

METHEOROLOGICAL AND ENVIRONMENTAL OSCILLATIONS IN THE MEDITERRANEAN - SITUATION IN THE DUBROVNIK AREA IN THE COURSE OF 1997.

METEOROLOŠKA I OKOLIŠNA KOLEBANJA NA MEDITERANU - PRILIKE NA PODRUČJU GRADA DUBROVNIKA U 1997. GODINI

UDK 551.5

Izvorni znanstveni članak
Original scientific paper

Sažetak

Zemljopisni položaj grada Dubrovnika na Mediteranu karakterističan je po tome što se nalazi u zoni vlažne mediteranske klime. Njegov položaj na 42°N ukazuje da je dubrovačko područje smješteno u središtu mediteranske klimatske zone. Dugogodišnjim je motrenjem hidrometeoroloških procesa ustanovljeno da vrijednost Embergovog pluviometričkog indikatora na području grada Dubrovnika iznosi oko 200 ($Q=200$). Taj indikator, uz manja ili veća odstupanja, rijetko zalazi u drugu zonu.

Istraživanje hidrometeoroloških procesa u gradu Dubrovniku u 1997. godini otkrivaju da se vremenske anomalije nastavljaju. Najznačajnija su: zatopljenja, smanjenja padalina i prodori kiselih kiša.

Srednja godišnja temperatura zraka u 1997. godini iznosila je 16,7°C dok je klimatski prosjek (razdoblje od 30 godina) 16,2°C. Maksimalna je temperatura u 1997. godini iznosila 33,3°C, a minimalna 1,0°C. Zatopljenje u 1997. godini bilo je u dva godišnja doba; zimi za 1,4°C. U proljeće i jesen temperatura je zraka bila niža za 0,4, odnosno za 0,2°C. Ukupna je količina oblačnosti bila manja od klimatske za oko 28%, dok je trajanje sunčeva sjaja bilo dulje za oko 10%.

Također i padaline bilježe anomalije. U 1997. godini one su iznosile 804 mm, dok klimatski prosjek iznosi 1300 mm. Ovo je najniža zabilježena vrijednost u ovom stoljeću. Do tada najniža vrijednost padalina je bila u 1994. godini. Njezina je vrijednost iznosila 855 mm. Prodor kiselih kiša se nastavlja. Tako je udio jako kiselih kiša iznosio 29%, umjereno kiselih 46% a preostalih 25% kiše su bile lužinaste.

Ključne su riječi: vremenske prilike i odstupanja, padaline i kisele kiše.

Summary

Geographic location of Dubrovnik in the Mediterranean is typical.

Its location on 42°N points out that the Dubrovnik area is situated in the centre of the Mediterranean climatic zone.

In the course of long-standing observations of hydrometeorological processes it has been disclosed that the value of the Emberg's pluviometric indicator in the area of Dubrovnik figures out about 200 ($q=200$). That indicator with lesser or greater oscillations is rarely penetrating into the second zone.

Researches of hydrometeorological processes in the city of Dubrovnik in 1997. reveal that weather anomalies keep going on. The most significant ones are: milder weather spells, precipitation subsidence and penetration of acid rains.

Annual mean temperature in 1997 was 16.7°C while the climatic average (period of 30 years) is 16.2°C. The maximum temperature in 1997. was 33.3°C while the minimum temperature was 1.0°C.

Milder weather spells occurred during two seasons of the year during winter by 1.4°C and in the summer by 0.4°C. In the spring and autumn the air temperature was lower by 0.4°C i.e. 0.2°C. Total cloudiness was lower than climatic by about 28% while the duration of sunshine happened to last by about 10% longer. Precipitation register anomalies as well. In 1997 it was 804 mm, while the climatic average is 1300 mm. This is the very lowest registered value in the course of this century. Until then the lowest precipitation value was 855 mm registered in 1994.

Penetration of acid rains keep going on. Thus, the share of very acid rains was 29%, moderately acid 46% and the remainder of 25% were alkaline.

Key words: weather situation and oscillations, precipitations and acid rains.

*dr. sci. Antonije Đukić
Veleučilište u Dubrovniku, Dubrovnik

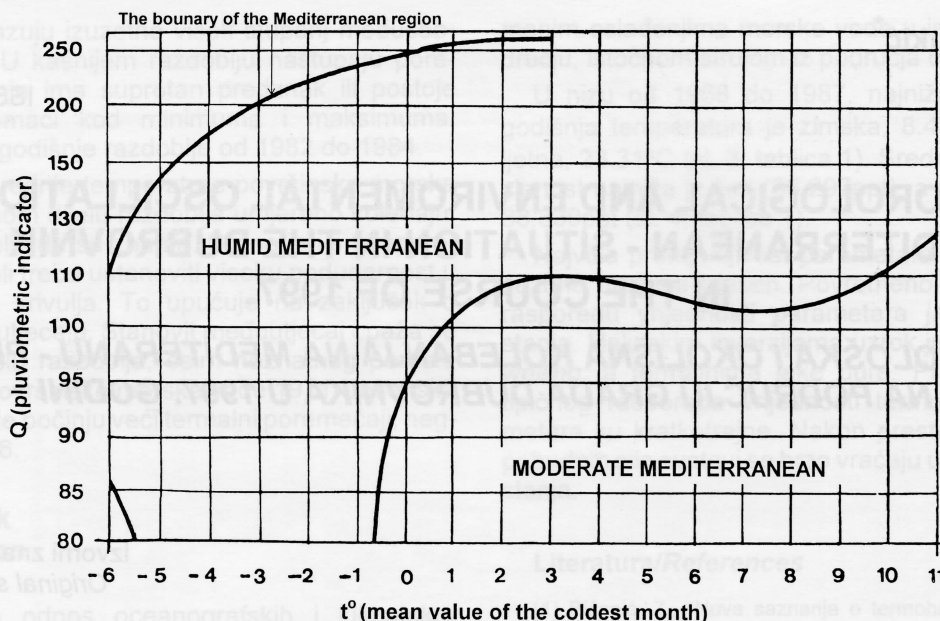


Figure 1. Mediterranean water characteristics

Slika 1. Obilježja mediteranske klime

1. Introduction

Uvod

Research methods used in the making of this paper are the most contemporary ones, the computerised monitoring environmental station manufactured by German feagar + CO gauged according to the who instructions.

For physical-chemical analysis of the processes in the atmosphere I used Hanna instruments made by Japanese manufacturers, multiparametric electrochemical analysis, including spectrometric analyses.

In the course of the last ten years and more the weather situation in the area of the city of Dubrovnik indicate that the oscillations from long-standing - annual climatic ones became more frequent. Those are: milder climatic spells, arrid period, cloudiness and other ecological processes in connection with the meteorological processes.

What are these processes like in 1997, what kind of oscillations relating to climatic are the subject of this original research paper.

Today research of these environmental processes linked to the meteorological are one of the more current ones. They are being increasingly implemented. Especially in the sphere of tourism research of this kind new guidelines in tourism processes on different levels: regional and local (Smith 1990, Giles, Perry 1998)

The researches demonstrated here are implemented in the field of protection of nature and monuments of culture (Morselli, 1991).

Current investigations have shown that cultural monuments are unfriendly influenced by atmospheric chemical processes.

2. Climatic position of Dubrovnik in the Mediterranean

Klimatski položaj Dubrovnika na Mediteranu

Emberg's method is the most favourable for studying climatic processes within the European Mediterranean. It is based on thermic and pluviometric regulations.

According to this classification there are five different zones: dry, partly dry, moderate, humid and mountain. As the Dubrovnik area is situated at 420 n lat. it corresponds entirely to the central position of the Mediterranean zone.

During long standing observations of hydrometeorological processes in Dubrovnik (fig. 1) it has been established that the value of pluviometric indicator is about 200 ($q=200$). This indicator with smaller or greater oscillations is rarely penetrating into another zone. The characteristic of this zone is s maximum rainfall with an extended summer arridness. Therefore the meteorological processes taking place in the Dubrovnik area are representative in the Mediterranean.

3. Weather characteristics of the city of Dubrovnik

Vremenske osobine grada Dubrovnika

The global and comprehensive insight into the weather characteristics in the city of Dubrovnik in 1997. indicates at Walter's model (fig. 2) (Walter 1973, Scossiroli 1987) type of which presents the totality of hydrometeorological characteristics best.

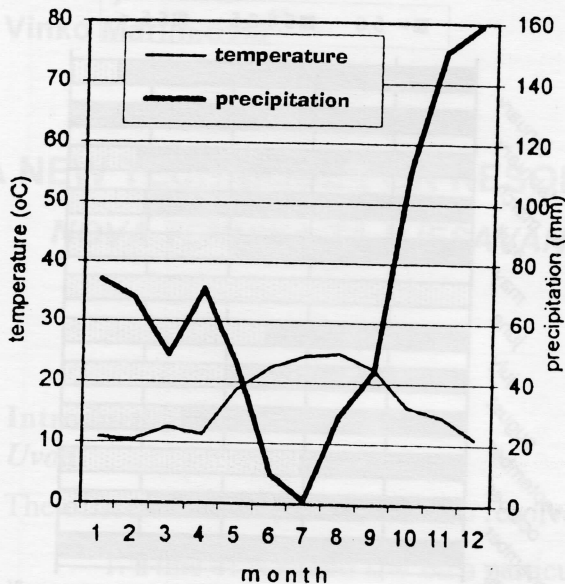


Figure 2. Weather in the Dubrovnik region in 1997.

Slika 2. Prikaz vremena na području Dubrovnika u 1997. godini

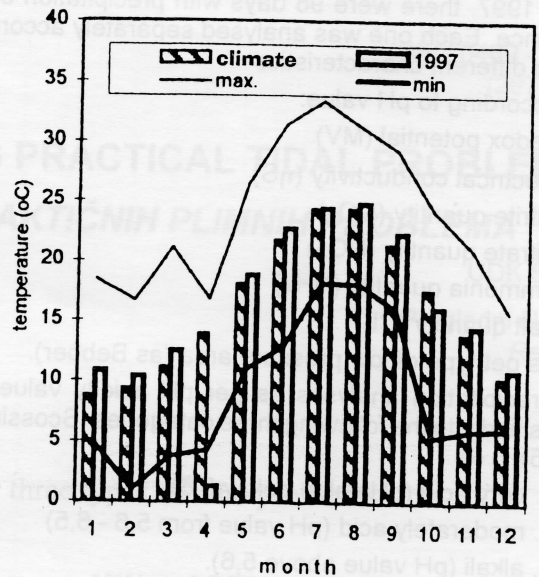


Figure 3. Climatic and mean temperature changes in the Dubrovnik area in 1997.

Slika 3. Kretanje klimatske i srednje temperature zraka na dubrovačkom području u 1997. godini.

The temperature characteristics in 1997 are demonstrated by months and are compared to climatic.

The mean temperature in 1997 was $16,7^{\circ}\text{C}$. With regards to the climatic (mean temperature in the period of 30 years) $16,2^{\circ}\text{C}$ oscillation of $0,5^{\circ}\text{C}$. But if the same is considered per each single month (and during the seasons of the year) then one can obtain a thoroughly different picture.

Warmer spells in 1997 run during two seasons of the year; in winter it went up by $1,4^{\circ}\text{C}$ and in autumn by $0,4^{\circ}\text{C}$.

In spring and summer the air temperature was by $0,4^{\circ}\text{C}$ lower i.e. $0,2^{\circ}\text{C}$. It is interesting that the air temperature during the year has not dropped below 0°C , while the maximum temperature went up to $33,3^{\circ}\text{C}$.

The total precipitation in 1997. is the lowest registered value in this century. It was 803 mm (Đukić, 1994).

This record arid year was "evenly distributed" so that the lack of precipitations was for a major part compensated (by the temperature values).

This is after all disclosed in the presented Walter's model. In this model the relation between temperature and precipitation is presented 1:2 in favour of precipitation; the 10°C temperature value is equivalent to 20 mm precipitation etc., while the extended arid period is valued proportionally 1:3.

Due to the substantial connection between precipitation and cloudiness the question arises what was this connection like in 1997; what were its characteristics like, as well, and whether those considerable oscillations resulted from it. Climatic value for cloudiness in the Dubrovnik area is 4,9 tenths.

Temperature and precipitation is presented 1:2 in favour of precipitation; the 10°C temperature value is

equivalent to 20 mm precipitation etc., while the extended arid period is valued proportionally 1:3.

In relation to latitude it is in compliance with the general model (Đukić) 1988.

Cloudiness as well as aforementioned meteorological processes confirm the fact that weather oscillations are to be continued.

The total cloudiness in 1997 in Dubrovnik area was $3,9^{\circ}$ tenths. It is by 30% lower than climatic.

There were greater oscillations in the winter and the spring which they were insignificant in the summer and the autumn.

4. Penetration of acid rains Prodor kiselih kiša

Penetration of acid rains in the area of the city of Dubrovnik is more and more frequent.

According to the international reports the presence of acid rains is increasing (acid news 1995).

In distinction from more intense research of acid rains in industrial areas where such an influence is direct, researches pertaining immediate influence (impact) is more infrequent.

Therefore these researches have a wider importance within local limits.

The location of the city of Dubrovnik, away from industrial regions is a highly representative stage in research on ecological and climatic interaction.

Precipitation analysis and their physical and chemical characteristics in the area of the city of Dubrovnik have been carried on, only in course of the last four years.

In 1997, there were 98 days with precipitation occurrence. Each one was analysed separately according to different characteristics

According to pH value:

Redox potential (MV)

Electrical conductivity (η S)

Nitrite quantity (NO_2)

Nitrate quantity (NO_3)

Ammonia quantity (NH_4)

Salt quantity (CL)

As per type of low pressure area (as Bebbber).

Precipitation analyses as per pH acidity value is classified into the following three categories (Scossiroli 1995).

1. very acid (pH value below 5,6)
2. moderately acid (pH value from 5,6 - 6,5)
3. alkali (pH value above 5,6).

Out of total of 98 precipitations during 1998, 28 were very acid, 45 were moderately acid and the remaining 25 were alkali.

Distribution of precipitation quality according to the seasons or the year i.e. per each single month is demonstrated by graph 3.

An insight into this graph distribution of rain quality and their pH value one can conclude that acid rains were more frequent during winter, in autumn and spring kept being irregular, while they failed to appear in the summer.

4. Conclusion Zaključak

Dynamism of meteorological system is neither a simple nor a regular process.

These specific qualities are reflected in their different aspects. Although the mean values of meteorological processes in the city of Dubrovnik during 1997 happened to be of a various and diversified gradation they were representing enough to point at the fact that weather oscillations in the Mediterranean are to be continued.

The basic characteristics of these processes in 1997 is a strong differentiation of oscillations during different seasons of the year with a highlighted pluviometric system.

Although the average (mean) temperature in 1997 was insignificantly above its climatic value the low quantity of precipitations point at the fact that 1997 was an extreme one.

The main features of these processes are:

1. warmer spells during cold period of the year
2. cloudiness subsidence
3. precipitation.

When the point in question is referring to physical and chemical processes the situation is dynamic. It is being reflected in the more substantial penetration of acid rains in the Mediterranean.

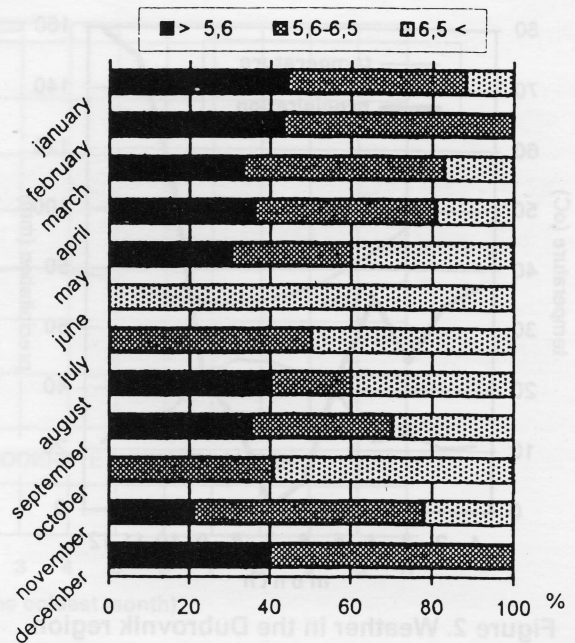


Figure 4. Precipitations quality in the Dubrovnik region

Slika 4. Prikaz kvalitete padalina na dubrovačkom području prema vrijednosti pH u 1997. godini

Since the Dubrovnik area is not an industrial one, these processes confirm the interaction of climatic and the environmental processes.

Bibliography

Literatura

- [1] Acid News (1995) Latest Monitoring (European Monitoring Evaluation Program, 5 Swedish NGO Secretariat on Acid Rain.
- [2] DHZ (1998) Klimatske anomalije temperature i oborina u Hrvatskoj za 1997. godinu, Državni hidrometeorološki zavod, Zagreb, prikaz br. 6
- [3] Đukić, A. (1998) Medium-term cloudiness variation within the area of City of Dubrovnik - processes in the period from 1987. until 1997., Naše more, Dubrovnik, 1/2, 124-128
- [4] Đukić, A. (1994) Vrijeme u gradu Dubrovniku u 1994. godini - hidrometeorološka obilježja i procesi, Naše more, 241-245
- [5] Giles, A.R., Perry, A.H. (1998) The use of a temporal analogue to investigate the possible impact of projected global warming on the UK tourist industry, *Tourism Management*, 19(1), 75-80
- [6] Mieczkowski, Z. (1985) The tourism climate index: a method of evaluating for tourism, *The Canadian Geographer*, 29(3), 220-233.
- [7] Morselli, L. (1991) Depositioni acide - L'interazione con l'ambiente e i materiali, Ambiente Territorio-Edilizia Urbanistica, Bologna, 351-374
- [8] Scossiroli, R.E. (1995) Elementi di ecologia, Zanichelli, Bologna, 137.
- [9] Smith, K. (1990) Tourism and climate change, *Land Use Policy*, 7(2), 176-180.
- [10] Walter, H. (1973) Vegetation on the earth, The English Universities Press, London.

Rukopis primljen: 7.5.1998.