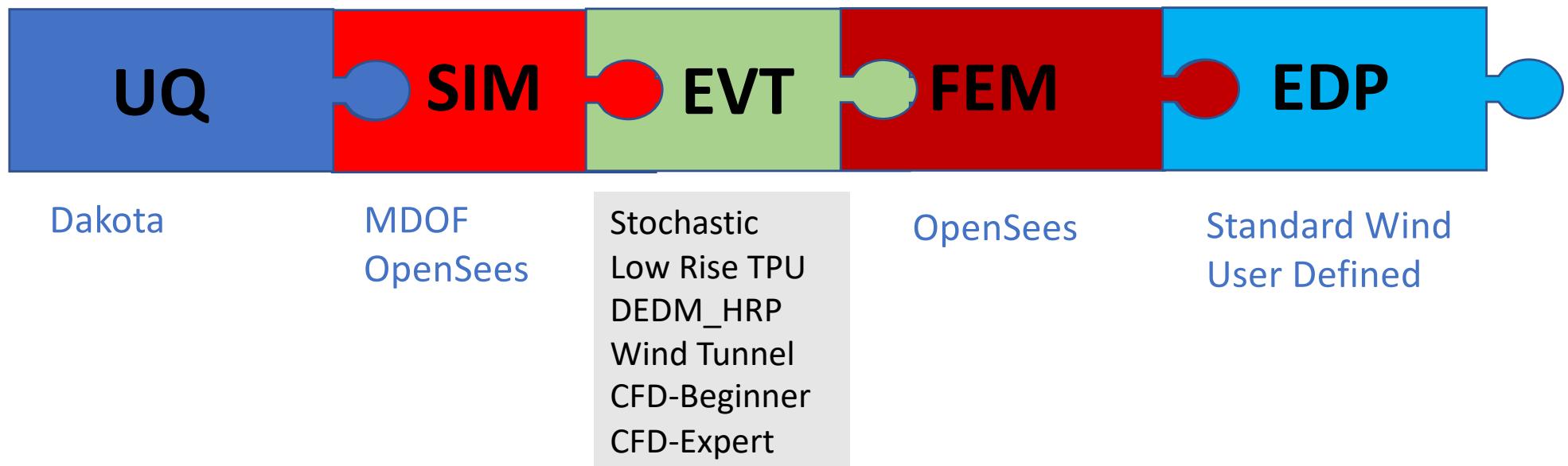
The screenshot shows the 'WE-UQ: Wind Engineering with Uncertainty Quantification' software. On the left is a vertical menu bar with buttons for GI, SIM, EVT, FEM, UQ, EDP, and RES, where EVT is highlighted. The main panel has a header 'Loading Type: DEDM_HRP' and a banner for 'Vortex-Winds' with the tagline 'A Virtual Observatory to Reduce the Risk of Extreme Winds on Society'. Below this are sections for 'Wind Tunnel Building Geometry' (with a diagram of a building of height H=1), 'Building Height' (radio buttons for H=1 to H=5), 'Exposure Condition' (radio buttons for 'Urban/Suburban Area' and 'Open Terrain'), 'Wind Speed and Duration' (input fields for 'Mean Wind Velocity at Building Top' (100.0 mph), 'Duration' (10 min), and 'Angle of Incidence' (0 degrees)), and buttons for 'RUN', 'RUN at DesignSafe', 'GET from DesignSafe', and 'Exit'. At the bottom is a note from the National Science Foundation and the SimCenter logo.

Research Opportunities:

- Finite element modeling
- Hazard characterization
- UQ including surrogate model generation
- Datasets for model calibration
- CFD Simulation
 - Inflow Conditions
 - Meshes
 - Coupling CFD-FEM



Is WE-UQ a Scientific Workflow System?



Integrates Simulation Applications with UQ Engine(s)

Application:

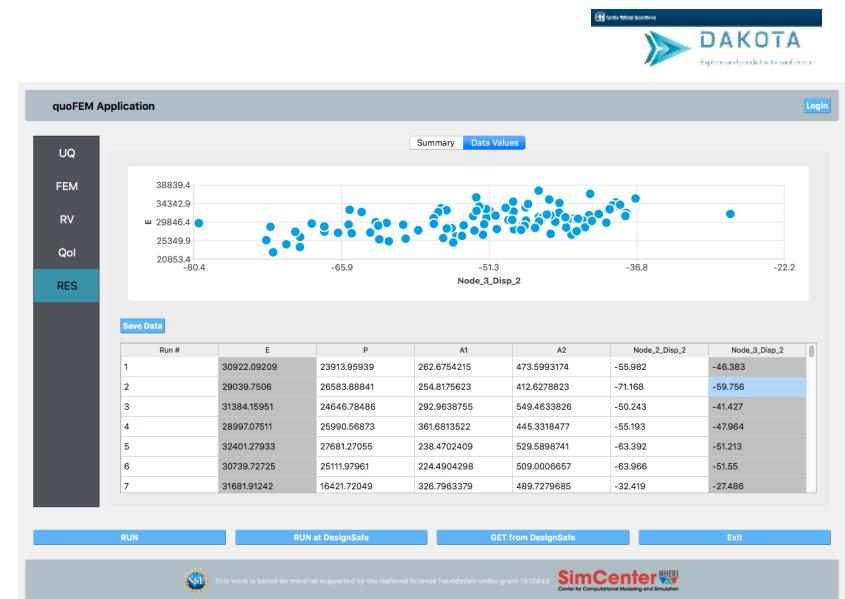
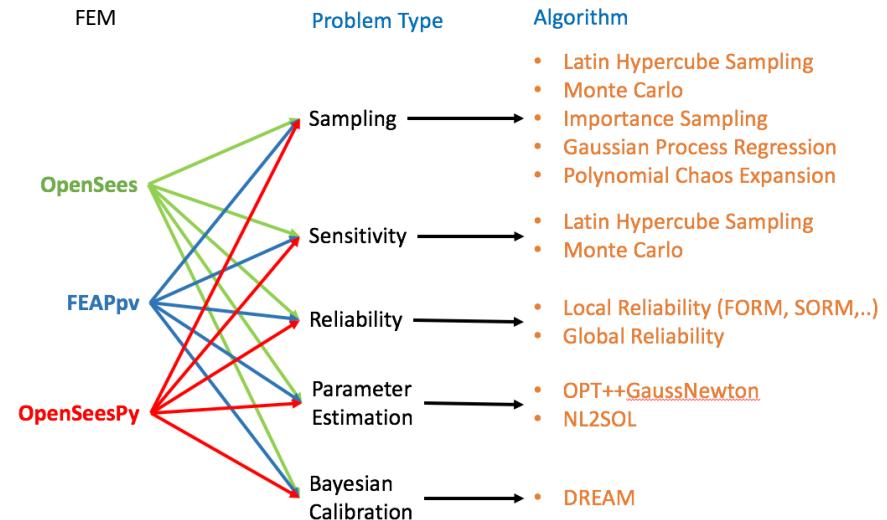
- **Inputs:** FEM model, input uncertainty specification, UQ method & post-processing script
- **Outputs:** Depends on problem type and post-processing (e.g. Uncertainty measures of outputs)

Release Dates:

- **V1.0 (2018)** Forward, Calibration
- **V2.0 (2019)** – Bayesian Calibration, Reliability, Sensitivity
- **V3.0. (2020)** – External Advanced Methods

Research Opportunities:

- Surrogate Modeling
- Model Calibration

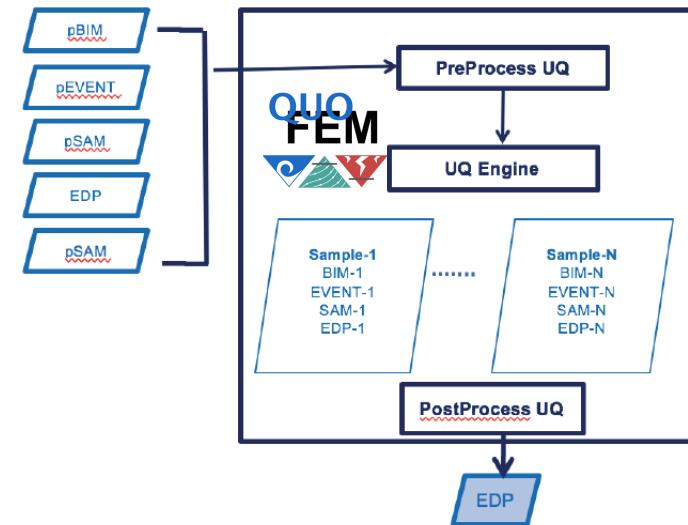


Earthquake Engineering

- Quantifies uncertainty in building response when subjected to an earthquake

Application:

- Inputs:** Building information, structural modeling, earthquake event & inputs for UQ
- Outputs:** Uncertainty measures of building response

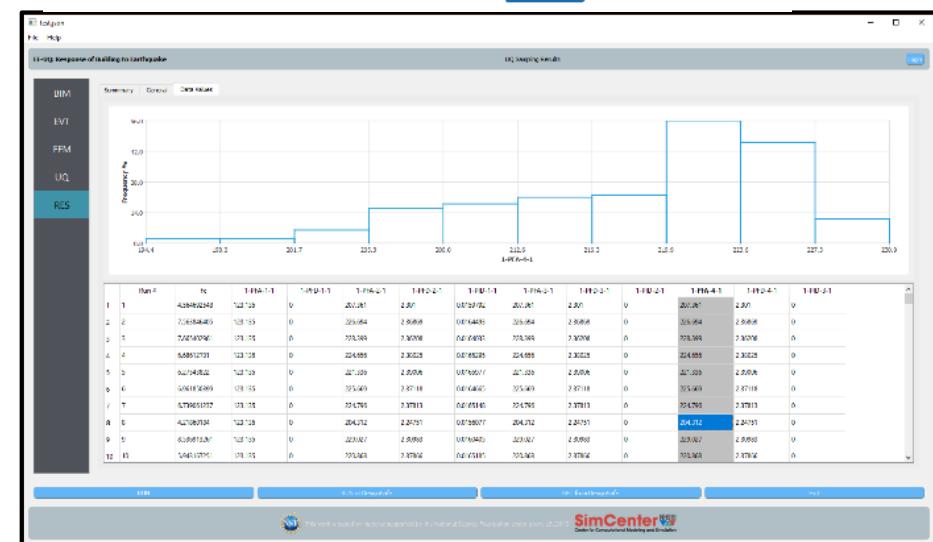


Release Dates:

- V1.0 (2018)** Uniform Excitation, Sampling
- V2.0 (2019)** Rock Outcrop motions
- V3.0 (2020)** Soil Box around Building + Expert System Sensitivity, Reliability

Research Opportunities:

- Finite element modeling
- Hazard characterization
- UQ including surrogate model generation
- Datasets for model calibration

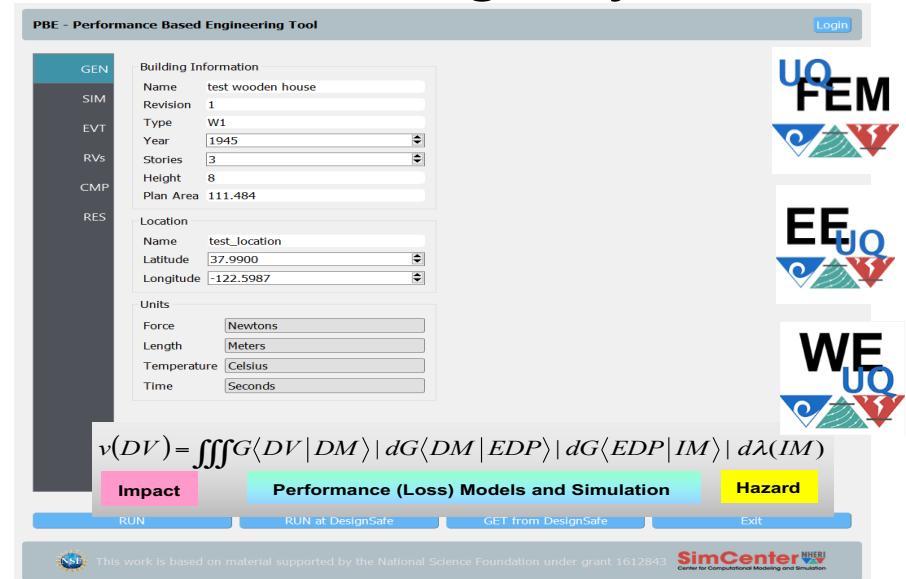


PBE Application

- Probabilistic damage & loss calculations of a building subjected to a natural hazard

Application:

- **Inputs:**
Building & structural information,
Hazard characterization, UQ inputs,
Contents, Damage & loss functions, e.g. P58,
HAZUS, **Pelicun**, or user-defined.
- **Outputs:** Damage, loss, and consequences

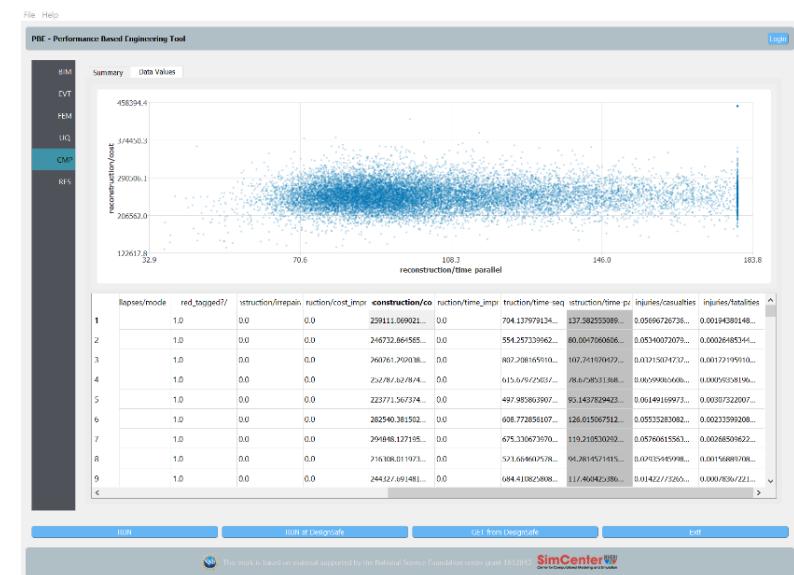


Release Dates:

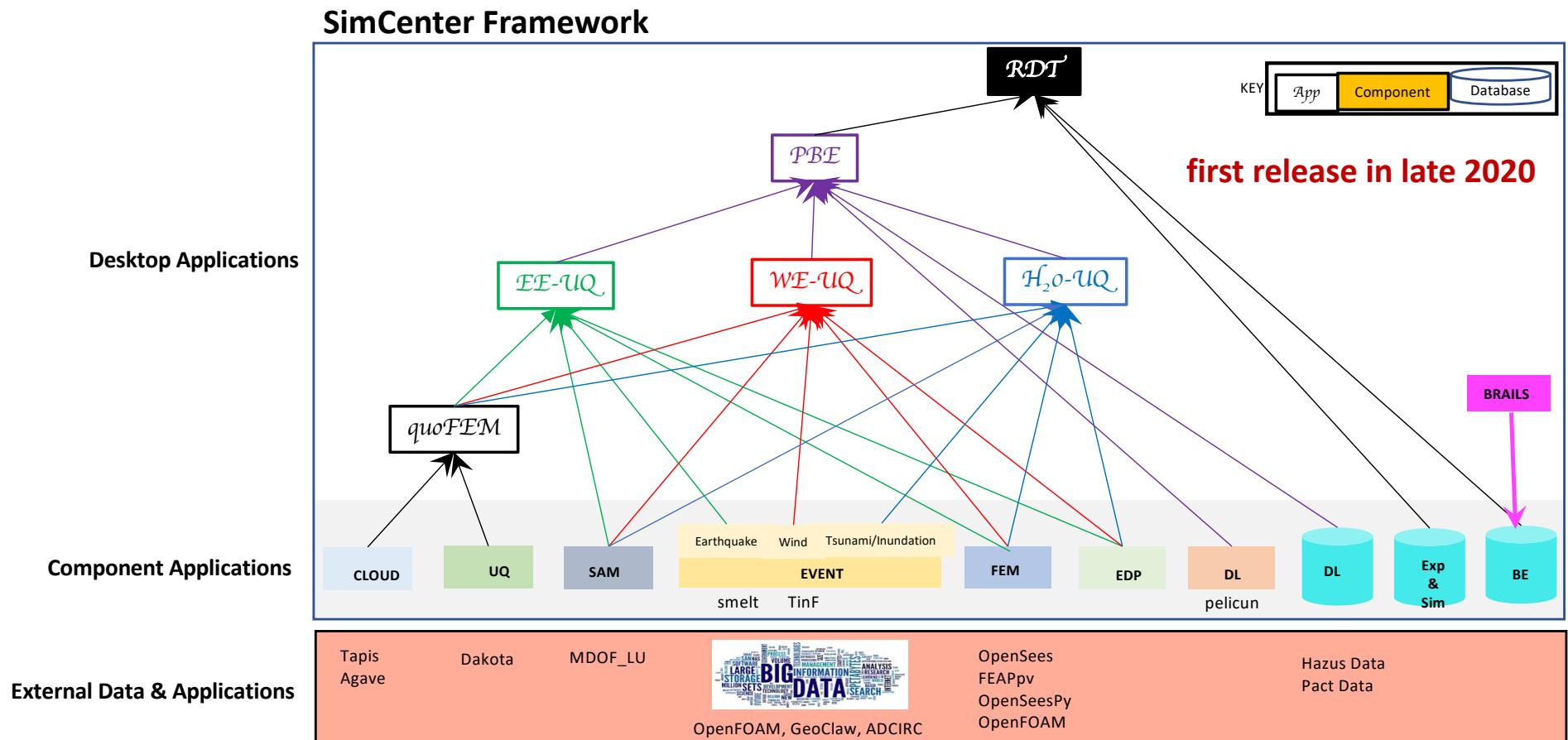
- **V1.0 (2019)** Earthquake. P58
- **V2.0 (2019)** Hazus
- **V3.0 (2020)** Other Hazards: Wind Hazus

Research Opportunities:

- Damage & loss calculations
- Validation of fragility and consequence functions
- Wind & Storm Surge Functions



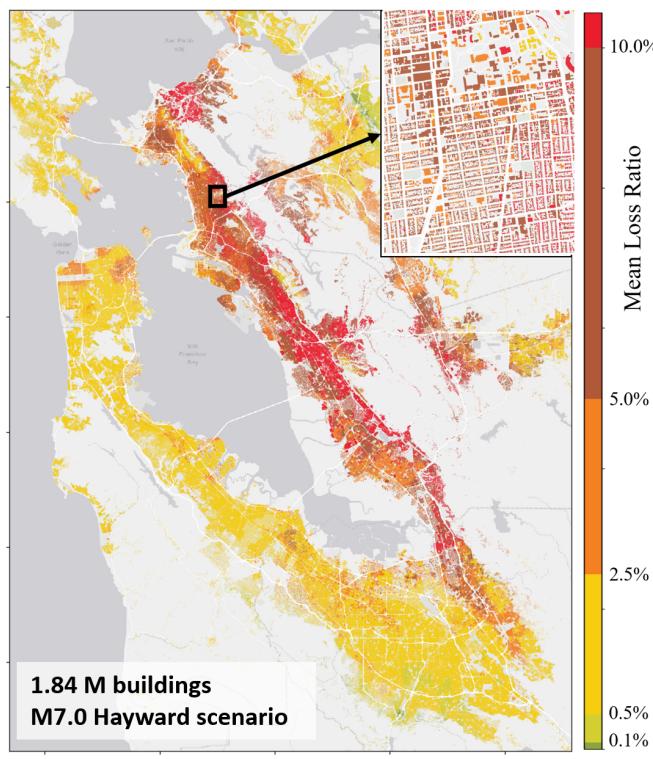
Upcoming Software (Hydro & RDT)



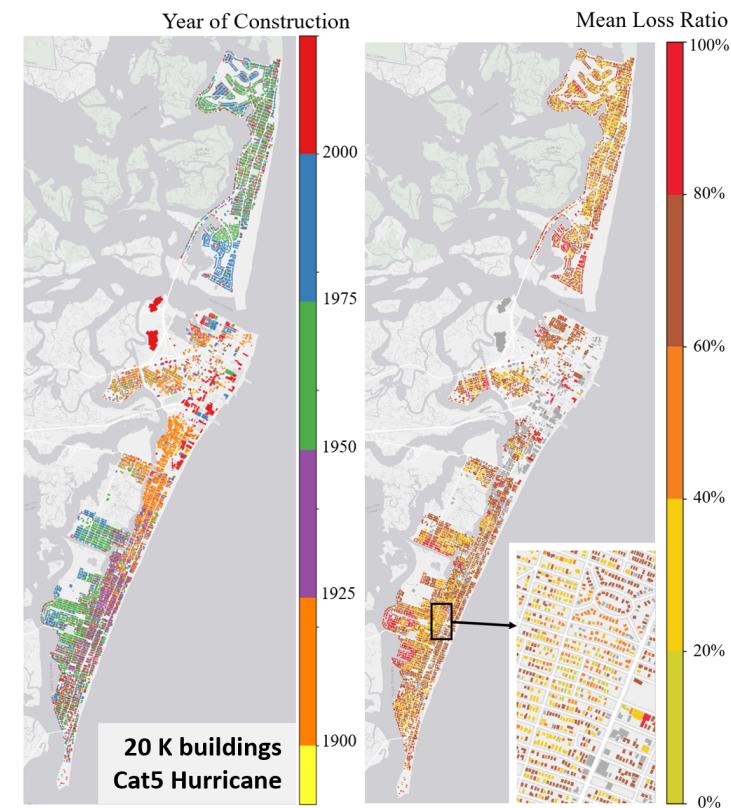


Resiliency Determination Tool (coming 2020)

To allow users to create **complex workflows** and make them **publicly available** to facilitate research in regional natural hazard risk management.



San Francisco Bay Area



Atlantic City, NJ



Application:

- **Inputs:**
Identify Region
Hazard (Earthquake, Hurricane)
Damage & loss functions **HAZUS**,
- **Outputs:** Damage, loss, and consequences

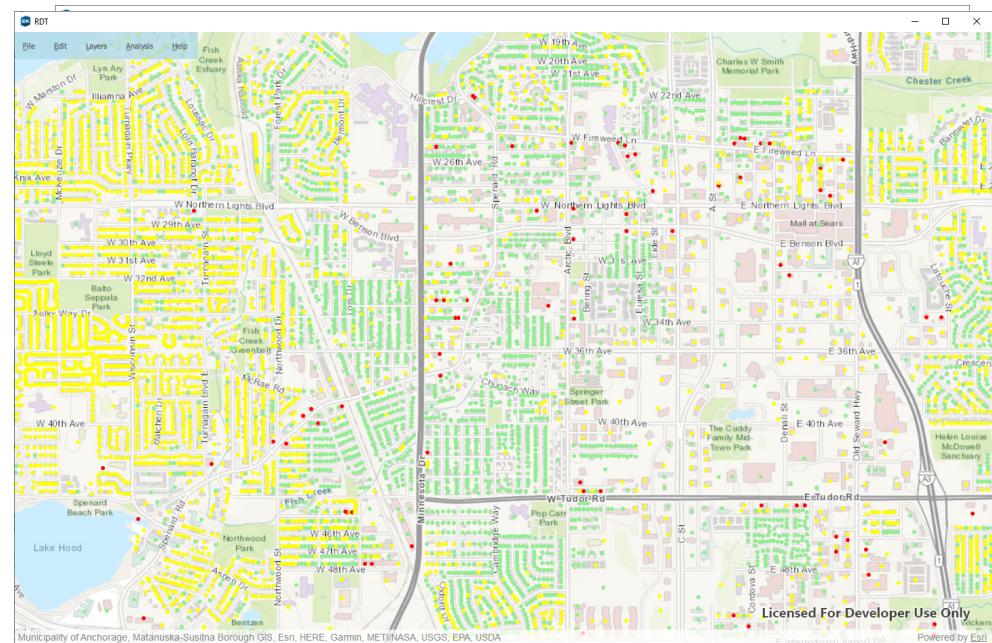
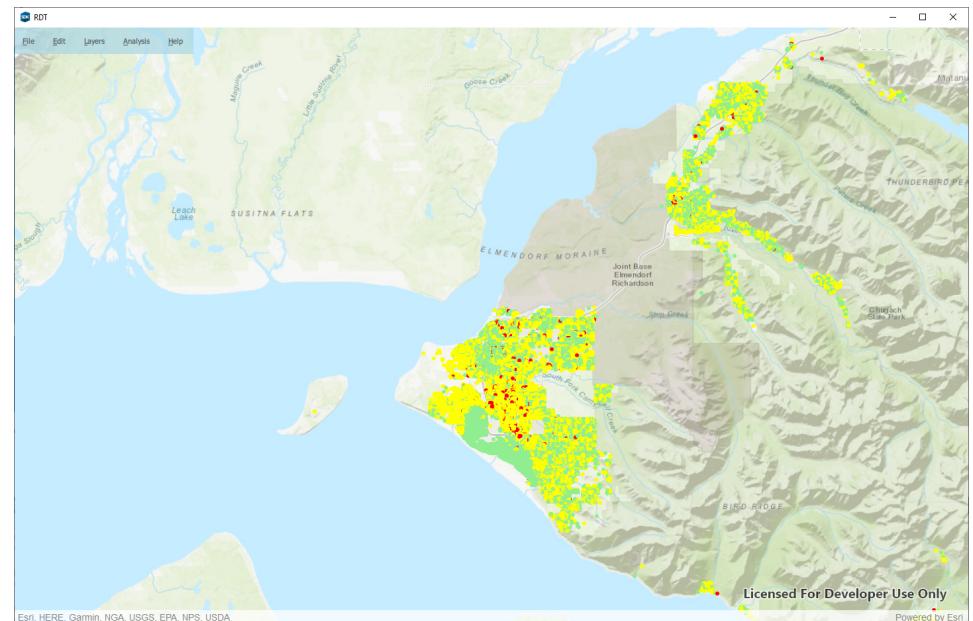
Release Dates:

- **V1.0 (2020)** Earthquake
- **V2.0 (2021)** Other Hazards

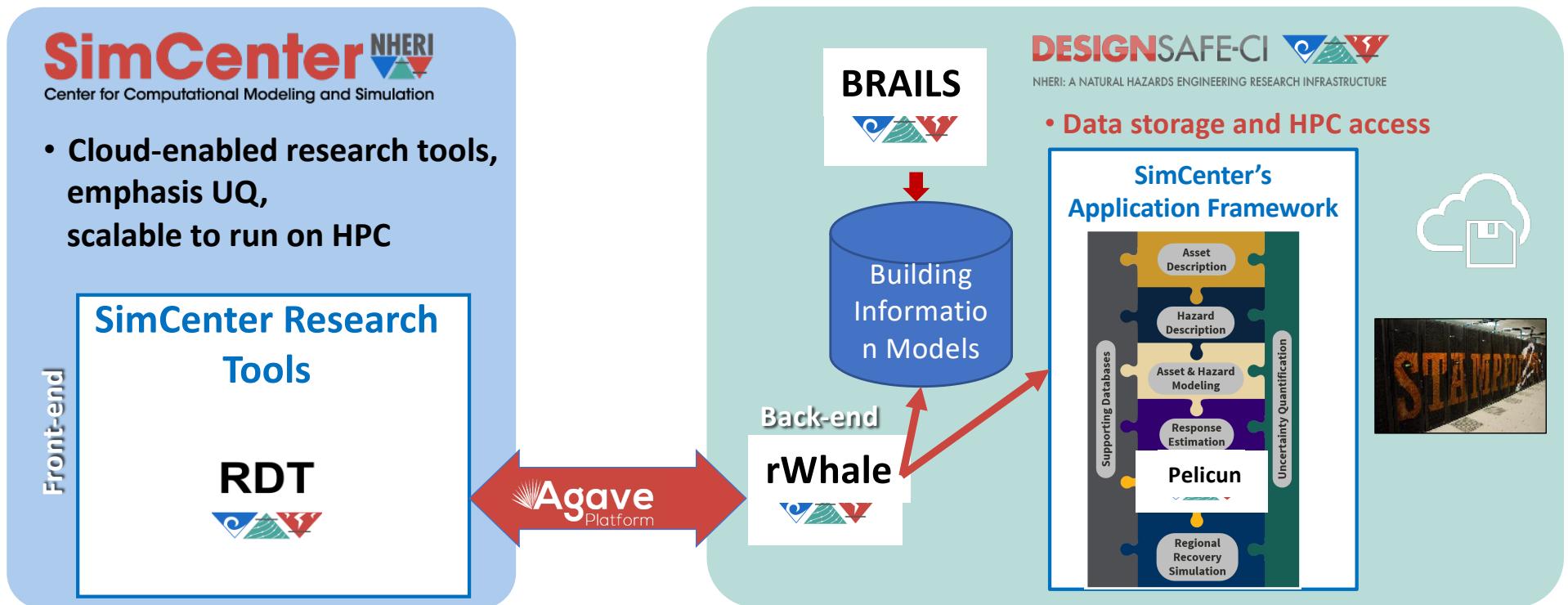
Research Opportunities:

- Regional Building Inventories
- Regional Hazard Modeling
- Building Inventories to structural models
- Regional Recovery
- Modeling Effect of City Growth
- Effect of Policy Planning on Impact in the future
- Lifeline Impact

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RDT Component Design



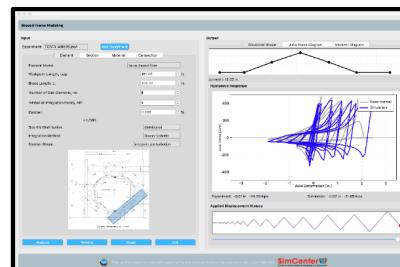
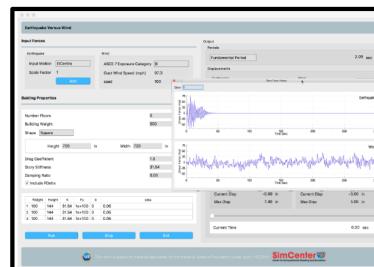
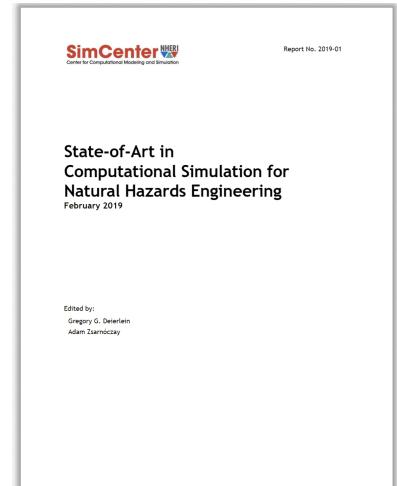
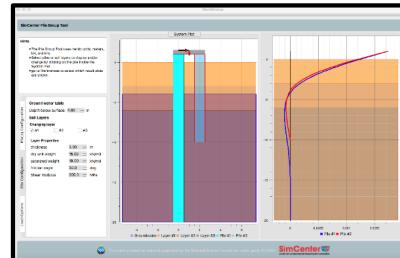
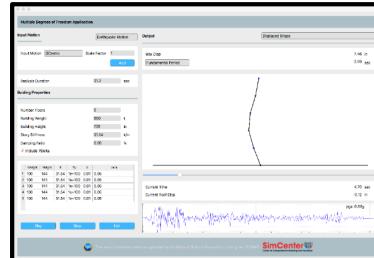
rWhale: Focus of talk by Tracy today at 10am

pelican: Focus of talk by Adam tomorrow at 10am

Community Building

We are building a community around computer simulation

Workshops

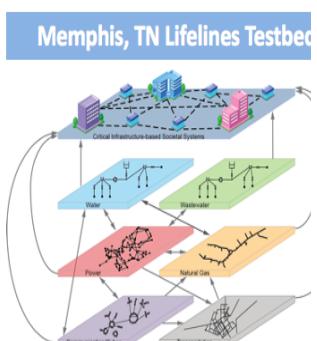
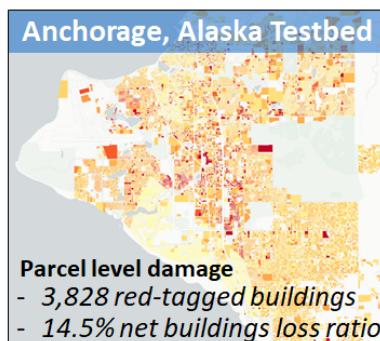
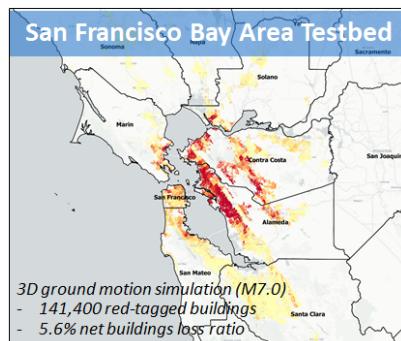
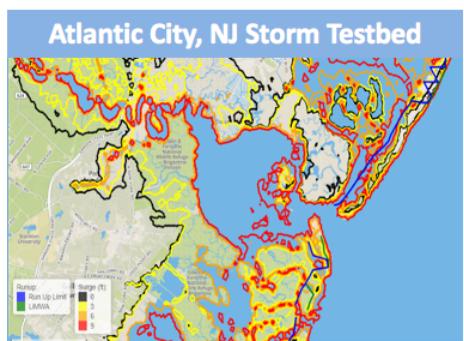


Tool Training, Programming Bootcamp & Summer REU program

Educational Applications

State-of-Art Report

&
Testbeds



Your Feedback is NEEDED

<https://simcenter-messageboard.designsafe-ci.org.smf/index.php>

Your feedback drives our tool development

SimCenter Forum

Hello adamzs
Show unread posts since last visit.
Show new replies to your posts.
June 16, 2020, 04:59:30 AM

simplemachines forum

Search

News:
SMF - Just Installed!

[Home](#) Help Search Moderate Profile My Messages Members Logout

SimCenter Forum

General		Unread Posts
	General Questions General Questions about SimCenter	0 Posts 0 Topics
	Installation Problems Installing SimCenter applications	0 Posts 0 Topics

Research in Natural Hazards Engineering		Unread Posts
	Uncertainty Quantification (quoFEM) Questions, observations and discussions related to Uncertainty Quantification or usage of the quoFEM application	12 Posts 7 Topics
	Wind Engineering (WE-UQ) Questions, observations and discussions related to Wind Engineering or use of the WE-UQ, CWE, and TinF applications	0 Posts 0 Topics
	Earthquake Engineering (EE-UQ) Questions, observations and discussions related to earthquake engineering or use of the EE-UQ application	26 Posts 8 Topics
	Performance Based Engineering (PBE) Questions, observations and discussions related to Performance Based Engineering or use of the PBE application Moderator: adamzs	15 Posts 8 Topics
	Damage & Loss (PELICUN) Questions, observations and discussions related to Damage and Loss calculations or use of the Pelicun python module. Moderator: adamzs	6 Posts 2 Topics
	Regional Hazard Simulation (RDT, rWhale) Questions, observations and discussions related to regional hazard simulation or use of the RDT and rWhale applications	37 Posts 7 Topics
	AI use in Regional Simulation (BRAILS) Questions, observations and discussions related to the use of AI in calculations related to regional hazards or questions related to use of the BRAILS software package.	0 Posts 0 Topics
	Site Response Analysis (s3hark) Moderator: charles	9 Posts 3 Topics

Closure

- Relatively new project 3.0 years old:
 - Origins of features are Grand Challenge driven, NHERI Science Plan driven
 - Now community driven
- All software is opensource – including building inventories
 - <http://SimCenter.DesignSafe-CI.org>
 - <http://github.com/NHERI-SimCenter>
- The Center is open for collaborations: Looking to facilitate research
- Follow us on Twitter & Facebook. Subscribe to our newsletter. Come to our workshops. Attend our webinars.
- Most importantly contribute.