Preliminary research on air temperature in the Prut River valley between Oroftiana and Stânca-Costești

Recherches préliminaires sur la température de l'air dans la vallée de la rivière Prut entre Oroftiana et Stânca-Costești

Ciprian Ionuț ADAM[1,2] *, Dumitru MIHĂILĂ[2,3] , Petruț Ionel BISTRICEAN[2,3] , Andrei MIHALACHE[1,2]

[1]Doctoral School of Applied Sciences and Engineering, "Ștefan cel Mare" University of Suceava, Romania
[2] Center for Applied Geography Research (GeA-USV)
[3] Department of Geography, "Ștefan cel Mare" University of Suceava, Romania

* Correspondence to: Ciprian-Ionuț ADAM. E-mail: ciprian82cip@gmail.com.

Vol. 36.1 / 2026, 227-243

GEOREVIEW

Received:
27 October2025

Accepted:
10 February 2026

Published online:
13 February 2026

How to cite this article:
Adam, C. I., Mihăilă, D., Bistricean, P. I., Mihalache, A. (2026) Preliminary research on air temperature in the Prut River valley between Oroftiana and Stânca-Costești. Georeview, 36, 1, https://doi.org/10.4316/GEOREVIEW.2026.01.15

ABSTRACT: The study presents the preliminary results of research on air temperature conducted in the Prut valley between Oroftiana and Stânca-Costești in the winter of 2024-2025 and the summer of 2025. Temperature monitoring was carried out using a network of 15 sensors, located at representative points in the study area, which recorded the target element on an hourly basis. Significant spatial and temporal temperature differences were observed between stations, determined by the particularities of the relief and their position in relation to the Prut River valley. In the Prut floodplain, compared to the surrounding areas, minimum temperatures are lower in winter (by 0.5–1.7°C) and maximum temperatures are higher in summer (by 0.2–1.1°C). The average number of hours of frost in winter is 34 fewer at stations along the valley compared to stations on slopes and hilltops, and the number of tropical hours in summer is 35 more. The average winter-summer temperature range is 0.3°C higher in the Prut Valley than in the surrounding areas, and the maximum range is 2.8°C higher.

KEY WORDS: topoclimate of the Prut Valley, cuestiform relief, subsequent sector, consequent sector, topoclimate of Lake Stânca-Costești.

RÉSUMÉ : L'étude présente les résultats préliminaires d'une recherche sur la température de l'air menée dans la vallée du Prut, entre Oroftiana et Stânca-Costești, durant l'hiver 2024-2025 et l'été 2025. La surveillance de la température a été réalisée à l'aide d'un réseau de 15 capteurs, situés à des points représentatifs de la zone d'étude, qui ont enregistré l'élément cible toutes les heures. D'importantes différences de température spatiales et temporelles ont été observées entre les stations, déterminées par les particularités du relief et leur position par rapport à la vallée du Prut. Dans la plaine inondable du Prut, par rapport aux zones environnantes, les températures minimales sont plus basses en hiver (de 0,5 à 1,7 °C) et les températures maximales sont plus élevées en été (de 0,2 à 1,1 °C). Le nombre moyen d'heures de gel en hiver est de 34 heures de moins dans les stations situées le long de la vallée par rapport aux stations situées sur les pentes et les sommets des collines, et le nombre d'heures tropicales en été est de 35 heures de plus. L'amplitude thermique moyenne hiver-été est supérieure de 0,3 °C dans la vallée du Prut à celle des régions environnantes, et l'amplitude thermique maximale est supérieure de 2,8 °C.

MOTS CLÉS : topoclimat de la vallée du Prut, relief cuestiforme, secteur subséquent, secteur conséquent, topoclimat du lac Stânca-Costești.

1. Introduction

The study analyses the thermal characteristics of the Prut River valley between Oroftiana and Stânca-Costești (PRVOSC) for the winter of 2024–2025 and the summer of 2025 in a topoclimatic context. The thermal regime of the air and its spatial differences are an essential element in identifying the particularities of the local topoclimate. In PRVOSC, the thermal spatiality and regime of this element is influenced by the morphology of the terrain, the orientation of the slopes, and the presence of water bodies, which modify air circulation.

Several studies in this field refer to *the general meteorological and climatic characteristics* of the territory in northeastern Romania and northwestern Moldova. Apostol L. (2000) described the characteristics of the moderate continental climate in eastern Romania. In 2008, Mihăilă and Roșca analyzed the climate risks on the Romanian side of the Prut River basin. Puțuntică and Sofroni (2011) analyzed the variations in annual and monthly precipitation amounts in the Republic of Moldova, with the analyses also referring to the northwestern part of the country. Romanescu et al. (2011) analyzed the hydrological risk and effects of flooding in the Prut Valley, providing a useful hydrological framework for interpreting climatic phenomena. Piticar and Ristoiu (2012), Piticar (2013a, 2013b) identified trends of increasing average temperatures and an increase in the frequency of droughts in northeastern Romania. Sfîcă et al. (2013) analyzed the vulnerabilities of snow accumulation in drifts in Botoșani County. Buruiană (2015) highlighted the climatic and topoclimatic role of water resources in the Moldavian Plain in the context of climate change. The research of Apostol and Mihăilă (2015a) analyzed the effects of heat waves on health in low-lying areas, while that of Apostol V. (2020) demonstrated an increase in the frequency of extreme phenomena: hail, drought, and heat waves in the Prut basin. The effects of climate change and the hydroelectric exploitation of water resources on the hydrological and climatic regime of the transboundary Prut River were analyzed by Potopová et al. (2019) and Corobov et al. (2021). Recent research by Sîrbu and Covaliov (2019) and Covaliov and Sîrbu (2021, 2022) on the middle Prut basin analyzes thermal variability and the impact of dams on agriculture and water supply in northern Moldova.

General or applied studies on *valley topoclimate and local microclimates* were developed by Bojoi (1990), who emphasized the role of relief in thermal differentiation at the topoclimatic scale. Mănoiu (2018) analyzed topoclimatic variations in the hilly and valley territories of Romania. Ungureanu and Beșliu (2018), and Ungureanu and Cotiugă (2020) demonstrated the importance of topoclimatic modeling using satellite data and numerical models to describe solar radiation distribution and thermal variations in northeastern Romania.

There are few studies in the literature that directly refer to *the topoclimate of the Prut Valley* in the researched sector. Mihăilă (2006a, 2006b, 2006c) analyzed the variability of the climate regime, air temperature, and river runoff in Northern Moldova, and in his doctoral thesis, he identified a distinct climatic subunit (subregion) in the Prut Valley at the northern and eastern limits of the Moldavian Plain. This subunit was distinguished from the other subunits by its thermo-hygrometric and other characteristics. In the Prut basin and floodplain, Tofan (2019a, 2019b, 2020) highlighted the climatic influences on runoff, the role of topography in the distribution of solar radiation, and the occurrence of thermal inversions and fog on the thermal regime and population health. Similarly, the works of Dragotă (2018) and Apostol V. (2021) addressed the impact of the Stânca–Costești dam on the local microclimate and on riverside communities, revealing significant changes in the thermal and hygrometric regime. Roșu (2019, 2022) studied the distribution of fog and thermal inversions around the Stânca–Costești reservoir.

The influence of geomorphological factors and relief on nighttime temperatures was documented by Koshelev (2020), who correlated temperature values with hypsometric variations in the Prut valleys. This study is the first step in filling gaps in the topoclimatic and microclimatic research of this valley sector. PRVOSC imposes a complex topoclimate, where factors such as altitude, exposure, degree of relief fragmentation, distance from the watercourse, and the presence of the reservoir determine a certain specificity of the thermal complex. The study is based on direct measurements taken with automatic recording sensors and is a novelty in topoclimatic research in this part of Romania and the Republic of Moldova. *The purpose* of this study is to identify and analyze the particularities of the thermal regime in the studied sector, based on our own monitoring network. *The main objectives* are: *i)* to outline the areas with the highest/lowest air temperature/thermal amplitudes and the highest frequency of risk phenomena such as air frost or tropical weather; *ii)* explaining the causality of these distributions and the regime of calculated/measured thermal parameters in terms of the influence of local climatogenic factors.

2. Study area

The Prut Valley sector between Oroftiana and Stânca-Costești stretches across the towns and communes in the north and east of Botoșani County (Suharău, Hudești, Concești, Darabani, Păltiniș, Viișoara, Rădăuți-Prut, Coțușca, Mitoc, Adășeni, Avrămeni, Manoleasa, Ripiceni, Hănești, Mihălășeni, Dobârceni, Durnești, and Ștefănești), the southern part of the Chernivtsi district, through the communes of Vancicăuți and Mămăliga, as well as the western part of the Briceni, Edineț, and Rîșcani districts in the Republic of Moldova. From an administrative point of view, it covers the territory of three countries: Romania (18 administrative units), the Republic of Moldova (34 administrative units) and Ukraine (2 administrative units), total area 2.563, 23 km^2 - (Figure 1).

Figure 1 Geographical location of the PRVOSC within the continent of Europe (bottom left), Romania, Ukraine, and the Republic of Moldova.

Figure 2 The Prut River at Oroftiana.

Figure 3 The Prut River at Mitoc.

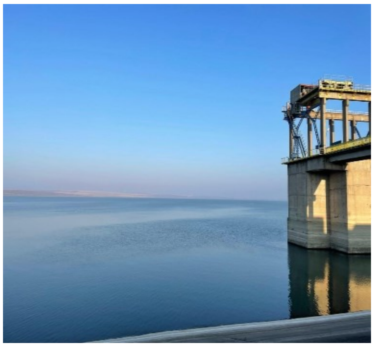

Figure 4 Lake Stânca-Costești.

The relief of the PRVOSC (Figure 5) is varied, arranged in longitudinal strips, consisting of plateaus and hilly plains, with the following subunits: The Hotin Plateau, the southern part of the Volîno-Podolic Plateau, part of the Northern Moldavian Plateau, the Ibănești Hills, the Bașeului Hills, and small parts of the Jijia Plain and the Bălți Plain. The maximum altitude of 315 m is in the Ibănești Hills and the lowest altitude, below 50 m, is in the Prut Valley, in the consequent sector, downstream of the Stânca-Costești dam. PRVOSC consists of two sectors: a subsequent sector (Figure 2) between Oroftiana and Rădăuți-Prut and a second, consecutive sector (Figure 3) between Rădăuți Prut and Lake Stânca-Costești (Figure 4).

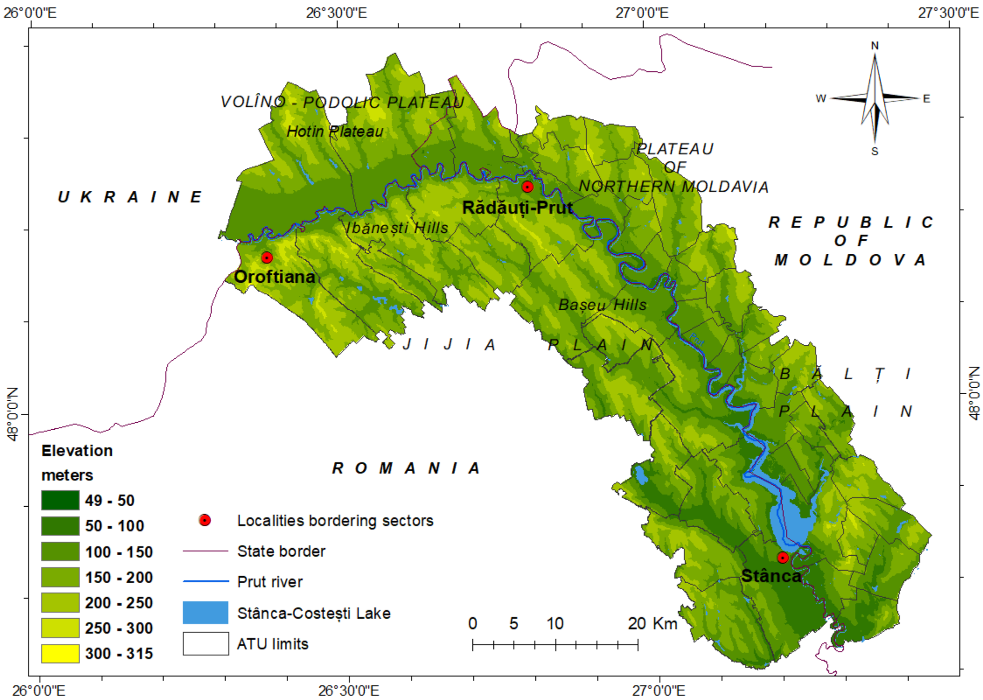

Figure 5 Hypsometric map of PRVOSC.

In the subsequent sector, the steeper, cuestiform right slope of the Prut valley is less heated and lit (because the slopes are generally exposed to the north) compared to the left slope, which corresponds to a cuestiform reverse (generally exposed to the south).

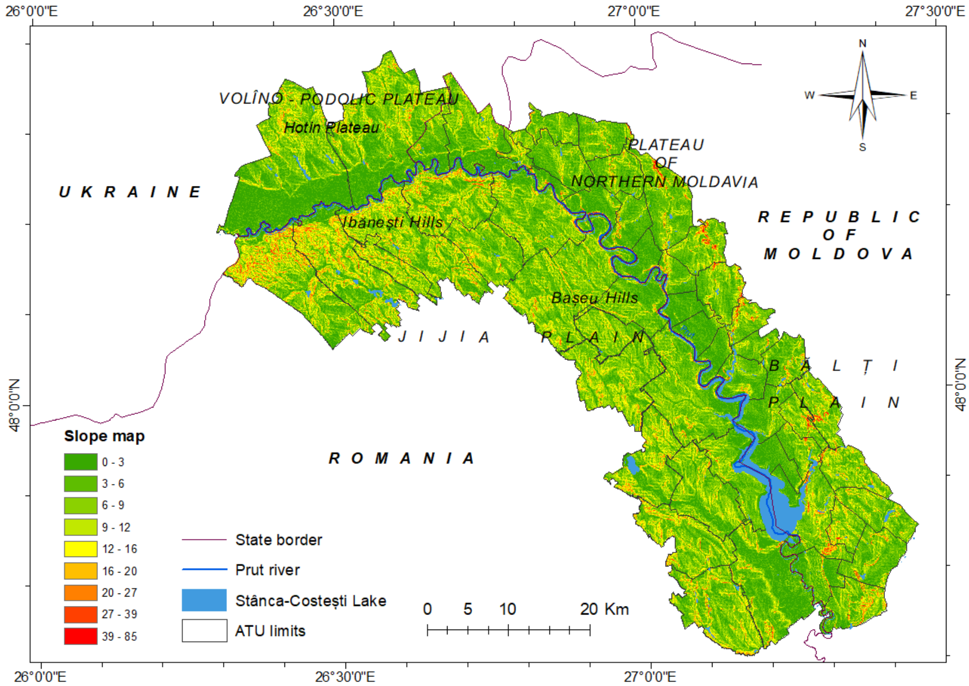

Figure 6 Map of the relief slope (in degrees) in PRVOSC

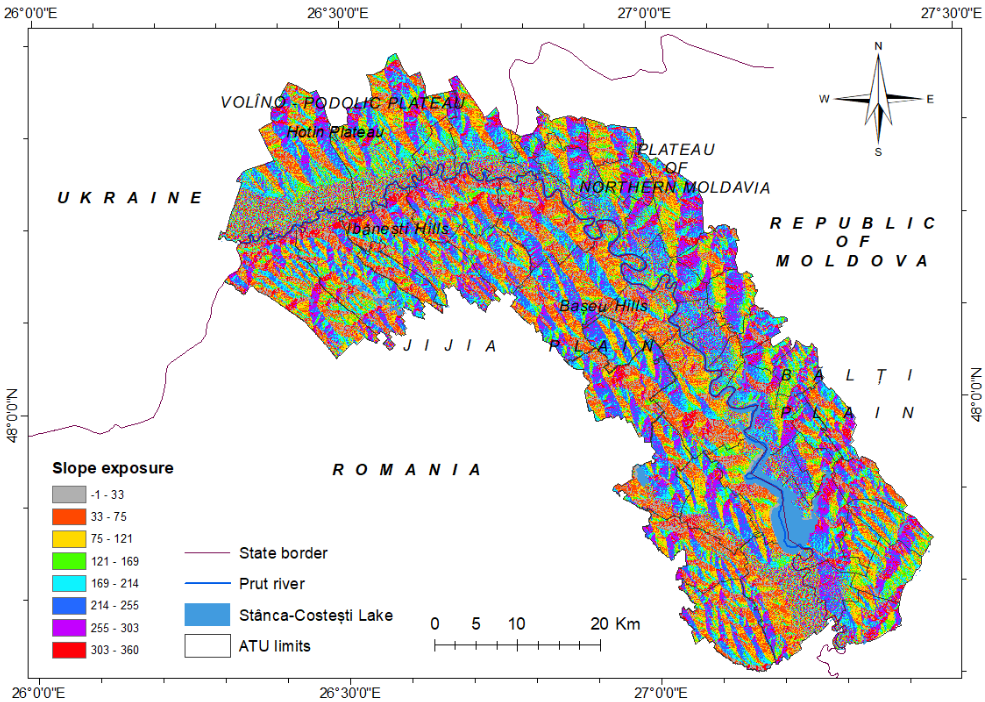

Figure 7 Map of slope exposure in relation to north in PRVOSC.

In PRVOSC, the slopes of the relief (Figure 6) generally have low values (between 0-5°), corresponding to the major bed of the Prut River and the low terraces. The slopes bordering the valley, on the other hand, have moderate values (5-15°), and in areas with pronounced fragmentation, towards the interfluves, the slopes locally exceed 20°. The distribution of slopes reflects a wide, gently sloping valley morphology, flanked by relatively steep slopes upstream, between Oroftiana and Rădăuți-Prut, and gentler slopes downstream from Rădăuți-Prut to Stânca-Costești-Româneşti.

Analysis of the exposure of the slopes (Figure 7) highlights the predominance of southern and southeastern orientations on the left bank of the Prut and northern and northwestern orientations on the right bank. This arrangement gives the valley an asymmetrical climate: the sunny slopes have higher temperatures and lower relative humidity, while the shaded slopes have more moderate temperatures and higher humidity. Exposure thus controls the local radiation regime, influencing evapotranspiration processes and temperature distribution on a microclimatic scale.

3. Methods

In order to highlight the specific topoclimatic and microclimatic characteristics of PRVOSC, we used 15 thermo-hygrometric sensors, employing the stationary observation method.

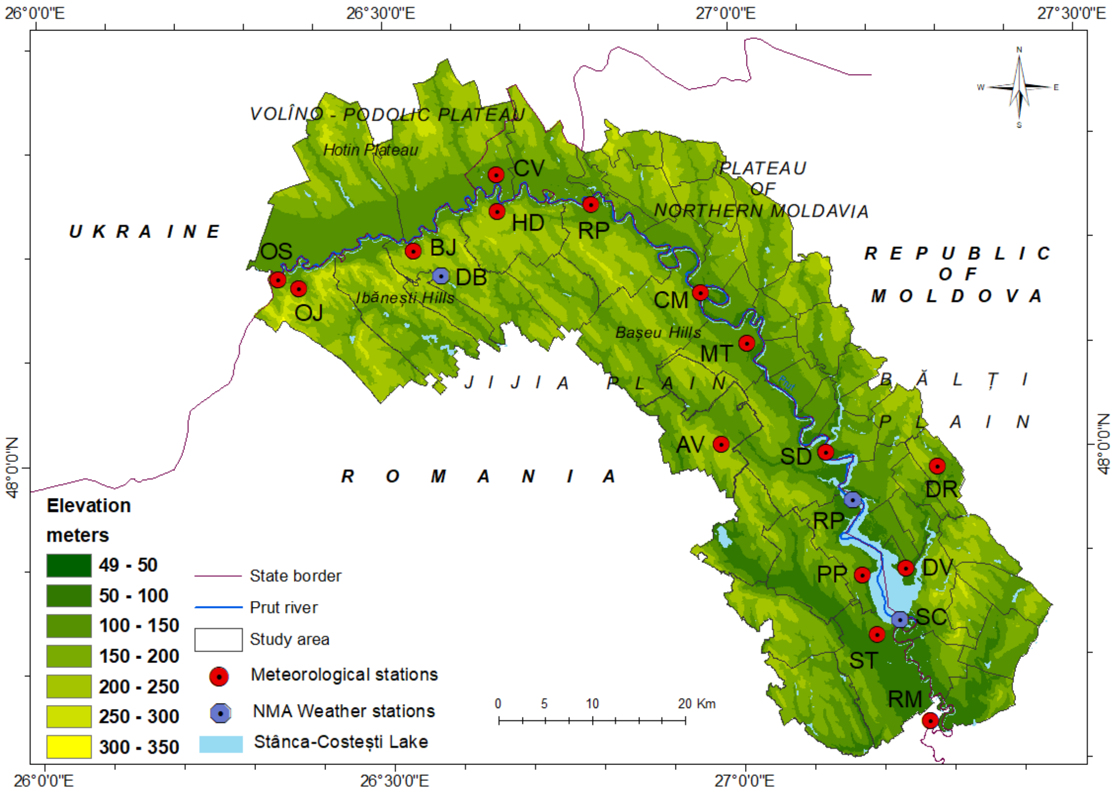

Figure 9 Location of meteorological stations of National Meteorological Administration (NMA) and posts in PRVOSC.

Table 1 Meteorological stations in the study area, code and geographical coordinates.

No. No.	Weather Stations	Callsign	Alt.	Lat.	Long.	The topoclimatic particularities of the site
1.	Oroftiana de Sus	OS	165	48	26°21	Located on a cuesta front, on the right bank of the Prut River
2.	Oroftiana de Jos	OJ	135	48°10	26°22	Located on the first terrace of the Prut River, on the right bank of the river
3.	Bajura	BJ	251	48°11	26°31	Located on a cuesta front, right bank of the Prut River
4	Horodiștea	HD	197	48°14	26°43	Located on a cuesta front, on the right bank of the Prut River
5.	Criva	CV	113	48°16	26°39	Located on the first terrace of the Prut River, on the left bank
6	Rădăuți-Prut	RP	106	48°14	26°48	Located on the first terrace of the Prut, on the right bank of the river
7.	Cotu Miculinți	CM	120	48	26°56	Located on the second terrace of the Prut River, on the right bank of the river
8	Mitoc	MT	103	48°06	27°02	Located on the second terrace of the Prut River, on the right bank of the river
9	Avrămeni	AV	237	48°05	26	Located on a hillside 10 km away from the Prut Valley
10.	Sadoveni	SD	97	47	27°08	Located on a hillside, on the right bank of the river
11	Popoaia	PP	130	47	27°10	Located on a hillside, on the right bank of the river
12	Stânca	ST	83	47	27°12	Located near the dam
13	Druța	DR	124	47°57	27°17	Located on a tributary of the Prut River in the lake sector
14	Duruitoarea Veche	DV	110	47	27°15	Located on the left bank of Lake Stânca Costești
15	Românești	RM	58	47	27°14	Located on the first terrace of the Prut River, on the right bank

We have set up a network of 15 weather stations located at representative points of the PRVOSC, aiming to cover both sectors of the valley: subsequently between Oroftiana and Rădăuți-Prut, with a steeper right slope, represented by a cuestiform front of almost 40 km, with the left slope being gentler, corresponding to a cuesta reverse, and consistently between Rădăuți-Prut and Stânca-Costești, characterized by the narrowing of the valley, while also taking into account the exposure of the slopes and the local geomorphological/geographical configuration. Twelve stations are located in Romania, at Oroftiana de Sus, Oroftiana de Jos, Bajura, Horodiștea, Rădăuți-Prut, Cotu Miculinți, Mitoc, Sadoveni, Avrămeni, Popoaia, Stânca, and Românești, and three in the Republic of Moldova, at Duruitoarea Veche, Druța, and Criva (Figure 9 and Table 1). The sensors were installed in mini weather stations at a standard height of 2 meters and programmed to record temperature, relative humidity, and dew point hourly (Figure 10).

The proposed monitoring period is a minimum of 3 years, until December 31, 2027. To date, 55,600 hourly temperature data have been downloaded for the winter of 2024-2025 and the summer of 2025, which have been statistically and cartographically processed for the purpose of preliminary analysis of the thermal characteristics of PRVOSC. The sensors used in data collection are Peak Tech 5185 Datalogger (Figure 11).

Figure 10 Weather shelter installed at Stânca.

Figure 11 Peak Tech thermo-hygrometric sensor.

These sensors allow the recording of 32,000 data points (16,000 for temperature and 16,000 for humidity). The data storage rate is selectable from 2 seconds to 24 hours. The data visualization software is installed automatically, and the data can be saved in *.txt* and/or *.xls* format. The sensors were set to record values every hour, at the half-hour mark. After statistically processing the data in *Excel* for the parameters studied, we proceeded to draw up thematic maps in ArcMap 10.8, using the combined GIS method of regression with ordinary Kriging.

4. Results and discussions

The analysis of the thermal characteristics of PRVOSC during the winter of 2024-2025 and the summer of 2025 in a topoclimatic context, highlighted a number of significant aspects related to local topoclimates: obvious spatial differences in temperature, influenced by altitude, fragmented relief, proximity/distance from the Prut River, and other local characteristics of the natural environment (presence or absence of nearby forests, degree of anthropization, etc.). The analysis of the air temperature parameters recorded and calculated at the 15 meteorological stations located along the PRVOSC highlights a spatial differentiation of the thermal field, controlled by local factors: morphology, altitude, exposure, the influence of the Prut River, local vegetation, etc. Some of the stations were located on slopes and the fronts/summits/reverses of the cuestas: Oroftiana de Sus (165 m), Bajura (251 m), Horodiștea (197 m), Avrămeni (237 m), Popoaia (130 m), Druța (124 m). Another part of the stations were located on the valley/meadow and lower terraces: Oroftiana de Jos (135 m), Criva (113 m), Rădăuți-Prut (106 m), Cotu Miculinți (120 m), Mitoc (103 m), Sadoveni (97 m), Duruitoarea Veche (110 m), Stânca (83 m), Românești (58 m). Between these two major categories of stations (on the Prut valley and on the nearby slopes and hills), there are a number of temperature differences in both summer and winter.

4.1. Thermal parameters during winter

4.1.1. Local differences in minimum temperatures recorded in PRVOSC

The minimum temperatures recorded at the stations in the studied river valley ranged from –15.6°C in Criva to –10.1°C in Avrămeni (Table 2).

Table 2 Minimum temperatures, number of hours of frost, average winter temperatures, maximum temperatures, number of tropical hours, average summer temperatures, average and maximum temperature ranges recorded/calculated at weather stations in the study area during the winter of 2024–2025 and the summer of 2025.

No. No.	Weather Stations	Tmin	Frozen hours	Tavg_W	Tmax	Tropical hours	Tavg_S	A avg	Amax
1	Oroftiana de Sus	-12.4	821	1.	35.8	95	16.2	15.8	48.2
2	Oroftiana de Jos	-14	802	0.5	35.8	105	16.4	16	49.8
3	Bajura	-11.2	970	2	35.8	98	16.7	14.7	47
4	Horodiștea	-11.2	901	2	36.4	126	16.9	14.9	47.6
5	Criva	-15.6	747	2.7	38.0	151	18.1	15.4	53.6
6	Rădăuți-Prut	-14.7	912	1.9	37.0	143	16.6	14.7	51.7
7	Cotu Miculinți	-13.5	865	1.	36.5	138	17	15.2	50
8	Mitoc	-13.7	852	1.8	36.3	140	17	15.2	50
9	Avrămeni	-10.1	677	2.4	35.6	145	17.1	14.7	45.7
10	Sadoveni	-13	807	2	36.8	189	17.4	15.5	49.8
11	Popoaia	-11.4	816	2.1	36.2	126	17.3	15.2	47.6
12	Stânca	-11.9	644	2.9	37.7	186	17.7	14.8	49.6
13	Druța	-15.2	733	2.8	36.9	191	18.1	15.3	52.1
14	Duruitoarea Veche	-12.1	794	3	39	222	18.7	15.3	51.1
15	Româneşti	-14.3	654	2.1	37.8	213	17.2	15.1	52

These values indicate relatively significant spatial differences in this thermal index for the winter of 2024-2025, as well as the relatively moderate nature of the past winter in this valley sector, influenced by the circulation of air masses along the valley axis (in a general west-east direction in the subsequent sector; northwest-southeast in the subsequent sector) and the sheltering effect of the marginal hilly relief. At stations located in the valley, at lower altitudes: Oroftiana de Jos, Criva, Rădăuți, and Româneşti, lower minimum temperatures were recorded due to the stagnation of cold air in the depression sectors, under conditions of thermal inversion stratification.

The minimum temperatures at the weather stations in the valley were on average 1.7°C lower than at the stations located on the surrounding slopes and hills (at the stations in the valley, the average minimum was -13.6°C, and at those on the slopes and nearby peaks, it was -11.9°C). Similar results regarding the occurrence of winter minimum temperatures in the Prut Valley were also obtained by Apostol et al. (2015b), Șoitu et al. in 2016, and Nedealcov et al. in 2017, and in the valleys of other rivers in the region Sfîcă (2007, 2015) for the Siret valley, but also Mihalache et al. (2025), and Apostol et al. for the Jijia valley in 2015.

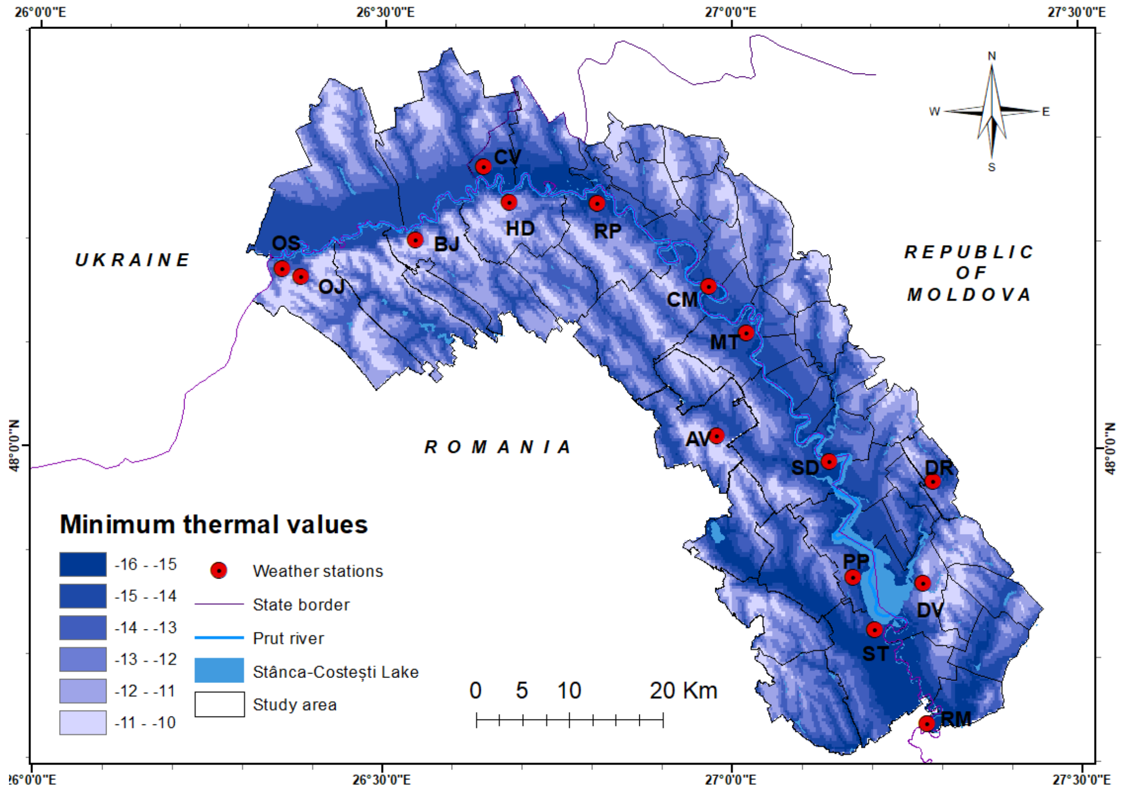

Figure 12 Spatial distribution of minimum temperatures recorded at weather stations located in PRVOSC.

4.1.2. Local differences in the number of hours of frost recorded in winter in PRVOSC

The hourly temperature values recorded allowed us to estimate that this thermal parameter varied between a minimum of 644 hours in Stânca, near the large lake basin, and a maximum of 970 hours in Bajura on a marginal cuesta on the right side of the Prut Valley, fully exposed to atmospheric circulation in the northwestern and eastern sectors (Table 2). north, and east (Table 2). The frequency of hours with frost decreases progressively from N-NW to S-SE in the direction of Oroftiana - Stânca-Românești, reflecting the increasing moderating thermal influence of the volume of water accumulated behind the Stânca–Costești dam. Weather stations located at higher altitudes and on more fragmented terrain, more exposed to atmospheric dynamics (Bajura, Horodiștea), record the most hours of frost due to radiative loss and exposure to cold winds. In contrast, the wet meadow of the Prut River and the proximity of the lake have a mitigating thermal effect, reducing the duration of frost by 250-300 hours compared to the northern extremity.

On average, frost occurred in the air for a total of 810 hours for the entire sector (786 hours at stations in the Prut valley and 820 hours at stations on slopes and interfluves, with a difference of 34 hours between the two major categories of stations). Similar results regarding the stratification of the frost phenomenon on the transverse profile of the valley were obtained by Mihăilă (2004) for the Prut Valley and Mihăilă et al. (2006) for the Siret Valley.

4.1.3. Local differences in average temperatures recorded in winter in PRVOSC

The average winter temperatures in PRVOSCwere 2.1°C overall (between 0.5°C in Oroftiana de Jos in the north and 3.3°C in Duruitoarea Veche on the left bank of the Stânca-Costești reservoir). In the subsequent, more northern sector corresponding to the Oroftiana-Bajura-Horodiștea-Rădăuți-

Prut stations, the average winter temperatures for 2024-2025 ranged between 0.4 and 2.0°C. For the Avrămeni station, located on a southern slope at an altitude of 237 m, we calculated the highest average temperature in the middle of the studied valley sector (2.4°C), confirming the role of sunny exposure and ventilation in reducing the nighttime cooling effect. The average temperatures during the winter of 2024-2025 reached 2.1°C in Românești and 3.3°C in Duruitoarea Veche, the latter representing the highest winter average in the entire sector. The explanation is related to the thermal moderating effect of the lake, which reduces diurnal temperature amplitudes and maintains positive air temperature values during periods of overcast skies. Similarly, the Stânca and Druța stations, located in the immediate vicinity of the lake, show averages between 2.7 and 2.9°C, confirming the trend of local warming of the topoclimate under the moderating influence of the lake. In winter, average temperatures are higher around reservoirs (Apostol et al., 2012; Mihalache et al., 2025).

4.2. Thermal parameters during summer

4.2.1. Local differences in maximum temperatures recorded in summer in PRVOSC

The maximum temperatures recorded in the summer of 2025 rose to 35.6°C in Avrămeni and 39°C in Duruitoarea Veche (Table 2).

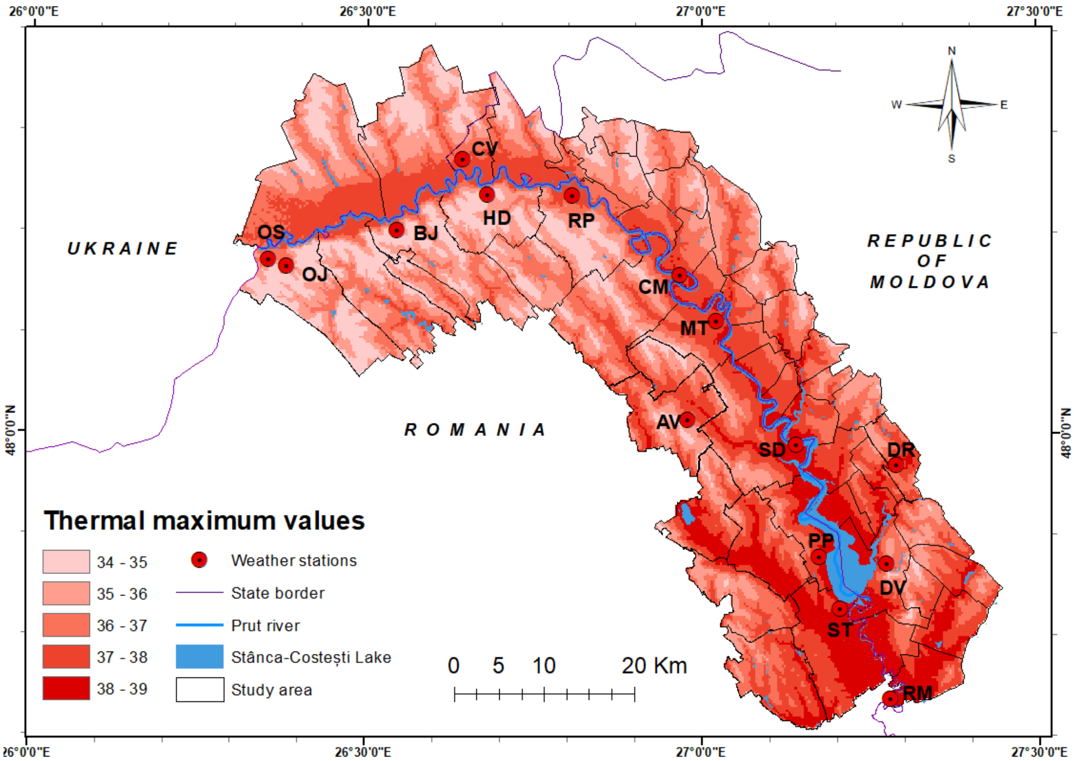

Figure 13 Spatial distribution of maximum temperatures recorded at weather stations located in PRVOSC.

These values show that summers are hotter at weather stations located near the main channel of the Prut River and cooler on the marginal heights of the valley, which are better ventilated. The Prut valley records the lowest temperatures in winter (Figure 12 and Table 2) and the highest temperatures in summer (Table 2 and Figure 13) under anticyclonic conditions. Similar temperature distributions were noted for the Prut River valley by Apostol and Șoitu in 2016, Castraveț in 2018, and for the Suceava River valley by Briciu et al. in 2023.

4.2.2. Local differences in the number of tropical hours recorded in summer in PRVOSC

On average, in the summer of 2025, there were 151 hours of tropical weather in PRVOSC. The spatial distribution of the number of tropical hours in PRVOSC varies between 95 tropical hours in Oroftiana de Sus and 222 hours in Duruitoarea Veche, values that give a spatial differentiation between stations of 127 hours between the northern and southern extremities of the sector. In the subsequent sector, comprising the stations Oroftiana de Sus, Oroftiana de Jos, Bajura, Horodiștea, Criva, and Rădăuți-Prut, the number of tropical hours remains lower (120 hours) due to the latitudinal position, higher altitude (135–250 m), exposure, and dynamics of the colder air in the northwestern sector. In the middle sector of the valley (between Cotu Miculinți and Popoaia), the number of tropical hours increases considerably, averaging 148 hours. The highest values of this indicator are recorded in the southern part of the studied sector (Duruitoarea Veche, Românești, Stânca, and Druța) (203 hours of tropical weather as an average for the summer of 2025). These stations are located in the direct sphere of influence of the Stânca-Costești reservoir, where intense solar radiation and high evapotranspiration favor heat accumulation in the lower atmosphere. At the same time, the presence of water heated during the day causes high temperatures to be maintained for longer during the night, extending the duration of tropical weather. The valley weather stations recorded an average of 165 hours of tropical weather, while those on the slopes and nearby peaks recorded 130 tropical hours. We therefore note a difference of 35 tropical hours between the two major categories of weather stations. The summer of 2025 was marked by a higher frequency of tropical hours in the consistent sector of the PRVOSC, especially at stations near the valley and the reservoir. Similar situations were identified by Apostol and Șoitu (2016) for the Prut River valley and by Sfîcă (2007) for the Siret River valley.

4.2.3. Local differences in average temperatures recorded in summer in PRVOSC

Across the entire study area, the average temperature for summer 2025 was 17.2°C. The average temperatures calculated for the summer of 2025 in PRVOSC ranged from 16.2°C in Oroftiana de Sus to 18.7°C in Duruitoarea Veche, with a clear upward trend from north to south as altitude decreases and the influence of the reservoir's water mass increases. Between the northern sector, which had an average temperature of 16.8°C in the summer of 2025, the middle sector (average temperature of 17.2°C), and the lower sector (average temperature of 17.9°C), we note clear temperature differences (of 1.1°C). Between the average temperatures of the weather stations in the valley (17.3°C) and those on its slopes and marginal peaks (17.1°C), there was a temperature difference of 0.2°C in favor of the former. The stations on the cuestiform hills and slopes (Oroftiana de Sus, Bajura, Horodiștea, Avrămeni, etc.) had slightly lower average temperatures (between 16.2–17.1°C) due to their higher altitude and more intense air circulation. In contrast, stations in the floodplain and lower terraces (Mitoc, Sadoveni, Stânca, Druța, Duruitoarea Veche, Românești) had higher average temperatures (17.5–18.7°C), explained by their lower altitude, more favorable exposure to solar radiation, different heating and cooling regimes of wet surfaces and water masses, and the sheltering effect in relation to atmospheric dynamics. Mihăilă (2006c) noted the same thermal zoning during the summer in the climatic sector of the Prut Valley studied in this study, the causes being both positional, the latitudinal extent of the valley, its morphology, and the presence of the water mass of Lake Stânca-Costești.

4.3. Thermal amplitudes analyzed in a topoclimatic context

4.3.1. Local differences in average temperature amplitudes in PRVOSC

The average temperature ranges (winter-summer) recorded in PRVOSC show moderate territorial differences (between 14.7 and 15.8°C), which are controlled by altitude, morphology, and the type of underlying surface. The highest values of average temperature amplitude were specific to weather stations on slopes and on hilly cuestifoeme peaks (Oroftiana de Sus, Bajura). In contrast, in the floodplain and on the lower terraces (Mitoc, Româneşti), the temperature ranges are slightly lower due to the moderating influence of the Prut River and Lake Stânca–Costeşti. Overall, there is a slight decrease in temperature amplitude from north to south, due to the attenuation of seasonal temperature contrasts and the mitigating thermal influence of the lake. This was also noted by Mihăilă in 2004.

4.3.2. Local differences in maximum temperature ranges in PRVOSC

The maximum temperature ranges (the differences between the minimum temperatures in winter and the maximum temperatures in summer) remained within the range of 47-50°C, which highlights, even though the analysis covers only one winter and one summer, the continental nature of the region in terms of temperature. These high temperature ranges, typical of extra-Carpathian regions, reflect the strong contrast between cold winters and hot summers. In the north of PRVOSC (Oroftiana, Bajura, Horodiştea), less severe minimum temperatures were recorded due to the altitude and exposure of the slopes, while in the middle and southern sectors (Cotu Miculinţi, Stânca-Costeşti), higher maximum temperatures were recorded, which may be associated with better exposure to solar radiation and the local influence of the flatter relief. The maximum temperature amplitudes in the valley were higher (by 2.9°C) than on the surrounding slopes or peaks.

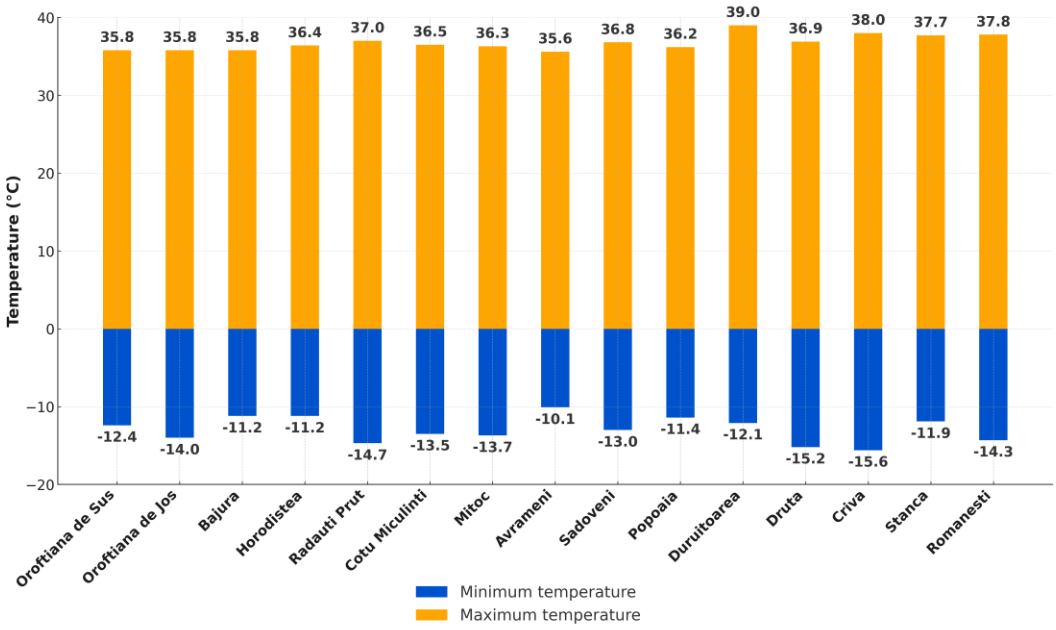

Figure 14 Minimum and maximum temperatures recorded in PRVOSC December 2024-August 2025.

The Prut Valley has frequent episodes of frosty weather (in winter). In summer, however, episodes of tropical weather are more frequent than in the surrounding areas. The topoclimate is more extreme in the valley than in the surrounding areas, and this is also reflected in the higher values of extreme temperature ranges at weather stations located in the floodplain or lower terraces of the Prut. This aspect was noted for the Suceava Valley by Prisacariu (2023) in his doctoral thesis, but also by Briciu et al. (2023) for the valley of the same river.

Data on maximum temperature amplitude show that PRVOSC has a continental climate, but the differences in this parameter in the analyzed topoclimatic space, although significant, are not very consistent in terms of value. The spatial differences in amplitude between stations can be explained by local topographical and microclimatic features, but the influence of regional climatic factors on the entire sector tends to diminish its climatic personality and degree of topoclimatic independence.

5. Conclusions

Analysis of the temperature values obtained from the network of 15 thermo-hygrometric sensors located between Oroftiana and Stânca–Costești highlights a significant spatial differentiation of the main parameters of air temperature, influenced by altitude, latitude, morphology, position relative to the Prut River and the reservoir on its course, air dynamics, and anthropogenic interventions. The minimum temperatures in the winter of 2024-2025 ranged from -10.1°C in Avrămeni to -15.6°C in Criva, with lower average values (by 0.4-1.7°C) at the weather stations in the floodplain or on the lower terraces. The number of hours of frost was highest in Bajura (970 hours) and Horodiștea (901 hours), located on north-facing slopes, and the lowest values in Stânca (644 hours) and Româneşti (654 hours), where the influence of the Stânca-Costești reservoir mitigated the winter temperature regime. The weather stations in the Prut Valley recorded an average of 34 fewer hours of frost than the stations on the surrounding slopes and peaks. The average winter temperature ranged between 0.5°C (Oroftiana de Jos) and 3.3°C (Duruitoarea Veche), with a gradual increase from north to south, in the direction of Oroftiana-Stânca–Costești. On average, during the winter of 2024-2025, the temperature differences between valleys and slopes/hilly peaks were not significant enough to support a clear temperature differentiation between the two types of areas analyzed comparatively. The maximum temperatures during the summer ranged between 35.6°C (Avrămeni) and 39.0°C (Duruitoarea Veche), highlighting an accentuation of temperature jumps during tropical weather episodes at stations in the Prut valley or on the shores of Lake Stânca - Costești. The number of tropical hours varied between 95 hours in Oroftiana de Sus and 222 hours in Duruitoarea Veche, with a regional average of 151 hours, indicating a higher frequency of positive temperature extremes in the southern part of the PRVOSC. At stations in the Prut Valley, the number of tropical hours in the summer of 2025 was 35higher than at stations in the surrounding area. The average summer temperature ranged between 16.2°C (Oroftiana de Sus) and 18.7°C (Duruitoarea Veche), confirming the thermal influence of the more southerly location of the Duruitoarea Veche station. Average temperature amplitudes ranged between 14.7 and 16°C, with the highest amplitudes recorded in the Prut Valley. The maximum temperature ranges ranged between 45.7°C in Avrămeni and 53.6°C in Criva, highlighting stronger temperature variations at the meteorological stations located in the Prut floodplain. The northern part (subsequent subsector) differs thermally from the central and southern parts (the median subsector along the Prut River and the subsequent southern subsector along the Stânca-Costești reservoir). The valley and terrace subsector differs thermally from the one with slopes and hilly interfluves and slopes typical of the cuestiform relief. Overall, the results obtained indicate that the Prut valley is the preferred area for the highest seasonal and diurnal temperature variations. Although the minimum temperatures during thermal inversion episodes are lower in the Prut valley, the number of hours of frost is lower than in the surrounding areas due to the presence of water in the more humid, lacustrine areas or represented by the water surface of the minor bed of the Prut river. The thermal complexity derived from the positional and topoclimatic complexity, which is a consequence of the heterogeneity of the active surface of the PRVOSC, is evident. Regional and local atmospheric dynamics and anthropogenic intervention (through agro-forestry practices and hydrotechnical or infrastructural development of the territory) complicate the spatial distribution and regime of air temperature at the topoclimatic level. Research into the thermal specificity of the PRVOSC at the topoclimatic level remains our focus, and future observations will most likely reinforce aspects already noted in this study. The study confirms the strong influence of cuesta-type relief on local thermal contrasts, contributing to an improved understanding of topoclimatic processes. These findings may provide useful support for agricultural planning, frost risk assessment, and land-use management. However, the main limitations of the study are related to the relatively short monitoring period and the limited number of measurement points. Future research should focus on long-term monitoring, seasonal analyses, and the integration of GIS and remote sensing data.

References

Apostol, L. (2000). Climate variability in Moldova region, Revista Geografică, VII, 115–123.

Apostol, L., Mihăilă, D. (2015a). Effects of heat waves on health in low-lying areas, Revista Geografică, 22, 88–97.

Apostol, L., Ilie, N., Ichim, P., Sfâcă, L., Țoitu, D. (2015b). The cold wave that characterized the weather in northeastern Moldova between January 25 and February 17, 2012, Analysis based on MODIS data, Proceedings of the 22nd International Symposium on Geographic Information Systems, Academy of Sciences of Moldova, Institute of Ecology and Geography of the Academy of Sciences of Moldova, Chișinău.

Apostol, L., Șoitu, D. (2016). Soil surface temperature in the lower Prut basin, Climate change and environmental risks, Ecological and geographical problems in the context of sustainable development in the Republic of Moldova: achievements and prospects, September 15-16.

Apostol, V. (2020). Climate risks in the Prut basin: hail and drought, Scientific Bulletin of the State University of Moldova, 3, 93–104.

Apostol, V. (2021). The impact of the Stânca-Costești dam on local communities, Romanian Journal of Applied Geography, 13(2), 99–108.

Bojoi, S. (1990). Topoclimates of the valleys in the Moldavian Plateau, Studies and Research in Geography, 37, 47–58.

Buruiană, G. (2015). Water resource use in the context of climate change: Lake Stânca–Costești, Hidroenergia Journal, 61(1), 45–52.

Briciu, A.-E., Mihăilă, D., Oprea, D. I., & Prisăcariu, A. (2023). Urban Stream Temperature Surge—Streamwater Temperature Variability after Rainfall in Suceava City Metropolitan Area. Sustainability, 15(10), 7882, https://doi.org/10.3390/su15107882.

Castraveț, T. (2018). Modeling water erosion in the Middle Prut Plain as a support for sustainable development planning, Doctoral thesis in geonomic sciences, Chișinău.

Corobov, R., Ene, A., Trombitsky, I., Zubcov, E. (2021). The Prut River under the impact of climate change and hydropower, Sustainability, 13(1), 1–18, https://doi.org/10.3390/su13010066.

Covaliov, T., Sîrbu, I. (2021). Thermal variability in the Middle Prut basin, Bulletin of the Academy of Sciences of Moldova, Life Sciences, 4, 55–64.

Covaliov, T., Sîrbu, I. (2022). Assessment of the impact of dams on agriculture and water supply in northern Moldova, Bulletin of the Institute of Ecology and Geography, 30, 57–66.

Dragotă, R. (2018). The influence of dams on the local thermal regime: the example of the lower Prut, Annals of the University of Bucharest – Geography Series, 67, 143–156.

Koshelev, V. (2020). Geomorphology and nighttime temperature in Prut valleys, Ukrainian Journal of Environmental Studies, 10(1), 41–50.

Mănoiu, R. (2018). Topoclimatic analysis in hilly and valley areas of Romania, Present Environment and Sustainable Development, 12(2), 137–150.

Mihalache, A., Mihăilă, D., Bistricean, P.-I., Medei (Pop), E. (2025). Preliminary research on thermal inversions occurring in the Northeast Region of Romania. Georeview, 36, 1, published online, https://doi.org/10.4316/GEOREVIEW.2026.01.09

Mihăilă, D. (2004). Some aspects related to the variability of the evolution over time of climatic elements and phenomena in the Moldavian Plain, Annals of the "Ştefan cel Mare" University of Suceava, Geography Section, Year XIII – 2004.

Mihăilă, D. (2006a). Variability of the climate regime and river runoff in Northern Moldova, Geographia Napocensis, 3(1), 45–58.

Mihăilă, D. (2006b). Variability of air temperatures in Northern Moldova, Annals of the University of Suceava, Geography Section, 15, 123–132.

Mihăilă, D. (2006c), The Moldavian Plain. Climate Study, Suceava University Press, ISBN (10) 973-666-219-5, ISBN (13) 978-973-666-219-5, 465 pp.

Mihailă, D., Budui, V., Cristea, I. A., Tănasă, I. (2006). Considerations on climate risks in Suceava County, Annals of the "Ştefan cel Mare" University of Suceava, Geography Section, Year XV – 2006.

Mihăilă D. and Roșca B. (2008). The climate regime and meteorological and climatic hazards occurring in the Prut river basin, in Bucuresteanu M. (ed.) et al., The Prut river basin, Diagnosis of the ecological status of natural water resources, MARESEP project, Suceava University Press, ISBN 973-666-289-6, Chapter II, pp. 15–78.

Nedealcov, M., Răileanu, V., Apostol, L. (2017). Digital Atlas of Air Temperature and Precipitation in the Prut River Basin, Akademos 2.

Piticar, A. (2013a). Recent climate trends in northeastern Romania, Carpathian Journal of Earth and Environmental Sciences, 8(4), 147–156.

Piticar, A. (2013b). Climate risks in the valley areas of northeastern Romania, Risks and Catastrophes, 12(1), 45–56.

Piticar, A., Ristoiu, D. (2012). Trends in temperature and rainfall in Moldova, Risks and Catastrophes, 11(1), 67–78.

Potopová, V., Cazac, V., Boincean, B., Soukup, J., Trnka, M. (2019). Application of hydroclimatic drought indicators in the transboundary basin of the Prut River, Theoretical and Applied Climatology, 137(3–4), 3103–3121, https://doi.org/10.1007/s00704-019-02789-w.

Puțuntică, A., Sofroni, A. (2011). Variations in annual and monthly precipitation amounts in the Republic of Moldova, Bulletin of the Academy of Sciences of Moldova, Life Sciences, 3, 55–63.

Prisacariu, A. (2023). Climatic, topoclimatic, and microclimatic study of the metropolitan area of Suceava, "Ştefan cel Mare" University of Suceava, 49p, https://usv.ro/fisiere_utilizator/file/Doctorat/2023/sustineri/prisacari/Rezumat_Prisacariu_Alin.pdf.

Romanescu, G., Stoleriu, C., Romanescu, A. M. (2011). Water reservoirs and the risk of accidental flooding, Case study: The Stânca-Costești Reservoir and the historical floods of the Prut River in July-August 2008, Romania, Hydrological Processes, 25(13), 2056–2070, https://doi.org/10.1002/hyp.7957.

Roșu, L. (2019). Fog distribution in the Siret and Prut floodplains, Risks and Catastrophes, 18(2), 73–82.
Roșu, L. (2022). Energy balance components and thermal inversion analysis around Stânca–Costești lake, Geographia Napocensis, 16(1), 43–58.
Sfîcă, L. (2007). Number of days with characteristic temperatures in the Siret corridor and associated climate risk aspects, Annals of the "Ștefan cel Mare" University of Suceava, Geography Section, Year XVI – 2007.
Sfîcă, L., Andrei, A., Bărcăcianu, F., Cojocaru, Ș., Enea, A., Hapciuc, O.E., Iosub, M., Ichim, P. (2013). Analysis of snow-drifting vulnerability. Application to Botoșani County, Proceedings of the "Dimitrie Cantemir" Geography Seminar, 36, 43–54.
Sfîcă, L. (2015). Climate of the Siret Corridor and neighboring regions, Alexandru Ioan Cuza University Press, Iași.
Sîrbu, I., Covaliov, T. (2019). Microclimate monitoring in northern Moldova with local sensors, Bulletin of the Academy of Sciences of Moldova, 3, 73–84.
Șoitu, D., Apostol, L., Ichim, P. (2016). Thermal inversions in the lower Prut basin, Environment and sustainable development, 3rd edition, Chișinău, Moldova.
Tofan, C. (2019a). Climatic influence on runoff in the upper Prut basin, Present Environment and Sustainable Development, 13(1), 123–137.
Tofan, C. (2019b). Solar radiation and topographic influences in the Botoșani–Prut region, Risks and Catastrophes, 24(2), 95–104.
Tofan, C. (2020). Fog regime and its impact on health in the Prut floodplain, Scientific Bulletin of Geography, 13, 60–73.
Ungureanu, G., & Beșliu, A. (2018). Topoclimatic modeling with WRF and DEM in NE Romania, Geographia Technica, 13(1), 77–88.
Ungureanu, G., Cotiugă, M. (2020). Integration of DEM and Landsat data for solar radiation distribution in NE Romania, Geographia Technica, 15(2), 67–80.