

PARAMETERS OF CLIMATIC ELEMENT IN THE POLOG REGIN

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Abstract

According to the geographic latitude and proximity to the Aegean and Adriatic Sea, in a sense Macedonia belongs to the Mediterranean climate, but because of the stress relief it has a variable climate. These climatic features are presented with essentially the Pollog hollow where Sharr, Korab, and Rudoka mountains, on the border with Albania, measures to prevent infiltration of humid air coming from the Adriatic Sea. Therefore, due to this the Pollog hollow is characterized with not a lot of precipitation such as the Adriatic coast.

The distribution of air pressure has significant influence on thermal conditions and climate in this hollow. Pressing air in January mainly declines moving toward the South, while in July is moving toward the southeast. In relation to this, air currents are directed to these directions. Air currents during the summer and winter move from larger geographical width toward smaller ones and thereby reduce the temperature influence. Although, the character of the climate over certain areas is influenced by many factors, in this paper particular attention will be given to changes of temperature, winds, air, humidity and rainfalls.

Keywords: Temperature; Clime; Pollog; Winds, Relative Humidity.

1. Air temperature

Pollog hollow is under the influence of changing Mediterranean and continental climate. Winters are very cold because of all sides is surrounded by high mountain mass, that they have major impact on climate regime in the region. For this reason, the Pollog hollow when summer arrives great heat reigns, nights are much fresher and more pleasant than, as is the case, e.g. the Hollow in Skopje. For this difference, no doubt the change affects the amount of height from 100 to 250 meters, so it has greater altitude the Pollog hollow from Skopje. While in Skopje hollow the spring season, since some years there it hardly lasts more or less, it passes from winter to a real summer. Indeed, in this aspect of Pollog hollow exist an emphasized delay, therefore seasons are more clearly differentiated. Due to the large hypsographic differences between the lowest and highest point, the air temperature drops to every 100m around 0.6 °C. This decrease in air temperature also supports the fact that with increasing height in the air decreases the amount of dust and other air sediments that make absorption of the sun's heat, and then on the greater heights air has little effect on the absorption of solar heat.

Table 1. Monthly and annual average gradient of temperature

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	m.v
Tetovo-Sunny Hill	0,24	0,32	0,38	0,68	0,64	0,64	0,65	0,64	0,54	0,41	0,30	0,23	0,44
Gostivar - Sides of Mavrovo	0,17	0,42	0,59	0,71	0,70	0,64	0,60	0,56	0,48	0,41	0,27	0,17	0,48
Sides of Mavrovo-Sunny Hill	0,27	0,16	0,49	0,60	0,51	0,71	0,65	0,67	0,55	0,43	0,33	0,25	0,47

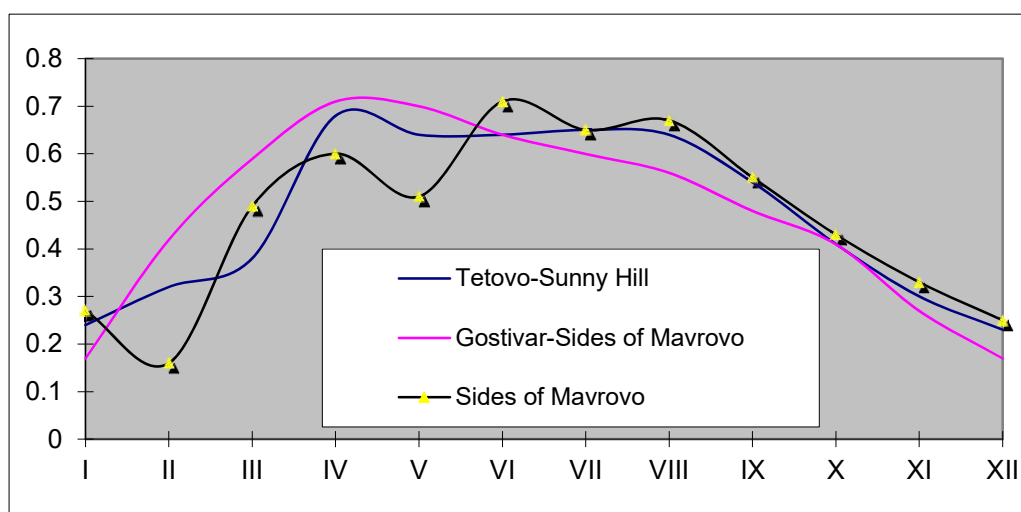


Figure 1. Monthly and annual average gradient of temperature in the Polog Hollow

The data show that the gradient of average monthly and annual temperature does not have the same value within months of the year. Naturally lower gradient of temperature is noted between meteorological stations Tetovo-Sunny Hill, as in December it has a value of 0.23 and 0.24 in January. On the other hand, the differences of the value of the temperature gradient are characteristics sides of Mavrovo and the Sunny Hill for the month with a value of 0.16. Of course such changes of air temperature gradient, the values are changed monthly and annual average temperature. The average annual temperature in the meteorological station in Tetovo totals of 11.0 °C, Gostivar 10.4°C, eat and Mavrovo 7.1°C and Hill of the Sun of only 4.6°C.

Table 2. The average monthly temperature, monthly average maximum and minimum monthly average in the period 2009-2019

Station	Temp.	I	II	III	IV	V	VI	VII	VII I	IX	X	XI	XII	Ann. Average
Tetovo	Average.	-1,2	1,8	6,5	11,4	15,8	19,2	21,2	20,8	16,8	11,0	5,6	0,7	10,8
	Max*.	3,1	6,5	11,9	17,1	22,0	25,7	28,3	28,2	24,3	17,9	10,6	16,7	17,6
	Min**.	-4,7	-2,5	1,3	5,0	8,7	11,5	12,8	12,3	9,3	5,0	1,4	-3,0	4,8
Gostivar	Average	0,7	1,6	5,5	10,8	15,5	18,8	20,6	20,0	16,0	10,0	6,0	1,0	10,4
	Max	3,9	7,1	11,7	15,2	21,2	25,5	27,1	26,3	22,1	16,5	10,5	4,9	16,0
	Min.	-4,7	-1,3	0,2	4,8	8,5	11,5	12,9	12,5	8,5	4,2	0,3	-3,8	4,4
Sunny Hill	Average	-3,8	-3,2	-1,2	2,6	7,9	11,1	13,0	13,2	9,8	5,7	2,4	-1,5	4,6
	Max	-5,9	-2,3	6,9	10,9	14,6	17,9	20,7	18,0	15,7	10,1	4,2	-1,0	8,9
	Min.	-6,9	-3,8	5,6	8,7	11,7	15,3	17,9	15,0	13,7	8,9	3,7	-3,1	6,2
Sidesof Mavro	Average	-2,7	-1,6	1,4	6,1	10,8	15,1	17,5	16,7	13,3	8,8	3,7	0,0	7,3
	Max	-4,5	-2,6	6,1	10,2	14,1	17,3	19,7	17,0	14,7	10,4	4,5	-2,0	8,7
	Min.	-7,9	-3,5	5,1	8,9	11,2	14,3	16,9	14,0	13,9	7,9	3,1	-2,8	5,2

Source: Office hydro-meteorologic Skopje, 2009-2019

* The maximum monthly median temperatures

** the minimum monthly median temperatures

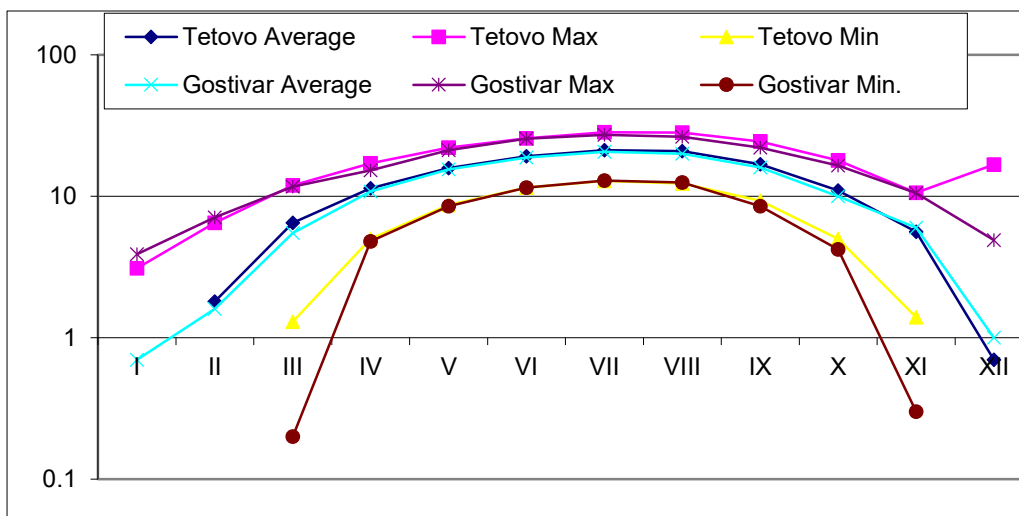


Figure 2. The movement of average monthly temperatures, maximum monthly average and minimum monthly average meteorological Tetovo and Gostivar in the period 2009-2019

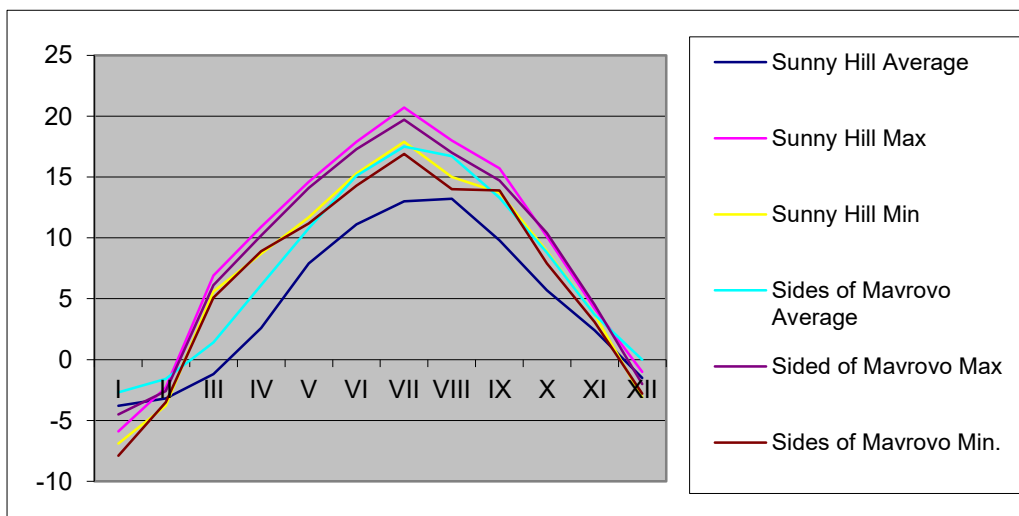


Figure 3. The movement of average monthly temperatures, average monthly maximum and minimum monthly average meteorological and sides of Mavrovo, Sunny Hill during 2009-2019

Lower temperatures occur in January in all meteorological stations mentioned, as is the case of Tetovo from -0.7°C , Gostivar -1.2°C , sides of Mavrovo -2.4°C [8] and the Sunny Hill of -3.8°C . Movement of temperature is also important to be seen by seasons of the year [4].

Table 3. According to seasons and average temperatures during vegetative period 2009-2019.

Meterological Stations	Winter	Spring	Summer	Autumn	Vegetative period	Annual Temp.
Tetovo	0,4	11,1	20,8	11,4	17,7	11,0
Gostivar	0,5	10,2	19,8	11,0	17,0	10,4
Sunny Hill	-1,8	3,3	12,4	5,9	9,6	4,6
Sides Mavrovo	-1,3	5,8	15,7	8,3	12,5	7,1

Source: SHMM, 2009. The data are processed

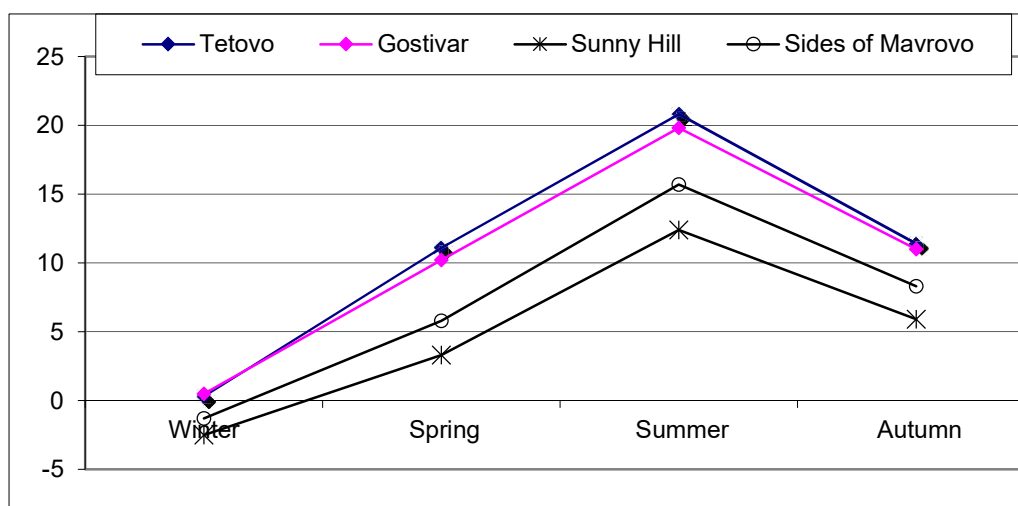


Figure 4. According to seasons and average temperatures during vegetative period 2009-2019.

According to the data from the table it shows that average temperatures are higher in autumn season than in the spring season, Gostivar marks lower temperature than Tetovo. This is explained by the fact that Gostivar is found farther from the impacts of the Mediterranean climate through the Vardar valley than Tetovo. Also, it is characteristic to mention the values of air temperature according to the seasons of the year are higher in Hanet of Mavrovo than in the SunnyHill.

Temperature Inversion. -Due to the large hypsometrical differences between the (last) Pollog hollow and the highest mountains of Sharr, also appears inversion of temperature processes. Of course, the phenomenon of air movement measures that create inversion are mainly the months of autumn and winter when in the last part of the hollow exist relatively low temperatures. Such phenomena are characteristic for the months of November, December and January, while rarely the temperature inversion appears also in the month of February.

2. Winds

Pollog hollow of the specifics of its geomorphologic and climatic characteristics of the total are common phenomena as a result of temperature changes between certain countries. Air-movement measures-winds are determined by the terrain configuration. Frequency of wind north of Tetovo is from 220% and with an annual average power of 1.5 bofor and with a speed of 1.6 m / sec. North is windy throughout the year but reaches maximum in April of 270 % (average speed of 2.1 m / sec.) The wind reaches maximum in June and in December, with a maximum speed of 26.5 m / sec. A northeast wind in the Polog Hollow appears with a speed of only 90 ‰, with average power of 1.9 borof power and with a speed to 2.2 m / sec. More frequent wind in April with an average speed of 2.8 m / sec. It is peculiar to note that the maximum power of the wind reaches 8 bofors with a maximum speed of 19.0 m / sec.

Northwest wind stands the frenzy of average speed of 76 ‰ with a speed of 1.5 m / sec. and with a power of 1.6 bofor. Maximum power of the wind reaches 10 bofor, with top speed of 26.5 m / sec. Of course, winds that blow from other directions are of a smaller speed and the most distinguishable are the south winds with a speed of 51 ‰, with average power of 1.7 bofor (maximum 7 bofor) and average speed 1.5 m / sec, while the maximum speed up to 13.9 m / sec. Western Wind is characterized by frenzy of 68 ‰, wind 48 ‰, southwest wind 44 ‰ and the south from 25 ‰. The speed of these winds move from 3 to 9.7 m / sec. depending on season of the year and rapid change of air temperature fronts in the area and surroundings. Winds from south, southeastern, western and northwestern in Tetovo Hollow bring moisture, while the north wind, the northeastern, east and southeast bring mainly dryness [1].

3. Relative Humidity

Air temperature and humidity are always in direct ratio. Naturally when the air temperature records a rise, then relative humidity drops and vice versa. Air humidity is lower in the days of sobering and sunny, while higher on days with fog, overcast days and atmospheric precipitation [1].

Table 5. Monthly and annual average humidity of the air in the period 2009-2019.

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual average
Tetovo	83	78	71	66	68	66	64	65	72	78	83	83	73
Gostivar	78	78	77	72	71	67	66	67	73	76	80	80	74
S. Hill	73	73	75	72	70	71	69	66	71	72	73	74	72
Sides of Mavrovo	81	77	74	68	66	67	66	69	75	76	74	78	73

Source: EHMM, 2001

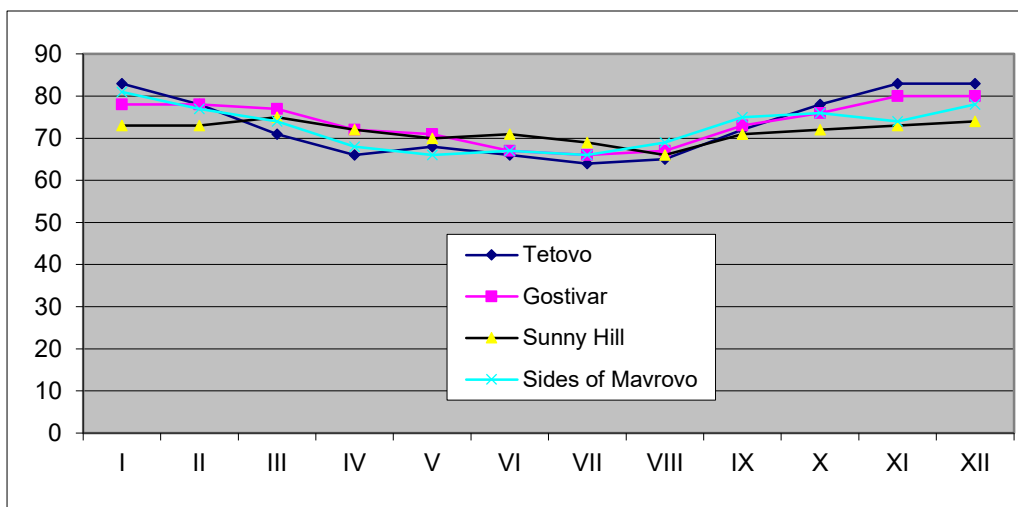


Figure 6. Monthly and annual average humidity of the air in the period of 2009-2019

The data for relative humidity in the Pollog hollow show that there are significant differences between upper and lower Pollog, and oscillation are relatively small.

4. Overcast

Cloudiness is calculated as an important climatic element that depends on degrees of heat from the sun even with the air temperature, air relative humidity, rainfall and others. Annual average cloudiness in the Polog hollow compared with other regions of the Republic of Macedonia, Central and Eastern Europe is higher. So, for example, the value of 4.8 reaches cloudiness of tenths in the Sun Hill to 5.9 tenths in Tetovo, while in Gostivar and sides of Mavrovo ranges from 5.6 to ten. This can be seen from the table below:

Table 6. Movement of air relative cloudiness of Pollog Hollow period 2009-2019.

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Avrg.Ann.
Tetovo	7,6	7,0	6,8	6,4	6,1	5,4	4,0	3,7	4,4	5,6	7,0	7,4	5,9
Gostivar	7,1	6,6	6,6	6,1	5,7	4,6	3,9	4,0	4,8	5,4	6,2	6,7	5,6
Sunny Hill	5,2	5,1	5,9	5,6	5,1	4,5	3,5	3,3	3,8	4,5	5,4	5,5	4,8
Sides of Mavrovo	6,6	6,8	6,4	6,0	5,3	4,8	4,1	4,3	5,0	5,4	5,8	6,3	5,6

Source: EHMM, 2009

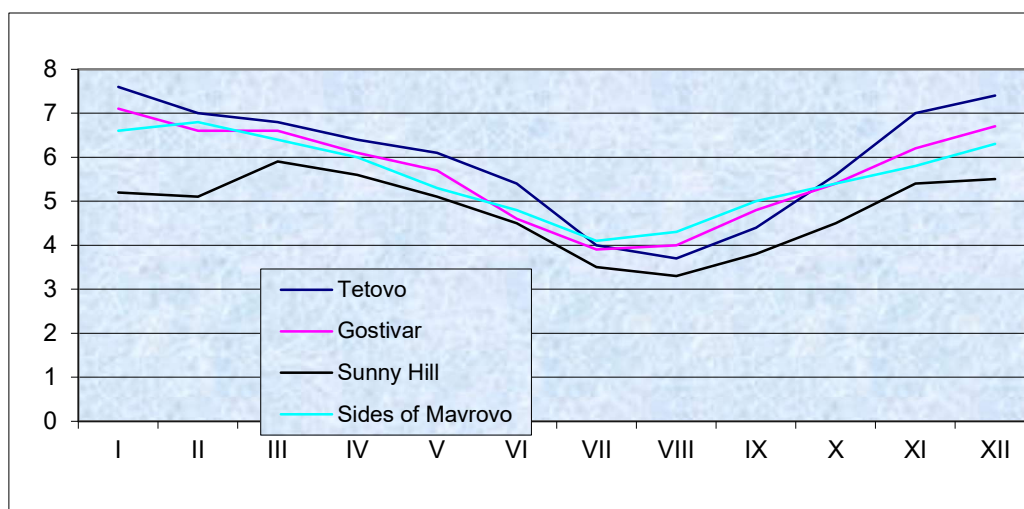


Figure 7. Movement of air relative cloudiness of Pollog Hollow period 2009-2019

Data Table and Chart show the monthly average cloudiness of Pollog hollow is greater during the winter months, and lower during the summer season.

4. Fog

Fog is often a phenomenon in the Pollog hollow due to major hypsometric differences of the lowest and highest points of the hollow. Fog within a year in Tetovo reaches 33.4 days while in Gostivar 21, 2 days. On the other hand, in the Sun Hill fog reaches 37.2 days, while in sides of Mavrovo 47.0 days, compared with that found in Skopje hollow, the situation better (71 days with fog).

5. Rainfall

Given the fact that the climatic factors, rainfalls are the main ingredients for the formation of surface water flows, this part of the data we have available, during the subsequent exposition for this phenomenon will be given greater attention.

To gain better access to the amount of rainfall within the soil, using data from ten stations for measuring the amount of rain, collected during the past ten years, by the Hydrometeorology Institute in Skopje, are processed several types of isoline maps. According to isoline maps of the Pollog located in the Hydrometeorology state office, total amount of precipitation falls in the direction of southwestwards in northeasterly direction.

Table 7. Monthly and annual average amount of rainfall in mm for the period 2009-2019

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Avg. Ann.
Tetovo	84,1	71,4	70,0	58,8	70,1	43,9	39,3	37,3	46,2	71,0	102,0	92,6	783,8
Gostivar	90,5	80,0	92,3	70,3	72,1	43,9	49,5	34,0	54,5	78,6	110,6	99,2	875,5

Sunny Hill	74,1	63,2	84,8	100,9	119,6	73,5	67,0	58,1	76,8	109,5	150,3	118,4	1096,2
Sides of Mavrovo	113,4	106,8	99,6	83,0	92,9	59,9	48,0	43,0	70,6	106,6	148,9	130,3	1103,3

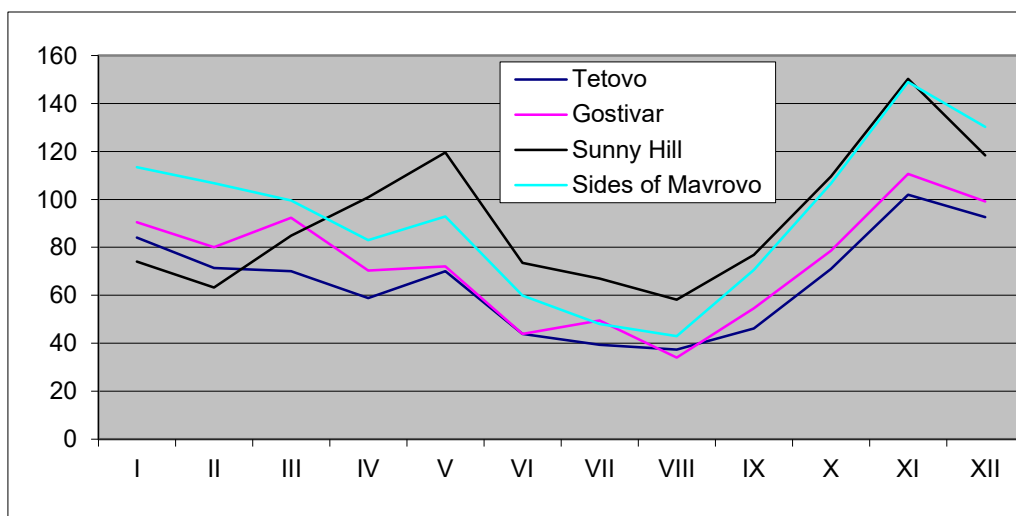


Figure 7. Monthly and annual average amount of rainfall in mm for the period 2009-2019

It is important to review the structure of annual rainfall by seasons of the year and vegetative period. This has economic importance, especially for agricultural activities and beyond. Naturally, the largest amount of atmospheric precipitation falls during the winter. So, for example, in Tetovo, their quantity reaches 348.1 mm, or about 32% of the total amount of rainfall, and then in Gostivar 269.7 mm or 30.8%, 380.5 sided of Mavrovo or 25.0 mm % and the Sunny Hill 305.3 mm or 27.9% of the total amount of rainfall in the Pollog hollow. This can be seen from this table:

Table 8. The amount of precipitation as seasons of the year for the period2009-2019

Meteorological Station	Winter	Spring	Summer	Autumn	Vegetative period	Annual Amount
Tetovo	198,9	116,9	219,9	348,1	359,5	783,8
Gostivar	234,7	127,5	243,7	269,7	324,3	875,5
Sunny Hill	305,3	196,6	336,6	255,7	495,9	1096,2
Sides of Mavrovo	257,5	150,9	326,1	380,5	397,4	1103,0

During the spring season rainfall amount is larger in the Sunny Hill (305.3 mm) while less in Sides of Mavrovo. These differences appear between rain-gauge stations during the summer season [4], [2].

Snow Layers. Given the fact that the upper course of the Vardar River dominates the high mountain terrain, it is natural that the rains and snow, for there to be more voluminous unlike the hollows. In rural mountain heights depending on altitude and position of the terrain itself, layers of snow remain 100 to 170 days, and has years when its maximum thickness reaches up to 2m. Low air temperatures condition the renewal of uninterrupted of rains and snow in most cases by the end of April. According to D. Andreevski³, S. Kirovski and M. Mihajlovski during 1969/70 in Mountain Sharr the first snow in fell in early October and has continued uninterrupted from 28th of November 1969 until 23rd of April 1970, thus 147 days continuously. Its maximum thickness is recorded in the first days of March, and had a density of 0.35 and total water content of 517 mm / m².

Frosts. Initial frost date is October 26th in Pollog and April 11th is of the spring is the last. The average frost is 168 days. Frosts occur earlier on September 30th while the later ones on May 13th so extreme periods of days with frost appears in 229 days. However, the real frosts occur only 90 days.

From this Pollog climate has a possibility to do damage to agricultural crops by the appearance of frost in early fall and late spring.

Earlier autumn frosts appear in the month of October and that is 48% in the second decade with 28% in the first 12% and 8% in the third.

But the late spring frosts occur in April with 60% and those of May with 12%.

6. Drought

From the relative major rains in Pollog appears also dry periods that are most common in summer months and in different years. Droughts in addition to occurring in summer also appear in different seasons of the year.

Dry periods of summer and many winter rains, show the influence of Mediterranean climate. Dry periods appear from 10-15 days and that with 62%, from 16-20 days occur 17%, from 20-25 to 9%, while over 25 days dryness 12%.

From all of the dry periods 78% occur in the vegetation period from seasons with more during 3 months of summer, in autumn and winter are rare. In the Pollog hollow longer periods of dryness has lasted 76 days [5].

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