Course name

Vulnerability to climate change and climate risks

General information

A general description of the training/education required, outlining the main objectives and providing an explanation of the need for training/education at the organizational/country/regional level

The increase in global temperatures, caused by increased greenhouse gas emissions from human activities, is significantly altering the global climate system. This affects weather patterns, natural ecosystems and the quality of life of people, creating numerous challenges for every country. The consequences of climate change are becoming increasingly tangible, requiring urgent action at all levels.

Climate change not only causes physical and environmental changes, but also exacerbates social inequalities and negatively affects the health of populations. According to the World Health Organization, between 2030 and 2050, climate change could cause an additional 250,000 deaths annually due to malnutrition, disease and heat stress. Extreme weather events also cause loss of life, forced displacement and increased poverty.

In this context, training professionals who can assess the social and economic impacts of climate change is vital. They should offer effective measures for adaptation to climate change and mitigation of its impact, ensuring the resilience of society and the economy to climate risks. Such training is key to achieving sustainable development both at the organizational level and at the national or regional levels.

The aim of the course offered is to develop in future climate service professionals an understanding of how climate and its changes affect the socio-economic life of humanity, as well as to develop skills in assessing the consequences of these changes for ecosystems and society.

Audience

The primary audience of the course and any secondary audience that may influence decisions about the course structure or content

The expected level of knowledge and skills of the primary audience (current or minimum required), as well as other factors (e.g., cultural characteristics, level of technical training, Internet access) that should be considered when planning the course, as they may influence the choice of teaching methods, materials, and approaches to interacting with the audience

The main audience is graduate students of Ukrainian universities who are studying in the field of climate services. The course can also be partially used as a refresher course for specialists in meteorology and climatology, as well as for specialists in other fields that require decision-making based on climate factual and forecast information.

1. Level of knowledge and skills of the main audience:

Fundamental knowledge:

The audience should have a basic knowledge of natural sciences, in particular geography and climatology, to understand climate processes and their impact on socio-economic systems, as well as the basics of economic theory, in particular basic economic concepts.

Analytical preparation:

Participants should have basic statistical analysis methods, including working with big data and its interpretation, as well as skills in working with economic indicators, forecasts and scenarios.

Technical preparation:

Participants should have basic computer and Internet skills, and be familiar with the tools used to access interactive learning platforms (e.g. Moodle). It is desirable that the audience has basic skills in data analysis and presentation.

Proficiency in analytical tools such as Excel, Python, R or specialized software for risk modeling and economic vulnerability assessment is desirable, as well as basic knowledge of GIS for spatial analysis of climate risks.

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English language level:

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

2. Other factors:

Inclusivity and Accessibility:

The teaching process will use a variety of delivery methods (text, audio, video, interactive tasks).

Learning materials are provided in accessible formats, such as large print text, audio files, or files compatible with screen readers.

Students will be given a choice in the learning methods that best suit their needs

Internet Access:

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

Competencies

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

Competencies on which the training will be focused.

C4. Assess the vulnerability, resilience and adaptability of an economic sector or the economy as a whole to climate risks under current and future climate and environmental changes in Ukraine.

Learning outcomes and performance criteria

Learning outcomes and performance criteria formulated taking into account the knowledge and skills that will be acquired during the learning process.

Efficiency criterion:

PC1. Define and differentiate between the concepts of impact, vulnerability, risk, adaptive capacity and uncertainty in both written and oral presentations.
PC2. Conduct climate vulnerability and risk assessments for specific economic sectors/geographical areas/vulnerable communities/ecosystems, using relevant data and analytical tools.
PC3. Estimate the economic losses that will be incurred by an industry/enterprise/geographical area as a result of climate change.

Learning Outcomes:

LO1. Explain key concepts of impact, risk, vulnerability, adaptive capacity, and uncertainty related to climate variability and climate change.

LO2. Identify the regional dimension of climate change and the possible consequences for different sectors (e.g., agriculture, water resources, healthcare, and infrastructure).

LO3. Select and apply appropriate analytical tools and methodologies to conduct climate vulnerability and risk assessments, ensuring accuracy and reliability of results.

LO4. Prioritize vulnerabilities and risks based on their severity, likelihood, and potential impact on vulnerable communities, ecosystems, and economic sectors.

LO5. Provide a detailed analysis of the short-term and long-term social and economic impacts of climate change.

LO6. Use appropriate economic models to assess damages and determine adaptation needs based on these economic evaluations

Course Content

Provide a content plan that aligns with the objectives and learning outcomes. This may be a course outline as presented to students, but it does not have to be a full syllabus.

Include a general list of all topics you consider necessary to cover. If helpful for clarity, indicate what will not be covered.

Module 1: Climate Risks – Key Concepts

Core concepts related to climate change, including impact, risk, vulnerability, adaptive capacity, and uncertainty.

Module 2: Climate Change Impacts Regional aspects of climate change and their consequences for different sectors such as agriculture, water resources, healthcare, infrastructure, etc.

Module 3: Analytical Tools and Methodologies. Analytical tools and methods for assessing climate vulnerability and risks. Selection and application of appropriate tools for accurate evaluation of climate threats.

Module 4: Identifying Climate Vulnerabilities and Risks. Identification and prioritization of climate vulnerabilities and risks based on their severity, likelihood, and potential impacts on communities, ecosystems, and economic sectors.

Module 5: Understanding Economic Impacts. Social and economic consequences of climate change, including short-term and long-term effects on various economic and social domains.

Module 6: Economic Losses and Adaptation Needs. Assessment of economic damages caused by climate change and identification of adaptation needs across different sectors of the economy, using economic models to develop effective adaptation strategies.

Learning Solutions and Their 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 master's students, blended learning is generally the preferred option where possible. From a practical perspective, this format makes it significantly easier for learners to manage their study time independently. Considering their educational background, master's students are typically well prepared for online learning, as they already possess strong self-directed learning skills, time management abilities, and high motivation.

However, since the course aims to achieve complex and comprehensive learning outcomes, it is important to complement online learning with in-person sessions that allow students to consolidate and apply their knowledge in practice. This is most effectively achieved in an offline setting.

Students are expected to meet with the instructor in person 1–2 times per week to discuss knowledge gained from video lectures and other materials, as well as to practice and refine their skills. The online component will be primarily asynchronous, with the instructor monitoring progress and engagement through discussion forums to support deeper interaction and address emerging questions.

At the end of the course, a final assessment of learning outcomes will be conducted, and students will be awarded certificates upon successful completion.

Given the current challenging conditions in Ukraine, master's student groups may alternatively be offered fully asynchronous online learning, with the possibility of occasional synchronous sessions.

In an online format, students' educational needs can often be addressed more effectively than in a purely offline setting, as it allows for the involvement of a wider range of experts who might otherwise be unavailable due to time constraints. This can enhance the overall effectiveness of the learning experience. In this context, it is essential to ensure frequent and purposeful communication between instructors and students, as achieving a deep understanding of complex climate, economic, and related issues requires close and consistent interaction.

Learning Strategies

Consider which learning strategies will be used. Provide justification for their selection, including how they will help participants achieve the intended learning outcomes.

Combine different learning strategies to create a diverse learning environment that accommodates various learning styles. This will enhance learning effectiveness and support the achievement of the intended outcomes. This section does not require detailed descriptions of specific activities.

The following learning strategies will be used:

Lectures and Reading Resources

Lectures and existing online resources will provide the necessary scientific knowledge on climate impacts and climate change in socio-economic contexts. They will introduce students to the concept of climate risk, methods of its assessment, and the identification of adaptation needs.

Case-Based Learning Strategies

Through the analysis of specific cases, students will develop practical skills in applying climate risk concepts to support the adaptation of economic sectors, regions, and cities to climate change.

Discussion-Based Strategies

Meetings and debriefing sessions will help students develop critical thinking, analyze available information, formulate well-reasoned conclusions, and identify optimal solutions for developing climate adaptation and mitigation strategies.

Project-Based Learning Strategies

Project development will enable students to understand the process of climate risk assessment, apply it in specific contexts, draw conclusions regarding adaptation at the level of regions, enterprises, or economic sectors, and propose well-justified solutions.

The use of these strategies ensures a learning process that meets two key criteria: flexibility (the ability to adapt to different conditions and student needs) and diversity (the combination of theoretical and practical learning approaches).

In addition, all proposed strategies meet both academic and practical requirements, as they contribute to the development of in-depth knowledge and key competencies necessary for working with climate risks.

Learning Activities

Describe the main learning activities included in the course, such as lectures, readings, case studies, discussions, exercises, practical tasks, simulations, role-playing, etc. Also describe the roles of instructors and students during these activities.

The learning activities for master's students will consist of lectures, accounting for approximately 20% of the total course time. Practical components will include various hands-on tasks (20%), case study analysis (30%), and project work (30%). Case studies and projects will also incorporate discussions, either after completing tasks or during their implementation. To assess knowledge across course sections, self-assessment quizzes and final tests will be provided.

Lecture Topics:

1. Climate risks: definitions and key concepts (LO#1)
2. Overview of the IPCC risk framework and its application (LO#1)
3. Climate change impacts on agriculture, water resources, and infrastructure (LO#2)
4. Interconnections between climate impacts, ecosystems, and human systems (LO#2)
5. Tools and methods for climate vulnerability assessment (LO#3)
6. Data requirements and sources for climate risk analysis (LO#3)
7. Impact chains and risk drivers (LO#3)
8. Methods for prioritizing climate vulnerabilities (LO#4)
9. Risk severity and likelihood assessment (LO#4)

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10. Community-based approaches to risk identification (LO#4)
11. Economic damages from climate change: short- and long-term impacts (LO#5)
12. Methods for assessing economic vulnerability (LO#5)
13. Fundamentals of economic loss assessment due to climate change (LO#6)
14. Identifying and addressing adaptation needs in key sectors (LO#6)

Discussions:

1. Cascading impacts of climate hazards across sectors
2. Prioritizing risks for local communities using severity and likelihood metrics (LO#4)
3. Assessing economic impacts of flood or drought scenarios (LO#5)

Group Project:

"Developing a Climate Change Adaptation Strategy for SMEs Based on Real Climate Risk"

General Description:

This case study is based on the use of an Excel-based tool and a five-step methodology designed to support small and medium-sized enterprises (SMEs) in developing Climate Adaptation Strategies (CAS). The methodology and worksheets were developed by the German Agency for International Cooperation (GIZ) in collaboration with the think tank adelphi, commissioned by BMZ. They are aimed at systematically assessing climate risks, identifying opportunities, and formulating adaptation actions based on real climate impacts on businesses.

Objective of the Case Study:

To provide students with practical experience in applying climate risk analysis and adaptation planning methodologies in the context of SMEs, and to enhance understanding of cross-sectoral climate impacts and methods for economic loss assessment.

Student Tasks:

Students work in groups to analyze a specific climate risk case (e.g., flood, drought, heatwave) using Excel-based tools.

Кожна група:

1. Each group will:

- Identify key components of climate risk (LO#1):
- Climate hazard (e.g., flooding in Western Ukraine or a heatwave in Kyiv)
- Potential impacts on the enterprise (e.g., production loss, supply chain disruption)
- SME vulnerability (e.g., location, lack of contingency planning)
- Adaptive capacity of the enterprise

2. Assess the impacts of one or multiple hazards (e.g., how drought affects agriculture, transport, trade, etc.)
3. Use severity and likelihood criteria to prioritize the most critical climate risks for a community or business (LO#4)
4. Conduct an approximate economic assessment of potential damages (e.g., warehouse flooding, product loss, infrastructure repair), using provided data and justified assumptions (LO#5)

Expected Outputs:

- Completed Excel worksheets
- Group presentation with adaptation strategy recommendations
- Conclusions on the most effective adaptation measures for SMEs in a specific climate context
- Enhanced understanding of the relationships between climate hazards, SME vulnerability, and adaptation responses

Additional Activities:

Essay: "Impact Chains of Climate Risks: From Extreme Events to Socio-Economic Consequences" (LO#3)

Student presentation: Action plan for minimizing economic losses through adaptation (LO#6)

Role-play: Simulation of stakeholder discussions to prioritize adaptation measures (LO#6)

Throughout the course, students will also complete a group project involving a comprehensive assessment of a company's vulnerability to climate change and the development of adaptation recommendations.

Roles of Instructor and Students:

The instructor acts as a facilitator, mentor, and consultant, guiding the learning process and fostering active student engagement. During lectures, the instructor provides the theoretical foundation, explains key concepts, and demonstrates their practical application. In practical sessions, the instructor organizes student activities, poses problem-based questions, and supports the development of critical thinking and case analysis skills. During project work, the instructor advises on research methodology, monitors progress, provides constructive feedback, and helps integrate knowledge into real-world applications.

Students play an active role in the learning process by completing both group and individual tasks. They participate in discussions, analyze case studies, develop projects, and present their findings. Through collaboration and practical application of knowledge, students develop skills in critical analysis, decision-making, and evidence-based argumentation.

Assessment of Learning

Describe the plan for assessing 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 training of master's students, the following assessment methods will be used:

- Online self-assessment tests will be used throughout the course to help students better understand theoretical material, analyze their own mistakes, and prepare for the final assessment. Final online tests are also предусмотred, and their results will be taken into account in the overall course grade;
- Students will participate in a seminar where they will present an action plan for adaptation to minimize economic losses. The assessment will include peer evaluation (analysis of the completeness of the topic coverage, validity of conclusions, etc.);
- To develop communication skills and the ability to express arguments, discussions and round tables will be conducted, where students will discuss current issues in the field of climate risks and adaptation;
- Practical skills and analytical abilities will be assessed through case study analysis, during which students will analyze real cases. The assessment will include peer evaluation (analysis of completeness, validity of conclusions, practical relevance, etc.);
- Final test assessment (exam).

Type of Activity	Share of Total Grade
Online self-assessment tests and module tests	**15 %**
Seminar: presentation of an adaptation action plan	**20 %**
Essay	**10 %**
Case study analysis	**25 %**
Final test (exam)	**30 %**
Total	**100 %**

2. Seminar: presentation of an adaptation measures plan (20%)
Students present an action plan for adaptation to reduce economic losses from climate risks.

Assessment Criteria:

Criterion	Weight
Completeness of climate risk analysis	5 %
Justification of proposed measures	5 %
Practical feasibility of the plan	5 %
Quality of presentation and argumentation	5 %

Case Study Analysis (25%)

Students analyze a real climate case (e.g., heatwave, drought, flooding).

Criteria:

Criterion	Weight
Analysis of climate hazard	5 %
Assessment of vulnerability and exposure	5 %
Proposed adaptation measures	10 %
Practical relevance of solutions	5 %

Розкадровка навчання (навчальний сторіборд)

Використайте для створення візуального сценарію вашого змішаного навчального заходу

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 by you to implement the learning solutions, including educational technologies and operational equipment (hardware, software, and collaboration tools).

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Scientific and analytical publications

1. Simpson N. P., Orr S. A., Sabour S., Clarke J., Ishizawa M., Feener M., Ballard C., Mascarenhas P. V., Pinho P., Bosson J. B., Morrison T., Zvobogo L. **ICSM CHC White Paper II: Impacts, vulnerability, and understanding risks of climate change for culture and heritage: Contribution of Working Group II to the International Co-Sponsored Meeting on Culture, Heritage and Climate Change.** Charenton-le-Pont; Paris: ICOMOS & ICSM CHC, 2022. https://drive.google.com/file/d/18u087QngHvu1ysP4fmQlcmOwJrwnAw2v/view?usp=drive_link
2. **The concept of risk in the IPCC Sixth Assessment Report: A summary of cross-Working Group discussions. Guidance for IPCC authors.** Intergovernmental Panel on Climate Change (IPCC). https://drive.google.com/file/d/1-2PSHO5dmgDBIDrwrsVNhiPXdb8d8XU2/view?usp=drive_link
3. **Generic conceptual framework for vulnerability measurement.** European Commission, DG Environment. Seventh Framework Programme, Cooperation Theme 6 – Environment (including Climate Change). Collaborative Project, Grant Agreement No. 211590.

Analytical materials and web resources

4. Climate Expert. **Climate risk and adaptation knowledge platform.** URL: https://www.climate-expert.org/en/home (date of access: 13.03.2026).
5. DNV. **Uncertainty and climate risk. Future of Digital Assurance research programme.** URL: https://www.dnv.com/research/future-of-digital-assurance/uncertainty-and-climate-risk-content-page/ (date of access: 13.03.2026).