

The Quakeworx Science Gateway

Amit Chourasia¹, Choonhan Youn², Fabio Silva⁴, Bar Oryan², Chunhui Zhao³, Jeena Yun², Napat Tainpakdipat³, Fabian Kutschera², Akash Bhatthal⁴, Francesco Serafini⁵, Jerome Ronquillo¹, Benjamin Winjum¹, Philip Maechling⁴, Dave May², Ahmed Elbanna, Alice-Agnes Gabriel, Yehuda Ben-Zion

¹University of California Los Angeles, ²University of California San Diego, ³University of Illinois Urbana-Champaign, ⁴University of Southern California, ⁵University of Bristol

Abstract

Quakeworx is a science gateway that provides an accessible, web-based cyberinfrastructure for the earthquake science community to seamlessly run, reuse, and contribute advanced computational tools for simulation and data analysis. Designed to reduce technical barriers and accelerate scientific discovery, Quakeworx enables rapid adoption of emerging methods while supporting reproducibility and FAIR data practices.

The platform delivers a growing suite of state-of-the-art earthquake modeling applications, including SeisSol, Tandem, MooseFarm, UCERF3-ETAS, pyCSEP, and HFQsim. These applications can be executed seamlessly in either batch or interactive mode on project servers, national HPC, and cloud computing resources.

Key Gateway Capabilities

- **Curated Apps and Pipelines** – Preconfigured simulation and modeling tools ready to run with reference configurations.
- **Curated Data** – Shared datasets for benchmark problems and scenario simulations, with tracked provenance.
- **Job Management** – Monitoring and tracking of resource usage and job history.
- **Publishing Tools** – Support for publishing data, results, workflows, and reports with persistent identifiers in alignment with FAIR principles.
- **Community Contributions** – Users can upload new applications (via containers or executables), datasets, or publications directly through the browser.
- **Access Control** – Fine-grained sharing options allow users to keep resources private or share them broadly with the community.
- **User Management** – Integrated single sign-on (SSO) for institutional users across academia and government.

Keywords

Science Gateway, Data management, Community models, HPC, Containers

Quakeworx Project and Community Activities

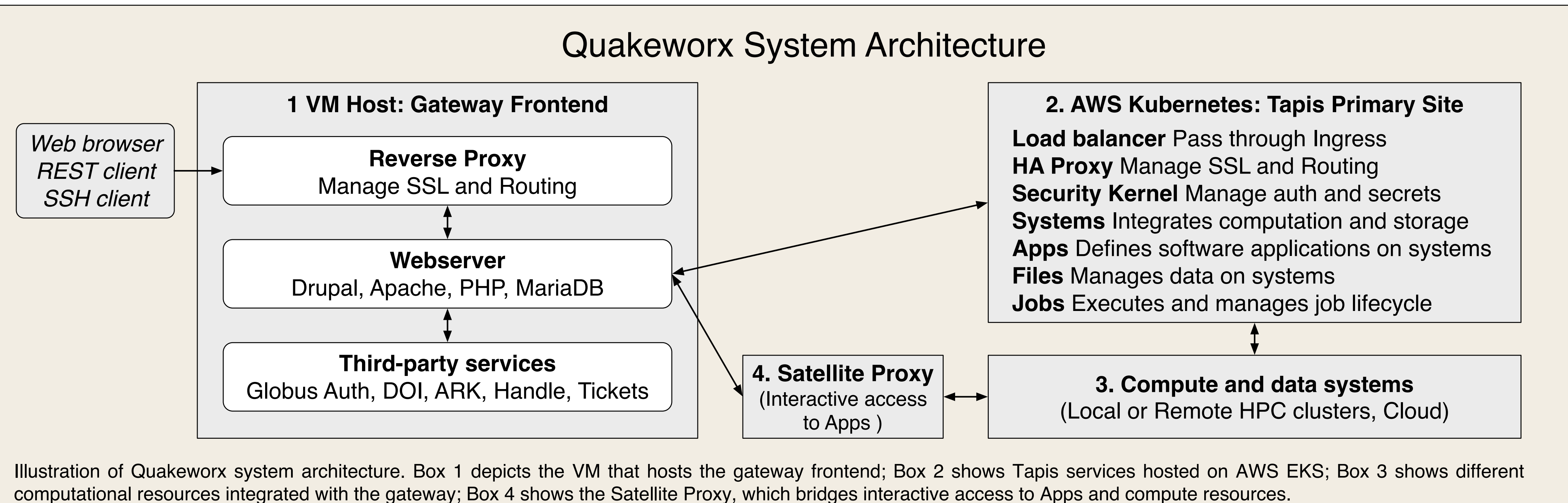
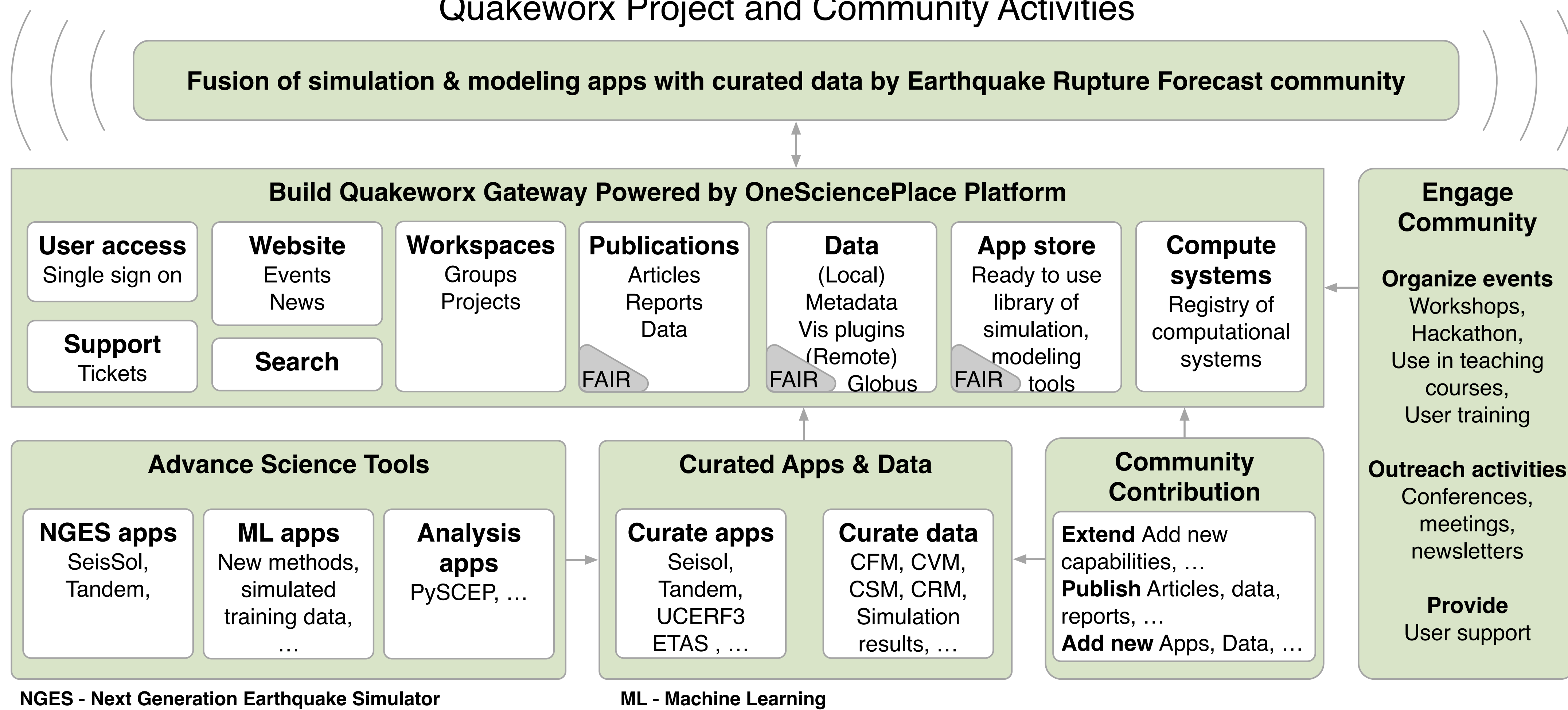


Illustration of Quakeworx system architecture. Box 1 depicts the VM that hosts the gateway frontend; Box 2 shows Tapis services hosted on AWS EKS; Box 3 shows different computational resources integrated with the gateway; Box 4 shows the Satellite Proxy, which bridges interactive access to Apps and compute resources.

Quakeworx Gateway Invites Early Users >>> Visit <https://quakeworx.org>



• Broadband Platform • HFQsim • Moose-FARMS • pyCSEP • QuakeNN • SeisSol • Tandem • UCERF3-ETAS • UCVH with CVM-H • Jupyter • Linux Desktop/Terminal • RStudio

Project Progress

Since its launch under the NSF CSSI award in 2023, the Quakeworx project has made significant strides in advancing a science gateway for earthquake simulation, data analysis, and collaborative research. Below is a summary of key accomplishments and ongoing activities:

1. Platform Infrastructure and Integration

- A staging gateway for Quakeworx has been built on the OneSciencePlace platform.
- Robust support has been added for interactive (Jupyter, VNC) and batch apps, job monitoring, and user data management through Tapis APIs.
- The gateway is now onboarding early users to finalize required capabilities for production.
- Single sign-on integration via Globus auth is under testing, which will enable seamless access for users from academic and government institutions.

2. App and Data Curation

- A curated registry of earthquake modeling tools: Broadband Platform • HFQsim • Moose-FARMS • pyCSEP • QuakeNN • SeisSol • Tandem • UCERF3-ETAS • UCVH with CVM-H
- Initial reference problems and scenario datasets have been made available for download and execution.
- Containerized apps have been deployed using Singularity/Docker, enabling reuse & reproducibility.

3. User Experience and Tools

- Capabilities for creating apps, systems, cloning jobs, and browsing curated content are now available.
- An advanced UI builder now supports app creation, reducing the learning curve for non-expert users.
- Job provenance tracking and output previews are now available.

4. Community Engagement

- The Kick-off Workshop (Jan 2025) brought together 65 researchers selected from over 150 applicants from 16 countries for hands-on training. Since then, over 1,300 users have accessed the training materials.
- The first Tandem Hackathon (July 2025) is aiming to extend Tandem capabilities with GPU support, benchmarks, and co-authorable publications.
- Educational integration was completed with the incorporation into Alice Gabriel's "Advanced Seismology" course, alongside the development of new teaching materials.

5. Publications and Scientific Output

- The project team has published peer-reviewed scholarly content that includes 14 papers, 16 posters & oral presentations, and 16 papers are either in press, preprint, or under review.
- Quakeworx is enabling scalable and easy-to-access and use simulation and modelling for inclusion in courses and for national agencies such as the USGS.

6. Next Steps

- Launch Quakeworx gateway in production
- User onboarding workshops and scientific hackathon
- Implement FAIR publishing options (e.g., with DOIs via DataCite)
- Enable user-contributed Apps

