**PROCEEDINGS OF THE YEREVAN STATE UNIVERSITY**
**УЧЕНЫЕ ЗАПИСКИ ЕРЕВАНСКОГО ГОСУДАРСТВЕННОГО УНИВЕРСИТЕТА**
***Geology and Geography*** **1**, 2026 ***Геология и география***

*Special Issue*

УДК 574.9

# FORECASTING OF EXTREME VALUES OF TEMPERATURE, PRECIPITATION, AND THE CASPIAN SEA LEVEL IN CONDITIONS OF NON-STATIONARY CLIMATE CHANGE

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Climate change leads to the restructuring of geosystems, creating risks for the environment and infrastructure. Therefore, the climate forecast should include information about extreme events. The rare largest and most intense extremes are not fully reproduced in the Earth system models (ESM). They stand out among others not only for their power, but also because they do not fit into the basic probability distribution function (PDF). Such events are sometimes called “black swans” or “dragon”. The reason why these events are not recreated during modeling is, as can be assumed, the lack of spatial resolution of the ESM. Therefore, it is necessary to develop a special approach, in which the results of climate modeling would be integrated into the methodology of the statistical theory of nonstationary extremes. The classical statistical theory describing the PDF of extremes can be generalized to the case of unsteady processes. In climate forecasting, the parameters of non-stationary PDFs are estimated based on climate modeling data. However, this approach ensures that only the “correct” extremes of the basic PDF are predicted, that is, it does not eliminate the problem of “black swans” (or “dragons”). An alternative option is to use time-averaged (or space-averaged) indicators for which the occurrence of rare events is not critical for their PDF. This is possible due to the physics of climate processes, in which anomalies do not turn out to be as significant as they are, for example, in financial mathematics.

https://doi.org/10.46991/PYSUC.2026.SI1.001

**Keywords:** extremes of non-stationary changes, extremes of climate change, “black swans”, “dragons.”

**References:** Kislov A., Alyautdinov A., et al. A Spatially Detailed Projection of Environmental Conditions in the Arctic Initiated by Climate Change. *Atmosphere* **14** (6) (2023), 1–31. https://doi.org/10.3390/atmos14061003

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