

# **Geoinformation in Environmental Management**

Organized by

Mediterranean Agronomic Institute of Chania

# Geoinformation in Environmental Management

**MAI coordinator:** Dr. Ioannis MANAKOS

**Aims:** The programme of Environmental Management focuses on the ever growing demand for highly specialized and effectively educated scientists to tackle significant environmental issues in today's natural environment, agro-environmental issues and land use functions. Graduates, professionals and specialists from the Mediterranean and Balkan region majoring in a compatible discipline and background knowledge on Environmental issues have the opportunity to specialize on (a) Geographical Information Systems and Remote Sensing, their application to Environmental Management and other problems related to Environment, (b) Utilization of quantitative and decision support tools to strategic and environmental impact assessment within the environmental policy and legislative framework of the European Union. The attainment of the M.Sc. degree qualifies them with in depth academic knowledge and practical skills in Environmental Management, which enable a successful continuation of their doctorate studies and/or pursue of an international career in both the public and private sector.

**Objectives:**

- To provide a basis or opportunity for originality in developing or applying ideas while addressing a research hypothesis connected to decision support for environmental issues;
- To apply knowledge and understanding in solving real life problems in a multidisciplinary context, such as a strategical environmental assessment or the management of Mediterranean ecosystems require;
- To demonstrate the ability to integrate knowledge of the natural processes, and the environmental legislation and policy, handle complex geo-information technologies, and formulate judgments, even with incomplete raw data;
- To communicate their conclusions and the underpinning knowledge and rational addressing different audiences; in ways that enable the discussion with specialists or raise the interest of non-specialist audiences;
- Study under the supervision of specialized tutors that promote self-initiatives and autonomous handling while dealing with the research topic.

# Part 1

## Post graduate specialization programme

The programme is organized in 6 Units (60 ECTS)

**Unit I**  
04 to 22 Oct'10

### **ENM 510 INTRODUCTION TO STATISTICS (6 ECTS)**

**Components:**

- 510.1 Statistics
- 510.2 Spatial Statistics – Theory

**Learning outcomes:**

- a) Understand randomness and probability and their roles and rules and why they are necessary in statistics.
- b) Understand and visualize via simulation the idea of the sampling distribution of a statistic.
- c) Understand and master the basis of statistical inferences (both in the form of confidence interval and hypothesis testing) for a single population parameter(s).
- d) Understand and master the basis of statistical inferences (both in the form of confidence interval and hypothesis testing) when comparing two population parameters.
- e) Understand and master the inference in Simple Linear Regression and also learn how to expand the comparisons between two population means to several population means via the ANOVA model.
- f) Point out the differences between classical and spatial statistics
- g) Demonstrate a working knowledge of analytical methods relevant for analyzing (statistically) geographical data.
- h) Suggest appropriate decision support and analytical techniques for case studies (real life problems with geographical data) described and justify their choice.
- i) Apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to the field of Spatial Statistics.
- j) Have the learning skills to allow them to continue to study in more advanced topics in Spatial Statistics.

**Unit II**  
25 Oct. to  
03 December'10

### **ENM 520 SUSTAINABILITY AND THE ENVIRONMENT (12 ECTS)**

**Components:**

- 520.1 Environment, Ecosystems Processes and Issues
- 520.2 Environmental Legislation
- 520.3 Management of Grazing and Forest Resources and Landscapes
- 520.4 Sustainable Water Resources Management

**Learning outcomes:**

- a) Develop the ability to recognise basic ecosystems types.
- b) Improve the understanding on ecosystems process.
- c) Evaluate the potential impacts of anthropogenic activities upon ecosystem processes.
- d) Develop the ability to incorporate specific environmental patterns and processes into management.
- e) Learn to develop system-dynamics modelling approaches, parameterize models in order to apply them to specific case studies and answer specific questions.
- f) Demonstrate a basic knowledge on how to look up and understand the main features of legal texts concerning the integration of environmental protection in various areas of development.
- g) Distinguish between legally mandatory requirements of international and European legislation and the national margin of appreciation in environmental matters.
- h) Knowledge of the peculiarities of Mediterranean natural resources and landscapes.
- i) Ability to evaluate land use changes in Mediterranean landscapes
- j) The students will be able to identify and assess problems related to the quality of soil and water resources.
- k) They will be able to integrate knowledge, handle complexity, and formulate judgements for the sustainable management of soil and water resources.
- l) They will have the scientific background, the necessary skills and competences to develop integrated management plans and provide solutions and management measures at both riverbasin and local scale.

**Unit III**  
06 Nov'10 to  
04 February'11

**ENM 530 REMOTE SENSING AND GIS ANALYSIS TECHNIQUES  
(12 ECTS)**

**Components:**

530.1 Remote Sensing – Theory  
530.2 Geographical Information Systems  
530.3 GIS Applications  
530.4 Digital Image Analysis

**Learning outcomes:**

- a) Enhance understanding in Remote Sensing and develop capacity for critical thinking and utilizing its tools in various disciplines.
- b) Ability to theoretically tackle with and plan Remote Sensing applications in Geosciences.
- c) Understand the basic spatial data concepts within GIS.
- d) Use various GIS software packages / understand basic GIS functionality.
- e) Integrate different spatial data in GIS context in order to complete complex real world applications.
- f) Create maps as GIS outputs.
- g) Identify and implement GIS applications.
- h) Use advanced GIS functionality for spatial analysis.
- i) Thorough understanding of Earth Observation imagery.
- j) Adequate skills in using imaging software.

**Unit IV**  
07 February to  
19 March'11

**ENM 540 INTEGRATED GIS/RS APPLICATIONS (12 ECTS)**

**Components:**

- 540.1 Basic Geodesy & Digital Photogrammetry
- 540.2 Remote Sensing Applications
- 540.3 Integrated GIS/RS Case Studies
- 540.4 Advanced Methods in Remote Sensing Analysis

**Learning outcomes:**

- a) During the course the students have learned to refer an aerial or satellite image to ground space and make all the appropriate preparation to make an accurate Digital Map using stereoscopic frame camera images or satellite scenes.
- b) The students will be able to guide a surveyor to take measurements of a land region, acquire the appropriate imagery and perform a photogrammetric project outcomming digital mapping products and solutions.
- c) Overview of potential applications of remote sensing in environmental management.
- d) How digital image analysis techniques can be applied on satellite imagery in order to produce thematic information needed in environmental management.
- e) Be familiar with advanced remote sensing methodologies including benefits and limitations.
- f) Have an overview of potential applications of these techniques in environmental monitoring.

**Unit V**  
21 March to  
06 May'11

**ENM 550 ENVIRONMENTAL ASSESSMENT, PLANNING & MANAGEMENT (9 ECTS)**

**Components:**

- 550.1 Strategic Environmental Assessment
- 550.2 EIA Theory and Process
- 550.3 Decision Support Using GIS

**Learning outcomes:**

- a) Demonstrate a working knowledge of analytical methods relevant for environmental planning decisions.
- b) Demonstrate a working knowledge of SEA procedures.
- c) Identify and include relevant qualitative as well as quantitative data in decision processes in a way that demonstrates an appreciation of the need to communicate issues such as uncertainty and quality.
- d) Demonstrate a working knowledge of EIA procedures.
- e) Suggest appropriate decision support and analytical techniques for the case study described and justify their choice.
- f) Demonstrate good team-working, presenting and report writing skills as part of the case study.

Unit VI  
09 May to  
10 June'10

## **ENM 560 QUANTITATIVE METHODS FOR ENVIRONMENTAL ASSESSMENT (9 ECTS)**

### **Components:**

- 560.1 Quantitative Analysis of Mediterranean Ecosystems
- 560.2 Environmental Cost Benefit Analysis
- 560.3 Spatial Statistics - Practice

### **Learning outcomes:**

- a) Demonstrate a working knowledge of analytical methods (clustering, ordination, information theory, fuzzy set theory and permutation techniques) relevant for quantitative integrated assessment of landscape and for definition of landscape changes.
- b) Demonstrate a working knowledge of landscape data integration procedures and to find correlation between different data sets.
- c) Suggest appropriate analytical techniques for defining and describing operational geographic units (OGUs) and to measure their change along gradients (natural and of human impact).
- d) Demonstrate the ability to make sound choice among the available methods to make the integrated assessment of the Mediterranean landscape quality.
- e) Demonstrate a working knowledge of analytical methods relevant to environmental CBA and decision-making.
- f) Suggest appropriate decision support and analytical techniques for assessing environmental planning decisions using cost-benefit techniques.

13 to 17 June'11 **RETAKE EXAMS**

23 June'11 **ORAL EXAM**

### **EXAMINATIONS**

Participants take an examination at the end of each subunit. Examinations are in the form of a project presentation, or computer assisted exam, and/or written exam in classroom, including problems sets of questions, exercises, or multiple choice questions.

Participants may retake failed exams once, and up to 9 ECTS credits. No retake exams are allowed for Units for IV-VI and subunits that involve projects/assignments.

At the end of the 1<sup>st</sup> year program, participants take a comprehensive oral examination before an international jury.

*Language of instruction: ENGLISH*

### **ACADEMIC FACULTY WITHIN THE MSc PROGRAM**

The academic faculty within the MSc Program is selected according to the needs of the Program, which is dynamically changing according to the recent scientific developments and market trends, and the excellence of expertise of the potential invited lecturers to the specific topic. Specialization on the taught topic, international experience in teaching, and international recognition in the academic community, comprise major criteria for the selection of the faculty. Each invited lecturer's performance is evaluated against the set learning outcomes and the students' and supervisor's opinion every academic year. Lecturer's performance above the average is the crucial criterion for an invitation for the next year.

Following this procedure of fine tuning of the curriculum through the adjustment of the content of the Units according to the developments and needs of the society, and the choice of a more experienced and compatible with the curriculum academic faculty, for the last 20 years, a dedicated team of professors has been selected that addresses in the best way the needs of the Program, while at the same time the dynamic of change in persons and improvement is maintained into it.

Weeks	TITLE	INSTRUCTORS	WEIGHT	%	DATES
	<b>Unit I: ENM510 Introduction to Statistics - 6 ECTS</b>				<b>04/10/2010-22/10/2010</b>
1	510.1 STATISTICS	A. Mavromoustakos	3	50%	4-8/10/2010
2	510.2 SPATIAL STATISTICS - THEORY	T. Daras	3	50%	11-15/10/2010
3	EXAMS				18-22/10/2010
	<b>Unit II: ENM520 Sustainability and the Environment - 12 ECTS</b>				<b>25/10/2010-08/12/2010</b>
4	520.1 ENVIRONMENT, ECOSYSTEMS PROCESSES AND ISSUES (1 field trip)	A. Mazaris	4	35%	25/10 - Tue.02/11/2010
5	520.2 ENVIRONMENTAL LEGISLATION	M. Kouskouna	2	15%	Wed 3 - 5/11/2010
6	EXAMS				08-12/11/2010
7	520.3 MANAGEMENT OF GRAZING AND FOREST RESOURCES AND LANDSCAPES (1 field trip)	V. Papanastasis	3	25%	15-19/11/2010
8	520.4 SUSTAINABLE WATER RESOURCES MANAGEMENT	A. Psilovikos	3	25%	22 - Sat.27/11/2010
9	EXAMS				29/11-03/12/2010
	<b>Unit III: ENM530 Remote Sensing and GIS analysis Techniques - 12 ECTS</b>				<b>06/11/2010-04/02/2011</b>
10	530.1 REMOTE SENSING	I. Manakos	3	25%	06-10/12/2010
11	EXAMS				13-17/12/2010
12	EXAMPREPARATION				20-24/12/2010
13	EXAMPREPARATION				27/12/2009-31/12/2010
14	530.2 GEOGRAPHICAL INFORMATION SYSTEMS	C. Chalkias	3	25%	03-07/01/2011
15	530.3 GIS APPLICATIONS	C. Chalkias	3	25%	10-14/01/2011
16	EXAMS				17-21/01/2011
17	530.4 DIGITAL IMAGE ANALYSIS	C. Karydas	3	25%	24-28/01/2011
18	EXAMS				31/01-04/02/2011
	<b>Unit IV: ENM540 Integrated GIS/RS Applications - 12 ECTS</b>				<b>07/02/2011-19/03/2011</b>
19	540.1 BASIC GEODESY & DIGITAL PHOTOGRAMMETRY	V. Tsioukas	3	25%	07-11/02/2011
20	EXAMS				14-18/02/2011
21	540.2 REMOTE SENSING APPLICATIONS	I. Gitas / K. Perakis	3	25%	21-25/02/2011
22	540.3 INTEGRATED GIS/RS CASE STUDIES	K. Perakis / I. Gitas	3	25%	28/02-04/03/2011
23	EXAMS				07-11/03/2011
24	540.4 ADVANCED METHODS IN REMOTE SENSING ANALYSIS	G. Mourtakis	3	25%	14 - Sat.19/03/2011
	<b>Unit V: ENM550 Environmental Assessment, Planning &amp; Management - 9 ECTS</b>				<b>21/03/2011-06/05/2011</b>
25	550.1 STRATEGIC ENVIRONMENTAL ASSESSMENT	G. Carsjens	3	34%	21 - Sat.26/03/2011
26	EXAMS				28/03-01/04/2011
27	550.2 EIA THEORY AND PROCESS (1 field trip)	P. Gikas	3	33%	04 - Sat.09/04/2011
28	550.3 DECISION SUPPORT USING GIS	M. Dragan	3	33%	11-15/04/2011
29	EXAMS PREPARATION				18-22/04/2011
30	EXAMS PREPARATION				25-29/04/2010
31	EXAMS				02-06/05/2011
	<b>Unit VI: ENM560 Quantitative Methods for Environmental Assessment - 9 ECTS</b>				<b>09/05/2011-10/06/2010</b>
32	560.1 QUANTITATIVE ANALYSIS OF MEDITERRANEAN ECOSYSTEMS	E. Feoli	3	34%	09-13/05/2011
33	560.2 ENVIRONMENTAL COST BENEFIT ANALYSIS	M. Shelby	3	33%	16 - 20/05/2011
34	EXAMS				23-27/05/2011
35	560.3 SPATIAL STATISTICS - PRACTICE	A. Mavromoustakos	3	33%	30/05 - Sat.04/06/2011
36	EXAMS and Retake Preparation				06-10/06/2011
37	RETAKE EXAMS				13-17/06/2011
38	ORALS				23/06/2011

GEOINFORMATION IN ENVIRONMENTAL MANAGEMENT PROGRAM  
Academic year 2010-2011

## Part 2

### The Master of science programme

#### **Project (9 months duration, 60 ECTS)**

The qualified second year graduates (Master of Science Degree candidates) pursue their research thesis under the supervision of visiting and/ or own MAICH faculty in an environment fully equipped with modern facilities and the most recently updated software. Research addresses spearhead topics supporting national and EU Environmental policies within an interdisciplinary international scientific network.

#### **Research activities: Topics generally available for Master of Science thesis:**

- Desertification Monitoring,
- Environmental Resource Management,
- Environmental Impact Assessment,
- Landscape Ecology,
- Soil Erosion Risk Assessment,
- Agricultural Practices Monitoring,
- Precision Agriculture,
- Forest Fire Risk Assessment
- Fire Behaviour Modelling & Effectiveness of Fire Retardants,
- Management of Mediterranean Ecosystems, and
- Regional and Rural Development

#### **INDICATIVE MASTER THESES REALIZED WITHIN THE AREA**

1. **Title:** Hyperion classification using pixel object-based and artificial neural network techniques for land cover mapping in Anopoli  
**Author:** Alata Elatawneh, Surveying and Geomatics Engineer, Palestine  
**Place of realization:** MAICH  
**Thesis Director(s):** Dr. T. Schneider, Dr. I Manakos, Dr. C. Kalaitzides
2. **Title:** Impact and risk assessment of heavy metal pollution from the leakage of landfill leachates on agricultural soils and cover mapping using object-based classification of medium-high and high resolution imagery  
**Author:** Mohamed El-Hag, Botanist, Egypt  
**Place of realization:** MAICH  
**Thesis Director(s):** Prof. G. Zalides, Dr. V. Takavakoglou
3. **Title:** Land cover mapping using object-based classification of medium-high and high resolution imagery  
**Author:** Ivan Mincev, Forester, FYROM  
**Place of realization:** MAICH  
**Thesis Director(s):** Prof. N. Silleos, Prof. I. Gitas
4. **Title:** Investigation of socio-cultural issue in management and monitoring in Protected Areas: development of participation guidelines  
**Author:** Fabrizia Buono, Environmentalist, Italy  
**Place of realization:** MAICH  
**Thesis Director(s):** Prof. Gerrit Carsjens, Dr. Kalliope Padiaditi
5. **Title:** Development of a Method to Assess the Risk of Water Pollution from Olive Mill Wastewater Using Geographic Information Systems: The Case Study of Keritis Watershed  
**Author:** Anas Altartouri, Civil Engineer, Jordan  
**Place of realization:** MAICH  
**Thesis Director(s):** Prof. Nikolaos NIKOLAIDIS, Dr. Kalliope Padiaditi

***Detailed additional information (ECTS guide) and in particular an analytical syllabus is available at [www.maich.gr/env/](http://www.maich.gr/env/)***