Syllabus

Course Title

Climate forecasts and scenarios

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**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

Today, the fact of global warming is beyond doubt and is considered experimentally proven: increases in global air and ocean temperatures, reductions in sea ice extent, and rising sea levels have been confirmed by long-term instrumental observations. Climate changes occurring over the past decades continue to concern scientists. In this context, methods for forecasting global climate changes and their possible consequences are developing more actively, with mathematical methods for modeling atmospheric processes coming to the forefront. Future climate changes represent one of the greatest challenges facing humanity in the new century. The need for information on climate change is essential to assess its impact on humans and natural systems, with the goal of developing appropriate adaptation measures and strategies to mitigate the negative effects of climate change at the national and even regional levels.

To assess possible changes in the regional climate of Ukraine, one can use modeling results obtained for the territory of Europe within the framework of the CMIP3 project (Coupled Model Intercomparison Project, phase 3). This project was guided by the Intergovernmental Panel on Climate Change (IPCC) and organized with the aim of studying future climate changes using global climate models. Therefore, proficiency in techniques for analyzing and visualizing climate information is a necessary competency for future master's-level climatologists and specialists whose work is related to climate-dependent sectors of Ukraine's economy.

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

Master's students enrolled primarily in specialties E2 "Ecology," E4 "Earth Sciences," G2 "Environmental Protection Technologies," and C6 "Geography and Regional Studies," as well as future specialists in climate-dependent sectors of the economy—G "Engineering, Manufacturing and Construction," H "Agriculture, Forestry, Fisheries and Veterinary Medicine," and I "Health Care and Social Welfare."

Representatives of management personnel and educators who are improving their qualifications in the field of climate change adaptation across various sectors of Ukraine's economy may also participate in the training.

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.

- To apply forecasts and scenarios for informed decision-making in the sustainability of economic sectors and sustainable planning, as well as to identify and classify uncertainties in various contexts.

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.

Learning outcomes for the educational component:

LO1. Explain the economic and environmental foundations of the main SSP-RCP climate change scenarios, identifying the key driving forces for each scenario.

LO2. Discuss the projections of regional climate models for climate projections based on the worst-case and best-case scenarios, as well as their impacts on various economic sectors, geographic regions, ecosystems, human health, and the economy as a whole.

Performance criteria:

Identify the possible future consequences of climate change under different SSP-RCP climate change scenarios.

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: EMISSION SCENARIOS AND THEIR IMPACT
1.1. Emission scenarios
1.2. SSP-RCP climate change scenarios
1.3. Practical work: “Analysis and projection of climate indicators for Odesa (2021–2050) under RCP4.5 and RCP8.5 scenarios based on EURO-CORDEX data”

MODULE 2: REGIONAL CLIMATE MODEL PROJECTIONS
2.1. Current climate changes in Ukraine based on numerical climate model data
2.2. Analysis and visualization of climate information using the Copernicus platform
2.3. Practical work: “Using the Copernicus web portal to download, visualize, and analyze data useful for assessing climate risks”

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.

For the achievement of the planned learning outcomes, a set of learning solutions will be applied in the course, ensuring diversity in the educational process, flexibility in learning formats, and practical orientation.

Selected learning solutions

1. **Classroom learning (face-to-face instruction)**
    - Reasons for selection: creates opportunities for direct interaction between the instructor and participants, promotes discussions, exchange of experience, and the development of communication skills.
    - Implementation: lectures, seminars, group discussions.
2. **Online learning**
    - Reasons for selection: ensures accessibility for participants regardless of their location and allows the use of interactive digital tools.
    - Implementation: synchronous sessions in the form of video conferences and asynchronous materials (recorded lectures, interactive tests).
3. **Blended learning**
    - Reasons for selection: the combination of face-to-face and online formats enables participants to benefit from both direct interaction and the convenience of remote access to resources.
    - Implementation: in-person training sessions combined with online assignments for independent work.

4. **On-the-job training**

    - Reasons for selection: allows participants to immediately apply acquired knowledge in a professional context and increases the practical value of the training.
    - Implementation: completion of practical tasks and projects in real-world conditions.

5. **Online resources for self-directed learning**

    - Reasons for selection: promote the development of self-organization skills and provide an individualized pace of learning.
    - Implementation: platforms with electronic textbooks, video lectures, and interactive assignments.

6. **Coaching and mentoring**

    - Reasons for selection: support an individual approach, enable participants to receive feedback, and foster the development of professional and personal competencies.
    - Implementation: individual consultations and mentorship provided by experts.

Rationale for selection

The combination of the above learning solutions will:

- cover different learning styles and formats;
- integrate theory with practice;
- ensure flexibility and accessibility of the educational process;
- create conditions for the personal and professional growth of participants.

Thus, combining classroom, online, and practice-oriented learning will ensure the most effective achievement of the planned learning outcomes.

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.

During the implementation of the course, a combination of different learning strategies will be used, aimed at ensuring maximum effectiveness in mastering the material and achieving the planned learning outcomes. Considering the diversity of participants' learning styles (visual, auditory, kinesthetic, reflective), the selected approaches will provide multifaceted interaction with the learning content.

Applied strategies

1. **Active learning**
   This will ensure participants' engagement in the process through analysis, discussion, and practical application of knowledge. Such an approach will promote the development of critical thinking and a deeper understanding of the material.
2. **Collaborative learning (group work)**
   Working in small groups helps participants develop teamwork skills, exchange experiences, and build collective solutions. I his will enhance learning effectiveness through different perspectives and peer learning.
3. **Problem-based learning (PBL)**
   Participants will solve practical tasks and analyze real cases. This will allow them to transfer acquired knowledge into a professional context, contributing to the development of analytical skills, decision-making abilities, andcreative thinking skills.
4. **Reflective learning**
   This will include time for self-analysis, self-assessment, and reflection on individual progress. It will help participants identify their strengths and areas for development, as well as increase their motivationfor further learning.
5. **Multimodal approaches**
   The use of information and communication technologies (presentations, interactive platforms, visualizations, videos) will ensure a variety of content delivery formatsand improves information retention.

Rationale for strategy selection

The combination of these approaches creates a balanced learning environment that:

- accommodates different learning styles;
- integrates theory with practice;
- promotes the development of both individual and team skills;
- builds competencies necessary for applying knowledge in real-world conditions.

Thus, the selected strategies will contribute to achieving the planned learning outcomes and increasing the effectiveness of the educational process.

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.

The course assumes a total of 24 contact hours—12 hours of lectures and 12 hours of practical sessions (40%), while 36 hours (60%) are allocated for students' independent work. The course incorporates a variety of learning activities that combine theoretical knowledge with practical skills. This will allow participants not only to acquire information but also to learn how to apply it in real-world conditions.

Main learning activities

1. **Lectures**
   - **Purpose:** to provide foundational knowledge, key concepts, and theoretical frameworks of the subject.
   - **Role of the instructor:** organizer and source of knowledge who explains the material and structures key ideas.
   - **Role of students:** active listeners who take notes and ask clarifying questions.
2. **Literature and recommended materials review**
   - **Purpose:** to broaden understanding of the topic and teach how to work with scientific and professional sources.
   - **Role of the instructor:** provides a list of literature and methodological guidance for independent study.
   - **Role of students:** read materials, prepare notes, and formulate key points for further discussion.
3. **Case studies (analysis of practical cases)**
   - **Purpose:** to apply theoretical knowledge to real-world situations and develop analytical and decision-making skills.
   - **Role of the instructor:** acts as a discussion moderator, presenting the case and guiding analysis.
   - **Role of students:** analyze the situation, propose solutions, and justify their own viewpoints.
4. **Практичні завдання та вправи**
   - **Purpose:** to consolidate knowledge through task completion and develop practical skills.
   - **Role of the instructor:** provides instructions and feedback.
   - **Role of students:** complete individual or group assignments.

Summary

The combination of lectures, reading, case studies, discussions, and practical activities ensures a balance between knowledge acquisition and skill development, while promoting active student engagement in the learning process.

- Instructors act not only as sources of knowledge but also as facilitators, mentors, and moderators.
- Students become active participants who take responsibility for their own learning and outcomes.

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.

During the learning process, various assessment methods will be applied to comprehensively monitor participants' progress and ensure the achievement of the planned learning outcomes.

1. Questioning (short discussions with the instructor after lectures)

- **Purpose:** to check understanding of key concepts and provide an opportunity to clarify unclear points.
- **Connection to learning outcomes:** helps consolidate material immediately after presentation and develops oral argumentation skills.

2. Self-assessment (mini-test after the first module)

- **Purpose:** allows participants to independently determine their level of understanding and identify areas that require further study.
- **Connection to learning outcomes:** develops self-reflection skills and encourages revisiting the material.

3. Formative assessment during the course (practical exercises checked by the instructor)

- **Purpose:** to monitor progress and the ability to apply knowledge in practice.
- **Connection to learning outcomes:** enables gradual competency development and provides feedback for improvement.

4. Summative assessment after the course (final test after each module

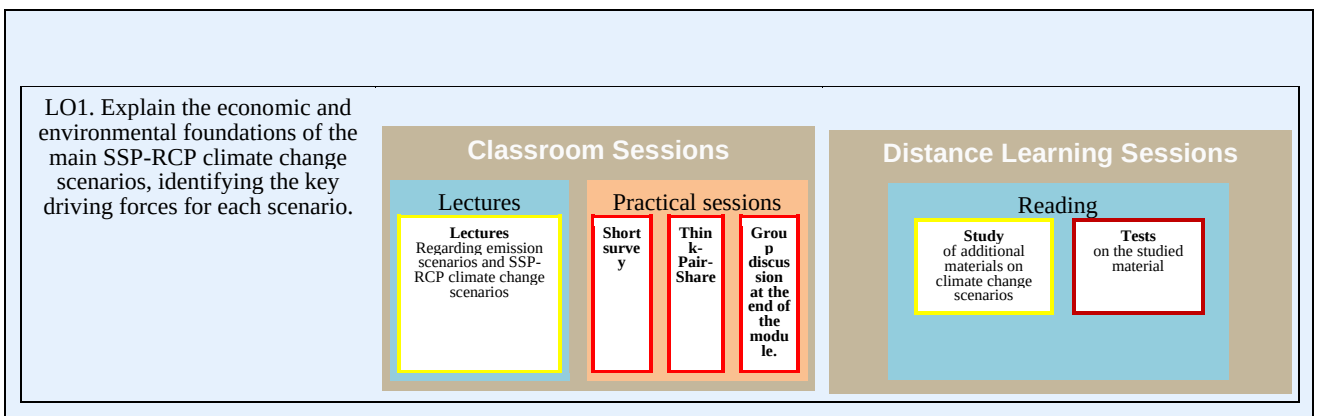
- **Purpose:** to evaluate the level of mastery of key knowledge and the integration of acquired information.
- **Connection to learning outcomes:** confirms that participants have reached the necessary knowledge level to proceed to the next stage or complete the course.

Thus, the combination of questioning, self-assessment, formative, and summative assessment allows:

- continuous monitoring of progress;
- providing participants with tools for self-development;
- ensuring that the final outcomes align with the stated course objectives.

Storyboard of Learning (Learning Storyboard)

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



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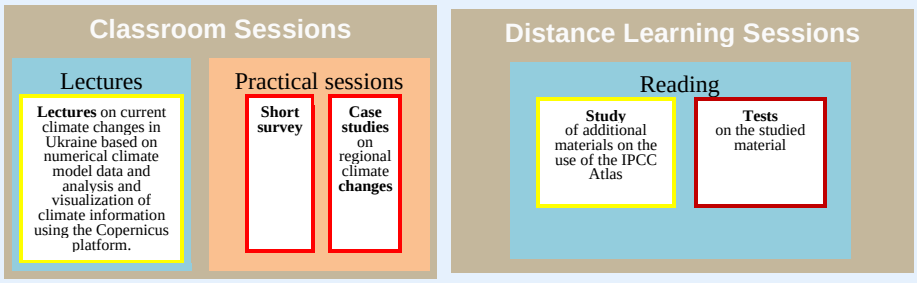
LO2. Discuss the projections of regional climate models for climate scenarios based on the worst-case and best-case outcomes, as well as their impacts on various economic sectors, geographic regions, ecosystems, human health, and the economy as a whole..	

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 learning solutions, including educational technologies and operational equipment (hardware, software, collaboration tools).

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