Syllabus

Course Title

Obtaining climate products

General information

General description of the required training/preparation, outlining the main objectives and providing an explanation of the need for training/preparation at the organization/country/region level.

The course “Obtaining Climate Products” is one of the main components of the professional cycle of disciplines for PhD student training within the “Climate Services” program.

The main objective is to train specialists who, using all modern tools and techniques for providing high-quality information adapted to user needs, including explanations of its possible applications, are able to create and interpret various climate products for different geographical regions and time periods.

The physical parameters of the state of the atmosphere and the Earth’s hydrosphere constitute hydrometeorological information. Knowledge of the relevant statistical algorithms and the ability to correctly apply them in the analysis of this information will help address current issues related to the formation, change, and forecasting of hydrometeorological processes.

It is clear that empirical research in hydrometeorological sciences is of primary importance. On its basis, regularities inherent in certain characteristics of the atmosphere or hydrosphere are established. Empirical data serve as criteria for the validity of regularities, hydrodynamic equations, and characteristics of atmospheric or hydrological processes, among others.

Hydrometeorological data are quantitative characteristics of the state of the atmosphere and hydrosphere. Due to the significant spatial and temporal variability of the physical parameters of the atmosphere and hydrosphere, numerous measurements of their state are necessary to observe and study the regularities of ongoing processes and, most importantly, to forecast them. It is well known that the main source of hydrometeorological information is the results of regular and specialized meteorological and hydrological observations and measurements, aerological sounding data, expedition research data, and others.

Each physical parameter of the atmosphere or hydrosphere depends on one another, as well as on external influences, and changes randomly over time and space, forming random fields or sequences. Processing and analysis of systems of random variables are carried out using a specially developed research framework that constitutes the methods of mathematical statistics.

When working with open data, one often deals with datasets containing hundreds, thousands, or even hundreds of thousands of observations. Therefore, it is necessary to apply various tools for summarizing and compressing information in order to draw correct conclusions from these data. Descriptive statistics and methods of multivariate statistical analysis are widely used for processing and analyzing meteorological variables in climatological research.

Audience

The primary target audience of the course and any secondary audience, if it may influence decisions regarding the course structure or content.

The expected level of knowledge and skills of the primary audience (current or minimally required), as well as other factors (for example, cultural characteristics, level of technical proficiency, internet access) that

should be considered when planning the course, since they may affect the choice of teaching methods, materials, and approaches to audience interaction.

The primary target audience consists of PhD students of higher education institutions in Ukraine who are studying in the field of climate services. The course may also partially be used as a professional development course for specialists in meteorology and climatology, as well as for specialists in other fields where decision-making based on climate information is required.

Level of knowledge and skills of the primary audience:

Fundamental knowledge:

The audience should have basic knowledge in the natural sciences, particularly in geography and climatology, to understand climate processes and their impacts on socio-economic systems.

Analytical background:

Participants should possess basic statistical analysis skills, including working with large databases and their interpretation.

Technical background:

Participants should have basic computer and Internet skills, as well as familiarity with tools used for access to interactive learning platforms (for example, Moodle). It is desirable that participants have basic data analysis skills, presentation preparation skills, and experience using analytical tools such as Excel.

English language proficiency:

An intermediate level of English proficiency (B1 or higher) is recommended for working with international research, reports, and economic models.

2. Other factors:

Inclusiveness and accessibility:

Different methods of content delivery will be used during teaching (text, audio, video, interactive tasks). Learning materials will be provided in accessible formats such as large-print text, audio files, or files compatible with screen-reading software.

Participants will be given a choice of learning methods that best meet their needs.

Internet access:

The course includes online components, but all materials will be available for download and offline use due to possible limitations in Internet access.

Competencies

Training needs at the individual level or at the organization/country/region level, as well as a description of how these needs were identified and recognized as relevant.

The competencies that the training will target.

C1. Assessment of the impacts of climate change, climate variability, and climate extremes on various sectors (society, environment, economy, etc.) at different scales, taking into account the full range of interconnections between components of the climate system and transdisciplinary interactions with society.

Learning outcomes and performance criteria

Learning outcomes and performance criteria formulated with consideration of the knowledge and skills that will be acquired during the learning process.

Performance criteria:
PC1. Identify and obtain climate data from various sources for the creation of climate products.

PC2. Accurately calculate key climate products, including normals, mean values, anomalies, and climate indices adapted to the needs of economic sectors.

PC3. Apply statistical and geostatistical analysis for monitoring the spatial distribution and temporal evolution of climate.

PC4. Create additional products such as graphs, maps, and reports to explain climate characteristics and their dynamics according to the needs of specific sectors such as healthcare, agriculture, water resources, energy, and disaster risk management.

Learning outcomes:
LO6. Obtain climate and sectoral data from primary sources both within and outside the organization, organize, store, and document them.

LO7. Describe the climate of the study area, its variability, and recent changes by applying methods of descriptive statistics and statistical significance analysis.

LO8. Describe and analyze the climate of the study area and its spatial and temporal changes by applying knowledge of climate classifications, methods of inferential and multivariate statistics, as well as geostatistical techniques, including data interpolation methods.

LO9. Effectively create synthesized reports that transform climate products into accessible climate services for users by applying and adapting various software tools for climate data analysis and climate product generation.

Course content

Provide a content outline that aligns with the objectives and learning outcomes. This may be a course outline as it will be presented to students, but not necessarily a complete curriculum.

Include a general list of all topics that you consider necessary to cover. If you believe it would help clarify the scope, indicate what will NOT be covered.

Module 1: Data acquisition and management for climate product generation.

Obtain climate and sectoral data from primary sources both within and outside the organization, organize, store, and document them.

Module 2: Methods of descriptive statistics for climate analysis.

Describe the climate of the study area, its variability, and recent changes by applying methods of descriptive statistics and statistical significance analysis.

Module 3: Advanced methods of climate analysis.

Describe and analyze the climate of the study area and its spatial and temporal changes by applying knowledge of climate classifications, methods of inferential and multivariate statistics, as well as geostatistical techniques, including data interpolation methods.

Module 4: Climate data analysis and product generation.

Effectively create synthesized reports that transform climate products into accessible climate services for users by applying and adapting various software tools for climate data analysis and climate product generation.

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Learning approaches and implementation methods

List the teaching approaches (learning methods) that will be used and explain why they were chosen. For example: classroom learning, online learning, blended learning, workplace learning, online self-learning resources, coaching or mentoring, etc.

For PhD students, blended learning should preferably be selected whenever possible. Considering practical criteria, it can be concluded that with this choice of learning format, online learning allows this audience to regulate their study time much more easily. Based on educational needs, it can be assumed that PhD students are prepared for online learning, since they already have sufficiently developed self-learning skills, time management skills, and high motivation. However, since rather complex and comprehensive learning outcomes must be achieved, it is desirable that learning be accompanied by direct practical consolidation of acquired knowledge, which is best achieved in offline mode.

PhD students are encouraged to meet with the instructor offline 1–2 times per week to discuss knowledge acquired through video lectures and other materials, as well as to consolidate and refine skills and competencies. Online learning, which will mostly take place asynchronously, will be monitored by the instructor through forums for closer discussion of issues arising during the learning process.

At the end of the training, a final assessment of learning outcomes will be conducted.

Considering the current difficult conditions in Ukraine, groups of PhD students may be offered asynchronous online learning with the possibility of conducting synchronous activities.

In the case of online learning, the educational needs of PhD students can be considered better than in offline learning, since it is possible to involve more experts in relevant fields who otherwise could not participate due to their workload, which will positively affect learning effectiveness. In this case, it is very important to create opportunities for frequent and purposeful communication between the instructor and the PhD student, since deep understanding of various aspects (climatic, economic, etc.) of emerging problems can only be achieved through close interaction.

Learning strategies

Consider which learning strategies you will use. Provide justification for why you want to apply them, including reasons why they will help participants achieve the planned learning outcomes.

Combine different learning strategies to create a diverse learning environment that will meet different learning styles of participants. This will increase learning effectiveness and help achieve the planned learning outcomes. In this section, it is not necessary to describe specific activities in detail.

The following learning strategies are planned to be used during teaching.

Discussion strategy – will allow participants to develop practical experience in jointly discussing and solving theoretical and practical problems.

Situational analysis strategy – is an important element in the preparation of future climate service managers.

Simulation strategy – interactive models of climate products oriented toward specific sectors of the national economy, which in their internal characteristics are максимально close to corresponding real climatic conditions.

Learning activities

Describe the main learning activities that will be included, such as lectures, reading, case studies, discussions, exercises, practical tasks, simulations, role-playing games, etc.

Also describe the roles of teachers and students during these activities..

The course includes lectures and practical classes (40% of the total course hours) and independent student work (60% of the total course hours). For each module, 12 academic hours are allocated for contact hours, while 18 hours are allocated for independent student work. Thus, the contact hours will consist of 1–3 lectures and practical classes, to which the remaining time will be devoted.

The main organizational form of learning is the lecture, and the course begins with a lecture. During the first lecture, participants become acquainted with the instructors, the objectives and structure of the course; the connection between the theoretical content of the course and practical tasks is explained; a list of educational and scientific sources for studying the course is provided; and the conditions for current and final assessment are communicated.

The main requirements for lectures are: scientific validity and informativeness; substantiation and the presence of a sufficient number of scientific justifications, facts, documents, vivid and convincing examples; activation of students' thinking through reflective questions; clear structure and logical progression of material presentation; methodological processing of educational material, explanation of new terms, highlighting of key ideas, provisions and conclusions, repetition of conclusions in different interpretations, etc.

At the final lecture, a brief review of the studied material is provided, as well as systematization of knowledge with mandatory explanation of the most difficult examination questions.

The learning process also includes practical classes. They provide participants with the opportunity for deeper study of the course and play an important role in developing PhD students' skills in applying acquired theoretical knowledge to solving practical tasks. Practical classes allow the instructor to develop and monitor the process of mastering the course material by PhD students. Practical classes may be implemented in the form of tasks, exercises, situational problem solving, and development of teamwork skills during research and analysis of obtained results.

Independent work of PhD students is an essential part of the learning process. The effectiveness of classroom work depends on the student's self-preparation. Effective completion of independent work requires planning and monitoring by the instructor, as well as planning of its volume within the curriculum. Independent work is performed not only for mastering the course, but also for developing skills of independent work in general — in educational, scientific, and professional activities — as well as for acquiring the ability to take responsibility, independently solve problems, find constructive solutions, and overcome crisis situations, etc.

Independent work of the PhD student includes preparation for lectures, practical classes, and assessment activities, as well as completion of part of the practical assignments.

The role of the lecturer during lectures is defined by the overall control of the learning process, the selection of learning activities, and learning strategies. During practical classes, the lecturer acts as an instructor or supervisor who determines the direction of practical tasks. Throughout the course, the lecturer provides support to PhD students in the form of scheduled and unscheduled consultations.

The role of the PhD student is to acquire knowledge, skills, and competencies in practical work and teamwork while completing tasks assigned by the lecturer, which prepares the learner for their future professional activity.

Assessment of learning

Describe the assessment plan for participants before, during and/or after the course, including tests, exercises, activities, and projects that are subject to evaluation. Indicate whether self-assessment or peer assessment will be used. Explain how assessment is linked to learning outcomes.

Before the start of the course, an initial assessment of PhD students' knowledge is conducted – an entry test. Its purpose is to determine the level of preparation of participants and their knowledge of the basic component required for studying the course. This method of assessment is considered necessary for the instructor to understand the educational needs of each PhD student and may be conducted in a distance format using the online learning platform.

For monitoring students' knowledge, a modular form of assessment is used. The modular assessment is based on dividing the course into separate logically connected blocks (modules) in the form of tests of different types. The integrated assessment of theoretical knowledge and skills consists of scores obtained for each module (3 theoretical modules with a maximum score of 10, 20, and 20 points respectively). The total score includes points from each module, reflecting the importance of each module in acquiring basic knowledge and skills, as well as the rhythm of learning – timely completion of assessment activities according to the course schedule. Tests are conducted in an online format via the distance learning platform. Testing allows the instructor to assess the degree of students' understanding of theoretical material. Theoretical tests consist of at least 20 questions. Correct answers to 50–74% of questions correspond to a sufficient (minimum) level, 75–89% to a good level, and 90–100% to an excellent level of mastery.

Students may also independently monitor their level of understanding through self-assessment tests prepared for each course section and available on the learning platform. This form of assessment is aimed at deeper understanding of theoretical material and error correction.

Practical classes are conducted under the supervision of the instructor during contact hours defined in this syllabus. Tasks and input data for practical assignments are provided on the learning platform. Completed practical assignments are uploaded by students to the platform for review and feedback. Correctly completed practical tasks are evaluated by the instructor according to learning outcomes and quality criteria. The course includes 4 practical assignments. Points are distributed as follows: practical work 1 – 10 points, practical work 2 – 10 points, practical work 3 – 10 points, practical work 4 (synthesized report) – 20 points. Practical assignments are assessed as follows: excellent level – the student completed all tasks independently (80% of the grade) and presented results in a presentation (20%) and answered questions during presentation; good level – the student completed all tasks independently without presentation (80%); sufficient level – the student completed all tasks with the help of the instructor (60%).

The final course grade is calculated as the arithmetic sum of points from all modules (theoretical modules and practical work), i.e., the cumulative score during the semester, which represents the final assessment of course completion.

Learning storyboard (instructional storyboard)

Use this to create a visual scenario of your blended learning activity.

Acquisition

Learning through acquisition is what Masters students do when they listen to lectures or podcasts, read books or websites, and watch demonstration videos or recordings:

• reading books, articles (reading digital books, articles, multimedia, websites, documents and resources);

• listening to instructors' presentations and lectures (listening to podcasts, webcasts);

• watching demonstrations, workshops (watching animations, videos, demonstrations, workshops);

• question-and-answer forum.

Learning resources and tools

List the available resources that will be used for different types of learning activities and recommended to students.

Describe the technologies that will be used to implement the learning solutions, including educational technologies and operational equipment (hardware, software, collaborative tools).

Learning resources and tools

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2. Настанова з метеорологічного прогнозування. Український гідрометеорологічний центр. Київ, 2019. 35 с. Режим доступу: https://www.meteo.gov.ua/f/pro_nas/normatuvni_akt/Nastanova%20z%20meteoprognozuvannia.pdf.
3. Кліматичні ризики функціонування галузей економіки України в умовах зміни клімату: монографія / за ред. С. М. Степаненка, А. М. Польового. Одеський державний екологічний університет. Одеса: ТЕС, 2018. 548 с.
4. Врублевська О.О., Катеруша Г.П., Миротворська Н.К. Кліматологічна обробка окремих метеорологічних величин. Навчальний посібник. Одеса: Вид-во «ТЕС», 2004. 150 с.
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7. Школьний Є.П., Гончарова Л.Д., Миротворська Н.К. Методи обробки та аналізу гідрометеорологічної інформації. Навчальний посібник. Київ: Міносвіти України, 2000. 419 с.
8. Гончарова Л.Д. Методи багатовимірного статистичного аналізу метеорологічних полів та атмосферних процесів: Навчальний посібник. Одеса, 2016. 195 с. http://eprints.library.odeku.edu.ua/id/eprint/593
9. Гончарова Л.Д. Методи обробки та аналізу гідрометеорологічної інформації. Конспект лекцій. ОДЕКУ. Одеса, 2017. 120 с. http://eprints.library.odeku.edu.ua/id/eprint/459
10. Гончарова Л. Д. Методи аналізу випадкових метеорологічних процесів: Конспект лекцій. Одеськ. державний екологічний ун-тет. Одеса; 2019. 105 с. http://eprints.library.odeku.edu.ua/id/eprint/7314
11. Школьний Є.П., Серга Е.М., Галич Є.А. Багатовимірний статистичний аналіз гідрометеорологічної інформації. Навчальний посібник. Одеса: ТЕС, 2015. 161 с. http://eprints.library.odeku.edu.ua/id/eprint/5429
12. Лоєва І.Д., Сєрга Е.М., Школьний Є.П. Методи теорії випадкових процесів: навчальний посібник. Одеськ. державний екологічний ун-тет. Одеса; 2019. 132 с.

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15. Юссеф Ель Хадрі, Хохлов В.М. Режим швидкості вітру в Танжері у 2021-2050 роках. *Ukrainian hydrometeorological journal*, 2019, 23, p. 5-13. doi:10.31481/uhmj.23.2019.01

Online resources:
1. https://www.securities.io/uk/descriptive-statistics/ Definition, overview, types and examples of descriptive statistics
2. https://uk.economy-pedia.com/11035821-descriptive-statistics Descriptive statistics – what it is, definition and concept. Main statistical parameters
3. https://socialdata.org.ua/manual/manual4/ Open guide to open data. 4. Basics of statistics and data analysis
4. https://dl.khadi.kharkov.ua/mod/url/view.php?id=146974 Application of descriptive statistics in Microsoft Excel
5. https://uk.extendoffice.com/documents/excel/7466-descriptive-statistics-excel.html Descriptive statistics in Excel (Quick and simple guide)
6. https://statanaliz.info/excel/diagrammy/diagramma-yashhik-s-usami-boxplot-v-excel-2016/ Boxplot diagram in Excel 2016
7. https://stud.com.ua/93299/statistika/poperedniy_analiz_danih_opisova_statistika Preliminary data analysis. Descriptive statistics
8. https://www.houseofmath.com/uk/encyclopedia/statystyka-ta-ymovirnist/statystyka/diahramy/shcho-take-korobkovi-hrafiky What are box plots?
9. https://statorials.org/uk/%D0%BA%D0%BE%D0%BB%D0%B8-%D0%B2%D0%B8%D0%BA%D0%BE%D1%80%D0%B8%D1%81%D1%82%D0%BE%D0%B2%D1%83%D0%B2%D0%B0%D1%82%D0%B8-boxplot/ When should a boxplot be used? (3 scenarios)
10. https://wordpress.mediadoma.com/uk/rizni-tipi-diagram-i-grafikiv-jaki-vi-vikoristovuvatimete/ Different types of charts
11. https://www.wikiwand.com/uk/articles/%D0%9A%D0%BE%D1%80%D0%BE%D0%B1%D0%BA%D0%BE%D0%B2%D0%B8%D0%B9_%D0%B3%D1%80%D0%B0%D1%84%D1%96%D0%BA Box plot

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