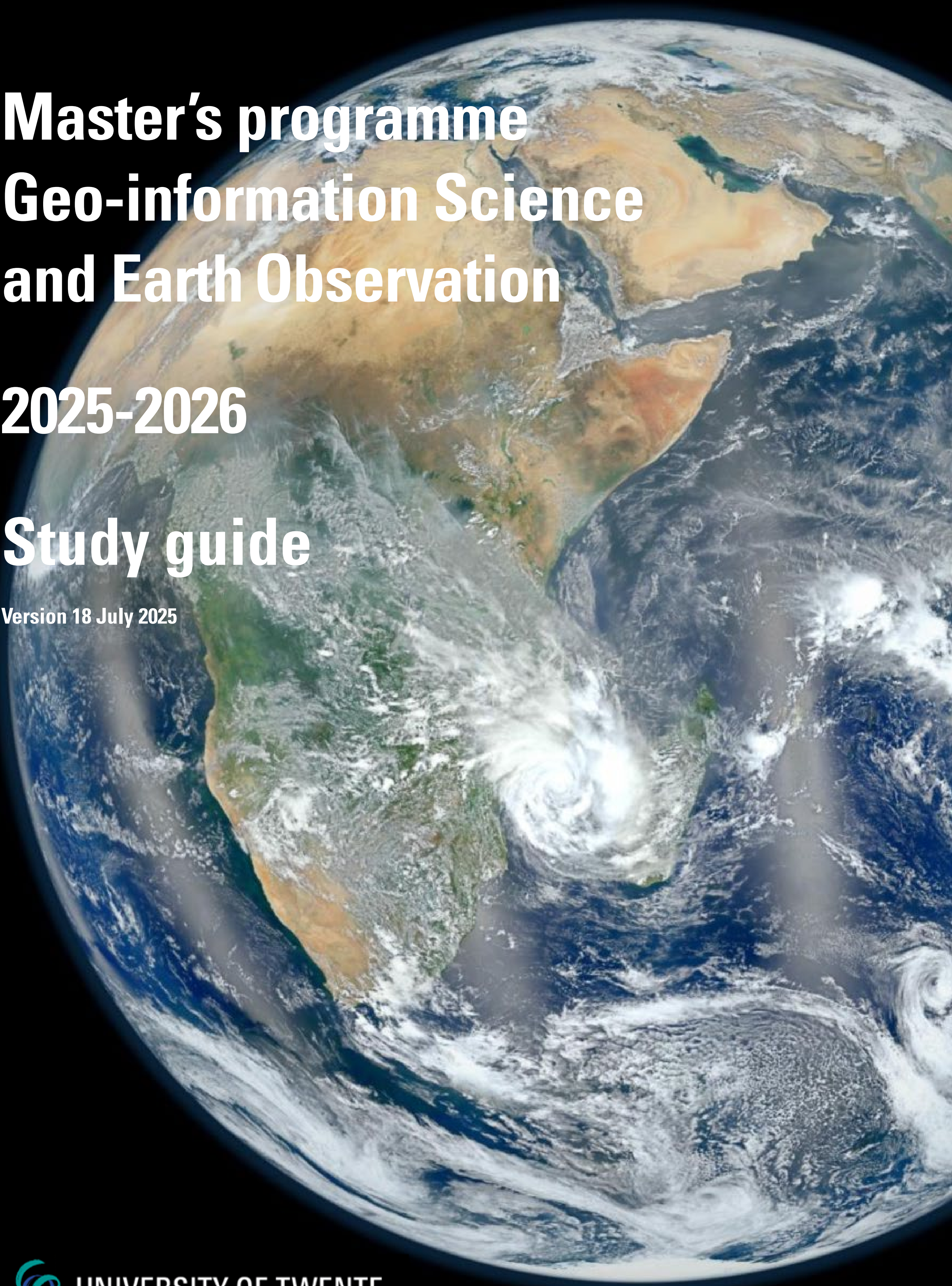


Master’s programme Geo-information Science and Earth Observation

2025-2026

Study guide

Version 18 July 2025

UNIVERSITY OF TWENTE.

Contents

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.

We cannot design a sustainable future without 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 geographic 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': 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.

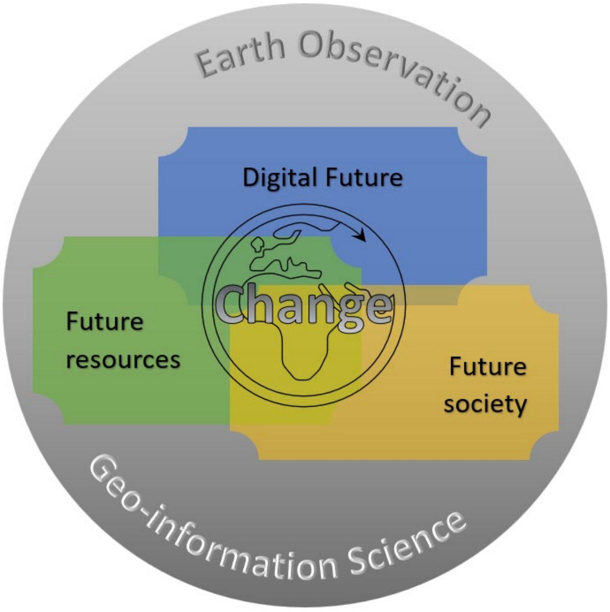


Figure 1: designing a sustainable future with geospatial science, data and technology

This international Master's programme, taught fully in English, is open to a diverse audience of all backgrounds. What all participants have in common in an interest in tackling global challenges with geospatial technologies. The 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 to leverage geospatial technologies and data such as remote sensing, to address complex problems and engineer, design or develop innovative and sustainable solutions.

During the programme you will develop a variety of technical and professional skills. There is a global demand for experts in earth observation and geographic information sciences with advanced skills in GIS, applied remote sensing, and data science, including artificial intelligence (AI) and machine learning. 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 pathways that can be tailored to achieving a diverse range of career goals with a personalised educational experience. We have created these pathways under four interrelated themes that enable us to use the expertise of the ITC faculty to address the future challenges. These themes are: GeoAI, Resources Security, Disaster Resilience and Urban & Land Futures (fig. 2). Each of these themes use digital innovations to address the future challenges and solutions for the sustainability of our earth's resources and society.

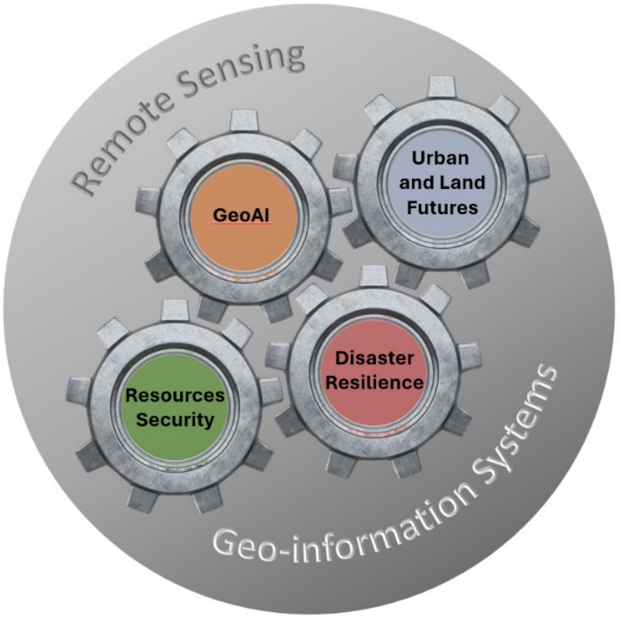


Figure 2: the interlinked themes of M-GEO, representing the future challenges, technologies and solutions for the sustainability of our earth's resources and society

Based on your personal interest, motivation, prior completed education and expertise, you can choose a learning pathway from a variety of themes as entry points into the programme where you will learn the latest skills and domain knowledge. A learning pathway follows a sequence of teaching and learning that starts with your personal interest and motivation (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 choose a thematic field to enhance your domain knowledge and learn to apply your skills within that context. You will complement your programme 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 what you learned.

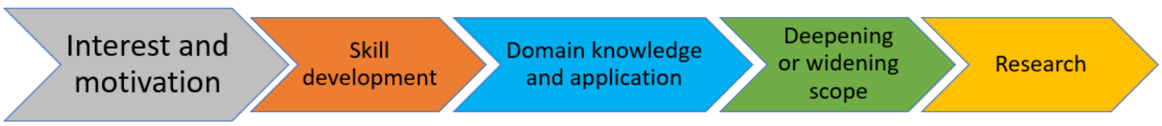


Figure 3: the sequence of learning pathways in M-GEO

2. Admission to the programme

Admission requirements

To be admitted to the Master's in Geo-information Science and Earth Observation, you should have a bachelor's degree or an equivalent qualification from a recognised university or accredited institution in a discipline related to the programme. We warmly welcome recent graduates, working professionals, midcareer individuals, and career changers. Working experience in a related field is not necessary but considered preferential.

Academic criteria

- A Cumulative Grade Point Average (CGPA) of 3.0 or higher on a 4.0 scale, or
- Upper Second Class standing or higher.

Note: a Lower Second Class standing may be accepted based on evidence of relevant professional experience and/or other further academic development.

Language requirements

Success in your studies requires a high level of English proficiency. Therefore, prospective students with an international degree must meet the English language requirement. As proof that you meet this requirement, you will be asked in the application procedure to upload one of the requested language certificates:

- IELTS (academic) with an overall band score of at least 6.0 (with a minimum sub-score of 6.0 for speaking and writing) and certificates not older than two years.
- TOEFL iBT (internet-based) with an overall score of 80 (with a minimum sub-score of 20 for speaking) and certificates not older than two years. Please note that the University of Twente does not accept the MyBest scores of the TOEFL test.
- Cambridge C1 Advanced Formerly known as; Cambridge English Advanced (CAE), obtained with an A, B or C grade.
- Cambridge C2 Proficiency Formerly known as; Cambridge English Proficiency (CPE) obtained with an A, B or C grade.

You are exempted from the English language requirement if you hold:

- a relevant bachelor's degree from an accredited academic institution in the Netherlands
- if you are a national of one of the countries in this list (PDF)

a three-year bachelor's degree in Australia, Canada (English-speaking part), Ireland, New Zealand, UK or USA. When your awarding institution is in one of these countries, but your teaching institution was not, you are not exempted. The same rule applies to distance (online) education.

See our website for full information: https://www.itc.nl/education/admission/

Admission process

When you apply for the programme, you will apply for general admission to the programme. During the process you will be requested to indicate your interest in one of the thematic lines of the programme. Your academic records will be assessed based foremostly on whether your prior education and experience will allow you to complete the programme within two academic years.

Once admitted, you are in the diving seat! A the start of the programme you can reevaluate your interest and crystalize your choice of learning path. Your study adviser will help you make your choices.

If your admission request is rejected, you will receive this rejection with a justification. If you are admitted, you are admitted to the general programme.

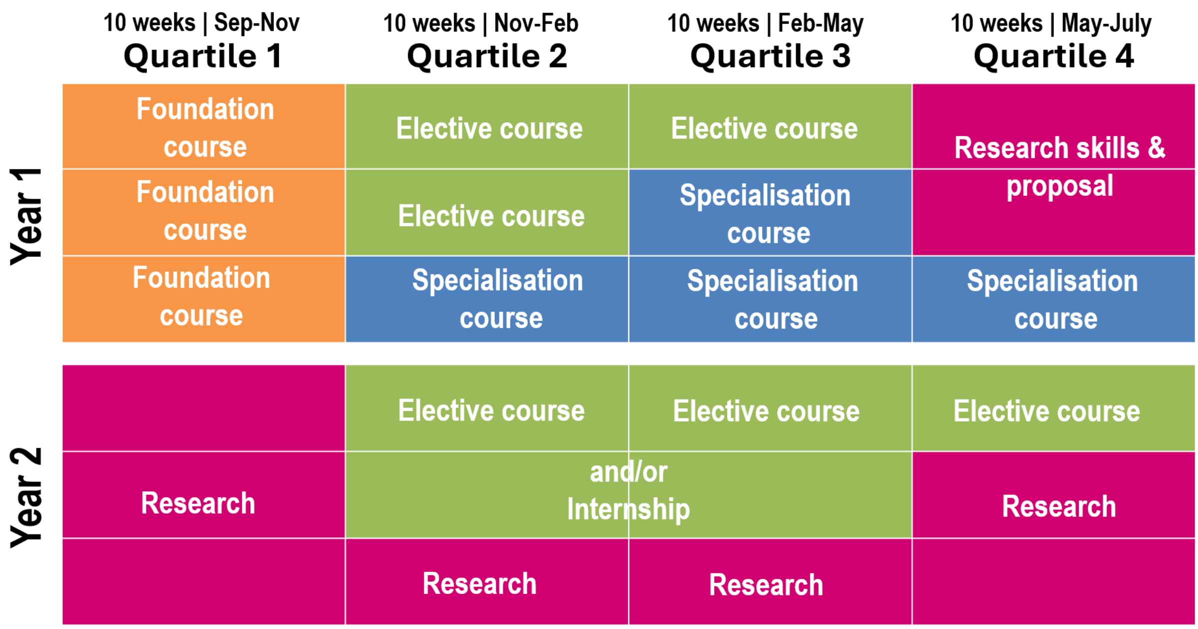
See our website for full information: https://www.itc.nl/education/how-to-apply/

3. Structure of the programme

Programme name	Geo-information Science and Earth Observation
RIO	101506874
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**.

Our courses are each 5EC with a few at 2.5EC. In brief our Master's is broken down into 4 parts so that you develop the technical and theoretical giscience skills along with specific skills in an area of interest through the specialisations, while also further developing your professional skills needed in the workplace.



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. Foundation courses are mandatory courses.

Specialisation courses (20EC): We offer specialisations that are centred around technologies (Geo-AI), the natural environment (Resource Security), and society (Urban Futures and Disaster Resilience). To complete the programme you must pass 20EC of specialisation courses.

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 centered 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
- Spatial Data Science*

Each specialisation represents the future challenges, technologies, and solutions for the sustainability of our earth's resources and society. Within each specialisation you are able to further refine your learning pathway.

*The Spatial Data Science specialization is a 'free specialisation' that offers you the opportunity to create your own learning pathway, based on the courses of the other specializations. Your study adviser and a mentor will advise you on the feasibility of your choices.

Electives (35EC): 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 35EC of elective courses.

Internship (15EC). In the second year, you can choose to do an internship 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. To help you choose we have an internship coordinator who organises Internship Fairs and will help you with setting up an internship. Doing an internship is optional, and is part of the 35 EC elective course choice.

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 often called 'soft skills' will enhance your chances of securing a job after graduation. To complete the programme, you must take 5EC's of these courses.

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, this 5EC's course is compulsory.

MSc Research and Thesis 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 and be introduced to the wide-variety and ongoing research and innovations taking place here. 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:

- Connect the state-of-the-art scientific knowledge and methods used in geo-information science and earth observation to an application domain.
- Analyse problems from a geospatial perspective by taking into account the relevant temporal, social and cultural context in which these problems occur.
- Acquire, create, transform and/or fuse geographic and earth observation data into useable and contextualized actionable information.
- Design, implement and evaluate tools and solutions for geospatial problems, taking into account the relevant temporal, social and cultural context to which they apply.
- Critically reflect on the ethical implications and academic integrity of their own actions and work.
- Independently conduct scientific research, contributing to knowledge development in the field of geo-information science and earth observation.
- 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.
- 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.
- Function cooperatively and empathically in culturally and disciplinarily diverse teams.

4. 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	• Academic research skills (workshops)	• Communication & outreach • Project management & collaboration	• MSc research
Q3	• Academic research skills (workshops)	• Peer review & academic publishing • Introduction to entrepreneurship	• MSc research
Q4	• Academic research skills • 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 Skill 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 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.

5. Elective courses

Beyond the courses that are offered with each programme component in this study guide, there are also free elective courses available for the 1st and second year. These are predominantly important to complete the second year of a learning pathway, but might also be relevant to tailor pathways in the first year. The offer of courses changes annually, and most courses will not be offered if there are too few participants. The descriptions of these courses can be found in Osiris through the links below. Check Osiris and canvas regularly for updates on these elective courses.

Course code	**Course name** You access the descriptions of each course by clicking on the course titles
201900138	Land Use Transport Interactions
202500091	GeoHealth
202500092	Entrepreneurship
202500093	Climate awareness raising
202500094	Water Decisions and Health (WASH)
202500095	3D Modelling for city digital twins
202500105	Engaging climate communication
202500106	Geo-journalism
202500107	Space for Ethics
202500108	Modelling Environmental Space-Time Processes
202500109	Economics & finances for geosciences
202500268	Participatory Planning Tools and Processes

6. Specializations and their learning pathways

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 centered 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 (Spatial Data Science)

Each specialisation represents the future challenges, technologies, and solutions for the sustainability of our earth's resources and society. There are a number of predefined pathways within each specialisation. You are able to further refine your learning pathway based on your personal ambitions.

Specialisation	Predefined pathway names	Brief Description
Disaster Resilience	• 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, • Geological Remote Sensing	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.
Spatial Data Science	• Free Specialisation	We offer you the opportunity to create your own learning pathway, based on the courses of different specializations. Your study adviser and a mentor will advise you on the feasibility of your choices.

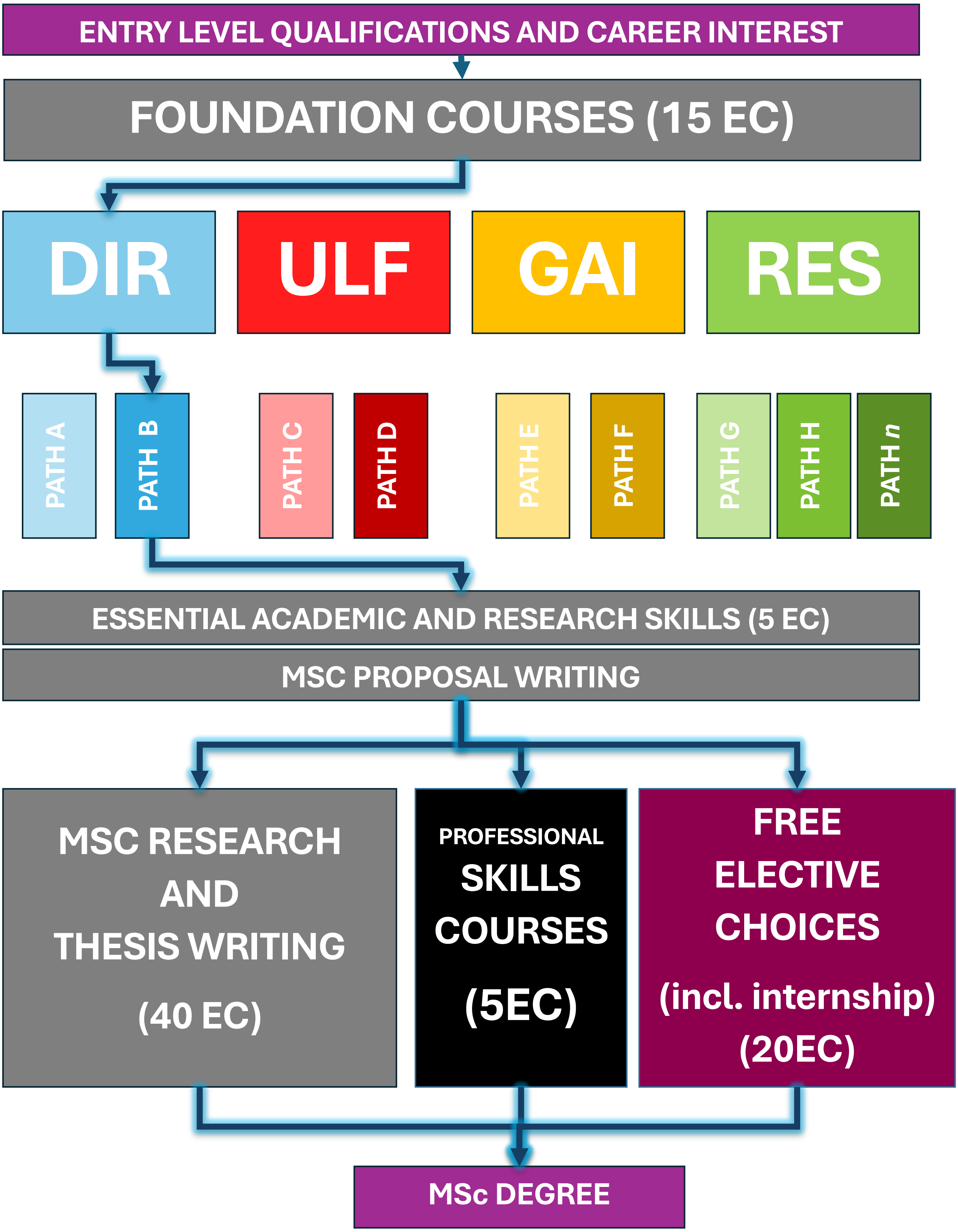


Figure 4. illustration of the programme with the nine predefined learning pathways and how these result ina Degree in Geo-information Science and Earth Observation. Further details are given with the specialisation descriptions.

Disaster Resilience specialisation

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, organised by learning pathways focused on *managing*, *modelling* or *data analysis* related to disaster risk.

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

Disaster Resilience Managing pathway

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). Since much of risk management relates to appropriate urban planning, this learning pathway includes courses taught in *Urban and Land Futures*.

Disaster Resilience modelling and data analysis pathway

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.

	Disaster Resilience Pathways and courses * You access the descriptions of each course by clicking on the course titles	
	Disaster Resilience Managing pathway	*Disaster Resilience modelling and data analysis pathway*
Q2	Introduction to Hazard, Risk & Resilience, & Role of Geodata (5 EC)	Introduction to Hazard, Risk & Resilience, & Role of Geodata (5 EC)
	Introduction to Data-driven Hazard Modelling (5 EC)	Introduction to Data-driven Hazard Modelling (5 EC)
	Anticipating and Responding to Disasters (5 EC)	Scientific Programming for Geosciences (5 EC)
Q3	Weather & Climate (5 EC)	Weather & Climate (5 EC)
	Planning for Disaster Resilient Cities (5 EC)	Modelling and Mapping (5 EC)
	Multi-hazard Risk Assessment (5 EC)	Physically-based Hazard Modelling (5 EC)
Q4	Urban and Land Futures Studio (5 EC)	Lab and fieldwork skills (5 EC)

You access the descriptions of each course by clicking on the course titles

* a pathway consists of the courses listed in either of the columns in the table. The total ECTS of courses in each column should add up to 35 EC. It is also possible to mix courses between the columns to create a personal pathway. It is recommended to discuss this first with your mentor. When you are interested in mixing courses from different specialisations in your pathway (courses that are not in this table), you must first discuss this with the study adviser.

Geospatial Artificial Intelligence (GeoAI)

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

Remote Sensing Specialist pathway

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 pathway

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.

	GeoAI pathways and courses * You access the descriptions of each course by clicking on the course titles	
	Geospatial Data Engineer and Analyst pathway	*Remote sensing specialist pathway*
Q2	Scientific Programming for Geosciences (5 EC)	Scientific Programming for Geosciences (5 EC)
	Earth Observation for Resource Security 1 (2.5 EC)	Earth Observation for Resource Security 1 (2.5 EC)
	Volunteered Geographic Information and Geo Citizen Science (2.5 EC)	Volunteered Geographic Information and Geo Citizen Science (2.5 EC)
	Big Geodata Processing (5 EC)	UAV for Earth Observation (5 EC)
	OR	OR
	Geovisualisation & ARVR (5 EC)	Radar Remote Sensing (5 EC)
Q3	Machine Learning for Geospatial Application (5 EC)	Machine Learning for Geospatial Application (5 EC)
	Geospatial Database Engineering (2.5 EC)	Geospatial Database Engineering (2.5 EC)
	3D Geoinformatics for Engineering Applications (2.5 EC)	3D Geoinformatics for Engineering Applications (2.5 EC)
	Advanced Geospatial Analysis & Time Series (5 EC)	Laser Scanning & Point Cloud Processing (5 EC)
	OR	OR
	Geoweb Apps & Services & SDI (5 EC)	Advanced Geospatial Analysis & Time Series (5 EC)
Q4	Advanced Machine Learning for Geospatial Application (5 EC)	Advanced Machine Learning for Geospatial Application (5 EC)

* a pathway consists of the courses listed in either of the columns in the table. In both quartile two and three (Q2 and Q3) you must choose one of the shaded courses. The total ECTS of chosen courses in each column should add up to 35 EC. It is also possible to mix courses between the columns to create a

personal pathway. It is recommended to discuss this first with your mentor. When you are interested in mixing courses from different specialisations in your pathway (courses that are not in this table), you must first discuss this with the study adviser.

Urban & Land Futures specialisation

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. Geographic 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 predefined pathways exist. These pathways offer a coherent set of courses directed at a certain career path. Probably one of the available pathways in the programme will suit your needs. You can tailor some of the courses and choices in these pathways, but you should discuss this first with your mentor or study adviser.

Planning for Liveable and Resilient Cities pathway

The *Planning for Liveable and Resilient Cities* learning pathway will equip you with geographic information science skills that will enable 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 pathway

The *Making Cities and Land SMART** learning pathway 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 andT-Tenured

Urban & Land Futures Pathways and courses * You access the descriptions of each course by clicking on the course titles		
	Planning for liveable and resilient cities pathway	*Making cities and land SMART pathway*
Q2	Urban and Land Futures (2.5 EC)	Urban and Land Futures (2.5 EC)
	Volunteered Geographic Information and Geo Citizen Science (2.5 EC)	Volunteered Geographic Information and Geo Citizen Science (2.5 EC)
	Planning for liveable cities (5 EC)	Responsible Land Administration (5 EC)
	Free choice (5 EC)	Free choice (5 EC)
Q3	Designing Urban and Land Information Systems (2.5EC)	Designing Urban and Land Information Systems (2.5EC)
	Geospatial Database Engineering (2.5 EC)	Geospatial Database Engineering (2.5 EC)
	Urban Futures Modelling (5 EC)	Organizing Land Information in Practice (5 EC)
	Planning for Disaster Resilient Cities (5 EC)	Urban & Land Geo-data Acquisition and Dissemination (5 EC)
Q4	Urban and Land Futures Studio (5 EC)	Urban and Land Futures Studio (5 EC)

* a pathway consists of the courses listed in either of the columns in the table. In both pathways, you have a free choice of 5 EC elective course(s) that you must choose in quartile two (Q2).You can check the Osiris study guide for the available courses.The total ECTS of courses in each column should add up to 35 EC. It is also possible to mix courses between the columns to create a personal pathway. It is recommended to discuss this, and the elective course choice, first with your mentor. When you are interested in mixing courses from different specialisations in your pathway (courses that are not in this table), you must first discuss this with the study adviser.

Resources Security specialisation

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**. With three dedicated **learning pathways**—Natural Resource Security, Water Resource Security, and Geological Remote Sensing—this Master's specialisation combines an interdisciplinary approach to "System Earth" with the possibility to specialise in one learning pathway.

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

Natural Resources Security pathway

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 pathway 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.

Through this pathway, 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 pathway

The Water Resource Security pathway 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, modeling, and visualization.

This pathway explores 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 modeling, 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 (Geological Remote Sensing) pathway

In this learning pathway, 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 learning pathways related to the "*Disaster Resilience*" theme clearly overlaps with parts of the *Resources Security* Theme. Depending on the interest of the students, they may choose to follow certain course components with students from other learning pathways (e.g. interest in water-related, vegetation-related, or geological extreme events).

Resources Security pathways * You access the descriptions of each course by clicking on the course titles			
	Geological Remote Sensing	*Natural Resource Security*	*Water Resource Security*
Q2	Earth Observation for Resource Security 1 (2.5EC)	Earth Observation for Resource Security 1 (2.5EC)	Earth Observation for Resource Security 1 (2.5EC)
	Earth Observation for Resource Security 2 (2.5EC)	Earth Observation for Resource Security 2 (2.5EC)	Earth Observation for Resource Security 2 (2.5EC)
	Dynamic Earth (5 EC)	Natural Resources Management Fundamentals (5 EC)	Water Cycle in the Anthropocene (5 EC)
	Thermal Infrared remote sensing (5 EC)	Quantitative Remote Sensing of vegetation parameters (5 EC)	Water and Carbon Dynamics in Ecosystems (5 EC)
			OR
			Observation & Quantification of Surface Water (5 EC)
Q3	Modelling and Mapping (5 EC)	Modelling and Mapping (5 EC)	Modelling and Mapping (5 EC)
	Impact monitoring and management (5 EC)	Impact monitoring and management (5 EC)	Impact monitoring and management (5 EC)
	Geological remote sensing for regional mapping (5 EC)	Env. monitoring with integrated EO data and time series (5 EC)	RS & Modelling of Primary Prod of Plant Growth (5 EC)
			OR
			HydroSat+ (5 EC)
Q4	Lab and fieldwork skills (5 EC)	Lab and fieldwork skills (5 EC)	Lab and fieldwork skills (5 EC)

* a pathway consists of the courses listed in either of the columns in the table. In the Water resources security pathway you must choose one of the shaded courses in both quartile two and three (Q2 and Q3). The total ECTS of chosen courses in each column should add up to 35 EC. It is also possible to mix courses between the columns to create a personal pathway. It is recommended to discuss this first with your mentor. When you are interested in mixing courses from different specialisations in your pathway (courses that are not in this table), you must first discuss this with the study adviser.

Free specialisation (Spatial Data Science)

We live in a data-centric world where spatial data is vital for decision-making, policy development, and the development of solutions to tackle the challenges we face. Learn how to leverage vast amounts of geospatial data to identify patterns, develop insights, and solve location-based problems using the latest technologies alongside statistics, machine learning and GeoAI methods and apply them to a specific problem situation.

You can use spatial data in many ways to understand where and why things happen. You will gain an understanding of the scientific field and how spatial data science skills can be applied to tackle a wide range of challenges we face today, which can range from disasters, urbanisation, health and the environment. To this purpose you can construct a personal pathway where you will develop the geospatial and data analysis skills that are useful for extracting information, mapping, monitoring, and modelling to suit your personal goals.

If you feel that existing specialisations and their pathways are not exactly offering you what you are looking for, it is possible to explore the combinations of courses from different specialisations. You do this together with the study adviser.

Spatial data science requires a combination of data science fundamentals, geospatial expertise, and strong analytical skills. This field integrates geographic information systems (GIS) and data science techniques to analyse spatial data, providing insights for various applications. Key requirements include proficiency in GIS software, programming languages, database management, and a solid understanding of spatial data formats and coordinate systems. You are able to acquire these skills through the compulsory programme courses and through the courses we offer across the specialisations and with the elective courses.

You can create a personal learning pathway on top of the 25 EC of compulsory coursework in the first year. You select a minimum of 20 EC specialisation courses and add as many courses to complete the study load of the first year. If your own pathway offers a feasible programme, the programme director will approve it. You can check the Osiris study guide for the available courses.

7. Assessment vision and policy of M-GEO

The full vision on testing and assessment for the faculty ITC, is available in the document "Assessment Policy Faculty Geo-Information Science and Earth Observation – ITC"

For M-GEO, the main elements of our assessment policy are following the assessment policy for the higher education accreditation system of the NVAO: "the programme must have (accreditation standard 3) an adequate system of student assessment in place". For M-GEO the means we ensure that:

- The student assessments are valid, reliable and sufficiently independent;
- The requirements are transparent to the students;
- The quality of interim and final examinations is sufficiently safeguarded and meets the statutory quality standards;
- The tests support the student's own learning processes.

<u>The purpose of testing and assessment</u> is: to allow students in the programme to demonstrate that they have, either individually or in groups, obtained the knowledge and skills taught in the programme to the level that is described in the learning outcomes of the courses.

To accomplish this, the programme has formulated clear final qualifications that meet international standards. The starting points are the domain-specific framework and the Meijers criteria or the Dublin Descriptors. M-GEO has established a relationship between the final qualifications and the learning objectives of the units (courses) in the curriculum. These learning objectives are formulated concretely and specifically, according to Bloom's taxonomy. Consequently, a firm relationship exists between the final qualifications, the learning objectives and the assessment of the learning objectives.

Within M-GEO, the selected test methods are consistent with the instructional methods and the learning objectives, following the principle of constructive alignment. Ultimately, this results in tests that are well-spread in time and a balance is maintained in each course between summative and formative purposes and individual and group testing.

Within the programme, there is room for experimentation with new test methods like competence-based testing, testing practical skills, etc. Also, methods like self-assessment and peer feedback are options. Digital testing is implemented related to the usefulness and practicality of this method and in accordance with the philosophy of the University on digital testing.

The quality of the examiner is reflected in the quality of the test. The test competency of examiners and the quality of tests are the programme director's responsibility. The Examination Board supervises the quality of the tests and examinations

Test Quality

It is essential that each test strives to fulfill the quality criteria for assessment:

Transparency: the students are clearly informed on how and what they are going to be assessed prior to the test. Clear information is available for students on when and what tests are scheduled. This includes information about the deadlines for assignment submissions and the size/estimated workload. The course coordinator is responsible for providing this information as early as possible to the students in the course, but never later than the second week of the course. Re-programming a test is only possible after clearance of the Examination Board.

Validity: the test covers the learning objectives. In validity, content (congruent with the learning objectives), level (of difficulty) and representativeness play a role.

Reliability: the test makes a meaningful distinction between the students who have a good or less good command of the learning objectives. The quality of the test plays a role here (distinctive character, minimal chance of gambling, clarity), the circumstances under which the test is administered (standardization and objectivity) and the way in which the results are assessed (objective, not random, accurate).

Manageability: A test should be doable: A maximum of one test per day is allowed. A written test should not commence within 24 hours of the start of the previous written test.

Test plan

Often, courses are graded by combining results from more than one test. In these cases, a test plan is necessary. In a test plan, the learning objectives of the course/module are represented and related to all the tests. In addition, the test methods are described, as well as the weight they have regarding the final grade. The test plan guarantees the consistency of the test with the learning objectives. The examiner is responsible for filling out the test plan. The test plan is considered valid when:

- Each course offers a mix of test methods that enables the examiner to assess the level of knowledge attained by the student as well as the authenticity of any submitted work.
- Each test is related to one or more specific learning objectives of the course.

Authenticity of submitted work

Within M-GEO, we follow the University guidelines for academic fraud and plagiarism. This includes the restrictions put on the use of generative AI. Examiners will always use software to check submitted written assignments for (self-)plagiarism. The student must be able to demonstrate that the submitted work is authentic and that the use of generative AI falls within the given restrictions. As a consequence, each assignment must be accompanied by clear guidelines or restrictions on the use of generative AI.

If the examiner cannot immediately assess the authenticity of the work, oral tests can also be used as an additional means to ascertain this.

Group assessment

A group assignment implies the collaboration of one or more students with the aim of achieving a specific result. With a group assignment, the student is also tested for mastery of secondary skills, such as collaboration, research, analysis, decision making, applying, designing, presenting, advising, evaluating and improving. The following aspects have to be considered:

- Clear expectations in instructions and guidelines for the students. Instructions for the grading, including rubric and weighing of various components (if applicable).
- The individual and the group components are assessed using an assessment framework derived from the learning objectives.

Oral tests

The task of the examiners is to make an objective assessment. Because each candidate is examined individually, it is difficult to guarantee comparability between students. As a result, there is often a difference between the mutual evaluation of teachers. There are a number of things that examiners must do to overcome most of this:

- A second examiner is present to enhance the objectivity of the assessment. Otherwise, a recording of the conversation must be made. All exam questions are written down, to ensure all students are assessed on exactly the same questions.
- An answer model for expected answers is prepared to use during the test;

Avoid uncertainty with the candidate: indicate whether questions are asked to clarify the answer or to gauge the insight. Let the candidate know whether, in addition to substantive criteria, other elements, such as the language used or the structure of the answer, are included in the assessment.

8. Student well-being and support

Career choices and study trajectories are demanding for every student. The choices to be made with uncertainties about the future and the need to perform are the pressures that many students experience during their academic programmes. At the University of Twente we are very much aware of these things and we do our best to prevent or to mitigate them. We have a team of professionals that will do this together with you. We will provide you with:

- Transparent communication during your application process
- Assistance in obtaining the necessary visa and making travel arrangements
- A guaranteed accommodation offer
- Assistance with health insurance and banking issues
- A soft landing in your study programme with a well-structured introduction programme that informs you about the basics of student life in the Netherlands

For this you can count on a study advisor and a mentor to be available to you for academic issues whenever you need them, and a student affairs team that is ready to help you with anything else.

Furthermore, the university offers a variety of self-help and moderated courses related to well-being.

9. Transitional arrangement

The Education and Examination Regulations are approved for each academic year. Therefore, for a two-year academic programme, no guarantee can be given that all the study units, as they existed at the time of a student's enrolment in a Master's programme, continue to be part of the student's study programme in their second year of enrolment. The study programme as most recently approved by the Faculty Board serves as the basis for establishing the results of the Master's final examination.

The curriculum for the MSc programme Geo-information Science and Earth Observation for the academic year 2025-2026 has significantly changed compared to the academic year 2024-2025. These changes will affect students:

1. That have started the programme in 2024 and still need to pass courses from their first academic year.
2. That have started the programme before 2024 and still need to pass courses from the old curriculum.

Students that have started the programme in 2024, can graduate in one of the following specialisations:

- Applied Remote Sensing for Earth Sciences (ARS);
- Geoinformatics (GFM);
- Geo-information Management for Land Administration (GIMLA);
- Natural Hazards and Disaster Risk Reduction (NHR);
- Natural Resources Management (NRM);
- Urban Planning and Management (UPM);
- Water Resources and Environmental Management (WREM).

For students that have started the programme before 2024, the Examination Board will determine, on the basis of the individual course record and the advice of the Programme Management, whether an old or new specialisation name can be applied.

The purpose of this transitional arrangement is to ensure that students do not experience any adverse effects of this change. In exceptional cases and to the student's benefit, the examination board may deviate from the prescribed number of opportunities to sit exams and/or tests related to study units that have been dropped from the curriculum.

Ad 1: students who have started the programme in September 2024 are entitled to:

- one test opportunity for each test of each course or study unit from the academic year 2024-2025 that is no longer offered in the 2025 curriculum. These test opportunities may be a full test, a repair or an alternative test. These test opportunities must be taken within the academic year 2025-2026. It will not be possible to still attend a course that is no longer offered.
- request approval from the examination board to replace the missing course(s) with course(s) from the new curriculum.
- keep the original specialisation of their enrolment on their diploma and course record if all specialisation courses or approved replacement courses were successfully completed.

Ad 2: students who have started the programme <u>before</u> September 2024 are entitled to:

- one test opportunity for each test of only one course of their first academic year they still need to pass and one test opportunity for each test of each course from their second academic year.

This is applicable for courses and study units that are no longer offered in the 2025 curriculum. These test opportunities may be a full test, a repair or an alternative test.These test opportunities must be taken within the academic year 2025-2026. It will not be possible to still attend a course that is no longer offered.
- keep the original specialisation of their enrolment on their diploma and course record if all specialisation courses or approved replacement courses were successfully completed.
- request approval from the examination board to replace the missing course(s) with course(s) from the new curriculum.

Furthermore, for all students who started their programme before September 2025 counts that:

- The MSc research proposal and thesis writing phase remains 45 EC in total
- A successfully completed Internship earns 10 EC.
- The following programme learning outcomes should be achieved:

1. Identify and explain principles, concepts, methods and techniques relevant for geo-information processing and earth observation.
2. Analyse problems and cases from a (geo-)spatial perspective.
3. Use and design models to simulate (or: study) processes in the system earth with a spatial component.
4. Apply principles, concepts, methods and techniques in the context of system earth, the user and an application domain to solve scientific and practical problems.
5. Independently design and carry out research in the domain according to scientific quality standards.
6. Analyse issues in an academic manner and formulate judgments based on this.
7. Analyse scientific and practical domain problems in a systematic manner and develop scientifically valid solutions for these problems in a societal context.
8. Communicate both orally and in writing on findings of research work to specialists and non-specialists.
9. Explore the temporal and social context of geo-information science and technology and be able to integrate these insights in the scientific work.
10. Explain and contrast cultural and contextual differences that influence the collection, classification and visualization of spatial information.
11. Operate professionally and ethically in a multi-cultural environment.
12. Critically reflect on own and other's work.
13. Study in a manner that is largely self-directed and autonomous.

The study adviser will gauge the interest and requirements of students to achieve their study plans before the end of the academic year 2024-2025 to ensure that the above transitional arrangements can be implemented without any problems.

In the event of any further demonstrable, considerable unreasonableness or unfairness caused by this transition during the academic year the Examination Board can permit departures from the provisions of these Regulations.

The full text of the transitional arrangement is published in the Education and Exam Regulations

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