FEM-31806 Models for Ecological Systems

Opleidingen

Vak

Studiepunten 6.00

OnderwijstypeContacturen	
Lecture	20
Practical	93
Group work	5

Course coordinator(s)	dr. ir. FJ Sterck
Lecturer(s)	HJ de Knegt
	dr.ir. GJ Reinds
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	dr. ir. FJ Sterck
	dr. ir. MMPD Heijmans
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	dr. M de Jong
	JP van der Sleen
Examiner(s)	dr. ir. FJ Sterck
	dr. ir. ing. AGT Schut

Language of instruction:
English

Assumed knowledge on:

We expect participants to have experience with elementary mathematics, for instance as taught in the courses MAT-14903 (Mathematics 2) and MAT-15003 (Mathematics 3) using the book "Mathematics at Work, Volumes 1 and 2", by M. de Gee, Mathematical and Statistical Methods Group, Wageningen University (Dutch version: Wiskunde in Werking, Deel 1 en 2, Epsilon-Uitgaven deel 48 en 49), available at the WUR Shop.

Contents:
The dynamics of ecological systems are driven by multiple interacting processes and are therefore considered complex. Through modelling, we simplify this complexity of ecological reality in order to better understand the key processes and relationships between system components, and ultimately improve our insight in an ecological problem. In this course, you will learn to use the concepts of systems analysis to describe, understand and analyse complex, ecological systems quantitatively. The focus is on the behaviour of deterministic (repeatable) dynamic models of ecological systems. You will learn how to work with differential equations that determine changes in the modelled system and link these to algebraic descriptions

to Forrester and state-flow diagrams. Further, you will learn to work with R software to analyse data and to implement, test and solve mathematical models. You will apply these new skills in evaluating the characteristics and quality of applied models, which are currently used by scientists and policy makers.
In this course, the major focus will be on terrestrial (tundra and forest) and aquatic (fresh water lake) ecosystems. The goal is to understand the dynamics in, for example, the abundance of species populations, production, or succession of species in such systems as determined by processes, which are often driven by environmental conditions. You will learn to simplify, conceptualize, build, implement, test and run models of ecological systems. The learning trajectory of this course takes three steps: 1) starting with conceptual diagrams and mathematical tools (the theory and concepts of ecological modelling), 2) implementation of mini-models in an R environment, and 3) evaluation of existent applied models. These three steps are reflected by the intended learning outcomes and the educational activities of this course.

Learning outcomes:

After successful completion of this course students are expected to be able to:

- understand, apply and evaluate the conceptual and mathematical tools for modelling ecological systems;
  - understand system analysis concepts and apply tools such as Forrester diagrams, and state-flow diagrams;
  - understand mathematical tools that act as the mathematical building blocks for models of ecological systems: algebraic equations, ordinary and partial differential equations, analytical integration;
  - understand and apply numerical integration, state and rate variables, feedback mechanisms, and evaluate time coefficients;
  - understand mathematical tools to evaluate model behaviour and perform quality checks: time step analysis, unit analysis, sensitivity analysis, equilibrium analysis, mass balance checks.

- implement and evaluate mini-models for ecological systems in an R-environment;
  - apply basic R skills to manage, describe and visualise data, apply basic data and plotting functions, write functions and set up structured code to model ecological systems;
  - implement your own mathematical mini-model for an ecological system in an R environment, using all explained conceptual and mathematical building blocks (apply tools from learning outcome 1);
  - evaluate the behaviour and quality of your mini-model by applying all model checks (apply tools from learning outcome 1).

- evaluate the behaviour and quality (strengths and limitations) of, and generate predictions with, an existing complex model that is applied in science and society for addressing problems in ecological systems;
  - evaluate the model quality by applying all the quality checks (apply tools from learning outcome 1);
  - define, run and evaluate model simulation scenarios for a real-world ecological problem.

Activities:

Theory & concepts
- lectures and practicals.

Mini-models & R
- lectures and practicals introducing the basics of the R environment;

- lectures and practicals on ecological mini-models in R.

Applied models
- lectures;
- practicals in groups;
- report and poster presentation.

Examination:

- theory and concepts: individual examination ((50%);

- mini-models & R: individual R examination (10%),

- individual mini-model assignments (10%);

- applied model assignment (30%).

To pass the course, each component requires a minimum mark of 5.5.

Literature:

- a syllabus is provided on Blackboard: Schut, A.G.T., de Knegt, H.J. & Sterck, F.J. 2018. Syllabus Models for Ecological Systems FEM-31806.;
- other literature sources are also provided on Blackboard.

	Opleiding		Fase	Specialisatie	Periode
Verplicht voor:	MFN	Forest and Nature Conservation	MSc	C: Ecology	3WD
Keuze voor:	MEE	Earth and Environment	MSc	C: Biology and Chemistry of Soil and Water	3WD
	MCL	Climate Studies	MSc	C: Ecological and Agroecological Systems	3WD