



The impact of climate and its changes on the state of ecosystems and human activity in the polar and mountainous regions

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Coordinator	Eduard Podgaiskii (Russian State Hydrometeorological University, Russia)
Credits	3 ECTS (optional course), 54 in-class hours
Lecturer	Vladimir Drozdov (Russian State Hydrometeorological University, Russia)
Level	MSc
Host institution	Russian State Hydrometeorological University , Department of Ecology and Bioresources
Course duration	September 1 – December 31, 2019

Summary

This 3 ECTS course is elaborated for graduate students studying ecology and environmental management. The purpose of the discipline "The impact of climate and its changes on the state of ecosystems and human activity in the polar and mountainous regions" is the formation of a complex of scientific and practical knowledge about the physiological, behavioral and technological adaptations of man to various types of climate and their changes, to carry out daily production activities and social planning. -economic development of the regions of the Arctic, Siberia, the mountainous regions of the European part of the Russian Federation, etc.

Target student audiences

MSc students in ecology and environmental management

Prerequisites

Required courses (or equivalents):

- Ecology and Evolution of the Biosphere;
- Physical Geography;
- Geocology;
- Hydrology of inland waters;
- Physics;
- Chemistry;
- Basics of Nature Management.



Goals and objectives

The goal of mastering the discipline "The impact of climate and its changes on the state of ecosystems and human activity in the polar and mountainous regions" is the formation of a complex of scientific and practical knowledge about the physiological, behavioral and technological adaptations of man to various types of climate and their changes, to carry out daily production activities and social planning. -economic development of the regions of the Arctic, Siberia, the mountainous regions of the European part of the Russian Federation, etc.

The objectives of the discipline are as follows:

- the formation of knowledge about the main directions of the influence of a changing climate on human evolution and the development of society; about the historical features of the development of human civilizations in cold and mountain climates;
- formation of knowledge about the main types of human and society adaptations to different types of climates and their changes (physiological, behavioral, technological adaptations);
- the formation of knowledge about the main types of human and society adaptations to the climate of highlands using examples from the Caucasus and other regions of the World;
- formation of knowledge about the limits of the adaptive capabilities of the organism;
- formation of knowledge and skills in the field of urban environment formation in extreme conditions of a dry hot climate: energy sources, water supply, architectural features;
- formation of knowledge and skills in the field of urban environment formation in extreme cold climate conditions: energy sources, water supply, architecture features.

General learning outcomes:

As a result of mastering the discipline "The impact of climate and its changes on the state of ecosystems and human activity in the polar and mountainous regions", the student must:

- Know:
 - o theoretical foundations of ecology, resource use and resource conservation, as well as human ecology, social ecology, applied ecology;
 - o theoretical and practical bases of human adaptation to various types of climate and their changes..
- Be able to do:
 - o summarize the results obtained in the context of previously accumulated knowledge in science;
 - o use theoretical knowledge of the basics of environmental monitoring, regulation and reduction of environmental pollution, competently use models of natural-technical systems, as well as methods for processing geo-ecological and ecological information;
 - o methodically competently develop an action plan for environmental audit, monitoring compliance with environmental requirements, environmental management of production processes.
- Master:
 - o knowledge of modern computer technologies used in the collection, storage, processing of information;



- ability to actively communicate in the scientific, industrial and social and public spheres of activity; the ability to freely use Russian and foreign languages as a means of business communication;
- the general methods and means of retrieving, storing, processing information, have skills in working with a computer as a means of managing information.

Overview of sessions and teaching methods

The discipline program consists of lecture-type classes (36 hours) and seminars (18 hours). Individual studies (54 hours) are arranged by exploring theoretical course and accomplishing practical tasks available at e-course platform. Tasks are developed for both group and individual work (case-studying, various data analysis and generalization). The process of individual studies is very convenient as the students are provided with a diverse range of electronic resources (tutorials, scientific articles, cartographic material, databases, video sessions) enabling them to learn and analyze various information.

The student's independent work should be based on studying educational materials on teacher's recommended lists of basic and additional educational literature, studying an electronic course of lectures in the form of slide presentations, visiting recommended Internet resources, including the official websites of the largest specialized domestic and foreign scientific organizations, studying recommended scientific publications for the preparation of reports at the seminar. Examples of tasks: review of climatic conditions and the main environmental factors determined by them that can affect the human body; review of specifics of life and work in the polar night, etc.

Guidelines about tasks completion and response placement procedure shall be presented in the task description message. The quality point shall be awarded for each assignment (test, interactive lecture, exercise, case analysis) during semester period with all the points summarized in the end. Monitoring of individual studies shall be organized at the time of classroom activities and by means of e-learning course (tasks attachments, test tasks performance, scientific papers reviews, essays, etc.)

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	18
Moderated in-class discussions	Understanding various policies and management contexts and common problems in communication in environmental governance	Class participation and preparedness for discussions	36
Independent work			
E-course: - the study of theoretical	The ability to analyze and interpret data from various information resources, own methods of processing	Class participation, creative and	44

material and development of group and individual assignments in the online environment	and interpreting environmental information during scientific and industrial research	active contribution to discussion	
Settlement tasks	Solution of settlement tasks, situational tasks using the knowledge gained	Analysis and interpretation of settlement results	10
Total			108

Grading

The students' performance will be based on the following:

- level of readiness to participate in classroom discussions and seminars (50%)
- contribution to group tasks (20%)
- individual calculation tasks (30%)

Course schedule

Module 1 The concept of climate, climatic conditions of human existence and their variability	
Topic 1.1	Climatic conditions and environmental factors caused by them.
Topic 1.2	General patterns of human adaptation to environmental factors
Topic 1.3	The concepts of physiological, behavioral and technological adaptation of a person to the climate and its changes.
Module 2 Physiological and behavioral human adaptation to the cold climate of the Arctic and Antarctic	
Topic 2.1	Specificity of climatic and weather conditions in the regions of industrial development of the Arctic and Antarctic near cities, industrial centers and research stations. Indigenous peoples of the North .
Topic 2.2	Human physiological adaptations to life in the cold climate of the Arctic and Antarctic. Reactions and adaptations of the cardiovascular, nervous and respiratory systems, water metabolism. The specificity of food consumption and coal exchange in people living in cold climates.
Topic 2.3	Behavioral human adaptation to life in the cold climate of the Arctic and Antarctic. Specificity of lifestyle, especially the mode of work and rest. The specifics of work in the polar night.
Module 3 Physiological and behavioral adaptations of a person to the conditions of life in a mountain climate	
Topic 3.1	The specifics of climatic and weather conditions in regions with a mountain climate (at altitudes of more than 2500 m above sea level) of Europe are exemplified by the Caucasus. The specifics of climatic and weather conditions in regions with a mountain climate (at altitudes above 2500 m

	above sea level) in Asia are exemplified by the Himalayas. Indigenous peoples living in mountainous regions.
Topic 3.2	Physiological adaptations of a person to life in a mountainous climate - an increase in the vital capacity of the lungs, changes in the composition of the blood, etc.
Topic 3.3	Behavioral adaptations of a person to life in a mountainous climate - the specifics of lifestyle, especially the mode of work and rest.
Module 4 Technological Adaptation to Living Conditions in a Cold and Mountain Climate	
Topic 4.1	Modern technological support of the processes of study and development of the polar regions. Using the latest achievements of science and technology for life support in an extremely cold climate.
Topic 4.2	High-temperature non-freezing coolants. Sources of electricity and heat supply are modern mobile diesel and gas-diesel generators of container design .Hybrid mobile wind power and diesel power plants .The use of nuclear energy in the Ar to tick.Atomic icebreaking fleet and floating nuclear power plants.
Topic 4.3	Modern formation of residential buildings and the urban environment in extreme climatic conditions: energy sources, architectural features. The use of energy-saving technologies and materials in the construction of premises for various purposes.Explanting experience of modern Russian bases, observation stations and observatories in the Arctic and Antarctic.

The content of the sections

Module 1 "The concept of climate, climatic conditions of human existence and their variability"

Introduction. The goals and objectives of the course. The concept of climate, climatic conditions of human existence and their variability. Climatic conditions and environmental factors they cause. General patterns of human adaptation to environmental factors. Adaptation to the type of climate as a new physiological state, characterized by increased resistance of the organism to extreme influences. The concepts of physiological, behavioral and technological adaptation of a person to the climate and its changes. Genotypic and phenotypic adaptation of man. Limits of the body's adaptive capacity to climate change. Features of the physiological adaptations of the children's body to the influence of climatic factors. The main directions of the influence of a changing climate on human evolution and the development of society. Historical features of the development of human civilizations in different climatic conditions.

The forecast scenarios of climate change for the medium and long term are taken into account in the state programs of socio-economic development of regions.

Module 2 "Physiological and behavioral human adaptation to the cold climate of the Arctic and Antarctic"

Specificity of climatic and weather conditions in the regions of industrial development of the Arctic, as well as the location of research stations. The high and low-latitude regions of the Arctic, the western and eastern sectors are distinctive features of the climate and nature of life activity. Indigenous peoples of the North - especially their nature management and adaptation to the type of climate. The specificity of climatic and weather conditions in the regions where research stations are located to study the Antarctic on the coast and in the depth of the continent. The modern model of the general adaptation syndrome in a cold climate. The specific nature of adaptation to the influencing factors. Phases of the adaptation process. Physical and chemical



adaptation to cold. Reactions and adaptations of the cardiovascular, nervous and respiratory systems, water exchange. The specificity of food consumption and carbohydrate exchange in people living in cold climates. The specifics of life and work in the polar night.

Indigenous peoples of regions with a sharply continental climate — especially their nature management and adaptation to the type of climate. Specific features of physiological and behavioral adaptations of the population coming from other regions. Reactions and adaptations of the cardiovascular, nervous and respiratory systems, water metabolism.

Module 3 “Physiological and behavioral adaptations of a person to the conditions of life in a mountain climate”. The specifics of climatic and weather conditions in regions with a mountain climate (at altitudes of more than 2500 m above sea level) of Europe are exemplified by the Caucasus. The specifics of climatic and weather conditions in regions with a mountainous climate (at altitudes of more than 2500 m above sea level) in South America are exemplified by the Andes. The specificity of climatic and weather conditions in regions with a mountain climate (at altitudes above 2500 m above sea level) in Asia is exemplified by the Himalayas. Indigenous peoples living in mountain regions - especially their nature management and adaptation to the type of climate. The specifics of the physiological and behavioral adaptations of the population coming from other regions. Mountain sickness in conditions of hypoxia - manifestation and adaptation. Reactions and adaptations of the cardiovascular, nervous and respiratory systems, water metabolism.

Module 4 "Technological Adaptation to Living Conditions in a Cold and Mountain Climate"

Modern technological support of the processes of studying and mastering the polar regions. Using the latest advances in science and technology for life support in extremely cold climates. High-temperature non-freezing coolants. Sources of electricity and heat supply such as modern mobile diesel and gas diesel generators of container form factor. Hybrid mobile wind power and diesel power plants. The use of nuclear energy in the Arctic. Atomic icebreaking fleet and floating nuclear power plants. Modern formation of residential buildings and the urban environment in extreme climatic conditions: energy sources, architectural features. The use of energy-saving technologies and materials in the construction of premises for various purposes. The experience of exploitation of modern Russian bases, observation stations and observatories in the Arctic: on Svalbard, Wrangel island, Kotelny island, etc. and the adaptation of their employees. Experience in the operation of modern Russian bases, observation stations and observatories in the Antarctic: at Vostok, Mirny, Bellingshausen, and other stations and the adaptation of their employees.

Course assignments

Assignment #1 Consideration of the main directions of the influence of a changing climate on human evolution and the development of society .Historical features of the development of human civilizations in different climatic conditions.

Assignment #2 Individual task. Indigenous peoples of the North are features of their nature management and adaptation to the type of climate. The specifics of climatic and weather conditions in the regions where research stations are located to study the Antarctic on the coast and in the depth of the continent. Physical and chemical adaptation to cold. Reactions and adaptations of the cardiovascular, nervous and respiratory systems, water exchange. The specificity of food consumption and coal exchange in people living in cold climates..

Assignment #3 Individual task. The indigenous peoples of the regions with a sharply continental climate are features of their nature management and adaptation to the type of climate. The specifics of the physiological and behavioral adaptations of the population coming from other



regions. Reactions and adaptations of the cardiovascular, nervous and respiratory systems, water metabolism.

Assignment #4 Individual task. Indigenous peoples living in mountain regions - especially their nature management and adaptation to climate type. Specifics of physiological and behavioral adaptations of the population arriving from other regions. Mountain sickness in hypoxia - its manifestation of adaptation. Reactions and adaptations of the cardiovascular, nervous and respiratory systems, water metabolism

Literature

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