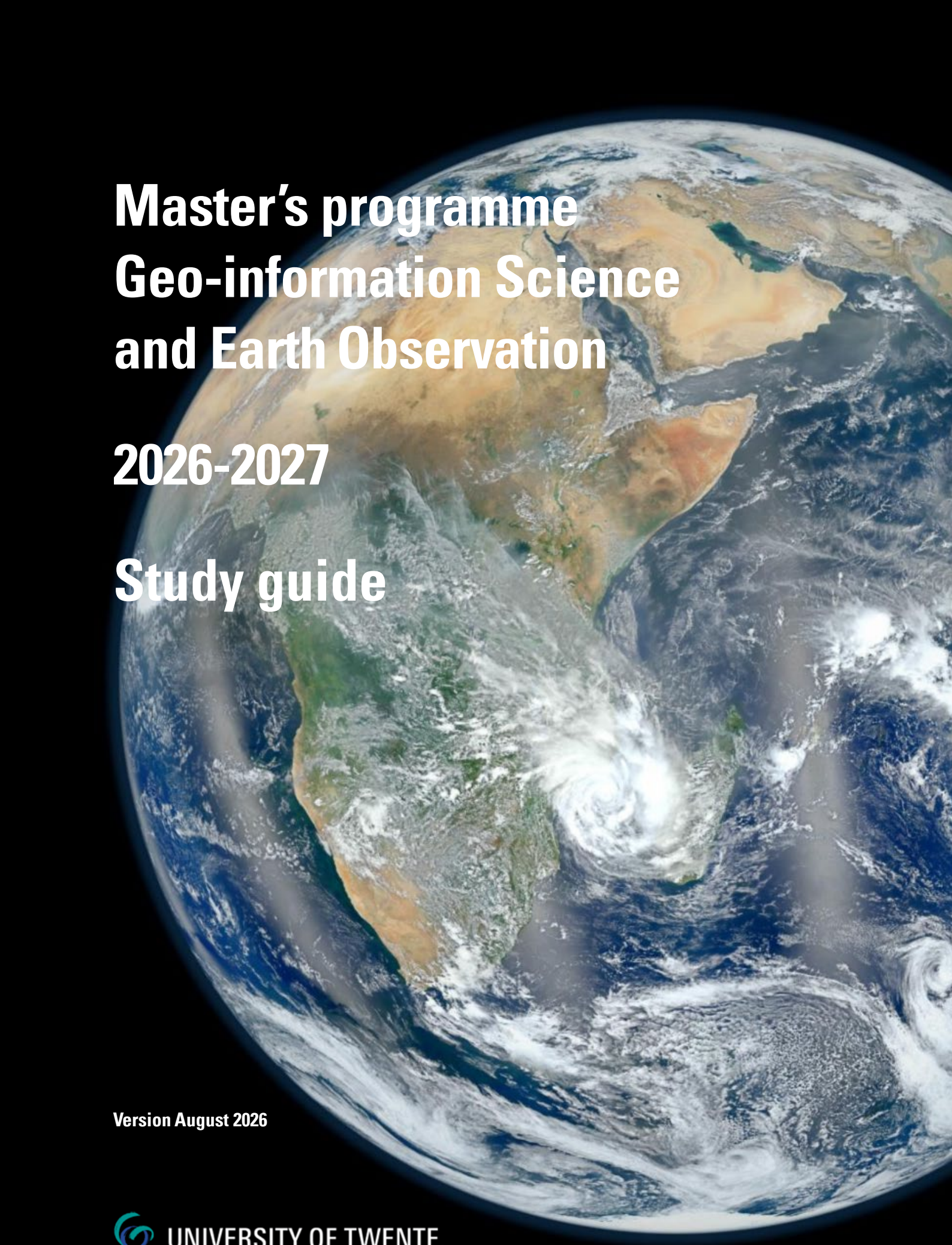
Master's programme Geo-information Science and Earth Observation

2026-2027

Study guide



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1. Introduction

You can contribute to creating a liveable and sustainable healthy planet and solve some of the world's most pressing challenges - such as climate change, food and water security, land scarcity, and natural disasters - by mastering the acquisition, analysis, and processing of geo-information and earth observation data.

You can design a sustainable future using geospatial information (fig 1). For example, we currently live in a digital society that is being geo-enabled by vital and ubiquitous earth observation data and geo-information. Consequently, we must use and manage, with the help of artificial intelligence, the vast quantities of earth observation and geospatial data available for real-time decision-making, monitoring the environment, finding & assessing our earth's resources, tracking species occurrences, quantifying ecosystem services, mapping health risks, analysing land-use patterns and predicting the changing climate. In short, a purpose of this programme is to help societies become geo-enabled.

Our planet is changing and we need to know where it is changing to understand how it is changing to design or engineer solutions for the changes that affect the sustainability of our society and living environment. This is the 'science of where': to analyse where changes are taking place, where stakeholders are affected, where solutions are most effective, and where we find the resources needed to support these solutions.

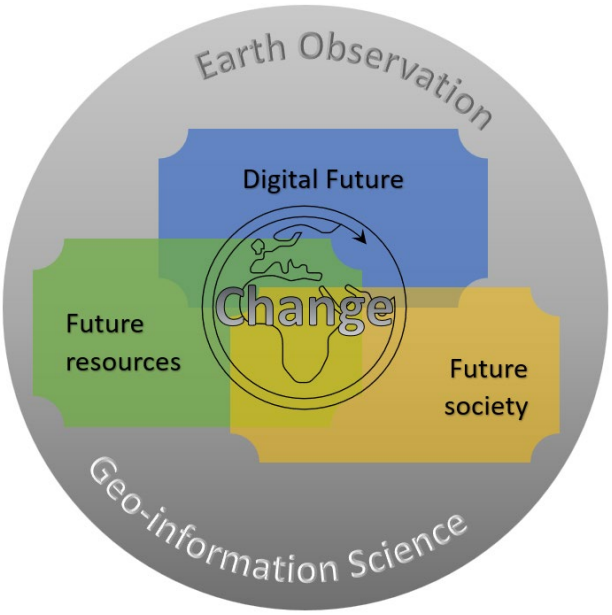


Figure 1: designing a sustainable future with geospatial science, data and technology

This international MSc programme, taught fully in English, is open to a diverse audience. What all participants have in common in an interest in tackling global challenges with geospatial technologies. The "MGEO" programme equips you with the geospatial skills needed to address the global challenges of today and tomorrow, finding solutions through local actions. You will gain the theoretical knowledge, develop the technical skills, and data competencies and achieve a critical attitude, to leverage geospatial technologies and data such as remote sensing, to address complex problems and engineer, design or develop innovative and sustainable solutions.

There is a global demand for experts in earth observation and geo-information sciences with advanced skills in GIS, applied remote sensing, and data science, including artificial intelligence (AI) and machine learning. MGEO therefore helps you develop a variety of technical and professional skills. During your study you will enhance your technical, digital and investigative capabilities while also taking into account the social and cultural context of the future society in which you will be applying these skills. This will enable you to translate technical knowledge into the actionable decisions that aid the policymakers to sustainably manage our future resources.

As a graduate of this programme, the skills and knowledge you acquire will enable you to work across disciplines for various national and international organisations. You'll have opportunities to connect with industry professionals through an extensive alumni network, guest lectures, internships, and career fairs. Whether you aspire to harness the latest geospatial technologies or innovate new ones, join us to acquire the skills needed to meet the growing demand in this exciting field.

The master's programme Geo-information Science and Earth Observation offers you specialisations that support a diverse range of career goals, and which can be tailored into a personalised educational experience. The specialisations are four interrelated themes within the programme's domain of geo-information science and earth observation: GeoAI, Resources Security, Disaster Resilience and Urban & Land Futures (fig. 2).

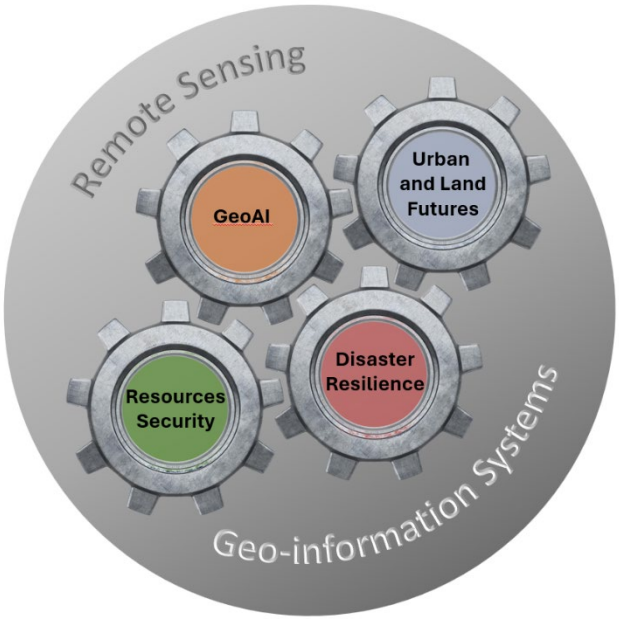


Figure 2: the interlinked themes of M-GEO, representing the future challenges, technologies and solutions for the sustainability of our earth's resources and society

Based on your personal interest, motivation, prior completed education and expertise, you choose a specialisation as entry point into the programme. By adding elective courses to the specialisation courses you create your own learning path, ultimately leading to your individual MSc research project (fig.3).

The programme starts with fundamental skills development, ensuring that all participants have the same base level of skills and knowledge about geo-information science and earth observation. Based on your intertest or career aspirations, you then decide on a specialisation to enhance your domain knowledge and learn to apply your skills within that context. You will complement your specialisation by a personal choice of elective courses that will further enable you to deepen or broaden your knowledge and skills and work on your professional development. Your studies will culminate in an individual research project where you will be able to apply everything that you have learned.

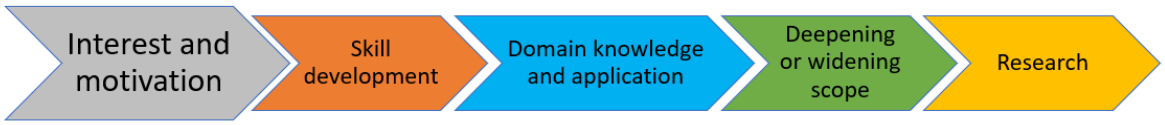
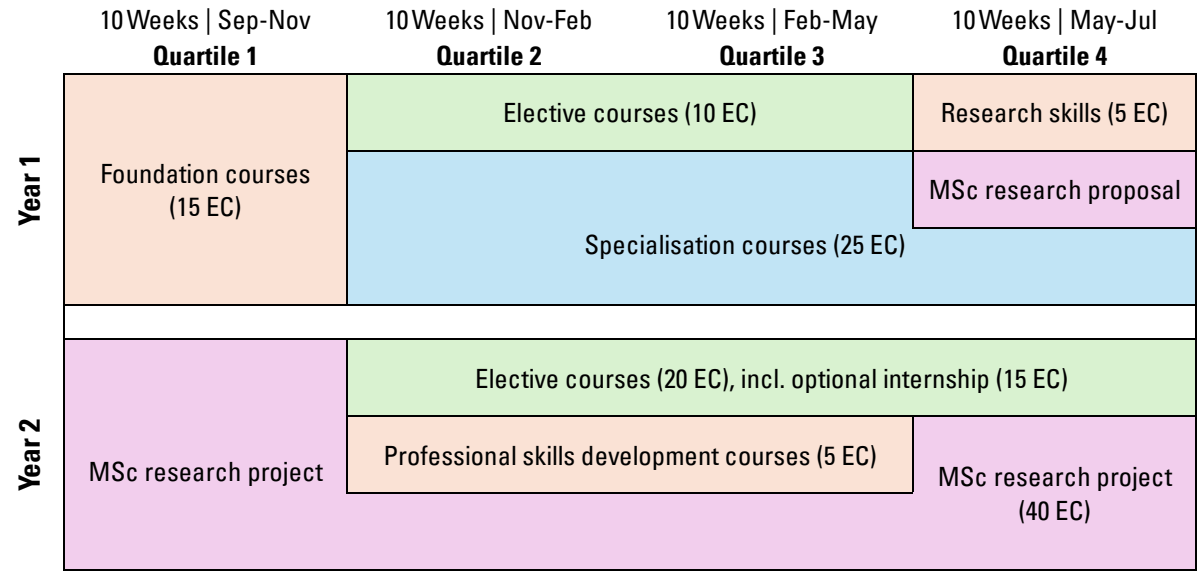


Figure 3: the sequence of learning in M-GEO

2. Structure of the programme

Programme name	Geo-information Science and Earth Observation
RIO	60480
Duration	Two academic years, divided over 4 quartiles each
ECTS	120
Language	English

For the Master's programme you will need to complete a total of 120 credits in 2 years. Each academic year is divided into **four quartiles**. Within each quartile, all **courses run over 10 weeks** according to the academic calendar of the University. The start and end dates of all courses in a quartile are therefore the same. Within each week of a quartile, the study load per course can vary. However, the **average study load per week is around 42 hours** (one EC is equivalent to 28 hours of study).



25EC	Mandatory courses for all programme participants
25EC	Mandatory courses for all specialisation participants
30EC	All participants must choose 30EC additional courses
40EC	MSc research project includes proposal writing, research implementation and thesis writing
120EC	(one EC is equivalent to 28 hours of study)

Our courses have a study load of either 5EC or 2.5EC. In brief, our Master's is built from 4 parts so that you develop the technical and theoretical GI-science skills along with specific skills in an area of interest through the specialisations, while also further developing your professional skills needed in the workplace:

1. **Programmme courses, mandatory courses for all programme participants (25EC).** There are three types of mandatory programme courses:

   Foundation courses (15EC): During the foundation courses you will learn the essential geospatial skills.These are designed to ensure that all participants develop the necessary geospatial skills to be successful for the remainder of the programme. Even if you already have some of these skills, during these courses you will be able to dive deeper and further refine and build on the knowledge you already have.

   Academic Research Skills (5EC). During the first academic year you will receive training and guidance on the necessary academic and research skills you will need to become an ethical academic professional and start your MSc research.To complete the programme, these 5EC's of courses and workshops are compulsory.

   Professional Skills (5EC). We have created a set of 2.5 EC elective courses to help you develop professional skills that are appreciated in the work field.These courses are essential to let you meet the additional demands of the labour market that go beyond technical skills and domain knowledge.These skills will enhance your chances of securing a job after graduation.To complete the programme, you must take 5EC's of these courses.

2. **Specialisation courses, mandatory for all participants in a specialisation (25EC**)

   The master's Geo-information Science and Earth Observation offers specialisations that allow you to focus on an application domain.The purpose of these specialisations is to provide students with further depth into an application domain.These are centred around the research strengths and expertise of the faculty so that you are learning from leaders in the field.These are:

   - Disaster Resilience
   - GeoAI
   - Resources Security
   - Urban & Land Futures
   - Free Specialisation*

   Each specialisation represents the future challenges, technologies, and solutions for the sustainability of our earth's resources and society. (*)The 'free specialisation' offers you the opportunity to create your own path, based on courses from different specializations.Your study adviser and a mentor will advise you on the feasibility of your choices.

3. **Electives (30EC):**
   We offer a range of electives that will enable you to further advance your technical skills, broaden your areas of interest and develop your professional skills.The electives offered each year may change from year to year depending on availability and demand.To complete the programme you must pass 30EC of elective courses.
   In the second year, you can choose to do an internship (15EC), where you can apply what you have learned before you graduate, gain additional work experience and explore different industries.You can do an internship at a consulting company, government agency, research institute, or a non-governmental organisation in the Netherlands or anywhere in the world.The choice is yours.You arrange an internship yourself.To help you, the internship coordinator organises Internship Fairs and can give you advice to arrange your internship. Doing an internship is optional, and is part of the 30 EC elective course choices.

4. **MSc Research andThesis writing (40EC):**
   The thesis research project starts with guided proposal writing in your first year, where you develop a project proposal. During the first year, you will meet many ITC faculty researchers and be introduced to the wide-variety and ongoing research and innovations taking place there. We have integrated different topics into the courses, giving you opportunities to learn more about how geospatial information and technologies are being used as well as providing you with opportunities to start to explore potential research topics that you can develop further as part of your MSc research. For your Master's thesis you are free to choose a topic of your choice. You can contribute to an ongoing research project or develop your own topic that falls within a research theme at ITC. Together with your supervisors, you develop the focus of the topic of your master's thesis research. Throughout the second year you will do the research and thesis writing with the guidance of your supervisors. The research project is a mandatory part of the programme.

Programme Learning Outcomes

Students should, upon completion of the programme, be able to:

1. Connect the state-of-the-art scientific knowledge and methods used in geo-information science and earth observation to an application domain.
2. Analyse problems from a geospatial perspective by taking into account the relevant temporal, social and cultural context in which these problems occur.
3. Acquire, create, transform and/or fuse geographic and earth observation data into useable and contextualized actionable information.
4. Design, implement and evaluate tools and solutions for geospatial problems, taking into account the relevant temporal, social and cultural context to which they apply.
5. Critically reflect on the ethical implications and academic integrity of their own actions and work.
6. Independently conduct scientific research, contributing to knowledge development in the field of geo-information science and earth observation.
7. Critically reflect on their own scientific work and that of others, to come to a judgement of the status of the work and how it could be used and improved or extended.
8. Communicate their work to specialists and non-specialists in the scientific and professional field, using appropriate communication channels and taking into account open science principles and the relevant social and cultural context.
9. Function cooperatively and empathically in culturally and disciplinarily diverse teams.

3. Programme Courses

The following courses are compulsory courses of the programme:

	Foundation and essential academic skills (1st year)	**Professional skills** (must choose two courses) **(2nd Year)**	**MSc research and thesis writing (2nd year)**
Q1	• Fundamentals of GIS and EO • Fundamentals of Spatial Data Engineering and Innovations • Fundamentals programming for geospatial data analysis		• MSc research
Q2	• Essential academic research skills (workshops)	• Communication & outreach • Project management & collaboration	• MSc research
Q3	• Essential academic research skills (workshops)	• Peer review & academic publishing • Introduction to entrepreneurship	• MSc research
Q4	• Essential academic research skills • Space for Ethics • MSc research and proposal		• MSc thesis defence

The M-GEO Foundation courses

During the foundation courses, students will learn essential geospatial skills.These are designed to ensure that all participants develop the necessary geospatial skills to be prepared for the remainder of the programme. Even if students already have some of these skills, during these courses they will be able to dive deeper into the science and further refine and build on the knowledge and skills they already have.

QGIS is the key tool we use in the programme for mastering through hands-on learning the basic geospatial concepts. Successfully completing the foundation courses grants students an official QGIS certificate, a valuable boost to their CV and career in geo-information.

Professional Skills Development courses

As students near the end of their MSc programme, many begin to look ahead to life after graduation. The professional skills electives offered in Quarters 2 and 3 of the second year are designed to support this transition, combining theory with hands-on experience to prepare students for diverse career paths in academia, industry, policy, and beyond.

Four standalone courses allow students to choose (at least) two that best match their personal interests and career goals.Those considering an academic path—such as a PhD—are encouraged to take *Peer Review and Academic Publishing*. Students leaning toward careers in industry, especially those interested in launching a business, may benefit from *Introduction to Entrepreneurship*.

Communication and Outreach helps students learn how to effectively convey scientific ideas to broader, non-specialist audiences, including stakeholders and policy professionals. Meanwhile, *Project Management and Collaboration* focuses on planning, teamwork, and group dynamics—essential skills for working in interdisciplinary and international (academic) teams.

The MSc research phase

The MSc research phase is geared towards supporting the students i) to deepen their knowledge and skills within the chosen research theme; ii) to help students to define their own MSc Research Proposal, and iii) to facilitate students to individually write a concise, logical and well-structured thesis. For this purpose, the research phase includes activities taking place along the two academic years.

During the first year several activities and workshops are organized to support you in your choice of research topic and to help you develop the essential skills to conduct your research during year 2. These activities include:

- A *topic fair*, where potential thesis topics are introduced and as a student you have the opportunity to meet and engage with potential supervisors;
- *Academic skills course and the "The Scientist's Toolkit" workshops*, hands-on sessions organized around several key topics that can be useful during your thesis writing phases
- *Proposal Writing Sessions*, that include peer-review and key-note lectures that directly feed in to your thesis proposal, that you have to defend by the end of Q4, in Year 1.

In the second year, the thesis phase is essentially determined by you (the student) and by your supervisory team. You should identify and plan with your supervisory team when you will go on fieldwork, which electives you are attending and when, and when a possible internship is expected to take place. Regular individual progress meetings with the supervisors will be held to facilitate the progress on the research and thesis writing, and records of the progress will be kept.

The activities in this second year include:

- Deepening of literature review, including assessment of the usability of literature and previous research;
- Collection of relevant data. If appropriate, preparation and execution of fieldwork to collect primary data required for the research;
- Data processing and analysis
- Active participation in seminars and activities of the research theme under which the MSc research resorts;
- Preparation of a final manuscript of the MSc thesis
- A critical review of the quality, use, usefulness and ethical considerations of the data and results, as well as the learning process;

Halfway between the proposal defence and the planned thesis defence, a Mid-term presentation is given by the student to show the progress made. This is a formative assessment, offering feedback on the achievements but predominantly designed to let the student show their grasp on what is still to come. A Thesis Assessment Board will assess the written thesis and an oral defence, by the end of Q4.

4. Specializations

The master's Geo-information Science and Earth Observation offers five specialisations. The purpose of these specialisations is to provide students with further depth into an application domain. These are centred around the research strengths and expertise of the faculty so that you are learning from leaders in the field. These are:

- Disaster Resilience
- GeoAI
- Resources Security
- Urban & Land Futures
- Free specialisation *

Each specialisation represents the future challenges, technologies, and solutions for the sustainability of our earth's resources and society. Specialisations offer courses and suggest elective choices to serve predefined interests or (career) directions. You can choose your elective courses as you like based on your personal ambitions.

Specialisation	Covered interests/directions	Brief Description
Disaster Resilience (DIR)	• Disaster Resilience Management • Disaster Resilience modelling and data analysis	Focus on risk reduction, disaster preparedness and response, recovery, and the build-up of resilience, especially in the context of climate change.
GeoAI (GAI)	• Remote Sensing Specialist • Geospatial Data Engineer and Analyst	Fusion of innovations in GI-Science and big geospatial data with the rapid growth of methods in AI and machine learning. Harnessing the power of technology to automate the analysis and interpretation of large and complex spatial datasets.
Resources Security (RES)	• Natural Resource Security, • Water Resource Security, • Earth Resource Security	focusing on water, food, energy, biodiversity and critical raw materials. An interdisciplinary approach to "System Earth," designed to develop competencies in quantitative remote sensing, resource modelling, and impact management.
Urban & Land Futures (ULF)	• Planning for liveable and resilient cities • Making cities and land SMART	Tackling social, environmental, economic, and land tenure challenges in urban and regional areas. Capturing the dynamic changes occurring in our cities, mapping and managing land security to help design sustainable cities of the future.
*** Free Specialisation**	If these options are not completely fitting your ambitions, we also offer you the opportunity to create your own learning path, based on the courses of different specializations. Your study adviser and will advise you on the feasibility of your choices.	

Disaster Resilience specialisation (DIR)

The *Disaster Resilience* specialisation offers exciting learning opportunities for students eager to focus on risk reduction, disaster preparedness and response, recovery, and the built-up of resilience, especially in the context of climate change. You will gain invaluable skills and knowledge tailored for various disaster resilience-related career opportunities, such as *managing*, *modelling* or *data analysis* related to disaster risk.

Under this specialisation, two suggested (career) directions exist. These offer a coherent set of courses directed at a certain career path. Probably one of the available (career) directions in the programme will suit your needs. You can tailor some of the courses and choices, but you should discuss this first with your mentor or study adviser.

Disaster Resilience Managing

Disaster risk is calculated using models, using different types of geodata. However, knowledge alone of an existing risk is not sufficient to reduce it and prevent or mitigate disasters. Instead, risk assessment often has to be fine-tuned or adjusted to specific locations, for example, a town or city. Then, specialists are needed to develop and execute strategies to reduce the risk. This can be done by reducing the hazard, such as giving rivers more spillover space before the water reaches the populated area. Or we can work on reducing the so-called vulnerability of people or structures, such as through better awareness-raising, or implementation of suitable building codes in areas susceptible to earthquakes. Finally, early warning and adequate action before an impending event such as a tropical storm arrives allows evacuation of people and securing of property. An increasing number of cities are employing dedicated resilience officers, such a those in the *100 Resilient Cities* initiative (funded by the Rockefeller Foundation).

Disaster Resilience modelling and data analysis

The resilience managers require appropriate risk information. This is generated by experts in modelling who understand the different forms of quantitative risk modelling, or by advanced data analysis experts trained in machine learning or Big Data analysis. In this course, we focus on modelling approaches using statistical information from past events, such as earthquakes or landslides, or on methods that make use of physical information, such as the specific geotechnical and topographic properties of areas susceptible to landslides. The Resilience Modelling expert thus becomes proficient in the use, adaptation and further development of different types of models, including the relevant statistical data and machine learning methods that apply. The data analysis direction will emphasise 3D modelling with photogrammetry and computer science approaches, machine learning, and semantic scene analysis, as well as relevant statistical and programming elements. This is suitable for students who want to work in the disaster resilience domain, but who also have a strong quantitative interest, and who are interested in a career in academia, a space agency or a research institute. Students who wish to specialise in advanced data analysis will follow several courses in the *GeoAI* specialisation.

For students interested in the Disaster Resilience (DIR) specialisation, the recommended curriculum is as follows:

Y1	**Programme courses (MANDATORY):**			
Q1	202600247 *	Fundamentals of GIS and Earth Observation (5 EC)		
Q1	202600248	Fundamental Spatial Data Processing and Analysis (5 EC)		
Q1	202600249	Fundamental Programming for Geospatial Data Analysis (5EC)		
Q4	202600417	Space for Ethics (2.5 EC)		
Q4	202600416	Essential Academic and Research Skills (2.5 EC)		
Q4	202500080	MSc proposal writing (5 EC)		
Y1	**Specialisation courses (LIMITED CHOICE, 10 EC in Q2 and 10 EC in Q3):**			
Q2	202500074	Introduction to Hazard, Risk & Resilience, & Role of Geodata (5 EC)		
Q2	202500075	Introduction to Data-driven Hazard Modelling (5EC)		
Q3	202500076	Weather & Climate (5 EC)		
Q3	202500077	Physically-based Hazard Modelling (5 EC)	**OR**	
	202500088	Multi-hazard Risk Assessment (5 EC)		
Q4	202500060	Urban and Land Futures Studio (5 EC)	**OR**	
	202500069	Lab and fieldwork skills (5EC)	**OR**	
	202500049	Advanced Machine Learning for Geospatial Sciences (5 EC)		
Y1	**+ 10 EC of the following recommended courses (CHOICE, 5 EC in both Q2 and Q3): ****			
Q2	202500045	Volunteered Geo-information and Geo Citizen Science (2.5 EC)	**AND**	
	202500087	Anticipating and Responding to Disasters (2.5 EC)		
Q2	202500044	Scientific Programming for Geosciences (5 EC)		
Q3	202500063	Planning for Disaster Resilient Cities (5 EC)		
Q3	202500068	Modelling and Mapping (5 EC)		
Q3	202500047	Machine Learning for Geospatial Sciences (5 EC)		
				60 EC
Y2	**Programme courses (MANDATORY):**			
	202500080	MSc thesis writing (35 EC)		
Y2	**+ 5 EC of the following professional skills development courses (LIMITED CHOICE):**			
Q2	202500113	Communication and outreach (2.5 EC)		
Q2	202500114	Project management and collaboration (2.5 EC)		
Q3	202500269	Peer review and academic publishing (2.5 EC)		
Q3	202500270	Introduction to entrepreneurship (2.5 EC)		
Y2	**+ 20 EC of the following courses (CHOICE): *****			
Q2	202500095	3D Modelling for city digital twins (5EC)		
Q2	202500051	Big Geodata Processing (5 EC)		
Q2	202500094	Drinking Water, Sanitation and Hygiene (WASH) for Improved Health		
Q2	202500083	Env. monitoring with integrated EO data and time series		
Q2	202500268	Participatory PlanningTools and Processes (5 EC)		
Q2	202500111	Qualitative Research Methodologies (5 EC)		
Q2	202500053	Radar remote sensing (5 EC)		
Q2	202500090	Thermal Infrared Remote Sensing (5 EC)		
Q2	202500057	UAV for Earth Observation (5 EC)		
Q3	202500055	Advanced Geospatial Analysis &Time Series (5 EC)		
Q3	202500056	Geoweb Apps & Services & SDI (5 EC)		
Q3	202200305	Laser Scanning & Point Cloud Processing (5 EC)		
Q3	202500052	Quantitative RS of Vegetation Parameters (5 EC)		
Q3	202500110	Spatial Analyses of Ecosystem Services (5 EC)		
Q3	202500066	Urban & Land Geo-data Acquisition and Dissemination (5 EC)		
YEAR	202500086	Internship (15 EC, available all year)		
				60 EC
				120 EC

* **For detailed course descriptions, enter the course code in: https://utwente.osiris-student.nl/onderwijscatalogus/extern/cursus**

** these 10 EC of courses can be changed into other curriculum courses if this better suits your personal goals.This can be decided together with your mentor and study adviser

*** choices can also include any of the specialisation courses offered in the first year, or courses from other programmes

Geospatial Artificial Intelligence (GAI)

Geospatial artificial intelligence (GeoAI) is an exciting fusion of innovations in spatial science (GIScience) and big geospatial data with the rapid growth of methods in AI and machine learning helping us to increase our understanding of earth processes and support the development of solutions to better manage earth's resources and ecosystems, improve our living environment and for example assess disaster risks. If you're passionate about harnessing the power of technology to automate the analysis and interpretation of large and complex spatial datasets integrating, for example, remote sensing images, UAV data, citizen science and local sensor data, then GeoAI is the perfect theme for you.

Under this specialisation, two suggested (career) directions exist. These offer a coherent set of courses directed at a certain career path. Probably one of the available (career) directions in the programme will suit your needs. You can tailor some of the courses and choices, but you should discuss this first with your mentor or study adviser.

Remote Sensing Specialist

As a Remote Sensing Specialist, you have extensive knowledge and skills on a wide variety of Remote Sensing sensors, and you understand the operational behaviour, limitations and capabilities of the platforms carrying them. You have an interest in the technology and how to advance its application for global challenges. This means you can cover the whole range from satellite remote sensing, through aerial survey, 'down to' drones/UAVs using, for example, optical (multispectral and hyperspectral sensors), radar or LiDAR sensors. It is not only vital to understand how to acquire relevant data but also to understand how to integrate the variety of data types and sources to support solving important critical environmental and societal challenges related to urban expansion, food security, disaster management, or climate change. You will explore and understand algorithms ranging from traditional machine learning like Random Forest and Support Vector Machine to cutting-edge deep learning such as, Convolutional Neural Networks or Transformer Networks. We emphasize on the appropriate application of these machine and deep learning algorithms to e.g. map changing glacier patterns, classify and monitor crops, study the spatiotemporal variations of nutrients in crop grains but also efficiently and accurately model 3D building and infrastructure for urban expansion modelling and flood assessment and prediction. There is a wide range of applications in which you can contribute with your versatile technical knowledge and competences in Remote Sensing.

Geospatial Data Engineer and Analyst

Data has become vital for governments, public organizations, and businesses to remain competitive, realize their aims, or fulfil legal mandates. Much of this data is geospatial and enables a wide range of applications. As a Geospatial Data engineer and scientist, you are responsible not only for building data infrastructures, integrating data from multiple sources, and enriching data to access relevant information, but also for (systems) modelling and analysing spatial and temporal data. You will help study, understand and address human and environmental problems thereby contributing to a more sustainable and digitally fairer world. As part of your tasks, you contribute to developing geodata-intensive solutions requiring you to translate scientific and technical questions from colleagues, management, or customers into data and information products. You can visualize and communicate analytical outcomes appropriately. You have a high level of conceptual thinking and a critical attitude when translating information needs into geospatial products and solutions. You can work with big data in the cloud or in a distributed fashion to perform and automate specialized tasks using coding. As an expert in using up-to-date analytical and artificial intelligence techniques, methods and tools, you can

reveal new patterns and insights from heterogeneous data sources. In short, you will contribute to the advancement of knowledge and technology by delivering actionable spatiotemporal information or information systems.

For students interested in the Geospatial Artificial Intelligence (GAI) specialisation, the recommended curriculum is as follows:

Y1		**Programme courses (MANDATORY):**		
	Q1	202600247 *	Fundamentals of GIS and Earth Observation (5 EC)	
	Q1	202600248	Fundamental Spatial Data Processing and Analysis (5 EC)	
	Q1	202600249	Fundamental Programming for Geospatial Data Analysis (5EC)	
	Q4	202600417	Space for Ethics (2.5 EC)	
	Q4	202600416	Essential Academic and Research Skills (2.5 EC)	
	Q4	202500080	MSc proposal writing (5 EC)	
Y1		**Specialisation courses (LIMITED CHOICE, 10 EC in Q2 and 10 EC in Q3):**		
	Q2	202500045	Volunteered Geo-information and Geo Citizen Science (2.5 EC)	**AND**
		202500042	Earth Observation for Resources Security 1 (2.5 EC)	
	Q2	202500044	Scientific Programming for Geosciences (5 EC)	
	Q3	202500047	Machine Learning for Geospatial Sciences (5 EC)	
	Q3	202500046	Geospatial Database Engineering (2.5 EC)	**AND**
		202500048	3D Geoinformatics for Engineering Applications (2.5 EC)	
	Q4	202500049	Advanced Machine Learning for Geospatial Sciences (5 EC)	
Y1		**+ 10 EC of the following recommended courses (CHOICE, 5 EC in Q2 and 5 EC in Q3): ****		
	Q2	202500051	Big Geodata Processing (5 EC)	
	Q2	202500053	Radar remote sensing (5 EC)	
	Q2	202500057	UAV for Earth Observation (5 EC)	
	Q3	202500055	Advanced Geospatial Analysis & Time Series (5 EC)	
	Q3	202500056	Geoweb Apps & Services & SDI (5 EC)	
	Q3	202200305	Laser Scanning & Point Cloud Processing (5 EC)	
				60 EC
Y2		**Programme courses (MANDATORY):**		
		202500080	MSc thesis writing (35 EC)	
Y2		**+ 5 EC of the following professional skills development courses (LIMITED CHOICE):**		
	Q2	202500113	Communication and outreach (2.5 EC)	
	Q2	202500114	Project management and collaboration (2.5 EC)	
	Q3	202500269	Peer review and academic publishing (2.5 EC)	
	Q3	202500270	Introduction to entrepreneurship (2.5 EC)	
Y2		**+ 20 EC of the following courses (CHOICE): *****		
	Q2	202500095	3D Modelling for city digital twins (5EC)	
	Q2	202500094	Drinking Water, Sanitation and Hygiene (WASH) for Improved Health	
	Q2	202500083	Env. monitoring with integrated EO data and time series	
	Q2	202500268	Participatory Planning Tools and Processes (5 EC)	
	Q2	202500111	Qualitative Research Methodologies (5 EC)	
	Q2	202500090	Thermal Infrared Remote Sensing (5 EC)	
	Q3	202500063	Planning for Disaster Resilient Cities (5 EC)	
	Q3	202500052	Quantitative RS of Vegetation Parameters (5 EC)	
	Q3	202500110	Spatial Analyses of Ecosystem Services (5 EC)	
	Q3	202500066	Urban & Land Geo-data Acquisition and Dissemination (5 EC)	
	YEAR	202500086	Internship (15 EC, available all year)	
				60 EC
				120 EC

* **For detailed course descriptions, enter the course code in:** https://utwente.osiris-student.nl/onderwijscatalogus/extern/cursus

** these 10 EC of courses can be changed into other curriculum courses if this better suits your personal goals. This can be decided together with your mentor and study adviser

*** choices can also include any of the specialisation courses offered in the first year, or courses from other programmes

Urban & Land Futures specialisation (ULF)

By 2050, 68% of the world's population is projected to live in urban areas, therefore making cities liveable, inclusive, safe and resilient to climate extremes is important. In addition, with more than 70% of the world's land parcels unregistered, the need for efficient, responsible land administration has never been greater. Land is the foundation of every society, yet millions face uncertainty about land ownership, particularly in and around urban areas. Geo-information and geospatial technologies play a vital role in capturing the dynamic changes occurring in our cities, mapping and managing land security to help design sustainable cities of the future.

The Urban and Land Futures specialisation is designed for students like you who are passionate about tackling social, environmental, economic, and land tenure challenges in urban and regional areas.

Under this specialisation, two suggested (career) directions exist. These offer a coherent set of courses directed at a certain career path. Probably one of the available (career) directions in the programme will suit your needs. You can tailor some of the courses and choices, but you should discuss this first with your mentor or study adviser.

Planning for Liveable and Resilient Cities

This will equip you with geo-information science skills that enables you to model, assess, and put forward solutions for creating more resilient, equitable, and inclusive cities and regions.

Through a blend of theory and hands-on practice, you'll master the latest tools and techniques for spatial planning and management while focusing on real-world impact. We emphasize **people-centric, socio-technical approaches** so that you can leverage advanced tools and methods like **digital twins, ecosystem services, nature-based solutions**, and **digital participatory planning** to design thriving urban environments. Join us to become a leader in shaping the smarter and more inclusive cities of tomorrow.

Making cities and land SMART*

This equips you with the expertise to develop responsible land administration systems that document and map people-to-land relationships. Without such systems, authorities, and communities don't know who owns what, residents don't have security of tenure and can lose their land or get evicted at any time.

Master cutting-edge technologies, including advanced geo-information and land surveying methods. Learn to model and utilize both **direct data sources (terrestrial and mobile data)** and **remotely sensed data (satellite, aerial, and UAV-drone imagery)**. Expand beyond **2D to develop 3D cadastral systems**, laying the groundwork for creating **Digital Twins**.

If you're passionate about solving global land issues or looking to enhance your career in land administration, this specialisation will give you the skills to make a real-world impact. Join us and be part of the solution to one of the most pressing global challenges- land tenure security!

*where SMART is: S- Sustained; M-Measured; A-Adjudicated; R-Registered and T-Tenured

For students interested in the Urban and Land Futures specialisation, the recommended curriculum is as follows:

Y1		**Programme courses (MANDATORY):**		
	Q1	202600247 *	Fundamentals of GIS and Earth Observation (5 EC)	
	Q1	202600248	Fundamental Spatial Data Processing and Analysis (5 EC)	
	Q1	202600249	Fundamental Programming for Geospatial Data Analysis (5EC)	
	Q4	202600417	Space for Ethics (2.5 EC)	
	Q4	202600416	Essential Academic and Research Skills (2.5 EC)	
	Q4	202500080	MSc proposal writing (5 EC)	
Y1		**Specialisation courses (LIMITED CHOICE, 10 EC in Q2 and 10 EC in Q3):**		
	Q2	202500045	Volunteered Geo-information and Geo Citizen Science (2.5 EC)	**AND**
		202500065	Urban Futures Modelling (2.5 EC)	
	Q2	202500061	Responsible Land Administration (5 EC)	**OR**
		202500062	Planning for liveable cities (5 EC)	
	Q3	202500046	Geospatial Database Engineering (2.5 EC)	**AND**
		202500059	Designing Urban and Land Information Systems (2.5 EC)	
	Q3	202500065	Urban Futures Modelling (5 EC)	**OR**
		202500064	Organizing Land Information in Practice (5EC)	
	Q4	202500060	Urban and Land Futures Studio (5 EC)	
Y1		**+ 10 EC of the following recommended courses (CHOICE, 5 EC in both Q2 and Q3): ****		
	Q2	202500268	Participatory Planning Tools and Processes (5 EC)	
	Q2	202500111	Qualitative Research Methodologies (5 EC)	
	Q2	202500095	3D Modelling for city digital twins (5EC)	
	Q3	202500063	Planning for Disaster Resilient Cities (5 EC)	
	Q3	202500066	Urban & Land Geo-data Acquisition and Dissemination (5 EC)	
				60 EC
Y2		**Programme courses (MANDATORY):**		
		202500080	MSc thesis writing (35 EC)	
Y2		**+ 5 EC of the following professional skills development courses (LIMITED CHOICE):**		
	Q2	202500113	Communication and outreach (2.5 EC)	
	Q2	202500114	Project management and collaboration (2.5 EC)	
	Q3	202500269	Peer review and academic publishing (2.5 EC)	
	Q3	202500270	Introduction to entrepreneurship (2.5 EC)	
Y2		**+ 20 EC of the following courses (CHOICE): *****		
	Q2	202500094	Drinking Water, Sanitation and Hygiene (WASH) for Improved Health	
	Q2	202500083	Env. monitoring with integrated EO data and time series	
	Q2	202500090	Thermal Infrared Remote Sensing (5 EC)	
	Q2	202500051	Big Geodata Processing (5 EC)	
	Q2	202500053	Radar remote sensing (5 EC)	
	Q2	202500057	UAV for Earth Observation (5 EC)	
	Q3	202500055	Advanced Geospatial Analysis & Time Series (5 EC)	
	Q3	202500056	Geoweb Apps & Services & SDI (5 EC)	
	Q3	202200305	Laser Scanning & Point Cloud Processing (5 EC)	
	Q3	202500052	Quantitative RS of Vegetation Parameters (5 EC)	
	Q3	202500110	Spatial Analyses of Ecosystem Services (5 EC)	
	YEAR	202500086	Internship (15 EC, available all year)	
				60 EC
				120 EC

* **For detailed course descriptions, enter the course code in:** https://utwente.osiris-student.nl/onderwijscatalogus/extern/cursus

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*** choices can also include any of the specialisation courses offered in the first year, or courses from other programmes

Resources Security specialisation (RES)

The **Resources Security** specialisation provides a comprehensive foundation for sustainable management of the natural environment, focusing on **water, food, energy, biodiversity** and **critical raw materials**. This Master's specialisation combines an interdisciplinary approach to "System Earth."

It is designed to **accommodate** diverse **academic backgrounds** and **career aspirations**. You will develop advanced competencies in quantitative remote sensing, resource modelling, and impact management through a combination of core courses and specialised electives. These skills prepare for a career as a geospatial information expert in hydrology, agriculture, environmental conservation and geology.

Under this specialisation, three suggested (career) directions exist. These offer a coherent set of courses directed at a certain career path. Probably one of the available (career) directions in the programme will suit your needs. You can tailor some of the courses and choices, but you should discuss this first with your mentor or study adviser.

Natural Resources Security

Natural resources are vital to the health and prosperity of societies. Their sustainable management is essential to balance the needs of people and the environment. This leverages geo-information and earth observation technologies to support the sustainable management of natural resources. It enhances your understanding of the systems and the processes that influence the availability, stability, quality, interactions, and resilience of agricultural, forestry and ecological resources, enabling their sustainable use, development, preservation or restoration. You will gain specialized expertise in the means and measures that are essential to understand and keep track of changes, and enable action, to sustain biodiverse and productive systems. You will develop skills in areas such as big data analysis, AI and machine learning, Earth observation, advanced image analysis, field measurements, spatial environmental monitoring and modelling, and programming with Python, in the context of real-world sustainable development challenges.

Water Resources Security

This equips participants with advanced knowledge in satellite hydrology to tackle societal challenges related to water resources and environmental security. It emphasizes the application of Earth observation, emerging sensor technologies, big data, artificial intelligence, and advanced tools for data analysis, modelling, and visualization. You will explore both the physical aspects of the water cycle - such as storage, variability, and changes in water quantity - and the biogeochemical aspects - such as variability in carbon and nitrogen cycles and changes in water quality. Participants will work with technologies including time-series satellite and airborne observations, in-situ measurements, environmental monitoring, numerical and systems modelling, data assimilation, and integration techniques. The goal is to assess, quantify, project, and predict key issues in water resources (e.g., floods, droughts, water use, climate and land-use impacts on water quantity) and environmental security (e.g., water pollution and quality under changing climate and land-use conditions).

Earth Resources Security

Here, students will learn to analyse and integrate geological and geophysical data to identify areas of mineral resources and geothermal fields, which are essential sources of clean, renewable energy. Students will learn methods and strategies to investigate the science related to geology and mineral resources, focusing on the application of multispectral and hyperspectral remote sensing, optical and thermal infrared spectroscopy, geophysics, geochemistry, and advanced image analysis. By the end of

the programme, students will know how to integrate remote sensing data with laboratory and field measurements and extract information from these datasets in digital workflow environments to explore essential Earth resources.The specialisation has clear links with "*Disaster Resilience*". Depending on the interest of the students, they may choose to follow certain course components with students from other specialisation (e.g. interest in water-related, vegetation-related, or geological extreme events).

For students interested in the Resources Security specialisation, the recommended curriculum is as follows:

Y1		**Programme courses (MANDATORY):**	
	Q1	202600247 *	Fundamentals of GIS and Earth Observation (5 EC)
	Q1	202600248	Fundamental Spatial Data Processing and Analysis (5 EC)
	Q1	202600249	Fundamental Programming for Geospatial Data Analysis (5EC)
	Q4	202600417	Space for Ethics (2.5 EC)
	Q4	202600416	Essential Academic and Research Skills (2.5 EC)
	Q4	202500080	MSc proposal writing (5 EC)
Y1		**Specialisation courses (LIMITED CHOICE, 10 EC in Q2 and 10 EC in Q3):**	
	Q2	202500042	Earth Observation for Resources Security 1 ((2.5 EC)
	Q2	202500043	Earth Observation for Resources Security 2 (2.5 EC)
	Q2	202600419	Resources Security Fundamentals (5 EC)
	Q3	202500068	Modelling and Mapping (5 EC)
	Q3	202500067	Impact monitoring and management (5 EC)
	Q4	202500069	Lab and fieldwork skills (5EC)
Y1		**+ 10 EC of the following recommended courses (CHOICE, 5 EC in both Q2 and Q3): ****	
	Q2	202500083	Env. monitoring with integrated EO data and time series (5 EC)
	Q2	202500090	Thermal Infrared Remote Sensing (5 EC)
	Q3	202500052	Quantitative RS of Vegetation Parameters (5 EC)
	Q3	202500110	Spatial Analyses of Ecosystem Services (5 EC)
			60 EC
Y2		**Programme courses (MANDATORY):**	
		202500080	MSc thesis writing (35 EC)
Y2		**+ 5 EC of the following professional skills development courses (LIMITED CHOICE):**	
	Q2	202500113	Communication and outreach (2.5 EC)
	Q2	202500114	Project management and collaboration (2.5 EC)
	Q3	202500269	Peer review and academic publishing (2.5 EC)
	Q3	202500270	Introduction to entrepreneurship (2.5 EC)
Y2		**+ 20 EC of the following courses (CHOICE): *****	
	Q2	202500094	Drinking Water, Sanitation and Hygiene (WASH) for Improved Health
	Q2	202500051	Big Geodata Processing (5 EC)
	Q2	202500053	Radar remote sensing (5 EC)
	Q2	202500057	UAV for Earth Observation (5 EC)
	Q2	202500268	Participatory PlanningTools and Processes (5 EC)
	Q2	202500111	Qualitative Research Methodologies (5 EC)
	Q2	202500095	3D Modelling for city digital twins (5EC)
	Q3	202500063	Planning for Disaster Resilient Cities (5 EC)
	Q3	202500066	Urban & Land Geo-data Acquisition and Dissemination (5 EC)
	Q3	202500055	Advanced Geospatial Analysis &Time Series (5 EC)
	Q3	202500056	Geoweb Apps & Services & SDI (5 EC)
	Q3	202200305	Laser Scanning & Point Cloud Processing (5 EC)
	YEAR	202500086	Internship (15 EC, available all year)
			60 EC
			120 EC

* **For detailed course descriptions, enter the course code in:** https://utwente.osiris-student.nl/onderwijscatalogus/extern/cursus

** these 10 EC of courses can be changed into other curriculum courses if this better suits your personal goals.This can be decided together with your mentor and study adviser

*** choices can also include any of the specialisation courses offered in the first year, or courses from other programmes

5. Elective courses

In the programme, you have 30 EC of free elective space that you can fill with all the available courses in the programme. During the first year, there will be 10 EC of recommended elective courses, that best fit with the specialisation you have chosen. In your second year you must choose another 20 EC of elective courses. You can choose any course that you did not yet follow as an elective course in your second year. The offer of courses changes annually, but in principle the courses are the same for both academic years. Courses will, however, not be offered if there are too few participants. The descriptions of all courses can be found in Osiris. Check Osiris regularly for updates on these elective courses.

6. Second academic year

In the second academic year, the available courses are expanded with the professional skills development courses. Otherwise, the courses offered in the curriculum are the same as that of the first year. The following courses are available from the M-GEO programme:

Y2		**Programme courses (MANDATORY):**	
	202500080	MSc thesis writing (35 EC)	
Y2		**+ 5 EC of the following professional skills development courses (LIMITED CHOICE):**	
Q2	202500113	Communication and outreach (2.5 EC)	
Q2	202500114	Project management and collaboration (2.5 EC)	
Q3	202500269	Peer review and academic publishing (2.5 EC)	
Q3	202500270	Introduction to entrepreneurship (2.5 EC)	
Y2		**+ 20 EC of the following courses (FREE CHOICE): ***	
Q2	202500268 *	Participatory Planning Tools and Processes (5 EC)	
Q2	202500111	Qualitative Research Methodologies (5 EC)	
Q2	202500095	3D Modelling for city digital twins (5EC)	
Q2	202500094	Drinking Water, Sanitation and Hygiene (WASH) for Improved Health	
Q2	202500083	Env. monitoring with integrated EO data and time series	
Q2	202500090	Thermal Infrared Remote Sensing (5 EC)	
Q2	202500051	Big Geodata Processing (5 EC)	
Q2	202500053	Radar remote sensing (5 EC)	
Q2	202500057	UAV for Earth Observation (5 EC)	
Q3	202500055	Advanced Geospatial Analysis & Time Series (5 EC)	
Q3	202500056	Geoweb Apps & Services & SDI (5 EC)	
Q3	202500063	Planning for Disaster Resilient Cities (5 EC)	
Q3	202500066	Urban & Land Geo-data Acquisition and Dissemination (5 EC)	
Q3	202200305	Laser Scanning & Point Cloud Processing (5 EC)	
Q3	202500052	Quantitative RS of Vegetation Parameters (5 EC)	
Q3	202500110	Spatial Analyses of Ecosystem Services (5 EC)	
YEAR	202500086	Internship (15 EC, available all year)	
			60 EC
			120 EC

* choices can also include any of the specialisation courses offered in the first year, or courses from other programmes

** **For detailed course descriptions, enter the course code in: https://utwente.osiris-student.nl/onderwijscatalogus/extern/cursus**

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