UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Earth Observation for Geology

2526-2-F7401Q102

Aims

The course aims to provide students in Geological Sciences and Technologies with:
• an understanding of the fundamental principles of remote sensing and its applications in the geological field;
• the ability to analyze and interpret satellite data acquired from optical, thermal, and radar sensors, both active and passive;
• the ability to process satellite data using open-source software, producing digital outputs and thematic maps;
• the capacity to independently analyze complex geological phenomena through the integration of remote sensing data.

By the end of the course, students will be able to:
• interpret remotely sensed images for applications such as lithological mapping, and the monitoring of landslides, volcanoes, floods, and glacial/periglacial environments;
• process and analyze satellite data using specialized software (e.g., ESA-SNAP, QGIS);
• produce thematic maps and maps of geophysical parameters derived from satellite imagery.

Students will also develop independent judgment, enabling them to:
• select the most appropriate methods and data for geological analysis through satellite remote sensing;
• assess the quality, reliability, and limitations of the data used.

Throughout the course, students will also strengthen their learning skills, in particular the ability to:
• apply the knowledge gained to contexts different from those addressed during lectures;
• understand scientific articles and technical documentation related to the use of remote sensing in the geosciences.

Contents

Theory and practice for remote sensing data analysis using open-source software for image processing for

geological applications.

Detailed program

Basis of remote sensing: electromagnetic spectrum, optical, thermal, lidar and microwave (radar) remote sensing, synthetic aperture radar (SAR), SAR interferometry, characteristics of active and passive remote sensing instruments and platforms (e.g. ESA – Sentinels satellites).

Data elaboration and image analysis: satellite image visualization; pre-processing techniques; image processing and extraction of biogeophysical parameters.

Applications: 1) lithological mapping using optical satellite data; 2) monitoring of the cryosphere (e.g. glaciers, rock glaciers) with active and passive remote sensing techniques; 3) thermal remote sensing for active fire detection, urban heat island mapping and monitoring of active volcanos; 4) flood monitoring with Sentinel-1 SAR data; 5) monitoring surface deformation related to landslides, volcanos and land subsidence with SAR interferometry.

Laboratory exercises: use of open-source softwares (e.g. ESA-SNAP, QGIS) for geological applications using the above mentioned techniques. The exercises are a key part of the course and will be held using computer labs.

Prerequisites

Teaching form

Laboratory (4 credits)
16 three-hour lab activities, in person, Interactive Teaching using virtual computer laboratories

Textbook and teaching resource

Handouts and slides

Brivio, P.A., Lechi, G., and Zilioli E., 2006. Principi e metodi di Telerilevamento, De Agostini - Città Studi edizioni, Torino (Italy), pp. 525.

Lillesand T. & Kiefer R. (2015). Remote sensing and image interpretation, 7th edition, 736 p.

Jensen J.R. (2014). Remote Sensing of the Environment: An Earth Resource Perspective, 2nd edition, Pearson New International edition, 619 p.

Semester

First semester

Assessment method

The exam allows to evaluate the preparation reached in terms of theoretical and practical knowledge of the topics covered during the lessons and the laboratories.

The evaluation of the examination is established through a report on the resolution of a geological / environmental case study aimed at the evaluation of the student’s skills to apply the remote sensing techniques in geological applications (40% of the final evaluation) and an oral examination with open questions which allow to verify the theoretical and practical knowledge of the topics covered during the lessons and the laboratories (60% of the final evaluation).

The expositive ability and adequacy of the student's language is also assessed. The examination is retained positive for an evaluation of 18-30/30.

Office hours

During working hours with email appointment to micol.rossini@unimib.it

Sustainable Development Goals

INDUSTRY, INNOVATION AND INFRASTRUCTURE