HYDRODYNAMIC AND STATISTICAL MODEL OF OPERATIVE FORECAST TO 36 H AHEAD OF DANGEROUS SUMMER WIND INCLUDING SQUALLS AND TORNADOES IN THE EUROPEAN PART OF RUSSIA AND IN EUROPE

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Development of successful method for automated statistical forecast of heavy rainfalls, as well as strong summer winds, including squalls and tornadoes, that often result in human and material losses, could allow one to take proper measures against destruction of buildings and to protect people. Well-in-advance forecast (from 12 hours to two days) of heavy rainfalls makes possible to take proper measures against floods and to reduce the losses. Prediction of the phenomena involved 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 heavy rainfalls and the maximal speed of wind, hence the main tools of objective forecast are statistical methods using the dependence of the phenomena involved on a number of atmospheric parameters (predictors).

Successful development of hydrodynamic models for short- and mid-term forecast and improvement of two-three-day forecasts of pressure, temperature and others parameters allow us to use the prognostic fields of those models for calculations of the discriminant functions in the nodes and the values of probabilities of dangerous precipitation and winds and thus to get fully automated forecasts. Statistical decisive rules for the alternative and probability forecasts for each of the phenomena involved were obtained in accordance with the concept of "perfect prognosis" using the data of objective analysis. For this purpose the teaching samples were automatically arranged that include the values of forty physically substantiated potential predictors.

Then the empirical statistical method was used that involved diagonalization of the mean correlation matrix of the predictors and extraction of diagonal blocks of strongly correlated predictors. Thus for each phenomena the most informative predictors were selected without loosing information, those predictors being either a representative of each block or an independent informative predictors. The statistical decisive rules for diagnosis and prognosis of the phenomena involved were calculated for the most informative vector-predictor that includes the most informative (we used the criterion of distance of Mahalanobis and criterion of minimum of entropy by Vapnik-Chervonenkis) and slightly dependent predictors.

For prognosis of the phenomena involved with the given advance period the values of the discriminant functions and the probabilities of the phenomena were calculated using the prognostic values of the hemispherical model in the nodes of the rectangular mesh 150x150 km over the European part of Russia and Europe. In order to change to the alternative forecast the author proposes the empirical threshold values specified for each phenomena and advance period.

According to the Pirsey-Obukhov criterion (T), the success of the 24-hour forecast and the method of forecast of dangerous precipitation in the warm season for the first and second day, as used in Hydrometeorological Center of Russia since 1998 as the main calculation method, is T=0,49-068. The same is true for the forecast of dangerous squalls and tornadoes, that was tested by Hydrometeorological Center of Russia in 1999-2000 and was included into the automatic prognosis system in the summer of 2001.The method for forecast of very dangerous precipitation (the quantity over 50 mm/12h) was tested successful in some regions of European part of Russia in 1998-2002 .

The forecast of strong summer wind with the value of velocity over 25m/s is developed for next day and next night to 36 hours ahead and is included into operative system of Hydrometeorological Center of Russia. Nowadays this forecast is produced two times per day as the help tool for a synoptic.