ECL 707 (MSc) - ECL 807 (PhD)
Summer School in Biodiveristy Modelling
Orford Musique – August 20–24, 2018

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General Objective

Biodiversity modelling is now an integral part of the work of biologists in many subfields of biology from fundamental ecology to evolutionary biology and conservation biology. By the end of this course, the student will be able to use different biodiversity modelling techniques and understand the limits of different types of ecological data. The student will also be able to understand the basis of the different approaches used to model and predict different facets of the biodiversity (e.g. species distribution or trophic networks structure) and to use these approaches in his own projects. Finally, the student will also be able to apply the different techniques discussed during the course to decide and inform on the structure of biodiversity of a particular region.

Specific Objectives

By the end of this course, the student will :

- be able to use different biodiversity modelling techniques (statistics, differential equations, stochastic simulations)
- be able to use outputs of climate change models for biodiversity modelling
- be able to devise various biodiversity scenarios based on the analysis of empirical data
- have developed critical thinking about the methods used in different biodiversity scenarios
- be able to evaluate the source of uncertainty in predictions of biodiversity

Prerequisites

To follow this course, intermediate knowledge of scientific programming is required.

Pedagogical Approach

For each topic covered, short lectures on the basic theory will be separated by practical sessions designed to apply what was learned in the lecture. The sections will end with an exercise highlighting the different aspects of the topic covered. Each topic will be complemented by discussions on the characteristics of the approaches discussed and their use in practice. Students will have a data analysis project to complete that will encompass all aspects of what has been seen during the summer school.

All the course material will be made available on the following git repository :
https ://github.com/EcoNumUdS/ScenariosBiodiv

Topics

Day 1

Morning – Introduction

- Phenomenological vs mecanistic approches
- Use of biodiversity scenarios for decision makers
  - Overview of tools used (DGVM, Forest Gap Models, SDM, SAR ...)
  - Examples of biodiversity scenarios
- Basis of modelling (ODE, stochastic, statistics)
- An example : The QUICC-FOR project

Afternoon – Anthropogenic Change Scenarios

- Climatic models
- Resource selection models

Exercice

Temperate forest migration simulations

Seminar (optional)

Directed exercises on algorithmic
- ODE
- Stochastic simulations

Day 2 – Spatial and Land Use Change Models

Morning – Spatial dynamic

- Stochastic simulations : Markov chains
- Metapopulation theory
- Cellular automata

Afternoon – Connectivity

- Landscape connectivity tools
- Using landscape occupations open data

Exercice

Spatial co-dynamic of forests and avian communities

Seminar

Marie-Josée Fortin, University of Toronto

Day 3 – Biodiversity Distribution and Climate Change

Morning – Species Distribution Models (SDMs)

- Théorie
- MaxEnt
- BioMod and ensemble forecasting

Afternoon – Using Open Data on Biodiveristy

Exercice

Mapping bird richness and uncertainty in the south of Québec

Seminar

Anne Bruneau, Université de Montréal

Day 4 – Community Models

Morning – Joint Species Distribution Models (JSDMs)

— Theory
— Using the `HMSC` R package

Afternoon – Networks Dynamics, Extinctions and Ecosystem Use

— Robustness Analysis
— Ecosystem Dynamics

Exercice

— Mapping bird richness and uncertainty in the south of Québec (revisited)
— Spatial dynamics of ecological networks

Seminar

Anouk Simard, Gouvernement du Québec

Day 5 – Decision Making

Morning – Tools for Decision Makers

— Evaluation of uncertainty
— Structural sensibility
— Optimization

Afternoon

— Student's presentation
— Integrative exercises : optimizing a network of protected areas to maximize avian communities conservation

Evaluation

The evaluation will be based on a class project to complete alone or in a team. A presentation of the project and of the model use will be made during the week. A final report, including the code used to perform all analyses, will need to be handed in at the latest by **December 31, 2018**. Students will have the opportunity to use their own data or open access data to carry out their project.