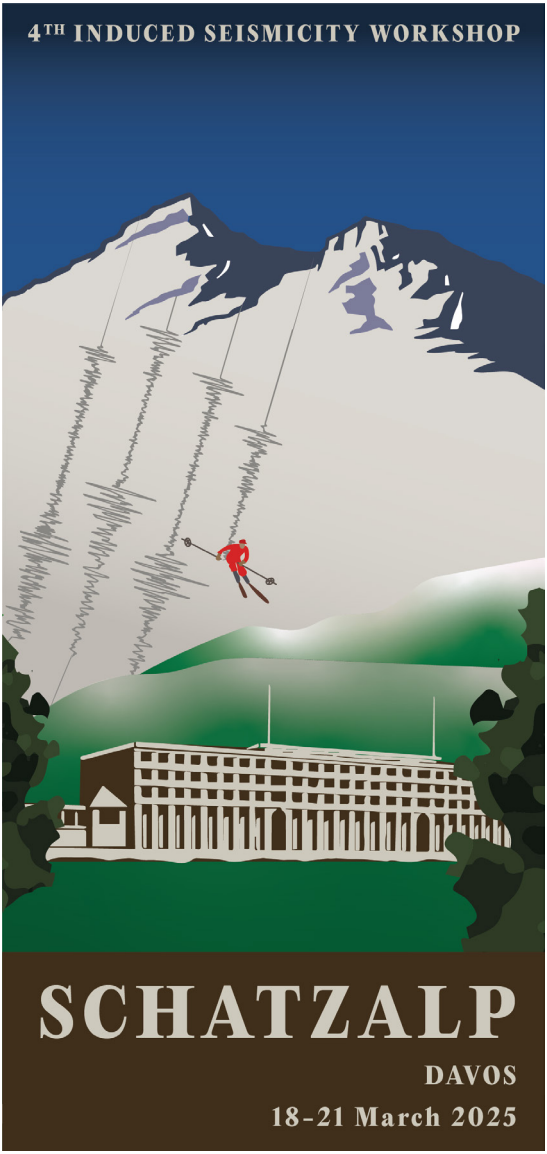

Preliminary Programme

Schatzalp 4th Induced Seismicity Workshop
18 – 21 March 2025

Sessions

- Physics of induced earthquakes
- Case studies
- Modelling of induced seismicity
- Fault activation and fault zone structures
- Advances in techniques for monitoring induced seismicity
- Ground shaking hazard, risk assessment and mitigation
- Induced seismicity research infrastructures, governance & communication

Confirmed invited speakers

- Jean-Philippe Avouac (California Institute of Technology, USA)
- Greg Beroza (Stanford University, USA)
- Fabrice Cotton (GFZ Potsdam, Germany)
- Domenico Giardini (ETH Zurich, Switzerland)
- Bettina Goertz-Allmann (NORSAR, Norway)
- Yves Guglielmi (Lawrence Berkeley National Laboratory, USA)
- Federica Lanza (Swiss Seismological Service (SED), ETH Zurich, Switzerland)
- Nicole Lupi (Swiss Federal Office of Energy, Switzerland)
- Patricia Martinez-Garzon (GFZ Potsdam, Germany)
- Chris Marone (PennState, USA)
- Men-Andrin Meier (SED, ETH Zurich, Switzerland)
- Jack Norbeck (FERVO Energy, USA)
- Sandrine Ortet (Canton of Vaud)
- Julian Osten (RWTH Aachen, Germany)
- Kristine Pankow (University of Utah, USA)
- Ryan Schultz (SED, ETH Zurich, Switzerland)
- Jean Schmittbuhl (Institut Terre et Environnement de Strasbourg, France)
- Katinka Tuinstra (SED, ETH Zurich, Switzerland)
- Karin Van Thienen-Visser (Ministerie van Klimaat en Groene Groei, Netherlands)

Tuesday, 18 March 2025

Optional programme item

15:00- 16:30	Excursion: WSL Institute for Snow and Avalanche Research SLF in Davos

The WSL Institute for Snow and Avalanche Research SLF is an interdisciplinary research and service centre located in Davos Dorf. It forms part of the WSL – the Swiss Federal Institute for Forest, Snow and Landscape Research – and thus belongs to the domain of the ETH (Swiss Federal Institutes of Technology). Its scientists conduct research on snow, the atmosphere, natural hazards, permafrost and mountain ecological systems, and develop innovative products that translate their knowledge into practical applications. The SLF seeks to engage in top-level research while contributing to the resolution of urgent societal issues, for example in the fields of natural hazard warning systems and the analysis of climate and environmental change.

- The excursion is for free and can be booked in the registration form
- Approx. 30 min. journey by funicular and bus from the Hotel Schatzalp
- Approx. 15 min. journey by bus from the Hotel Europe

more infos:

Workshop start

from 16:00	Registration at Schatzalp lobby
18:00	Ice-breaker
20:00	Self-paid dinner (registration upon arrival)

Wednesday, 19 March 2025

08:30 - 10:00	Welcome & talks
10:00 - 11:00	Coffee break: posters & PICO
11:00 - 12:30	Talks

Lunch break

14:00 - 15:30	Welcome & talks
15:30 - 16:00	Coffee break
16:00 - 17:00	Talks
17:00 - 18:15	Wine & cheese: posters & PICO
18:30 - 19:30	Social activity
20:00 -	Conference dinner

Thursday, 20 March 2025

09:00 - 10:00	Talks
10:00 - 11:00	Coffee break: posters & PICO
11:00 - 12:30	Talks

Lunch break

14:00 - 15:30	Talks
15:30 - 16:00	Coffee break
16:00 - 17:30	Panel discussion - with two intro talks
17:30 - 19:00	Apéro: posters & PICO
19:30 -	Outdoor cheese fondue & soup

Friday, 21 March 2025

09:00 - 10:30	Talks
10:30 - 11:00	Coffee break
11:00 - 12:30	Talks
12:30 -	*Lunch break & end of workshop*

Session descriptions

1. Physics of induced earthquakes

The physical mechanisms that control induced earthquakes remain poorly understood due to the complex stress redistribution that occurs in natural systems. Additional complexity arises from the heterogeneous fault structures that host earthquakes in how they prepare, nucleate, propagate, and arrest over a range of spatiotemporal scales. Recent improvements in our understanding have led to a number of physical behaviors that can affect these phases. Physical mechanisms we are focusing on include earthquake interactions, pore pressure diffusion, thermoelastic stresses, fault zone wear and damage, poroelastic coupling, and aseismic deformation, but others are welcome.
This session invites studies that address any of these topics from an experimental or theoretical perspective. We encourage studies that also provide insight into general operational issues such as maximum magnitude (Mmax) constraints or physics-based injection strategies aimed at controlling rates and reducing runaway seismicity, among others.

2. Modelling of induced seismicity

Numerical modelling is a challenging but essential part in advancing our understanding of induced seismicity. Predictions from modelling can be tested against real data and in this way contribute to the falsification or validation of scenarios. Recent challenges in numerical modelling of induced seismicity include the development of algorithms that accurately handle the complex physical coupled processes. In addition, advanced traffic light systems rely on algorithms that can provide “good enough” results in near real-time. We invite papers that report on the application and advancement of numerical modelling of induced seismicity in all geotechnical and geoengineering applications.

3. Fault activation and fault zone structures

It is increasingly possible to study earthquake fault activation not just at the smaller scale of rock mechanics laboratories, but also in-situ. In a growing number of experiments worldwide, natural fault zones are activated, with different types of near- and on-fault monitoring. Direct measurements of fault dilation and compaction, aseismic shear motion, pore pressure, etc. can potentially shed light on the complex interplay between the various factors that govern the preparation, nucleation, propagation and arrest of seismic ruptures on real, complex fault zones. High-resolution seismicity catalogues, furthermore, can provide insights into how these primary fault zone processes induce seismicity, which is more easily observable from a distance. The process understanding gained from fault activation studies can potentially help us to better quantify the likelihood of fault activation and may constrain hazards in both natural (tectonic) and fluid injection contexts. In this session we solicit talks broadly related to fault activation studies, including observational studies from in-situ and laboratory experiments, as well as numerical models.

4. & 5. Advances in techniques for monitoring induced seismicity

High-resolution monitoring and analysis of induced seismicity are crucial for characterizing and optimizing safety and efficiency in geoenergy projects. Advances in machine learning, template matching, Distributed Acoustic Sensing (DAS), and Large-N nodal arrays have significantly improved catalogue resolution and site monitoring. However, effectively exploring these large and diverse datasets remains challenging. Digital twins, for instance, offer a solution by generating synthetic datasets that maximize information gain and optimize deployment campaigns, while considering realistic sources and site noise conditions.

We invite contributions spanning from classical seismicity analysis methods to theoretical, numerical, instrumental, and processing advancements aimed at enhancing seismic monitoring. We welcome contributions that introduce new methodologies for seismicity analysis applicable to large datasets, either retroactively or in (semi) real-time. Contributions across various scales are encouraged: from laboratory and in situ experiments to regional studies, including those extending beyond geoenergy applications, with a focus on algorithmic and technological solutions for enhanced monitoring.

6. & 7. Case studies

Various geotechnologies, such as geothermal, mining, tailing dams, CO2 or wastewater injection/storage, have induced earthquakes causing damage to local infrastructure and resulting in substantially reduced efficiencies, or even project shutdowns. Thus, concerns around induced earthquakes are a serious impediment to the development of these emerging subsurface operations. We invite case studies that illuminate these issues from scientific, licensing, and industry perspective and discuss (long-term) remediation measures and their effectiveness. We also especially look for success stories, cases where indicated seismicity could be successfully limited or mitigated.

8. Ground shaking hazard, risk assessment and mitigation

Ground shaking from earthquakes has the potential to cause significant hazards or risk impacts. Correspondingly, some exceptional cases of induced seismicity have caused nuisance, damage, and even human losses – sometimes causing premature project abandonment, or even moratoriums on future resource development. Thus, accurately appraising and understanding the hazards/risks of induced earthquakes is important for effective management. Despite this importance, relatively little thought has been directed towards how induced seismicity should be risk-informed. For example, open-ended questions still remain: how can tectonic-based workflows be adapted, under what conditions are approaches applicable, and what conceptual gaps are still missing? In this session, we invite abstracts quantifying the hazards/risks of induced seismicity cases, proposing novel methods to improve estimation approaches, discussing implications for management, or those that consider secondary risks.

9. Induced seismicity research infrastructures, governance & communication

Ultimately, the success of a subsurface operation depends critically on the effective management of induced seismicity risks – both real and perceived. The ability to do so depends strongly on the legislative, regulatory, and social environment. To navigate these issues, 'good practice' guidelines have been developed to link disparate geophysical fields. Guidelines have covered inter-linked topics regarding the use of pre-screening analysis, seismic risk estimation, risk tolerance inference, design of traffic light protocols, mitigation measures, performance targets for monitoring, and effective communication/outreach. We invite to this session abstracts that propose or have been involved in developing good practices for risk governance of induced seismicity (or individual framework parts) – to ensure safe and successful subsurface operations.

Contact

For any inquiries, don‘t hesitate to reach out to us via email:
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Website

seismo.ethz.ch/research-and-teaching/schatzalp-workshop-2025/

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ETH zürich