

Fundamentals of GIS for ecology, and species distribution modeling workshop

Instructor: **Dr. Alice Hughes**, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences

GIS skills are essential to modern day ecologists. No matter what their specialism ecologists have had to acknowledge that species, and ecological phenomena occur in the real world, and that the relationships exist between environmental factors and other species can only be properly understood by acknowledging the spatial relationships and therefore by using GIS techniques. Species distribution modeling techniques also represent powerful and popular tools to extrapolate from the known records of a species distribution to predict the potential distribution of a species under various conditions, and better understand factors underlying these distributions.

The workshop aims to; A) train students in fundamental GIS tools and techniques using a number of different available software programs; B). teach students how to design and implement studies that utilize GIS techniques, and avoid potentially confounding biases; C). discuss the use of predictive modeling techniques to spatially project species distributions, using various approaches. D). use predictive approaches to project species distributions under changing conditions and; E). use various approaches and spatial statistics to interpret and analyse the results. Further information on the course schedule and structure is available at the base of this document).

During each part of the workshop students will be asked to reflect on how the approaches can directly be used in their own studies, and the final ½ day of the workshop will be available for students to start working with their own data so they have something they can continue to work on following the workshop.

All students will receive a digital booklet compiled for the course that provides explanations for all tasks, background theoretical material and suggested further reading. Students are also encouraged to bring their own data-sets as there will be the opportunity to start developing their own research using the techniques covered (and any others of interest) in the final afternoon of the four day workshop.

By the end of the workshops all participants should have the skills to develop and competently use GIS and species distribution modeling techniques in their own research.

Each evening during the workshop students can choose to attend a GIS Clinic: and go through their own study with the instructor on a one to one basis, to design, develop and analyze their own studies-further work on this will also occur on the final day of the workshop, but these appointments will enable students to advance their work further in the final day.

Requirements: Students for the initial part of the workshop can be at any level. Students who are competent can move through tasks quickly and without support-whereas total beginners can move through more slowly and be helped as needed. Participants need to bring a laptop if possible, and GIS data of species distributions if they have them.

During the workshop we will start at 8.30am each day, have a coffee break at 10.10-10.30, Lunch will be from 12-1, Afternoon break: 3-3.30. Finish workshop between 5.30/6, GIS clinics from 7-9pm (Optional appointments)

Day 1-3 Using GIS in Ecological research (Components A-B).

The workshop will start with a 45 minute seminar on Using GIS in ecological research, before a combination of short seminars and tasks to lead the students through basic GIS skills and choosing appropriate environmental variables for their research. We also go into remote sensing, so the understand what data is available and how it is generated.

In this component of the workshop students will get an overview of various available GIS software available. Students are requested to install Quantum GIS (freely available from <http://qgis.org/en/site/>) and ArcGIS (either from their research institute or from the online free trial) before the workshop.

We will go through a number of basic, and some advanced GIS methods using various pieces of software, and how students can access and develop data needed to compile all the appropriate environmental variables. These skills will include uploading field-collected data, digitizing various forms of data, converting and manipulating GIS data and many other GIS skills. As not all students have access to ArcGIS at their home institutions, most tasks will be possible in both ARC and freeware, and detailed instructions have been prepared for both.

By the end of this component of the course the students should feel comfortable with using GIS software to upload, download and manipulate data.

During this component we will also discuss experimental design, database development, and distribution data preparation. We will learn how to use different data formats, to digitize landcover from imagery and to develop continuous data layers for parameters like temperature or humidity based on data they have collected in the field, or downloaded. Here they will become comfortable with adapting spatial approaches to address ecological questions, and how to source and develop appropriate data.

Day 4 Using predictive approaches in ecology (Components C-E).

Seminar on Species distribution modeling: the versatility and value of models, understanding assumptions and developing studies using Species distribution modeling techniques.

Using Species distribution modeling techniques (primarily MaxEnt-<http://www.cs.princeton.edu/~schapire/maxent/>), projecting under different environmental conditions and interpretation and analysis. Students will run a number of models, then compare and interpret model outputs for different species and timescales. Students will also learn how to interpret and understand these models.

Spatial statistics or developing your own models and studies using GIS and SDMs. We will be tailoring data and approaches for each of your studies-so that at the end of the course you can all go away with parts of your own studies complete and a better understanding of how to take them forward and develop them further. The day will end with a critical thinking test, to help students “think spatially” and help further develop their approaches to GIS.

Day 5 Working with data: using the students own data, or research projects to design appropriate spatial techniques to better understand their research questions