

**On the application of ensemble methods in short-range regional forecasting** / Astakhova E.D., Bundel A.Yu., Alferov D.Yu., Rozinkina I.A., Rivin G.S. // Hydrometeorological research and forecasts. 2025, no. 1 (395), pp. 6-36.

A hierarchical ensemble system for short-term forecasting based on the non-hydrostatic ICON model has been developed. The global ICON-Ru-EPS system with a model horizontal grid step of 40 km over the globe and 20 km over the European part of Russia is a source of initial and boundary conditions for the regional ICON-Ru2-EPS system over the Central Federal District of Russia (CFD) with a grid step of about 2.2 km and explicitly resolved deep convection. A detailed verification of the regional ensemble system ICON-Ru2-EPS was performed using the METplus package. The high quality of probabilistic forecasts was demonstrated as well as the need to combine various metrics when analyzing the results. The efficiency of the random parameter perturbation method for accounting for model uncertainty in high-resolution ensemble forecasting was investigated for the CFD domain. Recommendations were prepared on the parameters to perturb and on the size of the regional ensemble.

*Keywords:* regional ensemble forecast, random parameter perturbations, model uncertainty, non-hydrostatic ICON model, verification of ensemble forecasts, METplus package

Tab. 1. Fig. 8. Ref. 72.

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**The RANGES system: structure, calculation procedure and application example** / Bogdanovich A.Yu. // Hydrometeorological research and forecasts. 2025, no. 1 (395), pp. 37-50.

The RANGES computing system is described, which is intended for calculating the climatic area of distribution (CAD) of a natural phenomenon based on the climatic characteristics and parameters (climatic predictors) – hydrometeorological variables and indices calculated on their basis – that determine the formation of the CAD. The methodology of the system is based on a probabilistic Bayesian approach, which allows assessing the belonging of a geographic point to the CAD of the phenomenon under study. The system is implemented as a set of programs and is equipped with a user-friendly interface to automate the process of data entry, minimizing errors. The system maintains operation both with observational data and with data of global and regional models (in the present version of the system, these are the models of Marchuk Institute of Numerical Mathematics of the Russian Academy of Sciences and Voeikov Main Geophysical Observatory). The software package allows taking into account multiple climatic predictors to describe the conditions influencing a natural phenomenon. Based on the analysis of climatic predictors, the system provides probabilistic estimates of the belonging of geographic points to the CAD and ranks the estimates according to the IPCC methodology.

An example of using the RANGES system to calculate the dominant CDA in the warm season (defined as a period with a number of days with positive temperatures above 182) is given. Changes in the CDA for the base period (1990–1999) and for 2030–2039 and 2050–2059 under the RCP8.5 scenario are calculated. Shifts in the boundaries of the warm-season dominant CAD illustrating the impact of climate change are shown.

*Keywords:* climate, natural phenomenon, climatic area of distribution, computing system, application example

Tab. 2. Fig. 3. Ref. 15.

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**Reproducibility of seasonal cycle and annual amount of precipitation over the Black Sea from CMIP6 models** / Polonsky A.B., Sukhonos P.A. // Hydrometeorological research and forecasts, 2025, no. 1 (395), pp. 51-69.

The quality of simulation of the seasonal cycle and annual amount of precipitation over the Black Sea is considered using the calculations of 36 global numerical models (173 realizations) from the Coupled Model Intercomparison Project Phase 6 (CMIP6). The calculation results are compared with the ERA5 reanalysis data for the historical period of 1959–2022. It is shown that most of the CMIP6 models poorly simulate the climatic seasonal cycle and annual amount of precipitation over the Black Sea. In general, the results of modeling winter precipitation are more consistent with the ERA5 reanalysis data than summer precipitation. This indicates a low quality of parameterization of convective precipitation in the Northern Hemisphere midlatitudes in most of the CMIP6 models. Five of 36 models that can be used for estimating annual precipitation over the Black Sea are selected, and only three of the models can be used to estimate monthly precipitation.

*Keywords:* precipitation, seasonal cycle, Black Sea, CMIP6  
Tab. 1. Fig. 2. Ref. 15.

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**The impact of large-scale climate oscillations on the vegetation cover on the Crimean Peninsula** / Krasovskaya V.S., Voskresenskaya E.N., Maslova V.N., Lubkov A.S. // Hydrometeorological research and forecasts. 2025, no. 1 (395), pp. 70-94.

The paper examines the response of Crimean vegetation (deciduous, pine, juniper species, mountain steppe yayla) to the changes in teleconnection indices using the Normalized Difference Vegetation Index (NDVI) based on remote sensing data for the period of 2000–2023. The interrelation of the NDVI and nine Northern Hemisphere teleconnection patterns is analyzed using the Pearson's correlation coefficient, multiregression modeling, and composite analysis. It was found that 80% of variability of the vegetation index of forest species in April–June is associated with the joint impact of the North Atlantic Oscillation, East Atlantic pattern (EA), Arctic Oscillation, and Polar/Eurasia pattern from December to May. At the same time, 59 % of variability of in the NDVI index for steppe species in April–June is explained by the EA and Mediterranean Oscillation indices from January to May. The vegetation index of all plant communities increases during the phases of teleconnection patterns that are accompanied, as a rule, by increased cyclone activity. At the same time, the NDVI of forest communities increases with a decrease in cyclone activity in the winter months, which may be due to more frosty conditions for maintaining solid precipitation in the mountains.

*Keywords:* undisturbed plant communities, Black Sea region, teleconnection indices, biomass predictors, deciduous species, pine species, juniper species, mountain steppe yayla  
Tab. 5. Fig. 6. Ref. 34.

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**Conditions for occurrence and forecasting of heavy rains and squalls in the Moscow region: Case Studies for June 2024** / Dmitrieva T.G., Alekseeva A.A. // Hydrometeorological research and forecasts. 2025, no. 1 (395), pp. 95-117.

The paper presents a comparative analysis of synoptic conditions and the results of numerical forecasts of severe convective events in the Moscow region on June 5–6 and 20, 2024. The forecasts of weather events by the Cosmo-Ru2 mesoscale model assimilating radar data and the forecasts based on the data of the regional model of the Hydrometeorological Center of Russia are used. The DMRL-C Vnukovo weather radar data and the data obtained on the basis of the DMRL-C network in the experimental diagnostic technology complement the pattern of synoptic processes and their features. Recommendations are given on the use of synoptic information in cases of the formation of active convection with severe weather events in addition to numerical forecasts to improve the accuracy of storm warning and forecasting.

*Keywords:* heavy rains and squalls, forecast, warm season, COSMO-Ru2 model, DMRL-C weather radar data

Tab. 1. Fig. 17. Ref. 16.

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**Analysis of sea level measurements and wind wave parameters in Aniva Bay (Sea of Okhotsk)** / Myslenkov S.A., Pishchalnik V.M., Kondrashov A.A., Kuptsova O.V., Arkhipkin V.S., Latkovskaya E.M. // Hydrometeorological research and forecasts. 2025, no. 1 (395), pp. 118-130.

The paper presents an analysis of measurements of sea level and parameters of wind waves in Aniva Bay, performed using hydrostatic pressure sensors in June–August 2023. Measurements were carried out at mooring stations at depths of 10 and 15 m. Hydrostatic pressure data in the analysis of wind waves were adjusted taking into account the linear theory. The total range of sea level fluctuations was 1.63 m in syzygy and 0.3 m in quadrature. The maximum of significant wave height was 1.73 m, and the maximum height of an individual wave was 2.82 m. The presence of anomalous waves with an anomaly index of more than 2 has been detected. When comparing the wave height according to the simulation results with the measurement data, it was found that the correlation coefficient is 0.84, and the RMS error is 0.17 m.

*Keywords:* sea level measurements, wind wave measurement, Sea of Okhotsk, Aniva Bay, wind waves, abnormal waves

Fig. 8. Ref. 23.

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**Forecasting water inflow into the Iriklienskoe Reservoir** / Arefyeva O.N., Golodnyuk N.E., Simonov Yu.A., Khristoforov A.V., Yumina. N.M. // Hydrometeorological research and forecasts, 2025, no. 1 (395), pp. 131-148.

A system of methods for forecasting the water inflow into the Iriklienskoe Reservoir on the Ural River are proposed. The system includes the long-term forecast of the inflow volume over the spring flood period and the second quarter, which is annually released on March 5, as well as methods for the preliminary long-term forecast of these quantities, which is annually released in January and February. These methods are based on linear dependences of the forecasted water inflow on the maximum snow water equivalent and on the pre-winter moisture index of the reservoir's catchment area. Based on the hydrograph extrapolation method, techniques for daily short- and medium-term forecasting of the inflow to the reservoir for 1, 3, 5, 7 and 10 days have been developed. A verification using the data for the period from 2003 to 2024 showed satisfactory quality of all proposed methods, which allows recommending them for application in order to improve the efficiency of using water resources of the Iriklienskoe Reservoir.

*Keywords:* reservoir, inflow volume, methodology, linear dependences, hydrograph extrapolation, verification, forecast quality

Tab. 5. Fig. 2. Ref. 18.

**DOI: <https://doi.org/10.37162/2618-9631-2025-1-131-148>**

**Modern features of air temperature in the Caspian region of Azerbaijan** / Huseynov J.S., Ismailova N.N. // Hydrometeorological research and forecasts, 2025, no. 1 (395), pp. 149-164.

The study examines the modern features of the air temperature distribution in the Caspian region of Azerbaijan using initial data from 27 hydrometeorological stations of the National Hydrometeorological Service of Azerbaijan located in the Caspian region over the period from 1961 to 2023. The statistical significance of the time series was estimated, and mathematical averages as well as the features of their distribution were determined. It is shown that 90 % of the warmest years in the series occurred after 2005, while the coldest years were recorded before 1993, which is a clear evidence of dramatic warming in the region. In 1991–2023, the average annual air temperature in the region increased by 0.9 °C (the highest increase was observed in August – by 1.5 °C). Climate changes in the Caspian region are exacerbating processes of desertification, salinization, and erosion. It is recommended to consider these findings when solving construction and energy production problems and elaborating policy on mitigation strategies.

*Keywords:* air temperature, global warming, climatic norm, anomaly, DEM (Digital Elevation Model), air temperature trend

Tab. 3. Fig. 5. Ref. 16.

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**Investigation of the cyclic nature of severe hydrometeorological events** / Sidorenkov N.S., Silnitskaya M.I. // Hydrometeorological research and forecasts, 2025, no. 1 (395), pp. 165-170.

The synchronization of severe hydrometeorological events with the maxima-maximora of the tidal forces of the Moon and the Sun is checked. The cycles of lunar and solar eclipses – Saros and Exeligmos – are used as indicators of the latter. Flood levels on the Ural, Tobol, Ishim, Vagai, and Oka rivers in 2024 and 1970 are compared. It is shown that the catastrophic flood levels in 2024 were preceded by record flood levels in 1970. Severe droughts in the Volga region in 1921 and 1975 and abnormal frosts in Moscow in 1924 and 1978 are associated with the same Exeligmos cycle.

*Keywords:* lunar and solar eclipse cycles, Saros cycle, Exeligmos cycle, synchronization, severe hydrometeorological events

Fig. 1. Ref. 4.

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