UAB
Universitat Autònoma de Barcelona

Climate Change

Code: 43056
ECTS Credits: 6

2024/2025

Degree	Type	Year
4313784 Interdisciplinary Studies in Environmental, Economic and Social Sustainability	OT	0

Contact

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Teachers

Peter Graham Mortyn

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

There are no prerequisites.

Objectives and Contextualisation

We wish to enhance student understanding of the Earth's climate system, considering its many sub-systems (biological, chemical, physical, geologic, etc.) and their complex interactions over a range of temporal (past, present, and future) and spatial (local, regional, global, etc.) scales. Concerted effort will be made to distinguish Climate Change (CC) aspects and patterns from other realms of Global Change. While emphasis is naturally placed on the ocean's role in CC, the course also explores vital terrestrial aspects to CC as well. In the case of terrestrial CC, reference will be made to the spatio-temporal evolution of the climate, its variability and the indicators to measure it. It will also delve into the effects of CC on biodiversity, landscape and human health.

Competences

- Analyse how the Earth functions on a global scale in order to understand and interpret environmental changes on the global and local scales.
- Apply specific methodologies, techniques and resources to conduct research and produce innovative results in the area of Environmental Studies.

- Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.
- Communicate orally and in writing in English.
- Continue the learning process, to a large extent autonomously.
- Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
- Seek out information in the scientific literature using appropriate channels, and use this information to formulate and contextualise research in environmental sciences.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
- Work in an international, multidisciplinary context.

Learning Outcomes

1. Analyse and interpret climate records and results based on different techniques.
2. Apply specific methodologies, techniques and resources to conduct research and produce innovative results in the area of Environmental Studies.
3. Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.
4. Communicate orally and in writing in English.
5. Continue the learning process, to a large extent autonomously.
6. Evaluate and explain the different facets of climate change and the evidence for these, and their future consequences.
7. Identify the fields in which climate can be applied to the different environmental problem areas.
8. Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
9. Seek out information in the scientific literature using appropriate channels, and use this information to formulate and contextualise research in environmental sciences.
10. Show understanding of the concept of climate change from natural or anthropic causes.
11. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
12. Work in an international, multidisciplinary context.

Content

1.1. Introduction to Climate Change (GM)

Here we will introduce some of the guiding principles of "change", which are often only superficially understood by the general public. We will also discuss spatial and temporal scales, regional vs. global aspects, global vs. climate change (CC) distinctions, as well as the most important CC concepts. We will also touch on some of the key topic issues to be addressed later in the course. The concept of linkage between global climate change (e.g. recent warming) and the Earth's seasonal monsoon climate system will be explored, especially from the standpoint of SE Asia where it is most dramatic.

1.2. Archives and Proxies as recording systems and tracing tools (GM)

Here we will discuss a range of Earth "repository" recording systems of change, considering archives vs. proxies and basic geological and biological guiding principles. We will also get into the actual proxy mechanisms from several important archives (ice cores, marine sediments, corals, trees, and more), considering some geochemical, micropaleontological, physical, and biological "tools" to track change over many temporal and spatial scales.

1.3. El Niño/Southern Oscillation (ENSO) as a globally relevant case study concept (GM)

ENSO will serve as a Pacific-born, yet globally relevant phenomenon to consider a plethora of impacts, including climate, marine and terrestrial biology, agriculture, drought, economies, fisheries, water supply, human health, and more.

1.4. Hurricanes and Atlantic warming of recent decades (GM)

Recent events (Typhoon Haiyan, Superstorm Sandy, etc.) will be placed into a temporal context of recent decades, especially with Atlantic focus, to try and delineate how global climate change may be impacting storms. We will consider the evidence, knowledge shortfalls, and even paleoceanographic suggestions at the "link".

1.5. Ocean Acidification (OA) (GM)

OA will be explored in the context of a "sister" issue to CO2 emissions and anthropogenic climate change. Both broad-based concepts will be considered, including simplified chemistry, as well as newly acquired knowledge of the most vulnerable regions. Particular focus on the Mediterranean Sea and the newly acquired results will be presented. Arenas of impact touch on seawater chemistry, marine ecosystems (both planktonic and benthic) and marine ecosystem services (tourism, socioeconomics) and more.

1.6. Spatio-temporal evolution of the climate of the Iberian Peninsula (MN)

The Iberian Peninsula is an unbeatable laboratory for the study of the CC since on the one hand it is a territory that presents enough information and on the other hand, geographically it is a zone of transition that many of the predictive models place like centers of important changes in the near future.

1.7. Detection and measurement of the CC (MN)

These sessions will delve into the concept of climate anomaly and explore possibilities for detecting and measuring changes in climate patterns through various metrics.

1.8. Effects of CC (MN)

Some case studies will be carried out which will reflect the impacts on the loss of biodiversity, changes in uses in the landscape (a good example of the interaction between climate and anthropogenic action), the ecophysiology of plant ecosystems and the human health.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Students participation in the aula	6	0.24	1, 3, 4, 5, 6, 8, 10
Teaching at the aula	30	1.2	5, 8, 11, 12
Type: Supervised			
personal working	30	1.2	1, 2, 4, 6, 7, 9, 12
Type: Autonomous			
Study and own work	79	3.16	1, 2, 6, 7, 9, 12

In-class presentations will be made via Power Point, and detailed class discussions will ensue between the students and teaching staff. We aim to conduct the class sessions in as informal a manner as possible, in order to best facilitate active and inclusive participation, as well as engaged learning. The class discussions will also highlight controversial points, current events, and local phenomena as much as possible to pique the

interest of all involved. The course will also engage other researchers in conferences outside of the formal class structure.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exam	100%	5	0.2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

There will be a take-home exam, contributing to 100% of the final mark. The weight of questions will be proportional to the contribution of each professor. The final mark will be calculated by the two professors.

Not submitting the take-home exam on time will imply a non-evaluated mark, and it will not be possible to perform the recovery assignment.

If the student does not pass the take-home exam, the student will be able to complete a separate assignment (short research paper) on an assigned topic, within a week after the take-home exam evaluation has been published.

This module does not offer Single Assessment, as agreed with the coordination of the degree and with the Dean's Office of the Faculty of Sciences.

Bibliography

Background literature

Sub-Module 1: The Ocean's Role in Global Change

1.1. Introduction to Global Change and Climate Change

- Anderson, D.M, J.T. Overpeck, and A.K. Gupta, Increase in the Asian southwest monsoon during the past four centuries, *Science, 297*, 596-599, 2002.

- Barker, S., and A. Ridgwell, Ocean acidification, *Nature Education Knowledge*, 3(10):21, 2012.

- Black, D.E., The rains may be a-comin', *Science, 297*, 528-529, 2002.

- Broecker, W.S., The great ocean conveyor, *Oceanography, 4*, 79-89, 1991.

1.2. Archives and Proxies as recording systems and tracing tools

- Cronin, T.M., *Principles of Paleoclimatology*, Columbia University Press, New York, 1999.

- Mortyn, P.G, and M.A. Martinez-Boti, *Planktonic foraminifera and their proxies for the reconstruction of surface-ocean climate parameters*, Contributions to Science, 3, 371-383, 2007.

1.3. El Niño/Southern Oscillation (ENSO) as a globally relevant case study concept

- McPhaden, M.J., S.E. Zebiak, and M.H. Glantz, ENSO as an integrating concept in Earth Science, Science, 314, 1740-1745, 2006.

1.4. Hurricanes and Atlantic warming of recent decades

- Elsner, J.B., Evidence in support of the climate change - Atlantic hurricane hypothesis, Geophysical Research Letters, 33, doi:10.1029/2006GL026869, 2006.

- Emanuel, K., Increasing destructiveness of tropical cyclones over the past 30 years, Nature, 436, 686-688, 2005.

- Emanuel, K., Hurricanes: tempests in a greenhouse, Physics Today, p. 74-75, August 2006.

- Hoyos, C.D., P.A. Agudelo, P.J. Webster, and J.A. Curry, Deconvolution of the factors contributing to the increase in globalhurricane intensity, Science, 312, 94-97, 2006.

- Trenberth, K.E., and D.J. Shea, Atlantic hurricanes and natural variability in 2005, Geophysical ResearchLetters, 33, doi:10.1029/2006GL026894, 2006.

- Webster, P.J., G.J. Holland, J.A. Curry, and H.-R. Chang, Changes in tropical cyclone number, duration, and intensity in a warming environment, Science, 309, 1844-1846, 2005.

- Witze, Temperatures flare at hurricane meeting, Nature, 441, p. 11, 2006.

- Kerr, R.A., A tempestuous birth for hurricane climatology, Science, 312, 676-678, 2006.

1.5. Ocean Acidification (OA)

- Barker, S., and A. Ridgwell, Ocean acidification, Nature Education Knowledge, 3(10):21, 2012.

"IPCC assessment":

IPCC, 2013: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

https://www.ipcc.ch/report/ar5/wg1/

IPCC, 2018: *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]

https://www.ipcc.ch/sr15/

USGCRP, 2018: *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp.

https://doi:10.7930/NCA4.2018

"C40 cities":

https://c40-production-images.s3.amazonaws.com/researches/images/68_C40_GHGE-Report_040518.original.p

http://lameva.barcelona.cat/barcelona-pel-clima/sites/default/files/documents/pla_clima_cat_maig_ok.pdf

1.5°C: Aligning New York City with the Paris Climate Agreement. Published pursuant to Executive Order 26 of 2017. This document was produced by the New York City Mayor's Office of Sustainability. December 2017

https://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/1point5-AligningNYCwithParisAgrmt-0228

Gases de Efecto Invernadero:

The Global Carbon Project (CO2, CH4, N2O) (an annual update of carbon budget and trends)

http://www.globalcarbonproject.org/carbonbudget/index.htm (an annual update of carbon budget and trends)

National Academies of Sciences, Engineering, and Medicine 2018. *Improving Characterization of Anthropogenic Methane Emissions in the United States*. Washington, DC: The National Academies Press.

https://doi.org/10.17226/24987

Ejercicio:

A 1978 essay and some links in the web.

https://www.foreignaffairs.com/articles/2017-06-22/what-might-man-induced-climatechange-mean-excerpt

https://www.foreignaffairs.com/articles/1978-04-01/what-might-man-induced-climate-change-mean

Software

Office.

Miramon 8.2

Language list

Name	Group	Language	Semester	Turn
(TEm) Theory (master)	1	English	first semester	afternoon