Global Climate Change Impacts on Albania: Meteorological Analysis of Ohrid Basin

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Abstract

Albania is a small country,but there are important climatic differences, which are result of the very broken country's relief. Four climatic area: Lowland-Mediterranean area, Hilly-Mediterranean area ,Pre-mountain-Mediterranean area and Mountain-Mediterranean area. Typical Mediterranean climate characterizes the lowlands and the plains. The mountainous area has in principle typical continental climate with a slight Mediterranean influence. But there is a significant difference between the North and the South. In the South the summers are drier and the differences between summer and winter temperatures are not as big as in the North. The data climatic for same year's period where minimal and maximal temperature and precipitation on micro zone in territorial areas Ohrid_Pogradec, Albania, take on study, we have value from coefficients of Q with small limits boundary. The index Q from applied method Emberger is 102.9. Eco zone in the mountainous and lake ecosystem of Ohrid_Pogradec classification on bioclimatic model, with humidity, with value (Q) over 90. The data climatic for same year's period where minimal and maximal temperature and precipitation on micro zone in territorial areas Ohrid_Pogradec, Albania, take on study, we have value from coefficients Ic, It, Io: the index Ic from applied method Rivas Martine's is 11.13, the index It from applied method Rivas Martine's is 371.3 and the index Io from applied method Rivas Martines is 4.6.

Key words: *climatic index, meteorological data, climate change, ohrid basin*

Introduction

The lake ecosystems are in a constant change. This variability has as a cause the general global changes as well as the use of the resources in these ecosystems. In order to have a long-term and stable development of lake ecosystems it is necessary to carry out monitoring studies for the base indicators with a abiotic and biotic nature. abiotic indicators that can be measured are the climatic indicators such as the temperature , rain, relative humidity of air, earth erosion etc. biotic indicators are the number of phitocenosis and biocenosis. From the condition of biotic and abiotic indicators is evaluated the ecosystem and the future of ecological resources. The use of ecological resources of the lake ecosystems based on constant studies and monitoring insures a

stability and long life. Even the study on climatic and hydrological evaluations of the lake ecosystem Oher_Pogradec influences the improvement of the quality of hydrological resources.
The concept over climate (Stoutjesdijk, Ph., J. J. Barkman, 1992) is important this time. Same consideration are presenting in the study. *Aspect* refers to the compass direction a landscape faces. *Climate* refers to the weather situation over a long period of time, usually 30 years or more. *Ecoclimate* is the climate inside vegetation. *Macroclimate* is the weather situation over a long period of time, usually the average of 30 years or more. Macroclimate is independent of local topography, soil type and vegetation and may extend for hundreds of kilometers. Typically, macroclimate temperatures are measured 1.5 meters above the ground and wind speed is determined at 10 meters above ground. Macroclimate considerations are important for the study of biogeography. *Mesoclimate* or *termo climate* is a local variant of macroclimate caused by topography and sometimes by vegetation or human action. Mesoclimates are found in ravines, over large lakes, and in big cities. The focus of mesoclimate studies is usually horizontal surfaces which may extend from kilometers to hectometers. Typically, mesoclimate temperatures are measured at 1.5 meters and/or at 0.5 meters above the ground, humidity is measured at 0.5 meters above the ground, and wind speed is determined at 1-2 meters above the ground. Mesoclimate considerations are important for the study of urban ecology and bioclimatology. *Microclimate* is the climate of the lower two meters of the atmosphere and the upper 0.5 to 1 meter of the soil. Vegetation has considerable influence on microclimate. Other important considerations are aspect (compass direction) and inclination. A microclimate typically extends over meters to hectometers. Typically, microclimate temperatures are measured at 1.5 meters and/or at 0.5 meters above the ground, humidity is measured at 0.5 meters above the ground, and wind speed is determined at 1-2 meters above the ground. Microclimate considerations are important for studies of vegetation ecology and population dynamics of plants and animals. *Nanoclimate* or *epiclimate* is the climate of the on the surface of leaves, in the air cavities in litter, along the slopes of an ant hill, or in the fissures in rocks. Nanoclimate extends vertically a few centimeters, or perhaps a decimeter and extends horizontally for centimeters. Studies of nanoclimate are important for ecophysiology and population ecology of very small organisms. *Weather* refers to the conditions of a certain moment as opposed to climate, the long-term average of weather conditions. Thus, terms such as *macroweather* and *microweather* are analogous to macroclimate except that they describe short-term conditions. (Stoutjesdijk, Ph., J. J. Barkman,1992)

Material and Methods

The climatic data are a result of temperature and precipitation indexes obtained from observations on Ohrid_Pogradec eco-zone. Among these indexes is a significant relation. This data are gathered on Hydrometeorology Institute's stations in Pogradec. This data period is over than three decades from 1972 to 2007.

- The methodology used is been based on Emberger's and Rivas Martinez theory and comparative method (Mankolli H.,2006)
- As a supplied method is been used the statistic, table, graphic,and investigated one.

Classification Rivas Martines based on climatic index Ic, It, Io (Martinez Rivas. S.1996).

(i) **Ic**, that is an annual thermal interval index calculated as

Ic = Tmax-Tmin

(ii) **It**, that is a thermatic index (or termotipo) calculates as (1)

It = (T+ m+ M)*10

(iii) **Io**, that is an ombrothermic index (or ombrotibo) calculated as

Io = 10x Pp /Tp

Where: Tmax = average temperature of the hottest month of the year;

Tmin = the average temperature of the coldest month of the year;

Pp =.sum of the monthly mean rainfall data (mm) of the months in which the average temperature is 0°C;

Tp =.sum of the mean temperature values for months with T>0°C;

T =.mean annual temperature; m =.mean of the minimum temperature of the coldest month in the year;

M = mean of the maximum temperature of the hottest month in the year.

Classification Emberger based on pluviometric index, Q is results (EMBERGER 1969).

$$Q = \frac{2000\,P}{(M - m)(M + m)} \quad (2)$$

Where: Q = coefficient index; P = annual precipitation; M = Mean of the maximum temperature of the coldest month in the year in °K (Calvin); m = mean of the minimum temperature of the coldest month in the year in °K (Calvin);

The Lake of Pogradec or Oher is a small ecosystem, with water nature in the northeast of Albania. It is found in a height of 695 m above sea level and it is surrounded by mountains that overpass the height of 2200 m. The waterside has a length of 87.5 km and a surface of about 358 km2. The maximal depth reaches to 289 m. About two thirds (2/3) of the lake is in Macedonia and one third (1/3) in Albania. The hydrologic resources in the lake of Ohrid. The main water amounts that are poured in the Ohri Lake, in the Macedonian part, are the resources that flow from Galicice Mountain and the surface currents that come from the lake. The resources of St. Naum are found in the eastern waterside of the lake, close to the Albanian-Macedonian border. The water of the resources comes from the mountain of Galicice, from the rain and from the waters of Prespa Lake. These measures show that the exit of water from the resource of St. Naum varies through 4.0 and 12.0 m3/s,with an average flow of exit Q = 7.50 m3/s. the resources of Biljane come from the mountain of Galicictis, close to the Hydro biological Institute in Oher, in the location of Studencise. The average amount of annual flows is 0.260 m3\s. Koselska River has its resource from the eastern side of the mountain of Palenska. The upper part is a developed hydrographic system and this is the source with the greatest amount of water. The long-term of average amount of water discharges reaches to 1.30 m3. In the river of Sateska the average amount of flow reaches to 6.15 m3/s. the sources of Tushemisht, the river of ceaves, the river of Pogradec and the river of Verdoves. Their hydrologic characteristics are given as follows. The

long-term average discharge is estimated to be v 2.5 m3/s. the river of Cerave is the greatest river in the Albanian part that is poured in the Ohrid Lake, a close amount of flow is estimated to be 1.5 m3/s. the river of Pogradec is a small flow that passes through the city of Pogradec. The annual amount of the flow is estimated to be 0.250 m3/s. the superficial exits of the water from the lake of Ohrid. The lake of Ohrid has a superficial exit in the river of Drinit te Zi which is poured in the Adriatic Sea. Hydrological parameters of the river of Drini i Zi are measured by the hydrologica station "Struga", founded in 1923, based on the long-term measurements of the water amounts that flow from the lake has been estimated as an average amount of Q =22.0 m3/s. the water changes of the lake of Ohrid, Pogradec.

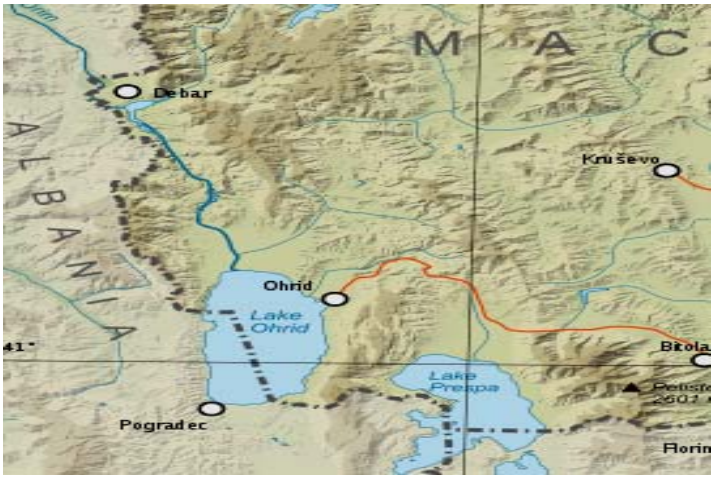


Fig.1. Map of lake ecosystem of Ohrid_Pogradec,Albania-Macedonia

Tab. 1. The data bases: Temperature and precipitation, Oher_Pogradec ecosystem (1972-2007), ALBANIA

Months Climatic data	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Years Total	Years Average
Maximal air temperature °C	8	9	13	15	18	22	25	26	22	18	14	11	**201**	**16.75**
Minimal air temperature °C	1	2	3	5	7	9	10	11	8	7	3	0	**66**	**5.5**
Average air temperature °C	4.5	5.5	8	10	12.5	15.5	17.5	18.5	15	12.5	8.5	5.5	**133.5**	**11.13**
Average precipitation (mm)	70	85	67	60	58	35	21	26	51	88	114	90	**765**	**63.9**

Sources: Data are from Hydro meteorological Institute of Albania

Results and Discussion

The data climatic for same year's period where minimal and maximal temperature and precipitation on micro zone in territorial areas Ohrid_Pogradec, Albania, take on study, we have value from coefficients of Q with small limits boundary.
The index Q from applied method Emberger is 102.9. Eco zone in the mountainous and lake ecosystem of Ohrid_Pogradec classification on bioclimatic model, with humidity, with value (Q) over 90. In table no.2 we have coefficient Q for micro zone of Oherid_Pogradec, Albania.

Tab. 2. Coefficient index Q

Ecozone	M max	m min	Pm/years	Q
Pogradec	26	0	765	**102.9**

Sources: Analyzing data from Emberger Method

The data climatic for same year's period where minimal and maximal temperature and precipitation on micro zone in territorial areas Ohrid_Pogradec, Albania, take on study, we have value from coefficients Ic, It, Io:
The indexes Ic from applied method Rivas Martine's is 11.13.
The indexes It from applied method Rivas Martine's is 371.3.
The indexes Io from applied method Rivas Martines is 4.6.

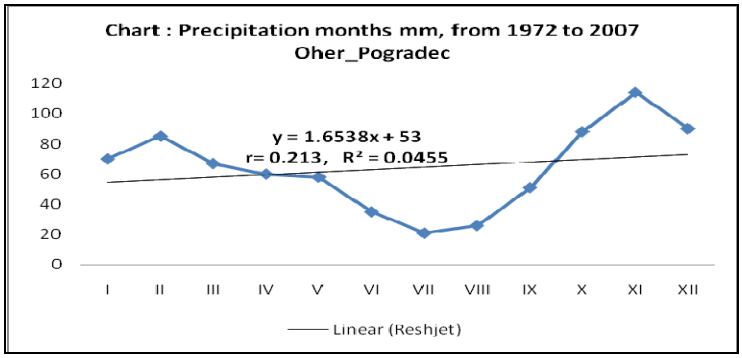
Tab.3. Coefficient index Ic, It, Io

Ecozone	T	m	M	Tp	Pp	Ic	It	Io
Pogradec	26	0	11.13	1648	765	**11.13**	**371.3**	**4.6**

Sources: Analyzing data from Rivas Martine's Method

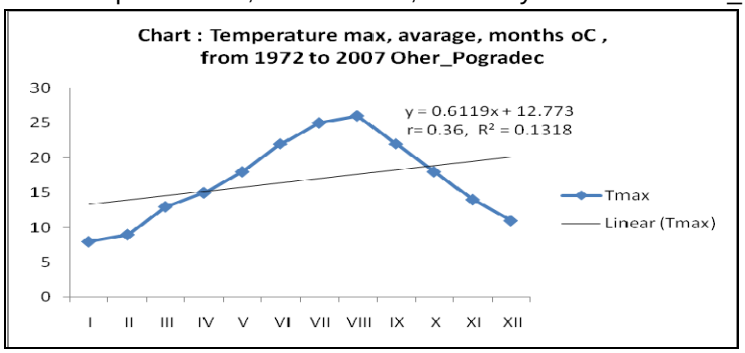
From the climatic point of view based on the applied methods in study we see that the values of climatic indicators have changes which are caused by the presence of vegetation. In order to show the connection between the values of climatic indicators and vegetation we need other studies but we refer to the correlation that exists between the vegetative mass and evapotranspiration in different types of plants (Natura 2000 Newsletter., 2007).Thus the greatest density and vegetative surface present in Oherid_Pogradec gives us a special micro bioclimatic indexation. Another important factor that gives us the chance to discuss the values taken in study regarding their variability and the presence of microbioclimates is the height above the sea level. From the studies carried out by different authors (MARACCHI G., 1983) the height above the sea level corrects the temperature values from 0.3-0.5 °C, for any 100 m of height.

Fig. 2. Chart of precipitation mm, months, from 35 years, area Ohrid _Pogradec



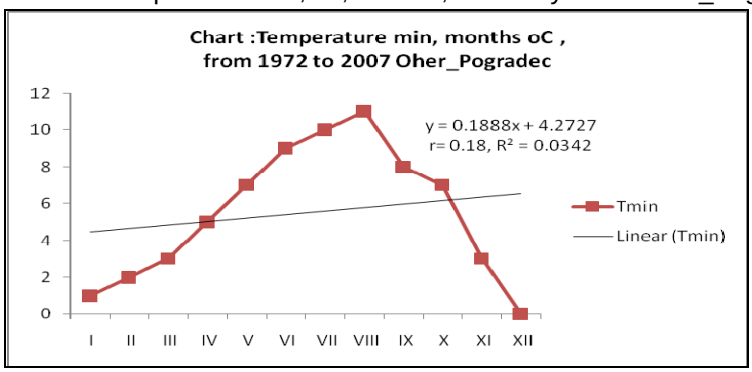
Sources: Analyzing data from Chart Excel,2009

Fig. 3. Chart of temperature ^{o}C, max. months, from 35 years area Ohrid _Pogradec



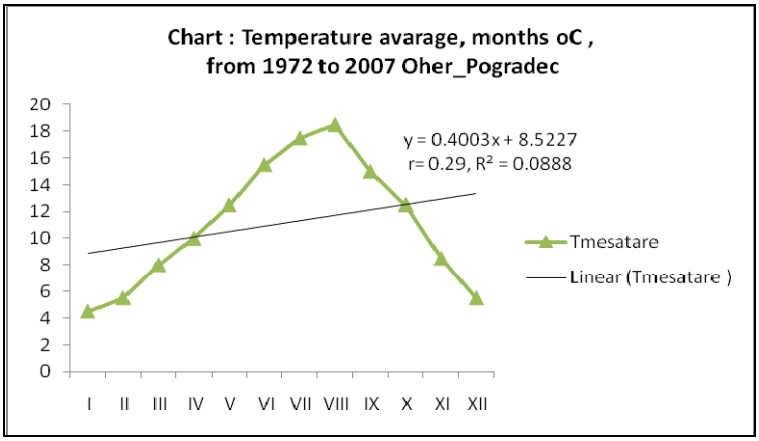
Sources: Analyzing data from Chart Excel,2009

Fig. 4. Chart of temperature min, ^{o}C, months, from 35 years Ohrid _Pogradec



Sources: Analyzing data from Chart Excel,2009

Fig. 5. Chart of temperature average ^{o}C, months,from 35 years area Ohrid _Pogradec



Sources: Analyzing data from Chart Excel,2009

The level of water in the lake of Ohrid changes very little. The variations of the level of the water of the lake are observed in three hydrological stations, that are found in the waterside of the lake of Oher, in Pestan and in St. Naum. Ten years before there has been a station in Kaliste. The old station "Ohri" was founded since in 1924 and in it are done automatic registrations. The point of the diapason of the measurement of the level belongs to the height 693.1 7m mnd. The measurements in the Albanian part started in 1948, in Pogradec. The annual maximal level has been observed in the spring, May, June, and minimally in October. This phenomenon shows the influence of the melting of the snow in the water level of the lake. In normal conditions, amplitude varies from 40 up to 90 cm, while in long-term periods the amplitude has moved up to140cm. The changes of the level of the water do not follow the natural changes because the extremes in the level of water are not permitted. According to the agreement done in 1962 through Yugoslavia and Albania, the maximum of the level of water in the lake of Ohrid is not allowed to exceed the value of 693 m mnd, while the minimum of the level is not permitted to go under the value of 691.65 m mnd.

CONCLUSIONS

Based on obtained results from the data processing according to Emberger and Rivas S. Martinez's Method and the discussions about the study "GLOBAL CLIMATE CHANGE IMPACTS ON ALBANIA: METEOROLOGICAL ANALYSIS OF OHRID BASIN" are concluded:

- The results taken from the processing of data classify Ohrid_Pogradec, lake ecosystem as bioclimatic Humid (humidity) and the values of index Q are higher than 102.9.
- The ecosystem of Ohrid_Pogradec, based on the indicator Ic is evaluated in Macroclimate Lakes with interval 11-21 with result Ic is 11.13 and index Io with interval 3.6-6 where Ic result is 4.6
- The ecozone of Ohrid-Pogradec based on index It is considered in Microbioclimate Termotemplado where It result 371.3.
- The effects of changes lake ecosystem Ohrid_Pogradec are appeared to be as following:
  - on the period 1972-2007, the temperature maximal presented via regression equation y = 0.611x+12.7, r= 0.36, where the monthly range is 0.611 °C.

- on the period 1972-2007, the temperature minimal shows the relation y = 0.188x+4.27, r = 0.18, where the monthly range is 0.18 °C.
- on the period 1972-2007, the temperature average shows the relation y = 0.400x+8.52, r = 0.29, where the monthly range is 0.40 °C.
- on the period 1972-2007, the precipitation area shows the relation y = 1.65x+53, r = 0.21, where the monthly range is 1.65 mm.

- The tendences of climatic indicators of temperature, rain and water resources that belong to the lake ecosystem of Ohrid_Pogradec show little changes. The indicators of the maximal monthly temperature for a period of time of 35 years are in the values of 0.6 ^{O}C and that of the minimal monthly temperature are 0.1 ^{O}C. the indicator of the rain has a tendency of growth with 1.6 mm per month for a period of time of 35 years. The amplitude of the level of the lake results about 40-90 cm. from the study results that the climatic and hydric indicators of the ecosystem of the lake of Ohrid_Pogradec does not have distinctive changes.

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