ITC
STUDY
GUIDE
2008 / 2009

NATURAL
RESOURCES
MANAGEMENT

Master of Science (MSc)
Course

NATURAL RESOURCES MANAGEMENT

MSc

Study Guide
2008-2009

Contents

Foreword

Dear course participants,

Welcome to ITC.

Having left your family and country, you have come to ITC to further your education. We hope that the course you have selected will fulfil your expectations.

Education at ITC is characterised by:

- a modular set-up,
- a mixture of theory and practice, often including participants' own experiences
- a core curriculum for Remote Sensing (RS) and Geo-information Systems (GIS), common to all programmes, and
- choice options according to individual (research) interest and/or the needs of your own organisation.

We are pleased to present you this study guide for the 2008/2009 courses offered full-time at ITC Enschede. This study guide gives you information on the courses, an overview of the modules and the detailed content of the course modules. ITC is continuously modifying its courses to the needs of its students and their organisations. The structure of the MSc courses was adjusted last year in order to strengthen the links between the courses and the research projects, implemented by ITC.

Description of all elements of education at ITC and the descriptions of the modules of other courses are available on the ITC website (http://www.itc.nl/education/courses/modules.aspx).

But there is more to life at ITC than only education. You have arrived at an institute with more than 400 students from over 70 countries. Furthermore, also the ITC staff is originating from more than 30 countries: a truly international environment where you will be able to meet colleagues from all over the world. ITC is organising all sorts of social, cultural and sports activities. Well-known are the International Sports Tournament, the International Food Festival and the International Cultural Event. We would like to encourage you to participate in many if not all of these events and to make new friends in the process.

We will do our best to provide you with the quality of education that you expect from our institute.
We wish you the best of success during your studies and a pleasant stay at ITC and in The Netherlands.

Prof. Dr. Ir. M. Molenaar, Rector ITC

Introduction to ITC

One of humanity's greatest challenges is to achieve an appropriate balance between the development of natural resources and the maintenance of an optimal natural environment. To meet this challenge we need information on the earth's surface and sub-surface: spatially referenced information or *geo-information*.

Many different types of *earth observation* provide efficient ways of gathering geo-information. These types include conventional photographic and non-photographic imaging techniques, electro-optical sensing of the wider spectrum by multi-spectral, thermal infrared and radar scanning as well as geophysical and geochemical data-acquisition techniques. All these methods are used in mapping the earth's topography, monitoring the natural environment and exploring for natural resources and all are applied by specialist groups within the Institute.

ITC specializes in the collection, management and visualisation of geo-information and its integrated interpretation in support of resource management and policy development. In this way, scientific earth observation supports decision-making for sustainable development and the alleviation of poverty in the developing world.

The International Institute for Geo-Information Science and Earth Observation was established in 1950, and is usually referred to as ITC because of its original name: International Training Centre for Aerial Survey. It is the largest institute for international higher education in the Netherlands.

ITC is an autonomous organisation operating under the aegis of the University of Twente, and is funded by the Ministry of Education, Cultural Affairs and Science of the Netherlands. ITC is subject to the national quality assurance procedure for universities in the Netherlands. It is based in Enschede. ITC's main activities are education, research and advisory services. These activities are carried out by six scientific Departments:

- Department of Earth Observation Science (EOS)
- Department of Earth Systems Analysis (ESA)
- Department of Geo-information Processing (GIP)
- Department of Urban and Regional Planning and Geo-information Management (PGM)
- Department of Natural Resources (NRS)
- Department of Water Resources (WRS)

They are supported by the education, research, consultancy and general support departments.

Education

ITC has a scientific staff of some 150 professionals of 31 nationalities. More than 19,000 students from over 150 countries have graduated from courses at the institute since 1952. ITC offers courses at different levels: PhD degree (conducted in collaboration with Netherlands universities), Master of Science degree, Master degree, postgraduate and undergraduate Diploma and Certificate courses.

The ITC degree programmes are nationally accredited and registered in the Central Register of Higher Education (CROHO) of The Netherlands.

Recently ITC embarked on a programme of decentralizing its education, through joint education programmes with partners in various countries throughout the world. ITC also offers a growing number of distance education courses.

Updating the knowledge and skills of ITC alumni is an important task, in addition to the institute's regular courses. Therefore, ITC organises refresher courses at ITC and abroad.

The language of instruction is English.

Research

ITC carries out multidisciplinary and problem-oriented research that focuses on strengthening organisations involved in survey, management and planning for sustainable development. To this end, a strategic multidisciplinary research programme with the following themes is established:

- Biodiversity in fragmenting landscape
- Carbon-cycle and climate change
- Stochastic methods for image mining and data quality
- Disaster management
- Earth systems science
- Food security and environmental sustainability
- Governance and Integrated Spatial Assessment
- Spatial data infrastructure technology
- Spatio-temporal data integration and visualization
- Informed multilevel governance of urban regions
- Land administration for informed governance
- Managing water scarcity
- Sustainable urban-regional dynamics
- Utilisation of sensor developments for efficient topographic mapping
- Water cycle climate

Advisory services

ITC's transfer of knowledge also encompasses advisory services, mainly in developing countries. Advisory services of ITC often act as a follow-up service to alumni and their organisations and institutes.
Approximately 1000 projects have now been completed and ITC is presently committed to a wide variety of assignments around the world. The majority of these are based in developing countries and are education-oriented.

Introduction to ITC's educational programmes

At degree level ITC offers PhD, MSc and Master degree courses. Also Diploma courses, and short courses (some through distance education) are offered as part of the regular education.

The MSc degree programme in Geo-Information Science and Earth Observation (lasting 18 months) consists of seven courses, each with a specific orientation:

- **Applied Earth Sciences**
- **Geoinformatics**
- **Land Administration**
- **Natural Resources Management**
- **Urban Planning and Management**
- **Water Resources and Environmental Management**
- **Governance and Spatial Information Management**

The Master degree programme (lasting 12 months) consists of two courses:

- **Geoinformatics**
- **Natural Resources Management**

Postgraduate Diploma courses (lasting 9 months) are offered in:

- **Applied Earth Sciences**
- **Geoinformatics**
- **Land Administration**
- **Natural Resources Management**
- **Urban Planning and Management**
- **Water Resources and Environmental Management**

Programmes in cooperation with other institutes
ITC cooperates with Universities in The Netherlands, Europe and throughout the world in full-time and part-time joint education programmes, leading to MSc and Master degrees and to Diplomas:

- In The Netherlands ITC cooperates with the universities of Utrecht, Delft and Wageningen in an MSc course, focusing on Geographic Information Management and Applications (GIMA). The course is offered through distance learning, with four periods of classroom learning.
- In Europe, ITC cooperates with the universities of Southampton, Lund and Warsaw in an MSc course on Geo-information Science and Earth Observation for Environmental Modelling (GEM). The course is taught in four countries: UK, Sweden, Poland and The Netherlands.
- ITC has entered into partnership with reputable education institutes for the purpose of providing joint courses in several countries throughout the world. At present, MSc and Master courses are or will be conducted in Bolivia, China, Ghana, India, Indonesia, Iran, Kenya, Mexico, Nigeria and Tanzania.

For more information on our joint courses, please consult the ITC website (http://www.itc.nl/education/jointcourses.aspx).

Master of Science degree, Master degree and Postgraduate Diploma

Master of Science degree
The 18 month Master of Science degree programme is intended for participants with a future task in research and development. In addition to 12 months regular coursework, the Master of Science participants learn by doing research and/or by developing new methods or techniques in a 6 months thesis period.

Successful completion of the MSc degree programme provides graduates with a qualification that enables them to continue to PhD level, either in the Netherlands or abroad.

All Master of Science courses lead to a degree with the title:
"Master of Science in Geo-Information Science and Earth Observation".

Master degree
The 12 month Master degree programme is more profession oriented and teaches more practical skills. It could be compared to taught masters in other countries.

All Master courses lead to a degree with the title:
"Master in Geo-Information Science and Earth Observation".

Postgraduate diploma
The 9 month Postgraduate diploma programme caters for young and mid-career professionals who need to be proficient in applying geo-information science and earth observation in their field of interest, analysing problems and applying new methods and techniques, and managing (multi)disciplinary scientific teams.
The Postgraduate diploma course is equal to the taught part of the MSc course.

The Postgraduate Diploma course leads to a Diploma with the title:
"Postgraduate Diploma in Geo-Information Science and Earth Observation''

Course structure

The duration of the Master of Science courses is 18 months, of the Master courses 12 months and of the Postgraduate Diploma course 9 months.
All ITC courses are divided into 3 week periods (modules) or multiples of 3 weeks (blocks) in which one subject or related subjects are taught. All Master, Master of Science and Postgraduate Diploma courses start on the same date in September each year. The Postgraduate Degree programme is taught together with the MSc programme during the first nine months. The Master programme is taught separately.

ITC's core business is the collection and handling of geo-information and its application in various fields involved in sustainable resource development. ITC has given its core business a prominent place in the courses. Block 1 (modules 1-4) in all degree courses contains ITC's core curriculum: (at least) three weeks of these core modules are spent on Geographic Information Systems (GIS) and (at least) three weeks are spent on Remote Sensing. In addition to these core modules all programmes offer more advanced modules in geo-information and earth observation techniques that vary per course.

Master of Science and Postgraduate Diploma programme

The Master of Science programme is split up in 4 *blocks*. The PGD programme is equal to the MSc programme during Block 1 and 2. MSc and PGD students follow these blocks together in class.

Figure 1

Structure of MSc and PGD courses

Block 1	Block 2	Block 3	Block 4
Principles of RS and GIS (4 modules)	Scientific domain (6 modules)	Research profile (5 modules)	Individual MSc research (8 modules)
MSc programme →			
PGD programme →			

Figure 2

MSc and PGD course structure in detail

			MSc	PGD
Block 1	1	Introduction, Principles of RS and GIS, Application in domain		
	2			
	3			
	4			
Block 2	5	Domain modules, different per course (AES, GFM, GSIM, LA, NRM, UPM, WREM)		
	6			
	7			
	8			
	9			
	10			
Block 3	11	Research skills		Final assignment
	12	Advanced subjects		
	13			
	14	Research themes, MSc proposal		
	15			
Block 4	16	Individual MSc research	MSc thesis	
	17			
	18			
	19			
	20			
	21			
	22			
	23			

Block 1: Principles of GIS/RS

Block 1 is the common core of all ITC educational programmes. It teaches the basic principles of Remote Sensing and GIS, and how these can be applied in various domains. This common core ensures a basic level of GIS and RS for all students, regardless of their background and experience. Block 1 also contains an introduction to the course as a whole and the teaching approach, and a student advisor is assigned to each student.

Block 2: Domain

Block 2 is specific for the different courses within ITC MSc programme (AES, GFM, GSIM, LA, NRM, UPM, WREM). In this block the basic principles of the domain and application of GIS and RS in it are taught and deepened. Please look at the course specific parts of

this study guide to find out more about the content of Block 2 in your course. Students need to select an MSc thesis topic in this block and work this out in an MSc pre-proposal. An MSc day and MSc fair are organised to support this.

Block 3: Research profile
Block 3 prepares the student for his/her MSc research by offering learning opportunities on research skills, advanced research tools and methods, and deepening of research topics.

It starts with a module on research skills. The module is similar for all courses. The objectives are common, but examples and cases are used from the scientific domain of each course. Two MSc supervisors are assigned to each student.

The second part contains "advanced topics". These topics go in-depth in a certain research method or tool. These have a more generic nature and are supposed to attract students from different domains. Students have to make a choice from these advanced topics, which match to their envisaged MSc thesis topic. Because of the advanced level, entry requirements may be defined for the advanced topics.

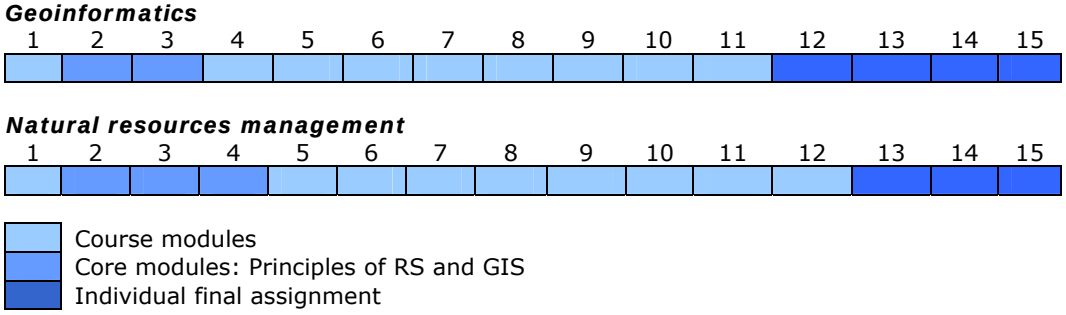
The third part of this block is assigned to the ITC research themes. Students have to formulate their MSc thesis topic within one of ITC research themes. In the last two modules students will study state-of-the-art knowledge and research in these themes in a group research assignment. Parallel to this, the student will work on his/her final MSc thesis proposal. The student has to make a choice for a certain research theme, based on his envisaged MSc thesis topic.

Block 4: Individual MSc research
In Block 4 the student works individually on his/her MSc thesis. It is required to have an approved MSc research proposal before entering this block. During this block there is interaction with the staff, PhD and MSc students of the research theme, for example in *capita selecta*. Each student will be assigned 2 MSc supervisors. Formal assessment will be given at the mid-term presentation and of course the final MSc exam (see MSc regulations).

Master programme
The Master programme is made up of 15 modules, consisting of core modules about GIS and Remote Sensing, course modules, and an individual final assignment.

Figure 3

Structure of Master courses



Course modules
In the first module, the course domain and principles of databases are introduced. In module 5 and further the core modules are applied within this course domain.

Core modules
Modules 2 and 3 teach the basic principles of Remote Sensing and GIS, and how these can be applied in various domains. This common core ensures a basic level of GIS and RS for all students, regardless of their background and experience. The core modules are taught together in class with the MSc and PGD students.

Individual final assignment
The Master programme concludes with an individual final assignment in which the participant can work on a case and topic which is tailored to his or her particular situation

and interest. Participants are encouraged to bring data and other material from their home country for this purpose, subject to approval.

Academic Profile MSc

The academic profile of the MSc programme puts strong emphasis on the scientific discipline, a scientific approach, basic intellectual skills, co-operation and communication and the temporal and social context of research. The emphasis on doing research and/or designing or developing new methods or techniques depends on the application domain.

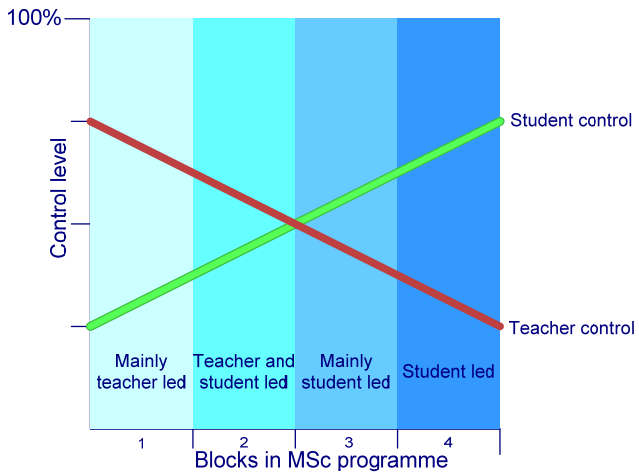
Multi-disciplinary research is an important focus for the MSc programme because (applied) research in practice seldom concerns one discipline but is more likely to be multidisciplinary. Students have to be prepared for that. Starting with a sound basis in their own domain they will be brought into learning situations in which students from different domains work together. It should be noted that most if not al research at ITC is already multidisciplinary in nature. This is evident in the wide scope of expertise within departments, and the common denominator to carry out applied research contributing towards development related issues as specified in ITC's mission.

Teaching Approach MSc

In their profession, the graduates have to apply knowledge and skills independently. The MSc programme is therefore focused at handing over the control of the learning process to the student. At the beginning of the programme, the teacher will have the main control and the programme will contain some choices, especially concerning preparation for the MSc research. The choices should be motivated, fit to the envisaged research trajectory, and be accepted by the course director. During the programme the teacher role will develop towards the role of advisor. The student takes the lead in his/her own learning process by developing his/her own learning plan within the MSc framework and guidelines. The teacher supports this as a coach (while still passing on his/her experience).

Figure 4

Handing over control from the teacher to the student



Block 1: Mainly teacher led

In Block 1 the teacher takes the lead. He/she defines the content to be studied and learning tasks and exercises which have to be executed. Students can make limited choices between learning strategies and learning tasks. The number of contact hours between teacher and students is relatively large in this stage, mainly consisting of lectures and supervised practical exercises. Each student will be assigned a student advisor in Module 1 for advice on study related matters, especially the choice trajectory towards the

MSc topic selection, but also for day-to-day problems, remedial self-study, etc. The student advisor is assigned for the whole MSc course.

Block 2: Teacher and student led
In Block 2 both the teacher and the student take the lead. The teacher defines the framework in which the student can make his/her own choices about study tasks. The amount of choice options varies across the different courses (or streams). The student has to start thinking about his/her MSc research topic and consult staff about its feasibility. The number of contact hours between teacher and students is reduced in favour of group work and independent study and assignments.

Block 3: Mainly student led
In Block 3 the student takes control by choosing advanced subjects and a research theme which fit within his/her MSc thesis topic. The student works on the final version of MSc research proposal and consults his student advisor and other specialised staff about its feasibility and quality. The final version of the MSc research proposal has to be presented and defended by the student for the Thesis Admission Committee. The number of contact hours between teacher and student is further reduced to make room for independent study by the student. Two MSc supervisors (first and second) are assigned for MSc supervision at the beginning of Block 3.

Block 4: Student led
In Block 4 the student works individually and independently on his/her MSc research project. This will be supported by meetings with the MSc supervisors and *capita selecta* meetings, organised by the research themes. The student is responsible for progress and quality of his/her own research project and its defence at the end. The number of contact hours between teacher and students is reduced to a minimum in this period. It is therefore wise to look for peer support and peer review opportunities in this phase, which is offered in the research theme where staff, PhD and MSc students are together.

Study load of the ITC degree programmes

The European Union has developed a European Credit Transfer System (ECTS) to allow easy comparison of study load of courses within Europe. ITC has adopted this system as a means of improving academic recognition for study abroad.
In ECTS, 60 credits represent the workload of an academic year (9-10 months) of study. These include lectures, practical work, seminars, tutorials, fieldwork, and self study. At ITC, each module of three-week duration has a study load of 5 ECTS.
The MSc course consists of 23 modules and three additional weeks of remedial teaching, catch-up activities and graduation ceremonies, totalling 118 ECTS. The Master course consists of 15 modules and two weeks of remedial teaching, catch-up activities and graduation ceremonies, totalling 77 ECTS. The Postgraduate Diploma course consists of 12 modules and 1 week of remedial teaching, and catch-up activities, totalling 61 ECTS.

Opening hours of various ITC facilities

ITC building	
Monday-Thursday	07:30 - 22:30
Friday	07:30 - 21:00
Saturday	09:00 - 17:00

Bookshop (room 0-006)	
Monday-Friday	08:30 – 12:15 12:45 – 16:00

Library (room 3-038)	
Monday, Thursday, Friday	08:30 - 17:00
Tuesday, Wednesday	08:30 – 21:00

Audio-Visual centre (room 3-039)	
Monday, Thursday, Friday	08:30 - 17:00
Tuesday, Wednesday	08:30 – 21:00

Students' financial administration desk (room 1-130)	
Monday-Friday	10.30 – 13.30

Computer helpdesk (room 1-004)	
Monday-Friday	08:30 - 12:45 13:30 – 17:00

Restaurant (ground floor)	
	Monday-Friday
Coffee break *free coffee/tea*	10:15 – 10:45
Lunch	12:00 - 13:30
Tea break *free coffee/tea*	15:15 – 15:45

Starting dates modules and holidays

Module number	2008 / 2009 / 2010
Registration *Opening Academic year*	*Monday, September 15, 2008* *Thursday, September 25, 2008*
Module 1	September 29 through October 17
Module 2	October 20 through November 7 *RS core exam: November 7*
Module 3	November 10 through November 28 *GIS core exam: November 28*
Module 4	December 1 through December 19 *RS core re-sit exam: December 10*
DIES celebration	*GIS core re-sit exam: December 17: morning* *Wednesday, December 17: afternoon no classes*
X-mas	*December 25 through December 26*
New Year	*January 1, 2009*
X-mas break	*December 22, 2008 through January 2, 2009*
Module 5	January 5 through January 23, 2009
Module 6 *MSc day*	January 26 through February 13 *Wednesday, January 28, 2009*
Module 7	February 16 through March 6
Module 8 *MSc fair*	March 9 trough March 27 *Wednesday, March 11, 2009*
Module 9	March 30 through April 17
Good Friday	*April 10*
Easter Monday	*April 13*
Module 10	April 20 through May 8
Queen's day	*Thursday, April 30*
Liberation day	*Tuesday, May 5*
Catch-up week	*May 11 through May 15*
Module 11	May 18 through June 5
Ascension Day + compulsory ADV	*May 21 through May 22*
Whitsun Monday	*June 1*
Closing week PGD	*June 8 through June 12*
Closing PGD	*Friday, June 12*
Module 12	June 8 through June 26
Module 13	June 29 through July 17
Module 14	July 20 through August 7
Module 15	August 10 through August 28
Closing week Master - Catch-up week MSc	*August 31 through September 4*
Graduation Master	*Friday, September 4*
Module 16	September 7 through September 25
Module 17	September 28 through October 16
Module 18	October 19 through November 6
Module 19	November 9 through November 27
Module 20	November 30 through December 18
X-Mas, New year break	*December 24, 2009 through January 1, 2010*
Module 21	December 21, 2009 through January 15, 2010
Module 22	January 18 through February 5
Module 23	February 8 through February 26
Closing week MSc	*March 1 through March 5, 2010*
Graduation MSc	*Friday, March 5, 2010*

Master of Science (MSc) Course

NATURAL RESOURCES MANAGEMENT

Natural Resources Management

Sustainable development requires the implementation of policies for ecologically sound, economically viable and socially acceptable resource management. To achieve this, planners, managers and researchers must understand the complexity of factors involved in the management of natural resources. They must collect and interpret the required data and work together with specialists from other disciplines. A large amount of information is needed to make informed decisions about the planning and management of the use of land. The Natural Resources Management MSc course provides participants with the knowledge and technical skills needed for the collection, interpretation and management of spatial information, using remote sensing and geographic information systems, to support planning and decision-making processes.

MSc course objectives

The MSc course aims at individuals with an interest in building up critical understanding and competence in applied research. It emphasises the strengthening of academic research skills and culminates in the execution of an independent research project.
On completion of the MSc course, participants are able to:

- Analyse a problem encountered in NRM practice and develop an appropriate method to study and/or solve the problem
- Apply appropriate methods for spatial data acquisition, verification and quality control
- Use GI science and earth observation technology to generate, integrate, analyse and display spatial data
- Evaluate and apply relevant and appropriate methods and models for data analysis and problem solving in NRM
- Apply research skills to formulate and carry out an independent research project
- Communicate and defend findings of this research work.

The MSc course includes fixed course work, research training and advanced choice modules, followed by an individual research project (usually including fieldwork) resulting in a MSc. thesis. Successful completion of the course leads to the degree of Master of Science in 'Geo-Information Science and Earth Observation'.

General outline

The programme consists of a number of modules. Each module lasts three weeks and comprises theoretical lectures, workshops and practical assignments. The first four modules form block 1 of the course and are common to participants in all NRM courses (MSc, Master and Short Course). These four modules prepare participants for a role as natural resource geo-information specialist, working at the interface of natural resources management, natural resource data acquisition & analysis and geo-information technology. Students master the principles of GIS, remote sensing and information technology applied to NRM.

The second block, comprising modules 5 – 10 are taught in a multidisciplinary fashion to all participants together. Participants with particular interests (e.g. in forestry, agriculture, etc.) will nevertheless be able to select from a number of practical exercises and assignments most suited to their particular background and area of interest.

In the third block, after a module (11) to help participants develop research skills, participants can choose from a wide range of advanced topics offered in modules 12 and 13. Furthermore, in modules 14 and 15, participants will work in small research groups to prepare for individual MSc research in a specific field.

During the final block of the course, i.e. the MSc research, emphasis is placed on problem definition, method selection, data acquisition, analysis and thesis writing.

MSc students following the Natural Resources Management course may select their research topic in one of ITC's 15 research themes. In 2008, most students selected topics in one of the following four research themes:

1. Biodiversity in fragmenting landscapes (BIOFRAG), which deals with the topics *biodiversity, carbon sequestration, fragmenting landscape*.
   For details, please refer to http://www.itc.nl/research/themes/biofrag/default.asp

2. Carbon cycle and climate change (C-CYCLE), which deals with the topics *carbon cycle, forestry, assessment, monitoring, impacts, information quality, decision support.*
   For details, please refer to http://www.itc.nl/research/themes/ccycle/default.asp

3. Governance and Integrated Spatial Assessment (GISA), which deals with the topics *integrated Assessment, spatial decision support, participatory spatial planning and management.*
   For details, please refer to http://www.itc.nl/research/themes/gisa/default.asp

4. Food security and environmental sustainability (FSES), which deals with the topics *agriculture, water, food production, soil, natural hazards, land use competition, land use planning and management, spatial resource analysis, impact assessment, scenario development.*
   For details, please refer to http://www.itc.nl/research/themes/fses/default.asp

Programme Natural Resources Management

Module	*Module Title*	*Module coordinator*	*Page*
Block 1			
Module 1-2-3 29-9-08 / 28-11-08	Principles and Applications of GIS and Remote Sensing	Drs. E. Westinga	23
Module 4 1-12-08 / 19-12-08	Introduction to Natural Resources Management	Dr. I.C. van Duren	25
Block 2			
Module 5 5-1-09 / 23-1-09	Systems analysis for NRM	Dr. Ir. L.G.J. Boerboom	27
Module 6a 26-1-09 /6-2-09	Geo-information for NRM	Drs. L.M. van Leeuwen	29
Module 7 9-2-09 /27-2-09	Mapping of Natural Resources	Dr. M. Schlerf	31
Module 8 2-3-09 /20-3-09	Monitoring of Natural Resources	A. Kooiman, MSc	31
Module 9 23-3-09 /10-4-09	Causes and impacts of changing resources	Dr. P.E. van Laake	33
Module 6b 13-4-09 / 17-4-09	Societal response and reflection on NRM	Prof. Dr. Ir. E.M.A. Smaling	35
Module 10 20-4-09 / 8-5-09	Project	Ir. B.G.C.M. Krol	37
CATCH-UP WEEK (11-5-09 /15-5-09)			
Block 3			
Module 11 MSc 18-5-09 /5-6-09	MSc Research Skills	Dr. D.G. Rossiter / Dr. J. de Leeuw	39
Modules 12 +13 MSc 8-6-09 / 17-7-09	**Advanced Subjects**: 13 topics module 12 11 topics module 13	Specified per advanced topic	41
Module 14 + 15 20-7-09 /28-8-09	**Research Themes / MSc Qualifier** 15 Research themes	Specified per theme	43
CATCH-UP WEEK (31-8-09 / 4-9-09)			
Block 4			
Module 16-23 MSc 7-9-09 / 5-3-2010	MSc Research and Thesis	Supervisor(s)	47

Principles and Applications of GIS and Remote Sensing			
Module: 1-2-3		Co-ordinating staff:	
Start:	29-9-2008		
End:	28-11-2008	Drs. E. Westinga	
Level: MSc			U08-NRM-128

Introduction
These modules introduce the principal concepts and techniques of geographical information systems (GIS) and remote sensing (RS). The modules consist of three interrelated parts: a theoretical part which focuses on the concepts, a practical part which aims at developing hands-on skills in using software tools, and, an application oriented part in which participants learn how to design and carry out sequential data processing steps for solving a typical application problem in natural resources management.

The concepts and techniques introduced in these modules will be further elaborated during subsequent modules of the programme.

Contents
The modules cover the following topics:

Introduction to the Natural Resources Management course.

GIS and RS principles
- Geographic information and spatial data types
- Spatial data entry and preparation
- Spatial data analysis
- The electromagnetic spectrum
- RS Sensors and platforms
- Geometric aspects of remotely sensed data
- Image enhancement and visualisation
- Image classification and interpretation
- Spatial data visualisation
- Quality assessment of spatial data.

GIS/RS applications in NRM
- RS data interpretation for land resource inventory
- RS and GIS for land resource change analysis
- GIS tools for landscape analysis.

Objectives
The aim of these modules is to learn how to generate information about the earth from remote sensing and data stored in geographic information systems.

At the end of the core modules participants will be able to:

1. Explain the principles and use the vocabulary of RS and GIS.
- Describe the nature of geographic phenomena and their representation in the context of geo-informatics;
- Outline the principal data models for spatial and non-spatial data used in GIS databases;
- Outline the main components of a GIS and their functions;
- Explain the relationship between spatial data and coordinate systems;
- Outline the main spatial data analysis functions;
- Explain the role of RS in GIS;
- Describe the physical background of remote sensing and compare the main platforms and sensor systems;
- Explain the main digital image processing procedures;
- Describe the common methods of image analysis;
- Outline the principal rules for cartographic visualisation;
- Describe aspects of data quality and how various stages of spatial data handling affect it.

2. Carry out basic RS/GIS operations
- Carry out basic data preparation, geo-referencing and data entry into a GIS;
- Perform basic manipulation, analysis and visualisation operations using a GIS;
- Perform basic image processing techniques;
- Carry out a visual interpretation of an AP stereo pair and a satellite image;
- Apply basic data quality assessment procedures.

3. Apply appropriate RS/GIS methods for problem solving
- Understand the capabilities, uses and limitations of GIS and RS for geo-information production in a NRM context;
- Design and carry out sequential data processing steps for solving a typical application problem;
- Evaluate the results of data processing;
- Be aware of organisational issues of GIS development and implementation.

Prerequisites
Not Applicable

Recommended Knowledge
Basic computer skills

Hardware and Software Requirements
Standard network connected PC; Software: ERDAS and ArcGIS.

Teaching Materials
Principles of GIS (ITC textbook) and Principles of Remote Sensing (ITC textbook).

Allocated Time per Teaching Learning Method

L	SP	GA	IA	S	O
60	100	30	90	130	10

Time (in # of hours) allocated per major method:
L lecture,
SP supervised practical,
GA group assignment (e.g. workshop, project),
IA individual assignment (including Thesis, IFA),
S self study,
O overhead (e.g. QH, exam, opening)

Assessment
Form:
- Two written, closed book, examinations (one on GIS and one on Remote Sensing, each with a weight of 1 module).
- Submitted results of selected exercises and assignments (weight: one module).

Introduction to Natural Resources Management			
Module: 4		Co-ordinating staff: Dr. I.C. van Duren	
Start:	1-12-2008		
End:	19-12-2008		
Level: MSc			M08-NRM-120

Introduction

The module has a multi-disciplinary focus which challenges the participants to develop a common basis for the assessment of the multi-actor, multi-purpose and multi-disciplinary nature of NRM, thus recognizing the complexity and conflicts involved in NRM issues. This is achieved through the sharing of the professional background of the participants and their functions in relation to the tasks and processes of NRM. The concepts derived from the individual experiences are then further developed into a more general framework.

Particular care is given to highlighting the importance of geo-spatial data in the NRM processes. Participants are introduced to a selection of concepts, techniques and tools relevant to working with spatial information for natural resource management, both in the office and in the field. This module develops analytical reasoning and critical thinking when working with geographical data and products. This analytical reasoning and critical thinking will be further developed in block 2 (modules 5-10), of the course.

Contents

The module covers the following topics:

- Natural resources and natural resource management
- Actors and objectives in natural resources management
- Conflicts and participation in NRM problem situations
- Problem Structuring in NRM
- Case of multi-sector NRM planning in the Netherlands
- Introduction to disciplinary approaches and information requirements in NRM conflict situations
- Skills in Information sourcing and Presentation

Objectives

Upon completion of the module, participants will be able to:

- define Natural Resource Management and explain their own professional contribution to it.
- outline the complex nature of Natural Resource Management and the major issues involved.
- describe the role of sustainable development and Natural Resource Management
- justify the need for multi-stakeholder approaches in Natural Resource Management.
- outline the principles/approaches of collaborative Natural Resource Management
- apply some relevant planning and management tools for Natural Resource Management
- describe geo-spatial information requirements in Natural Resource Management.

Elements of the educational approach:

The educational approach is based on the principles of experience-based learning and adult education.

This is done through reflecting upon the professional context of the participants` functions in relation to the tasks and processes of Natural Resource Management. In line with the aim of the module, participants practice a multi-disciplinary teamwork approach.

The module is characterised by short presentations, individual and group exercises, "hands-on` learning, games and role play, video presentations, and field exercise. Participants are stimulated to contribute to an interactive learning environment.

Prerequisites

Not applicable

Recommended Knowledge
Basic computer skills

Hardware and Software Requirements
Personal productivity software tools, ArcGIS.

Teaching Materials
Required: Users's guide to the NRM module.
Recommended: Planning and management tools, Groenendijk, E.M.C., Dopheide, E.J.M. 2003.

Allocated Time per Teaching Learning Method

L	SP	GA	IA	S	O
14	26	36	10	26	8

Time (in # of hours) allocated per major method:
L lecture,
SP supervised practical,
GA group assignment (e.g. workshop, project),
IA individual assignment (including Thesis, IFA),
S self study,
O overhead (e.g. QH, exam, opening)

Assessment
Participants will have to satisfactorily complete the various assignments given during the module. Participants will have to demonstrate that they can perform satisfactorily in an inter-disciplinary group work preparation, development of materials, and presentation.

Systems analysis for NRM			
Module: 5		Co-ordinating staff:	
Start:	5-1-2009		
End:	23-1-2009	Dr. Ir. L.G.J. Boerboom	
Level: MSc			M09-NRM-112

Introduction

This module aims at introducing basic concepts and issues in Natural Resources Management. It provides the NRM context and a conceptual framework that will be emphasised throughout block 2. A systems approach to NRM will be applied.

Contents

- Main concepts and issues in Natural Resource Management, such as:
  - Land use/cover classification concepts, agro-ecological zoning
  - Biodiversity conventions and consequences
  - Landforms, major land resource areas, including soil and terrain characteristics
  - Global forest resource assessment
  - Food security issues
  - Governance
- Framework(s) for assessing Natural Resource Management policies and interventions
- Problem and systems analysis and application in a chosen field
- Application of geo information for the analysis of natural systems, such as:
  - Problem analysis and problem structuring
  - System and situation analysis including organizational setting
  - Ecosystems analysis
  - Livelihood concept and analysis
  - Farming systems analysis
  - Natural resources degradation analysis
- Introduction to basic statistical inference and its application
- Introduction to scientific argumentation.

Objectives

At the end of module 5, participants are able to:

- Describe, analyse and discuss the interaction between society, environment and production in relation to Natural Resource Management
- Assess the organizational context within which the system is situated
- Evaluate the potential of geo information and earth observation for Natural Resource Management

And, more specifically:

- Discuss the main concepts and issues in Natural Resource Management
- Adopt and adjust a framework for assessing Natural Resource Management policies and interventions
- Analyze a natural system in terms of cause and effect relations
- Distinguish and apply approaches for scientific inference
- Evaluate the potential of geo information and earth observation for the analysis of natural systems and explicitly link this to the organization that uses or could use these technologies.

Prerequisites

Modules 1-4 of the NRM MSc course

Recommended Knowledge

See above prerequisites.

Hardware and Software Requirements

STELLA, Arc GIS.

Teaching Materials
Under revision.

Allocated Time per Teaching Learning Method
Under review (final schedule will be published in Black Board).

Assessment
Written examination.

Geo-information for NRM			
Module: 6a		Co-ordinating staff:	
Start:	26-1-2009		
End:	6-2-2009	Drs. L.M. van Leeuwen	
Level: MSc			U09-NRM-126

Introduction

Natural Resources Management requires adequate geo-information about the spatial and temporal dimensions of a natural resource system, for example for the modelling of future scenarios and/or to plan for intervention.

In this module participants focus on the information and data requirements for analysis of a natural system. They learn to critically assess the extent to which existing data meet these requirements. This course unit expands upon proven methods and examines new approaches to database design and geo-information handling for natural resources management. It prepares the participants for the more technical oriented modules 7 and 8.

Contents

- Assessment of information requirements
- Assessment of existing spatial databases
- Data quality assessment and evaluation
- Database design.

Objectives

At the end of Module 6a, participants are able to specify information data needs and design the structure of a geo database to support Natural Resource Management.
And more specifically:

- assess information requirements and translate these into specifications for spatial data and data needs
- assess the suitability of existing spatial data to meet these needs
- evaluate the quality of existing/available data
- design a structure for a database for natural resource management
- demonstrate a scientific attitude towards geo-information handling.

Prerequisites

Modules 1-5 of the NRM MSc course

Recommended Knowledge

See above prerequisites.

Hardware and Software Requirements

Arc GIS.

Teaching Materials

Handouts.

Allocated Time per Teaching Learning Method

Under review (final schedule will be published in Black Board).

Assessment

Individual written reports and presentation.

Mapping and Monitoring of Natural Resources			
Module: 7 + 8		Co-ordinating staff:	
Start:	11-2-2009		
End:	20-3-2009	Dr. M. Schlerf and A. Kooiman, MSc	
Level: MSc			U09-NRM-127

Introduction

Under the influence of driving forces (including demography, economic growth, and even natural phenomena), human activities (*e.g.* industrial and agricultural activities) exercise pressure on the environment. This often results in a disturbance - or even degradation - of the state of the environment, resulting in an impact on ecological systems (*e.g*. biological diversity) and ecosystem services (such as food supply). This module focuses on the mapping of the characteristics and spatial dimensions of ecological systems - being the "carriers" of natural resources - and on the monitoring of changes as result of impact on these ecosystems. Because it allows emphasis on the relationships among (components of) ecological systems and human interference, a land ecological focus is followed. A solid understanding of, and adequate information about the spatial and temporal dimensions of a natural resource system, is required in order to model future situations and to plan interventions in the natural resource system.

Contents

- Field and image-based methods and techniques for mapping natural resources
- Principles of spatial-temporal modelling of ecological and socio-economic systems
- Change detection and assessment methods & techniques for monitoring natural resources, including development of indicators
- Change assessment in normative and/or economic terms
- (Geo-)statistics for quantitative spatial data analysis
- (Digital) terrain analysis for landform characterization
- Digital image processing for land cover identification
- Participatory techniques for spatial data acquisition
- Sampling approaches for field data acquisition
- Field data acquisition techniques and tools (also including mobile GIS).

Note ***Common topics and 'guided choice'***

Depending on his/her background and interests, the student will elect to focus on particular mapping and monitoring goals relevant in the NRM context.

Objectives

This module prepares students to apply geo-information and earth observation techniques (RS/GIS) for the mapping and monitoring of selected natural resources and their interrelationships. At the end of the module students will be able to

- combine up-to-date theoretical concepts and approaches with RS/GIS literacy (remote sensing, image processing, database management, spatial-temporal modelling, automated data acquisition, etc.) to provide relevant spatial-temporal information for further addressing a NRM problem.

And more specifically:

- select appropriate (in terms of efficiency, cost, quality, *etc*.) methods (including empirical- and physical-based techniques) for acquiring spatial data for the defined problem
- apply the selected methods of spatial data collection
- evaluate the quality/reliability of the acquired data
- demonstrate a scientific attitude towards using methods for earth observation and geo-information acquisition.

Prerequisites

Modules 1-6 of the NRM MSc course.

Recommended Knowledge

See above prerequisites.

Hardware and Software Requirements
Arc GIS, ERDAS and NVIS.

Teaching Materials
Handouts.

Allocated Time per Teaching Learning Method
Under review (final schedule will be published in Black Board).

Assessment
Written examination and assignments.

Causes and impacts of changing resources			
Module: 9		Co-ordinating staff:	
Start:	23-3-2009		
End:	10-4-2009	Dr. P.E. van Laake	
Level: MSc			M09-NRM-113

Introduction

The previous modules strengthened the ability to inventory natural resources and detect
The previous modules strengthened the ability to inventory natural resources and detect
and assess change. Addressing such negative changes requires understanding of the processes which degrade the environment. A mechanistic world view is the basis of commonly used methods to reverse resource degradation or alleviate its consequences. Proper understanding of cause and effect in resource degradation are crucial to achieve this. Inference of causation, however, is a problem in environmental science because of limited possibility of experimentation.

In this module participants will study techniques to infer causation from environmental data and to develop models to predict change in the state of the resource base in response to changes in the environment.

Contents

Whereas the preceding modules 7 and 8 placed emphasis on earth observation for mapping and monitoring, this module emphasizes the role of GIS as a tool for examining causes and impacts using models of natural resources.
During the module, all participants study a range of generic approaches to infer causation from environmental data and to assess the possible impacts of change on the resource base.
Throughout the module (and especially during the case study), however, participants have the opportunity to apply the techniques learned to discipline-specific examples, for example:
Land Use Planning and Land Evaluation, crop yield modelling, forest yield modelling, fire hazard modelling, erosion modelling, population viability analysis for biodiversity studies, and modelling impacts of climatic change.

1. Techniques for empirical modelling

- Sampling and experimental design
- Simple, multiple and curvilinear regression analysis
- Inference of causation
- Replication and pseudoreplication
- BACI (before-after-control-impact) methods.

2. Predictive and dynamic process modelling

A number of different models of natural resources will be presented, as well as specific issues related to working with these models. These models take different approaches to the description of the natural world, depending on the objectives of the model. These range from simple static models to dynamic process models. A discussion of elements of proper use is included, and special use cases such as Spatial Decision Support Systems are presented.

Objectives

The participants will gain an understanding of different classes of models of natural resources and have experience in their applicability and application.

The participants focus more in depth on the use of methods and techniques in a particular modelling context at 'guided choice' basis. Case studies and assignments are also intended to further develop student's analytical and problem solving competence.

- Describe limitations of correlative statistics and select and apply appropriate techniques to infer causation in environmental science;
- Apply appropriate sampling design and statistical technique to infer causation from environmental data;

- Describe, select and apply various available techniques to predict impacts and consequences of environmental change (modelling, scenario building);
- Apply these techniques in a case study and critically assess the quality and uncertainty of the resulting predictions.
- Demonstrate awareness of causation in natural resources management (essay).

Prerequisites
Modules NRM 1-8.

Recommended Knowledge
Not applicable

Hardware and Software Requirements
ArcGIS, several models.

Teaching Materials
Papers and handouts will be distributed during the module.

Allocated Time per Teaching Learning Method

L	SP	GA	IA	S	O
28	12	0	48	48	8

Time (in # of hours) allocated per major method:
L lecture,
SP supervised practical,
GA group assignment (e.g. workshop, project),
IA individual assignment (including Thesis, IFA),
S self study,
O overhead (e.g. QH, exam, opening)

Assessment
Participants will write an exam on the theory of the course and submit a small written report on an Individual Assignment applying a model of natural resources.

Societal response and reflection on NRM			
Module: 6b		Co-ordinating staff:	
Start:	13-4-2009		
End:	17-4-2009	Prof. Dr. Ir. E.M.A. Smaling	
Level: MSc			U09-NRM-129

Introduction
Society responds to changes in or threats to its natural resource base with policies and programmes that intend to prevent, reduce or mitigate pressures and negative impact on a desired state.

In this module, participants focus on the potential and limitations, on the effectiveness of geo-information in natural resources management. This also involves an element of evaluation, whether the various concepts, methods, techniques and tools considered constitute a solid whole; to reflect on the role of the natural resources information specialist (i.e. as typical ITC graduate) in the NRM process.

Objectives
The objectives of this module are twofold.
On the one hand participants will be confronted with examples of societal response: they will see whether and how natural resource expertise and geo-information is actually being used by elements of society involved in NRM.
On the other hand, as an exercise in reflection on NRM, participants will critically evaluate methods and approaches emphasized so far in NRM block 2 to see if, and how, the various concepts, tools, techniques and methods constitute a solid whole.

Contents
- Guest lectures about practical issues and examples related to societal response in NRM.
- Study trip to a Dutch NRM project
- Simulation game to help participants to evaluate the role of expertise and geo-information about natural resources in elements of societal response.

Prerequisites
Modules 1-9 of the MSc course.

Recommended Knowledge
See above prerequisites.

Hardware and Software Requirements
Not applicable.

Teaching Materials
Handouts.

Allocated Time per Teaching Learning Method
Under review (final schedule will be published in Black Board).

Assessment
Participants will have to satisfactorily complete the various assignments given during the module. Participants will have to demonstrate that they can perform satisfactorily in an inter-disciplinary group work preparation, development of materials, and presentation.

Project			
Module: 10		Co-ordinating staff:	
Start:	20-4-2009		
End:	08-5-2009	Ir. B.G.C.M. Krol	
Level: MSc			M09-NRM-114

Introduction
In the course of the previous five modules, participants worked through a cycle of scientific approaches to using geo-information science and earth observation to support natural resources management. During these modules, participants studied

- Systems analysis for NRM
- Geo-information for NRM – geo-information management and the societal response
- Mapping and monitoring
- Analysis of causes and the prediction of impacts

The final module of Block 2 of the course is devoted to a small project in which participants, working in small groups (*circa* 3 persons), reflect upon the knowledge and skills gained and then apply these to a real NRM problem. This module serves as an important benchmark for the following block of the MSc course and as a wrap-up activity for participants who follow module 5-10 as a short course.

Contents
Participants will select the topic of their project around the middle of module 9 (i.e. about 10 days before the start of this module). In most cases, suitable topics will be offered by and the required basic material provided by ITC. Within ITC, there is a large range of such topics and material, including examples of LUP and LE, crop yield modelling, forest yield modelling, fire hazard modelling, erosion modelling, population viability analysis for biodiversity studies, and modelling impacts of climatic change. If an individual student can convincingly show that he/she has all the required material from his/her own country and that the work can be undertaken within the limited time available, then such a project may also be approved.

Objectives
The module is almost entirely devoted project-based learning. In order to implement this approach, however, participants will receive clear guidelines for their (individual and group) role, and the role of the tutor in this process. Particular emphasis will be given to the importance of clearly defining work goals and preparation of and adherence to the associated time plan.

The first 2-3 days of the module will be devoted to introducing the project-based approach to learning, to the design of the project, and to defining work goals and preparation of a time plan. The final 2-3 days are allocated to the compilation of reports and to the assessment of the participants' presentations.

Prerequisites
Modules 1-9 of the NRM MSc course.

Recommended Knowledge
See above prerequisites.

Hardware and Software Requirements
As required for the chosen project.

Teaching Materials
Handouts and relevant material from previous modules.

Allocated Time per Teaching Learning Method
Full-time (group)work.

Assessment
The module will be assessed in two parts, namely *i)* the output of the group (quality and completeness of the deliverables) and *ii)* the individual participants understanding of and contribution to the project.

MSc Research Skills			
Module: 11		Co-ordinating staff: Dr. D.G. Rossiter	
Start:	18-05-2009		
End:	05-06-2009		
Level: MSc			P09-EDU-100

Introduction

The ITC MSc thesis research phase aims to strengthen your ability to execute scientific research. The success of your thesis research depends, apart from skills and conceptual background in your scientific discipline, also on the ability to adequately structure your thesis. This module provides a set of generic research skills applicable to all MSc students at ITC to improve performance in the subsequent thesis research. The module teaches you why research is structured as it is and challenges you to develop the ability to critically review scientific work of yourself and others. You will be trained to analyze the structure, logic and quality of research with examples from your own scientific field. Also you will develop skills to structure scientific research. The module finally aims to create common understanding of what is expected of a thesis and how it will be assessed, to allow you to comply with these expectations.

Contents

- Logic and structure of scientific research.
- Inference in various scientific disciplines.
- Literature search, citation and bibliography.
- Abstracting and reviewing scientific research.
- Scientific writing and argumentation.
- Research quality and thesis assessment.
- How to structure an MSc thesis.
- Ethics and professionalism in research.

Objectives

Upon completion of the module, participants will be able to:

- understand why scientific research is structured as it is,
- recognize and critically assess research quality,
- present scientific research at a standard acceptable to the scientific community,
- find, evaluate, and summarize the most relevant and up-to-date scientific literature to support research, and
- structure an MSc thesis research according to academic expectations.

Prerequisites

Before entering module 11 participants have to submit their intended line of research (MSc pre-proposal), based on the available MSc projects presented at the MSc fair (March 11). This includes: choice of topic and rationale, choice of module 12, 13 and 14-15, available datasets, (optional) fieldwork planning and envisaged MSc supervisors.

At the start of module 11 participants must be able to:

- Present and discuss research in public;
- Communicate about technical subjects in written English;
- Understand the importance of innovation, quality and independent thinking in science.

Besides participants are expected to have:

- A background in at least one relevant scientific field;
- A critical/creative attitude.

Prerequisites

Not applicable.

Staff involved

Dr. P.M. van Dijk, Director Graduate Programme

Dr. D.G. Rossiter, overall coordinator module 11

Delegate coordinators per course:
Dr. N. Kerle (AES)
Dr. J.E. Stoter (GFM)
Drs. J.C. de Meijere (GSIM)
Ir. W.T. de Vries (LA)
Dr. J. de Leeuw (NRM)
Dr. R.V. Sliuzas (UPM)
Dr. A.S.M. Gieske (WREM)

other departmental staff and supporting staff (Library, RC, IT)

Hardware and Software Requirements

Networked PCs, Word, End note and access to scientific bibliographic databases.

Teaching Materials

Digital presentations, description of assignments, reader, scientific articles and MSc theses for review.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
31	4	0	0	0	98	11

Time (in # of hours) allocated per major method:
L lecture,
SP supervised practical,
UP unsupervised practical,
GA group assignment (e.g. workshop, project),
IA individual assignment (including Thesis, IFA),
S self study,
O overhead (e.g. QH, exam, opening)

Assessment

(1) Full participation in (group)discussions is expected;

(2) Further, the mark is derived from four written assignments:

1. Literature skills: (i) Finding relevant literature from specified information resources, (ii) entering references to these in a bibliographic database, (iii) organizing the main points into a coherent paragraph, and (iv) formatting a reference list from the bibliographic database;
2. Summarizing and abstracting an important scientific paper in the research field of your course;
3. Assessing a published thesis from your course according to ITC criteria;
4. Arguing a scientific position in correct, compact and direct structured technical English.

Advanced topics 12 & 13			
Module: 12 & 13		Overall Co-ordinating staff: Dr. P.M. van Dijk	
Start:	08-06-2009		
End:	17-07-2009		
Level: MSc			P09-EDU-101/102

Introduction

Modules 12 and 13 form the backbone of the third Block of the MSc programme. Following module 11 on research skills and before the engagement in research themes during modules 14-15, students are equipped with advanced subjects for their research. During modules 12 and 13 students will learn in depth about specific research tools, methodologies and applications that are important for their envisaged MSc research. Participants have to make a logical choice that fits with their envisaged MSc research during Block 4 (MSc research phase; modules 16-23). The choice is made and explained in the MSc pre-proposal that has to be submitted after the MSc fair (March 12th 2008) and before the start of module 11 (exact date and format to be specified).
The final list of choice for the 2008/09 courses will be available by January 2009, after evaluation of the 2007/08 courses and final approval by the Academic Board. The subjects may be updated/changed, new subjects may be added and some may be deleted.
In this generic study guide description the 24 advanced subjects of the 2007/08 course are mentioned to show the range of subjects. Their descriptions can be viewed in the "Search module descriptions" option on internet:
http://www.itc.nl/education/courses/modules.aspx, select study guide = 2007-2008, level = MSc and module = 12, respectively 13.

Contents

Module 12:	Title	Chair	Module Coordinator
M09-EOS-100	Advanced image analysis	Prof. A. Stein	Dr. V.A. Tolpekin
M09-GIP-100	Design and Implementation of Spatial Databases	Prof. M.J. Kraak	Dr. R.A. de By
M09-ESA-100	Essentials of physical process modelling	Prof. V.G. Jetten	Prof. V.G. Jetten
M09-EOS-101	Geostatistics	Prof. A. Stein	Dr. D.G. Rossiter
M09-ESA-101	Hyperspectral Remote Sensing	Prof. F.D. van der Meer	Dr. H.M.A. van der Werff
M09-EOS-102	Inferential statistics	Prof. A. Stein	Dr. J. de Leeuw
M09-EOS-103	Laser scanning and InSAR	Prof. M.G. Vosselman	Prof. M.G. Vosselman
M09-PGM-100	Managing geoinformation systems in the public sector	Dr. C.M.J. Paresi	Dr. D.D. Navarra
M09-NRS-100	SAR Remote Sensing	Prof. A.K. Skidmore	Dr. Y.A. Hussin
M09-PGM-101	Spatial growth and spatial interaction modelling	Dr. R.V. Sliuzas	Dr. M.H.P. Zuidgeest
M09-PGM-102	Spatial planning support systems and scenario development	Dr. C.M.J. Paresi	Dr. M.A. Sharifi
M09-PGM-103	Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) applying Spatial Decision Support tools	Prof. A. van der Veen	Drs. J.M. Looijen
M09-GIP-101	Time series	Prof. M.J. Kraak	Prof. M.J. Kraak

Module 13:	Title	Chair	Module Coordinator
M09-EOS-104	3D Geoinformation	Prof. M.G. Vosselman	Dr. M. Gerke
M09-EOS-105	Advanced statistics	Prof. A. Stein	Prof. A. Stein
M09-PGM-104	Applying research methods for public sector geoinformation management	Dr. C.M.J. Paresi	Dr. D.D. Navarra
M09-GIP-102	Design and implementation of Geoinformation Services for SDI	Prof. M.J. Kraak	Ir. R.L.G. Lemmens
M09-ESA-102	Geophysics and 3D geo-visualization of the subsurface	Prof. F.D. van der Meer	Dr. M. van der Meijde
M09-ESA-103	Integrated Risk Assessment	Prof. V.G. Jetten	Dr. C.J. van Westen
M09-WRS-100	Large scale process modelling and data Assimilation	Prof. Z. Su	Prof. Z. Su
M09-PGM-105	Participatory GIS – principles and applications	Dr. R.V. Sliuzas	Dr. M.K. McCall
M09-WRS-101	Quantitative retrieval of geo(bio)physical parameters	Prof. W. Verhoef	Prof. W. Verhoef
M09-PGM-106	Scenario analysis and collaborative decision support	Dr. C.M.J. Paresi	Dr. M.A. Sharifi
M09-NRS-101	Spatial modelling of biological Ecosystem Properties	Prof. A.K. Skidmore	Dr. P.E. van Laake

Objectives
Specified per advanced subject.

Prerequisites
MSc modules 1-11 (and other specifications as given per subject).

Recommended Knowledge
Specified per advanced subject.

Staff involved
Appointed per advanced subject.

Hardware and Software Requirements
Specified per advanced subject.

Teaching Materials
For each advanced subject a collection of resources will be available in the digital learning environment Blackboard, the library or in hard copy.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
16	20	0	30	30	40	8

Time (in # of hours) allocated per major method:
L lecture,
SP supervised practical,
UP unsupervised practical,
GA group assignment (e.g. workshop, project),
IA individual assignment (including Thesis, IFA),
S self study,
O overhead (e.g. QH, exam, opening)

Assessment
Specified per advanced module, the assessment must result in a mark.

Research Themes / MSc Qualifier			
Module: 14 & 15		Overall Co-ordinating staff: • Dr. P.M. (Paul) van Dijk • Research project coordinators appointed per research theme • 2 MSc supervisors appointed beforehand for each participant	
Start:	08-06-2009		
End:	17-07-2009		
Level: MSc			P09-EDU-103

Introduction

Modules 14 and 15 form the last part of Block 3 of the MSc programme. While Modules 11 to 13 have instrumented the students with research methods and tools, the last two modules focus on the research themes of ITC. These themes form the subject framework and organizational structure in which MSc students conduct their individual MSc research in Block 4 of the MSc programme (modules 16-23). At the end of Module 15, a Thesis Admission Committee decides whether a student is admitted to Block 4.
Each ITC research theme offers one or more projects for Module 14 and 15, where possible together with one or more other themes. The general structure is the same; the content will be theme specific, and where possible inter-disciplinary. Research themes are free to fill this in within the boundaries described in this module description.
The purpose of Modules 14 and 15 is to deepen the knowledge and skills of students within the research theme and to help students to define their own MSc research proposal.
The student has to make a choice for a certain research theme, based on his/her envisaged MSc thesis topic. The following 15 themes are available:

Education Unit 14 / 15:	Title Research theme	Research theme leader
U09-NRS-101	Biodiversity in fragmenting landscape	Prof. A.K. Skidmore
U09-NRS-102	Carbon-cycle and climate change	Prof. A. de Gier
U09-ESA-100	Disaster management	Prof. V.G. Jetten
U09-ESA-101	Earth systems science	Prof. F.D. van der Meer
U09-NRS-103	Food security and environmental sustainability	Prof. E.M.A. Smaling
U09-PGM-100	Governance and Integrated Spatial Assessment	Prof. A. van der Veen
U09-PGM-101	Informed multilevel governance of urban regions	Prof. Y. Georgiadou
U09-PGM-102	Land administration for informed governance	Prof. J. Zevenbergen, Prof. P. van der Molen
U09-WRS-100	Managing water scarcity	Dr. M. Lubczynski
U09-GIP-100	Spatial data infrastructure technology	Dr. R.A. de By
U09-GIP-101	Spatio-temporal data integration and visualization	Prof. M.J. Kraak
U09-PGM-103	Sustainable urban-regional dynamics	Prof. F.A.M. van Maarseveen
U09-EOS-100	Stochastic methods for image mining and data quality	Prof. A. Stein
U09-EOS-101	Utilisation of sensor developments for efficient topographic mapping	Prof. M.G. Vosselman
U09-WRS-101	Water cycle climate	Prof. Z. Su, Prof. W. Verhoef

For more information about the content and scope of the ITC research themes, please visit: http://www.itc.nl/research/themes.asp

Contents

Two main activities run parallel in Module 14 and 15:
1. Finalizing the research proposal for the individual MSc thesis.
2. A group research project.

1. Finalizing the research proposal

The MSc research proposal is finalized by the student in mutual agreement with his/her MSc supervisors, appointed in Module 11. The research proposal should be a logical and ordered exposition of the envisaged research (as introduced in Module 11), including data availability, (fieldwork) methodology, a flowchart, and time allocation. All data should be available at the time of the proposal presentation. The research proposal should be presented before a Thesis Admission Committee (see MSc assessment regulations paragraph 5.1.1). Acceptance of the proposal is a prerequisite for the start of module 16. The MSc student will draft a supervision plan with the two appointed MSc supervisors.

2. Group research project

The purpose of the group project is:
- To let students place their own MSc research project and research interests in a wider scientific context.
- To give students a possibility to practice conducting a research project before their individual MSc research project.
- To give students an opportunity to practice doing research in a team.
- To give students the opportunity to share their knowledge in a multi-disciplinary context.

These are considered important as a preparation for conducting the individual MSc research in Block 4, as well as the professional academic working practice afterwards in which projects are often conducted in multi-disciplinary groups.

Research projects can be defined by one or several research themes. In any case, the projects are defined with a wide angle in order to cater for a variety of research approaches and interests, as well as the relevance for society. Projects are described with a title, a problem definition, and available dataset. The student group, consisting of a maximum of 5 students, is responsible for working this out into various activities according to an agreed plan. The student group has the freedom to make their own choices, supported by a tutor. The available projects will be made known early in 2009 in order to give the participants the opportunity to select a project that matches with their research interest. The choice has to be submitted before the start of module 11 (exact date to be specified) and should be justified within the MSc pre-proposal.

In a plenary session at the start of module 14, the Principal Investigator of the research group will introduce the various MSc subjects and their interrelation in the framework of the research of his/her group, and introduce the research assignments. A tutor will be appointed during module 14-15 to guide the students groups. The tutors will convene plenary sessions (in principle per research group) to monitor the progress of all participating students and exchange experiences in a discussion forum.

Objectives

Upon completion of these modules students will be able to:
1. Write an MSc research proposal.
2. Define ways how to tackle a scientific problem and structure research.
3. Place research projects in a wider scientific and societal context.
4. Structure scientific research to specifications of the scientific discipline.
5. Meet quality standards and excellence in research.
6. Present scientific information in written English at a standard acceptable to the scientific community.

Prerequisites
Completion of Module 1 to 13 of the MSc curriculum.
Because the research themes will be taught at advanced level, it is necessary to have a basic level of knowledge in the chosen research theme. Students who want to choose a research theme which differs from their choice in Block 1 and 2, have to provide evidence that they have the right background.

Recommended Knowledge
To be specified per research theme.

Staff involved
Overall coordination: Dr. P.M. van Dijk, Director Graduate programme:
- Research project coordinators appointed per research theme;
- 2 MSc supervisors appointed beforehand for each participant.

Hardware and Software Requirements
Identified per research theme.

Teaching Materials
For each research theme a collection of resources will be available in the digital learning environment Blackboard, the library or in hard copy.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
10	0	0	70	(120)	16 (+32)	(40)

Time (in # of hours) allocated per major method:
L lectures, (max. 10 = 5 hr/week during 2 weeks of project)
SP supervised practical,
UP unsupervised practical,
GA group assignment (= Group Research Project, incl. supervision),
IA individual assignment (= MSc proposal writing, incl. supervision),
S self study (8hr/week = 48 hr outside normal class/office hours),
O overhead (last week reserved for MSc proposal presentations).

Important:
The numbers are calculated for **two** modules: 96 hr (= 2 weeks) are allocated for the group research project, and 192 hrs (= 4 weeks) are reserved for the MSc proposal (=numbers between brackets).

Assessment
1. Group report of the research project.
2. Individual written reflection report on the group research project.
3. Individual MSc research proposal (written and oral presentation).

MSc Research and Thesis Writing			
Module: 16-23		Co-ordinating staff: Dr. P.M. van Dijk, Director Graduate Programme Course directors of all MSc courses 2 MSc supervisors per student	
Start:	07-09-2009		
End:	26-02-2010		
Level: MSC		AES, GFM, GSIM, LA, NRM, UPM, WREM	U09-EDU-111

Introduction
The final stage of the MSc course is dedicated to the execution of an individual research project. Each student works independently on an approved research topic (see module 15) connected to one of the 15 research themes of ITC. In the project the students develop their research skills further, interact with their fellow students, PhD's and staff members, and have to demonstrate that they have achieved the course objectives for the Master of Science degree by research, on academic level.

Contents
Based on the pre-proposal handed in before module 11, and the final accepted research proposal prepared in module 15, the student will carry out the planned activities. The students will be provided with guidelines for the thesis early in the course (specifically in module 11). Regular individual progress meetings with the supervisors will be held to monitor the progress on the research and thesis writing, and records of the progress will be kept. The supervisors keep the course director informed about the progress.

The activities normally include:
- Describe and define a problem statement and research topic and its research margins.
- In-depth literature review, including assessment of the usability of literature and previous research.
- Collection of relevant on-line and archived data.
- Preparation and execution of a (data collection) fieldwork (optional).
- Data processing and analysis and, if deemed necessary, adjustment of the research plan in consultation with the supervisors (based on sound arguments).
- Active participation in Institute seminars and *capita selecta* of the research theme under which the MSc research resorts.
- Mid-term presentation (first week of November).
- Preparation of the final manuscript of the MSc thesis (=hardcopy thesis and CD-rom with thesis, appendices and full dataset including original data and results).
- A critical review of quality, use and usefulness of the data and results, as well as the learning process.
- Oral presentation and defence of the MSc thesis before the Thesis Assessment Board, all in accordance with the relevant paragraphs of the MSc regulations.

Objectives
The student must be able to:
- Define, plan and execute a research project dealing with a problem related to the application of geo-information and earth observation in a domain that suits his/her background and course followed.
- Write a concise, logical and well structured thesis describing the key elements of the research process, the findings and recommendations.
- Orally present and defend the work done before the Thesis Assessment Board.

Prerequisites
Successful completion of MSc modules 1-15, and the ability to do research independently (ref. to par. 5.3.1. of the MSc regulations).

Recommended Knowledge
During the research phase, the students can specialise further in their own field of expertise.

Hardware and Software Requirements
Any hardware and software with authorisation of the MSc supervisors.

Allocated Time per Teaching Learning Method

L	SP	UP	GA	IA	S	O
0	0	0	0	1136	0	16

Time (in # of hours) allocated per major method:
L lecture,
SP supervised practical,
UP unsupervised practical,
GA group assignment (e.g. workshop, project),
IA individual assignment (including Thesis, IFA),
S self study,
O overhead (e.g. QH, exam, opening)

Assessment

A Thesis Assessment Board (TAB) will carry out the individual assessment based on the thesis and a presentation plus defence. The assessed aspects are:

- Research skills;
- Contribution to the development of the scientific field;
- Independent working;
- Critical and professional thinking;
- Scientific report writing;
- Presentation and defence.

For further details on the regulations and thesis assessment, see:

- ITC Regulations for courses leading to an ITC Master of Science (M.Sc.) Degree (September 2008);
- Instructions for Thesis Assessment Board.

ITC Assessment Regulations