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HOUZARDOUS METEOROLOGICAL EVENTS IN THE SHKODRA LAKE BASIN

Përmbledhje: Veçoritë klimatike dhe pozicioni gjeografik i Liqenit të Shkodrës bëjnë të mundur shfaqjen e ngjarjeve të jashtëzakonshme. Ndër këto ngjarjet atmosferike, që ndikojnë në këtë basen mund të përmënden: reshjet intensive, shtresa e dëborës (pjesa kodrinore e tij), valët e të nxehtit, valët e të ftohtit, thatësira etj. Në këtë studim janë analizuar rastisja, zgjatja dhe shkalla e ashpërsisë së tyre. Gjithashtu është vlerësuar frekuenca e ngjarjeve ekstreme të tilla si: temperatura ekstreme e ajrit dhe numri i ditëve me temperaturë maksimale e minimale mbi/nën një prag të dhënë. Bazuar në skenarët e ndryshimeve klimatike, janë vlerësuar ndyshimet e pritshme të frekuencës, zgjatjes, ashpërsisë etj. të ngjarjeve të jashtëzakonshme atmosferike.

Fjalë kyçe: *elementët meteorologjikë ekstremë (reshje intensive, temperaturë ekstreme, thatësira, valët e të nxehtit, valët e të ftohtit), skenarët e ndryshimeve klimatike*

Abstract: The climate features and geographical positions of Shkodra Lake basin make possible the occurrence of meteorological hazardous. Among the meteorological hazardous that has affected this basin it can be mentioned: heavy rain, snow depths (hilly part of it), heat wave, cold wave, drought etc. Their occurrence, frequency, duration, and severity are studied. Also, the frequencies of extreme meteorological events as: extreme air temperature and the number of days with maximum and minimum temperature over/under a certain threshold are estimated too. Based on climatic change scenarios are expected changes of the frequency, duration, severity, etc. of meteorological hazardous

Key words: *extreme meteorological elements (heavy rain, extreme temperature, drought, heat wave, cold wave), climate change scenario*

INTRODUCTION

Referring to the climate classification of Albania, the surrounding of Shkodra Lake is included in North Mediterranean field and hilly zones (HIDMET, 1988*)*. The

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west Albanian Alps are not included in the analyzing of the extreme meteorological elements.

General climate features are characterized by wet mild winters and hot dry summers (HIDMET, 1975). The climate features and geographical positions of Shkodra Lake basin make possible the occurrence of meteorological hazardous.

According to the level of destructiveness, all the adverse weather phenomena may be divided into categories as follows:

– *Extraordinary (e),* are called the adverse weather phenomena, which are not destructive, in the extreme cases they influence the human life and human activities;

– *Dangerous (d)* weather phenomena are considered to be those which are directly affecting human life and material goods;

– And *catastrophic (c,)* weather phenomena designated and dangerous phenomena affect an extremely large area or reach the absolute maximum of intensity at some station.

The extreme event will be considerate such phenomenon, its frequency is very rare. Among these we will separate; heavy rain, maximum and minimum absolute temperature, strong winds and prolong and severe drought, heat and cold wave etc. (KNMI, 2010)

MATERIAL AND METHODS

Methodology of threshold calculation

The frequency distribution of meteorological variables is used to calculate threshold calculation for adverse weather phenomena identification.

For practical reasons we shall consider the daily maximum of precipitation for a 10-year return period as a threshold for heavy rain amount. Estimation of the maximum[2]4 hours precipitation for 10 years return period is calculated by Gumbel distribution (Radinović, 1997).

Air temperature becomes adverse, when it reaches extreme values (exceed certain thresholds). The further analysis in this section will be focused to the maximum and minimum temperature regimes. Referring to this, the maximum temperature exceeds the value 35°C and minimum temperatures under -5^0 C are chosen as threshold. The temperature over/under this threshold influences in the quality of human life as well as in the agriculture and other economy branches. Heat waves are cases when at least in six consecutive days the maximum air temperature is 5°C more than the long-term average temperature of the corresponding days. Cold waves are cases when at least in six consecutive days the minimum air temperature is 5°C less than the long-term average temperature of the corresponding days. Drought is a protracted period of deficient precipitation resulting in extensive damage to crops, resulting in loss of yield.

According to the DMCSEE project, SPI index is used to evaluate severity of drought in this target zone (McKee *et al*., 1993*)*. The drought classification by SPI value is presented in the table 1.

Table 1 Classification of Drought based on the SPI values

Classification	Extremely wet	Very wet	Moderate wet	Near normal	Moderate dry	Severe dry	Extremely dry
SPI value	> + 2	1.99–1.5	1–1.49	0.99–0.99	-1–1.49	-1.5 -1.99	<-2

RESULTS AND DISCUSSION

Air temperature extremes

The number of days with the air temperature exceeds the threshold 35°C is calculated for each year. Averagely the number of such days is 7.5 days/year. It is obvious that the number of days with temperature > 35°C is more frequently during the last decade (Fig. 1).

It can be seen that up to year 1980 the number of days with temperature >35°C has not been yearly phenomenon, while after this year such temperatures are present every year. As far minimum temperatures, the absolute value registered in the Shkodra zone is –16°C. The number of days with minimum temperature ≤ -5°C is averagely 1.4 days/year. In last decade a lower number with such temperature is observed (Fig. 2).

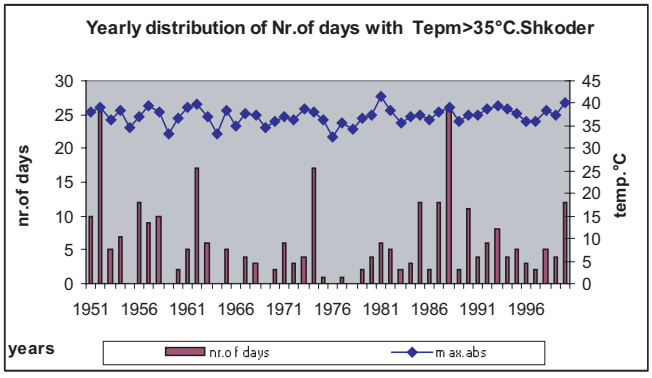

Figure 1. Number of days with temperature >35^{0}C and maximum temperature values

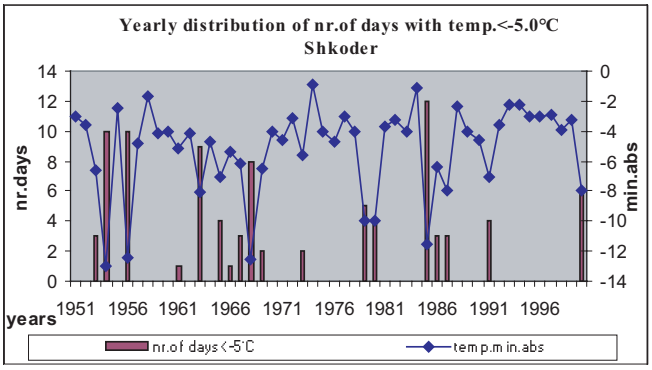

Figure 2. Number of days with temperature ≤ -5^{0}C and minimum temperature values.

Intensive rain

In general this zone is characterized by heavy rainfall. We can mention the heavy rain on 2 October 1946 when in Shkodra region was registered 398.0 mm in 24 hours. (Muçaj *et al.*, 1985).

Table 2 shows the mean number of days over the threshold and the 24 hour maximum precipitation for every decade.

Taking in consideration the threshold (>110 mm) for the Shkodra zone is found out that in the last two decades there is no change in the frequency of heavy rain days.

Table 2. The mean number of rainy days over the specific threshold of precipitation. Shkoder

Decades	51–60	61–70	71–80	81–90	91–2000	01-'08
Nr. of days	1.1	1.2	0.9	1	0.9	1
24 h of prec.	291	206.4	135	244.1	345	190

In the Figure 3 is shown the time series of rainy days >110 mm for Shkodra station.

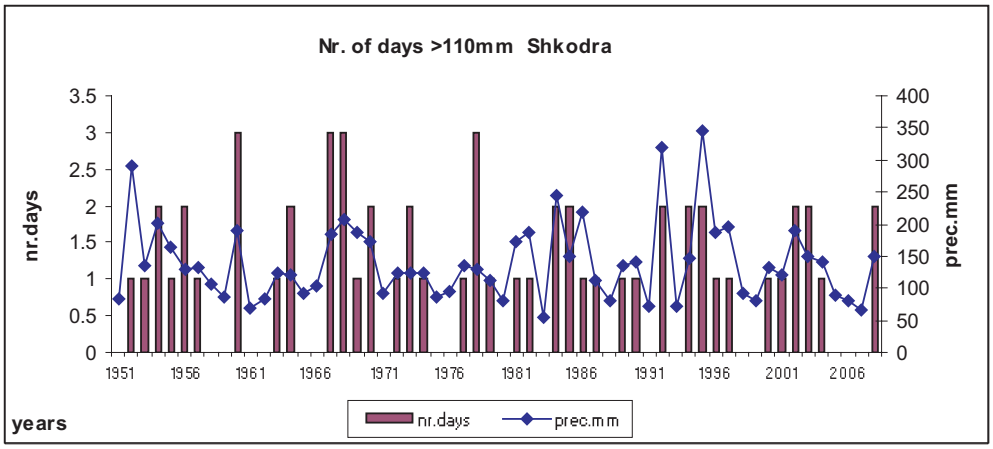

Figure 3. Number of days > 110 mm and 24 h maximum values of precipitation. Shkoder

Drought

The cases with SPI 3 <-1.5 (severe and extremely dry) for every decade is shown in the Table 3. For all the period (1951–2004) are verified 43 cases with severe and extremely drought.

Table 3. The cases of severe and extremely drought

Period	1951-'60	1961-'70	1971-'80	1981-'90	1991-'00	2001-'04
cases	6	4	3	15	8	7

These *SPI* values calculated for Shkodra station point out, that period 1981–1990 has the maximum cases with drought follow by the last period 2001–2004. The year 2003 is very distinguished regarding the drought. Every month from February to August was characterized by very scarce precipitation. Also severe droughts are observed during the winter 1953–1954, winter 1991–1992 etc. It can be said that the cases with severe drought have the increase tendency in the last decades. There is not verified a significant difference of occurrence of severe drought by seasons of season.

Heat wave

For all the period 1951–1990 are observed 207 days with heat wave. It tells heat wave is a very common phenomenon in this zone. In the table below are presented the distribution of days with heat wave during the year.

Table 4. Number of days with heat wave for every season

Season	spring	Summer	Autumn	Winter
days	88	47	29	43

As it can be seen heat wave is more frequent during spring and summer. But this phenomenon is present also during the winter and autumn season.

In the Figure 4 is shown the days with heat wave for each year. An increasing trend of days with heat wave is present after the year 1984.

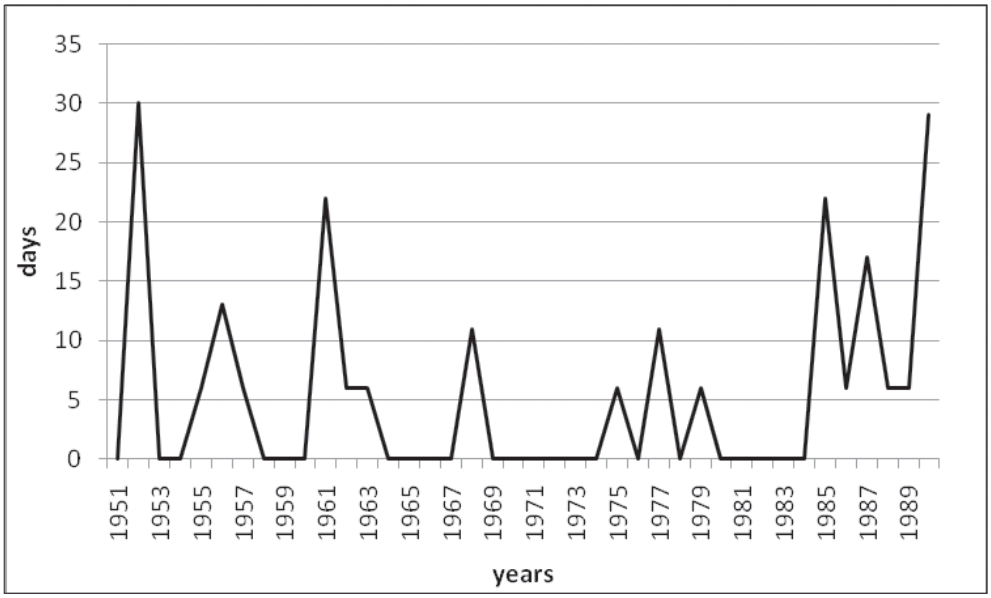

Figure 4. Days with heat wave

Cold wave is another adverse meteorological phenomenon which influence in the life activity of this region. During the period 1951–1990 are observed in total 160 days with cold wave. Occurrence of this phenomenon is very different from season to season (Table 5).

Table 5. Number of days with cold wave for every season

Season	spring	summer	autumn	winter
Days	29	0	41	90

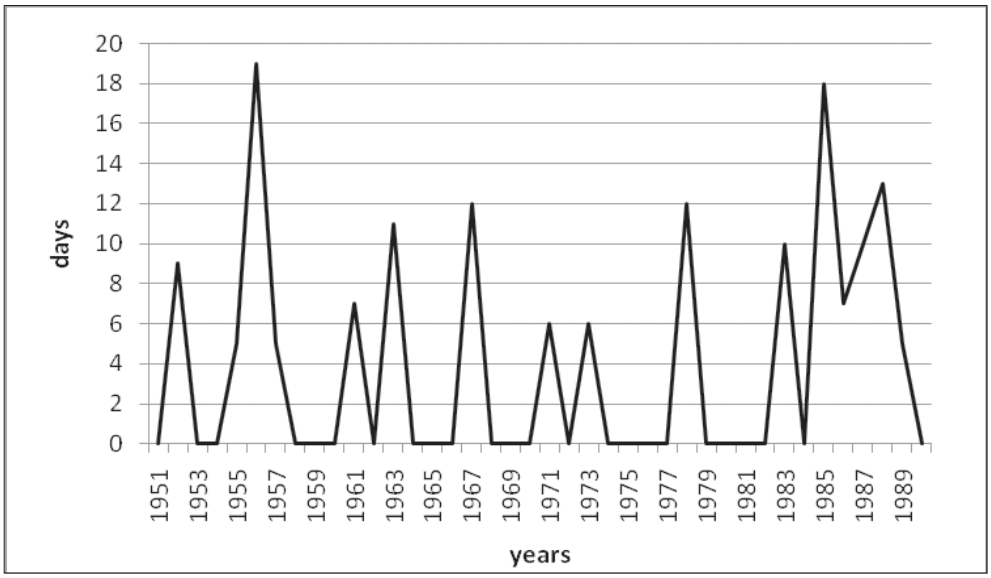

Figure 5. Days with cold wave

The winter is the season with highest frequency of occurrence of cold wave, 90 days. While in summer during this period is not observed any cold wave. The days for each year are shown in the (Fig. 5).

As it can be seen from this figure does not exist any tendency in the occurrence of cold wave during this period.

Expected impacts of climate change in occurrence of extreme events

Regarding to the climate change scenarios running for Albanian the annual temperature is expected to increase up to 2.0°C by 2050 time horizon; annual precipitation are expected to decrease around -6.1%, and the see level rise up to 30–40 cm. (UNDP, 2002)

Decreasing in the number of frozen day, (temp. <-5°C) will occur (less than one day/year in Shkodra zone).

Increasing of days with maximum of air temperature >35°C. Related to 1951–2000, an increase of 2–3 days for 2025, up to 5–6 days for 2050 and 9–10 days for the time horizon 2100 respectively is expected.

Increasing in the number of days with intensive rain (>110 mm in 24 hours); related to 1951–2000, increasing of about 1–2 days by 2025, of about 2–3 days by 2050, and of about 3–5 days by 2100 time horizons is expected.

Drought

Because of the good relation between drought event and precipitation amount an increasing of occurrence of severing drought is expected. Respectively by the time horizon 2025 an increasing of 1–2 cases per decade, by 2050 up to 4–5 cases and by 2100 up to 8–9 cases per decade is expected.

CONCLUSIONS

1. The number of days with temperature > 35°C is more frequently during the last decade of the period (1951–2000) and is expected to increase about 9–10 days by 2100 time horizons;

2. The number of days with minimum temperature ≤ -5°C is lower in last decade of the period (1951–2000) and is expected to be very low (less than one day/year);

3. Heat wave is a very common phenomenon and increasing tendency of such days is expected;

4. An increase of the number of rainy days with hazardous rainfalls, about 3–5 days by 2100 time horizons is expecting to be;

5. An increase of occurrence of severe drought is expected by 2100 time horizon.

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