**1) General course information**

**- Course title:**

Modeling species distributions: methods and applications

**- General course description:**

**Background:** Species Distribution Models (SDMs) are now widely used in many research fields for several purposes across terrestrial, freshwater, and marine realms. In all these contexts, the main issue is to link information on the presence/absence or abundance of a species to environmental variables to predict where (and how much of) a species is likely to be present in unsampled locations or time periods. In ecology, SDMs have been implemented in different theoretical and practical cases, including the identification of critical habitats, the study of the risk associated with invasive species, the potential effects of climate change, the design of protected areas and delineation of hot spots of biodiversity and species richness.

Many algorithms of spatial distribution models can be used to predict the distribution of species, however, these algorithms do not always provide accurate results as data can includes a large amount of variability and errors due to multiple factors (errors in the identification of the species, errors in taking the geographical coordinates , etc.). In this context, Bayesian spatial-temporal methods have several advantages over traditional ones, since they provide a more realistic and accurate estimate of uncertainty.

**Objective:** The general objective of this course is to provide a critical view of the existing techniques of species distribution models with a frequentist and Bayesian approach, discussing their strengths and limitations. At the end of the course, participants will learn about:

1. Formal knowledge about the main statistical approaches relating to SDMs;

2. Specific examples of SDMs with different model algorithms (GLMs, GAMs, Boosted Regression Trees) using a frequentist approach;

3. An introduction to the Bayesian inference and modeling framework;

4. Specific examples of SDMs using a Bayesian approach.

**- Date (detailed dates for the course): 05-08 November 2018**

**- Times:** 3 days full-time from 9.00 (see detailed program)

**- Language:** Portuguese.

**- Suggested maximum number of places:** 20

**2) Specific course information**

**- Detailed program (day by day description of contents):**

**Day 1**

9.00-9.30: Presentation of the course, professor and participants.

9.30-12.30: Theoretical section

- Species Distribution models (SDMs)

- Spatial data

- Data types and sources

- Modeling algorithms

- Model selection and calibration

14.00-17.30: Practical section

Testing different algorithms of SDMS in R: applied case studies.

**Day 2**

9.00-12.30: Theoretical section

- Concepts

- Priors

- Posteriors

- Predictive distributions

- Inference and prediction

- Numerical approaches

- Hierarchical Bayesian Models

- Why use HBMs for SDMs?

14.00-17.30: Practical section

- Basic of Bayesian analysis in R with the hSDM package.

- Working with satellite data

**Day 3**

9.00-12.30: Theoretical section

- INLA and latent Gaussian models

14.00-17.30: Practical section

- Developing SDMs with hSDM in R.

- **Recommended reading:** I usually provide access a dropbox folder a week before the course with different references, instructions to download R and packages required for practical sections, lectures and practical sections.

**- Student requirements (background, qualifications, bring own computer with installed software, previous readings, etc.):**

Some experience in the computer language R is desirable, and experience with Bayesian statistic is helpful. All participants must bring their own personal laptop.