

# **Predictive modeling and upscaling of flow and reactive transport in heterogeneous aquifers**

**February 6-8, 2121 (Lectures) 2138 (Exercises) Géopolis, University of Lausanne**

## **Instructors:**

**Jesus Carrera (IDAEA-CSIC)**  
**Olaf Cirpka (University of Tübingen)**  
**Marco Dentz (IDAEA-CSIC)**

### **February 6 (Jesus Carrera):**

**Lecture, 9h00-10:30.** Principles of GW flow; Hydraulic conductivity; Storage coefficient; Flow equation; Dimensionless form of the flow equation.

**Coffee Break, 10:30-11:00**

**Lecture, 11h00-12:00.** Introduction to numerical methods and groundwater modeling.

**Exercises 12:00-13:00.** Excel exercises on 1-D flow

**Lunch 13:00-14:00**

**Lecture, 14:00-15:30** Principles of solute transport; Diffusion; Dispersion; the ADE equation; Mixing and reactions.

**Coffee Break, 15:30-16:00**

**Lecture, 16h00-17:00.** Introduction to numerical methods for solving transport.

**Exercises 17:00-18:00.** Excel exercises on 1-D transport.

### **February 7 (Olaf Cirpka):**

**Lecture, 9h00-10:30.** Principles of bioreactive transport 1: Reaction kinetics and system behavior in 1-D bioreactive transport

**Coffee Break, 10:30-11:00**

**Lecture, 11h00-13:00.** Principles of bioreactive transport 2: Mixing-controlled bioreactive transport in homogeneous and heterogeneous domains 2-D domains

**Lunch 13:00-14:00**

**Exercises, 14:00-15:30** Matlab exercises on 1-D bioreactive transport

**Coffee Break, 15:30-16:00**

**Exercises, 16:00-18:00** Matlab exercises on 2-D bioreactive transport

**February 8 (Marco Dentz):**

**Lecture, 9h00-10:30h.** Transport in heterogeneous media, overview, questions and challenges

**Coffee Break, 10:30-11:00**

**Lecture, 11h-13h.** Stochastic transport modeling, random walks, central limit theorem, dispersion, macrodispersion

**Lunch 13:00-14:00**

**Lecture 14:00-16:00.** Non-Fickian transport models, continuous time random walks, generalized central limit theorem, multirate mass transfer

**Coffee Break, 15:30-16:00**

**Excercises 16:00-18:00.** Numerical implementation of a simple random walk and determination of mean velocity and dispersion. Generalization to dispersion in a stratified medium. Numerical implementation of a continuous time random walk and calculation of solute breakthrough curves.