Anlage 7: Modulbeschreibungen zu Artikel 2-4

Nr.	4HDEMA01	
Modultitel	Uncertainty in soil mechanics and water resources	
Pflicht/Wahlpflicht	P	
Moduldauer	1 Semester	
Angebotshäufigkeit	WiSe	
Lehrsprache	Englisch	
LP	6	
SWS	4	
Präsenzstudium	60 h	
Selbststudium	120 h	
Workload	180 h	
Lehr- und Lernform	**ggf. Veranstaltungen/Modulelemente**	**SWS**
Vorlesung	Uncertainty in soil mechanics and water resources	3
Seminar	Uncertainty in soil mechanics and water resources	1
Leistungen	**Form**	**Dauer/Umfang**
Prüfungsleistungen	Klausur	120 Min
Studienleistungen	Keine	
Qualifikationsziele	Students have a basic understanding of uncertainties related to environmental processes (spatial heterogeneity, soil properties, weather, flow processes), their interrelations and representation in environmental modelling. For this, the course is divided into three parts: <u>Part 1: Concepts of uncertainty characterization</u> • Basic understanding of uncertainty quantification and assessment, including the concept of predictive probability density. • Basic understanding of Bayesian theory (prior distributions, likelihood and posterior distributions) for model parameterisation. • Basic understanding of stochastic modelling of time-dependent environmental processes (e.g. Markov chain modelling). • Skill acquisition in the use of statistical and graphical libraries for representation in Python (scipy, matplotlib). <u>Part 2: Uncertainties in water resources</u> • Students learn to understand uncertainty in water resources-related problems (flow forecasting, reservoir management). Acquaintance of students with the relative role of uncertainties in water resources management (meteorological and climate uncertainty vs. model and parameter uncertainty). • Students will learn how to address parameter uncertainty through Bayesian inference. • Students become familiar with the concept of predictive uncertainty in flow forecasting. • Students are introduced to (stochastic) dynamic programming in water resources management under uncertainty. <u>Part 3: Uncertainties in soil mechanics</u> • Students will understand the relationship between formation history of the ground and the composition of soil as a multiphase porous medium; they will further be able to reflect differences in the resultant mechanical behaviour. • Students are familiar with ground investigation methods and	

	the procedure to establish a 3D ground model required for reliability-based geotechnical analyses. • Students will understand sources of uncertainties related to soil mechanics (inherent uncertainty of soils, model uncertainty and measurement errors, statistical uncertainty, uncertainties of structural loading) • Students will be able to establish procedures to address spatial variability of soil parameters in geotechnical design. • Students are familiar with the use and benefits of Bayesian updating in cases of scarce soil data.
Inhalte	<u>Part 1: Concepts of uncertainty characterization</u> • Introduction to and repetition of basic statistical concepts (statistical moments, linear regression models of variates, correlation and autocorrelation). • Essential parametric distribution models and their properties (Normal, Log-normal, Beta, Gamma and Weibull distribution). • Brief introduction to Gaussian multivariate distributions and their use in uncertainty assessment. • Introduction to Bayesian inference (prior distribution, likelihood, posterior distribution) for addressing parameter uncertainty. <u>Part 2: Uncertainties in water resources problems</u> • Introduction to sources of uncertainty and their relative roles in hydrological and water resources models (model uncertainty, parameter uncertainty, weather and climate uncertainty). • The concept of predictive uncertainty for weather and flow forecasting, climate projections. • Assessing parameter uncertainty in hydrological models through Bayesian inference • Introduction to stochastic dynamic programming for optimal reservoir management under conditions of uncertainty. <u>Part 3: Uncertainties in soil mechanics</u> • Formation history of soils, types and composition of soils, soil classification, deformation and strength characteristics of soils, the role of water in soil mechanics. • Basic concepts of field and laboratory ground investigation; establishing the ground model. • Characterization of uncertainties related to soil mechanics and illustration of the resultant consequences for geotechnical design. • Procedures for uncertainty description within probabilistic analyses (e.g. selection of appropriate distribution type, spatial averaging, Bayesian updating)
Verwendbarkeit in den folgenden Studiengängen	MA Engineering of Hydro-Environmental Extremes
Voraussetzungen für die Teilnahme	Keine
Voraussetzungen für die Vergabe von LP	Bestandene Prüfungsleistung