lbres2102
2020

Engineering of the water and the pollutants in grounds and groundwaters

Due to the COVID-19 crisis, the information below is subject to change, in particular that concerning the teaching mode (presential, distance or in a comodal or hybrid format).

4 credits	22.5 h + 22.5 h	Q2

Teacher(s)	Vanclooster Marnik ;
Language :	French
Place of the course	Louvain-la-Neuve

Main themes	The course aims to introduce students into the modeling of transport phenomena (transport of water, solute transport, heat transfer) in variably-saturated soil and in groundwater aquifers. The following topics are covered:
	  - Theoretical concepts governing the transfer of water, solutes and other pollutants and heat in partially saturated soils and aquifers;
	  - Approaches for modeling transport processes in soil and aquifers (analytical approaches, numerical approaches, transfer function);
	  - Methods for the assessment of hydrodynamic properties of soils and aquifers;
	  - Integration of hydrodynamic aspects in soil and water engineering and management.

Aims	a. Contribution to Learning Outcomes program
	    M1.1 , M1.2 , M1.3 , M2.1 , M2.2 , M2.3 , M5.1 , M5.6 , M5.8 , M6.1 , M6.2 , M6.4 , M6 . 9 , M7.1 , M7.2 , M8.1 , M8.2 , M8.3 , M8.4 ;
	
	b . Specific formulation for this activity LO program (maximum 10)
	    At the end of the course (2 ECTS) and pratical work (2 ECTS) , students will be able:
	    - To explain the principles of flow of water and solutes (including pollutants) in soils and aquifers;
	    - To develop and implement the transport equations for modelling flow in unsaturated (soil) and saturated (aquifer) natural porous media in steady state and transient conditions;
	    - To discuss and understand hydrodynamic assessment techniques for soils and groundwater aquifers, especially using hydrogeophysical techniques;
	    - To estimate, using traditional methods and advanced methods (inverse modeling , data assimilation) the hydrodynamic properties of soils and aquifers;
	    - To apply hydrodynamic modeling to solve complex engineering problems of water and soil.
	
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	The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".

Evaluation methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** Oral exam with written preparation. The examination consists of 3 parts: • a complex case study to assess the student's ability to integrate the different elements of the subject matter to solve a complex soil hydrodynamics problem; • specific theoretical questions. • solving a concrete problem in a computer room (Hydrus and/or Modflow) The evaluation covers the consistency of the response, the accuracy of the answers, the quality of the preparation document, the quality of the oral defence.
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** **Lectures**: Reverse class. Through the course website (Moodle), the student has access to a syllabus, video clips that explain the theoretical foundations of the course and Python notebooks to illustrate certain aspects. Classes in the classroom allow students to answer questions and deepen their knowledge of the subject. Due to lecture room capacity limitations related to the COVID crisis, some part of the course can be organised at distance. **Practical work:** Exercises in computer rooms.

Content	**Lectures:** Methodological approaches for quantitative modelling, applied to water and solute (nutrients, pollutants) transport in to soil and groundwater systems.
	- Equations for water transport in soil (Richards equation, Fokker-Planck equation), solute transport in soil (convection-dispersion equation, with degradation, adsorption, mobile-immobile water), water diffusion in groundwater . - Solutions: analytical solutions (Laplace and Boltzman transformation); numerical solutions (finite differences, finite elements); integrated solutions (transfer function). - Methods for characterizing hydrodynamic parameters. Laboratory methods, in situ methods. Inverse modelling. - Applications: water infiltration in the soil, pollutant transport in the soil, pumping tests in a groundwater system. **Practical work:** The main concepts presented during the courses will be illustrated by exercises in the computer room using Python notebooks and open source software . - Estimation of hydrodynamic parameters from laboratory observations. - Analytical solutions for water transport and solutes. - Numerical modelling in water-unsaturated soils using HYDRUS 1-D. - Modelling of groundwater diffusion using MODFLOW
Inline resources	Moodle site of the course - Organization of the course - Course syllabus - Video clips - Python notebooks - Tutorial & assignments
Bibliography	M. Vanclooster, 2019. Modelling soil and subsoil hydrodynamic processes. Syllabus AGRO-UCLouvain. 120 pp.
Other infos	This course can be given in English.
Faculty or entity in charge	AGRO

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Master [120] in Environmental Bioengineering	BIRE2M	4		🔍
Master [120] in Chemistry and Bioindustries	BIRC2M	4		🔍
Master [120] in Agriculture and Bio-industries	SAIV2M	5		🔍