Proc. VI Serbian-Bulgarian Astronomical Conference, Belgrade 7-11 May 2008,
Eds. M. S. Dimitrijević, M. Tsvetkov, L. Č. Popović, V. Golev
Publ. Astr. Soc. "Rudjer Bošković", No. 9, 2009, 269-273

ASTROCLIMATIC CHARACTERISTICS OF VIDOJEVICA MOUNTAIN

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Abstract. The Vidojevica Mountain belongs to the mountain group of the Southern Serbia that elongates the Rodop mountain system. Other mountains of the group are: Arbanaska, Sokolovica, Pasjača and Rgaja. The Vidojevica Mountain is near to the town of Prokuplje and directly faces the town from the South. In fact, it extends into the direction from the North to the South West. The average height of the Vidojevica Mountain is 780 m and it is the natural barrier of the Southern side of the Toplica valley. It has one dominant peak Bandera (1154m), and two minor ones, Beli kamen (1072 m) and the peak Perina Livada (1072 m). The new astronomical station (ASV) of the Astronomical Observatory in Belgrade (AOB) is situated at the peak Bandera, therefore the astroclimatic properties at the mountain will have an important role in the future plans for the utilization of ASV. We present in this paper the comparative investigations of the microclimatic and macroclimatic properties of the mountain Vidojevica and the vicinity and some of the astroclimatic conditions, as well.

1. MACROCLIMATIC CHARACTERISTICS OF THE TOPLICA VALLEY

We investigate the temperature variations in the Toplica valley using data obtained by the meteorological stations located in the towns of Prokuplje, Blace and Kuršumlija. The data cover the period from 1925-2002. As seen in the Table 1, July is the hottest month in Prokuplje, while January is the coldest. Data for the Vidojevica Mountain are similar to these ones, but with the less difference between temperature extremes.

Table 1. The average monthly temperature of the air in the Toplica valley

Station	1	2	3	4	5	6	7	8	9	10	11	12	Average temperature	Amplitude
Prokuplje	-0,4	-0,6	5,7	11,6	16,1	19,8	22,6	21,7	18,2	12,3	7,4	1,3	11,4	23,0
Vidojevica	-0,8	-0,7	5,6	10,4	15,0	17,8	20,3	19,8	15,7	10,8	5,3	2,7	10,3	21,1

Table 2. The average temperature of the air per period of the year.
(Data are obtained from the meteorological station of the town of Niš, 1900-2004.)

Place	Winter	Spring	Summer	Autumn
Prokuplje	0,5	11,1	21,4	12,6
Vidojevica	- 2.5	8,3	17,5	11,7

The Table 2 shows that winter is coldest at both places, at the Vidojevica Mountain and in the town of Prokuplje. The temperature changes, as expected, with the change of the altitude; the temperature falls 6.5°C in average with every thousand meters. Further, other atmospheric phenomena occur at the mountain. For example, the temperature inversion sometimes becomes visible at the Vidojevica Mountain. Instead of temperature falling with the height, it sometimes rises up to 10°C comparing to the bottom of the mountain. The difference between seasonal extreme temperatures is high. In the summer months, the extreme temperature goes high as 40°C, while in the winter months it could be as low as -20°C.

2. RELATIVE HUMIDITY

The flow of the temperature humidity changes proportionally to the change of the temperature. It is larger in the night than in the day-time and it is smaller in summer then in winter.

Table 3. Relative humidity per months, 1950-2004.

Stations	1	2	3	4	5	6	7	8	9	10	11	12
Prokuplje	84%	81%	76%	72%	71%	68%	63%	65%	69%	75%	82%	85%
Kuršumlija	85%	83%	79%	76%	76%	70%	65%	66%	71%	79%	83%	87%
Blace	86%	84%	78%	75%	75%	71%	64%	67%	70%	80%	85%	88%
Vidojevica	82%	81%	73%	72%	71%	64%	60%	65%	69%	75%	82%	84%

According to these data, the relative humidity in Jun, July, August and September in the Toplica region does not exceed 70% and at Vidojevica it is several percents lower.

3. CLOUDINESS AND INSOLATION

The cloudiness is an important element of the climate on which the insolation obviously depends. According to the data in the Table 4, the cloudy weather in the Toplica region is mostly presented in January and December, and it is the least presented in August, July and September. For example, the cloudy weather on Vidojevica is 70% of days in January, while in August it takes only 29%.

Table 4. The average of the cloudiness per months, 1950-2004.
(The table depicts the percentage of cloudy days in one month)

Stations	1	2	3	4	5	6	7	8	9	10	11	12	yearly
Prokuplje	73	62	54	52	51	40	29	28	30	48	60	71	49
Kuršumlija	74	64	56	53	54	43	30	29	33	50	64	74	52
Blace	75	63	55	54	56	44	31	30	32	49	62	75	52
Vidojevica	70	60	49	50	50	31	28	29	31	44	59	58	49

By observing the seasonal cloudiness at the Vidojevica Mountain, we note that the cloudy weather decreases from winter to summer as it is rather low in June, July, and August, then it rises again when the winter months approach. Note that the cloudy weather is in the opposite proportion to the annual temperature flow. The total amount of insolation during the year in average is 1841 h. It is smallest in December, 45.5 h, and in January it is 75.3 h with the average daily insolation of 1.4 and 2.4. It is highest in August, 258 h, and 249 in July, with the average daily amount of 8.3 h and 8.2 h respectively. The observed data agree with the Hendman's conclusion that the insolation is directly proportional to the temperature and the humidity.

Table 5. Average insolation per months and per year in hours.

Station	1	2	3	4	5	6	7	8	9	10	11	12	Insol.
Prokuplje	75,3	77,2	107,4	155,2	203,9	210,8	248,7	258,1	229,6	152,2	76,1	45,5	1841

4. PRECIPITATION

According to data in the Table 6, the Toplica region is one of the driest in Serbia, as it gets only 580 mm of the accretion measured on the annual basis. And Vidojevica Mountain even belongs to semi-arid rain with the total precipitation amount of 533 mm on annual basis.

Table 6. The average of precipitation per month in mm, 1950-2004.

Station	1	2	3	4	5	6	7	8	9	10	11	12	year
Prokuplje	41	31	36	40	60	45	33	37	26	64	49	54	516
Kuršumlija	44	40	37	48	71	68	39	41	30	68	51	60	597
Blace	44	40	40	55	74	72	55	42	31	64	60	51	628
Vidojevica	39	33	34	41	58	59	40	39	27	63	49	51	533
Niš	49	42	39	50	70	69	42	43	33	70	54	62	624
Leskovac	47	41	40	51	71	72	43	44	32	68	55	58	622

Precipitation is comparatively unbalanced in respect to the months and the type of precipitation. Rain and snow dominate. As seen from the displayed data, the greatest amount of rain is in May and in October, whiles the least is in September and in February. Such precipitation distribution belongs to the continental evaporation regime, in this case the Danube evaporation regime. However there is a small variation in the monthly distribution of precipitation; the greatest amount of precipitation is in September, not in February. We also see that the summer months July and August especially lack precipitation (especially in the Prokuplje area). Particularly, rains often come as short downpours.

5. MICROCLIMATIC CHARACTERISTICS OF THE VIDOJEVICA MOUNTAIN

Vidojevica is deeply extended into the continental climate; therefore there is the influence of this type of climate into this region. During the winter Vidojevica is under deep snow one to three months, in average 2.5 months. As the auxiliary road which connects ASV and the main road is 2.5 km long, this may affect in the wintertime the communication between ASV and the main road.

In accordance to the temperature gradient principle the average temperature on the peak of Vidojevica is lower about 5^0 C in comparisons to the average temperature in the Toplica valley. However, the temperature inversions often appear, particularly in summer and in winter. An explanation would be that the river Toplica crosses the Toplica valley just next to the foot of Vidojevica. It is the coldest hydrological object in the summertime and it could be colder up to 7^0 C than the objects on the land. Thus, the colder air along the river keeps under the warm air along the mountain, while on the top of Vidojevica appears the stream of the colder air. This streaming can be so strong that can be sensed on the human body since the temperature difference can amount up to 10^0 C. The other explanation would be as follows. The colder air from the mountain mixes up with the air currents rising from the valley, comes near the river valley suppressing the warmer air which goes up and so becomes less dense. Thus, noticeable currents are created in the valley; the current speed is 2-3 m/s up hill. When the air current moves southwards, it reaches the first obstacle when it comes to the North West side of Vidojevica. Then the air current flows near the very top of the mountain splitting into two directions. One direction again follows the Toplica valley, while the other direction goes from the top of the mountain towards the higher sea level heights and further into the troposphere. The other current that goes back changes its direction of moving in the midday.

On the other side, during the winter time there are more sunny days on the top of the mountain than in the Toplica valley. So the temperature is higher at the top of Vidojevica than in the valley and again appears the temperature inversion. For better understanding of just described microclimatic phenomena at Vidojevica Mountain, we give the Table 7 with meteorological parameters recently measured.

Table 7. Climatologic elements at the Vidojevica Mountain

Date	Peak Bandera	Height of snow	Precipitations	Maximum ºC Minimum ºC	Air pressure	Relative Humidity
15.01.2004	/	14,5 cm	Jan. 39 ml	-9,0 -1,0	1016 mb	79%
02.04.2004	/		Apr. 29 ml	- 4,1 14,0	1010 mb	70%
09.06.2004	/		June 21 ml	+8,0 +31,0	1009 mb	64%
10.10.2004	/		Oct. 47 ml	+6,0 +13,0	1013 mb	73%

6. CONCLUSION

Weather prediction has always been considered an important tool for the routine operation of an observing site. This paper approaches the topic with particular reference to the new astronomical station ASV at the Vidojevica Mountain. This research is based on meteorological data for the Toplica region which are collected in last 50 years; some of them are more than 100 years old. There are often noticeable air currents at the top of the Vidojevica Mountain where the station is situated. But they appear on the North direction from the station so they should not be the significant obstacle for the future observations since most of them will be dedicated to the observations of the southern celestial objects. Long term observations of other meteorological parameters, in particular the precipitation, shows that the climate at Vidojevica becomes drier turning into almost semi arid climate. This shows that the choice of the Vidojevica Mountain as a place for building of an astronomical station was good.

References

***: 1980a, *Synoptic maps of region Niš*, Meteorological station in Niš, 1990-2004. Niš.

***: 1980b, *Major meteorological maps of region Niš*, Republic meteorological institute, Belgrade.

***: 1981, *Astroclimatic observation for future astronomical station in Serbian mountains*, Observatory in Belgrade.

Denon, R.: 1978, *Microclimatic parameters and astroclimatic parameters*, London.

Mijajlović, Ž, Valjarević, A, Simonović, A.: 2006, Climate properties of the Toplica region, *Publ. Astron. Obs. Belgrade*, **80**, 361.

Valjarevic, A.: 2002, *Project of construction astronomical observatory at the Vidojevica Mountain*, Kruševac.