UAB
Universitat Autònoma de Barcelona

Remote Sensing for Urban Systems

Code: 104548
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500001 Management of Smart and Sustainable Cities	OT	3

Contact

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Teaching groups languages

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

Prerequisites

Many of the bibliography of the subject is in the English language, so the student should be able to at least read in that language.

Objectives and Contextualisation

In recent years, remote sensing has became a basic tool in geographic analysis thanks to the systematic availability of satellite images and, increasingly, aerial images, whether from aircraft or, lately , from UAV devices like drones. The discipline has experienced a spectacular evolution since the first images available for civil use in the early 1970s to the present day. Nowadays there are many orbiting sensors around the earth's surface that allow us to analyze it in a way never seen. In this sense, the subject represents an interesting opportunity to understand the scope of Remote Perception as a discipline.

In the course, it is not intended to train in a specific software. The message is that in the case of a case of use, the student must know (or learn if necessary) the necessary concepts, understand what strategies it is appropriate to apply and know what tools are available. With this in mind, the maturity of the case of use will allow you to find out what features you need in each situation and choose or adapt to the possibilities that you will find at each moment and place of the future development of your activity.

Among the objectives presented in the course, which are both theoretical and practical, we should highlight:

- Know the main platforms and sensors available in Remote Sensing. This objective will be achieved through theoretical discourse, the study and a search exercise to be carried out by the students.
- Understand the nature of multispectral images and the characteristic response of the main types found in the soil. The theoretical discourse will be dressed with a series of examples from the most conceptual point of view (spectral band, spectral signatures, electromagnetic spectrum), as practical (evaluation and interpretation of spectral signatures of different covers, false color composites, etc). The practical part of the subject, then, will begin with the definition of the legend and the demonstration of the spectral separability of differentground coverings.
- Know how to perform the basic treatment of the images, from their acquisition to their exploitation for categorical thematic cartography. This objective will be achieved in several cases applied until the determination of the thematic accuracy of the obtained cartography and through careful editing of the final maps.
- Learn examples applied in urban environments: land use and land cover, heat islands, air quality, etc.

Competences

- Design platforms of management, integration of public and government services applying technologies and systems of sensorization, acquisition, processing and communication of data.
- Generate innovative and competitive proposals in professional activity.
- Identify and use the different ways of acquiring and managing geographical information to carry out regional interpretations and, in particular, interpretations of maps and images of the observation of the earth.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.

Learning Outcomes

1. Be aware of how to use images deriving from remote sensors.
2. Describe the operating principles, benefits, sources of error and components in a location system based on radio-frequency signals by satellite and land.
3. Distinguish the main platforms and sensors available.
4. Generate innovative and competitive proposals in professional activity.
5. Identify and use geoprocess functions for the distinct needs of a project aimed at the management of cities.
6. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
7. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.

Content

The various aspects to be developed in the subject are:

1. Overview of Remote Sensing.
2. The electromagnetic spectrum and the spectral signatures.
3. Remote sensing basic concepts: spatial, radiometric, spectral and temporal resolution.
4. Types of platforms and sensors. Main satellites and sensors.
5. Nature of the images. Formats. Elemental notions of geometric and radiometric corrections.Calculation of vegetation indices. Use of digital terrain models.
6. Reading and interpretation of satellite images in digital format.
7. Techniques of digital classification. Verification of results. Final cartographic refinement. Post-classification techniques.
8. Remote sensing applications for urban areas.

The application in practical cases will be developed throughout the course, in an integrated way in the various subjects covered in the course.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			

Approach to the objective and method of solving the practices	15	0.6
Exposure of basic concepts	35	1.4
Practices carried out autonomously by the students	30	1.2
Type: Supervised		
Guided resolution of the practices in the computer lab	20.5	0.82
Type: Autonomous		
Preparation and presentation of results	15	0.6
Study of theoretical material	30	1.2

The contents of the subject will be developed through the following activities:

- Oral presentations and documentation and reading guides presented by the teacher.
- Reading of chapters of books or articles (individual activity of the students complementary to the classroom work).
- Teacher-guided class practices and practice development guides provided by the teacher.
- Practices carried out autonomously by the students based on proposals from the teachers.

For the accomplishment of the subject specific free software will be used: MiraMon and Google Earth Engine.

The preferred communication channel with students will be before, during and after face-to-face lectures, by email and scheduled tutorials when necessary. The virtual platform is the moodle site of the subject.

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
Practical exams	20%	1.5	0.06	1, 2, 3, 4, 5, 6, 7
Practical exercises	30%	0	0	1, 2, 3, 4, 5, 6, 7
Preparation and presentation of personal projects, or Article comments	10%	0	0	4, 6
Theoretical exams	40%	3	0.12	1, 2, 3, 4, 5, 6, 7

The evaluation activities are:

- Small theoretical exams (40% of the grade) and small practical exams (20% of the grade), taken throughout the course, in the form of a truly continuous assessment. These exams will be in person,

short (approximately 30 ') and will be carried out at the beginning of the class, regularly between fortnightly and monthly to check that there is a progress in the study and understanding of the topics of the course. Then is is consolidated as needed in the classroom with the teacher also through practical exercises. In addition, the results of the micro-assessments are obtained almost immediately, which allows the student to have a very fine control of how the course is advancing. This brings us closer to a flipped classroom teaching strategy, in which students do not have to prepare for partial or final exams because they prepare classes in advance, self-assessing themselves continuously and consolidating in the classroom, resolving doubts and tackling all kinds of practical exercises (but based on a good knowledge of theory).

- Practical exercises delivered throughout the subject (30% of the grade) individual or in group of maximum two people. Comments on articles (mandatory attendance) or Preparation and presentation of works (10%).

The subject is passed with a 5. The student who has presented less than 20% of the requested works as one that has not been submitted to any of the theoretical-practical tests will be considered "not assessable". The mark of the students qualified with "Fail" when they have not reached the minimum mark in some evaluative activity will be considering the mark obtained.

The re-evaluation will be of the theoretical and practical exams, within the dates stipulated for that purpose by the Faculty. The review of grades for each assessment activity is done by writing an email to the responsible teacher in order to specify the date and time.

No differentiated treatment isconsidered for repeat students.

Honor grades needs 9.1 or higher qualification. Moreover, it needs to verify the rest of the conditions that depend on the number of students enrolled in the subject

The copying or plagiarism of material, both in the case of works and in the case of examinations, constitute a crime that will be sanctioned with a zero to the activity. In the case of recidivism, the entire subject will be suspended. Let's remember that a "copy" is considered a work that reproduces all or most of the work of one or more partners. "Plagiarism" is the fact of presenting all or part of an author's text as its own, without citing the sources, whether in paper or in digital format. See UAB documentation on "plagiarism" at: http://wuster.uab.es/web_argumenta_obert/unit_20/sot_2_01.html.

In the event of a student committing any irregularity that may lead to a significant variation in the grade awarded to an assessment activity, the student will be given a zero for this activity, regardless of any disciplinary process that may take place. In the event of several irregularities in assessment activities of the same subject, the student will be given a zero as the final grade for this subject.

In the event that tests or exams cannot be taken onsite, they will be adapted to an online format made available through the UAB's virtual tools (original weighting will be maintained). Homework, activities and class participation will be carried out through forums, wikis and/or discussion on Teams, etc. Lecturers will ensure that students are able to access these virtual tools, or will offer them feasible alternatives.

Single evaluation: This subject does not foresee a single evaluation system.

Bibliography

Books and cartography:

- Arbiol, R., O. Viñas, J.M. Camarasa i V. Palà (1986). "Mapa d'usos del sòl de Catalunya a partir de dades del satèl·lit Landsat-2". Institut Cartogràfic de Catalunya. Barcelona. 154 pàgs. + 1 mapa.
- Barret, E. C. i L. F. Curtis (1999). *"Introduction to Environmental Remote Sensing".* Cheltenham, Stanley Thornes Publishers Ltd.
- Campbell, J. B. i Wynne, R. (2011). *"Introduction to Remote Sensing",* New York, The Guilford Press. 667 pàgs. 5ª edició.
- Chuvieco, E. (2010). *"Teledetección Ambiental",* Barcelona, Ariel. 592 pàgs. 3ª edició.

- Colwell, R.N. (1983). *"Manual of Remote Sensing".* American Society of Photogrammetry. Falls Church. Virginia. 2 vol.
- Conway, E. D. (1997). *"An introduction to satellite image interpretation",* Baltimore, John Hopkins University Press.
- Cracknell, A. P. i L. W. B. Hayes (2007). *"Introduction to Remote Sensing",* London, CRC Press, Boca Ratón. 335 pàgs. 2ª edició (1ª edició de 1991).
- Díaz-Delgado, R., Lucas, R. and Hurford, C. (Eds.) (2017). "*The Roles of Remote Sensing in Nature Conservation. A Practical Guide and Case Studies"*. Springer International Publishing AG2017. Pp. 318. Springer, Cham, Switzerland.
- Emery, W. i A. Camps (2017). "*Introduction to Satellite Remote Sensing. Atmosphere, Ocean, Land and Cryosphere Applications*". Elsevier. 860 pàgs.
- Fra, U. (2011). *"Diccionari terminològic de fotogrametria"*. Barcelona: Institut Cartogràfic de Catalunya: Enciclopèdia Catalana. 351 p
- Girard, M.C. i C.M. Girard (1999). *"Traitement des données de télédétection".* Dunod. Paris. 529 pàgs. ISBN 2-10-004185-1.
- Gandía, S. i J. Melià (1991). *"La teledetección en el seguimiento de los fenómenos naturales. Recursos renovables: Agricultura".* Departament de Termodinàmica. Universitat de València.
- Institut Cartogràfic de Catalunya (1992) *"Mapa d'usos del sòl de Catalunya"*. Institut Cartogràfic de Catalunya. Barcelona. 118 pàgs. + 20 làmines + 1 mapa.
- Jensen, J.R. (2016). *"Introductory Digital Image Processing. A Remote Sensing Perspective".* Prentice Hall. Englewood Cliffs. 656 pàgs. 4ª edició.
- Lillesand, T.M., R.W. Kiefer i J. Chipman (2015). *"Remote Sensing and Image Interpretation"*. John Wiley & Sons. N.Y. 736 pàgs. 7ª edició.
- Mather, P.M. i M. Koch (2010). *"Computer Processing of Remotely-Sensed Images"*. J. Wiley & Sons. Chichester. 460 pàgs. 4ª edició.
- Nunes, J. (2012). *"Diccionari terminològic de sistemes d'informació geogràfica".* Enciclopèdia Catalana i Institut Cartogràfic de Catalunya, Barcelona. 551 p.
- Paine, D. i J. Kiser. (2003). *"Aerial Photography and Image Interpretation".* J. Wiley & Sons. Chichester. 648 pàgs. 2ª edició.
- Pinilla, C. (1995). *"Elementos de Teledetección Espacial".* Madrid, RA-MA.
- Pons, X., Arcalís A. (2012). *"Diccionari terminològic de Teledetecció".* Enciclopèdia CatalanaiInstitut Cartogràfic de Catalunya, Barcelona. 597p. Disponible online: http://www.termcat.cat/ca/Diccionaris_En_Linia/197
- Rabella, J.M., Panareda, J.M., Ramazzini, G. (2011). *"Diccionari terminològic de cartografia".* Enciclopèdia Catalana i Institut Cartogràfic de Catalunya, Barcelona. 417 pàgs.
- Rees, W.G. (2012) "Physical principles of remote sensing", Cambridge University Press. Cambridge. 3ª edició. 492 pàgs.
- Richards, J. A. i X. Xia (2005). *"Remote Sensing Digital Image Analysis. An Introduction".* Berlin, Springer-Verlag. 439 pàgs. 4ª edició.
- Schowengerdt, R. A. (2006). *"Remote Sensing. Models and methods for image processing".* San Diego, California, Academic Press. 560 pàgs. 2ª edició.
- Sobrino, J. A. (Ed.) (2000). *"Teledetección".* València, Servei de Publicacions, Universitat de València.
- Ustin, S. (Ed.) (2008). *"Remote Sensing for Natural Resource Management and Environmental Monitoring".* (Manual of Remote Sensing - Third Edition), Wiley and American Soc. of Photogrammetry and Remote Sensing. New York. 768 p.

Main scientific journals (online):

- *Remote Sensing of Environment*. Elsevier Science Publishing Co. Inc.
- *IEEE Transactions on Geoscience and Remote Sensing*. Institute of Electrical and Electronics Engineers. També editen *IEEE Geoscience and Remote Sensing Letters*, amb articles més curts i una més ràpida dinàmica de publicació.
- *Photogrammetric Engineering & Remote Sensing*. American Society for Photogrammetry andRemote Sensing.
- *International Journal of Remote Sensing*. Taylor & Francis Ltd.
- *ISPRS Journal of Photogrammetry and Remote Sensing*. International Society for Photogrammetry and Remote Sensing.

- *International Journal of Applied Earth Observation and Geoinformation*. Elsevier Science Publishing Co. Inc.
- *Remote Sensing*. MDPI
- *Revista de Teledetección* de la Asociación Española de Teledetección.
- *GeoFocus* de la Asociación de Geógrafos Españoles

Software

MiraMon. Geographic Information System and Remote Sensing software. 1994-2023.

The version to be used is the desktop one for Windows (64 and 32 bits), freely downloadable from https://www.miramon.cat/Index_usa.htm and also available in the classroom.

Web based application to Google Earth Engine platform. Free with Google account.

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	611	Catalan	second semester	afternoon
(PLAB) Practical laboratories	611	Catalan	second semester	morning-mixed
(TE) Theory	61	Catalan	second semester	afternoon