Time Series Analysis

Course description sheet

Basic information

Field of study Remote Sensing and Geo Informatics **Major** All **Organisational unit** Faculty of Geo-Data Science, Geodesy, and Environmental Engineering **Study level** Second-cycle studies **Form of study** Full-time studies **Profile** General academic	**Didactic cycle** 2025/2026 **Course code** DRSGIS.II2.14245.25 **Lecture languages** English **Mandatoriness** Obligatory **Block** Core Modules **Course related to scientific research** Yes

Course coordinator	Krystyna Michałowska
Lecturer	Krystyna Michałowska, Beata Hejmanowska

Period	**Method of verification of the learning outcomes**	**Number of ECTS credits**
Semester 2	Completing the classes **Activities and hours** Lectures: 10 Workshop classes: 40	4

Goals

C1	The aim of the class is to familiarize you with temporal-spatial analyses, mainly related to the land surface, based on acquired satellite images.

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	the technologies, capabilities of recording satellite multi-temporal data and repositories of archived data	RSGI2A_W02, RSGI2A_W03	Participation in a discussion, Report, Case study, Involvement in teamwork
W2	techniques and algorithms for processing multi-temporal images	RSGI2A_W02, RSGI2A_W04	Participation in a discussion, Report, Case study, Involvement in teamwork
W3	contemporary concepts, methods and techniques from geoinformatics applied to spatial and spatio-temporal environmental analysis	RSGI2A_W04, RSGI2A_W05	Participation in a discussion, Report, Case study, Involvement in teamwork
Skills – Student can:			
U1	acquire and integrate remote sensing data in preparation for multi-temporal analyses	RSGI2A_U02, RSGI2A_U03, RSGI2A_U04	Participation in a discussion, Report, Case study, Involvement in teamwork
U2	select and apply appropriate spatial-temporal techniques and algorithms, including machine learning, to analyse and solve environmental problems	RSGI2A_U02, RSGI2A_U03, RSGI2A_U04, RSGI2A_U05	Participation in a discussion, Report, Case study, Involvement in teamwork
Social competences – Student is ready to:			
K1	intentionally select fit-to-use data	RSGI2A_K02	Participation in a discussion, Involvement in teamwork
K2	dissemination of information on ongoing environmental changes, including climate change	RSGI2A_K02	Participation in a discussion, Involvement in teamwork

Program content ensuring the achievement of the learning outcomes prescribed to the module

The student will acquire advanced knowledge of the time series analysis. During the lectures, the student will gain knowledge of archival remote sensing data resources (aerial imagery, civil and military satellite missions) as well as currently continuing multi-temporal missions. Methods for the analysis of multi-temporal image data with different levels of data detail and with different time horizons will be presented.

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	10
Workshop classes	40
Preparation for classes	15

Examination or final test/colloquium	2
Preparation of project, presentation, essay, report	25
Realization of independently performed tasks	15
Contact hours	3

Student workload	**Hours** 110
Workload involving teacher	**Hours** 50

* hour means 45 minutes

Program content

No.	Program content	Course's learning outcomes	Activities
1.	The analysis of spatial-temporal changes in the environment, especially on the land surface, is crucial for many fields, such as ecology, agriculture, urbanisation, climate change. This information is also an important element in a GIS database. During the lectures, the student will gain knowledge of archival remote sensing data resources (aerial imagery, civil and military satellite missions) as well as currently continuing multi-temporal missions. Methods for the analysis of multi-temporal image data with different levels of data detail and with different time horizons will be presented. Methods and algorithms will be discussed divided into photo-intepretive and computer-assisted methods (classification, decision trees, regression, machine learning). A comprehensive discussion of data resources and data processing methods and algorithms will enable their correct selection, taking into account the intended purpose and the spatial-temporal GIS data and multi-temporal imagery available in the case. Topics covered during the workshop include analysis of changes in impervious surfaces based on photointerpretation of aerial photographs, multi-temporal analysis of satellite images through the use of spectral indices, CVA change vector analysis, classifications for the development of LULC maps, machine learning using large multi-temporal environmental datasets.	W1, W2, W3, U1, U2, K1, K2	Lectures, Workshop classes

Extended information/Additional elements

Teaching methods and techniques :

Workshop, Mentoring, Problem Based Learning, Design thinking, Group work, Case study, E-learning, Discussion, Lectures

Activities	Methods of verification	Credit conditions
Lectures	Participation in a discussion, Case study	Lectures are optional, knowledge verification during the credit test
Workshop	Participation in a discussion, Report, Case study, Involvement in teamwork	Workshops are obligatory. Credit is given on the basis of individual and group work reports and student activity

Conditions and the manner of completing each form of classes, including the rules of making retakes, as well as the conditions for admission to the exam

The assessment is based on a case study project done in a group, an individual partial report done by each student (including a description of the work done individually by the student), a assessment testand the student's activity in class.

Method of determining the final grade

Final grade = average of group workshop presentation, individual report, assessment testand class activity.

Manner and mode of making up for the backlog caused by a student justified absence from classes

Completion of outstanding assignments due to absence: depending on the subject of the course - individual completion of exercises with the help of individual consultations with the instructor, completion in the form of handed in additional reports.

Prerequisites and additional requirements

Knowledge of the courses: 1 semester: Earth observation and Geoinformation Science, Python for remote sensing, Transitional work on geo-informatics in remote sensing – individually selected issue solved under the supervision of a tutor

Rules of participation in given classes, indicating whether student presence at the lecture is obligatory

Classes in the semester are taught in blocks. Time series analysis is preceded by blocks: Earth observation and Geoinformation Science, Python for remote sensing, Transitional work on geo-informatics in remote sensing. The knowledge and skills from these classes will be used in a block of classes. The topics of the lectures are related to the workshop, their aim is to broaden the knowledge on a given topic. Lectures are of an optional nature. The student is obliged to learn by the lecture method or independently. Workshop include the training of practical application of the knowledge and is compulsory.

Literature

Obligatory

1. Satellite Image Time Series Analysis (open-access online book) : https://e-sensing.github.io/sitsbook/

Optional

1. Remote Sensing Time Series Analysis: A Review of Data and Applications American Association for the Advancement of Science Journal of Remote Sensing December 20244(6626) DOI:10.34133/remotesensing.0285

Scientific research and publications

Research

1. 2020-2022 Integration of remote sensing data for control in the agricultural direct payments system (IACS), Excellence Initiative - Research University - AGH

Publications

1. Harmonizing satellite thermal data with ground-based observations for climate long-term monitoring / Ewa GŁOWIENKA, Eva Savina Malinverni, Marsia Sanità, Krystyna MICHAŁOWSKA, Marcin KUCZA // The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences ; ISSN 1682-1750. — 2025 — vol. XLVIII-M-7-2025, s. 127-132. — Bibliogr. s. 131-132, Abstr. — Publikacja dostępna online od: 2025-05-24. — 44th EARSeL symposium : 26–29 May 2025, Prague, Czech Republic / eds. Eva Matoušková, Lena Halounová
2. Long-term dynamics of urban heat island and hot spots in Wrocław: a 25-year satellite-based analysis using machine learning / Melika Tasan, Jolanta Dąbrowska, Krystyna MICHAŁOWSKA, Anna Uciechowska-Grakowicz // Sustainable Cities and Society ; ISSN 2210-6707 . — 2025 — vol. 132 art. no. 106797, s. 1-19. — Bibliogr. s. 17-19, Abstr. — Publikacja dostępna online od: 2025-09-05

Learning outcomes prescribed to a field of study

Code	Content
RSGI2A_K02	is ready for creative time management, working under time pressure
RSGI2A_U02	can acquire remote environmental data
RSGI2A_U03	is able to process geospatial data and automate data processing in an advanced manner
RSGI2A_U04	is able to use IT tools for spatial data processing
RSGI2A_U05	can work both individually and in teams; can prepare a proposal for a research project
RSGI2A_W02	has an enhanced knowledge of physics necessary to understand the interaction of electromagnetic radiation in the atmosphere and with the Earth's surface
RSGI2A_W03	has a deep understanding of remote environmental data acquisition methods
RSGI2A_W04	has a deep understanding of methods, algorithms and automation of spatial data processing
RSGI2A_W05	has an enhanced knowledge of the use of computer science in geoscience