Imperial College London

MRes in Ecosystem and Environmental Change

Course Guide 2020 – 2021

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 Amanda Ellis (amanda.ellis@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 the end of September. Research projects start towards the end of the first term. But before you start your research project, through weeks 1 to 9 of the first term, you will receive intensive instruction in key skills and knowledge needed by all practitioners.

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 experiments. 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 Micheal 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 Amanda Ellis (ext. 42251, amanda.ellis@imperial.ac.uk)

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Senior Tutor:
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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 1–9, 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. The cohort of students will be divided into groups. Each group will choose a topic. 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. Each student in the group will make a brief (5-minute) oral presentation of the key point(s) that they have worked on. Two examiners will mark the report (at group level), the individual students' contributions to the report, and the presentations.

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,* or in the science pages of a newspaper). The topic can be any recent development in any field of science – something that has caught your interest.

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, including its Summary for Policymakers, will be **26 August 2021 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 **6-10 September 2021**. 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 13–17 September 2021**. 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.

Summer conference on ecosystems and environmental change. There is no assessment for this activity, but successive cohorts of eeChange students have found it to be interesting and fun! The eeChange students work as a group, to organize and host a one-afternoon or evening public event for a wide audience, to take place in June or July. Students will have to decide on a theme and format, and invite speakers from Imperial College or the greater London community to participate. **It is expected that the whole cohort will fairly share out the work associated with planning and organizing this event.**

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

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

External Examiner

The External Examiner for 2020-2021 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:

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

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

We will use multi-mode delivery of teaching for the taught components of the course. In practice, this means that some activities will be online and others in person. The content and activities associated with any in person activities will either be duplicated, or replaced with substitute activities, online to ensure students participating remotely are still able to meet the learning objectives of the course. If you are unable to physically attend the teaching sessions, you will still be able to engage in live lectures, discussions and practicals remotely.

Projects

This year presents the course with the unprecedented challenge of a pandemic. International travel is heavily restricted and there are social distancing rules in the United Kingdom and most other countries of the world. There is no certainty about when, or to what extent, travel restrictions and social distancing will be lifted in the future. Projects relying on lab analyses or 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.

COVID-19 Safety: https://www.imperial.ac.uk/safety/safety-by-topic/laboratory-safety/biological-safety/covid-19-guidance/

https://www.imperial.ac.uk/about/covid-19/students/learning-experience/postgraduate-research/programme-details-for-academic-year-2020-21/mres-ecosystem-and-environmental-change-offer-holders/

Course details and module descriptions

Key teaching staff

Cristina Banks-Leite (c.banks@imperial.ac.uk, ext. 42289)
Wouter Buytaert (w.buytaert@imperial.ac.uk, ext. 41329)
Catalina Estrada (c.estrada@imperial.ac.uk, ext. 42217)
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Outline timetable

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

Dates	**Week number**	**Module name**
5–9 October 2020	1	Induction and Course Introduction
12–16 October 2020	2	Field Ecology Skills
19–23 October 2020	3	Biological Computing in R
26–30 October 2020	4	Statistics in R
2–6 November 2020	5	Spatial Analysis and Geographic Information Systems (GIS)
9–13 November 2020	6	Social Context and Policy
16–20 November 2020	7	Landscape Ecology and Conservation
23–27 November 2020	8	Energy, Water and Plants
30 November – 4 December 2020	9	Biogeochemistry

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 and Course Introduction

Convenor: Amanda Ellis

Aim of the module

This module is to introduce all of the new Silwood Masters students to key things that they need to know about their course, and about studying at Silwood Park. Thursday and Friday will be devoted to general preparatory sessions run by the Graduate School.

Teaching format

Online lectures (live or pre-recorded)
Individual course directors and lectures discussions (online/in person).

2. Field Ecology Skills

Convenors: Catalina Estrada, David Orme
Week: 2
Dates: 2020-10-12 to 2020-10-16
Courses: MSc EA, MSc EEC, MRes EEC, MRes eeChange, MRes TFE

Description

In this module you will 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 campus grounds fields and long-term experiments. The campus, with about 100 ha of land, is recognized as an important refuge for wildlife and has several types of natural habitats including grassland, wetland and woodlands. It is also an active place of field research, hosting multiple long-term experiments and study sites for global studies. The course will take place outdoors at the campus grounds or in a suitable area near you if are taking this course remotely.

Aims

- 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
- Sutherland WJ (ed) (2006) Ecological census techniques: a handbook. Second edition. Available online with Imperial College libraries 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

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

Lectures and resources for field practicals will be available online (Blackboard and TEAMS) and we expect to meet with you at least three times in live sessions using Microsoft Teams. Field activities are run in groups, so it is important that you check the module materials on Monday early morning of the week module, the latest.

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: 2020-10-19 to 2020-10-23
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: 2020-10-26 to 2020-10-30
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.

Module delivery

Lecture recordings will be provided online asynchronously. Practicals, where students get hands-on support (in a socially distanced way), will take place in-person in Silwood Park, and remotely. Student groups may be formed. All practicals will also have a live remote option for students who cannot take part in person. Asynchronous Q&A sessions will take place to allow ample opportunity for any further student questions

5. Spatial Analysis and Geographic Information Systems (GIS)

Convenors: David Orme
Week: 5
Dates: 2020-11-02 to 2020-11-06
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. Social context and policy

Convenors: Colin Prentice
Week: 6
Dates: 2020-11-09 to 2020-11-13
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.

7. Landscape Ecology and Conservation

Convenors: Cristina Banks-Leite
Week: 7
Dates: 2020-11-16 to 2020-11-20
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

Module delivery

Lectures will be pre-recorded and available on Panopto. Lectures will be subdivided into topics (e.g., edge effects, connectivity, etc) such that they will be roughly 10 minutes long. At the end of each lecture, there will be suggested reading to deepen the knowledge. This module includes a computer practical where students will be able to analyse a bird dataset and obtain landscape metrics from a map. Demonstrators and lecturer will be available online to help and answer questions.

8. Energy, Water and Plants

Convenors: Wouter Buytaert, Colin Prentice
Week: 8
Dates: 2020-11-23 to 2020-11-27
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.

Module delivery

Lectures will be pre-recorded, and released by midnight on the day before the Q&A sessions. The Q&A sessions will be held via Teams. Students are expected to watch the lecture before they attend a Q&A session about it. They may choose which of the two Q&A sessions to attend. The 9 am Q&A sessions are provided mainly for the benefit from students in East Asia; students on-campus will likely prefer the 12 pm sessions.

9. Biogeochemistry (To be confirmed)

Convenor: To be confirmed

Week: 9
Dates: 2020-11-30 to 2020-12-04
Courses: MRes eeChange, MRes TFE

Aim of the module

The aim of this module is to provide an introduction to biogeochemical cycles at the global and ecosystem scales, with a particular focus on the carbon cycle.

Learning outcomes

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

The main biotic and abiotic drivers of global biogeochemical cycles.
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.
The key findings from enhanced CO_2 experiments at the plant and ecosystem scales.

The fate of anthropogenic CO_2.

Teaching format

Online lectures (live or pre-recorded)

Online/in person group discussions
Online/in person computer-based practicals

Reading

C Le Quéré *et al.* (2018) Global Carbon Budget 2018. *Earth System Science Data* **10**: 2141–2194.

Y Malhi *et al.* (2013) The productivity, metabolism and carbon cycle of two lowland tropical forest plots in south-western Amazonia, Peru. *Plant Ecology and Diversity* **7**: DOI: 10.1080/17550874.2013.820805.

RJ Norby & DR Zak (2011) Ecological lessons from free-air CO_2 enrichment (FACE) experiments. *Annual Review of Ecolology, Evolution, and Systematics* **42**: 181–203.