MASTER OF SCIENCE
IN ENGINEERING

Module Description, available in: EN

Spatio-temporal methods for sustainable environmental systems

General Information

Number of ECTS Credits

3

Module code

TSM_SustEnSys

Valid for academic year

2025-26

Last modification

2023-06-20

Coordinator of the module

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Explanations regarding the language definitions for each location:

- Instruction is given in the language defined below for each location/each time the module is held.
- Documentation is available in the languages defined below. Where documents are in several languages, the percentage distribution is shown (100% = all the documentation).
- The examination is available 100% in the languages shown for each location/each time it is held.

	Lausanne			Lugano	Zurich		
Instruction					**X** E 100%		
Documentation					**X** E 100%		
Examination					**X** E 100%		

Module Category

TSM Technical scientific module

Lessons

2 lecture periods and 1 tutorial period per week

Entry level competences

Prerequisites, previous knowledge

Basic programming and data handling knowledge (any programming language). Background knowledge in Geomatics or Planning or strong interest in the topics covered in this module.

Brief course description of module objectives and content

How resilient are urban and natural systems to various developments and changes? Such as changes in the urban fabric, water availability or heat. And what methods and processes exist to gain insights and derive an understanding of urban and natural systems? Our environment consists of complex systems. Understanding and managing them is the key to sustainable development of large settlement- and landscape areas.

This module introduces methods for data collection and processing, simulation and decision making that help to analyse interrelationships of spatial and environmental systems. The focus is on the analysis of large-scale systems and their integration into human settlement areas. This module explores questions regarding the resilience of urban and natural systems with regards to different topics such as urban climates, urban density, or water resources.

The module builds on previous knowledge and methods from geomatics and planning, but also welcomes people from different backgrounds with a strong interest, for instance MSE profiles Data Science or Energy & Environment. The module uses the didactic concept of the "flipped classroom" at the beginning to align the students' knowledge in geomatics and planning.

Aims, content, methods

Learning objectives and competencies to be acquired

- The students can apply the theory and the knowledge of urban and natural systems to support the analysis and exploration of urban and natural system.
- The students understand the impact of environmental changes and consequences on various aspects in urban system such the availability of resources and future resilience of urban systems.
- The students can apply theory and methods of remote sensing techniques for acquiring, evaluating, and extracting information from spatial data for landscape planning and environmental assessment.
- The students know how to integrate and manage spatio-temporal data at different scales effectively to support decision-making processes.
- The students know the principles of simulation, including modelling, methods, and application, and can apply them to understand urban and natural systems.
- The students demonstrate critical thinking and problem-solving skills to study the effects on urban and natural systems, temporal evolution and effects of and on policies.
- The students are aware of ethical considerations and environmental impact assessments relevant to engineering projects in spatial and natural systems.
- The students understand and can apply methods to show the impact of changes in urban system and applied policies over time with means of quantitative and qualitative geospatial data sources.

Module content with weighting of different components

- Introduction to spatial development or GIS based on prior knowledge in the form of flipped classroom with the aim of aligning for prior knowledge of the students with different backgrounds notably in geomatics and urban planning. This approach entails students independently studying foundational materials before class. During class sessions, emphasis is placed on active learning and application, ensuring alignment with diverse backgrounds.
- The module introduces urban and natural systems, with a focus on application cases. It explores issues within systems such as urban climate, urban density, water distribution, regional urban systems and questions regarding the resilience of such systems. Case studies are used to illustrate concepts and principles, where students explore characteristics of urban and natural systems such as metropolitan areas or river delta, and examine issues related to land use, environmental impact, and sustainable development.
- Students learn about and can use remote sensing data, especially with satellite-based data collection. The students learn about data acquisition methods, sensor technology and the different types of remote sensing data. Practical exercises focus on accessing and working with remote sensing data. Students acquire skills in data evaluation, image processing and information extraction. They analyse land cover, vegetation indices and other relevant data for the analysis of urban and natural systems.
- The module covers the integration and management of spatio-temporal data, emphasising its importance for environmental decision-making. Students learn to combine data, perform spatio-temporal data management and analysis, data integration techniques and data quality considerations. Students perform practical exercises, learn to combine, and manage spatio-temporal datasets.
- The module introduces the basic principles of simulation, its modelling, methods, and application. Students learn to develop simulations based on use cases e.g. 15 min cities and better understand the process of developing simulations.
- The module follows and encourages an interdisciplinary approach particularly between the field of geomatics and planning with a focus on GIS and urban planning.

Teaching and learning methods

Lectures, exercises (individual and group work), flipped class room

Literature

- Slides given during the course from the Lecturers
- Reference books details will be given at the beginning of the course

Assessment

Additional performance assessment during the semester

The module does not contain an additional performance assessment during the semester

Basic principle for exams

As a rule, all standard final exams are conducted in written form. For resit exams, lecturers will communicate the exam format (written/oral) together with the exam schedule.

Standard final exam for a module and written resit exam

Kind of exam

Written exam

Duration of exam

120 minutes

Permissible aids

Aids permitted as specified below:

Permissible electronic aids

Open book, all materials and documents
No information search is allowed (PC in flight mode, no connection available, no use of artificial intelligence system local or remote)

Other permissible aids

No other aids permitted

Exception: In case of an electronic Moodle exam, adjustments to the permissible aids may occur. Lecturers will announce the final permissible aids prior to the exam session.

Special case: Resit exam as oral exam

Kind of exam

Oral exam

Duration of exam

30 minutes

Permissible aids

Aids permitted as specified below:

Permissible electronic aids

Open book, all materials and documents
No information search is allowed (PC in flight mode, no connection available, no use of artificial intelligence system local or remote)

Other permissible aids

No other aids permitted