Introduction to Geospatial Data Visualization (IGDV)

The recent introduction of mapping skills courses in numerous academic programs across various disciplines worldwide highlights the increasing importance of mapping as a fundamental literacy skill for a growing number of students. In order to optimize the learning outcomes for CEU community, the 2-credit IGDV course is divided into two interconnected modules: IGDV-I (Basic) and IGDV-II (Advanced), each worth 1 credit. Successful completion of IGDV-I is a prerequisite for enrolling in IGDV-II, unless a student can demonstrate prior experience in geospatial visualization. This flexible structure allows students to enroll in either or both of the modules.

These courses are available to both undergraduate and graduate students, with the workload adjusted accordingly. For MAs/PhDs, the workload consists of 600 classroom minutes per credit, while for BAs, it amounts to 720 minutes per credit.

Introduction to Geospatial Data Visualization I (Basic)

Lecturers: Viktor Lagutov, Anastasia Kvasha, guest speakers
Credits: 1 credit
Duration: September - November
Course level: BA / MA / PhD
Maximum number of students: 25
Pre-requisites: none
Software: GoogleEarthPro (GEPro), qGIS, online mapping tools (GoogleMaps, ArcGIS Online)

The ability to work with spatial data has become an essential skill, not only in academic research but also in our daily lives. These skills encompass various aspects, including data collection, storage, visualization, and analysis. The choice of technology depends on the specific issues at hand, goals to be achieved, and the level of computer literacy.

The aim of this course is to develop a basic understanding of Geographic Information Systems (GIS) principles, familiarize students with spatially referenced data, and cultivate fundamental skills in geospatial data visualization (mapping). While the course primarily focuses on practical mapping skills for societal and environmental phenomena, it also provides a brief introduction to alternative data collection technologies such as satellite imagery, crowdsourcing, and expert knowledge. Various geospatial data file formats, including vector and raster, will be introduced. Many freely available geospatial datasets remain underutilized by researchers. Participants will learn about the types of data that can be stored in these datasets, as well as how to obtain, develop, and share them. Additionally, students will gain an understanding of map design considerations for different purposes, such as internet-based publications and journal articles.

The course will explore both desktop and online mapping solutions, including Google Earth Pro, Google Maps, and qGIS. QuantumGIS (qGIS), the most popular and widely used open-source GIS package, will serve as the primary software for illustrating geospatial data collection, generation, and visualization techniques. Through practical exercises using qGIS, participants will acquire the foundations of working with a typical GIS package and learn essential mapping principles.

Learning Outcomes

By the end of the course, students will be able to:

- Acquire geospatial information from different internet sources.
- Create simple maps using basic mapping packages (GEPro, qGIS) and online mapping tools (ArcGIS Online).

The course will be organized as a series of short online presentations followed by practical exercises and individual map development.

Learning outcomes	Assessment	Activities	Estimated workload* (h)
Awareness of geospatial data types and their usage in various research areas	Class participation	Lectures and computer-based seminars	4
Knowledge of GIS and practical skills in geospatial data retrieval and visualization.	Class participation and exercises	Computer-based seminars led by instructors, step-by-step exercises, consultations	12
Acquaintance with online satellite imagery, their products, and applications in various areas	In-class exercises and homework	Self-study, Individual work and step-by-step exercises, consultations	6
Hands-on experience with mapping software, various mapping techniques, and tools	In-class exercises and homework	Self-study, Library/ Internet search and reading, consultations	18
Ability for independent data collection and visualization	Homework	Self-study, Computer-based Individual work, consultations	20
Total			**60**

** The workload for graduate students is 60 hours (600 classroom minutes per credit). For BA students, additional mandatory sessions and tutorials are required, totaling 72 hours (720 classroom minutes per credit).*

Course Assessment

The course evaluation (pass/fail) is based on the following categories:

- Online class participation: student participation in online discussions is expected and encouraged.
- Practical sessions: students will develop and submit a series of maps.

Sessions outline

N	Session description	Exercises
1	Overall introduction to the course. Theory - Intro to cartography and geodata visualization, mapping basics, map design and components.	Self-introduction. Find any maps online to illustrate phenomena of interest.
2	Using GoolgeEarth/Pro - GoogleEarth (GE) basics, retrieving sites location; maps development, maps overlay, etc.	Create a dataset in GE (kml) describing any phenomena
3	Online mapping tools, sharing, GoogleMaps	Create an online map/s using kml dataset
4	Data sources for mapping - Existing data sources and Internet data search; Online databases	Explore available sources, find useful datasets
5	Data sources (cont.) - using data in CSV / Excel format (coordinates, address); Earth Observations, Remote Sensing; ArcGIS Online	Visualize dataset from CSV / Excel file. Exploring Sentinel Hub, ArcGIS Online
6	Desktop mapping - practical mapping skills, map creation using qGIS	Map/s development in qGIS

Introduction to Geospatial Data Visualization II (advanced)

Lecturers: Viktor Lagutov, Joszef Laszlovsky, Ruben Mnatsakanian, Kanat Sultanaliev (AUCA), guest speakers
Credits: 1 credit
Duration: November - December
Course level: BA / MA / PhD
Maximum number of students: 15
Pre-requisites: Introduction to Geospatial Data Visualization I
Software: qGIS

Geospatial methods and mapping have gained popularity across various research areas due to their cross-disciplinary recognition and availability. The advancements in hardware and software have opened up new possibilities for researchers in different disciplines to enhance their traditional research methods. This course aims to build upon the students' basic understanding of GIS applications developed in the previous course and further advance their skills in the use of geospatial data and GIS. The sessions will provide both theoretical understanding and practical use of geospatial data and technologies for mapping societal and environmental phenomena.

The course will primarily utilize qGIS, the most popular open-source GIS package, to showcase modern techniques of geospatial data collection, generation, and visualization. Students will learn advanced features of qGIS and how to utilize them for their own research. The course will also include guest lectures and workshops on mapping methods and applications.

The focus of the course will be on practical skills in geospatial data visualization (mapping) and will consist of:

- Theoretical sessions onaltenrative methods in geospatial data visualization, cartography, and GIS features;
- Practicals to learn GIS methods and develop mapping skills using free open-source packages.
- Supervised and independent work on course projects.

Successful participation and completion of the course depend on students' ability for independent work and self-education.

Learning Outcomes

By the end of the course, students should be able to:

- Understand the variety of data mapping approaches, their principles, and the benefits of their usage.
- Develop their own datasets based on different data sources such as statistics or expert knowledge.
- Create detailed topical maps using advanced features of qGIS.
- Consider alternative ways of collecting geospatial data, including online data mining and participatory science (geospatial data crowdsourcing).

Learning outcomes	Assessment	Activities	Estimated workload* (h)
Hands on experience with mapping software, basic spatial analysis techniques, datasets development	In-class exercises and homework	Self-study, library/ internet search and reading, consultations	10
Practical skills of data visualization and sharing using online mapping tools	In-class exercises and homework	Self-study, individual work and step-by-step exercises, consultations	10
Acquaintance with online satellite imagery / their products, basic image classification techniques	In-class exercises and homework	Self-study, individual work and step-by-step exercises, consultations	10
Knowledge of data collection in the field and crowdsourcing techniques	In-class exercises	Self-study, individual work and consultations	4
Development and implementation of Mapping Project	Individual project	Individual and supervised work on term project, reading, consultations	20
Awareness of mapping applications in public policy, humanities and social studies	Class participation	Case studies presentations by instructors; presentations of projects by course participants	6
Total			**60**

** The workload is given for graduate students (600 classroom minutes per credit). BA students are requested to attend additional mandatory sessions and tutorials (720 classroom minutes per credit)*

Course Assessment

The course assessment is based on the following criteria:

- 30% Practical Sessions: Completion of several in-class exercises;
- 70% Graded Individual Project: Development and presentation of a mapping project.

Students are required to select a topic for their mapping project from a provided list or suggest their own. The project can be relevant to their thesis research or other courses.

Sessions outline

N	Session description	Instructors	Exercises
1	QGIS advanced – data manipulation, georeferencing and digitizing	V.Lagutov, TAs	Submit Ideas for Individual Project; Develop own dataset using georeferencing
2	QGIS advanced (cont.) – introduction to spatial analysis (in vector raster)	V.Lagutov, TAs	Submit own map based on the class exercise
3	Online tools (cont.) - Data collection in the field and crowdsourcing	V.Lagutov, TAs	Individual project progress report
4	Applications of geospatial methods – case studies presentations by course instructors, invited guests	Course instructors and guest speakers	Work on individual project, consultations
5,6	Project presentations – work on final projects, consultations	V.Lagutov, TAs	Individual project