UNIVERSITY OF BERGEN
Center for Modeling of Coupled Subsurface Dynamics

Course description:

Winter School on Modelling of Coupled Subsurface Dynamics

Myrkdalen March 13.-17., 2023

Multi-disciplinary winter school for PhD candidates and early career scientists in mathematics, earth science and related fields

ECTS: 2 (Estimated workload 25-30 hours per ECTS)

Background and objective:

Subsurface technologies are important for our energy systems and for mitigating the climate problem. These technologies require that we understand and can control processes involving injection and extraction of fluids in the underground. The main objective of the Winter school is to introduce participants to problems at the research front related to subsurface technologies in the context of deformable porous media.

An important role of scientists is to disseminate and discuss relevant research results and scientific questions with stakeholders. These include politicians, NGOs, industry, peers, and the public. Proposed solutions for energy storage and carbon sequestration in the subsurface are promising technologies. However, they also contain associated risks. Examples of such risks are leakage, induced seismicity, groundwater contamination, and cross coupling between reservoirs at larger scales, all due to fluid injection and extraction.

It is important - and challenging - to communicate risks and possible mitigation strategies of new and possibly controversial technologies. The Winter school will address expectations to, and skills needed by, the next generation of scientists, particularly in a context of the political and ethical discourse related to energy safety and climate change.

Content:

The winter school will be composed of three modules focused on research challenges (70%), political and ethical perspectives (15%) and soft skills (15%). The research challenges module will address mathematical modelling and simulation, CO2 sequestration and energy storage and risks such as induced seismicity and CO2 leakage. The political and ethical perspectives module will include activities related to policy-making and science communication. The soft skills module will focus on career development and how to succeed in academia.

The teaching during the winter school with be a combination of lectures and student assignments to be completed in groups. Preparatory reading will be assigned before the winter school.

Learning Outcomes:

On completion of the winter school the participants should have the following learning outcomes defined in terms of *knowledge, skills, and general competence*:

Knowledge

- Insights into new and outstanding challenges in the mathematical modelling and computational simulations of subsurface processes.
- Knowledge of mathematical modelling of relevant physical and chemical processes which may lead to induced seismicity or other risks due to subsurface engineering.
- Knowledge of computational challenges in the simulations of these processes.
- Knowledge of research directions and open questions in the fields of energy storage and carbon sequestration.

Skills

- Perform simulations based on PorePy.
- Evaluate and choose between different numerical methods.
- Present and discuss opportunities and challenges related to subsurface technologies.

General competence

- By hosting a diverse group of graduate students and young scientists from different fields, the participants will be trained in interdisciplinary teamwork. Participants will obtain an improved understanding of their role as a scientist in the society by discussing political and ethical questions related to energy extraction and storage in the subsurface and will be given insights into career development for young scientists.

Required Previous Knowledge:

The participants are expected to be at graduate or post-graduate level and have a good understanding of mathematical tools used in modelling in the subsurface. The participants will be provided with relevant reading material on the mathematical and computational challenges involved in the induced seismicity. This preparation will entail on average 20 hours working time.

Compulsory Assignments and Attendance:

Participation in all sessions of the winter school is mandatory. When parallel sessions, the participants will be assigned to a relevant session.

As part of the winter school, participants must give a presentation or hand in a written report, a video or a podcast on a topic involving energy storage or carbon sequestration. The assignment can be done in teams with a statement from each participant on how the work was performed. The assignments will be uploaded on the Winter school website hosted at the Vista Center.

Forms of Assessment:

Assessment will be based on active participation in the winter school and on the presentation/written assignment, video or podcast submitted after the Winter school.

Grading Scale:

Pass or fail.