Università Ca'Foscari Venezia

cmcc Centro Euro-Mediterraneo sui Cambiamenti Climatici

PHD & MASTER'S PROGRAMMES

Science and Management of Climate Change

PhD
Master
Programmes
2024-2028

» The PhD & Master in *Science and Management of Climate Change* are aimed at preparing researchers and professionals capable of navigating and connecting the challenging, complex and multi-faceted dimensions of climate change

PHD and MASTER'S PROGRAMMES IN SCIENCE AND MANAGEMENT OF CLIMATE CHANGE

PRESENTATION

Climate change is one of the main challenges posing major risks to the society at large, as well as to business and industries. According to the World Economic Forum, the failure to implement effective mitigation and adaptation policies is one of the top-five economic risks for the business world.

The PhD in Science and Management of Climate Change is a 4-year programme aimed at preparing researchers capable of navigating and connecting the complex and multi-faceted dimensions of climate change.

It is a joint initiative of Ca' Foscari University, Venice, and the Euro-Mediterranean Center on Climate Change.

The Master of Research in Science and Management of Climate Change is a 1-year programme aimed at preparing professional leaders capable of managing the complex and multi-faceted risks posed by climate change, as well as the opportunities that might arise. It features the collaboration of an increasing number of partners from the business, NGO, and policy sectors. With the PhD it shares the 1st year of didactical activities.

Objectives

Provide high-level academic training about the physical basis and the socio-economic aspects of climate change;

Prepare scientists who can understand, synthesize, and communicate the biophysical and socio-economic nature of climate change, evaluate the socio-economic implications of climate change impacts and risks, and design innovative policy solutions and risk management strategies;

Acquire quantitative modeling and statistical skills to i) assess the socio-economic impacts of climate change, their costs and benefits, ii) evaluate and manage climate change physical and transition risk, iii) analyze, evaluate, and design innovative climate policy solutions, iv) conceive transformational pathways in the context of sustainable development.

Activities and university credits (CFU)

In the first year, PhD and Master students will follow 11 compulsory courses (66 CFU). Didactical activities will consist of frontal lectures, seminars, hands-on sessions, group activities, presentation of group/individual projects. Guest lectures and seminars from international experts will be offered throughout the year. Additional 75 hours of optional courses and practical, hands-on sessions will be available to all students. Master students end their programme with a 250 hours internship. From the second year, PhD students work on their research and have the opportunity to be involved in teaching activities. PhD students are encouraged to spend a period of at least 3 months in a foreign institution or university, to be agreed with the tutor and approved by the PhD Board. During the fourth year, PhD candidates finalize their thesis.

FIRST TERM

FOUNDATIONS

The first term will build the foundations and will be articulated into five common, compulsory courses: Mathematical Modeling and Programming, Statistics, Introduction to Programming and Machine Learning, Introduction to Climate Dynamics, Environmental and Climate Economics and one optional course, Climate of the Past. In the second term, students will choose one of the two streams articulated in 4 courses each.

1- **Climate Economics and Finance:** CGE and Integrated Assessment Modeling of CC Impacts and Policies; Applied Environmental Economics and Policy Evaluation; Domestic and International Climate Policies; Climate Finance.
2- **Climate Modelling and Impact Assessments:** Chemodynamics, Climate Change and Environmental Quality; Climate Modeling and Monitoring; Risk Assessment and Decision Support System for Environmental Impacts of Climate Change; Climate Damage Modeling and Assessment.

All students will be offered three optional LABS: Data, Tools and Methods for Earth Sciences (introduction and practicals, 15 hours each); Topics in Science and Management of Climate Change (15 hours). They will also follow 2 out of 3 common courses: Energy Systems and Technologies; Adaptive Management of Natural Resources and Agricultural Systems; Decision Theory and Multi-criteria Analysis.

Mathematical Modelling and Programming

Understanding of dynamic systems and preliminary concepts such as linear algebra, eigenvalues, complex numbers. Introduction to mathematical instruments for dynamic systems and applications to environmental problems. Lectures will focus on theory as well as on applications through hands-on sessions.

Statistics

Introduction to the statistical methods useful to quantify changes in climate variables and the impacts of climate change on human activities. Students will choose two modules, 15 hours each, for a total of 30 hours (6 credits), from the following four 15-hour (3 credits) modules:

- Introductory Statistics: Exploratory data analysis and descriptive statistics, probability basics (distributions and sampling), basic inference (testing for the mean in one sample and two sample problems);
- Regression Models and Distribution Fitting: Estimation procedures for univariate distributions (distribution fitting). Simple and multiple linear linear regression: estimation, model building and evaluation, inference for linear models, prediction;
- Statistical Models: Generalized Linear Models and Extensions: Logistic regression and generalized linear models. Non-parametric/non-linear regression (loess, splines, generalized additive models);
- Spatio-temporal Statistical Models: Introduction to time-series data and models (ACF, PACF, decompositions and ARIMA models). Spatial data (variogram, ordinary kriging).

Introduction to Programming for Statistics

Introduction to the R and Python statistical softwares. Lectures will focus on imparting data handling and analysis skills utilizing various commonly used scientific data formats (e.g. netCDF, ascii etc). Students will also be introduced to geo-spatial mapping routines in R to facilitate rapid spatiotemporal aggregation and mapping of environmental and socio-economic data.

Machine Learning

Introduction to the principles and elements of machine learning. Application of commonly used neural networks and other machine learning approaches with focus on climate science will be a central theme of the course. Lectures will include hands-on machine learning algorithms using Python programming language. Students will get an overview and experience in data science, a hot topic having wide-ranging applications in environmental studies.

Earth System Dynamics

Introduction to climatology. Basic understanding of how Earth's climate operates and how it is investigated by contemporary and pioneering climate research, with focus on the physical components of climate. Students will become familiar with the main modern tools used for characterization, understanding and prediction of climate and learn fundamentals of anthropogenic climate change and natural climate variability. Lectures will be frontal.

Environmental and Climate Economics

Introduction to the concept of market failures and the role of climate policy. Climate-economy tools to simulate and evaluate climate policy instruments. Lectures will focus on theory and applications through hands-on sessions, group discussion, and students' presentations. Students will learn to compare costs and benefits of climate change, analyze, evaluate, and design climate policy solutions, and conceive transformational pathways in the context of sustainable development.

Climate of the Past

Introduction to paleo-climate, time scales of climate change, and climate in human history. Methods for detecting climate change, including proxies, ice cores, instrumental records and time series analysis. Lectures will focus on the physical and chemical processes in climate, including primordial atmosphere, ozone chemistry, carbon and oxygen cycles, and heat and water budgets. Students will learn about the internal feedback mechanisms in earth's climate system, including ice, aerosols, water vapor, clouds and ocean circulation.

SECOND TERM

Students can choose to follow Stream 1 or Stream 2 during the second term, 2 of the common courses and any lab they wish.

STREAM 1: CLIMATE ECONOMICS AND FINANCE STREAM

Students in Stream 1 take all these courses.

CGE and Integrated Assessment Modelling of CC Impacts and Policies

Introduction to macroeconomic approaches used to study the socio-economic impacts of climate change and the policy responses. Introduction to four key-topics related to modeling aspects: discounting, uncertainty, impacts assessment, mitigation and adaptation policy assessments. Focus on Computable General Equilibrium (CGE) models. Lectures will offer theoretical insights as well as applications with hands-on sessions. Students will learn the theoretical foundations of those models and learn how to apply them for the analysis of the socio-economic impacts of climate change.

Applied Environmental Economics and Policy Evaluation

Introduction to econometric methods to evaluate historical environmental and climate policies, with an empirical focus on their impacts on innovation and employment.

Domestic and International Climate Policies

Introduction to the recent history of international negotiations on climate change and to the main factors that prevent countries from achieving a widespread and effective agreement. Lectures will focus on the economic theory of climate negotiations using a quantitative approach based on game theory. The course will also review the main climate policy instruments with particular emphasis on the design of emission permits schemes both nationally and internationally.

Climate Finance

Introduction to the new scientific approaches required to describe and manage climate-related risk, a topic of increasing interest for practitioners of both public and private financial institutions. Students will learn: i) the main theoretical notions of climate financial risk (in class) and ii) practical know-how for the computation of metrics of climate financial risk on empirical data (hand-on sessions).

STREAM 2: CLIMATE MODELING AND IMPACT ASSESSMENTS

Students in Stream 2 take all these courses.

Chemodynamics, Climate Change and Environmental Quality

Introduction to environmental chemistry and thermodynamics. Climate system under a chemical and thermodynamic perspective. Impacts of climate change on environmental chemical pollution. Environmental risk assessment by exposure to chemicals. Lectures will focus on the behavior of environmental pollutants having different lifespans, with emphasis on the feedback cycle under climate change. Students will learn of the overall framework of contaminants' management, and to estimate and manage climate change risk.

Climate Modelling and Monitoring

Introduction to climate modeling and monitoring, the science of remote sensing, with a particular focus on its viability for recognition of environmental problems, as well as different applications to issues related to climate variability and its management. Overview of key aspects of climate modeling, including the numerical implementation of different physical and dynamical processes and the evaluation and assessment of simulation outputs. Particular attention will be given to international climate simulation activities, like CMIP6.

Risk Assessment and Decision Support System for Environmental Impacts of Climate Change

Introduction to the tools and methods for assessing environmental hazards, vulnerability, and risks posed by climate change in the context of global environmental changes. Decision Support System for climate change risk assessment and management. Lectures will focus on theory as well as on applications through hands-on sessions, students' presentations, and group discussion. Students will learn to define and implement environmental risk analysis, impacts and vulnerability assessment, and use related specific decision support systems.

Climate Damage Modelling and Assessment

Introduction to the theoretical and practical understanding of the methods and tools to assess climate change risk and the economic benefits of climate adaptation. Analysis of climate policies and management of risks deriving from climate change and variability. Lecture will focus on methods as well as applications in R and QGIS. Students will learn to estimate and manage climate change risk utilizing current geospatial modeling tools and practices.

COMMON COURSES

Students choose 2 courses.

Decision Theory and Multi-criteria Analysis

Introduction to decision theory under uncertainty, utility theory, decision tree, group decision, weighted averaging, ordered weighted averaging. Methods for optimization problems, in particular Linear Programming approach and some extensions. Lectures will focus on methods as well as hands-on exercises in R. Students will learn how to understand, specify, describe some problems in this field, and to implement a resolution strategy.

Energy Systems and Technologies

Introduction to the basic energy principles and laws (thermodynamics principles), and overview of the energy system, generation and conversion technologies, with particular attention to low-carbon and renewable technologies, as well as the relationship between climate change and the built environment.

Adaptive Management of Natural Resources & Agricultural Systems

Introduction to the principles of natural resources management. Lectures will focus on the interactions between natural and human elements of socio-ecosystems and agroecosystems in particular. Sustainability and sustainable development will be central themes of the course. System dynamics will be the most widely used approach. Spatial and temporal dynamics are explored with concrete examples and case studies. Students will be involved in individual and group case-studies and learn methods and tools for problem-solving approaches.

LABS

Students choose which lab to attend.

Data, Tools and Methods for Earth Sciences - Introduction

The lab will introduce students to recent tools, methodologies, data repositories and advancements in computing infrastructures applicable in Earth Sciences, with special emphasis on climate impacts and risk assessment.

Data, Tools and Methods for Earth Sciences - Practicals

Students will develop an understanding of various observational/model simulated data sources, scope and limitations of usage, and tools to access and process Earth Sciences' data on cloud computing infrastructures such as the Copernicus Data Store.

Topics in Science and Management of Climate Change

Every year this course will cover a specific topic within the field of science and management of climate change. The contents will be communicated at the beginning of the academic year.

ADDITIONAL INFORMATION

PhD

Coordinators

- Coordinator prof. Enrica De Cian
- Deputy coordinator prof. Francesco Bosello

Teaching method

Frontal lectures, hands-on-sessions, discussion groups, labs, seminars, guest lectures from international experts.

Language

English

Attendance

Attendance will be monitored through a register. Regular attendance in the classroom is compulsory to passing the individual modules. Absences must not in any case exceed 20% of teaching hours for each individual module. Credits are assigned with completion of the individual modules and internship/project work activities and passing of the final examination. Students employed in a professional activity coherent with the Master's course can replace the internship with the working activity.

Course locations

Scientific Campus Via Torino, Mestre (VE) / Economic Campus San Giobbe, Venezia / VEGA Scientific Park, Mestre (VE)

Selection procedure

A selection committee will be appointed to assess candidates based on their CV and a remote interview. The oral admission test, in English, will assess: candidate's motivations, quantitative mathematical and statistical skills and fluency in English.

Course period

September 2024 – June 2028

Qualification

PhD students completing their studies and receiving their PhDs will also receive the Master of Research's Diploma (2nd level) in Science and Management of Climate Change at the end of their 4-year programme, provided they fulfill all the necessary didactic and administrative requirements.

Admission requirements

To enroll in the PhD, candidates must be in possession of at least a second cycle, specialization or pre-reform (Italian Ministerial Decree no. 509/99) title.

An English language proficiency level of at least B2 level is required and it will be evaluated during the interview; an official certificate is required within the deadlines specified in the annual call. Notions of calculus and linear algebra are required. Only applications accompanied by all the required documentation, including two letters of recommendation, will be considered. The Call for Applications and relative attachments are published every year in the second half of April on the webpage of Ca' Foscari, PhD programmes:
www.unive.it/web/en/167/home

Available places

Maximum number of available places with a fully funded scholarship: **10**.

Graduate eligibility

Students about to graduate may also be admitted to the course, provided they qualify within the deadline specified in the annual call, corresponding approximately to two months from the start of the course. In this case, enrolment to the PhD's programme may be finalized only after the valid qualification for admission has been awarded. Non-enrolled people may attend as auditors and will be awarded a certificate of attendance.

Website

https://www.unive.it/web/en/166/programme

Contacts

On enrolment procedures, please contact the Post-lauream office, e-mail: postlauream@unive.it
Tel: (+39) 041 234 8067

On didactic activities, calendar of lessons and internships, please contact the Secretariat, e-mail: phd-climate-change@unive.it
Tel: +39 041 234 8530

MASTER

Coordinators

- Coordinator prof. Francesco Bosello
- Deputy coordinator prof. Enrica De Cian

Teaching method

Frontal lectures, hands-on-sessions, discussion groups, labs, seminars, guest lectures from international experts.

Language

English

Attendance

Attendance will be monitored through a register. Regular attendance in the classroom is compulsory to passing the individual modules. Absences must not in any case exceed 20% of teaching hours for each individual module. Credits are assigned with completion of the individual modules and internship/project work activities and passing of the final examination. Students employed in a professional activity coherent with the Master's course can replace the internship with the working activity.

Course locations

Scientific Campus Via Torino, Mestre (VE) / Economic Campus San Giobbe, Venezia / VEGA Scientific Park, Mestre (VE)

Selection procedure

A selection committee will be appointed to assess candidates based on their CV and a remote interview. The oral admission test, in English, will assess: candidate's motivations, quantitative mathematical and statistical skills and fluency in English.

Course period

September 2024 – June 2025

Qualification

Students attending the didactic activities, completing the internship and passing the intermediate verifications and final examination will be awarded the Master of Research's Diploma (2nd level) in Science and Management of Climate Change.

Duration and summary of didactic activities and university credits (CFU)

The Master's lasts for one year with 330 hours of compulsory didactic activities (66 CFU), and additional 75 hours of optional courses and practical, hands-on sessions.
A 250 hour internship (10 CFU) forms an integral part of the course and represents an excellent opportunity for a real-life on-the-job experience. The internship is mandatory. For students already working professionally in the sector, the same activities, accompanied by the drafting of a project work (2CFU), will be recognized as valid for the completion of the internship.

Admission requirements

To enroll in the Master's, candidates must be in possession of at least a second cycle, specialization or pre-reform (Italian Ministerial Decree no. 509/99) title. English language to proficiency level of at least B2 level is required and it will be evaluated during the interview; no official certificate is required. Notions of calculus and linear algebra are required. Master's applicants interested in the Deloitte scholarship need to explicitly mention that in the cover letter and will be interviewed by a company representative as well. Only applications accompanied by all the required documentation will be considered.

Graduate eligibility

Students about to graduate may also be admitted to the course, provided they qualify within one month from the start of the course. In this case, enrolment to the Master's programme may be finalized only after the valid qualification for admission has been awarded.
Non-enrolled people may attend as auditors and will be awarded a certificate of attendance.

Available places

Maximum number of available places: **15**.

Course fees: € 6.000

- 1st installment by 09/08/2024: € 3.016 (including € 16 stamp duty, not refundable, to be paid through PagoPA)
- 2nd installment by 10/01/2025: € 3.000

Study support

Loans are available from the University's partner banks (for more information: http://www.unive.it/pag/8560/).

A full waiver for the fees will be granted to the most deserving student. Another full grant will be funded by Deloitte for a student interested in carrying out the 250-hour internship within the company in Italy.

Enrolment

- ADMISSION APPLICATION SUBMISSION (online procedure, Call for Applications, art. 3): June 2024, updated dates will be published here
- SELECTION AND RESULT ANNOUNCEMENT by July 29, 2024
- ENROLMENT COMPLETION (online procedure, Call for Applications, art. 6) by August 9, 2024
- START of courses: September 2024. See: https://www.unive.it/data/en/165/courses

Website

www.unive.it/pag/39158/

Contacts

On **enrolment procedures**, please contact:
Post-lauream Office, **e-mail:** postlauream@unive.it,
Tel: (+39) 041 234 8067

On **didactic activities, calendar** of lessons and **internships**, please contact:
PhD and Master's Secretariat, **e-mail:** phd-climate-change@unive.it; **Tel**: +39 041 234 8530