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Wind gust nowcasting using numerical forecasts, radar technologies and machine learning: implementation, capabilities and limitations / Smirnov A.V., Kiktev D.B., Muravev A.V. // Hydrometeorological research and forecasts. 2025, no. 4 (398), pp. 7-32.

The paper presents the results of testing a surface wind gust nowcasting system conducted in May–September 2024 at the Hydrometcentre of Russia using the machine learning Random Forest algorithm applied to the output products of the pySTEPS statistical nowcasting model and the COSMO-Ru2.2 numerical weather prediction system. The significance of observations from automatic weather stations in the Central Federal District as control data for wind gust nowcasting is assessed. Some systematic features of numerical gust forecasts during the testing period are revealed. The problems of synchronizing data from various sources are discussed, the weather conditions with significant gusts over a large area are analyzed in detail, and the quality assessment is provided using the FSS metric. In the developed version of the nowcasting system, on the basis of accumulated information and according to the FSS skill score, the useful forecast horizon for wind gusts is limited to 30 minutes.

Keywords: wind gust nowcasting, numerical weather prediction, radar observations, machine learning

Tab. 8. Fig. 13. Ref. 11.

DOI: https://doi.org/10.37162/2618-9631-2025-4-33-51

Evaluation of the information content of radar data in the analysis of frontal cumulonimbus clouds in Western Siberia / Gorbatenko V.P., Kizhner L.I., Apostolidi C.T., Karpova A.A. // Hydrometeorological research and forecasts, 2025, no. 4 (398), pp. 33-51.

The objective of the study was to select a set of radar parameters characterizing frontal cumulonimbus clouds during thunderstorms and hail events registered by meteorological stations in the Novosibirsk region. In total, 1883 thunderstorms and 67 hail events were analyzed from 2021 to 2023. Statistical characteristics of cloud radar parameters for thunderstorms and thunderstorms with hail were calculated. Differences between these parameters were demonstrated, and threshold values were calculated based on DMRL-C Novosibirsk data. In addition to the parameters already proven in practice for identifying convective phenomena, the examined parameters included turbulence and vertically integrated liquid water content.

Keywords: Western Siberia, thunderstorm, hail, DMRL-C, radar characteristics, threshold values, meteorological observations

Tab. 5. Fig. 2. Ref. 26.

DOI: https://doi.org/10.37162/2618-9631-2025-4-52-73

Comparison of temperature and wind speed forecasts for the COSMO-Ru/icon configurations in the European part of Russia for six months of 2025 and during the episode of adverse meteorological conditions in Moscow / Revokatova A.P., Kuznetsova I.N., Kirsanov A.A. // Hydrometeorological research and forecasts. 2025, no. 4 (398), pp. 52-73.

The current technology for forecasting the meteorological indicator of pollution dispersion (MIPD) used at the Hydrometcentre of Russia is based on the COSMO-Ru6ENA configuration forecasts. Due to the transition to using ICON-Ru system forecasts with a 6 km horizontal grid spacing, model calculations of temperature and wind at the levels of 1000, 925, and 850 hPa for the COSMO-Ru6ENA and ICON-Ru13/6N29 configurations were compared with radiosonde data over the European Part of Russia. An advantage of ICON-Ru forecasts over COSMO-Ru was revealed using the test sample. A joint analysis of ICON-Ru forecasts of meteorological characteristics with observational data from the Ostankino TV Tower and a radiosonde station revealed characteristic features of the forecasts of temperature and wind speed profiles. These results are of practical importance for predicting pollution dispersion conditions. The results of the MIPD forecast verification using pollutant concentration measurements at the TV tower and Mosekomonitoring surface monitoring stations during the episode of adverse meteorological conditions at the end of March 2025 confirmed the connection of type 1 MIPD (weak dispersion) with increased pollutant concentrations at urban-type stations and indicated reasonability of using the ICON-Ru system data for MIPD forecasting.

Keywords: adverse meteorological conditions, meteorological indicator of pollution dispersion (MIPD), verification, atmospheric pollution, ICON-Ru, COSMO-Ru

Tab. 2. Fig. 9. Ref. 14.

DOI: https://doi.org/10.37162/2618-9631-2025-4-74-93

Testing a new SnowDraw snow cover model for climate forecasting of Elbrus glaciation dynamics / Drozdov E.D., Toropov P.A. // Hydrometeorological research and forecasts, 2025, no. 4 (398), pp. 74-93.

A new specialized SnowDraw snow cover model of intermediate complexity aimed at climate forecasting of glacier dynamics and river runoff in mountainous regions was tested for the Elbrus mountain glacier. The model verification versus direct observation data from the mountain glacier demonstrated a high-quality reproduction of the seasonal dynamics and water content of the snow cover. A comparison of results of the presented model with other available models of different complexity (NoahMP, SNOWPACK) demonstrated that it is a computationally efficient and high-quality tool for forecasting snowpack dynamics and glaciation in the mountains. Using the presented model as the IGRICE parameterization module for mountain glaciation allowed obtaining estimates of a long-term snow cover distribution and a snow component of runoff for the Elbrus glaciation.

Keywords: numerical modeling, observations, snow cover, verification, Elbrus, Garabashi glacier, IGRICE model

Fig. 6. Ref. 22.

DOI: https://doi.org/10.37162/2618-9631-2025-4-94-113

Evaluation of Wave Height and Wind Speed Forecast Quality in the Tsemess Bay of the Black Sea / Rybalko A.D., Myslenkov S.A., Kruglova E.E., Grigoriev A.V., Senchenko V.G. // Hydrometeorological research and forecasts, 2025, no. 4 (398), pp. 94-113.

A study was conducted to assess the accuracy of wind wave height forecasts in the Tsemess (Novorossiysk) Bay using the spectral model WAVEWATCH III forced by GFS winds (0.25°). Comparison of model simulations with in situ measurements obtained at the Sheskharis pier during December 2023 – August 2025 showed that the system provides satisfactory forecast quality of wave heights for different lead times up to 72 hours. The root-mean-square error of significant wave height forecasts ranges from 0.17 to 0.22 m, the correlation coefficient is 0.85–0.9, and the systematic bias is negative (–0.09…–0.13 m). The smallest errors were observed for a lead time of 15 hours. Seasonal variability analysis revealed higher forecast accuracy in the autumn–winter period and lower accuracy in the spring–summer season due to the influence of local wind effects. It was found that the model reproduces wave characteristics more accurately during offshore winds (from sea to land) than during onshore winds (from land to sea). The obtained results can be used to improve the accuracy of operational wave forecasting systems and to enhance maritime safety in the Tsemess Bay area.

Keywords: Black Sea, Tsemess Bay, wind waves, wave forecast, spectral model, WAVEWATCH III, GFS, forecast accuracy, lead time, Novorossiysk bora

Tab. 1. Fig. 8. Ref. 32.

DOI: https://doi.org/10.37162/2618-9631-2025-4-114-128

Short- and medium-range forecasting of water levels on Russian rivers based on statistical methods / Simonov Yu.A., Khristoforov A.V., Yumina N.M., Semenova N.K., Volov I.S., Shevchenko A.I. // Hydrometeorological research and forecasts, 2025, no. 3 (397), pp. 114-128.

A set of methods for short- and medium-range forecasting of water levels on Russian rivers is proposed. The methods utilize observation data from stream gages. The forecast is expressed as a linear function of observed water levels and is adjusted by replacing its extreme values with an acceptable minimum or maximum.

The first method of hydrograph extrapolation takes into account only water levels observed at the forecast gage. The second, more general method additionally takes into account water levels observed at an upstream gage. The third, even more general method additionally takes into account water levels observed at a tributary gauge. Validation of these methods using independent data showed that each can produce satisfactory forecasts for a great number of river gages. Recommendations for implementing the presented methods in Roshydromet's operational hydrological forecasting practices are provided.

Keywords: stream gage, water level, short- and medium-range forecast, forecast quality, choice of method

Tab. 5. Fig. 1. Ref. 20.

DOI: https://doi.org/10.37162/2618-9631-2025-4-129-143

Improvement of the methodology for forecasting spring runoff characteristics of rivers in the Zhaiyk-Caspian basin under the conditions of available hydrometeorological information / Sairov C.B., Tillakarim T.A., Serikbay N.T., Aitymova B.B. // Hydrometeorological research and forecasts. 2025, no. 4 (398), pp. 129-143.

The results of research and approbation of improved methodology of pro-forecasting of maximum water levels in the spring period of the year using regression analysis are presented. The rivers of the Zhaiyk-Caspian basin belonging to the Kazakhstan type with spring flood are chosen as the object of research. The article considers the improvement of the existing methodology for predicting maximum water levels by using additional factors of spring runoff formation. Thus, in addition to the factors of spring runoff formation (temperature regime of spring, winter precipitation, hydrological regime of rivers at the time of forecast release), as additional predictors it is proposed to take into account characteristic parameters of hydrological regime, such as: duration and water discharge at the end of the flood of the previous year, as well as the minimum winter runoff. Taking into account these factors allowed to increase the accuracy of forecasts of the maximum water level of spring floods – the quality criterion of the methodology increased from 0,02 to 0,25.

Keywords: hydrological forecast, maximum level, monitoring, floor-soil, snow supply, Kazakhstan

Tab. 3. Fig. 4. Ref. 19.

DOI: https://doi.org/10.37162/2618-9631-2025-4-144-152

Comparative analysis of drought indices to assess drought conditions in agricultural regions of Northern Eurasia / Emelina S.V., Khan V.M. **//** Hydrometeorological research and forecasts, 2025, no. 4 (398), pp. 144-152.

The paper analyzes two approaches to assessing drought conditions: the Selyaninov hydrothermal coefficient (HTC) widely used in Russian agrometeorological practice and the Standardized Precipitation Evapotranspiration Index (SPEI). The study evaluates the frequency of extreme droughts in agricultural regions of the European part of Russia and Central Asia from 1991 to 2020. The results of a comparison of the time series of these indices with observed soil moisture data are presented. Statistical analysis of droughts based on HTC and SPEI over the study period demonstrates similar results. However, SPEI generally exhibits slightly higher correlation coefficients with observational data than HTC. Recommendations are provided for the operational and research use of HTC and SPEI indices by the North Eurasian Climate Centre.

Keywords: drought indices, Standardized Precipitation Evapotranspiration Index (SPEI), hydrothermal coefficient (HTC)

Tab. 2. Fig. 2. Ref. 12.

DOI: https://doi.org/10.37162/2618-9631-2025-4-153-171

Peculiarities of spatiotemporal variability of soil moisture in the European part of Russia / Klang P.S., Tarasova L.L., Cherkasova A.V. // Hydrometeorological research and forecasts. 2025, no. 4 (398), pp. 153-171.

Based on the long series of data (for 1958–2024), a statistical structure of the field of available moisture content in the meter layer of soil under grain crops for the European part of Russia was estimated, and an impact of observed climate change on the soil moisture regime was assessed. It is shown that in the 21st century, soil moisture content is higher than in 1958–1999, and currently observed climate changes are mainly positive for the agricultural industry in Russia. Seasonal variations in the available moisture content were built according to modern data, which can be applied in operational agrometeorological practice. The main reasons for the changes were analyzed: an increase in the frequency of warm winters and the cyclical nature of the climate system.

Keywords: soil moisture, climate, seasonal variations, probabilistic characteristics, correlation function

Tab. 5. Fig. 2. Ref. 26.

DOI: https://doi.org/10.37162/2618-9631-2025-4-172-178

Soil freezing trends in the Arkhangelsk region in a changing climate / Grishchenko I.V. // // Hydrometeorological research and forecasts, 2025, no. 4 (398), pp. 172-178.

An analysis of changes in soil freezing parameters (freezing depth and freezing time) in the Arkhangelsk region for a period of 1961–2020, as well as for 30-years intervals within this period (1961–1990, 1971–2000, 1981–2010, 1991–2020), was conducted. A decrease in the freezing depth was revealed during all periods, except for 1961–1990. The linear trend coefficients for the freezing depth were calculated. A trend towards a shift to later dates was found in the dates of the onset of the first and stable freezing.

Keywords: freezing depth, dates of first and stable freezing, surface air temperature, linear trend

Tab. 3. Fig. 1. Ref. 6.