

Scope

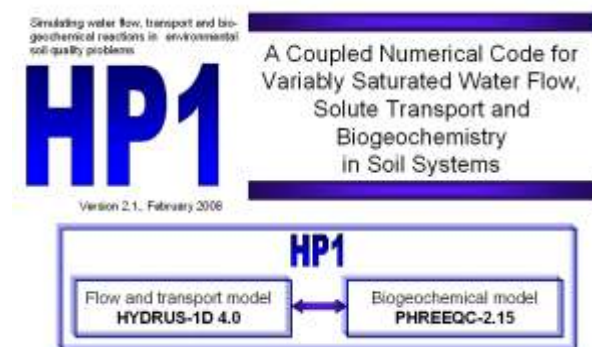
Migration of inorganic and organic contaminants in the subsurface is affected by a multitude of complex, interactive physical, geochemical and microbiological processes. Cycles of precipitation and evaporation largely determine if contaminants remain near the soil surface. Changes in the chemical composition or pH of the soil solution may impact the retention of radionuclides and heavy metals on organic matter or iron oxides. Dissolution and precipitation of radionuclide or trace element bearing minerals generally buffer the transport of a solution with a different pH through the soil profile. Simulation of these and related processes requires a coupled reactive transport code that integrates the physical processes of variably-saturated water flow and convective-dispersive solute transport with a range of biogeochemical processes.

Numerical modelling is becoming an increasingly important tool for analyzing such complex problems involving water flow and contaminant transport in the unsaturated zone. This course is designed to familiarize participants with the principles and mathematical analysis of variably-saturated flow, transport processes and coupled multicomponent reactive transport, and the application of state-of-the-art numerical codes to site-specific subsurface flow and transport problems.

Although participants should have a general background in the principles of soil physics and chemistry, the course gives an introduction to some theoretical aspects of water flow, solute transport, and heat transport in soils, geochemical equilibrium modelling and geochemical processes as cation exchange, surface complexation and kinetic reactions. Most of the time, "Hands-on" computer sessions will familiarize participants with the basic use of the software packages, as well as with the conceptualization of practical problems for numerical analysis.

Course Software

The course introduces a new generation of Windows-based numerical models for simulating water, heat and/or contaminant transport in variably-saturated porous media. These include the HYDRUS-1D and HYDRUS (2D/3D) codes for one- and two-dimensional simulations, respectively, PHREEQC-2 for geochemical calculations and HP1 for one-dimensional biogeochemical transport. HYDRUS-1D and HYDRUS (2D/3D) are supported by interactive graphics-based interfaces for data-preprocessing, generation of unstructured as well as structured finite element grid systems, and graphic presentation of the simulation results. Two graphical interfaces are also available for PHREEQC. The graphical interfaces of HYDRUS-1D and PHREEQC-2 are used to set up the reactive transport problems to be solved with HP1. Except for HYDRUS (2D/3D), all software packages are in the public domain.



Instructors

Jirka Simunek is a Professor of Hydrology at the department of Environmental Sciences at the University of California. He is the author of the HYDRUS-1D, HYDRUS (2D/3D) software principally developed for modeling water flow, chemical movement and heat transport through variably-saturated soils. He is also involved in the development of the reactive transport code Hp1. He is a recipient of the Soil Science Society of America's Don and Betty Kirkham Soil Physics Award and serves currently as the past chair of the Soil Physics (S1) of SSSA.

Diederik Jacques is a researcher at the Performance Assessment Unit, Institute of Environment, Health, and Safety of the Belgian Nuclear Research Centre. He is working on different aspects of coupling unsaturated water flow, solute transport and geochemical reactions, including the development and testing of the coupled code HP1, its application to (long-term) solute transport in soils, and interaction between different systems (clay-concrete, or soil-concrete).

Dirk Mallants is a researcher at the Performance Assessment Unit, Institute of Environment, Health, and Safety of the Belgian Nuclear Research Centre. He has a long experience in modelling flow and transport phenomena in porous systems and the use of transport codes in assessing the long term performance of waste disposal sites.

Evelien Martens is a researcher at the R&D Disposal Unit, Institute of Environment, Health, and Safety of the Belgian Nuclear Research Centre. She has experience in geochemical and coupled reactive transport calculations.

Course audience

The course is intended for PhD. students, researchers and practicing professionals wishing to expand their knowledge on water flow and transport and biogeochemical reactions in soils and engineered barriers (clay, concrete) using the HYDRUS and HP1 software.

Programme

DAY 1

- Background on variably-saturated water flow and solute transport processes
- Review of the hydraulic properties of unsaturated porous media
- Introduction to HYDRUS-1D software package
- Application of HYDRUS-1D to simple one-dimensional problems
- Application of HYDRUS-1D to a transient water flow and solute transport problem
- Advanced one-dimensional forward and inverse problems with HYDRUS-1D

DAY 2

- Application of HYDRUS (2D/3D) to simple one- and two dimensional problems
- Application of HYDRUS (2D/3D) to a complex two-dimensional problems
- New developments in the HYDRUS-software

DAY 3

- Principles of biogeochemical equilibrium modelling
- PHREEQC-2: Introduction, Database
- PHREEQC-2: Definition of the initial solution
- PHREEQC-2: Examples of reaction path modelling

DAY 4

- Reactive transport in the vadose zone: examples and approach in HP1
- First example with HP1
- Surface-related processes
- Exchange processes in PHREEQC-2 and HP1

DAY 5

- Surface complexation processes in PHREEQC-2 and HP1
- Kinetic reaction networks
- Abiotic and biotic kinetics in PHREEQC-2 and HP1

Date

September 28 – October 2, 2009

Registration

Please register via http://www.sckcen.be/en/Events/TC_HP1 before August 28, 2009. Detailed information will be send by email.

Registration fee

- 650 € for Ph.D students
- 850 € for others

This price includes course documentation, coffee breaks, lunches, a social event and a conference dinner.

Computer exercises will be done on your own personal laptops. Please inform us if you are not able to bring your own computer.

Lodging

www.visitgent.be

Contact

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Ghent, Belgium
September 28 – October 2, 2009

Course on 'Simulating soil water movement and transport using the biogeochemical transport model HP1'



Organised by SCK•CEN

Location

Het Pand
Onderbergen 1
BE-9000 Ghent

<http://www.ugent.be/en/facilities/pand>

www.sckcen.be