How to Apply

**Grade requirement:**
You are expected to have a GPA of 3.0, a credit or grade B average or equivalent in a related degree.

**English requirements:**
If you are a non-native English language speaker, our English requirements are IELTS 6.5 (with at least 6.0 in writing and 5.5 in the other elements); Pearson PTE Academic 58 overall with at least 50 in writing and 42 in equivalent IELTS elements, CEFR B2-C1 or equivalent.

Students who have IELTS 6.0 (with at least 5.5 in each element) or Pearson PTE Academic 50 overall (with at least 42 in each element) can take part in the 4 week **English for Academic Purposes (EAP)** course instead of retaking their tests.

IELTS and Pearson certificates are valid for 2 years from the test date and your certificate will need to be valid on the start date of your studies at Lancaster.
If you are a non-native English speaker studying at an English-speaking university, please include a copy of the Secure English Language Test (SELT) certificate e.g. IELTS, Pearson or TOEFL you submitted when you applied to your home University/College.

**Students coming for more than 6 months**
We will accept the most recent SELT according to the English Language requirements outlined above or equivalent. There are several ways that you can provide evidence of your English Language ability, details are listed [here](#).

**Students coming for less than 6 months**
If you are coming to Lancaster for less than 6 months, we will still need to review your English Language ability. However, we can accept a wider range of certificates including qualifications listed [here](#) or confirmation from your home university.

If you have any further questions about this, you can email studyabroad@lancaster.ac.uk

**You can study at Lancaster for:**
- Michaelmas term (October - December)
- Lent & Summer terms (January - June)
- Summer term (April – June)
  *Only for selected partners and previously agreed with Lancaster*
- Michaelmas & Lent term (October – March)

**You are required to take:**
- 24-30 ECTS credits during the Michaelmas term or Lent term
- 32-40 ECTS credits during Lent & Summer terms
- 48 ECTS credits during Michaelmas & Lent terms
Modules available to Erasmus+ students

Although we make every effort to ensure the accuracy of information about modules, there may be some unavoidable changes. At the stage of the application, you are only completing a provisional study plan and it will only be confirmed when you arrive in Lancaster. We recommend you to have a strong list of back-up options in case you need to make changes to your provisional study plan.

Please note that you can change your mind if you need to and switch modules during your first week at Lancaster.

LEC.400: Research Methods in the Social Sciences

Terms Taught: Michaelmas Term Only

ECTS Credits: 8 ECTS Credits

Pre-requisites:
- This module is only available to Postgraduate Erasmus+ students from selected partners
- You must have completed a degree and enrolled in a postgraduate programme in a related discipline

Module Description
This module is designed to provide students with a critical understanding of the research process and the main approaches, methods and techniques which are typically used for research. The module is intended to enable students to undertake their own independent research as part of their Masters degree and to provide a solid foundation for PhD research.

Educational Aims
The module provides methods related knowledge and understanding applicable to social science at postgraduate level generally. In addition, the module provides training on communicating research outcomes.

On successful completion of this module, students should be able to:
- Situate decisions about methods through reference to the way science philosophies and existing literatures shape research design;
- Explain a range of ethical issues and dilemmas associated with research and ways of managing these issues and dilemmas;
- Use secondary data to develop original research;
- Describe the pros and cons of a range of methods for data collection and data analysis respectively
- Choose between a range of qualitative and quantitative research methods, when designing research, in a way that results in aims and objectives being effectively fulfilled.
- Write a research proposal;
- Communicate research to different audiences.
Outline Syllabus

• Formulating a research project
  - What is social science research?
  - How does ethics matter?
  - Positioning research in the literature
  - How to write a research proposal
  - How to plan a research project

• Choosing and engaging with methods
  - Collecting data by asking questions or observing
  - Analysing data quantitatively or qualitatively

• Working on individual research proposals
  - Supervision support available

• Communicating research

Assessment Proportions

• 100% Coursework

LEC.401/ LEC.401b: Perspectives on Environment and Development

Terms Taught: Michaelmas Term Only

ECTS Credits: 8 ECTS Credits / 10 ECTS credits

Pre-requisites:

• This module is only available to Postgraduate Erasmus+ students from selected partners
• Some experience of social science, human geography or development studies
• You must have completed a degree and enrolled in a postgraduate programme in a related discipline

Module Description
This module aims to provide a theoretical foundation for the study of development and the environment from a geographical perspective. As such, it will focus on understanding the ways in which scholars have brought together development theory with the analysis of nature-society relations in the majority (i.e. ‘developing’) world. The intent of the module is to provide students with a critical understanding of the evolution of contemporary development discourses, and new ways of thinking about the relationships between environment and development. Some of the key topics that
will be discussed are: theories of development, indigenous knowledge and development, biotechnology and food security, the political economy of natural resources.

**Educational Aims**
The module aims to enhance students’ academic skills in developing reasoned arguments through the analysis, interpretation and critical appraisal of complex evidence. The module is also built to deepen students’ understanding of the relationship between theory and practice. The module is also built to strengthen students’ skills in oral presentation and academic writing.

On successful completion of the module, students should be familiar with:

- A range of theoretical arguments about development, from modernisation theory to sustainable development to post-development
- Geographical approaches to the study of nature and society, including cultural ecology and political ecology
- Contemporary themes, considerations and case-studies in geographies of development

**Outline Syllabus**

- Sustainable Development
- Politics of the Earth? Mapping Green Discourses
- (Post)Development
- Development in times of Climate Change
- A Digital Turn in Environmental Governance?
- Food: from Colonial Biopolitics to Global Biotechnologies
- Ecosystem Services: Neoliberal Natures and Green Governmentality in the Global South?
- Can local knowledge deliver sustainable agro-ecological systems?
- Environmental Justice and Social Movements
- Final Discussion and Student Presentations

**Assessment Proportions**

- 100% Coursework

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**LEC.402: Geoinformatics**

**Terms Taught:** Lent Term Only

**ECTS Credits:** 8 ECTS Credits

**Pre-requisites:**

- This module is only available to Postgraduate Erasmus+ students from selected partners
- You must have completed a degree and enrolled in a postgraduate programme in a related discipline
Module Description
This course introduces students to the fundamental principles of GIS, remote sensing and simulation modelling and explores how these complimentary technologies may be used to capture, manipulate, analyse and display different forms of spatially referenced environmental data. This is a highly vocational module with lectures complimented by computer-based practicals (using state-of-the-art software such as ArcGIS and ERDAS Imagine) on related themes. At the end of the module students are required to complete a project in which a functioning analytical environmental information system is generated for a given area from a variety of primary and secondary sources of data.

Educational Aim
On successful completion of this module a student will gain:

- An understanding of the fundamental principles and applications of GIS and Remote Sensing
- An appreciation of the strong linkages between these disciplines and their fusion to create meaningful spatially-referenced environmental information
- A critical appreciation of current and future potential applications
- Training in the use of advanced software packages including ArcGIS and ERDAS Imagine
- Project management skills through completion of a geoinformatics project

Outline Syllabus
The following topics will be covered in lectures:
- Geoinformatics – definitions, components and the nature of spatial data
- Principles of RS: physical basis, sensors, platforms and systems
- Applications of RS
- Principles of GIS
- Vector GIS
- Raster GIS and spatial modelling
- Data Integration and Metadata
- Geoinformatics project design
- The following topics will be covered in practicals:
  - Getting to know ArcGIS (ArcGIS)
  - Introduction to Image Processing (ERDAS)
  - Spatial Enhancement and Image Rectification (ERDAS)
  - Image Classification (ERDAS)
  - Building a Spatial Database (ArcGIS/ERDAS)
  - Data Sources and Geoprocessiong (ArcGIS)
  - Data Comparison (ArcGIS)
  - Raster analysis: Simple Map Overlay (ArcGIS)
  - Cartography (ArcGIS)
  - Project Work (ArcGIS/ERDAS)

Assessment Proportions

- 100% Coursework
LEC.403/LEC.403b: Environmental Governance and Management

**Terms Taught:** Michaelmas Term Only

**ECTS Credits:** 8 ECTS Credits / 10 ECTS Credits

**Pre-requisites:**
- This module is only available to Postgraduate Erasmus+ students from selected partners
- You must have completed a degree and enrolled in a postgraduate programme in a related discipline

**Module Description**
This module provides students with a critical perspective on the underlying principles, approaches, tools and techniques associated with the management of natural resources and the environment. Particular attention is given to the challenges of dealing with change, complexity, uncertainty and conflict in the environment and the different strategies which can be deployed.

**Educational Aim**
On successful completion of this module, a student will:
- Have a critical appreciation of the nature of resource and environmental management
- Be aware of the underlying characteristics and challenges associated with contemporary environmental problems
- Have knowledge of the different approaches and strategies which may be adopted for the management of natural resources and the environment.
- Be able to critique current environmental policies and develop proposals for future public policy

**Outline Syllabus**
The following topics will be covered:
- The nature of resource and environmental management
- Futuristic methods
- Sustainable development
- Ecosystem and adaptive environmental management
- Environmental assessment
- Public participation
- Local knowledge systems
- Gender and resource management
- Conflict resolution
- Policy Implementation
- Environmental monitoring and evaluation

**Assessment Proportions**
- 100% Coursework
LEC.404: Environmental Justice

Terms Taught: Lent Term Only

ECTS Credits: 8 ECTS Credits

Pre-requisites:
- This module is only available to Postgraduate Erasmus+ students from selected partners
- You must have completed a degree and enrolled in a postgraduate programme in a related discipline

Module Description
This module critically examines environmental justice as a new agenda and discourse for environmental policy and politics. It considers how the environment and the practices of environmental management have equity and justice implications for different socio-economic groups and the research, policy debates and political action that have focused on questions of both distributive and procedural justice. The module is international in scope considering experience in the US, UK and Europe and environmental and risk issues that operate across local to global scales.

Educational Aim
On successful completion of this module, a student will have:
- an understanding of core principles and concepts for environmental justice
- an understanding of the evolution of environmental justice discourse, politics and policy making in the US, UK and Europe
- an ability to critically evaluate evidence of patterns of environmental inequality and their causation and claims made for environmental justice at local through to global scales
- an understanding of theoretical and practical issues of procedural (in)justice in the context of public participation in environmental decision-making

Outline Syllabus
The following topics will be covered:
- Definitions and core concepts and theory
- Environmental justice and sustainability
- Distributive and procedural justice at different spatial scales
- Environmental justice in the US; evidence, politics and policy
- Environmental justice in the UK; evidence, politics and policy
- Environmental justice in Europe and the Aarhus convention
- Evidence of environmental inequality and the geographical distribution of environmental risk
- Public participation, access to information and equity/inclusion issues
- Policy appraisal and distributive analysis
- Case studies; waste management, transport, climate change
- Policy interventions and equity issues.

Assessment Proportions
- 100% Coursework
LEC.406/406b: Climate Change and Society

Terms Taught: Lent Term Only

ECTS Credits: 8 ECTS Credits / 10 ECTS credits

Pre-requisites:
- This module is only available to Postgraduate Erasmus+ students from selected partners
- You must have completed a degree and enrolled in a postgraduate programme in a related discipline

Module Description
This module aims to explore and reconfigure the ways in which climate change is understood through a focus on the social, rather than the scientific-environmental discourses that have dominated the policy and politics of climate change. This module offers students a wide-ranging and intensive introduction to the politics, cultures and theories of climate change research in the social sciences and humanities.

Educational Aim
Students will be able to critically evaluate different theoretical perspectives on a range of climate change debates and present alternative arguments.

On successful completion of this module, students should be able to:
- Evidence a sufficient grounding in the theoretical, political and epistemological discourses of climate change;
- Critically analyse in writing and orally of different theoretical approaches to studying nature, society, and environmental change;
- Discuss the social theory of climate change, in particular, evidence how climate discourse is constructed, practiced, made, and deployed within a political and cultural context;
- Analyse the politics of climate change and discuss forms of cultural production on range of scales;
- Discuss the range of scientific, public, governmental, non-governmental and indigenous “cultures” within the climate change debate.
- Analyse a variety of practice-led, creative, alternative and indigenous societal responses to climate change.
- Evidence a familiarity with the theories and philosophies of risk theory, social theory and the literatures of climate change, environment and society, posthumanism, social practice.
- Evidence the ability to identify, analyse and evaluate a range of different societal interactions with climate.

Outline Syllabus
The module will include the following topics:
- Climate Change and Society – Welcome to the Anthropocene
- “Human Dimensions” in climate policy and science
- Rethinking Climate Change and Society
- Climate change and uncertainty
• Climate Change and Risk
• Climate Change and Biopolitics
• Climate Change, Vulnerability and Ethics
• Anthropocene Governmentality
• The geopolitics of climate change or post-political politics?
• Living with environmental change or cultures of change?

Assessment Proportions

• 80% Essay(s)
• 20% Presentation (Assessed)

LEC.421: Food Security, Agriculture and Climate Change

Terms Taught: Michaelmas and Lent Terms Only

ECTS Credits: 8 ECTS Credits

Pre-requisites:
• This module is only available to Postgraduate Erasmus+ students from selected partners
• You must have completed a degree and enrolled in a postgraduate programme in a related discipline
• The exam will take place in January, hence this is a two term module

Module Description
Food security is achieved when all people have access to an adequate supply of safe and nutritious food. Currently there are almost one billion people who are inadequately fed, while a similar number suffer from diet-related illnesses caused by over-consumption! We consider the requirements of a healthy diet and ways in which those in the developing world can access sufficient nutrients (e.g. fish consumption, crop biofortification). We address issues contributing to variation in food availability driven by local and global factors, the access that people have to food and the different ways in which food is utilised. The impact of the food production system on the environment is considered, along with the tensions arising from our quest for food security, energy security and water security. The approach to the study of these issues is interdisciplinary in nature. The course takes an international perspective on GFS (Global Food Security).

Educational Aims
On completion of this module a student should be able to:
• Understand the component parts and the interdisciplinary basis of the food system
• Detail the challenges facing global agricultural production as a result of climate change
• Understanding of the shortage of key resources for food production
• Understand the issues affecting peoples’ access to food
• Have some understanding of factors impacting food safety and food quality
• Detail the problems posed for plants growing in dry soil, at high temperature and in high ozone concentrations
• Demonstrate how basic plant physiology can inform both plant breeding and agronomy to increase the sustainability of agriculture.
• Familiarity with several current/impending crises in global food security

Outline syllabus

Lectures

• The interdisciplinary basis of Food Insecurity and the shortage of resources for food production.
• Food Sovereignty
• A fair and just food system
• Food Production I Food production systems: local and global
• Food Production II Plant Breeding/Crop Improvement for yielding under drought
• Food safety and quality

Workshop sessions include consideration of

• The Food Security Challenge.
• The Royal Society report on Science for Enhancing Food Production/Foresight Report on Food and Farming.
• Food Systems: factors impacting food availability, access and affordability. Food Chains.
• Novel crop and resource management systems
• Interviews with those working in the food chain, researchers, policy makers and NGOs

Assessment Proportions

• 50% Reflective Report
• 50% Essay

LEC.424: Using the National Vegetation Classification

Terms Taught: Summer Term Only

ECTS Credits: 8 ECTS Credits

Pre-requisites:
• This module is only available to Postgraduate Erasmus+ students from selected partners
• You must have completed a degree and enrolled in a postgraduate programme in a related discipline

Module Description

This module aims to provide a thorough grounding in the principles and practice of the vegetation survey including Phase 1 Survey and National Vegetation Classification (NVC). The module will consider the use of NVC for the description and understanding of plant communities and its
application for vegetation survey, assessment and monitoring. The module is taught intensively within one week.

**Educational Aims**

On completion of this module a student should be able to:
- Plan and execute a vegetation survey of a site
- Identify a range of plant communities
- Appreciate the complex relationships between vegetation and climate, soils and human impacts
- Assess vegetation in local, regional and national contexts
- Understand the potential and limitations of the NVC as a monitoring, management and design tool

**Outline syllabus**

*Lectures/workshops*

- **Plant species identification** – Using vegetation keys to identify plant species.
- **Phase 1 habitat survey** – conducting phase1 habitat surveys and mapping vegetation types
- **Introduction to the National Vegetation Classification** – An outline of the origin and purpose of the NVC as a systematic and comprehensive survey of the plant communities of natural, semi-natural and major artificial habitats in Britain.
- **The NVC survey methodology** – Basic technique of recognising boundaries and homogeneous strands, of locating sample quadrats and recording essential features of the composition and structure of the vegetation and its relationship to the habitat.
- **Using keys to identify plant communities** – Assembling field data into floristic tables, understanding the concepts of frequency and abundance to identify plant communities encountered in the field.
- **Understanding floristic tables of vegetation data** – Using these results to understand the basic style of phytosociological floristic tables; the concepts of communities and sub-communities; constant, associate, differential and preferential species.
- **Applications of the NVC for vegetation monitoring and management** – Using the data and results from the above in case studies to demonstrate descriptive and predictive applications of the NVC for vegetation monitoring, management and landscape design.

Several of the above sessions include practical field exercises involving data collection from a range of vegetation types with subsequent analysis, evaluation and interpretation.

**Assessment Proportions**

- 100% Coursework
LEC.425: Habitat Management

Terms Taught: Lent Term Only

ECTS Credits: 8 ECTS Credits

Pre-requisites:

- This module is only available to Postgraduate Erasmus+ students from selected partners
- You must have completed a degree and enrolled in a postgraduate programme in a related discipline

Module Description

This module aims to develop students’ understanding of the ecological principles of habitat management for biodiversity conservation, and how these can be applied for effective management of a range of priority habitat types in the UK. The module will also critically examine the construction of habitat management plans.

Students will gain experience in writing such a plan, in which conservation objectives are specified, threats identified, and management actions defined, taking into account the dynamic nature of ecosystems and conflicts of interest in land use. The course is taught by a mix of Lancaster staff and external lecturers who are directly involved in the application of ecological principles to habitat management. Much of the module is field-based, with excursions designed to exemplify the material presented in class.

Educational Aims

On completion of this module a student should be able to:

- discuss the principles underlying the management of habitats for conservation
- describe how those principles can be applied in specific habitat types
- construct an effective conservation management plan

Outline syllabus

Lectures
The lecture material will be delivered by the module convener and several external contributors. Topics covered will include:

- Introduction - habitats and their conservation.
- Ecological principles of community assembly and succession, and their implications for habitat management.
- Conservation grazing and grassland management.
- Woodland and wetland management
- Conservation in the wider countryside – farmland and uplands

Excursions
There will be three excursions to sites of conservation interest, led by external contributors and the module convener.
**Workshops**

- Conservation Management Planning
- Ecological theory and its utility in management planning

**Assessment Proportions**

- 50% Exam
- 50% Coursework

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**LEC.427: Wildlife Population Ecology**

**Terms Taught:** Michaelmas and Lent Terms only

**ECTS Credits:** 8 ECTS Credits

**Pre-requisites:**

- This module is only available to Postgraduate Erasmus+ students from selected partners
- You must have completed a degree and enrolled in a postgraduate programme in a related discipline
- Some elementary mathematics, e.g. Secondary-level Maths or equivalent
- The exam will take place in January, hence this is a two term module

**Module Description**

The module takes a step-by-step approach to understanding wildlife population ecology, from the basics up to more complex interactions between species. The practical element of the module includes laboratory practicals and modelling assignments. After taking this module, students will appreciate the factors that contribute to population change, be able to construct life tables from birth and death data, and be able to apply quantitative models of population ecology to applied situations. Knowledge of these processes is vital for people working in the fields of conservation or management of natural resources, such as harvesting of fish stocks, infectious disease control, and pest management, examples of which are scattered throughout the module.

**Educational aims**

- The module will provide opportunities for students to develop generic skills in data collection, data management (using Excel), modelling (using free software) and presentation skills (using PowerPoint).
- Demonstrate a knowledge of basic population concepts, such as density-dependence, trade-offs, competition, predation, parasitism, etc.
- Generate a life table using demographic (birth and death) data.
- Demonstrate a knowledge of the fundamentals of population models, such as the Logistic and Lotka-Volterra models, and appreciate the use of population models in applied ecology

**Outline Syllabus**

**Lectures**

- Introduction: what is wildlife population ecology and how do we study it?
Population growth: from water fleas to blue whales
Life Tables I: quantifying survival and death rate - humans, sheep and fruit flies
Life Tables II: quantifying reproduction and birth rate - mussels, moose and mice
Density-dependence I: scramble and contest competition - from beetles to grouse
Density-dependence II: intra-specific competition and the route to chaos
Interactions between species I: inter-specific competition - a tail of two squirrels
Interactions between species II: predator-prey interactions - the lynx and the hare
Pests, parasites and pathogens I: biological control, parasitoids and rats
Pests, parasites and pathogens II: rabies, foot-and-mouth and nematode worms

Practicals and Workshops

- Mark-release-recapture methods: laboratory practical
- Constructing life tables: data collection in the field and Excel practical
- Collecting population data: seed beetle density-dependence
- Population modelling: computer simulation practical using Populus
- Case studies in applied population ecology; presentation and workshop

Assessment Proportions

- 50% Exam
- 50% Coursework

LEC.428: Wildlife Monitoring Techniques

Terms Taught: Michaelmas Term only

ECTS Credits: 8 ECTS Credits

Pre-requisites:
- This module is only available to Postgraduate Erasmus+ students from selected partners
- You must have completed a degree and enrolled in a postgraduate programme in a related discipline

Module Description

Fieldwork skills are essential for ecologists and conservation biologist in both research and applied contexts. The module will teach a range of taxonomically-based field skills that will combine identification, sampling and other methods used to quantitatively monitor or assess populations. Components will include sessions on birds, mammals and invertebrates.

Educational Aims

The module will provide students with a range of generic skills such as team working, report writing, critical observation and accurate data recording and interpretation.

On completion of this module a student will be able to:
Demonstrate identification skills with the key taxa used on the module
Identify appropriate sampling methods and apply them in the field
Outline the fundamentals of sampling bias and distinguish how they are associated with different trapping, recording and sampling methods
Explain how surveys are used at different scales

Outline Syllabus

The module will have five sections, each delivered with one or two lectures and including a field component in campus or away. Section content will be determined by staff skills and may vary from year to year in relation to availability, but examples of key components include:

- Bird census techniques. Identification of key groups, such as waders or woodland birds using plumage and song.
- Mammal census techniques. Small mammal trapping and marking, issues of sample bias, camera traps, indirect methods.
- Terrestrial Invertebrate sampling methods. Identification of key taxa to various levels of detail, trapping methods (e.g. pitfall, sweep netting, suction sampling).
- Measuring and representing species diversity (computer-based session using EstimateS software).

Assessment Proportions

- 100% Coursework

LEC.432: Lake Ecology

Terms Taught: Michaelmas Term Only

ECTS Credits: 8 ECTS Credits

Pre-requisites:
- This module is only available to Postgraduate Erasmus+ students from selected partners
- You must have completed a degree and enrolled in a postgraduate programme in a related discipline
- Basic Ecology knowledge

Module Description
This module aims to introduce the principles of lake ecology, an area with an acknowledged national lack of expertise. The course presents a holistic approach to the drivers and internal interactions that control water quality in lakes. The course will teach basic ecological principles, elucidated using lake ecology, introduce application of state-of-the-art techniques and provide essential background information for anyone dealing with EU Directives such as the Water Framework Directive in the future.

Educational Aims
On successful completion of this module students will be able to:
• Identify the processes leading to nutrient inputs to lakes
• Demonstrate a knowledge of the effects of climate change on lakes
• Identify the factors controlling fish populations
• Understand the potential and limits of state-of-the-art techniques in lake ecology
  Appreciate the principles and uses of lake and catchment modelling

Outline Syllabus

• Major drivers of lake ecology
• Overview to the structure and rationale of the course
• Introduction to lakes and their role in the landscape and global cycling
• Nutrient sources to lakes
• Lake physics & atmospheric drivers
• Changing lakes
• Sediments as a record of change
• Acidification & recovery
• Records of long-term change
• Methods of sampling lakes: field trip on Windermere
• Trophic interactions
• Zooplankton Fish biology
• Trophic interactions & alternative stable states
• Approaches to lake management
• Molecular methods in freshwater ecology
• Lake modelling
• Multiple stressors & the Water Framework Directive
• Use of high-frequency lake measurements to estimate physical factors & response to climate forcing Identification of plankton using microscopy & overview of modern techniques
• Methods of sampling lakes: field trip to Windermere (as above)
• Modelling lake responses to external forcing

Assessment Proportions

• 20% Presentation (Assessed)
• 80% Report

LEC.462: Data assimilation and integration

Terms Taught: Michaelmas Term Only

ECTS Credits: 8 ECTS Credits

Pre-requisites:
• This module is only available to Postgraduate Erasmus+ students from selected partners
• You must have completed a degree and enrolled in a postgraduate programme in a related discipline
• College-level Maths or equivalent
• Familiarity with Microsoft Excel

Module Description

Making cutting-edge advances in the environmental sciences increasingly involves using a wide variety of data, collected using different sensors or instruments. Successful integration of such large and diverse data sets is facilitated by modern digital techniques, but must be underpinned by a rigorous scientific approach. This module aims to teach the fundamentals of accessing, annotating, analysing and interpreting heterogeneous digital data, whilst considering the potential errors and pitfalls involved. Everyday problems in data collection, both avoidable and unavoidable will be demonstrated, together with techniques that minimise their impact. Concepts such as identifying errors, dealing with missing data and data visualisation run throughout the module. Using a practical, hands-on approach, students develop data manipulation and visualisation skills with a variety of sources and software. Specialist software, such as ArcGIS and MATLAB, will be introduced and an awareness of available tools to maximise the data utility will be developed. Datasets from across the environmental sciences will be used and the techniques and benefits of integrating different data streams illustrated.

Educational Aims

On successful completion of this module students will be able to:

• Identify and overcome difficulties in the analysis of real and incomplete datasets
• Define metadata requirements for specific data types
• Assess the applicability of non-standard data sources
• Appropriately combine results from disparate datasets
• Discuss the strengths and weaknesses of a range of observational techniques
• Make appropriate use of visualisation tools

Outline Syllabus

• Remote sensing and metadata (I): data availability, source system properties, measurement trade-offs, analysis tools, processing multi/hyperspectral products, visualisation, data users
• Time series: tools and techniques for collection, analysis, visualisation and interpretation of time series data, issues requiring annotation, including non-stationarity, long range dependency, missing data
• Ground-based techniques: transducers, sensors and wireless sensor networks, cost versus accuracy, analysis and manipulation tools, geo-referencing and co-ordinate systems
• Databases, data mining and metadata (II): large data volumes and use of databases for storage, access and analysis; concepts behind data mining and metadata for disparate sources and observation types
• Historical and other data sources: historical data and non-conventional sources, accuracy and annotation issues, citizen-science and multi-scale integration

Assessment Proportions

• 100% Coursework
LEC.467: Catchment Protection (field course—limited to 16 places and priority given to MSc Sustainable Water Management/Flood & Coastal Risk Management students)

Terms Taught: Lent and Summer Terms Only

ECTS Credits: 8 ECTS Credits

Pre-requisites:
- This module is only available to Postgraduate Erasmus+ students from selected partners
- You must have completed a degree and enrolled in a postgraduate programme in a related discipline
- Undergraduate Hydrology module or relevant work experience
- Limited places available on this module

Module Description
Catchments are increasingly understood to be complex and highly interconnected systems. This presents significant challenges for those who manage catchments, but also a range of novel and timely research opportunities. In this context, the module aims to provide students with understanding and practical experience of key research and management challenges facing the future management of catchments. The module will take the Eden catchment as a case study, and draw on the latest land and water management framework, derived from the Water Framework Directive, as a basis for discussion. After analysing this framework and identifying significant challenges, students will use a combination of field, laboratory and data analysis techniques to investigate research questions related to biophysical processes within catchments. These investigations will lead to an appreciation of the limits to current knowledge and the opportunities for future research.

Educational Aims
On successful completion of this module students will be able to:
- Analyse management frameworks relevant to sustainable water management, and identify and justify linked research and management challenges that emerge from these frameworks
- Apply relevant field, laboratory and data analysis techniques to investigate these challenges, and describe the limitations and potential sources of error in these techniques
- Critically appraise the current state of knowledge related to these challenges, and plan and justify future research activities to address gaps in knowledge

Outline Syllabus
The module will be run as a series of linked project days. The content of the week will provide students with experience of:
- Interaction with Environment Agency/Water Company/Rivers Trust staff
- Links between land use and sustainable water management
- Assessing morphological conditions in rivers
- Water resources management and river discharge gauging
- Pollutant sources, pathways and impacts in receiving waters
Assessment Proportions

- 100% Report

LEC.468: Modelling Environmental Processes

Terms Taught: Lent Term Only

ECTS Credits: 8 ECTS Credits

Pre-requisites:
- This module is only available to Postgraduate Erasmus+ students from selected partners
- You must have completed a degree and enrolled in a postgraduate programme in a related discipline
- Secondary-level Maths, Physics or equivalent, preferably College-level

Educational Aims
On completion of this module students should be able to:

- Be able to individually undertake some simple modelling tasks and to analyse experimental data.
- Evaluate the principles and problems of computer aided modelling of environmental systems.
- Use contemporary industry standard numerical software to analyse and simulate environmental systems.

Outline Syllabus

Lectures

- Throughout the course case studies and examples will be used to illustrate the material. Guest lecturers may be invited to contribute depending on availability.
- Scope of the course; Scientific methodology and modelling: Introduction to modelling as a process;
- Approaches to modelling: the role of data and perceptions in the modelling process; the problems of badly defined systems in the context of modelling environmental processes; problems of scale (temporal and spatial) and uncertainty in quantifying environmental systems.
- The concept of dynamic system. First order linear systems, with the Nicholson blowfly dynamics and the Aggregated Dead Zone (ADZ) model of dispersion in a river used as practical case studies. Transfer function models, steady state gain and time constant; serial, parallel and feedback connections of first order systems. Block diagram analysis.
- Muskingum-Cunge, Lag and Route, and General Transfer Function models of flow in a river system
- Second order linear systems with the predator-prey equations and a climate model as practical examples; natural frequency and damping ratio; higher order systems
- Linear vs. Nonlinear systems – basic introduction
Practicals/workshops
- Blowfly population modelling and simulation (MATLAB/Simulink package)
- Aggregated Dead Zone (ADZ) modelling (MATLAB/Simulink package)
- Predator-Prey population dynamics modelling and Gilliland Climate model
- Modelling river flow

Assessment Proportions
- Coursework: 50%
- Exam: 50%

LEC.474: Geological Hazards

Terms Taught: Lent Term Only

ECTS Credits: 8 ECTS Credits

Pre-requisites:
- This module is only available to Postgraduate Erasmus+ students from selected partners
- You must have completed a degree and enrolled in a postgraduate programme in a related discipline

Module Description
This module takes a broad look at geological hazards, covering contemporary events, to those that have shaped the Earth over geological time. Specific hazards addressed are: 1) earthquakes and tsunamis, 2) terrestrial and sub-marine landslides at a variety of differing scales, landslide triggering and principles of run-out, 3) volcanic hazards (eruption styles, plumes and pyroclastic flows) and 4) extreme events which civilisation has yet to witness. The module explores in depth the fundamental processes involved, and to what extent events can be predicted, and how they might be predicted. Case histories of national and international disasters will be used to illustrate these hazards, with the inherent risks and potential mitigation measures discussed. More numerate skills are a key focus. The module develops a sense of human-place in the geological world, promoting an understanding of how the geological world impacts human society, and what can be done to limit that impact.

Educational Aims
On completion of this module students will be able to:
- Describe and explain the concepts and foundations of geological hazards
- Apply and report on the methods of prediction and mitigation strategies of geological hazards
- Apply simple principles of analysis of slope failure using a variety of natural hazard situations
- Demonstrate and elaborate an understanding of geological processes responsible for the occurrence, recurrence and magnitude of hazards.
• Apply simple prediction scenarios of geological hazard occurrence, using geological data sets.
• Explore and gather data from landslide hazards in the field

Outline Syllabus

Lectures (2 hr):

• How faults rupture and earthquake prediction
• Records of earthquakes, tsunamis, forecasting and hazard mapping
• Mitigation of earthquake & tsunami hazards
• Hazardous slopes and landslides and monitoring landslides
• Methods of landslide prediction
• Landslide risk mitigation, Landslide scaling and big landslides
• The rheology of landslides and volcanic flows
• Volcanic hazards & volcano monitoring
• Major & extreme events

Practicals (3 hrs each):

• Probabilistic forecasting of earthquakes
• Landslide prediction, based on inventory maps
• Hekla hazards
• Fieldtrip to assess the Falls Foot landslide and associated CW assessment

Seminars (each 2hrs long):

• Seismic Hazards
• Application of landslide modelling
• Volcanic risk

Assessment Proportions

• 100% Coursework

LEC.475: Data Analysis and Programming Skills

Terms Taught: Lent Term Only

ECTS Credits: 8 ECTS Credits

Pre-requisites:

• This module is only available to Postgraduate Erasmus+ students from selected partners
• You must have completed a degree and enrolled in a postgraduate programme in a related discipline
• Basic numeracy skills required (e.g. Microsoft Excel)
Educational Aims

On completion of the course the student should be able to:

- Design, modify, run and debug simple MATLAB programs; with a potential to use MATLAB as a comprehensive programming language
- Relate the concepts of serial, parallel and feedback connections to processes in the environment
- Formulate and use Simulink block diagram representations of simple environmental systems

Outline Syllabus

This module consists of 24 2-hour interactive computer-based workshops followed by on-demand drop-in sessions focused on dissertation projects

- Introduction; Aims of programming; Course aims; Basic definitions; The scientific method; Programming languages: development, common features, application areas
- Starting and using MATLAB; scripts; toolboxes; search paths; variables and expressions; programmer’s tools: editor/debugger; Program control: loops and nested loops
- The concept of a dynamic system, transfer function, ADZ model of dispersion in a river
- Introduction to graphical simulation systems: Simulink, block diagrams analysis
- More program control: Conditional statements. Functions and subroutines
- Simulink: second order system examples: Gilliland climate model; feedback connections
- First module test (appr. week 24)
- MATLAB and general defaults handling; error handling. Files and data input and output;
- Computer graphics and visualisation with handle graphics
- Advanced visualisation (multivariable data) – continued from ENV201
- Program design, libraries; program development and debugging
- Summary and revision workshop. End of module test (appr. week 27)
- Case studies and dissertation data processing clinics

Assessment Proportions

- 50% Coursework
- 50% Test

LEC.476: Volcanic Process Field Course

Terms Taught: Full Academic Year

ECTS Credits: 8 ECTS Credits

Pre-requisites:

- This module is only available to Postgraduate Erasmus+ students from selected partners
- You must have completed a degree and enrolled in a postgraduate programme in a related discipline
Module Description

During an intensive week-long field course to an active volcanic region, students will explore many of the complex processes that take place both on the surface and beneath volcanoes. Through observing features over scales varying from millimetres to kilometres, interpretations will be made of processes such as lava flow emplacement and explosive dynamics. Geological evidence for the volcano’s constructional (eruptive) history as well as for destructive (collapse) events will be considered in terms of contemporary hazard analysis and mitigation efforts. This problem-based learning module covers two levels of problems: the higher-level problem (e.g. understanding the plumbing system of a complex volcano or the role of ‘volcano spreading’ or slope instability in the evolution of volcanoes) will occupy the entire module. Lower level problems will be solved at a number of key localities where students will be expected to unravel the processes involved.

Educational Aims

On completion of this module students should be able to:

- Systematically observe and interpret field evidence for emplacement processes of volcanic rocks
- Describe the intrusive, effusive and explosive processes that take place during volcanic eruptions
- Recognise the role of regional tectonics, gravitational deformation of the volcano and major slope instabilities on the evolution of basaltic volcanoes
- Explain the problems of dealing with volcanic hazards on heavily populated active volcanoes

Assessment Proportions

- 100% Coursework

LEC.477: Global Change and the Earth System

Terms Taught: Michaelmas and Lent Terms Only

ECTS Credits: 8 ECTS Credits

Pre-requisites:

- This module is only available to Postgraduate Erasmus+ students from selected partners
- You must have completed a degree and enrolled in a postgraduate programme in a related discipline
- Previous knowledge of climate and weather; willingness to engage in some Maths, Chemistry and Physics
- The exam will take place in January, hence this is a two term module
The module begins with the underlying concepts that shape the Earth’s climate (energy transfer, the greenhouse effect, atmosphere and ocean circulation) before considering natural and human drivers of climate change, such as volcanoes, solar output, greenhouse gases and land use change. In addition, it will also introduce the computer models and global observation networks that scientists use to understand the Earth system as well as the IPCC process.

Educational Aims
On completion of this module a student will be able to:

- Explain the major parts of the Earth system and how they interact
- Describe what an Earth system model is and evaluate their strengths and weaknesses
- Summarise the components of the global energy balance and greenhouse effect
- Identify and describe the major human and natural causes of global climate change

Outline Syllabus

Overall, the lectures will cover:

- Science fundamentals of climate and Earth system science
- Atmospheric composition and climate
- Earth system components and feedbacks
- Earth system models and observation platforms

Other:

- Radiative balance of the atmosphere at Hazelrigg Field Station
- Workshop on climate interactions and feedbacks Fieldtrip to Manchester Museum of Science and Industry
- Student presentations

Assessment Proportions

- 50% Exam
- 50% Coursework

LEC.478: Physical Volcanology

Terms Taught: Full Academic year

ECTS Credits: 8 ECTS Credits

Pre-requisites:

- This module is only available to Postgraduate Erasmus+ students from selected partners
- You must have completed a degree and enrolled in a postgraduate programme in a related discipline
- No formal pre-requisites, but Mathematics at College level recommended
Module Description

This module aims to provide a broad understanding of volcanoes and volcanic systems, and is based on an understanding of the properties and behaviour of volcanic materials gained through laboratory, theoretical and field study. The interaction of volcanic processes with the biosphere, atmosphere and hydrosphere are discussed, together with the hazard presented to current human activity.

Educational Aims

On successful completion of this module students will be able to:

- Recognise different types of volcanic activity
- Understand why volcanoes behave in different ways
- Appreciate the role volcanoes have played in the biosphere, atmosphere and hydrosphere over geological time
- Be able to quantify volcanic processes and risk
- Recognise volcanism as present on many solar-system bodies

Outline Syllabus

- History of volcanology, introduction to volcanic terminology, VEI, structure of Earth, what volcanoes represent (gravity driven planetary cooling/degassing mechanism, source of primitive atmosphere), study approaches (fieldwork, numerical simulation, laboratory characterization and models)
- Physics and chemistry of magmas. Volatiles (what are they, where do they come from, how do they behave), phase diagrams of temperature, pressure and composition (heating, cooling and degassing), rheology (temperature, pressure, chemical composition, phases, viscoelasticity)
- Volcanism from below. Where does molten rock come from (mantle melting, interaction with crust). How does heat get transported (advection, convection, conduction, diapirs, dikes, crustal plumbing and storage systems).
- Volcanism from above: effusive (lavas), extrusive (domes) and explosive (significant atmospheric interaction) eruption modes
- Volcanic hazards, risk assessment and monitoring
- Volcanoes, climate change and mass extinction (end Permian example)
- Volcanic systems on other solar-system bodies

Assessment Proportions

- 100% Essay(s)
LEC.500: Dissertation Project (Exchange students)

Terms Taught: Michaelmas, Lent or Summer terms

ECTS Credits: 15 ECTS Credits

Pre-requisites:

- This module is only available to Postgraduate Erasmus+ students from selected partners
- You must have completed a degree and enrolled in a postgraduate programme in a related discipline
- Module Convenor approval required to undertake dissertation project

Module Description

100% on a final 5,000-word report. An academic supervisor is appointed to each project providing guidance on the definition of the research question, identification of the appropriate methodology and feedback on the Progress Report, Poster and draft sections of the thesis. The Progress Report and Posters are formative assessments because the student requires feedback but invariably the project is still evolving to such an extent that this feedback should not count toward their final mark for this element. The summative assessment is on the 5,000-word dissertation where it belongs.

Educational Aims

On successful completion of this module students will be able to develop specialised, master level knowledge and experience in a specific area of research.