

Coordinate splitting, Riemann's equations, grid-characteristic method, alternating direction scheme and the use of integral conservation laws to correct the solution of finite-difference approximation of the equation for an ideal baroclinic fluid / Pressman D.Ya. // Hydrometeorological Research and Forecasting, 2019, no. 3 (373), pp. 6-29.

The system of hyperbolic equations of the dynamical core of the prognostic model for the ideal atmosphere without filtration of any waves is approximated by finite differences. The grid-characteristic method is applied to the Riemann's equations obtained after the coordinate splitting. The scheme of alternating directions is used, and the solution is corrected using the integral conservation laws for mass, energy and momentum. The flow limited from above by a free material constant-pressure surface propagates over the horizontally periodic relief.

Keywords: finite-difference approximation, ideal baroclinic atmosphere equations, coordinate splitting, Riemann's equations, grid-characteristic method, alternating direction scheme, solution correction, integral conservation laws

Fig. 6. Ref. 9.

The use of the spectral algorithm for calculating turbulence coefficients in the COSMO-Ru model to forecast stable situations / Efremov S.V., Nikitin M.A., Perov V.L. // Hydrometeorological Research and Forecasting, 2019, no. 3 (373), pp. 30-42.

The article describes the main results of applying the spectral algorithm for calculating turbulent flows in the atmospheric boundary layer (ABL) module of the COSMO-Ru model. An important role in calculating turbulence coefficients is played by stability functions. The spectral approach allows obtaining the form of these functions theoretically, unlike the current approach based on empirical stability functions. This makes it possible to remove the problems of calculating turbulent flows for the cases of stable and very stable stratification. The performed calculations allow studying the effect of turbulence anisotropy in ABL and demonstrate a decrease in the mean error of air temperature at 2 m and at lower model levels as compared to the calculations based on the original model.

Keywords: stable boundary layer, stability functions, COSMO-Ru numerical weather prediction system

Fig. 8. Ref. 9.

Analysis of numerical forecasts of heavy precipitation with the WRF model using various convection schemes (a case study for the Perm Krai) / Kalinin N.A., Shikhov A.N., Bykov A.V., Tarasov A.V. // Hydrometeorological Research and Forecasting, 2019, no.3 (373), pp. 43-59.

The accuracy assessment of numerical forecasts of heavy convective rainfalls (≥ 15 mm/12h) with the WRF model (7.2 km horizontal grid size) using various convection schemes and explicit simulation is presented. The study is performed for the Perm Krai and is based on data for August 2016. The assessment of forecast accuracy is performed with a partial use of the object-based approach. Two accuracy scores such as Critical Success Index (SCI) and Extremal Dependence Index (EDI) are calculated and compared. Both indices show consistent results, and the highest forecast accuracy is obtained in case of using the Betts–Miller–Janjic convection scheme. It is shown, that the explicit simulation of deep convection predicts the local zones of heavy convective rainfalls, and their maximum intensity is close to the observed values. When modeling using any convection parameterization (except for the Kain-Fritsch scheme), the precipitation area is significantly overestimated, and the maximum rainfall intensity is underestimated, that leads to a decrease in false alarms.

Keywords: convective precipitation, WRF model, convection parametrization schemes, Perm Krai, SCI, EDI

Tab. 5. Fig. 3. Ref. 34.

Regional model of atmospheric dynamics for the system of numerical modeling of the Arctic climate / Rubinshtein K.G., Zarochencev G.A., Ignatov R.Yu., Bychkova V.I., Volodin E.M., Yakovlev N.G., Gritsun A.S. // Hydrometeorological Research and Forecasting, 2019, no.3 (373), pp. 60-72.

The first results of the harmonization of the WRF-ARW regional model with the INM RAS global climate model for simulating the Arctic climate are presented. The results of two experiments with different parametrizations of physical processes in the regional model are compared with measurement data in the region and with the Arctic reanalysis. It is shown that the results obtained in the regional model are closer to observations in some cases.

Keywords: Arctic climate modeling, regional model, global climate model, numerical experiments

Tab. 5. Fig. 2. Ref. 21.

A method for long-range forecasting of young and first-year ice distribution in the southeastern Barents Sea in autumn-winter with a lead time of 30-45 days / Tyuryakov A.B., Mochnova L.P. // Hydrometeorological Research and Forecasting, 2019, no. 3 (373), pp. 73-92.

A method is based on the natural correlations and continuity in the development of ice conditions in the southeastern Barents Sea during the autumn-winter period. The authors elaborated the criteria that allow dividing the southeastern Barents Sea ice conditions into five types (extremely light, light, medium, severe and extremely severe), each characterized by the certain distribution of young and first-year ice. The method takes into account a number of meteorological and ice parameters: the sea ice extent in the southeastern Barents Sea in previous months, air temperature at the polar stations, the direction and intensity of atmospheric circulation in the central part of the southeastern Barents Sea in previous months. All parameters are available and can be reliably determined using data of AARI, polar stations and satellite imagery.

The method quality is assessed during the test period from December 2013 to April 2017, the test forecasts are based on independent data. The average 4-year accuracy of long-range forecasts of young and first-year ice in the southeastern Barents Sea in autumn-winter amounted to 82%. Taking into account that the climatic probability is equal to 61%, the method efficiency amounted to 21%.

Keywords: long-range forecast, southeastern Barents Sea, young and first-year ice, types of ice conditions, typification criteria, predictors, forecast accuracy

Tab. 10. Fig. 4. Ref. 3.

Scientific and methodological prospects of studying the development rates for spring cereal crops as one of the criteria of their productivity / Shul'gin I.A. // Hydrometeorological Research and Forecasting, 2019, no. 3 (373), pp. 93-120.

The possibility to assess the production of spring cereals during their ontogenesis on the basis of the quantitative analysis of consecutive stages of plant shoot organ formation is considered. It is shown that the analysis of duration of individual organogenesis stages allows estimating the number of created metameric organs of stems and inflorescences and, hence, to improve the agrometeorological prediction of cereal crop yields. It is also shown that the number and formation rate of organs at each organogenesis stage depends both on weather conditions and on the implementation of the unique genetic program of plant development aimed at the organism functioning with a maximum efficiency of using daily absorbed solar radiation and at the maximum crop productivity under current conditions for the plant species conservation purposes. It is emphasized that the observations on organogenesis stage durations as well as well on the known phases of plant development can be used for the elaboration of the "bioclimatic passport" of individual crop species reflecting its "normal" response to the past and modern climatic conditions in a given region. Such "passport" is necessary for the comparison of available data on the state of crops and on the rate of their development in the current year in order to prepare the agrometeorological forecast of potential crop production.

Keywords: agricultural meteorology, climate, wheat, development, organogenesis stages, productivity, research prospects

Tab. 5. Fig. 2. Ref. 69.

Agrometeorological conditions and forecasting of sunflower seed yield in the Central Federal District / Strashnaya A.I., Bereza O.V., Klang P.S. // Hydrometeorological Research and Forecasting, 2019, no. 3 (373), pp. 121-138.

The dynamics of sunflower yield and its variability in the subjects of the Central Federal District for the period from 1996 to 2017 is studied. The rate of the yield increase due to crop farming and the yield variations due to weather conditions are analyzed. New physical and statistical models for predicting crop yields with a lead time of one to three months before harvesting are developed.

Keywords: sunflower, yield variability, dynamics, agrometeorological factors, yield forecast

Tab. 8. Fig. 4. Ref. 14.

A cartographic subsystem for the ten-day meteorological and agrometeorological information in the automated information and prediction system / Lebedeva V.M., Shklyayeva N.M., Kalashnikov D.A. // Hydrometeorological Research and Forecasting, 2019, no. 3 (373), pp. 139-150.

The previously developed agrometeorological automated information and prediction system (IPS) includes a subsystem for mapping operational ten-day information received via communication channels in the KN-21 code. A conformal conic projection (EPSG: 102012) is used to construct the skeleton maps. The IPS provides the formation of schematic maps for the whole territory of Russia, for the European and Asian parts of the country, for each of the eight federal districts, and for the south of Russia (Southern and North Caucasian federal districts). For non-programmer users that may work with the system, all functions are automated when building a skeleton map. For each of the parameters, a template was created that includes layers of the base map, elements of the layout and design of the map (>500 templates). For the convenience of users working with skeleton maps, the IPS provides the possibility of constructing composite skeleton maps and atlases.

Keywords: data visualization, mapping automation, operational meteorological and agrometeorological data, composite skeleton maps, atlases

Fig. 12. Ref. 7.

Comparison of phenological models for determining the beginning of birch pollen dispersion for numerical forecasting of allergens transport / Emelina S.V., Nabokova E.V., Rubinstein K.G. // Hydrometeorological Research and Forecasting, 2019, no. 3 (373), pp. 151-160.

The possibilities of using phenological models to determine the date of the beginning of birch pollen dispersion in the European part of Russia are considered. The study uses the temperature-time, sequential, parallel, and alternating phenological models. Simulation data are compared with pollen monitoring data for St. Petersburg (2012–2013) and Nizhny Novgorod (2009–2010). It is shown that the temperature-time phenological model is the most accurate in determining the dates of the start of pollen dispersion in the cities. The results can be useful for the numerical prediction of birch pollen transport.

Keywords: phenological model, birch pollen, pollen emission, birch pollen dispersion forecasting

Tab. 4. Ref. 25.

Climate change as a risk factor for the Russian economy / Oganesyan V.V. // Hydrometeorological Research and Forecasting, 2019, no. 3 (373), pp. 161-184.

The possible losses for the economies of different countries in such areas as market impact, non-market effects, and social-induced loss caused by the possible force majeure events of social nature are presented. Climate change in Russia is characterized by a significant increase in the temperature of the cold seasons, by the evaporation growth accompanied by the maintenance and even reduction of total precipitation for the warm season, by the increasing frequency of droughts, by the changes in annual river runoff and its seasonal redistribution, by the change in sea ice extent in the Arctic Ocean basin and in the mouths of the northern rivers. The main warming-related risks are: an increased frequency, intensity and duration of droughts in some regions, extreme precipitation, floods, cases of dangerous waterlogging for agriculture in other regions; an increased fire hazard in forests and peatlands; the disturbance of the usual way of life of indigenous northern peoples; permafrost degradation causing damage to buildings and communications; the violation of ecological balance, the displacement of some species by others; an increase in electricity consumption for air conditioning in summer for most of the country. The positive changes are: the warming in the Arctic will increase the duration of navigation along the Northern Sea Route and will facilitate the development of oil and gas fields on the shelf; the heating season will be reduced by 2-3 days, and hence energy consumption will decrease; the northern border of agriculture will move to the north, thereby increasing the area of agricultural lands, especially in Western Siberia and the Urals.

Keywords: weather anomalies, weather risks, climate change, intensity, frequency and duration of droughts, extreme precipitation, floods, permafrost degradation, disturbance of ecological balance, economy of business entities

Tab. 4. Fig. 2. Ref. 18.