Geotwins: Co-designed, Reviewed, and Reusable Decision Support Tools to De-Risk Deep Geothermal Energy

Knowledge Sharing Workshop

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Challenges of Deep Geothermal Energy

Deep geothermal energy has the potential to become a widespread and abundant energy source for heating and power. It is a **key technology in the transition** to climate neutrality by 2050.

... but ...

Widespread roll-out is challenged in many places for three main interlinked reasons:



Induced earthquakes



Societal acceptance

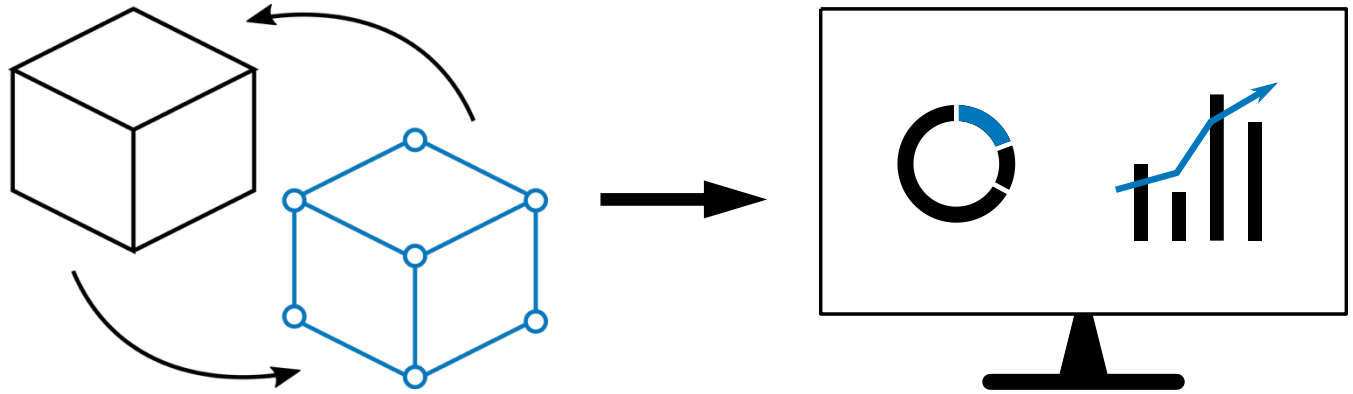


Economic viability

The Geotwins contribution:
Calibrated, tested, and adaptable multi-disciplinary chained digital twin workflows to de-risk deep geothermal energy

What is a digital twin?

Digital twins are calibrated **virtual replicas** of physical systems or process. They mirror real-world objects and environments, allowing for real-time **monitoring**, **forecast**, and **decision support.**



This technology has been successfully applied in diverse sectors such as manufacturing, healthcare, civil engineering, meteorology, and aerospace and is now spreading into the **Earth Sciences**.

The Geotwins consortium

9 academic partners

DIAS Institiúid Ard-Léinn Bhaile Átha Cliath | Dublin Institute for Advanced Studies

Ecole et Observatoire des Sciences de la Terre

UNIVERSITÀ DI TRENTO

Bochum University of Applied Sciences TECHNOLOGY BUSINESS HEALTH

GFZ Helmholtz-Zentrum POTSDAM

Schweizerischer Erdbebendienst Service Sismologique Suisse Servizio Sismico Svizzero Swiss Seismological Service

ETH zürich

INGV

Fraunhofer IEG

EARTH OBSERVATORY OF SINGAPORE

5 industrial operators and service companies

MONDAIC

DMT

GEO ENERGIE SUISSE

SEISMIX

vito

3 profiles of users in mind when designing the integrated tool:
industrial operators, **scientists**, and the **wider society**



User stories

Co-designed

The current stimulation test at my deep geothermal site is inducing more seismicity than previous stages. How do I best reduce the seismicity while maintaining reservoir creation efficiency?



Deep geothermal plant operator

What is the chance of shaking strong enough to damage my house? How does it compare with everyday risks?



Local population

What impact does the velocity model have on wave propagation and ground motion expected for a specific site?



Scientist

Demonstration sites

Reviewed

2026 circulation
4 months, 25L/s







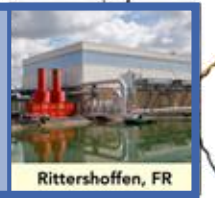








2025 seismic crisis,
8+ months shut-in





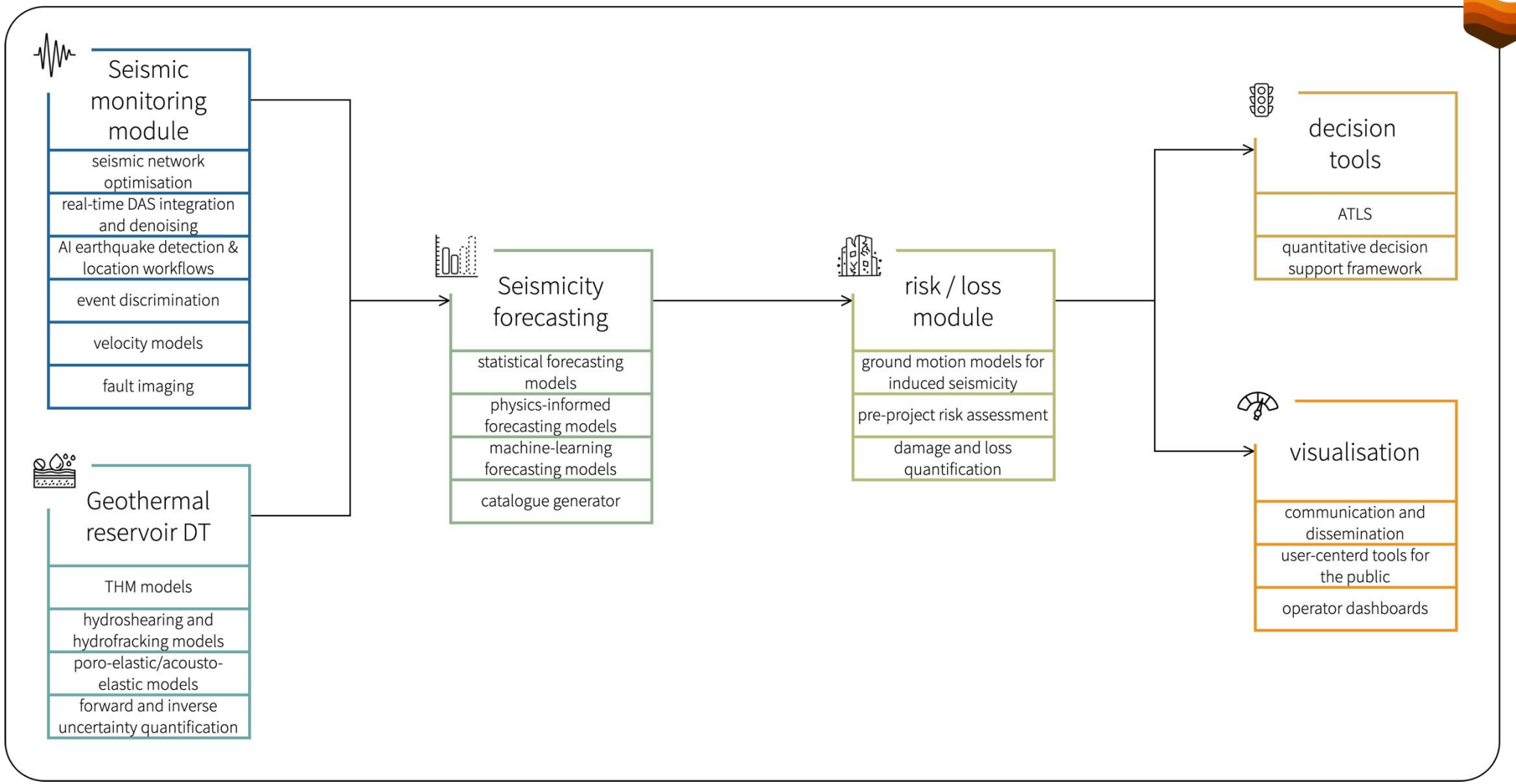




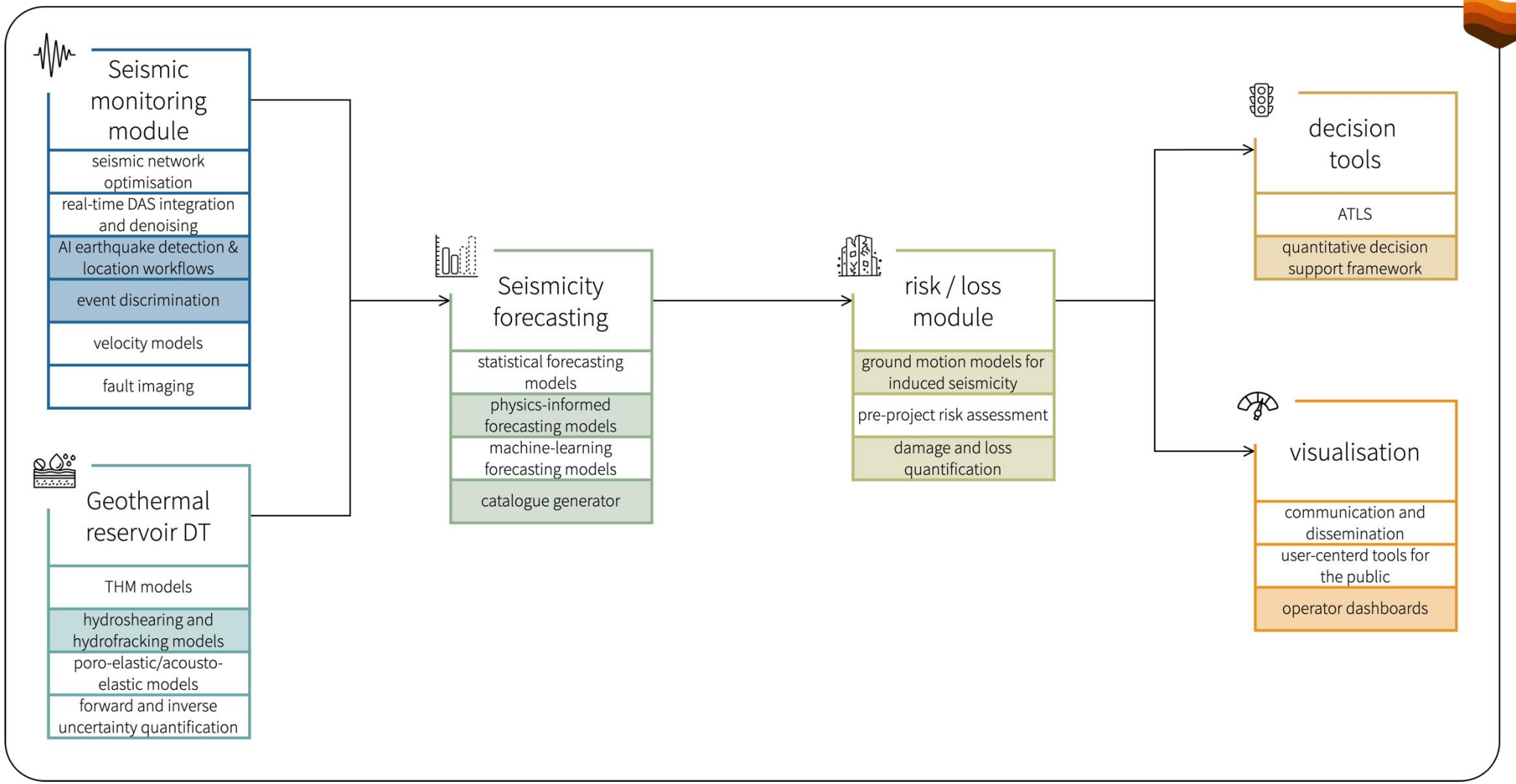
2025 test
stimulation
10 days, 430m^3

Modular based on user needs & questions

Reusable



Example chain: operator question



Co-designed, Reviewed, and Reusable

The Geotwins project contributes to de-risking deep geothermal energy by building calibrated, tested, and adaptable multi-disciplinary chained digital twin for the use of scientists, industrial operators and society.

Co-designed to ensure the tool can be used to satisfy the needs of different users

Reviewed to high scientific standards by being calibrated and tested on real sites

Reusable with a lightweight modular and open framework to ensure it outlasts the project

Work is underway to demonstrate the readiness of tools at TRL 8 by end of 2027. Follow up projects already plan to use the product of Geotwins: Earth-AID & GeoHeat (both Horizon Europe Framework Programme).

Questions / ideas / collaboration: *vanille.ritz@sed.ethz.ch*