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Investigation of the mountain wave generation over the European part of Russia and assessment of forecasting capabilities for aviation using COSMO-RU6.6 model / Ivanova A.R., Komasko N.I., Skriptunova E.N., Zavialova A.A. // Hydrometeorological Research and Forecasting, 2023, no. 4 (390), pp. 6-24.

The probability of the mountain wave generation over the European part of the Russian Federation in May–August 2023 is studied. The conditions for the occurrence of strong downdrafts and leeward orographic turbulence are discussed for 4 domains including the mountain systems of the Urals, the North Caucasus, the Kola Peninsula and Crimea. An analysis of circulation and thermodynamic conditions favorable for the generation of mountain waves over European Russia were calculated using the initial and forecast data of the COSMO-Ru6.6 model. The accuracy of forecasting the parameters used in the calculations was assessed. It was found that in some cases, moderate turbulence reported in AIREP Speci aircraft observations near the areas with complex terrain could be of orographic nature.

Keywords: mountain waves, pilot reports, COSMO-Ru model, orographic turbulence

Tab. 8. Fig. 5. Ref. 19.

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Thunderstorm activity and characterization of atmospheric instability according to ERA5 reanalysis data over the Asian part of the Russian Arctic / Nechepurenko O.E., Kuzhevskaja I.V., Pustovalov K.N., Gorbatenko V.P., Kravets K.A.// Hydrometeorological Research and Forecasting, 2023, no. 4 (390), pp. 25-45

Thunderstorms in the Arctic sector of the Russian Federation are a key indicator of climate change, as they signal a temperature rise in this cold region. The paper considers the variability of the number of days with thunderstorms in the Asian part of the Russian Arctic for 2015–2021 based on ground-based observations. No rapid increase in the number of days with thunderstorms as compared to the long-term data was found. However, an increase in the frequency of thunderstorm activity is registered at some stations. A verification of the Total Totals instability index values obtained from the ERA5 reanalysis product with the same name and rawinsonde data did not show critical differences. The best fit was demonstrated for Yakutsk station (1.4 %); at Turukhansk and Vanavara stations, the percentage of inconsistency was 3.1 and 3.5 %, respectively. The use of the ERA5 Total Totals product in the Arctic regions is relevant for the retrospective determination of the presence of thunderstorms and their localization in sparsely populated areas.

Keywords: Arctic, number of days with thunderstorm, verification, Total Totals, rawinsonde

Tab. 2. Fig. 4. Ref. 52.

DOI: <https://doi.org/10.37162/2618-9631-2023-4-46-71>

Experimental Methods of the Hydrometcentre of Russia for Producing Storm Warnings about Adverse and Severe Weather Events / Dmitrieva T.G., Smirnov A.V., Alekseeva A.A., Vasil'ev E.V. // Hydrometeorological Research and Forecasting, 2023, no. 4 (390), pp. 46-71.

The results of testing a method for very-short-range forecasting of precipitation intensity (for a period up to 12 hours) and wind gusts (up to 2 hours), as well as the technology for the diagnosis of severe convective events based on radar data for use in the operational practice of storm warning about adverse and severe convective weather events are analyzed. Case studies of synoptic conditions for the occurrence of such events are considered. New types of cartographic products of the Cosmo-Ru-2.2 high-resolution numerical model are presented. The benefit from using new experimental methods in operational practice is assessed.

Keywords: adverse and severe weather events, nowcasting, precipitation intensity, squall, wind gusts, radar-based diagnosis, DMRL-C, COSMO-Ru2.2 high-resolution numerical model

Tab. 2. Fig. 21. Ref. 10.

DOI: <https://doi.org/10.37162/2618-9631-2023-4-72-85>

Assessing the accuracy of simulation of meteorological characteristics with the WRF model for the Caspian Sea / Fomin V.V., Vyruchalkina T.Y. // Hydrometeorological Research and Forecasting, 2023, no. 4 (390), pp. 72-85.

The paper presents the accuracy estimates for the simulation of meteorological characteristics obtained from the WRF model with a spatial resolution of 6 km adapted for the Caspian Sea. It was used to simulate meteorological characteristics using various parameterizations of physical processes available in the WRF model. The model was verified using data from coastal weather stations for 2021. It was found that the best results in reproducing meteorological characteristics are achieved using the Thompson graupel scheme as a parameterization of physical processes, the Tiedtke scheme as a parameterization of convection, the RRTMG scheme as a parameterization of long-wave and short-wave radiation, the MYJ scheme as a boundary layer parameterization, and the Noah Land-Surface Model as a surface layer parameterization. An analysis of the simulation results versus observational data from weather stations showed that the model correctly reproduces the modulus and direction of wind speed, air temperature, and sea-level pressure. It was found that the model correctly reproduces not only the average characteristics of wind speed, but also its extreme values, which is especially important when modeling storm surges in the Caspian Sea.

Keywords: Caspian Sea, regional nonhydrostatic atmosphere circulation model, numerical methods

Tab. 3. Fig. 5. Ref. 22.

DOI: <https://doi.org/10.37162/2618-9631-2023-4-86-104>

Post-processing of ground-level ozone numerical forecasts using machine learning / Borisov D.V., Kuznetsova I.N. // Hydrometeorological Research and Forecasting, 2023, no. 4 (390), pp. 86-104.

Monitoring the quality of air pollutant concentration forecasts based on chemical transport models (CTMs) currently used in the technology of the Hydrometcentre of Russia indicates the feasibility of the post-processing procedure application. For the first time, artificial neural networks (ANNs) were used to correct ground-level ozone model calculations. Retrospective hourly CTM CHIMERE forecasts for 2019–2023 formed the training dataset. Experiments were carried out to select the optimal ANN settings. Results of the experimental testing of the best ANN on a week-long summer period with an episode of high ozone concentrations and a spring period with an episode of high ozone concentrations due to active tropospheric mixing are presented. The effectiveness of using ANNs to improve model forecasts of ground-level ozone and its daily dynamics is shown.

Keywords: artificial neural networks, ground-level ozone, numerical forecast of pollution, chemical transport model, CHIMERE

Tab. 5. Fig. 4. Ref. 12.

DOI: <https://doi.org/10.37162/2618-9631-2023-4-105-117>

Analysis of ice conditions on the Caspian Sea shipping routes / Nesterov E.S., Maksimov A.A., Fedorenko A.V. // Hydrometeorological Research and Forecasting, 2023, no. 4 (390), pp. 105-117.

An analysis of ice conditions on the shipping routes in the northern part of the Caspian Sea is given. The thickness and concentration of sea ice on the routes in the winter seasons of 2011/2012, 2015/2016, and 2022/2023 are considered. The most severe ice conditions were observed in the winter season of 2011/2012. On the basis of satellite information, examples of the spread of stamukhas, which are the ice structures, dangerous for navigation, are given.

Keywords: Caspian Sea, ice cover, shipping routes, thickness and concentration of sea ice, stamukhas
Fig. 6. Ref. 13.

DOI: <https://doi.org/10.37162/2618-9631-2023-4-118-137>

Agrometeorological conditions and prediction of the yield of grain and leguminous crops in the subjects of the eastern Siberian Federal District / Strashnaya A.I., Pavlova A.V., Kulakova T.V., Klang P.S. // Hydrometeorological Research and Forecasting, 2023, no. 4 (390), pp. 118-137.

The results of studying agrometeorological conditions and the possibility of using satellite data to evaluate and predict the yield of grain and leguminous crops in the subjects of the eastern part of the Siberian Federal District are presented. Reasonability of using satellite information in combination with surface data for the development of a method for forecasting the yield in the Krasnoyarsk krai, where a high correlation between the yield and the NDVI (Normalized Difference Vegetation Index) was found, is shown. In the Republics of Khakassia, Tyva and the Irkutsk oblast, no significant correlations between the NDVI and the yield was detected. The importance of improving agricultural standards and the role of meteorological factors differently contributing to an increase in the yield in the regions during 2001-2020 are shown. Using the correlation and regression analysis, the meteorological factors that have the greatest impact on the yield were investigated and selected. Regression models developed on the basis of the joint use of satellite and ground-based data are presented to predict the average yield of grain crops and spring wheat in the Krasnoyarsk krai, and those based on surface data are presented to predict the yield of grain crops in the republics of Khakassia, Tyva and the Irkutsk oblast.

Keywords: agrometeorological conditions, grain crops, yield, satellite data, forecast

Tab. 4. Fig. 5. Ref. 21.

DOI: <https://doi.org/10.37162/2618-9631-2023-4-138-153>

Monitoring of glaze ice on the territory of Russia / Arzhanova N.M., Korshunova N.N. // Hydrometeorological Research and Forecasting, 2023, no. 4 (390), pp. 138-153.

A methodology for monitoring glaze-rime deposits (GRD) is developed to be included in the national climate monitoring system. Based on this methodology, in order to assess the current state of GRD characteristics, the standard station characteristics (total number of cases, total duration, and average weight) are calculated for each type of GRD for the period of 1991-2020. The anomalous pattern of GRD throughout Russia is assessed. The trends are analyzed that are characterized by linear trend coefficients based on the weather station data and on the average values for quasihomogeneous regions (1984-2021). The study showed a statistically significant positive trend for the number of cases, duration, and weight of wet snow deposits in several regions. In some quasihomogeneous regions, both positive and negative significant trends in the number of cases, duration, and weight of crystal rime are obtained. In some quasihomogeneous regions, a significant positive trend for the number of cases and duration of glaze ice is also obtained.

Keywords: monitoring methodology, glaze-rime deposits, glaze ice, rime, wet snow, anomaly, trend

Tab. 3. Fig. 7. Ref. 7.

DOI: <https://doi.org/10.37162/2618-9631-2023-4-154-169>

Outcomes of 25th session of the North Eurasian Climate Outlook Forum combined with the project inception regional workshop under the auspices of the UN ESCAP: Enhancing knowledge and capacity to build resilience to slow-onset disasters in Central Asia / Khan V.M., Vilfand R.M., Tishchenko V.A., Sumerova K.A., Emelina S.V., Nabokova E.V., Kaverina E.S., Kulikova I.A, Kruglova E.N., Tolstykh M.A. // Hydrometeorological Research and Forecasting, 2023, no. 4 (390), pp. 154-169.

The North Eurasian Climate Center held the 25th session of the North Eurasian Climate Outlook Forum (NEACOF-25) combined with the project inception regional workshop under the auspices of the UN Economic and Social Commission for Asia and the Pacific (ESCAP). In total, 143 participants from 12 countries were registered at the event, 60 of them took part in the forum in person. During NEACOF-25, a consensus forecast of air temperature and precipitation anomalies for the territory of Northern Eurasia for the winter of 2023/2024 was presented. The NEACOF-25 consensus forecast is in agreement with the outlook of the large-scale atmospheric circulation from other world forecasting centers. Based on the consensus forecast and using the ESCAP methodology, an experimental outlook of the impact on agriculture, water resources and emergency management was given for the first time. During the program, work was also done to identify and harmonize national climate risk profiles in the countries of Central Asia.

Keywords: North Eurasian Climate Outlook Forum, ESCAP, climate model, climate risks, consensus outlook, air temperature and precipitation seasonal anomalies

Fig. 8. Ref. 8.