

WATER, WETLANDS AND CLIMATE CHANGE

Building Linkages for their Integrated Management

Mediterranean Regional Roundtable
Athens, Greece,
December 10-11, 2002

GREECE-Water Resources Planning and Climate Change Adaptation

Prepared by:

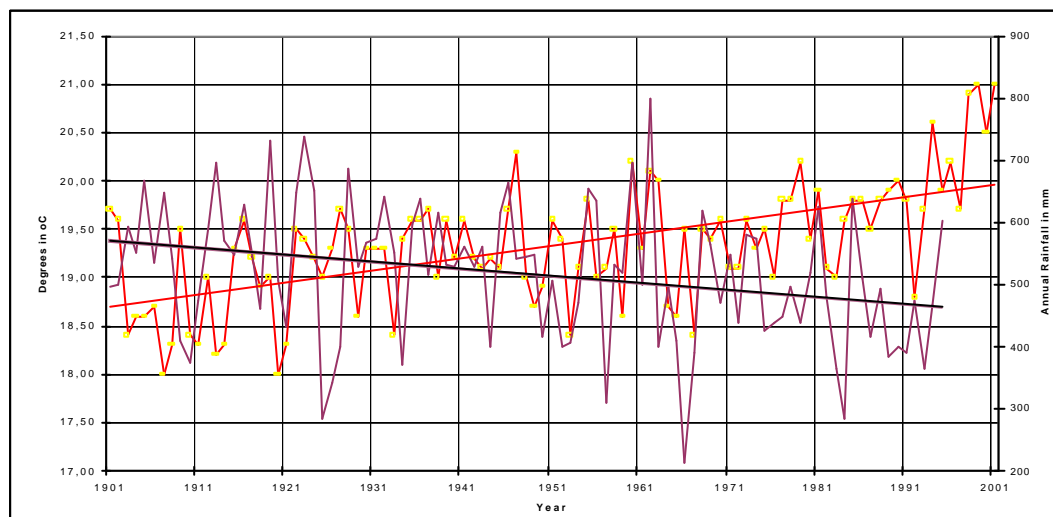
Nicos X. TSIOURTIS

Consultant

Nicosia-Cyprus

Tel:+357 22 33 22 26, Fax +357 22 33 22 26

e-mail:tsiourti@dial.cylink.com.cy



Draft for Discussion
November 2002



IUCN Centre for Mediterranean Cooperation



Global Water Partnership – Mediterranean

Preface

The Global Water Partnership (GWP), the Dialogue on Water and Climate Change, and IUCN-The World Conservation Union, have joined forces to facilitate an exchange of views on the common challenges faced by Mediterranean societies in enhancing their capacities to adapt to climate change.

Scientific consensus is that climate change would have a pervasive influence on the future demand, supply and quality of fresh water resources in the Mediterranean, and would add pressure to water and environment resources, and coastal systems currently under stress. All sectors of the economy, environment and society may be vulnerable to one degree or another, where steps to increase the capacity to adapt to greater hydrological variability, including more frequent flood and drought extremes are required.

Under Article 4 of the UNFCCC, it was agreed all Parties would develop short, medium, and long-term strategies for climate adaptation in a phased manner, taking into account the different socio-economic contexts. A number of Mediterranean countries are now at the preliminary stages of identifying and formulating specific climate change adaptation strategies and responses, while others have yet to start.

This document is one of twelve country base-line studies and thematic papers prepared as background material for a Roundtable meeting in Athens, Greece in December 2002, to discuss key linkages between climate change, water and wetlands resource and management in the Mediterranean. While the primary aim is to exchange views, perspectives and experience on climate change adaptation planning, the discussion would also explore the opportunities to enhance synergies in responses to the UNFCCC and Ramsar Conventions.

Eight country base-line studies were prepared for:

- Cyprus
- France
- Greece
- Italy
- Morocco
- Spain
- Tunisia
- Turkey

The four crosscutting thematic papers are:

- Mediterranean Water Resource Planning and Climate Change Adaptation
- National Approaches to Drought Preparation in the Mediterranean
- Adaptation Strategies for Improved Flood Management in the Mediterranean
- Biophysical and Socio-Economic Impacts of Climate Change on Water and Wetlands in the Mediterranean

Electronic copies of the reports and paper noted above may be downloaded from the web page of The IUCN Centre for Mediterranean Cooperation at www.uicnmed.org

Disclaimer:

The views, conclusions, and recommendations contained herein are those of the authors, and are not necessarily the views of the Governments of the countries concerned, the GWP, the Dialogue on Water and Climate Change, or the IUCN.

Table of Contents

	Preface	ii
	Contents	iii
	Summary	iv
A	Part A. The country context	1
A.1	Location and geology	1
A.2	Climate	2
A.3	Current water resources and wetland resources	2
A.4	Climate variability in the last century	3
A.5	International conventions and protocols on climate change	7
A.6	Climate change and effects	8
A.7	Water resources and climate change effect	9
A.8	Climate change and water uses vulnerability	10
B	Part B-Institution/processes and networks working on water, wetland and climate change issues	11
B.1	Climate change and water uses vulnerability	11
B.2	Coordination between institutions and organizations	13
B.3	Committees for climate change matters and their duties	13
B.4	Discussions on adaptation policies for climate change matters	15
B.5	Key institutions providing data on climate change impact	15
B.6	Research institutions	15
B.7	Coordination between institutions involved in climate change	15
C	Part C-Integration of water and wetlands resources management policy and practices and climate change demands	17
C.1	Most essential issues and opportunities for the integration of water and wetlands	17
C.2	Case Studies	18
D	Part D-Towards adaptive strategies-discussion points for the regional round-table	19
D.1	Issues or points for discussion in the regional roundtable.	19
	References	20

List of Figures

No	Description	Page
1	Figure 1. Rainfall-Runoff relationship.	9

List of Tables

No	Description	Page
1	Table 1. Present water use by sector	2
2	Table 2. Present natural water resources availability by Source	2
3	Table 3. Change in the Precipitation in Europe, the Mediterranean, Greece and Regions of Greece	
4	Table 4. Change in the Temperature in Europe, the Mediterranean, Greece and Regions of Greece	

Summary

Greece climate changes in the last Century are not in line with the other Mediterranean countries. Where in the rest of the Mediterranean countries the temperature showed an increase in Greece it showed a decrease, with the exception of the last decade where a steady increase of the temperature was observed. On the other hand the precipitation showed negative trend during the second half of the last century. The decrease is observed during the period 1951-1990. The reduction in precipitation in the Marathon and Attica areas is 20.4% during the period 1926-1990 where in the areas of Aliartou and Athens the reduction is 28% and 14.2% respectively. Similar trends are observed in the Northwest parts of Greece, which are mainly the results of reduction of rainfall during the winter months. Concerning the extreme climatic events the studies have shown that during the decade 1990-2000 the heats have tripled in comparison with the previous 30-year period, where floods have also shown an increase during the last decade.

Although the climate change or climate variability is observed and analysed, no decision has been taken so far by the state to study the effects of these phenomenon on the Greek economy, on the social life and on the environment. Greece complying with the International Conventions and the Kyoto Protocol has initiated the necessary actions for the reduction of the emissions of greenhouse gasses to the atmosphere but did not do anything to evaluate those impacts and to prepare an action plan for minimizing these effects and on climate change adaptations. Water resources availability and quality and climate change are interlinked and obviously reduction in precipitation if it continues in the present century shall have adverse effects on the availability and quality of the water resources creating difficulties in satisfying existing and increasing future water demands. The need for the adoption of the European Water Framework Directive makes it necessary to take into consideration all up to date data and information on the climate and other data for evaluating the availability and quality and the status of the surface and ground water resources. And since the availability and status of both resources is dependent on the prevailing climate, this offers an opportunity to initiate and carry out, on a national scale, a plan for the re-evaluation of the naturally available water resources and the projected water demand taking into consideration the planned development of the country. Of course the changing climate parameters must be taken into consideration. On the other hand Greece has a long coastline due to the long coasts of the continental land and the numerous small islands in the Ionian and Aegean Seas, and the projected sea level rise due to the Global Warming, is expected to affect the scarce groundwater and land resources of the coastal areas and mostly of the smaller islands. This presents a challenge, since the continuation of "existence" of the small islands as we know them today shall depend to a great extent on their ability to provide water for the basic needs of their inhabitants, and for the preservation of their development and of their environment.

Greece's Institutes and Organizations have carried out a number of studies on climate change and have prepared at the request of the Government strategic plans for Climate Change, the Wetlands Management and on Desertification but no plans were prepared for the Integrated Management of the Water Resources and the Wetlands. The meeting at Athens gives the opportunity to the participants from Greece to appreciate the climate change and climate change impacts and provides the forum for discussions and exchange of information, know-how and expertise on the subjects that are related to the climatic change. The Mediterranean countries due to the scarcity of water are very vulnerable to climatic conditions and must get ready to study the effects and prepare their action plans.

Part A

Country Context

A.1 Location and Geology

Greece is a country in southeastern Europe that forms the southern extremity of the Balkan Peninsula and it is bordered on the west, south, and east by the Ionian, the Mediterranean, and the Aegean seas, and on the north by Albania, the Republic of Former Yugoslav Republic of Macedonia (FYROM), Bulgaria, and Turkey. Greece encompasses many island groups, including the Ionian Islands to the west and the Sporades and Cyclades to the east, as well as the larger islands of Crete, Lesbos, Rodhos, Samos, Samothraki, Chios, and Lemnos. The total number of islands is around 3000 out of which 63 are inhabited.

Greece is a mountainous country, with flat land restricted to many small coastal plains. The mountains, which form part of the Alpine system, generally stretch from northwest to southeast. They are highest and most rugged in the northwest, where the Grammos Mountains rise to 2,519 m and the Pindhos to over 2,285 m, although the highest mountain, Olympus, in the country is in the east central Greece (OLYMPUS; 2,917 m). The mountains are interrupted by the long, narrow Gulf of Corinth, which almost cuts off southern Greece the Peloponessos from the rest of the peninsula. But the mountains continue south of the gulf and terminate in the three headlands of southern Greece. The mountain ranges, extending in the same direction, are continued offshore, and their highest portions appear as the chains and groups of islands that dot the Aegean. The Cyclades continue the eastern ranges toward the Turkish mainland, and Crete and Rhodes are continuations of the more westerly ranges. Both mountains and islands are composed of sedimentary rocks, mainly limestone and sandstone. Only near the northern boundary of Greece are igneous rocks significant in the landscape. The largest plains are those of Macedonia, Thessaly, and Thrace, all of which border the Aegean Sea. The soils in Greece are thin and poor, and over much of the country the bare rock shows at the surface. The only good soils are on the small coastal lowlands. These are mainly alluvial soils, but their productivity is greatly reduced by the long summer drought.

Few rivers exist in peninsular Greece; all are small, and most dry up in the summer. Only those rivers that rise farther north in the Balkan Peninsula and flow through northern Greece to the sea, for example, the Vardar and Struma, have significant summer discharge. The small size and seasonal character of most rivers is the primary reason for the limited use of irrigation. Of the several lakes within the mountains--many of them in northern Greece--most occupy basins that were formed by the dissolution of limestone.

Naturally occurring vegetation is adapted to the climate and consists largely of xerophytes, which are plants that are able to withstand the summer drought by the storage of water. Spring is the primary growing season, and flowering plants make a brilliant show during this time, before withering under the summer heat. The mountains are mostly clothed with a relatively dense scrub brush (called maquis). Evergreen forests may once have covered much of the land but have been largely destroyed in southern Greece. Extensive forest is found only in the mountains of northwestern Greece, where large stands of fir occur. About 19 percent of the total area of the country is forested.

Greece is predominantly an agricultural country, although less than one-third of its area is cultivated. The country is self-sufficient in basic foodstuffs, and agricultural products make up most of Greece's exports. Tourism is well developed and is economically important.

Greece has an area of 131,944 square kilometres, with coastlines of 15,000 kilometres. Greece has some 3000 islands with total area of 28,827 square kilometres and coastline 7300 kilometres. Of the 3000 islands 63 are inhabited. The total population of Greece is around 11 Millions.

A.2 Climate

The climate of Greece is typically Mediterranean. Summers are long, hot, and dry. The average temperature in July in Athens the capital is 26.7 degrees C, but is much lower in the mountains. Winters are mild; the average January temperature is 9.2 degrees C. Winter temperatures are also much lower in the interior; in mountain valleys averages are close to freezing, and prolonged frosts may occur. Snow is not uncommon away from the coasts. Precipitation varies greatly. In Athens it averages 394 mm annually, but it is much higher away from the east coast and rises to more than 1.200 mm in the higher mountains. In all parts of the country rainfall is seasonal, most of it coming in late fall and winter months. Only in Macedonia and Thrace is there a significant summer rainfall, where in the rest of the country there is no rain in summer times.

A.3 Current Water Resources and Wetland Resources and Use

The rainfall in Greece is variable in space, increasing from the south to the North, due to the change of climatic conditions varying from dryer and warmer to humid and cooler conditions because of the increase in latitude, and also increasing from the east to west due to the separation of the country to two different climatic unities, brought by the Pindos range and its extension to Peloponessos and Crete. The natural water resources of Greece are made up of the internal water resources (resulting from the precipitation) and the external water resources as shown on Table 2 below. Greece has some 381 wetlands of total area 201.267 Hectares (2.012 km²) out of which 11 are Ramsar sites, with a surface area of 107400 Hectares (1.074 km²). The present water resource uses are shown on Table 1.

Table 1. Present water use by sector

No	Description of Use	Quantity in MCM	Percentage
1.	Agriculture	7540,0	84,49
2.	Domestic	1150,0	12,89
3.	Industry	154,0	1,72
4.	Electric Power Cooling	80,0	0,90
5.	Total	8924,0	100
6.	Water Use per capita per year in m3	811	

The present water resources are shown on Table 2 below.

Table 2. Present natural water resources availability by Source

No	Description of Source from	Quantity in BCM	Percentage	Comments
A	Internal water Resources	54,0	(78,3)	From Rainfall over the main and island's lands
A.1	Surface	51,5	74,6	
A.2.	Groundwater	10,3		
A.3	Overlapping	7,8		
B.	External water resources	15,0	(21,7)	From rivers originating in the North of Greece
B.1	Surface	15,0		
B.2	Groundwater	0,0		
C.	Total Natural	69,0		
C.1	Surface	66,5	96,4	
C.2	Groundwater	2,5	3,6	
D.	Water resources per capita in m3		6270	

A.4 Climate Variability in the last Century

A.4.1 Global Tendencies

During the last 420.000 years earth had frequent climatic changes with a pronounced periodicity. The last period of ice started 120.000 years ago and ended 16.000 years ago. Since then the earth is under a thermal period. All climatic changes were caused by the content variation of the greenhouse gasses in the atmosphere such as Carbon Dioxide, and Methane whose origin was from natural processes. Following the industrial revolution in the 1900's both gasses content in the atmosphere started to increase at high rates which was followed by an increase in the temperature from 0,4 to 0,8 °C in a global level during the period 1860 to 2000. Globally the increase of temperature occurred in two steps, the first in the period 1910-1945, and the second in the period 1975-2000. The big increase is mainly to anthropogenic activities and partly to physical process. The 1990-2000 decade was the warmest period for the northern hemisphere for the last 1000 years due to great increases in summer temperatures. Concerning rainfall this shows an increase in the greater parts of the middle and higher latitude regions of the North Hemisphere, but in the largest part of the tropical areas the conditions are becoming dryer.

According to the Inter-governmental Panel of Climate Change (IPCC) the great increase of the green house gasses in the atmosphere shall cause by the year 2100, the increase of the temperature of the Planet by 1,7-4,0 °C and the sea level shall rise by 22-75 centimetres. Concurrently the rainfall is expected to increase in most of the tropical regions throughout the year, to reduce in the majority of the subtropical regions and to increase slightly in the larger latitude regions. The rainfall is also expected to decrease in the internal areas of continental regions of the Northern Hemisphere.

A.4.2 Mediterranean Climate tendencies

While the Global climate shows tendencies for change, the same would be expected to occur in the Mediterranean region. However it is impossible due to the small extent of the area and the high variability of the local climates to come to some reliable conclusions as to the tendencies regarding the climate change in the Mediterranean region. This is becoming even more difficult because of the short duration of observations, which do not allow the analysers to draw safe conclusions. With regard to temperature, from studies carried out it can be concluded that the evolution during the last 100 years is similar to Global changes with a increasing tendency, although some deviations are observed locally. On the other hand precipitation in the regions surrounding the Mediterranean Sea has decreased during the last century up to 13%, with the exception in the region, which extends from Tunisia to Libya, where a small increase has been recorded. Generally there is a tendency for the reduction of precipitation in the southern Europe where in the majority of the regions in the north Europe an increase is recorded.

A.4.3 Climate tendencies in Greece during the last century

During the 20th century, the climate of Greece and specifically the two basic parameters, the precipitation and the temperature show some variation, but not in line to what occurred in the other countries of Europe and Mediterranean countries. The temperature showed a decrease in contrast to the other countries where it showed an increase where the precipitation has presented a reduction, but of no significant statistical importance. From the records analysis and results from the various climate models it can be concluded that both the temperature and the precipitation showed a decrease.

a) Precipitation Reduction in the last century. Greece is presenting a reduction of precipitation during the last 20 years of the period 1951-1990, but there appears a trend of recovery the following decade. Regionally during the same period the variations are as follow.

- **North Greece:** In the period after 1967 there is a tendency for the reduction of the precipitation, which is due to the reduction of the precipitation in the winter months. The trend is higher in the northwestern Greece and less in the eastern Macedonia-Thrace region.
- **Athens area:** In this area the precipitation reduced during the period 1925-1999, by 10%, but not statistically significant. During the period 1976-1990 there was a gradual reduction of the precipitation, which led to the great drought period in 1989/90 This was followed by a significant increase in precipitation during the decade 1990/2000.
- **Thessalonica Area:** The precipitation in this area is quite different from that of the Athens, showing a statistically significant increase in precipitation up to the 1980's. Thereafter during the decade 1980 there is a significant reduction trend, which trend is reversed during the decade 1990-2000, similar to the Athens area.
- The decade 1984-1994 is the most drought decade in both areas in Athens and Thessalonica.

The changes in precipitation during the last century as recorded are shown on Table 3 below.

Table 3. Change in the Precipitation in Europe, the Mediterranean, Greece and Regions of Greece

Region	1900-2000	Decade of 1900										
		0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-00	
North Europe	Increase 10-50%											
South Europe	Some areas Decrease											
Mediterranean	Indications Reduction 5-20%						+	-	-	--	+	
Greece	Decrease	+	+	+	+		-	-	--	--	+	
Athens	No Definite Trend	++	++	++	-	-	0	0	-	--	+	
Thessaloniki	No Definite Trend	++	++	++	+	0	0	+	-	--	++	

- + Increase
- ++ Great Increase
- Reduction
- Great Reduction
- 0 No Change
- ; Indication

b) Temperature variation in the last century. While the temperature globally and in Europe has showed an increase during the last century by 0.8 °C, in Greece it has showed a small decrease. From the analysis of the available data the following can be concluded.

- Most of the meteorological stations in Greece show a decreasing trend of temperature from the 1950's to the 1990's. Recovery of the decreasing trend is observed in many regions after 1975, which is caused by the increase in summer temperatures, irrespective of the decrease trend, which is observed in the winter temperatures after 1985.
- The 1970-1980 decade was the most cold of the century for all of the areas of Greece.
- There is a trend of temperature increase after 1990, which rate increases with time.

- There is a trend for warmer summers since the middle of 1970's till the year 2000, with the summer months of the year 1999 being the warmest in Athens in the last Century. The summer months of the year 2000 in Athens were equally warm like that of the summer of year 1998, which show that the summer months of the last three years are fluctuating between higher temperatures.
- There are indications but not evidence that the Athens regional climate is affected by the urbanization. These indications are derived from studies of annual temperature records in the Athens region in relation to other stations and from comparisons of the average maximum temperatures of the National Observatory of Athens with the average maximum temperatures in the Aliartos area during the period 1950-1985.
- In Thessalonica the temperature shows a decreasing trend with greater decreasing rates in spring and autumn months periods.
- In Athens and Thessalonica the average temperature seems to increase gradually since 1980 and especially in warmer summers. A greater increase is observed in the Athens region in the beginning of the 1990-decade, where in Thessalonica the increase is smaller and steady after 1980. During the four years 1996/99 in Thessalonica there appears a rapid increase of the temperature similar to that of the Athens but at a smaller rate.

The temperature variations during the last century as recorded from different reports are summarized in Table 4.

Table 4. Change in the Temperature in Europe, the Mediterranean, Greece and Regions of Greece

Region	1900-2000	Decade of 1900									
		0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-00
Europe	Increase by 0.8 °C	+ 0,65 °C				0	0	- 0,35 °C		+ 0,55 °C	+ Most Warm Decade
Eastern Mediterranean		-- 0,4°C	++	+	0	0	0	--	-	+	
Western Mediterranean	Temp. Incr. at a rate 0,8 °C per 100 yrs							-			
Greece	Small Decrease							-		+	+
Athens	No Definite Trend	-- 0,50 °C	+ 0,35 °C	++ 1,10 °C	0	- 0,35 °C	0	-	-- 0,40 °C	+ 0,25 °C	++ ,70 °C
Thessalonica	Negative Trend	-- 0,85 °C	+ 0,40 °C	-	- 0,55 °C	++ 0,80 °C	-	- 0,69 °C	-- 0,70 °C	++ ,070 °C	++ 1,0 °C

- + Increase
- ++Great Increase
- Reduction
- Great Reduction
- 0 Steady

c) **Extreme climatic phenomena.** Although the frequency of repetition as well the intensities of extreme events in Europe did not show a definite trend, for Greece the following are noted.

- During the decade 1990 the number of Heats was three times more than those recorded during the previous thirty-year period. No similar observations were made for Colds or Freezing.
- During the period 1970-97, more extreme precipitation events were observed.
- In Athens the frequency of daily maximum temperatures with values greater than 35°C, 36°C, 37°C and 38°C, during the last three years is the largest of the century. The duration of the periods with temperatures above 35°C, presents an increasing trend and especially during the decade 1990 the duration of the high temperature periods is double of that of the 1940's.
- The frequency of repetition and the duration of cold events in Athens are reducing steadily after 1950 and are zeroed after 1991 irrespective of the intensity of the events.

d) Sea level elevation. With the temperature globally increasing at a rate of 0.8°C per 100 years it is expected that the level of the oceans will rise accordingly due to the seawater volume expansion (thermal expansion) and the melting of the ice in some parts of world such as in Greenland and in the poles. From the analysis of the available data the following can be summarized.

- **Globally.** From the records and analysis it can be concluded that on the Global level during the period 1880-1980 the sea level was rising at a rate of 1,8 ±0,1 mm per year. During the last century the sea level rose by 18 cm with margin of uncertainty 2.5 cm.
- **Mediterranean Sea.** Most of the Mediterranean coasts have undergone similar changes with the sea level rising at a rate 1-2 mm per year. There are of course regions in the Eastern Mediterranean and Alexandria, where the water level has been reduced because of tectonic movements.
- **On the other side in the deltas of big rivers,** the rate of sea level rise was much larger than the global average due to sinking of the areas. In the Nile delta the rise was 4,8 mm/year, in the Thessalonica delta areas by 4,0 mm/year, and in Venice delta by 7,3 mm/year.
- **For Greece** no data is available and no study was carried out for estimating the long-term changes in the sea level rising. The recording of such data and information started in 1974 and the reliable annual series for such data started in 1985.

A.4.4 Projections for the future. The future climatic changes globally and regionally shall depend on the following four parameters.

- The future concentrations of the greenhouse gasses in the atmosphere and changes in the balance of solar radiation.
- The sensitivity of the climate in greenhouse gases concentration
- The influence of the greenhouse gasses on the climate changes and
- The thermal absorption of the oceans, which causes retardation to the reaction of climate system and reduces the rate of increase of the global temperature.

The size of the future climate change is estimated by the use of mathematical models that simulate all the natural processes that take place in the ocean-atmosphere-and the sea and earth ice systems, which define these changes. The most frequently used models are the Atmospheric Ocean General Circulation Models (AOGCM), which evaluate the future evolution of the climatic parameters such as temperature, precipitation, and humidity. From the model applications results the following can be summarized.

- **Future Global Climate Change:** The global average surface temperature is projected to increase by 1,4 to 5,8 °C over the period 1990-2100, where the mean sea-level is projected to rise between 0,09 and 0,88 meters. Precipitation is expected to increase in the Northern Hemisphere (Autumn

and Winter) and decrease in the tropics and sub-tropics of both hemispheres. The frequency of extreme events is likely to increase with global warming.

- **Europe:** From the results of five climatic models it can be said that the temperature shall rise from 0 to 4 °C in the winter months depending on the latitude with higher values in the Scandinavian countries, and in the summer months from 0-3 °C with the greatest increase over the Southern and Central Europe. For Southern Europe (Mediterranean) the temperature rise in winter shall be less than that of the Northern Europe where the summer temperature rise shall be more than in the North Europe. Concerning the precipitation this shall increase up to 20% in the North Europe countries during winter months and shall remain the same with some increase in the summer months. In the remaining of Europe the models do not agree in their conclusions, with some projecting a decrease in precipitation in the Mediterranean area and in the Central and Eastern Europe where other models project an increase.
- **Mediterranean:** The temperature is projected to increase from 0,7-1,6°C per 1°C of global increase, where the precipitation according to the majority of the models is expected to decrease in most parts of Mediterranean area that are below the geographical latitude 40 ° and 45 ° and an increase in the areas above the geographical latitude 45 °.
- **Greece:** By using the five Climatic Models, Michel and Hulme (2000) concluded that Greece is expected to have an increase in the mean temperature 3,1°C to 5,1°C with an average of 4,3 °C. Other models give an increase between 1,5-2,3 °C with more increase in summer temperatures than in winter. Concerning the precipitation this is more difficult to project since Greece is lying in the transition zone. All the models agree that the precipitation shall decrease in summer months and that there exists a greater probability that precipitation shall increase in the Northern regions of Greece. Other studies show an increase of the annual precipitation in Crete by 14,4 mm up to 23,8 mm by the year 2030.

A.5 International Conventions and Protocols on Climate Change

a) The Framework Convention on Climate Change: In response to the emerging evidence that climate change could have a major global impact, the UN Framework Convention on Climate Change (UNFCCC), was adopted on the 9th of May 1992 and countries were asked to ratify it. Greece signed the convention in Rio and ratified it in 1994. The objective of the Convention is the *stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous effects on the climate system from anthropogenic activities*. This, shall be achieved jointly and individually by the countries by,

- i) Returning to the 1990 emission levels,
- ii) By adopting policies and measures to mitigate climate change and,
- iii) By providing technology transfer and financial resources to help developing countries.

With this Convention the UN Framework Climate Change Committee (UNFCCC) was established for monitoring the implementation of the Convention. This convention sets limits for the increase of greenhouse gasses in the atmosphere during the period 1990-2000.

b) The Kyoto Protocol, a legal instrument: In December 1997 the UNFCCC finalised the negotiations related to the establishment of the Kyoto Protocol on Climate Change, which establishes **legally binding targets** for the reduction of greenhouse gas emission. The legally binding commitments of the developed countries is to reduce jointly and individually emissions of six (6) greenhouse gasses by more than 5% in the period 2008-to 2012 below their 1990 level by the use of the following.

- Voluntary adoption of policies and measure,
- Establishment of emission trading regimes,
- Joint implementation,

- Protection and promotion of sinks to absorb CO₂ and
- Establishment of a clean development mechanism.

Greece signed and ratified the protocol on the 30th of May 2002.

c) Obligations of Greece: The obligations of Greece under the UNFCCC Convention are being fulfilled jointly with the other EU Member States. For Greece, the agreed figure was a realistic objective to restrict the overall increase of CO₂ up to +15% ±3% by 2000 compared to 1990 levels, which was achieved. As far as the EU Member Countries target under the Protocol the European Union (EU) has stated that this will be achieved jointly by all its Member-States under the Article 4 of the Protocol. The “Burden Sharing Agreement” which was finalized during the Environment Council of the EU, in June 1998 provides that Greece restricts the increase of the six gasses to the atmosphere for the period 2008-2012 to +25% compared to the 1990 levels. This shall be achieved by the implementation of a National Programme, whose progress of implementation must be reported annually to the European Union Monitoring Mechanism. To achieve harmonization of the transmitted data and enable direct comparisons across sectors and between different countries all emission estimates should be reported following the methodology suggested by the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

The National Observatory of Athens has been contracted by the Greek Ministry of Environment, Physical Planning, and Public Works to compile annual inventories for emission and to prepare the National Programme for meeting the obligations under the Convention and the Protocol. The National Observatory of Athens has drafted the Climate Change National Programme for the reduction of Greenhouse Gases, for the period 2000-2010. The Report has been prepared for the Ministry for the Environment, Physical Planning, and Public Works and was submitted in March 2002.

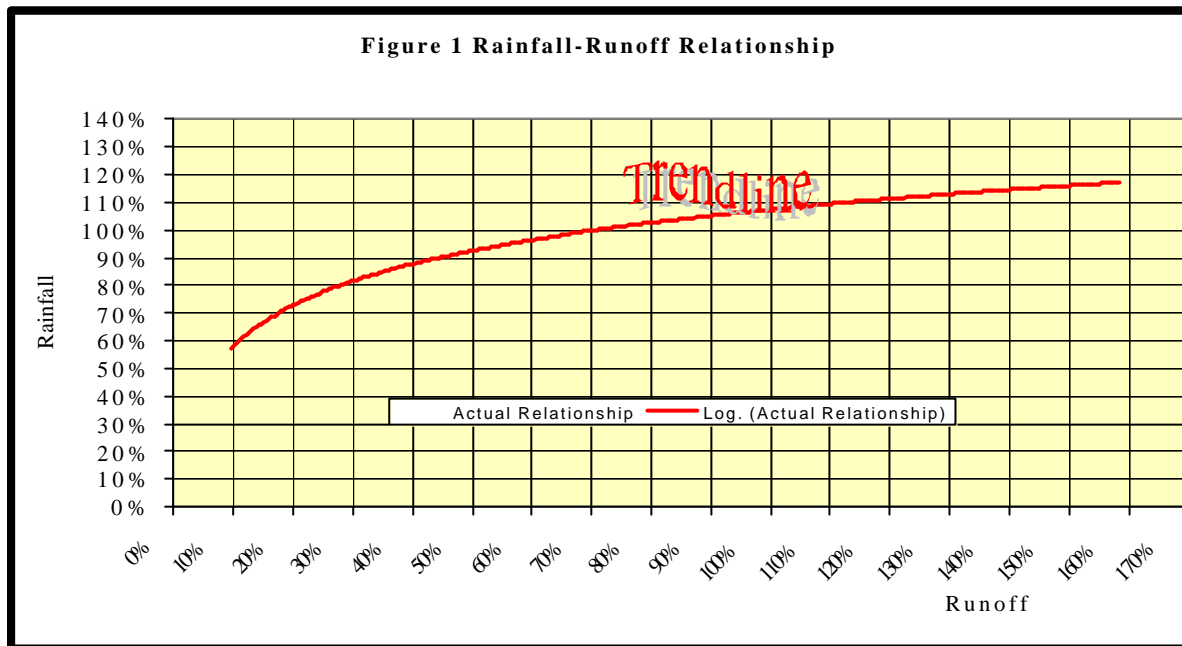
A. 6 Climate Change and Effects

The climate parameters such as the temperature, the rainfall, and others such as the sea level and the occurrence of extreme events such as floods and droughts, have shown variability during the last century with adverse and/or beneficial impacts on the economy on the social life and on the environment. The climate change that was observed during the last Century is expected to continue in the next century because of the increase in emissions, globally, of the greenhouse gasses to the atmosphere with effects on the following for Greece.

- The total average precipitation in mm per year and Km³ per year shall reduce in the southern parts and increase in the Northern parts.
- The evapo-transpiration in mm per year and Km³ per year shall increase in the southern parts because of temperature increase and reduce in the northern parts because of decrease in the local air temperatures.
- The total surface runoff is expected to decrease in the regions with reduced precipitation and increase in other areas with increased precipitation. The decrease in runoff shall be at higher rates than decrease in precipitation rates as shown on Figure 1.
- The crop water demand in mm per year shall decrease in some areas and increase in other areas, which means that more water shall be needed to irrigate one unit area of irrigated land, in some regions and less in other areas.
- Water demand for general domestic needs per capita shall increase.
- Groundwater volumes in the coastal aquifers shall reduce due to the rise of the seawater level, which shall be caused by the global warming and melting of the ice in Greenland and by the sea volume expansion due to seawater temperature rise. This effect shall be catastrophic for the great number of islands of Greece and of the coastal areas. Greece has one of the longest coastlines per unit area.
- More frequent extreme events shall create problems to the existing water structures, operational and safety as well on their capacity and reliability to develop and control water resources.

Extreme events such as floods and drought shall be catastrophic and devastating affecting the economy of the country, the social life, and the environment.

- Springs that now deliver steady flows of water inland and in the coastlines shall be affected by droughts and sea level rise with adverse effects on the water balance.
- Wetlands water balance shall be upset either by the reduction of fresh water inflow or increase of inflow in the coastal wetlands.
- Generally the ecological equilibrium shall be slightly or largely upset causing many adverse effects on the well-being of all the population, the income of large part of the population, the social life and the environment.
- The arable and tourist land in the coasts shall reduce due to the rise of the seawater level, depriving the population of high valued land.



A.7 Water Resources and Climate Change Effects

From the above it can be deduced that the effect of climate change on the water resources shall be adverse in many ways, since the hydrological cycle will be affected, the existing water structures shall prove to some extent inefficient to develop the planned quantities of water, creating water deficits, the structures shall not be capable to confine the extreme floods with damages to the neighbouring property and to the environment and to the wetlands, the natural aquifers capacity shall be reduced, the drought events shall be more frequent becoming more difficult to mitigate, the wetlands natural habitat shall be adversely affected with impacts (quantitatively and qualitatively) on their use as water resources, as recreation sites or as natural habitat for fish, birds and animals. Greece extending from the south to the north between latitudes 35-41° and made up of continental lands and of many islands, is expected to face different climatic changes in different parts of the country. The effects from climate change are listed below as follows.

- Small islands and coastal areas shall suffer from the rise of the sea level with adverse effects on the limited groundwater resources. This shall make the water problems of the islands much more difficult. Of course the process shall be gradual.
- Fertile arable land and valuable land for tourist purposes shall be flooded, depriving the present owners of a valuable asset.
- Coastal wetlands shall be adversely affected due to the sea level rise, upsetting their qualitative and quantitative water balance, where the rise in the temperature shall affect the wetlands habitat.

- Extreme climatic events (floods or droughts) both inland and in the coastal areas and on the islands, whose frequency is growing at high rates shall increase the risks of damages and cause social, economic and environmental problems.
- The climate change impact on the inland water resources shall be varying from place to place. This shall vary from water shortages due to reduction of precipitation or change of river flow patterns, to excess water because of increase in precipitation, increase of river flow and change in river flow patterns. This may create the need for water transfer from areas with excess water to areas with water shortage.
- Inland wetlands water balance qualitative and quantitative may change with effects on their utilization. Some may suffer from water shortage while others may have to accept more water. In both cases the wetlands balance shall be upset creating an imbalance in the wetlands system.
- River flows from the northern Balkan countries forming the external water resources of the country are expected to vary since similar climate changes are expected to occur in these countries.
- Rain fed crops shall be affected either due to increase in the rainfall or due to reduction of the rainfall.

A.8 Climate Change and Water Uses Vulnerability

The climate change and the water use vulnerability in Greece shall be as follows.

- The coastal water resources of Greece of the continental areas and of the islands are expected to be vulnerable due to the long coastline of the continental part (Area 103.000 sq km and coastline 7.700 kilometres, 75 m/sq km) and the long coastline of the many islands (about 7.300 kilometres for an area of 28827 square kilometres, 267 m/sq km). The seawater level rise shall reduce the capacities of the coastal aquifers and shall turn the water into saline, limiting the capabilities of these aquifers to supply sufficient good quality water for satisfaction of the existing and increasing needs. Boreholes shall become saline, natural spring now above or near the sea level shall be submerged and the aquifers capacity and yields shall reduce because of the sea level rise, creating an imbalance in the water supply water demand formula.
- The coastal wetlands shall be affected adversely because of the rise in the sea level, by upsetting their qualitative and quantitative balance. Their capacity to provide good quality water shall be limited, their area of extend may expand at the cost of good agricultural land and of land used for tourist development. If their level shall drop then the habitat and their capability to supply fresh water shall be adversely affected.
- Water related extreme events such as flood and droughts caused by the climate change, shall increase the risk of the populations living in areas prone to such extreme events. Floods if not controlled may affect large portions of the population with damage to their properties, deprivation of good land, and causing high economic, social and environmental damages. On the other hand droughts may cause water shortage and water scarcity with effects on the well being of the population, reduction in irrigation and agricultural activity, less income to the farmers with economic, social and environmental adverse effects.
- Inland river flows are expected to increase or decrease affecting in some manner the water use or the amounts impounded in the dams or wetlands. Depending on their use the river flows water quality may be affected.
- External river flows to Greece may increase or decrease depending on the climate change that may occur in the neighbouring country catchments, with effects on the quantity and quality of the incoming external water resources.
- The inland aquifers shall be affected accordingly, either positively or negatively depending on the climate change trends.
- The forest land and the rainfed crops shall be affected by the reduction in the precipitation.

Part B

Institutions/Processes And Networks Working On Water, Wetland And Climate Change Issues

B.1 Climate Change and Water Uses Vulnerability

B.1.1 Centres and Institutions working on Climate Change

The climate change matters institutions may be classified into four categories as follows:

- a) Data collection and analysis Institutions and organizations,
- b) Research Institutions and organizations,
- c) Institutions dealing with climate change effects
- d) Policy and decision taking Institutions on climate change matters.

The institutions named below are not responsible per se for climatic change matters but they are involved directly or indirectly in climate change matters, since climatic parameters and their effects are part of their activities. At the moment there is no decision by the Government to study or analyse in detail the climatic change and matters related to climatic change except those that are included in the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. The institutions involved in one or another way in the climate and climate change matters are the following.

a) Hellenic National Meteorological Service, HNMS (Data collection and Analysis Institute).

Founded in 1931, it is a part of the Hellenic Ministry of Defence, it is staffed with civilian and military personnel, and its mission is the meteorological support of the national economy, national defence, and the whole society. This is responsible for climatological data collection, analysis, and forecast of the weather for the nation in general. The Service promotes the research in critical sectors such as numerical prediction, climatology, hydrology, and agricultural meteorology. The work of Operational Meteorological Centres is the supply of meteorological support in 24h basis to whom it may concern. Having the responsibility of meteorological support during the Olympic games of 2004, HNMS will provide general and specific weather forecasts related to all Olympic Events. This Service is responsible for the provision of meteorological services for the requirements of the civil aviation, the collection of meteorological data and information, the compilation of climatological statistics and monitoring of climatic variations and trends and the preparation of climatological studies and reports. It is also responsible for the provision of weather information and consultative services for applications in various fields such as agriculture, water resources, fisheries, and shipping industry, regional planning and development, tourism, architectural and civil engineering works, renewable energy resources, environmental studies etc.

b) National Observatory of Athens . (A research Institute). This research institute being the oldest in Greece and founded in 1842, is made up of four research institutes. This institute carries out research and studies on climate change and has taken initiatives or at the request of Government Ministries for carrying out studies on measures, actions, and plans for the reduction of greenhouse gases emissions in Greece. It has prepared studies on Climate Change in the Mediterranean and in Greece, and has prepared for the Governments of Cyprus and Greece the National Strategic Plans for the reduction of the Greenhouse Gas Emissions as specified in the UN Framework Convention on Climate Change (UN FCCC), and has also provided, through the Development Assistance Committee program, assistance to the Balkan countries for developing their national plans for promoting activities related to the implementation of the UNFCC Convention on climate change and the Kyoto Protocol. It has also undertaken to prepare and submit the monitoring reports of the national emission inventory in the scope of the European Union Monitoring Directive. The National Observatory of Athens forecast the 72-hours weather forecasts for the Eastern Mediterranean and Greece on a daily base. Specific forecasts for sailing and for the main Athens

2004 Olympic Games venues shall be provided by the National Observatory of Athens. This Institute has been appointed as the Focal Point for the implementation of the Kyoto Protocol, and it is an adviser to the Ministry of the Environment, Physical Planning, and Public Works, which is responsible for coordinating the implementation of the Convention and Kyoto Protocol. At present this is the main institute dealing extensively on research and studies related to Climate Change.

- c) **The Institute of Environmental Research and Sustainable Development (IERSD):** This is one of the four institutes that constitute the National Observatory of Athens and its aim is to promote meteorological, climatological and environmental science. The IERSD deals with Environmental Studies, Meteorology-Climatology, Physics of the Atmospheric Environment, Atmospheric and Water Pollution, Solar and Wind Energy, Climate Change, Resource Management and Sustainable Development, Hydrology. Its main activities are collecting and processing of various meteorological data, research programmes, performing relevant studies, providing training and other services to third parties. The goals of the IERSD's research and technology policy are the continued activity of the centre for meteorological observations, extending the institute's research activities, extending the institute's international co-operation on research activities, modernising the institute's scientific instruments, the automation and normalisation of all activities related to meteorological observations and the integration of all data into a modern electronic data base.
- d) **National Agricultural Research Foundation (N. Agr. Re. F.):** New socio-economic conditions affecting agriculture in Europe and worldwide include globalisation of the agricultural products market, expansion of the European Union, development of a new Common Agricultural Policy within the European Union (Agenda 2000), and increasing demand for quality control of agricultural products. In addition, environmental protection measures dictate sustainable management of natural resources and the preservation of biodiversity. The need to encompass all these factors has resulted in a major change from quantitative to qualitative production. The National Agricultural Research Foundation (N.AG.RE.F.) includes a specialized scientific staff of significant research capacity with modern laboratory and field infrastructure at their disposal. N.AG.RE.F supports and coordinates initiatives for development suggested by the Ministry of Agriculture, the agricultural cooperatives, product distributors, producers' groups etc. New scientific knowledge and technical innovations are directed towards creating a dynamic and competitive agriculture, which is protective of the environment and capable of providing excellent and inexpensive nutrition for the people. N.AG.RE.F strives for constant improvement in competitiveness of Hellenic agricultural products in the international market. Moreover, it works to symmetrically upgrade the quality of life in the Greek countryside, with the aim of reversing migration and preventing the degradation of our unique environment. All above activities naturally include climatic data and climatic parameters are very important in the carrying out of research on the improvement of the Greek agricultural products.
- e) **Ministry of Environment Physical Planning and Public Works (YPEHODE):** This Ministry is in charge of the coordination of the implementation of the UN Framework for Climate Change Convention and of the Kyoto Protocol. In its structure it includes the Directorate of Environmental Planning, which includes the Departments for Water and Air Quality. Both Departments are deeply involved in the implementation of the National Plan for the reduction of Greenhouse gas emissions, in accordance with the Convention and the Kyoto Protocol.
- f) **Ministry of Development.** This Ministry according to the existing water framework law is the "Coordinator for the management" of the water resources of Greece. According to the Law this Ministry is responsible at the higher level for the management of the Water Resources until they are allocated to the responsible Ministry. In addition to the responsibility of Coordinator the Ministry is also given the responsibility to manage the water resources allocated for Industry and for Multiple Uses. Under this Ministry the Central Directorate for the Water Resources and Natural Resources is organized which is responsible for the Coordination of the Water Resources Management. The law also provides that the Ministry is responsible for the organization and execution of studies and research for the evaluation of the available water resources and for this

reason Institutions and Organizations shall undertake this. The availability of water resources depends on the climate parameters and mainly on the precipitation, the temperature, etc.

- g) **Ministry of Agriculture:** This Ministry is responsible for the management of the water resources allocated to agriculture and for the use of the water at the farm level. The ministry advises the farmers or irrigators on the crop water requirements, and the efficient and effective use of the allocated water. Water demand depends mainly on the climatic parameters of temperature, precipitation, wind velocity etc.
- h) Other Institutions cooperating on matters related to climate change due to their activities are the Centre for Renewable Energy Sources, the Institute for Geological Studies, the National Technical University of Athens, the University of Athens etc.

B.2 Coordination Between Institutions and Organizations

So far no official decision was taken to study the climate change matters except those in connection to the UNFCCC Convention and the Kyoto Protocol, which are at the initial stages as will be seen in the next section of this Report. However events have obligated the Institutions and Government Departments dealing with the water resources sector to develop some form of cooperation and coordination on the meteorological data collection and analysis, on the evaluation of adverse effects from the water scarcity, the development and promotion of measures and policies to mitigate the adverse effects of water scarcity resulting mainly from the climate change and on research and development. The cooperation and coordination was initiated by the Ministry of Environment, Physical Planning and Public Works, all in accordance with the UNFCCC Convention and the Kyoto Protocol. In accordance with the Convention and the Kyoto Protocol the National Observatory of Athens was appointed as the National Focal Point with the duties to watch and follow the international activities on the Climate Change Convention and the Kyoto Protocol. The National Observatory has cooperated with the Hellenic National Meteorological Service, and the Ministry of the Environment, Physical Planning and Public Works and other ministries and institutions for the preparation of the National Strategic Plan for the reduction of emissions of Greenhouse gasses to the Atmosphere.

B.3 Committees for Climate Change Matters and their Duties

- a) **The United Nations Framework on Climate Change (UNFCCC) Convention and Kyoto Protocol Committee.** Focal point for reporting the implementation of the above two obligations undertaken by the Government of Greece is the National Observatory of Athens (NOA). The duties and responsibilities of the NOA are to follow up the activities of the Intergovernmental Panel on Climate Change and monitor the implementation of the Protocol provisions. The responsibility for the coordination of the implementation of the actions necessary to meet the obligations of the Convention and the Kyoto Protocol are vested to the Ministry of the Environment, Physical Planning, and Public Works (MEPP and PW). The National Strategy Programme for the reduction of the Emissions of Greenhouse Gases has been prepared for the Ministry of the Environment, Physical Planning and Public Works by the National Observatory of Athens in March 2002. According to the Plan the reduction of emissions shall be achieved by the implementation of measures, which shall be applied by the Ministry of the Environment Physical Planning and Public Works (8%), the Ministry of Development (85%), the Ministry of Transportation (4%), the Ministry of Agriculture (1%), the Ministry of Commercial Navy (?) and the Ministry of Interior (2%). The coordination shall be undertaken by the Ministry of the Environment, Physical Planning, and Public Works and an Inter-ministerial Working Committee made up of the following shall carry out the monitoring.

- Representative, Ministry of the Environment, Physical Planning, and Public Works, Coordinator.
- Representative, Ministry of Interior, member

- Representative, Directorate of Technical Services, Department for the Protection of Environment, Ministry of Interior, member
- Representative, Ministry of Finance and Economy, (Directorate of relation with E.U, Directorate of International Financing Organizations), member
- Representative, Ministry of Development, Energy Directorate General of Industry and Research and Technology), member
- Representative, Ministry of Transportation, Department of International Relations, member
- Representative, Ministry of Agriculture, National Agricultural Research Foundation, member
- Representative, Ministry of Commercial Navy. Directorate for the protection of marine environment, member
- Electricity Authority of Greece, Directorate of Planning and Strategies, member
- National Observatory of Athens, member
- University of Athens, Physics Department, member

Each representative shall see that the emission plans are applied as agreed by the Government and shall report to the committee. The National Observatory of Athens, using inputs from the different Ministries, shall prepare the annual report on emissions.

The responsibilities of the Committee are the following:

- a) To study, analyse and advise the Government on the steps to be taken for meeting the obligations from the Climate Change Convention and the Kyoto Protocol.
- i) To develop scenarios and propose measures for implementation called the Strategic Plan for achieving the targets set by the E U Council in accordance with the Climate Change Convention and the Kyoto Protocol.
- ii) To supervise and coordinate the implementation of the Strategic Plan for the stabilization of emissions of greenhouse gasses.

The National Strategy Plan has already being prepared by the National Observatory of Athens and has been presented to the above Committee for comments and proposals to the Government for taking decisions on the measures to be adopted.

b) Climate Change Matters and Committees

Greece did not set up yet officially any Committee for climate change matters. However certain actions taken individually by the Government Ministries show that some ministries are aware of the climate change. Some actions are the results of reduced rainfall or droughts and they the following.

- Desertification National Action Plan, prepared in January 2001.
- Wetlands, Strategic Plan, which has provisions for the preparation of plans for wetlands conservation, for the setting up of the necessary legislation for wetlands management, and for raising the public awareness and promote education on the wetland socio-economic and environmental value.
- Actions on limitation of areas to be irrigated in areas where water is scarce. The Ministry of Agriculture took such actions by issuing instructions to the farmers how to face the water shortage due to reduced rainfall, or reduced water supply from projects.
- Greece has suffered from water scarcity in the period 1989-1993, which was due to low rainfall. The precipitation then returned to normal, but extreme events, mostly floods are more frequent. No specific action was taken by the Government except to accelerate the construction of specific projects mainly for domestic water needs.

B.4 Discussions on Adaptation Policies for Climate Change Matters

As has been said earlier the Government has not taken any official decision for introducing adaptation policies for climate change matters. Since no such decision has been taken no Climate Change Committee has been established for the study of the effects of the climate change. However following international activities some actions were taken by individual ministries or organizations for carrying out studies on climate change, mitigating desertification, national strategy plan for greenhouse gasses emissions and for control of agricultural expansion in water scarcity areas.

Since no official discussion has started on climate change except the one emanating from the implementation of the UNFCC Convention and the Kyoto Protocol, I think it is time that Greece should start discussions on introducing adaptation policies for facing the climate change effects. The climate change effects on Greece should first be identified and evaluated and actions and measures must be agreed, public awareness must be raised, cost estimates must be made with and without the mitigation measures and be ready to act the soonest possible. Greece shall be greatly affected by the sea level rise phenomenon affecting the great number of the small islands and the coastal areas. **A National Committee on Climate Change should be established like the one that was set up for studying Desertification.**

B.5 Key Institutions Providing Data on Climate Change Impact

The key institutions that provide data on climate and climate change at present are mainly the **Hellenic National Meteorological Service, the National Observatory of Athens and the Institute of Environmental Research and Sustainable Development**. These Organizations provide observations of raw data and to some extent studies on climate change. However no key Institutions have carried out studies to identify per se the impacts from climate change. The National Observatory of Athens is carrying out studies on climate change, and has prepared the National Programme Strategies for meeting the Kyoto obligations, but it did not yet studied the impacts of climate change on the various sectors of the economy, on the social life, and on the environment.

B.6 Research Institutions

A few institutions in Greece are working on Climate Change Impacts per se but many other institutions are researching on matters related to climate change. The institution mostly working on climate change is the National Observatory of Athens, which has taken the initiative to prepare also studies on climate change in the Mediterranean and has prepared the National Strategy Plans for reducing Greenhouse emissions to atmosphere for Greece and Cyprus and has assisted other Balkan countries to prepare their own national plans. Other Research Institutions working on climate change are the University of Athens, the National Technical University of Athens; the Aristotole University of Thessalonica, the Hellenic National Meteorological Service, the Institute of Environmental Research and Sustainable Development and other smaller universities and institutions.

B.7 Coordination Between Institutions Involved In Climate Change

- The Government of Greece did not yet decided the preparation of any plan for mitigating the effects of climate change and for adapting policies on climate change. This is supported by the fact that no visible or understandable climate changes have been noticed by the public and that no adverse effects have been realised except the floods which are attributed solely to human intervention in the physical planning, no support was given by any official for studies and research on climate change impacts. The only studies that were carried out are those carried within the framework of the UNFCC Convention and the Kyoto Protocol. For the preparation of these studies there was a closed cooperation between the National Observatory of Athens and the Ministries of the Environment Physical Planning and Public Works, of Development, of Transportation, of Agriculture of the Marines and the Ministry of Internal Affairs. The cooperation included the selection of data and analysis and the study of the results for agreeing on

a common strategy plan. The cooperation was made on administrative, scientific, and technical levels by the transfer of information, of data, and of know-how.

- It is the opinion of the author that a political decision should be taken on the preparation of Climate Change Plans and for this a National Committee on Climate Change must be established with the legal and administrative powers to prepare a national plan for mitigating the climate change effects, and for the selection of policy adaptation measures.

Part-C

Integration of water and wetland resource management policy and practices and climate change

C.1 Most Essential Issues and Opportunities for the Integration of Water and Wetlands

The Administrative organization for the Management of the Water Resources of Greece has obvious problems. The set up of the administrative structure did not include and was not so flexible to introduce criteria that are necessary for the management of the water resources in a continuously evolving environment. In parallel the great number of authorities and organizations involved in the water management, in most cases competing among themselves with fragmentation and conflicting responsibilities, combined with the inability of cooperation or coordination makes the subject even more complicated than it is, make the setting of priorities and every effort for an integrated water resources management very difficult. With the present legislation in force for water resources management, whose implementation is very slow due to the great number of decrees to be issued, the non sufficient staffing of the central and regional services, and the Water Framework Directive approved by the European Parliament, combined with climate change, and the need for an Integrated water Resources Management within a new or improved legal framework is more than before a necessity.

The climate change impacts on the water resources, on the wetlands and on the agricultural land, cause adverse impacts on the economy, on the social life and on the Environment, which in a way accelerate the implementation of plans and actions that could have been implemented later. With the preparation of the strategic plan on wetlands conservation, a master plan for the Integrated Water Resources Management should be prepared, taking into consideration the fact that wetlands are an inseparable part of the natural water resources.

Based on the above and the need for integrating the water resources and wetland resources management the most essential opportunities and issues are the following.

- **Opportunities**
 - a) The need for the protection and conservation of the water quality and quantity of the surface and groundwater resources as outlined in the Water Framework Directive.
 - b) The need for avoiding adverse impacts on the water resources and on the wetlands because of climate change.

- **Issues**
 - a) A political decision must be taken followed with political will to proceed with the integrated approach of water and wetland resources management, within a National Strategy Plan.
 - b) An enabling planning and execution environment must be created, by providing the appropriate and flexible legal and institutional framework.
 - c) Participation by all must be secured and their participation must be sought, through democratic processes, which require public awareness, public education, and transparency in problems analysis, decision taking and in the execution of the decisions.
 - d) Since knowledge data and availability of capacity are necessary inputs, research, data collection education and training on the subjects must be financed and promoted. This involve the participation, cooperation and coordination of research, educational, and data collection institutions and organizations
 - e) The Central Government should provide the coordination and provide the right environment through legal, social, financial and environmental measures and encourage the regional cooperation on the Integrated Management of the Water Resources and the Wetlands.

Although nobody is certain whether the climate change which occurred during the last century in Greece shall continue, it is certain that global warming shall continue resulting to the rise of the

seawater level affecting the coastal aquifers and the coastal areas of the numerous islands of Greece and continental land. Further the natural water resources variability, which already has taken place, must be considered for revising the existing water projects utilization including water allocation/reallocation. The approach to the solution of the water problems created by the climate change should be in an integrated manner and for this there must be first a decision by the Government. The Decision should provide for a Plan to mitigate the adverse effects created by the climate changes on the water resources management in an integrated manner. The plan should provide studies on the following:

- Policies for water and wetland resource management,
- The formation of the enabling system (legal framework, institutional framework, including public and users participation),
- Consideration of measures and options to meet the adverse effects,
- Costs and benefits including environmental benefits from the implementation of such a plan.
- The outcome should be a National Strategy Plan on Climate Change Adaptive Policies.
- The formulation of adaptation policies for facing the climate change adverse impacts.

C.2 Case Study

No time allowed the presentation of a case study.

Part D

Toward adaptive strategies-discussion points for the regional round table

D.1 Issues or points for discussion in the regional round table

Climate change is not yet confirmed although in practice many countries including Greece are experiencing regional climatic changes and extreme climatic phenomena such as droughts, floods, higher temperature, which in conjunction with global warming cause problems to the availability of surface and groundwater resources, with problems caused by the more frequent floods, more fires eruptions because of the very dry soil and environment conditions, deforestation and desertification, wetlands water levels dropping or drying up, all causing social, economic and environmental problems increasing at a high rate. The Government of Greece faced the results of the climate change or climate variability, such as the drought of 1989-1990 and the floods at an ad-hoc manner by taking short-term measures.

The regional roundtable gives the opportunity for the participants to discuss issues and points that are important for all countries facing the adverse effects of climate change or climate variability. Based on the experience gained during the last years while trying to face extreme climatic conditions the following issues or points of importance are proposed for discussion.

- Type of data and information necessary for the study of the climate change and their impacts,
- Methodology for defining the climate change
- Methodology for evaluating the effect on the natural water resources and re-evaluating the natural water resources.
- Methodology for evaluating the effect on groundwater resources due to the sea level rise.
- Methodology for evaluating the effects of climate change on water demand.
- Legal and Institutional Frameworks for water management under changing climatic conditions and reduced water availability, with the objective of maintaining a sustainable development.
- Public awareness and participation in the studies and measures to mitigate adverse effects of climate change.
- Technical, legal, institutional, economic, social and environmental measures necessary to face the adverse or beneficial effects of climate change such as water shortages, floods, increasing water demand, seawater level rising, more frequent fire eruptions, etc.
- The role and contribution of each of the stakeholders in facing climate change effects.

Reference:

1. Climate change in the Mediterranean , by Charalambos Feidias and Demetrios Lalas Athens November 2000.(In Greek)
2. Precipitation Decreasing Trends in Greece and Cyprus since the middle of our century, Amanatidis, T. G., Reparis, C. C., Metaxas, D.A., Paliatsos, A. G. and Bartzis, G.J., 1992, Climate Conference 14-18 June 1992, Bad Durkheim, Germany.
3. ? e??t? t?? ?????se???? ?????pt?s?? st? ?? ?????da ?a? ??p?? (Studies of the precipitation series of SE Greece and Cyprus), Hadjioannou, L., Retalis, D., Pasiardis, S., Nicolakis, D., Sakellariou, N.,Asimakopoulos, D., Lourantos., 1998.
4. THE Mediterranean in Figures-Water resources and Uses in the Mediterranean countries Figures and facts. Iean MARGAT & Domitille VALLEE, Plan Blue March 2000
5. Ministry of the Environment, Physical Planning and Public Works “Climate Change, Emissions Inventory’ prepared by the National Observatory of Athens June 2001.
6. Ministry of the Environment, Physical Planning and Public Works “Climate Change, Natina Programme for the Reduction of Greenhouse emissions (2000-2010). Athens March 2002.
7. Dialogue on water and climate, First “White (Position)Paper Version 28-02-2002, Editors Kabat and all lead authors.
8. Ministry of Agriculture General Directorate on Water Improvement Structures, “Water Resources Management in the Agricultural Sector” by Mr Papastamatiou, J., and Pergaliotis, Pan., Athens 2001.
9. IPCC, 1992: Climate Change 1992: THE supplementary Report to IPCC ScientificAssessment, Cambridge University Press, Cambridge.
10. IPCC, 1996: Climate Change 1995, The Science of Climate Change, (Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change) Cambridge University Press.
11. IPCC, 2000: Third Assessment Report, Working Group I Report.
12. Hadley Centre, 1995: Modelling Climate Change 1860-2050.
13. Greenpeace 1999: Climate Change in the Mediterranean in Greek, by the Greenpeace office , November 1997.
14. Hoffman, J. S., Keyes D., and Titus, J. G., 1983, Projecting Future Sea-Level Rise. US Environmental Protection Agency, EPA 230-09-007, p.121.
15. Mitchel, T. and Hulme, M., 2000: A Country by Country Analysis of past and future warming rates. Tyndall Centre Internal Report, No 1 November, 2000, UEA, Norwich, UK, 6pp. (<http://www.tyndall.uea.ac.uk/main.htm>).
16. Hellenic Committee for fighting Desertification. “ Greek National Action Plan for Fighting Desertification” Athens January 2001.