CLIMATE CHANGE IMPACT UPON WATER RESOURCES IN THE BUZĂU AND IALOMIȚA RIVER BASINS

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Key-words: climate change impact, hydrology, water resources.

L'impact de changements climatiques sur les ressources d'eau dans les basins versants des rivières Buzău et Ialomița. L'objectif de notre étude a été l'évaluation d'impacts de changement climatique sur l'hydrologie, en utilisant différentes simulations de changement climatique, dans les basins hydrographiques des rivières Buzău et Ialomița. La modélisation hydrologique basée sur des scénarios de changement climatique globale et régionale a indiqué des changements saisonniers remarquables dans l'écoulement des rivières. Ces changements étaient localement spécifiques, apparemment dans la connexion avec la position géographique et l'altitude des sous-bassins. Dans les mois d'hiver et printaniers, un écoulement augmenté et temporellement modifié a été modelé aux parties significatives de sous-basins situés dans les régions montagneuses. Pour les sous-bassins de plaine, la diminution d'écoulement est survenue pendant hiver et printemps.

1. INTRODUCTION

Information regarding the impact of climate change in hydrology and water management at regional and local scales is required in order to develop adaptation measures and mitigation strategies at national and regional level.

The aim of this study was to evaluate impacts of the future projected climate change impact on water resources of the Buzău and Ialomița rivers and also their tributary streams.

Covering an area of 14,392 km², Buzău and the Ialomița river basins are located outside the of Curvature Carpathian Mountains (Fig. 1) into an area characterized by the presence of a wide diversity of relief represented by mountains (31%), hills (34%) and plains (35%), varying from the heights of Bucegi Mountains (2,500 m) to the Romanian Plain, where the elevation is about 8 m.

The total hydrographical network of these two rivers basins has a length of 5,919 km and the reception area, represent about 6.6% of the country's surface.

Ialomița River, with a total length of 417 km and a general flow direction NW-SE, drains directly into the Danube River and has as main tributaries Prahova and Cârcinov rivers. A tributary of the Siret River, the Buzău River, with a length of 303 km, has the same general flow direction like Ialomița River and in turn has a number of tributaries with lower reception areas.

Morphology of these river basins and the climatic factors lead to a variation of vegetation and soils with the altitude. Also, in conformity of altitude, the annual precipitation varied from 1,400 mm/year, in the mountainous area to 400 mm/year in the plane area and the evapotranspiration between 500 mm/year in the high area to 850 mm/year in the plane area. However, due to a very high variability of weather conditions, droughts as well as excessive humidity periods occur in the course of a year.

In this area there are 8 reservoirs: Bolboci, Pucioasa, Dridu, Paltinu, Măneciu in Ialomița river basin and Siriu, Cândesti, Cireşu in Buzău river basin.

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Data series of 17 meteorological stations have used to estimate precipitation, air temperature, relative air humidity, wind speed and sunshine duration. In addition for precipitation are used data series of 89 rain gauging stations. In the analysed area the hydrological database includes data of 50 runoff gauging-stations.

Due to very big differences in data sets, the period from 1970 until 2000 was chosen because in this period for the most part of gauging stations there are continuous series of measured discharges.

For this study the mean monthly discharges at 4 gauging stations from the Buzău river basin and 13 gauging stations from Ialomiţa river basin are used for the analyse of flow modification in this area.

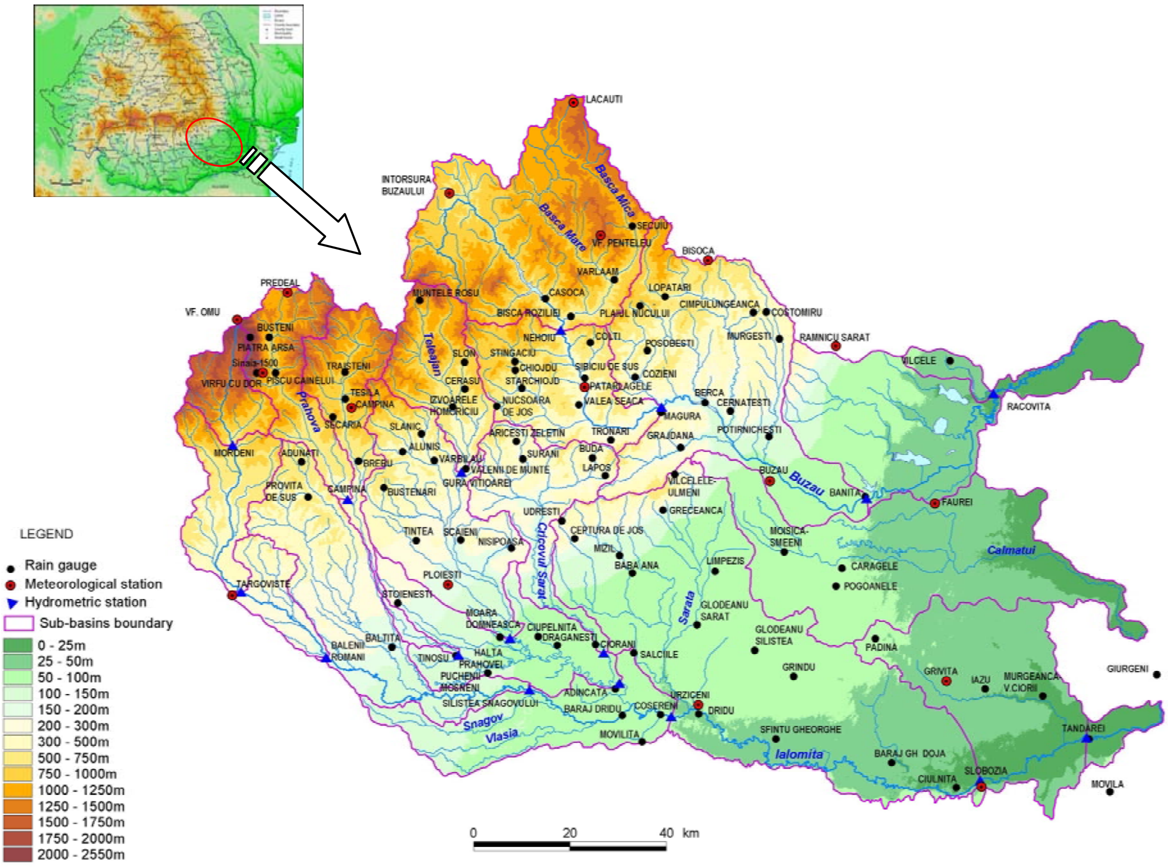


Fig. 1 – Buzău and Ialomiţa river basins and the analysed cross-sections.

The analysis of monthly river flow in future climate conditions derived from already existent simulations with global and regional climate models was achieved. A regional climate model (RegCM3) with two spatial resolutions (25 km and 15 km) was considered, the higher spatial resolution (10 km) simulations being achieved within the CECILIA project (http://www.cecilia-eu.org/).

The river flow analysis in different cross-sections of selected area was undertaken in order to describe the modifications of the surface water resources, in climate change conditions, from the upper parts of the basin towards the lowlands.

Evaluation of river flow is based on mathematical modelling of the precipitation-runoff process with the conceptual, spatially lumped water balance model WATBAL *(Yates, 1994)*.

The model calibration, based on historical data, is presented in section 2. Sections 4 and 5 show the results regarding the climate change impact on water resources based on simulations achieved with global climate models (GCMs) and regional climate model RegCM3, respectively. The conclusions are summarised in section 6.

2. MODEL CALIBRATION

For modelling the response of river basins to potential climate change, the WatBal model was used, a water balance model combined with the Priestley-Taylor method for computing potential evapotranspiration. The integrated tool designed in the EXCEL 5.0 is simple to use and takes advantage of IIASA's mean monthly hydrological data *(Yates, 1994)*.

The WatBal model will be adjusted to the local conditions of a specific region before modelling river basin water balance. In order to complete this task, the hydrological model was calibrated, for each analysed sub-basin, using the observed climatic data for the reference period 1971-2000. Climate input data used for the calibration of hydrological model were: total monthly precipitation and monthly mean of temperature, relative humidity, wind speed, sunshine duration or solar radiation. The observed series from the meteorological stations (and the rain stations in case of precipitation) corresponding of each sub-basin were used for computing the average values of mentioned climatic parameters.

The errors between the measured and simulated discharges were estimated by means of the following numerical criteria:

- The root mean square error (RMSE):

$$\mathrm{RMSE} = \sqrt{\frac{\mathrm{F}}{\mathrm{N}}} \qquad (1)$$

with: $F = \sum_{i=1}^{N} \left(O_i - \hat{O}_i\right)^2$, where: O_i are the measured discharges; $\hat{O}_i$ - the simulated discharges; F - the residual variation; N - the number of discharge values.

- The NTD criterion *(Nash & Sutcliffe, 1970)*, which compares the residual variance with initial one, because a universal criterion was required, which does not depend on the value of the data and on the length of the series.

$$NTD = 1 - \frac{F}{F_0} \qquad (2)$$

where the initial variance is calculated with the relation:

$$F_0 = \sum_{i=1}^{N} \left(O_i - \overline{O}\right)^2 \qquad (3)$$

with $\overline{O}$ the mean of the measured discharges.

The mean monthly discharges at 4 gauging stations from the Buzău river basin and 13 gauging stations from the Ialomița river basin were used for the analysis of flow modification in study area. The calibration of the WATBAL model for each of the 17 analysed sub-basins was accomplished by the simulation of monthly discharge hydrograph at the outlets of sub-basins and using, as input data, the average values (1971–2000) of observed climatic parameters corresponding to each sub-basin. As example, in Fig. 2 are presented the observed and simulated mean monthly discharge hydrographs during the period of calibration 1971–2000 at the Țăndărei gauging station, situated at the outlet of the Ialomița River.

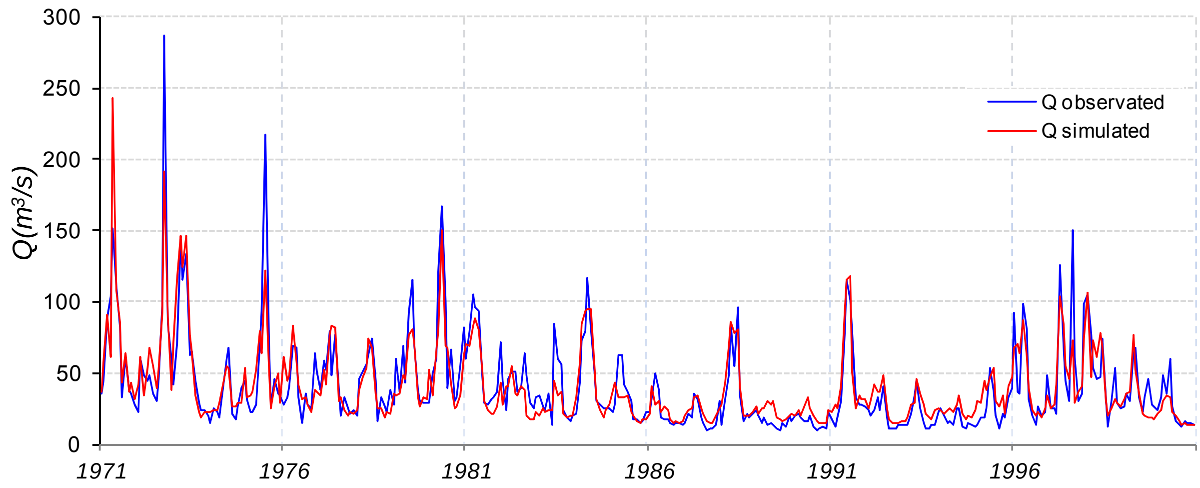


Fig. 2 – Observed and simulated mean monthly discharge at Ţăndărei gauging station on the reference period (1971–2000).

The results of the numerical criteria above mentioned, applied for the period 1971–2000, for the all analysed cross-sections of Buzău and Ialomiţa river basins, indicate a variation of RMSE, in concordance with the river basin surface, between 1.0 and 16.0 m^3/s. Nash-Sutcliffe criterion ranged between 0.66 and 0.79 (Table 1).

Table 1

The values of the assessment criteria of deviations between discharges in the period 1971–2000 for the considered sections within Buzău and Ialomiţa river basins.

River basin	River	Section	Surface of sub-basin (km^2)	RMSE (m^3/s)	NTD
Buzău	Buzău	Nehoiu	1572	9.94	0.66
		Măgura	2290	10.19	0.76
		Baniţa	3997	11.67	0.74
		Racoviţa	5066	12.97	0.73
Ialomiţa	Ialomiţa	Moroeni	263	2.76	0.58
		Târgovişte	686	3.57	0.73
		Bălenii Români	924	4.21	0.73
		Siliştea Snagovului	1885	4.97	0.77
	Prahova	Câmpina	476	2.42	0.79
		Halta Prahova	978	4.37	0.72
		Adâncata	3682	8.49	0.79
	Teleajen	Gura Vitioarei	491	2.49	0.67
		Moara Domnească	1398	3.49	0.75
	Cricovul Sărat	Ciorani	601	1.0	0.73
	Ialomiţa	Coşereni	6265	15.63	0.76
		Slobozia	9154	15.97	0.75
		Ţăndărei	10309	15.43	0.77

Even if it is a simplified model, the obtained results show that WatBal model behaves well. This is confirmed by the NTD parameter values that, except for three gauging stations (Nehoiu on Buzău River, Moroeni on Ialomița River and Gura Vitioarei on Teleajen River), are above 0.7. In addition, the model WatBal turns out to be very sensitive to the effective precipitation establishment, so a temperature variation of 1–2°C can be significant in determining the quantity of water resulting from snow melting. WatBal model testifies its performance for the monthly time step especially where precipitation was relatively uniform during the year (melting process is insignificant) and the flow changes are due especially to the evapo-transpiration.

3. CLIMATE PROJECTIONS

The climate change scenarios were developed using (i) the pattern scaling techniques applied to the outputs of 3 global climate models (GCMs) under various emission scenarios and (ii) outputs of the regional model RegCM *(Giorgi et al., 1993)* with two spatial resolutions under A1B IPCC emission scenario: 25km (achieved within the ENSEMBLES project, *Van der Linden & Mitchell, 2009),* referred in the following as *RegCM3–25*) and 10 km (achieved within the CECILIA project, referred in the following as *RegCM3–10*). The *RegCM3–25* has been developed at the ICTP, Trieste *(Van den Linden, 2005)* and is driven by the ECHAM5-r3 global climate model (developed at the Max-Planck Institute for Meteorology, *(Busuioc et al., 2010a)* while *RegCM3–10* is driven by the *RegCM3-25* and has been developed at the National Meteorological Administration (NMA). The performance of the both RegCM3 versions in terms of their ability to reproduce the temperature and precipitation characteristics over Romania has been analysed in *Busuioc et al. (2010a)*. More details for the RegCM3 are presented in *Busuioc et al. (2010b)*. It was found that, in average over Romania, the *RegCM3–25* overestimates the temperature in winter and underestimates it in rest of the year; the precipitation is generally overestimated, except for summer when it is underestimated.

For all analysed river basins, the climatic input parameters for the future periods used in hydrological modelling were obtained by correcting the measured values over the calibration period with the changes simulated by each model. Mean monthly temperatures used as input data to hydrological simulations were obtained by addition of temperature increase, in climate change hypothesis, to the actual temperatures, and the others climatic parameters by addition of monthly deviations to the mean monthly climatic parameters.

In the first step, the climatic parameters of three global climate models (GCMs) ECHAM, HadCM and NCAR (noted below with E, H and N, respectively), (Table 2), for three future time horizons (i.e. 2025, 2050, and 2100) and three emission scenarios were used (*Dubrovsky et al., 2005*). The three emission scenarios are the following: LO (low estimate of climate sensitivity - optimistic emission scenario), MI (mean estimate of climate sensitivity - mean emission scenario), HI (high estimate of climate sensitivity - high emission scenario). Therefore, a total of 27 climate scenarios were constructed specifically for each sub-basin.

Table 2

GCM simulations used in the determination of standardised scenarios (according to Dubrovsky *et al*. 2005)

Model	Acronym	Atmospheric resolution
ECHAM4 / OPYC3	ECHAM	2.8×2.8°
HadCM2	HadCM	2.5×3.75°
NCAR DOE-PCM	NCAR	2.8×2.8°

The projected mean ± optimistic/pessimistic annual changes in temperature, precipitation, solar radiation, and wind speed estimated by the three GCMs for three future time horizons, compared to the reference period 1971–2000, for Ialomiţa and Buzău river basins, are presented in Fig. 3.

There was a consistent increase in mean annual temperature in Buzău and Ialomiţa river basins in all three models (Fig. 3). An increasing of temperature was projected by all models in target river basins area, with mean increases of 0.7–1.0°C, 1.3–2.1°C, and 2–3°C in 2025, 2050, and 2100, respectively. The optimistic changes were lower by ~50% than these mean values but the pessimistic changes were higher by up to ~100%.

The precipitation amounts decreased in all model projections for all time horizons. The solar radiation change showed almost a mirror pattern compared to the precipitation both in the long-term averages and the seasonality. Also the projected wind speed changes were relatively small and of different sign between the models.

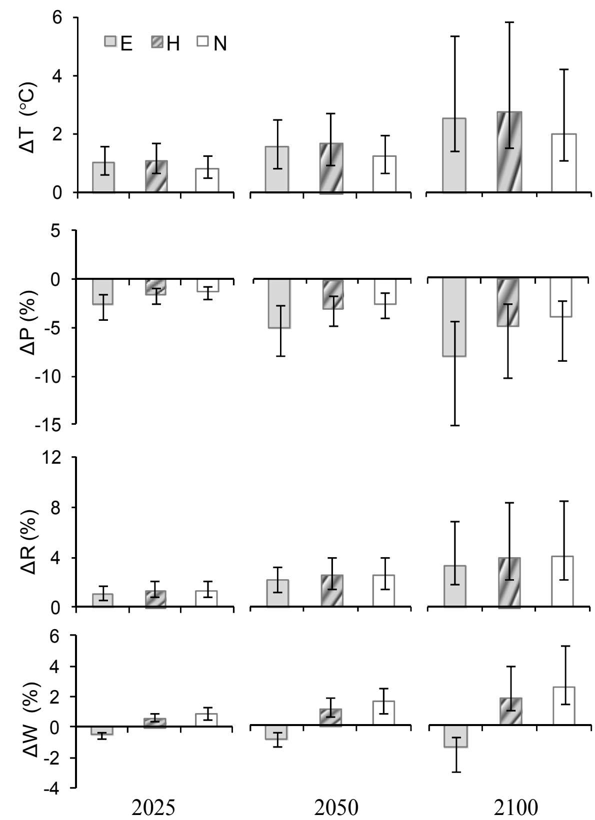


Fig. 3 – Mean annual changes of climatic parameters, simulated by three GCMs (E – ECHAM, H – HadCM, N – NCAR) for middle ± optimistic/ pessimistic (vertical lines) climate change scenarios, in Buzău and Ialomiţa river basins.

Fig. 4 shows the projected changes of mean monthly temperature and precipitation. For all models and times horizons an important increasing of temperature in summer (month of July and August, especially) was estimated, which could reach 4–5°C in 2100. Regarding mean monthly precipitation, it will decrease for the ECHAM model during February to November, HadCM model during May to October and NCAR model during June to November. It is noted so that for all models and times horizons precipitation will decrease during June to October. In the rest of the year, precipitation will increase.

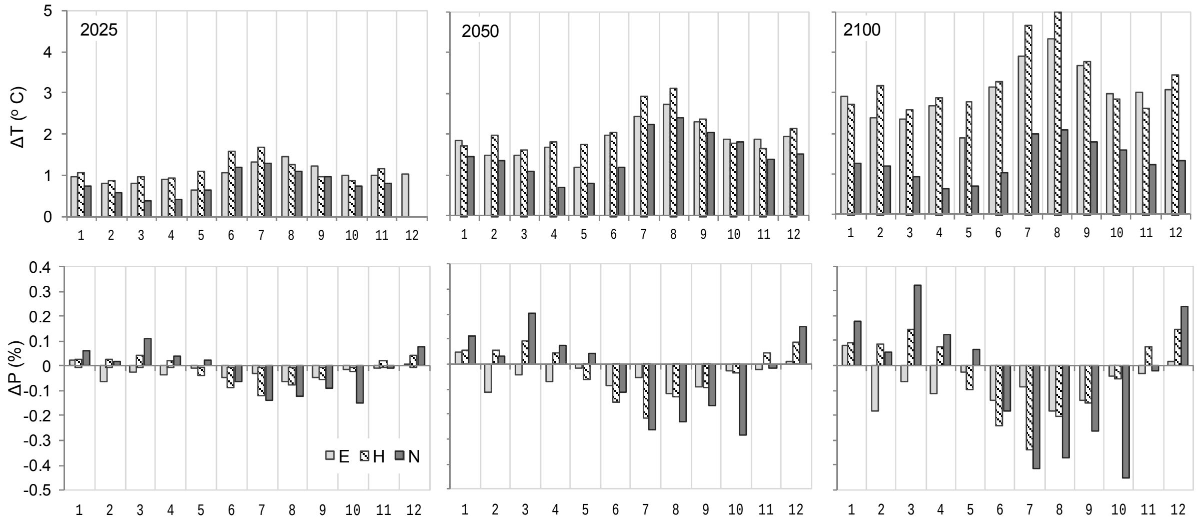
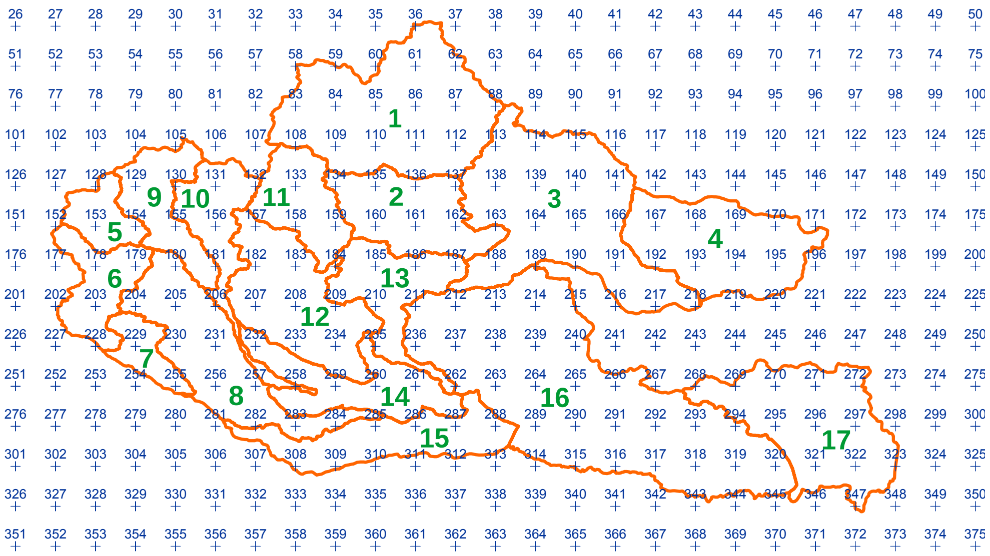


Fig. 4 – Mean monthly changes of temperature and precipitation, simulated by three GCMs (E – ECHAM, H – HadCM, N – NCAR) for middle climate change scenarios, in Buzău and Ialomiţa river basins.

The high-resolution regional climate projections of the RegCM3 (*RegCM3–25*, *RegCM3–10*) under the A1B scenario were also used for hydrological simulations in the analyzed area. For both RegCM3 spatial resolutions, the estimated changes of the main climatic parameters were calculated as differences between climatic parameters corresponding to the two periods 2021–2050 and 2071–2100 and to the reference period 1971–2000, for each calendar month. These changes are supplied in each model grid point. The average spatial change over each sub-basin is then computed. Fig. 5 shows the nodes used for each of 17 analysed sub-basins.



Buzău river basin: *Nehoiu: 1; Măgura: 1+2; Baniţa: 1+2+3; Racoviţa: 1+2+3+4*

Ialomiţa river basin: *Moroeni: 5; Târgovişte: 5+6; Bălenii Romani: 5+6+7; Siliştea Snagovului: 5+6+7+8; Câmpina: 9; Halta Prahova: 9+10; Gura Vitioarei: 11; Moara Domnească: 11+12; Ciorani: 13; Adâncata: 9+...+14; Coşereni: 5+...+15; Slobozia: 5+...+16; Ţăndărei: 5+...+17.*

Fig. 5 – Nodes of grid climatic model (+) and limits of sub-basins (—).

The results regarding temperature and precipitation changes simulated by the two resolutions of RegCM3 model, for the near and remote periods, in case of Buzău and Ialomiţa river basins, are illustrated in Fig. 6. The temperature is projected to increase about 0.8–1.5 °C over 2021–2050 and about 2.8–3.1°C over 2071–2100, with higher values in the summer and autumn months. The RegCM3 temperature changes on Buzău and Ialomiţa river basins are similar to those obtained from GCM simulations presented above.

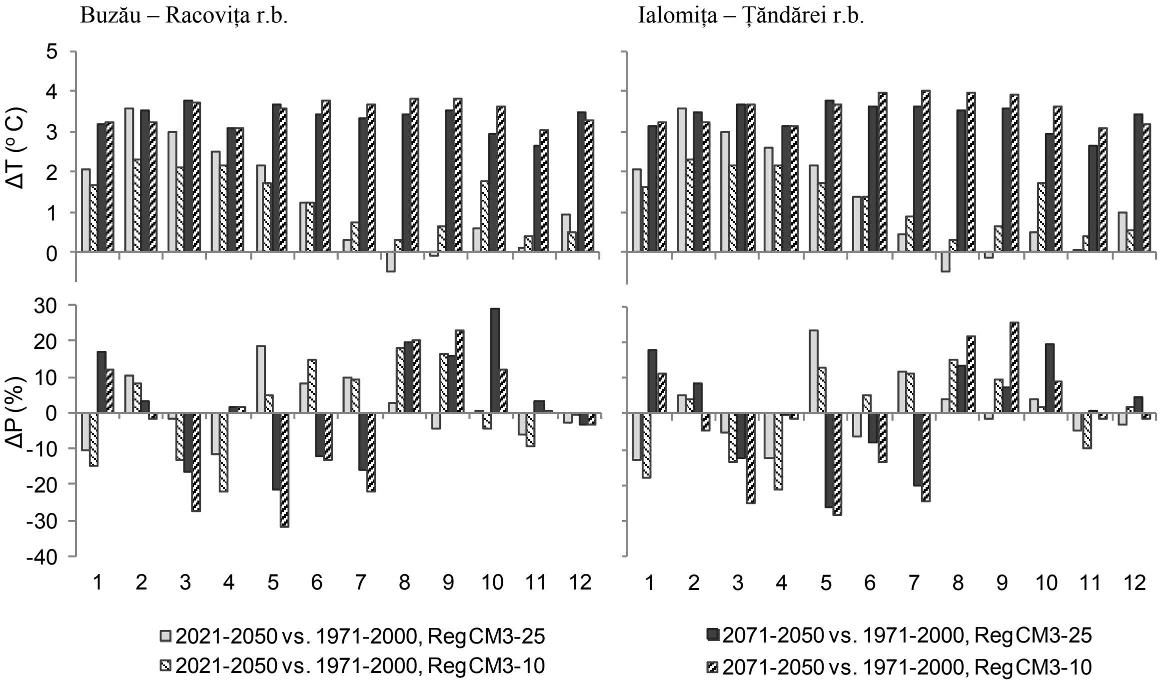


Fig. 6 – Monthly differences between the values of temperature and precipitation simulated with RegCM3 model, for the future periods 2021–2050 and 2071–2100 in comparison with the reference period 1971–2000.

The precipitation amounts decreased in most RegCM3 projections. Notable differences existed between the two spatial resolutions (25 km and 10 km) in the seasonal distribution of precipitation. The *RegCM3–10* outputs show small seasonal changes in the near future period (2021–2050) and a significant decrease in summer precipitation in the far future period (2071–2100) by contrast to the *RegCM–25* outputs that had an increased precipitation in winter and spring months but deficits in the summer and autumn.

4. ASSESSMENT OF CLIMATE CHANGE IMPACT ON WATER RESOURCES BASED ON THE OUTPUTS OF GLOBAL CLIMATE MODELS (GCMS)

The simulated flow using WatBal model (*Yates, 1994*) in current and forthcoming climate change conditions allows the assessment of climate change impact in water resources of the Buzău and Ialomiţa river basins.

Taking into account the new values of the climatic parameters for each of the 17 analyzed sub-basins were simulated the mean monthly flows and then were calculated the relative deviations between the mean monthly discharges in current regime and in simulated ones, in the hypothesis of the climate change. For the comparison of the modified regime of flow, as a result of climate changes, with the current multi-annual monthly hydrological regime, the mean monthly discharges with middle +/- optimistic/pessimistic (error bars) GCM scenarios for time periods 2025, 2050 and 2100 are presented in Fig. 7, for two gauging stations: Moroeni and Ţăndărei on Ialomiţa River. We can observe a less modification of monthly discharge in the case of Moroeni gauging station, this being a characteristic of all the catchments with high mean altitude (Carpathian and Subcarpathian area).

The largest increase in the seasonal flow variability is observed at Ţăndărei gauging station, which is characteristic for all cross sections corresponding to the river basins with low mean altitude (plain sector). The uncertainty in the runoff predictions increased with time and in the time horizon of 2100 it occupied a very wide range of runoff values. In the summer and autumn months this uncertainty belt was narrower because the results of the three models were more coincident and the decrease in runoff seems to be doubtless.

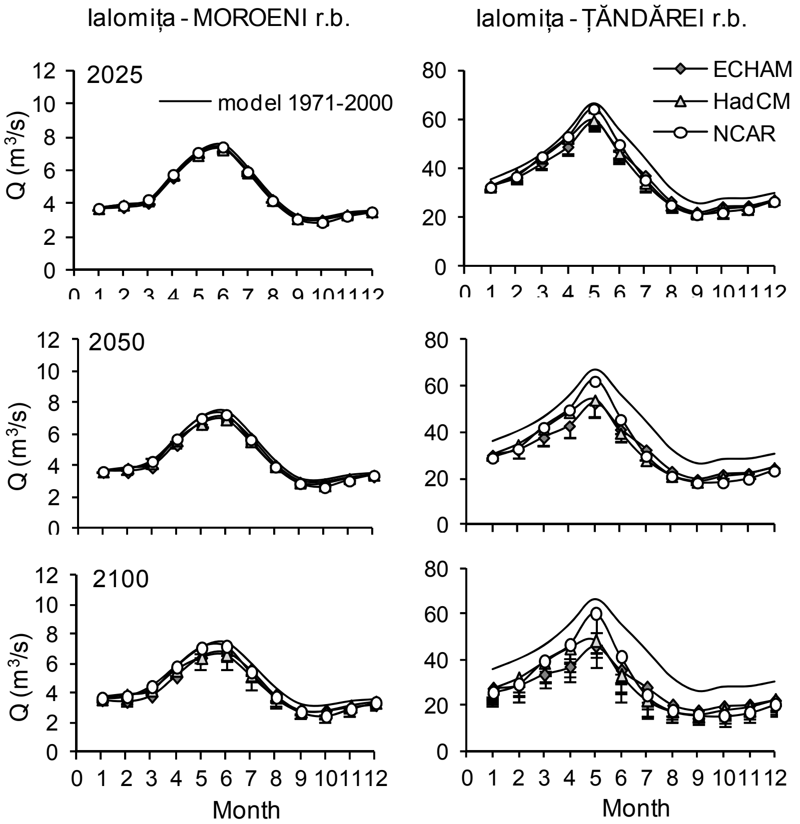


Fig. 7 – Variation of current and simulated mean monthly discharges for time periods 2025, 2050 and 2100 and middle +/- optimistic/pessimistic (error bars) global temperature change scenarios at the Moroeni and Ţăndărei gauging stations on Ialomiţa River.

Also, in Fig. 8 can be seen that the mean annual discharge decreases in climate change conditions. The relative errors to the current regime are larger for all climate models, especially for the time horizon 2100 and they reach 30% in case of river basins with lower mean altitudes.

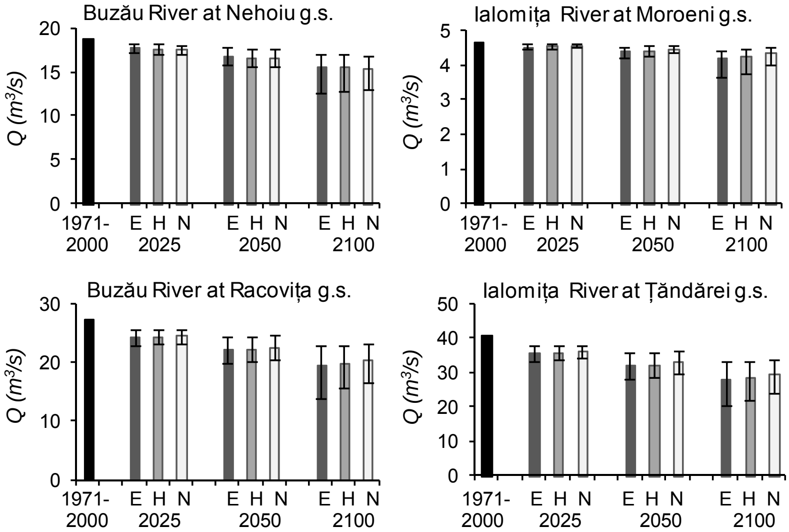


Fig. 8 – The mean annual discharges for reference period and for the middle +/- optimistic/pessimistic (error bars) GCMs scenarios for Nehoiu and Racovița gauging stations on Buzău River and for Moroeni and Țăndărei gauging stations on Ialomița River.

5. ASSESSMENT OF CLIMATE CHANGE IMPACT ON WATER RESOURCES BASED ON THE OUTPUTS OF REGIONAL CLIMATE MODELS

The assessment of climate change impact on water resources in the selected basins, using the RegCM3–25 and RegCM3–10 simulations under the A1B scenario, was the second stage in the analysis of the impact of climate change on hydrological regime presented in this paper.

With the changed input climate data, the monthly discharge series were simulated at all 17 gauging stations from the Buzău and Ialomița river basins, for the above mentioned time horizons. The changes of mean monthly runoff and differences in the seasonal runoff distribution in the reference period (1971–2000) and future time horizons 2021–2050 and 2071–2100 were estimated and compared.

The Fig. 9 shows the simulated monthly average discharges at the outlet of Buzău and Ialomița river basins for the future time horizons in comparison with the reference period.

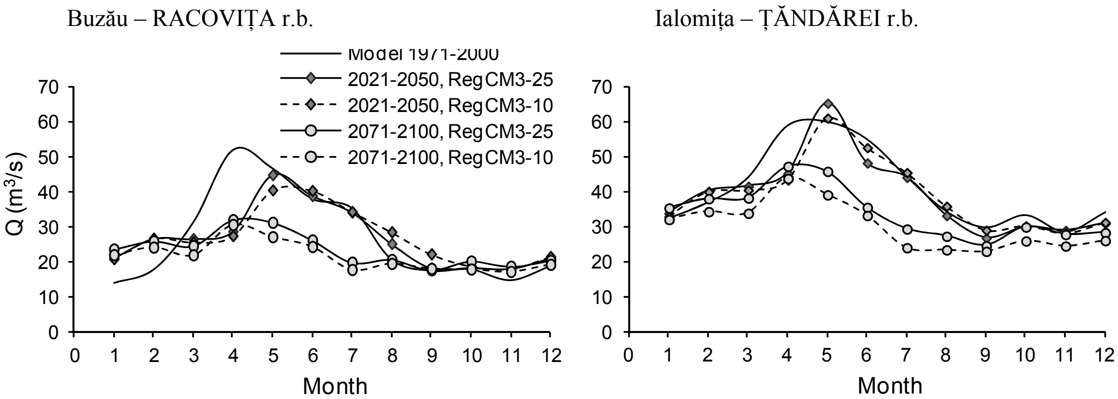


Fig. 9 – Comparison of mean monthly discharges modification in climate change conditions due by RegCM3 with 25km and 10km spatial resolutions.

The analysis of the hydrological scenarios results shows that in all analysed areas the mean annual flow decreases as the time horizon is larger.

Generally, it can be concluded that the hydrological modelling based on the regional climate models indicate notable seasonal changes of the flow in all pilot basins for both of the investigated time horizons.

During the winter and early spring periods, it can be observed an increase in the long-term of mean monthly flow. The period of increasing in flow could have occured from November/December to February/March. This increase could be caused by the increase in air temperature and a shift of the snow melting period from spring months to the winter period. These changes were locally specific, apparently in connection with the geographical position and altitude of the catchment.

During the months of winter and spring, an increasing of flow was modelled at those river profiles where significant parts of catchments are situated in mountainous areas.

At lowland river sections, the decreases of flow occurred in winter and spring in all the river basins. In the months of summer and autumn, a significant reduction in river flow was modelled for all climatic models in all sub-basins, apparently due to the increase in evapotranspiration. In addition to the general drop in runoff, the predicted climate change induced also amplification in the seasonal inequality of flow, which might have important implication for the management of water resources.

Also, for each sub-basin, the mean annual discharge was computed in climate change condition and compared with the mean annual discharge of the reference period (Fig. 10). The mean annual discharge will decrease, especially at the end of the XXI century. The decreasing is more accentuated to the sub-basins having a lower mean altitude.

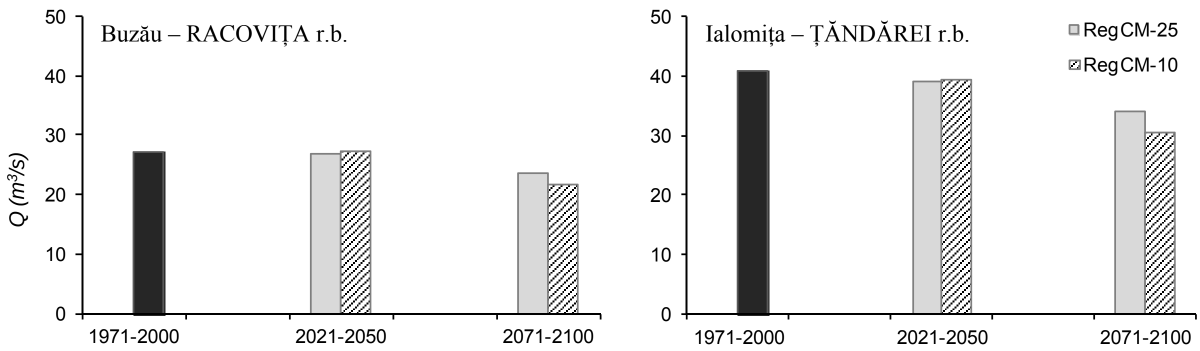


Fig. 10 – Comparison of mean annual flow modification in climate change conditions due by RegCM3 with 25 km and 10 km spatial resolutions.

6. CONCLUSIONS

Climate change impacts on hydrology were analysed in Buzău and Ialomiţa river basins using different climate projections.

The hydrological modelling based on the global and regional climate models indicated notable seasonal changes in the river discharges in all studied sub-basins. In parallel with it global decreasing variation these changes were locally specific, apparently in connection with the geographical position and mean altitude of the sub-basins.

For the sub-basins with high mean altitude (Carpathian and Subcarpathian area) or those sub-basins where significant parts were situated in mountainous areas an increased and temporally modified flow patterns were modelled especially in the winter and spring months. These modifications of flow can be explained as a result of the decreasing of the snow depth and duration of snow coverage due to the air temperature increasing in winter time.

For the lowland cross-sections (situated in the plain) the flow presents in general a largest decrease in worm season and an increasing in winter and early spring time. The important increasing simulated in winter and early spring results from earlier occurrence of floods produced by snow-melt and reduction of spring combined floods (snow-melt and rain) through the desynchronisation between the snow-melt and spring rain occurrence.

Mean multiannual discharge, when using global climate models as well as regional, will decrease as the time horizon is larger. Using global climate models led at the river basins with lower mean altitudes to a decrease which can reach 30%.

When using regional climatic models, regardless of their resolution, simulated discharges for the period 2021–2050 are comparable, while, hydrological simulation results for the period 2071–2100 show a decrease in mean multiannual discharge, in the case of the use the changes in climatic parameters resulting from the regional climate model with resolution of 10 km *(RegCM-10)*, that could reach 20%.

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DETECTION OF URBAN SUMMER WARMING IN TEMPORAL CHANGE OF HEAT STRESS-RELATED INDICES IN THE ROMANIAN PLAIN REGION

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Key-words: urban and suburban areas, summer temperature change, heat stress, Romanian Plain.

The study presents evidence of an increased frequency of hot temperatures and the corresponding urban heat stress in southern Romania, in response to the observed changes in the upper tails of the probability density function distribution of summer daily maximum temperatures, since the mid 1980s. This paper discusses the seasonal variability trends of some relevant heat stress-related indices, yet not directly comparable by their definitions, derived from daily minimum and maximum temperature *in situ* measurements. The analyses aimed also at assessing the change in the frequency, persistence and magnitude of heat stress at six weather stations located in the Romanian Plain Region, found representative for urban and suburban thermal conditions. The study suggests that, during the last decades, the cities in the Romanian Plain Region experienced a significant increase of heat stress under a higher occurrence probability of hot summer days and nights and prolonged heat waves, corrensponding to a growing need for cooling in summer, as well as in early autumn and late spring months, in response to the recent seasonal trends in minimum and maximum temperatures.

1. INTRODUCTION

Europe's climate is changing and air temperatures are projected to increase at levels higher than the global average, at a rate of about 2–6°C by the end of the 21st century (EEA, 2008, 2012b). In addition, Europe exhibits regions of relative large changes in the frequency of some extreme events (e.g. floods, heat waves, storms, droughts) and this pattern is projected to amplify by the end of the 21st century (Beniston *et al*., 2007; IPCC, 2013), posing serious threats to human health, physical assets and economic activities in most European cities, as well as great challenges for their adaptation to climate change. Recent outstanding examples stand for the European summer heat wave of 2003, which resulted in 80,000 excess deaths across twelve European Countries (Brücker, 2005; Sardon, 2007; Robine *et al*., 2008) and the intense heatwave in Eastern Europe of 2010 (Russia), which determined 55,000 deaths (Barriopedro *et al*., 2011, NatCatService, 2012). Rosenzweig *et al*. (2011) emphasized that worldwide, many cities had already faced significant climatic and environmental challenges, related to the urban heat island effect, air pollution and existing disruptive climatic extremes (e.g. typhoons, hurricanes).

Climate change is increasingly being discussed as an emerging global security issue (UNEP, 2012) and cities are greatly aware of the need to prepare for coping with greater variability in temperature, precipitation, as well as an intensification of weather extremes (*Guide to climate adaption in cities*, 2011). In 2013, the Carbon Disclosure Project (http://www.cdpproject.net) published the summary (the third consecutive year) of the most comprehensive survey carried out on global cities and climate change. The selected cities account currently for just over 1 billion tonnes of greenhouse gas emissions and report over 1,000 individual actions designed to reduce emissions and adapt to a changing climate. The results of this survey showed that most participatory cities (110) have

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experienced significant climate change-related risks, the "temperature increase/heat waves" (88) and "more intense/frequent rainfall" (81) being the most commonly risk categories identified. A similar pattern was also observed among the participatory European cities (30) (Fig. 1).

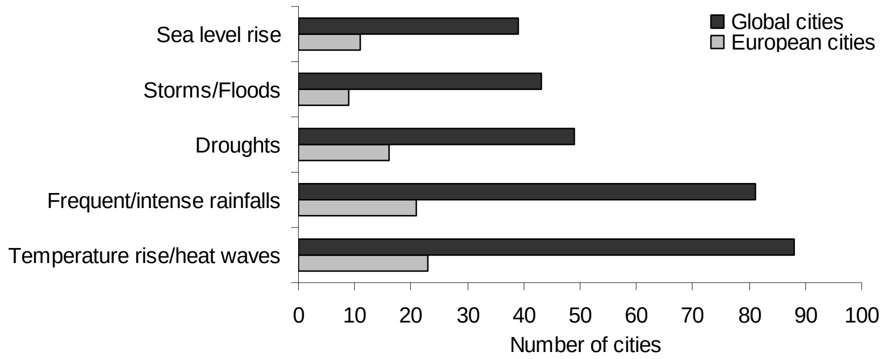

Fig. 1 – Climate change-related risks reported by global and European cities (After: GDP Report, 2013).

The European Commission has recently adopted (April 2013) its first EU strategy on Adaptation to Climate Change, which explicitly states the aim to promote climate adaptation actions in European cities. Furthermore, the proposal of the EU Multi-annual Financial Framework for the period 2014–2020 foresees a much higher share (20%) of the budget for climate change actions, including the support for both adaptation and mitigation of climate change impacts in urban areas. In support, the recently established European Climate Adaptation Platform CLIMATE-ADAPT (http://climate-adapt) brings together adaptation case studies, the outputs of European complementary research projects (e.g. EU Cities Adapt project) and guidance on adaptation planning. Currently, a rather small number of European cities and urban regional governments have developed or are in the early stages of implementing local plans for climate change adaptation (e.g. Copenhagen, London).

In response to the EU Green Paper "Adapting to climate change in Europe – options for EU action", in 2008 the Ministry of Environment and Forests of Romania developed the "*Guide to the adaptation to the climate change effects*" (GASC), approved by Ministerial Order (no. 1170/2008), providing a set of recommendations aiming at reducing the negative effects of climate change in 13 key sectors (agriculture, biodiversity, water resources, forests, infrastructure, construction and urban planning, transport, tourism, energy, industry, health, recreational activities and insurance). The National Climate Change Strategy 2012–2020 (launched in December 2011 for public debate), has no special referees on climate change adaptation for cities. As regards local climate adaptation actions, worth mentioning is the initiative of the Romanian Municipalities Association to assess climate change risk and its implications for public services and local communities, as well as their capacity to adapt to climate change. Climate change has been increasingly recognized as a major challenge for European cities to adapt to and cope with its related effects. The EU Cities Adapt aims at providing capacity building and assistance in developing and implementing local adaptation strategies for 21 cities. The Sfântu Gheorghe town is the only Romanian one participating in this action.

The present study is focussed on understanding the challenge of coping with signficant summer warming in some urban areas of medium (Roşiori de Vede, Călăraşi), large (Craiova, Buzău, Galați) and very large-size (Bucureşti), located in southern Romania (the Romanian Plain Region). Relative to other countryside regions, the thermal discomfort in the cities located in the Romanian Plain is rather strong during summer months (Table 1), in response to the intense and prolongued warm and dry spells, whose occurrence was rather frequent in the last decade (Georgescu *et al*., 2013). This research has sought to investigate the frequency and magnitude of summer warming in southern Romania, as a measure of the general physical exposure of urban communities to the heat stress. In Europe, the summer heat stress is closely related to the increase of mortality rate of urban population in recent years, from 7.6% in 1990 to 33.6% in 2004 (D'Ippoliti *et al.*, 2010).

Table 1

Types of bioclimatic thermal discomfort at some weather stations located in the Romanian Plain (1961–1990) (After Ionac and Ciulache, 2008).

Weather stations	DI-Thom (°C)			HUMIDEX (°C)			Scharlau (units)		
	Jun	Jul	Aug	Jun	Jul	Aug	Jun	Jul	Aug
București–Băneasa	Moderate discomfort (24–27)			Discomfort (30–40)			Significant discomfort (<-3)		
Buzău	Slight discomfort (21–24)	Moderate discomfort (24–27)		Discomfort (30–40)			Significant discomfort (<-3)		
Călărași	Significant discomfort (27–29)			Discomfort (30–40)			Significant discomfort (<-3)		
Craiova	Moderate discomfort (24–27)			Discomfort (30–40)	Significant discomfort (40–55)		Significant discomfort (<-3)		
Galați	Slight discomfort (21–24)	Moderate discomfort (24–27)		Discomfort (30–40)			Significant discomfort (<-3)		
Roșiori de Vede	Moderate discomfort (24–27)			Discomfort (30–40)	Significant discomfort (40–55)		Significant discomfort (<-3)		

2. DATASETS AND INDICES

The analysis is based on the daily mean, minimum and maximum temperature records from six weather stations (Table 2), available from the European Climate Assessment and Datasets project (http://www.eca.knmi.nl), which cover a 49-year period of observations (1961–2009). The non-blended temperature time-series were checked for inconsistencies and outliers, using the RClimdex package. The daily temperature time-series used in this study have no missing data. The weather stations used in this work reflects both urban and suburban climatic conditions (Table 2). According to Raliță (2005), most of the selected stations have open meteorological platforms and no/or no major nearby natural or anthropic obstacles were identified to add inhomogeneities to the *in situ* temperature measurements (except for Bucureşti–Băneasa, located in a nearby forest and orchard area). No site relocations have been reported during the 49-year period surveyed in this study.

Table 2

Weather stations location parameters and settings.

Weather station	**Latitude**	**Longitude**	**Altitude**	**Station type**	**Relief units**
Bucureşti–Băneasa	44°30'	26°08'	90 m	Urban	Vlăsia Plain
Buzău	45°09'	26°49'	97 m	Suburban	Buzău Plain
Călăraşi	44°12'	27°21'	19 m	Urban	Danube Floodplain
Craiova	44°19'	23°52'	192 m	Periurban	Contact between the Olteț Piedmont and the Romanați Plain
Galați	45°29'	28°02'	69 m	Urban	Galați Plain
Roşiori de Vede	44°06'	24°59'	102 m	Periurban	Boianu Plain

The paper is focused on high-impact hot weather phenomena that have affected the southern Romania region frequently and severely during the last decades (e.g. hot days, hot nights, heat waves). The analysis is based on several relevant indices aiming at quantifying the response of climatological heat stress to temperature change under current climate conditions:

1. Tropical heat stress (THS), a composite index which combines the day-time (THS_{day}) and night-time (THS_{night}) heating effect of warm and dry tropical advections. The index was computed for summer by cumulating the absolute frequency of tropical days (Tmax >30°C) and nights (Tmin >20°C). Because of the urban heat island effect (UHI), minimum temperature is generally higher in urban areas compared to rural and suburban areas, tending to underestimate the heat stress exposure. No paired sites analysis was undertaken in the present study to quantify the UHI effect.

2. Combined heat stress (CHT), also a composite index between the number of tropical nights (Tmin >20°C) and hot days (Tmax >35°C), introduced by EEA (EEA, 2012a).

3. Heat waves (HW) were defined as number of consecutive days when the maximum temperature exceeded 35°C, the corresponding threshold of canicular day occurrences. This fixed threshold, roughly corresponds to the long-term daily 95^{th} percentile of maximum temperatures within the June–August season, at all the selected weather stations, calculated for the 49-year period of observations.

4. Cooling degree-days (EEA, 2012b) is derived from daily mean temperature measurements and is defined relative to the 22°C base temperature (the outside temperature below which a building is assumed to need cooling according to STAS 6648/2, which regulates the size of cooling systems for buildings, based on external temperatures in July).

The Mann-Kendall (MK) non-parametric test was used to assess the local statistical significance of the trends and change rates in the variability of the selected heat stress indices. The MK test is a rank-based procedure and is particularly suitable for analysis of data series containing outliers. The significance threshold was set to the 5% level. The trends and change-points in the variability of summer temperature and heat stress indices were identified using the non-parametric Pettitt test, which is based on the Mann-Whitney test.

The generalized extreme value (GEV) distribution has been fitted to the 49-year time series of the highest maximum temperature summer records to assess the magnitude of some rare and severe heat wave episodes and the corresponding return periods of these records.

3. CURRENT AND FUTURE TEMPERATURE CHANGE SIGNALS IN SOUTHERN ROMANIA

The analysis of the long trends of countrywide temperature time-series (1901–2005) has indicated a significant rise of the annual average temperature by about 0.5°C (0.05°C/decade), for most regions of Romania, but yet, at higher rates in the southern and eastern ones (including the littoral area), up to 0.07–0.08°C/decade (GASC, 2008). This behaviour has been confirmed by the results of the analysis on the evolution of temperature extremes in the Romanian Plain Region over the 1961–2009 period. Regionally wide, the 49-year trends of both temperature extremes are persistently positive since the mid-to-late 1980s for most seasons, except autumn. The six selected weather stations show common variability patterns and similar seasonal change rates. Peak warming rates are specific to summer for most sites (0.5–0.6°C/decade), excepting Craiova and Bucureşti–Băneasa stations where winter warming is the largest over the period, yet at comparable rates of about 0.5°C/decade. At all the stations the entire distribution of the summer extreme temperatures shifts significantly towards higher values, most visible changes occurring in the upper tail of the maximum temperature extremes, after 1985. This shift is accompanied by a decadal change in the extreme tails of the probability density function (PDF): an increase of the 95% quantile of summer maxima (of 0.6° to 1.6°C) and a similar shift even at the 99th percentile level (of 0.6° to 2.6°C).

In one of the most comprehensive synthesis on climate variability and change in Romania, Busuioc *et al*. (2010) showed that the Extra-Carpathian regions of Romania (particularly the southern ones) are under a higher frequency and duration of warm extremes since mid-to-late 1980s or early 1990s. Furthermore, these trends pinpoint areas that appear to widely overlap those which have also experienced more frequent episodes of severe droughts in the recent decades (e.g. 2000, 2007) (Sandu *et al*., 2010). In a study conducted on the mechanisms of controlling hot summer occurrence in Romania (Busuioc *et al*., 2007), the strong summer temperature anomalies in recent years (2000, 2003, 2007) have been associated to the increased frequency of high-pressure systems in altitude (500 mb level), which were optimum correlated to positive temperature anomalies at 850 mb level centered above the South-East European territory (in terms of both spatial extension and anomalies).

The climate projections by the end of the 21^{st} century, under A1B scenario (CECILIA FP7 Project – www.cecilia.org), indicate a further intensification of summer warming in the southern Extra-Carpathian regions:

– by maximum temperatures: at a rate ranging from 0.7–0.8°C (2021–2050) to 4.0–4.3°C (2071–2100);

– by minimum temperatures: at a rate ranging from 0.7–0.8°C (2021–2050) to 3.7–4.1°C (2071–2100);

It is also projected that some warm extremes (e.g. summer days when Tmax>25°C, tropical days when Tmax>30°C) will significantly increase in summer until 2100, at a rate of 7 to 40%.

4. RESULTS

4.1. Tropical heat stress (THS)

The tropical heat stress is considered a reliable variable in the assessment of the thermal extreme regime of urban regions, as combining the day-time and night-time heat exposure of city communities. Considering the value range of the two THS components, the Romanian Plain Region displays one of the highest tropical heat exposure in Romania. Among the cities surveyed in this study, Roşiori de Vede and Călăraşi show the highest THS_{day} (37–39 days/summer), while Galați and Buzău distinguish themselves by the highest frequency of THS_{night} (about 8 nights/summer). The large-scale circulation patterns resulting in a great tropical heat stress across the region explain the narrow value range of this index, from 36 to 44 units. Yet, peak THS values are recorded at Roşiori de Vede (41 units) and Călăraşi (44 units), while its minima are specific to Galați (36 units) and Craiova (37 units). Generally, THS_{day} has the highest share to the overall THS across the region (above 77%), while the contribution of THS_{night} does not exceed 20% (excepting Galați 22.8%) (Fig. 2a).

In response to the summer maximum and minimum temperature rise, THS is on a significant increase across the Romanian Plain Region, since the early 1980's, which marks a recent warming phase across the whole country (Fig. 2b). Table 3 indicates the decadal changes in THS components over the study period, with considerable increase in the day-time heat stress (above 100 cases at Buzău, Craiova and Roşiori de Vede), particularly between the second and third decades (Table 3). The THS trends over the period are robust (>5% level) at all the selected sites, but they are highly significant at Roşiori de Vede, Buzău, Galați and Călăraşi (0.1% level)

Table 3

Decenial variation of the day- and night-time tropical heat stress (number of cases) in urban areas of the Romanian Plain Region.

Weather stations	1961–1970		1971–1980		1981–1990		1991–2000		2001–2009	
	THS_{day}	THS_{night}	THS_{day}	THS_{night}	THS_{day}	THS_{night}	THS_{day}	THS_{night}	THS_{day}	THS_{night}
Bucureşti–Băneasa	333	30	229	10	317	30	408	12	426	20
Buzău	272	51	187	40	307	43	383	102	355	135
Călăraşi	345	35	288	32	357	27	462	53	469	76
Craiova	297	35	188	11	296	39	402	81	378	66
Galaţi	217	86	187	26	249	46	327	100	366	139
Roşiori de Vede	325	22	240	13	375	37	457	47	438	76

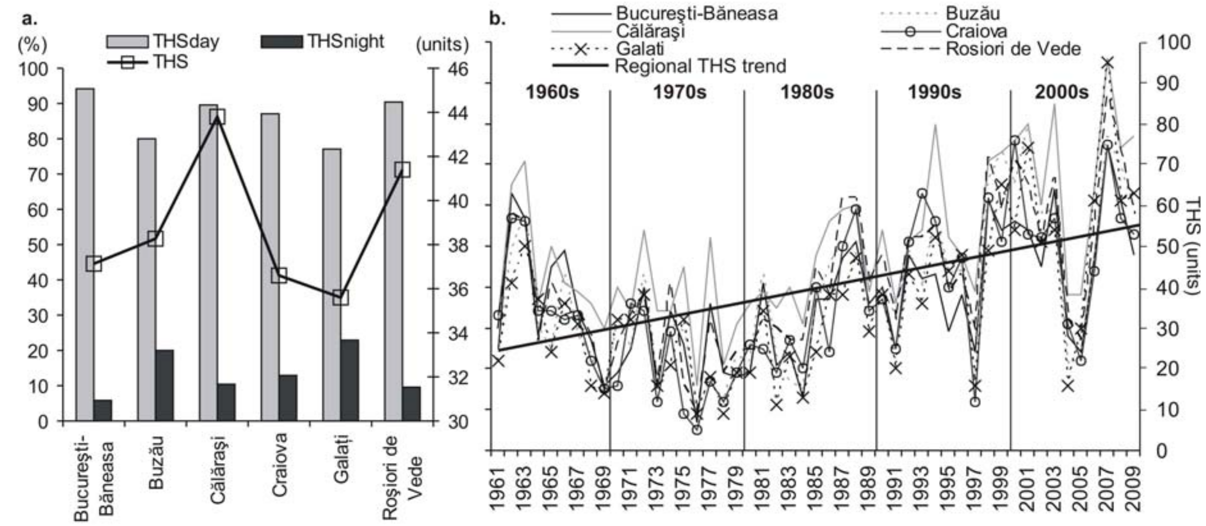

Fig. 2 – Average share of THSday and THSnight to the total THS (a) and the 49-year variability of the total THS (b).

4.2. The combined heat stress (CHT)

The combined heat stress index (CHT) is an exposure indicator of urban comunities to the heat summer thermal stress, which has been found to explain the spatial and temporal variance in excess mortality during the recent heat waves in Europe (EEA, 2012a).

The cities located in the Southern Romanian Plain display a considerable combined heat stress, similarly to those located in the plain and tableland regions of Central and Southern Europe, frequently exposed to persistent hot and dry summer airflows of North-African origins (e.g. the central and southern areas of the Iberic Peninsula, the Padan Plain, the Pannonian Plain). Southern Romania is particularly affected by hot days and tropical nights in summer. Consequently, the value range of the CHT across the region is rather small, showing a fairly similar heat stress exposure among the selected sites, under common large-scale circulation patterns: from 6.3 units at Bucureşti–Băneasa to 10.3 units at Galaţi and Buzău (Fig. 3a). The changes in the CHT evolution under current climate conditions are robust at all the sites and are particularly explained by a growing share of tropical nights at four out of the six sites. Along with, a slight expansion heat stress interval towards early autumn was observed in several years under the influence of some warm September months e.g. 1986–1987, 1994, 2008 (Fig. 3b).

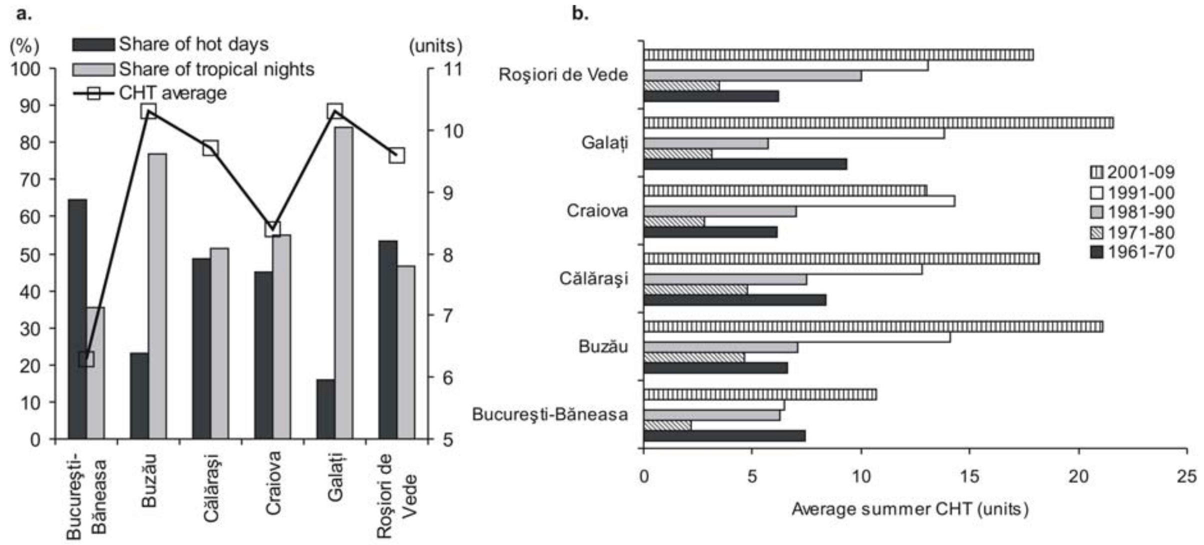

Fig. 3 – The share of hot days and tropical nights to the summer CHT (a) and its decennial variation (b).

The 21st century projections (IPCC A1B emission scenario), averaged from five Regional Climate Model simulations within the EU-ENSEMBLES project, indicate an ongoing increase of the CHT index (relative to the 1961–1990), implying a clear northward expansion of the affected regions (Fischer and Schär, 2010) (Fig. 4).

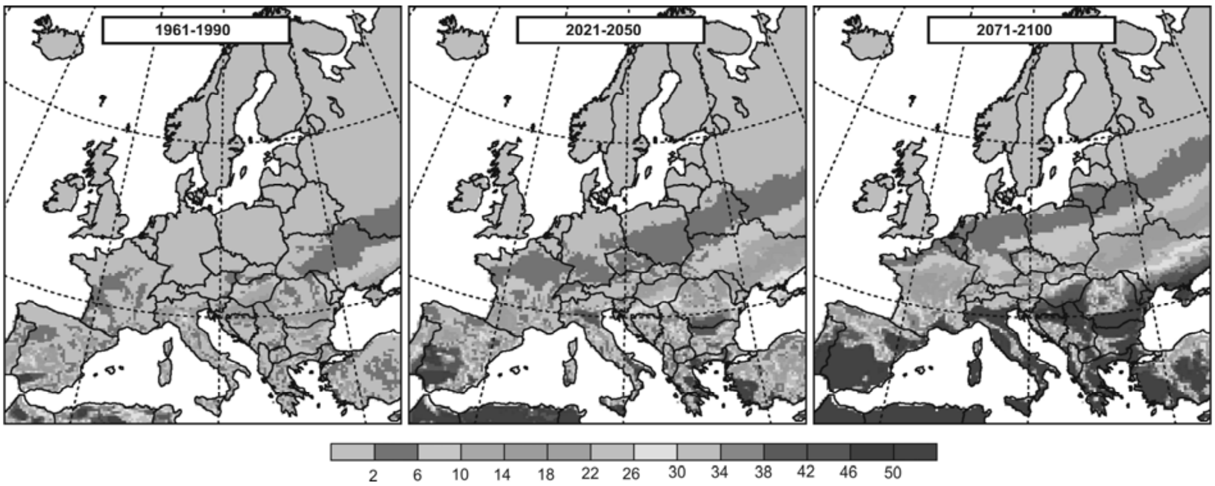

Fig. 4 – Projected CHT change over the 21st century in Europe (EEA, 2012).

4.3. Heat waves (HW)

There is a great concern for cities in warmer climates (e.g. hot summers in most European cities) due to an increased duration and severity of heat waves (EEA, 2012). In the study-region, heat waves are sporadic but highly recurrent and their frequency, duration and intensity are closely related to hot tail maximum temperatures of over 35°C. The cities particularly prone to frequent heat waves (>50 cases/period) are: Călăraşi (57), Roşiori de Vede (55) and Bucureşti–Băneasa (52), as for the rest of the cities, their frequency did not exceed 40 cases/period: Craiova (39), Buzău (33), Galați (26). There is a clear evidence of increasing frequency of these extremes in the region over the 1961–2009 period, from less than 10 cases/decade during the 1961–1990 interval to more than 10 cases in the 1991–2009 period (Fig. 5a).

The duration of an individual heat wave episode did not exceed 11 days across the region (July 1987 at Roşiori de Vede) and did not fall below 9 consecutive days in the rest of urban and suburban sites. On an annual average basis, the heat wave duration is rather low in the region (below 5 days), with a 70 to 90% probabilty in all the locations. The occurrence probability of heat wave durations of 6 to 10 days is up to 30%, while those of more than 10 days did not exceed 10%, providing evidence of hot and dry summer incidence (e.g. 1988, 2000, 2007). The evolution of decadal cummulated heat wave durations suggests a significant summer warming in all the surveyed cities, mostly visible in the last two decades of the 49-year period (Fig. 5b).

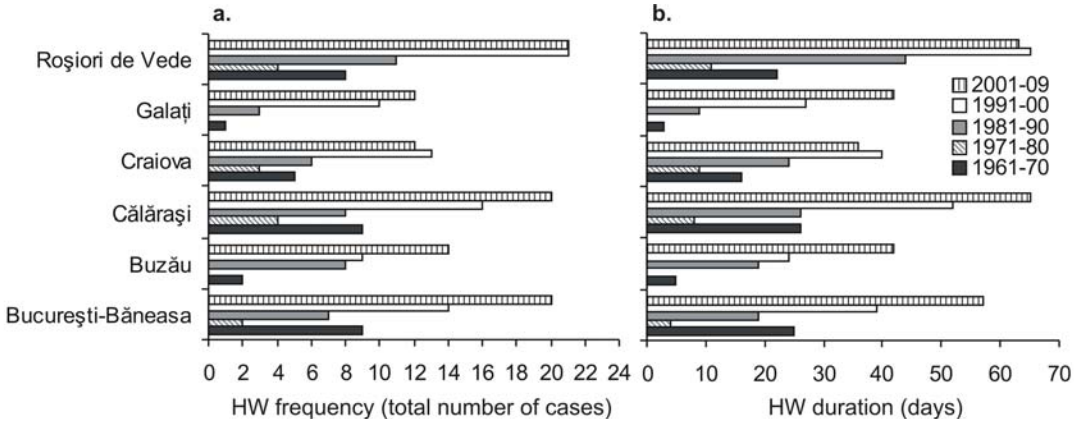

Fig. 5 – Decadal change in the cumulated frequency (a) and duration of heat waves (b).

The exposure to heat stress of the urban and suburban areas of the Romanian Plain Region is on an overall increase: at a rate of 5–7 days/decade of the annual duration of HW and of about 0.2–0.5 days/decade of the maximum length of individual HW (Fig. 6). These trends are highly statistically significant (for 5% to 0.1% levels). However, two out of the six selected urban areas appear to be the ones most exposed to more persistent HW under current climate conditions (Roşiori de Vede, Călăraşi).

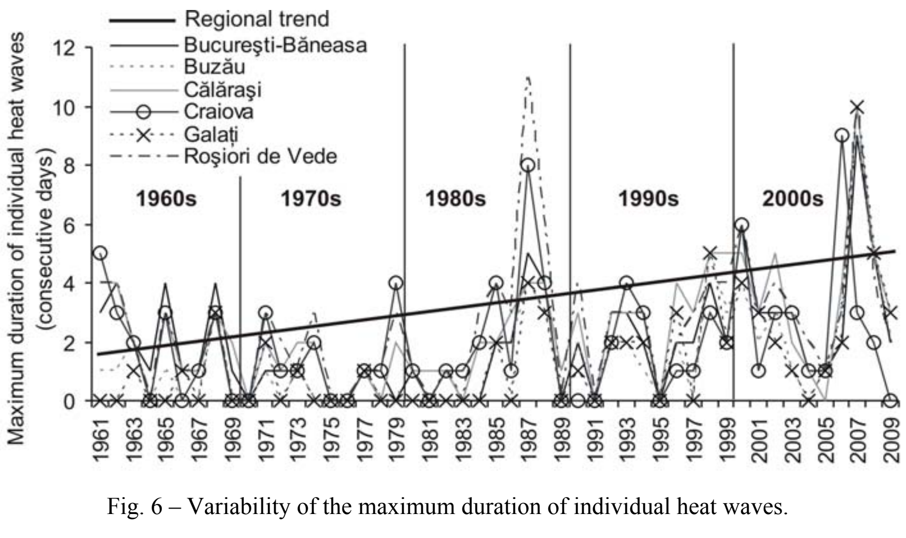

Fig. 6 – Variability of the maximum duration of individual heat waves.

These results are confident to those obtained by Busuioc *et al.* (2010), who emphasized similar variability patterns of these extremes across the country and a concentration of the most persistent heat wave episodes after 2000. However, the southern and eastern plain regions appear to be particularly exposed to such extremes, as they are showing the highest increasing rates in their duration, also to share common large-scale circulation causality. Georgescu *et al*. (2013) investigated the connections between the large-scale circulation patterns using the COST733 catalogue and heat waves and droughts recorded during the May–September interval after 2000, in Romania. Accordingly, the occurrence and persistence of hot temperatures and prolonged drought episodes in southern Romania is closely correlated to quasi-stationary high pressure circulation anomalies over South-Eastern Europe, with a strong southern circulation component. Ioniță *et al*. (2013) linked the the multi-decadal variability of summer temperature over Romania to the sea surface temperature anomalies associated to the Atlantic Multidecadal Oscillation (AMO).

The maximum intensities of heat waves were fitted in the Generalized Extreme Value (GEV) distribution in order to derive the return periods of their values. The highest magnitudes of the heat wave episodes were recorded in 2000 (Craiova 42.3°C and Bucureşti–Băneasa 42.2°C) and more widely in 2007 (Roşiori de Vede 42.7°C, Craiova 42.6°C, Galați 40.5°C, Buzău 40.3°C). The return periods of these events were of at least 30 years (Craiova 30.6 years, Buzău 36.3 years) and exceptionally over 120 years in a single location (Bucureşti–Băneasa 125.9 years) (Fig. 7a). Heat wave episodes of more than 40°C intensity had an occurrence probability of only 4 to 10% over the study period. The intensification of heat waves in southern Romania became highly visible after 1985–1988 (Fig. 7b), when over the study period of observations the magnitude of heat waves reached for the first time the 40°C threshold, which represents the now-casting maximum temperature threshold corresponding to the orange alert of the National Meteorological Administration (NMA). However, in 2007 (a maximum temperature record year for most weather stations in southern Romania), the magnitude of heat waves measured at Roşiori de Vede and Craiova stations was only 0.3–0.4°C lower than the NMA red alert threshold (43°C).

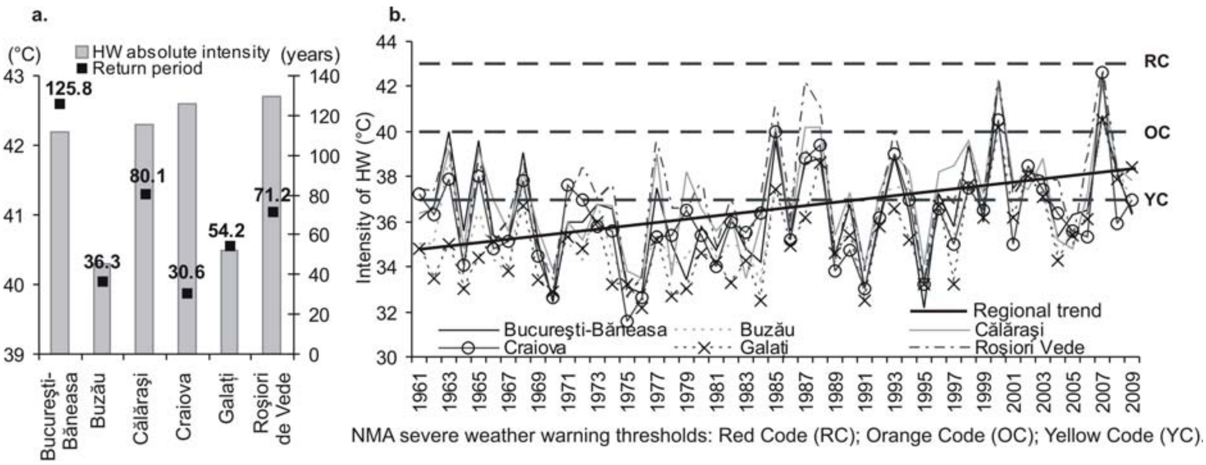

Fig. 7 – The absolute intensity of heat waves and the corresponding return periods (a) and the observed variability of heat wave intensity (b).

4.4. Cooling degree days (CDDs)

Rising peak energy demand in summer is an issue of particular concern for policy-makers, particularly in countries with significant summer peaking, where the awareness of cooling demand is already strong (e.g. the Mediterranean countries) (Aebischcher *et al*., 2007). The cooling-degree days index is a proxy for the energy demand for indoor cooling and for the magnitude of heat stress, as it is based on the external temperature directly affected by climate change. The observed increase in the number of hot days and heat waves resulted in an increase in the cooling demand in most southern European cities (EEA, 2012b) and a higher energy consumption, as cooling is delivered currently, almost exclusively through electricity. For such reasons, climate adaptation action in Europe uses weather-related derivatives, based on specific weather triggers (e.g. rainfall, temperature, number of heating or cooling degree days, soil humidity), as components of the overall risk management strategy (European Climate-Adapt Platform).

The regional average CDDs in summer is about 217, showing a variation range of 191 (Bucureşti–Băneasa) and 239 (Călăraşi). The share of summer to the overall cooling degree days in the selected urban areas is about 90.8%, while the contribution of extra-summer months (May and September) count up to 4.3% and 4.6%, respectively (Fig. 8a). Explicitly, the share of April and October is rather insignificant (below 0.5%), as their contribution to the overall annual CDDs is visible only in some warm spring (e.g. 1983, 1998, 2000) and autumn months (e.g. 1993, 1999, 2001).

In response to the recent temperature rise over the last two decades of the 49-year period analyzed, the summer CDDs is on a statistically significant increase (for 5% to 0.1% levels) at all the selected sites (Fig. 8b). Summer months are mostly responsible for the overall positive trend in the urban cooling demand, at rates of 26 to 34 CDDs/decade in most locations. The nearby local vegetation of the Bucureşti–Băneasa measurement site (consisting in forest vegetation and orchards) explains the lower values of the indicator, as well as the change rates in summer (16 CDDs/decade), still significant but only for the 10% level.

The projected temperature change, resulting from higher temperatures and heatwaves, are expected to affect human health and to entail a number of socio-economic and environmental impacts in cities across Europe, e.g. disturbancies in energy and water supply and transport services along with additional socio-economic challenges in summer such as failure of power transport networks, higher energy demand for cooling, failure of power supplies (Schauser *et al.*, 2010, EEA, 2008). However, indoor cooling (using air conditioning units) in highly-dense built-up urban areas, is not an option for outdoor activities during hot days or for low-income groups and is considered only a mid-term adaptation option to reduce heat exposure (WHO, 2009).

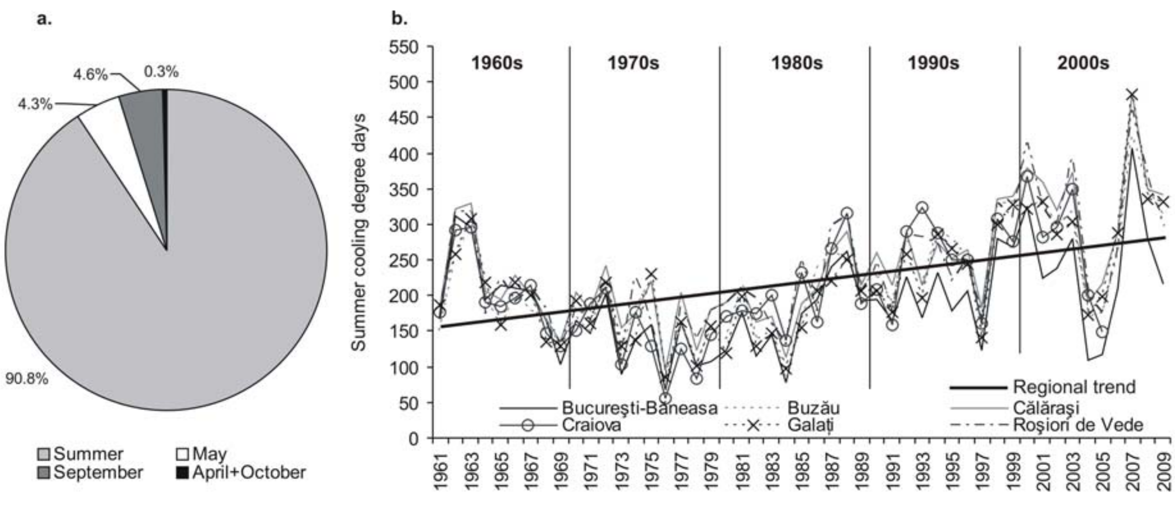

Fig. 8 – Share in the annual CDDs (a)
and the summer CDDs variability and trend (b).

5. CONCLUSIONS

The foregone analyses serve to emphasize the intensification of summer thermal heat stress in all the selected urban/suburban sites of southern Romania, in response to the behaviour of minimum and maximum temperature evolution in recent decades. However, some local city features proved to be more important than regional climate characteristics in sizing the heat stress exposure variation (e.g. the Bucureşti–Băneasa case).

Comparing the observed trends of the heat stress indices, the cities located in the Romanian Plain Region are tending to experience a strong increase in the frequency and persistence of hot summer weather, a fact also confirmed by changes in the upper extreme tails of PDFs of maximum temperatures. The mid-1980s marks a robust shift in the variability of the selected heat stress indices all over the study region, suggesting the beginning of a recent warming phase in most regions of Romania (as confirmed by Busuioc *et al*., 2010).

The results suggest that the cities selected for this analysis are clustered in a wider region sensitive to heat impact including the southern and south-eastern parts of the Romanian teritorry, which also shares similar variability patterns of summer temperature with many urban areas located in some South European countries (e.g. Spain, Italy, Bulgaria, Greece). The recent extreme temperature change patterns in summer explain the visible rise in the frequency of hot tropical days by the end of the period (above 30° and even 35°C) after 1981–1985. The differences between the average and maximum frequency of hot nights before 1980 and after 1981 is of 12–17 days and up to 34 days, respectively, regardless of the urban and periurban local settings. Combining the day- and night-time tropical heat stress (THS index), Roşiori de Vede, Buzău, Galați şi Călăraşi appear to be the most affected, as the THS increase is highly significant over the period (0.1% level). The consecutive occurrence of canicular days and hot nights has been found to explain the spatial and temporal variability of heat stress during the persistent warm airflows of tropical origin (North-African). The change signals of the combined heat stress effect of tropical nights and hot days (CHT index) are significant for all the selected urban and suburban areas of the Romanian Plain Region and they are perceptible after 1985. There is a strong evidence from the EU-ENSEMBLE projections (A1B SRES scenario) that in the study region, as well as in the limitrophe northern regions (e.g. the Subcarpathian sector) the heat stress impact will be further amplified by the end of the 21st century, considering the changes in the CHT index value range and expected heat wave occurrences.

The heatwave episodes recorded in recent decades (particularly in 2000 and 2007 years) in the study region were among the most severe ones, determining prolongued intervals of hot temperatures and extremely high intensity peaks (30 to 125 year return periods). The Călăraşi, Roşiori de Vede and Bucureşti–Băneasa sites appear to be the ones most frequently affected by this phenomena (above 50 case/period). After 1985–1988, the severity of heat waves has visibly increased, reaching and exceeding the 40°C threshold (the NMA orange alert level) and even spreading, in some locations (Roşiori de Vede and Craiova), towards the NMA red alert code threshold of 43°C by the end of the study period (in 2007).

In response to the recent temperature rise observed in the second half of the 49-year period, the summer cooling need is on a significant increase (for 5 to 0.1% levels) in all the selected cities. An expansion of the cooling interval towards the late spring (May) and early autumn months (September) was also observed in the region, in response to the higher occurrence probability of hot summer temperatures and heat waves after 1985–1990.

Considering the model results concerning the mid-term and long-term temperature projections for Europe and Romania, the human population living in the Romanian Plain Region (in urban, suburban and rural environments) is expected to become more sensitive to the summer temperatures increase of over 4°C (on average). Most cities located in southern Romania are likely to grow more vulnerable to heat stress impact as heat waves and hot summer days are projected to occur with greater frequency by the end of the 21st century.

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THEORETICAL FRAMEWORK FOR THE SELECTION OF SOCIAL INDICATORS CHARACTERISING REGIONAL DISPARITIES*

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Key-words: social regional disparities, theoretical framework, indicators.

Abstract. Identification and measurement of regional disparities is the decisive factor in solving the perceived disparities between regions. The key task here is the selection of correct and relevant indicators in terms of the final aim. The main goal of the article is, with emphasis on the broader theoretical and systemic salient points for the selection of indicators, to present basic and most frequently used indicators for the assessment of social regional disparities. The knowledge of the relevant indicators of social, socio-pathological and socio-demographic nature, based on general analysis of the differentiated aspects, attributes and statement value to research are presented. The paper is focused on the presentation of individual indicators, their contents, broader aspects and implications as far as the subject of analysis is concerned, their assets, drawbacks and possible modifications.

1. INTRODUCTION

Like in other post-communist countries of Central Europe (the Czech Republic, Hungary and Poland), social regional disparities in Slovakia became evident in the 1990s in consequence of the political and economic situation, which exposed until then disguised low living standard of part of the population on one side, and brought about some new phenomena which caused poverty (unemployment, increase of economic, social and income inequalities) on the other. The principal reforms in five key areas (tax system, education, health care, public administration and social security) also contributed to the negative social consequences for certain population groups, some of them being more vulnerable than others. In spite of positive changes in many ambits of society's development on national and international level, numerous problems, above all in the socio-economic sphere, emerged, the depth of which was not expected and which concern many of the inhabitants of these countries in their everyday life. The gradual diversification of the socio-economic situation in these coutries caused not only distinct changes in the stratification of society, but also an increase of social regional disparities. Naturally, there are some national specifications, but the basic trends are generally the same in all these countries.

The identification and measurement of regional disparities (hereafter RDs) is a decisive factor for the solution of perceived disparities between regions. The selection of indicators for the identification and measurement of RDs is the key role of its research. However, a successful solution of this task is complicated by uncertainties connected with different approaches and contradictory trends. The EU Member states apply a scale of different ways and methods of RD identification and gauging (OECD 2003). The issue of gauging regional cohesion in the EU runs into the problem of a correct choice of indicators. There are several ways to approach indicators and their definitions (Brüngger 2004). Indicators are statistical variables, which facilitate the transformation of data into relevant information. They are important for the definition of conceptual systems and serve to specific analytical purposes. Since social regional disparities concern life quality, the rank among dominant regional disparities. They reflect different forms of disparities and result from the distinct economic conditions of regions.

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They are expressed by inequalities in the socio-economic and socio-demographic status of population, living standard, infrastructure and amenities, level of household equipment and the dimension expressed by socio-pathological parameters. At present, the indicators of social (specifically socio-demographic and socio-pathological) nature are among the frequently used indicators gauging the social level and depth of RDs. A correct selection of indicators depends on many factors: the aim and purpose of the analysis, territorial scale and specificities, the value of indicators and possibilities of their evaluation. The selection of indicators of social regional disparities is often affected by various problems relating to information sources and statistical data. Officially monitored social indicators do not always truly reflect and capture the relevant aspects of RDs; they are often inaccessible and their value, reliability and comparability are not always satisfactory. Problems of their spatial interpretation, or the fact, that the data are not on the required geographical scale, can also emerge. The paper, apart from the theoretical and systemic circumstances of the selection of indicators and gauging of regional disparities, also concentrates on the description and assessment of their suitability or modification, especially regarding some specific conditions in the socio-economic development of society in Slovakia. The aim of the paper is to emphasize the broader theoretical background and empirical knowledge and to present basic and most frequently applied indicators of assessing social RDs relying on the basic systemic classification of regional disparities. This aim also requires the identification of their pros and cons, nuances and modifications in the light of the spatial specificities characterizing post-communist countries in Central Europe.

2. THEORETICAL AND SYSTEMIC BACKGROUND OF A CORRECT SELECTION OF SOCIAL INDICATORS CHARACTERIZING RDS

The basic attributes of RDs also include the sphere of their occurrence, territoriality (geographical levels), their measurability and time dimension. The multidimensional level of investigation of RDs characterizes the following attributes; they present a wide spectrum of views of RDs and produce systemic salient points for understanding and approaching, their research. From a geographical point of view, the territorial aspect associated with both the vertical and horizontal classification of RDs is interesting. Vertical classification estimates disparities in geographical units of different size (world, Europe, state, region or municipality). The aspect leans on the knowledge that disparities change in accord with the geographical scale. Disparities, as a rule, increase with the diminishing territorial scale. It means that a different rate and different view of the observed disparity level is obtained from different territorial scales. The horizontal classification of disparities is connected with the subject-matter sphere of their occurrence. The horizontal aspect normally draws on two classifications, depending of their substance, namely material or non-material, and if the sphere of occurrence in a territory is taken into account they are territorial (physical), economic, and social (Wishlade, Yuill 1997).

The authors of this paper focus on social disparities, which are considered to be the most significant (Dunford 2009, Michálek 2010), because they are outputs of the economic development and they directly reflect the living conditions of the population and social climate in regional societies. Regional social disparities manifest themselves in a wide spectre of phenomena and processes that can be measured and evaluated (Michálek 2012a). Such measurement and evaluation must rely on the selection of correct indicators. They are significant in the framework of the defined conceptual systems and the applied methods and they serve specific analytical purposes (Michálek 2012b). A suitable choice depends on the aim of the particular analysis, territorial scale specificities and weight of indicators, etc. Social indicators as tools helping to observe the nature and level of social phenomena and processes, development, change and trends should also be analytical, penetrating the substance of the phenomenon, significant and comprehensible (clear, brief and simple), comprehensive (covering the whole statistical unit or geographical region), trustworthy (low statistical error), inherently comparable (comparison of the same indicator for subgroups), and comparable in time.

They should be simultaneously accessible in terms of existing data, fluent in terms of introducing a temporal order, i.e. identical regarding the reference period and modifiable regarding spatial specificities. The choice of indicators for the identification of social RDs and descriptors obviously plays an important role in the nature of final results, their explanation and an overall view of the issue. The basic material applied to the choice of indicators was the European System of Social Indicators, as a methodological tool for gauging the social status of a community (Noll 2002). The System applies six relevant theoretical social concepts: welfare, quality of live, social quality, liveability, social cohesion, and sustainability. In the EU, stress is laid upon the policy of social cohesion and inclusion. The indicators of these dimensions are the most prioritised, elaborated and most closely watched over. Conclusions of scientific and political discussions show that two relevant dimensions exist in the framework of the social cohesion policy and its aims. Firstly, there is the dimension of Inequalities with the corresponding aim to reduce disparities, inequity in opportunities and social exclusion. Secondly, there is the dimension of Social Capital which involves the strengthening of social contacts, interactions and bonds (Berger-Schmitt 2000, 2002).

The quoted principles and criteria for the formulation of indicators, adopted from the theoretical and systemic spheres or empirics were observed while generating and selecting the indicators for the identification of regional social disparities in Slovakia, as an example. It is also important and necessary to integrate (merge) the basic indicators into homogeneous, acceptable for the system and logical groups. The integration of indicators is possible by applying different methods. Correctly integrated indicators represent homogeneous wholes, such as labour status, social status or health condition.

Individual indicators of regional social disparities should reflect the most significant aspects of the social climate in regional communities, relevant demographic as well as socio-pathological characteristics in the studied regional units. While considering candidate indicators, one must bear in mind that they have been determined by the socio-economic development after 1990 and the basic circumstances it implied. The economic transition and the associated reforms brought about some deep changes in the demographic social and socio-pathological area. New phenomena, processes and tendencies appeared along with new conditions in the population's life, increased inequalities becoming the features of economic development. In a short period of time, a series of phenomena which had not been here before, like unemployment, cohabitation would soon emerge, while others (crime) or tabooed (poverty) were repressed. Socio-demographic disparities include the ones determined by economic conditions and inequities. They are the disparities connected with the labour market and with demographically relevant population characteristics and structure. Individual indicators of socio-demographic regional disparities should reflect the most important aspects of social climate in regional societies and relevant demographic characteristics of population in the regional units studied. The labour market and the demographic phenomena are among the most important dimensions affecting the level of social disparities and their fluctuation, because they are simultaneously controlling many other phenomena and processes nationwide (Michálek, Podolák 2011).

3. CONTEXT AND DESCRIPTION OF RD INDICATORS DETERMINED BY THE LABOUR MARKET

The situation in the labour market is one of the most important factors controlling the level of social disparities. It seems that the most important indicators, in terms of relevance and data accessibility, are those associated with unemployment. Slovakia experienced the emergence and dramatic increase of unemployment already in the early 1990s and it has remained the most important problem of the country's economy, as Slovakia is now one of the EU countries with the highest unemployment rate. The unemployment rate is a symptom of economic prosperity of a region, it has an impact on the income and situation of individuals and points to the rate of social disparities. Unemployment, especially long-term, is a great problem not only of the labour market, but also of regions. Several stressors are connected with unemployment, more or less directly related to the economic, territorial, social and personal life. Long-term unemployment affects selected aspects of the population, such as quality of life, poverty, and increased incidence of socio-pathological phenomena in affected regions. A high spatial concentration and incidence of regions where the population cannot find jobs is characteristic of Slovakia since 1990s. These are the regions where more than a third of the available population is not economically active.

An important indicator connected with the labour market pointing at disparities is wage. Although its share in a household income decreases, it is still an important factor that sets the rate of disparities between economically active persons. Real wages distinctly dropped at the beginning of transition, influenced by economic reforms and lagged behind inflation. Low wages (price of labour) on one side has increased the presence of foreign investors in the country, but it also led to the pauperisation of a considerable part of the population. At present, wages are one of the most obvious forms of inequalities, the cause of increasing discontent in some regions. Increasing wage inequity and very low wages in some regions make people refuse working, hence further increase of the unemployment rate (sometimes it pays better not to work and live on unemployment benefits), part of the economically active population remains idle or goes abroad. Demotivation via wages hinders the development of a region. The optimal combination of wages and the rate of wages inequity is an important factor that may influence the satisfaction of population in terms of consumption. Regions with a low level of wages are often hit by negative phenomena, such as social dependency, low purchasing power, poverty, social exclusion, emergence of subcultures, etc. Apart from macroeconomic effects (economic level and options of development), wages and labour price in Slovakia, the possibilities and conditions of employers are also controlled by individual factors which, in turn, depend on efforts, education, capacities and the options of individuals participating (competing) in the labour market. Obviously, lack of certain skills leads to increased demand and increases the level of wages. Higher education, qualifications and skills may in some circumstance lead to the reduction of wage disparity (if the concerned individuals are working in regions where they reside).

Unemployment and/or low wages determine and directly affect the number/proportion of individuals suffering from material poverty, which is an important indicator of the socio-economic level of a region. The growth of the economy and of work productivity in Slovakia increased the State's income, which might have led, apart from others, to lowering the proportion of individuals in material poverty[2] not only on national but also regional level. The EU policy of eliminating poverty and supporting social inclusion has also been targeting regions with a high proportion of people in material poverty. On the other side, the above-mentioned high unemployment level, big investments in the economy, non-paying management and "wild" privatisation in the 1990s, followed by retrenchment in time of the rightist reforms, did not reduce the socially dependent population group. It even became another impulse that increased social disparities in regions with low educational and working potential.

4. CONTEXT AND DESCRIPTION OF SOCIO-PATHOLOGICAL INDICATORS OF RDS

Socio-pathological disparities are those produced by the negative impact of the historic transition and reform, of new, often misinterpreted, options of freedom and democracy. Individual indicators of socio-pathological disparities between regions should reflect the undesirable negative aspects of such disparities. The increase of inequalities in all the spheres of economic and social life has manifested

[2] "Material poverty is the status when the citizen's or physical persons' income is lower than the living minimum pursuant the special provision and the citizen and physical persons considered along with the citizen cannot obtain or increase the income by proper efforts. The material poverty benefit pertains to a citizen suffering from material poverty and physical persons considered along the citizen for provision of basic living conditions" (Ministry of Labour, Social Affairs and Family of the Slovak Republic 2013).

itself through social exclusion and poverty of comparatively large groups of population. Lack of finances and material resources on the side of potential perpetrators and increased "opportunities" in a richer society with privileged groups along with the increase of social disorganization, gaps in legislation and other factors, contributed to the increase and concentration of crime. Lack of financial and other sources, failure to participate in the labour market, deficient or no social inclusion, weakened both formal and informal social control have led to various anomalies in some regions. They manifested themselves in increased morbidity (cardiovascular diseases, cancer and especially increased occurrence of psychic disorders). Among the most conspicuous factors that influence the level of socio-pathological disparities are the phenomena connected with social exclusion (poverty) and with safety (crime).

Poverty is the attribute and cause of social exclusion and simultaneously the factor determining the level of social disparity. Already at the beginning of the 1990s increase of poverty in Slovakia became evident. Some regions of the country belong to the poorest of Europe even today. It is a "new" poverty, which is closely connected with the labour market. High unemployment and low level of wages is typical of poor regions. These are accompanied by underdevelopment, poor human potential in terms of qualifications and skills, experience and demographic parameters including population structure. Poverty is inherited here and the majority of inhabitants, who do not move on, are trapped. The level of poverty in regions is an indicator *par excellence* of social (socio-pathological inequalities) in Slovakia. Poverty indicators in this county are most frequently represented by all poverty indicators capturing the essential attributes of poverty or of a wide spectre of deprivations.

Crime in Slovakia reflects the socio-political, socio-economic and historic-cultural development plus the dramatic changes after 1989. Economic problems connected with the transition and reforms (unemployment and its increase, loss or reduction of social guarantees, existential problems and drop of the living standard, etc.) pressure a considerable part of the population while some of them infringe legal standards. Among the consequences of abrupt social changes, social self-control has been weakened, value orientation confused, aggression increased, first of all in the marginalized population groups, increasing violent crime. The opening of frontiers made Slovakia became a crossroads for drug traffic and drug market. Some new forms of crime, which require not only material and technological preparedness, but also international cooperation did emerge. The period that followed 1989, is characterised by a distinct increase of crime, only its quantity (volume) but also its quality (structure, methods and composition of perpetrators, etc.) changed. New possibilities of drawing on various funds and sources from international programmes, aiming at the restraint and suppression of crime in risk regions and localities, opened up when Slovakia accessed the EU. Conditions for the reduction of regional disparities in the level of crime were created along with allotted finances. The outlined trend should also show, apart from reduced criminality, in reduced RDs in terms of crime[3].

5. CRITERIA FOR THE SELECTION OF DEMOGRAPHIC INDICATORS

The demographic dimension, especially the basic demographic characteristics that have considerably changed after 1990, is an equally important factor of RDs. "New" demographic characteristics (phenomena, processes and tendencies), which appeared and comparatively rapidly spread in recent years, influencing different aspects of the social development in regions, deserve a special attention.

The population of Slovakia has reached another stage of long-term demographic development characterized by a distinct shift in the values of individual indicators of its development and structure. These changes are to a great extent influenced by the power and rate of socio-economic development

[3] Some specific types of crime may be and probably are spatially concentrated due to global development and local conditions.

at country regional level. Demographic development became more varied. Models followed by population for decades, which boasted a clearly established order of individual demographic events (education – marriage – fertility – economic activity, etc.) changed into highly complicated individual life courses, where it is often problematic to generalise and estimate the sequence of individual steps. They are influenced by the different preferences of citizens in different stages of their lives. In this way, the development of individual demographic indicators is much more varied and influenced by a wide spectre of socio-economic and psychological conditions. It is appropriate to consider the following clusters of problems that reflect the changed socio-economic conditions and their development while selecting relevant indicators of social disparities in Slovakia:

- Changed models of family and reproductive behaviour, which influence the indicators of marriage, divorce, fertility and natality rates.
- Development of mortality rate and health condition in the population, which affects the specific and standardized indicators of mortality rate and consequently (along with other impacts) the age-structure of the population.
- Changed models of migration behaviour influencing (beside others) the development of regional social disparities in Slovakia.

All quoted changes in Slovakia possess not only the temporal, but also the spatial dimension and in this sense it is justified to monitor their manifestations in the regional context via several indicators. The following indicators were selected from the point of view of relevance and accessibility of reliable data; each of them captures and expresses the relevant aspect of population as a carrier of social disparity:

6. CONTEXT AND DESCRIPTION OF INDICATORS OF FAMILY BEHAVIOUR AND REPRODUCTIVE BEHAVIOUR

The change of models of the population's family behaviour depends on many more demographic implications connected with increasing individualism and diminishing uniformity of an individual's life course as far as the temporal sequence of individual steps and ways are considered. Apart from demographic agents, there are also others that contribute to the abrupt changes in the population's demographic behaviour. Apart from material factors, an overall social climate, which reflects the attitude of the population to reproduction and can, in certain circumstances, increase/reduce the prestige of family and child, plays an important role in demographic developments. These facts that characterize reproductive behaviour and indexes both qualitatively and quantitatively, find their reflection in models. The distinct change of family behaviour models is all-European in nature, these tendencies having first appeared in some western and northern European countries several decades ago, while in Slovakia this happened in the 1990s. This trend manifests itself by an increasing tendency to other than marital forms of coexistence – cohabitations (increasing number of single males and females as a consequence of low or decreasing marriage rate), increased age of partners entering into marriage, and that of parents at the birth of the first child. The process is also accompanied by increased extra-marital fertility and proportion of babies born outside wedlock and increasing proportion of such babies in the overall number of born children.

The rate of extramarital fertility is an important indicator in the context of research into social disparity. The distinct increase of extramarital fertility values is one of the basic manifestations of the changed reproduction pattern of the entire population. It is evident that these manifestations are socially and regionally differentiated in the two groups of women accounting for the trend. On one side, extramarital fertility is connected with young women with low education and income levels and to the Roma women (Šprocha 2007). High extramarital fertility became the synonym of marginality and social exclusion. The second social group consists of women with medium level and university education. Although in absolute values they are not a dominant group, yet the highest increase of this indicator was observed precisely in this group. This development is connected with the fact that the institution of marriage is losing its significance and the alternative forms of partnership are becoming popular. This is the reason why observation of the extramarital fertility indicator is relevant for the research of social disparities. Some additional indicators are fertility and natality rates (in the context of a difficult social situation for large families), marriage indexes (namely on the decrease), increasing number and rate of divorce (in the context of a difficult social situation for single or large families).

7. CONTEXT AND DESCRIPTION OF INDICATORS OF THE POPULATION DEATH RATE AND HEALTH CONDITION

Indicators of average life expectancy also have a high statement value. It is the most frequently used global characteristic for evaluating death rate. Given the differentiation of death rate in males and females, individual values are quoted separately. The evaluation of the whole population is subject to high degree of generalization and it is applied in international comparisons where there are no data from some developing countries are available.

The most frequently used indicator is average life expectancy (ALE) at birth (of males and females), it revealing the mortality rate in the whole population. When interpreting the values, one must bear in mind that specific death-rate values in individual age-categories differ and are inherent to the level of average life expectancy at birth. The statistical increase of ALE values in Slovakia is secured by the dominantly positive development in infant (below 1 year of age) mortality rate and less so by higher life expectancy in our population (statistical probability of survival) even in senior age categories. The analysis of ALE values at the age of 50+ (or 65+, 80+) may provide a more detailed picture, as it takes into account the mortality situation (or its development) only within the framework of specified age categories and is meaningful in evaluating the population's ageing processes, their regional differentiation and social consequences (Jurčová and Mészáros 2010).

A suitable indicator, which combines the benefits both of objective and subjective identification of the population's mortality rate and health condition, is the health-adjusted life expectancy (Rychtaříková 2006). A certain drawback of this indicator in Slovakia is that regional comparison can be made only on the NUTS 2 level (Mészáros 2010). It can be expected though that after an appropriate recording system of the population's health condition established it will be possible to exploit this characteristic for comparisons on the lower regional level as well, just like they do in the economically developed countries of northern and western Europe.

Regarding the high rate of regional differentiation in terms of population number it is appropriate to use standardized mortality rates (overall mortality and that caused by selected diseases), which partially compensate the biggest differences. The statistical results reached can be considered more relevant than gross mortality rates. The highly revealing indicator, which also reflects the social situation on the regional level, is the standardized rate of reversible mortality. This method is based on observation of selected death causes that led to premature deaths (Burcin and Mészáros 2008, Newey 2004). Such diseases can be cured by therapeutic or preventive methods (for example appendicitis) or death can be postponed (hypertension therapy), or they can be avoided by preventive measures (giving up smoking, alcohol abuse, and changing the diet). Accretion of indicator, in this case standardized death rate, measuring mortality rate due to the above-mentioned causes, can point to the poor quality of health care, or poor preventive measures or their deficient adoption by certain population groups. The standardized rate of reversible mortality represents a very suitable indicator of the role of health care (both from the view point of the provider and the beneficiary) reflecting in regional differentiation.

The infant mortality rate can here be used as a supplementary indicator. Although the values of this indicator are dropping in the majority of regions, there are still several “extreme” regions where infant mortality values are increasing. The phenomenon is closely connected with the social situation in some parts of Slovakia (regional aspect) or with some social groups (vertical stratification of society). The result of reproductive behaviour, the mortality situation and health condition of the population in combination with the rate of migration in a particular region is the population’s age structure. Routinely used characteristics in the analysis of age-structure are various age indexes which correlate with individual age groups, for example: the economic burden, the Billeter index, the dependency of elderly population index, mean age index, etc. The population group in the post-productive age is given increasing attention in the context of accelerated ageing of the population and its social consequences. This is justified in view of the increasing absolute figures and relative representation of the elderly and their generally acknowledged unfavourable social situation. Usually the oldest age-categories are associated with the need for special care, social or family support. As State-provided social care in Slovakia (compared with the advanced European countries) is distinctly inferior, the oldest citizens are often wholly dependent on the care of their families. From the socio-demographic point of view, the significance of the potential social support index (Dlugosz and Kurek 2009, Káčerová *et al*. 2012) is obvious. With respect to certain demographic trends and demographic parameters of the population in Slovakia, it is useful to use the age-limit of 80 years in relation to the 50–64 age population group (the category that very often takes care of their parents).

One of the most important determinants of population’s development in terms of socio-demographic aspects is education with effects in all spheres and areas of social life. It is kind of a cross-sectional indicator interacting with other indicators of demographic behaviour both on the level of prevention and consequences. Incomplete or insufficient education limits not only options in the labour market, but also a responsible approach to life; it deteriorates living conditions, increases social risks and eventually deteriorates the individual’s health condition. Probably the greatest impact on the social aspects of human life is given by the boundary between elementary and secondary education. The more pupils continue their education at secondary schools concluded by examinations, the better the chances of a socially secure population. This is the reason why it is appropriate to use some education indexes, such as proportion of population with completed elementary education, proportion of university graduates, etc. when analysing regional social disparities.

8. CONTEXT AND DESCRIPTION OF THE POPULATION’S SPATIAL MOVEMENT INDICATORS

The spatial movement of population is another important component of regional development. The analysis of individual components of the population’s spatial movement trends, implications and interaction with other areas of life in society, population groups and individuals, is an inseparable part of the geographical, social and demographic research of regional disparities. The population’s spatial movement indicators can also point to the attractiveness of some territorial units. In the population’s spatial movement, interactions occur between a number of social-economic, demographic, psychological and ecological conditions on one side and the actively/passively behaving subjects, on the other. Citizens try to improve their social situation by migration, but it should be borne in mind that the socially weakest ones usually cannot even pay for moving to prospering towns. In the context of spatial disparities it is appropriate to concentrate on the following indicators:

One of the basic values of migration statistics, i.e. net migration (migration balance) is an appropriate indicator of the effect migration exerts on the population increase in regions. An extra simple construction and accessibility of data are the obvious benefits of this indicator. On the other side, the population imbalance in individual regions of the country may pose a problem no matter whether it is the case of statistical districts or functional urban regions (Bezák 2011). Elevated heterogeneity of population number may lead to the situation when even the very low absolute migration increase in the region with a small population number will reflect in extremely high values of the net migration rate. In contrast, a big migration movement may manifest itself as a relatively very low increase, given that it is relativized by the high population number in a particular region.

One of the possible and often described ways of expressing in greater detail the effect of migration on population distribution is the efficiency rates (for example Plane 1984, Podolák 1995, 2006, Blake *et al*. 2000). The migration efficiency rate can be used in the basic form or modified when only migration flows in a closed system are considered – in Slovak conditions, for example, excluding international migration. Such an approach is justified in some analyses. The use of migration efficiency rate is suitable if the position (differentiation) of regions within a closed system is considered, for instance characteristics of inter-regional migration trends in Slovakia. If migration efficiency is researched within a closed system (without taking into account international migrations) the value of results within the framework of the selected system is of a compact nature. The summarized characteristics of efficiency rates (such as dispersion, standard deviation and total net migration rate) facilitate the analysis and assessment of the level of regional differentiation and its development in the particular migration system (Bezák 2006). The characteristics of migration efficiency complement the basic indicator of migration change on the level of individual regions and make it possible to characterize spatial links and dynamics in the development of social disparity.

9. CONCLUSIONS

The issue of disparities, their identification and assessment is closely related to the selection of indicators, which lack the generally defined criteria. The representativeness and capacity to capture variability are of crucial significance for the selection of indicators (Kutscherauer *et al*. 2011). Integrated indicators that are able to capture and identify the rate of interregional differences and to provide relevant and comprehensive information seem to be practical and advantageous. The situation and options of choice of socio-demographic and socio-pathological relevant indicators were researched based on theoretical and systemic approaches, empirical knowledge and general analysis of attributes and statement value of differentiated aspects. Their relevance, aspects and relations to the object of the analysis (social disparities and their identification) value, benefits, drawbacks and nuances were studied in a broader context regarding some specific conditions of Slovakia. Several indicators capable of capturing and expressing the crucial aspects of social disparities were selected. Simultaneously, the context of indicators, which is an important part of the selection for a particular analysis is presented. The assumption that an indicator contains a number of inherent attributes, which emerge only under deeper scrutiny, was confirmed. This fact points to the significance of their detailed analysis as an indispensable condition for gauging (social) regional disparities. The demonstrated analysis of selected relevant indicators for the monitoring of social RDs could represent a sort of guideline for the selection of appropriate indicators necessary for the acquisition of exact results, identification, and measurement of social RDs.

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CROSS-BORDER CO-OPERATION EUROREGIONS IN THE ROMANIAN DANUBE BORDER-ZONE[1]

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Key-words: cross-border co-operation Euroregions, doublet settlements, Danube, Romania.

Abstract. Since several transversal issues have been cropping up, the need was felt for a unitary system to tackle them. So, the building of some cross-border co-operation structures both at local level (cross-border zones) and at regional level (cross-border Euroregions) appeared as highly necessary and desirable. Their typology depends on the intensity and character of cross-border fluxes, the existence of local convergence cores, and of elements of complementariness and homogeneity between the frontier spaces. The Danube-lined Romanian frontier represents an axis of discontinuity between natural regions, each with its own distinct traits. As a result, the limitrophe border zone shows particular social and economic characteristics. Although the Danube River has favoured the emergence of an urban area, yet the respective towns do not form a coherent system, the zone itself being extremely rural as a whole. The Romanian cross-border zone in the Danube sector features by a sudden variation in transversal fluxes, concentrating on certain directions imposed by the pattern of communication routes and the layout of doublet towns.

1. INTRODUCTION

The contradiction between the institutional division of the territory and the existence of cross-border issues that asked for a unitary approach and consequently cross-border co-operation led to the appearance of new types of regional co-operation structures which coincide with state-frontiers: cross-border co-operation euroregions. This kind of co-operation should take into consideration the fact that between the cross-border zones there is a strip of frontier and, there are different legislations with distinct requirements of the co-operation framework. Consequently, *breaking up the process* represents the main threat to cross-border regions; if this process is not properly co-ordinated at central level, there is the risk of loosing control, the cross-border region gravitating towards one of the co-participant states.

The issues that fuel cross-border dynamics are part of the level of harmonization of the policy for the development of cross-border zones that come into contact. The areas situated on each side of the border have, or have not, the tendency to evolve in the same way, as a result of central and local policy, but also of specific local situations.

The separation caused by hydrographical systems has led to the individualization of some transversal fluxes concentration cores, as a result of favourable local topographic conditions. Thus, the presence of crossing fords has led to the concentration of population on both banks and gradually doublet settlements would appear, with local or even regional polarization role. In time, the cores of cross-border demographic concentration have acted as Euroregion' embryos through the extension of a low border traffic at macro-territorial scale based on the existing relationships within the settlement systems of conterminous administrative-territorial units.

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This is also the case of the cross-border zone in the Romanian Danube sector; throughout the centuries, the river was both an important axis of structuring transversal fluxes and the main navigation thoroughfare, which favoured longitudinal fluxes between Central Europe and the Black Sea Basin. Its presence generated a real "urban belt" in the southern part of this country, contributing to the development of a specific economic activity, thereby increasing the polarization potential of port towns. The latter is closely related to connecting harbours to the land transport system, and to some towns acting as customs points (Fig. 1).

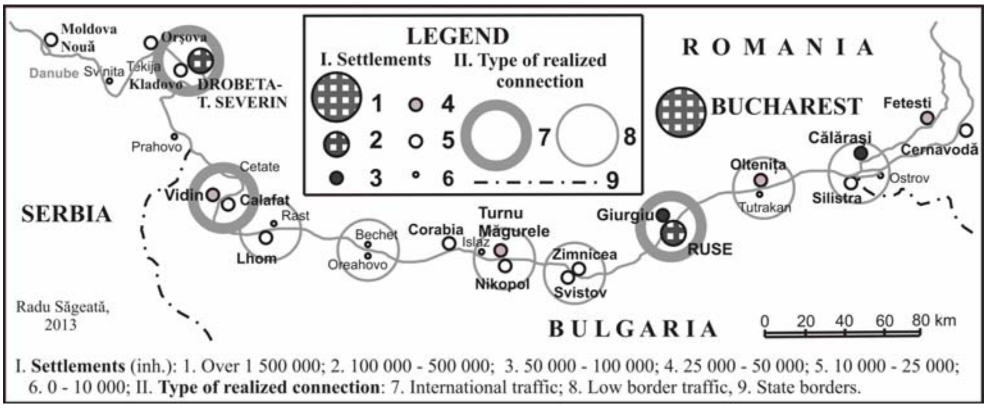

Fig. 1 – The doublet settlements within the Danube-lined sector of the Romanian border and categories of connections materialized through them.

2. THE HISTORICAL CONTEXT AFTER THE SECOND WORLD WAR

After the Second World War, the Romanian Sector of the Danube became an axis that attracted different industries (Fig. 2):

– *chemistry* at Drobeta-Turnu Severin, Turnu Măgurele, Giurgiu, Brăila and Tulcea;
– *water-power stations* at Iron Gate I and II;
– *thermal-power stations* at Drobeta-Turnu Severin, Brăila and Galați;
– *integrated metallurgical complexes* at Galați and Călăraşi;
– *nuclear-power stations* at Cernavodă.

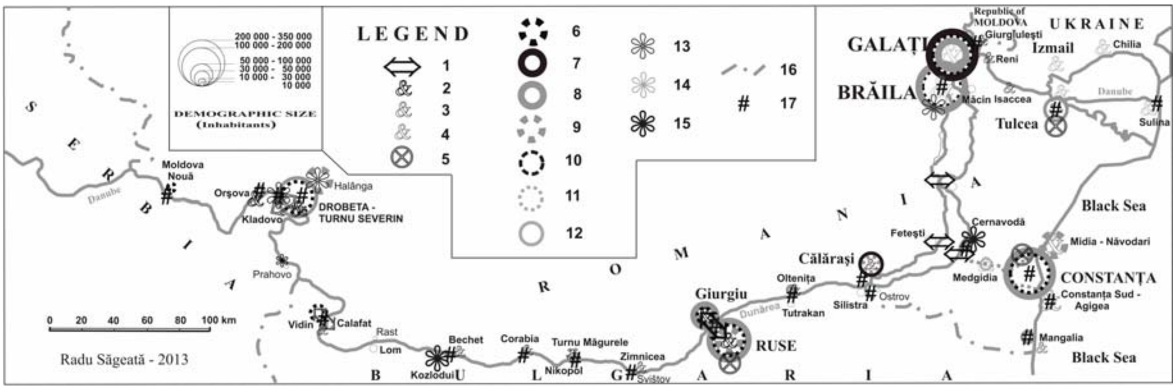

Fig. 2 – The urban system in the Lower Sector of the Danube.
1. Bridges; 2. River harbours; 3. River-maritime harbours; 4. Maritime harbours; 5. Airports; 6. Copper ore extraction centres; 7. Iron-and-steel estates; 8. Ship-yards; 9. Chemical and petro-chemical industries; 10. Building-materials industries; 11. Paper and cellulose industries; 12. Cement factories; 13. Thermal-power stations; 14. Water-power stations; 15. Nuclear-electric stations; 16. Terrestrial borders; 17. Cross-border connections.

As a result, ecological problems with cross-border implications favoured by northeast and northwest winds cropped up, tensioning cross-border relationships several times.

Following the structural changes after 1989, the economic evolution of settlements in the Romanian sector of the Danube took up a negative course.

The causes behind this process are:

– the general decline of the Romanian economy, with direct effects on the depleted volume of goods transited on the Danube and the industrial production capacity of units located in industrial ports;

– the dismemberment of COMECOM, resulting in the loss of some important markets, affected especially the export-oriented industrial branches, mainly metallurgy

– the dramatic decrease of investments in industry hindered the development and modernization of this sector, and maintained low-labour productivity levels;

– the intensification of environmental protection was a pressure element for the polluting industries (chemistry, metallurgy), forcing them to limit production in order to observe acceptable pollution standards.

3. THE PRESENT SOCIO-ECONOMIC SITUATION THE EUROPEAN UNION STRATEGY FOR THE DANUBE REGION

The analyzed space, although greatly transformed during the last 20^{th} century decades, is extremely rural, urban areas being fewer and scattered (Table 1).

The share of the active population and its professional structure show employment to stand between 29% and 76%, but most of the time the percentage is lower than the all-country average value, lowest values being registered in the highly rural countryside.

The low percentage of industrial population in the village area supports this assertion.

Taking into account the structure of the active population, some functional types of settlements can be outlined in terms of development and location: ship-building: *Orşova, Drobeta - Turnu Severin*, *Giurgiu*, *Olteniţa*, *Brăila*, *Galaţi*, and *Tulcea*; iron-and-steel industry: *Zimnicea*, *Călăraşi* and *Galaţi*; chemical industry: *Turnu Măgurele*, *Olteniţa* and *Tulcea* and agriculture.

Table 1

The number of population in the Danubian towns of Romania (1977–2011).

Urban Settlements	**Number of population (inh.) (Population census)**				**Change in population number (%) (Population census)**			
	1977	1992	2002	2011*	1977/1992	1992/2002	2002/2011	1977/2011
Moldova Nouă	15 973	16 862	13 917	11 603	+ 5.65	- 21.16	- 19.94	- 37.64
Orşova	13 701	15 985	12 965	10 080	+ 16.67	- 23.29	- 28.62	- 35.92
Drobeta - Turnu Severin	76 686	115 526	104 557	88 758	+ 50.64	- 10.49	- 17.80	+ 15.74
Calafat	15 568	20 435	18 858	17 280	+ 31.26	- 8.36	- 9.13	+ 11.00
Bechet[1]			3 864	3 542			- 9.09	
Dăbuleni[1]			13 888	12 297			- 12.94	
Corabia	19 705	22 522	20 610	14 978	+ 14.29	- 9.28	- 37.60	-31.56
Turnu Măgurele	32 341	36 825	30 089	25 015	+ 13.86	- 22.38	- 20.28	- 29.28
Zimnicea	13 964	17 140	15 672	13 170	+ 22.74	- 9.37	- 19.00	- 6.03
Giurgiu	51 544	74 236	69 345	53 260	+ 44.02	- 7.05	- 30.20	+ 3.33
Olteniţa	24 414	31 743	27 213	23 307	+ 30.02	- 16.64	- 16.76	- 4.75
Călăraşi	49 727	76 886	70 039	57 129	+ 54.62	- 9.77	- 22.60	+ 14.88
Feteşti	27 491	34 945	33 294	27 795	+ 27.11	- 4.96	- 19.78	+ 1.10
Cernavodă	13 608	22 046	18 915	16 143	+ 62.01	- 16.53	- 17.17	+ 18.63

Table 1 (continuing)

Hârşova	8 239	10 342	10 097	9 127	+ 25.52	- 2.43	- 10.63	+ 10.78
Brăila	195 659	234 706	216 292	176 004	+ 19.95	- 8.51	- 22.89	- 11.17
Măcin	10 544	12 047	10 625	8 473	+ 14.25	- 13.38	- 25.40	- 24.44
Galaţi	238 292	325 788	298 861	241 776	+ 36.72	- 9.01	- 23.61	+ 1.46
Isaccea	5 347	5 588	5 374	4 947	+ 4.51	- 3.98	- 8.63	- 8.08
Tulcea	61 729	97 500	91 875	68 608	+ 57.95	- 6.12	- 33.91	+ 11.14
Sulina	4 911	5 492	4 601	3 903	+ 11.83	- 19.36	- 17.88	- 25.82

2011 * - Preliminary results; Bechet, Dăbuleni [1] – Towns since 2004
Source: Population Census 1977, 1992, 2002, 2011. Data processing by Radu Săgeată.

The European Union Strategy for the Danube Region represents a vast regional co-operation project signed by the representatives of 14 states and adopted by the Council of Europe on the 24th of June, 2011 after lengthy public debates and political, economic, administrative and scientific meetings (Bălteanu 2012, p. 8). The document includes the official communique and action plan of 11 priority domains, grouped by four axes: environmental protection, prosperity-building in the region and improvement of governance, also stipulating concrete actions for the sustainable development of each domain.

Transports fall into the "connectivity" axis, measures referring to traffic on the Danube and its navigable tributaries, alternative energy resources and development of tourism. The strategy starts from the reality that, for all the great importance of the Danube – Black Sea fluvial-maritime axis in enlarging economic relations between the EU and the Central Asian states, transport on the Danube is insufficiently developed. The idea is to have multi-modal terminals built in the Danubian ports until 2020, in order to better connect river transport to road-and-rail facilities (European Commission, 2012–b).

4. CROSS-BORDER CO-OPERATION EUROREGIONS IN THE ROMANIAN BORDER ZONE OF THE DANUBE SECTOR

The topographic peculiarities, preferential directionalization and the intensity of cross-border fluxes are the factors that individualize and characterize a cross-border area.

The delimitation of the Romanian sector of the cross-border area depends on two essential elements:

– the closed character of the border, which imposes the degree of narrowness of cross-border area;

– the preferential orientation of transversal circulation axes, which determines the width in some specific sectors of maximum intensity of cross-border fluxes.

The intensity of cross-border is given by the exchange vectors caused by the doublet settlements, location and type of customs points (low frontier traffic, international traffic) and not least by the specific of connection axes (bridge or ferry-boat), which determines the intensity of cross-border fluxes.

In these conditions, cross-border co-operation in the Danubian sector imposed new exigencies: on the one hand, easing traffic flows, and on the other, securing the European Union's external frontiers by efficiently controlling the human and material fluxes arriving at its eastern borders.

The integration of Romania into the Schengen space, as well as the country's position at the eastern periphery of Europe's area of free circulation implies stressing co-operation exigencies, moreover so, as the Romanian ethnical element on both sides of the eastern border is very homogeneous. Therefore, facilitating cross-border traffic on either side of the Prut River is extremely necessary.

Between 2001 and 2005, a number of seven cross-border co-operation euroregions were formed: five with bilateral participation (Romanian-Serbian and Romanian-Bulgarian) and two, situated at the

EU eastern border, with trilateral participation (Romania, Bulgaria and Serbia; Romania, Ukraine and the Republic of Moldova).

The Middle Danube-Iron Gate Euroregion (Fig. 3) associates the Romanian counties of Caraş-Severin and Mehedinţi, lying on the lefthandside of the Danube, with the Serbian districts of Branicesvski and Borski (Bor) on the righthandside of the River. Since the Romanian administrative units are larger, the Romanian sector covers 64.5% of all of the Euroregion's surface-area. The main cross-border polarizing nuclei are found in the Romanian sector: the towns of Drobeta-Turnu Severin (92,617 inh.) and Reşiţa (73,282 inh.) rank first in the urban hierarchy of Caraş-Severin and Mehedinţi counties; municipia: Caransebeş (24,689 inh.) and Orşova (10,441 inh.); the Serbian sector: Požarevac (44,183 inh.) and Bor (34,160 inh.).

Fig. 3 – Middle Danube – Iron Gate Euroregion.
1. Romanian sector; 2. Serbian sector; 3. Main polarizing cores;
4. Secondary polarizing cores; 5. State border.

What makes this Euroregion functional is in the first place is the homogeneous natural potential of the Danube Defile and of the adjacent mountain zones. Thus, the co-operation framework is based on the protection of fragile natural ecosystems, a *sine qua non* for sustainable regional development. The two hydro-power and navigation systems in this Danubian sector (Iron Gate I and II) have engendered a very anthropogenic landscape, so that rare or endemic ecosystems are highly vulnerable.

The "Danube 21" Association of cross-border co-operation (Fig. 4) belongs to the category of euroregions is formed of three sectors: Romanian, Serbian and Bulgarian. Just like the former Euroregion it is situated on the external EU frontier. As Serbia is expected to join the European Union, the two Euroregions will fall inside the EU space, at the junction between Central Europe and the West Balkans. Euroregion "Danube 21" is an associative structure grouping 8 Serbian, and 8 Bulgarian municipalities and 5 Romanian administrative territorial units: 4 communes and one town. Cross-border converging nuclei make it functional Vidin (48,071 inh.), Zaječar (43,860 inh.), Calafat (17,336 inh.) and the Calafat-Vidin bridge across the River (Danube Bridge 2), inaugurated on June 14, 2013. The geostrategic importance of the bridge lies in revitalising the Athens – Sofia – Timişoara – Budapest traffic axis, as an alternative to the old Ruse – Giurgiu – Bucharest one with connections to the former Soviet space.

Fig. 4 – "Danube 21" Cross-border Co-operation Association.
1. Romanian Sector; 2. Serbian Sector; 3. Bulgarian Sector;
4 Polarizing cores; 5. State border.

A peculiar feature of the *"South Danube" Euroregion* (Fig. 5) is discontinuity of the Romanian sector, it consisting of four distinct areas corresponding to the administrative territory of four towns in Teleorman County: Alexandria, Roşiori de Vede and Zimnicea, fact that reduces considerably territorial functionality in the Romanian sector and implicity its viability. In opposition, the Bulgarian sector is contiguous, and has three municipalities: two (Nikopol and Belene) in Pleven Province and one (Svishtov) in Veliko-Tarnovo Province, so that this Euroregion has entirely an urban population (ca 564,000 inh.). Cross-border polarization axes are represented by doublet towns situated on either side of the River (Turnu Măgurele – Nikopol, and Zimnicea – Svishtov, respectively) connected by ferry-boat traffic.

"Danubius" and *"Giurgiu-Ruse"* are two overlapping Euroregions formed around the polarizing nucleus of Ruse (149,642 inh.) and Giurgiu (61,353 inh.), linked by the first bridge, built across the Danube (Danube Bridge 1, Friendship Bridge) in the Romanian-Bulgarian cross-border sector and commissioned on June 20, 1954. This is the main convergence axis of cross-border fluxes.

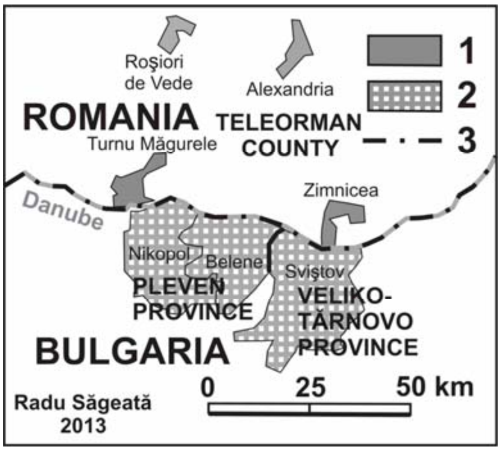

Fig. 5 – "South Danube" Euroregion.
1. Romanian Sector; 2. Bulgarian Sector; 3. State border.

The "Danubius" Euroregion (Fig. 6) is formed of the two administrative structures co-ordinated by the towns of Ruse in the Bulgarian sector (Ruse Province with 8 municipalities) and Giurgiu in the Romanian sector (with three towns, one of them a municipium, and 51 communes). The Euroregion covers 6,310 km^2 and has around 564,000 inhabitants.

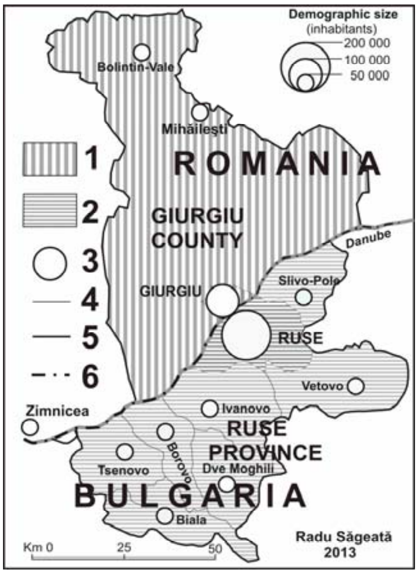

Fig. 6 – "Danubius" Euroregion.
1. Romanian Sector; 2. Bulgarian Sector; 3. Polarizing cores; 4. Limits of municipalities;
5. Limits of the Euroregion; 6. State border.

"Giurgiu-Ruse" Euroregion (Fig. 7) is part of *"Danubius" Euroregion*, being co-ordinated by the same cross-border axis of polarization. It has but one town (Giurgiu Municipium), 14 communes in Giurgiu County, and 7 municipalities in Ruse Province. Total surface-area 2,784 km^2, and a population around 353,000 inhabitants.

Fig. 7 – "Giurgiu – Ruse" Euroregion.
1. Giurgiu; 2. Ruse; 3. Rural territories in Romania; 4. Rural territories in Bulgaria;
5. Limits of communes/municipalities; 6. State border; 7. The Danube.

The Danube-Dobrogea Euroregion (Fig. 8) is the only one in the Romanian-Bulgarian cross-border sector circumscribed to both a river cross-border sector (west of Călaraşi-Silistra doublet towns) and a terrestrial sector (between Călăraşi-Silistra and Vama Veche). It is the largest (24,177 km^2) among the bilateral Romanian-Bulgarian cross-border co-operation euroregions, including three Romanian counties (Ialomiţa, Călăraşi and Constanţa) and two Bulgarian provinces (Dobrich and Silistra). The system's functionality is ensured by Călăraşi-Silistra and Olteniţa-Tutrakan doublet towns in the Danubean cross-border sector (ferry-boat connection) and Negru Vodă – Kardam and Vama Veche – Durankan in the terrestrial sector. The main macro-territorial polarizing nucleus is Constanţa Municipium (283,872 inh.), lower hierarchical-rank towns being Călăraşi, Slobozia, Medgidia, Mangalia, Năvodari, Feteşti and Olteniţa in the Romanian sector and Dobrich and Silistra in the Bulgarian sector (65,000 and 35,000 inh., respectively).

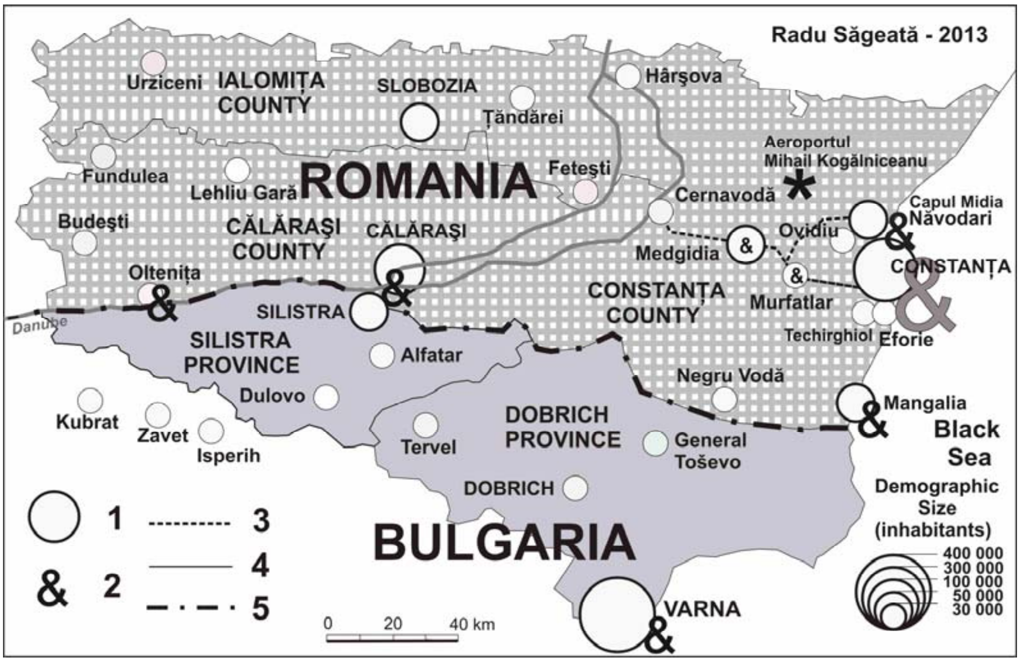

Fig. 8 – "Danube-Dobrogea" Euroregion
1. Polarizing cores; 2. Ports; 3. Navigable canals;
4. Administrative borders; 5. State border.

The Euroregion's economy is quite complex, featuring complementary sectors co-ordinated by sea ports (Constanţa-Sud – Agigea, Midia – Năvodari and Mangalia) and river ports (Olteniţa, Călăraşi, Cernavodă, Medgidia and Murfatlar); it has a diversified industry and remarkable littoral tourism assets both in the Romanian and Bulgarian sectors; agriculture, though on the decline, has a great prospective potential.

The Lower Danube Euroregion (Fig. 9) is the only one enjoying trilateral participation in the Romanian Danube cross-border sector that overlaps the EU eastern border. It is by far larger (53,468 km^2; 3,909,000 inh.) than the other euroregions in the studied cross-border sector, due mostly to Odessa Region (33,310 km^2, 2,687,000 inh.), in the Ukraine, which hosts the main polarization nucleus with macro-regional functions (Odessa City, 1,003,800 inh.), next in line, but at great distance, coming the Romania administrative centres (the towns of Galaţi – 249,432 inh; Brăila – 180,302 inh., and Tulcea – 73,707 inh.) and the Republic of Moldova towns (Cahul – 41,100 inh. and Cantemir – ca. 6,000 inh.).

Fig. 9 – "Lower Danube" Euroregion.
1. Polarizing cores; 2. River ports; 3. Fluvio-maritime ports;
4. Sea ports; 5. Airport; 6. Borderlines; 7. Administrative bounds.

The cross-border co-operation framework of this Euroregion is governed by the necessity to secure the eastern EU frontier as best as possible, a prerequisite for Romania's accession to the Schengen space, and by the presence of the homogeneous Romanian ethnical bloc, especially in the Prut cross-border sector, which implies permeability of frontier flows. This situation accounts for several cross-border connections prevailing in the Moldova-Ukrainian sector, whereas in the sector in which Romania is a participant, connections between Romania and the Republic of Moldova are ensured by Oancea – Cahul and Galați – Giurgiulești and between Romania and Ukraine by Galați – Reni axes.

5. CONCLUSIONS

Cross-border co-operation Euroregions represent territorial structures created to intensify inter-regional and cross-border co-operation, so as to obtain a coherent space for economic, scientific, social and cultural development.

The formation of these Euroregions is closely related to the intense cross-border co-operation within the western European space; urban cores of cross-border polarization and state border configuration are the main factors that generate them. The rapid industrial development in the post war period and liberalization of the customs regime have contributed to the development of urban agglomerations beyond national borders.

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RURAL POPULATION DYNAMICS IN THE CURVATURE CARPATHIANS

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Key-words: rural population, evolution, rural settlements, Curvature Carpathians.

Abstract. This over 10,000 km^2 sector numbers 800,000 inhabitants, 271 villages grouped into 19 communes and urban centres (18 municipia and towns). The greatest habitat potential have the intra-montane depressions which concentrate approximately two-thirds of the villages in the region, most of them medium-sized demographically with 500–2,000 inhabitants each. Urban population represents 59%, rural population 41%. This geographical area has been inhabited since the Palaeolithic and the Musterian (60,000 – 40,000 BC) a period that made the transition to the Neolithic Times. The analysis of the numerical evolution throughout the rural Curvature Carpathians covers one hundred years (1910–2011) and is based on census data. At communal level, the study focusses on two major periods: communist (1966–1989), when the demographic evolution was rather fluctuating and post-communist (1990–2011), when numbers were mostly on the decline. The analysis of population dynamics has focussed largely on major component elements like the natural and territorial movement which are of primary importance in estimating the demographic vitality of any geographical space.

1. OLDNESS AND CONTINUITY OF HABITATION

The Curvature Carpathians and Braşov Depression have been populated from times immemorial. Archaeological research places it in the Palaeolithic and the Mustarian (60,000 – 40,000 BC), that is the period of transition to the Neolithic Age. Similarly, such old habitation is also found in the Buzău–Siriu Mountains and Întorsura Buzăului Depression, while discoveries made at Cernat, Covasna, Reci, and Turia (Boian Culture) and at Moacşa (Precucuteni Culture) indicate the Late Neolithic phase. Settlements of the Ariuşd Culture, contemporaneous with and influenced by the Cucuteni Culture, exist at higher altitudes (at Ciocaş in the Baraolt Mts.) and on promontories (Cernat, Leţ, Moacşa, Sânzieni, and Reci). The Bronze Age (ca. 2,500–1,200 BC) offers more consistent evidence by the discoveries made at Turia, Reci, Zăbala, Sânzieni, Moacşa, Peteni, Poian, Albiş, Valea Seacă, and Valea Scurtă; other vestiges lying on Dealul Melcilor (hillside) and at Şchei (Pietrele lui Solomon – Salomon’s Rocks) stand proof to permanent habitation, the development of an ancient civilisation based on sedentary occupations (the cultivation of plants and metal-working) and a stable life-style. The fortified settlements (Hallstatt) at Bodoc and Cernatu de Sus belong to the Dacia, the time when the first Roman castra were erected at Olteni and Hoghiz.

In Daco-Roman Times there were lots of settlements in the area (vestiges exist at Braşov, Hărman, Codlea, Rotbav, Teliu, Sfântu Gheorghe, Baraolt, Cernat, Poian, etc.).

The castra at Râşnov (ancient Cumidava), Covasna and Hoghiz (Fig. 1) bespeak of the Roman Period, the discoveries made at Cristian, Feldioara, etc. are dated to the time when the process of formation of the Romanian people was being completed.

In Post-Roman Times (4th cent. A.D.) other populations, the Carpae and the Goths, would settle beside the majority Daco-Romans. This historical reality is sustained by the money hoard at Cernat and the finds at Reci, other vestiges originating from Cernatu de Sus, Dalnic, Pădureni, and Turia.

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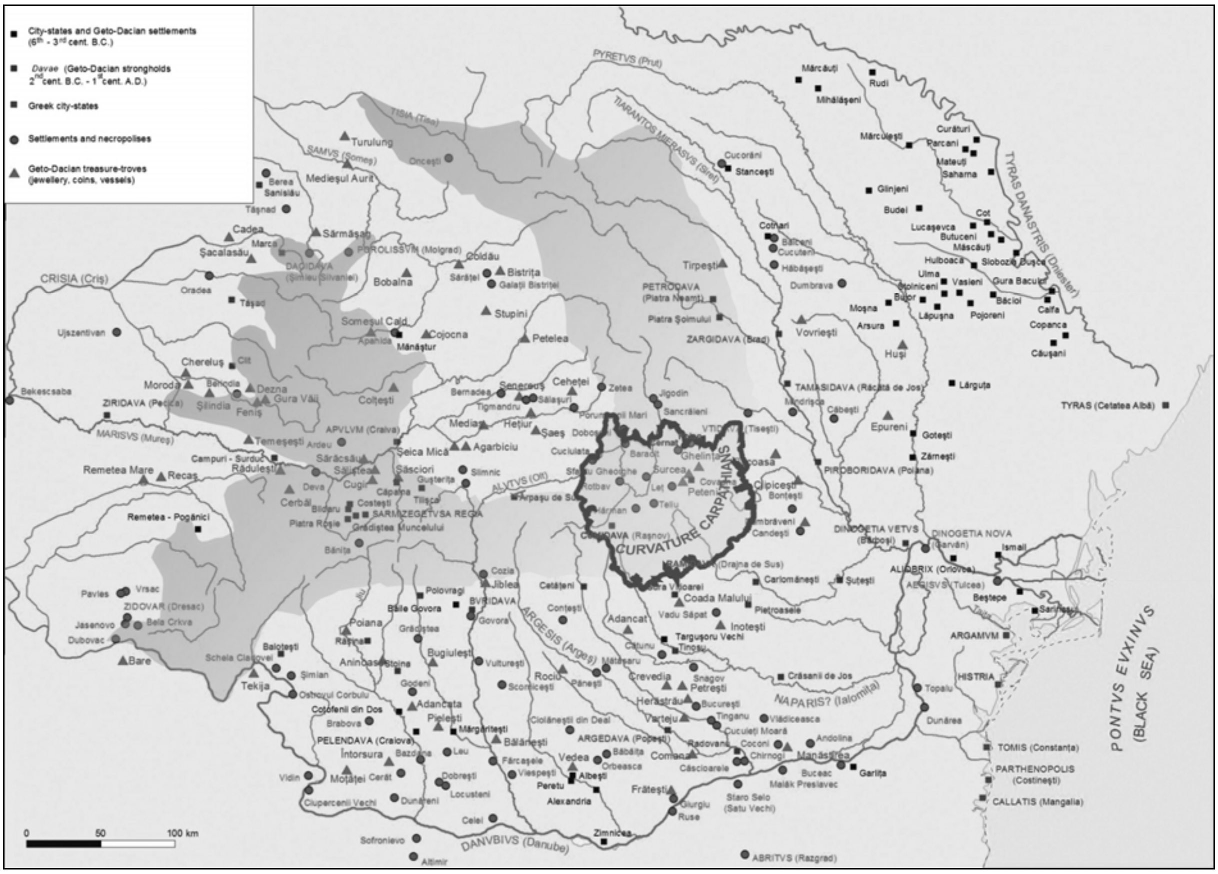

Fig. 1 – Archaeological attestation of ancient habitation, 4th cent. BC – 1st cent. AD (maps, National Atlas of Romania, 1972–1979).

River valleys and natural depressions were places where the Romanian people created its own social-political organizations, the so-called lands (Rom. *Ţări*), cnezdom and voivodeships, e.g. Ţara Bârsei ("Bârsa Land") sited in the depressionary area around Braşov, inside the Carpathian Curvature at the point where the three Romanian Principalities were intersecting. It is a strongly populated area with numerous settlements mentioned in documents as early as the 12th century. Another relevant case are the settlements and necropolises of the Ipoteşti–Cândeşti Culture (6–7th cc A.D.) and Dridu Culture (8–9th cc A.D.) on the territory of Buzău, which made some historians consider it the nucleus of a former pre-state formation: "Buzău Land". The continuity of settlement of the Romanian population in this space, when the Szecklers were being colonised, (12th cent. A.D.) is attested by numerous pre-historical archaeological finds (Dacian and Roman) at Ivăneţu, Nucu, Găvanele, Chiojdu, Merişor, etc. (Geografia României, III, 1987).

A characteristic feature of the Romanian people, transmitted from one generation to the next, is the intimate link with the Carpathian-Danubian-Pontic space, its birth-place, the hearth of its genesis.

The Carpathian Mountains have always been a polarising element for the Romanians, a state-axis in the time of the Dacian kings Burebista and Decebalus, and has continued to be the hardcore of the Romanian people's unitary development in the hearth of its forefathers.

The Carpathians have been playing a huge part in the life of our people, being a safe shelter-place in times of affliction and, moreover, a source of vital elements: water, wood, animals, salt and metals (also gold).

2. HUMAN CONCENTRATION LEVEL DISTRIBUTION OF THE POPULATION

The Curvature Carpathians cover a vast geographical space (over 10,000 km^2), very much populated (about 800,000 inhabitants in 2011), average density: 70 inh./km^2, total number of rural settlements: 271 villages grouped into 90 communes; urban centres: 18 municipia and towns; 59% of the population live in town and 41% in the country-side.

Looking at the geographical distribution in the region it emerges that most people (61%) occupy the intra-montane depressions (208,000 inh. and 147 villages). The rural population of the mountainous zone numbers to 132,985 people and 124 villages (Fig. 2). The territorial dissemination of villages by demographic size shows depressions to rank first, most villages (27) being large-sized with over 2,000 inhabitants each, compared to the mountain area (11 large settlements) dominated by small and very small settlements (below 500 inh. each). The large country-side communes (31, 4,000–8,000 inh. each, house 47% of the total rural population); medium-sized communes (41, 2,000–4,000 each, total 36% of the population), small communes (14, below 2,000 inh. each, with 6%) and very large communes (4, with 8,000–10,864 inh. each, total 11%) (Fig. 3).

There are two geographical areas in the territory with a high concentration of population and settlements: 1) the depressionary area (Braşov-Prejmer-Râu Negru) in the central-western part of the region and 2) the mountain-Subcarpathian contact area in the south-south-east.

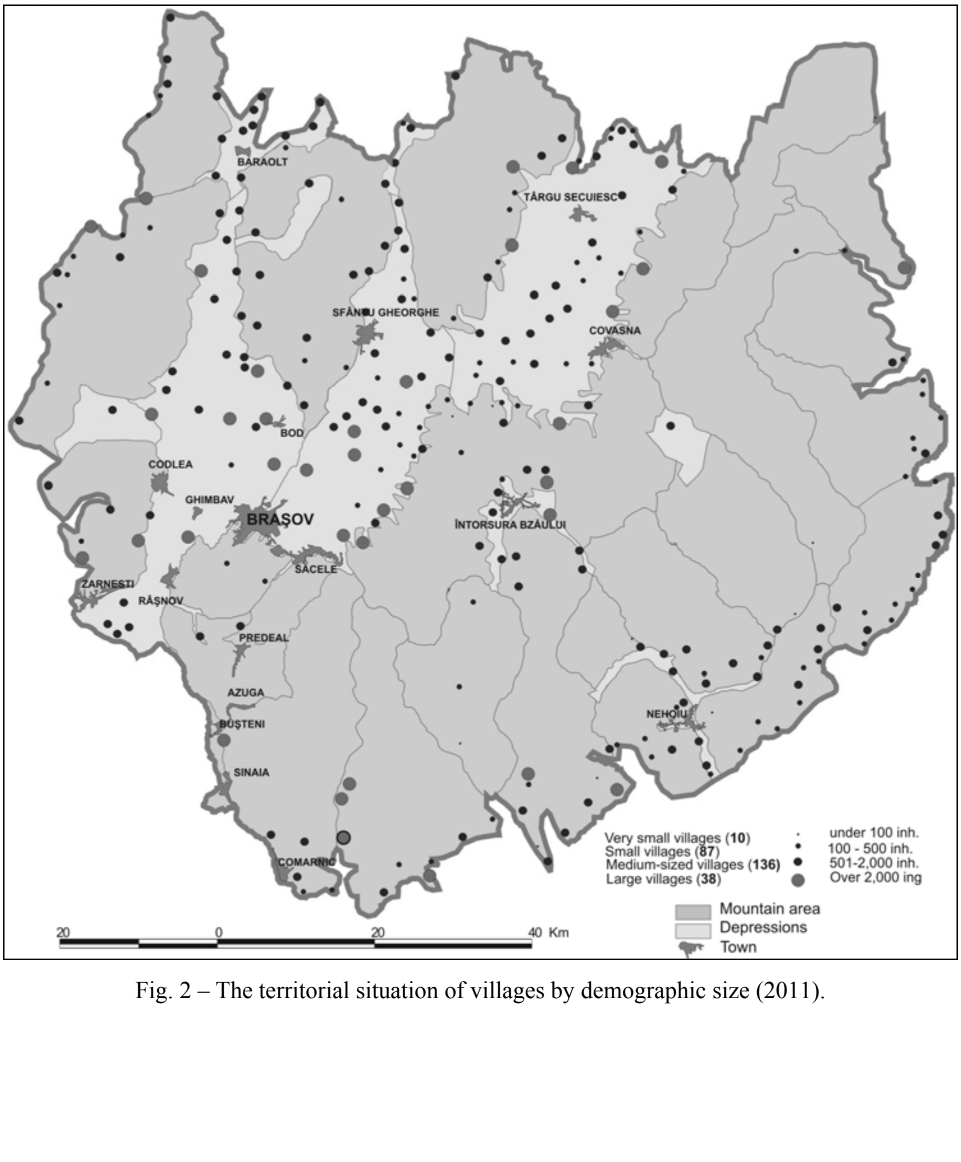

Fig. 2 – The territorial situation of villages by demographic size (2011).

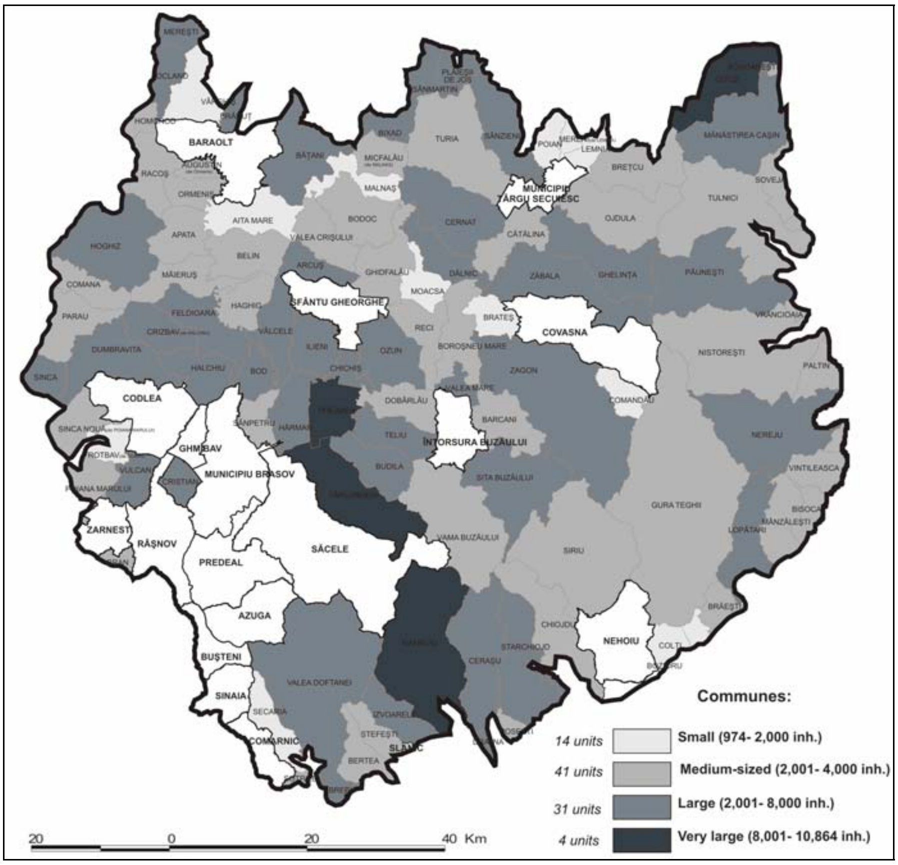

Fig. 3 – The territorial situation of communes by demographic size (2011).

The main depressionary areas of the Curvature Carpathians have the best natural conditions for habitation (more than 100 villages) having a marked oikomenic character that dominates geographical landscape dynamics. The second human concentration consist of an alignment of contact settlements under the Carpathian "eaves", grouping 50 villages in a row, the most of them located at the sources of mountain rivers.

3. NUMERICAL EVOLUTION OF THE RURAL POPULATION IN THE 20th CENTURY AND EARLY 21ST CENTURY

The first census of population and settlements (Dec. 19, 1912) showed 310,338 people living in the Curvature Carpathian country-side, and only 340,985 in 2011, which means an overall increase of 30,647 inhabitants in the lapse of one century, basically less than 10 per cent.

Twentieth-century census data give a demographic maximum (382,079) in 1977, which means overall population increase in the first half of that century (1912–1977) by nearly 72,000 people, and a decrease in the second half (1977–2011) by some 58,000 people (see growth rate in Fig. 4).

The multi-annual evolution of the region's rural population from 1960 to 2011 (Fig. 5) was distinctly different in terms of the political and economic situation and demographic behaviour. Two major periods can be distinguished: 1) *the communist period* of population growth between 1966 and 1977 due to the state pro-natality policy, followed by stagnation (1977–1984) as the urban industrialization drive in the region used to attract the rural labour force; 2) *the post-communist period* (after 1989) marked a decreasing trend (correlated with demographic decline) owing to the negative natural and migratory balance, lowest values being recorded in 2006; between 2007 and 2011 a slight increase being noticed.

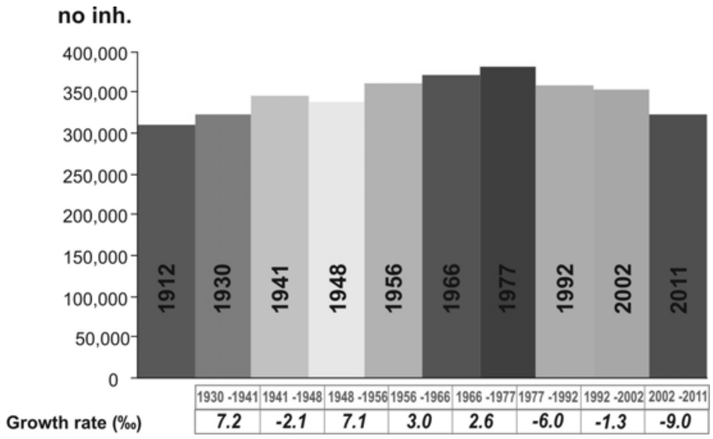

Fig. 4 – Numerical evolution of inhabitants and rural population growth in the Curvature Carpathians.

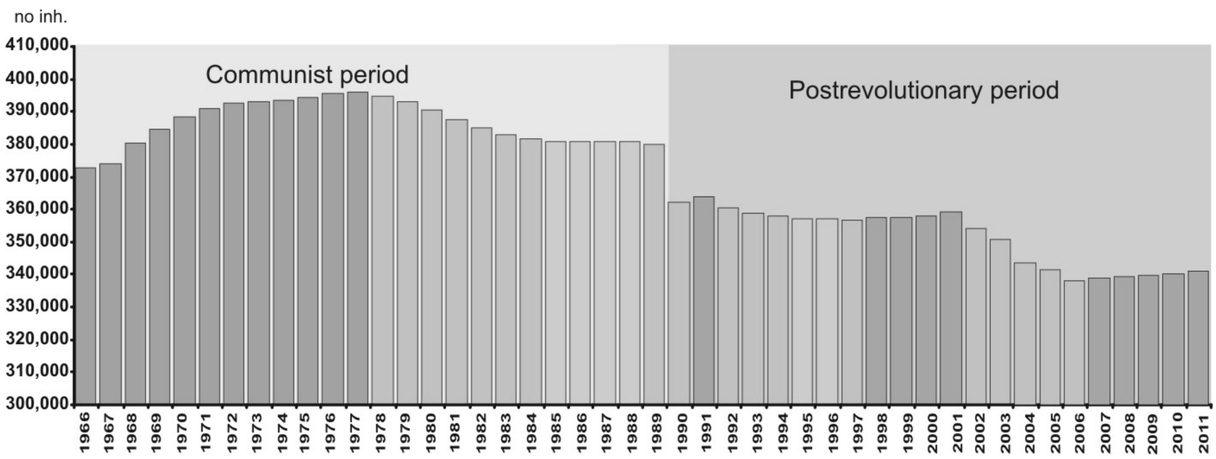

Fig. 5 – Multi-annual evolution of the rural population in the Curvature Carpathians (1966–2011).

The demographic evolution of communes within the lapse of one century (1912–2011) registered pretty large variations both in communes with high growth rates (Vâlcelele, Covasna County +48%; from 2,769 inh. in 1912 to 4,475 inh. in 2011) and in those with a negative score (Plăieşii de Jos – 47%: from 6,372 inh. to 3,033 over the same interval). Increases were recorded in 50 communes, that is 55% of all of the region's units, and decreases in 40 (45%). Demographic decline in the region's communes, obvious throughout the studied period, got momentum in the last two decades according to the analysis of population losses and observations in the territory. The findings have shown that in early 21st century (2002–2011) this situation affected twice as many communes (70) compared to the early 20th century (32 from 1912–1930). The overall population deficit of -8,895 inh. in 1912–1930 was four times higher (-41,731 inh.) in 2002–2011.

The natural demographic movement has always been a demographic determinant in the numerical evolution of an area's population, the main component, natality, playing a major role in demographic planning and geo-demographic policies. Throughout the Curvature Carpathians, birth-rate index values over 1990–2011 showed fluctuations, yet generally falling from 15.4‰ to 11.1‰ (Fig. 6).

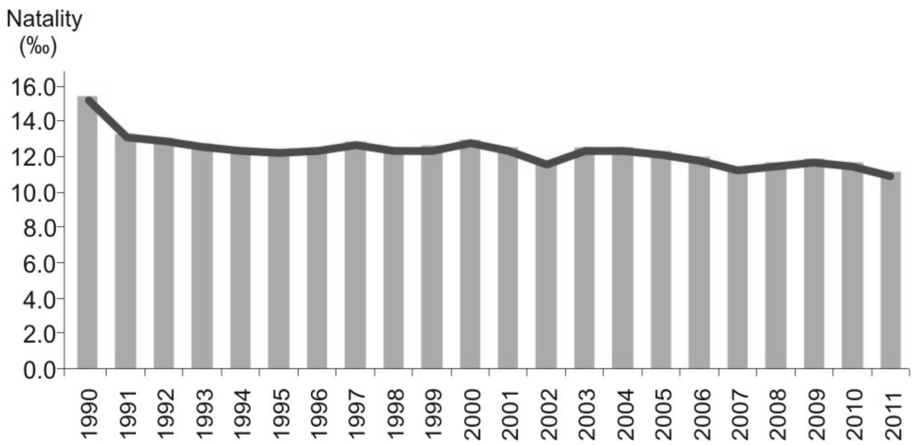

Fig. 6 – Rural natality over 1990–2011.

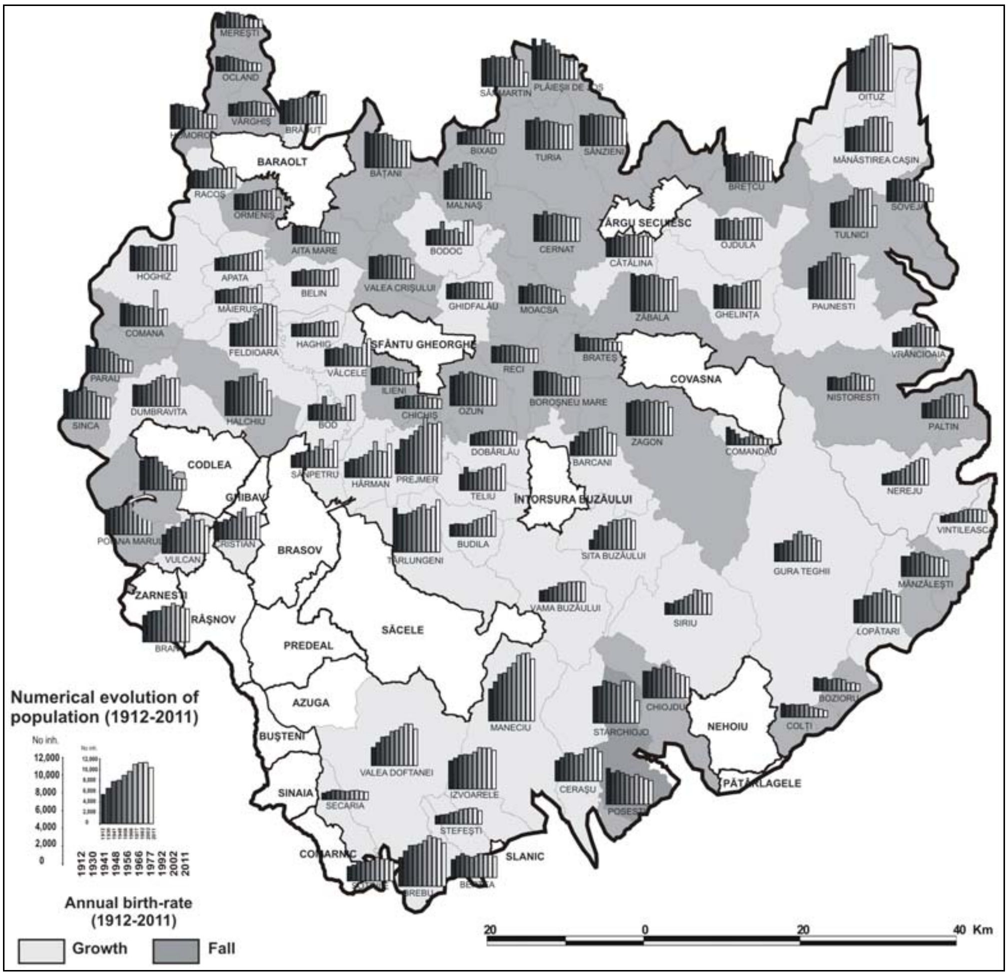

Fig. 7 – Distribution of the population in the territory by communes (census data) and annual average rate.

As shown on the map (Fig. 7), some communes have a very high birth-rate (over 100%), e.g. Budila, Hărman, Nereju, Sânpetru, Sita Buzăului, which means a twofold increase of population, others register sharp decreases (-50%), the case of Plăieşii de Jos, Lemnia, Moacşa, Părău, Poaian, etc. There are also communes featuring a downslide trend at each census (1912–2011), suggestive of almost permanent demographic decline. Each census registered growth-rates at Apaţa, Nereju, Budila, Brăduţ, Măneciu and other communes.

Summing up we would say that, according to census data, the numerical evolution of the Curvature Carpathian rural population in the 20th and early 21st centuries had been on the increase until 1977 (2.6% … 7.2%), followed by a decrease (-6% … -9%) to this day.

4. RURAL POPULATION DENSITY

This demographic indicator stands for the population/territory ratio, basically for the distribution of an area's human capital. Population density components indicate the extent of anthropisation of the geographical space and the area's human concentration. Analysing the territorial distribution of population density in the Curvature Carpathians implied calculating both average density and area index in order to find out the territory's capacity to sustain population numbers.

Average or general density, defined as total population number and inhabited area expressed by number of inhabitants per square kilometre and analysed at communal level, designates the distinct distribution of the rural population. The average density of the Curvature Carpathian rural population in the latter half of the 20th century indicates significant and almost steady decrease from 44.8 inh./km^2 in 1977 (the highest value in the studied period) to only 38.6 inh./km^2 in 2011, a value far below national averages (Table 1).

Table 1

Average density of rural population at censuses

Census years	1966	1977	1992	2002	2011
Average density of the rural population in the Curvature Carpathians	**42.2**	**44.8**	**40.8**	**40.1**	**38.6**
Average density of the rural population in Romania	**55.4**	**53.2**	**48.9**	**47.9**	**45.3**
Average density of the population in Romania	**77.4**	**86.5**	**90.7**	**86.7**	**89.6**

Source: *National Institute of Statistics*.

The average density of population over most of the territory (two-thirds of all communes) was on the decrease both in the communist period (studied over 1966–1992) and in the post-communist period, a situation correlated with demographic decline throughout the Carpathian area after 1990. Significant average decreases (from 30 to 40 inh./km^2) were recorded at Paltin, Starchiojd, Poiana Mărului, communes with high concentrations of population (over 100 inh./km^2), average density being in excess of 30 inh./km^2 only at Şinca (from 96 to 131 inh./km^2 between 1992 and 2011).

Density distribution at communal level registered highest values in the west, south-west and south of the region, in Braşov and Prahova counties at: Cristian 170 inh./km^2, Prejmer 154 inh./km^2, Bod 139 inh./km^2, Şinca 131 inh./km^2, Brebu 126 inh./km^2, Şotrile 115 inh./km^2, etc.

Average rural population density values of 50.1 – 100 inh./km^2 are characteristic of the intra-montane depressions of Braşov, Prejmer and Râu Negru and of some communes edging the neighbouring Prahova Subcarpathians (Bertea, Ştefeşti, Izvoarele, Măneciu, Ceraşu, and Starchiojd), the Buzău Subcarpathians (Lopătari) and the Vrancea Subcarpathians (Paltin).

Nearly half the other communes have a *below average record (39 inh./km^2)*, most of them located at the region's periphery, only 20–50 inh./km^2, Secăria 28 loc./km^2 and Valea Doftanei 23 inh./km^2 in the Gârbova Mts; Mânzăleşti 29 inh./km^2, Bisoca 37 inh./km^2, Vintileasca 24 inh./km^2, Nereju 32 inh./km^2 in the Vrancea Mts. (Furu and Zboina Frumoasă); Cernat 34 inh./km^2, Turia 26 inh./km^2 in the Bodoc Mts.; Comana 28 inh./km^2, Hoghiz 29 inh./km^2 in the Perşani Mts. etc.

Lowest densities (7.5–20 inh./km^2) are found in mountainous communes (Întorsura Mts.) at Siriu, Gura Teghii, Zagon, Nistoreşti and Tulnici (Fig. 8).

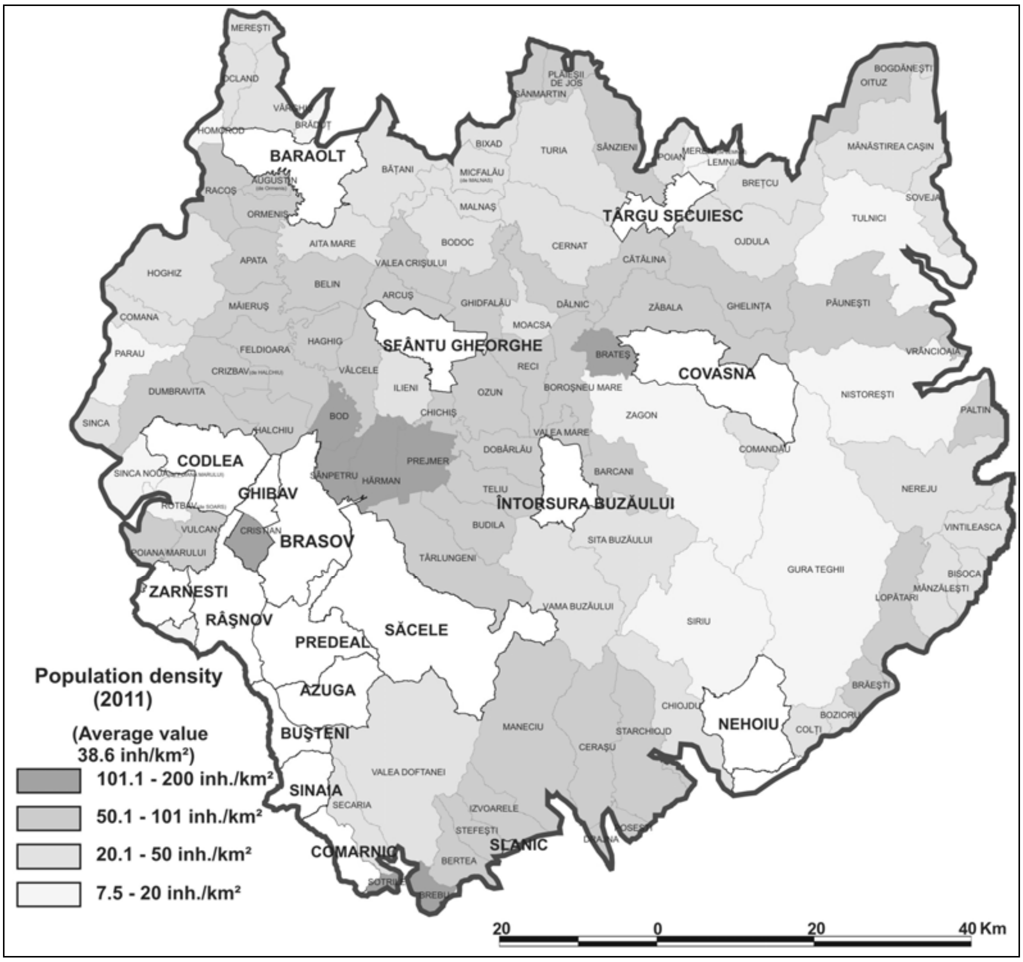

Fig. 8 – Distribution of population density by communes (2011).

In the Curvature Carpathians, **area index value** (2011) shows broad variations per capita (0.6–13.4 ha/inh.). Low values, below the region's average (under 2.6 ha/inh.) have 60% of the communes, over 10 ha/capita only Nistoreşti (11.5 ha/inh.) and Gura Teghii (13.4 ha/inh), with 1 ha/inh. in six communes: Cristian, Prejmer 0.6 ha/inh. each, Bod 0.7 ha/inh., Brebu 0.8 ha/inh., Şotrile, and Sânpetru with 0.9 ha/inh. each.

These index values stand proof to the area's demographic decline. Thus, in 1977, the year with the most numerous population (382,079 inh.), index values were the lowest (2.2 ha/inh.) (Table 2); in 2011, a year with fewest inhabitants, index values were slightly on the increase (up to 2.6 ha/inh.).

Table 2

Area index value in the rural (ha/inh.).

Census years	1966	1977	1992	2002	2011
Area index value – Carpathian rural population	**2.4**	**2.2**	**2.5**	**2.5**	**2.6**
Area index value – rural population in Romania	**1.8**	**1.9**	**2.0**	**2.1**	**2.2**

Source: *National Institute of Statistics*.

The relatively low density and area values are specific to areas of demographic decline. However, it appears that demographic bearability in the study area is by far greater than the all-country average.

5. POPULATION DYNAMICS

The general dynamics of the population depends on two major demographic components: natural movement and territorial movement involved in changing demographic behaviour and number. Population dynamics is influenced by the geographical area, in this ease the Curvature Carpathians, and accounts for important changes over time in the population system, e.g. numerical demographic structures and people's state of mind (psychological, material, spiritual, etc.). Natural and territorial movement are generally determining the level of a community's demographic vitality, the new generation warranting continuity of habitation. Nevertheless, if the two components have long-time negative evolutions, the result could be depopulation.

Rural population dynamics over 1992–2011 indicate demographic decline in 70 communes (Fig. 9), some 60% of them having decrease rates ran between -10% and -50% (-10% in 25% and more than -50%) at Bixad, Micfalău, Malnaş, Comana and from -0.4% at Bogdăneşti and -78% at Malnaş to +0.9 at Turia and +98% at Bod.

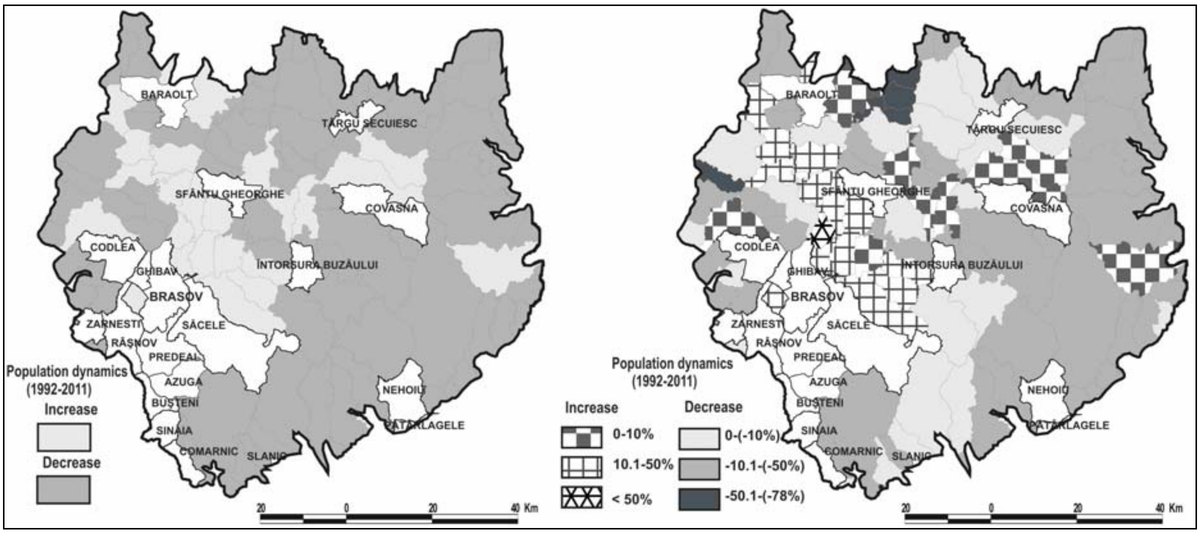

Fig. 9 – Territorial location of communes in terms of population dynamics (1992–2011).

After 1990, all of Romania's regions, the Carpathian Curvature included, registered numerical loses, distinctively different in town and country-side.

In the Curvature Carpathian country-side the number of inhabitants was declining by 10% on average (1990–2011), natural growth in the whole region being for the first time negative (-3‰) in 1993. The mountain area, inhabited only by a rural population had permanently a natural decrease. All in all, over the same period, the Curvature Carpathian rural population dropped by 35,500 inhabitants, mostly at Malnaş (-4,050 inh.), Starchiojd (-3,200 inh.), Tulnici and Comana (by -2,500 inh., and -2,900 inh., respectively).

5.1. The rural population natural movement

Natural movement signifies permanent numerical change of population in any rural or urban community. The difference between birth-and-death-rates is called *natural growth* or *natural demographic balance*, its value whether positive or negative, is added to the initial population number.

Evolution of natality in the rural Curvature Carpathians, according to census data: 1977, 20.1‰, and half this value in 2011 (11.1‰), from 7,959 to 3,688 newborns (Table 3).

Table 3

Demographic balance in the rural Curvature Carpathians

Census years		1966	1977	1992	2002	2011
Birth-rate	(‰)	**15.8**	**20.1**	**13.2**	**11.8**	**11.1**
Death-rate	(‰)	**9.2**	**10.0**	**13.1**	**12.8**	**12.3**
Natural balance	(‰)	**6.6**	**10.1**	**0.1**	**-1.1**	**-1.3**

Source: *National Institute of Statistics*.

Birth-rate decreases in the country-side are the result of a deeply rural economy in the studied settlements, most people working in the towns of Braşov Depression. This would explain the village-to-town migration, hence the depopulation of villages, demographic ageing gaps in population structure.

The highest natality disparities at communal level registered Nereju: 1966 (33.3‰), 1977 (32.6‰) and 1992 (35.2‰), but steep decreases over the following years: 14.9‰ in 2002 and 15.2‰ in 2011, a proof of demographic decline here, due primarily to negative economic factors despite traditional pro-natality behaviour. The same situation after 2000 in many of the region's communes (Lopătari, Paltin, Păuleşti, and Vintileasca); 1966: the best situation had Soveja Commune, 11.4‰ decreases, but the same downward trend to only 5.2‰ in 2011 (Fig. 10).

Mortality, a demographic component of population natural movement and dynamics, indicates the rate of death. In the Curvature Carpathian rural area mortality values kept increasing up to a maximum of 13.1‰ in 1992, tending to slightly decrease between 2002 (12.8‰) and 2011 (12.3‰). lowest rates were recorded at Comandău 3.2 ‰ (1966), Tulnici 5.8‰ (1977), Ceraşu 7.8‰ (1992), Ormeniş 4.8‰ (2002) and Măieruş 6.5‰ (2011), highest values at Soveja, 24.9‰ (2011), Colți 23.6‰ (1992) and Părău 21.5‰ (2002).

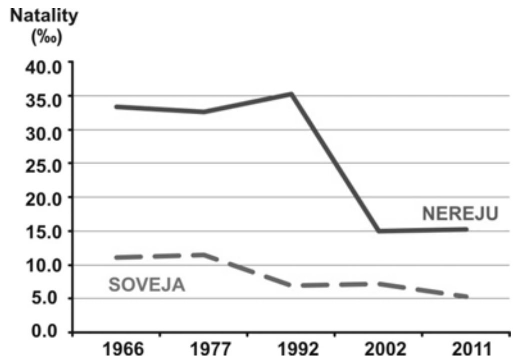

Fig. 10 – Extreme birth-rate values in Nereju and and Soveja communes, Vrancea County.

The natural balance, or natural growth-rate stands for the difference between natality and mortality, suggesting general evolution trends in the number of population, basically numerical balance or imbalance. The general evolution of the natural demographic balance of the entire Curvature Carpathian rural population and the respective communes was followed over the 1966–2011 period. The findings revealed a maximum threshold in 1967 that is highest birth-rates (27.8‰ versus 9.6‰ death-rates). However, in the post-communist period, natural growth was negative, which means higher population deficit (Fig. 11).

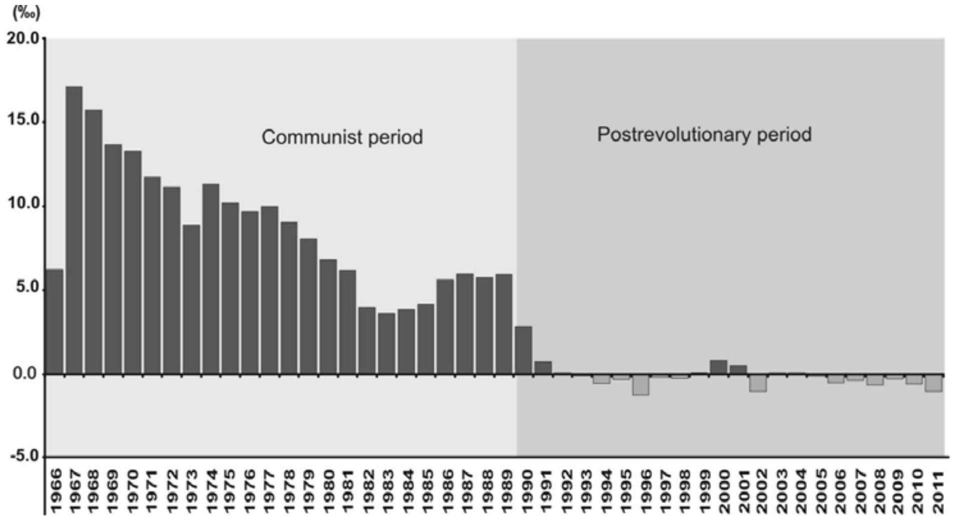

Fig. 11 – Multi-annual evolution of the rural population natural balance in the Curvature Carpathians.

Between 1967 and 1977 the Curvature Carpathians registered rather high natality rates compared to mortality, hence high natural increases, nevertheless decrease numerical. The post-1977 period featured a steep demographic decline of natality and of natural growth, reaching its lowest in 1983 in the whole communist period: 1,446 individuals (3.7‰) even fewer than in 1966 when natural growth in the region's rural area was of 2,489 persons (6.5‰).

The forcible implementation of pro-natality political measures, in effect until 1989, were strictly implemented through the family planning process. The result was natural growth. The post-communist period began with a negative social interval, dramatic from a demographic viewpoint, the negative balance persisting every year between 1992 (-0.02‰), minimum values in 1996 (-1.4‰) and 2011 (1‰) (Fig. 11).

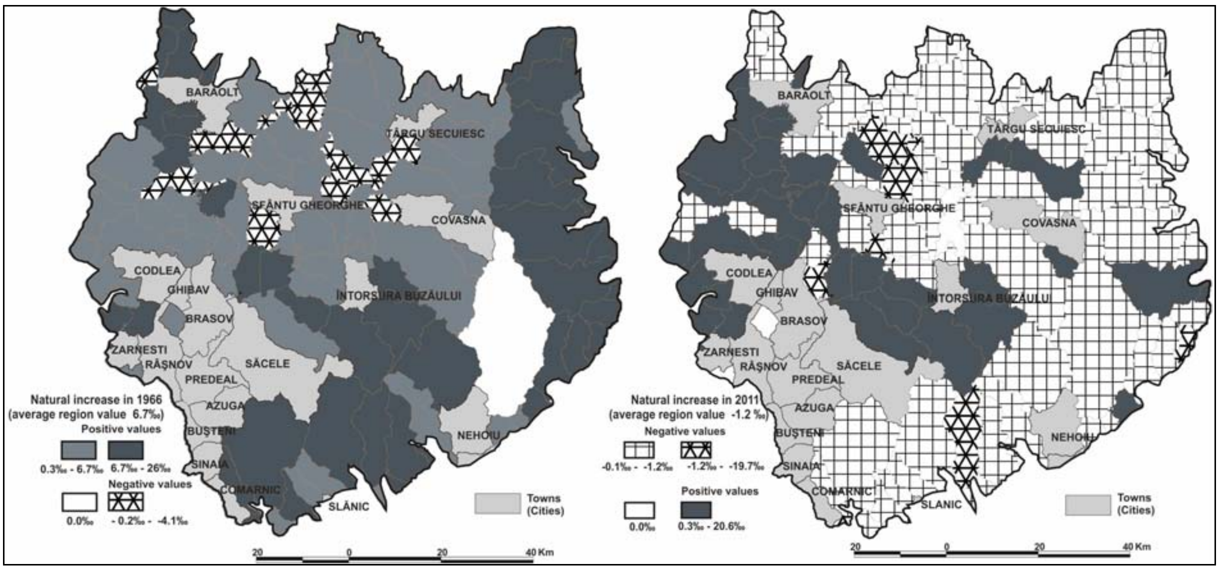

Fig. 12 – Territorial distribution of communes in terms
of natural growth values (1966–2011).

The territorial distribution of the natural balance in the communes of the Curvature Carpathian area and a comparative analysis of cartographic representations for 1966 and 2011 reveal a steep decline of this indicator down to negative values in over 60% of the studied territory (Fig. 12). In 1966, the balance was negative only in 11 communes, that is, more deaths and fewer births – Aita Mare -4‰, Moacşa -2.7‰, Brateş -2.4 ‰, Măieruş -1.2‰, Ilieni -1.1‰, etc.), on the other hand, in 2011, in nearly two-thirds of the 90 communes the demographic potential was drastically diminished as natural balance values were negative (Soveja -19.7‰, Colţi -17.9‰, Brateş -13.2‰, Vintileasca -11.1‰, Aita Mare -10.2‰, etc.).

5.2. Migration of the rural population

Departures have in time led to demographic imbalances visible especially in the age-group structure.

In general, before 1989 migratory flows went usually from the village-to-town, from the Curvature Carpathian country-side to the local urban centres in the intra-montane depressions – Braşov, Covasna, Zărneşti, Săcele, Codlea, Sfântu Gheorghe, Târgu Secuiesc, etc.). This trend was characteristic throughout the country, as the village labour force was attracted to the industrial branches in town. During *communism*, the highest departure rate was 20.4‰ (1967), minimum values (8.6‰) being registred towards the end of that period, when the urban industry was no longer in need of new workers. At the same time, large cities like Braşov were sealed to new settlers. In post-communist times, departures got momentum (14.7‰ in 1992 and 14.4‰ in 2004) as many people from outside the region would settle in town, or go abroad. Lowest values (10.2‰ and 10.3‰) were recorded in 2000 and 2005, respectively.

A data analysis of migratory flows shows 1990 to be a peak year, around 12,100 people leaving their rural residence to live in town. Departures abroad (40‰), mostly of German nationals, who were very numerous in the region, took advantage of post-communist legal regulations allowing the free circulation of people everywhere in Romania and abroad. In the following years, the rural-urban flow would slow down, but continued to top the urban-rural one until 1996 when things turned he other-way-round, however the urban one use to prevail every year, with ups-and-downs until 2010; however, the upward trend was dominant.

From 1966 to 1989, more than 100 people/year would leave their communes, e.g. 150 from Prejmer (150 persons/year), Păuneşti (139), Tărlungeni (125), Hărman (122), Malnaş, Vulcan, Sânpetru, Măneciu, Feldioara, Oituz, Hălchiu, etc. and Bertea, Chichiş, Prejmer, Starchiojd and Zăbala after 1989.

Arrivals of population is the second main component of territorial movement with major social and economic impact on the community. In the communist period, the rate of arrivals in the rural Curvature Carpathians fluctuated between a maximum of 15.4‰ in 1967 and a minimum of 33‰ in 1985, average rate 7‰. In post-communist times, ever more townspeople chose to live in the country-side, compared to their rural counterparts who opted for the city. This trend is obvious from 88,579 inhabitants in 1990 compared to 65,413 before 1989. Communes of choice were Hărman, Prejmer, Feldioara, Bod, Sânpetru, Cristian, at an average of over 100 new settlers per year.

The migratory demographic balance, namely, the difference between immigrants and emigrants per 1,000 inhabitants between 1966 and 1989, reveals the rural Curvature Carpathians to have registered a deficit of population every year, with a record low after 1990 (-33.4‰/ per total population, basically 362,000 individuals) due to massive shifts from village to town, and of most German nationals migrating to Central Europe, taking advantage of the new legislation that stipulated open borders and free circulation. However, leaving aside the above situation, the trend of the migratory demographic balance was upgoing in the Carpathian rural environment in most regions of Romania, from a negative low (-15‰) in 1980 to a positive high (3.6‰) in 2007, and a slight decrease (1.8‰) in 2010, but still positive (Fig. 13).

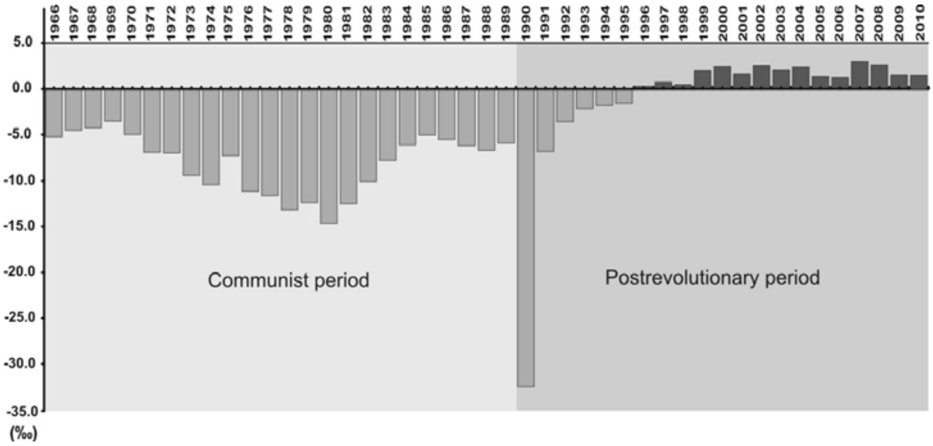

Fig. 13 – Multi-annual evolution of rural population migratory balance, Curvature Carpathians (1966–2011).

Analysing this indicator at regional and communal level from 1966 to 2010 indicates a negative-to-positive evolution of the migratory balance in the majority of communes; in 1966, 80% of communes had a negative score: -2‰ at Comandău and -0.1‰ at Budila and Nistoreşti, while in 2010 only 40% of communes registered negative values: -20.8‰ at Paltin and -0.4‰ at Sita Buzăului (Fig. 14).

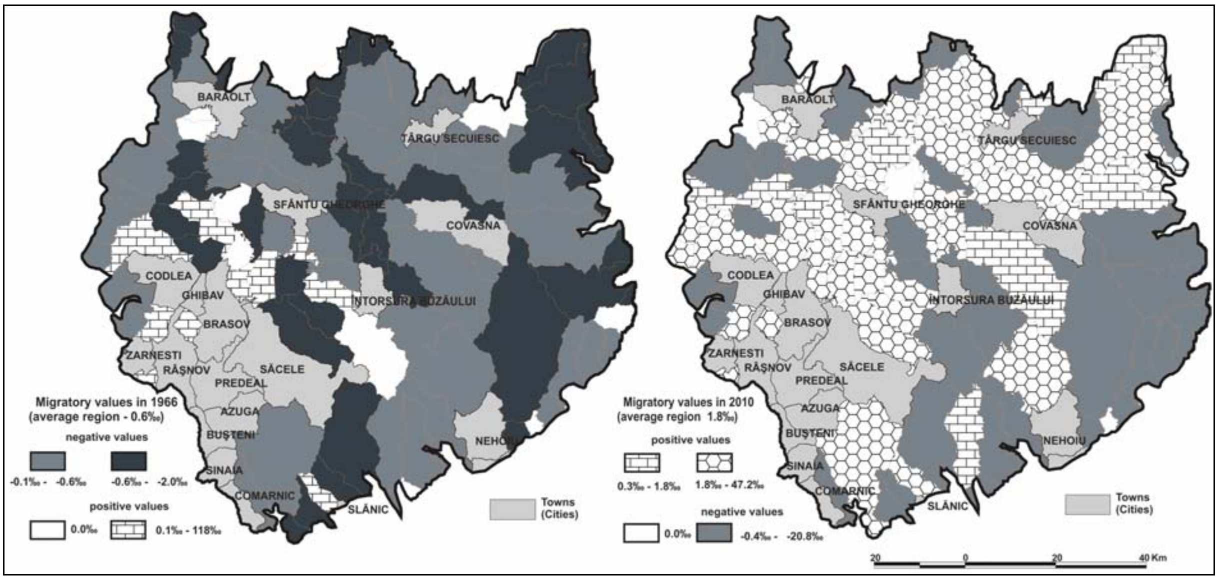

Fig. 14 – Territorial distribution of communes in terms of migratory values (1966–2011).

As a **conclusion**, it can be said that a temporal and spatial analysis of this phenomenon is not that simple, it depending on several facts, both local (regional) and general (all-country). Although the urban-rural flow has been increasing in the past few years, yet it would be premature to speak of a transition to urban exodus. As a matter of fact, what actually happened is the expansion of the town over its rural neighbourhood, and in some cases, the development of tourist sites revitalising the country-side. On the other hand, the economic crisis and unemployment discouraged migration to town. However, there is a great disparity between communes on the way of revitalisation, those located in the vicinity of an industrial town, or that have tourist resources, and the category of poor communes in which the demographic and economic decline is ongoing. Now, in two-thirds of the Curvature Carpathian rural space 41% of the population lives and works, and enjoy most of the region's resources. Therefore, studying the rural and the evolution of its components is of capital importance, as acknowledged also by profile authorities. So, over the past few years, the stress has been laid on promoting a rural development policy instead of an agrarian policy, the aim being also to change the direction of migration and gradually bridge the socio-economic gaps existing between town and village.

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THE EFFECTS OF EXCESS PRECIPITATION FALLEN IN THE CURVATURE SUBCARPATHIANS (ROMANIA) DURING THE WARM PERIOD OF THE YEAR. CASE-STUDY: SĂRĂȚEL AND BĂLĂNEASA DRAINAGE BASINS

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Key-words: pluvial regime, annual precipitation quantities, seasonal average quantities, monthly precipitation quantities, Buzău drainage basin.

Abstract. The present work aims at presenting the main characteristics of the pluviometric regime in the Bălăneasa and Sărățel basins, represented by the quantitative parameters of the warm season (spring-autumn). The climatic data provided by the Pătârlagele Weather Station are representative for the geographical area we are interested in. The period analysed (1961–2007) is statistically relevant in terms of climatology, covering the standard climatological period (1961–1990), the last decade of the twentieth century and the early years of the current decade which are characterized by major extreme pluvial events on a global, regional and local scale. The distribution of precipitation quantities presents value differences on various time-scales. In the annual rain regime specific to the temperate-continental climate of Romania, the quantities of the warm semester have the greatest share. For adequate decisions to be made and implemented in order to diminish the negative environmental effects of excess/deficient precipitation, the present article has been aimed at establishing the multi-annual water values in the warm semester of the year. The analysis and conclusions are based on the annual, seasonal and monthly precipitation values, highlighting the value differences, imposed mainly by the complexity of the Subcarpathian Curvature sector.

1. INTRODUCTION

The Subcarpathian sector studied is one of the most complex physical-geographical units in Romania in terms of geology, morpho-structure and intense sedimentation processes, e.g. folding, overfolding and overthrust, visible in the general landform features.

The present paper has been aimed at establishing the multi-annual water values in the warm semestre of the year, for adequate decisions to be made and implemented in order to diminish the negative environmental effects of excess/deficient precipitation.

The ISU (Inspectorate for Emergency Situations) database of 2005 (May and August), 2006 (May), 2009 (July) and 2010 (July) has been used to identify and quantify the damage produced by the exceptional pluvial events of those years.

2. MATERIAL AND METHODS

The paper uses available data from weather stations representative from a climatic point of view located in the Curvature Subcarpathian region (Pătârlagele), covering the 1961–2007 period, which also encompasses the standard climatic interval recommended by the WMO (1961–1990) for all statistical processings used in international and national climatology; the aim is to compare the results obtained. This period also includes the most intense frequency and intensity of the extreme weather events associated to the current trend of climate change. The climatic variability discussed in the present study addresses different time episodes: annual, quarterly, monthly and multi-seasonal.

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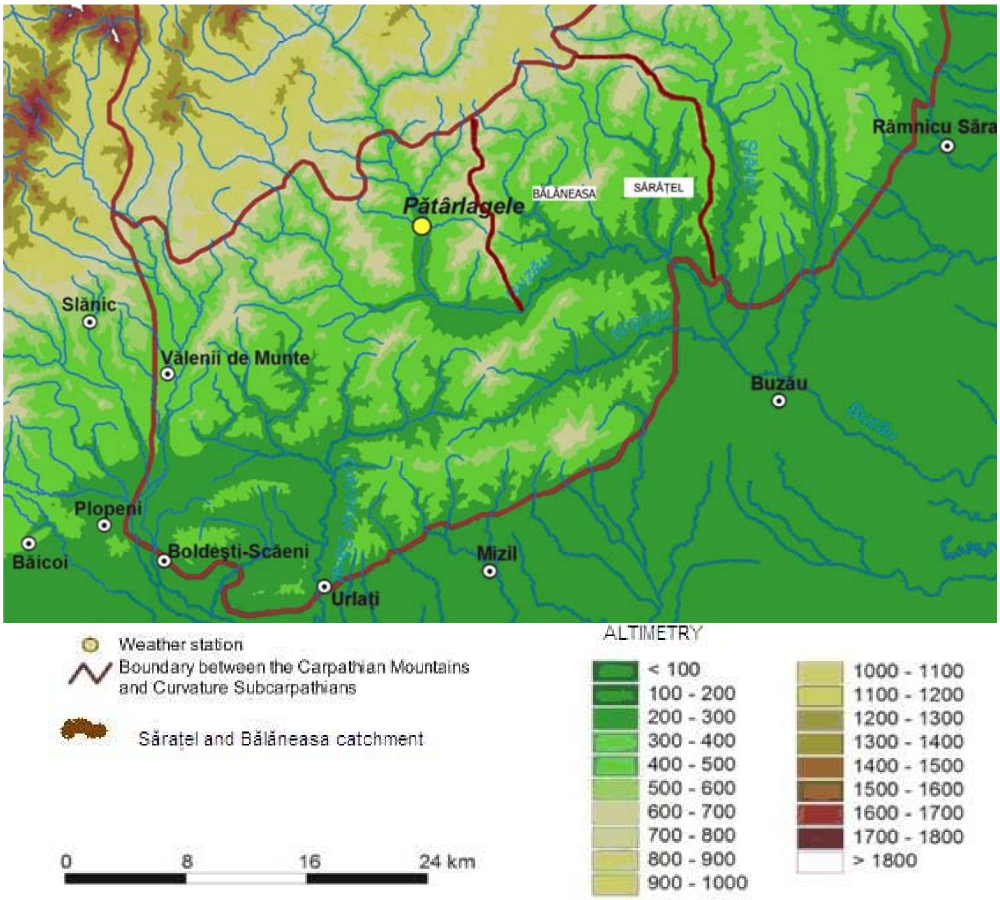
The database used was provided by the Information and Public Relations Departament of ISU Buzău.

3. RESULTS AND DISCUSSION

The moderate temperate-continental climate (Fig. 1) of the study-area corresponds to the low and high hilly regions (380–800 m). The major influence exerted by the Curvature Carpathian orographic barrier and the great incidence of foehn winds are largely involved in the distribution of the main meteorological elements and climatic phenomena, their frequency, duration and intensity being particularly relevant in the Curvature Subcarpathians.



Source: *CLAVIER – Impact of extreme events on soil erosion and the agri-environmental potential in the Curvature Carpathians and Subcarpathians, 2009.*

Fig. 1 – Study-area: geographical position and altitude.

Among the factors initiating, unleashing and/or maintaining the present-day modelling processes which control and affect land-use in this very active geomorphological region, atmospheric precipitation play a major part.

The mechanical action, exerted by precipitation alone or in conjunction with other weather phenomena, does contribute to gullying and slope modelling, producing flash- floods and overflows.

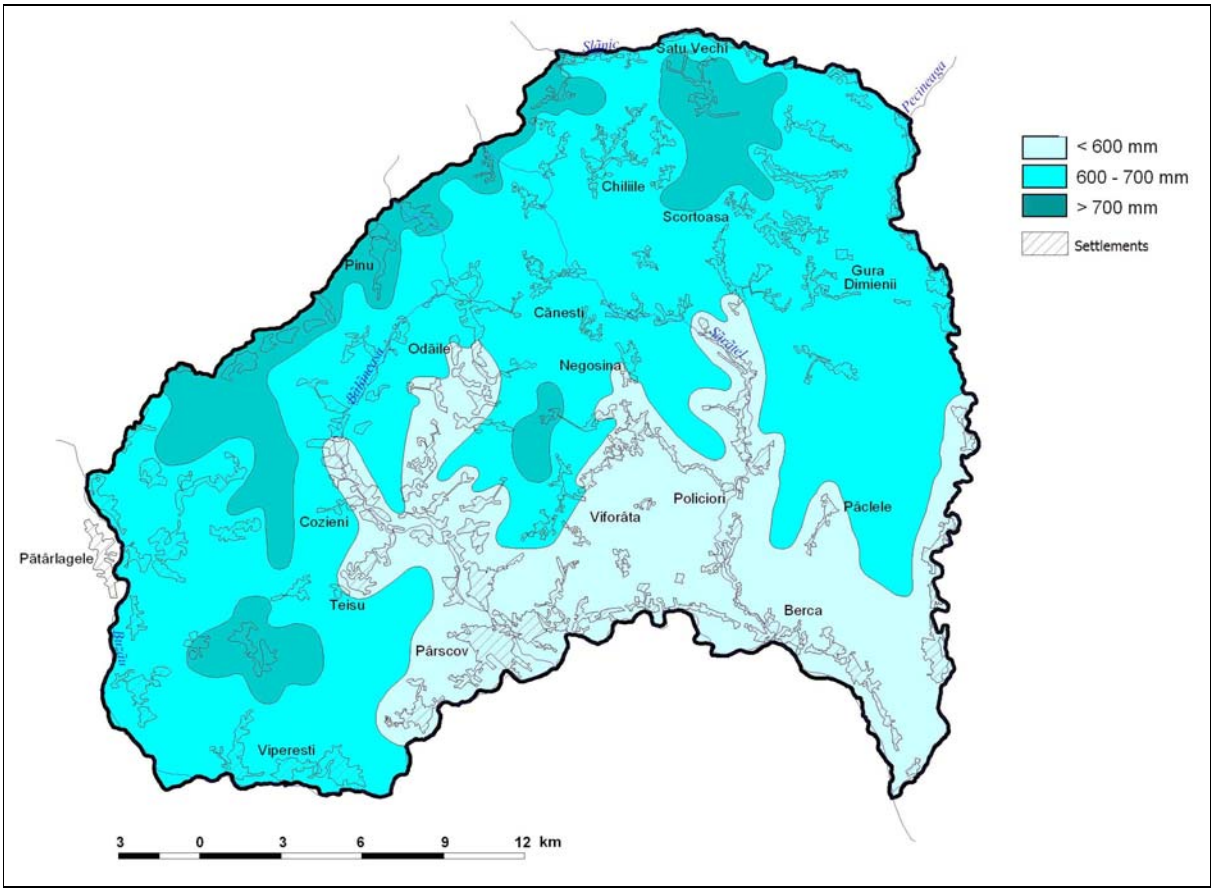
The characteristic features of the general atmospheric circulation, coupled with a specifically local subjacent surface, basically landform morphology and morphography, account for variations in the quantity of precipitation on all temporal scales.

The area's rain regime falls into distribution type IV, which means a precipitation maximum in summer (June, 93 mm) and a winter minimum (February, 30 mm) (*Clima României*, 2008).

The multi-annual pluvial regime, extremely uneven in time and space, presents contrasting values (Fig. 2). Thus, in the Sărățel and Bălăneasa basins, a multi-annual mean of 640 mm was registered in the series of observation years (1961–2007) studied. The driest years were 1972 and 2000 (386 mm and 389 mm, respectively) while 2005 was a record high rainy year (993 mm). The annual variability range does not exceed 600 mm.

Looking at the evolution of annual precipitation trends suggests that in terms of quantity (see regression line, Fig. 3) there are periods of decrease (1961–1963; 1972–1985) and of increase (1964–1974; 1988–1995; 2002–2007), delimited by a six-order polynomial regression line.

The distribution of precipitation quantities over the year shows significant value differences on various time-scales. Thus, the quantities of the warm semester have the greatest share in the annual rain regime specific to the temperate-continental climate of Romania. In the study-area, the annual averages of the warm semester are of 429 mm (67.5% semestrial ratio), with maximum variability of 525 mm between the rainiest six months in 2005 (717.4 mm) and the driest ones in 1987 (192.3 mm) (Dragotă, Grofu 2010).



Source: *Grofu, Ph.D. thesis, 2012.*

Fig. 2 – Annual average quantities of atmospheric precipitation, in the Sărățel and Bălăneasa basins (1961–2007).

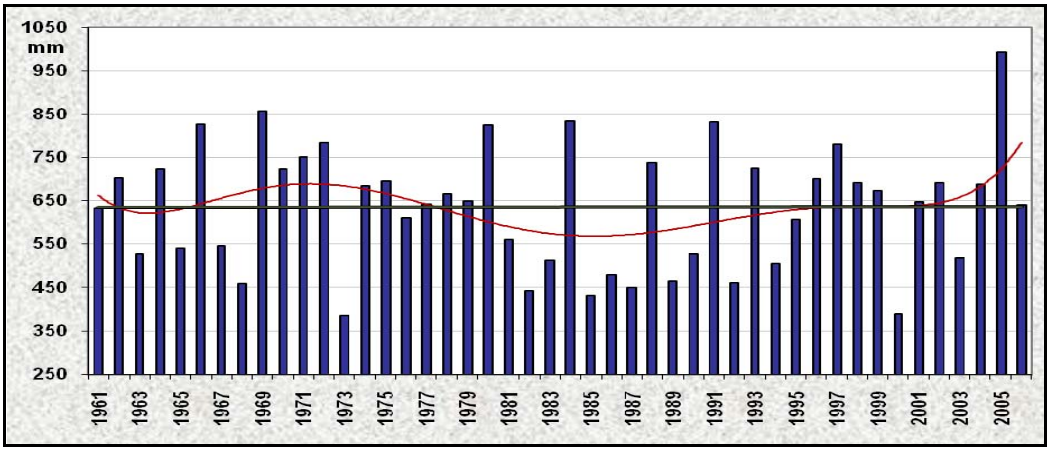


Fig. 3 – Variation in the annual quantities of precipitation (1961–2007) and variation trend, Pătârlagele Weather Station.

Viewed at country level, semestrial average quantities in the two catchments are relatively evenly distributed (400–500 mm) in terms of altitude, local modification deriving from landform configuration, position and orientation versus the local circulation, micro- and topoclimatic conditions, etc.

In 2005, a historical record year in the hierarchy of rainy years in Romania, the country was affected by six flooding episodes in the warm season and one more in November. These months are representative flood years for the study-area:

May 7. The Buzău ISU Demage Report reads: 5.5 km of road on county road DJ 103 that links the settlements situated in the north of the study-area; 5 bridges, two of which completely destroyed, leaving 370 households with 1,700 inhabitants isolated, 80% unpaved village roads, 150 flooded households and7 households without electricity.

August: 20 flood-affected settlements between the towns of Buzău and Slănic, 4 schools at Pănătău and Chiojdu, two schools and a kindergarten at Cătina; 60 flooded households, 10 wells and 4 villages isolated, traffic on County Road (DJ) 102 L blocked by alluvia and mass movements in 5 points.

A second rain-induced flood event hit Pănătău once again. Falls lasted around 3 ½ hrs; flood waves destroyed part of the county rood linking Pănătău to Pătârlagele Town; 18 localities had no electricity that night.

In Buzău County, the floods of 2005 affected 53 localities. It is the case of : Beceni, Berca, Buzău, Bozioru, Buda, Bisoca, Breaza, Cătina, Căneşti, Calvini, Cernăteşti, Chiojdu, Colţi, Cislău, Costeşti, Cozieni, Gherăseni, Lopătari, Luciu, Mărăcineni, Merei, Mânzăleşti, Murgeşti, Mărgăriteşti, Movila Banului, Nehoiu, Năieni, Odăile, Pănătău, Pătârlagele, Pâscov, Pardoşi, Puieşti, Poşta Câlnău, Racoviţeni, Râmnicelu, Râmnicu Sărat, Siriu, Scorţoasa, Săhăteni, Săpoca, Stâlpu, Săruleşti, Topliceni, Ţinteşti, Tisău, Ulmeni, Valea Salciei, Vintilă Vodă, Verneşti, Vipereşti and Zărneşti (ISU Buzău).

That same year, there were situations when the Sărăţel and Bălăneasa basins were ready to overflow:

– February 22–25 (heavy precipitation and increased discharge on the Bălăneasa Stream);
– May 6–8 (heavy rains, run-off on slopes);
– May 30–31 (heavy rains and hail);
– July 6–22 (heavy rains and run-of on slopes).

Time sequences in the warm semester of the year and multi-annual average seasonal quantities were determined by the Musset-Gaussen Index (Summer-Spring-Autumn-Winter). The findings have revealed a main pluvial maximum in July–August and an annual minimum in December–February, emphasising the dominance of the powerful Summer–Spring sequence (Table 1).

Table 1

The Musset-Gaussen index values.

Musset-Gaussen Index (IM–G)		
Season	Multi-annual average quantity of precipitation (mm)	Index IM–G
Summer	**257.8**	**S.S.A.W.**
Spring	**151.2**	
Autumn	129.2	
Winter	97.4	

So, the multi-annual average summer quantities in the two catchments reached a seasonal maximum of 405.8 mm in summer 1991 and a minimum of 82 mm in summer 1965 fluctuating around a multi-annual average of 257.8 mm. These precipitations occur in the conditions of maximum thermodynamic convection over the year, destabilising the masses of air and intensifying cyclonic activity alongside the polar front, especially in June. The rate of evolution of summer precipitation amounts in the study-areas is positive (Fig. 4).

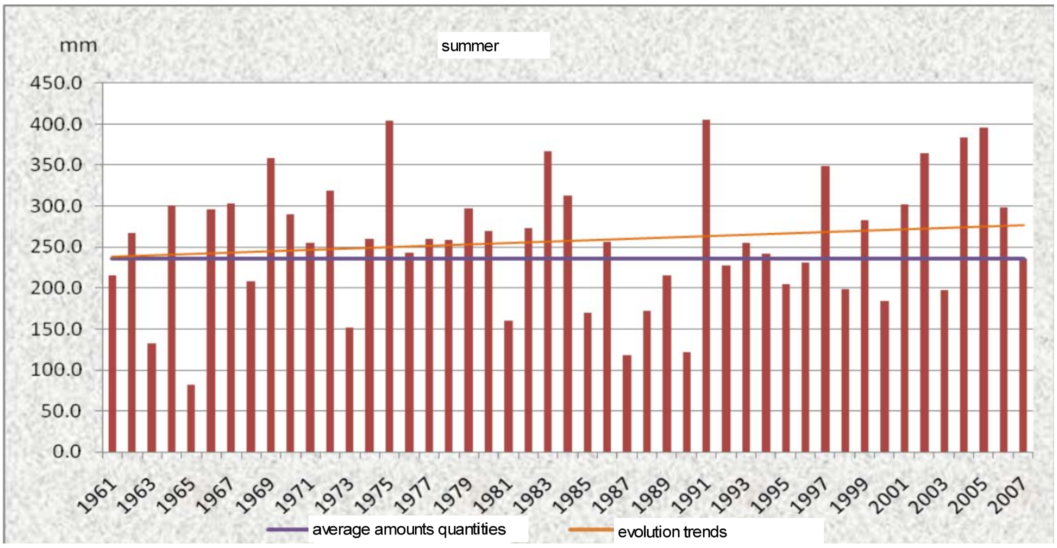


Fig. 4 – Multi-annual average seasonal precipitation amounts in summer, Pătârlagele Weather Station.

July 2009

That year was rich in summer precipitation with overflows in several regions of Romania. Buzău County in July: 5 villages isolated, over 30 households flooded, scores of wells silted, two communal roads (Bădila–Palici and Ursoaia–Ruşavăţu) alluvia – covered and destroyed. Pănătău Commune: isolated villages (Râpele, Zahareşti, Măguricea, Tega and Mânăstirea; Nehoiu Town: four households flooded at km. 69 on National Road (DN), 10 km blocked by a landslide. Tisău: seven households flooded, and several wells silted; similar problems in Bădila Village, Pârscov Commune; traffic blocked by alluvia and boulders on DN 10 Buzău–Braşov, close to Siriu Water–Power Station.

July 2010

Short-term heavy rainfall and hazardous hydro-meteorological phenomena triggered landslides and floods in the administrative territory of Pătârlagele Town and adjacent villages:

– Natural Park DN 10, at Criveni outside Pătârlagele was completely blocked by alluvia over a distance of 1 km, traffic stopped in both directions;

– Communal Road (DC 91) between Pătârlagele and Valea Muscelului, was destroyed by a rain-triggered landslide over a distance of 40 m (at Toma point), people having to go on foot to the 200 households in the proximity;

– Communal Road DC 69 between Pătârlagele and Colți was covered by alluvia over a distance of 1 km;

– a concrete dam on the Muscel Brook (facing Fundăturile Village) was destroyed;

– a number of 44 households in Pătârlagele Town and a church in Sibiciu de Sus Village were affected.

(Source: *Information and Public Relations Department, ISU Buzău, July 13, 2010).*

In springtime, the multi-annual average rain regime cumulated more than 150 mm, that is about 24% of the total multi-annual average. This situation is the result of increased air and implicitly soil temperatures, reflected by thermal convection, overlapping a more active evolution generated by pressure differences between masses of interacting oceanic and continental air. The maximum seasonal variability range was 335.9 mm (spring 1988) and only 45.4 mm (spring 1968), the trends in the evolution of spring rain quantities indicating a decrease (Fig. 5).

22 May 2006, torrential rainfalls, scores of flooded houses and cellars, silted wells, hail-bitten vineyard in 4 communes: Cislău, Cătina, Vipereşti, and Siriu. In Cislău 13 houses and 11 cellars flooded, 15 silted wells; 30 homesteads overflown; Cătina: county road (DJ) 102B sank over a distance of 100 m at 500 m from Zeletin and 4 silted wells; Vipereşti: four houses flooded; DN 10 blocked by run-off from slopes. Disrupted telephone service in Buzău, Pătârlagele, Calvini, Pietroasa, Cătina, Nehoiu and Cislău; Merei: large cultivated terrains and vineyards bitten by hail (source: USI Buzău Report).

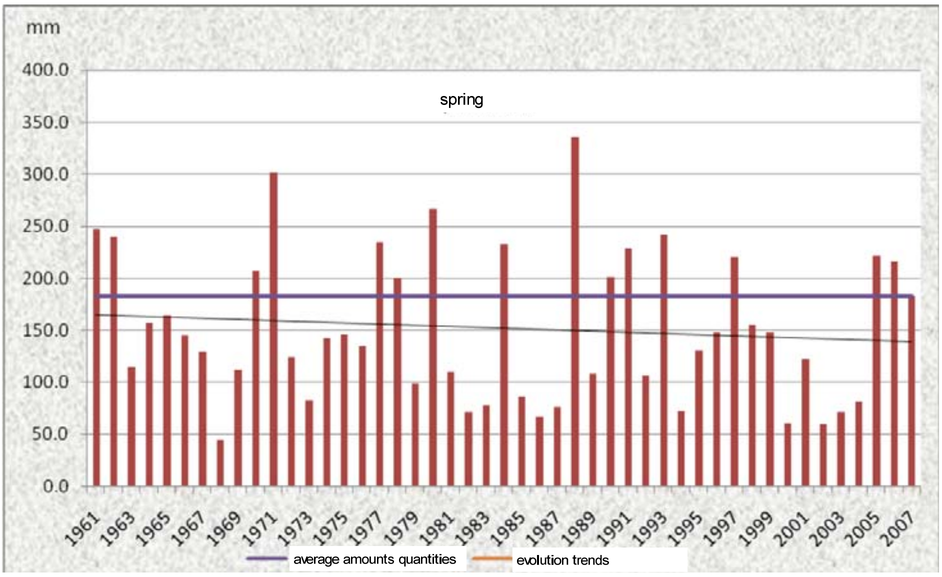


Fig. 5 – Multi-annual average seasonal (spring) amounts of precipitation, Pătârlagele Weather Station.

Autumn precipitation amounts are significantly lower as anticyclonic pressure fields are prevailing. At Pătârlagele Station, the multi-annual seasonal average was of 129.2 mm (20.3%). In the studied Subcarpathian areas, highest quantities (270.2 mm) were registered in 1972, the lowest ones (44.9 mm) in 1967, seasonal evolution trends being positive (Fig. 6).

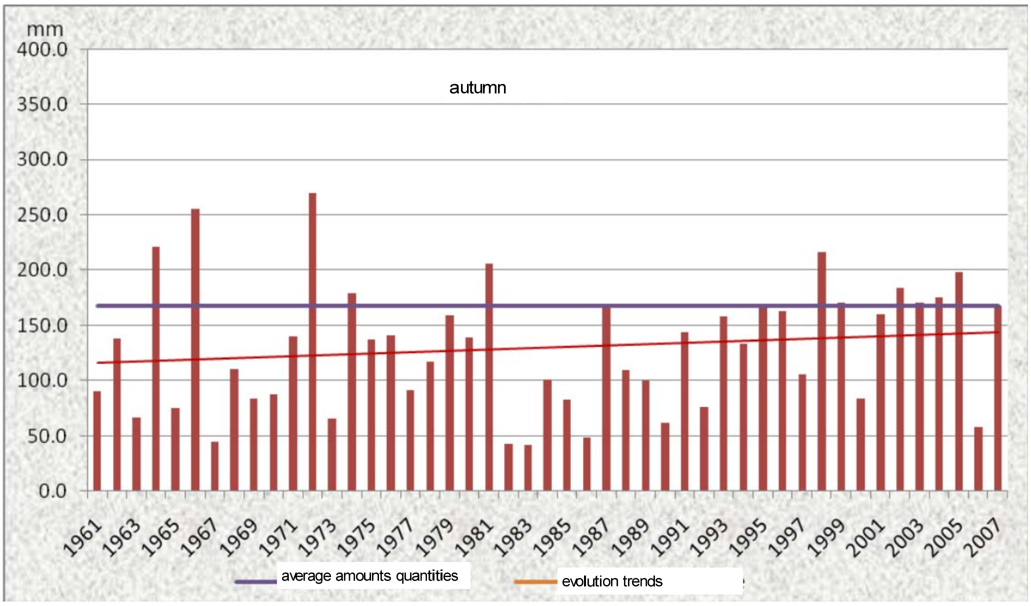


Fig. 6 – Multi-annual average autumn quantities of precipitation, Pătârlagele Weather Station.

In the warm semestre of the year (between April and September) the monthly variability of cumulated quantities was very high, as revealed by differences between maximum and minimum values (282.5 mm, July 1975 and 0.1 mm, August 1962, respectively). The row of observation years showed no year completely free of precipitation in the warm season.

June is the month of the main annual rain maximum, with multi-annual average amounts of 90.8 mm, that is 14.3% of the overall annual quantities (635.1 mm).

June rainfalls in the Subcarpathian study-area had a slightly deficitary evolution yet not statistically significant (Pătârlagele -3.5 mm/47 years) (Fig. 7) (Dragotă, 2010).

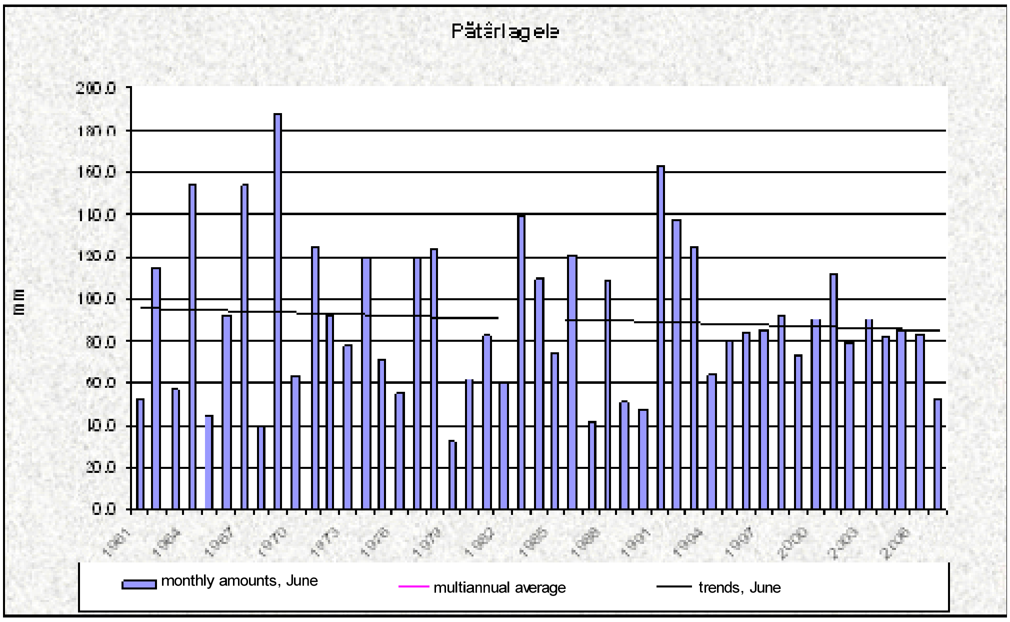


Fig.7 – Multi-annual monthly average amounts of June rainfalls, Pătârlagele Weather Station.

A representative pluvial semester in terms of cumulated quantities, duration and intensity of rain, the degree of continentalism in the region is also discussed. "The Köppen Index [KI=PP(year) /T (year)+7]" quantifies this element by associating the annual precipitation amounts with the annual air temperature regime in Romania. The findings have revealed the following values:

– KI values below 30 units in the plain and lower hilly regions of the south, east, extreme wet being designated by high continentalism;

– KI values of 30–50 units in hillsides and tablelands indicate moderate continentalism;

–KI values over 75 units stand for weak continentalism.

In the Sărățel and Bălăneasa catchments, KI values of 30–60 units indicated moderate-to-weak continentalism (Fig. 8).

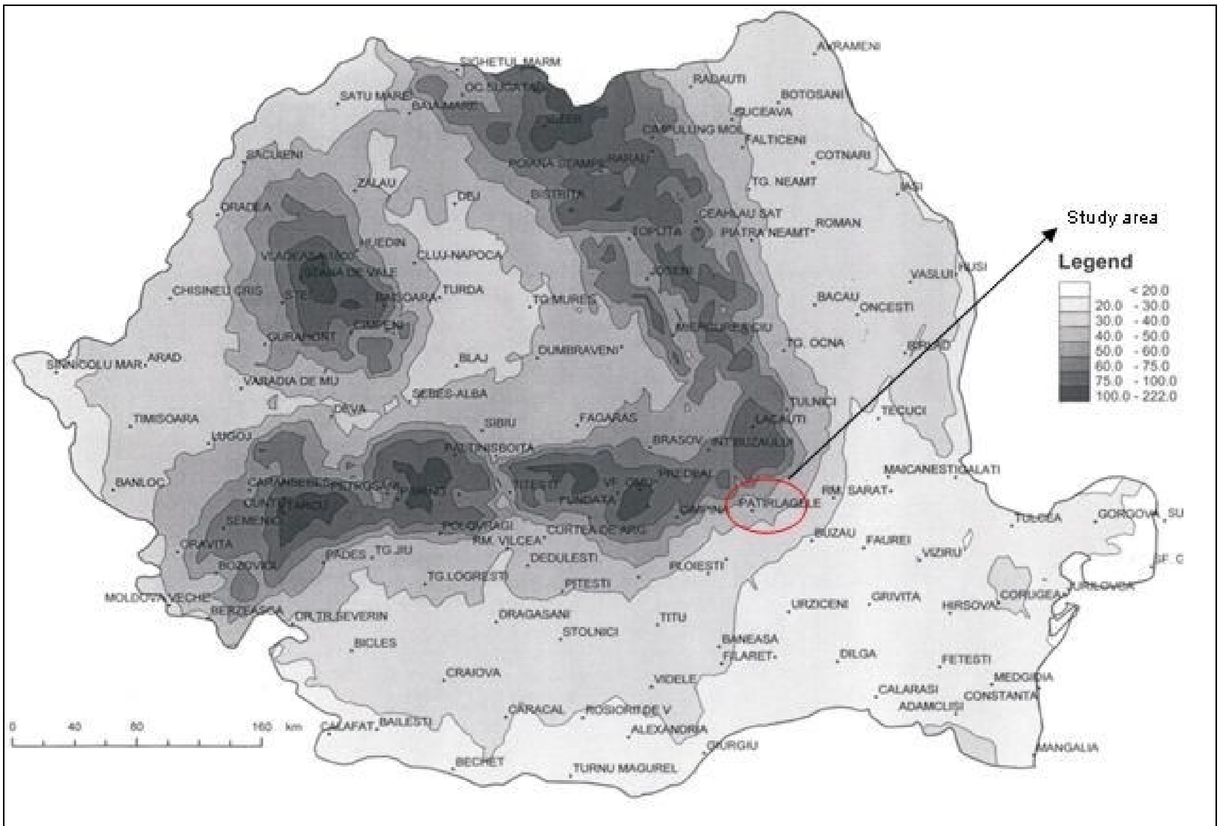


Fig. 8 – Köppen Index values in Romania (A. Dumitrescu *et al.*, 2005).

Summing up we would say that analysing the total quantities of precipitation fallen in the warm semester and their variability trends in the Sărățel and Bălăneasa basins over 1961–2007 has revealed important value aspects. These precipitation have a major impact on present-day slope dynamics and land-use, which are extremely sensitive to any climatic variation, primarily having in view the pluvial regime, and the effects of general climate warming in Romania.

As a result, the following aspects are worth outlining:

– continentalism in the Sărățel and Bălăneasa catchments is moderate-to-weak, also decreasing with altitude (KI values);

– the main climate-related hazards in the warm semester are flash-floods in small catchments, triggering flood events (especially due to the June-July annual pluvial maximum), frontal and convective rains associated with high winds and storms; here and there, moderate droughts and aridisation phenomena also occur, mostly between August and September, an aspect not tackled in this paper;

– the high precipitation rates in the warm semester call for the correct management of rain sources in order to reveal the negative effects of excess/deficient precipitation amounts;

– the case-studies chosen are significant for recent years, indicating some segments of the pluvial regime in the warm semester in which highest quantities, that have an essential impact on the environment, are recorded. The damage caused by excess precipitation affected both slopes and stream channels, producing important material losses.

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EUROPEAN GEOSCIENCES UNION – GENERAL ASSEMBLY 2013 APRIL 7–12, VIENNA, AUSTRIA

The European Geosciences Union (EGU) is the greatest geosciences union of Europe (over 12,500 members), the initiatives of which aim at strengthening the geoscience community by promoting the cooperation between scientists and advancing scientific research of excellence in geosciences, planetary and space sciences. It was established in September 2002 as a merger of the European Geophysical Society (EGS) and the European Union of Geosciences (EUG). The EGU publishes 15 open-access journals, and organizes meetings, education and outreach activities. Its annual General Assembly is the largest geosciences conference in Europe, attracting over 11,000 scientists; organized in over 500 sessions it includes an average of around 4,500 oral presentations and over 9,000 posters.

The EGU General Assembly in 2013 was attended by 11,167 scientists from 95 countries (including Romania – 79 researchers). The Conference program scheduled 448 scientific sessions, 96 Poster Summaries & Discussions, as well as 143 side-events (e.g. the launch of the Light Optical Aerosol Counter, which measured aerosol profiles up to 100 m twice a day at 10:30 and 15:30, in front of the main building of the Austria Center Vienna). The event numbered 4,684 oral presentations, 8,207 posters, and for the very first time, 452 PICO (Presenting Interactive Content) presentations. The meeting included 10 Union sessions (e.g. the EGU Awards Ceremony (Great Debates, Medal Lectures, Keynote Lectures, Short Courses, Geo Cinema) and addressed a wide range of topics grouped into 25 core Scientific Divisions (e.g. Atmospheric Sciences; Cryospheric Sciences; Energy, Resources and Environment; Geomorphology, Hydrological Sciences, Seismology, Natural Hazards). The Conference provided good opportunities for building fulfilling careers for young scientists and students and supporting them to be in the mainstream of geoscience research by attending meetings, round tables open discussions with key experts and leading scientists, the young geoscientist forum and network, mentoring schemes, short courses for acquiring knowledge and new skills (e.g. non-linear time series analysis, applying the Fast Fournier Transformation), workshops (e.g. open access to publishing, how to apply for a job), and the job market. In 2013, the EGU has teamed up with UNESCO to take the GIFT (Geosciences Information for Teachers) workshop to Africa, aiming at sharing the latest scientific findings in geosciences beyond the European borders. The GIFT workshop gathered more than 1,000 science teachers, the debates addressing the greatest challenges in Earth Sciences (e.g. traditional mineral extraction versus environmental management, climate change adaptation, prevention of natural hazards, ensuring access to drinking water).

The scientific results of participants in the EGU Conference are encouraged to be published within the EGU open-access peer-reviewed journals, which are included in its current portfolio (e.g. Earth Surface Dynamics, The Cryosphere, Climate of the Past, Biogeosciences, Natural Hazards and Earth System Sciences, Hydrology and Earth System Sciences). The impact factor of the EGU journals (in 2013) ranged between 1.37 and 5.51.

The Institute of Geography of the Romanian Academy was represented by nine researchers who gave presentations at four scientific sessions of the EGU Conference, namely: Natural hazards – *Uncertainty associated within regional landslide risk analysis – a case study in Buzău County, Romania* (V. Zumpano, R. Ciurean, **M. Micu, D. Bălteanu** and T. Glade), *Comparing the predictive capability of landslide susceptibility models in three different study areas using the Weights of Evidence technique* (H. Hussin, V. Zumpano, S. Sterlacchini, P. Reichenbach, **D. Bălteanu, M. Micu**, G. Bordogna and M. Cugini); Cryospheric Science – *Snow line analysis in the Romanian Carpathians under the influence of winter warming* (**D. Micu** and I. Şandric); Climate: Past, present, future – *Climate services for an urban area (Baia Mare City, Romania) with a focus on climate extremes* (**M. Sima**, **D. Micu, C-S. Dragotă** and **S. Mihalache**); Soil System Sciences – *Climate change adaptation options for sustainable management of agriculture in the Eastern Lower Danube Plain, Romania* (**E-A. Popovici, M. Sima, D. Bălteanu, C-S. Dragotă, I. Grigorescu** and **Gh. Kucsicsa**).

The next EGU General Assembly will take place in Vienna (Austria), between April 27 and May 02, 2014.

Dana Micu

Rev. Roum. Géogr./Rom. Journ. Geogr., **57**, (2), p. 163–165, 2013, Bucureşti.

6^{TH} INTERNATIONAL SYMPOSIUM ON GULLY EROSION IN A CHANGING WORLD (6^{th} ISGE) MAY 6–12, 2013, IAŞI, ROMANIA

The international symposiums on gully erosion have been organized every two or three years since the first edition held in 2000 in Belgium: 2002 in China, 2004 in the USA, 2007 in Spain and 2010 in Poland. Their aim has been to encourage the understanding of gully erosion and its controlling factors.

The 6^{th} International Symposium on Gully Erosion was held in Iaşi on 06–12 May 2013. The task of organizing this edition was attributed to the Department of Geography of the "Alexandru Ioan Cuza" University of Iaşi. Besides, the event evolved under the auspices of the International Association of Geomorphologists, the Association of Romanian Geomorphologists and the European Society for Soil Conservation. The meeting was chaired by Prof Ion Ioniță (Dept. of Geography, Faculty of Geography and Geology, "Al. I. Cuza" University of Iaşi, Romania) and co-chaired by Prof. Jean Poesen (Head Division of Geography, Dept. of Earth and Environmental Sciences, KU Leuven, Belgium).

This edition's topic has been *Gully Erosion in a Changing World* with the focus on promoting communication and exchange of scientific knowledge on gullies, identifying existing gaps in their research and discussing better management practices for land under the threat of gullies in the context of climate change and human pressure.

The symposium was attended by almost 50 participants coming from 21 different countries. Among them Prof. J. Poesen (Belgium), Prof. M.A. Fullen (UK), Dr. W. Zglobicki (Poland), Prof. S.J. Bennett (USA), Prof. D. Torri (Italy), Prof. J. Casali (Spain), Prof. D. Bălteanu (Romania).

The scientific meeting was divided in several parts. Two days were devoted to oral and poster presentations. Other three days were occupied by scientific field trips and one post-conference excursion. The first two scientific field trips allowed participants to discover the characteristic features (causes, rates of activity in time, mechanisms) of mainly valley-bottom-type gullies in the Bârlad Plateau, as well as those of small discontinuous gullies of valley-sides in the Jijia Rolling Plain. The post-conference excursion crossed the Moldavian Subcarpathians and the Eastern Carpathians of Romania. Landforms in relation to the morphostructural units, present-day geomorphic processes as well as environmental issues raised by the presence of the Izvoru Muntelui and the Bicaz reservoirs were in the center of discussions.

On the 9^{th} of May a special ceremony was organized, as part of the symposium, at the Senate of the "Alexandru Ioan Cuza" University of Iaşi. The aim of it was to offer Prof. Jean Poesen (Katholic University of Leuven, Belgium), President of the Belgian Association of Geomorphologists, the title of *Honorary Professor of the "Alexandru Ioan Cuza" University of Iaşi* for his outstanding research in the field of geomorphological processes, soil erosion and soil and water conservation.

Marta Jurchescu

THE 8th INTERNATIONAL CONFERENCE ON GEOMORPHOLOGY OF THE INTERNATIONAL ASSOCIATION OF GEOMORPHOLOGISTS (IAG) "*GEOMORPHOLOGY AND SUSTAINABILITY*", AUGUST 27–31, 2013, PARIS, FRANCE

Between August 27–31, 2013, more than 1,500 participants worldwide gathered in Paris at the Cité des Sciences de La Villette for the 8th International Conference on Geomorphology of the International Association of Geomorphologists (IAG). Entitled "*Geomorphology and Sustainability*", the Conference was co-organized by the Groupe Français de Géomorphologie (GFG) and it was opened to all scientists and practitioners in geomorphology and connected sciences. The Conference included 26 scientific sessions, one open session, 5 keynote lectures and one Workshop devoted to Young Geomorphologists. Beside the numerous scientific sessions, the organizers presented a wide variety of scientific excursions (3 pre-Conference, 7 mid-Conference, 13 post-Conference) in both France and neighboring countries (Belgium, Switzerland, Spain).

The sessions covered a broad range of topics, focusing on both theoretical and fundamental (history and epistemology of geomorphology, geomorphology and earth system science, planetary geomorphology, mega-geomorphology, methods in Geomorphology) and practical, applied issues (hillslope processes and mass movements, fluvial geomorphology and river management, methods for landslide hazard and risk assessment). An important part was devoted to the anthropocene geomorphology and its relationships with history (geoarcheology) or ecology (human impacts on landscape, geoconservation and geoturism). The numerous devastating events occurred worldwide during the last 3-4 years (earthquakes, large floods and tsunamis, massive landslides, hurricanes) were approached within the sections devoted to geomorphic hazards, risk management and climate change impact. The increased demand of online scientific services or interactive solutions gathered numerous presentations focusing on modelling in geomorphology, remote sensing, radar and laser scanning, statistics in geomorphology, applied geomorphological mapping, DEMs, GIS and spatial analysis.

The Romanian geomorphologists had an active participation, the representatives of the Universities of Bucharest, Cluj-Napoca, Timişoara, Suceava, Iași presenting issues related to slope processes, periglacial geomorphology, coastal geomorphology, landslide and flood hazard, causes and consequences, human-induced hazards. The Institute of Geography of the Romanian Academy was involved, besides scientific presentations, in the organization of the event at the level of Scientific Committee and Scientific Session Convening.

Mihai Micu

Maria Nedealcov (2012), *Resursele agroclimatice în contextul schimbărilor de climă* (Agroclimatic resources and climate change), Institute of Ecology and Geography, Academy of Sciences of the Republic of Moldova, Chişinău, 306 p., 5 chaps., 18 subchap., 82 figs., 47 tabs., 314 references, conclusions and practical recommendations, summary in Romanian, Russian and English.

Maria Nedealcov is one the outstanding personalities of the Institute of Ecology and Geography in Chişinău. The close collaboration between the late Tatiana Constantinov, a Member of the Academy and director of the Institute of Geography in the Republic of Moldova, and renowned geographer and climatologist with preoccupations for agroclimatology and a very good specialist in this science.

Her preoccupations were of great theoretical, methodological and practical relevance, moreover so, as the climate of her country raises numerous problems for agricultural crops. Lying at a cross-roads, the Republic of Moldova experiences the passage of hot tropical masses of air in summer, obviously entailing numerous meteo-climatic risks (mainly soil moisture deficit, dryness and drought) and of cold polar or arctic air in winter with severe meteo-climatic phenomena in that season (high occurrence frequency and duration of frost-freeze and very low temperatures are a major risk for crops).

Since nowdays climatic variability has been increasing and extreme climatic phenomena are more and more frequent, Nedealcov's studies are of great topicality. Thus, the sustainable development of agriculture is of consequence for assessing a country's agroclimatic potential within the context of possible climate changes.

The author's over two-decades-long experience of field and lab research corried out with interest and passion led her to valuable conclusions regarding the agroclimatic potential in the Republic of Moldova, where productions are affected by the ever higher incidence of climate risk phenomena.

Maria Nedealcov was the first researcher in the specialist literature to elaborate a new methodology for evaluating and regionalising agroclimatic potential in the conditions of climate warming, based on complex heat indices (minimum temperature with 10% assurance, duration of freeze and freeze-free intervals, the sum of >10ºC active temperatures and the number of days with >5ºC temperatures), humidity indexes (annual quantities of precipitation, the sum of annual precipitation in the warm and the cold seasons, Seleaninov's water-temperature coefficient and snow depth) instead of generalised agroclimatic indexes (only temperature and precipitation) which do not accurately reflect the degree of agroclimatic favourability in the new climate change conditions.

So, the author provides the theoretical and practical bases to assess agroclimatic resources and study the intensity of climate risk phenomena, such as aridisation, freezing etc., as well as climatic favourability for various crops, especially fruit, climate warming in her country requires adapting crops to the new conditions and finding new frost-resistant varieties.

The new methodology proposed by the author referring to the regionalisation of the agroclimatic potential is based on GIS – scaling of climatic favourability (from 1 to 4) of heat and humidity sources using the previously-mentioned complex indexes to appraise agricultural lands, an extremely useful approach applicable at national, regional and local levels. Maria Nedealcov's merit is also to have worked out the first freeze and drought regionalisation maps, having in view both local geographical factors (position, altitude, slope aspect, slope declivity and fragmentation grade) and climatic factors by resorting to a wide range of risk intensity indexes regarding the most hazardous situations: freezing frosts in early autumn and late spring with temperatures of -5ºC, the lowest temperatures that allow to estimate crops unpairment level; the probability for hazardous freezing (-5ºC) to occur every 10 years and vulnerability grades, e.g. frost-sensitive vine varieties, up to critical unpairment temperatures of ≤-17ºC, relatively frost-resistant varieties up to ≤-22ºC and varieties resistant at temperature of -25ºC.

The superposition of climatic thematic layers over the digital elevation model of the region led to estimating frost and drought vulnerability grade in various units.

The authors's researches show that ever severer climate warming will make the southern zone, with active temperatures of >10ºC, to slightly shift to the north, hence lower freezing risk for some thermophilic plants, such as late vine varieties, some fruit-trees and mild for maize and sun-flower.

These fundings were helpful in outlining areas of climatic optimum and climatic risk for fruit-trees, vine crops and some agricultural plants, with a view to achieving sustainable development in agriculture. The author had already made these maps available for the local authorities and profile research institutions.

To sum up, we wish to stress once again the great many original theoretical, methodological and practical contributions made to agroclimatology by the communications delivered in foreign languages winning Maria Nedealcov natural and international notoriety and the title of Doctor Habilitatus of Geography/Climatology – Agroclimatology after having written this volume.

In specialist studies, this work is a model of agroclimatic approach, a practical working-tool in organising agricultural lands, and a landmark for future profile researches.

Octavia Bogdan

Rev. Roum. Géogr./Rom. Journ. Geogr., **57**, (2), p. 167–169, 2013, Bucureşti.

Thede Kahl, Larisa Schippel (eds.), *Leben in der Wirtschaftskrise – Ein Dauerzustand?*, in the series Forum: Rumänien, 12, Frank & Timme, Berlin, Germany, 2011, 236p., ISBN 978-3-86596-395-6

Since 2003, every year in Vienna a meeting called *Forum: România* takes place, at the core of which lie debates on Romanian topics, humanist regional studies on Romania. This forum on Romanian research, also materialized in a series of publications called *Forum: Rumänien*, is meant to help in a better understanding of mentalities and cultures and in facilitating political relations.

The event of its 8th edition, in 2010, was devoted to the topic of the *crisis*. More precisely, the need was sensed of adding to the widely available economical analysis of the crisis other researches from the point of view of the human and cultural sciences.

This volume gathers a series of studies brought about by the 2010 edition of the *Forum: România* and undertaken by researchers in the fields of sociology, history, literature sciences, economical geography, law, political sciences and educational sciences. The book provides, therefore, a multidisciplinary view on the different effects of the economical crisis and the particularities of its manifestations in the Romanian environment.

Already in the introduction, the editors Thede Kahl and Larisa Schippel draw the attention to the very concept of *crisis,* which is defined, in the context of social transformations, as exceptional situations of social nature. Such a definition renders the use of the notion very difficult when referring to Romania where economical problems are long lasting ones. On the other hand, the crisis hit in 2008, i.e. in a moment when Romania had just been recording some progresses, which justifies an inquiry into the various effects of the crisis.

The contributions in this volume aim to investigate on the role of long-term and constant causes favoring the predisposition of a society to being affected by crisis, as well as on the effects of the new inclusion of Romania into international structures. At the question, if, besides the causes of the global and European economic crisis, there were also other, internal causes acting on the long-term and demonstrating their effects at present, three main categories of causes are distinguished by A. Sterbling in case of Romania: i) the deficiency in achieving democracy after 1990; ii) the profound moral crisis as an inheritance of the late Ceauşescu regime and iii) the institutional deformation as a consequence of particularistic orientation of actions and partial modernization. Investigated crisis manifestations range in time from the recent post-communist period to the former communist period and even to older historical times. Aspects of the crisis in Romania are discussed in relation to: the role of Romanian intellectuals on the political thinking, the real estate transactions, the directions of cinema after 1989, the public space and urban life, education and universities, the evolution of the New Right in areas occupied by Hungarians, cultural institutions, the Constanța harbor etc.

The editors of this book have a large research experience in East-European studies. Thede Kahl studied geography, Byzantine studies and Slavistics in Münster, Köln and Hamburg and has done research in all the countries of East and South-East Europe. He currently works as Professor for South Slavic studies at the Friedrich-Schiller University of Jena. Larisa Schippel studied both in Berlin and Bucharest Romanian and Russian translational studies. At present she holds a Professor position at the Centre for Translation Studies of the University of Vienna teaching transcultural communication. The authors of the various papers are coming either from Romania or from Germany or Austria, but most of them have studied in both Romania and a German country. They have backgrounds in various domains of humanistic sciences, with a special focus on Romania, the Balkan region or Eastern Europe.

Most of the texts are published in German, representing either original versions or translations, but there are also some chapters available in Romanian or English, which make the book easily accessible for a wide range of readers.

Marta Jurchescu

Ion Zăvoianu, Gheorghe Herişanu, Cornelia Marin, Nicolae Cruceru, Mihai Parichi, Florin Vartolomei (2011), *Relații cantitative între producția de aluviuni în suspensie şi factorii de mediu/Quantitative relationships between suspended sediment yield and environmental factors*, Edit. Transversal, Bucureşti, 321 p., bilingual text Romanian-English, 3 chaps., 135 figs. and colour photos,13 tables, bibliography.

The present work, co-ordinated by Prof. I. Zăvoianu Ph.D; reflects the research activity of the Faculty of Geography Staff, ”Spiru Haret” University, over the 2009-2011 period under PN II-IDEI Project 631/2008. The project, financed by CNCSIS-UEFISCDI[1] had in view the elaboration of Models of suspended sediment yield in terms of rock, soil and land use in representative basins.

The working methodology proceeds from hierarchising Horton-Strahler's classification of the network of stream segments by calculating their length and level differences between source and confluence. The data-rows thus obstained were

[1] National Council of Sicentific Research – Executive Agency for Higher Education, Research, Development and Innovation Funding

used to set the laws of morphometric drainage and slope models for the whole basin and its sub-basins in which water-gause stations measure the yield of water discharge and of suspended sediment load.

Sediment discharge, indicating intensity of erosion and depleted soil quality, had been studied also by other Romanian and foreign researches, but the novelty of this work is the interdisciplinary approach to in quantifying the contribution to suspended sediment yield of each factor of the environment the drainage basins are located in. The present work, written in a modern style, based on reliable observation data provided by water-gange stations over a 30-year period and GIS-processed, has three parts, bassicaly chapters of some 100 pages each.

Part One discusses the methodology (already presented above), a novel element being the use for the first time in Romania of a smithammer in order to asses rock resistance-dependence (especially on consolidated rocks) of alluvial discharge (the lihtological substrate is considered of great consequence) and the development of a new methodology for the classification of the stream network and of drainage basins.

Part Two enlarges upon a case-study, the well idividualised, that includes Bârlad Basin, 13 sub-basins supplied with measuring devices for maximum sediment flow, particularly during flood waves.

Another element of novelty in geographical research is the determination of some morphometric variables not only of stream network and drainage basins, but also of the basin's geomorphological units. This enables a better insight into sediment flow in these units. In this away, a drainage model of stream segment slopes was created and applied to three of the basin's units: the Central Moldavian Plateau, the Tutova Hills and the Fălciu Hills.

Part Three deals with sediment discharge in the representative drainage basins of Romania, with highlight on the connections between average drainage basin elevation and the resistance grade of the respective geological surface formations, e.g. metamorphic, magmatic and sedimentary rocks in the Carpathians, Subcarpathians and the tableland area.

Using maps of solid sediment flow and distribution of specific average discharge previously elaborated, the authors conclude that sediment flow is not subjected to altitude-imposed vertical steps, like the other environmental factors are.

Analysing the relation between sediment discharge and some elements of the physical environment (e.g. the connection between water flows and drainage basin surfaces, between suspended sediment load and the total length of stream segments, as well as between suspended sediment load and the total number of stream segments etc.), the authors came to the conclusion that the best relations characterising suspended sediment flows are those designating the total number of stream segments which influence the formation of the sediment stock, on condition that determining generalisation relations is based on drainage systems or geomorphological units. This is necesary in order to obtain high-value determination coefficients, a priority for research in Romania and the world.

As a conclusion, the morphological elements of the stream network are directly involved in sizing sediment discharge (dependent on environmental factors: rock, vegetation, soil, land use, etc.) and can be used in predicting them. The research carried out in this direction proves the contribution of the research team co-ordinated by Professor I. Zăvoianu to the development of hydrology in Romania and on the globe.

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