Verification of seasonal forecasts of sea surface temperature and sea ice characteristics based on the INM RAS Earth system model / Resnyanskii Yu.D., Zelenko A.A., Stepanov V.N., Strukov B.S., Khan V.M., Volodin E.M., Gritsun A.S., Tarasevich M.A., Bragina V.V. // Hydrometeorological Research and Forecasting, 2024, no. 4 (394), pp. 6-38.

The accuracy of seasonal forecasts of sea surface temperature (SST) and sea ice characteristics is assessed. Forecast skill scores are calculated for two versions of the INM RAS Earth system model (INM-CM5 and INM-CM6) differing in the horizontal resolution of the atmospheric and aerosol modules and in some parameterizations of physical processes: cloudiness, indirect aerosol effects, snow cover evolution.

It is shown that in most cases the skill scores of SST and ice characteristics forecasts based on the INM-CM6 version are higher than those for the INM-CM5. The scores are comparable with those in foreign centers, confirming the compliance of the forecasting system based on the INM RAS model with the world level of accuracy of seasonal forecasts.

Keywords: Earth system model, sea surface temperature, sea ice, seasonal forecasts, verification

Tab. 21. Fig. 4. Ref. 17.

DOI: https://doi.org/10.37162/2618-9631-2024-4-6-38

Analysis of ultra-long-term forecasts of meteorological characteristics of Russian river basins using the INM-CM5 climate model outputs / Gritsun A.S., Semenova N.K., Simonov Yu.A., Khan V.M., Khristoforov A.V. // Hydrometeorological research and forecasts, 2024, no. 4 (394), pp. 39-57.

The analysis of the quality of ultra-long-term forecasts with 1-5 year lead time of the monthly and annual precipitation sums, the average monthly and average annual surface air temperature obtained using the INM-CM5 climate model's outputs is performed. Series of verification forecasts for the period from 1991 to 2023 were used. Forecasts were checked for 12 river basins located in different parts of Russia.

To eliminate systematic forecast errors used a method for correcting, which reduces the error of ultra-long-term precipitation forecasts by almost two times, and air temperatures by almost three times. Forecasts of intra-annual precipitation distribution were satisfactory for 8 out of 12 river basins. Forecasts of the intra-annual distribution of air temperature were good for all 12 river basins.

Demonstrated, that the INM-CM5 climate model outputs can be used for ultra-long-term forecasting of monthly and annual precipitation, average monthly and average annual air temperature.

Keywords: climate model, ultra-long-term forecast, precipitation, mean temperature, intraannual distribution, verification forecasts, correction

Tab. 6. Fig. 5. Ref. 24.

DOI: https://doi.org/10.37162/2618-9631-2024-4-39-57

Turbulent length scales in urban canopy flow and their relation to velocity fluctuation spectra / Glazunov A.V., Mortikov E.V., Debolskiy A.V. // Hydrometeorological research and forecasts, 2024, no. 4 (394), pp. 58-77.

This study presents results of numerical experiments of neutrally-stratified turbulent flows over idealized urban surfaces using a Large-Eddy Simulation (LES) model. It is shown that the turbulent length scales necessary for the formulation of multilayer local one-dimensional Reynolds-Averaged Navier–Stokes (RANS) models of the urban canopy are related to the spatial spectra of turbulence. An algorithm based on the application of Taylor's frozen turbulence hypothesis is proposed to compute an analog of the spatial velocity spectrum inside an urban layer containing objects («buildings»). A qualitative explanation of the dependence of length scales on the morphological characteristics of the urban surface is given.

Keywords: atmospheric boundary layer, urban canopy, large-eddy simulation, LES, turbulence spatial spectra

Tab. 1. Fig. 3. Ref. 36.

DOI: https://doi.org/10.37162/2618-9631-2024-4-58-77

Correction and assimilation the date of water objects surface temperature hydrological observations / Rogutov V.S., Tolstykh. M.A. // Hydrometeorological Research and Forecasting, 2024, no. 4 (394), pp. 78-89.

The paper proposes an algorithm for correcting the data of hydrological observations of water temperature and an algorithm for assimilating corrected data for calculations of water body surface temperatures in Russia. The temperatures are used in initial data for computing global medium-range weather forecasts with the new version of the SLAV10 model with a grid spacing of about 10 km. The correction algorithm for hydrological observations of water temperature makes it possible to eliminate ambiguity in temperature coding at most gauging stations. The assimilation of corrected hydrological observations allows reducing water body surface temperature errors in the SLAV10 model initial data as compared to specifying water temperature from the data of the nearest land points.

Keywords: hydrological observations of water temperature, data assimilation, SLAV model

Fig. 3. Ref. 5.

DOI: https://doi.org/10.37162/2618-9631-2024-4-78-89

Deep learning long-term method of maximum water level forecast of the Iset / Akmaev E.R., Romanov A.V. // Hydrometeorological Research and Forecasting, 2024, no. 4 (394), pp. 90-108.

Numerical analysis of using deep learning in the development of long-term method of maximum water level forecast for several gauging stations of the Iset (Kataysk, Shadrinsk, Mekhonskoe) has been carried out. The possibilities of implementing two architectures of neural network model within the framework of using the same set of initial hydrometeorological observation data have been analysed in detail. It is shown that the transition to the new N-HiTS architecture allows increasing the correctness of the forecast on the validation sample in comparison with the previously used TFT architecture. Using cross-validation we obtained estimates of the classical statistical criterion of correctness of the developed method confirming the possibility of its use in operational practice for all three analysed gauging stations. Within the framework of the developed forecasting method the analysis of groundwater level observation data at groundwater wells of the Rosnedra system was carried out. It is shown that in a number of cases using such observation data allows significantly improve the correctness of forecast.

Keywords: hydrological long-term forecasts, flooding, hydrologic equation, regression equation, neural networks, water level, water regime, deep machine learning

Tab. 5. Fig. 8. Ref. 9.

DOI: https://doi.org/10.37162/2618-9631-2024-4-90-108

Freezing precipitation in European Russia in 1979-2022 and its reproduction by the ERA5 reanalysis / Leonov I.I., Sokolikhina N.N., Lavrenteva A.I. // Hydrometeorological research and forecasts, 2024, no. 4 (394), pp. 109-127.

The quality of reproduction of freezing precipitation by the ERA5 reanalysis in European Russia is assessed. The analysis was performed using the data of the main 3-hour observations of weather phenomena and the ERA5 atmospheric reanalysis data with a step of 0.25° in space and 1 hour in time. The maps of the average number of days with freezing precipitation in the form of drizzle, rain, and their combination were drawn for the period from 1979 to 2022. Similar maps of the average number of days with freezing rain were obtained from the ERA5 data on the precipitation type. It is shown that the ERA5 successfully reproduces individual cases of high-intensity freezing precipitation formed under the stratification of the “warm nose” type. When comparing the reanalysis data on the number of simulated cases of freezing rain with observational data from 214 meteorological stations, the coefficient of determination R^2 was 0.291 for freezing rain and 0.14 for freezing drizzle. The low values of the coefficients of determination are related to the fact that the formation of freezing rain in the ERA5 is possible only in the presence of a melting layer, due to which the predominant number of cases of freezing precipitation occurring in a completely cold atmosphere is not reproduced by the reanalysis. The ERA5 data on the precipitation type are most useful for analyzing the conditions of high-intensity freezing rain formed according to the “classic mechanism”.

Keywords: severe weather events, ice accretion, icing, freezing precipitation, freezing rain, ice pellets, glaze ice, reanalysis, ERA5

Tab. 1. Fig. 7. Ref. 21.

DOI: https://doi.org/10.37162/2618-9631-2024-4-109-127

Assessment of changes in the hydrological regime of a raised bog under conditions of expected climate change during the period until 2060: A case study for the Lammin-Suo bog / Zhuravleva A.D., Kurochkina L.S., Skorospekhova T.V. // Hydrometeorological Research and Forecasting, 2024, no. 4 (394), pp. 128-145.

The paper assesses expected changes in the hydrological regime of a typical raised bog in Northwestern Russia, taking into account various climatic scenarios. The object of the study is the Lammin-Suo raised bog (the Leningrad region), where routine meteorological and hydrological observations have been carried out since 1950. The HBV conceptual hydrological model was used in studying the process of formation of runoff from the bog. For taking into account expected climate change in the region, an analysis based on the results of the CMIP6 climate modeling project was carried out. Calculations are presented for two scenarios of socioeconomic development: SSP2-4.5 and SSP5-8.5. Based on simulated data on the volume of runoff from the raised bog, its level regime was assessed until 2060, and a forecast of related changes in bog microlandscapes was given.

Keywords: aised bog, runoff modeling, climate forecast, climate change, bog microlandscapes

Tab. 3. Fig. 4. Ref. 26.

DOI: https://doi.org/10.37162/2618-9631-2024-4-128-145

Estimation of volumetric soil moisture from ERA5 reanalysis according to the station observations of moisture reserves in the regions of the Russian Federation / Klang P.S., Khan V.M., Tarasova L.L. // Hydrometeorological Research and Forecasting, 2024, no. 4 (394), pp. 146-162.

The study compares volumetric soil moisture based on the data from the fifth-generation global climate reanalysis (ERA5) and observations of productive soil moisture reserves in various soil layers at ten Roshydromet stations for the growing seasons from 2011 to 2023. The coordination of these series in mm of the water layer of total moisture with account of biases is carried out. It is shown that the reanalysis reproduces the main features of seasonal variations in soil moisture in the layers of 0–50 and 0–100 cm, its dynamics during the growing seasons, as well as the episodes of excessive moisture or drought conditions.

Keywords: soil moisture, ERA5, reanalysis, soil moisture observations, moisture reserves, modeling, statistical estimation

Tab. 4. Fig. 3. Ref. 14.

DOI: https://doi.org/10.37162/2618-9631-2024-4-146-162

Outcomes of the 27th session of the North Eurasian Climate Outlook Forum combined with the UN ESCAP workshop / Khan V.M., Vilfand R.M., Pomoshchnikov N.N., Srivastava S., Avi S., Pronina E.A., Gushchina D.Yu., Davlyatov R.R., Isabekova Zh.K., Kokulova V.A., Tishchenko V.A., Sumerova K.A., Lipka O.N., Emelina S.V., Travova S.V., Nabokova E.V.// Hydrometeorological Research and Forecasting, 2024, no. 4 (394), pp. 163-178.

The North Eurasian Climate Centre held the 27th session of the North Eurasian Climate Outlook Forum (NEACOF-27) combined with a workshop under the auspices of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), as a parallel section within the 8th All-Russian Joint Meteorological and Hydrological Congress. The joint event served as an important platform for the exchange of knowledge and experience in the field of climate research, seasonal forecasting and adaptation to climate change, which emphasized its importance for regional cooperation. During the forum, a consensus forecast of the temperature and precipitation regime for the territory of Northern Eurasia for the winter of 2024/2025 was presented. Based on the consensus forecast, using the impact-based forecasting model developed by ESCAP, a forecast of the likely impact of climate anomalies on economic sectors in the winter of 2024/2025 for the Northern Eurasia region was developed and presented. A discussion was held with the participation of representatives of ESCAP, NEACC and NHMS on the development of regional cooperation in the field of disaster risk reduction, adaptation to climate change, and strengthening the response to large-scale and transboundary emergencies in Central Asia.

Keywords: North Eurasia Climate Outlook Forum, ESCAP, climate model, climate risks, consensus forecast, impact-based forecast, seasonal mean anomalies of air temperature and precipitation

Fig. 7. Ref. 9.

DOI: https://doi.org/10.37162/2618-9631-2024-4-163-178