UAB
Universitat Autònoma de Barcelona

Climate Change

2026/2027

Code: 45789
Credits: 5

Degree programme	Type	Course
Interdisciplinary Studies in Environmental, Economic and Social Sustainability	OP	1

Contact lecturer

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Teaching staff

Miquel Ninyerola Casals

Group languages

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

Prerequisites

There are no prerequisites.

Objectives

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.

Learning outcomes

- CA42 (Analyse the complexity of climate science and the challenges of climate change, integrating knowledge and formulating critical opinions on the associated social and ethical responsibilities.) Analyse the complexity of climate science and the challenges of climate change, integrating knowledge and formulating critical opinions on the associated social and ethical responsibilities.
- CA43 (Communicate conclusions about climate change, its impacts and coping strategies to expert and amateur audiences clearly and unambiguously.) Communicate conclusions about climate change, its impacts and coping strategies to expert and amateur audiences clearly and unambiguously.
- KA42 (Describe the patterns, causes and mechanisms of climate change, both natural and anthropogenic, in ocean and terrestrial systems.) Describe the patterns, causes and mechanisms of climate change, both natural and anthropogenic, in ocean and terrestrial systems.

- KA43 (Describe the tools and methodologies for the study of climate, including numerical modelling, and their application in the understanding of climate change.) Describe the tools and methodologies for the study of climate, including numerical modelling, and their application in the understanding of climate change.
- KA44 (Describe the current and future impacts of climate change and its consequences on natural and social systems.) Describe the current and future impacts of climate change and its consequences on natural and social systems.
- SA39 (Independently select information from the scientific literature to support and contextualise research in the field of climate change.) Independently select information from the scientific literature to support and contextualise research in the field of climate change.
- SA40 (Continuously update their own knowledge in climate science and its challenges through self-directed learning strategies.) Continuously update their own knowledge in climate science and its challenges through self-directed learning strategies.
- SA41 (Critically select appropriate methodologies for assessing climate vulnerability and risk at different scales.) Critically select appropriate methodologies for assessing climate vulnerability and risk at different scales.

Contents

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.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
personal working	15	0.6	CA42, CA43, KA42, KA43, KA44, SA39, SA40, SA41
Students participation in the classroom	6	0.24	CA42, CA43, KA42, KA43, KA44, SA39, SA40, SA41
Teaching in the classroom	24	0.96	CA42, CA43, KA42, KA43, KA44, SA39, SA40, SA41
study and individual work	77	3.08	CA42, CA43, KA42, KA43, KA44, SA39, SA40, SA41

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

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes

Participation	10	0	0	CA42, CA43, KA42, KA43, KA44, SA39, SA40, SA41
Second exam	30	1	0.04	CA42, CA43, KA42, KA43, KA44, SA39, SA40, SA41
First exam	60	2	0.08	CA42, CA43, KA42, KA43, KA44, SA39, SA40, SA41

There will be a take-home exam , contributing to 90% of the final mark. The weight of questions will be exam proportional to the contribution of each professor. The final mark will be calculated by the two professors.

The other 10% will depend on student participation, proportional to the contribution of each professor.

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.

Model 3 - Permitted use: "In this subject, the use of Artificial Intelligence (AI) technologies is allowed as an integral part of the development of the work, provided that the final result reflects a significant contribution by the student in the analysis and personal reflection. The student must clearly identify which parts have been generated with this technology, specify the tools used and include a critical reflection on how these have influenced the process and the final result of the activity. The lack of transparency in the use of AI will be considered a lack of academic honesty and may lead to a penalty in the grade of the activity, or greater sanctions in serious cases."

Bibliography

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

Science, 297

four centuries, , 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.

41.2. 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

5https://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

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this link. To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TEm) Theory (master)	1	English	second semester	afternoon