Universitat Autònoma de Barcelona

2019/2020

Climate Change

Code: 43056
ECTS Credits: 6

Degree	Type	Year	Semester
4313784 Interdisciplinary Studies in Environmental, Economic and Social Sustainability	OT	0	1

Contact

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Use of Languages

Principal working language: english (eng)

Teachers

Jordina Belmonte Soler

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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.

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 Land Surface / Atmosphere interactions (Terrestrial and aquatic ecosystems) (JAM).

We will consider the Biogeochemistry of the production of organic matter, respiration, and anaerobic situations in relation to the distribution of sinks and sources of greenhouse gases.

1.7 Local and Regional Area of Influence: Adding up emissions and their signal along the Atmospheric Transport (JAM).

Discrete air masses have concentrations of greenhouse gases that are a function of the processes that occur in the ecosystems with which they interact. We will outline a survey on the basic models for quantifying it.

1.8 The Urban Systems as main drivers of the atmospheric composition in the context of Climate Change (JAM).

Large cities are considered the main actors responsible for the increase of greenhouse gases in the atmosphere. Consider what role they play compared to the change in land uses, intensive agriculture and the energy consumed in industry. The role of the national attribution of GHG emissions will be discussed.

1.9 Geoengineering vs. Management, or Mitigation vs. Adaptation? (JAM)

The problems caused by climate change have usually been focused on extreme temperatures and phenomena, as well as on the variability of precipitation (droughts and floods). We will look at the magnitude of the great changes promoted by the management of large areas of natural systems against climate change.

1.10. Earth observation systems of greenhouse gases through research and monitoring networks (JAM).

Current research on "ground surface / atmosphere interactions" will be accounted to assess how remote sensing observation systems are combined with surface infrastructures. Role of spatial and temporal resolution of measurements (bottom-up) with regard to the modeling of the top-down atmospheric dynamics in the operational prediction of atmospheric weather.

1.11. Answers to some questions in the light of the investigation (JAM):

"What does human-induced climate change mean?", "What are the current trends in the greenhouse gas budget (marine, terrestrial and atmospheric)?"

Methodology

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Students participation in the aula	10	0.4	1, 6, 4, 10, 8, 3, 5
Teaching at the aula	50	2	8, 5, 11, 12
Type: Supervised			
personal working	20	0.8	1, 2, 6, 9, 4, 7, 12
Type: Autonomous			
Exam	5	0.2	1, 6, 4, 10, 7, 8, 3, 5, 11
Study and own work	20	0.8	1, 2, 6, 9, 7, 12

Assessment

An exam, contributing to 50% of the final mark. The number of questions will be proportional to the contribution of each teacher. The final mark will be accorded by the four professors.

A research presented in a poster (50%). The aim is to conduct detailed literature research on a climate change topic of your choice, guided in part by the subjects covered in class but you should not at all feel restricted by their elements. You might look to NASA, NOAA, the International Geosphere-Biosphere Programme (IGBP) (www.igbp.net), or any number of potentially useful web sites and select the topic of your poster. You will prepare and abstract of the theme of the poster. The poster will include an introduction/background, material and methods or data and methodology used to address the issue, discussion and conclusions, and suggest future works. You should consider all relevant spatial and temporal scales (local, regional, global, past, present, future, etc.) to provide necessary context. The posters will be presented at the end of the classes, in a session that we will decide; the format of the presentation will be similar to that of researchers in a research conference/congress, where a researcher shows his/her research to the colleagues.

Specifics:

- Poster size standard A1 (we suggest Power Point or similar software)

- Minimum text size suggested 28-points

- Abstract of </= 500 words

- As many figures, tables and references as considered necessaries to make a clear presentation

- Topics decided have to be announced at the time indicated in the aula to jordina.belmonte@uab.cat and/or to graham.mortyn@uab.cat and josepanton.morgui@uab.cat per email

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exam	50%	25	1	1, 6, 4, 10, 7, 8, 3, 5, 11
personal working	50%	20	0.8	1, 2, 6, 9, 4, 7, 12

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 (CO_2, CH_4, N_2O) (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