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Probabilistic projection of the regional climate as the basis for the development of adaptation programs in the economy of Russia

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The prospects of using the probabilistic regional climate projection technique for adaptation to climate change in the territory of Russia are considered. The analysis focuses on future changes in the climatic indicators of the thermal regime and humidification which play a significant role in the evaluation of the reliability of the functioning of construction and technical systems as well as transport and energy infrastructure.

The analysis is based on the output of the 50-member ensemble of high-resolution climate projections using an RCM developed at the Main Geophysical Observatory (MGO). The RCM grid has a horizontal resolution of 25 km across Russia. Modeling projections have been recently used to assess the impacts of regional climate change on hydropower facilities (Shkolnik et al., 2018).

Numerical experiments are carried out from different (random) initial conditions for the baseline 1990-1999 and future periods 2050-2059 and 2090-2099 using the IPCC RCP8.5 scenario (Kattsov et al., 2020). The boundary conditions on the ocean surface are derived from the output of the five CMIP5 models. For each ocean state trajectory, ten experiments from the different initial conditions are conducted. Lateral boundary conditions for the RCM ensemble are provided by MGO AGCM under an identical experimental setup.

To study the future impacts of the thermal regime, several universal indicators are used, particularly, the annual and seasonal extremes of temperature for a given averaging period as well as the characteristics of intra-annual periods with the temperature above/below the thresholds. The thresholds are selected to meet the needs of construction, land transport, and the energy sector. Besides, the indicators of the precipitation regime are considered (seasonal maxima of daily amounts and characteristics of dry/wet periods).

Along with obtaining median ensemble estimates of changes in mean values, an analysis of future changes in the indicators in the probabilistic aspect is conducted. Using the temperature of the hottest 30-day period and the maximum duration of the dry period, the regional features of their projected changes are demonstrated accounting for the contribution of internal climatic variability. In agreement with observations, significant differences in the changes between the European part of Russia and certain regions of its Asian part are revealed.

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