Imperial College London

MRes in Ecosystems and Environmental Change

Course Guide 2021 – 2022

Along with this course-specific guidebook, you will receive a copy of the Silwood Park Campus Student Guidebook, containing (among many other things) the following important information:

Introduction to Silwood Park and the Department of Life Sciences

Including key contacts and information on the library, IT, safety and seminars.

Academic regulations

The Student Guidebook provides information about the general regulations that apply across all of these courses. These includes academic integrity, plagiarism, employment during your studies, and complaint and appeals procedures.

Welfare and Advice

Imperial has a wide support network for students. The Student Guidebook provides details of the available support and key contacts and links.

Student Feedback and Representation

We are very grateful for feedback on the course and will ask you for it at regular intervals! However, there is a range of options for providing feedback and getting support on your academic studies. The Student Guidebook provides details.

Thesis Guidelines

How to prepare your thesis, including word limits, formatting, etc.

Project and Supervision Guidelines

How to choose a project, student research budgets, and what to expect (and not to expect!) from supervisors.

The FrEEC Symposium

All about the student-run Frontiers in Ecology, Evolution and Conservation (FrEEC) summer Symposium at Silwood.

Electronic copies of the Student Guidebook are available on the course website as well as Blackboard. A copy can also be obtained by emailing the Course Administrator Mrs Fathima Uddin (f.uddin@imperial.ac.uk).

Course Overview

Welcome to the MRes programme in ecosystems and environmental change (eeChange) at Silwood Park! And welcome to an area of science that is vastly complex, fascinating, perplexing... and one that we need to understand much better; because the human pressures on ecosystems are relentless, and now compounded by the inevitability of continuing habitat and climate change – to which both ecosystems and human activities must adapt.

A key feature of this course is that *75% of your time will be spent on a single research project*. There is a huge variety of topics (and supervisors) to choose from, so it's important to start thinking seriously – and early – about your choice. Potential topics range from theoretical and mathematical, for those so inclined, to computationally intensive, to field-based and practical, and combinations of these; from atmospheric physics to vegetation science; from curiosity-driven, fundamental research on ecosystem function, to policy-oriented analysis of ecosystem and water resources management.

Moreover, you are not confined to studying the topics that supervisors have suggested. You are free to discuss possible topics with potential supervisors, who will be more than happy to help you to design the right project for your interests and aspirations. Many Masters projects are carried out at Silwood with a supervisor from another Department, and this is a feature appreciated by staff and students alike – an opportunity to develop new collaborations and strengthen existing ones, and make new interdisciplinary science happen.

Another key feature of the course is its emphasis on wider relevance, and communication with a non-scientific audience. It's impossible to be seriously involved in ecosystem science, and especially the science of environmental change, without recognizing the human and policy dimensions of the subject and the importance of careful communication – for example, distinguishing policy-relevant scientific information (what science really 'says') from policy prescription (what you, as a citizen, personally think). Recognizing that communication with a wider audience is a necessary and specialized skill, and that a broad understanding of the social and policy context is essential background for future practitioners and researchers, the eeChange Masters includes components designed to sharpen your faculties in these areas. There are group mini-projects to summarize information on various topics for a non-scientific audience, and a module in the social and policy context of environmental change.

The course runs for a full year, starting the first week in October, through to mid-September. Research projects start towards the end of the first term. But before you start your research project, through weeks 1 to 10 of the first term, you will receive intensive instruction in key skills and knowledge needed by all practitioners. During your project, you will also be offered the opportunity to engage with policy makers and stakeholders on a series of informal meetings.

Daily lectures and practicals, unless otherwise stated, begin at 10:00 and normally finish by 17:00, incorporating breaks. **Additional independent work is expected**: reading around the topics, and working on coursework assignments. Wednesday afternoons during this period are normally (but not always) reserved for private study, sports and leisure activities.

Teaching materials and other course materials will be provided using the online Blackboard virtual learning environment http://bb.imperial.ac.uk. Paper copies of lecture notes and

handouts are *not* normally provided, but you will receive printing credit for use during the course on your security card.

When carrying out your research project, you are expected to work full-time on the project but with flexible hours. Some projects may require out-of-hours work, for example maintaining greenhouse or lab experiments, while some will be entirely desk-based. As a researcher, you will be embedded in your main supervisor's research group and therefore you will participate in periodic lab meetings and activities, which are arranged independently by each supervisor.

The following sections provide a **summary** of the programme and assessment structure. The full programme specifications for the MRes are available on Blackboard and from the course website:

https://www.imperial.ac.uk/life-sciences/postgraduate/masters-courses/mres-in-ecosystem-and-environmental-change/

Course Administration

Please see the Student Guidebook for descriptions of the roles of the Postgraduate Administrator and Senior Tutor, and the Director of Postgraduate Studies. The Student Guidebook also includes information about other key staff.

Add 0207 59 to extension numbers to call from external phones.

Masters Co-ordinator:
Dr Michael Tristem (ext 42373, m.tristem@imperial.ac.uk)

eeChange Course Director:
Dr Cristina Banks-Leite (ext. 42289, c.banks@imperial.ac.uk)

Postgraduate Administrator:
Mrs Fathima Uddin (ext. , f.uddin@imperial.ac.uk)

Director of Postgraduate Studies:
Dr Niki Gounaris (ext. 45209, k.gounaris@imperial.ac.uk)

Senior Tutor:
Dr William Pearse (ext. , will.pearse@imperial.ac.uk)

eeChange Course Representative:
Up to you (see Student Guidebook for more details)

Course Aims

The course is designed to confer knowledge and understanding of the following subject areas:

- Key issues in the science of ecosystems and global change, ranging from the underlying human and physical causes of environmental change, through habitat and climate change impacts on ecosystems, to the contemporary policy context.
- The drivers of the state and change of ecosystems, including both physical and human environmental factors influencing biodiversity and ecosystem function.
- The state of current information and knowledge about ecosystem processes and responses, and tools with which knowledge gaps can be addressed – from data collection to statistical analysis and mathematical modelling.
- The role of science in policy-making, with particular reference to contemporary environmental change.

Learning Outcomes

Students will be equipped with the knowledge and skills required for the analysis of problems in ecosystems and environmental change science, and for the wider communication of scientific findings in a policy context. Specific outcomes include the abilities to:

- Plan and safely execute field-based data collection (in the case of field-based research projects).
- Use a variety of computational tools and packages.
- Analyse scientific results and determine their strength and validity.
- Give oral presentations.
- Write concisely and effectively for both scientific and lay audiences.
- Use the scientific literature effectively and efficiently.
- Integrate and evaluate information from a variety of sources.
- Transfer techniques and solutions from one discipline to another.
- Use Information and Communications Technology.
- Manage resources and time.
- Learn independently with open-mindedness and critical enquiry.
- Learn effectively for the purpose of continuing professional development.

Transferable Skills

During the course you will acquire and practice a range of broadly transferable skills:

- Research techniques, including literature search, information retrieval, experimental design and statistics, data analysis, modelling, sampling, field safety, and the analysis and presentation of results for a scientific audience.

- Multidisciplinary approaches to environmental problem solving, including the integration of quantitative and qualitative information from disparate sources.

- The formulation of explicit hypotheses, and research designs for the collection and analysis of data with which they can be tested.

- The choice of suitable modelling and decision support tools to translate scientific understanding into actionable, policy-relevant form.

- Planning, conducting and writing up a programme of original research.

- Management skills, including decision making, problem definition, project design and evaluation, risk management, teamwork and co-ordination.

- Communication of results through presentations in oral and written (poster, short report, scientific paper) forms.

In addition to the taught modules during weeks 1–10, all Masters students are strongly encouraged to attend:

Two lectures by Samraat Pawar on "**Choosing and Designing a Research Project**" and "**Applying for PhD positions/Academic jobs/Industry jobs**" (dates and times will be confirmed through iCalendar)

In addition, the Careers Advisory Service provides training and support for students on career options, job seeking and interviews.

Course Activities and Assessment (overview)

The following table shows the breakdown of total course marks by Components/Elements.

Component/Element	**Percentage of total mark**	**Percentage of Component**
Coursework		
First assignment	12.5 %	50 %
Second assignment	12.5 %	50 %
Coursework total	25 %	100 %
Research Project		
Thesis	45 %	60 %
Viva (oral examination)	15 %	20 %
Symposium presentation	7.5 %	10 %
Supervisor's mark	7.5 %	10 %
Research Project total	75 %	100 %

The first and second assignments together constitute the **Assessed Coursework** Component of the course.

The **first assignment** is an analysis and writing exercise. This assignment will be done in groups of up to four students, and you can create your group with similar minded students, or others who wish the study the same topics. Each group will choose a topic within ecosystem and environmental change. Ideally the topic that you will focus on is something relatively novel and important for society (e.g., screen use and health in young people, remote sensing and machine learning, etc), but not so novel that not enough information is available. Please check the topic with Course Convener before fully embarking on the research. Within this topic, each student will take responsibility for a particular aspect. The group will work together to produce a four-page report, designed for a non-specialist readership, in the format of a Parliamentary Office of Science and Technology (POST) briefing note, so please include tables and figures (see https://post.parliament.uk/type/postnote/ for further examples). The four pages limit includes the abstract but does not include references. Each student in the group will make a brief (~5 minutes) oral presentation of the key point(s) that they have worked on (maximum total presentation time 20 minutes). Two examiners will mark the report (at group level), the individual students' contributions to the report, and the presentations. Marks will be given for the group report (25%), individual contributions to the report (50%) and for the presentation (25%). See end of Guidebook for further information and marking criteria. Hand in date for the POSTnote report will be at **1pm on 19 January 2022,** please submit via Blackboard. The presentations will be at **10 am on 20 January 2022**.

The **second assignment** is a science communication exercise. Each student will write a piece in their chosen medium (such as an article in a popular science journal such as *New Scientist, The Economist or Scientific American,* or in the science pages of a newspaper), in up to 500 words. The topic can be any recent development in any field of science – something that has caught your interest. This article should be mainly about one piece of research that was published recently that you found particularly interesting - it could be in any area of science, but it needs to be within the subject of environmental change. You will then rewrite the findings and importance of this article in a popular science format. You can bring information from other articles as well, and you can interview scientists to get their opinions on this scientific article.

It's up to you (but there's no expectation of interviews). **On the 14 December 2021 at 10am, you will receive a short lecture** on how to write a popular science article. Before this lecture, please choose *two popular science articles* and bring to the lecture for further discussion. See end of Guidebook for further information and marking criteria. Hand in date will be at **1pm on 10 January 2022**, please submit via Blackboard.

The **Research Project** component will be assessed in four different ways.

First, and most importantly, a **thesis** (aka dissertation) in the format of a scientific paper: see the Student Guide for details) must be submitted. The hand-in date for the thesis will be **25 August 2022 at 13:00**.

Theses will be marked by two examiners independently. Their assessment criteria will focus on scientific quality, originality and clarity of presentation. The examiners will settle on an agreed mark before your viva (see below) begins.

Note that the thesis is to be submitted electronically – there is **no need for printing or binding**.

Second, you will present your work at the three-day **Frontiers in Ecology, Evolution and Conservation (FrEEC) symposium**, which will take place during the week of **5 September 2022**. Your oral presentation at the symposium will be marked by the same independent examiners.

Third, a **viva** (oral examination) led by your two examiners will take place during the **week of 12 September 2022**. In this thirty-minute session, you will be asked first to summarize the rationale and findings of your work (very briefly – three to five minutes). Then you will be engaged in a discussion about its content. Your viva performance will be marked by the examiners.

The fourth contribution to the overall project mark is the **supervisor's mark**, which does not assess scientific quality, but considers different aspects that the supervisor is best qualified to comment on, such as rigour and diligence.

Seminars

Attendance at **Thursday seminars** (Thursdays at 13:00), given by local or visiting academics, is expected while students are located at Silwood Park. See:
http://www3.imperial.ac.uk/silwoodparkcampus/research/thursdayseminars

We will also offer a series of **eeChange seminars**, starting from January 2022 where we will bring invited speakers, from around the world, who work alongside and/or are policy makers and stakeholders. These will be on Microsoft Teams and will be informal meetings structured so students can confidently ask questions. Time and start date to be informed later.

See the Student Guidebook for more information about seminars at Silwood Park, including **social seminars**.

Research Project proposal

Although this is not going to be formally assessed, you will need to send to your course convener a project proposal. This proposal should include: a working title, name and affiliation of supervisors, project description in up to 1000 words including the following sections: 1) Background and Research Gap, 2) Aims, Objectives or Hypotheses, 3) Novelty or Importance of research question, 4) Methods, 5) References, 6) Gantt Chart. Projects change along the way, so don't worry if you change your plans. **Hand in date will be at 1pm 31 January 2022**, please submit via Blackboard.

Office Hours

The Course Convener will be available every Wednesday 1-1:30 pm via Microsoft Teams. You can use these meetings for asking questions regarding the Course, the assignments, your project or discuss issues you may be experiencing. Please note that due to unforeseen circumstances these may be cancelled at last notice.

External Examiner

The External Examiner for 2021-2022 has not yet been appointed.

Background Reading

There is a unique **reference text for the climate change**, which is the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). The IPCC Reports, including this most recent one, are structured by Working Groups (WG). WG 1 deals with the physical science basis of climate change; WG 2 deals with impacts, adaptation and vulnerability, region by region and sector by sector; WG 3 deals with mitigation, including energy technology and economic aspects. These texts are extraordinarily detailed and wide-ranging. You will not want to read any single chapter right through. Instead, consider these (especially the Working Group 1 Report) as highly valuable, encyclopaedic reference works. The **entire AR5 is freely available online** at https://www.ipcc.ch/report/ar5/.

In addition, the following edited volume covers many aspects of global change science, including the societal context, and the following book is a great introduction to environmental problem solving:

Cornell, S.E., I.C. Prentice, J.I. House and C.J. Downy (eds) (2013) *Understanding the Earth System.* Cambridge University Press.

Harte, J. (1988) *Consider a Spherical Cow: A course in environmental problem solving*. University Science Books.

There is **no** textbook, however, that covers the whole subject matter of the course; or even any large part of it. This does **not** mean that you don't need to read anything else! On the contrary: **it is your responsibility to read widely** around the taught material and to read intensively and be fully up-to-date with the most recent literature on the topic of your research project. **You need to know the limits of our current understanding**. This can only be known from the literature. Searching and reading the literature is a habit and skill you should develop early on, and should be part of your daily routine. Readings suggested in course modules should not be the extent of your reading! Expertise in research methods is gained through experience, but mastery can only be gained through your own analysis of the literature. You will find that reading will be a source of enjoyment and inspire new ideas and approaches to your research.

Covid-19 contingency plans

Lectures and practicals

All lectures will be in person and recordings will be provided online. At the start of 2021-2022 academic year, there are still social distancing measures at place and we cannot teach all student within one single classroom. For this reason, eeChange students will be primarily based in their ***home room*** - the **Wallace Seminar Room in the Hamilton Building**. During all teaching weeks, students will attend classes in their home room and these may be either streamed from a nearby lecture classroom or in person (lecturers will rotate across rooms). Computer practicals will be online as this has been shown to be pedagogically beneficial for students.

The College will deliver the programme to ensure the approved learning outcomes are met and will take steps, subject to the requirements of public health guidance and College guidelines on social distancing and any health and safety measures, to make alternative arrangements in any extreme circumstances where this is not possible.

Projects

At the start of 2021-2022 academic year, international travel is still restricted and there are social distancing rules in many countries of the world. There is no certainty about when, or to what extent, travel restrictions will be lifted in the future. Projects relying on field work will only be able to go ahead if College regulations and country-specific restrictions are eased. However, there will be a range of projects on offer that can be done entirely using pre-existing data and supervisors will be able to work remotely to discuss project ideas and engage students in lab meetings.

Course details and module descriptions

Key teaching staff

Cristina Banks-Leite (c.banks@imperial.ac.uk)
Guy Woodward (guy.woodward@imperial.ac.uk)
Catalina Estrada (c.estrada@imperial.ac.uk)
Julia Schroeder (julia.schroeder@imperial.ac.uk)
Josh Hodge (j.hodge@imperial.ac.uk)
David Orme (d.orme@imperial.ac.uk)
Alex Mas Sandoval (a.mas-sandoval@imperial.ac.uk)
Colin Prentice (c.prentice@imperial.ac.uk)
Wouter Buytaert (w.buytaert@imperial.ac.uk)
Keith Bloomfield (k.bloomfield@imperial.ac.uk)

Outline timetable

The taught modules will take place during the autumn term, as follows:

Week	Starting	Module	Convenors
Week	Starting	Module	**Convenors**
1	4 Oct 2021	Silwood Campus Introduction	**Michael Tristem**
1	4 Oct 2021	Introduction to the MRes Ecosystem and Environmental Change	**Cristina Banks-Leite**
2	11 Oct 2021	Field Ecology Skills	**Catalina Estrada, Rodolfo Nóbrega**
3	18 Oct 2021	Biological Computing in R	**Josh Hodge**
4	25 Oct 2021	Statistics in R	**Julia Schroeder**
5	1 Nov 2021	Spatial Analyses and Geographic Information Systems (GIS)	**David Orme**
6	8 Nov 2021	Genomics and Bioinformatics	**Alex Sandoval**
7	15 Nov 2021	Landscape Ecology and Conservation	**Cristina Banks-Leite**
8	22 Nov 2021	Energy, water and plants	**Wouter Buytaert, Colin Prentice**
9	29 Nov 2021	Biogeochemistry	**Keith Bloomfield**
10	6 Dec 2021	Social context and policy	**Colin Prentice**
11	13 Dec 2021	eeChange MRes Project	**None**
12	20 Dec 2021	Winter Break	**None**
49	**6 Sep 2022**	**FrEEC Symposium**	**None**

Series module summary

Start	End	Module	Convenors
4 Oct 2021	9 Jul 2022	Thursday Research Seminars	None
14 Oct 2021	9 Mar 2022	Silwood Masters Workshops	Samraat Pawar

Taught Module Descriptions

The following descriptions of the content and learning objectives of the weekly lectures do not include day-level timetables, because these will be available through the iCalendar (aka iCal) service: see http://www.imperial.ac.uk/timetabling/view/icalendar.

The first week (Induction and Course Introduction) is an exception and you will be issued with a detailed timetable at the start of the first week.

1. Induction

Convenors: Michael Tristem
Week: 1
Dates: 2021-10-04 to 2021-10-08
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc CMEE, MRes CMEE

Description

These are the campus-wide components of the induction week, common to all of the Silwood Park Masters programmes. You will be introduced to key teaching and administration staff. Presentations will demonstrates the range of research within the department and helps you to start thinking about possible topics for your research projects. The week also includes a number of important induction events.

Introduction to MRes Ecosystem and Environmental Change

Convenors: Cristina Banks-Leite
Week: 1
Dates: 2021-10-04 to 2021-10-07
Courses: MRes eeChange

Description

This module runs alongside the Campus Induction week and covers introductions to the course staff and to the specifics of the eeChange programme. We will also discuss major global challenges and how to solve them.

2. Field Ecology Skills

Convenors: Catalina Estrada, Rodolfo Nóbrega
Week: 2
Dates: 2021-10-11 to 2021-10-15
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE

Description

In this module you will get experience planning and implementing field research, become familiar with basic field research methods and learn about data management. You will also get familiar with the Silwood Park fields and its long-term experiments.

Aims

The aim this week is that you get practical experience on

- Planning field research with emphasis on experimental design, time and data management
- Map reading and navigation
- General field sampling techniques
- Recording techniques and analysis of field data
- Taxonomic sorting and identification of common organisms
  Communicating your research

Reading

These are reference book for designing and planning ecological work aiming to survey populations and communities in a variety of habitats:

- Wheater Cp, Bell JR & Cook PA (2011) Practical Field Ecology. Jhon Wiley & Sons, Inc. 362p. Available online with Imperial College libraries (chapters 1-4)
- Sutherland WJ (ed) (2006) Ecological census techniques: a handbook. Second edition. Available online with Imperial College libraries (chapters 1-3)

Main document used for learning data management

- British Ecological Society (2018) Guides to better science: Data management. 37p Available at the British Ecological Society or Blackboard https://www.britishecologicalsociety.org/wp-content/uploads/2019/06/BES-Guide-Data-Management-2019.pdf?utm_source=web&utm_medium=web&utm_campaign=better_science

This book chapter contains the history of Silwood Park grounds, ecosystems and research:
- Crawley MJ (2005) Silwood Park and its history. In: Crawley MJ, ed. The Flora of Berkshire. Harpenden, Hertfordshire, UK: Brambleby Books, 215–253.

Check this link at Imperial College website to know more about Silwood long-term field studies:
http://www.imperial.ac.uk/silwood-park/research/field-experiments/

Module delivery

The course will take place outdoors at the campus grounds.

Recordings of lectures and resources for field practicals will be available online: in Blackboard and Microsoft Teams
https://teams.microsoft.com/l/team/19%3aJHWuomBfya3SMRwZsXfOHeXu2IW72IZFJ2s4nYJZ4ls1%40thread.tacv2/conversations?groupId=fb2f0b68-da60-40d0-b664-b9ebca657a0b&tenantId=2b897507-ee8c-4575-830b-4f8267c3d307

Additional information

Please wear suitable clothes and footwear for outdoor activities and according with the weather forecast. *Long trousers, waterproof footwear, waterproof coat, water, a charged mobile phone and a rucksack are recommended in Silwood Park.*

3. Biological Computing in R

Convenors: Josh Hodge
Week: 3
Dates: 2021-10-18 to 2021-10-22
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc TBE, MRes Biosys

Description

In this week, you will learn how to use this freely available statistical software with strong programming capabilities. R has become tremendously popular in Biology due to several factors: (i) many packages are available to perform all sorts of statistical and mathematical analysis, (ii) it can produce beautiful graphics, and (iii) it has a very good support for matrix-algebra (you might not know it, but you use it!). So with R, you have an expanded and versatile suite of biological computing tools at your fingertips, especially for automating statistical analysis and the generation of figures. Therefore, R should become an indispensable component of your biological research workflow.

Aims

- Navigate the R environment
- Perform basic commands to import, process and export data
- Write reproducible scripts
- Load and execute functions from various packages

Reading

- The Use R! series (the yellow books) by Springer are really good. In particular, consider: 'A Beginner's Guide to R', 'R by Example', 'Numerical Ecology With R', 'ggplot2' (we'll see this in another week), 'A Primer of Ecology with R', 'Nonlinear Regression with R', 'Analysis of Phylogenetics and Evolution with R'.
- Ben Bolker's 'Ecological Models and Data in R' is also very good.
- For more focus on dynamical models: Soetaert & Herman. 2009 'A practical guide to ecological modelling: using R as a simulation platform'.
- There are excellent websites. Besides CRAN, containing all sorts of guides and manuals, you should check out www.statmethods.net and en.wikibooks.org/wiki/R_Programming and google 'R Graph Gallery' for various sites showing graphing options and code.

Module delivery

Lecture recordings will be provided online asynchronously. Each day has an associated practical to work through with live help available on MS Teams. They'll be live Q&A sessions hosted on Teams or in-person throughout the week. Blackboard documents the daily activities that will be released at midnight (UK time) every day.

4. Statistics in R

Convenors: Julia Schroeder
Week: 4
Dates: 2021-10-25 to 2021-10-29
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc CMEE, MRes CMEE, MSc TBE, MRes Biosys

Description

In this week we will build upon the introduction to R you received in "Biological computing in R" week and learn to apply a core set of statistical methods that are of wide use in research projects. These statistical tests will form the basis for any data analysis you will do in the future. This week consists of short lectures and a range of longer practicals that you will have to work on by yourself, interactively with large or small groups. There will be the opportunity to bring your own data and discuss different ways of analysing the same question. Practicals will not only involve running statistical analyses, but importance is also placed on biological interpretation.

Aims

In this week you will learn how to use statistics to better understand ecology, evolution and conservation. You will learn to apply and interpret the results of pametric tests, including descriptive statistics, t-test, correlations, and linear models.

Reading

There are a wide range of introductory books for R. See later statistics and computing modules for more specialist texts but, for this week, the following are good introductory and reference texts that are available in Silwood library and as an e-book through Imperial:

- Beckerman, Andrew P. and Petchey, Owen (2012) Getting Started with R : An introduction for biologists Oxford University Press.
- Crawley, Michael J (2012) Statistics: An Introduction Using R. John Wiley.

5. Spatial Analysis and Geographic Information Systems (GIS)

Convenors: David Orme
Week: 5
Dates: 2021-11-01 to 2021-11-05
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc CMEE, MRes CMEE, MSc TBE

Description

This module will teach key skills in using and handling GIS data, along with core concepts in GIS and remote sensing. We will look at creating and georeferencing both vector and raster data and how to use GIS tools to create a workflow to carry out simple analyses. We will primarily be using `R` for data manipulation and analysis: you will already be familiar with `R` by this stage and it provides an open-source, scriptable and powerful engine for GIS. We will touch on the use of QGIS as a graphical interface for GIS that is better for data display.

Aims

At the end of this module you should have:

- Familiarity with a range of GIS data types
- Confidence in obtaining and handling GIS data
- Practical experience in creating maps
- Be able to perform basic data analyses and hypotheses testing in the spatial domain

Reading

Core text:

Geocomputation in R https://bookdown.org/robinlovelace/geocompr/

** GIS overview**:

Longley, PA (2011) Geographical information systems and science. Wiley.

Coordinate systems:

Van Sickle, G (2010) Basic GIS coordinates. CRC Press
https://www.dawsonera.com/abstract/9781420092325

6. Genomics and Bioinformatics

Convenors: Alex Sandoval
Week: 6
Dates: 2021-11-08 to 2021-11-12
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc CMEE, MRes CMEE, MSc TBE, MRes Biosys

Description

Population genomic data contain valuable information on how species relate to each other and how they evolved and adapted to their environment. As such, the study how genetic diversity within species is central to addressing many questions in evolution, ecology, and conservation. New sequencing technologies allow for the generation of large-scale genomic data which are pivotal for an understanding of population processes at deep resolutions. The goal of this module is to introduce students to the types of questions that can be addressed with population genomic data, and the theory and computational methodologies that are available for answering these questions.

Aims

This module provides an understanding of:

1. genomic data collection methods, and how to choose the data collection technique most appropriate to your question.
2. the wealth of data available to biologists in public genomic databases.
3. how genetic structure develops within and between populations and how to characterise it.
4. how demographic history affects genomic variation, and how to infer past population expansions and contractions from genomic data.
5. how migration affects genomic variation, and how patterns of gene flow can be inferred from genomic data.
6. how natural selection affects genomic variation, and how selection can be identified from genomic data.

Reading

- (optional) Nielsen, Slatkin, 2013. An Introduction to Population Genetics: Theory and Applications. Oxford University Press, Oxford.

7. Landscape Ecology and Conservation

Convenors: Cristina Banks-Leite
Week: 7
Dates: 2021-11-15 to 2021-11-19
Courses: MSc EA, MSc EEC, MRes eeChange

Description

This module is designed to introduce concepts from landscape ecology and how these can be applied into the conservation and management of natural systems. The week starts with the essence of how habitat transformation leads to the loss of biodiversity. Topics covered include how biodiversity is influenced by habitat area quantity and quality, isolation, edge effects, and how local patterns are modulated by processes occurring at the landscape and regional scales. We also will discuss how these aspects of habitat change influence individuals, species, communities and ecosystem functioning. The second part of the week focuses on using knowledge obtained in the first part to preserve biodiversity and natural ecosystems. Topics covered include biodiversity indicators, creation of habitat corridors and reforestation/restoration. We will discuss cases where findings have been implemented into policy.

Aims

By the end of the module, you will have gained a better understanding of the complexities of habitat transformation, and how habitat change can influence species and ecosystems in non-linear and unpredictable ways. You will also learn to sift through the myriad of biodiversity responses to habitat loss and degradation to obtain a simple and coherent message that can used into policy making.

Reading

- Pardini, R et al. (2010) Beyond the Fragmentation Threshold Hypothesis: Regime Shifts in Biodiversity Across Fragmented Landscapes. PLoS ONE. 5 (10), e13666.
- Banks-Leite, C., et al. (2014) Using ecological thresholds to evaluate the costs and benefits of set-asides in a biodiversity hotspot. Science 345:1041–1045.
- De Coster et al. (2015) Atlantic forest bird communities provide different but not fewer functions after habitat loss. Proceedings of the Royal Society B-Biological Sciences 282:20142844.
- Pfeifer et al (2017) Creation of forest edges has a global impact on forest vertebrates. Nature 551:187–191.
- Orme, C. D. L. et al. (2019) Distance to range edge determines sensitivity to deforestation. Nature Ecology and Evolution 3:886-891
- Betts, M. et al (2019) Extinction filters mediate the global effects of habitat fragmentation on animals. Science 366:1236-1239
- Williams, J.J., Newbold, T., (2021). Vertebrate responses to human land use are influenced by their proximity to climatic tolerance limits. Diversity and Distributions 27:1308–1323.

8. Energy, Water and Plants

Convenors: Wouter Buytaert, Colin Prentice
Week: 8
Dates: 2021-11-22 to 2021-11-26
Courses: MRes eeChange, MRes TFE

Description

This module aims to convey knowledge of the key principles of environmental physics, climatology and hydrology as they influence and interact with terrestrial ecosystems. Material covered includes the standard model for photosynthesis and the nature of the coupling between energy, water and CO2 exchanges at the scales from leaf to catchment. The module will begin by introducing students to the fundamentals of the Earth's climate system and how it generates the observed climate zones; proceed to consider processes by which soils, climate and plants interact; and end by showing how these processes bring about the observed spatial distribution of primary production and other aspects of ecosystem function. A class exercise will serve the function of "bringing to life" quantitative approaches to estimating fluxes of energy, water and CO2 between ecosystems and the atmosphere through hands-on small-group work.

Aims

Climatology and meteorology. An understanding of:

- Atmospheric structure
- The Earth's energy balance
- Energy transport in the atmosphere
- Drivers and patterns of atmospheric motion
- The major wind belts and climatic zones

Ecohydrology. An understanding of:

- The components of the catchment water balance
- The role of soil water storage in supporting primary production
- Key processes determining rates of transpiration and interception
- The main approaches to the estimation of evapotranspiration

Plant carbon and water exchanges. An understanding of:

- Plant hydraulics and the soil-plant-atmosphere continuum
- Stomatal control of water and CO2 exchange
- The energy balance of leaves and canopies
- Biochemical controls of photosynthesis
- Carbon isotopes
- Plant water and carbon economies
- The effects of CO2 concentration on plants

Global patterns of ecosystem processes. An understanding of:

- How climate determines vegetation structure and function
- How satellites monitor vegetation properties
- Eddy covariance data on water and CO2 exchanges
- Fundamentals of ecosystem modelling
- The controls and consequences of wildfire

Class exercise to acquire:

- hands-on familiarity with methods to estimate and analyse ecosystem water and carbon balances

Reading

- RG Barry and RJ Chorley (2009) Atmosphere, Weather and Climate. Routledge (9th edition).
- E Wohl et al. (2012) The hydrology of the humid tropics. Nature Climate Change 2: 655–662.
- HG Jones (2013) Plants and Microclimate: A Quantitative Approach to Environmental Plant Physiology, 3rd edition. Cambridge University Press.

9. Biogeochemistry

Convenors: Keith Bloomfield
Week: 9
Dates: 2021-11-29 to 2021-12-03
Courses: MRes eeChange, MRes TFE

Description

This module will introduce the global biogeochemical cycles for carbon, nitrogen and phosphorus. We consider the role of plants in each of these cycles and look at interactions within tropical forests.

Aims

By the end of the module, you will have gained an understanding of:

• The main biotic and abiotic drivers of global biogeochemical cycles and their many interactions. • The various sources of data and information about the global carbon cycle, past and present. The nature of the anthropogenic perturbation of the carbon cycle, and its interactions with other biogeochemical cycles. • Plant requirements for the macro-nutrients nitrogen and phosphorus. • The consequences of widespread chemical fertilisation in agriculture.

Reading

• EA Ainsworth & SP Long (2020) 30 years of free-air carbon dioxide enrichment (FACE): What have we learned about future crop productivity and its potential for adaptation. Global Change Biology. DOI: 10.1111/gcb.15375.

• P Friedlingstein et al. (2019) Global Carbon Budget 2019. Earth System Science Data 11: 1783-1838. • JN Galloway et al. (2008) Transformation of the nitrogen cycle: Recent trends, questions and potential solutions. Science 320: 889-892.

• Y Malhi et al. (2014) The productivity, metabolism and carbon cycle of two lowland tropical forest plots in south-western Amazonia, Peru. Plant Ecology and Diversity 7: 85-105.

10. Social context and policy

Convenors: Colin Prentice
Week: 10
Dates: 2021-11-08 to 2021-11-12
Courses: MRes eeChange

Description

This module is designed to encourage students to adopt a broad perspective on the implications of environmental science, especially global change science, for society; and to understand how scientific information feeds in (along with other aspects) to policy making at national and international levels. It includes a discussion element – students will work in groups to present an interpretation of a specific area of controversy, and brief presentations will be followed by collective discussion.

Aims

At the end of this module, you should have gained:

- An appreciation of the importance, and also the limits, of scientific information for policy making.
- An overview of major contemporary issues in climate policy, and climate-change impacts on biodiversity and human health.
- Understanding of how land-use influences ecosystems, biodiversity and the carbon cycle.
- Knowledge of the history and current status of climate-change mitigation efforts, including the role of the Intergovernmental Panel on Climate Change.

Reading

The following book is a must-read: insightful and provocative, in the best sense.

- RA Pielke, Jr (2007) The Honest Broker: Making Sense of Science in Policy and Politics. Cambridge University Press.

Winter Break

Convenors: None
Week: 12
Dates: 2021-12-20 to 2022-01-08
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc CMEE, MRes CMEE, MSc TBE, MRes Biosys

FrEEC Symposium

Convenors: None
Week: 49
Dates: 2022-09-06 to 2022-09-08
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc CMEE, MRes CMEE, MSc TBE, MRes Biosys

Project Vivas

Convenors: None
Week: 50
Dates: 2022-09-12 to 2022-09-16
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc CMEE, MRes CMEE, MSc TBE, MRes Biosys

Series module details

Thursday Research Seminars

Convenors: None
Dates: 2021-10-04 to 2022-07-09
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc CMEE, MRes CMEE

Description

This is a research seminar series that runs at Silwood Park. It runs on Thursdays 13.00 and seminars are typically presented by visiting academics. Masters students are expected to attend these seminar series – they will expose you to a much greater breadth of relevant topics and potential project ideas than happens within a single course.

Silwood Masters Workshops

Convenors: Samraat Pawar
Dates: 2021-10-14 to 2022-03-09
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE, MSc CMEE, MRes CMEE

Description

A Workshop series focused on Project management and Job/PhD application skill sets

MRes Ecosystems and Environmental Change Coursework

POST Note Instructions and Guidelines

The Parliamentary Office on Science and Technology produces a series of 4 page briefing papers for policymakers (https://www.parliament.uk/postnotes) on a wide range of technical and scientific issue. In this analysis, writing and communication exercise, you will work with other students to produce a POST note style report and then make a short verbal presentation that provides a deeper briefing on an aspect of the report.

The class will be divided into small groups and each group will choose a topic, in consultation with the Course Directors. The group should decide on the structure of the report and jointly contribute to introductory and concluding sections. Within the main text of the report, the group should split the topic areas up, with one student taking responsibility for the analysis and reporting of each section.

Marks will be given for the group report (25%), individual contributions to the report (50%) and for the presentation (25%).

Report details:

- Follow the POST note format: a short abstract, a bulleted overview box and a background section, followed by the specific topic areas.
- The content of the report must:
    - Address the wider context of the project. Why is this area of science important for policy, industry or human wellbeing? What challenges or opportunities does it address?
    - Summarize the approach and key findings of the research in a way that is intelligible to a general audience (e.g. a government minister, director of an NGO, or CEO of a company). You should include sufficient factual information for them to evaluate the validity and strength of evidence of the findings, including quantitative information.
    - Explain the implications of the findings and how they fit into the wider issues surrounding this area. If there is remaining uncertainty, state briefly what the main sources are and how they could be addressed.
- The report should:
    - Be no more than 4 pages of A4, using single spaced 11 point Arial font for body text and margins of 2.5 cm.
    - Include no more than three relevant images, diagrams or tables where they help communicate the issue.
    - Be properly referenced and supported using the literature. You should follow the POST note style of using numbered referencing and provide full reference details in a final Endnotes section.

Note that this will be shorter than real POST notes, which use 9 point font, smaller margins and frequently have reference lists that extend onto extra pages.

Some potentially useful examples of short briefing notes (for UK POST) are here:
https://researchbriefings.parliament.uk/ResearchBriefing/Summary/POST-PN-0603
https://researchbriefings.parliament.uk/ResearchBriefing/Summary/POST-PN-0597

Presentation:
Each student in the group will give an individual 5 minute extended briefing presentation on the section of the report that they led. The presentation must:

- Be pitched as if to a policymaker who has requested clarification and further detail on your section of the report.
- Start with a summary of the topic area material in the report.
- Provide a more detailed briefing on some aspect of your report section: you are free to choose what aspect this is, as long as you make it clear what you are going to address. Feel free to invent a question to frame your briefing: the Minister has asked for further detail on how the science on badger dispersal might affect policy options.

Note that one slide per minute is a good guideline and that your slides should predominantly contain material to support the words you are saying: they should not contain a script of the talk and they should be visually appealing.

Report Marking criteria

Grade	%	Criteria
*A**	100 95 90	**Exceptional** All procedures understood and applied properly, with a clear and logical write-up with evidence of some background reading, concise presentation of the scientific results, consideration of uncertainty or critical evaluation of the data, written and presented in a clear and accessible format, and correctly pitched to a policy audience (e.g. government minister)
A	85 80 76 72	**Excellent** Most of the above features but missing in one or two
B	68 65 62	**Very Good to Good** Good account of the scientific results, would require some extra work to provide comprehensive information for a policy audience, language either overly technical or over simplified for the audience.
C	58 55 52	**Adequate** Accurate account of the science but not targeted well to policy audience, lacking some important information or context.
D	48 45 42 38 35 30 25 20 15 10 5 0	**Unsatisfactory** Does not convey the scientific content of the work, includes errors or major omissions

Presentation Marking Criteria

Literal Grade	Percentage Grade	Criteria
		Exceptional.
A*	85-100	Presentation demonstrates: (*I)* complete understanding of the material to be presented showing high critical or analytical ability** as relevant, (*ii)* clear and logical organisation of the material, (*iii*) excellent use of appropriate resources and teaching aids, (*iv*) preparatory work including substantial background reading, and (*v*) ability to instruct with clarity of exposition and productive engagement with the audience resulting in a very positive learning experience.
		Distinction
A+	80	A very well presented exposition of the subject, showing all the above features, but not fully achieving one of them.
A	76	
A-	72	
		Merit
B+	68	Presentation has the following features, but without fully achieving one of them: (*i)* shows a clear understanding of the material with an accurate account that demonstrates good critical or analytical ability**, *(ii)* good use of resources, *(iii)* evidence of appropriate background reading, and *(iv)* succeeds in delivering all the relevant material clearly to the audience so that they appreciate its significance.
B	65	
B-	62	
		Pass
C+	58	Presentation: (*i*) shows a solid grasp of the material, (*ii*) gives a mainly accurate account of most of the relevant material, *(iii)* shows evidence of some background reading ,and *(iv)* successfully delivers most of the material to the audience in a way that they can understand it, but does not go beyond that.
C	55	
C-	52	
		Unsatisfactory / fail.
D+	48	Presentation: (*i*) shows only a basic grasp of the material (*ii*) shows evidence of little background reading or preparation, *(iii*) delivers most of the material accurately but makes errors or omissions resulting in a poor learning experience for the audience.
D	45	
D-	42	
		Very unsatisfactiory
F	40	Presentation: (*i*) shows that the material has not been understood, *(ii)* shows no evidence for background reading or preparation, and *(iii)* presents the material inaccurately and does not increase the audience's understanding.
	25	Presentation: (*i*) is too inaccurate, too irrelevant, or too brief to indicate more than a vague understanding of the material, and (*ii*) only succeeds in misinforming and confusing the audience.
	10	Presentation includes very little that is correct and relevant.
	0	Failure to make a presentation at all.

** *Analytical* = assessing a hypothesis or statement by breaking it down into its elements and examining their inter-relationships and contribution to the whole; cf. *Critical* = judging a hypothesis or conclusion by examining the validity of the evidence adduced for it.

POST Note report: marking form **Student's name, and title of article**	Plagiarism is the use of someone else's work without proper acknowledgement, presenting it as your own. Any plagiarism discovered in this work will result in a penalty, varying from deduction of marks to more serious disciplinary action, according to the severity of the offence. **By attaching this form to your work, you are declaring that this work is free from plagiarism** as defined by the college policy: http://www.imperial.ac.uk/registry/exams/examoffences
Marker	

How did this POST note meet the criteria for the grade it has been given?
Which criteria *were* met? Accurate? Pitched appropriately to a policy maker audience? Avoids excessive jargon or oversimplification? *etc.*

How might this POST Note have gained a higher grade?
How might some of the criteria that weren't met have *been* met?

First mark & marker's initials	**Second mark & marker's initials**	**Agreed mark**

Explanation of agreed mark

POST Note presentation: marking form

Student's Name _____

Course Title _____

Assignment Title _____

Planning and Preparation						
Evidence of plenty of research and careful preparation of material	A	B	C	D	E	Disorganised and confused
Subject Matter						
Content is relevant, accurate, based on sound evidence and well-pitched	A	B	C	D	E	Anecdotal, fails to address the topic, poorly pitched
Voice and Body Language						
Clear speaking voice, relaxed posture	A	B	C	D	E	Couldn't hear voice, tense, bad posture
Presentation						
Good use of Powerpoint and/or other audio/visual aids. Spoke to audience.	A	B	C	D	E	No Powerpoint or other props; Read from notes.
Overall Comments:						

Provisional grade _____

Signed _____

MRes Ecosystems and Environmental Change Coursework
Science Communication Assessment Instructions and Guidelines

Write a short piece for a general but scientifically interested audience. The choice of topic is open – it could related to project choices you are considering but can also be on any other recent scientific finding or analysis that interests you.

The piece should be 500 words long (double spaced), and we expect that it will:

- Have a catchy title and first paragraph that makes readers want to read on
- Be engaging
- Be, broadly speaking, appropriate in content, style and structure for a feature in a magazine such as New Scientist or Scientific American (though rather shorter than many features)
- Include at least one but no more than two relevant images or diagrams. These could be your own images or diagrams or appropriately credited image from another source.

In support of this, we recommend that you carry out the following before you begin to write:

- Read several articles in New Scientist, Scientific American, etc., with a critical eye, to give yourself a sense of what you are aiming for
- Read a couple of contrasting pieces of science writing (blogs; full length books) and compare the style
- Read the Introduction to the Economist Style Guide which is entertaining as well as useful: https://cdn.static-economist.com/sites/default/files/store/Style_Guide_2015.pdf

Science Communication assessment criteria

Class	%	Criteria
1st	100 95 90 85	The article is audience-appropriate and gives a **masterful synopsis of the topic**, showing **total command** of the most salient concepts and facts to be put across and is written in clear, engaging prose.
	80 76 72	The article meets all the requirements describe above but shows very minor deficiencies in one aspect.
2A	68 65 62	The article gives a **well-organised and audience-appropriate synopsis of the topic**. It demonstrates a mostly accurate account of the most salient concepts and facts to be put across and is written in clear prose. It **lacks significant errors of understanding**.
2B	58 55 52	The article delivers a largely accurate **synopsis of the topic** or, while accurate, is written in a style that is not completely suited to the target audience, or is marred by defective organisation, omissions or errors that indicate a lack of clear understanding of the purpose of the lay summary.
3rd	48 45 42	The article is not audience-appropriate in style **or** is poorly organised **or** fails to highlight the salient concepts and facts of the topic.
Fail	38 35 30	The article is not audience-appropriate **and** fails to include the salient points of the topic. It lacks clarity and is marred by major errors, brevity, and/or irrelevance.
	25 20	The article is too inaccurate, irrelevant, or brief to indicate more than a vague understanding of the topic or of the audience.
	15 10 5	The article presents **less than three relevant sentences** and is too inaccurate, irrelevant, or brief to indicate more than a vague understanding of the topic or of the audience.
	0	The article contains **nothing** that is both correct and relevant to the topic. Also, the mark given where the work presented is discovered not to be that of the candidate (plagiarised).

Science Communications article: report **Student's name, and title of article**	Plagiarism is the use of someone else's work without proper acknowledgement, presenting it as your own. Any plagiarism discovered in this work will result in a penalty, varying from deduction of marks to more serious disciplinary action, according to the severity of the offence. **By attaching this form to your work, you are declaring that this work is free from plagiarism** as defined by the college policy: http://www.imperial.ac.uk/registry/exams/examoffences
Marker	

How did this article meet the criteria for the grade it has been given?

Which criteria *were* met? Accurate? Pitched appropriately to a 'broadsheet' audience? Avoids excessive jargon? *etc.*

How might this article have gained a higher grade?

How might some of the criteria that weren't met have *been* met?

First mark & marker's initials	**Second mark & marker's initials**	**Agreed mark**

Explanation of agreed mark