



Schweizerischer Erdbebendienst
Service Sismologique Suisse
Servizio Sismico Svizzero
Swiss Seismological Service

ETH zürich

*Draft
Programme*

5 - 8 March 2019
DAVOS

SCHATZALP
*3rd Induced Seismicity
Workshop*

www.seismo.ethz.ch/schatzalp

Tuesday's Programme, 5 March 2019

from 16:00 **Registration at Schatzalp Lobby**

from 18:00 **Ice-breaker** (aperitif and Swiss music)

from 20:00 **Self-paid Dinner at Panorama Restaurant**
(menu for CHF 27.50)

Wednesday's Programme, 6 March 2019

from 07:30 **Registration and Installation of Posters Part A**

08:00 **Toni Kraft (SED) and Gunter Siddiqi (SFOE)**
Welcome address

Session 1 Case Studies I: World Tour

08:10 **Keynote: William L. Ellsworth (Stanford University)**
Induced Seismicity in the Permian Basin, USA

08:30 **Solicited: Brian Baptie (British Geological Survey)**
Seismicity Induced by Hydraulic Fracturing operations at Preston
New Road, Lancashire, 2018

08:45 **Solicited: Vala Hjorleifsdottir (Reykjavik Energy)**
Induced earthquakes in the Hellisheiði geothermal field, Iceland

09:00 **Solicited: Antony Butcher (University of Bristol)**
Induced Seismicity at Thoresby Colliery, UK

09:15 **Solicited: Kwang-Hee Kim (Pusan National University)**
The 15 November 2017 Pohang Earthquake

09:30 **Discussion**

09:50–10:20 **Coffee Break**

Session 2 Social Aspects of Induced Seismicity

- 10:20 **Keynote: Manuel Sintubin (KU Leuven)**
The Societal Role of Scientists in Induced Seismicity –
Lessons Learned from Groningen (The Netherlands)
- 10:40 **Keynote: Caspar Hirschi (University of St. Gallen)**
The Limits of Expert Knowledge as a Political Problem
- 11:00 **Keynote: Jen Schneider (Boise State University)**
All Shook Up: Rethorics of Induced Seismicity
- 11:20 **Keynote: Evelina Trutnevyte (University of Geneva)**
Views of the informed citizen panel to EGS and other electricity
generation alternatives in Switzerland
- 11:40 **Discussion**

12:00–13:30 **Lunch Break**

Session 3 Natural or Induced, and Beyond

- 13:30 **Solicited: Peter Meier (Geo-Energie Suisse AG)**
Understanding the Pohang EGS reservoir and the need for
advanced traffic light systems
- 13:45 **Keynote: Gunter Siddiqi (Swiss Federal Office of Energy)**
Non-seismic Reverberations of the M5.4 Pohang Earthquake in
Switzerland
- 14:05 **Keynote: Torsten Dahm (German Research Centre For
Geosciences)**
Earthquakes close to anthropogenic activities – statistical
discrimination without statistics?
- 14:25 **Solicited: Julian Bommer (Imperial College London)**
Towards a More Robust and Transparent Simplified Scheme for
the Discrimination of Induced from Natural Seismicity
- 14:40 **Keynote: Norman Sieroka (ETH Zurich)**
Human-induced or Natural? – Some Philosophical Considerations
and Concepts
- 15:00 **Discussion**

15:20–15:50 **Coffee Break**

Session 4 Induced Seismicity in the Dutch Gas Fields

15:50 **Solicited: Bernard Dost (Royal Netherlands Meteorological Institute)**

New developments in monitoring seismicity in the Groningen gas field

16:05 **Keynote: Stephen Bourne (Shell Global Solutions International B.V.)**

Physics-based, operational forecasting of production-induced seismicity within the Groningen gas field

16:25 **Keynote: Jan-Dirk Jansen (Delft University of Technology)**

An operational earthquake forecasting system to control induced seismicity

16:45 **Solicited: Sander Osinga (TNO)**

A Framework for Training and Testing Induced Seismicity Forecasting Models: the Groningen Case Study

17:00 **Discussion**

17:20–19:00 **Wine and Cheese, Posters Part A**

19:00 **Break**

19:30–20:30 **Snow Hike with Torches**

20:30–22:30 **Outdoor Dinner (Fondue) at Schatzalp Snow Beach**

Thursday's Programme, 7 March 2019

from 07:30 **Installation of Posters Part B**

Session 5 **Physics of Induced Earthquakes I**

- 08:00 **Keynote: Chris Marone (Pennsylvania State University)**
Laboratory Earthquakes Precursors and Prediction
- 08:20 **Solicited: Marco Scuderi (Sapienza University of Rome)**
Fluid-injection and the mechanics of frictional stability of shale-bearing faults
- 08:35 **Keynote: Art Mc Garr (U.S. Geological Survey)**
Seismic and Aseismic Response to Fluid Injection
- 08:55 **Keynote: Jean Schmittbuhl (Strasbourg University/CNRS)**
Induced seismic and aseismic slip in EGS reservoir: Case studies from Alsace, France
- 09:15 **Keynote: Alexandre Schubnel (Ecole Normale Supérieure de Paris)**
Energy budget during laboratory earthquakes
- 09:35 **Discussion**

09:55–10:25 **Coffee Break**

Session 6 **Physics of Induced Earthquakes II**

- 10:25 **Solicited: Lisa Johann (Freie Universität Berlin)**
Seismicity in Central Oklahoma shows features of reservoir-induced seismicity
- 10:40 **Keynote: Thomas Goebel (University of California at Santa Cruz)**
Examining the distance decay and effects of active mitigation on injection induced seismicity
- 11:00 **Keynote: Jean-Paul Ampuero (Université Côte d'Azur)**
Connecting physics-based models of natural and induced seismicity
- 11:20 **Solicited: François Passelegue (EPFL)**
On the nature of induced seismicity: Control from pore pressure distribution

11:35 **Solicited: Peter van den Bogert (Shell)**
Seismic rupture caused by merging of two slip patches

11:50 **Discussion**

12:10–13:40 **Lunch Break**

Session 7 Modelling Induced Seismicity

13:40 **Solicited: Antonio Pio Rinaldi (SED)**
Hydroshearing and permeability enhancement: Revisiting a fracture zone stimulation at Fenton Hill

13:55 **Solicited: Alice-Agnes Gabriel (Ludwig-Maximilians-Universität)**
Multi-physics earthquake simulations on complex fault networks across scales

14:10 **Solicited: Dominik Zbinden (SED)**
Induced seismicity during the St. Gallen deep geothermal project, Switzerland: insights from numerical modeling

14:25 **Solicited: Robert Vörös (Q-con GmbH)**
Inferring in situ Reservoir Pressure From Induced Earthquakes

14:40 **Discussion**

15:00–15:30 **Coffee Break**

Session 8 Deep Underground Laboratories

- 15:30 **Keynote: Jens Birkholzer (Lawrence Berkeley National Laboratory)**
Induced Seismicity and CCS at Scale: Understanding Caprock Integrity Impacts Based on Mesoscale Experiments
- 15:50 **Solicited: Kristine Pankow (University of Utah)**
Seismic Monitoring at the Utah Frontier Observatory for Research in Geothermal Energy
- 16:05 **Solicited: Georg Dresen (GFZ)**
STIMTEC – a mine-back experiment in the Reiche Zeche underground laboratory
- 16:20 **Keynote: Frédéric Cappa (Université Côte d’Azur)**
Injection-Induced Seismicity and Aseismic Fault Slip in Laboratory and In-Situ Experiments and Hydromechanical Models
- 16:40 **Keynote: Domenico Giardini (ETH Zurich)**
From rock-deformation laboratory to the deep underground laboratory of Bedretto: covering geothermal applications and earthquake physics at multiple scales
- 17:00 **Discussion**

17:20–19:20 **Wine and Cheese, Posters Part B**

19:20 **Break**

20:00–22:30 **Conference Dinner**

Friday's Programme, 8 March 2019

from 07:30 **Hotel Check-out**

Session 9 Advances in Monitoring Induced Seismicity

- 08:30 **Solicited: Joseph Doetsch (SED)**
The Grimsel in-situ stimulation project – on the seismo-hydro-mechanical response during hydraulic stimulation tests
- 08:45 **Solicited: Bettina Goertz-Allmann (NORSAR)**
Understanding reservoir processes in injection operations from advanced microseismic analysis
- 09:00 **Solicited: Marcus Herrmann (SED)**
Statistical and Phenomenological Analysis of a High-resolution Catalog of Induced Seismicity in Basel
- 09:15 **Solicited: Francesco Grigoli (SED)**
Monitoring induced seismicity with a single seismic station by combining coda wave interferometry with distance geometry solvers
- 09:30 **Solicited: Corinna Roy (University of Leeds)**
Quantification of location errors for mining induced seismicity in New Ollerton, UK, using 3D Monte Carlo body wave tomography
- 09:45 **Discussion**

10:05–10:35 **Coffee Break**

Session 10 Case studies II: panta rhei

- 10:35 **Solicited: Sigurjon Jonsson (King Abdullah University of Science and Technology)**
What Triggers Seasonal Earthquakes in South Iceland?
- 10:50 **Solicited: Grzegorz Kwiatek (GFZ German Research Centre for Geosciences)**
Controlling induced seismicity during hydraulic stimulation of a 6 km deep Enhanced Geothermal System in Finland
- 11:05 **Solicited: Andrew Barbour (United States Geological Survey)**
Slow Deformation and Rapid Seismicity-Rate Changes Triggered by Geothermal Fluid Redistribution

- 11:20 **Solicited: Enrique Chon (University of Colorado)**
Repeating Earthquakes and Shear Wave Anisotropy Measurements from an Induced Seismicity Case Study, Wattenberg Disposal Zone
- 11:35 **Solicited: Zhuo Yang (Harvard University)**
Fault reactivation by fluid injection considering permeability evolution in damage zones: a case study of Guy-Greenbrier sequence
- 11:50 **Keynote: Stefan Wiemer (SED)**
Testing advanced traffic light systems for the management of induced seismicity
- 12:10 **Discussion**
- 12:30 **Stefan Wiemer (SED)**
Farewell address

12:40–14:00 **Lunch Break and End of Workshop**

List of Posters

Posters part A Wednesday, 17:20–19:00 (Wine and cheese)

Posters part B Thursday, 17:20–19:20 (Wine and cheese)

Session 1 Case Studies I: World Tour

- tbd **Thorbjörg Ágústsdóttir (Iceland GeoSurvey)**
Seismicity rate and earthquake source mechanisms in the Hengill and Hverahlíð geothermal fields, SW-Iceland, October 2016-2018
- 2914 **Chris Bromley (GNS Science)**
Benefits of Non-Damaging, Publicly-Acceptable, Geothermal Induced Micro-Seismicity in New Zealand
- 3046 **Paul Friberg (ISTI)**
Seismicity Induced by Hydraulic Fracturing in Ohio in 2016: Case study of the Conotton sequence in Harrison County
- 3319 **Laura Gulia (SED)**
Reinvestigating the earthquake size distribution of induced seismicity at the Groningen gas field
- 3045 **Gregor Hillers (University of Helsinki)**
Data features from a network around the 2018 EGS stimulation in Espoo/Helsinki, Finland
- 2890 **Guoyan Jiang (The Chinese University of Hong Kong)**
Ground Expansion and Seismic Hazard Induced by the Hutubi Natural Gas Repository, Xinjiang, China
- 2905 **Andrew Jupe (altcom Limited)**
Seismic monitoring at the United Downs Deep Geothermal Project (UDDGP), Cornwall, United Kingdom
- tbd **Anne Obermann (SED)**
COSEISMIQ
- 3068 **Marc Schaming (EOST)**
Studying induced seismicity within the EPOS Thematic Core Service on Anthropogenic Hazards (TCS-AH)

- 3017 **Rob Skoumal (United States Geological Survey)**
Characterizing seismogenic faults and discerning hydraulic fracturing induced earthquakes in Oklahoma

Session 2 Social Aspects of Induced Seismicity

No posters

Session 3 Natural or Induced, and Beyond

- 3269 **Andrés Alcolea (Geo-Energie Suisse AG)**
Hydromechanical modelling of the hydraulic stimulation PX2-1 in Pohang (South Korea)
- 3394 **Celso Alvizuri (University of Lausanne)**
Seismic moment tensor analysis for the 2016 Gyeongju and 2017 Pohang earthquakes
- 3069 **Falko Bethmann (Geo-Energie Suisse AG)**
Seismicity analysis with spatial or temporal relation to the deep geothermal project in Pohang
- 3287 **Simone Cesca (GFZ-Potsdam)**
The November 15, 2017, Pohang earthquake: A potential anthropogenic event of Mw 5.5 in South Korea
- 3050 **Jin-Han Ree (Korea University)**
Reactivation of Unfavorably-oriented Faults for the 2017 Pohang Earthquake Sequence: Driven by Fluid Overpressure?

Session 4 Induced Seismicity in the Dutch Gas Fields

- 3061 **Loes Buijze (TNO)**
Elastic vs inelastic reservoir compaction: Effect on the stress path, fault reactivation, and induced seismic rupture
- 3037 **Annemarie Muntendam-Bos (SodM/Delft University of Technology)**
Clustering Characteristics of Gas-Extraction Induced Seismicity

Session 5 Physics of Induced Earthquakes I

- 2997 **Michelle Almakari (Mines ParisTech)**
Shear induced fluid flow and permeability enhancement during fluid injection lab experiment
- 2980 **Stephan Bentz (GFZ-Potsdam)**
Analysis of microseismicity framing Mw > 2.5 earthquakes at The Geysers geothermal field, California
- 3022 **Nathalie Casas (INSA-Lyon)**
Slip in granular fault gouges: factors influencing the slip regime.
- 3391 **Adam Klinger (University of Bristol)**
Stress drop parameters of fracking-induced microseismicity.
- 3164 **Brice Tanguy Alphonse Lecampion (EPFL)**
A-seismic fracture growth driven by fluid injection and remote nucleation of dynamic rupture in a weaker part of the fault
- 3020 **Jose Angel Lopez-Comino (King Abdullah University of Science and Technology)**
Rupture complexity of an injection induced event: the 2016 Mw 5.1 Fairview, Oklahoma earthquake
- 2991 **Yusuke Mukuhira (Tohoku University)**
Dependency of the induced seismicity b-value on the stress state of existing fractures
- 3393 **Verena Simon (SED)**
High-resolution analysis of seismicity patterns in microearthquake sequences using waveform similarity methods
- 3029 **Sergey Turuntaev (Institute of Geosphere Dynamics of Russian Academy of Sciences)**
Laboratory study of hydrofracturing and related seismicity
- 3251 **Clay Wood (Pennsylvania State University)**
The Effect of Roughness on the Elasticity and Permeability of Fractured Media

Session 6 Physics of Induced Earthquakes II

- 3010 **Jens-Erik Lund Snee (Stanford University)**
A second-generation stress map of the intraplate USA, and its utilization for managing the hazard of injection-induced seismicity
- 3162 **Corentin Noël (EPFL)**
Fault reactivation during pore pressure oscillations
- 3439 **Luca Urpi (SED)**
Can a deep geological repository in a clay formation maintain its integrity and still reactivate a nearby fault?
- 3354 **Marcel Schulz (Karlsruhe Institute of Technology)**
Analysis of injection data for pore pressure and minimum horizontal stress magnitude estimates in the Arbuckle Formation
- 3052 **Victor Vilarrasa (Spanish National Research Council)**
Inhomogeneous fault stability due to fluid injection
- 3055 **Brecht Wassing (TNO)**
Modelling of long-term temperature effects on fault reactivation and induced seismicity potential in conventional geothermal doublets in The Netherlands
- 3044 **Ju Hyi Yim (Seoul National University)**
Coulomb Stress Changes of Poroelastic Effect and Shearing Effect by Fluid Injection

Session 7 Modelling Induced Seismicity

- 3320 **Sebastian Anger (LMU Muenchen)**
Dynamic earthquake rupture modeling in fracture networks of geo-reservoirs accounting for the effects of thermal pressurization
- 3407 **Amir Ashrafi Habibabadi (ETH Zurich)**
Numerical Simulation of Fracture Failure and Propagation due to Fluid Injection, in the Context of Embedded Discrete Fractures
- 2969 **Giuseppe De Natale (Istituto Nazionale di Geofisica e Vulcanologia)**
Seismogenic potential of withdrawal-reinjection cycles: numerical modelling and implication on induced seismicity

- 2968 **Benjamin Edwards (University of Liverpool)**
A Hybrid Empirical Green's Function Technique for Predicting Ground Motion from Induced Seismicity: Application to the Basel Enhanced Geothermal System
- 3351 **Dimitrios Karvounis (SED)**
Testing Injection Scenarios with a 3D Discrete Fracture Hybrid Model
- 2955 **Maria Kozłowska (Institute of Geophysics Polish Academy of Sciences)**
How to model aftershocks in induced seismicity? Insight into seismicity of Kiruna Mine, Sweden
- 3072 **Georgios Michas (Technological Educational Institute of Crete)**
Stochastic modelling of fluid-induced earthquake sequences
- 3140 **Antonio Petrucci (Geo-Energie Suisse AG)**
Modeling far-field poroelastic effects in EGS systems
- 3028 **Maarten Pluymaekers (TNO)**
Depletion-induced seismicity at the Groningen gas field: Coulomb rate-and-state models for structurally complex reservoirs
- 3034 **Gudrun Richter (GFZ German Research Centre for Geosciences)**
Stress-based, statistical modeling of the induced seismicity at Groningen Gas Field
- 3166 **Vasily Riga (The Federal State Unitary Enterprise "All-Russia Research Institute of Automatics named after N.L. Dukhov")**
Numerical Analysis Of Friction Laws. Application To Induced Seismicity
- 3060 **Vanille Ariane Ritz (SED)**
Injection strategies for EGS: balancing seismic risk and stimulation efficiency
- 3064 **Justin Rubinstein (USGS)**
Forecasts of Induced Seismicity and its Hazard from a Hydromechanical Earthquake Nucleation Model

Session 8 Deep Underground Laboratories

- 3305 **Marian Hertrich (SCCER-SoE)**
Design of the seismic monitoring network for the stimulation experiments in the Bedretto Deep Underground Rock Laboratory
- 3066 **Xiaodong Ma (SED)**
In situ stress characterization in the Bedretto Underground Laboratory: implications for induced slip of existing fractures
- 3115 **Anne Obermann (SED)**
CS-D experiment: CO₂ injection and mobility within a fault zone in tight caprock at Mont Terri
- 3100 **Katrin Plenkers (GMuG)**
Seismic Response to Hydraulic Fracturing in Anisotropic Rock
- 3018 **Martin Schoenball (Lawrence Berkeley National Laboratory)**
Microseismic monitoring of meso-scale stimulations for the DOE EGS Collab project at the Sanford Underground Research Facility
- 2984 **Linus Villiger (SED)**
On the variability of seismic response during multiple decameter-scale hydraulic stimulations in crystalline rock

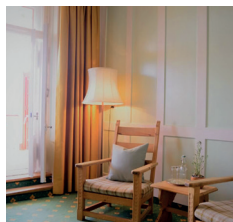
Session 9 Advances in Monitoring Induced Seismicity

- 2995 **Amandine Amemoutou (Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences)**
Moment tensors of waste-water disposal induced seismicity in southern Kansas
- 3054 **Nepomuk Boitz (Free University Berlin)**
The influence of seismic anisotropy on microseismic moment tensors and their radiation patterns
- 3074 **Tobias Diehl (SED)**
Towards Real-Time Double-Difference Hypocenter Relocation as Component for Advanced Traffic Light Systems
- 3073 **Laure Duboeuf (NORSAR)**
Automatic picking for induced seismicity in Iceland using an EAT (Empirically Aggregated Template) methodology

- 3063 **Sepideh Karimi (nanometrics inc)**
Practical Implementation and Evaluation of a Real-time Forecasting-based Induced Seismicity Management System
- 2987 **Jannes Kinscher (INERIS)**
Automatic full wave-form based monitoring at the deep Garpenberg metal mine
- 3155 **Andy Nowacki (University of Leeds)**
Automatic detection and location of induced and natural earthquakes using Multichannel Coherency Migration
- 2973 **Hanneke Paulssen (Utrecht University)**
P wave travel time changes in the Groningen reservoir
- 2931 **Natascha Vollmer (K-UTEC AG Salt Technologies)**
The seismic monitoring system in the Velenje mine, Slovenia

Session 10 Case studies II: panta rhei

No posters



Registration

Conference attendance is limited to 130 persons. Registrations is now open on a first-come, first-served basis with two different price categories:

- Standard: 450 Swiss francs
- Student: 300 Swiss francs

There will be a waiting list, once the 130 places are filled.

You can register an accompanying person for 200 Swiss francs. This includes the ice-breaker event on Tuesday and the dinners on Wednesday and Thursday.

[Click here to register](#)

Registration Deadline

31 January 2019



Conference Venue

Davos is located within the beautiful Swiss Alpine mountains of the Grisons. It's a city of culture, sports, and nature. It takes a 2:30 hours train ride from Zurich airport to get to Davos.

The conference venue "[Schatzalp](#)" is 300 m above Davos, at an altitude of 1861 m. A funicular takes you there in four minutes from Davos-Platz. The nostalgic Art Nouveau building with its Belle Époque atmosphere opened its doors in 1900 as a luxury sanatorium. The soul of the house, its architecture, has been preserved in its original form until today. A night-lighted sledge trail down to Davos, and the skiing region Schatzalp-Strela are nearby.



Hotel Booking

The entire historical Schatzalp hotel with its 101 rooms is reserved for the workshop. Once you have registered for the workshop, you will receive a promotion code to book a room at a special discounted rate (prices for room per night):

- Single occupancy: 115 to 165 Swiss francs
- Double occupancy: 210 to 240 Swiss francs

You are free to book rooms in [other hotels in Davos](#) (preferably in the district Davos Platz), but all events will take place in Schatzalp hotel, which is only accessible by funicular.





Organizing Committee

- Stefan Wiemer Director of the Swiss Seismological Service SED
- Toni Kraft Senior Seismologist at the SED
- Barbara Naegeli Communications Specialist at the SED

Contact: schatzalp@sed.ethz.ch

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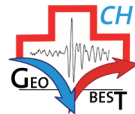


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We look forward to seeing you in Davos!

