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SHORT –TERM PROGRESS OF PRECIPITATION WITH USE OF SYNOPTIC-STATISTICAL METHODS (THE CONDITIONS OF EAST GEORGIA ARE CONSIDERED)

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ABSTRACT. In the present situation the improvement of the accuracy of the short-term prognosis of precipitation is still very important issue. The article suggests synoptic-statistical method for the short-term prognosis. The 5-year observational material was used for synoptic analysis; later the corresponding correlations were estimated. The values of correlation between calculated aerological data and meteorological elements (total diurnal and maximal values of precipitation) appeared to be sufficient. It allows the usage of the described method in the operational practice.

The problem of weather forecasting, particularly, the prognosis of precipitation is one of the most complicated and significant questions of the modern atmospheric science. Georgia is located at the border of the middle and subtropical latitudes, thus the diversity of weather is the result of the circular processes natural to both zones. The interaction of these circular processes with orography in different regions of the country brings about the weather conditions absolutely different from each other. Indeed, air flows aiming toward the Caucasus Range react with the complex relief which cause complicated spacious distribution of the vertical the fluxes eventually resulting in the compound spacious distribution of atmospheric precipitation.

At present the accuracy of the qualitative prognosis of atmospheric precipitation is less developed than that of the temperature and wind, especially, in the mountainous countries. On

the other hand, heavy precipitation is the significant source of heavy rains, river overflows, avalanches, landslides, and snowslides. That's why the elaboration and introduction of the new methodology in a practical meteorology is quite important and actual.

Till 60s of the last century the prognosis of precipitation was carried out by aerosynoptical method. It uses the expected changes of the circular processes in the atmosphere. The prognosis of this kind is dependant on the qualification of the specialist and thus, has subjective character. Further development of computer technology made possible the implementation of a quantitative prognosis of precipitation on the basis of the thermo-dynamical and statistical methods. However, the discussion about remarkable quantitative changes in precipitation prognosis is early. We think that the main reason of the existed situation is that modern methods of precipitation prognosis are carried out using the thermo-dynamical methods. They do not consider the regularity of alternation in time and space of the multiyear observation data and aerosynoptical methods characteristic to the certain region.

Thus, the combination of all three methods depicted above to work out the prediction methods for atmospheric precipitation could have become one of the most precise ways for prognosis.

The formation of atmospheric precipitation, first of all, has frontal character and is associated with long-scale atmospheric circulation. In the works of Georgian scientists [1-4] every synoptic process in the South Caucasus is researched and classified. The types of synoptic processes that determine weather characterized by precipitation or without it on the whole territory of Georgia or on the certain regions are recognized.

On the other hand, uneven heating of the Earth's surface causes the formation of powerful convective fluxes in the atmosphere during the warm period of the year, which in case of sufficient amount of water vapor brings about cumulonimbus clouds. Convective fluxes are characteristic to East Georgia where semi deserts, valleys, and forests are neighboring; in turn, it is the reason of uneven heating of the Earth's surface. Convective precipitation is natural to the first part of the warm period, when the upper layers of the soil are well

moistened and at the same time there is a good supply of water vapor in the atmosphere. Climate in East Georgia is continental and, providing significant drop of the amount of water vapor in the second part of warm period and thus, the possibility of the formation of cumulonimbus clouds despite convection.

Either meteorological or aerological 5-year observational data for 1982-1986 period is used to implement the probable prognostic method of precipitation. First of all, the data from 18 meteorological stations scattered on the whole territory of Georgia were collected and the database containing the diurnal and night total air temperature and precipitation data for above – mentioned time period was established.

Further, every single possible synoptic type influencing country's climate was established on the basis of diurnal synoptic analysis. Later, the initial information on the following meteorological elements: air temperature, deficit point of dew, wind velocity near the Earth's surface and on the 870, 700, 500, 300 isobaric layers of the atmosphere was obtained by air sounding in Tbilisi airport twice a day: 3:00 a.m. and 3:00 p.m. It was used to build a standard emagram. The emagram helps to calculate derived quantities like: pseudo-potential temperature, levels of condensation and convection stability or instability of the atmosphere, the thickness of stable atmospheric layer, maximal deviation of the state curve from stratification curve and its altitude form the sea level, the magnitude of convective vertical velocity at the certain level.

By the primary work-out of the prepared database [5,6] was proved that the precipitation fall-down in East Georgia can not be expected in the following cases:

- if dominating synoptic situation is anti-cyclone;
- if vertical stratification of atmosphere is stable;
- if the total deficit point of dew is more than 28^{o}C at 850, 700,

500, 300 isobaric levels.

Correspondingly, the above-mentioned synoptic situations were selected from database for further elaboration and, at the same time, arranged in accordance to the three dominating flows: eastern – 2, western 1, and wave turbulence form south – 3.

The correlative relations between the above-mentioned elements and precipitation were calculated. In case of the larger correlations the linear equation of regression was obtained. Here is given the regression equation with four variables, daily maximum precipitation (U_1), and total precipitation (U_2) for the pointed three flows.

1. Western flow:
   $U_1 = - 0.0892X_{11} - 1.1083X_{15} - 0.0639X_9 + 83.7106$
   $r = 0.90$; ER = 0.03
   $U_2 = - 116.5315X_3 - 12.4457X_7 - 3.2931X_9 + 140.3456$
   $r = 0.83$; ER = 0.05
2. Eastern flow:
   $U_1 = - 5.5868X_7 + 2.4986X_{17} + 1.62211X_{12} + 24.2422$
   $r = 0.91$; ER = 0.03
   $U_2 = - 1.1699X_8 + 4.9321X_{18} - 60.3906X_7 + 946.9146$
   $r = 0.77$; ER = 0.07
3. Wave turbulences developed in the southern flows:
   $U_1 = 0.0847X_4 + 0.0637X_{14} + 0.5151X_{20} - 80.8369$
   $r = 0.52$; ER = 0.08
   $U_2 = 0.3064X_4 + 0.1378X_{14} + 1.6075X_{16} - 254.7671$
   $r = 0.61$; ER = 0.07,

where **r** is a correlation coefficient; ER is the mean quadratic error of the coefficient of correlation; X_3 the level of condensation (km), X_4 – pressure on the level of condensation (mb), X_7 the upper level of instability , X_8 the pressure on the upper level of instability, X_9 pressure on the level of the maximal deviation (mb), X_{11} the direction of wind on 700mb level (m/s), X_{12} wind speed on 700 mb (m/s), X_{14} the direction of wind on 500 mb level (m/s), X_{15} wind speed on 500 mb (m/s), X_{16} the deficit point of dew on 500 mb level (^{0}C), X_{17} temperature on 700 mb level (^{0}C), X_{18} the total deficit point of dew on 500 mb level (^{0}C).

Finally, the large-scale magnitudes of the coefficients of correlation create the possibility of using the described method for a short-term precipitation prognosis in the operation practice.

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