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MASTER European Innovations for a Sustainable Management of Albanian Territories, Rural Areas and Agriculture: Instruments, policies, strategies

Module description
D3.3 v.2

Module 7
Data administration and geoinformatic tools

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CIHEAM MONTPELLIER · MUSE · UK FAN S. NOLI · Universiteti Europian i Tiranës · Université Paul Valéry Montpellier 3

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1. *Description of the module - objectives, and procedures*

1.1. OBJECTIVES OF THE MODULE

The module aims to provide students an introduction to the basic knowledge and concepts of geographic information systems (GIS) and Earth Observation (EO). It is designed to provide an understanding of GIS& EO data acquisition and handling from theory to practice, demonstrating also the different types of geospatial data in solving practical problems in a range of thematic areas. Simultaneously, the course will support the development of key skills of the participants relevant to group working, presentation and assignments preparation.

1.2. LEARNING OUTCOMES

On successful completion of this module students should be able to:

1. Describe and explain the underlying concepts of manipulating and representing spatial data
2. Select and apply appropriate techniques for the collection and processing of geographic spatial data in various forms within a GIS
3. Identify, for particular applications, the most appropriate remote sensing datasets.
4. Independently using remote sensing software for the analysis of different types of Earth Observation datasets
5. Implement approaches to the derivation of products from remote sensing data (e.g., vegetation indices and thematic maps of land use/covers).
6. Undertake field studies to support the interpretation and analysis of remote sensing data.
7. Be able to apply a classification of remote sensing imagery

1.3. DESCRIPTION OF THE MODULE

In this module the students will find information on the following issues (a short explanation for each topic that is going to be discussed):

Topic 1: Introduction to GIS.Vector-raster. QGis and other GIS software

Topic 2: Vector-Raster data analysis.Import geospatial data,geometric correction data,digitizing

Topic 3: Database and cartography. Database join, maps creating

Topic 4: Spatial analysis. Query builder, geometric operations (buffer zones, clip etc)

Topic 5: Digital elevation model (DEM), slope, aspect, Visualization (3D Mapping)

Topic 6: Spatial Interpolation methods

Topic 7: Introduction to remote-sensing principles & different types of EO data

Topic 8: Radiometric Indices from EO data. Vegetation Indices (NDVI, Burning ration index, Leaf area index)

Topic 9: EO imagery classification techniques and change detection analysis

Topic 10: Revision Lecture and exams preparation

1.4. PREREQUISITES

To complete the module successfully participants required to have basic knowledge of the following topics:

- on maps and data analysis,
- on natural resource planning,
- basic computing skills.

1.5. STUDENTS OBLIGATIONS AND THE EVALUATION METHOD:

Assessment of the module is based on the submission of an assignment (submitted at the end of the module) and of written final exam (also at the end of the module), as summarized below:

Nb.	*(the evaluation grid is only indicative, the pair of lecturers will decide of the final module evaluation grid)*	Evaluation in %	Maximal amount
1	Participation to teaching hours	%	0
2	Mid-term exams	%	0
3	Individual research work	%	50
4	Final exam (written)	%	50

1.6. REQUESTS TO THE STUDENT

A. Theoretical skills

B. Practical skills

1.7. EVALUATION OF LEARNING (calculation of ECTS)

Nb.	Learning elements	Work (hours)
I	*Learning elements (in the institution)*	
	Theoretical class	30
	Practical class	20
	Individual or team assignments	22
	Midterm exams	3
	Total I	75
II	*Individual work from the students*	
1	Individual work	70
2	Preparation for the exams	5
	Total II	75
	Total (I+II)	150/250
	Numbers of ECTS	6/10

2. Calendar of the module

Week/date	Theoretical/ practical class	Teaching materials/ literature
I	GIS theory QGIS & other GIS Source Software	• Geographic Information Systems and Science by P.A. Longley, M.F. Goodchild, D.J. Maguire, D.W. Rhind, 2nd edition, 2004 • GIS Commons: An Introductory Textbook on Geographic Information Systems, by Michael Schmandt, 2017 • QGIS User guide – QGIS Training manual. Access: https://www.qgis.org/en/docs/index.html • A Gentle Introduction to GIS, by T. Sutton, O. Dassau, M. Sutton, 2009.Access: https://download.osgeo.org/qgis/doc/manual/qgis-1.0.0_a-gentle-gis-introduction_en.pdf • Principles of Geographic Information Systems, An introductory textbook, by Otto Huisman and Rolf A. De By, 2009. Access :https://webapps.itc.utwente.nl/librarywww/papers_2009/general/principlesgis.pdf • Introducing geographic information systems with ArcGIS: a workbook approach to learning GIS. Book by Michael Kennedy 2013 Further reading.
II	Import geospatial data Geometric-Correction Raster Data	
III	Digitizing	
IV	Databases - join	
V	Creating Maps	
VI	Query Builder	
VII	Geometric Operations (buffer, clip….)	
VIII	DEM, Slope, Aspect	
IX	3D-Visualizations	
X	Spatial interpolation methods	
XI	Introduction to Remote Sensing	• Remote sensing and image interpretation, by Thomas M. Lillesand; Ralph W. Kiefer; Jonathan W. Chipman, 2015
XII	Vegetation Indices – Burning Ratio Index, Normalized difference vegetation (NDVI), Leaf area index(LAI).	• Remote sensing of vegetation: principles, techniques, and applications, by Hamlyn G. Jones; R. A. Vaughan 2010
XIII	Image Classification & Change Detection	• Introduction to the physics and techniques of remote sensing, by Charles Elachi, c1987

3. Content of the module

The module will provide an introduction and background to the concepts of geographical information systems (GIS) and of Earth Observation (EO), including theory and principles as well as practical experience in entering, manipulating, analysing and interpreting spatial data. Furthermore, the module will introduce students to EO data and processing, with data acquired by a range of remote sensing sensors. In this context, it is briefly introduced the background theory and focuses also on applications of remotely sensed data across a broad range of environmental disciplines.

The module has a strong focus on the practical implementation of GIS and EO imagery analysis. It is expected that following the module completion students will be comfortable to handle a variety of geospatial data using GIS software and remote sensing image packages, skills useful to be implemented later on in a wide range of geographical disciplines. Following the module completion, students should also be able to undertake basic analysis of remotely sensed data and be in a position to be an intelligent customer for acquiring expert services in remote sensing for future employers in a wide range of research activities and practical applications alike.

4. Planning of the practical teaching classes

Week/date	Practical class	Teaching materials/ literature
I	Introduction on GIS and GIS software tools	• QGIS User guide – QGIS Training manual https://www.qgis.org/en/docs/index.html • QGIS Training material https://www.qgis.org/en/site/forusers/trainingmaterial/index.html • Geographic Information Systems and Science by P.A. Longley, M.F. Goodchild, D.J. Maguire, D.W. Rhind, 2nd edition, 2004 • A Gentle Introduction to GIS, by T. Sutton, O. Dassau, M. Sutton, 2009. Access: https://download.osgeo.org/qgis/doc/manual/qgis-1.0.0_a-gentle-gis-introduction_en.pdf
II	Importing and Displaying data. Geodata processing and coordinate systems	
III	Create new geospatial data by digitizing	
IV	Manipulate database and join different databases	
V	Creating Maps	
VI	Spatial analysis procedures (Query Builder)	
VII	Geometric Operations (buffer, clip….)	
VIII	Create digital elevation models (DEM) and their products (slope, aspect)	
IX	Spatial interpolation methods on raster geospatial data. Example data to create raster maps (IDW and TIN).	• Principles of geographical information systems, by P. A. Burrough; Rachael McDonnell; P. A. Burrough, 1998 • Introduction to geographic information systems, by Kang-Tsung Chang, 201
X	Earth Observation: introduction to the principles and different sensor and platform types (Satellite & Drone)	• Remote sensing and image interpretation, by Thomas M. Lillesand; Ralph W. Kiefer; Jonathan W. Chipman, 2015
XI	Indices: (i) Vegetation indices (Normalized difference vegetation (NDVI); (ii) biophysical indices (Leaf Area Index LAI)	• Measurements for terrestrial vegetation, by Charles D. Bonham, 2013
XII	Image Classification techniques on EO data & Change detection approaches	• Remote sensing and image interpretation, by Thomas M. Lillesand; Ralph W. Kiefer; Jonathan W. Chipman, 2015
XIII	Revision	
XIV	Fieldwork	
XV	Field work	

5. Coursework

Coursework: laboratory skills report based on analysis of Remote Sensing and GIS datasets (3000 words)

6. Individual research project (if applied)

Preparation of the land cover map for the Agricultural University of Tirana (AUT) campus using satellite data and validation of the map.

DELIVERABLES DESCRIPTION

Each Topic consists of the lectures and the exercises. The zip files contain lectures, tutorials and all the necessary spatial data (Geospatial_Data.zip) in order to be implemented the practical part. Moreover, free literature (GIS_Bibliography.zip) are provided.

Topics	Theoretical(Lectures)	Practical (Tutorials)	Associated pedagogic material
Topic 1: Introduction to GIS. Vector-raster. QGIS and other GIS software	-Introduction to GIS. Basic Concepts	-Exploring QGIS Interface	Topic1_Introduction.zip Geospatial_Data.zip GIS_Bibliography.zip
Topic 2: Vector-Raster data analysis. Import geospatial data, geometric correction data, digitizing	-GIS Functionality & -Map Projections & Coordinate Systems	-Georeferencing scanned map in QGIS -QGIS Digitizing	Topic2_DataAnalysis.zip
Topic 3: Database and cartography. Database join, maps creating.	-Databases & Maps -Thematic Mapping	-QGIS Database: Create new Fields -QGIS Database: Join tables -QGIS: Map Creation	Topic3_DatabaseCartography.zip
Topic 4: Spatial analysis. Query builder, geometric operations (buffer zones, clip etc).	-Spatial Analysis	-Functions of Spatial Analysis -Proximity Analysis	Topic4_SpatialAnalysis.zip
Topic 5: Digital elevation model (DEM), slope, aspect, Visualization (3D Mapping).	-Digital Elevation Models& 3D Mapping	-QGIS: Digital Elevation Model (DEM) & 3D Representations	Topic5_DEM.zip
Topic 6: Spatial Interpolation methods.	-Spatial Interpolation	- Spatial interpolation surfaces in ArcMap environment	TOPIC 6 (Interpolation).zip
Topic 7: Introduction to remote-sensing principles & different types of EO data	-Introduction to Remote Sensing	- Introduction to ENVI and simple image manipulation	TOPIC_7 (Intro to RS).zip
Topic 8: Radiometric Indices from EO data. Vegetation Indices (NDVI, Burning ration index, Leaf area index).	- Radiometric Indices	- NDVI-Based Change Detection	TOPIC_8 (Vegetation Indices).zip
Topic 9: EO imagery classification techniques and change detection analysis.	-Classification & Change detection	-Change Detection	TOPIC_9 (Classification and change detection).zip