Syllabus

Course Title

Data and information for climate services

General Information

General description of the required education/training, outlining the main objectives and explaining the necessity of the education/training at the organizational/country/regional level

Climate change is one of the deepest and most complex problems currently affecting our society and economy. Scientific developments continue to increase the scale of concern and indicate that the problem of climate change may be even more serious than previously thought. Despite ongoing uncertainty regarding detailed relationships, extreme weather events are increasingly being linked to human interference, and growing attention is being paid to the need for preparation and adaptation to climate change. To understand the impacts of climate change, it is important to identify vulnerabilities and opportunities for a given region.

The aim of this course is to train professional meteorologists, meteorological managers of senior and middle level, and master's students in natural sciences to work with climate databases in order to provide climate service applications. Participants will learn to obtain climate information for end-user services using all available services and climate databases.

Audience

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

Expected level of knowledge and skills of the main audience (current or minimally required), as well as other factors (for example, cultural characteristics, level of technical training, access to the Internet) that should be considered when planning the course, as they may affect the choice of teaching methods, materials, and approaches to interaction with the audience

Second-cycle students in natural sciences (E4 "Earth Sciences", E2 "Ecology", G18 "Geodesy and Land Management").

Employees of meteorological services, managers, and executives who face risks from climate change and wish to learn about methods of mitigating the impact of global warming.

It is expected that course participants will have basic training in the following fields:

• Physical foundations of atmospheric processes.

• Analysis of climate data.

• Climate process modeling: the ability to use numerical models to predict climate changes and understand their consequences.

• Information and analytical activities: the ability to apply information and analytical technologies for collecting, processing, and presenting climate information.

In addition, knowledge in ecology, economics, and risk management will be useful, as climate change has a wide range of impacts on various aspects of society and the economy. These competencies will help students effectively work with climate data and develop strategies for adapting to climate change.

Competencies

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

Competencies targeted by the training.

C2. Obtain climate information to meet end-user needs, using all available services and climate databases (IRI/LDEO Climate Data Library, Copernicus Climate Data Store, IS-ENES Climate4Impact, etc.) to meet end-user needs, using all available services and climate databases (IRI/LDEO Climate Data Library, Copernicus Climate Data Store, IS-ENES Climate4Impact, etc.).

Learning outcomes and performance criteria

Learning outcomes and performance criteria formulated with regard to the knowledge and skills to be acquired during the training process.

LO1. Collect information on additional sources of climate data and metadata and use it for preparing and conducting data rescue campaigns.
LO2. Discuss the strengths and weaknesses of the observation network and data availability for climate research.
LO3. Apply quality control and homogenization techniques, assess the quality and homogeneity of the climate data network after collecting documentary, statistical, and graphical evidence.
LO4. Design a climate data and metadata database using a climate data management system, including raw, quality-checked, and homogenized data.
LO5. Create and document climate datasets for specific purposes, including metadata, and explain their possible use and associated uncertainties.

Course Content

Provide a content outline that corresponds to the learning objectives and 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. Collection of climate data and data rescue procedures.

Collect information on additional sources of climate data and metadata and use it for preparing and conducting data rescue campaigns.

Module 2. Assessment of observation networks for climate research.

Discuss the strengths and weaknesses of the observation network and data availability for climate research.

Module 3. Quality control and homogeneity of climate data.

Apply quality control and homogenization techniques, assess the quality and homogeneity of the climate data network after collecting documentary, statistical, and graphical evidence.

Module 4. Climate data management systems and database development.

Design a climate data and metadata database using a climate data management system, including raw, quality-checked, and homogenized data.Модуль 5 Створення та документування кліматичних наборів даних.

Create and document climate datasets for specific purposes, including metadata, and explain their possible use and associated uncertainties.

Learning Solutions and Methods of Implementation

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

Classroom course – based on the main lecture and practical topics. Some of the practical exercises can be completed at home or in groups in classrooms, with students helping each other. Learning materials will be distributed online, and the lecturer will be available online at a scheduled time for questions and consultations.

Learning methods: online, blended format, on-the-job training, online resources for self-study.

Learning Strategies

Consider which learning strategies you will use. Provide justification for why you intend 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 accommodates different learning styles of participants. This will increase the effectiveness of learning and help achieve the planned learning outcomes. This section does not require a detailed description of specific activities.

1. Establishing clear learning objectives. It is important that participants understand the expected outcomes. Objectives should be challenging but achievable, encouraging participants to reach high standards.
2. Flipped classroom strategy. The flipped classroom is a learning approach in which the main acquisition of new material by students takes place at home, while classroom time is dedicated to practical work—completing tasks and exercises, conducting laboratory and practical studies, and individual consultations with the instructor, etc.
3. Competency-based approach. This approach is focused on developing students' practical skills and abilities that they can apply in professional activity. It includes the integration of theoretical knowledge with practical tasks that reflect real working conditions.
4. Project-based learning. Involving students in real projects allows them to apply acquired knowledge in practice, develop analytical and research skills, and improve teamwork abilities.
5. Individualization of learning. Adapting the learning process to each student's needs and interests, and providing the opportunity to choose research or practical topics, promotes deeper engagement and motivation in learning.

Learning Activities

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

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

Learning activities will consist of lectures and practical exercises (in-class or online). Case studies will be carried out using time series of meteorological and climate data, enabling students to obtain the spatial-temporal distribution of climate indicators for the analysis of climate extreme events and climate change.

Practical exercises will be provided for obtaining climate data from different sources and creating purpose-specific time series (e.g., using the Climate Explorer database and Copernicus Climate Data Store). The main tasks during the training will focus on calculating basic climate products such as normals, anomalies, and climate indices, including those defined by the WMO. Students will use software to create graphs, maps, and reports based on climate forecasts and projections.

Roles of instructors during training:

1. Introducing participants to the course content.
2. Conducting classes according to the schedule.
3. Checking practical assignments and providing feedback.
4. Assessing the effectiveness of participants' learning.
5. Critical analysis of collaboration between participants and instructors.

Roles of students during training:

1. Studying the provided course materials.
2. Active participation in practical classes.
3. Independent work.
4. Collaboration with instructors.
5. Participation in group work.

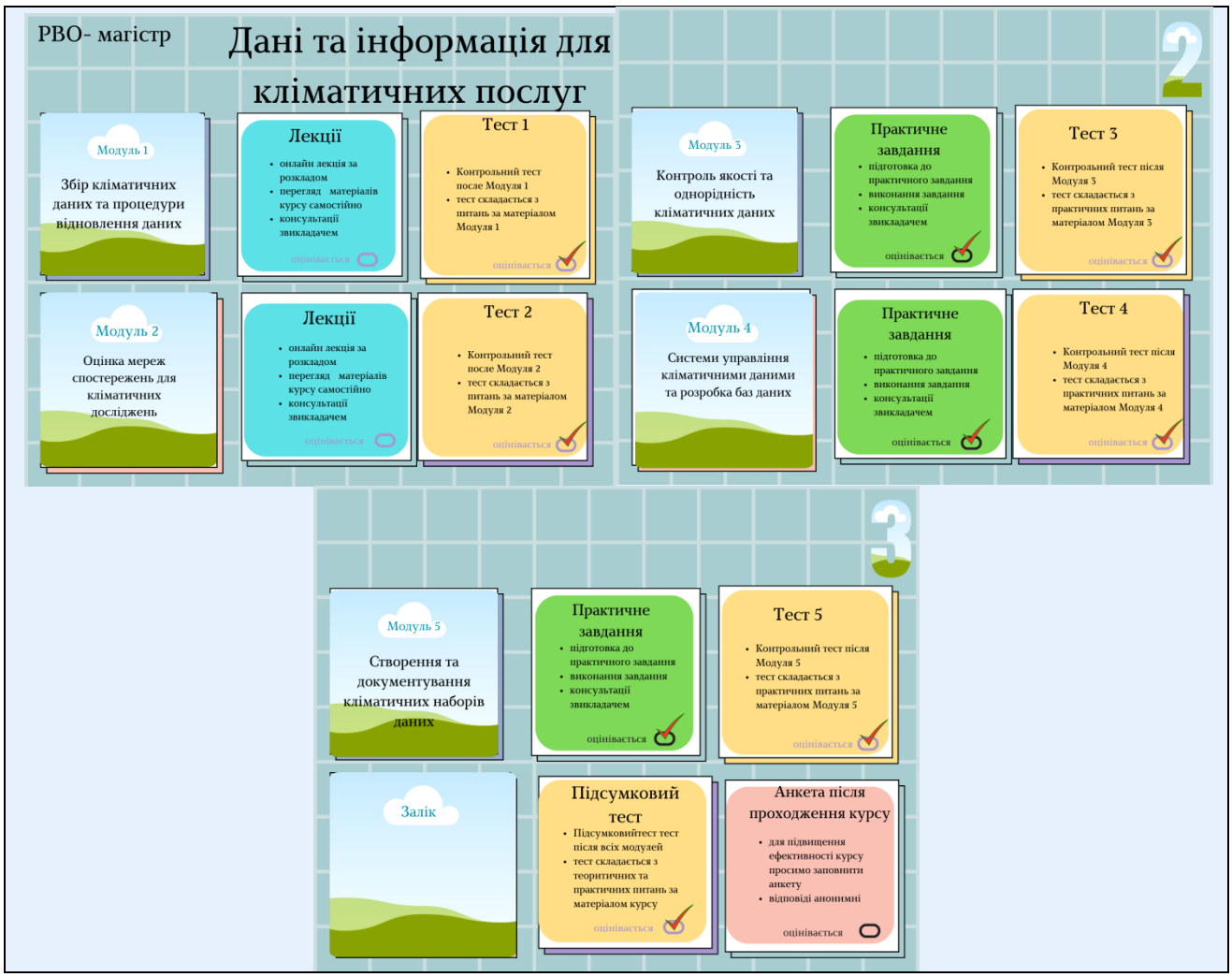
Assessment of Learning

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

The total number of points that each student can earn is 100. The maximum score for each module is 20 points. The first and second modules are tests consisting of 20 questions (20 points). Practical modules 3, 4, and 5 include 15 points for full completion of the assignment and 5 points for the defense of the practical work. Thus, the total maximum number of points a student can obtain upon successful completion of the course is 100 points, and the minimum passing score for completing the course is 60 points.

Storyboard of Learning (Learning Storyboard)

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



Learning Resources and Tools

List the available resources you will use for different types of learning activities and recommend to students.

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

Classroom for 5–10 students with a projector for blended learning.

1. Laptops or tablets with Internet access.
2. Moodle website (https://re.climed.network/course/), where course information is uploaded: objectives, calendar, participants, information about tests, forum, presentations, modelling, grades, and any additional materials.
3. Multiple online sessions are scaled to connect students with the instructor.
4. Internet modules for learning, for example conceptual models and verification.
5. Presentations and exercises created by trainers.
6. Registration and access to climate product portals; meteorological data, where participants will have access to real-time data, NMP products from various centers, observational data, etc.

URLs:

1. https://climatedataguide.ucar.edu/ Опис баз кліматичних даних
2. http://www.ipcc.ch/index.htm Звіти про оцінку

3. http://www.esa.int/Our_Activities/Observing_the_Earth/Space_for_our_climate/
Використання та інтерпретація супутникової інформації в кліматології.
4. Infrastructure for the European Network for Earth System Modelling. Climate4Impact Portal https://is.enes.org/sdm-c4i-portal/

Books:
1. Степаненко С.М. (2013). Динаміка та моделювання клімату. (Динаміка та моделювання клімату) – Одеса, Видавництво: „Екологія", 204 с. (електронний підручник)
http://eprints.library.odeku.edu.ua/id/eprint/6173 /
2. Степаненко С.М., Польовий А.М., Лобода Н.С. (2015) Кліматичні зміни та їх вплив на сферу економіки України: монографія. ОДЕКУ, Одеса. 520 с.
http://eprints.library.odeku.edu.ua/id/eprint/2269
3. Wilks, D. S. (2011). Statistical Methods in the Atmospheric Sciences. 3rd ed. Academic Press. Pages 2-676

WMO guiding documents:
1. Climate Data Management Systems (CDMSs) https://community.wmo.int/en/climate-data-management-systems-cdmss#:~:text=Long%2Dterm%2C%20high%2Dquality,global%20climate%20variability%20and%20change
2. Climate Data Management System Specifications WMO-No. 1131, 2025, 166 p. https://library.wmo.int/ru/records/item/51447-climate-data-management-system-specifications
3. WMO-No. 100 (Guide to Climatological Practices), 2018, 153 с. https://biotech.law.lsu.edu/blog/100-2018_en.pdf