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**MEDIUM-TERM CLOUDINESS VARIATION WITHIN THE AREA
OF THE CITY OF DUBROVNIK -
processes in the period from 1987. until 1997.**

**SREDNJOROČNE VARIJACIJE NAOBLAKE NA PODRUČJU GRADA
DUBROVNIKA - procesi u razdoblju od 1987. do 1997. godine**

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Summary

Medium-term cloudiness variations in the area of the city of Dubrovnik point out that in the period from 1987 until 1997 the cloudiness was reduced by about 15%.

The climatic average is 4,6 and the medium-term one is 4,0 measured in tenths. In the first five-year period from 1987 until 1991 the cloudiness was 3,8 and during the second from 1992 until 1997 it was 4,2.

In the course of seven years the cloudiness was below medium-term climatic average, during one year above medium-term (below climatic) and for two year above the climatic average.

Reconsidering observations of the annual, seasonal and daily cloudiness and precipitation values, the area of the city of Dubrovnik can be determined as a stable and a dynamic one.

Key words: cloudiness difference and oscillations from climatic values

Sažetak

Srednjoročne varijacije naoblake na području grada Dubrovnika ukazuju da je u razdoblju od 1987. do 1997. godine došlo do smanjenja oblačnosti za oko 15%. Mjereno u desetinama klimatski prosjek iznosi 4,6 dok srednjoročni 4,0. U prvom petogodišnjem razdoblju od 1987. do 1991. oblačnost je iznosila 3,8, u drugom od 1992. do 1997. godine 4,2. Sedam godina oblačnost je bila ispod srednjoročnog i klimatskog prosjeka, jednu godinu iznad srednjoročnog (ispod klimatskog), dvije godine iznad klimatskog. Sagledavanjem godišnjih, sezonskih i dnevnih karakteristika hodova naoblake i padalina tip naoblake na području grada Dubrovnika je stabilni dinamički tip.

Ključne su riječi: odstupanje i oscilacije naoblake od klimatskih vrijednosti.

Introduction

Uvod

Weather and climatic changes unfolding on the global level have their impact in the area of Dubrovnik as well. One of those factors is the cloudiness system.

Recording references into a weather log as per recommendations of World Meteorological Organisation (WMO 1960.) the detail cloudiness values in the area of the City of Dubrovnik from 1987 until 1997 and their comparison with the climatic values are presented.

The author has been performing an original research work, i.e. decoding (ciphering) overcast/clouds whilst in comparison with the climatic values. Literature dealing with this issue was utilised in the course of ten years, in the period from 1987 until 1997, a quality analytic basis for cloudiness values was obtained. Thus a comprehensive survey was pointing out whether and which kind of variations of cloudiness system exist in the area of the City of Dubrovnik.

This research is surpassing the local importance with its insight into climatological and ecological processes in the Mediterranean. It's because in the area of the City of Dubrovnik and wider within a diameter of about several hundred kilometers, there is no industrial pollution which could have a "local" impact onto the process of condensation and setting in of clouds of any formation.

Consequently the measuring station is adequate to the representative sample of the Mediterranean at the latitude of about 40°.

In this paper an emphasis is put to the detail characteristics of cloudiness of emphasis the area of the City of Dubrovnik as follows:

1. medium term differences with regard to climatic values
2. cloudiness variations
3. relation between cloudiness and precipitations.

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Today research work of this nature is more and more updated thus pointing at the influence of climatic changes onto the cloudiness system (Shaw, Glen, 1996).

1. Cloudiness differences with regard to climatic values

Odstupanje oblačnosti u odnosu na klimatske vrijednosti

Distribution of clouds on earth is not uniform. There are such areas which are more fair and those which are more cloudy.

An average cloudiness value is a relative indicator of the cloudiness quantity in addition to the considerable criticism of measurement of cloudiness quantity. One can note that cloudiness above oceans nearly in all zones is more intense than above the continent. As a consequence the average cloudiness in the southern hemisphere is higher than in the northern hemisphere.

The most intense cloudiness is in the high latitudes. Although the air has a smaller quantity of water vapour due to the lower temperatures one can find here multilayered (stratocumulus stratiformis) clouds veiling the sky entirely and staying there rather long. The smaller cloudiness exists around the equator area. The air is warmer and richer in water vapour and cumuliform clouds are prevailing, but they do not veil the entire sky.

The smallest extent of cloudiness is in the subtropical areas where air subsidence occurs thus preventing the formation of clouds.

During the last fifty years the cloudiness value in the Dubrovnik area ranges from 4,4 to 4,8 (Mihić; Penzar 1989).

Table 1. Average cloudiness values on Earth
Tablica 1. Srednje klimatske vrijednosti naoblake na Zemlji

Area	Sea	Land	Earth	Area	Sea	Land	Earth
90-80° N	6,3	-	-				
80-70° N	7,0	6,3	6,6				
70-60° N	7,2	6,2	6,3				
60-50° N	6,7	6,0	6,2				
50-40° N	6,6	5,0	5,6	N polutka	5,6	4,8	5,2
40-30° N	5,2	4,0	4,5				
30-20° N	4,9	3,4	4,1				
20-10° N	5,3	4,0	4,7				
10-00° N	5,3	5,2	5,3				
00-10° S	5,0	5,6	5,2				
10-20° S	4,9	4,6	4,8				
20-30° S	5,3	3,8	4,8				
30-40° S	5,7	4,8	5,4	S polutka	6,0	4,9	5,7
40-50° S	6,7	5,8	6,6				
50-60° S	7,2	7,0	7,2				
60-70° S	7,6	-	-				
70-80° S	6,4	-	-				
80-90° S				Zemlja	5,8	4,9	5,4

Izvor: Preuzeto od Gelo, 1996

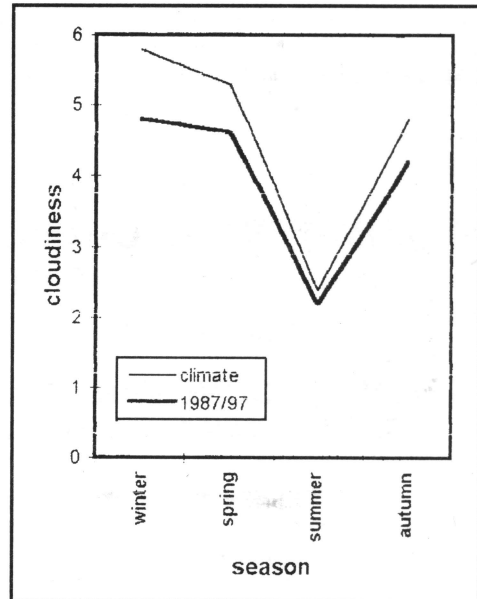


Figure 1. Cloudiness differences according to the seasons of the year in the area of the City of Dubrovnik

Slika 1. Prikaz odstupanja oblačnosti prema godišnjim dobima na području grada Dubrovnika u odnosu na klimatske prosjeke

The climatic cloudiness value in Dubrovnik is 4,6 (the city is located at 42° LAT).

With regard to the average cloudiness value at the same latitude on Earth points out that there are no crucial differences from the general (climatic) model.

The average cloudiness in the period from 1987 until 1987 in the are of Dubrovnik was 4.0 that is 15% lower than climatic.

This decrease of cloudiness was more significant during the winter and autumn periods while during the remaining seasons of the year it was insignificant (figure 1.).

2. Cloudiness character references from 1987 until 1997

Karakteristike naoblake od 1987. do 1997. godine

The characteristics of cloudiness in the period under observation suggest that cloudiness in the area of Dubrovnik ranged within and in compliance with meteorological situation on the global level within the Mediterranean zone.

In fact, such a value of cloudiness was influenced by "penetration" of the Mediterranean climatic zone along with more distinct features than in the course of an earlier period. These Mediterranean (Dubrovnik) alternations differ from those in other climatic zones. Moreover, on the global level they are opposed.

Table 2. Survey of moving of the average cloudiness values in the area of the City of Dubrovnik from 1987-1997.

Tablica 2. Prikaz kretanja srednjih vrijednosti oblačnosti na području grada Dubrovnika od 1987-1997.

Cloudiness categories	Values in tenths
ANNUAL VALUE	
- average	4,0
- max	4,9
- min	3,6
SEASONAL VALUE	
- winter	4,5
- spring	4,7
- summer	2,3
- autumn	4,7
DAILY VALUE	
- morning (7 a.m.)	4,3
- afternoon (2 p.m.)	4,5
- night (9 p.m.)	3,5

Analysing the results obtained from the cloud observation we got several different cloudiness categories: those are the average values of the annual, seasonal and daily moving (tab. 2.).

During annual and daily cloudiness moving one can differ the static, inverse and a dynamic type. In the first case the cloudiness moving is connected with the precipitation while in the second (daily) moving it is connected with the alternation of cloudiness intensity during the day.

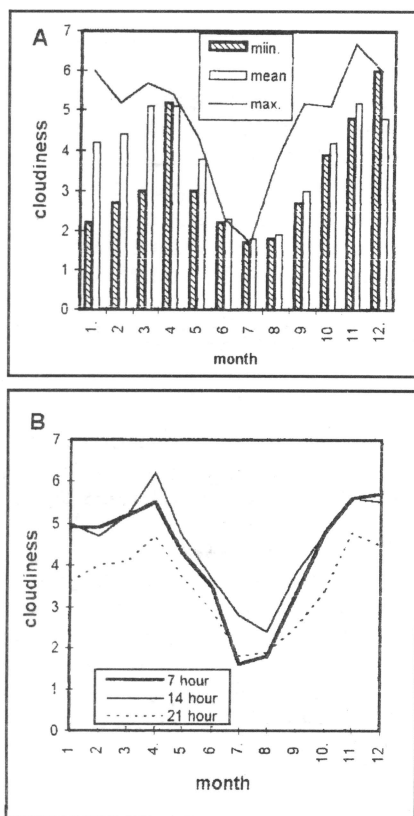


Figure 2. Survey of the average extreme annual and daily cloudiness values in the area of the City of Dubrovnik

Slika 2. Prikaz srednjih ekstremnih godišnjih (A) i dnevnih (B) vrijednosti naoblake na području grada Dubrovnika od 1987.-1997.

The static or inversion type of daily cloudiness moving has its maximum in the morning and its minimum in the evening. Such a type of daily cloudiness moving is predominantly determined by stratiformis clouds.

The dynamic type of the daily cloudiness moving reaches its maximum in the afternoon and minimum is met either during the night or in the morning. This type is predominantly determined by cumuliform. In the same place through different seasons of the year different types of daily cloudiness may occur. Thus in the moderate zone inland, the inversion: type with stratiform clouds is prevailing in the winter and the dynamic type with cumuliform clouds prevailing in the summer.

As previously mentioned the type of cloudiness is connected with the precipitation moving.

For a dynamic annual cloudiness value the relation between cloudiness and precipitations is the following:

The season of the year or part of the year with the greatest quantity of precipitations is at the same time the most cloudy season of the year.

Regarding static or inverse cloudiness type its maximum is reached in the very period of the year when the precipitations are scarce. And the opposite, the greatest amount of precipitations occurs during fair weather period of the year (figure 3).

All the characteristics of a dynamic type of cloudiness are completely affirmed in the area of the city of Dubrovnik (figure 2). This points out the annual and daily cloudiness moving which has a regular value without deviations (differences) in any weather (seasonal and similar) situation.

Regarding dynamic cloudiness moving the same atmospheric processes cause the maximum cloudiness and maximum precipitations with respect to the

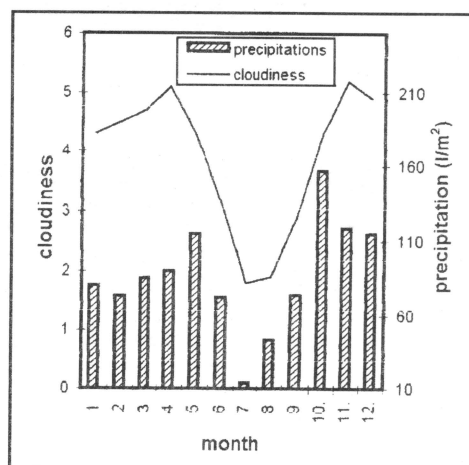


Figure 3. Relation of cloudiness and precipitations moving in the area of the City of Dubrovnik (from 1987.-1997.)

Slika 3. Odnos desetogodišnjeg prosjeka hoda naoblake i padalina na području grada Dubrovnika (od 1987.-1997.)

inverse cloudiness, the maximum occurs during the winter and maximum precipitations in the summer, whereas the winter/cloudiness (predominantly stratiform) comes into being through other processes rather than summer precipitations (prevailing from the cumuliform clouds).

A typical dynamic annual cloudiness moving occurs in the monsoon countries in the tropics with pronounced rainy period and in the areas with Mediterranean climate. The inverse type of annual cloudiness moving is prevailing inland.

Conclusion

Zaključak

Medium-term cloudiness variations in the area of the city of Dubrovnik which are presented in this paper confirm that the weather circumstances existing in the Mediterranean are selective ones. They tend to be more and more specific. That confirms the necessity of a continuous observation of weather and ecological processes in the area of Dubrovnik.

Global weather changes, oscillations and dynamic processes have made a cloudy system in the area of Dubrovnik relatively unstable. This "fall" of cloudiness

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in the area of the City of Dubrovnik and in the Mediterranean is not of a cyclical nature.

The weather changes typical of the area point at the fact that the cloudiness model which is being established in this climatic zone could reach a more lasting stability.

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