BRES2102 Soil hydrodynamics : modelling

[30h+30h exercises] 5 credits

This course is taught in the 2nd semester

Teacher(s): Charles Bielders, Marnik Vanclooster
Language: French
Level: Second cycle

Aims

At the end of the courses and practicals, the students will be able to :
- understand the hydrodynamic functioning of soils and aquifers
- apply the water and solute transfer equations to steady and unsteady flow in saturated and unsaturated media
- interpret the behaviour of an aquifer during a pumping test
- interpret the breakthrough curve in terms of the main processes affecting solutes during their transfer in a soil column
- master the functioning principles of advanced techniques for the characterization of soil hydrodynamic properties
- solve complex problems through the use of simulation models and field measurements.

Main themes

This course aims at initiating students to the modelling of water and solute transfer in heterogeneous, saturated or unsaturated media, at the scale of the pedo-geologic formation. More specifically, this course aims at : - reviewing the concepts of water and solute transfer in unsaturated heterogenous media and aquifers; - present the various approaches for the mathematical modelling of water and solute transport in soils and aquifer (analytical, numerical and transfer function aapproaches), - explain the functioning of advanced techniques for the hydrodynamic characterization of soils and aquifers; - initiate students to the use of numerical resolution tools of the water and solute transfer equations; - train the student to team work for the resolution of a realistic hydrodynamic problem.

Content and teaching methods

This course presents the equations of water and solute transfer in saturated and unsaturated media : Richards equation, convection-dispersion equation with degradation, adsorption, mobile-immobile water, etc. A lot of emphasis is placed on different approaches for the resolution of these equations (analytical, numerical and transfer function), as well as advanced methods for the characterization of hydrodynamic properties and solute concentrations : GPR and SAR radar, magnetic induction, inverse modelling, etc. Preferential flow of water and its impact on solute transport will be presented. Finally, the hydrodynamic characteristics of aquifers and the principles and interpretation of pumping test for the characterization of aquifer properties will be discussed. The main concepts presented during the course will be illustrated during the practicals : tension infiltrometer, use of numerical models for direct or inverse modelling in 1 (soils) and 2 (dams) dimensions of water and solutes in saturated / unsaturated media. Finally the students will present a 20 min. seminar on a theme of their choice related to the course.

Other information (prerequisite, evaluation (assessment methods), course materials recommended readings, ...)

Precursory courses Soil science, soil physics, transfer phenomena
Evaluation Evaluation is based on the seminar, a report on the practicals, open-book resolution of exercises, and the interpretation of a breakthrough curve.
Support Handbook, educational software, book or article excerpts.

Programmes in which this activity is taught

BIR2 Bio-ingénieur

Other credits in programs

BIR22/4C	Deuxième année du programme conduisant au grade de bio-ingénieur : Chimie et bio-industries (Technologies environnementales: eau, sol, air)	(5 credits)	
BIR22/4E	Deuxième année du programme conduisant au grade de bio-ingénieur : Sciences et technologie de l'environnement (Technologies environnementales: eau, sol, air)	(5 credits)	
BIR22/7A	Deuxième année du programme conduisant au grade de bio-ingénieur : Sciences agronomiques (Ressources en eau et en sol)	(5 credits)	Mandatory
BIR22/7E	Deuxième année du programme conduisant au grade de bio-ingénieur : Sciences et technologie de l'environnement (Ressources en eau et en sol)	(5 credits)	Mandatory
BIR23/4E	Troisième année du programme conduisant au grade de bio-ingénieur : sciences et technologie de l'environnement (Technologies environnementales: eau, sol, air)	(5 credits)	