Report:

Climate and climate change data for Albania

SHUKALB: Water Supply and Sewerage Utility of Albania (FB11)

Tirane, 2014

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Date last release	8.10.2014
State of document	Final Report

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DRINK ADRIA

Adriatic IPA Cross Border Cooperation 2007-2013

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The project is co-funded by the European Union, Instrument for Pre-Accession Assistance

CONTENT

1. INTRODUCTION

The republic of albania is located in southeastern europe, in the western part of balkan peninsula facing the adriatic sea and the ionian sea. Albania has a surface area of 28,745 km2. Its terrain is mountainous, where hilly and mountainous areas represent 77% of the country's territory. Climate of albania is typically mediterranean. It is characterized by mild winters with abundant precipitation and hot summers. Temperature values vary from 7° c over the highest zones up to 15° c on the coastal zone; in the south- west the temperatures even reach up to 16° c. Annual mean maximum of the temperature varies from 11.3 °c in the mountainous areas up to 21.8 °c in the low and coastal zones while annual mean minimum temperature various from 0.1°c - 14.6 °c.

The mean annual precipitation total over albania is about 1485 mm/year. The highest precipitation is recorded in the albanian alps with the value of 2800-3000 mm/year, while the southeast part has lower precipitation about 1000 mm/year. Since the country produces majority of the electricity from hydropower's the precipitation is an important factor in national electricity production and agriculture. Precipitation changes, increase of the temperature, and increases in the frequency and severity of natural disasters are forcing people to address the impacts in new and innovative ways and begin adapting to a climate changes.

Because of the high percentage of the electricity that is produced by hydropower and the industrial productivity that has continued to fall the levels of the greenhouse gas emissions in albania are about four to five times lower than average international levels. In a regional context albania is considered as one of the most risky countries in east europe and central asia this because of the high exposure to extreme weather, high sensitivity combined with low adaptive capacity[1].the albanian government became part of the united nations framework convention on climate change in 1995. Recently, approved the kyoto protocol.also, has just started the third national communication to united nation framework convention on climate changes with united nation development program and global environmental facilities [2].

2. EXISTING CLIMATE FEATURES IN ALBANIA

Albania is located in southeastern europe, in the western part of balkan peninsula facing the adriatic sea and the ionian sea. Generally speaking, the climate regime of albania is typical mediterranean, characterized by mild winters with abundant precipitation and hot, dry summers. Considering the complexity of the different physical and geographical factors, the country is divided in four main climate areas as shown in the picture below.

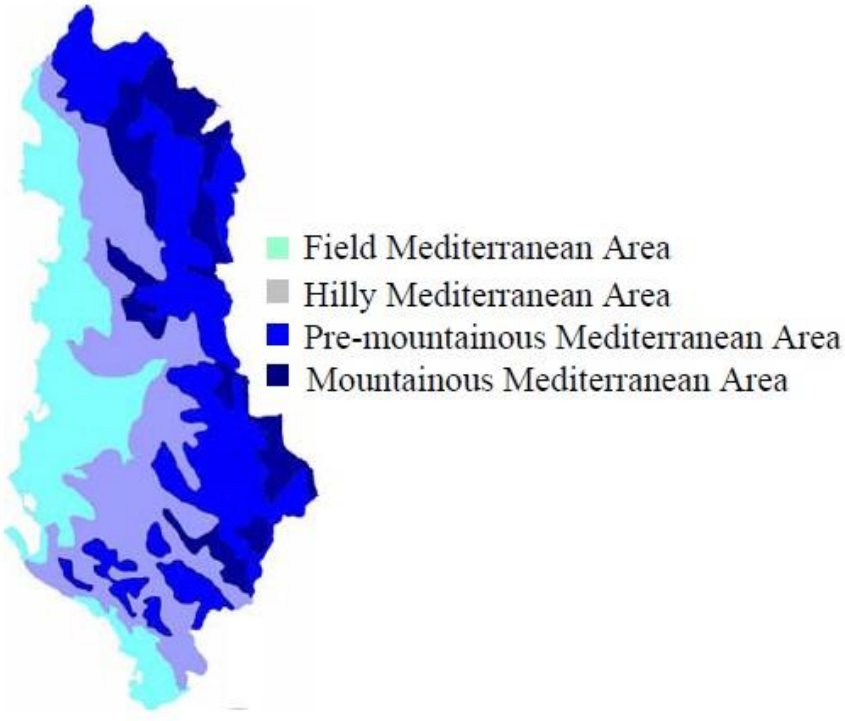

Figure 1. Climate areas in albania [3]

The field mediterranean area which is divided further in three subareas, northern, central, and southern, is characterized by mild winters, and a typical mediterranean climate. Due to the closeness to the sea, and the low elevation, the precipitation in this part of the country is mostly in the form of rainfall. The hilly mediterranean area, is located parallel to the coastal area, and extends to the inner of the country. Due to the extension of this area from north to the south, and the diversity of the elevation features, the climate can vary significantly in different parts of this part of the country. The hilly mediterranean area includes four climate subareas: northern, central, south-eastern, and south-western. The pre-mountainous mediterranean area is divided in two subareas: pre-mountainous northern mediterranean and the pre-mountainous southern mediterranean. The valley nature and the high elevation are the two main factors that drive the climate in this area. The mountainous mediterranean area represents the high elevations, above 1000-1300 m above sea level. It is divided in four subareas: northern mountainous mediterranean, eastern mountainous mediterranean, southeastern mountainous mediterranean, and the southern mountainous mediterranean [4].

The mean annual precipitation total over albania is about 1485 mm/year. However, the spatial distribution of precipitation varies a lot, depending on the physical and geographical features of the area. The alps and the north-western part of the country are the areas that receive more precipitation compared to other parts of the country, and in the same time they represent one of the areas with high precipitation in europe. The mean annual precipitation in the alps is roughly 2000 mm/year, and due to the high altitude, a major part of precipitation in this area is in the form of snow. The alps have recorded also the highest precipitation total with the annual values reach up to 3000 mm/year [5].

The southeast mountainous zone is also one of the areas with high precipitation, where the annual values reach up to 2200 mm.the north-eastern part of the territory is characterized by low precipitation due to the continental climate. The average annual precipitation in the area is between 700 and 900 mm. The eastern part of the central region represents one of the regions with the least amount of precipitation, and the annual average values of precipitation range between 600 and 700 mm. The southeast part of thecountry receives the smaller amount of precipitation with the annual value up to 600 mm.

The temperature values for the country range between 7°c in the highest altitudes up to 15°c in the coastal zone. The albanian alps together with the eastern central mountainous area represent one of the coldest zones. The mean annual temperature in this area is around 7°c. Annual mean maximum air temperature varies from 11.3 °c in the mountainous areas up to 21.8 °c in the low and coastal zones. The annual mean minimum varies from –0.1°c in the mountainous areas up to 14.6°c in the low and coastal zones. The central mountainous area is influenced by the cold continental air masses coming from the east as well as the cold air masses coming from the sea. As a result, the highest temperatures in this area are in the river valley of shkumbin (14-15°c), mat (12-14°c), drini i bardhe (12-13°c), drini i zi (11-12°c), etc. In the southern mountainous area, the warm air masses coming from the mediterranean bring high annual temperatures. The ionian coastal zone of this region is characterized generally speaking by high annual temperatures, varying from 7 to 18°c.

The lowland coastal zone, is under the direct effect of the warm air masses coming from the sea, and in the same time is influenced by the latitude of albania. As a result, despite of the high average annual temperature, the temperature varies a lot from 17°c in the south, up to 14°c in the north. The same temperature regime is present in the north-eastern part of the country, with the only difference that this area is affected also by the mountainous features of the area [6].the air temperature records measured in the meteorological stations of shkoder and tirana for the period 1931 - 2000 show an increase in the temperature by 1°c during the end of the first half of the 20th century. The third quarter of the 20th century is characterized by cooling of 0.6°c, while the rest of that period up to today, the climate has demonstrated an increase in temperature by 1.2°c, figure 2 and figure 3 demonstrate these variations in temperature for the above mentioned period, for some of the stations in albania.

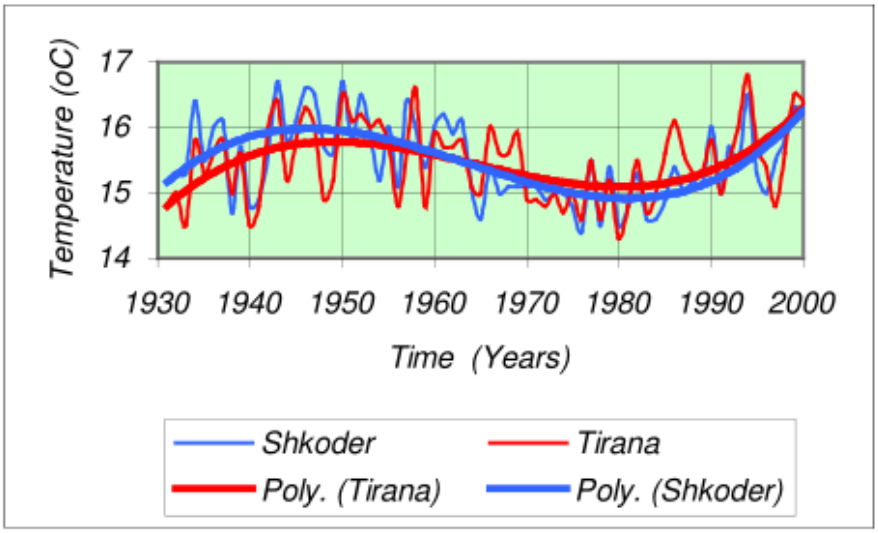

Figure 2. The mean annual air temperature variation in the meteorological stations of Tirana and Shkoder for teh period 1931 - 2000 [7]

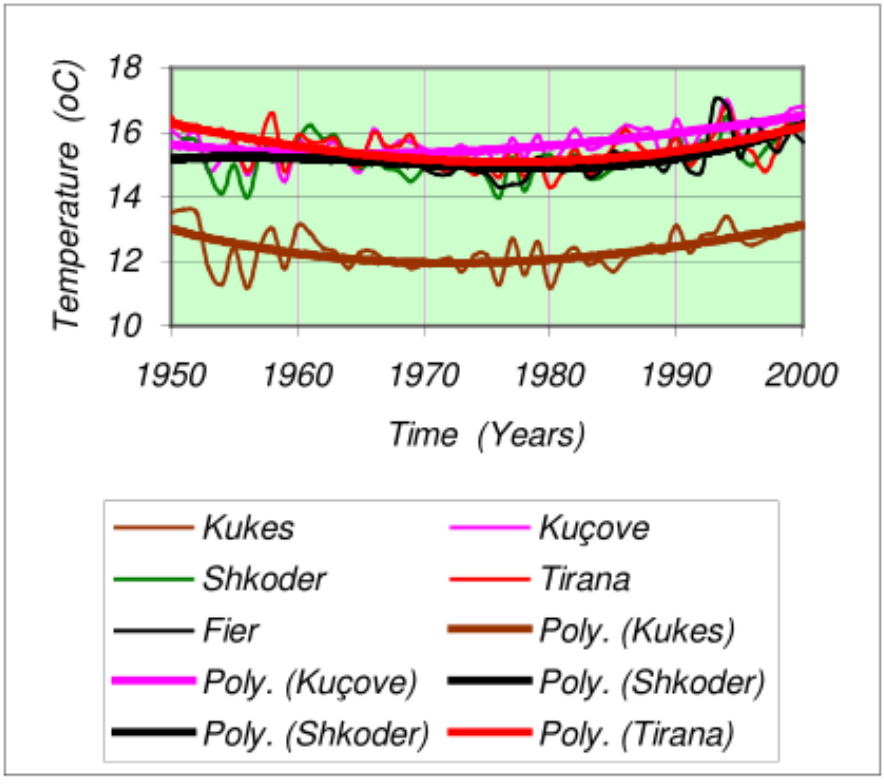

Figure 2.The mean annual air temperature variation in the meteorological stations of Tirana, Shkoder, Kukes, Kucova, and Fier [8]

The changes in the air temperature are associated with changes in the amount of precipitation as well as shown in the figure below. Temperature (^{0}c)

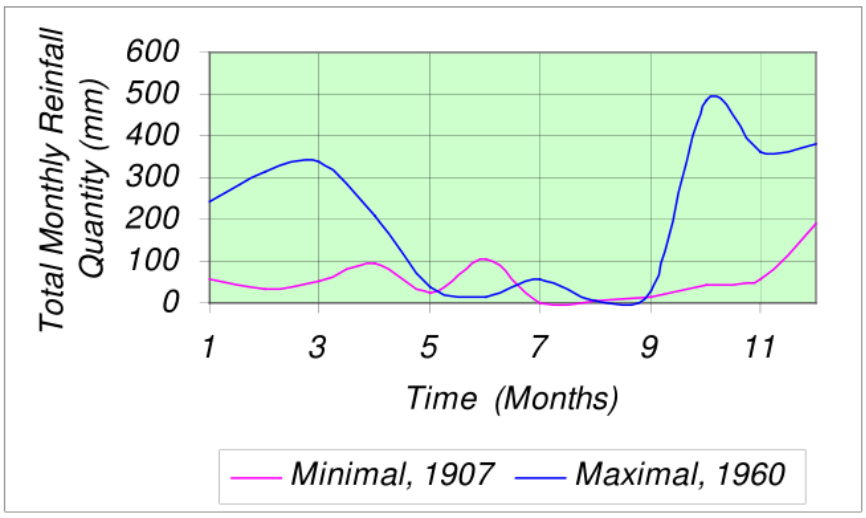

Figure 3.The total annual precipitation in the driest (1907) and wettest (1960) years, measured in the meteorological station of Shkoder [9]

This variability of climate can be also noticed in the below study area (drini river basin) from the report prepared on albania's second national communication on climate changefigure 4.

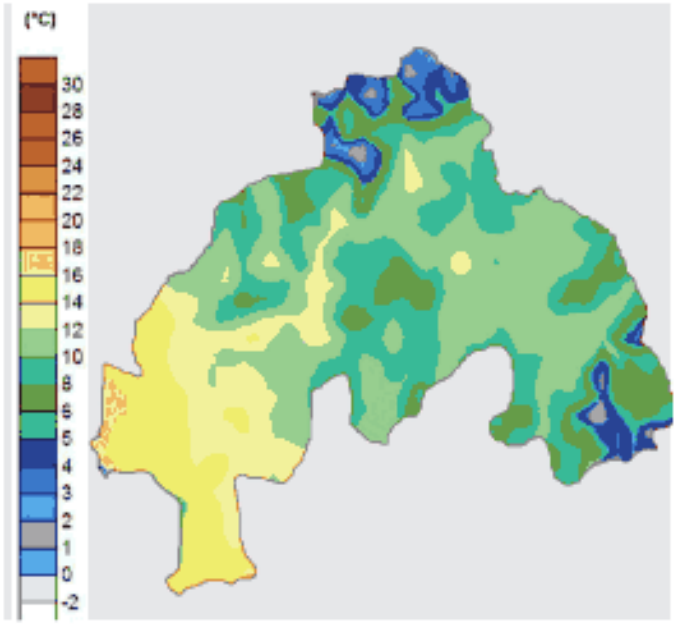

Figure 4.Yearly mean air temperature[10]

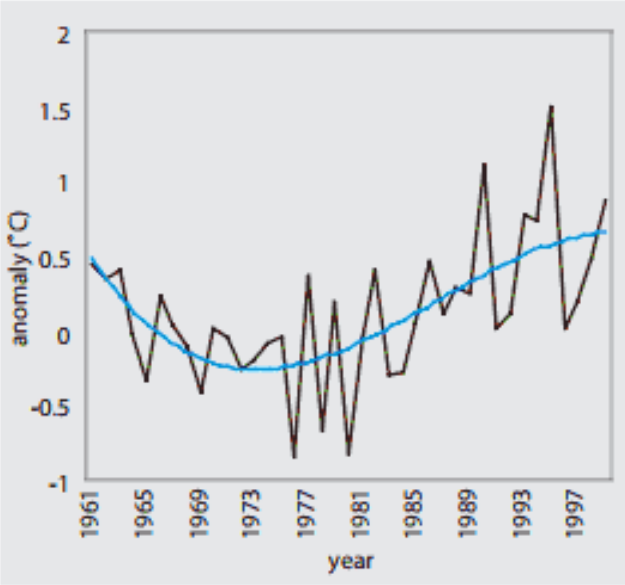

Figure 5.Yearly anomaly and the trend of airtemperature (Shkoder) [11]

From the graph in figure 5 it can be noticed that that in general the annual mean temperature has increased by approximately 1.0°c for the entirezone.

The precipitation in the drini river basin varies widely also from 910 mm in the eastern part (kukës) to 2260 mm in iballe, and the average precipitation is 1634mm per year as shown in figure 6.

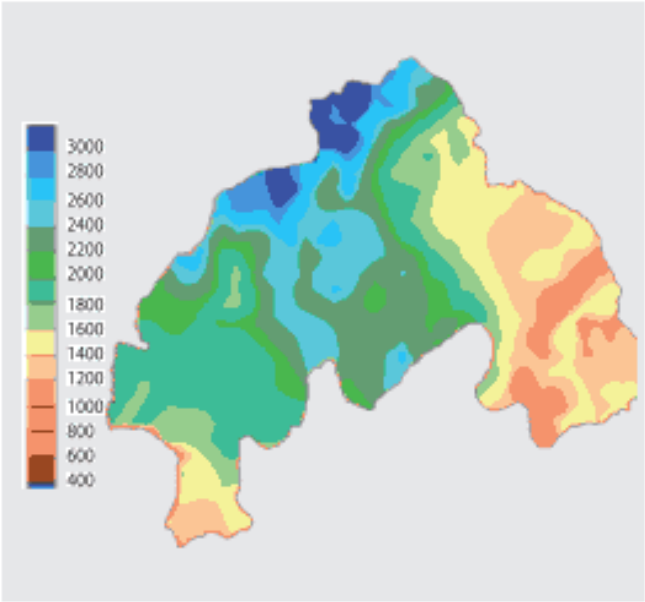

Figure 6. Distribution of annual precipitationtotal (1961–90)[12]

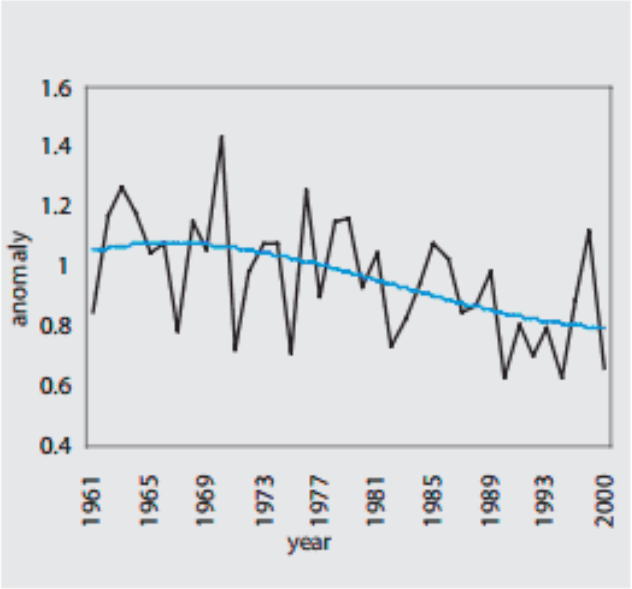

Figure 7.The annual precipitation anomaly andtrend (kukës)[13]

The data on precipitation for the period 1961-2000 show a slightly decreasing trend in the total precipitation. The highest amount of precipitation (66 % of the total), is recorded during the cold months (october-march). The wettest months are november–december, and the driest are july-august[14]

3. CLIMATE CHANGE SCENARIOS

According to the climate scenarios for albania, developed within the 2nd nc, milder winters, warmer springs, hotter and drier summers and drier autumns are likely to be expected. A dramatic increase in temperature (+4.0°c to +7.3°c) is projected for summer according to *the high-resolution regional climate projections sres a2 scenarios were provided by the hadley centre, uk for the project "climate change projection for south eastern europe", wb.* Within the south east european climate change framework action plan for adaptation report. The projections show a decrease in annual precipitation and a drastic decrease in summer precipitation (~40%). Sea level rise of between 30–45 cm is projected by 2100 for the adriatic sea.

According to the 2nd nc the projected change in climate extremes show more hot days and heat waves are very likely in almost the entire territory of albania. There are likely to be more frequent and severe droughts with greater fire risk. An increase in the wind speed is expected for the 2080s. A decreased number of frost days (temperatures ≤–5°c) in high altitudes is likely to occur. Owing to higher average temperatures in winter more precipitation is likely to fall in the form of rain rather than snow, and this will increase both soil moisture and run-off. Although total precipitation is expected to decrease, the number of days with heavy precipitation is likely to increase resulting in greater risks of soil erosion and landslides [15].

In albania reference *second national communication, 2009*, the results of the future climate change in a broader region of albania are discussed for temperature at 2 m (t2m) and precipitation.

Likely changes in temperature and precipitation in albania (including the study area) are presented in table 1. Temperature is expected to increase and precipitation to decrease, giving milder winters, warmer springs, hotter and drier summer and drier autumn, while figure 1, 2 illustrates likely annual changes for the study area.

Scanarios for albania		Time horizon		
		2025	2050	2100
Annual	Temperature (^{0}c)	0.8 to 1.1	1.7 to 2.3	2.9 to 5.3
	Precipitation (%)	-3.4 to -2.6	-6.9 to -5.3	-16.2 to -8.8
Winter	Temperature (^{0}c)	0.7 to 0.9	1.5 to 1.9	2.4 to 4.5
	Precipitation (%)	-1.8 to -1.3	-3.6 to -2.8	-8.4 to -4.6
Spring	Temperature (^{0}c)	0.7 to 0.9	1.4 to 1.8	2.3 to 4.2
	Precipitation (%)	-1.2 to -0.9	-2.5 to -1.9	-5.8 to -3.2
Summer	Temperature (^{0}c)	-11.5 to -8.7	-23.2 to -17.8	-54.1 to -29.5
	Precipitation (%)	1.2 to 1.5	2.4 to 3.1	4.0 to 7.3
Autumn	Temperature (^{0}c)	0.8 to 1.1	1.7 to 2.2	2.9 to 5.2
	Precipitation (%)	-3.0 to -2.3	-6.1 to -4.7	-14.2 to -7.7

Table 1. Predicted scenarios for climate changes [16]

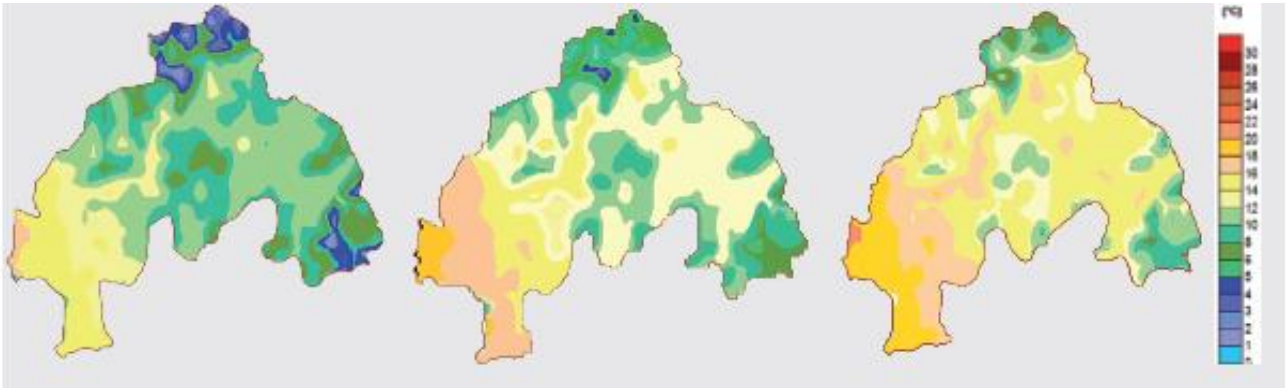

Figure 8. Expected changes in annual temperatures (Shkoder area part of Drini Basin) [17]

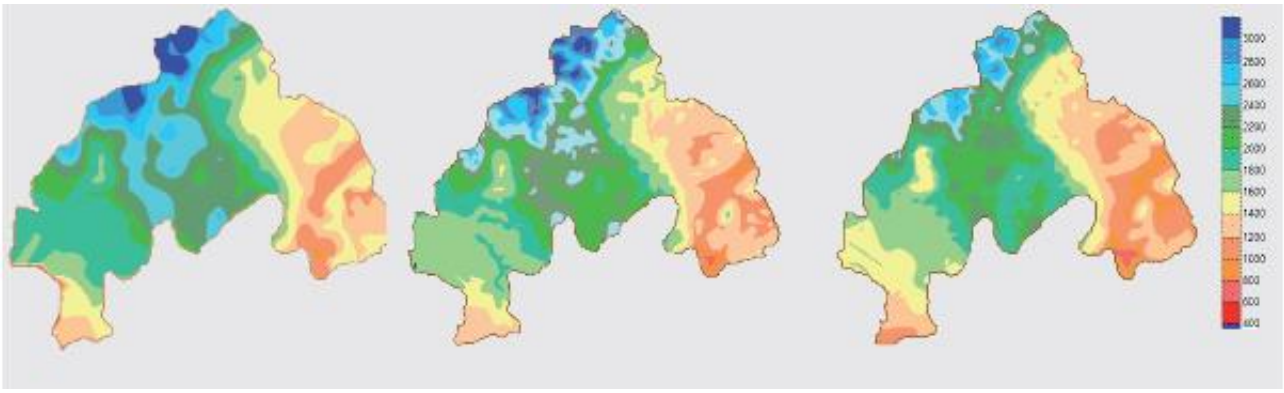

Figure 9. Expected changes in annual precipitation (Shkoder area part of Drini Basin) [18]

On the albania areafor theassessmentof climatechange scenarios severalclimate models are used. The most common isclimate modelregcm, developed in*international centre for theoretical physics* in trieste [19], which was used for climate predictionsfor the period 2011-2040. Gfdl-esm2m it is a global climate model which, for climate change simulations, takes initial and boundary conditions from joint global climate model echam5/mpi-om[20],[21]. For climate change assessment for the period up to the year 2100 inthe framework of project ccwaters[22], withmentionedgfdl-esm2mmodelwhere climate change projections are made until the year 2100.

From dynamical downscaling of gfdl-esm2m is performed several scenarios by considering different periodes as below:

1. 2025-2049 vs1980-2004
2. 2050-2074vs1980-2004
3. 2071-2095 vs1980-2004

In the first period of future climate (2025-2049 vs1980-2004) in albania (figure 3) during winter a temperature increase of 3 °c is expected, and 4°c during summer.

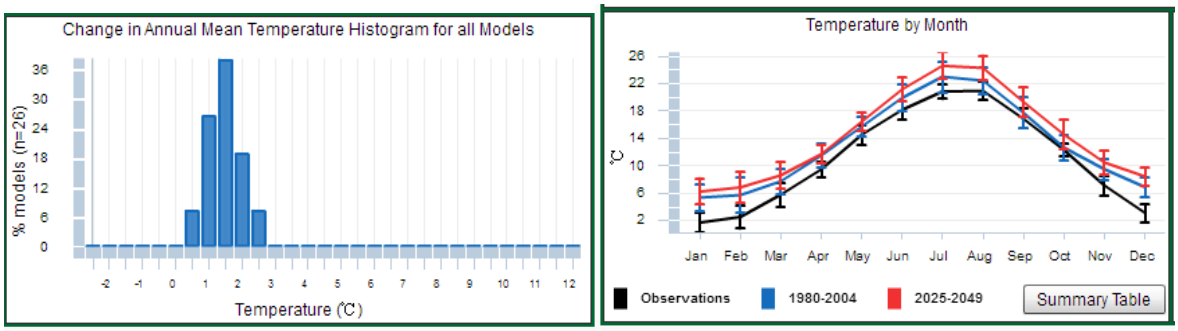

Figure 10. Change in ground air temperature (in °c) in Albania in the period 2025-2049 in respect of the period 1980-2004 according to the results of the ensemble mean of global climate model gfdl-esm2m

In the second period of future climate (2050-2074vs1980-2004) the expected increase amplitude in albania (figure 4) during winter is up to 4 °c and during summer up to 4.5 °c.

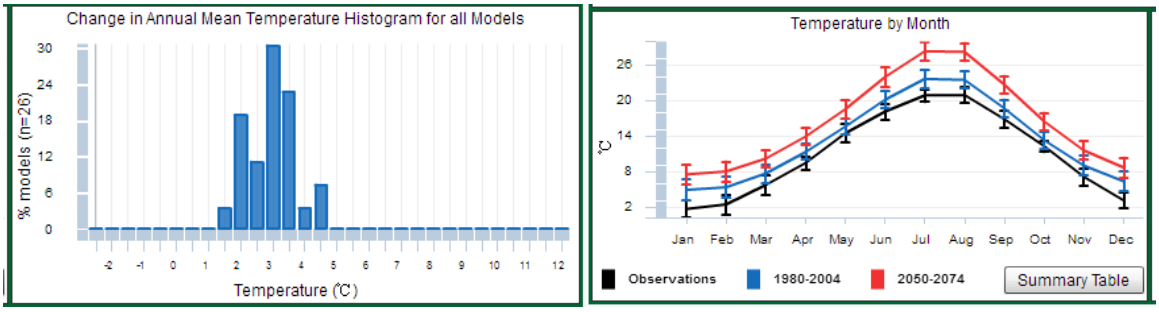

Figure 11. Change in ground air temperature (in °c) in Albania in the period 2050-2074 in respect of the period 1980-2004 according to the results of the ensemble mean of global climate model gfdl-esm2m.

In the third period of future climate (2071-2095 vs 1980-2004) the expected increase amplitude in albania (figure 4) during winter is up to 6 °c and during summer up to 6.4 °c.

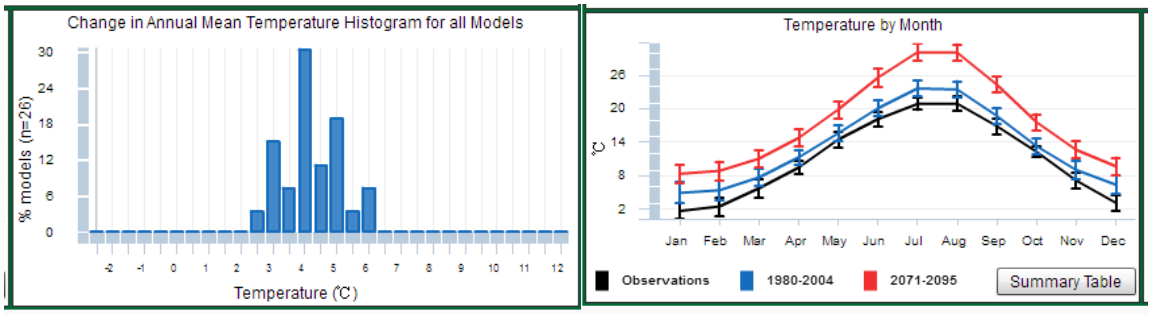

Figure 12. Change in ground air temperature (in °c) in Albania in the period 2071-2095 in respect of the period 1980-2004 according to the results of the ensemble mean of global climate model gfdl-esm2m.

In addition a long term scanirio is presented in figure 6, it is abvious that there is a significiant increase of temperature specially in coming years.

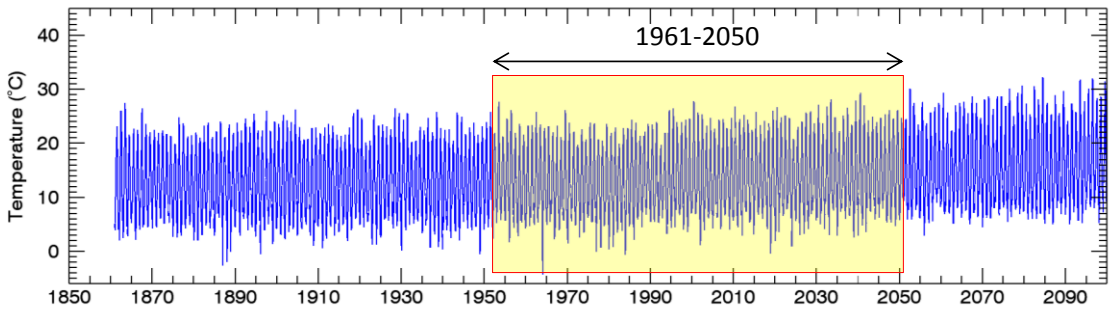

Figure 13. Change in ground air temperature (in °c) in Albania in the period 1850-2095 according to the results of the ensemble mean of global climate model gfdl-esm2m

Changes in precipitation amounts in the near future (2025-2049) are significiant small but they vary in the sign depending ofthe season (figure 7). The biggest change in precipitation, according to first scenario, can be expected in the adriatic inautumn when gfdl-esm2m indicates adecrease ofprecipitation with a maximumofapproximately5-6mmin the southern adriatic. However, this reduction of autumnprecipitation amountis notstatisticallysignificant.

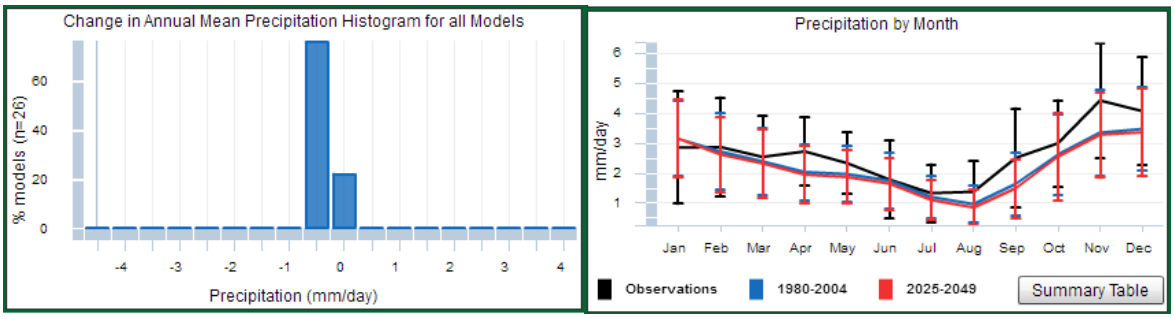

Figure 14. Change in precipitation in Albania (in mm/day) in the period 2025-2049 in respect of the period 1980-2004 according to the results of the ensemble mean of regional climate model gfdl-esm2m[3]

In the second period of future climate (2041-2070) precipitation changes in albania are somewhatmore expressed (figure 8). During summer in the mountainous albania and inthe coastal area a decrease inprecipitation is expected. Reductionsreachvalue of5-6 mm and they are statisticallysignificant. During winter an increase inprecipitationinnorth-western albania and on the adriatic can be expected, however that increaseis notstatisticallysignificant

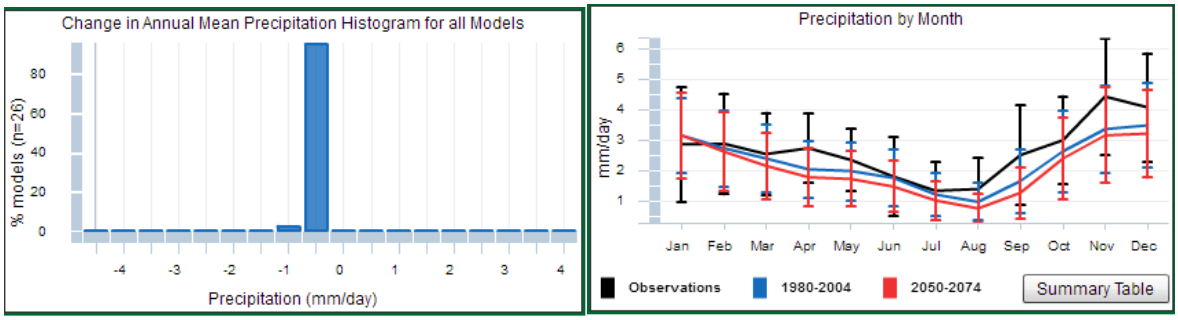

Figure 15. Change in precipitation in Albania (in mm/day) in the period 2050-2074 in respect of the period 1980-2004 according to the results of the ensemble mean of regional climate model gfdl-esm2m [3]

In the third period of future climate (205-2095) precipitation changes in albania are somewhatmore expressed (figure 9). During summer in the mountainous albania and inthe coastal area a decrease inprecipitation is expected. Reductionsreachvalue of5-6mm and they are statisticallysignificant. During winter an increase inprecipitationinnorth-western albaniaand on the adriatic can be expected, however that increaseis notstatisticallysignificant

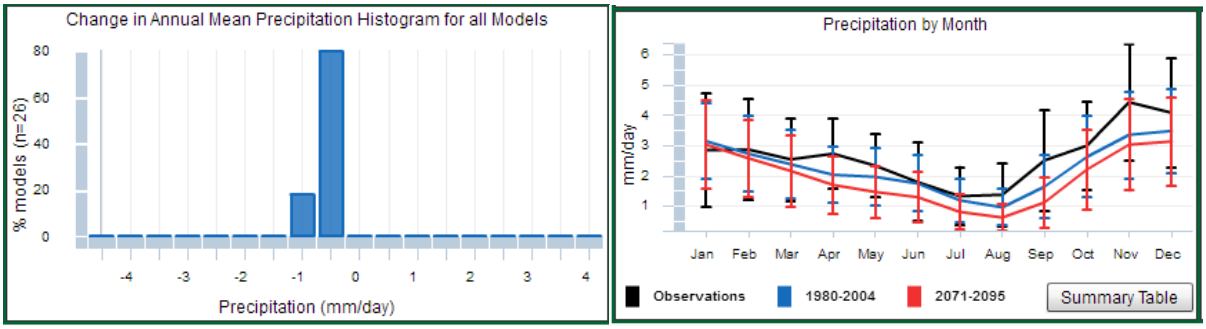

Figure 16. Change in precipitation in Albania (in mm/day) in the period 2071-2095 in respect of the period 1980-2004 according to the results of the ensemble mean of regional climate model gfdl-esm2m

In addition a long term scanirio is presented in figure 10; it is abvious that there is a significiant decrease of precipitation especially in coming years.

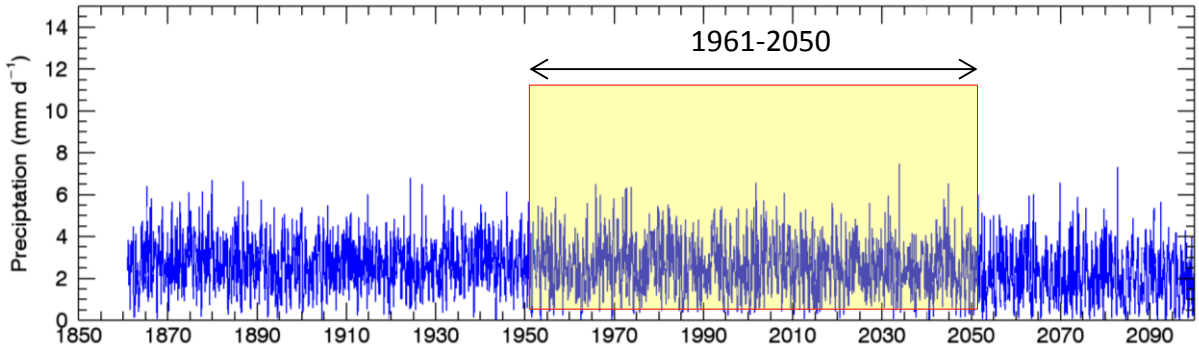

Figure 17. Change in precipitation in Albania (in mm/day) in the period 1850-2095 according to the results of the ensemble mean of regional climate model gfdl-esm2m

According to second national communication, drought is expected during summer due to increased temperature (likely increase up to 5.6 °c) and potential evaporation, not balanced by precipitation (reduction by 41%).increasing temperatures will raise the probability of extreme events and higher intra-annual variability of minimum temperatures. Higher increase of daily minimum than maximum temperatures is likely to occur. More frequent and severe droughts with greater fire risk are likely. Decreased number of frost days (temperatures ≤–5°c) in high altitudes is likely to occur. Expected decrease is 4–5 days, 9 days and 15 days by 2025, 2050 and 2100 respectively. Owing to higher average temperatures in winter more precipitation is likely to fall in the form of rain rather than snow, which will increase both soil moisture and run-off. Increase in total precipitation rate may induce greater risks of soil erosion, depending on the intensity of rain episodes. Increase in summer temperature is likely to result in increase in frequency and intensity of extreme weather events (heat waves). The number of days with the mtemperature ≥35 °c is likely to increase by 1–2 days by 2025 and by 3–4 days by 2050 compared to 1951–2000 average [23].

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