Vegetation modelling

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2020-05-27

Contents

Chapter 1

Introduction

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

1.2 Why do we need modelling?

1.3 Components of a model

1.4 The history of vegetation models

1.4.1 Early history of vegetation modelling

1.4.2 The first DVGMs centered around carbon fluxes

1.4.3 A new generation of DGVMs centered around vegetation functioning

1.5 Model types

1.6 Structure of the course

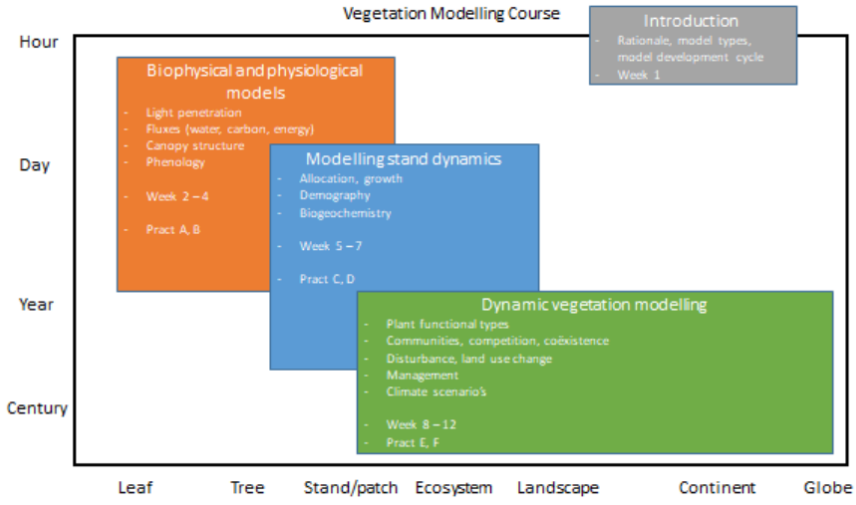

Figure 1.1: Here is the structure of the course!

Part I

Biophysical and physiological models

Chapter 2

Modelling plant basic processes

2.1 Photosynthesis and stomatal models

2.2 Respiration models

2.3 Transpiration

2.4 Upscaling from leaf to canopy

Chapter 3

Modelling light penetration, vegetation canopy representation, energy balance

3.1 Representing canopy structure in models

3.2 Direct and diffuse light

3.3 Ecosystem energy balance

Chapter 4

Temporal and seasonal dynamics

4.1 Leaf phenology

4.2 Drivers of seasonality and phenology

Part II

Modelling vegetation dynamics

Chapter 5

Modelling growth, timber production and Carbon allocation

5.1 Empirical growth modelling: growth curves

5.2 Process-based growth modelling: C-allocation models

Chapter 6

Modelling vegetation dynamics and demography

6.1 Seed dispersal and recruitment

6.2 Mortality

6.3 Gap models, individual and cohort based models

Chapter 7

Modelling biogeochemical cycles in vegetation

7.1 Carbon cycle models: stocks and fluxes

7.2 Nutrient cycle models: soil biogeochemical models

7.3 Water balance

Part III

Upscaling and applications

Chapter 8

Representing biodiversity in vegetation models

8.1 Functional diversity

8.2 Competition models

8.3 Communities

Chapter 9

Spatial heterogeneity, landscape scale, metapopulations

9.1 Patch dynamics

9.2 Land-use changes

9.3 Fire and disturbance

Chapter 10

Upscaling from leaf/tree to globe

10.1 Land surface models

10.2 DVGMs as a part of Earth system models

Chapter 11

Model projections and scenario analysis

11.1 Climate scenarios

11.2 Land-use scenarios

11.3 Management scenarios

Part IV

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