Co-funded by the
Erasmus+ Programme
of the European Union

Environmental Management in the Middle East (EMME): Spatial Methods

Course Syllabus

Course title

SDI-T for environmental change monitoring

Course ECTS credits: 10

Course hour distribution by methods of studies

Lectures	Exercises	Self-study	Seminar	Final project	Total
5 (video lectures)+25 (other materials)	83	77	14	76	**280**

Annotation of the course

This course is targeted to students of environmental studies, physical geography, engineering, landscape ecology, and sustainability of both undergraduate and graduate levels.

Aim of the course

This course aims at providing an in depth account of the use of GIS and RS as valuable resources for environmental change monitoring. Learners will be familiarized with concepts, techniques, algorithms, and tools to use in their professional endeavour for handling issues related to environmental management, e.g., detecting and measuring environmental variations. Students will also gain hands-on experience in designing field or laboratory based research projects to monitor environmental systems, making use of appropriate field, laboratory and measurement equipment.

Learning outcomes

On completion of the course, the student should be able to:
Knowledge and understanding

- Master GIS and RS concepts
- Understand environmental change monitoring issues (related to the ME)
- Know which GIS/ RS operations and functions are suitable for dealing with environmental applications
- Know which kind of data should be collected and how these should be analysed and processed with GIS/RS tools and applications to monitor environmental change
- Interpret charts, maps, diagrams, data relations

Skills and abilities

- Creatively apply and integrate new knowledge (models/ analysis techniques) for environmental change
- Collect, analyse, and process data
- Use RS/GIS tools and applications
- Plan and conduct field work
- Plan and run project-based activities

Critical judgement and evaluation

- Evaluate data quality, adequacy, and appropriateness
- Evaluate models' effectiveness
- Judge on severity of environmental change
- Apply effective methods and applications towards providing proper solutions on environmental change monitoring
- Validate proposed solutions by applying and evaluating them

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Methods of course studies (*Educational approach*)

The course will follow a student-centred approach in order to encourage and empower individual learning through project-based learning, inquiry-based learning, and problem-based learning (a two-week project along with small-scale exercises for the first 5 weeks), as well as an integrated approach combing theory and practice (applications and examples).

This 7-week course includes:

- for the first 5 weeks, an average of 6 hours of lectures (including video lectures and other material such as ppts, pdfs, youtube videos), per week.
- for the first 5 weeks, an average of 16-17 hours of exercises per week.
- self studies hours for the whole course are 77, not equally distributed, since weeks 2 and 3 are the more demanding (they constitute the core of the course) followed by 4 and 5.
- for the first 5 weeks, a total of 14 hours seminars (in the form of videos and other presentations, etc.).
- last two weeks constitute the project-based part of the course when students are expected to commit with 35 hours of individual work per week.

Methods for the assessment of student achievements (*the formula and the definition of the cumulative score)*

Exercises: 40%
Final Project (includes a report and a presentation): 60%

Study subject modules to be completed before this Course studies (*Prerequisites*)

Basic knowledge of mathematics, geography, physical processing, environmental protection.
Basic skills of Information Technologies.

Tentative Schedule (lectures)

Date	Topic	Objectives
Week 1	**1 Environmental Change Monitoring (LU)** 1.1 General Concepts (NTUA) 1.1.1 Pollution 1.1.2 Land use management 1.1.3 Ecology 1.1.4 Natural resources monitoring 1.2 GIS-related ECM (LU – David) 1.3 RS-related ECM (BASU - Yousef)	Introduction to Environmental Change Monitoring
Week 2	**2 GIS & Geovisualization (NTUA)** 2.1 Introduction to GIS and Geovisualization (NTUA) 2.2 Models and structures - Advanced models and structures (3D, temporal) (NTUA) 2.3 Data acquisition (GPS, RS, field surveying) (ENSG – VGTU) 2.4 Precision and quality of data (NTUA) 2.5 Reference systems and transformations (VGTU) 2.6 Spatial Databases (ENSG) 2.7 Spatial analysis and modelling of phenomena (LU) 2.8 Geovisualization (cartography) (NTUA)	Introduction to GIS
Week 3	**3 Remote Sensing (VGTU)** 3.1 Electromagnetic radiation theories (VGTU) 3.2 Platforms and Sensors (VGTU, UL) 3.3 Data Acquisition (VGTU) 3.4 Preprocessing (Atmospheric and radiometric corrections) (BASU) 3.5 Multi-spectral signatures and classification algorithms (VGTU) 3.6 Orthophotomapping (ENSG)	Introduction to RS
Week 4	**4 Application of GIS/RS in ECM** 4.1 Land use change and management (forest, vegetation changes) (LU – BASU) 4.2 Ground water levels management (BASU) 4.3 Land degradation (Erosion/ desertification) (UT, SU, TU) 4.4 Droughts and Flood events (NTUA) 4. 5 Soil moisture estimation (BASU)	Apply GIS and RS to real-life environmental variations
Week 5	**4 Application of GIS/RS in EP** 4.6 Groundwater vulnerability assessment to pollution (NTUA) 4.7 Water and soil pollution caused by oil refining (UT, UL) 4.8 Air pollution / Dust storms (BASU) 4.9 Coastal management (IKIU, UL)	Apply GIS and RS to real-life environmental variations
Week 6	Project	Knowledge Integration
Week 7	Project	Knowledge Integration

Tentative Schedule (Exercises, Lab work/Self-studies)

Date	topic	Type*/objective
Week 1	Environmental Change Monitoring (SU, TU)	• Answering Questions • Literature Review on Environmental Change related to the ME • Requirement analysis for environmental change monitoring
Week 2	Geographic Information Systems (NTUA)	• Data acquisition exercise (ENSG, VGTU) • Digitization, raster-to-vector (NTUA) • Exercise using different data sources (with different CRS) (VGTU) • Import non-spatial data and join with spatial datasets - (Simple) SQL queries (ENSG) • Spatial analysis operations (LU)
Week 3	RS (VGTU)	• Copernicus data access online. Using sentinel 1 and Landsat or MODIS data – work with ESA SNAP Toolbox (VGTU, UL) • Mapping desertification using SAR Data (VGTU)
Week 4	Application of GIS/RS in ECM	One exercise per topic: • Land use change and management - Land cover classification and accuracy assessment (BASU) • Ground water levels management (BASU) • Land degradation (Erosion/ desertification) (**SU**, UT, TU) • Droughts and flood events - Flood plain mapping and simulation with ESA SNAP Toolbox (NTUA) • Soil moisture estimation (BASU)
Week 5	Application of GIS/RS in ECM	One exercise per topic: • Groundwater vulnerability assessment to pollution (NTUA) • Water and soil pollution (UL) • Air pollution - Dust storms (BASU) • Coastal management (UL)
Week 6	Final Project	
Week 7	Final Project	

* e.g. answering questions, collecting data, performing analysis, writing codes, etc.

Tentative Schedule (Seminar, Project)

Date	topic	Type*/objective
Week 1	Seminar (LU, UT)	• Listening to relevant institutions in the respective countries, knowing the problems, figuring out possible solutions,

		● actively discuss the topics of interest (UT, BASU, IKIU, SU, TU) ● Identify the data sources and data relevant to environmental issues and variations (UT)
Week 2	Seminar	● QGIS Seminar (ENSG, UL)
Week 3	Seminar	● Environmental applications and solutions worldwide (NTUA)
Week 4	Seminar	● Environmental applications and solutions worldwide (ENSG)
Week 5	Seminar	● Introduction to emGeo and IMSEP web platforms (LU)
Week 6	Final Project (UT, IKIU, BASU, SU, TU)	● Environmental change monitoring project integrating a variety of environmental issues exposed in the previous weeks of the course: o flood assessment / prediction, o flood damage estimation o land use/cover planning, o urban sprawl, o urban heat island, o soil moisture estimation, o creating isometric maps, o dust storm detection o forest change detection ● The objective is to make students plan and conduct a project by integrating knowledge gained previously during the course.
Week 7	Final Project (UT, IKIU, BASU, SU, TU)	● same as above

Main bibliography (no more than 3 sources)

No.	Publication authors, year of issue, name, place of issue, publisher, (address of electronic publications and website)
1	Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind, Geographic Information Systems and Science, 2015
2	Campbel J.l, Shin M., Essentials of Geographic Information Systems, 2011, Saylor Foundation (https://www.saylor.org/site/textbooks/Essentials%20of%20Geographic%20Information%20Systems.pdf)
3	Fundamentals of Remote Sensing, A Canada Centre for Remote Sensing Remote Sensing Tutorial, 2016, http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/resource/tutor/fundam/pdf/fundamentals_e.pdf

Additional bibliography (no more than 10 sources)

No.	Publication authors, name, place of issue, publisher, year of issue (address of electronic publications and website)
1	Koushen Douglas Loh and Sasathorn Tapaneeyakul (August 1st 2012). GIS for Environmental Problem Solving, Sustainable Development Sime Curkovic, IntechOpen, DOI: 10.5772/50098. Available from: https://www.intechopen.com/books/sustainable-development-authoritative-and-leading-edge-content-for-environmental-management/gis-for-environmental-problem-solving
2	András Zlinszky, Hermann Heilmeier,, Heiko Balzter, Bálint Czúcz, and Norbert Pfeifer, Remote Sensing and GIS for Habitat Quality Monitoring: New Approaches and Future Research, Remote Sens. 2015, 7, 7987-7994;

	doi:10.3390/rs70607987 remote sensing ISSN 2072-4292 www.mdpi.com/journal/remotesensing
3	de Leeuw J., Georgiadou Y., Kerle N., de Gier A., Inoue Y., Ferwerda J., Smies M., and Narantuya D., The Function of Remote Sensing in Support of Environmental Policy, Remote Sens. 2010, 2(7), 1731-1750; doi:10.3390/rs2071731, http://www.mdpi.com/2072-4292/2/7/1731/htm
4	A Guide to GIS Applications: in Integrated Emergency Management" Publ. by Emergency Planning College
5	Gajos M. Sierka E., (2012): GIS Technology in Environmental Protection: Research Directions Based on Literature Review, Polish Journal of Environmental Studies, vol.21 (2), pp. 241-248
6	Jelokhani-Niaraki M., Sadeghi-Niaraki A., Choi S. M., (2018): Semantic interoperability of GIS and MCDA tools for environmental assessment and decision making, Environmental Modelling & Software, vol. 100, pp. 104-122
7	Berry J. K. (2000): GIS TECHNOLOGY IN ENVIRONMENTAL MANAGEMENT: A Brief History, Trends and Probable Future, [invited book chapter in Handbook of Global Environmental Policy and Administration, edited by Soden and Steel, Marcel Dekker, 1999, ISBN: 0-8247-1989-1]
8	**BOOK** - Barrow C. J. (2006): Environmental Management for Sustainable Development, 2nd Edition, Taylor & Francis Group

Required IT Resources

No.	*Name of the software, manufacturer*	*License type*
1	General GIS/RS software (QGIS, QGIS for RS, SNAP ...)	OPEN/Free
2		
3		
4		

Course completed by

(Signatures)

(Signatures)

Project Coordinator

(Signature)

Confirmation

The module certified by	Faculty of ....., University of		
Chairman of the studies committee (full name, signature)		**Date**	