de a fi afectate de procese geomorfologice contemporane, conturând aspectul morfodinamicii versanților. Reieşind din specificul caracteristicilor morfometrice ale reliefului, putem concluziona că Podişul Codrilor de Nord reprezintă o unitate distinctă de relief, având o altitudine medie de 140,6 m şi o declivitate redusă, suprafețele cu pantă sub 6° deținând o pondere de 55 %. Expoziția versanților reflectă, în mare parte, caracterul subsecvent al rețelei de drenaj. Versanții cu expoziție sud-vestică şi nord-estică dețin o pondere cumulată de 33 %. Cel mai extins interval al energiei reliefului este de 50-110 m (60%). Densitatea fragmentării, care acționează indirect structura asociațiilor vegetale prin formarea culoarelor de vale, pe unde se canalizează masele de aer, are o repartiție spațială neomogenă.

În aşa fel, analiza acestor indicatori morfometrici ai reliefului oferă posibilitatea de a identifica parametrii determinanți ai reliefului în formarea structurii peisagistice a regiunii şi de a prognoza direcția de modificare posibilă a acesteia în viitor.

S I G au permis de a cuantifica parametrii morfometrici ai principalelor elemente de relief, valori care pot servi ca suport în identificarea, caracterizarea şi clasificarea structurii peisagistice din aria de studiu.

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THE ASSESSMENT OF WIND MODE CHANGES OVER THE 20TH AND EARLY 21ST CENTURIES ON THE REPUBLIC OF MOLDOVA'S TERRITORY

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Abstract

The article presents a research focused on studying the statistical characteristics and identifying the patterns of spatial-temporal variability of wind mode in response to features of the complex relief conditions on the Republic of Moldova's territory over the 20th – early 21st centuries. The assessed results on the frequency of wind directions, monthly and annual average of wind speed indicators are submitted. The revealed trends in wind patterns are presented as a series of maps.

Key words: wind speed, wind mode, spatial-temporal variability.

Materials and investigation methods.

The information on wind speed registered at 14 meteorological stations of the State Hydro- meteorological Service of the Republic of Moldova was used as reference source for the research. Original results were obtained by applying up-to-date research methods and GIS-technologies. A database of monthly and annual wind speed for 1945-2010 years was created by using the MS Excel application. The statistical analysis was conducted by using the program STATGRAPHICS PLUS. Construction of maps was executed by the application SURFER package, specifically by use of "Minimum Curvature" interpolation method.

Introduction.

Wind is the reflection of the global scale atmospheric circulations processes. It plays a key role in the global transport of heat and energy. Variability, observed in the wind parameters, may be an indicator of larger changes in the overall climate system. Historically, in climate researches, more attention was dedicated to such parameters as temperature and precipitation, than to wind speed and direction. The last scientific information on the wind regime on the Republic of Moldova's territory was published in 1978 [1]. Since then, significant changes happened in the localization of the meteorological stations due to urbanization process, their instrumental performances, and changes in the height on the measuring instruments. Therefore, taking into account the changes in regional climate patterns is of specific scientific interest the evaluation of spatial-temporal variability in the wind regime in the current period of time.

Investigation results.

The wind mode may be defined as the temporal change of the direction, force and speed of wind. Direction data have been evaluated using traditional graphical methods, such as wind rose plots. This approach and a long time analysis of wind direction and speed dates (1950-2000 years) allow concluding that the Republic of Moldova's territory is dominated by winds of two opposite directions North-West and South-East. The northern and central parts of the country are affected by North-West winds, while the south – by the South and North winds. This is explained by the influence of the complex relief of the study region. Mean monthly wind direction and velocity fields show a typical seasonal progression: the North-Westerly and Northerly winds are dominated during the warm seasons and the increase in the frequency of the South-Easterly and Southerly winds is observed in the cold period of the year.

To identify changing trends in the wind mode there were used such statistical parameters as: average monthly and annual mean, minimum and maximum wind speed for the 1957-2010 years. The average annual wind speeds over the northern, central and southern regions of the country are presented in Figure 1.

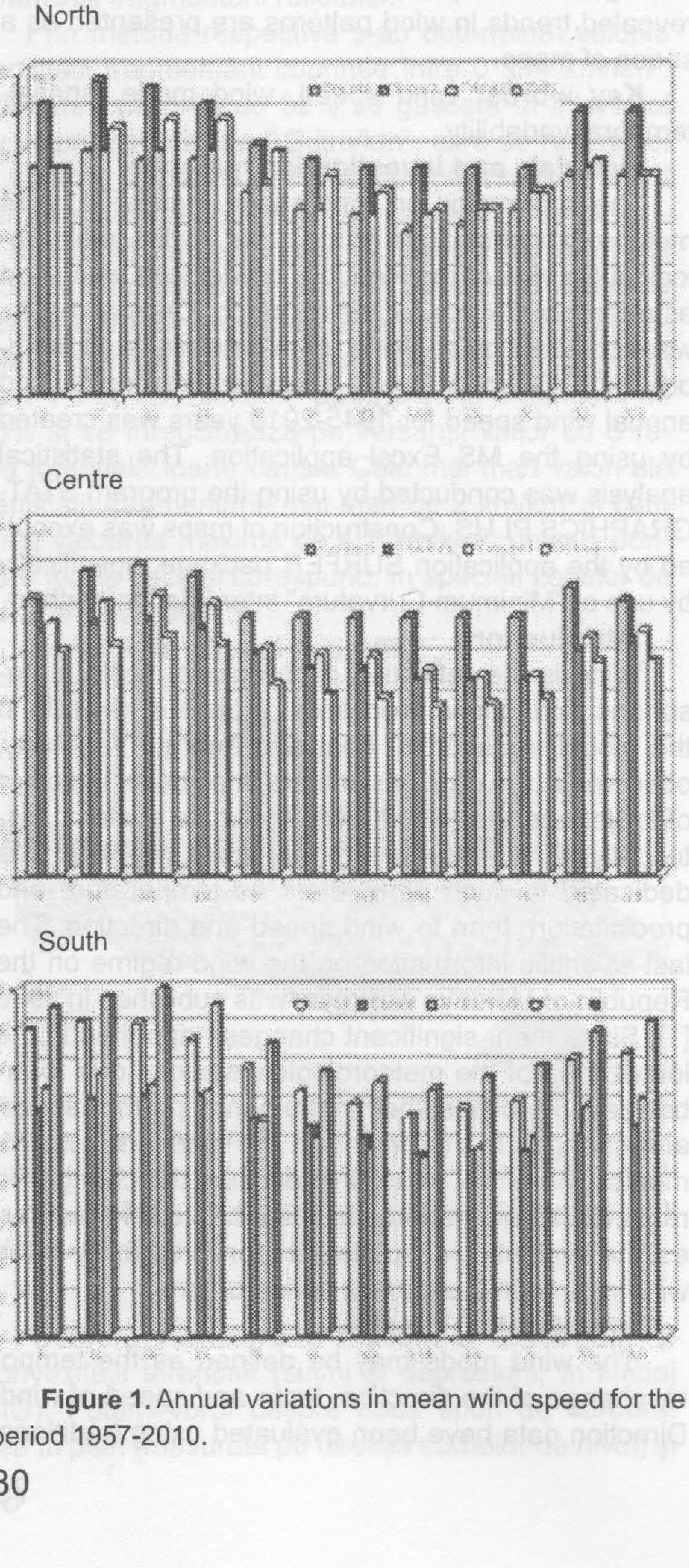


Figure 1. Annual variations in mean wind speed for the period 1957-2010.

The highest wind speeds, from 2.8 to 3.9 m/s, are characteristic to the North of the country, specifically within January to April time period. The maximum in the mean wind speed 3.9 m/s has been revealed in February (Soroca). A decrease of wind speed, from 3.1 to 2.2 m/s was observed within Mai-September time period. The minimum speed of 2.1-2.0 m/s is characteristic to August-September time period. In October-December the respective values increased from 2.5 to 3.5 m/s.

The same tendency of annual wind speed variability is observed in the central part of the Republic of Moldova. The highest values vary from 2.8 to 3.5 m/s, occur in winter and spring seasons, with maximum in February (Cornesti, 3.5 m/s). The wind speed decrease in the Mai-October period to 2.3-2.9 m/s. The lowest wind speed - 2.2 m/s is characteristic for August. An increase tendency in the wind rates, from 2.2 to 3.3 m/s, is recorded in autumn season.

It is interesting to note, that the highest monthly wind speed means have been found in the South of the country, varying from 2.9 to 4.5 m/s. The maximum of 4.5 m/s was registered in March (Cahul). A decrease in wind speed values is noted since April to September, from 3.8 to 2.4 m/s, and the lowest values are registered in August and September (Comrat, Stefan-Voda, 2.3 m/s).

The assessment for wind speed linear trends has enabled to establish the temporal change in wind mode (Fig. 2). According to linear trends of annual wind speed analysis, the reduction of wind speed is characteristic to the whole Republic of Moldova's territory.

The variability of wind speed values ranging from

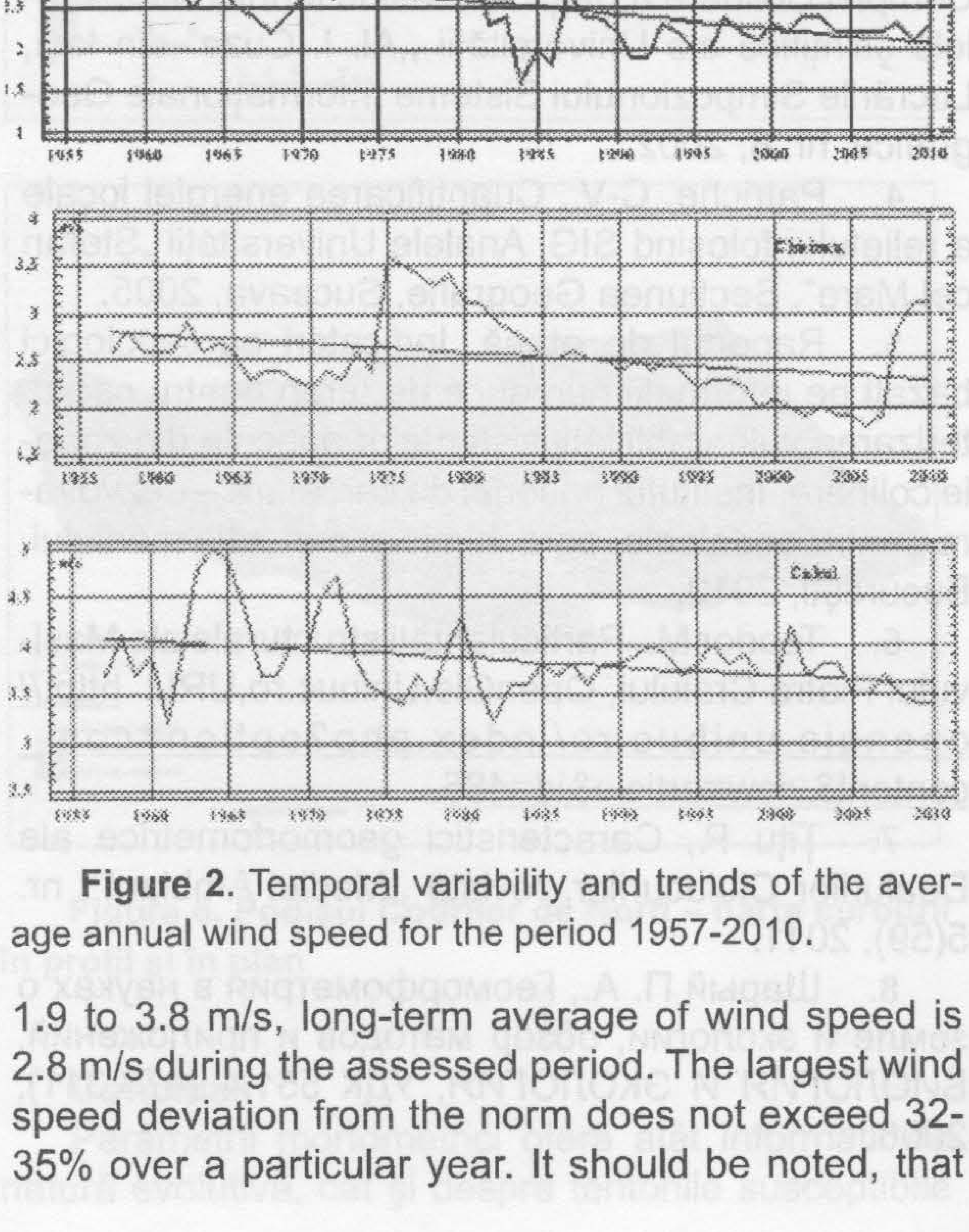


Figure 2. Temporal variability and trends of the average annual wind speed for the period 1957-2010.

1.9 to 3.8 m/s, long-term average of wind speed is 2.8 m/s during the assessed period. The largest wind speed deviation from the norm does not exceed 32-35% over a particular year. It should be noted, that the most intense winds were observed during the 1957-1970 period, and then a decrease of speed indicators was revealed. The average speed up to 1970 years was 3.3 m/s, while in the 1971-1990 period it was 2.8 m/s, in 1991-2000 period it decrease to 2.5 m/s, and the lowest value of 2.4 m/s is characteristic to 2001-2010 period.

To identify changes in the spatial characteristics of wind mode on the Republic of Moldova's territory in the 20th - early 21st centuries, there were chosen two time periods: 1st - 1961-1990 years, recommended by the World Meteorological Organization as the "climatological baseline period" and the2nd - 1991-2010 years, that characterizes the wind regime at current stage.

Analysis of the average annual speed revealed a decreasing pattern in the current climate period: in the North of the country by 0.4 m/s, in the Centre by 0.3 m/s, in the South by 0.7 m/s. The same pattern is characteristic for the wind speed extremes indicators. An essential decrease is observed in maximum wind speed values, at the North of the country from 0.3 to 1.8 m/s; in the Centre, from 0.5 to 1.1 m/s; and in the South, from 0.1 to 1.4 m/s. It has been registered a significant decrease in minimum speeds of the wind, between 0-0.8 m/s at the North, between 0-0.7 m/s in the Centre and between 0.5-1.3 m/s in the South of the country (Fig. 3).

The final step of analytical processing of long-

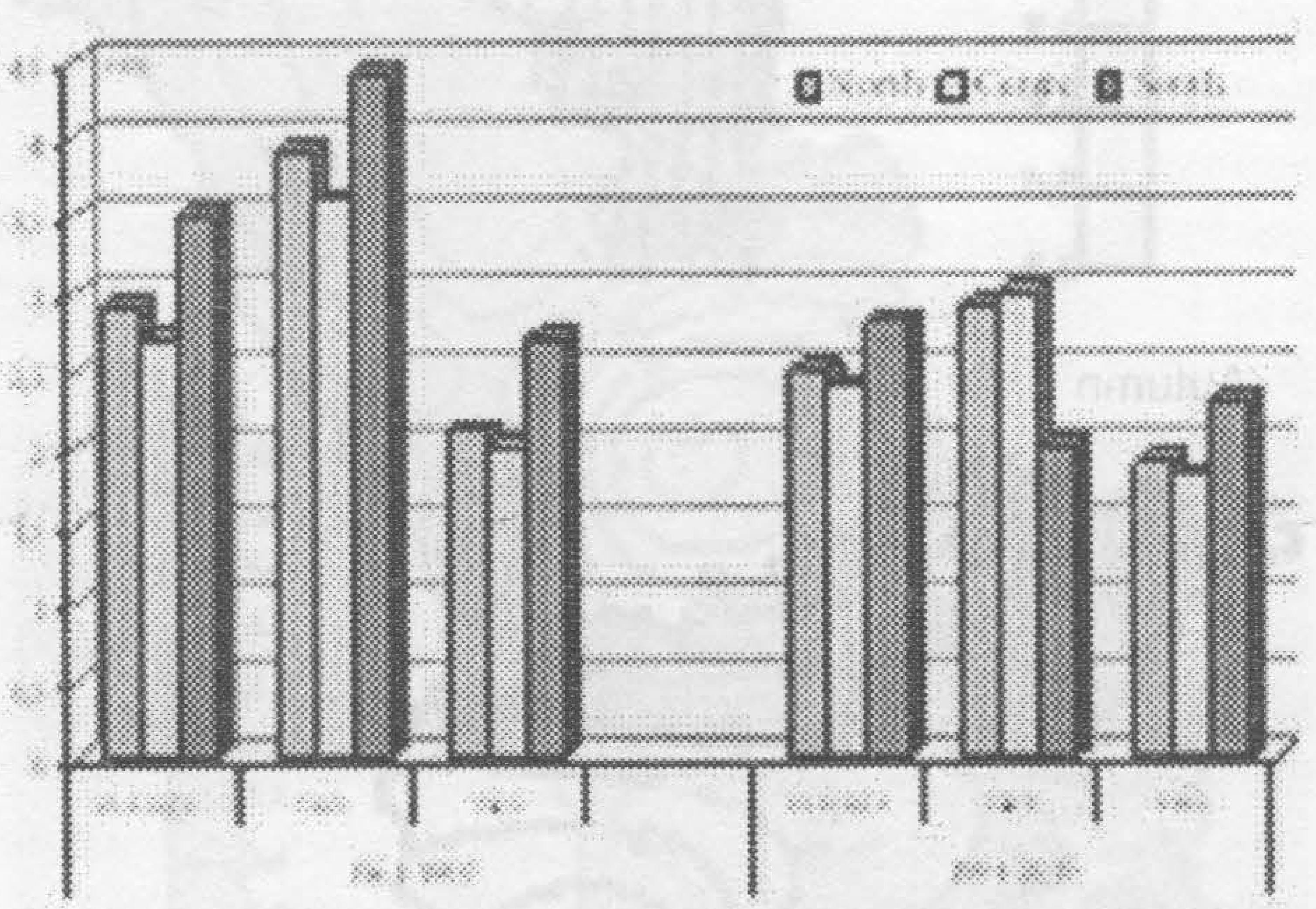


Figure 3. Average annual, maximum, minimum wind speed for two assessed periods.

term cumulated volume of observations consisted in the mapping of the assessed wind parameters. To provide a more comprehensive description of the changes of wind speed distribution, there were developed maps of means annual wind speed for the reference and current periods. The obtained data are presented in Figure 4.

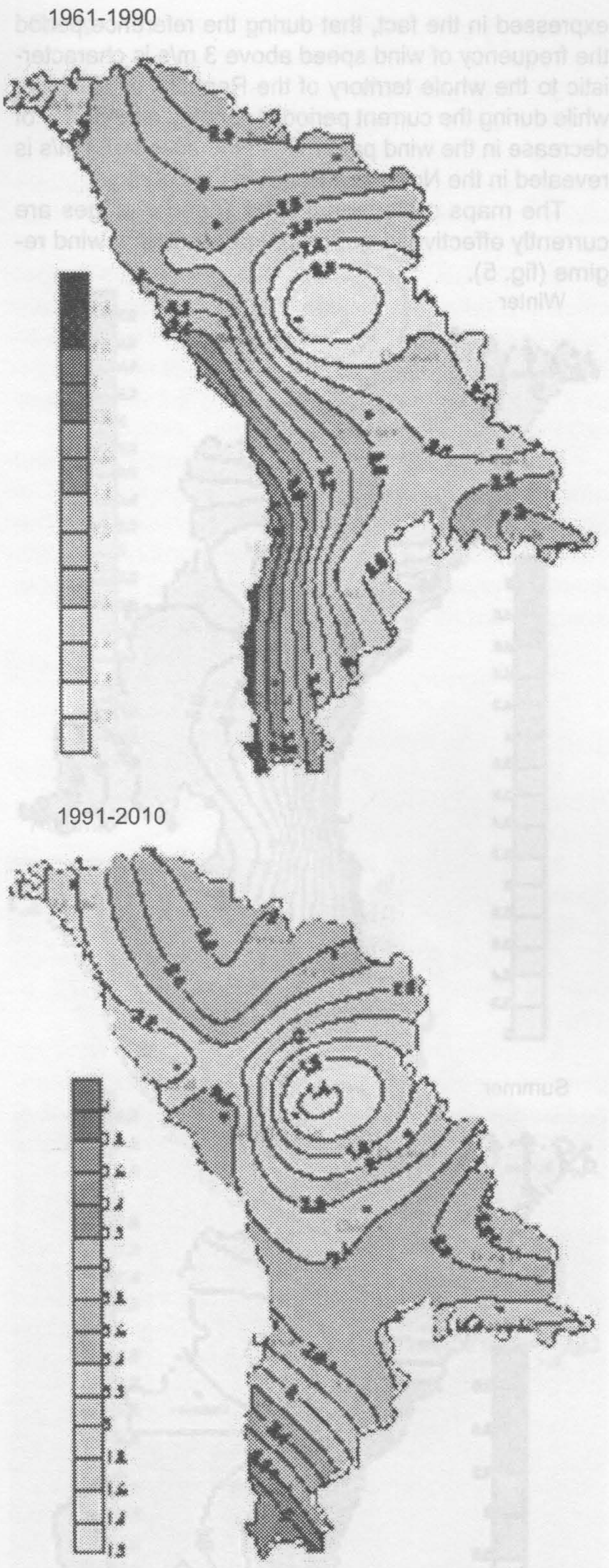


Figure 4. Changes in the average annual wind speed between the references (1961-1990) and current (1991-2010) periods of time.

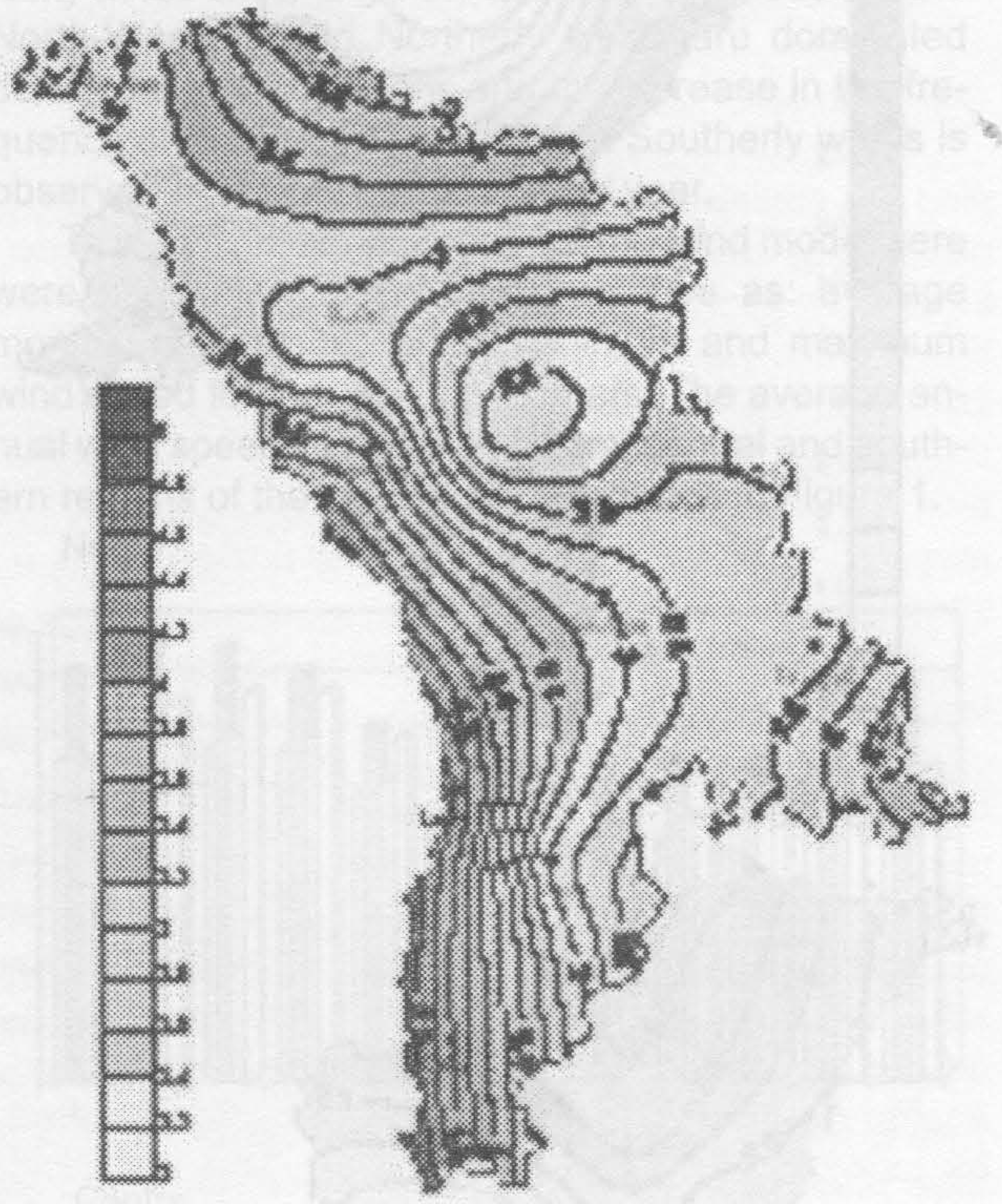
Variations in the wind rate for the reference period (1961-1990) are within from 2.1 to 4.1 m/s, the long-term average speed is 2.9 m/s. The wind characteristics in the current period (1991-2010) revealed a decrease tendency in wind speed, the means varying from 1.4 to 3.7 m/s, with a long-term average speed of 2.5 m/s. The dynamic of changes in wind regime is eloquently expressed in the fact, that during the reference period the frequency of wind speed above 3 m/s is characteristic to the whole territory of the Republic of Moldova, while during the current period, it is noted a tendency of decrease in the wind patterns, so the speed of 3 m/s is revealed in the North and South of the country.

The maps of seasonal wind speed changes are currently effective in geographical studies of wind regime (fig. 5).

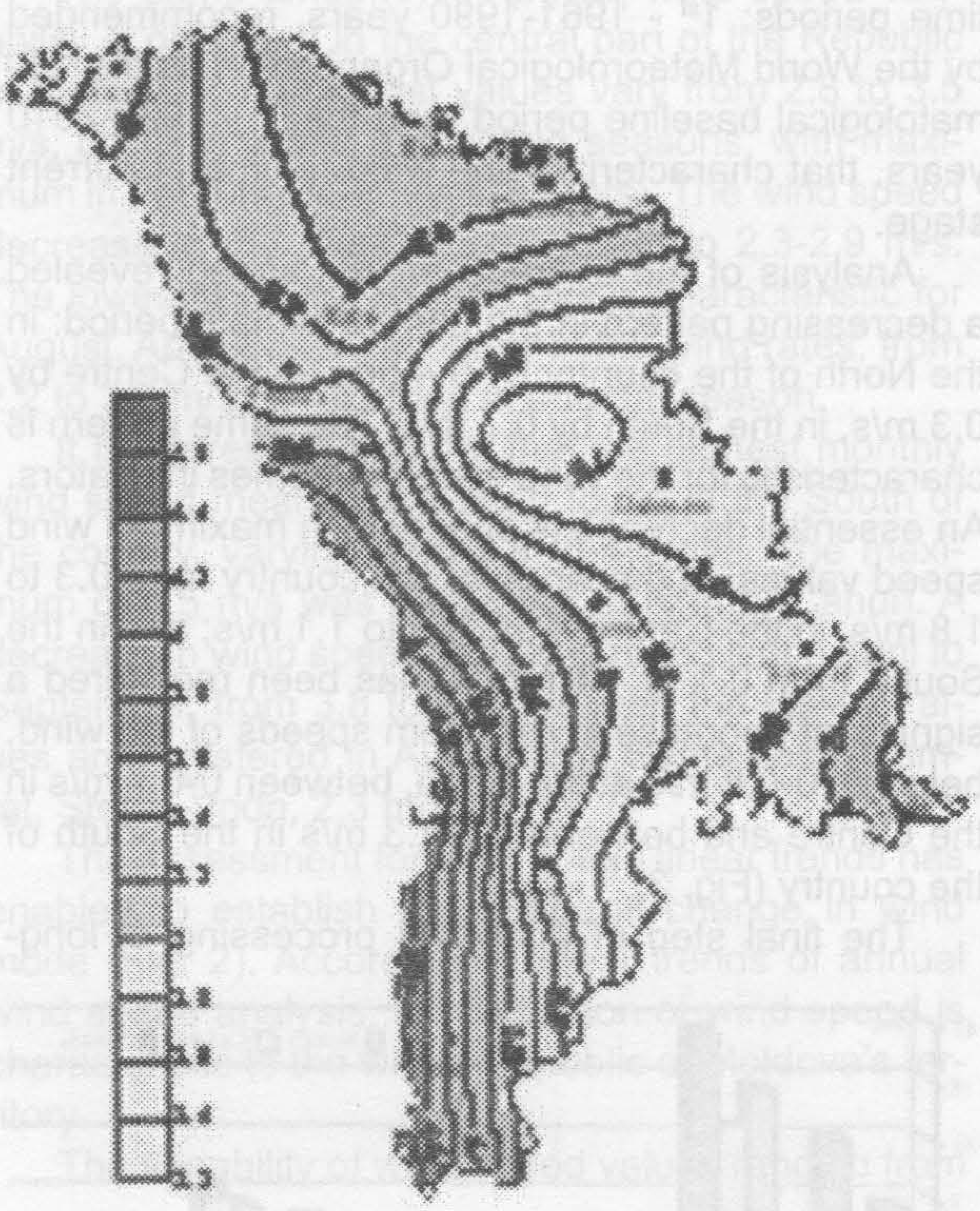
Due to the investigations of seasonal indicators, we can confirm the reduction in the wind speed values in the current period for winter season, by 0.6 m/s, within spring and summer seasons – by 0.5 m/s, for autumn season – by 0.3 m/s, all across the Republic of Moldova's territory.

The results presented in this article are in agreement with much of the literature examining observational wind trends of the late 20th - early 21st centuries. The

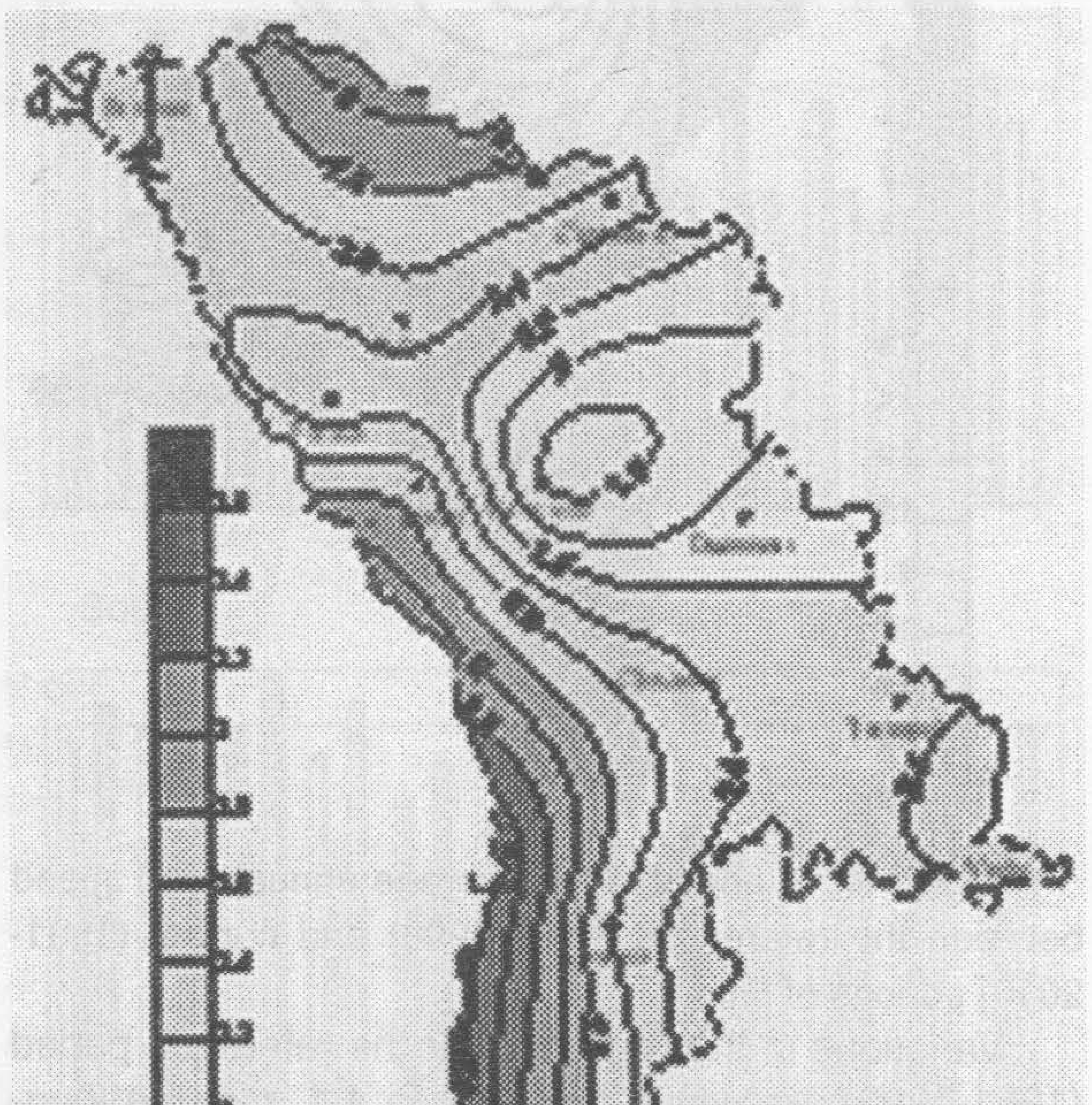
Winter



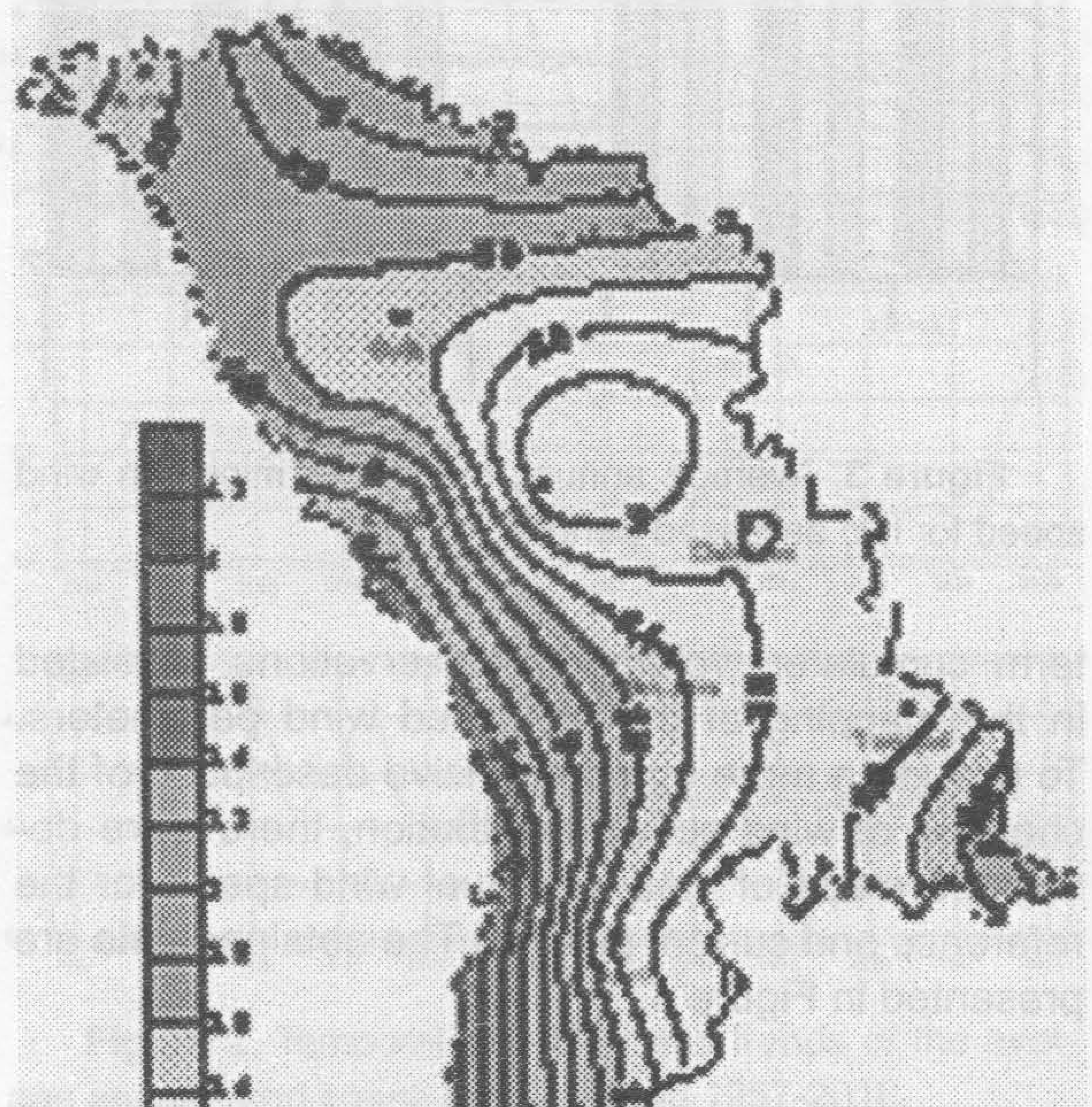
Spring



Summer



Autumn



1961-1990

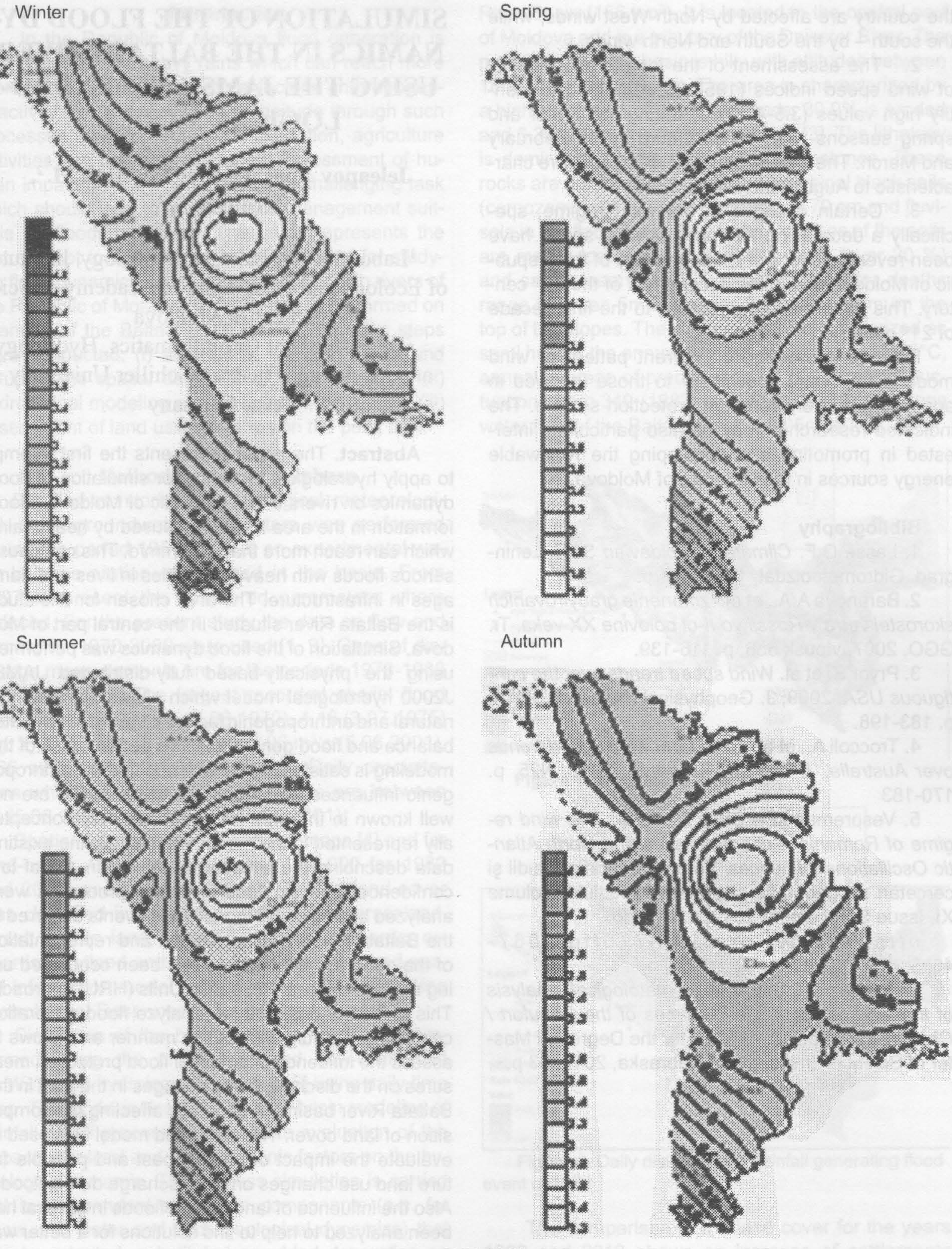


Figure 5. Seasonal distribution of wind speed respectively in the control run and modern climate period.

authors noted that worldwide wind speeds are slowing [2-5]. Several suggestions (i.e. increased surface roughness, changing in the global circulation and pressure gradients, etc.) have been offered for mid-latitude regions, but no definitive conclusions are reached. More researches into the physical mechanisms with impact on decreasing the wind speeds are necessary.

Conclusion

According to the carried out investigations the wind regime on the Republic of Moldova's territory can be characterized as follows:

1. Two opposite directions North-West and South-East winds are dominated over the Republic of Moldova's territory. The northern and central parts of

the country are affected by North-West winds, while the south – by the South and North winds.

2. The assessment of the long-term variability of wind speed indices (1957-2010) helped to identify high values (3.5-4.5 m/s) during the winter and spring seasons with the maximum in the February and March. The lowest values (2.3-2.0 m/s) are characteristic to August and September.

3. Certain changes in the wind regime, specifically a decreasing tendency of wind speed have been revealed over the whole territory of the Republic of Moldova during the second half of the 20th century. This pattern is characteristic to the first decade of 21st century.

Reliable knowledge on current pattern of wind mode is important specifically to those involved in agriculture and environment protection sectors. The indicated researches may be also particularly interested in promoting and developing the renewable energy sources in the Republic of Moldova.

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SIMULATION OF THE FLOOD DYNAMICS IN THE BALTATA RIVER USING THE JAMS/J2000 HYDROLOGICAL MODEL

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Abstract. The paper represents the first attempt to apply hydrological modeling for simulation of flood dynamics on rivers of the Republic of Moldova. Flood formation in the area is mainly caused by heavy rains which can reach more than 130 mm/d. This can cause serious floods with heavy casualties in lives and damages in infrastructure. The area chosen for this study is the Baltata River situated in the central part of Moldova. Simulation of the flood dynamics was performed using the physically-based fully-distributed JAMS/J2000 hydrological model which allows evaluation of natural and anthropogenic factors involved in the water balance and flood generation. The performance of the modeling is satisfactory considering that the anthropogenic influences like irrigation and reservoirs are not well known in the area and therefore only conceptually represented in the model. Additionally the existing data describing the situation in the basin are of low confidence. Specific flood formation processes were analyzed basing on 4 biggest flood events occurred in the Baltata River. Regionalization and representation of the geographical features has been conducted using the Hydrological Response Units (HRU) approach. This gives the possibility to analyze flood generation conditions in a fully distributive manner and allows to assess the influence of potential flood protection measures on the discharge. The changes in the past in the Baltata River basin are generally affecting the composition of land cover. The calibrated model was used to evaluate the impact of present/past and possible future land use changes on the discharge during floods. Also the influence of land use on floods in general has been analyzed to help to find solutions for a better water and land management.

Keywords: hydrological modeling, JAMS/J2000 model, floods, the Baltata River

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