Vegetation modelling

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Chapter 1

Introduction

Soil-Plant-Atmosphere continuum: the central role of vegetation

Why do we need modelling?

Components of a model

The history of vegetation models

Early history of vegetation modelling

The first DVGMs centered around carbon fluxes

A new generation of DGVMs centered around vegetation functioning

Model types

Structure of the course

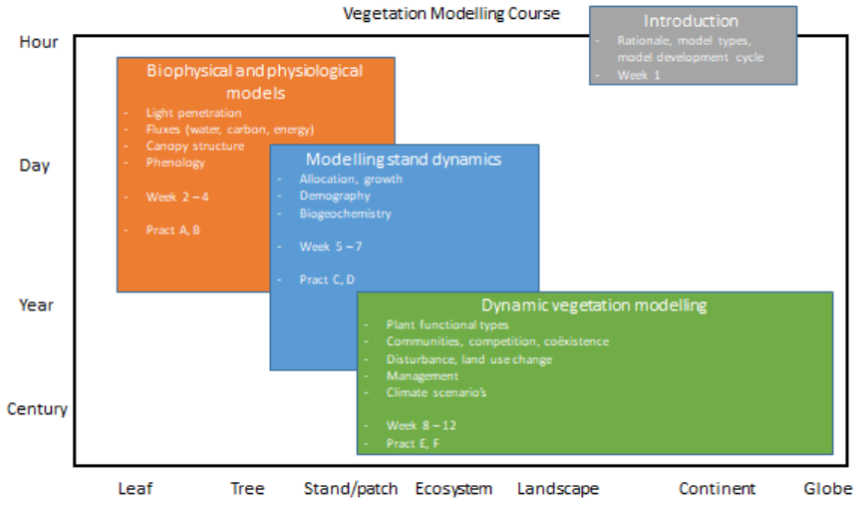

Figure 1.1: Here is the structure of the course!

(PART) Biophysical and physiological models

Chapter 2

Modelling plant basic processes

Photosynthesis and stomatal models

Respiration models

Transpiration

Upscaling from leaf to canopy

Chapter 3

Modelling light penetration, vegetation canopy representation, energy balance

Representing canopy structure in models

Direct and diffuse light

Ecosystem energy balance

Chapter 4

Temporal and seasonal dynamics

Leaf phenology

Drivers of seasonality and phenology

(PART) Modelling vegetation dynamics

Chapter 5

Modelling growth, timber production and Carbon allocation

Empirical growth modelling: growth curves

Process-based growth modelling: C-allocation models

Chapter 6

Modelling vegetation dynamics and demography

Seed dispersal and recruitment

Mortality

Gap models, individual and cohort based models

Chapter 7

Modelling biogeochemical cycles in vegetation

Carbon cycle models: stocks and fluxes

Nutrient cycle models: soil biogeochemical models

Water balance

(PART) Upscaling and applications

Chapter 8

Representing biodiversity in vegetation models

Functional diversity

Competition models

Communities

Chapter 9

Spatial heterogeneity, landscape scale, metapopulations

Patch dynamics

Land-use changes

Fire and disturbance

Chapter 10

Upscaling from leaf/tree to globe

Land surface models

DVGMs as a part of Earth system models

Chapter 11

Model projections and scenario analysis

Climate scenarios

Land-use scenarios

Management scenarios

(PART) Practicals

Supporting material

Crash course, basic programming (R), theory about model evaluation etc.

Practical A

PC-room, supervised exercise

Simple model on diurnal variation in solar angle, radiation extinction and photosynthesis in vegetation types with different and canopy structure and LAI: grassland, broadleaved forest, coniferous forest

Scale: aggregated stand level (big leaf model)

Methodological focus: model formulation: translating a few equations into code

Methodological focus: compiling code, running model, reading input-output

Practical B

Group work, report, PC room

Modelling diurnal cycle of carbon and water fluxes for flux tower sites (Savanna's Sahel)

Scale: aggregated stand level

Methodological focus: model-data comparison (goodness-of-fit), simple parameter optimisation

Practical C

PC-room, supervised exercise

Modelling the size structure of a temperate forest (stand diameter distribution)

Scale: forest stand

Methodological focus: initial conditions

Practical D

Group work, report, PC room

Modelling carbon stocks (above and belowground) and fluxes

Scale: ecosystem

Methodological focus: Spinup and sensitivity analysis (testing which climate variables have strongest impact on stocks)

Practical E

PC-room, supervised exercise

Simulating forest succession, meta-analysis of trait dataset to prescribe vegetation functional composition (using PEcAn-framework)

Scale: landscape

Methodological focus: parameter meta-analysis (PFT construction), data assimilation

Practical F

PC-room, group work, microteaching

Climate/land use/management scenario analysis

Scale: site/globe? (Pecan framework) each group choses a question and a model

Methodological focus: sensitivity and uncertainty analysis