United Nations
Environment
Programme

UNEP(OCA)/MED WG.33/2
24 November 1991

Original: ENGLISH

MEDITERRANEAN ACTION PLAN

First Meeting of the Task Team on
Implications of Climatic Changes
on the Syrian Coast

Damascus, 23-24 November 1991

REPORT
OF THE FIRST MEETING OF THE TASK TEAM ON IMPLICATIONS OF CLIMATIC CHANGES ON THE SYRIAN COAST

UNEP
Athens, 1991

TABLE OF CONTENTS

BACKGROUND

The greenhouse effect is among man's potentially most pressing long-term environmental problem, one which presents major scientific challenges which span a wide range of disciplines. Changes in global climate between now and the middle of the 21st century are likely to be dominated by the influence of global warming due to increasing concentrations of carbon dioxide and other "greenhouse gases" in the atmosphere. These greenhouse gases individually and collectively change the radiative balance of the atmosphere, trapping more heat near the earth's surface and causing a rise in global-mean surface air temperature and as a consequence substantial global warming is virtually certain.

In spite of uncertainties surrounding predicted climatic changes, greenhouse gases seem to have accumulated in the magnitude of the atmosphere to such a level that the changes may have started already and their continuation may now be inevitable.

The Second World Climate Conference (Geneva, 29 October-7 November 1990) concluded that without actions to reduce emissions, global warming is predicted to reach 2 to 5 degrees C over the next century, a rate of change unprecedented in the past 10,000 years. The warming is expected to be accompanied by a sea level rise of 65 cm ± 35 cm by the end of the next century. There remain uncertainties in predictions, particularly in regard to the timing, magnitude and regional patterns of climatic change, as well as in the numerous secondary effects of this warming and sea level rise.

In view of the importance of this issue, the Oceans and Coastal Areas programme Activity Centre (OCA/PAC) of the United Nations Environment Programme (UNEP) in co-operation with several intergovernmental and non-governmental organisations, launched, co-ordinated and financially supported a number of activities designed to contribute to an assessment of the potential impacts of climatic changes and to the identification of suitable policy options and response measures which may mitigate the negative consequences of the expected impacts.

As part of these efforts, Task Teams on the implications of climatic changes were established in 1987 for six regions covered by the regional seas programme (Mediterranean, Wider Caribbean, South Pacific, East Asian Seas, South Asian Seas and South-East Pacific regions) with the initial objective of preparing reviews of expected climatic changes on coastal and marine ecosystems, as well as on the socio-economic structures and activities within their respective regions. Three additional Task Teams were established later, two in 1989 (for the West and Central African region and for the East African region) and one in 1990 (for the Kuwait Action Plan region). The establishment of Task Teams for the Black Sea and for the Red Sea is under consideration.

In the framework of the activities of the Mediterranean Task Team six site specific case studies were prepared (deltas of the rivers Ebro, Rhone, Po and Nile, and for Thermaikos Gulf and Ichkeul/Bizerte lakes) in the period from 1987 to 1989. Since 1990 second generation site specific case studies (Island of Rhodes; Kastela Bay; Syrian coast; Izmir Bay; Malta; Cres/Losinj islands) have been and are being developed.

REPORT OF THE MEETING

<u>Opening of the meeting</u> - Agenda item 1

The meeting was opened by His Excellency Abdel Hammid Al Munajed, Minister of State for Environmental Affairs, who welcomed the participants on behalf of the Government of the Syrian Arab Republic and expressed his Governments' appreciation of the support of UNEP and of the Co-ordinating Unit for the Mediterranean Action Plan in preparing for the first meeting of the Task Team on the Implications of Climatic Changes on the Syrian coast. Further on, he stated that the whole world is concerned about the possible climatic changes and is making efforts to face all the probabilities through various kinds of cooperation to develop a clear and suitable environment for future generations capable of hard work for reaching all objectives in better living conditions.

Dr Al-Shalabei, Co-ordinator of the Task Team addressed the meeting by illustrating the aims of the project and stressing its essential role in the framework of integrated coastal planning of the Syrian coast. His address is appended as Annex I to this report.

Dr L. Jeftic, Senior Marine Scientist in the Co-ordinating Unit for the Mediterranean Action Plan (MAP) on behalf of Dr M. K. Tolba, Executive Director of UNEP, expressed his appreciation of the Minister's opening the meeting and the address of the Co-ordinator of the Task Team and thanked the Government of Syria for hosting the meeting. He continued by briefly outlining the background and scope of the meeting and expressed the hope that both the meeting and the work of the Task Team on the implications of climatic changes on the Syrian coast would be successful.

The meeting was held at the Ministry of State for Environmental Affairs. Meeting's participants and Task Team members are listed in Annex II to this report.

<u>Election of Officers</u> - Agenda Item 2

The meeting unanimously elected Dr N.M. Al-Shalabei, Co-ordinator of the Task Team as Chairman, and Dr G. Sestini as Rapporteur of the meeting. Dr L. Jeftic acted as technical secretary of the meeting.

<u>Adoption of the Agenda</u> - Agenda Item 3

The provisional agenda as proposed by the secretariat was adopted and appears as Annex III of this report.

<u>Overview of the implications of climatic changes</u> - Agenda Item 4

Dr L. Jeftic gave an overview of the current consensus views concerning the greenhouse effect, past and predicted changes in the temperature and sea level, as well as the possible implications of climatic changes. He referred to the activities organised by the Oceans and Coastal Areas Programme Activity Centre (OCA/PAC) of UNEP and MAP concerning the evaluation of the implications of climatic changes. He also informed the meeting that the Climate Research Unit of the University of East Anglia, Norwich, U.K., is working on a set of regional scenarios of climatic changes for the Mediterranean region and had agreed to provide sub-regional scenarios in support of case studies. As part of this work a sub-regional scenario shall be provided in support of the Syrian coast study by the end of 1991. Copies of the transparencies of his presentation are contained in Annex IV to this report.

In the continuation of this agenda item, Dr Sestini summarized the approaches and findings of the two case studies: Consequences of climatic changes for the Nile Delta and Po Delta-Venice lagoons, prepared for the UNEP's report "Impact of Climatic Changes in the Mediterranean Region".

He emphasized in particular:

a) the problems encountered in identifying and defining the present physical and socio-economic parameters of the two regions and in evaluating their possible changes in the next decades given their complex inter-relations;

b) the difficulties of making an analysis of impacts of climatic changes that are still undefined, and at best not yet modelled on a sufficiently local scale.

The case studies have shown that the most important changes involve:

(1) Atmospheric circulation - with consequences for precipitation, and for waves and currents, hence for water resources and coastal stability. This would be particularly relevant for the NE part of the Eastern Mediterranean, if climatic zones would shift northwards.

(2) Increased temperature, with consequences for lagoonal and wetlands biosystems, and for the arrangement and movement of water masses in the sea (e.g. stratification, currents).

(3) The consequent rise of sea level, which would exacerbate the present trends of coastal erosion due to river damming and to shoreline constructions; threaten the lagoonal ecosystems (even if the rise is small) and increase soil and groundwater salinities. The major problem of the coastal zone in many areas is that the coastlines are no longer able to respond and to adjust freely to natural changes, being more and more conditioned by the infrastructure of summer resorts, harbours and industrial centres, and by other shoreline land uses.

It is necessary, therefore, that:

(a) The consequences of atmospheric warming for society need to be assessed in relation to scenarios of economic and demographic changes, which imply a growing occupation of the coastal zones;

(b) the potential impacts should be evaluated in the context of the integrated planning and management of coastal regions.

<u>Implications of expected climatic changes for the Syrian coast</u> - agenda item 5

Project outline - Agenda Item 5.1.

Basic information on the Syrian coast was provided by Mr Y. Awaidah (Annex V to this report). Mr S. Nasri from the General Organization of Remote Sensing and member of the GIS working team on the Integrate Planning of the Syrian coast, presented four maps of the Syrian coast containing information on land-use, urban settlements and population, industrial activities, forests, specially protected areas, etc.

Dr L. Jeftic gave a detailed presentation of the objectives, assumptions and outputs of the project and they were adopted as presented in the Annex VI to this report. In his presentation, he emphasized that the study on implications of climatic change on the Syrian coast is integral part of the complex Coastal Areas Management Programme (CAMP) on the Syrian coastal region which is being developed and implemented by Syrian experts with the assistance of all components of the Mediterranean Action Plan. He also presented the proposed outline of the final report, which was adopted as presented in Annex VII to this report.

General Workplan and timetable - Agenda Item 5.2.

The proposed general workplan and timetable for the project as prepared by the secretariat was discussed and adopted as appearing in Annex VIII to this report. It was agreed that the Task Team will make all efforts to speed up the preparation of the report with the aim that the presentation of the report to the national and local authorities be done by June of 1992 instead of October 1992.

Detailed workplan for each Task Team member - Agenda Item 5.3.

Tasks and workplan for each Task Team member were briefly discussed and the lead authors for individual sections of the report were identified (Annex VII). Details of the approaches to be used during the study were agreed upon during individual discussions with each author. These would include, where possible, appropriate cost-benefit analyses for alternative response options and an integrated approach to impact assessment and sectorial evaluations.

Adoption of the report - Agenda Item 6

The draft report, including its substantive annexes, was considered and adopted by the meeting, as it appears in this document.

Closure of the meeting - Agenda Item 7

In his closing remarks, Dr L. Jeftic expressed satisfaction for the results of the meeting and the constructive spirit in which it was conducted. He also thanked the participants, Chairman and Rapporteur, the Government of Syrian Arab Republic and the staff of the Ministry of State for Environmental Affairs for technical and logistic assistance and their warm hospitality.

An exchange of courtesies followed after which the Chairman closed the meeting on 24th November 1991.

ANNEX I

ADDRESS BY DR NAFI MAHMUD AL-SHALABEI DEPUTY DIRECTOR OF THE METEOROLOGICAL DEPARTMENT, SYRIAN ARAB REPUBLIC

Mr Abdul Hameed El Munajed, Minister of State for Environment, Dr L. Jeftic, Senior Marine Scientist, Dr Giuliano Sestini, Consultant, Mr Bassam Mohmandar, Director General of the Meteorological Department, my colleagues:

I would like to extend a warm welcome to our guests. It is my pleasure to open the work of this meeting to estimate the results of the possible climatic change and its effect on the Syrian coast, within the integrated plan for the Mediterranean Sea. This change is considered to be a serious probability so the decision-makers must be aware of the consequences of this change on water resource management activities, agricultural land use, structural design and coast engineering projects.

The scientists have estimated that, if the present trend continues, the combined concentration of CO_2 and other greenhouse gases in the atmosphere would be equivalent to the doubling of the CO_2 of pre-industrial level, possibly as early as the 2030. Current modelling studies and experiments show a rise in globally averaged surface temperature between 1.5EC and 4.5EC. This will lead to sea level rise of 25-140 centimeters which would affect the coastal cities and agricultural areas, thus influences the rainfall regimes.

The short term objectives of the Task Team are to analyse the possible impact of expected climatic changes on the Syrian coast and marine ecological system as well as the socio-economic structures and activities. This will assist the Government in the identification and implementation of suitable policy options and response measures which may mitigate the negative consequences of this impact.

I would like to express my gratitude to the United Nations Environment Programme for this study and for financial support.

The Government of Syria is really concerned about the environment, so the results of our work will be taken into consideration in the future planning and studies.

I am convinced that our work together will produce excellent results.

Once again, I welcome you in Damascus and wish you a happy stay.

Thank you.

ANNEX II

LIST OF PARTICIPANTS AND TASK TEAM MEMBERS

CORE MEMBERS OF THE TASK TEAM

Mr Imad Al-Deen Khalil
Meteorological Department
Mazzeh Jabal
P.O. Box 4211
Damascus
Syrian Arab Republic
Tel: 963 11 249552, 249554
Tlx: 413204

Mr Fouad Al-Ek
Ministry of State for Environmental Affairs
Tolyani Street
Damascus
Syrian Arab Republic
Tel: 963 11 215426, 330510
Tlx: 412686 ENV SY

Dr Nafi Mahmud Al-Shalabei
Deputy Director
Meteorological Department
Mazzeh Jabal
P.O. Box 4211
Damascus
Syrian Arab Republic
Tel: 963 11 249552, 249554
Direct Tel: 963 11 249984
Tlx: 413204

Mr Yahya Awaidah
Ministry of State for Environmental Affairs
Tolyani Street
Damascus
Syrian Arab Republic
Tel: 963 11 215426, 330510
Tlx: 412686 ENV SY

Mr Mohammad Eido
Meteorological Department
Mazzeh Jabal
P.O. Box 4211
Damascus
Syrian Arab Republic
Tel: 963 11 249552, 249554
Tlx: 413204

Ms Shagaf Nahawi
Ministry of State for Environmental Affairs
Tolyani Street
Damascus
Syrian Arab Republic
Tel: 963 11 215426, 330510
Tlx: 412686 ENV SY

Ms Rania Nseir
Ministry of State for Environmental Affairs
Tolyani Street
Damascus
Syrian Arab Republic

Tel: 963 11 215426, 330510
Tlx: 412686 ENV SY

EXTERNAL MEMBERS OF THE TASK TEAM

Dr L. Jeftic
Senior Marine Scientist
Co-ordinating Unit for the Mediterranean
Action Plan
48 Vassileos Konstantinou
11635 Athens
Greece

Tel: 30 1 7244536/9, 7218246
Fax: 30 1 7291160
Tlx: 222564, 222611 MEDU GR

Dr Giuliano Sestini
Applied Earth Sciences Consultant
125 Viale di Mille
50131 Firenze
Italy

Tel: 39 55 588839
Fax: 39 55 2478591

ANNEX III

AGENDA

1. Opening of the meeting

2. Election of officers

3. Adoption of the agenda

4. Overview of greenhouse effect and its implications

5. Implications of expected climatic changes for the Syrian Coast

   5.1. Project outline
   5.2. General workplan and timetable
   5.3. Detailed workplan for each Task Team member

6. Adoption of the report

7. Closure of the meeting

ANNEX IV

OVERVIEW OF THE GREENHOUSE EFFECT AND ITS IMPLICATIONS

This Annex contains copies of transparencies reviewing:

- the basics of the greenhouse effect;
- past and predicted changes in temperatures and sea level;
- work of the Climatic Research Unit (CRU) of the East Anglia University, UK, on the development of Mediterranean scenarios (with sub-regional specifics) of future changes in temperature and precipitation;
- possible implications of climatic changes;
- activities organised by the Oceans and Coastal Areas Programme Activity Centre (OCA/PAC) of UNEP and MAP concerned with studying the implications of climatic changes in coastal areas;
- work carried out by the Mediterranean Task Team on climatic changes and its results;

Since these transparencies were prepared for oral presentations only, by using various sources of open and grey literature, in a number of transparencies the source of information was not cited.

ANNEX VI

OBJECTIVES, ASSUMPTIONS AND OUTPUTS OF THE STUDY

OBJECTIVES

- To identify and assess possible implications of expected climatic changes on the terrestrial, aquatic and marine ecosystems, populations, land-use and sea-use practices and other human activities;

- To determine areas or systems which appear to be most vulnerable to the expected climatic changes;

- To identify options and give recommendations for planning and management of coastal areas and resources, as well as for planning and design of major infrastructure and other systems.

ASSUMPTIONS

For the specific purpose of the study a sea level rise of 24-52 cm and a temperature elevation of 1.5 to 3 degrees Centigrade by the year 2050 will be used, taking into account:

- The best available information, knowledge and insights into the problems relevant to Syrian coast including major projects, planned or under consideration;

- The assumptions accepted at the Second World Climate Conference (1990), i.e. an increased temperature of 2-5E C and sea level rise of 65 +/- 35 cm by the end of the 21st Century.

- The IPCC statement concerning potential changes to the climate of Southern Europe (35E-50EN 10EW - 45EE) that: " warming would be about 2EC in winter and would vary from 2E to 3E C in summer. There is some indication of increased precipitation in winter but summer precipitation decreases by 5 to 15%, and summer soil moisture by 15 to 25%.";

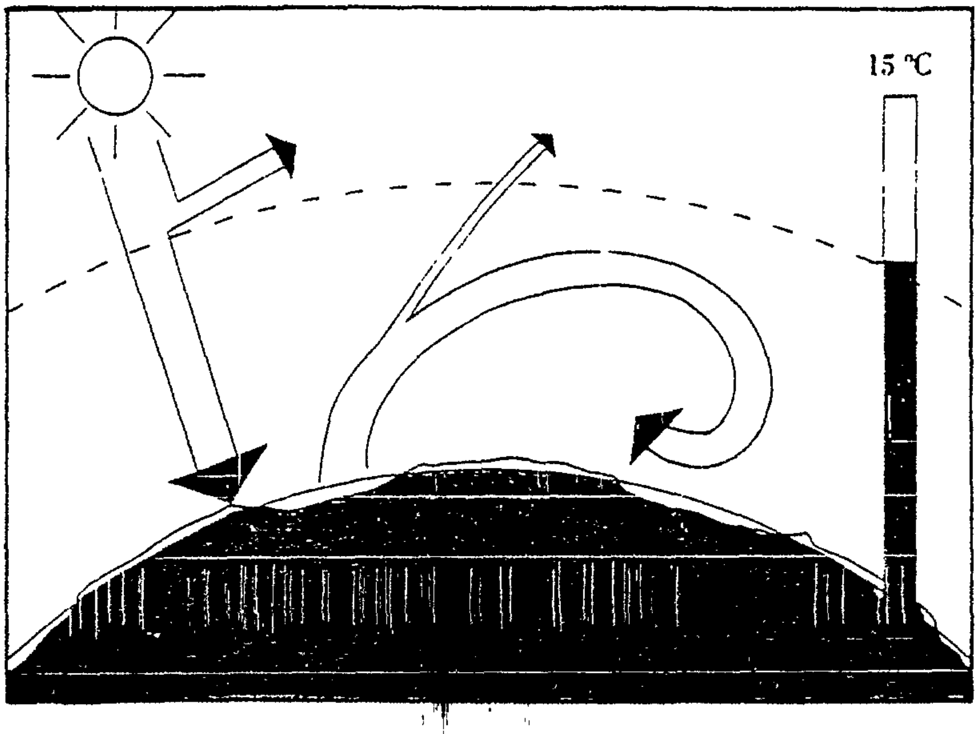
- The results of the University of East Anglia's Scenario analysis for the Mediterranean Basin with sub-regionally specific scenarios.

OUTPUTS

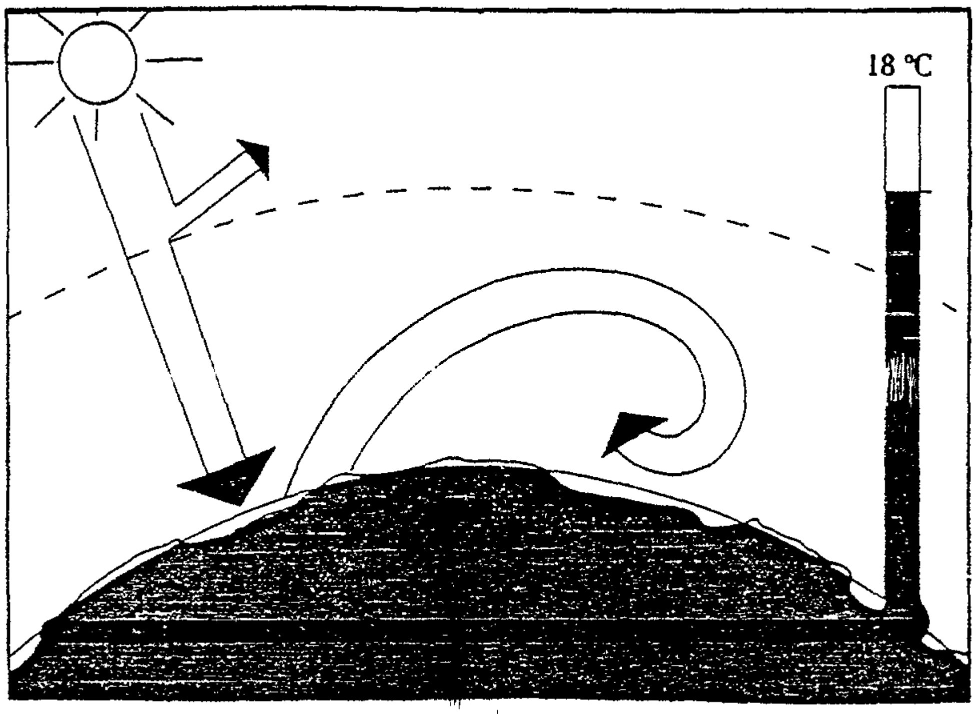
- Identified impacts of predicted climatic changes and sea level rise;

- An assessment of the magnitude and implications of the identified impacts;

- Proposed policies and measures to mitigate or avoid the predicted consequences of expected climatic change.

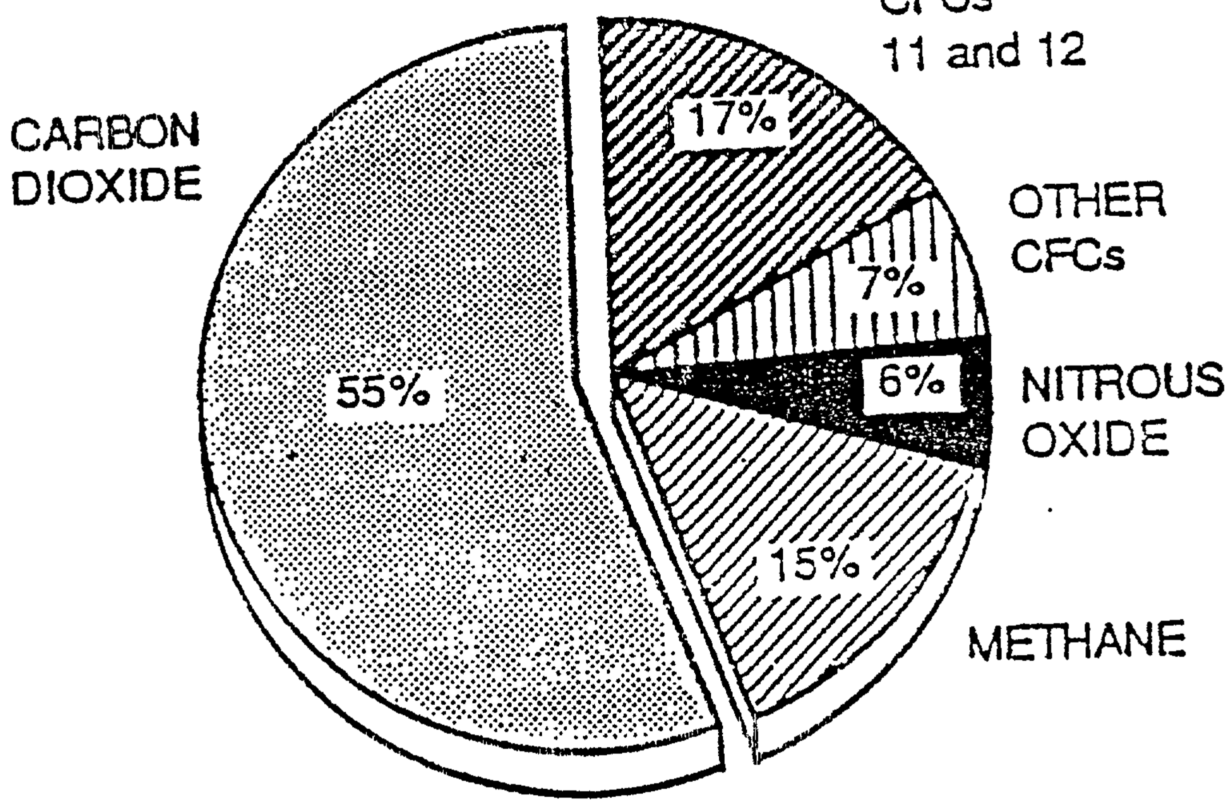


GREENHOUSE EFFECT AT PRESENT



GREENHOUSE EFFECT IN THE FUTURE

(From Maîtriser le réchauffement de la planète, Agence pour la Qualité de L'air, Paris)



CONTRIBUTION TO GREENHOUSE EFFECT BY VARIOUS GREENHOUSE GASES

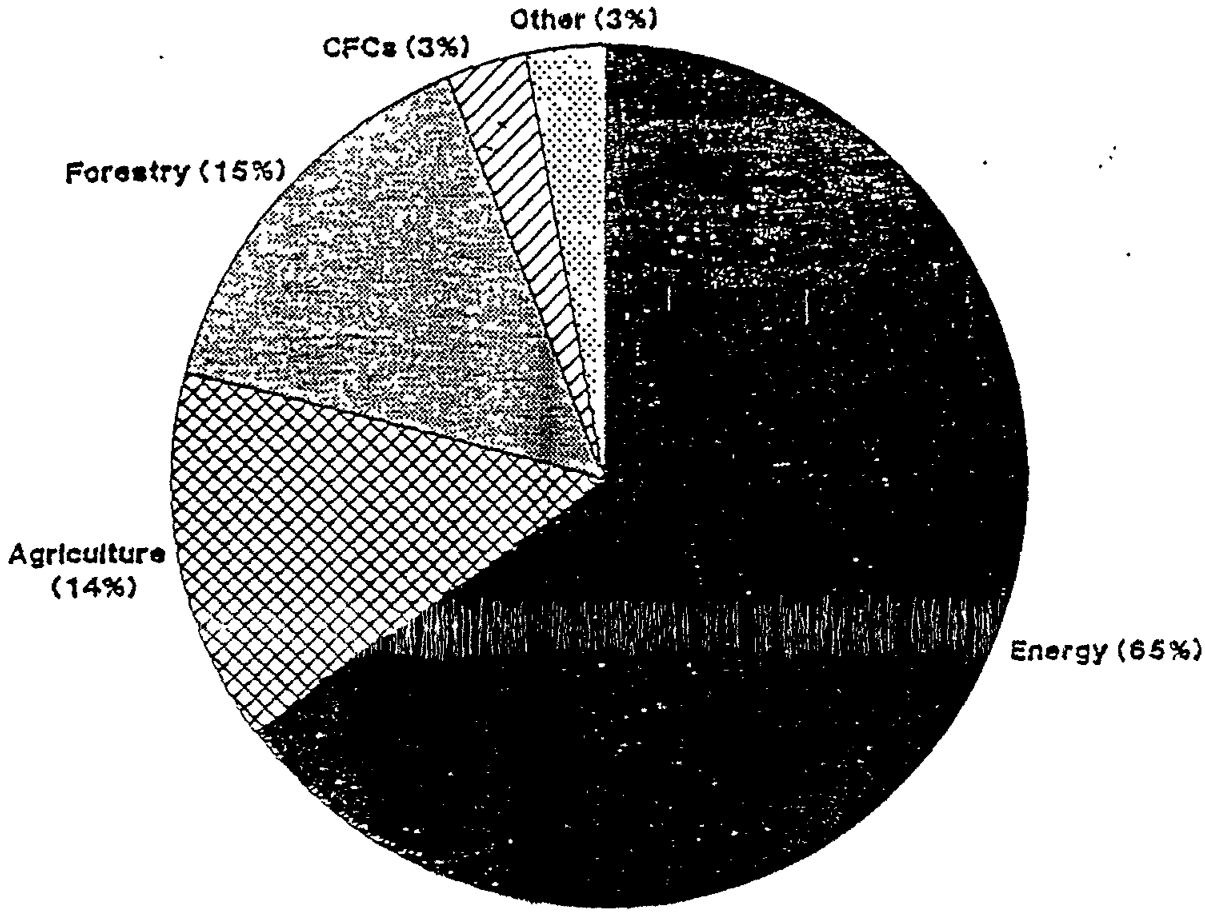
SUMMARY OF KEY GREENHOUSE GASES AFFECTED BY HUMAN ACTIVITIES

	Carbon Dioxide	Methane	CFC-11	CFC-12	Nitrous Oxide
Atmospheric concentration	ppmv	ppmv	pptv	pptv	ppbv
Pre-industrial (1750-1800)	280	0.8	0	0	288
Present day (1990)	353	1.72	280	484	310
Current rate of change per year	1.8 (0.5%)	0.015 (0.9%)	9.5 (4%)	17 (4%)	0.8 (0.25%)
Atmospheric lifetime (years)	(50-200)†	10	65	130	150

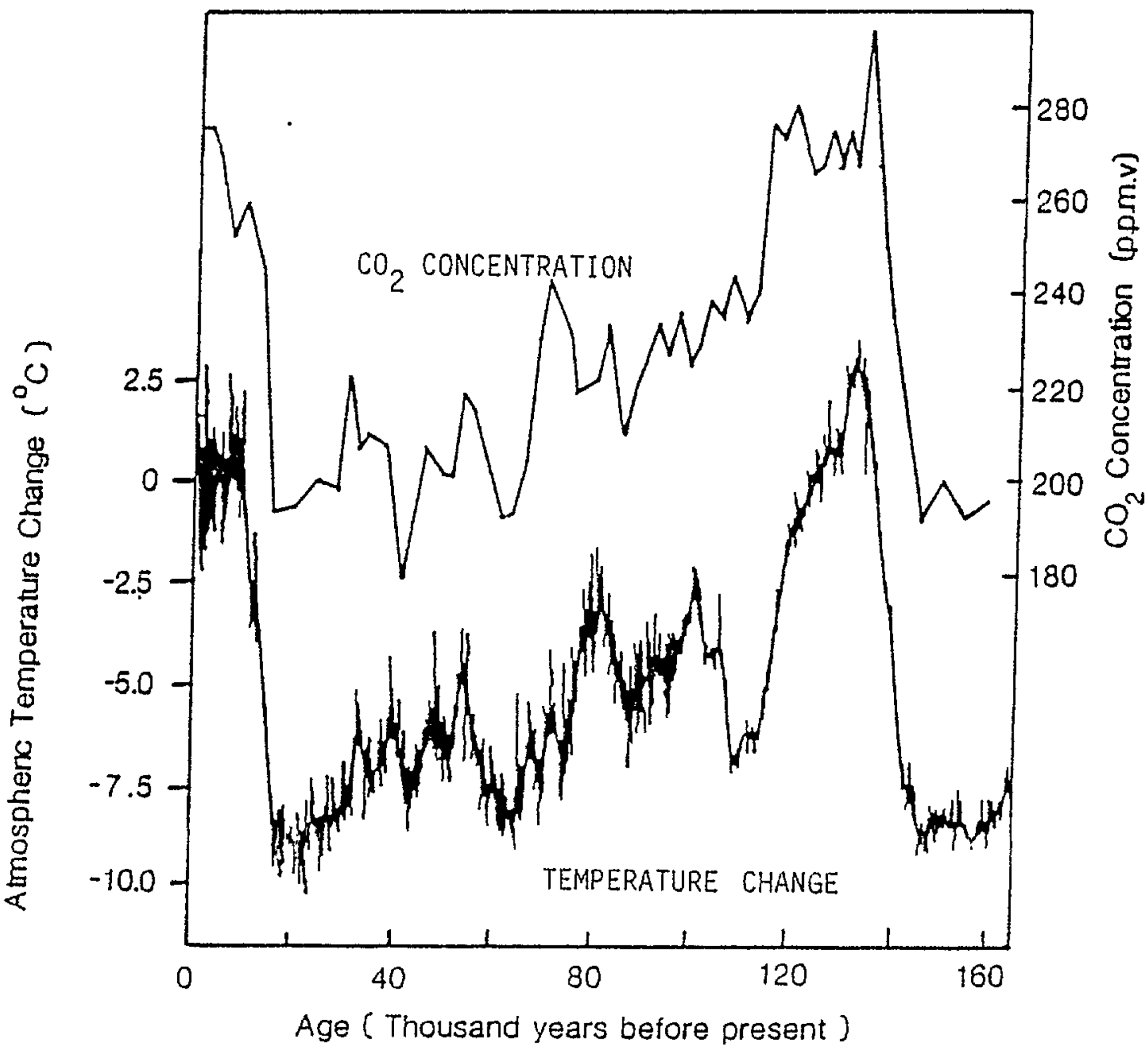
ppmv = parts per million by volume;
ppbv = parts per billion (thousand million) by volume;
pptv = parts per trillion (million million) by volume.
† The way in which CO_2 is absorbed by the oceans and biosphere is not simple and a single value cannot be given; refer to the main report for further discussion.

CONTRIBUTION TO RADIATIVE FORCING BY SECTOR: 2025 EMISSIONS

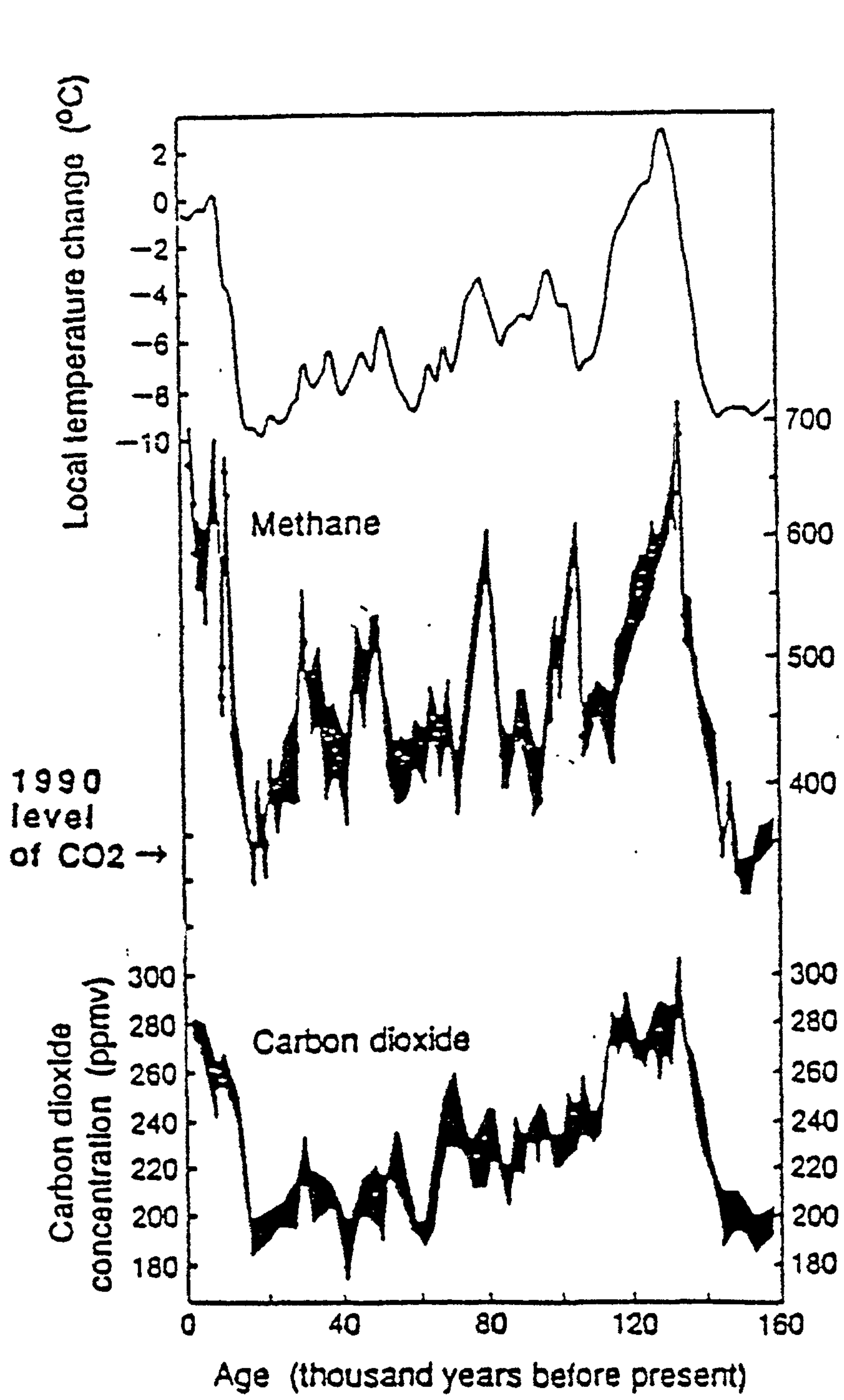
(Based on Global Warming Potentials For 100-Year Time Horizon)

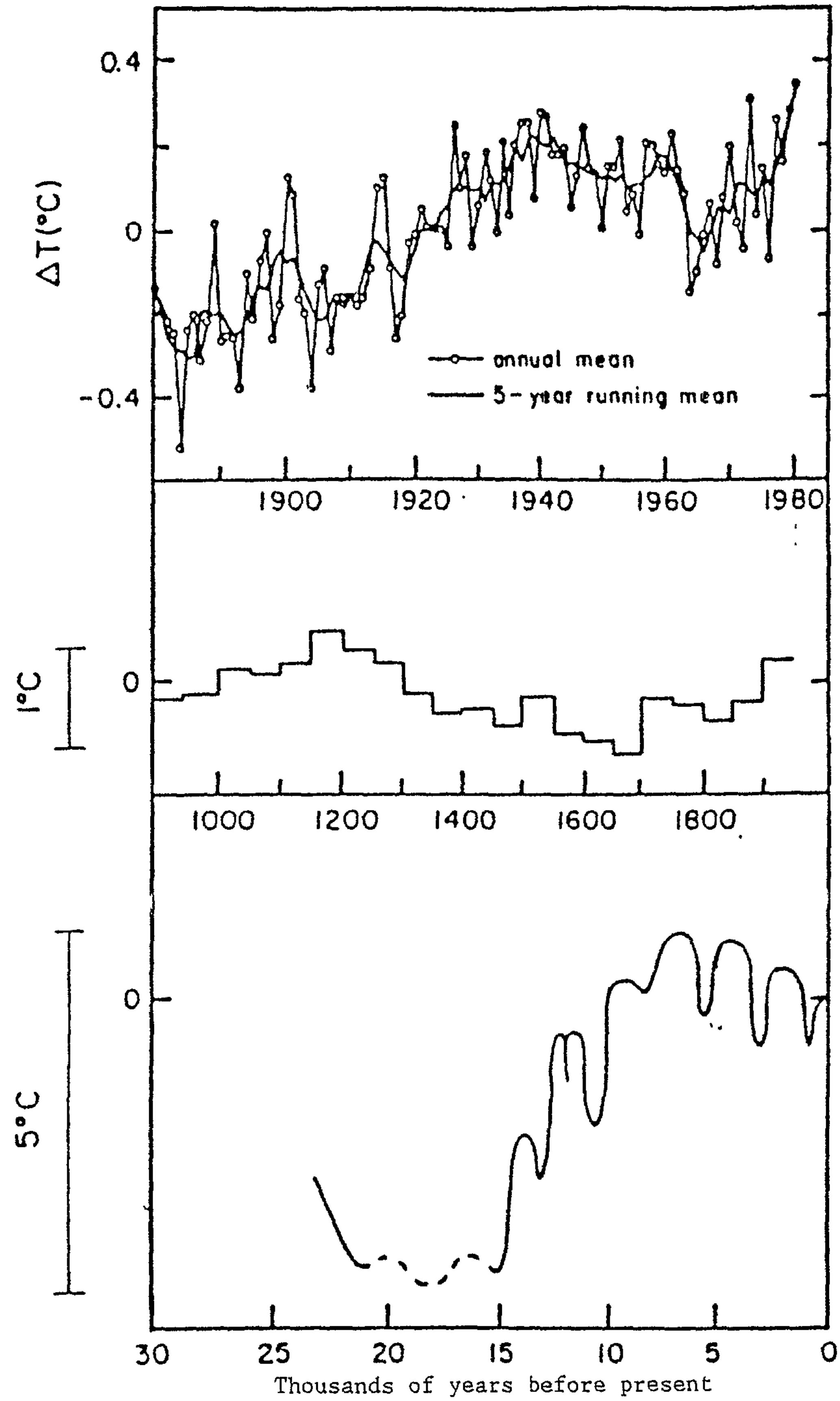


VOSTOK ICE CORE

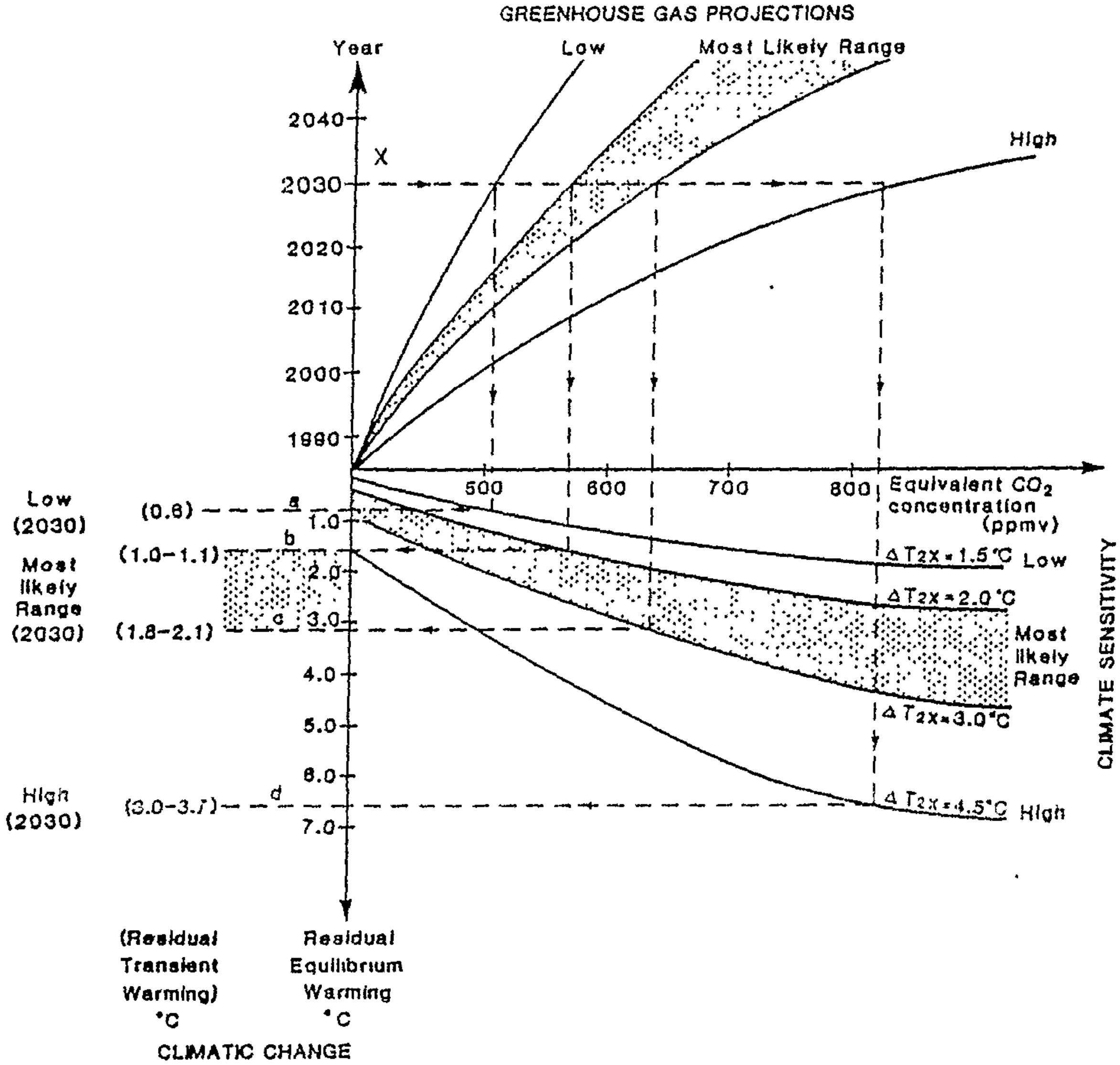


Source: Barnola (1987).


Local temperature change (°C)
2
0
−2
−4
−6
−8
−10
Methane
700
600
500
400
Methane concentration (ppmv)
1990 level of CO2 →
Carbon dioxide
Carbon dioxide concentration (ppmv)
300
280
260
240
220
200
180
0
40
80
120
160
Age (thousand years before present)


0.4
0
-0.4
ΔT(°C)
annual mean
5-year running mean
1900
1920
1940
1960
1980
1°C
0
1000
1200
1400
1600
1800
5°C
0
30
25
20
15
10
5
0
Thousands of years before present

Estimates of the Climate Sensitivity

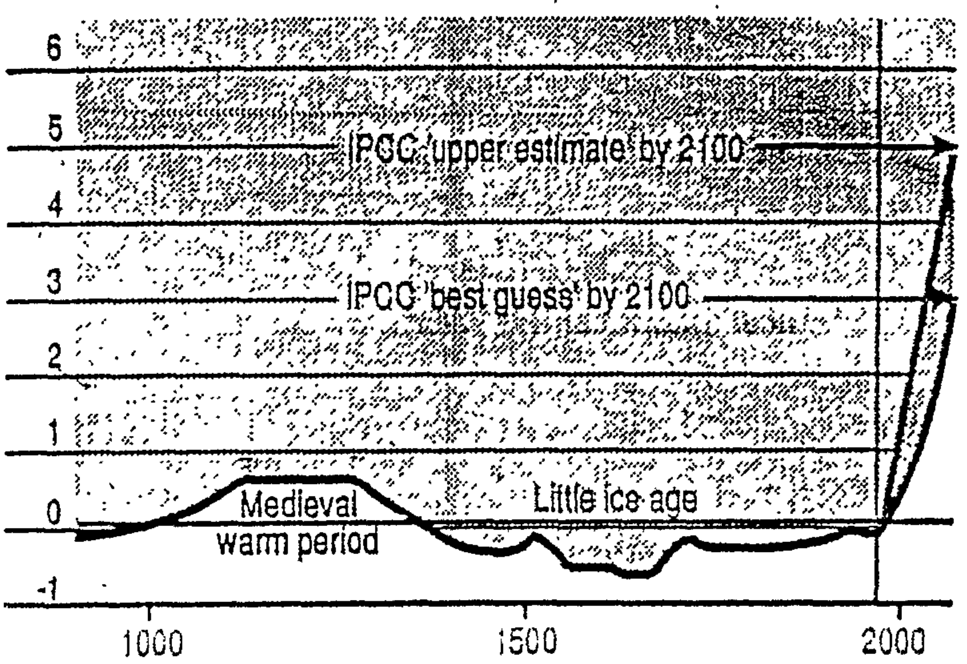


= 1.5 - 4.5°C warmer

for a CO_2 doubling

UN prediction of climate changes

Temperature change (°C) from today's average



ESTIMATES FOR CHANGES BY 2030

(IPCC Business-as-Usual scenario; changes from **pre-industrial**)

The numbers given are based on high resolution models, scaled to be consistent with our best estimate of global mean warming of 1.8° by 2030. For values consistent with other estimates of global temperature rise, the numbers below should be reduced by 30% for the low estimate or increased by 50% for the high estimate. Precipitation estimates are also scaled in a similar way.

Confidence in these regional estimates is low

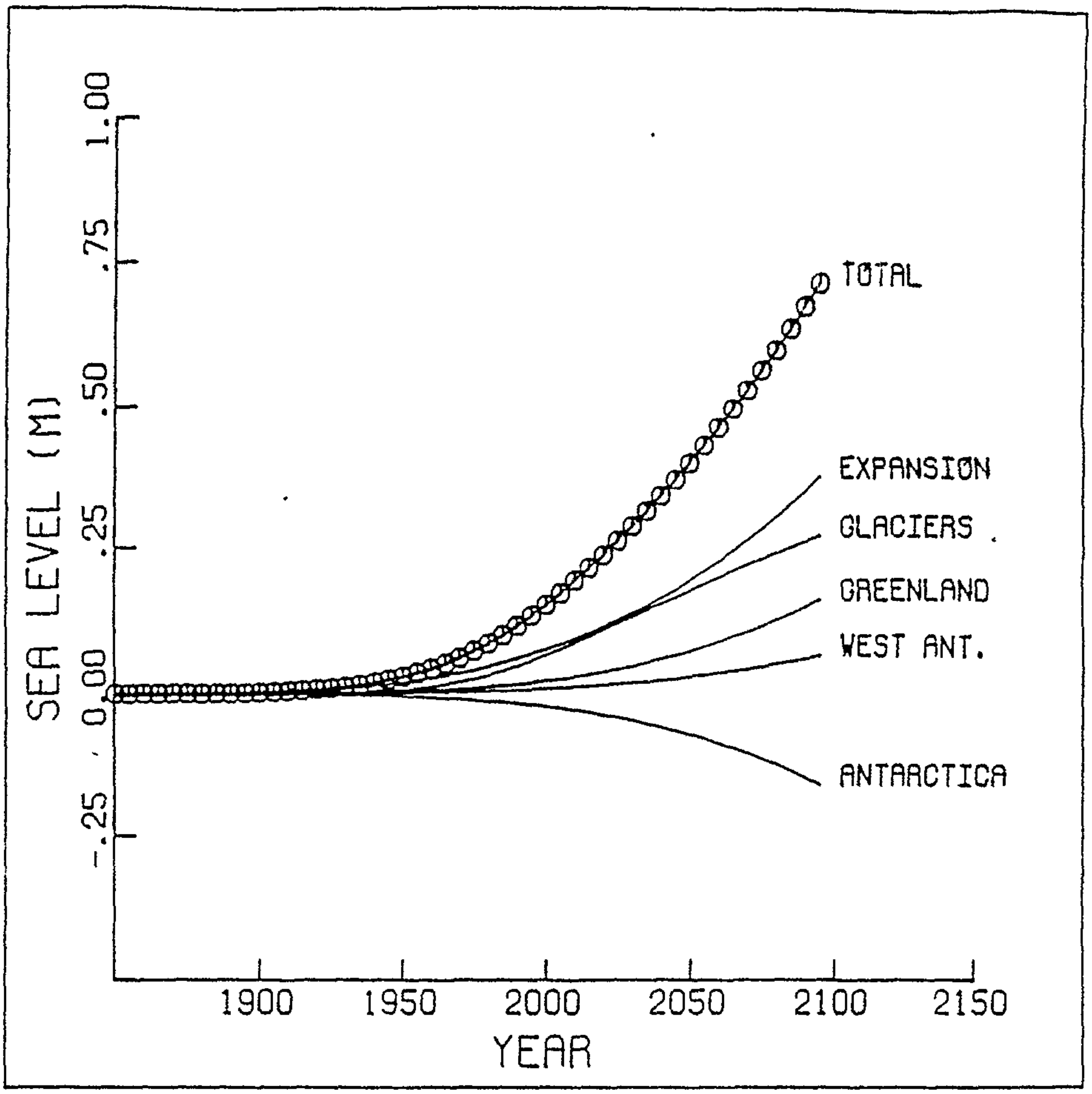
Central North America (35°-50°N 85°-105°W)
The warming varies from 2 to 4°C in winter and 2 to 3°C in summer. Precipitation increases range from 9 to 15% in winter whereas there are decreases of 5 to 10% in summer. Soil moisture decreases in summer by 15 to 20%.

Southern Asia (5°-30°N 70°-105°E)
The warming varies from 1 to 2°C throughout the year. Precipitation changes little in winter and generally increases throughout the region by 5 to 15% in summer. Summer soil moisture increases by 5 to 10%.

Sahel (10°-20°N 20°W-40°E)
The warming ranges from 1 to 3°C. Area mean precipitation increases and area mean soil moisture decreases marginally in summer. However, throughout the region, there are areas of both increase and decrease in both parameters throughout the region.

Southern Europe (35°-50°N 10°W-45°E)
The warming is about 2°C in winter and varies from 2 to 3°C in summer. There is some indication of increased precipitation in winter, but summer precipitation decreases by 5 to 15%, and summer soil moisture by 15 to 25%.

Australia (12°-45°S 110°-115°E)
The warming ranges from 1 to 2°C in summer and is about 2°C in winter. Summer precipitation increases by around 10%, but the models do not produce consistent estimates of the changes in soil moisture. The area averages hide large variations at the sub-continental level.


SEA LEVEL (M)
1.00
.75
.50
.25
0.00
-.25
TOTAL
EXPANSION
GLACIERS
GREENLAND
WEST ANT.
ANTARCTICA
1900
1950
2000
2050
2100
2150
YEAR

PROJECTED GLOBAL MEAN SEA LEVEL RISE

1985-2030 (CMS)

(from Raper et al., 1988)

GLOBAL MEAN SEA LEVEL RISE RESULTING FROM	LOW	BEST GUESS	HIGH
THERMAL EXPANSION	4	8 to 14	17
ALPINE GLACIERS	2	5 to 13	21
GREENLAND	1	1 to 2	3
ANTARCTICA*	-2	-3 to -1	3
	5	11 to 28	44

* Values chosen from analysis to maximise range

SCENARIA OF REGIONAL CHANGES IN CLIMATE IN THE MEDITERRANEAN

Approach taken by
Climate Research Unit, University of East Anglia

Statistical link between the large-scale quid-point GCM predictions and the small-scale detail of regional climates was achieved through the following approach:

1. **The approach is based on regression analysis techniques, whereby small-scale climate changes are related to regional-scale changes as predictors.**

2. **The basic assumption of the method is that GCM-derived, grid-point values for temperature and precipitation, are equivalent to regionally-averaged observations of the same variable.**

3. **Using observed climate data, a set of regionally-averaged time series is built up for each of the climate parameters which are to be considered as predictor variables.**

4. **Regression equations are constructed using present-day instrumental climate data. These relate variations in regionally-averaged climate variables (the predictors) to variations in single-station values of the variables to be predicted.**

5. **The regression equations are used to derive point values for the relevant climate variables in a high greenhouse gas world. The predictor variables used to construct the regression equations are replaced by GCM estimates of the perturbation due to a doubling of CO_2.**

6. **The climate values derived from the regression equations for a number of sites in a region are then contoured to produce a map of the climate perturbation expected for that region in a high greenhouse gas world.**

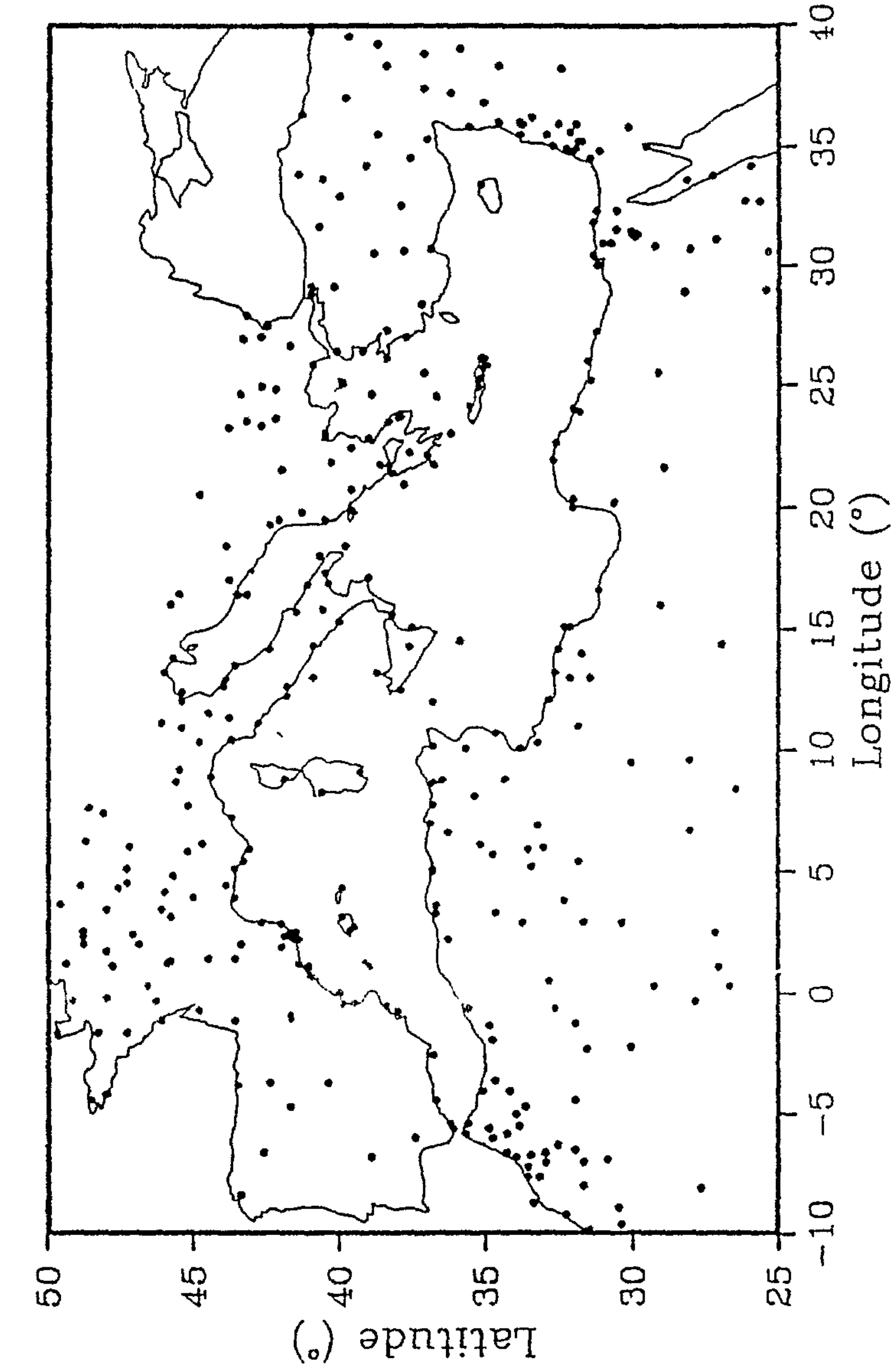
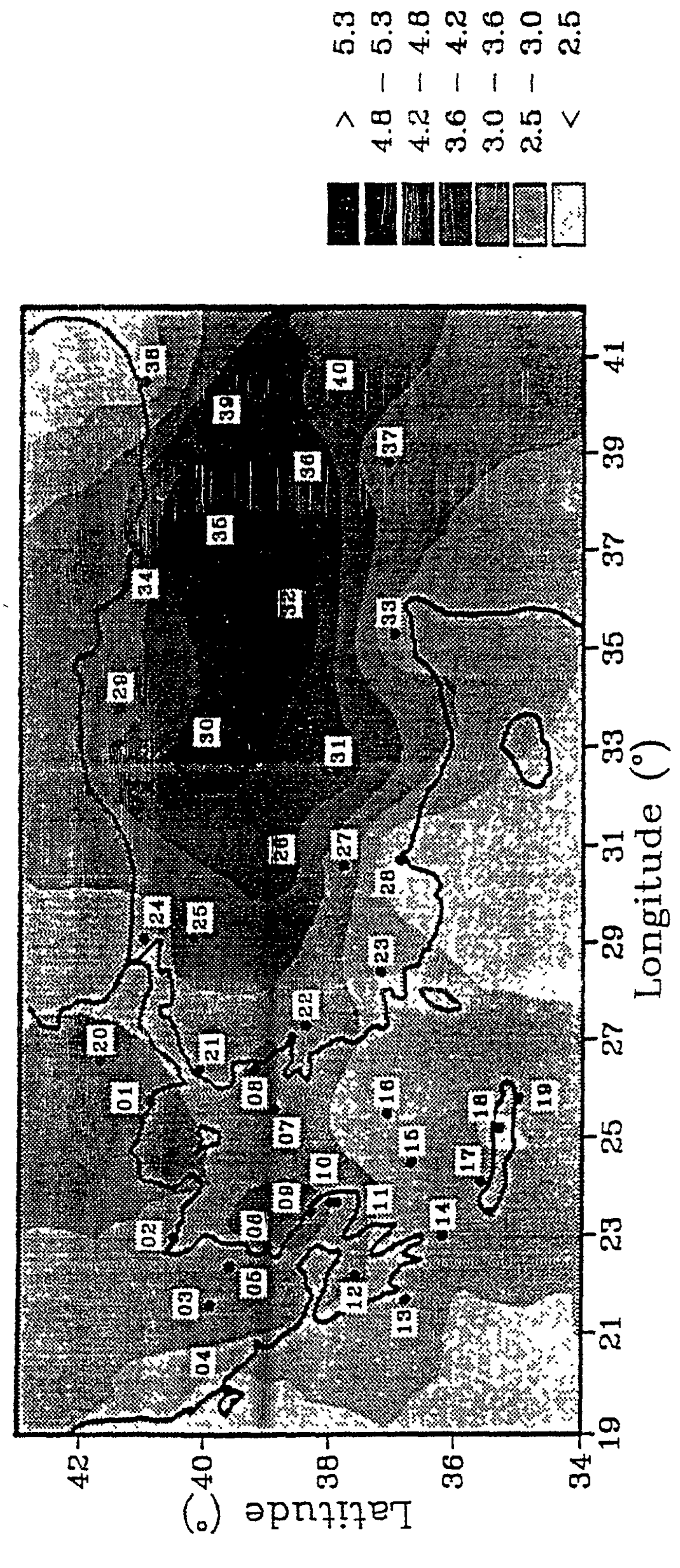
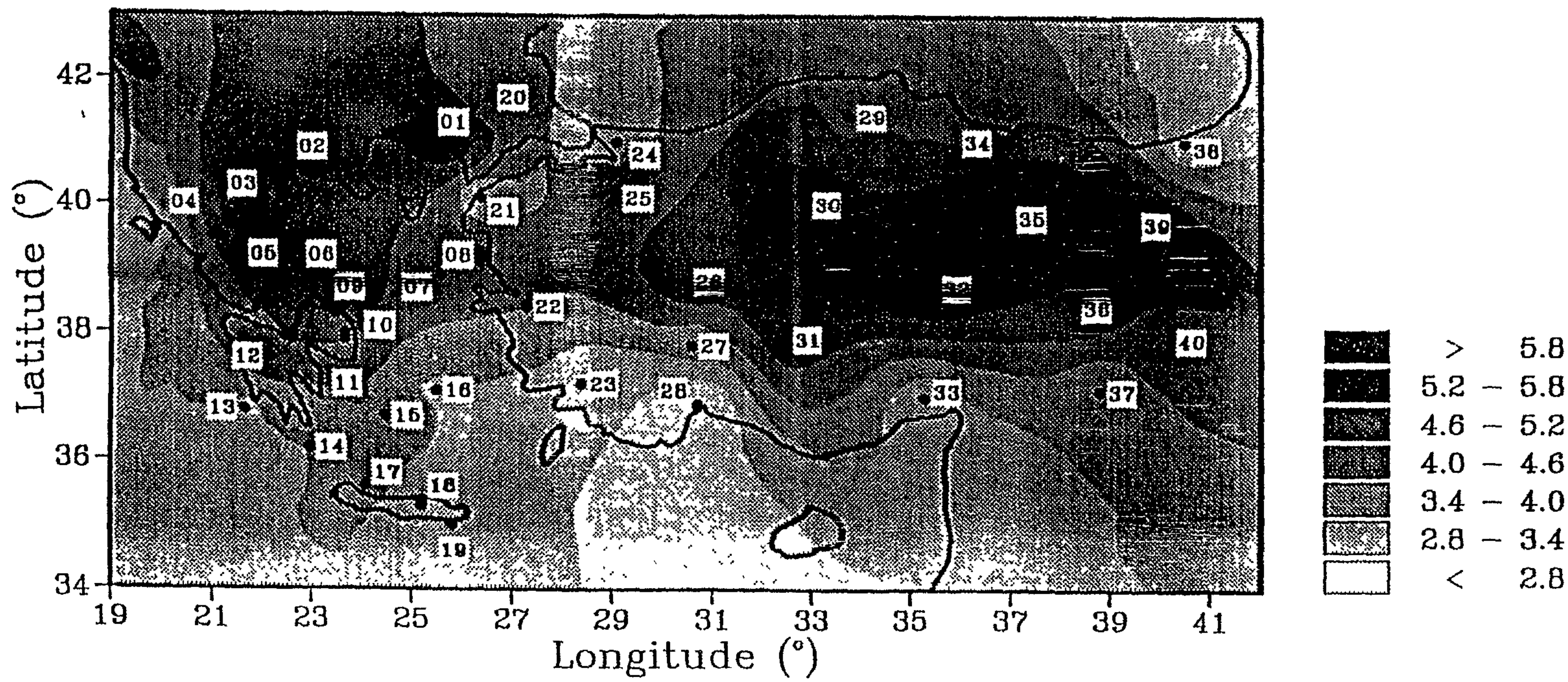


Fig. 1. Mediterranean stations for the UNEP project



2xCO$_2$ winter temperature increase (°C) in Turkey and Greece for OSU

2xCO_2 winter temperature increase (°C) in Turkey and Greece for CCM



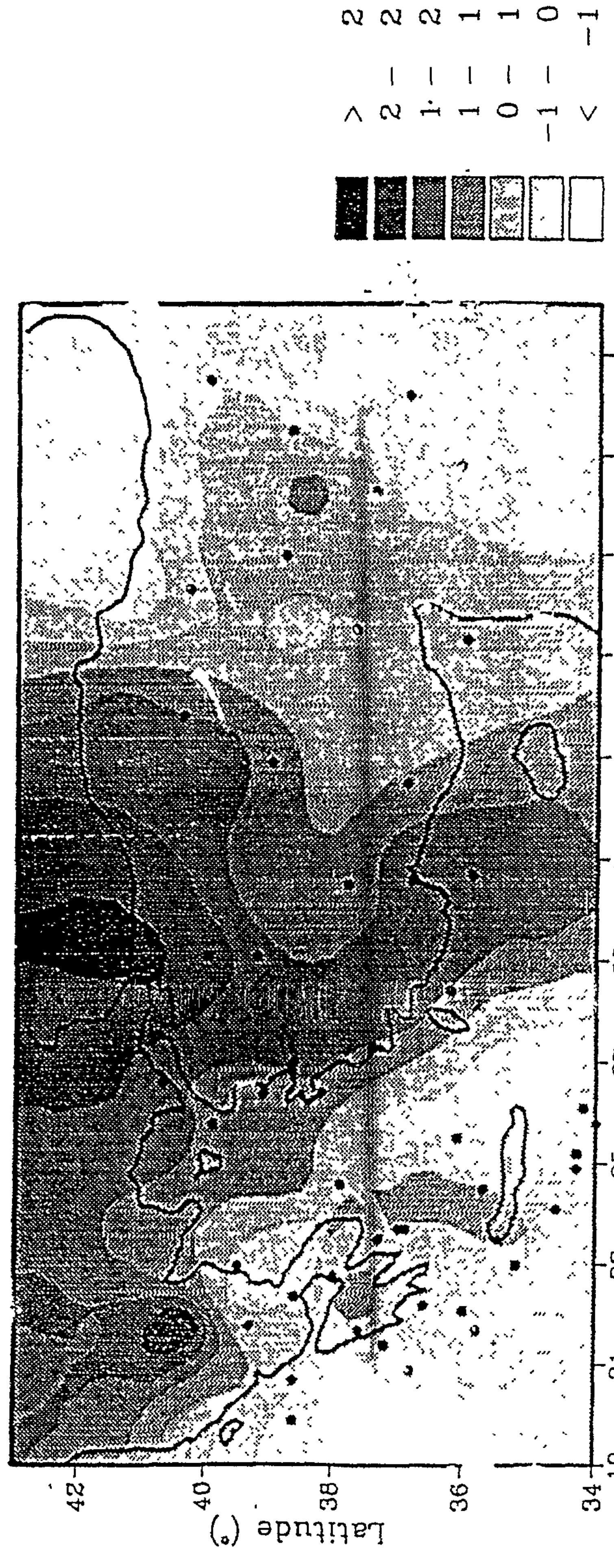


Fig. 15. Spring season 2xCO_2 CCM precipitation perturbation (mm/month) for Greece and Turkey.

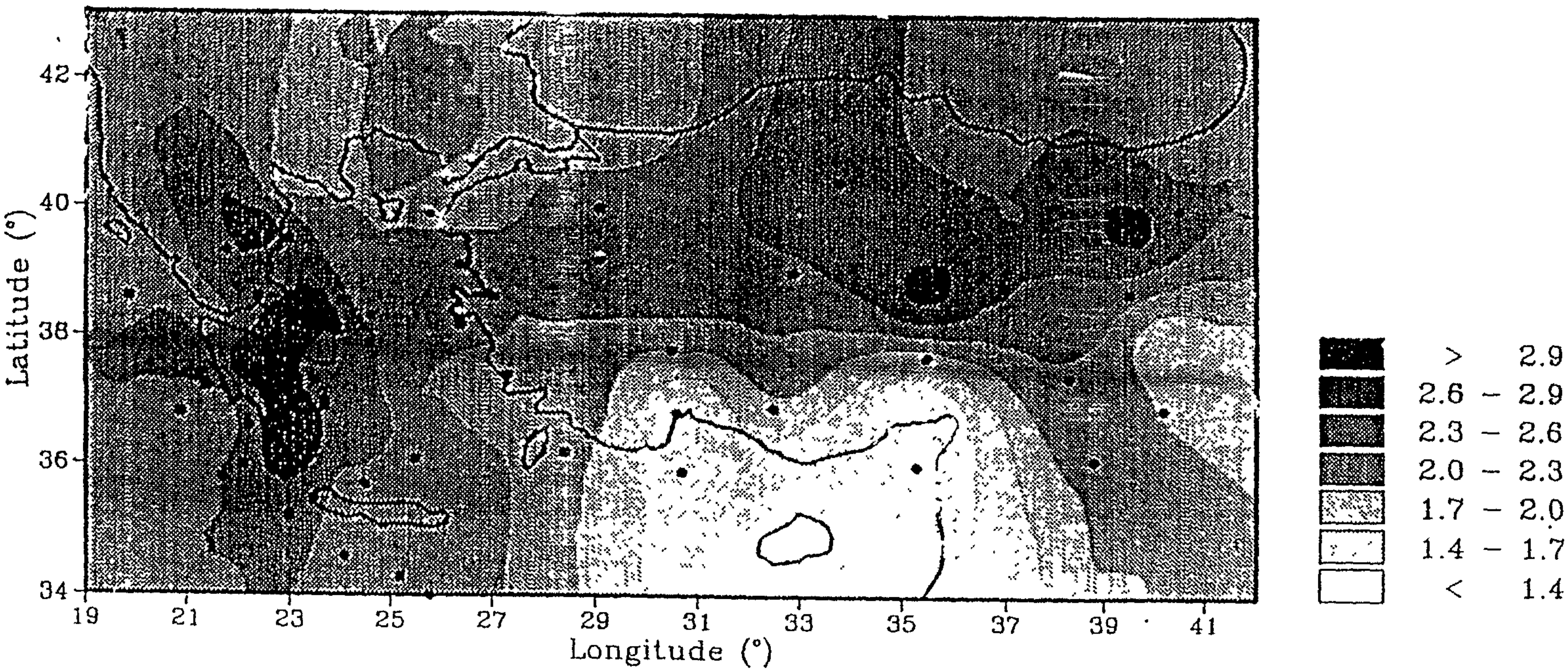
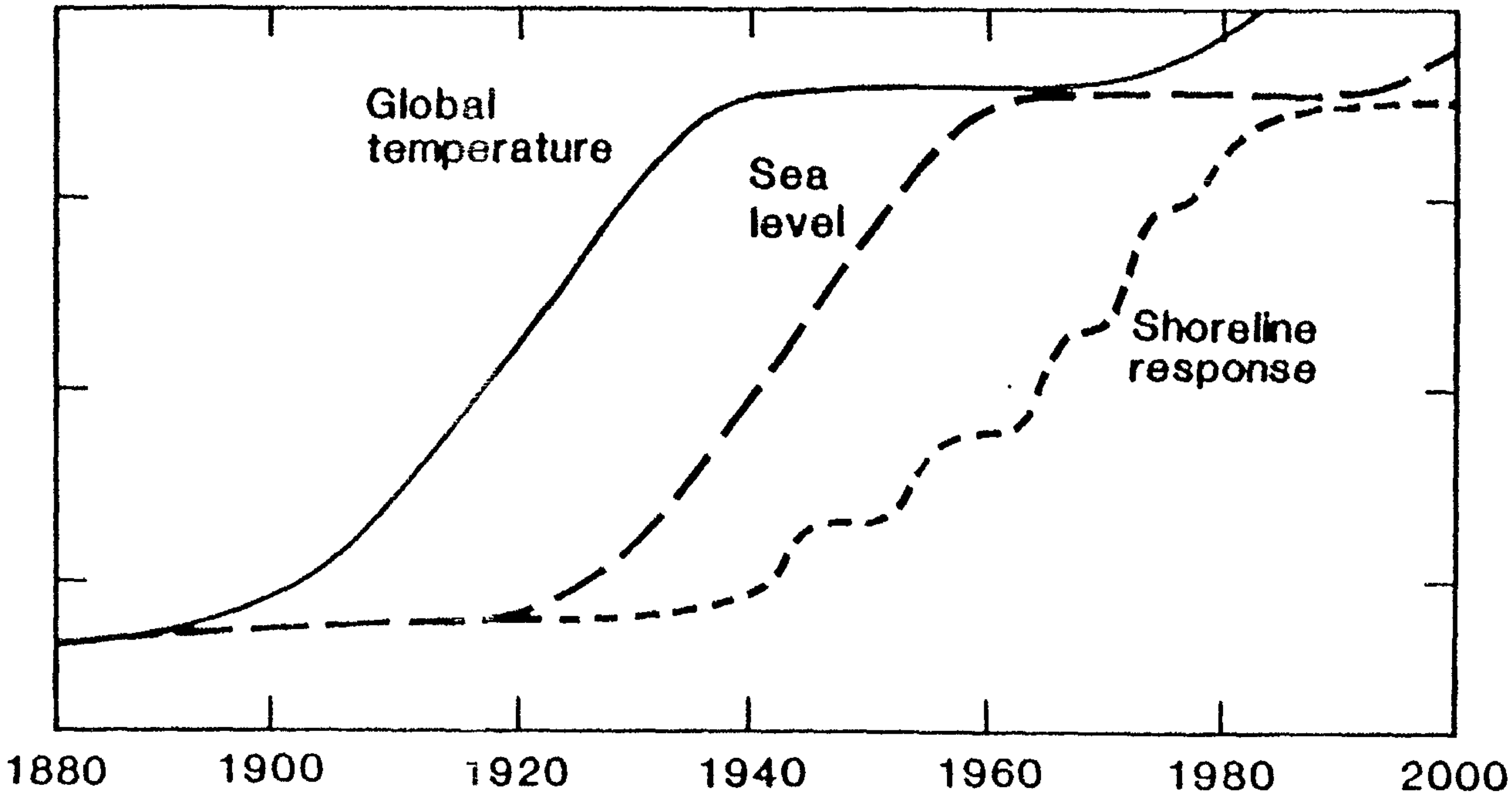
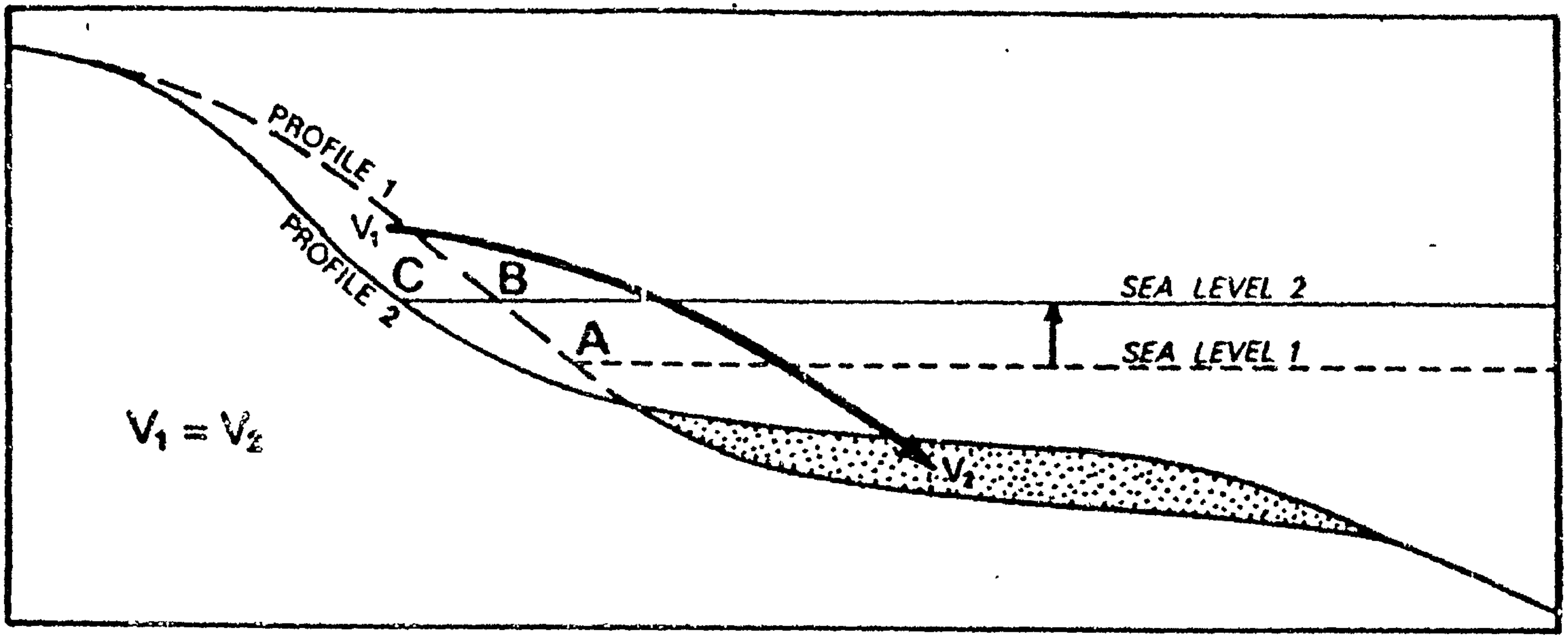


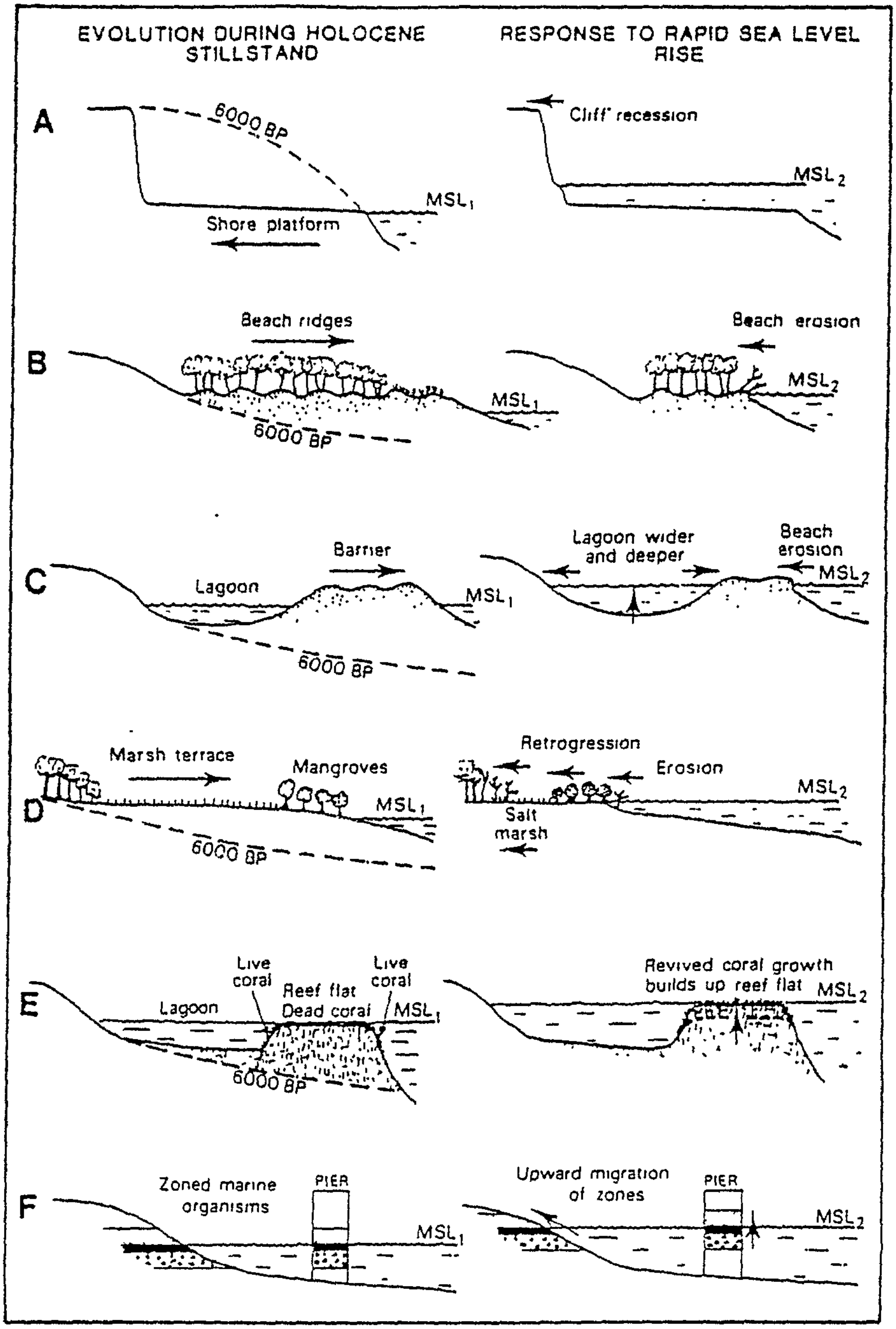
Fig 12. Summer season $2xCO_2$ CCM temperature perturbation (°C) for Greece and Turkey.



Schematic representation of the relationships between global warming(^{o}C), sea-level rise (m) and shoreline response (m). The latter is a step function associated with major storms. (From G.I. Pearman (Ed.), Greenhouse, Planning for climate change, CSIRO, 1989).



Brunn model of response of an equilibrium beach to a sea-level rise. The coastline retreats from A to C as the pre-existing transverse profile is restored by seaward transference of beach sediment. (From G.I. Pearman (Ed.), Greenhouse, Planning for climate change, CSIRO, 1989).



Response of coastal features to a sea-level rise. (From G.I. Pearman (Ed.), Greenhouse, Planning for climate change, CSIRO, 1989).

IMPACTS RESULTING FROM CLIMATIC CHANGES

FIRST ORDER IMPACTS

INCREASED AIR TEMPERATURE

INCREASED SEA SURFACE TEMPERATURE

CHANGES TO LOCAL CLIMATES AND WEATHER:

- CHANGED PATTERNS OF RAINFALL IN TIME AND SPACE;
- CHANGED PATTERNS OF WINDS IN TIME AND SPACE

IMPACTS RESULTING FROM CLIMATIC CHANGES

SECOND ORDER IMPACTS

CHANGES IN RELATIVE HUMIDITY

CHANGES IN RUN-OFF AND RIVER FLOW RATES

CHANGES IN SOILS

CHANGES IN LARGE SCALE COASTAL BIOME DISTRIBUTION

CHANGES IN COASTAL CURRENT AND WAVE REGIMES, AND STRATIFICATION/MIXING

CHANGES IN THE LOCATION AND/OR PERSISTENCE OF OCEANIC FRONTAL SYSTEMS

CHANGES IN SALINITY AND COASTAL WATER CHEMISTRY

CHANGES IN GEOGRAPHIC DISTRIBUTION, INTENSITY AND FREQUENCY OF STORMS

CHANGES IN PATTERNS OF COASTAL FLOODING AND OTHER EPISODIC EVENTS

CHANGES IN HUMAN COMFORT OF SPECIFIC LOCATIONS

IMPACTS RESULTING FROM CLIMATIC CHANGES

HIGHER ORDER IMPACTS

CHANGES IN RAINFALL AND TEMPERATURE WILL AFFECT RELATIVE HUMIDITY WHICH WILL ALTER EVAPO-TRANSPIRATION RATES HENCE AFFECTING:

- THE HYDROLOGICAL CYCLE AND LOCAL WATER BALANCE; WHICH WILL:
  - AFFECT VEGETATION DISTRIBUTION AND ABUNDANCE; HENCE AFFECTING:
    - ANIMAL DISTRIBUTION AND ABUNDANCE;
    - PRODUCTIVITY OF NATURAL AND AGRICULTURAL SYSTEMS;
    - SOIL DECOMPOSITION PROCESSES AND FERTILITY;
- HUMAN DRINKING WATER SUPPLIES; AND
- FRESHWATER MANAGEMENT PRACTICES;
- COASTAL WATER SALINITY AND MIXING; LEADING TO:
  - CHANGES IN COASTAL MARINE ECOSYSTEMS;
  - CHANGES TO FISHERIES PRODUCTIVITY AND MARICULTURE;

ALL OF WHICH WILL HAVE:

- SOCIAL AND ECONOMIC IMPACTS

IMPACTS RESULTING FROM SEA-LEVEL CHANGE

FIRST ORDER IMPACTS

INCREASED FREQUENCY OF FLOODING

INCREASED INLAND EXTENT OF FLOODING

REARRANGEMENT OF COASTAL UNCONSOLIDATED SEDIMENTS AND SOILS

INCREASED SOIL SALINITY IN AREAS PREVIOUSLY UNAFFECTED

CHANGED WAVE CLIMATES

ACCELERATED DUNE AND BEACH EROSION

UPWARD AND LANDWARD RETREAT OF THE BOUNDARY BETWEEN FRESHWATER AND BRACKISH WATERS

GREATER UPSTREAM INTRUSION OF SALTWATER WEDGES

CHANGES TO BANK AND WETLAND VEGETATION

CHANGES IN THE PHYSICAL LOCATION OF THE TERRESTRIAL-AQUATIC BOUNDARY

CHANGES IN COASTAL WATER CLARITY

CHANGES IN COASTAL WATER CIRCULATION PATTERNS, AND

CHANGES IN SEDIMENT SINK VOLUMES

IMPACTS RESULTING FROM SEA LEVEL CHANGE

SECOND ORDER IMPACT

CHANGES IN OFFSHORE BOTTOM PROFILES

CHANGES IN MARINE PRIMARY PRODUCTION, AND

CHANGES IN TERRESTRIAL (COASTAL) PRIMARY PRODUCTION

CHANGES IN SEDIMENT AND NUTRIENT FLUX RATES

IMPACTS RESULTING FROM SEA LEVEL CHANGE

HIGHER ORDER IMPACT

CHANGES IN BEACH PLAN FORM WILL ALTER:

- LOCAL CURRENT AND WAVE REGIMES; HENCE:
  - LOCAL PATTERNS OF EROSION AND DEPOSITION; AND
  - LOCAL DISTRIBUTION OF COASTAL SUBSTRATE TYPES; AND HENCE,
    - THE DISTRIBUTION PATTERNS OF BENTHIC ORGANISMS.
- SUSCEPTIBILITY OF THE COASTLINE TO WAVE ATTACK;
- CHANGE THE VULNERABILITY OF COASTAL AREAS TO EPISODIC FLOODING AND/OR SEASONAL OR PERMANENT INUNDATION; HENCE
  - AFFECTING CAPITAL INVESTMENT IN INFRASTRUCTURE; AND
  - SUITABILITY OF THE COASTLINE FOR HUMAN SETTLEMENT.

CHANGES IN MARINE PRIMARY PRODUCTION WILL AFFECT:

- ENERGY FLOW TO HIGHER TROPHIC LEVELS; HENCE
  - STANDING STOCKS OF HIGHER TROPHIC LEVELS; AND
  - OVERALL RATES OF SECONDARY PRODUCTION; AND ULTIMATELY
    - FINFISH AVAILABILITY FOR HUMAN CONSUMPTION.

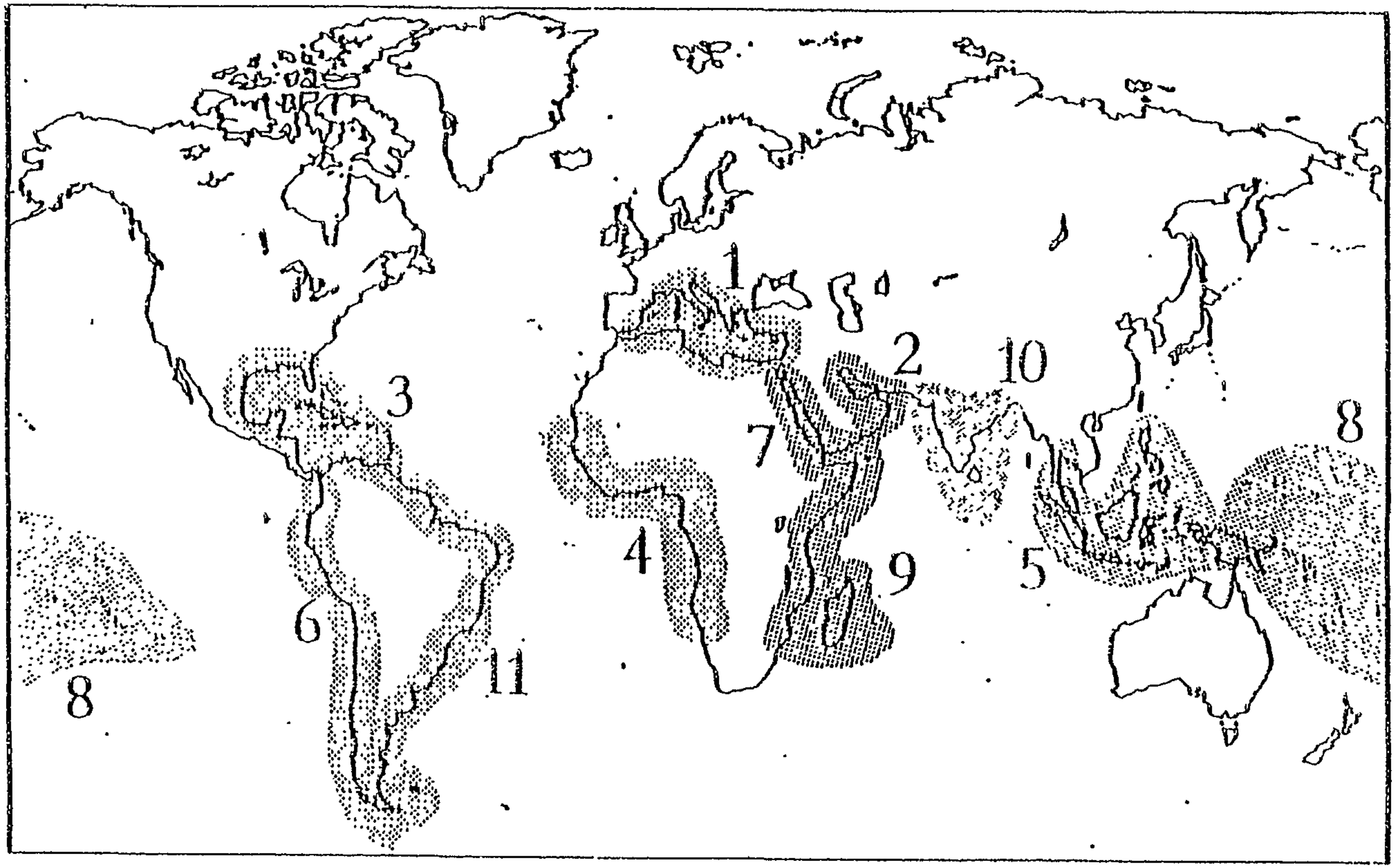
SEA LEVEL CHANGE
HIGHER ORDER IMPACT (2)

CHANGES IN COASTAL/TERRESTRIAL VEGETATION AND WETLANDS WILL:

- ALTER THE DISTRIBUTION AND ABUNDANCE OF DEPENDENT ANIMALS;
- AFFECT ECONOMIC ACTIVITIES BY AFFECTING COMMERCIALLY IMPORTANT SPECIES SUCH AS PENAEID PRAWNS AND SHRIMP;
- ALTER THE FLUX OF SEDIMENTS AND NUTRIENTS INTO THE MARINE ENVIRONMENT;
- ALTER DISTRIBUTIONS OF HUMAN DISEASE VECTORS; HENCE,
  - CHANGING THE EPIDEMIOLOGY OF VECTOR BORNE DISEASES.

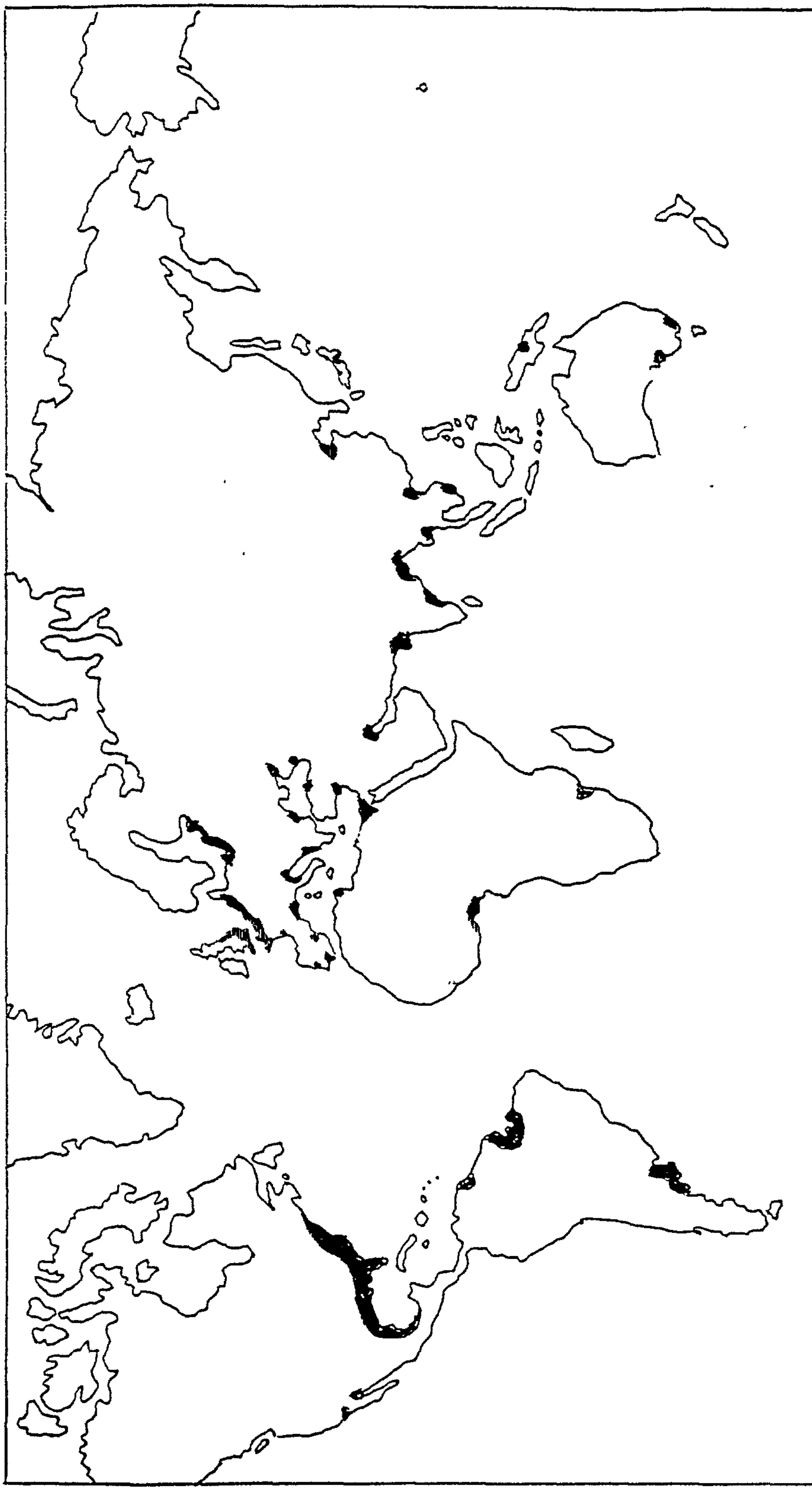
CHANGES IN NUTRIENT LEVELS IN COASTAL WATERS WILL CHANGE MARINE BASED PRIMARY PRODUCTIVITY; AND

- MAY CHANGE THE FREQUENCY OF HARMFUL ALGAL BLOOMS; WHICH MAY:
  - IMPACT FISH AND SHELLFISH RESOURCES; AND MAY THEREFORE:
    - AFFECT SUBSISTENCE AND COMMERCIAL ACTIVITIES IN HUMAN SOCIETIES.



1. Mediterranean Region
2. Kuwait Action Plan Region
3. Wider Caribbean Region
4. West and Central African Region
5. East African Region
6. South East Pacific Region
7. Red Sea and Gulf of Aden Region
8. South Pacific Region
9. Eastern African Region
10. South Asian seas Region
11. South West Atlantic Region

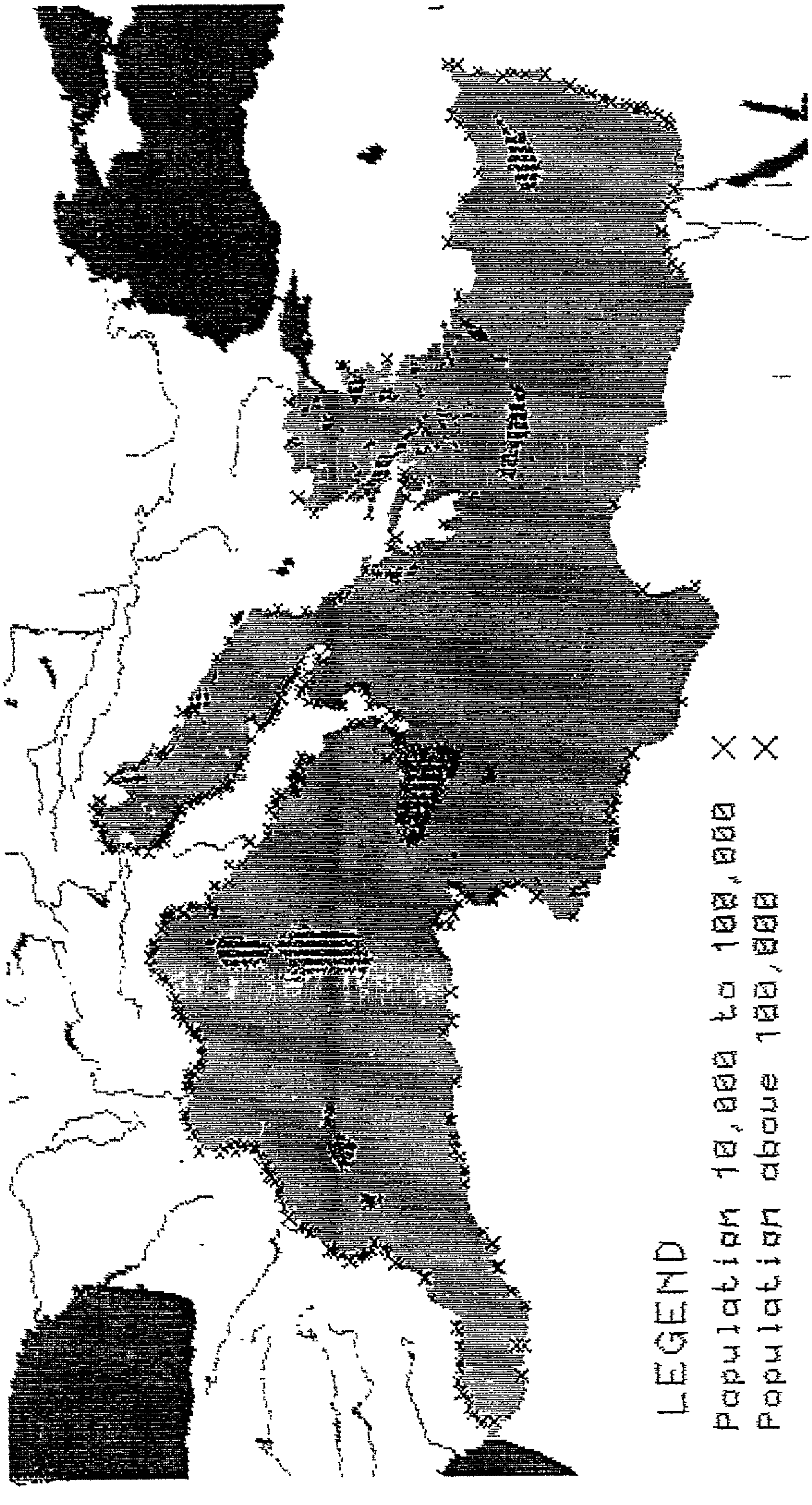
Geographic coverage of UNEP Regional Seas Programme



LOW-LYING AND SUBSIDENT ALLUVIAL-DELTAIC COASTLINES

Mediterranean Coastal Cities

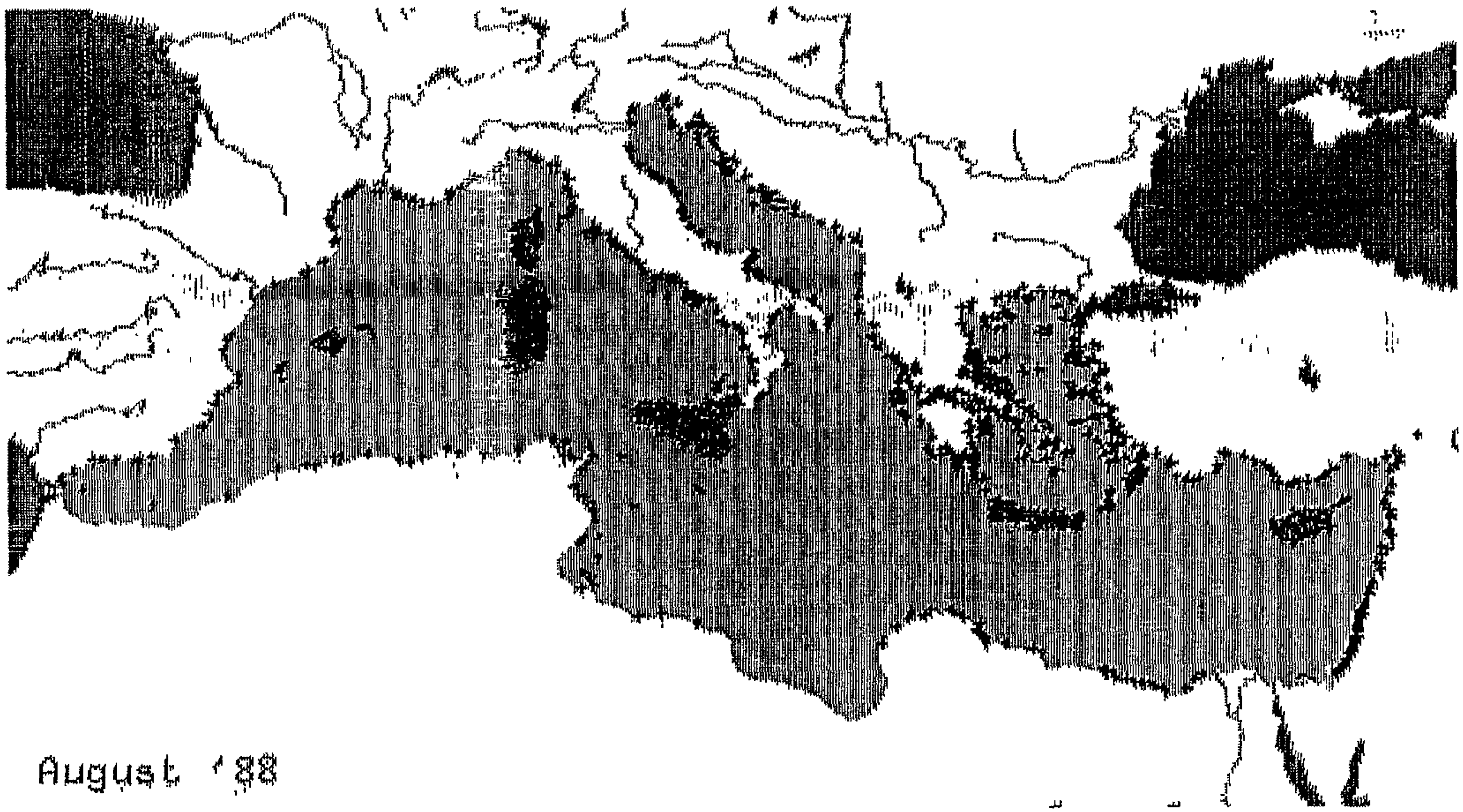
(Population above 10,000)



Mediterranean Specially Protected Areas

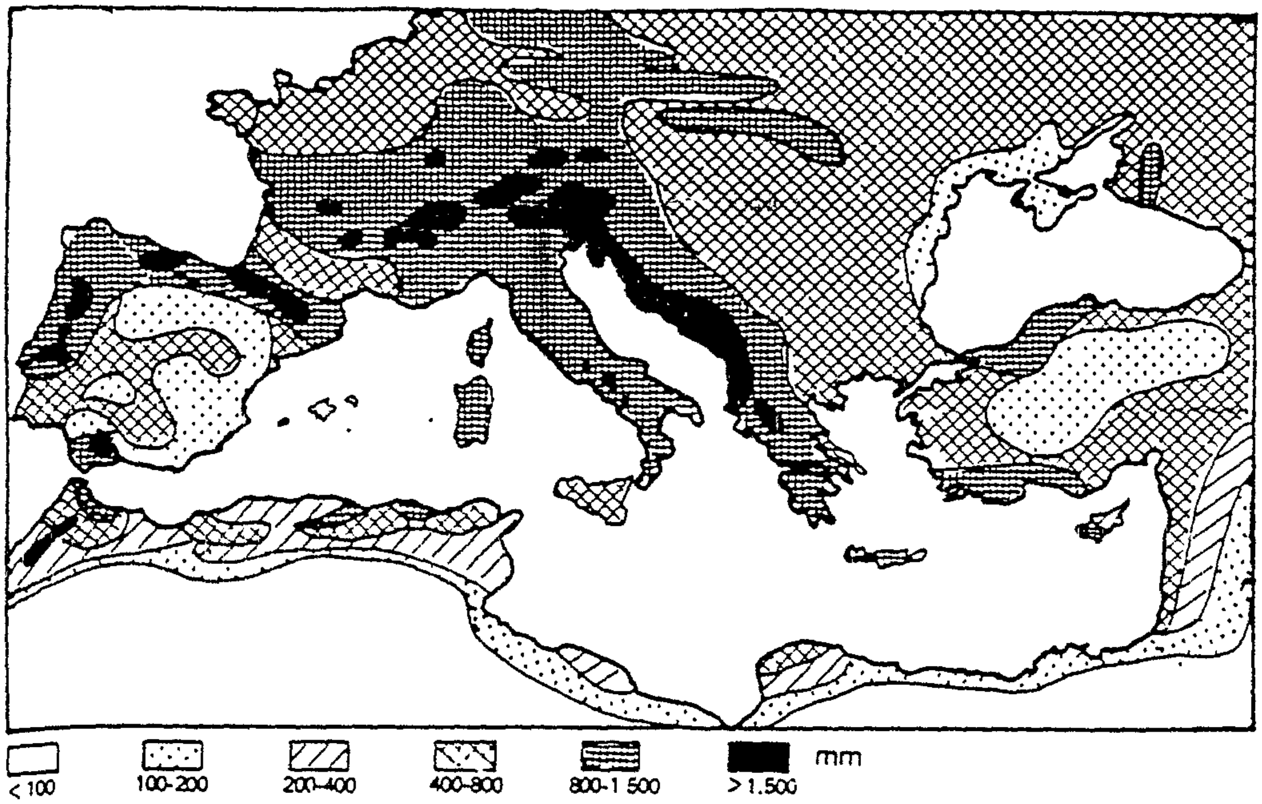
Coastal Archaeological Sites in the Mediterranean

(Source: N.C. Flemming)



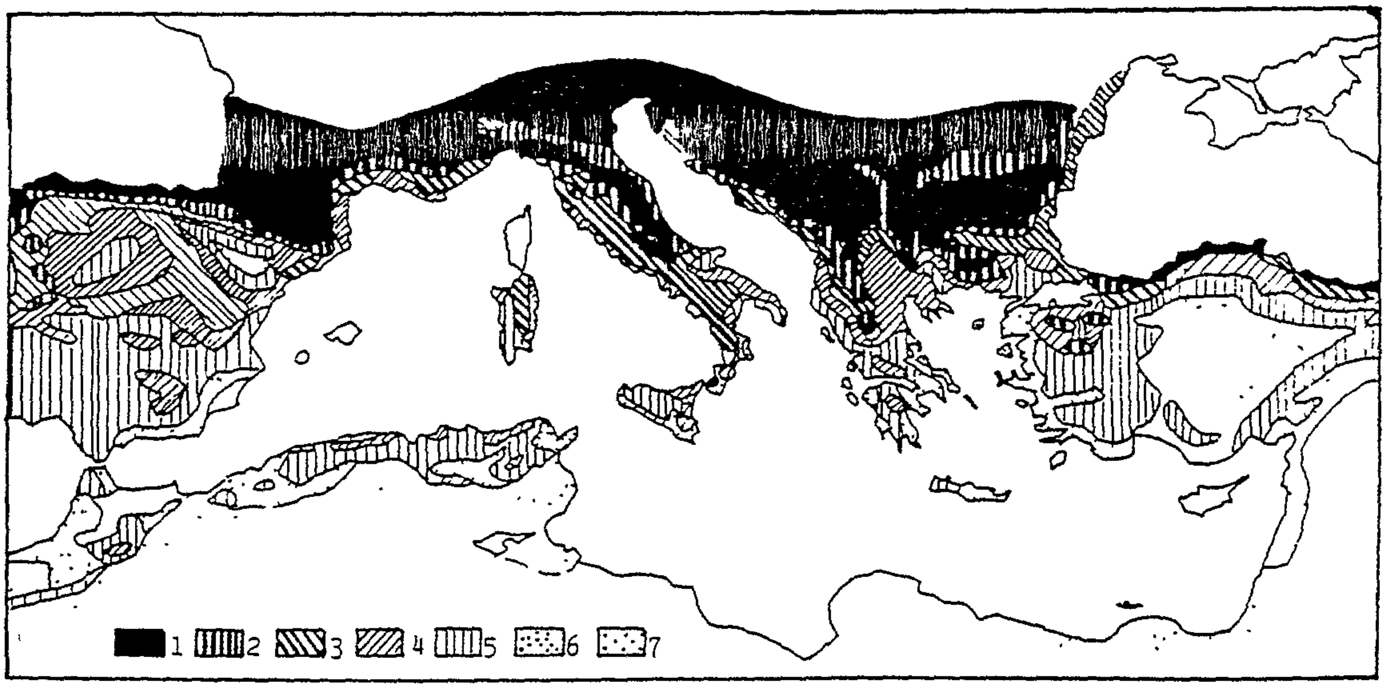
August '88

Mediterranean Historic Sites



Distribution of annual rainfall in the Mediterranean region

Fig. 6



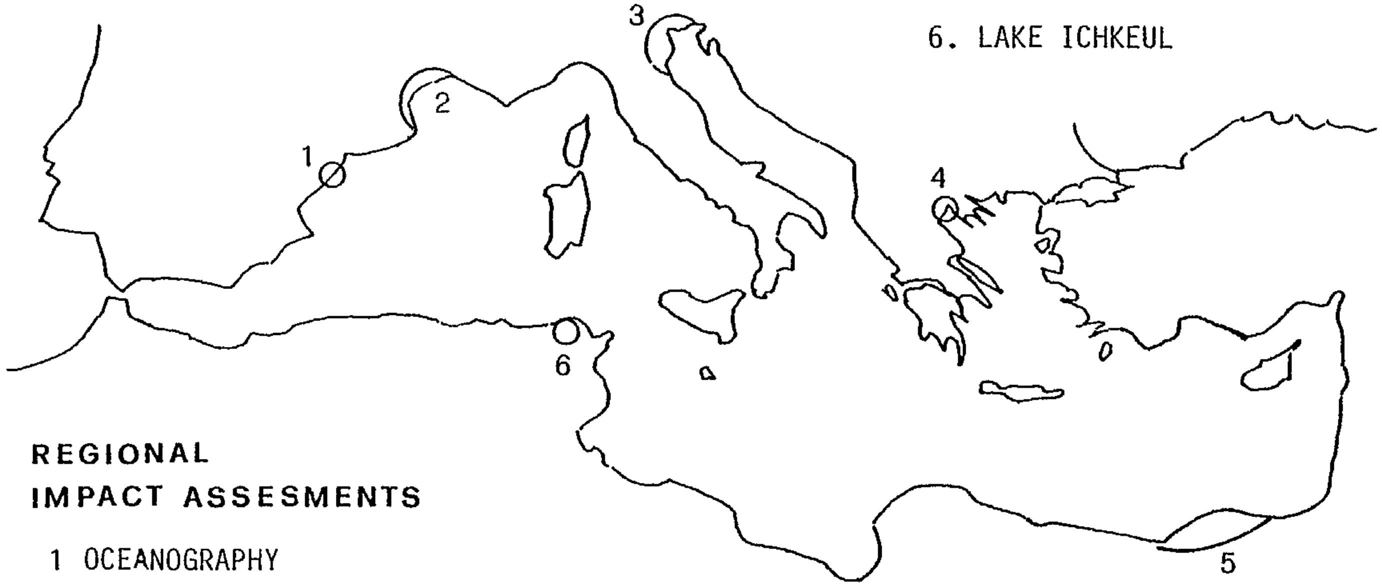
Extent of the dry season in the Mediterranean region (number of dry months: 1. None 2. One-two 3.Two-three 4.Three-four 5. Four-five 6. Five-seven 7. More than seven).

GENERAL CHAPTERS

1. OVERVIEW
2. CLIMATE CHANGES

CASE STUDIES

1. EBRO
2. GULF OF LIONS - RHONE
3. PO - NW ADRIATIC
4. AXIOS - THESSALONIKI
5. NILE DELTA
6. LAKE ICHKEUL

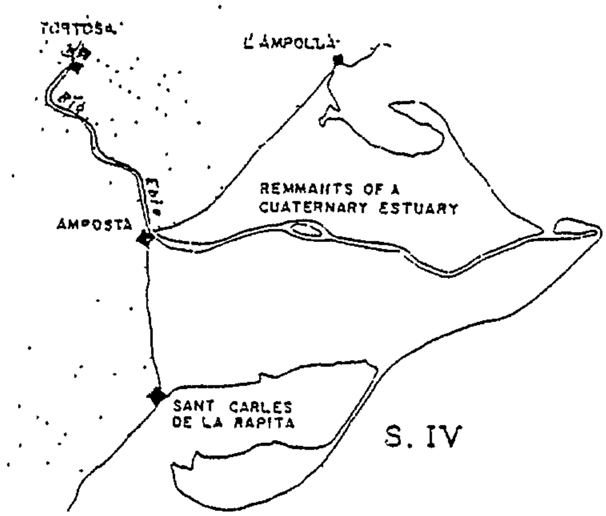


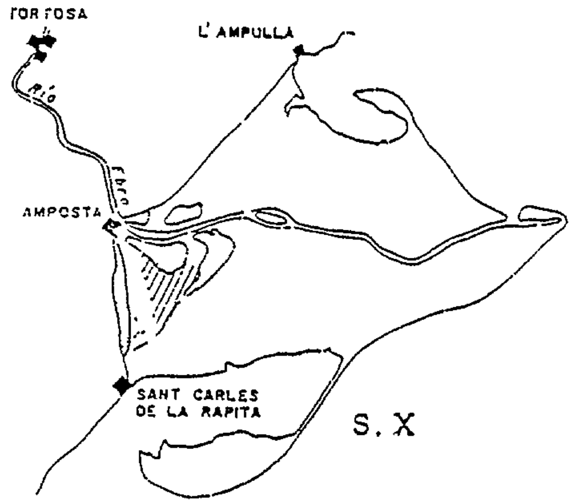
REGIONAL IMPACT ASSESMENTS

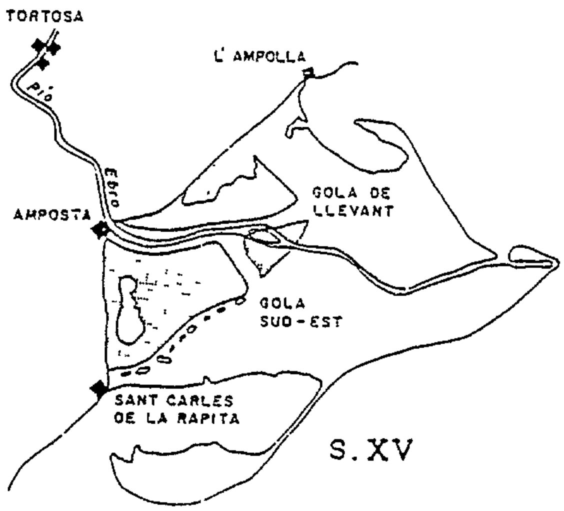
1 OCEANOGRAPHY
2 COASTAL STABILITY
3 SEA LEVEL CHANGES
4 HYDROLOGY
5 ECOSYSTEMS
6 VEGETATION
7 SOCIO - ECONOMICS

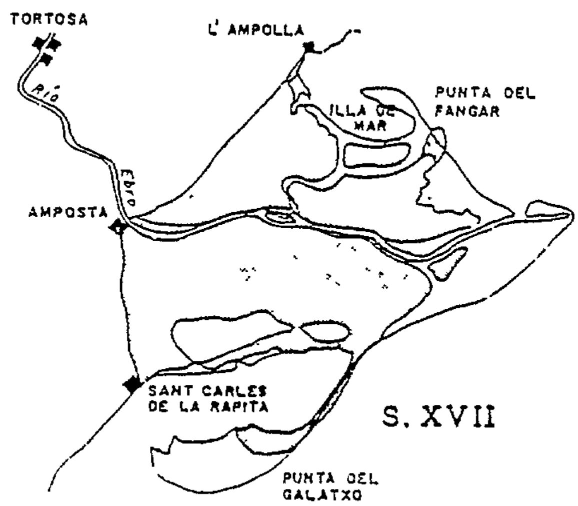
IMPLICATIONS OF CLIMATIC CHANGE IN THE MEDITERRANEAN REGION

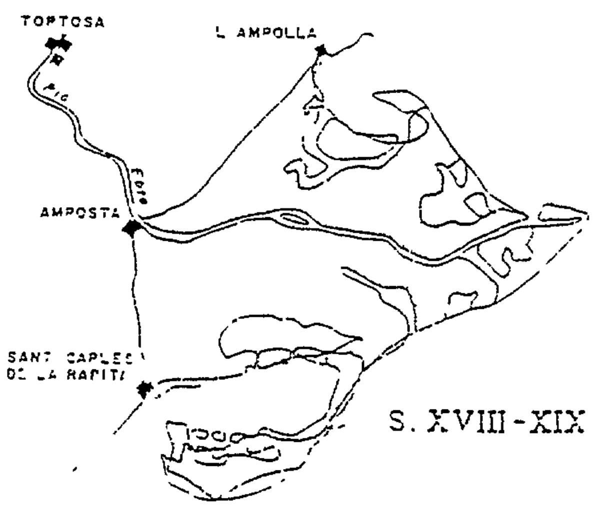
(UNEP 1989)

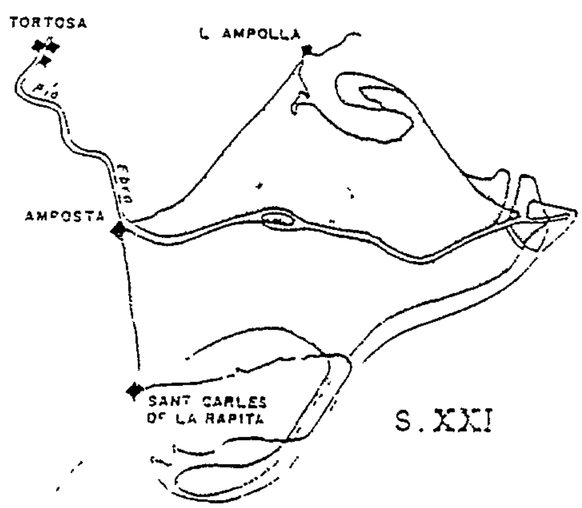

TORTOSA
L'AMPOLLA
Rió
Ebre
REMMANTS OF A
CUATERNARY ESTUARY
AMPOSTA
SANT CARLES
DE LA RAPITA
S. IV


TORTOSA
L'AMPULLA
Rió
Ebro
AMPOSTA
SANT CARLES
DE LA RAPITA
S. X


TORTOSA
L'AMPOLLA
Rió
Ebro
AMPOSTA
GOLA DE
LLEVANT
GOLA
SUD-EST
SANT CARLES
DE LA RAPITA
S. XV


TORTOSA
L'AMPOLLA
Rió
Ebro
PUNTA DEL
FANGAR
AMPOSTA
SANT CARLES
DE LA RAPITA
S. XVII
PUNTA DEL
GALATXO


TORTOSA
L AMPOLLA
Rió
Ebro
AMPOSTA
SANT CAPLES
DE LA RAPITA
S. XVIII-XIX


TORTOSA
L AMPOLLA
Rió
Ebro
AMPOSTA
SANT CARLES
DE LA RAPITA
S. XXI

IMPACT OF CLIMATIC CHANGE

Changed mean annual and seasonal temperature, general air circulation and precipitation will affect:

(a) surface and groundwater flow and river regimes, that is surface and ground-water availability, the incidence of floods and the amount of sediment transported and delivered to the sea;

(b) the movement of marine water masses (waves, currents, tides), especially in terms of direction and intensity of storms (i.e. erosion of the coasts) and of tidal range;

(c) natural ecosystems, due mainly to increased temperature and its effects on water and soil qualities;

(d) occupation and use of the coastal lowland regions (0-5 m) because of sea-level rise, and altered parameters of agriculture, fishing, industry, tourism and the quality of the environment.

SUMMARY OF IMPACTS

Potential evapo-transpiration will increase throughout the Mediterranean, coupled with a possible decrease in precipitation in the south and an increase in the northern part. Climatic changes generally will occur gradually and will not be specifically manifested for another 3-4 decades. Hot dry summers and exceptional events of drought or rainfall and floods, marine storms, tidal surges and of water stagnation and eutrophication, however, could increase in frequency.

Increase in temperature would lead to an increase of land degradation, deterioration of water resources, decline in agricultural production and damage to natural terrestrial and aquatic ecosystems. Salinization of irrigation water would have negative consequence on sensitive grain yield. Consequently new varieties of crops have to be introduced, adapted to the new natural setting and yield standards.

Marine circulation could be altered both in the Mediterranean and the Atlantic, thus affecting marine productivity and the pattern of pollutant dispersal.

Generally marine and land weeds are expected to benefit from warmer, CO_2 richer atmosphere. Flora and fauna of the wetlands will be forced to a gradual adaptation to induced conditions which might be crucial for the species that possess reduced tolerance to high salinities. As bioclimatic zonation will gradually shift northwards, several species will migrate to the north, and insect populations might increase. There will be favourable conditions for an increasing risk of agricultural pests, bacteria and diseases, especially in the swamps.

SUMMARY OF IMPACTS (2)

The effects of sea level rise are most predictable even though the extent of sea level rise is difficult to foresee: 1) direct wave impact on exposed coasts (e.g. the Venice lagoon coastal barrier, beach resorts) and on harbour installations (Alexandria, Port Said, La Golette-Tunis, etc); 2) flooding of estuaries, canals, lagoons, which should be more serious for agriculture than for the increasingly more valuable lagoonal fishing. Degradation of lagoons (e.g. Venice Lagoon), however, could seriously affect wildlife and fish resources; 3) a sea level rise of 10-20 cm will aggravate existing shore erosion problems.

A global mean eustatic rise in sea level of about 20 cm by 2025 would not, in itself, have a significant impact in the Mediterranean, except locally (e.g. lagoons). However, local sea level changes could be up to five times this amount because of natural land subsidence, that could be enhanced by excessive groundwater withdrawal. Particularly negative effects of this impact will be felt in low lying areas, deltas and coastal cities.

The future impacts on Mediterranean society by non-climatic factors (e.g. population increases, present development plans) may far exceed the direct impacts of climate change. Non-climatic factors will cause continuous increases in society's vulnerability to climatic stress, particularly in the south. Together, these demographic and climatic changes should increase the probability of catastrophic events and hasten their occurrence.

Most of the deltaic lowlands of the Mediterranean Sea are experiencing serious environmental problems because of agricultural, industrial, urban and tourist developments during the last two decades. Problems range from water pollution and salinization to land subsidence, shoreline erosion, and restriction and deterioration of wildlife habitats. This vulnerability is increased by adverse socio-economic conditions, the effect of which will be superimposed upon those of climatic change.

FUTURE STRATEGIES

To develop a strategy for responding to the impacts of change, it is essential to identify those parts of the Mediterranean coastal regions where knowledge is still inadequate.

The physical impact of sea level rise on the Mediterranean lowland coasts can be predicted, even modelled quantitatively on the basis of the present parameters of morphology, hydrodynamics, sediment budgets, land subsidence and the effects of artificial structures. Equally, the impacts of altered rainfall distribution on surface and groundwater could be modelled quantitatively, and the effects of increased air temperatures and changed soil-water parameters on biosystems can be estimated, at least qualitatively, which then give some idea of impacts on agriculture and fisheries. What is much more difficult to estimate, however, is the impact of these physical and biological changes on the future socio-economic framework of the threatened lowlands.

Coastal zone management must be based on "cost-effectiveness", which means an assessment of the "value" of the threatened land uses, not only in terms of their present functions, in the context of the local needs and of the importance of the lowland concerned to its hinterland and further, but especially of those of decades ahead.

Regarding sea level change, perspective actions can be either preventive or reactive. For example, entire coasts and lagoon margins can be walled in, or choices must be made between irreplaceable coastal uses (e.g. national and military harbours, towns of historical-artistic value, lagoonal resources, specialized agriculture) and adaptations. Examples of such relative actions would be (a) shifting land uses and (b) a different approach to beach recreation (i.e. less urbanized), the replacement of extensive, uneconomical crops in sub-zero lands, with lagoons destined to aquaculture and nature reserves. The lagoons would act as a buffer belt, since their inner margins can be more easily protected than the exposed coast.

Close attention needs to be paid to the conservation of soil, groundwater and wetlands resources in the Mediterranean, because they contribute substantially to environmental stability. The overall adverse effects on downstream human settlements and ecosystems by large dam schemes have not been considered sufficiently in past planning. Future water management plans must be scrutinized more closely in relation to climatic change.

Studies of the frequencies of extreme events (high temperatures, high and low precipitation events, storms surges, etc), and how these frequencies relate to mean climatic conditions, are required to help predict probabilities of occurrence.

The implications of climate impacts for some regions and processes are of very high complexity and therefore systems analysis seems to be the best approach to their study.

Attention should be given to identifying and accessing data that can be used for climatic impact assessment. The value of long-term data series is stressed. Monitoring programmes to collect such data should be maintained and/or extended.

Of particular importance is the need to initiate research on all climatically-induced changes and to control and plan coastal development well in advance of the postulated sea-level rise in order to minimize the negative effects of man-made dis-equilibriums already experienced in many parts and to make future protection cost-effective.

It is recommended that organisational and legal instruments be developed to control coastal development, land reclamation and groundwater exploitation. Lowlands could be analysed and zoned in high, medium and low risk categories.

PROPOSED CASE STUDIES
IN THE MEDITERRANEAN REGION

A. MEDITERRANEAN ISLANDS

1. RHODES ISLAND
2. ISLAND OF MALTA
3. ADRIATIC ISLANDS

B. MEDITERRANEAN COASTAL AREAS

1. IZMIR BAY
2. KASTELA BAY
3. COASTAL REGION OF SYRIA

ANNEX V

BASIC FACTS ABOUT THE COASTAL REGION OF SYRIA

INTRODUCTION - NATURAL ENVIRONMENT AND RESOURCES OF THE SYRIAN COASTAL ZONE

The total length of the Syrian coastal zone is about 160 km; multiplied with an average width of 10 km, this gives a figure of 160 km2. Since the real length of the coastline is 180 km, it might be also calculated that the surface is approximately 180 km2. This, however, is unlikely, due to many overlaps. Thus it may be concluded that the total area of the Syrian coastal zone is anywhere between 160 and 180 km2.

ENVIRONMENTAL RESOURCES - INVENTORY, ASSESSMENT, GOALS, POLICY RECOMMENDATIONS

1. Relief (geology and geomorphology)

While the Coastal Range of Jebel Saheiliyeh is mostly composed of Jurassic and Cretaceous dolomite, limestone, and marl. The Bassit Block (north of Lattakia) is of igneous origin (ophiolitic rocks). The coastal zone itself is mostly covered by Quaternary sediments, appearing in the form of sand, gravels, sandstone, conglomerate, pebbles, and clay. Exception to this is the area in the very north, from Ras el-Fassouri to the state border, and the area in the middle-south, from Baniyas to Tartous. The area in the north is made of Paleogene-Neogene sediments, and serpentinites and gabbros (north of Wadi Qandeel), while the area in the south is composed of Neogene basalt and Cretceous limestone.

Geomorphologically, the coastal zone is a flat area, compared to the rest of the region. In a division of the coastal region into 6 main geomorphological areas - shoreline, coastal plain, hilly country, river valleys, foothills, coastal range - the second and the third category cover most of the coastal zone. More precisely, about 60% of the total coastal zone area belongs to the category of coastal plain, about 30% is the hilly country, and the remaining less than 10% is the shoreline (beaches, dunes) and river valleys and wadis.

2. Soils

The red and brown Mediterranean soils prevail in the coastal region, with an addition of crumusol and alluvial soil patches. Predominance of the red soil is overwhelming in both coastal plains (Jableh and Akkiri). This is convincingly indicated by the data from Statistical Abstract for the two mahafazas. These soils contain clay and loam, and vary in depth; however, in the coastal zone, i.e. in the two plains, their depth usually goes to 1 m or more.

3. Mineral resources

Mineral resources are of no great importance either in the coastal region, nor in the coastal zone. There are no major deposits of fossil fuels, and there are only a few metal ore deposits (chromium, manganese, magnesite, iron), mostly in the hinterland of the northernmost sector of the coastal zone. This is related to the igneous origins of the Bassit Block.

The only important group of mineral resources is the group of rocks which serve as various construction materials - sand, gravel, sandstone, limestone, dolomite, marl, asbestos, and gypsum. There are also phosphate deposits near Tartous.

4. <u>Shoreline features</u>

Like no other category of natural resource, this one is intrinsically related to the essential fact about the coastal zone - that it represents the area of direct contact of the land and the sea. This simple fact results in the crucial properties of this resource - it is a limited and firmly positioned narrow strip of physical media which support many special life forms that thrive on contact of sea and land; which represents a highly distinguished and valued type of landscape; and which supports some very important economic activities (transport and recreation in the first place).

The length of the shoreline between the two state borders has been calculated at 180 km. It consists of several types of shores (including the ones which have been shaped by human hand). They can be analysed according to the systematics sketched below:

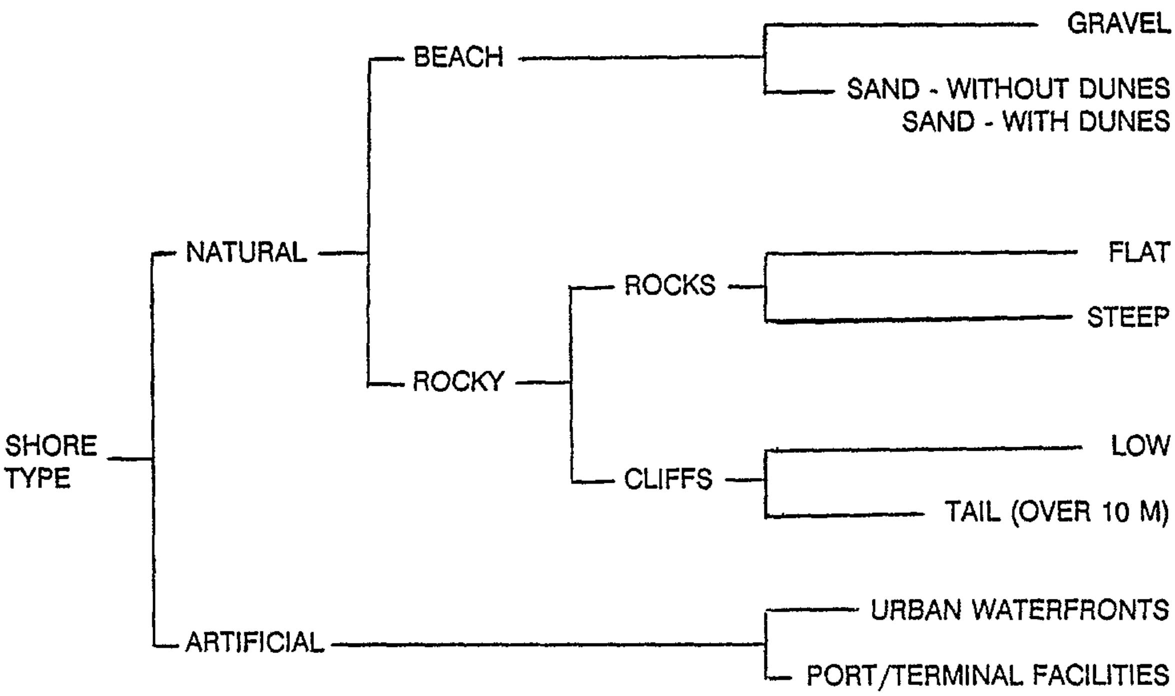


Figure 1: Tree diagram of types of shores in the coastal zone of Syria
(8 categories are distinguished)

5. <u>Climate</u>

The entire coastal region belongs to the Mediterranean humid or subtropical type of climate, with the amount of rainfall and temperatures gradually increasing from the West to the East and decreasing from the higher to the lower slopes of Jebel Saheiliyeh.

ANNEX VII

OUTLINE OF THE REPORT

EXECUTIVE SUMMARY (N.M. Al-Shalabei)

1. INTRODUCTION

1.1. Background (L. Jeftic)

1.2. Basic facts about Coastal Region of Syria (Y. Awaidah)

1.3. Methodology and assumptions used in the study (I. A. Khalil)

2. IDENTIFICATION AND ASSESSMENT OF THE POSSIBLE CONSEQUENCES OF CLIMATIC CHANGE

2.1. Climate (I.A. Khalil and M. Eido)

2.2. Lithosphere (I.A. Khalil)

2.3. Hydrosphere (F. Al-Ek)

2.4. Atmosphere (I.A. Khalil and M. Eido))

2.5. Natural ecosystems (Y. Awaidah)

2.5.1. Terrestrial (Y. Awaidah)
2.5.2. Freshwater (Y. Awaidah)
2.5.3. Marine (Y. Awaidah)

2.6. Managed Ecosystems (S. Nahawi and I.A. Khalil)

2.6.1. Agriculture (S. Nahawi and I.A. Khalil)
2.6.2. Fisheries (S. Nahawi and I.A. Khalil)
2.6.3. Aquaculture (S. Nahawi and I.A. Khalil)
2.6.4. Sylviculture (S. Nahawi and I.A. Khalil)

2.7. Energy and industry (F. Al-Ek)

2.8. Tourism (R. Nseir)

2.9. Transport and services (R. Nseir)

2.10. Health and sanitation (F. Al-Ek)

2.11. Population and settlement pattern (R. Nseir)

3. SYNTHESIS OF FINDINGS

3.1. Present situation (Y. Awaidah and I.A. Khalil)

3.2. Major expected changes and their impacts (Y. Awaidah and I.A. Khalil)

4. RECOMMENDATIONS FOR ACTION (N.M. Al-Shalabei)

4.1. Preventative policies and measures (N.M. Al-Shalabei)

4.2. Adaptive policies and measures (N.M. Al-Shalabei)

REFERENCES

ANNEX VIII

WORKPLAN AND TIMETABLE*

-	Nomination of the Co-ordinator of the Task Team	June 1991
-	Establishment of the Task Team	July 1991
-	First (preparatory) meeting of the Task Team	November 1991
-	Collection of data and relevant documentation by the members of the Task Team	Dec. 91-March 92
-	Analysis and evaluation of data and documentation by the members of the Task Team	Dec. 91-March. 92
-	Preparation of the first outline of individual substantive sections (Chpt. 2 of the enclosed outline) by the members of the Task Team, highlighting the main issues	Dec. 1991
-	Second meeting of the Task Team to review the first outlines of substantive sections	Dec. 1991
-	Preparation of extended versions of substantive sections by the members of the Task Team	Dec. 91-March 92
-	Submission of individual substantive sections by the Task Team members to the Co-ordinator	March 1992
-	Third meeting of the Task Team to review and revise the substantive sections of the report, and prepare the conclusions and recommendations	April 1992
-	Preparation of the final draft report, by the Co-ordinator of the Task Team	May 1992
-	Fourth meeting of the Task Team to finalise and adopt the report	June 1992
-	Publication of the report by the Co-ordinating Unit of the Mediterranean Action Plan	Sept. 1992
-	Presentation to the national and local authorities	October 1992

* In addition to the formal meetings of the Task Team it is envisaged that the core members will meet frequently between meetings of the full Team. The Co-ordinator of the Task Team will keep the external members informed of progress on a regular basis, by providing them with materials produced by the Core members of the Task Team.