

**COURSE DATA****Data Subject**

Code	43052
Name	Climate change and carbon cycle
Cycle	Master's degree
ECTS Credits	3.0
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
2139 - M.U. en Contaminación, Toxicología y Sanidad Ambient. 12-V.2	Faculty of Biological Sciences	1	Second term

Subject-matter

Degree	Subject-matter	Character
2139 - M.U. en Contaminación, Toxicología y Sanidad Ambient. 12-V.2	2 - Environmental pollution	Optional

Coordination

Name	Department
ANDREU MOLINER, ENRIQUE	357 - Cellular Biology, Functional Biology and Physical Anthropol.

SUMMARY

The understanding of the Carbon cycle and the prediction of its evolution in terrestrial ecosystems under future climatic scenarios are among the greatest current scientific challenges. Uncertainty associated with present knowledge of the Carbon cycle is one of the factors that determines the uncertainty of climate predictions in global models, to a large extent due to the great importance of feed-backs between terrestrial ecosystems and the climatic system, about which yet little is known despite its great importance.

In addition, the global change is an internationally recognized problem (IPCC, 2007). Its importance has triggered the signature of two international treaties: the United Nations Framework Convention on Climate Change (UNFCCC, 1997) and the Convention on Biological Biodiversity (CBD, 1992). In Kyoto, the European Community committed to reduce emissions of GHG (CO₂ and other greenhouse gases) for the period 2008-2012 to 8% below the levels of 1990.



Approximately the 30% of anthropogenic GHG emissions (CO_2 , CH_4 and N_2O) are due to agriculture and forestry activities. On the other hand, European forests are actually carbon sinks in a similar order of magnitude. So, political and technical decisions on management, use and land change use can increment climate anthropogenic perturbations or contribute to climate change mitigation.

Mediterranean ecosystems are very sensible to climate change due to water availability and the predicted reduction of precipitation by almost all general circulation models. Because of this, a proper management of forests and agricultural systems could be able to contribute to reduce the negative effects of climate change to Mediterranean ecosystems. This adaptation management should be based on knowledge of carbon stocks and GHG fluxes that occur at ecosystem level, taking into account their correlations and responses to changes in land use and management.

También se abordará desde un punto de vista histórico el proceso de negociación iniciado con el protocolo de Kyoto, con sus implicaciones políticas, socioeconómicas y técnicas.

The aim of this optional course, on 4 months basis, is to introduce a global view of carbon cycle components and the greenhouse gases (GHG) estimations in forest and agricultural systems at ecosystem level, regarding to their potential contribution to climate change mitigation. This course offers basic knowledge on climate change, criteria and principles for Mediterranean ecosystems management, with the objective to optimize GHG balance, land use and land management considering Kyoto protocol commitments. The course programme includes management strategies which aim to reduce GHG emissions, increase carbon sinks and replacement of fossil fuels. Furthermore, conflict of interest with other issues of Mediterranean region, as, water use, forest fires prevention, biodiversity conservation, etc., will be shown, and economical criteria for assessing the viability of a “climate friendly” land use management. A set of study cases.

Finally the programme includes an historical review of the negotiation process initiated with the Kyoto protocol, dealing with its political, socio-economical and technical implications.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

OUTCOMES

2139 - M.U. en Contaminación, Toxicología y Sanidad Ambient. 12-V.2

- Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.



- Students should demonstrate self-directed learning skills for continued academic growth.
- Students should possess and understand foundational knowledge that enables original thinking and research in the field.
- Capacidad de análisis, síntesis y razonamiento crítico en la aplicación del método científico.
- Capacidad para el aprendizaje autónomo y organizado y para la adaptación a nuevas situaciones.
- Comprensión del mundo natural como producto de la evolución y de su vulnerabilidad frente a la influencia humana.
- Desarrollo de un compromiso ético y capacidad de participación en el debate social.
- Conocer los mecanismos desarrollados por los organismos para la resistencia a la contaminación ambiental.
- Diseñar y ejecutar proyectos para aplicar indicadores de sostenibilidad ambiental.
- Conocer la estructura y dinámica de las poblaciones.
- Conocer los flujos de energía y ciclos biogeoquímicos en los ecosistemas.
- Valorar los efectos del cambio climático.
- Realizar diagnóstico de problemas ambientales.
- Interpretar el paisaje y restaurar hábitats.
- Diseñar los indicadores específicos para un riesgo ambiental concreto.

LEARNING OUTCOMES

SKILLS TO ACQUIRE.

- To handle scientific terminology properly and become familiar with their sources.
- To get an integrated view of the defense mechanisms of adaptation to the environment of animals. Make sense of foreground, interrelate and apply.
- Ability to analyze data, choosing the right method, critical evaluation and interpretation of experimental results in various forms of expression (tables, graphs ...).
- Acquire synthesis capacity to collect, coherently and in an organized way, information or data of different origins.
- Meet the management of basic scientific instrumentation typical of Applied Physiology.

SOCIAL SKILLS

- Develop capacity for critical thinking, fostering communication and discussion with a view to stimulating individual creative ability.
- Ability to work in groups when dealing with problematic situations collectively.
- Ability to build a comprehensive text written and organized.
- Ability to speaking to a public audience, such as the class itself, by exposure or intervention in a debate on a topic or controversial issue.
- Ability to interact with both the teacher and with peers.
- Interest in social and economic application of science and in particular the Environmental Toxicology.
- Interest in popular science and the impact of science on culture and consciousness of society.



– Professional training. Acquisition of scientific and technical knowledge related to resistance to xenobiotics that will facilitate the work in Environmental Toxicology in a society in continuous technological progress.

DESCRIPTION OF CONTENTS

1. Climatic change and Carbon cycle

Earth Radiative Balance, main greenhouse gases and their contribution to the greenhouse effect. The actual increment of the greenhouse effect is the real problem for climate change. The origin of this increment can be natural or/and anthropogenic. Role of CO₂ as main greenhouse gas. Main components of the carbon cycle at global level. Atmospheric balance of CO₂: seasonal cycles, increments: emissions, land use change.

Components of carbon cycle at ecosystem level (gross primary production, total ecosystem respiration, carbon pools and stocks).

Interrelationships between carbon cycle and climate, feedbacks.

Brief historical review of the negotiations on climate change (Kyoto protocol, conferences of the parties, etc.). Meaning of the commitments, compliance with them. Political and technical solutions.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Development of group work	7,00	0
Study and independent work	12,00	0
Preparation of evaluation activities	15,00	0
Preparing lectures	10,00	0
Preparation of practical classes and problem	1,00	0
TOTAL	75,00	

TEACHING METHODOLOGY

- Master class for acquiring the fundamental knowledge, including methodological aspects.
- Practice class on the evaluation of pollution effects.



- Students will work in groups (of 2 or 3 people) on specific subjects proposed by the lecturer, finally showing their results in an oral presentation to the rest of the class.
- A tutorship of 1.5 hours will be carry out in the class. On the other hand, other tutored sessions will be available by e-mail or using the “aula virtual” tool.
- All activities and master classes are reinforced with documentation and information exchanges between lecturers and students using the “aula virtual” tool of the Universitat de València webpage.

EVALUATION

SE1 - Evaluación continua del estudiante en las clases de teoría, laboratorio y seminarios: asistencia participativa, manipulación del material y equipos, organización del trabajo, comprensión y empleo del guión de prácticas, realización de cálculos, trabajo en equipo, etc.

SE2 - Evaluación de las actividades no presenciales relacionadas con las clases de laboratorio: memorias y/o informes de las prácticas entregados.

SE3 - Exámenes escritos sobre las clases teóricas y/o prácticas: basados en los resultados de aprendizaje y en los objetivos específicos de cada asignatura.

SE4 - Asistencia a tutorías para la realización del trabajo y/o asistencia participativa a curso/s programado/s para el fomento de las competencias transversales.

SE5 - Elaboración de una memoria sobre las actividades realizadas para el fomento de las competencias transversales

REFERENCES

Basic

- Christopher B. Field and Michael R. Raupach Eds. 2004. The Global Carbon Cycle: Integrating Humans, Climate, and the Natural World. ISLAND PRESS. London.
- E.-D. Schulze, E. Beck and K. Müller-Hohenstein. 2002. Plant Ecology. Springer-Verlag. Berlin.
- Baldocchi, D.D., 2003. Assessing the eddy covariance technique for evaluating carbon dioxide exchange rates of ecosystems: past, present and future. Global Change Biology, 9: 479-492.
- Cox, P. M., R. A. Betts, C. D. Jones, S. A. Spall, and I. J. Totterdell (2000), Acceleration of global warming due to carbon-cycle feedbacks in a coupled climate model, Nature, 408, 184-187.
- <http://www.manicore.com> : Divulgación, website con versión en ingles (cambio climático, efecto invernadero, gases de efecto invernadero, ciclo del carbono, calentamiento global y economía, energía y combustibles fósiles, etc.).
- <http://www.ipcc.ch/index.htm> Página web del Panel intergubernamental sobre cambio climático (Intergovernmental Panel on Climate Change, IPCC). Acceso a los diferentes informes, material divulgación, presentaciones etc., disponibles documentos en versión en castellano.



<http://unfccc.int/2860.php> : Secretaría de la Convención Marco sobre el Cambio Climático Convención.

Additional

- Dufresne, J. L. et al. On the magnitude of positive feedback between future climate change and the carbon cycle. *Geophys. Res. Lett.* 29(10), doi:10.1029/ 2001GL013777 (2002).
- Friedlingstein, P., J.-L. Dufresne, P. M. Cox, and P. Rayner (2003), How positive is the feedback between climate change and the carbon cycle?, *Tellus, Ser. B*, 55(2), 692700.
- Nemani RR, Keeling CD, Hashimoto H et al. (2003) Climate driven increases in global terrestrial net primary production from 1982 to 1999. *Science*, 300, 15601563.
- Bala, G., Caldeira, K., Mirin, A., Wickett, M., Delire, C., 2005. Multicentury changes to the global climate and carbon cycle: results from a coupled climate and carbon cycle model. *J. Climate* 18, 45314544.
- Davidson, E.A., Janssens, I.A., 2006. Temperature sensitivity of soil carbon decomposition and feedbacks to climate change. *Nature* 440, 165173, doi:10.1038/nature04514.
- Schulze E-D, Wirth C, Heimann M (2000) Climate Change: Managing Forests After Kyoto, *Science* 289 (5487), 2058. [DOI: 10.1126/science.289.5487.2058]

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

English version is not available