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Yesterday, today, and tomorrow of the Earth's climate system

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The problem of climate change, which is occurring at an unprecedentedly rapid pace, is one of the most pressing in the 21st century. Thanks to the improvement of ground-based observation systems and the establishment of regular satellite monitoring, as well as significant progress in the field of computer technology, in particular, the development of integrated climate models, in recent decades there has been a breakthrough in understanding the processes occurring in the Earth's climate system. However, the lack of long, statistically representative time series of weather data, the enormous inertia of the climate system (primarily the ocean) and its chaotic nature give rise to significant uncertainties in research estimates.

According to modern scientific ideas, climate change is mainly caused by human economic activity (primarily, the growing emissions of greenhouse gases), therefore, combating the negative consequences of such changes requires joint coordinated actions of the entire world community. For this purpose, scenarios for anthropogenic greenhouse gas emissions in the next decades (until the end of the 21st century) are being developed and constantly updated. These scenarios become the basis for model forecasts of how key characteristics of the climate system will change (temperature, precipitation, circulation of air and water masses, the number of abnormal weather events, etc.). Such forecasts form the basis of economic and political decisions. At the same time, due to the inertia of the climate system, these decisions cannot lead to an immediate improvement of the situation, therefore, along with them, it is necessary to take measures to adapt to current and expected climate changes in the near future.

Climate change is extremely important for Russia. The increase in temperature over its territory occurs 2.7 times (and in the Arctic zone - ~4 times) more intense than on a global scale. As a result, the permafrost, on which 2/3 of the country’s territory is located, is degrading, the ice of the Arctic seas is melting, the regimes of heavy precipitation or aridity in certain regions are worsening, etc. Thus, when developing economic policy in the future, considering regional climate change becomes a necessity.

Of particular interest are studies devoted to the peculiarities of the formation and evolution of the Earth's ozone layer, since ozone is not only a greenhouse gas, but also a filter of ultraviolet radiation.

Considering the above, I will discuss the following: (i) the current state of climate on a global scale, trends and causes of its changes, the role and contribution of the main greenhouse gases and the inherent variability of the Earth's climate system; (ii) principles for constructing scenarios for future greenhouse gas emissions; (iii) model predictions based on these scenarios; (iv) features of current and future climate changes on Russian territory and in the Arctic, the expected consequences of these changes; (v) the need for adaptation measures; (vi) the problem of ozone deficiency, ozone being both a greenhouse gas and a filter of ultraviolet radiation.