Operative Hydrodynamic-Statistical Forecast of St. Jude Storm and of other Dangerous Storm Winds over the Territory of Russia and Europe on the Base of the Regional Model of Russia

E.V.Perekhodtseva

Hydrometeorological Research Center of Russia
email: perekhod@mecom.ru

The development of successful method for automated hydrodynamic or statistical well-in-advance forecast (from 12 hours to two days) of dangerous storm winds with the velocity V>24m/s, including squalls and tornadoes, is actual problem till recently. The operative meteorologists in Russia have used objective physic-statistical forecast of squalls, tornadoes and the wind with the velocity V>19m/s and automated hydrodynamic-statistical forecast of dangerous wind (V>24m/s) on the base of hemispheric model of Russia (the author – Perekhodtseva E.V.). The areas 300x300km on the European part of Russia were used for the testing and for the verification of this hydrodynamic-statistical forecast [3]. The result was very successful. The value of Pirsy-Obukhov criterion for the forecast even to 36h ahead was equal T=0.9, the warning of the dangerous wind was equal P=93% for the North-West region. The values of T in other regions of Russia was successful too (T>0,075) [4]. Nowadays there is no successful hydrodynamic model for the forecast of such storm wind in Russia.

The statistical model of the summer storm wind (V>24m/s) recognition

The meteorological situation involved the dangerous phenomena – the squalls, tornadoes and wind with the velocity V>24m/s is submitted as the vector $\mathbf{X}(A)=(x_1(A), x_2(A), \ldots x_n(A))$, where n – the quantity of the empiric potential atmospheric parameters (predictors). The values of these predictors for the dates and towns, where these phenomena were, give us the set $\{\mathbf{X}(A)\}$ – the learned sample of the phenomena A presence. The learned sample of the phenomena A absence or the phenomena B presence ($\{\mathbf{X}(B)\}$) was obtained for such towns, where the atmosphere was instability, but the velocity values were not so high. The recognition model of the sets $\{\mathbf{X}(A)\}$ and $\{\mathbf{X}(B)\}$ was constructed with the help of Byes approach [1,3]. Before the problem of the sets $\{\mathbf{X}(A)\}$ and $\{\mathbf{X}(B)\}$ recognition it was compressed the predictors space without the information losses by our algorithm of the mean correlation matrix **R** diagonalization. The informative predictors - representatives from each of blocks of **R** and some independent predictors are given vector-predictor of the dimension n=7 (from 38 potential predictors). For this purpose we have estimated the most informative predictors using the criterion by Mahalanobis distance $\Delta^2=(m_i(A)-m_i(B))\uparrow 2/\sigma^2$ [1,2,4]. We have obtained follow informative vector-predictor:

$$(V_{700}, T_{ea}, Td_{ea}, H_{1000}, T_{300}, dT/dn_{ea}, Iw).$$

The values of the discriminant function $F(\mathbf{X})$ and $P(\mathbf{X})$ were calculated for this vector-predictor in the nodes of the greed 150x150km of the hemispheric model. The forecast probabilities $P(\mathbf{X})$ of dangerous wind were calculated by: $P(\mathbf{X})=100/(1+\exp(-F(\mathbf{X}))$.

The automated hydrodynamic-statistical forecast of storm wind on the base of the regional model forecasts

Nowadays the output data of the regional model (in rectangular mesh 75x75km) were used for the storm wind forecast in the before developed discriminant function $F(\mathbf{X})$ for the new hydrodynamic-statistical forecast of dangerous wind. The prognostic area is the area with the probability values $P>P_{thr}$ =65% (for the summer) and P>60% for the cold period. The

result of the independent automated station verification of this new forecast of these seldom phenomena during warm period of year 2010-2011 are submitted in [ ]. The quantity of meteorological stations with these phenomena cases was 109 from all tested cases at the European Part of Russia (50233). The warning of the phenomenon was equal 57%, the warning of the phenomenon absence was equal 85%, and criterion T was equal T=0,42.

The hydrodynamic-statistical forecast of the St. Iuda storm.

This forecast method was applied successful to the forecast of storm wind over the North and Norway seas for the forecast of wind waves, deep connected with storm wind [5]. So this storm wind forecast is calculated operative two times per day over Europe. Here the map of the dangerous wind forecast to 28.10.2014 with the earliness 36h. The forecast probabilities P are very high. The area with P=95%-85% is very great. Really, the observed velocity over the North Sea was equal V=190km/h.. Next day storm have visited East Europe and Russia (St. Petersburg and other cities) with the velocity V>25m/s. A lot of countries have a great losses at the period 28-29.10.2013. We have these successful forecasts to these days. Thus this hydrodynamic-statistical forecast of storms is successful help in the synoptic work.

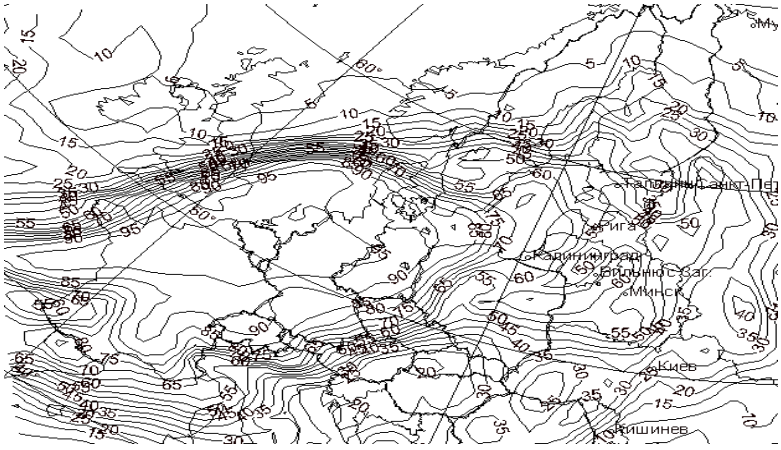

Fig.1 The storm wind forecast area to the date 28.10.2013. to 36h ahead. This area is occurred by the isoline of the probability **P**=60%.

References

1. Anderson T. The introduction in the polydimensional statistical analysis. – M.: Fizmatgiz, 1963 – 500p.

2. Perekhodtseva E.V. The forecast of the squalls by statistical methods of classification on the base of the diagnostic and prognostic connections. The proceedings of Hydrometcenter of USSR, 1985, vol. 271, p. 37-60.

3. Perekhodtseva E.V. Hydrodynamic- statistical model of forecast to 36 hours ahead of dangerous convective daytime and nighttime phenomena – squalls, tornadoes and rainfalls. Research activities in atmospheric and oceanic modeling, Report 32, 2003.

4. Perekhodtseva E.V., Zolin L.V. Hydrodynamic-statistical forecast and the expert system of the tornado forecast over the European part of Russia. // The proceedings of Hydrometcenter of Russia. – 2008. – vol. 342. – p. 45. – 54.

5. Perekhodtseva E.V. Hydrodynamic- statistical forecast of the storm wind over the North, Norway and Barents Seas. Abstracts. 44-th International Liege Colloquium on Ocean Dynamics, April, 2012.