Geomatics and Modelling

Spring semester, 2021/2022
The course is proposed for students in the academic year 2020-2021 as an optional one.

Coordinator	**Andrii Achasov** **Anatolii Polevoy**
Credits	3 ECTS, 24 in-class hours
Lecturers	**Andrii Achasov** (Karazin Institute of Environmental Sciences, V.N. Karazin Kharkiv National University, Ukraine) **Anatolii Polevoy** (Odessa State Environmental University, Ukraine)
Level	PhD students
Host institution	Karazin Institute of Environmental Sciences, V.N. Karazin Kharkiv National University, Ukraine
Course duration	February - May

Summary

The course "Geomatics and Modeling" is designed for PhD graduate students, conducting research on "environmental protection". The course is designed to increase the level of knowledge and skills of graduate students in the application of geomatics and modeling in research. The course involves active independent and classroom work with specialized computer software.

Target student audiences

PhD students in natural and environmental sciences.

Prerequisites

Required courses (or equivalents):
- Informatics and systemology
- GIS
- Modeling and forecasting of the state of the environment
- GIS in ecology
- System analysis of environmental quality

Aims and objectives

The course aims to teach PhD students in the methods of geomatics and modeling in the implementation of their specific scientific research as part of the preparation of a doctoral dissertation (PhD).

The brevity of the course "Geomatics and Modeling" presupposes the accelerated integration of knowledge and skills acquired during training at the first or second educational levels. Geomatics and modeling are now used in almost all branches of science and technology. These scientific areas include a huge variety of methods and technologies for solving specific scientific and practical problems. In the course of preliminary training, graduate students already have a basic knowledge base in these disciplines.

The objectives of the course are:

- updating the basic knowledge of postgraduate students in geomatics and modeling
- detailed acquaintance with the basic methods of geomatics and modeling
- familiarization of students with the capabilities of existing software, hardware, and information support
- in-depth study of the free software geoinformation product QGIS
- analysis of scientific works carried out by graduate students (PhD) to determine the possibilities of using the methods of geomatics and modeling in them
- choice of one \ several methods of geomatics by a graduate student for solving a specific scientific task

General learning outcomes:

After completing the course, graduate students must acquire new knowledge and develop existing competencies:

- basic knowledge of the functionality available in the GIS
- experience with free QGIS software
- knowledge of free sources for obtaining geodata, in particular, space images
- basic knowledge of spatial data analysis
- in-depth knowledge of certain types of spatial data analysis (depending on the chosen topic of scientific work)

Overview of sessions and teaching methods

The course assumes the following types of educational activities: lectures, practical works, independent work of graduate students.

The main emphasis in the study of the material will be placed on the unification of all these types of work based on individual scientific directions chosen by each graduate student.

In the first (basic) classes, graduate students update their theoretical knowledge in geomatics and modeling, receive information about new emerging methods, hardware, and software.

Postgraduate students are given an assignment for independent work - to analyze their scientific research, to determine the possibilities of using the methods of geomatics and modeling in them. In subsequent classes, collective discussions are held on each of the scientific topics of graduate students. As a result, a list of the most promising methods for use in scientific research is formed. Further classes are conducted according to an individual scheme, taking into account the results obtained in the previous step.

Graduate students choose topics for independent work. In the course of its implementation, they form a methodology for applying one or another direction of geomatics to solve their problems. During classroom lessons, this methodology is checked by the professor and tested.

The course involves intensive interactive scientific cooperation of graduate students with the lecturer at all stages. All practical exercises are conducted in computer labs. Depending on the topic of scientific research of graduate students, it is possible to conduct separate classes in the field.

Course workload

The table below summarizes course workload distribution:

Activities	Learning outcomes	Assessment	Estimated workload (hours)
In-class activities			
Lectures	Understanding theories, concepts, methodology and tools	Class participation, discussion activity.	12
In-class assignments	Experience with software. Experience in solving specific problems using geomatics methods	Class participation, quality of completed assignments, discussion activity.	12
Independent work			
Reading, completing individual assignments received	The ability to critically analyze the material read. Ability to report on the essence of the work performed. Ability to participate in brainstorming	Quality of completed assignments	66
Total			**90**

Grading

Evaluation of PhD students will be based on the following:
- quality of practical work performed (50%)
- the level of readiness to participate in seminars, dialogues and discussions in the classroom (25%)
- the quality of the preparation of assignments received for independent completion (25%)

Structure of the Course

Title of the topic	Total hours	In-class activities, hours		
		lecture	practical works and workshop	independent work
Section 1. Geomatics in ecology				
Topic 1.1. Spatial data analysis	20	2	4	14
Topic 1.2. Digital Elevation Model analysis	25	4	2	19
Total	**45**	**6**	**6**	**33**
Section 2. Modeling				
Topic 2.1Modeling the water-thermal regime of vegetation	15	2	2	11
Topic 2.2Harvest Modeling	15	2	2	11

Topic 2.3 Climate Resource Assessment Model	15	2	2	11
Total	**45**	**6**	**6**	**33**
Total of course	**90**	**12**	**12**	**66**

At the end of the course the student will have an exam. Grading system is presented below:

Scores	Mark
90 – 100	Excellent
70-89	Good
50-69	Satisfactory
1-49	Not passed

Course schedule
Dates and time will be provided later.
The overall schedule is provided below:

Day	Time	Topic	Lecturer
Day 1	2 hours	Lecture 1	Andrii Achasov
Day 2	2 hours	Practical work 1	Andrii Achasov
Day 3	2 hours	Lecture 2	Andrii Achasov
Day 4	2 hours	Practical work 2	Andrii Achasov
Day 5	2 hours	Lecture 3	Andrii Achasov
Day 6	2 hours	Workshop 1	Andrii Achasov
Day 7	2 hours	Lecture 4	Anatolii Polevoy
Day 8	2 hours	Practical work 3	Anatolii Polevoy
Day 9	2 hours	Lecture 5	Anatolii Polevoy
Day 10	2 hours	Practical work 4	Anatolii Polevoy
Day 11	2 hours	Lecture 6	Anatolii Polevoy
Day 12	2 hours	Workshop 2	Anatolii Polevoy
Day 13	2 hours	Final test - Exam	Andrii Achasov, Anatolii Polevoy

Course assignments

The course involves two assignments:

Assignment #1. Building and analyzing a model of a specific area using the ArcGIS, QGIS, or GRASS software platform. It is assumed that the model will include the following landscape elements: relief, hydrography, forest plantations, main buildings, roads, etc. The model will be presented in both 2D and 3D (2.5D) form. By default, the following types of analysis of the constructed model are assumed: 1) construction of maps of steepness and aspect of the surface, 2) assessment of surface insolation, 3) allocation of ecological and technological zones of lands for planning the placement of agricultural cultures, 4) identification of drainage areas in the study area, 5) forecast of water erosion of soil using the WEPP model. Options for assignments will be selected (or offered) by graduate students following the topic of their research.

Assignment #2. 1. Model of the water-thermal regime of the vegetation cover. The model includes a description of the radiation regime (calculation of total radiation, plant cover albedo, effective radiation, photosynthetically active radiation), calculation of evaporation and volatility, assessment of the moisture demand of plants and their moisture supply.

2. Modeling the formation of crops. The model describes the influence of environmental factors on the main processes of plant life (photosynthesis, respiration, growth, development) and the relationship between the processes themselves.

3. The model for assessing the agro-climatic resources of territories includes a quantitative description of the formation of potential productivity, determined by the biological characteristics of the plant and the arrival of photosynthetically active radiation, meteorologically possible productivity, taking into account the influence of the water-thermal regime of crops, really possible productivity, which takes into account the influence of soil fertility and productivity in production, determined by the level of agricultural technology for growing crops. Several complex indicators are given: the favorableness of agroclimatic conditions, the efficiency of the use of agroclimatic resources.

It is assumed that graduate students will choose a topic close to their research. Practical work is supposed to be carried out for each section.

Literature

1. Nekos A.N., Achasov A.B., Kochanov A.B. (2017). Metody vymiryuvannya parametriv navkolyshn'oho seredovyshcha: dystantsiyni metody. [Methods of measurement of environmental parameters: remote methods]. Textbook V.N. Karazin KhNU, 244 [In Ukrainian].
2. Svitlychny O.O., Plotnytsky S.V. (2006). Fundamentals of geoinformatics: a textbook. Sumy: University book, 295 p. (Світличний О. О. Основи геоінформатики: навчальний посібник / О. О. Світличний, С. В. Плотницький. – Суми : Університетська книга, 2006. – 295 с.) [In Ukrainian]

3. Kostrikov S.V., Segida K.Yu. (2016). Geographic information systems: a textbook for classroom and independent work of students majoring in "Geography", "Economic and social geography". Kharkiv, 82 p. (Костріков С. В., Сегіда К. Ю. Географічні інформаційні системи: навчально-методичний посібник для аудиторної та самостійної роботи студентів за спеціальностями «Географія», «Економічна та соціальна географія». – Харків, 2016 – 82 с.) [In Ukrainian]

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5. Polevoy A.M. (2013) Modeling of hydrometeorological regime and productivity of agroecosystems. Odessa:Ecology, 430 p. (Польовий А.М. Моделювання гідрометеорологічного режиму та продуктивності агроекосистем. – Одеса: Екологія. 2013. 430 с.) [In Ukrainian]