



Fog water collection with SFC on the mountain Velebit (Croatia) during the period 2000-2009

M. Mileta, T. Likso

Meteorological and Hydrological Service, Zagreb, Croatia, (mileta.cirus@dhz.hr / Fax: ++385 1 48 51 901)

Abstract

Zavižan (1594 m above mean sea level) is the highest mountain station in Croatia and it is chosen for collecting of fog water with a standard fog collector (SFC). It is situated on Velebit Mountain which is the boundary between maritime and continental climate. The methodology of collecting fog water was described in Schemenauer and Cereceda (1994). Fog water collection with SFC started in summer 2000. With a mean air temperature of 5.1°C the year 2000 was the warmest year in the available measurements (1953-2009). A significant increase in the annual temperature was observed during the whole period 2000-2009. Among 10 the warmest years at Zavižan, 5 were observed in this century (2000, 2007, 2008, 2002 and 2009). The paper discusses the daily fog water amounts collected during the different long periods in the warm parts of the period 2000-2009. The fog water collected in days without precipitation is analysed separately. Also a number of days with fog in the monitoring period have been compared with respect to the average values from the period 1961-1990. Maximum one day-value was 27.8 l/m² observed in October 2003, while the highest daily rate in days without rain was 19.0 l/m² observed in October 2002.

1. Introduction

The meteorological station Zavižan is equipped with the standard fog collector (SFC). It is located at the foot of Vučjak Hill on Northern Velebit, 1694 m above mean sea level (45°49' N, 14°59' E). The methodology used was described in Schemenauer and Cereceda (1994), and it is based on the use of a standard fog collector (SFC) of 1 m² of polypropylene mesh. The results presented here are the daily fog water amounts collected during different long periods in the warm part of 10 years (2000-2009). The measurements lasted until the air temperature became negative. The measurement of fog water in Croatia using the Grunow type of the fog collector (for the 30 years period) and using the

standard fog collector (SFC) was presented by Mileta (1998, 2003, 2004).

1.1 The air temperature and a number of foggy days during 2000-2009

A significant increase in the annual temperatures was observed in the first decade of this century. This was the warmest decade ever recorder as shown in Figure 1. Distribution of mean monthly number of foggy days during the observing period 2000-2009 is presented in Figure 2. The number of foggy days is dependent on a season. Maximum was in December (22.4 foggy days) and minimum in July (7.2 foggy days). The number of foggy days during the period 2000-2009 in comparison with the average 1961-1990 is presented in Figure 3. During summer months (June, July and August) and also in April, May and February in the period 2000-2009 the number of foggy days was below the average 1961-1990. In other months number of foggy days exceeded the average as shown in Figure 3.

2. Results of fog water measurement

The fog water amounts in the period 2000-2009 in the warm part of the years have been analysed. The data were obtained between July 27 and November 10 in 2000, May 16 and September 27 in 2001, June 26 and October 25 in 2002, July 3 and October 10 in 2003, during June and September (13-24) in 2004, between May 1 and August 31 in 2005, and June 2 and October 17 in 2006, between May 29 and October 12 in 2007 and between May 14 and September 16 in 2008 and from May 9 to October 13. The maximum one-day value was 27.8 l/m² recorded on October 8, 2003. The highest daily collection rate in days without rain was 19.0 l/m² on October 16, 2002. Synoptic situation on October 8, 2003 was characterised by west upper air current with advection of moist air from Atlantic and on October 16, 2002 was southwest upper current with advection of moist air from Mediterranean Mileta (2004).

3. Figures

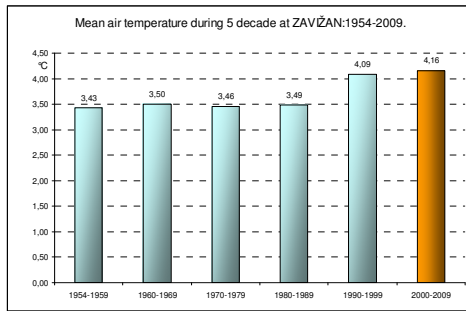


Figure 1: The mean air temperature during periods 1954-1959, 1960-1969, 1970-1979, 1980-1989, 1990-1999, and 2000-2009.

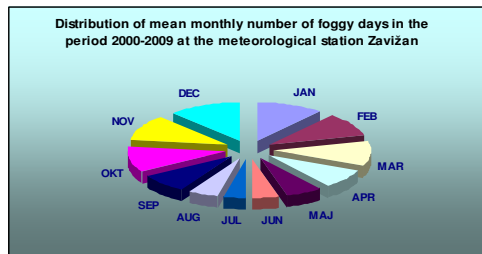


Figure 2: Distribution of mean monthly number of foggy days in the period 2000-2009 at Zavižan.

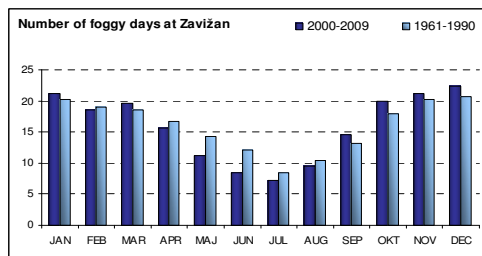


Figure 3: Distribution of mean monthly number of foggy days in comparison with the average 1961-1990.

4. Tables

Table 1: The monthly amount of fog water collected with SFC and fog water contribution with respect to rain (%)

	MAY		JUN		JUL	
	SFC	%	SFC	%	SFC	%
2000					0.3	15.8
2001	24.5	67.7	37.4	24.3	34.5	51.3
2002			14.3	32.9	21.0	37.5
2003					9.0	54.9
2004			61.5	59.0	-	-
2005	77.1	45.9	17.4	39.5	46.9	54.5
2006			36.9	37.8	22.3	27.6
2007	27.6	58.6	46.3	35.4	16.6	61.9
2008	46.9	43.4	41.6	29.8	10.6	22.3
2009	5.1	64.1	46.0	36.5	17.4	29.9

	AUG		SEP		OCT	
	SFC	%	SFC	%	SFC	%
2000	1.4	20.0	80.0	32.3	177.7	63.9
2001	8.2	78.8	87.8	36.3		
2002	99.8	26.9	128.5	31.4	165.9	162.5
2003	16.6	96.0	78.2	68.3	88.2	92.2
2004	-	-	44.9	26.6		
2005	92.1	34.4				
2006	75.3	30.4	-	-	27.1	250.9
2007	50.8	26.2	94.9	36.7	38.4	297.3
2008	18.1	54.5	32.5	142.5		
2009	29.4	25.9	27.7	42.5	16.9	20.6

	NOV	
	SFC	%
2000	102.5	48.5
2001		
2002		
2003		
2004		
2005		
2006		
2007		
2008		
2009		

Table 2: The amount of fog water in days without rain

	MAY	JUN	JUL	AUG	SEP	OCT
	SFC	SFC	SFC	SFC	SFC	SFC
2000			0.1	-	5.7	32.0
2001	7.5	1.2	4.4	2.2	1.2	
2002		4.0	4.4	2.3	5.4	35.5
2003			0.8	0.3	7.3	7.2
2004		0.9	-	-	1.0	
2005	0.9	1.6	3.4	10.8		
2006		1.6	0.4	0.5	-	24.9
2007	.	3.1	2.7	2.6	2.2	2.6
2008	2.3	1.4	2.5	2.1	0.6	
2009	0.4	0.3	0.5	1.4	4.2	3.7

5. Summary and Conclusions

The studies have shown that the fog water constitutes an important water resource in the considered area. The maximum amount of fog water occurs in autumn (October, November) together with the maximum of precipitation. This is caused by the cyclonic activity over the Adriatic Sea and Mediterranean. The greatest need for water occurs during the summer season when many visitors come in National Park where is located the meteorological station. That is the reason why is necessary to start with fog water collection earlier in spring but this is dependent on snow cover and air temperature in spring. It is interesting to note that even in drought condition fog provides a consistent amount of water.

References

- [1] Mileta, M.: Fog precipitation on the mountain in Croatia, 1. International Conference on Fog and Fog Collection, 20-24 July 1998, Vancouver, Canada, 1998.
- [2] Mileta M.: Special measurements of precipitation and fog water, Zavižan among snow, wind and sun. Meteorological Monography (in Croatian), Zagreb, 2003.
- [3] Mileta M., 2004: Results from fog water collection on Mt Velebit in Croatia, 3. International Conference on Fog, Collection and Dew, 11-15 October 2004, Cape Town, South Africa.
- [4] Schemenauer, R.S., Cereceda, P.: A proposed standard fog collector for use in high elevation region, Journal of Appl. Meteo., Vol. 33, pp. 1313-1322, 1994.