DOI: https://doi.org/10.37162/2618-9631-2026-1-6-29

A concept of global tropopause prediction in the Russian Area Forecast Center / Ivanova A.R., Sokolova U.O., Komasko N.I., Skriptunova E.N., Shakina N.P., Zavialova A.A. // Hydrometeorological research and forecasts, 2026, no. 1 (399), pp. 6-29.

The paper examines various tropopause definitions (WMO, PTGT, and dynamic) for operational weather information support for aviation based on the output of a global numerical weather prediction model. The limitations of each approach are discussed, and a rationale for a change in the sign of the Ertel's potential vorticity upon crossing the equator is presented. The validity for choosing an isertelic surface identifying the extratropical tropopause and an isentropic surface for forecasting the tropical tropopause is presented. An example of a forecast of tropopause characteristics based on a combination of two concepts for the entire globe is given.

Keywords: Russian Area Forecast Center, tropopause, global NWP model, radiosonde observations, Ertel's potential vorticity, isentropic surface

Tab. 8. Fig. 7. Ref. 19.

DOI: https://doi.org/10.37162/2618-9631-2025-4-30-50

An evaluation of changes in the frequency of freezing precipitation in Russia in the 20th–21st centuries using the INM-CM5 model / Gibadullina A.I., Leonov I.I., Kislov A.V., Sokolikhina N.N. // Hydrometeorological research and forecasts. 2025, no. 4 (398), pp. 30-50.

The quality of simulating freezing precipitation by the INM-CM5 climate model is assessed for Russia. The modeling data were verified using main 3-hour observations and visual observations of atmospheric events during 1979–2014. The INM-CM5 climate model was used to obtain the spatial distribution of the average annual number of days with freezing precipitation for this period. Forecasts of changes in the frequency of freezing precipitation in Russia were prepared for 2015–2100 and 2071–2100 based on three possible socioeconomic climate scenarios: SSP1-2.6, SSP2-4.5, and SSP5-8.5. The greatest changes in the frequency of freezing precipitation are expected under the SSP5-8.5 scenario. It is predicted that the frequency of freezing precipitation in Russia in the northern European part of Russia, southern and central Western Siberia, and the eastern part of the Chukotka Autonomous Okrug will increase by more than five times by the end of the 21st century. A decrease in the frequency of freezing precipitation is predicted in the areas of the islands and coasts of the Arctic Ocean, as well as the Bering and Okhotsk seas.

Keywords: climate change, climate forecast, severe weather events, freezing precipitation, glaze ice, icing, reanalysis, INM-CM5 model, CMIP6

Fig. 7. Ref. 36.

DOI: https://doi.org/10.37162/2618-9631-2026-1-51-68

Large-scale Atmospheric Circulation over the Northern Hemisphere in Summer of 2025 and Its Contribution to Extreme Weather in Russia / Sumerova K.A., Khan V.M., Tishchenko V.A., Vilfand R.M. // Hydrometeorological research and forecasts. 2026, no. 1 (399), pp. 51-68.

This study presents a comprehensive analysis of large-scale meteorological and circulation anomalies during the summer season of 2025 in the Northern Hemisphere. Based on the analysis of the fields of geopotential height, surface pressure, air temperature, precipitation, atmospheric circulation indices, sea surface temperature, and sea ice conditions, the paper investigates the features of atmospheric processes in the Northern Hemisphere and their role in triggering extreme and high-impact weather events across Russia in the summer season of 2025. The key role of meridional circulation patterns was revealed: a stable trough over the European part of Russia and a blocking anticyclone over Siberia. Relationships between the phases of the atmospheric circulation indices (EU, POL, WA) and temperature regimes, precipitation patterns, as well as the state of Arctic sea ice are determined. The results of the comprehensive analysis are important for improving seasonal forecasts and assessing climate risks.

Keywords: air temperature, precipitation, large-scale atmospheric circulation, sea surface temperature, circulation indices, Arctic sea ice, extreme, adverse, and severe weather events, heat waves, heavy precipitation, drought, economic impacts

Tab. 2. Fig. 2. Ref. 30.

DOI: https://doi.org/10.37162/2618-9631-2026-1-69-101

Evaluation of the ICON-Ru model sensitivity to the changes in the sea ice extent and sea surface temperature in forecasting the formation and development of polar lows / Nikitin M.A., Revokatova A.P., Lomakin I.R., Rozinkina I.A., Rivin G.S. // Hydrometeorological research and forecasts. 2026, no. 1 (399), pp. 69-101.

The paper deals with studying the sensitivity of the ICON-Ru model with a grid spacing of 2.0 km to changes in the sea ice extent and sea surface temperature when forecasting the formation and development of polar lows (PLs). The results of numerical experiments for the Norwegian and Barents seas for the cold season of 2022–2024 are presented by the example of analyzing the life cycles of several PLs. It is shown that decreasing sea ice extent and increasing water temperatures in the Arctic seas can increase the intensity of PLs.

Keywords: polar lows, sea ice, barotropic instability, convective instability, detailed numerical weather prediction, ICON model

Tab. 1. Fig. 17. Ref. 22.

DOI: https://doi.org/10.37162/2618-9631-2026-1-102-122

Relationship of the Caspian Sea level and water balance components with large-scale atmospheric circulation indices (1950–2023) / Ostrovskaya E.V., Pavlova A.V. // Hydrometeorological research and forecasts, 2026, no. 1 (399), pp. 102-122.

Based on observation data of the Volga runoff, the Caspian Sea level, and air temperature, as well as ERA5 reanalysis data (precipitation and evaporation), causes for the Caspian Sea level fluctuations during specific characteristic periods of its rise (1978–1995) and decline (1950–1977 and 1996–2023) are studied. It was found that the long-term average values of the Volga runoff and sea level differ statistically significantly among all three identified periods. Precipitation increased significantly only during the sea level rise phase (1978–1995), whereas an increase in air temperature and evaporation became statistically significant only in the modern period of the sea level decline (1996–2023). Interannual changes in the Caspian Sea level demonstrate a stable and increasing correlation with variations in the Volga runoff over time: the correlation coefficient increases from $r = 0.39$ in 1950–1977 to $r = 0.76$ in 1996–2023. However, the modern tendency towards a sea level decline corresponds rather to the positive trends in air temperature and evaporation than to the changes in the Volga runoff. The structure of the relationships between hydrological conditions and atmospheric circulation is variable over time. While the influence of global circulation mechanisms (the North Atlantic (NAO) and Arctic oscillations (AO)) prevailed in the mid-20th century, regional processes described by the EA/WR index (the East Atlantic/West Russia pattern) have begun to play a dominant role in few past decades. This shift is associated with an increased frequency of blocking anticyclonic conditions and a weakening of westerly moisture transport into the region, which ultimately affected the water balance of the Caspian Sea.

Keywords: Caspian Sea, sea level variations, Volga runoff, evaporation, precipitation, atmospheric circulation indices

Tab. 6. Fig. 4. Ref. 47.

DOI: https://doi.org/10.37162/2618-9631-2026-1-123-139

Climatic changes in water temperature in Aniva Bay / Myslenkov S.A., Pishchal’nik V.M., Arkhipkin V.S., Latkovskaya E.M. // Hydrometeorological research and forecasts. 2026, no. 1 (399), pp. 123-139.

The paper presents an analysis of water temperature based on archived instrumental observations in Aniva Bay from 1949 to 1994, satellite data from 1981 to 2025, and direct measurements made in 2023. According to the weather station from 1969 to 1925, the minimum trend value for air temperature is positive and is 1.2 °C for the entire period and is observed in December. For August, the increase in air temperature is about 1.6 °C, and for March about 3.4 °C. According to satellite data, a positive trend is observed for water temperature, with a value of about 1.6 °C over the entire period. In the interannual variability of the monthly average water temperature, the greatest positive trends are observed in July-August – about 2.1–2.4 °C over the entire period. According to in situ measurements, until 1994, maximum temperatures were observed in August and did not exceed 20.1 °C. According to ship measurements, a temperature of 21.46 °C was recorded in 2023, according to satellite data, the maximum 22.55 °C was observed in July 2021. On average, the trends in almost the entire bay during the study period were positive and amounted to 0.5–1 °C. The maximum warming is observed in Salmon Bay and in the northern part of Aniva Bay

Keywords: water temperature, Sea of Okhotsk, Aniva Bay, satellite data, climatic trends

Fig. 10. Ref. 24.

DOI: https://doi.org/10.37162/2618-9631-2026-1-140-158

Analysis of the spring flood of 2025 forecasting using an artificial intelligence model / Simonov Yu.A. , Khristoforov A.V. , Koliy V.M., Kovalev K.A., Malygin E.V., Osiptsov A.A., Sotiriadi N.S. // Hydrometeorological research and forecasts. 2026, no. 1 (399), pp. 140-158.

Forecasts for the 2025 spring flood were verified based a methodology developed and used at Sberbank based on an artificial intelligence model. Water level forecasts for the 2025 spring flood were verified using Sberbank's model for 1,083 river gauges located virtually throughout Russia. Long-term maximum water level forecasts for the 2025 flood period were verified for 88 river gauges using various methodologies. However, these forecasts currently do not fully meet the functional requirements of end users for Roshydromet forecast products and are inferior to those issued by the Hydrometeorological Center of Russia. A proposed correction to the forecasts based on Hydrometcentre of Russia methodology significantly improves their reliability. A methodology for generating probabilistic forecasts is recommended, based on the assumption that deterministic forecast errors flow the normal distribution with constant variance.

Keywords: flood forecasts, artificial intelligence, hydrological model, river gauge, water level, hydrograph, long-term forecast, verification, correction

Tab. 3. Fig. 4. Ref. 23.

DOI: https://doi.org/10.37162/2618-9631-2026-1-159-170

Adaptation of the runoff formation model for several southern rivers of Russia / Semenova N.K., Simonov Yu.A., Shatokhin M.V. // Hydrometeorological research and forecasts. 2026, no. 1 (399), pp. 159-170.

To assess river water availability in the south of European Russia over the next 5-year period, it is proposed to use a modified runoff formation model and a long-term meteorological forecast of the INM-CM5 model with a lead time of 1–5 years for several basins of the Don, Kuban, and Kuma rivers. These river basins are characterized by high loads on water management systems, which determines their sensitivity to both interannual and intraannual variability of river runoff and its main characteristics. To estimate such variability, the HBV hydrological runoff formation model was modified using an algorithm for describing the dynamics of snow density and snow depth, as well as a module for calculating the freezing depth. The modified version of the hydrological model was adapted for the studied rivers. The adaptation included the calculation of model coefficients, parameter optimization, and verification of calculations of the main river characteristics. A validation of the model results on an independent sample demonstrated a good performance of the model and its applicability for producing long-term forecasts of runoff characteristics. An optimum algorithm for correcting hydrological model calculations and forecasts taking into account autocorrelation of their errors was developed, which increased the modeling accuracy by 15–20 % for the study watersheds.

Keywords: river runoff, long-term forecast, hydrological model, verification

Tab. 2. Fig. 3. Ref. 24.

DOI: https://doi.org/10.37162/2618-9631-2026-1-171-188

Forecasting the dates of initial ice formation on the Kola Peninsula rivers / Kanashin S.A., Banshchcikova L.S., Sumachev A.E. // Hydrometeorological research and forecasts. 2026, no. 1 (399), pp. 171-188.

The objective of the present study is to evaluate the feasibility of using machine and deep learning methods to improve dependencies associated with forecasting the dates of occurrence of initial persistent ice phenomena. The study focuses on the rivers of the Kola Peninsula with varying ice formation conditions. A spatiotemporal analysis of the dates of initial ice phenomena and long-term variability of negative air temperature totals in the study area was performed. A database of hydrological and meteorological information for characteristic dates was compiled, and a predictive model was assembled. The paper presents a forecast of autumn ice phenomena using two approaches: regression and classification. The regression approach utilizes decision trees (XGBoost), while the classification approach relies on a hybrid neural network model (XGBoost – CNN-GRU). The forecast obtained by the hybrid approach does not exceed permissible errors and can be recommended for use.

Keywords: ice regime, Kola Peninsula, ice phenomena forecast, neural networks, machine learning, deep learning, XGBoost, LSTM

Tab. 3. Fig. 3. Ref. 28.