COURSE DATA

Data Subject	
Code	43269
Name	Geographical information systems
Cycle	Master's degree
ECTS Credits	3.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
2148 - M.D. in Biodiversity: Conservation and Evolution	Faculty of Biological Sciences	1	First term

Subject-matter

Degree	Subject-matter	Character
2148 - M.D. in Biodiversity: Conservation and Evolution	10 - Evaluation and management of ecosystems	Optional

Coordination

Name	Department
DELEGIDO GOMEZ, JESUS VALERIANO	345 - Earth Physics and Thermodynamics

SUMMARY

The spatial and temporal monitoring of terrestrial and aquatic ecosystems, as well as the detection of structural and dynamic changes in them, requires new techniques capable of providing the necessary information at the appropriate spatial and temporal scales. In this sense, airborne remote sensing techniques or sensors on board artificial satellites in orbit around the Earth provide an ideal tool. On the one hand, they are sensors based on observation not accessible to the human eye (infrared, microwaves), thus providing vital information to complement traditional techniques based on in situ sampling. On the other hand, by providing a detailed system image, and with adequate repeatability over time, such techniques are well suited to describe the spatial distribution and structure of ecosystems, as well as their temporal dynamics.

Furthermore, the management of all this spatial and temporal information through the use of Geographic Information Systems (GIS) allows applications that would otherwise be unthinkable, both in environmental management and resource assessment, as well as in action planning and the combination of

information to aid environmental decision-making.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

In this subject all the necessary basic knowledge will be taught so that no special knowledge in physics, chemistry, biology or computer science is assumed for the student. However, it is obvious that some background is desirable for better effective learning. There are no special requirements for this subject.

OUTCOMES

2148 - M.D. in Biodiversity: Conservation and Evolution

- Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.
- Be able to make quick and effective decisions in professional or research practice.
- Be able to access the information required (databases, scientific articles, etc.) and to interpret and use it sensibly.
- Be able to access to information tools in other areas of knowledge and use them properly.
- To be able to assess the need to complete the scientific, historical, language, informatics, literature, ethics, social and human background in general, attending conferences, courses or doing complementary activities, self-assessing the contribution of these activities towards a comprehensive development.
- Stimulate the capacity for critical reasoning and for argumentation based on rational criteria.
- Awaken interest in the social and economic application of science.
- Encourage ethical commitment and environmental awareness.
- Be able to communicate and disseminate scientific ideas.

LEARNING OUTCOMES

To:

- Know the processes for obtaining remote sensing images and the different operating systems for obtaining images applicable to the terrestrial and aquatic environment study.

-Know how to search for, download and process images, both satellite and airborne, from any area of the world, with the appropriate resolution.

-Learn to use both free and commercial software for the processing and extraction of information from remote sensing images.

-Know how to use geographic information systems to obtain maps and quantifiable information on biophysical parameters of terrestrial and aquatic ecosystems.

-Consult and select bibliographic databases to find out about previous studies from which to extract knowledge about a specific environmental problem.

DESCRIPTION OF CONTENTS

1. Importance of spatial information in monitoring terrestrial and aquatic ecosystems

1.1. Spatial and temporal scales.
1.2. Monitoring methods.

2. GIS components and their functions.

2.1. Components of a GIS.
2.2. Main functions of a GIS.
2.3. Coordinate system and projections.
2.4. Geographic Databases.

3. Remote sensing systems.

3.1. Remote sensing basics.
3.2. Major Earth observation satellites.
3.3. Data processing.

4. Applications in terrestrial ecosystem management.

4.1. Terrestrial environment monitoring.
4.2. Biophysical parameters of the vegetation.
4.3. Morphological characterisation.
4.4. Applications.

5. Applications in aquatic ecosystem management.

5.1. Characteristics of the aquatic environment.
5.2. Monitoring techniques for the aquatic environment.
5.3. Inland lakes and rivers applications.
5.4. Coastal areas applications.
5.5. Biophysical parameters derivation.

6. Applications to land-use planning and natural resource management.

6.1. Monitoring the evolution of the territory.
6.2. Long-term natural changes.
6.3. Natural disasters.
6.4. Human-induced changes.

7. Practical session 1. Digital processing of satellite images. Introduction to the SNAP programme.

Image display. False colour. Histograms. Colour scales in images.
Mathematical operations with bands. Regions of interest.
Saving images. Formats.

8. Practical session 2. Obtaining parameters in terrestrial and aquatic ecosystems.

Preparation of a chlorophyll-a map of the Albufera de Valencia lake.
LAI (leaf area index) map of a cultivated area from satellite images. Other indices (biophysical parameters of vegetation, desertification, fires, etc.).

9. Practical session 3. APPLICATIONS: Changes in the Amazon rainforest. Mar Menor eutrophication.

Classification methods: supervised and unsupervised.
Detection of changes in the Amazon rainforest. Deforestation analysis.
Sentinel-3 automatic water quality products. Mar Menor eutrophication.

10. Practical session 4. Introduction to gvSIG.

Installation and start of the free software gvSIG. Tables.
Creation of layers and tables. Georeferencing.
Layout and edition of maps. Geoprocessing.
Access to free remote servers.

11. Practical session 5. Applications integrating remote sensing and GIS data.

Indices for the study of forest fires by remote sensing and analysis of the burned area. Erosion risk analysis.

12. Environmental application of free choice.

Study of an ecosystem and/or environmental problem chosen by the student using remote sensing and GIS techniques.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	20,00	100
Computer classroom practice	10,00	100
Development of individual work	15,00	0
Study and independent work	5,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	5,00	0
Preparing lectures	5,00	0
Preparation of practical classes and problem	5,00	0
Resolution of case studies	5,00	0
TOTAL	**75,00**	

TEACHING METHODOLOGY

1.- Group learning with the teacher.

The lecture model is used in theory classes, as this model allows the teacher to focus on the most important aspects of each subject, to dominate the presentation time, and to present a certain way of working and studying the subject.

Practices will also be guided by the teacher (all students will do the same practice on the same day, instead of each group doing a different practice in each session, as this helps to focus the contents and avoid dispersion).

The participatory model will be used in some theoretical subjects and above all in practical classes, in which the aim is to prioritise communication between students and between students and the teacher.

The use of audiovisual methods and web pages, as well as discussion forums and email lists, allows direct and fluid communication between the students and the teacher, as well as between the students themselves, to exchange ideas, doubts and suggestions.

2.- Individual study.

This involves managing the student in learning-oriented activities. The model to be applied is that of the student researcher, in such a way that the student's activity is centred on finding, analysing, manipulating, processing and returning information, in a similar way to how a researcher looks for the information he/she needs. Individualised study techniques are proposed in the form of practicals that the student can do if they have a personal computer and access to the internet, both of which are common.

3.- Tutorials.

Tutorials will be carried out in groups to solve problems and direct the proposed work. Individual face-to-face and e-mail tutorials will also be encouraged, given their convenience for both the students and the teacher. If the topic requires it, voluntary seminars could be organised where such issues could be discussed in group in a more detailed way.

4.- Group work with classmates in seminars and activities.

In addition to motivating students to research, analyse and internalise information, the purpose of theory and practical work is to foster personal relationships and share problems and solutions when working with other people.

EVALUATION

In the laboratory practicals, each day's work will be evaluated during the course of the practicals, assessing class attendance, the ability to carry out the practical, as well as originality and creativity. The presentation of a brief report on each practical, with a description of the work carried out and detailing the results obtained, will enable the practical to be assessed, the mark for which will represent 1/2 of the final mark for the course.

The other half of the mark will be obtained from a project chosen by the student (Practice nº 6), in which the knowledge of the course is applied to the resolution of a practical case. A written report of this work will be handed in and will be presented by the student in the last class session.

REFERENCES

Basic

- E. Chuvieco.Teledetección ambiental. Ed. Ariel, Barcelona, 2008.
- Guía didáctica de Teledetección y Medio Ambiente. Editores Javier Martínez Vega y M. Pilar Martín Isabel. CCHS-IEGD. 2010. http://digital.csic.es/bitstream/10261/28306/2/guia_papel.pdf
- Comas, D., y Ruiz, E. Fundamentos de los sistemas de información geográfica. Ariel Geografía, Barcelona, 1993.

- Manual de gvSIG. http://www.gvsig.org/plone/docusr

Additional

- R.N. Colwell (editor). "Manual of Remote Sensing" (segunda edición), American Society of Photogrammetry, vol. I y II, 1983.
- Gutiérrez, J. Y Gould, M. SIG: Sistemas de Información Geográfica. Síntesis, col. Espacios y Sociedad, Madrid, 1994.