

THE HYDRODYNAMIC- STATISTICAL MODEL OF
OPERATIVE FORECAST OF THE COMPLEX OF DANGEROUS
PHENOMENA (HEAVY RAINFALL, STORM WIND
INCLUDING SQUALL AND TORNADO, THUNDERSTORM
AND HAIL) AT THE TERRITORY OF RUSSIA

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Development of successful method of forecast of strong summer winds, including squalls and tornadoes, heavy rainfall, thunderstorm and hail could allow to take the proper of the measures against destruction of buildings and other damage. Well-in-advance successful forecast (from 12 hours to 36 hour) makes possible to reduce the losses. Prediction of these phenomena is a very difficult problem for synoptic till recently. The existing graphic and calculation methods still depend on subjective decision of an operator.

At the present time in Russia there is no hydrodynamic model for forecast of the maximal speed of summer wind over then 20m/c and 25m/c, of the maximal quantity of precipitation more than 20mm/12h, of the thunderstorm and the hail. Hence the main tools of objective forecast of such phenomena are statistical methods using the dependence of the phenomena involved on a number of atmospheric parameters(predictors).

The statistical decisive rules of the alternative and probability forecast of these events were obtained in accordance with the concept of "perfect prognosis" using the data of objective analysis. For this purpose the teaching samples of the present and of the absent of these phenomena were automatically arranged that include the values of forty physically substantiated potential predictors.

The choosing of the group of slightly connected and informative predictors for every phenomenon was done by the empirical statistical method [1]. This method uses the diagonalization of the mean correlation matrix \mathbf{R} of the predictors for every phenomenon and the extraction of diagonal blocks of strongly correlated predictors. Thus for every of foregoing phenomenon the most informative predictors were selected without losing of information. Those predictors include either a representative of each block or some of independent informative predictor. We obtained for every phenomenon corresponding the group of the most informative predictors or the vector-predictor (we used the criterion of distance of Mahalanobis and criterion of minimum of entropy by Vapnik-Chervonenkis [1]). The statistical decisive rules for diagnosis and prognosis of every phenomenon were calculated for this vector-predictor. The development of the operative non-adiabatic hydrodynamic model for short-term forecast (the author – Berkovich L.V.) and improvement of 36h forecasts of pressure, temperature and others parameters allow us to use the prognostic fields of those models for the calculation of the values of the discriminant functions

and of the probabilities for prognosis either of dangerous wind or the precipitation or the thunderstorm or the hail in the nodes of the grid 150x150km and thus to get fully automated forecasts of these phenomena. At the map of European part of Russia the prognosis area of the forecast of foregoing phenomenon obtains by extraction of the isoline of the probability with empiric threshold **P**. This threshold of the probability was obtained for every phenomenon.

According to the Pirsey-Obukhov criterion (T), the success of these hydrodynamic - statistical methods of forecast of squalls and tornadoes to 36 hours ahead for the warm season, was used at the regional Departments of Meteorology like Central Region, the Region of High Volga (Nizhnii Novgorod), at the North-West Region (St-Petersburg) and others Regions as the automated objective calculation method, is $T = 0,54-0,78$ [2,4]. The forecast of the heavy precipitation with the quantity over 15mm/12h and over 50mm/12h are after the independent tests successful too. The criterion of Pirsey-Obukhov was 0.52-0.76 [4]. The alternative forecast of present of the thunderstorm and the hail has high enough assessment too. Such assessments were also obtained for the forecast of storm wind and heavy rainfalls at territory of Siberia during 2003-2005 years [3,4].

This way the synoptic can to take all of the maps of the forecast to 12-36h ahead for the every of foregoing phenomena together and then to extract the areas with three prognostic events (the storm wind, including squall and tornado, the heavy rainfall, the thunderstorm or the hail). These prognostic fields of appear probabilities of these phenomena calculated two times a day into operative system of Hydrometeorological Center of Russia. This automated method enables to use the forecast to 12h, 24h and 36h ahead of the complex of dangerous phenomena in the operative practice at the Departments of Meteorology of Russia.

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