EP

United Nations
Environment
Programme

UNEP(OCA)/MED WG.85/2
14 July 1994

Original: ENGLISH

MEDITERRANEAN ACTION PLAN

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

Tirana, 12-14 July 1994

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

UNEP
Athens, 1994

TABLE OF CONTENTS

BACKGROUND

As part of the efforts of the United Nations Environment Programme (UNEP) to analyze the potential implications of predicted climate change and to assist the governments in designing policies and measures which may avoid or mitigate the expected negative effects of this change, or to adapt to them, Task Teams on the implications of climate change were established in 1987 for six regions covered by the UNEP-sponsored 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 regional studies on expected climate change on coastal and marine ecosystems, as well as on the socio-economic structures and activities within these regions. Additional Task Teams were later established for the West and Central African, Eastern African, Persian/Arabian Gulf and Black Sea regions.

During the work on the Mediterranean regional study [1], in the period from 1987 to 1989, it was felt that while the general effects might be similar throughout the Mediterranean region, the response to these effects would have to be highly site-specific. Therefore in the framework of the Mediterranean Task Team six specific case studies were prepared (deltas of the rivers Ebro, Rhone, Po and Nile; Thermaikos Gulf and Ichkeul/Bizerte lakes) in 1989.[2]

In preparing these case studies it had become apparent that prediction of impacts was constrained by the absence of scenarios of future climates on a regional, sub-regional and local scale. Accordingly the Climatic Research Unit of the University of East Anglia had been commissioned by UNEP to attempt to produce a Mediterranean Basin scenario and to develop scenarios of future local climate for the selected case study areas.

Using the experience of the "first generation" case studies, in 1990 the preparation of the "second generation" of site-specific case studies was initiated for the island of Rhodes, Kastela Bay, the Syrian coast, the Maltese islands, the Cres-Losinj islands and the Bay of Izmir.

The objectives of these studies were:

- to identify and assess the possible implications of expected climate change on the terrestrial, aquatic and marine ecosystems, population, land- and sea-use practices, and other human activities;

- to determine areas or systems which appear to be most vulnerable to the expected climate change; and

- to suggest policies and measures which may mitigate or avoid the negative effects of the expected impact, or adapt to them, through planning and management of coastal areas and resources;

using the presently available data and the best possible extrapolations from these data.

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[1] Implications of expected climate changes in the Mediterranean. MAP Technical Reports Series No. 27. UNEP, Athens, 1989.

[2] The final results of the work on the Mediterranean regional studies and on the six case studies were published in the book "Climatic Change and the Mediterranean" (L. Jeftic, J.D. Milliman, G. Sestini, Eds.), Edward Arnold Publ., London, 1992.

The final results of these five case studies were presented at the meeting on Implications of Climatic Changes on the Mediterranean Coastal Areas (Island of Rhodes, Kastela Bay, Syrian Coast, Malta and Cres/Losinj), held in Malta in September 1992. The report of this meeting, containing the main findings, conclusions and recommendations of the five studies, was published as document UNEP(OCA)/MED WG.55/7.

A third generation of case studies was launched, in 1993, in the framework of the site-specific Coastal Areas Management Programme (CAMP). So far two such studies are being developed (Fuka-Matrouh coastal region and Albanian coastal region). For each of the second generation of case studies Task Teams were established and the same procedure will be followed for the third generation of case studies.

This meeting is the first meeting of the Task Team for Albanian case study.

Opening of the meeting - Agenda item 1

1. The meeting was opened by Ms E. Demiraj, the designated Coordinator of the Task Team. She thanked the United Nations Environment Programme (UNEP) for organizing and supporting the preparation of the study on the implications of climatic changes for the coastal area of Albania, and welcomed the participants on behalf of the Chairman of the Committee of Environmental Protection and Preservation (CEPP) of Albania. Her statement is attached as Annex I to the report.

2. Mr L. Jeftic, Senior Marine Scientist in the Coordinating Unit for the Mediterranean Action Plan (MAP) welcomed the participants on behalf of Ms E. Dowdeswell, Executive Director of UNEP, and expressed his appreciation for the support provided by the Government of Albania and the Institute of Hydrometeorology for the organization of this meeting.

3. The meeting was held at the Institute of Geology. The meeting participants and the members of the Task Team are listed in Annex II to the report.

Election of Officers - Agenda Item 2

4. The meeting unanimously elected Ms E. Demiraj as Chairperson, and Mr S. Keckes as Rapporteur of the meeting. Mr L. Jeftic acted as the technical secretary of the meeting.

Adoption of the Agenda - Agenda Item 3

5. The provisional agenda, as proposed by the secretariat, was adopted and appears as Annex III to the report.

Overview of Greenhouse Effect and its Implications - Agenda Item 4

6. Mr L. Jeftic presented an overview of the current views concerning the most likely greenhouse effect; past and predicted changes in global mean temperature and sea level; as well as the range of possible climatic change impacts which might occur in the coastal area of Albania (Annex IV). He also referred to the activities organized by the Oceans and Coastal Area Programme Activity Centre (OCA/PAC) of UNEP and MAP concerning the evaluation of the implications of climatic changes, and to the use of these evaluations in coastal area management programmes.

Coastal Area Management Programme (CAMP) for the Coastal Area of Albania - Agenda Item 5

7. Mr L. Jeftic presented a short general information on MAP and specifically referred to, and reviewed in detail, the Coastal Area Management Programme (CAMP) for the coastal area of Albania which is being undertaken in the framework of MAP (Annex V), and which serves as the general framework for the work of the present Task Team. The coordinators of each activity envisaged in the framework of the CAMP are identified in Annex V.

Climatic changes scenario for the Coastal Area of Albania - Agenda Item 6

8. Ms J. Palutikof presented the computer generated scenarios for the likely changes in temperature and precipitation due to the enhanced greenhouse effect which were prepared for the Mediterranean region as a whole and for the study area expected to be covered by the work of the Task Team (coastal area of Albania). According to these scenarios, the study area may experience a lower warming than the global average, but a slightly decreased precipitation over the year as a whole. Reduced precipitation in winter and autumn, partially offset by wetter conditions in spring, would be responsible for this annual change. The detailed temperature and precipitation scenarios for the study area are shown in Annex VI.

9. In the ensuing discussion the inherent limitations of the models and scenarios were stressed, with the recognition that they are based on the best presently available science.

10. The operative scenarios for temperature, precipitation and sea-level rise for the year 2030 and 2100 time horizons, which should be used as the Task Team's working hypotheses, are summarized in Annex VII.

Implications of expected climatic changes on the Coastal Area of Albania - Agenda item 7

Project outline - Agenda Item 7.1.

11. Mr L. Jeftic presented some basic information on the Albanian coast prepared by the Coordinating Unit for MAP on the basis of information available at the Unit. The information was reviewed and revised as deemed appropriate by the participants. A tentative map of the study area was also presented, and after discussion the meeting agreed on the indicative boundaries of the area. The revised information on the Albanian coast and the map with indicative boundaries of the study area are attached as Annexes VIII and IX to this report.

12. He then made a detailed review of the objectives, assumptions and expected outputs of the study, proposed by the Coordinating Unit. These were discussed by the meeting and revised as deemed appropriate (Annex X).

13. The outline of the final report of the study was proposed by Mr. L. Jeftic, and was adopted by the meeting with a few small amendment (Annex XI).

14. The meeting identified the members of the Task Team responsible for the preparation of the individual sections and sub-sections of the report (see Annex XI), and the relevant members of the Task Team proposed the possible content of the sections of the report dealing with the executive summary, the introduction, and the identification of present situation and trends. The proposals were discussed by the meeting, and are included in the outline of the report (Annex XI) as modified and not all-inclusive tentatively agreed annotations.

15. The contents of sections 3 and 4 of the report were left open, as they will depend on the findings reflected in section 2.

General Workplan and Timetable - Agenda Item 7.2.

16. A tentative workplan and timetable for the completion of the Task Team's report was presented by Mr L. Jeftic. The workplan and timetable were discussed by the meeting, and the agreed text is reproduced in Annex XII to this report. It was understood that in view of the interdependence of the work carried out by the Task Team and the team working on CAMP, the Task Team's schedule of work may have to be adapted to a certain degree to the progress in the preparation of CAMP.

Detailed workplan for each Task Team member - Agenda Item 7.3.

17. The members of the Task Team responsible for the individual sections and sub-sections of the final report were advised to establish an early close contact and cooperation with the coordinators of the relevant activities envisaged under CAMP (see Annex V).

18. The initial task of each author is identified in paragraph in the annotated outline of the final report (Annex XI). In preparing sections 3 and 4 of the report, the authors were advised to include, where possible, appropriate cost-benefit analyses for alternative response options and an integrated approach to impact assessment and sectorial evaluations.

<u>Adoption of the report</u> - Agenda Item 8

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

<u>Closure of the meeting</u> - Agenda Item 9

20. In his closing remarks, Mr L. Jeftic expressed satisfaction with the results of the meeting, with the enthusiasm expressed by the Task Team members for the study and the constructive spirit in which the meeting has been conducted.

21. An exchange of courtesies followed after which the Chairperson closed the meeting on 14 July 1994.

ANNEX I

OPENING ADDRESS OF MS E. DEMIRAJ, COORDINATOR OF THE TASK TEAM

Honourable guests and colleagues,

It is with great pleasure to open the first Meeting of the Task Team on Implications of the Climate Changes for the Coastal Area of Albania.

On behalf of the Chairman of the Committee of Environmental Protection and Preservation (CEPP), I would like to express our gratitude to UNEP which, through the Mediterranean Action Plan, and specifically through the Coastal Area Management Plan for Albania, has promoted the preparation of this study on the implications of climate changes for our coastal area.

We are aware of the fact that our coast and seas are some of our most important and valuable resources, which, through development, need to be vitalized, but meanwhile we must prevent their ecological damage.

Therefore, this study will be important and we hope that its results and recommendations will be taken in consideration in development of the required strategies and policies for the prevention of the possible adverse effects of climate changes in Albanian coastal areas.

ANNEX II

LIST OF PARTICIPANTS AND TASK TEAM MEMBERS

MEMBERS OF THE TASK TEAM

Ms Eglantina Demiraj Tel/Fax: 355 42 23518
Coordinator of the Task Team
Institute of Hydrometeorology (IHM)
Rruga "Durrësit"
Tirana
Albania

Mr Sotir Bebi Tel/Fax: 355 42 27835
Ministry of Transport
Tirana
Albania

Ms Mirela Bicja Tel/Fax: 355 42 23518
Institute of Hydrometeorology (IHM)
Rruga "Durrësit"
Tirana
Albania

Mr Emil Gjika Tel/Fax: 355 42 23466
Institute of Chemical Technology
Tirana
Albania

Mr Lekë Gjiknuri Tel: 355 42 25454
Natural Sciences Faculty Fax: 355 42 27048
Tirana
Albania

Ms Liri Gjoka Muçaj Tel/Fax: 355 42 23518
Institute of Hydrometeorology (IHM)
Rruga "Durrësit"
Tirana
Albania

Mr Dalip Habili Tel: 355 42 33343
Institute of Forestry Research
Tirana
Albania

Mr Fatos Hoxha
Institute of Hydrometeorology (IHM)
Rruga "Durrësit"
Tirana
Albania
Tel/Fax: 355 42 23518

Mr Perparim Hoxha
Faculty of Geology
University of Tirana
Tirana
Albania
Tel: 355 42 22592
Fax: 355 42 22592

Mr Sokol Kongoli
Ministry of Tourism
Tirana
Albania
Tel/Fax: 355 42 28123
Fax: 355 42 27922

Mr Vangjel Mustaqi *
Institute of Hydrometeorology (IHM)
Rruga "Durrësit"
Tirana
Albania
Tel/Fax: 355 42 23518

Mr Arian Pulluqi
Ministry of Agriculture and Food
Directory of Fishery
Tirana
Albania
Tel: 355 42 22882

Mr Mustafa Selfo
Ministry of Agriculture and Food
Directory of Fishery
Tirana
Albania
Tel: 355 42 22882

Mr Agim Shehi
Ministry of Health and Environmental Protection
Tirana
Albania
Tel/Fax: 355 42 34671

Mr Jani Vangjeli
Institute of Biological Research
Tirana
Albania
Tel/Fax: 355 42 22638

***** not present

EXTERNAL MEMBERS OF THE TASK TEAM

Mr L. Jeftic
Deputy Coordinator
Co-ordinating Unit for the Mediterranean
Action Plan
48 Vassileos Konstantinou
11635 Athens
Greece
Tel: 30 1 7253190/5
Fax: 30 1 7253196/7
Tlx: 222564, 222611 MEDU GR

Mr Stjepan Keckes
21 Lodovico Brunetti
Borik
52210 Rovinj
Croatia
Home Tel: 385 52 811543
Fax: 385 52 811543

Ms Jean Palutikof
Climatic Research Unit
University of East Anglia
Norwich NR4 7TJ
United Kingdom
Tel: 44 603 592090
Fax: 44 603 507784

OBSERVERS

Mr Gani Deliu
National Coordinator for MED POL
Committee of Environmental Protection and Preservation
Tirana
Albania
Tel/Fax: 355 42 27907

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. Coastal Area Management Programme for the Coastal Area of Albania

6. Climatic changes scenario for the Coastal Area of Albania

7. Implications of expected climatic changes on the Coastal Area of Albania

   7.1. Project outline
   7.2. General workplan and timetable
   7.3. Detailed workplan for each Task Team member

8. Adoption of the report

9. Closure of the meeting

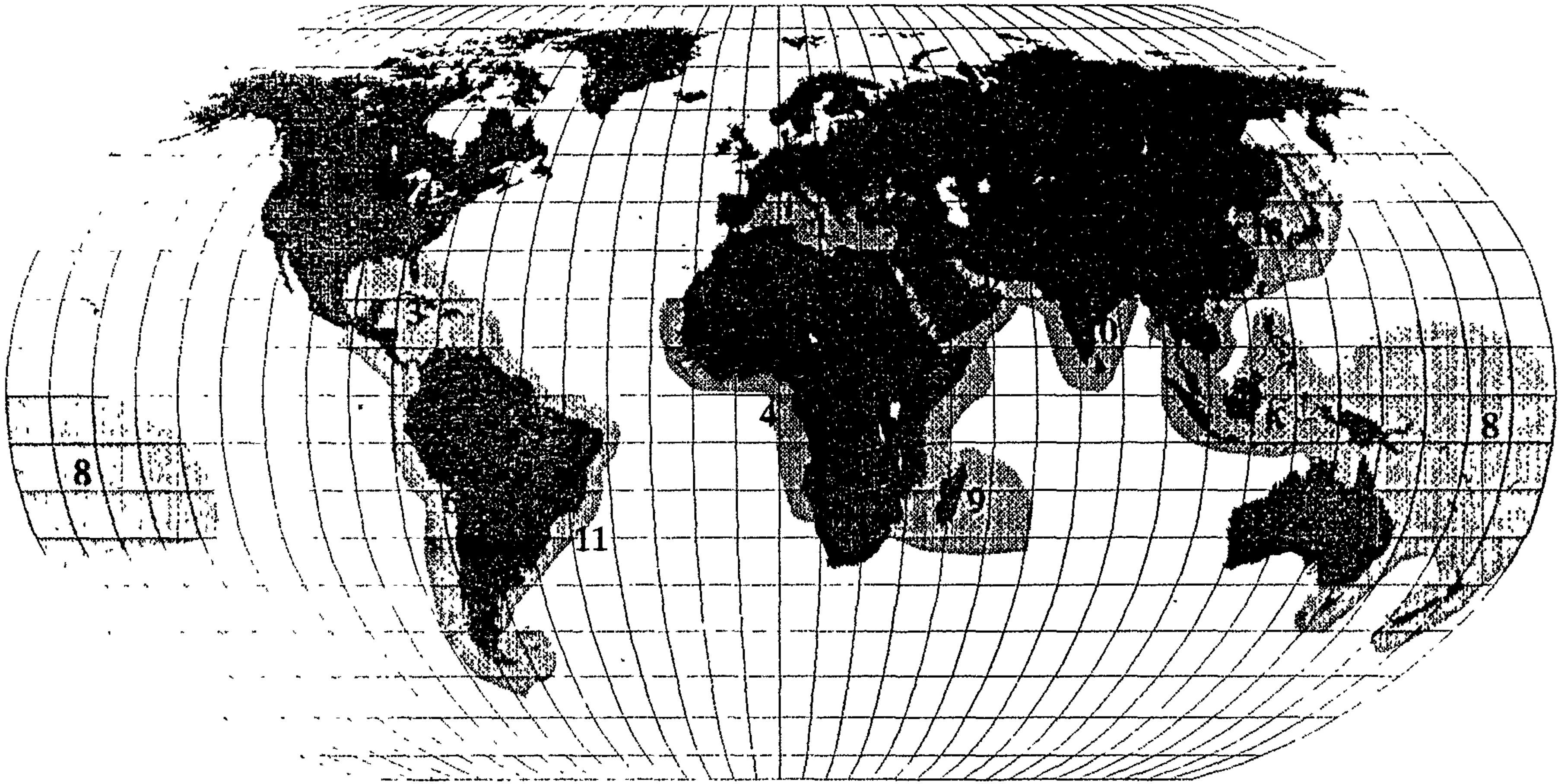
ANNEX IV

OVERVIEW OF THE GREENHOUSE EFFECT AND ITS IMPLICATIONS

This Annex contains copies of transparencies reviewing:

- the basic information on UNEP and MAP;
- description of the Coastal Areas Management programme of MAP;
- the basics of the greenhouse effect;
- past and predicted changes in temperatures and sea level;
- possible implications of climatic changes;
- work carried out by the Mediterranean Task Team on climatic changes and its results;
- 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.

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.



1 Mediterranean Region
2 Kuwait Action Plan Region
3 Wider Caribbean Region
4. West and Central African Region
5 East Asian Seas 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
12. Black Sea Region
13. North West Pacific Region

Geographic coverage of UNEP Regional Seas Programme

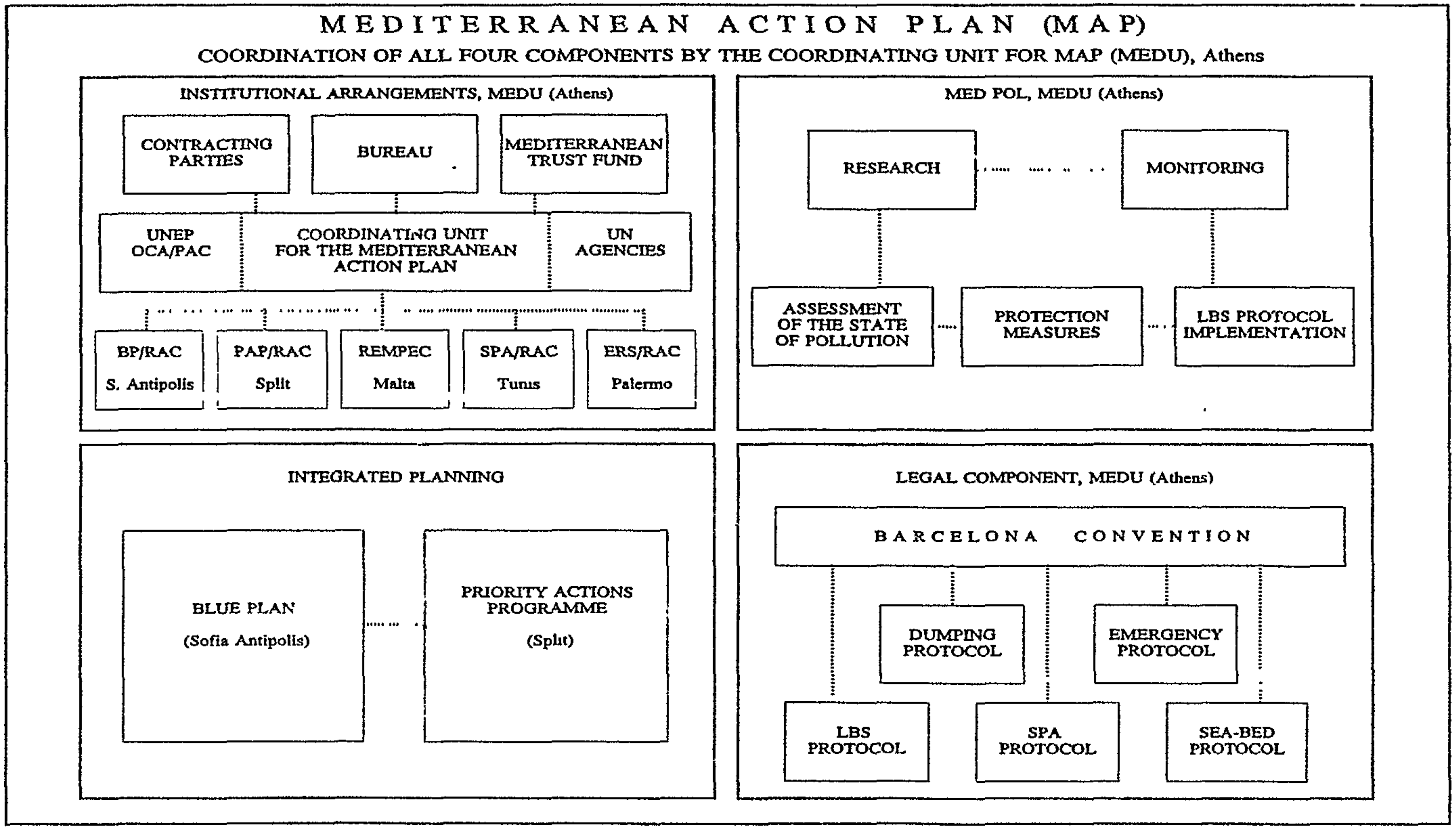
COMPONENTS
OF THE MEDITERRANEAN ACTION PLAN

- INTEGRATED PLANNING OF THE DEVELOPMENT AND MANAGEMENT OF THE RESOURCES OF THE MEDITERRANEAN BASIN (BLUE PLAN AND PRIORITY ACTIONS PROGRAMME);

- CO-ORDINATED PROGRAMME FOR RESEARCH, MONITORING AND EXCHANGE OF INFORMATION AND ASSESSMENT OF THE STATE OF POLLUTION AND OF PROTECTION MEASURES (MED POL);

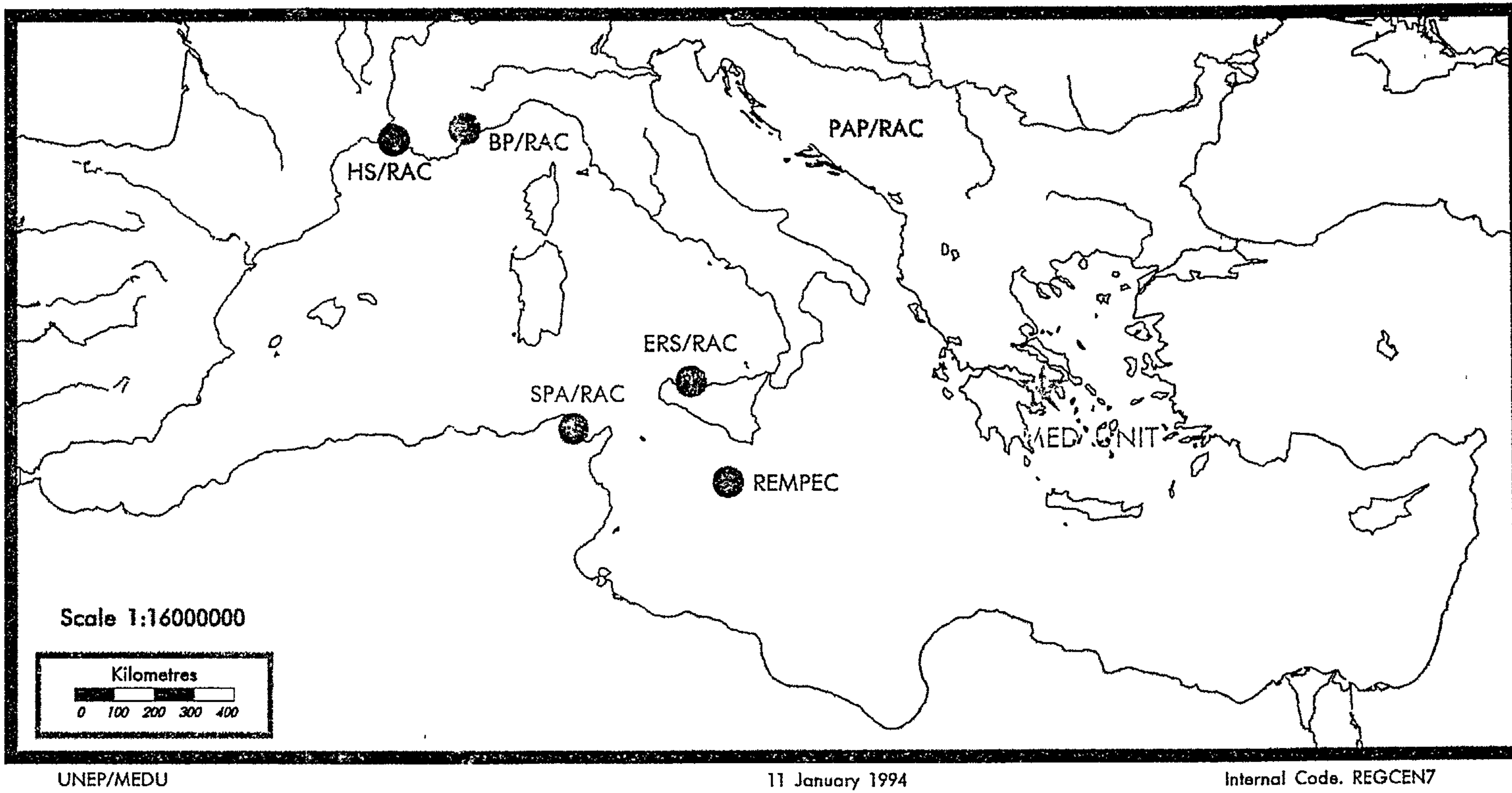
- FRAMEWORK CONVENTION AND RELATED PROTOCOLS WITH THEIR TECHNICAL ANNEXES FOR THE PROTECTION OF THE MEDITERRANEAN ENVIRONMENT;

- INSTITUTIONAL AND FINANCIAL ARRANGEMENTS.



MEDU = COORDINATING UNIT FOR MAP, OCA/PAC = OCEANS AND COASTAL AREAS PROGRAMME ACTIVITY CENTRE; BP = BLUE PLAN; RAC = REGIONAL ACTIVITY CENTRE; PAP = PRIORITY ACTIONS PROGRAMME; REMPEC = REGIONAL MARINE POLLUTION EMERGENCY RESPONSE CENTRE; SPA = SPECIALLY PROTECTED AREAS; ERS = ENVIRONMENT REMOTE SENSING; MED POL = COORDINATED PROGRAMME FOR RESEARCH, MONITORING, ASSESSMENT OF THE STATE OF POLLUTION AND PROTECTION MEASURES; LBS = LAND-BASED SOURCES; SEA-BED = EXPLORATION AND EXPLOITATION OF SEA-BED.

Mediterranean Action Plan



PROTOCOLS RELATED TO THE BARCELONA CONVENTION

PROTOCOL FOR THE PREVENTION OF POLLUTION OF THE MEDITERRANEAN SEA BY DUMPING FROM SHIPS AND AIRCRAFT (DUMPING PROTOCOL)

ADOPTED 18 FEBRUARY 1976 ENTRY INTO FORCE 12 FEBRUARY 1978

PROTOCOL CONCERNING CO-OPERATION IN COMBATING POLLUTION OF THE MEDITERRANEAN SEA BY OIL AND OTHER HARMFUL SUBSTANCES IN CASES OF EMERGENCY (EMERGENCY PROTOCOL)

ADOPTED 18 FEBRUARY 1976 ENTRY INTO FORCE 12 FEBRUARY 1978

PROTOCOL FOR THE PROTECTION OF THE MEDITERRANEAN SEA AGAINST POLLUTION FROM LAND-BASED SOURCES (LBS PROTOCOL)

ADOPTED 17 MAY 1980 ENTRY INTO FORCE 17 JUNE 1983

PROTOCOL CONCERNING MEDITERRANEAN SPECIALLY PROTECTED AREAS (SPA PROTOCOL)

ADOPTED 2 APRIL 1982 ENTRY INTO FORCE 23 MARCH 1986

PROTOCOL CONCERNING THE PROTECTION OF THE MEDITERRANEAN SEA AGAINST POLLUTION RESULTING FROM EXPLORATION AND EXPLOITATION OF THE CONTINENTAL SHELF AND THE SEA-BED AND ITS SUB-SOIL

(ADOPTION PLANNED FOR 14 OCTOBER 1994)

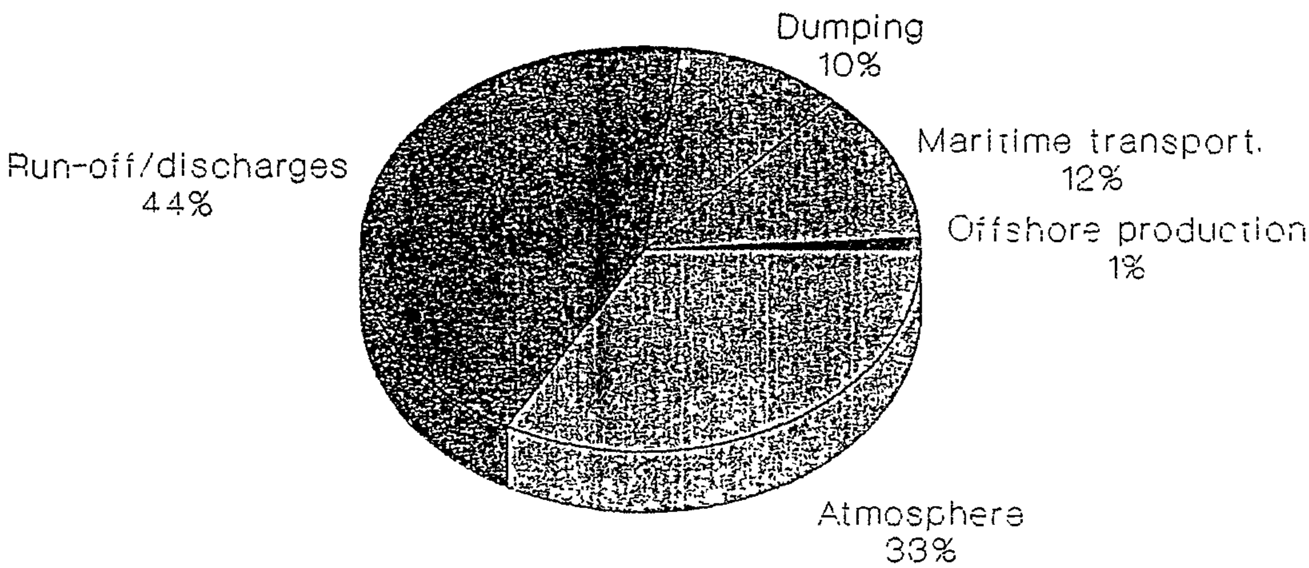
IMPLEMENTATION WORKPLAN FOR LAND-BASED SOURCES PROTOCOL

1.	**USED LUBRICATING OILS**	**1986**
2.	**SHELL-FISH AND SHELL-FISH GROWING WATERS**	**1986**
3.	**CADMIUM AND CADMIUM COMPOUNDS**	**1987**
4.	**MERCURY AND MERCURY COMPOUNDS**	**1987**
5.	**ORGANOHALOGEN COMPOUNDS**	**1987**
6.	**PERSISTENT SYNTHETIC MATERIALS WHICH MAY FLOAT, SINK OR REMAIN IN SUSPENSION**	**1988**
7.	**ORGANOPHOSPHORUS COMPOUNDS**	**1988**
8.	**ORGANOTIN COMPOUNDS**	**1988**
9.	**RADIOACTIVE SUBSTANCES**	**1989**
10.	**CARCINOGENIC, TERATOGENIC OR MUTAGENIC SUBSTANCES**	**1989**
11.	**PATHOGENIC MICROORGANISMS**	**1989**
12.	**CRUDE OILS AND HYDROCARBONS OF ANY ORIGIN**	**1990**
13.	**ZINC, COPPER AND LEAD**	**1990**
14.	**NICKEL, CHROMIUM, SELENIUM AND ARSENIC**	**1990**
15.	**INORGANIC COMPOUNDS OF PHOSPHORUS AND ELEMENTAL PHOSPHORUS**	**1991**
16.	**NON-BIODEGRADABLE DETERGENTS AND OTHER SURFACE-ACTIVE SUBSTANCES**	**1991**
17.	**THERMAL DISCHARGES**	**1991**
18.	**ACID OR ALKALINE COMPOUNDS**	**1992**
19.	**SUBSTANCES HAVING ADVERSE EFFECT ON THE OXYGEN CONTENT**	**1992**
20.	**BARIUM, URANIUM AND COBALT**	**1992**
21.	**CYANIDES AND FLUORIDES**	**1993**
22.	**SUBSTANCES OF A NON-TOXIC NATURE, WHICH MAY BECOME HARMFUL OWING TO THE QUANTITIES DISCHARGED**	**1993**
23.	**ORGANOSILICON COMPOUNDS**	**1993**
24.	**ANTIMONY, TIN AND VANADIUM**	**1994**
25.	**SUBSTANCES WHICH HAVE A DELETERIOUS EFFECT ON THE TASTE AND/OR SMELL OF PRODUCTS FOR HUMAN CONSUMPTION**	**1994**
26.	**BIOCIDES AND THEIR DERIVATIVES NOT COVERED IN ANNEX I**	**1994**
27.	**TITANIUM, BORON AND SILVER**	**1995**
28.	**MOLYBDENUM, BERYLLIUM, THALLIUM AND TELLURIUM**	**1995**

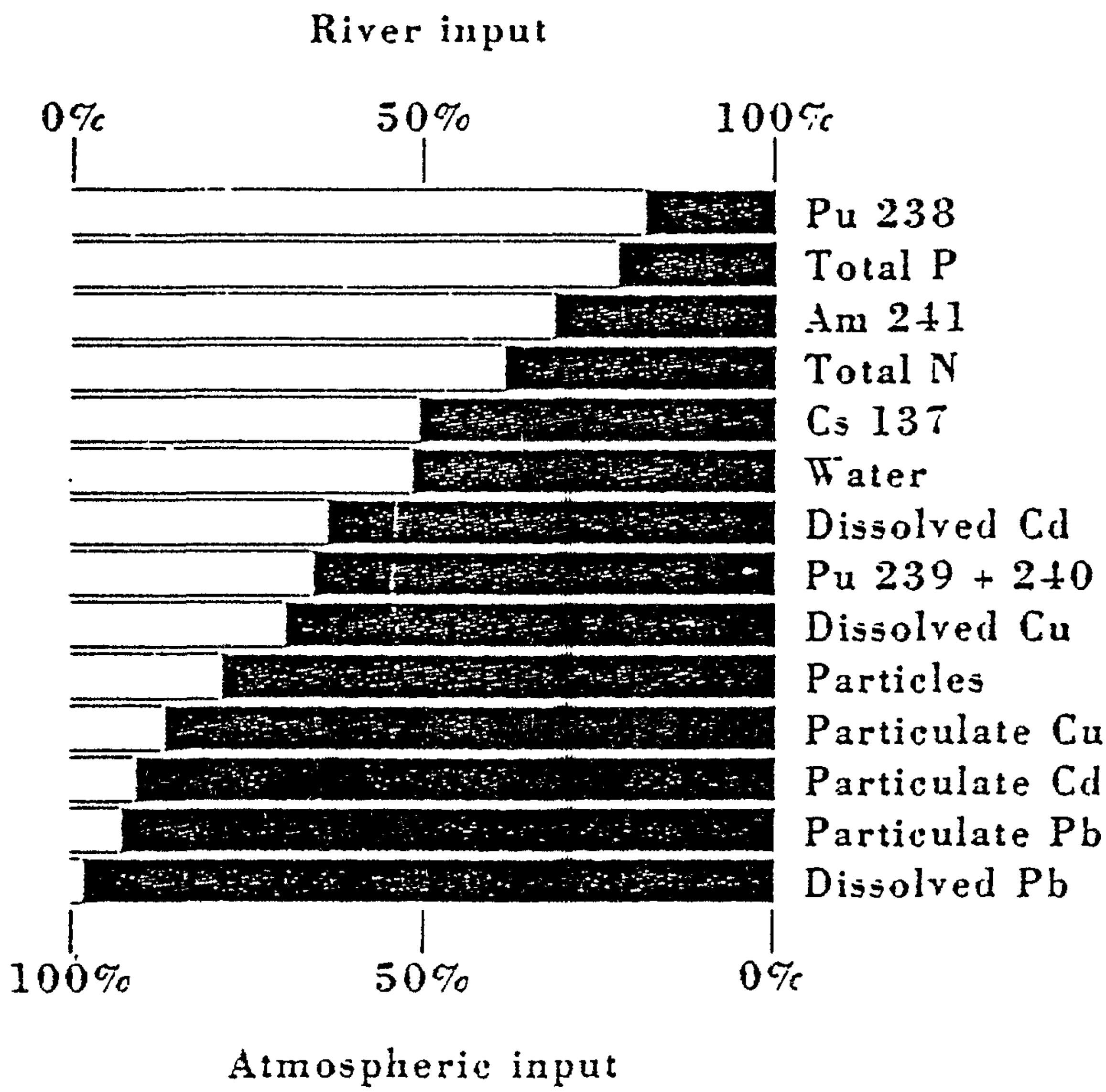
COMMON MEASURES ADOPTED BY THE CONTRACTING PARTIES TO THE BARCELONA CONVENTION

INTERIM ENVIRONMENTAL QUALITY CRITERIA CONCERNING MERCURY CONTENT OF SEAFOOD	**SEPT. 1985**
INTERIM ENVIRONMENTAL QUALITY CRITERIA CONCERNING MICROBIAL CONCENTRATIONS OF BATHING WATERS	**SEPT. 1985**
MAXIMUM CONCENTRATION OF MERCURY IN EFFLUENT DISCHARGES	**SEPT. 1987**
ENVIRONMENTAL QUALITY CRITERIA CONCERNING MICROBIAL CONCENTRATIONS OF SHELLFISH WATERS	**SEPT. 1987**
CONTROL OF POLLUTION BY USED LUBRICATING OILS	**OCT. 1989**
CONTROL OF POLLUTION BY CADMIUM AND CADMIUM COMPOUNDS	**OCT. 1989**
CONTROL OF POLLUTION BY ORGANOTIN COMPOUNDS	**OCT. 1989**
CONTROL OF POLLUTION BY ORGANOHALOGEN COMPOUNDS	**OCT. 1989**
CONTROL OF POLLUTION BY ORGANOPHOSPHORUS COMPOUNDS	**OCT. 1991**
CONTROL OF POLLUTION BY PERSISTENT SYNTHETIC MATERIALS	**OCT. 1991**
CONTROL OF POLLUTION BY RADIOACTIVE SUBSTANCES	**OCT. 1991**
CONTROL OF POLLUTION BY PATHOGENIC MICROORGANISMS	**OCT. 1991**
CONTROL OF POLLUTION BY CARCINOGENIC, TERATOGENIC AND MUTAGENIC SUBSTANCES	**OCT. 1993**

Relative contribution of contaminants to the marine environment

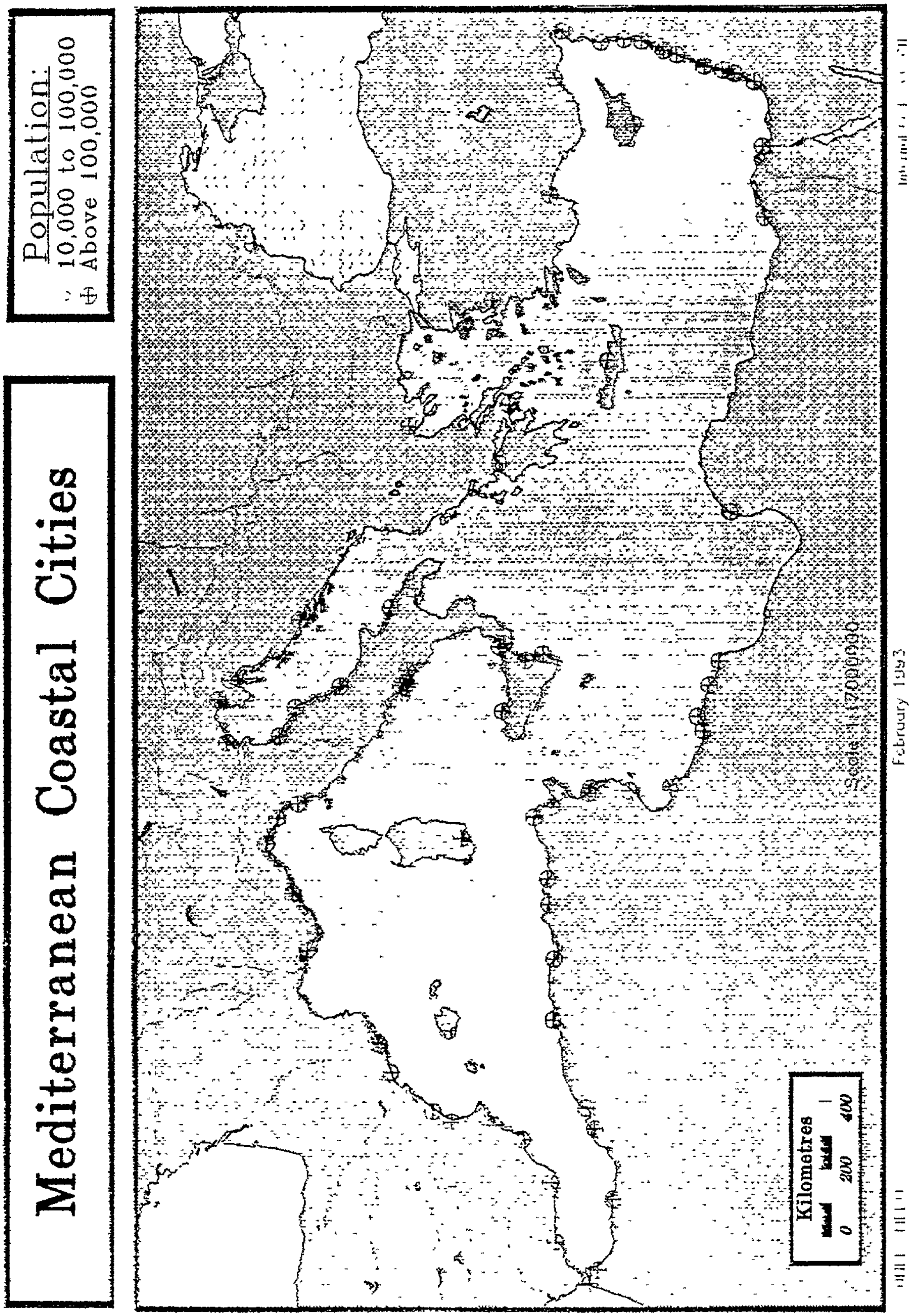


(based on GESAMP 1990)

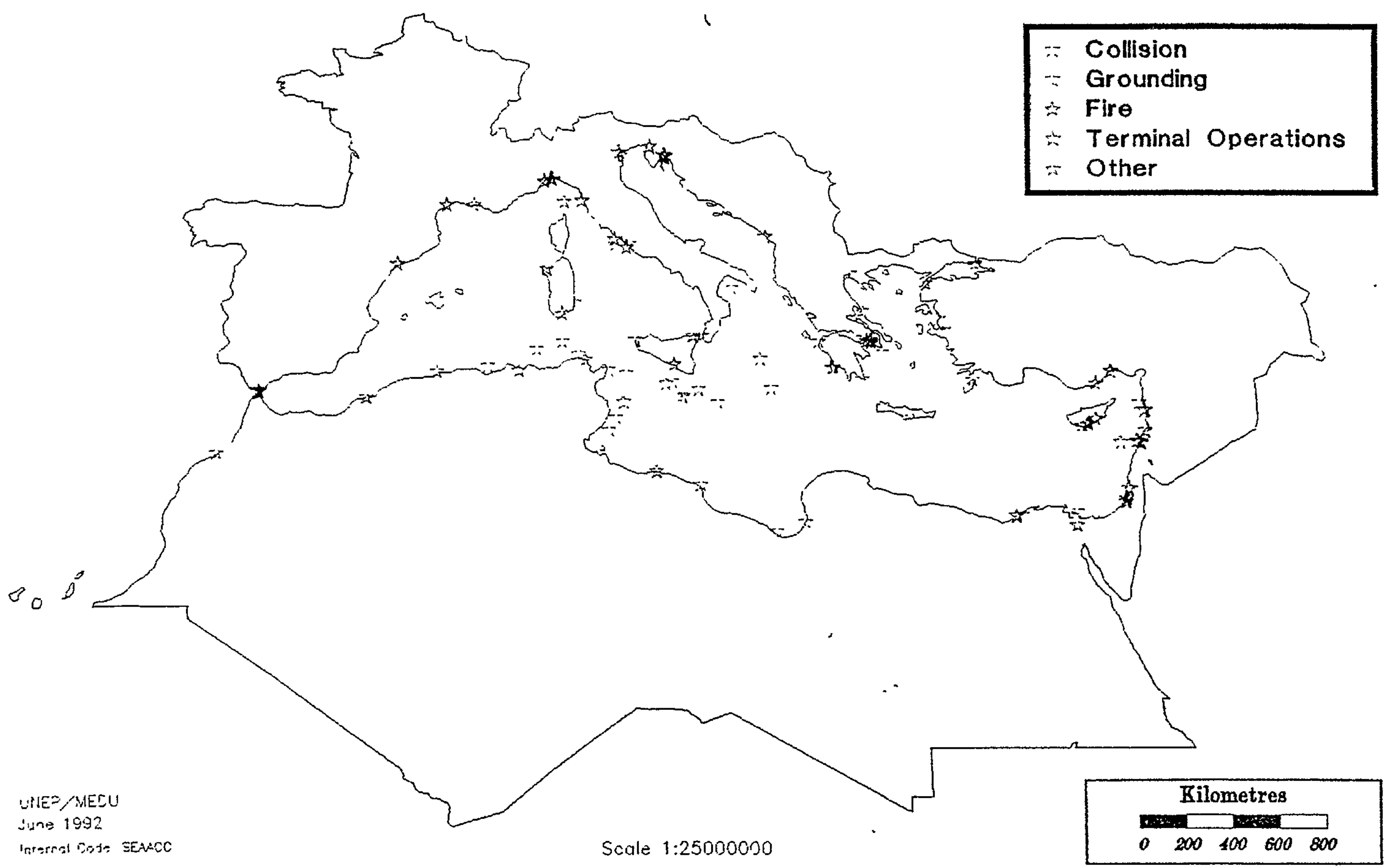

River input
0%
50%
100%
Pu 238
Total P
Am 241
Total N
Cs 137
Water
Dissolved Cd
Pu 239 + 240
Dissolved Cu
Particles
Particulate Cu
Particulate Cd
Particulate Pb
Dissolved Pb
100%
50%
0%
Atmospheric input

LENGTH OF MEDITERRANEAN COASTLINE

COUNTRIES	CONTINENT	ISLANDS	TOTAL	%
SPAIN	1,679	910	2,589	5.74
FRANCE	901	802	1,703	3.77
MONACO			5	0.01
ITALY	4,184	3,766	7,950	17.61
SLOVENIA			41	0.09
CROATIA	1,745	4,028	5,773	12.79
BOSNIA			24	0.05
MONTE NEGRO			278	0.62
ALBANIA			470	1.04
GREECE	7,300	7,700	15,000	33.23
TURKEY	4,141	499	4,640	10.28
CYPRUS			537	1.20
SYRIA			152	0.34
LEBANON			195	0.43
ISRAEL			222	0.49
EGYPT			996	2.21
TUNISIA			1,028	2.29
LIBYA			1,685	3.73
MALTA			190	0.42
ALGERIA			1,300	2.88
MOROCCO			352	0.78
TOTAL	19,950	17,705	45,130	100.00


Mediterranean Coastal Cities
Population:
10,000 to 100,000
Above 100,000
Kilometres
0 200 400
February 1993

Mediterranean Sea Accidents



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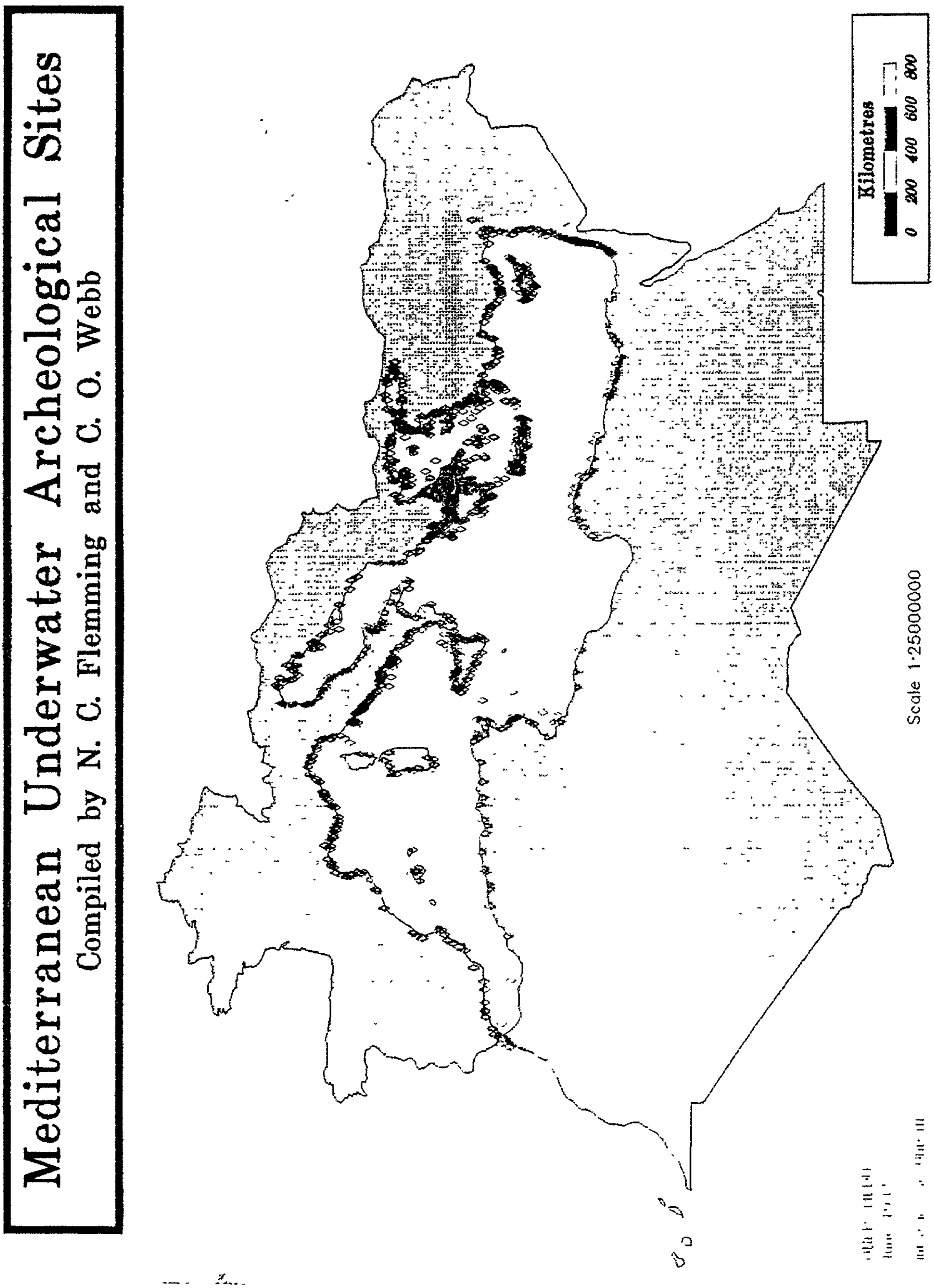
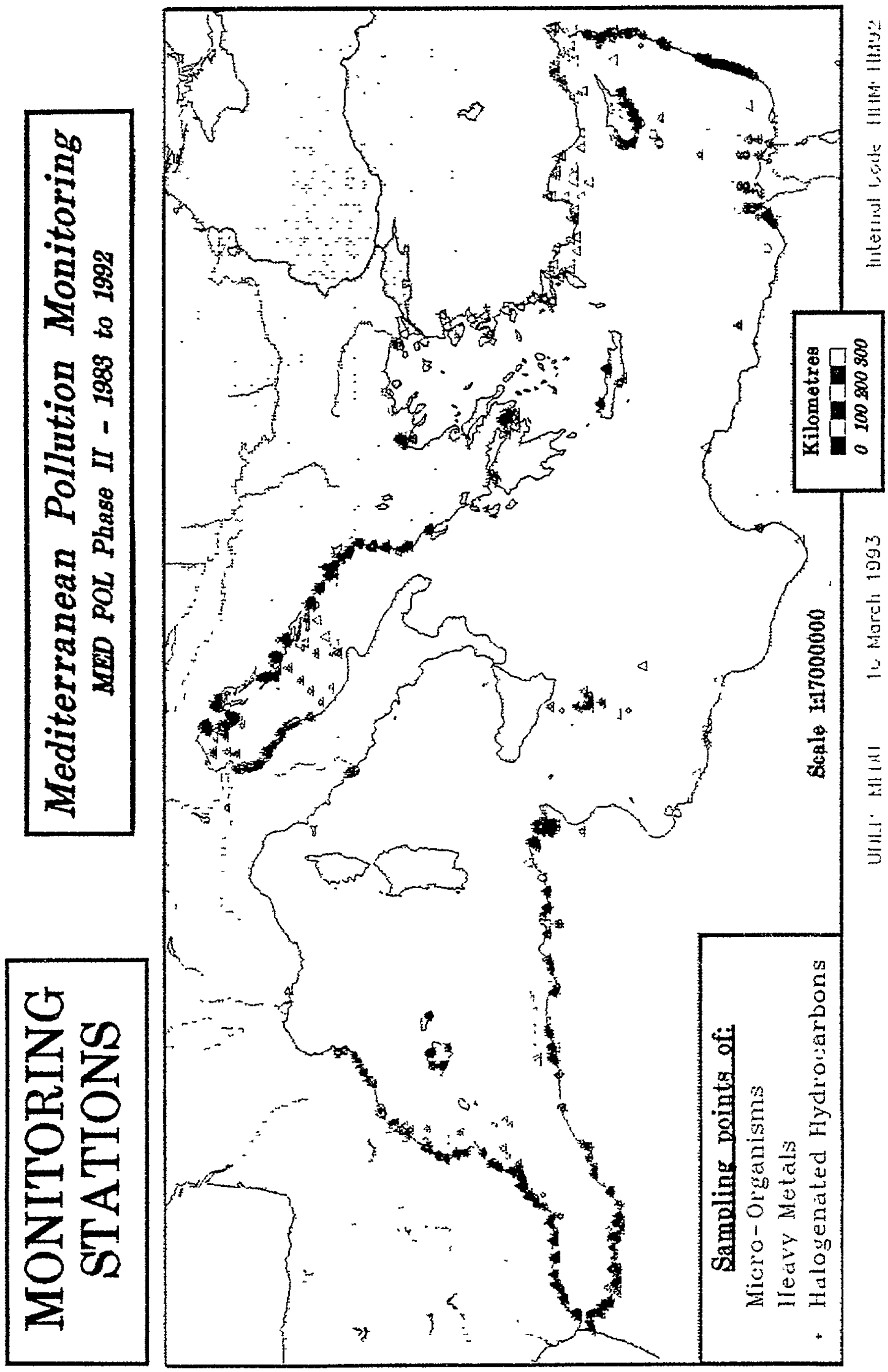
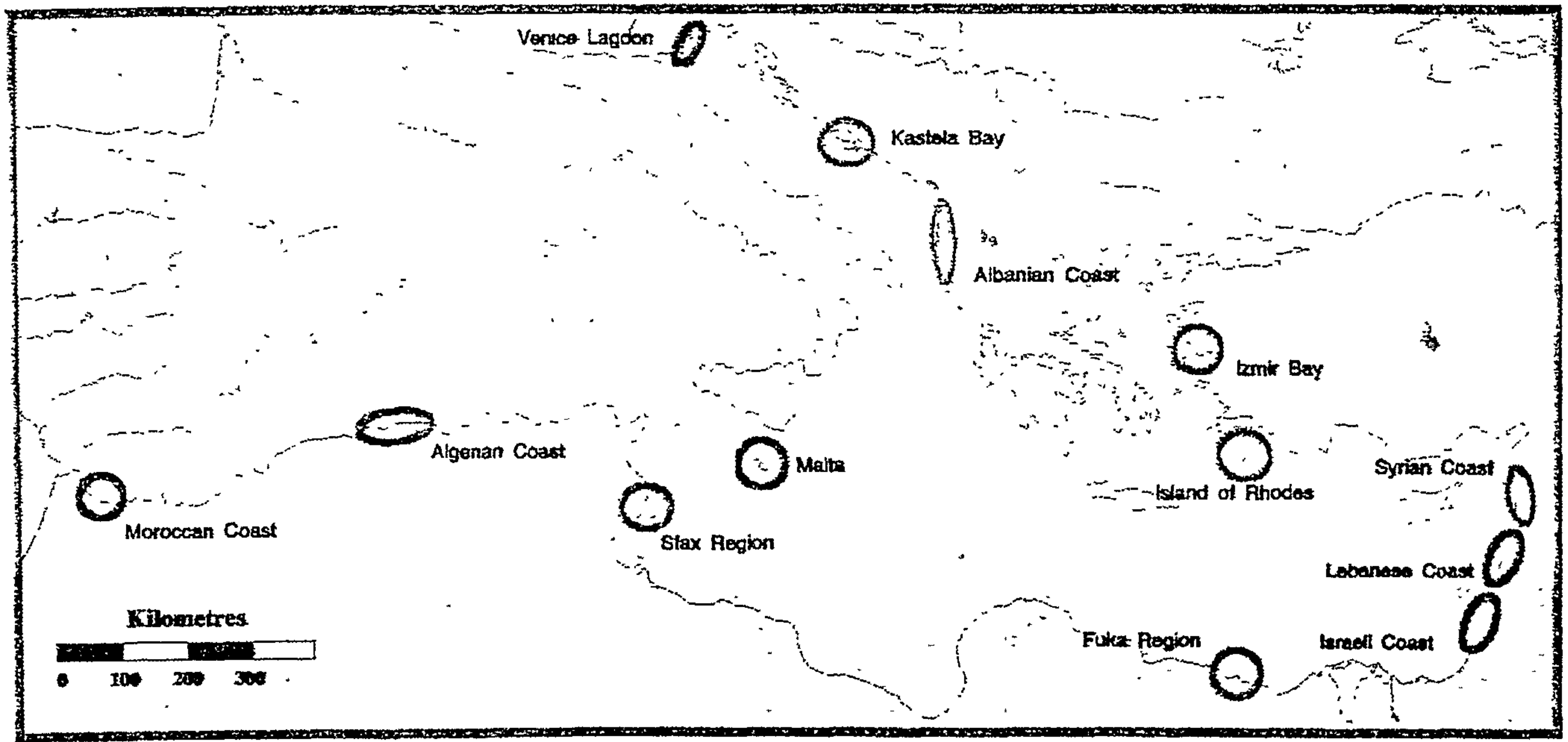
UNEP/MEDU
June 1992
Internal Code SEAACC


Mediterranean Underwater Archeological Sites
Compiled by N. C. Flemming and C. O. Webb
Kilometres
0 200 400 600 800
Scale 1·25000000


MONITORING STATIONS
Mediterranean Pollution Monitoring
MED POL Phase II - 1983 to 1992
Sampling points of:
Micro-Organisms
Heavy Metals
Halogenated Hydrocarbons
Kilometres
0 100 200 300
Scale 1:17000000
March 1993

Coastal Area Management Programmes

TO BE FINALIZED | INITIATED | TO BE INITIATED | TO BE APPROVED



UNEP/MEDU 5 July 1993 Scale 1:18000000 Internal Code. CAMPNOB2

DEFINITION	**A form of advanced collaboration with national and local authorities and institutions based on principles of sustainable development and integrated coastal zone management**
MAIN OBJECTIVES	**to introduce or develop the process of integrated planning and management of Mediterranean coastal zones, to contribute to a sustainable development and environment protection**
CAMP PHASES: **1. PREPARATORY**	 **- data collection** **- upgrading of institutional capacities** **- environmental knowledge (assimilative capacity, identification of problems and climatic impacts** **- programme formulation**
2. IMPLEMENTATION	**- database** **- training** **- coastal zone scenarios (development, climatic changes)** **- integrated planning studies (resource evaluation, impact assessment, development outlook, immediate and long-term mitigation measures)** **- programme of an integrated plan**
3. FOLLOW-UP	**- preparation of an integrated plan** **- implementation** **- monitoring** **- re-evaluation**

Methodological Framework for MAP Coastal Area Management Programmes

1 IMPLEMENTATION OF LEGAL INSTRUMENTS

LBS Protocol (monitoring, survey of pollution, common control measures); Emergency Protocol; Dumping protocol, MARPOL Convention)

2 RESOURCE EVALUATION, PROTECTION AND MANAGEMENT

Water; Soil; Forests; Coastline; Marine ecosystems; Protected areas

3 ACTIVITIES

Evaluation and trends

4 NATURAL HAZARDS AND PHENOMENA

Seismic risk; Implications of climatic changes

5 PLANNING AND MANAGEMENT TOOLS

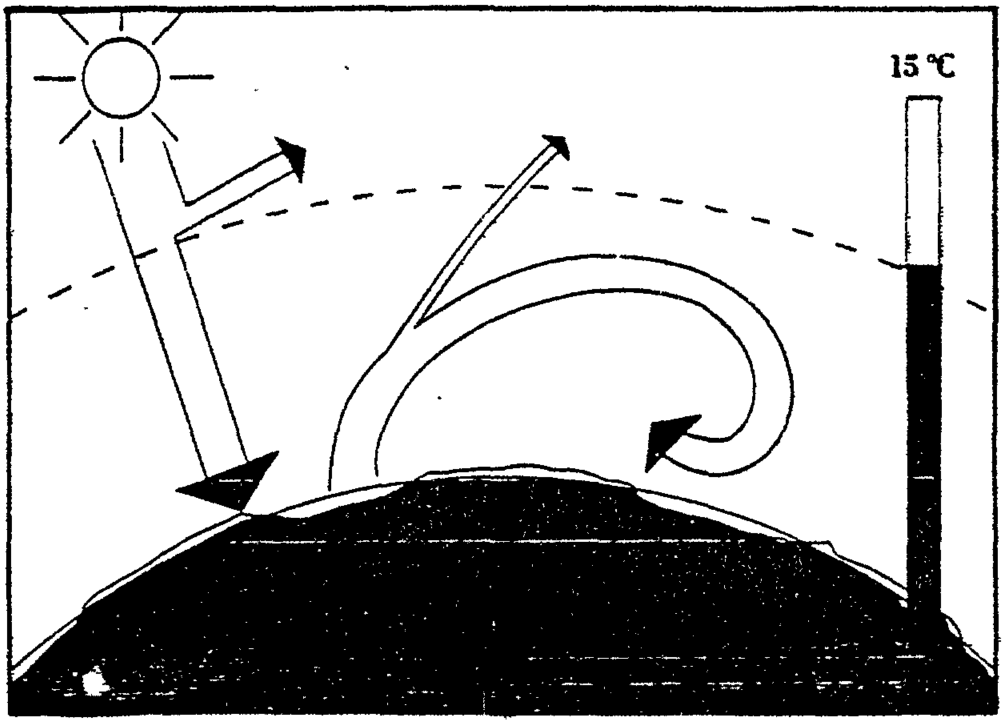
Database; GIS; EIA; Carrying Capacity Assessment for tourism activities

6 DEVELOPMENT-ENVIRONMENT SCENARIOS

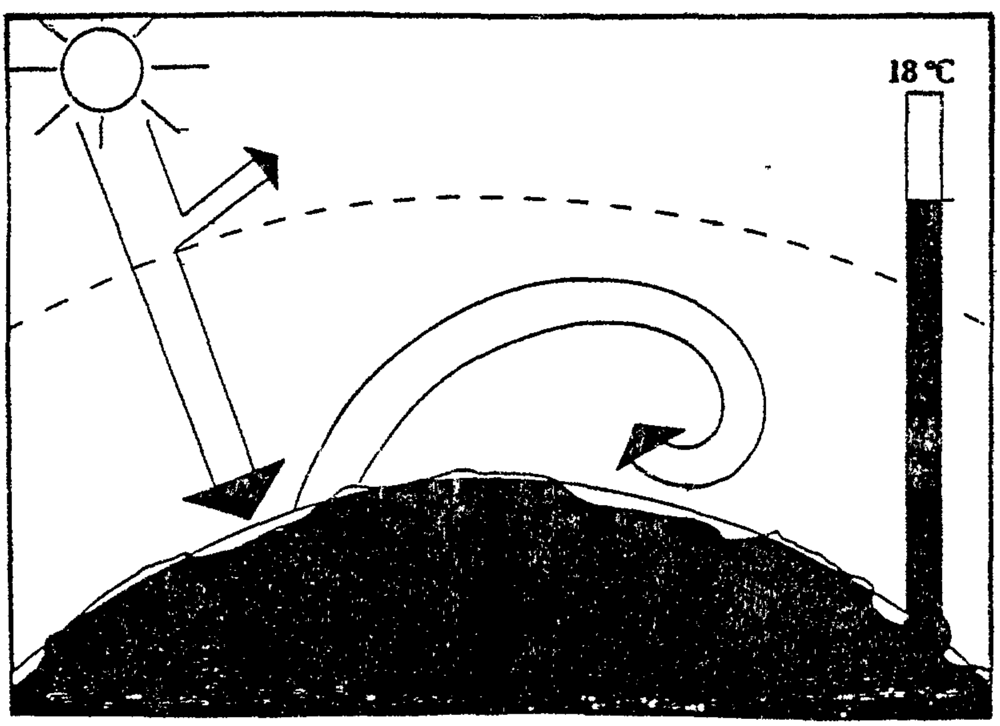
7 INTEGRATED PLANNING AND MANAGEMENT

Integrated planning studies; Resources protection and management plans

Standard Content of CAMPs

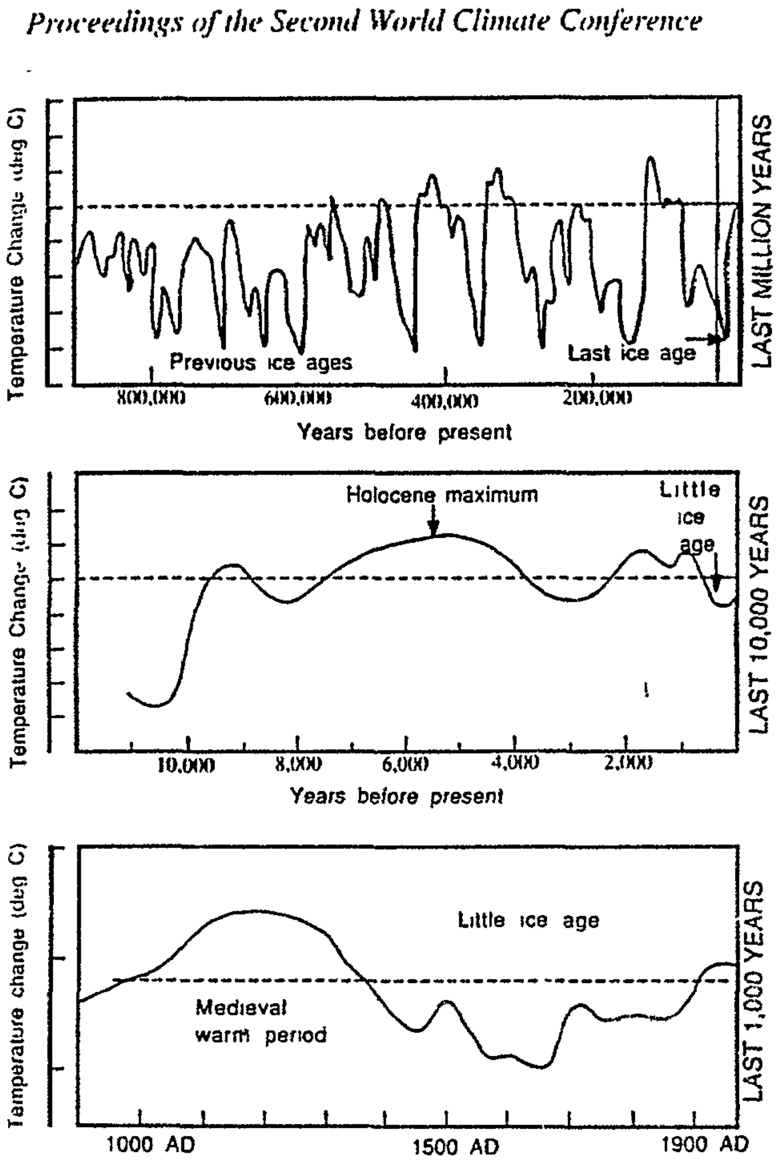


GREENHOUSE EFFECT AT PRESENT

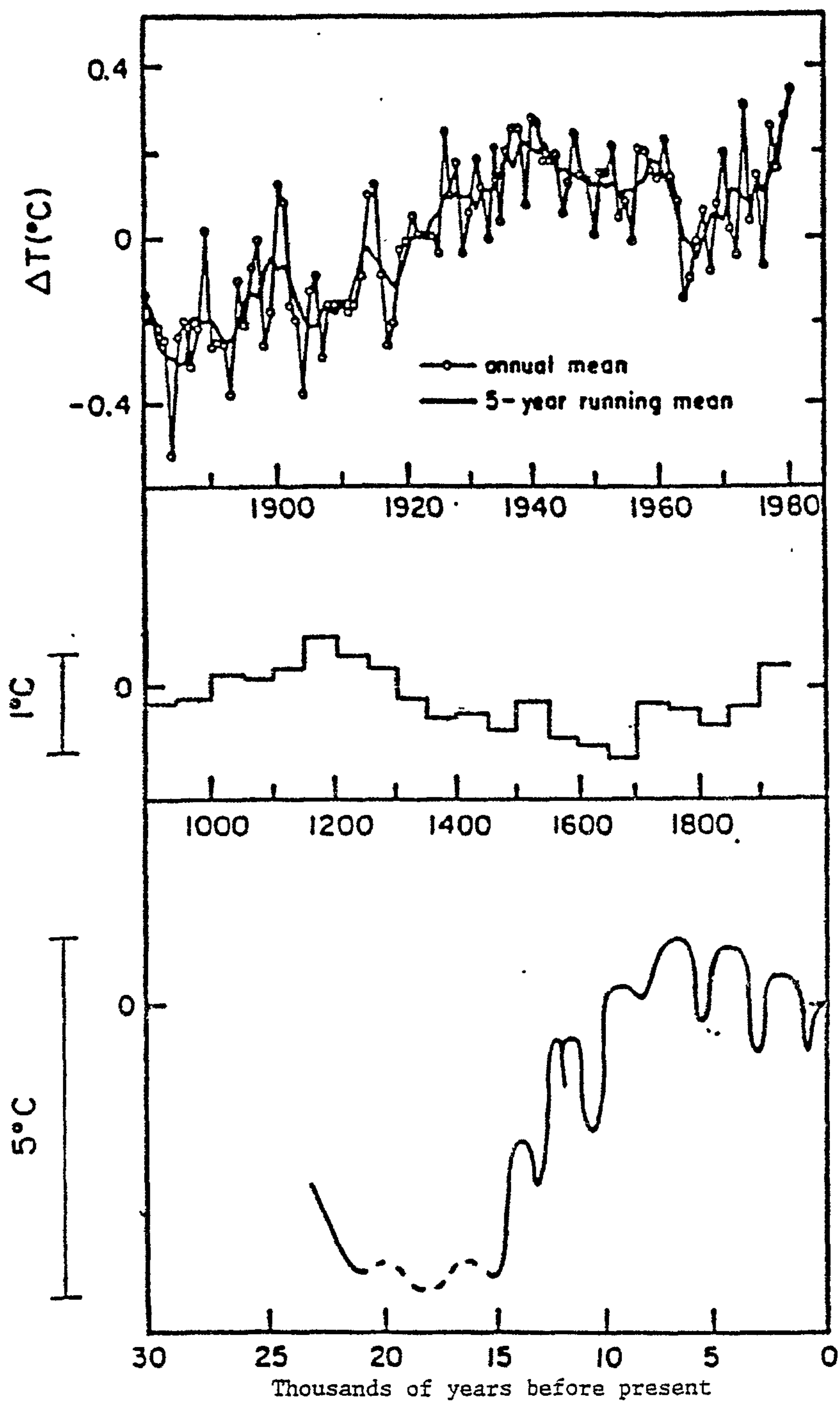


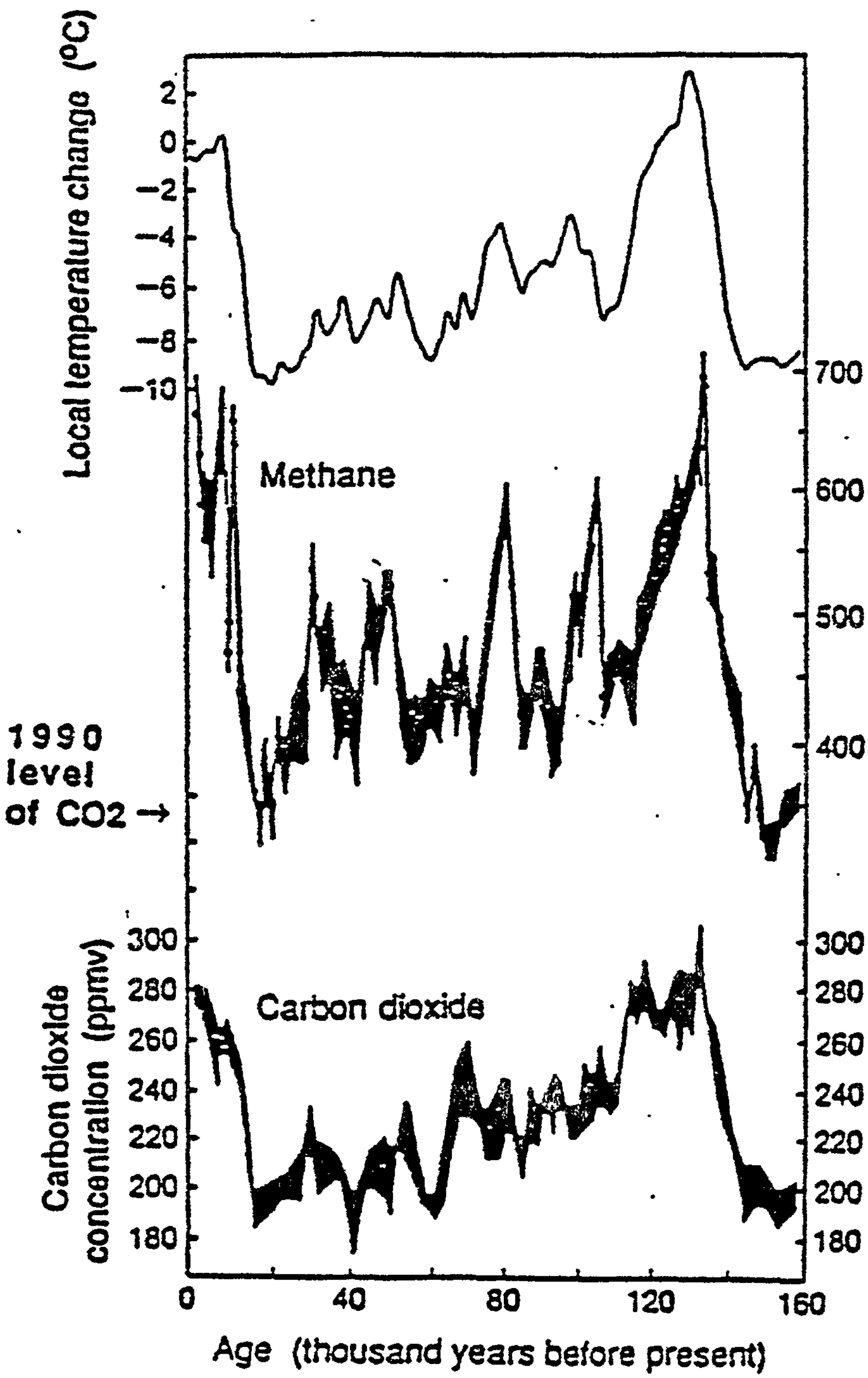
GREENHOUSE EFFECT IN THE FUTURE

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

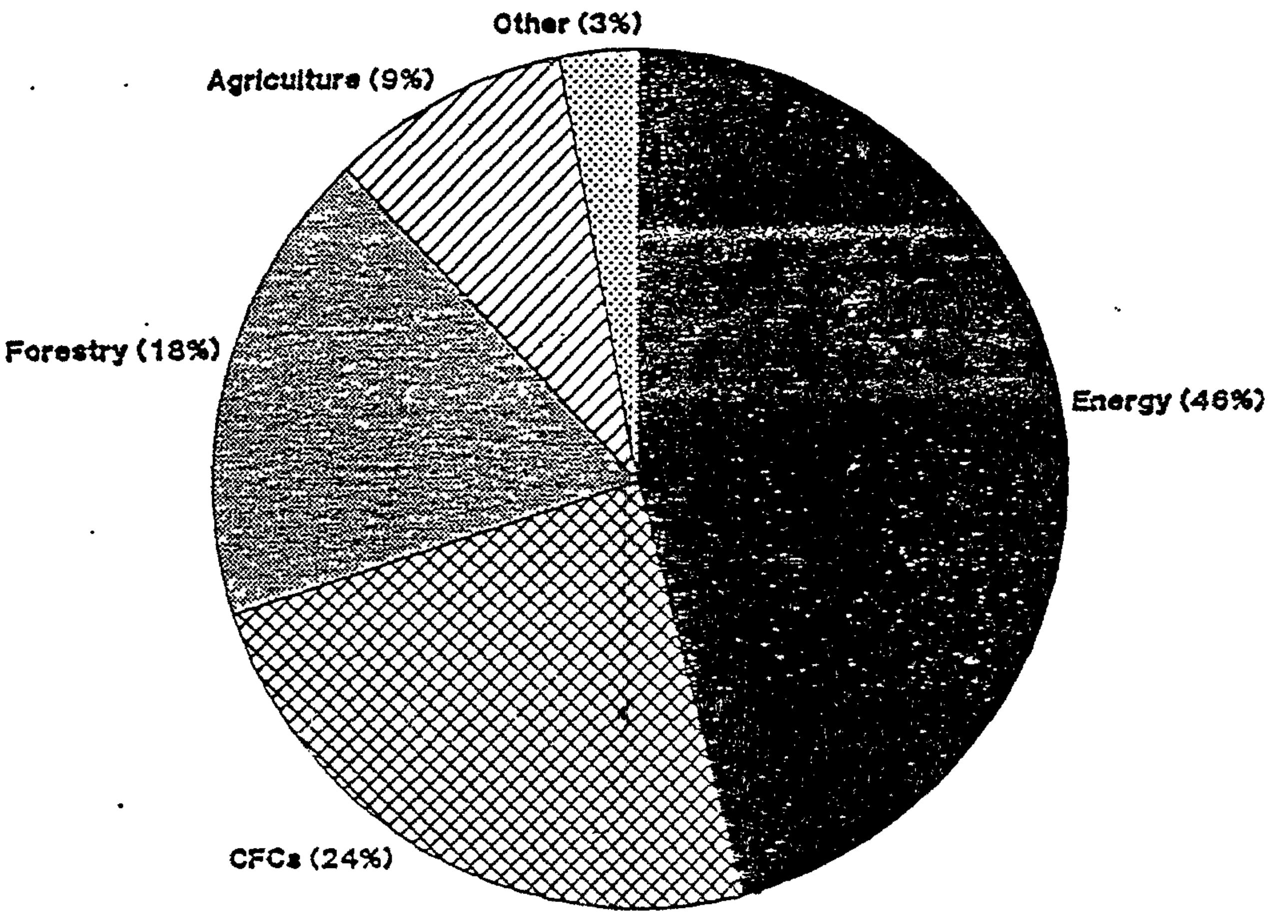


Schematic diagrams of global temperature variations since the Pleistocene on time-scales. The dashed line nominally represents conditions near the beginning of the twentieth century


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

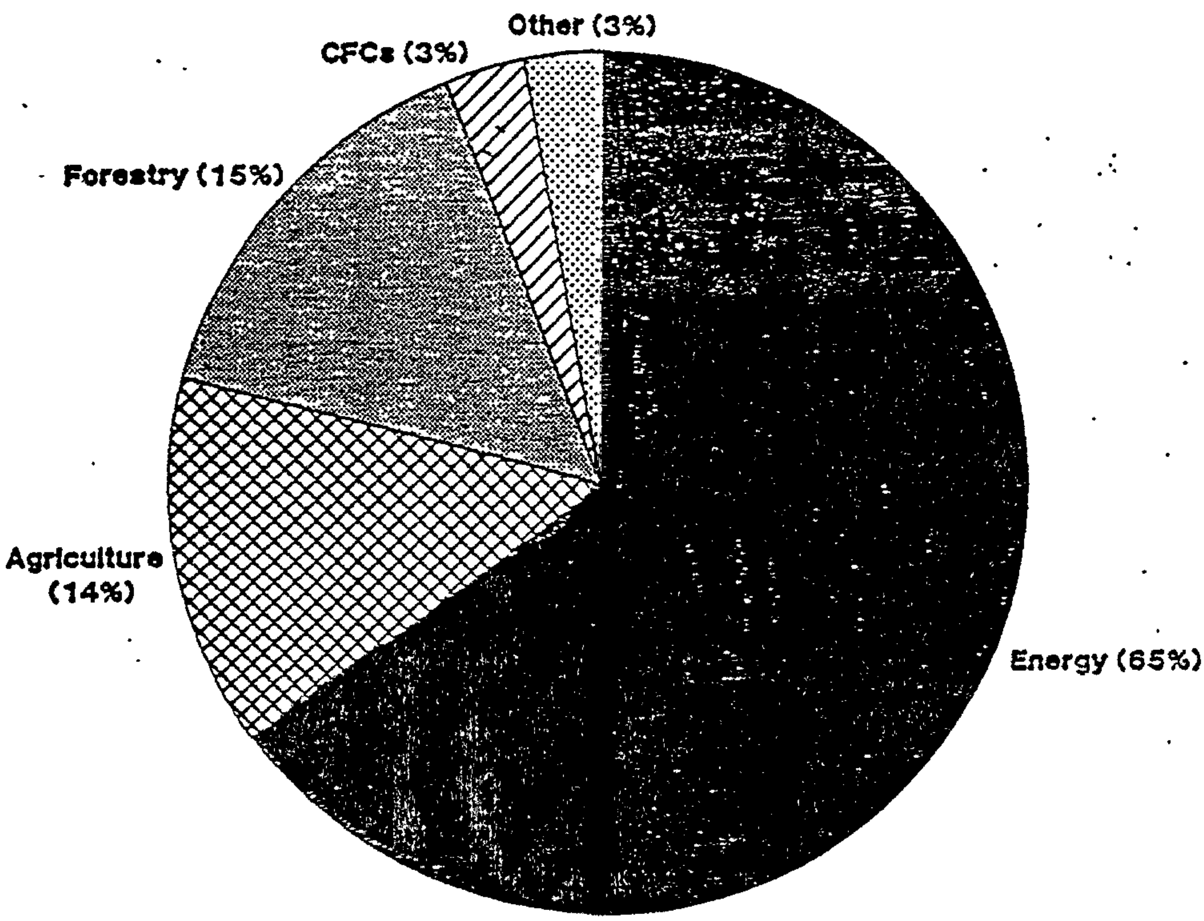

Local temperature change (°C)
2
0
−2
−4
−6
−8
−10
Methane
700
600
500
400
Methane concentration (ppmv)
1990 level of CO2 →
Carbon dioxide
Carbon dioxide concentration (ppmv)
300
280
260
240
220
200
180
0
40
80
120
160
Age (thousand years before present)

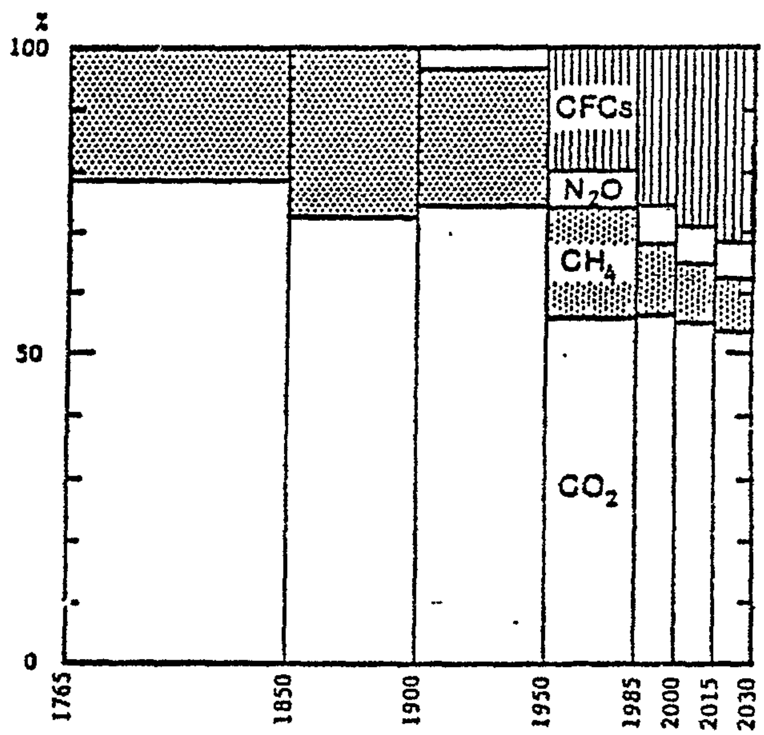
**CONTRIBUTION TO RADIATIVE FORCING
BY SECTOR
1980s**



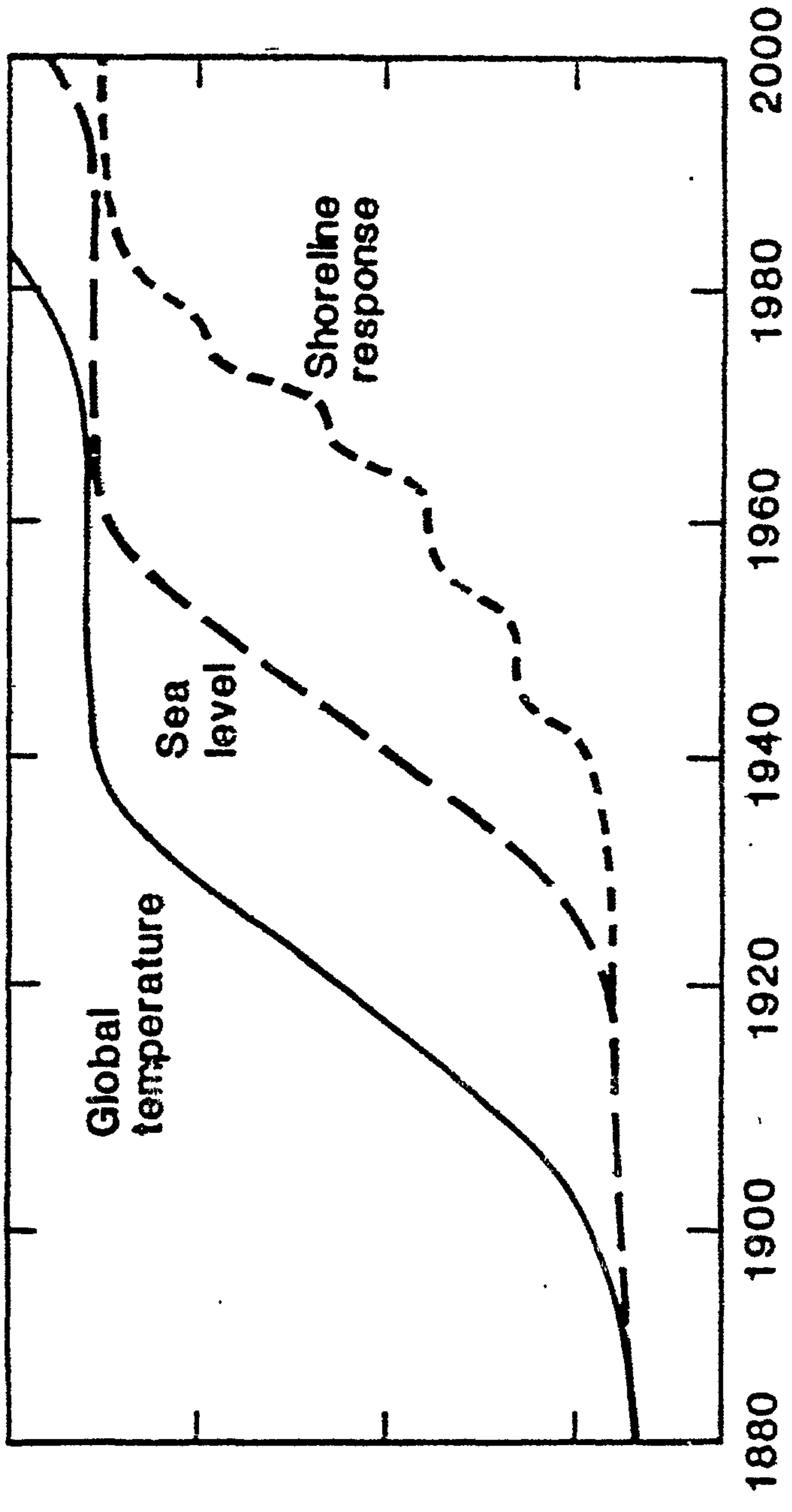
CONTRIBUTION TO RADIATIVE FORCING BY SECTOR: 2025 EMISSIONS

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

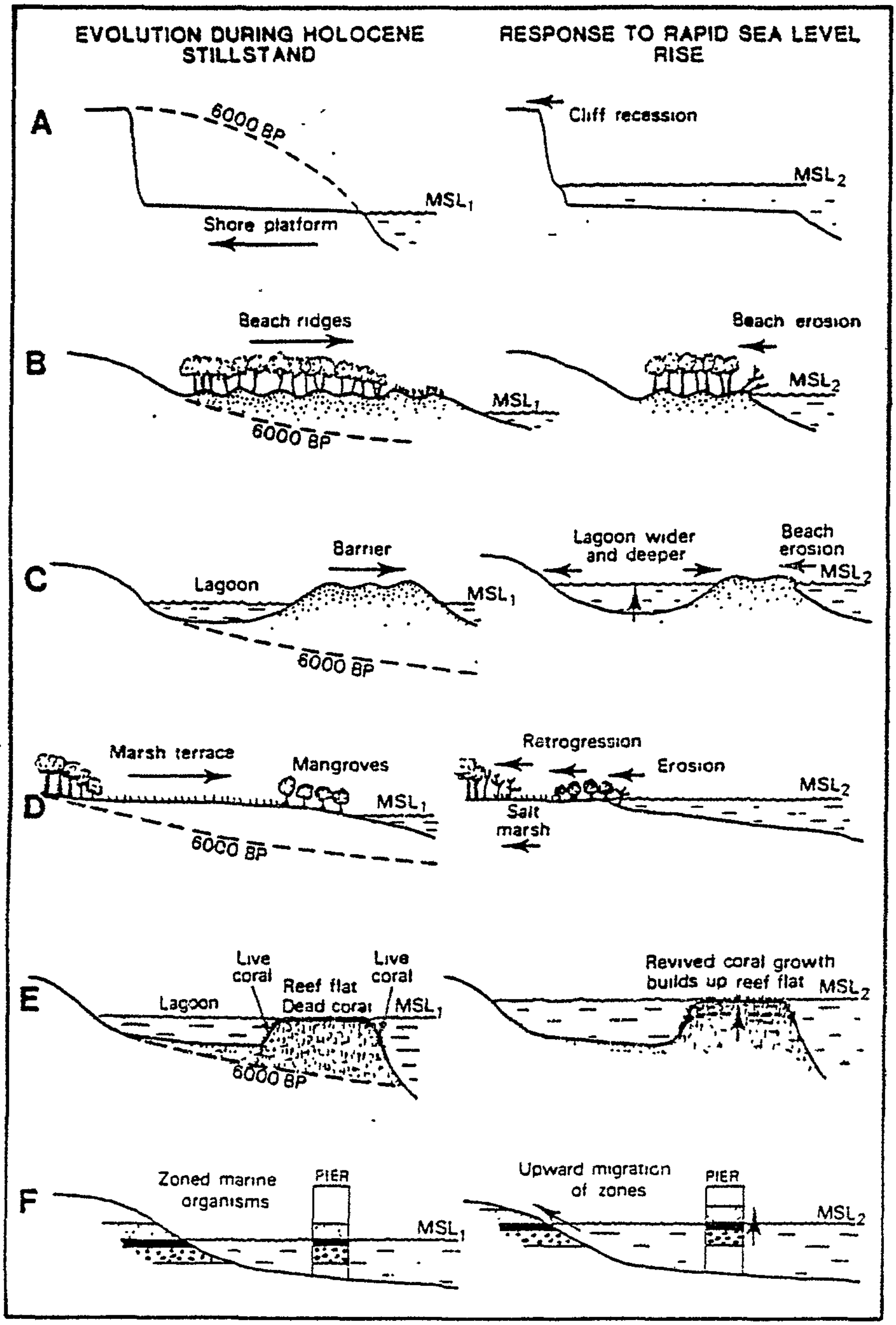




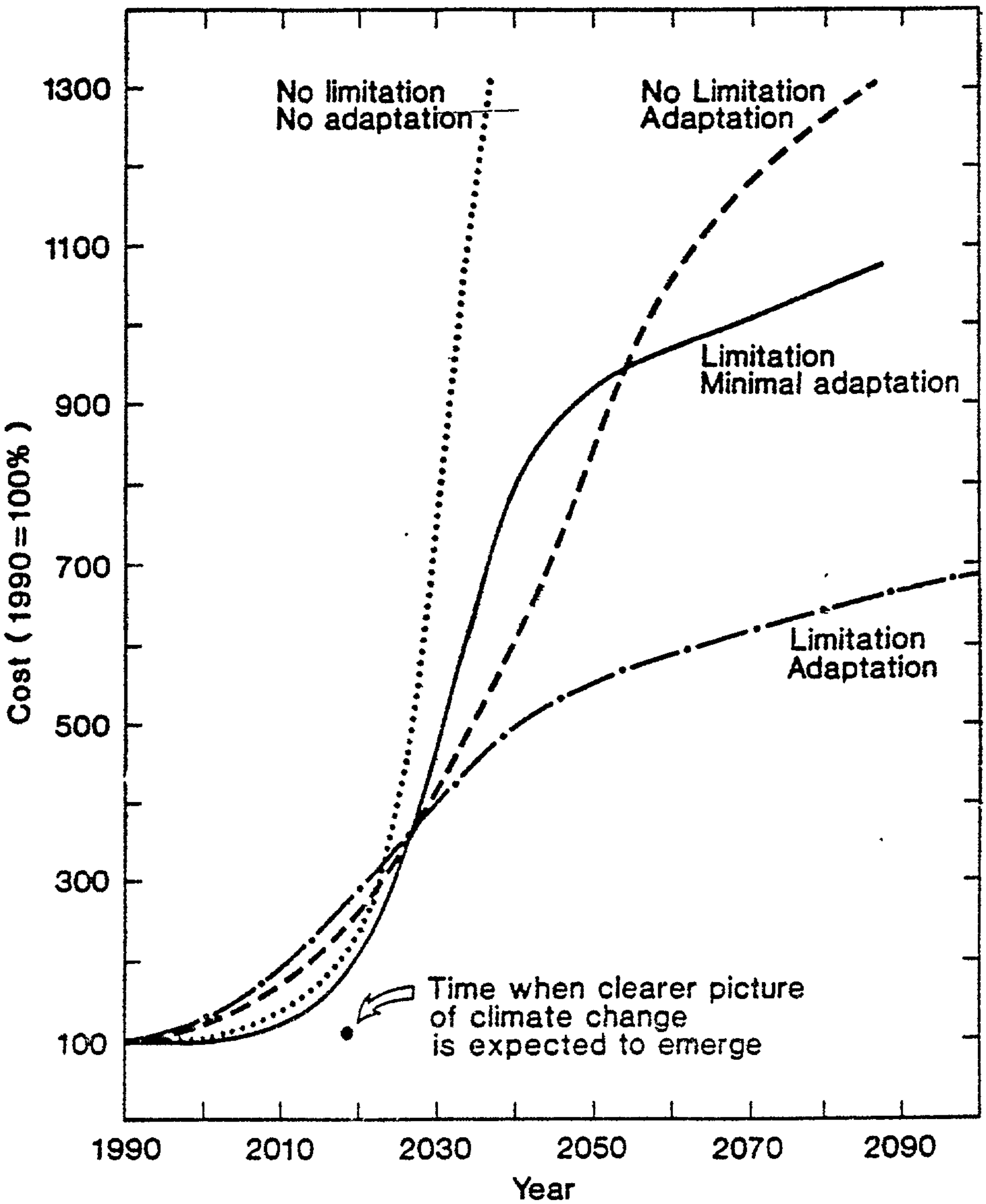
Source: Wigley (1987)



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).



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



Cost issues for management of a rising sea level. Very approximate relative costs are shown as percentages. No limitation: no additional actions on greenhouse emissions. Limitation: reduce emission by 2% per year. No adaptation: retreat from coastal damage. Minimal adaptation: ad hoc measures after disasters. Adaptation: selective coastal engineering measures. (From G.I. Pearman (Ed.), Greenhouse, Planning for climate change, CSIRO, 1989).

Future changes in global mean temperature and sea level

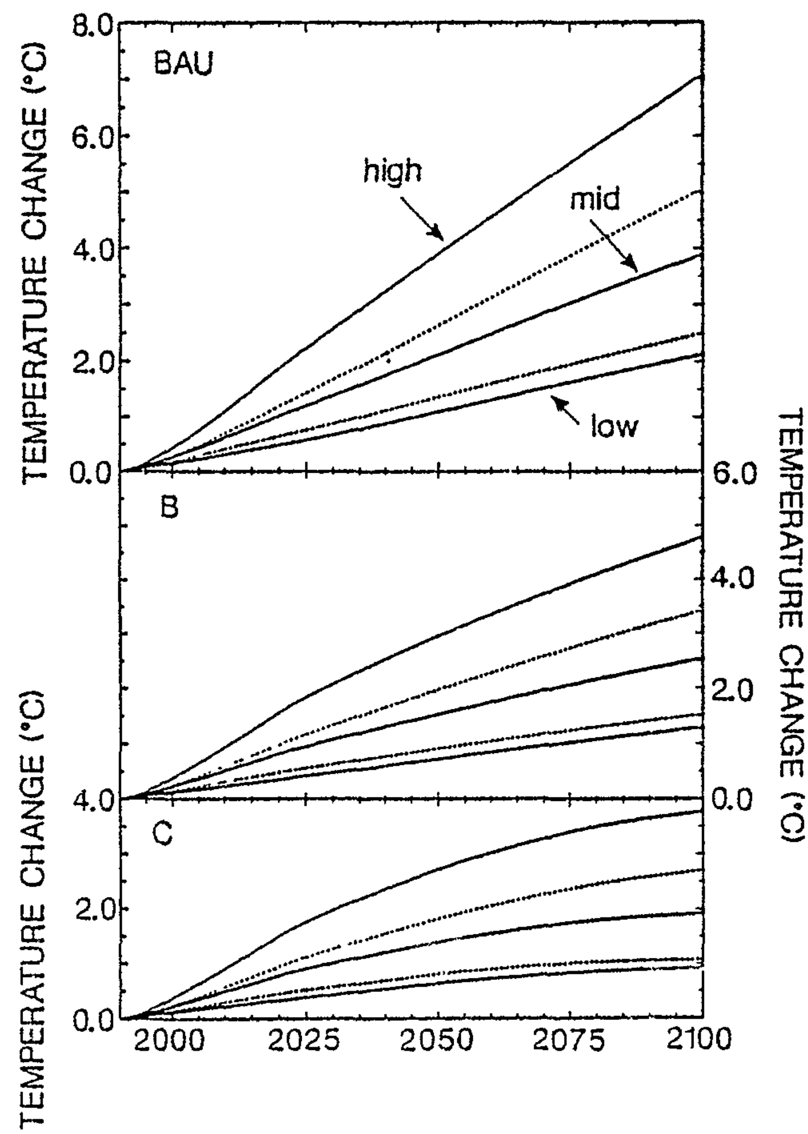


Fig. 7.8 Full range of projections of global mean temperature change under IPCC forcing scenarios BAU (top panel), B (centre) and C (bottom). The three full lines in each panel show low, mid and high estimates, based on the following model parameter values:

T.M.L. Wigley and S.C.B. Raper

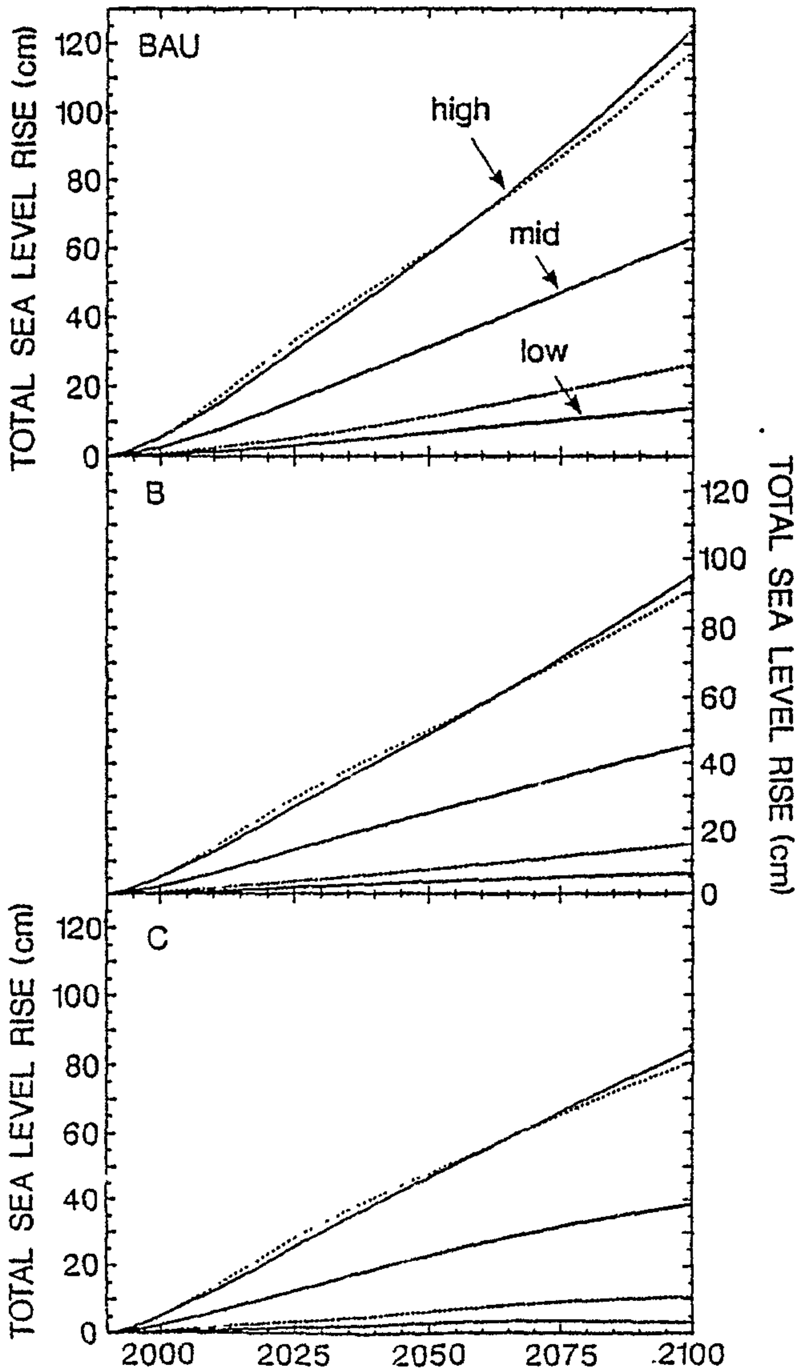
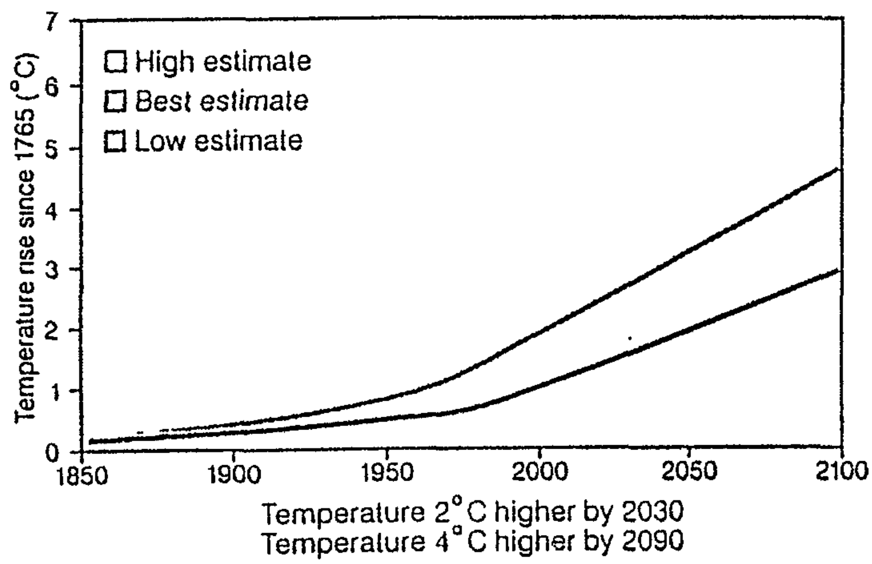
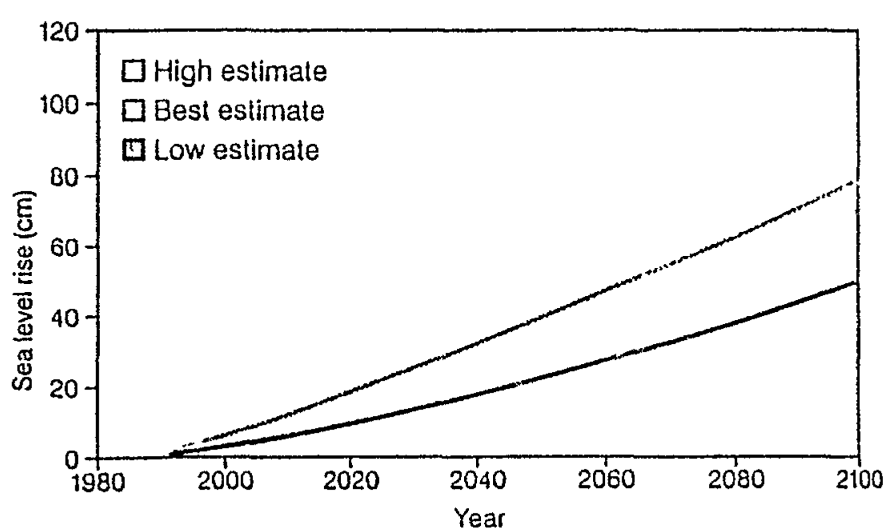


Fig. 7.9 Full range of projections of total global mean sea level rise under IPCC forcing scenarios BAU (top panel), B (centre) and C (bottom). The three full lines in each panel show low, mid and high estimates, with the two extremes based on parameter sets chosen to give extreme values of thermal expansion. The parameter values used are:



Temperature rise. IPCC Business as Usual Scenario



Sea Level rise IPCC Business as Usual Scenario

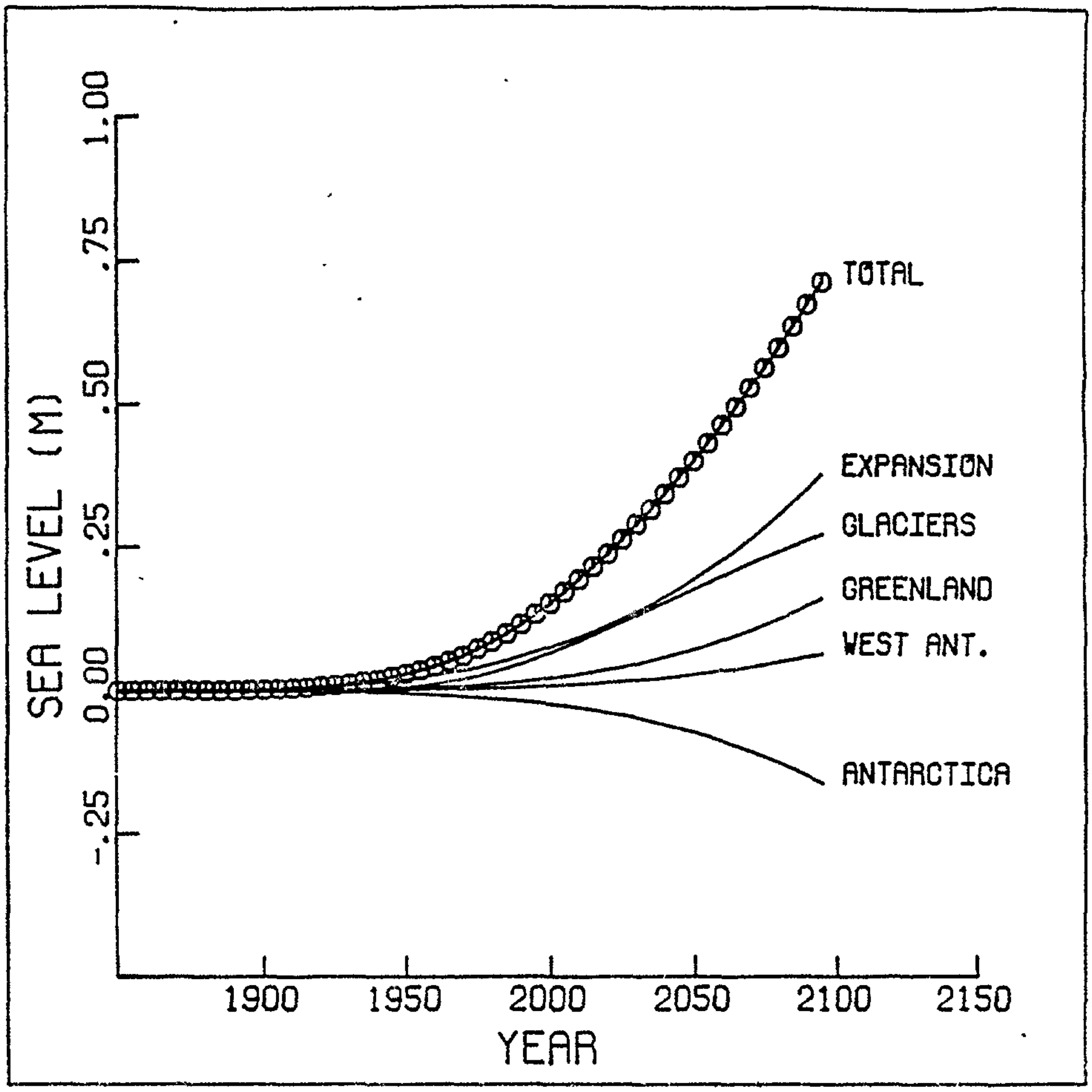
PROJECTED GLOBAL MEAN SEA LEVEL RISE

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


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

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

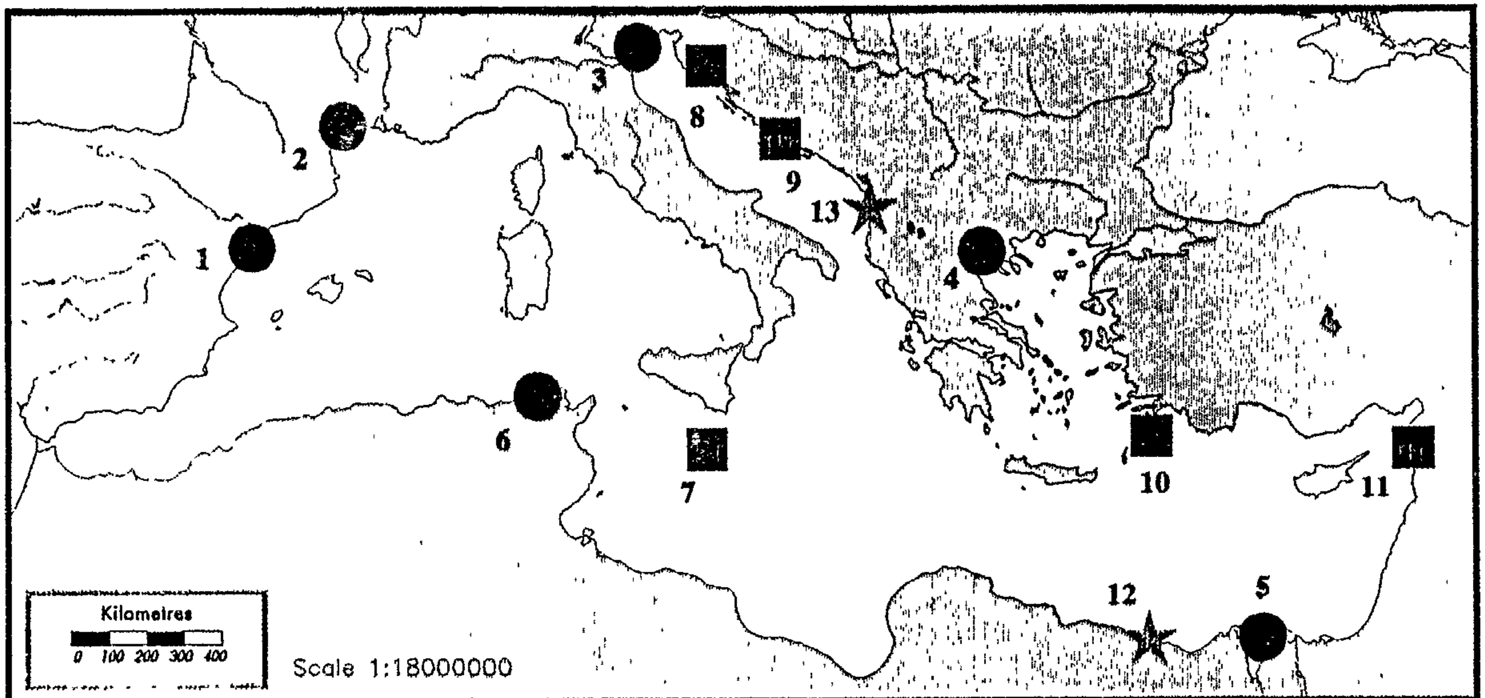
- MAY CHANGE THE FREQUENCY OF HARMFUL ALGAL BLOOMS; WHICH MAY:

    - IMPACT FISH AND SHELLFISH RESOURCES; AND MAY THEREFORE:

        - AFFECT SUBSISTENCE AND COMMERCIAL ACTIVITIES IN HUMAN SOCIETIES.

THE MEDITERRANEAN REGION

Location of Case Studies on Implications of Climatic Changes



UNEP MEDU — 11 January 1994 — Internal Code CASESTUD

1987 - 1989

1. EBRO DELTA
2. GULF OF LION/RHONE DELTA
3. PO DELTA/VENICE LAGOON
4. THERMAIKOS GULF
5. NILE DELTA
6. LAKES ICHKEUL/BIZERTE

1990 - 1992

7. MALTA ISLAND
8. CRES/LOSINJ ISLANDS
9. KASTELA BAY
10. RHODES ISLAND
11. SYRIAN COAST

1993 - 1994

12. FUKA MATROUH
13. ALBANIAN COAST

OVERVIEWS AND CASE STUDIES

THE OVERVIEWS AND CASE STUDIES WERE EXPECTED:

- **TO EXAMINE THE POSSIBLE EFFECTS OF THE SEA LEVEL CHANGES ON THE COASTAL ECOSYSTEMS (DELTAS, ESTUARIES, WETLANDS, COASTAL PLAINS, CORAL REEFS, MANGROVES, LAGOONS, ETC.);**

- **TO EXAMINE THE POSSIBLE EFFECTS OF TEMPERATURE ELEVATIONS ON THE TERRESTRIAL AND AQUATIC ECOSYSTEMS, INCLUDING THE POSSIBLE EFFECTS ON ECONOMICALLY IMPORTANT SPECIES;**

- **TO EXAMINE THE POSSIBLE EFFECTS OF CLIMATIC, PHYSIOGRAPHIC AND ECOLOGICAL CHANGES ON THE SOCIO-ECONOMIC STRUCTURES AND ACTIVITIES; AND**

- **TO DETERMINE AREAS OR SYSTEMS WHICH APPEAR TO BE MOST VULNERABLE TO THE ABOVE CHANGES.**

OBJECTIVES OF SITE SPECIFIC CASE STUDIES

OBJECTIVES OF THE CASE STUDY ARE:

- **TO IDENTIFY AND ASSESS POSSIBLE IMPLICATIONS OF EXPECTED CLIMATE CHANGE 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 CLIMATE CHANGE; AND**

- **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.**

OUTLINE OF THE SITE SPECIFIC STUDY

THE FOLLOWING OUTLINE FOR EACH STUDY IS USED, WITH POSSIBLE SLIGHT MODIFICATIONS DUE TO LOCAL SPECIFICITIES:

EXECUTIVE SUMMARY

1. INTRODUCTION

1.1. BACKGROUND
1.2. BASIC INFORMATION CONCERNING THE STUDY AREA
1.3. METHODOLOGY AND ASSUMPTIONS USED IN THE STUDY

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

2.1. CLIMATE
2.2. LITHOSPHERE
2.3. HYDROSPHERE
2.4. ATMOSPHERE
2.5. NATURAL ECOSYSTEMS
  2.5.1. TERRESTRIAL
  2.5.2. FRESHWATER
  2.5.3. MARINE
2.6. MANAGED ECOSYSTEMS
  2.6.1. AGRICULTURE
  2.6.2. FISHERIES
  2.6.3. AQUACULTURE
  2.6.4. SILVICULTURE
2.7. ENERGY AND INDUSTRY
2.8. TOURISM
2.9. TRANSPORT AND SERVICES
2.10. HEALTH AND SANITATION
2.11. POPULATION AND SETTLEMENT PATTERN

3. SYNTHESIS OF FINDINGS

3.1. PRESENT SITUATION
3.2. MAJOR EXPECTED CHANGES AND THEIR IMPACTS

4. RECOMMENDATIONS FOR ACTION

4.1. PREVENTIVE POLICIES AND MEASURES
4.2. ADAPTIVE POLICIES AND MEASURES

REFERENCES

GENERAL CONCLUSIONS AND RECOMMENDATIONS

According to a broad scientific consensus, increasing atmospheric concentrations of greenhouse gases resulting from human activities are expected to lead to changes in climate. These changes may have started already and their continuation may now be inevitable. The rise in global temperature and mean sea level are expected to be among the major consequences of the future climate change.

In spite of uncertainties surrounding the rate and magnitude of future climate changes, the scenarios developed by the Climatic Research Unit of the University of East Anglia (see Annex IV), seem a reasonable basis for the assessment of the possible impacts of climate changes on the natural and man-made systems of the case study areas. Nevertheless, work on improving the quality (precision) of area/site specific climate scenarios should continue in order to assist in the formulation of meaningful and effective policies and measures which are responsive to changes which may be specific for each site.

Another source of uncertainty stems from the presently limited capability for making predictions about the behaviour of natural and social systems under normal or stressed conditions, such as those which may be caused by changing climate conditions. Improving this capability should be considered as a matter of high priority, and should be achieved by:

- a more imaginative and creative use of existing data, for example more work on changes in extreme climate events;

- development of models and scenarios related to subjects such as future climate conditions, economic development, population dynamics, taking into account the possible non-linear responses of many systems and processes;

- building of necessary data bases and capabilities for use and interpretation of data; and

- target oriented research and monitoring in fields contributing to an improved understanding of the trends in key parameters and processes (e.g. temperature, sea level, extreme and episodic events, soil erosion and moisture), and to the development of new or improved models and scenarios relevant to climate changes.

The marine and terrestrial environments of the five study areas are heavily influenced by climate-driven events and processes in regions far removed from these areas (e.g. the hydrology of the North Adriatic drainage basin; the structure and movement of Levantine water masses; the cyclogenesis of the Mediterranean basin). Research and observation programmes should be intensified for a better understanding of the impact of these events and processes on the case study areas.

There are no reliable methodologies for the assessment of the risks and benefits which may be associated with climate changes; determination of the most vulnerable sites, systems or processes; or formulation of options for response policies and measures. On the basis of the experience gained through the eleven Mediterranean site-specific climate impact case studies, an attempt should be made to develop such methodologies and to test their applicability.

The impacts of non-climatic factors (e.g. population increases, present development plans) on the natural environment and the society in the study areas will, during the next several decades, most probably far exceed the direct impacts of greenhouse warming. Nevertheless, changes in climate conditions may contribute significantly to the continuous increase of society's vulnerability towards adverse environmental conditions and impair its sustainable development.

Many unprotected shorelines and low-lying regions are at present suffering from erosion and are experiencing periodic inundation during high sea level conditions (e.g. storms). Any increase in the mean sea-level, or in the frequency and intensity of episodic events affecting that level, would worsen the present situation. Highly site specific combination of protective and adaptive measures should be applied to avoid or mitigate the problems caused by erosion and inundation, with preference for soft, non-engineering solutions whenever they can be successfully applied.

The elevation of mean sea level would lead to increased seawater intrusion into the coastal aquifers and to a worsening of the difficulties, already present in the five study areas, with the supply of freshwater. Timely adoption and implementation of freshwater management policies and measures, based on realistic analyses and projections for freshwater demand, are an appropriate response to the expected climate change impacts on the aquifers of these areas.

The negative impact on natural vegetation and crops, as well as on the marine ecosystems in the study areas, is expected to be slight until the middle of the 21st century, except in areas where climatic or soil conditions are marginal. Forest areas would be adversely affected by the increased frequency of fires. Gradual latitudinal and altitudinal shifts in vegetation belts due to changes in precipitation and temperature might be experienced in some of the study areas. The positive economic impact of these shifts may be considerable, particularly if combined with modern agricultural practices (e.g. genetic engineering).

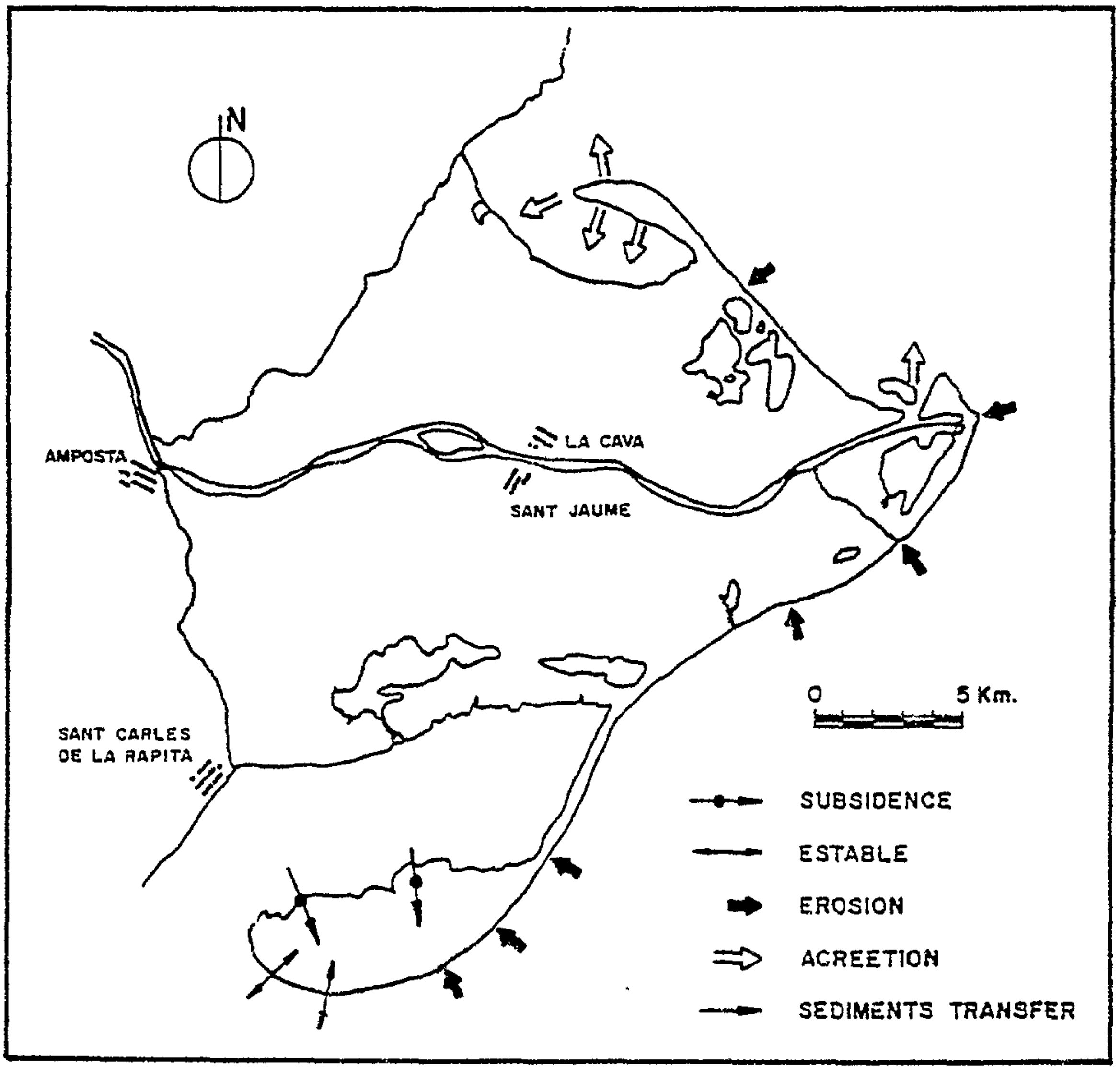
Until the end of the next century, the changes in climatic conditions are expected to have only a very limited impact on the distribution and dynamics of the human population in the study areas, which will remain strongly influenced by non climatic factors. In areas where the development of tourism is at present limited by temperature conditions, an increase in temperature would lead to a gradual extension of the tourist season, with concomitant problems and benefits.

By the middle of the next century, the impact on coastal settlements and construction (harbours, coastal roads, etc.) might be considerable, as most of them are only slightly above the present mean-sea level. Historic settlements and sites may require special, often quite expensive, protection measures, while the problems of other structures should be solved by their gradual transformation or transfer.

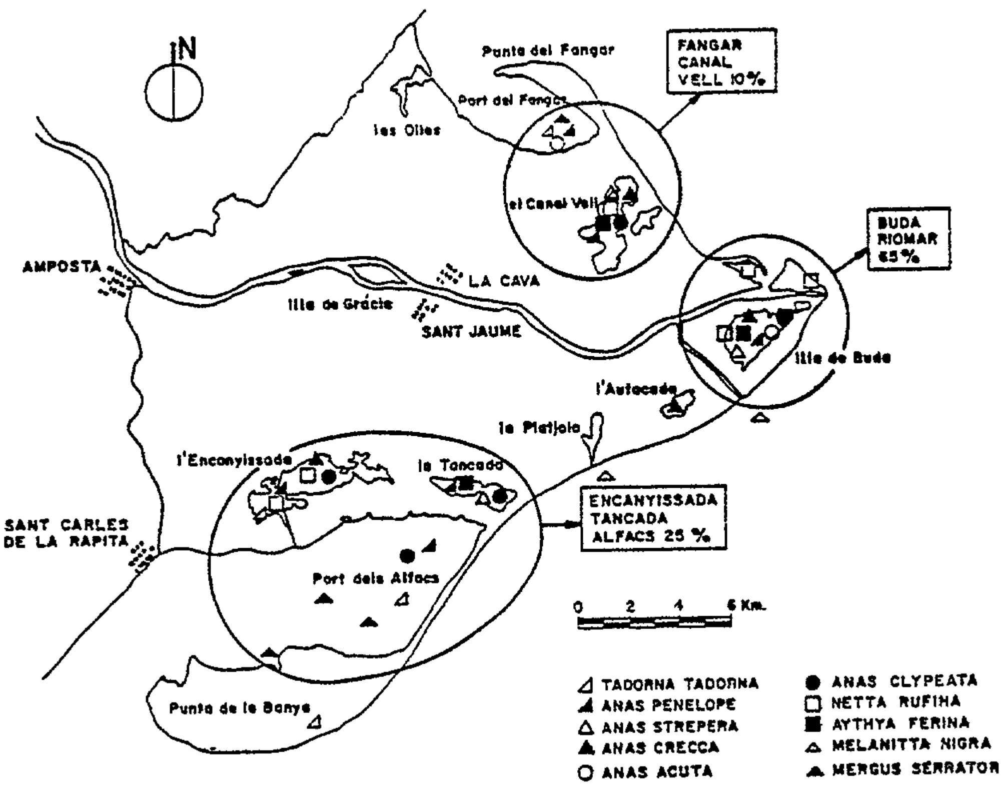
Sectorial approaches to the problems which may be associated with the impact of climate change will not lead to their long-term solution. The most promising general policy option to avoid or mitigate the eventual negative impact of expected climate changes is the broad application of integrated coastal zone planning and management which takes into account, among other factors, the requirements imposed by climate change.

Raising of the awareness of the general public about the problems which may be associated with expected climate changes is of great importance as it may facilitate the societal decision-making process and may generate the necessary public support for measures and expenditures which may be seen, by an uninformed public, as being unjustified.

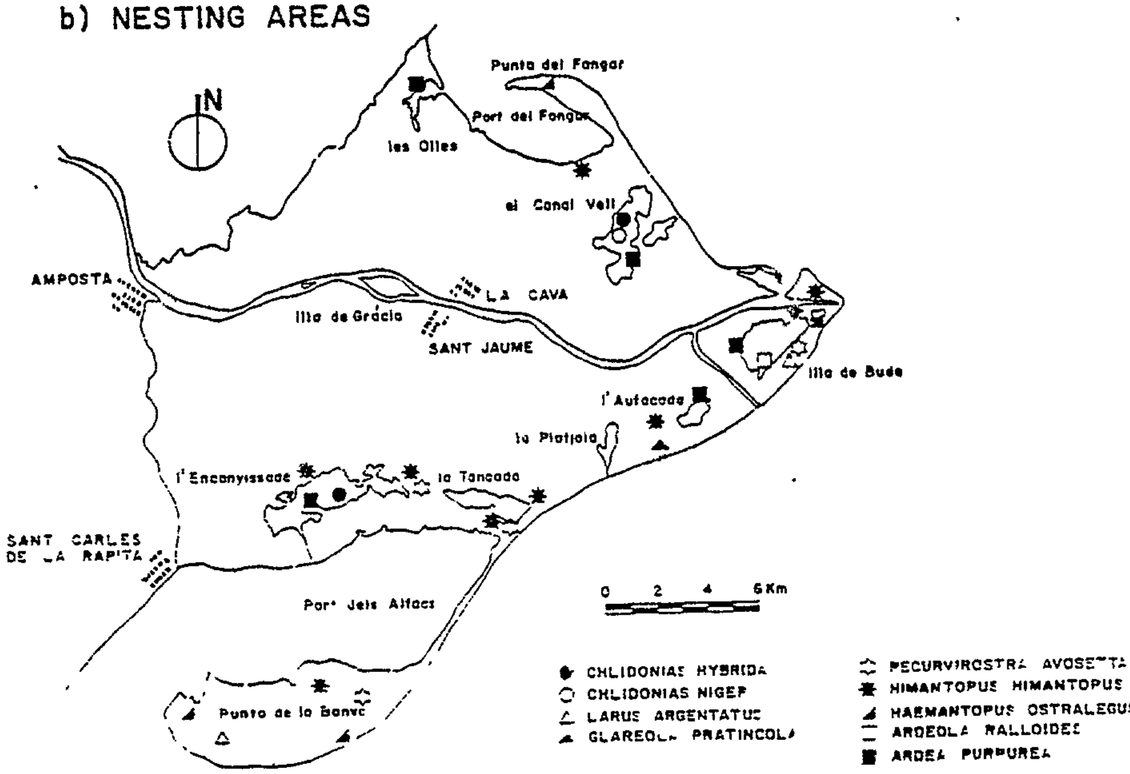
The conclusions and recommendations of the five case studies are primarily addressed to national managers and policy-makers, particularly those responsible for the administration and development of the geographic areas covered by the case studies. In order to ensure the full exposure of the main findings, conclusions and recommendations of these case studies, the convening of national seminars for the relevant policy-makers and managers, with the possible participation of media and public at large, are strongly recommended.

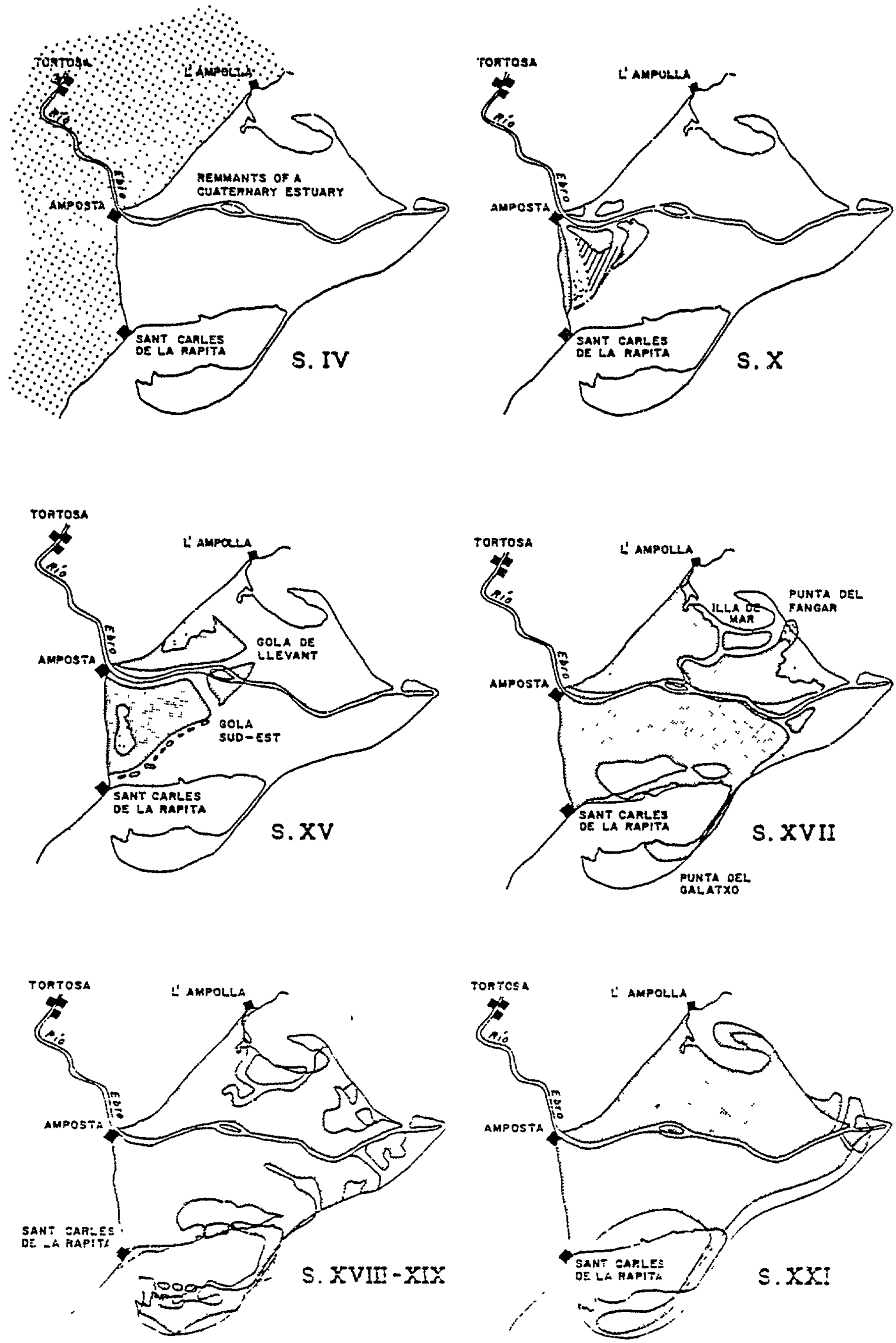

N
LA CAVA
AMPOSTA
SANT JAUME
0
5 Km.
SANT CARLES
DE LA RAPITA
SUBSIDENCE
ESTABLE
EROSION
ACREETION
SEDIMENTS TRANSFER

a) MAIN CONCENTRATION AREAS

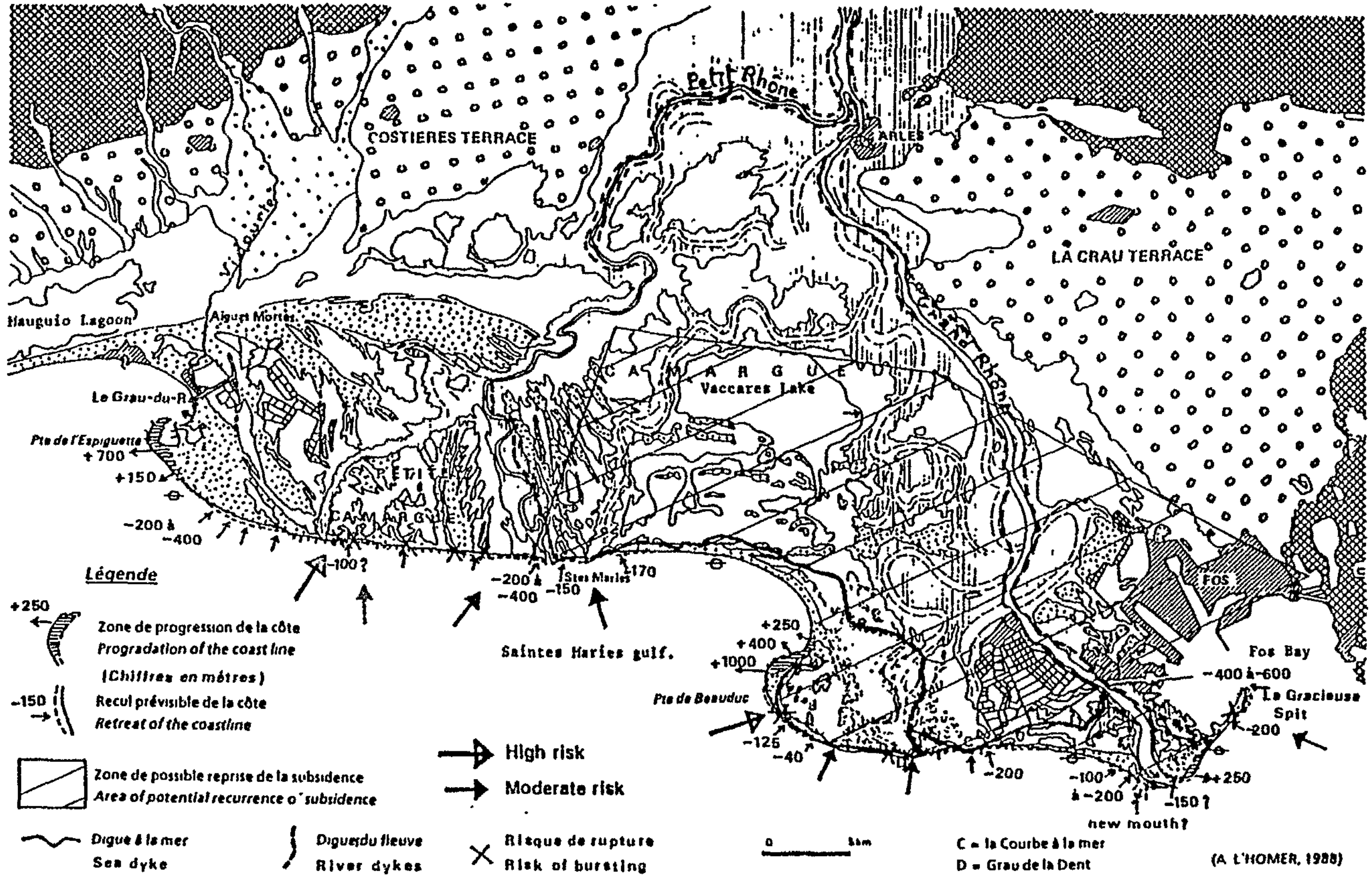


b) NESTING AREAS

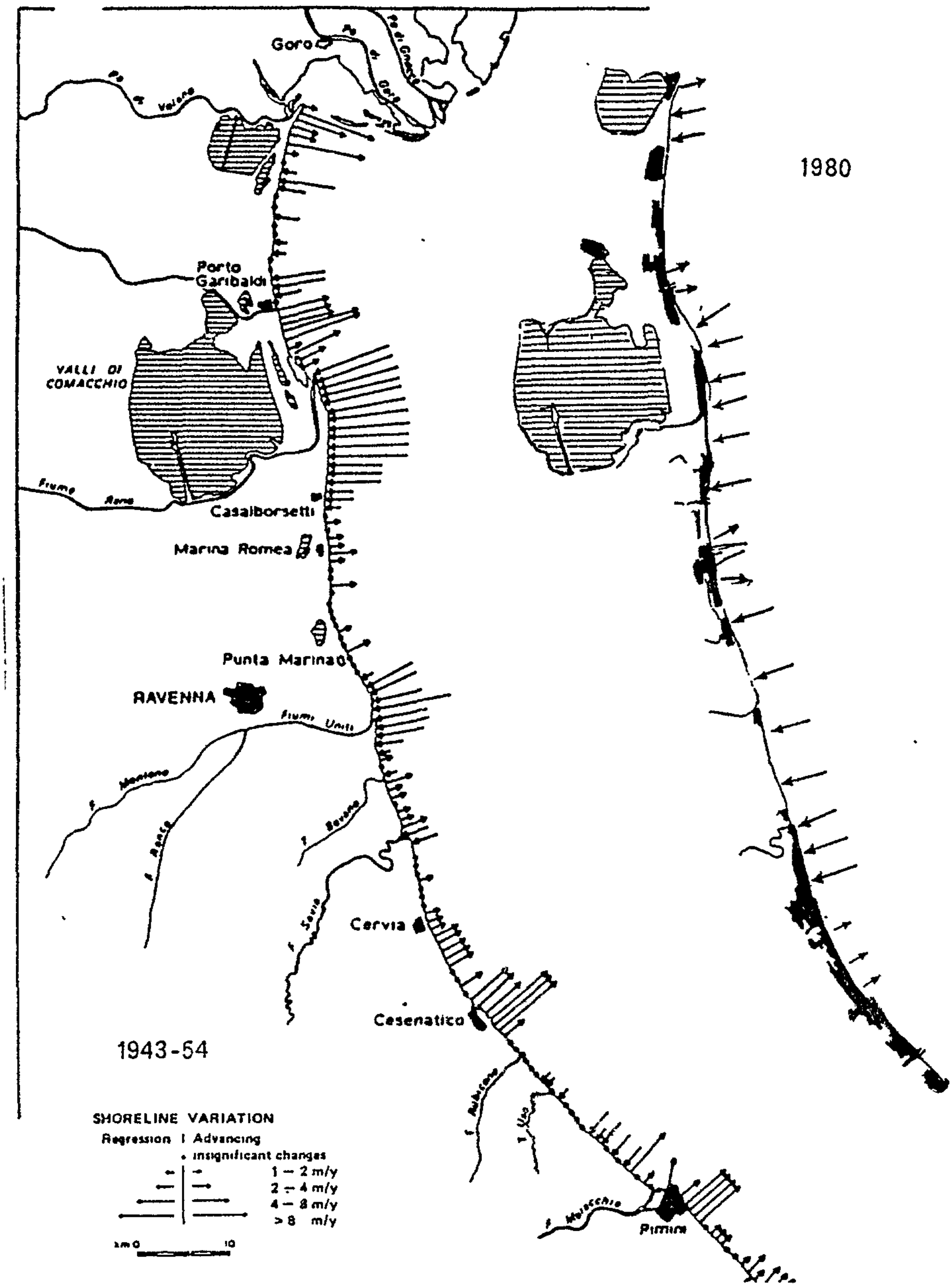



TORTOSA
L' AMPOLLA
Río
Ebro
REMMANTS OF A
CUATERNARY ESTUARY
AMPOSTA
SANT CARLES
DE LA RAPITA
S. IV
TORTOSA
L' AMPULLA
AMPOSTA
SANT CARLES
DE LA RAPITA
S. X
TORTOSA
L' AMPOLLA
GOLA DE
LLEVANT
AMPOSTA
GOLA
SUD-EST
SANT CARLES
DE LA RAPITA
S. XV
TORTOSA
L' AMPOLLA
PUNTA DEL
FANGAR
AMPOSTA
SANT CARLES
DE LA RAPITA
S. XVII
PUNTA DEL
GALATXO
TORTOSA
L' AMPOLLA
AMPOSTA
S. XVIII-XIX
TORTOSA
L' AMPOLLA
AMPOSTA
S. XXI

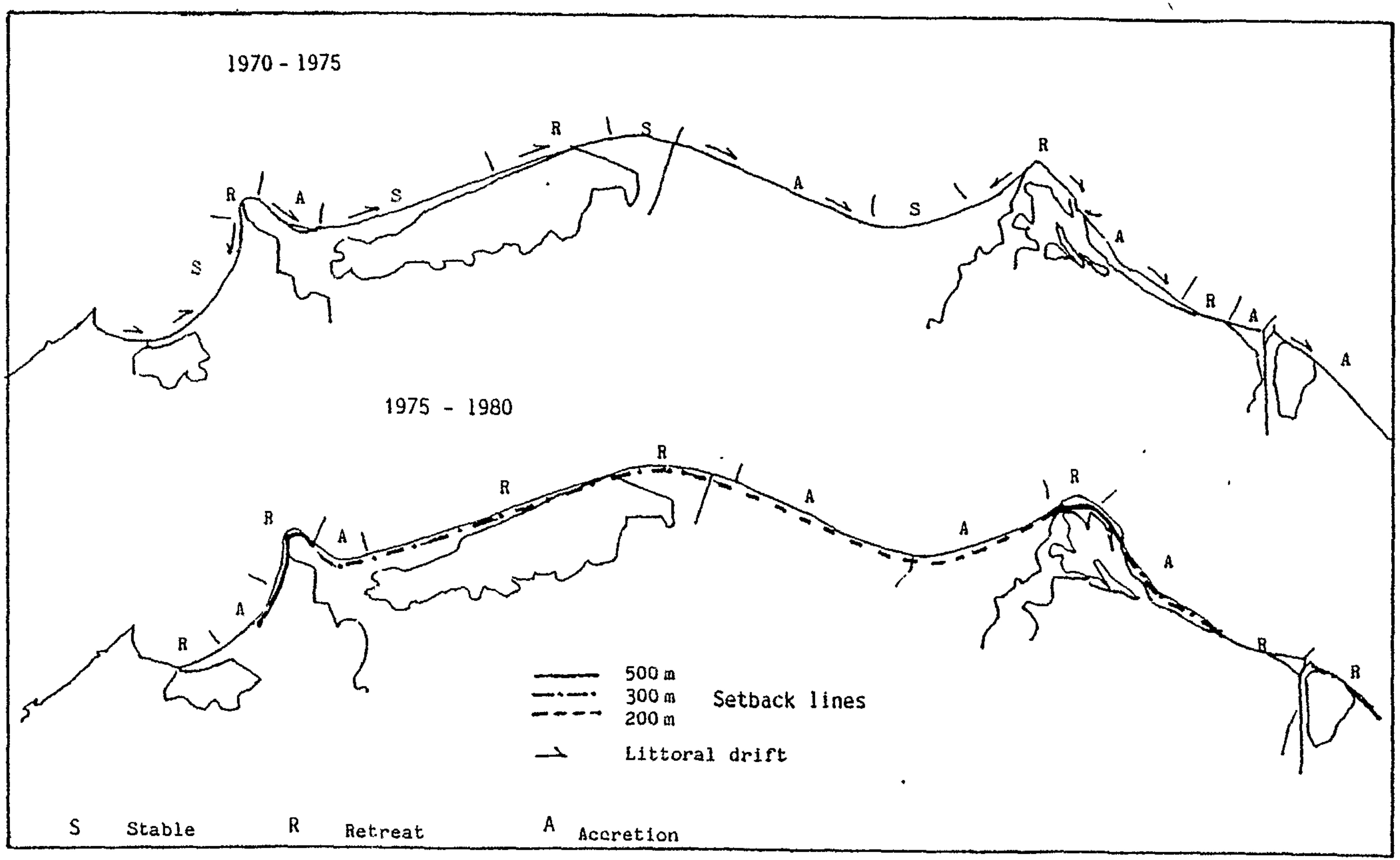
Projection du littoral à l'horizon 2025



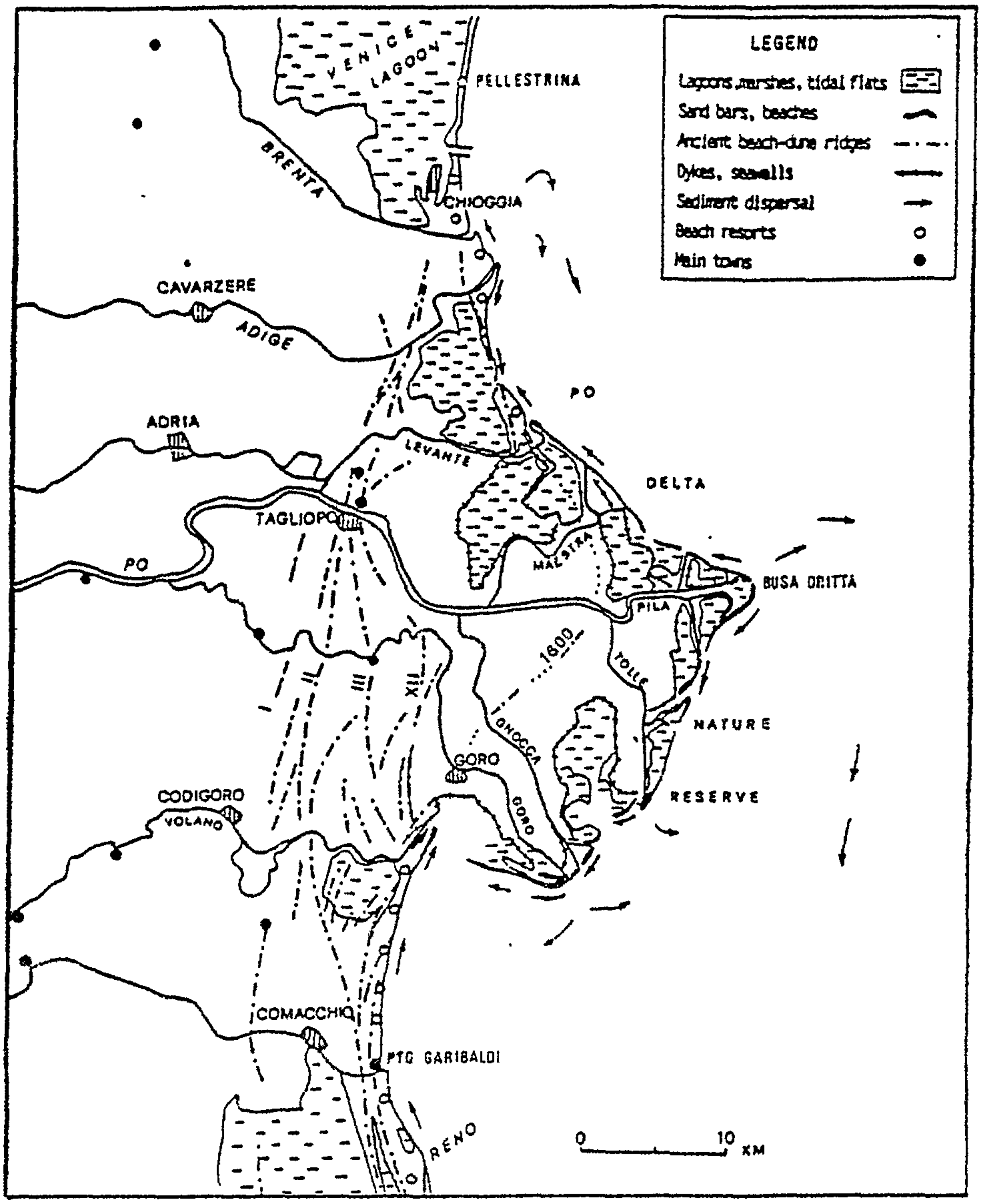
'Les chiffres indiqués sur la figure tiennent compte des effets des aménagements récents en particulier de ceux effectués pour protéger le littoral de la Petite Camargue'.

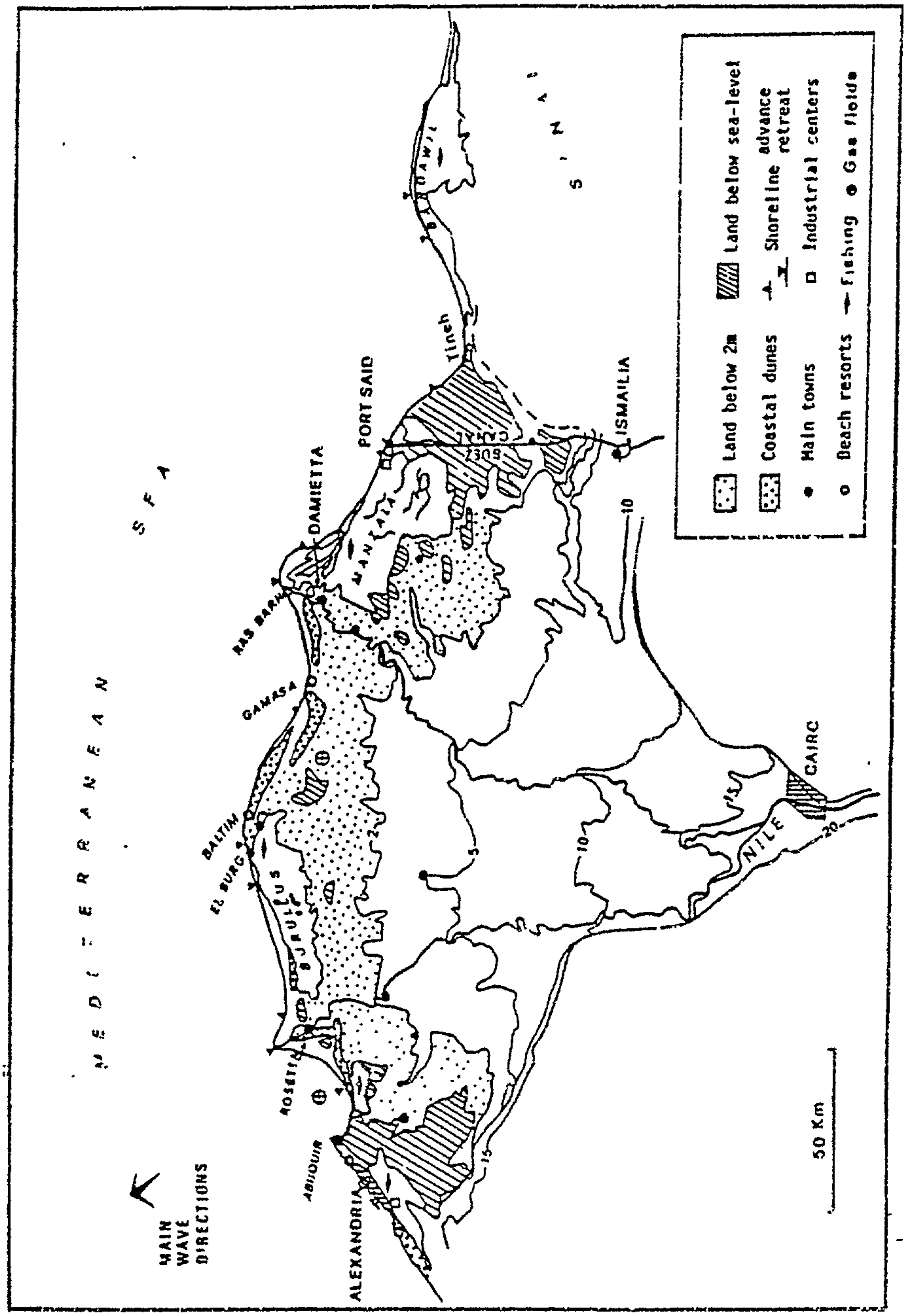


Summary of the state of erosion/accretion on the Romagna coast
(From Cencini et al 1979, CNR 1985)



Erosion-Accretion state of the Nile Delta shoreline. Top: from UNDP/UNESCO 1978; bottom, from Tetratech 1986 (based on Coastal Research Institute studies). Proposed setback lines, from Coastal Protection Master Plan.


LEGEND
Lagoons, marshes, tidal flats
Sand bars, beaches
Ancient beach-dune ridges
Dykes, seawalls
Sediment dispersal
Beach resorts
Main towns
VENICE LAGOON
PELLESTRINA
BRENTA
CHIOGGIA
CAVARZERE
ADIGE
PO
DELTA
ADRIA
LEVANTE
TAGLIOPO
PO
MAISTRA
BUSA DRITTA
PILA
1600
TOLLE
NATURE
RESERVE
GNOCCA
GORO
GORO
CODIGORO
VOLANO
COMACCHIO
PTO GARIBALDI
RENO
0
10
KM


MAIN
WAVE
DIRECTIONS
ALEXANDRIA
ROSETTA
BALTIM
GAMASA
DAMIETTA
PORT SAID
Tineh
ISMAILIA
NILE
50 Km
Land below 2m
Land below sea-level
Coastal dunes
Shoreline advance retreat
Main towns
Industrial centers
Beach resorts
fishing
Gas fields

ISLAND OF RHODES

a) A gradual increase in the rate of coastal erosion, mainly due to sea level rise is anticipated by the second half of the next century which will affect important coastal tourist areas, mainly in the northwest sector of the island.

> **ACTION: Coastal zone management (land-use, set-back zones for developing coastal zones of the Southern part) and readjustment of coastal building standards in terms of legislation with no social (public) compensation for erosion losses.**

b) A deterioration of water quality due to greater infiltration of sea water into the alluvial aquifer and increase of existing salinisation problems is expected by 2100.

> **ACTION: Water resource management and exploration for additional water resources, including construction of new dams and drilling of new boreholes into karstic aquifers.**

c) An increase in soil erosion will take place due to an increase in aridity caused by increased temperature and evapotranspiration, combined with changes in rainfall patterns and ecosystem status.

> **ACTION: Reforestation under scientific guidance and assistance.**

d) An increase of the maximum temperature by 2 to 3 E C will modify the pattern of tourist arrivals. Nevertheless, the climatic scenarios indicate that even during the next century Rhodes will continue to constitute a fresher and milder spot in a warmer northeast Mediterranean.

> **ACTION: Study of the consequences of the changes to tourist season and services in relation to the islands economy and population.**

KASTELA BAY

a) The rise in mean sea level over the next century would cause gradual and permanent inundation of the Pantana spring as well as areas around the Zrnovica estuary. An increased frequency of episodic flooding of low-lying coastal areas up to 2 m altitude is likely to occur during the second half of the next century when the mean sea level is expected to exceed 50 cm.

b) Rising sea levels will result in intrusion of saline water into the estuaries of the rivers Jadro and Zrnovica and into ground water resulting in river flooding and changes to local ecosystems.

c) Even a small rise in the water table, and increased ground water salinity will have negative impacts on coastal services and infrastructure with associated maintenance costs, as well as causing accelerated deterioration of the valuable historical buildings.

> **ACTION: Take into account the findings of this study in on-going and future construction projects in the region (sewerage system construction, port reconstruction, etc); re-evaluate existing land use plans, zoning policies for building, sanitary and other regulatory codes and instruments, technical standards and recommendations involving coastal areas; revise major policies and programmes and analyse the economic costs and benefits of flood hazard mitigation measures.**

d) The expected increase in temperature may increase domestic, industrial and agricultural water requirements and enhance aridity of the land.

> **ACTION: To reconsider energy and water demands and sources of supply, in the light of expected changes.**

MALTA

a) No major impacts due to climate change are expected to occur by the year 2030. It is likely that Malta will face bigger environmental problems during the intervening period from intensive land use and increasing coastal zone use.

ACTION: It is strongly recommended that any local or national structure plans should take into consideration the possible impacts of climate change on the natural environment as well as on the socio-economic sector, so as to ensure that any future developments (including land and coastal use) will not increase the vulnerability to these impacts.

b) The potential future rise in mean sea level will increase the problems of water resources which are already under critical pressure.

ACTION: Assess in detail the impact of sea level rise and the local climate changes on the local aquifers. This study should be quantitative and be based on mathematical hydrological models calibrated for Malta. The study should also include economic aspects attributed to any changes in availability of water from the aquifers. It is further recommended that measures for water conservation be adopted.

c) Increased aridity leading to soil erosion and loss of fresh water habitats.

ACTION: Prevention of soil erosion by proper maintenance of existing dry stone walls and terrace systems and by planting suitable trees and plants to retain the soil.

d) Increase in potential risk for human health, livestock and crops from pathogens and pests.

ACTION: Assessment through further research of vulnerability of humans, lifestock and crops to future increases in pests and pathogens as well as on the consequences of climate change and the adoption and implementation of appropriate response strategies to mitigate anticipated impacts.

e) Possible changes in air circulation patterns which will adversely affect precipitation and other meteorological parameters.

ACTION: Seek through UNEP to obtain and implement a central Mediterranean, limited area Climate Model.

CRES/LOSINJ ISLANDS

a) Mean sea level rise of more than 50 cm (expected to happen during the second half of the next century) could lead to an increase in the salinity of Lake Vrana, presently the only source of fresh water on the islands.

ACTION: Trapping and storage of peak flows of karstic rivers over the Kvarner mainland and artificial recharge of the karstic underground aquifers during the prolonged summer dry season; or supply of additional quantities of drinking water from mainland in response to projected demands for fresh water.

b) Mean sea level rise of up to 30 cm (likely to occur towards the middle of the next century) is not expected to have a significant effect on coastal urban areas and constructions; mean sea-level rise of 1 m (not expected to be reached before the end of the next century) would inundate about 35 hectares of the economically or historically most important urban areas (about 600 buildings in 12 coastal settlements, many of them of great historic value, housing about 13 percent of the islands' present population) and some of the present tourist facilities.

ACTION: Elevation of coastal defense structures in order to protect valuable existing buildings and structures; during periodic revisions of physical and urban development plans, the expected impacts of climate change should be taken duly into account.

c) An increase of about 2 EC (may be expected by the year 2030) in the mean temperature would probably extend the tourist season from the present three to five months.

ACTION: The requirements of the extended tourist season should be examined in the light of their implications for demand on additional space and services.

d) Any increase in the temperature, with the concomitant decrease in humidity, would lead to incurred risk from forest fires.

ACTION: Application of suitable protective measures against forest fires such as clearing of undergrowth, cutting of fire breaks.

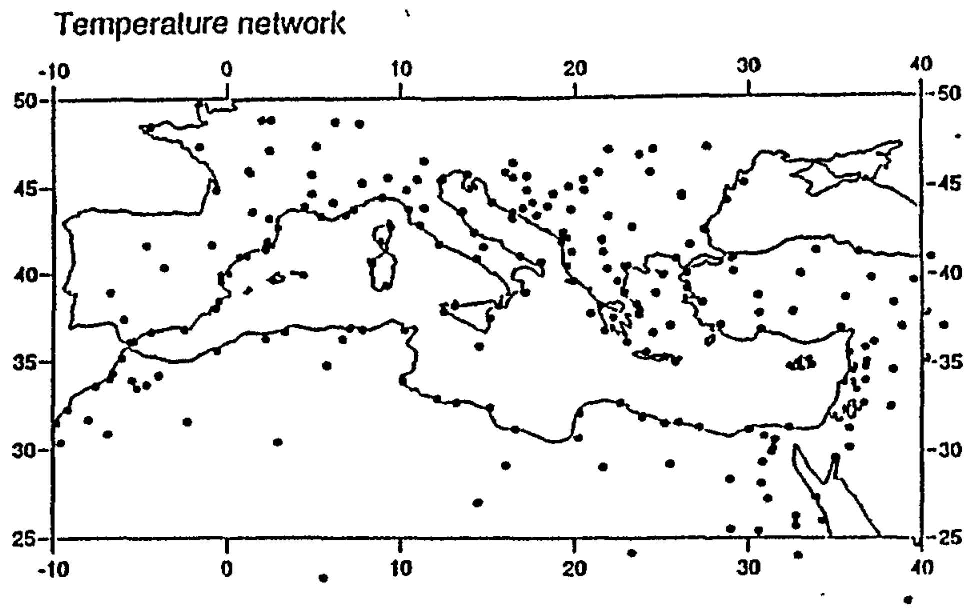
SYRIAN COAST

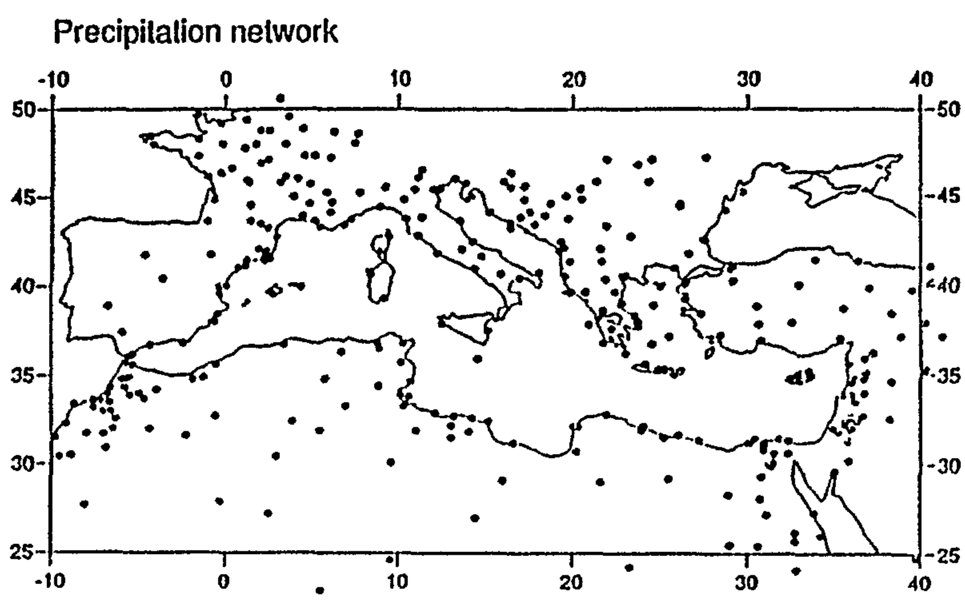
a) Gradual acceleration in the next century of soil erosion and general modification of vegetation cover due to increased aridity.

b) Increased salinisation (expected by 2030) of underground water due to increased evaporation during a longer dry season and to sea level rise.

c) Erosion of beaches and significant damage to coastal structures and human settlements close to the shore will occur as a consequence of exceptional storm surges even if mean sea level rise is only of the order of 10 cm.

> **ACTION: Problems of soil and coastal erosion and increased salinisation should be dealt with through integrated coastal zone management and planning. Such planning should include development of water management plans, monitoring programmes; and, establishment of a data bank on natural and cultivated vegetation.**





Network of temperature (above) and precipitation (below) measuring stations (Palutikof et al. 1991).

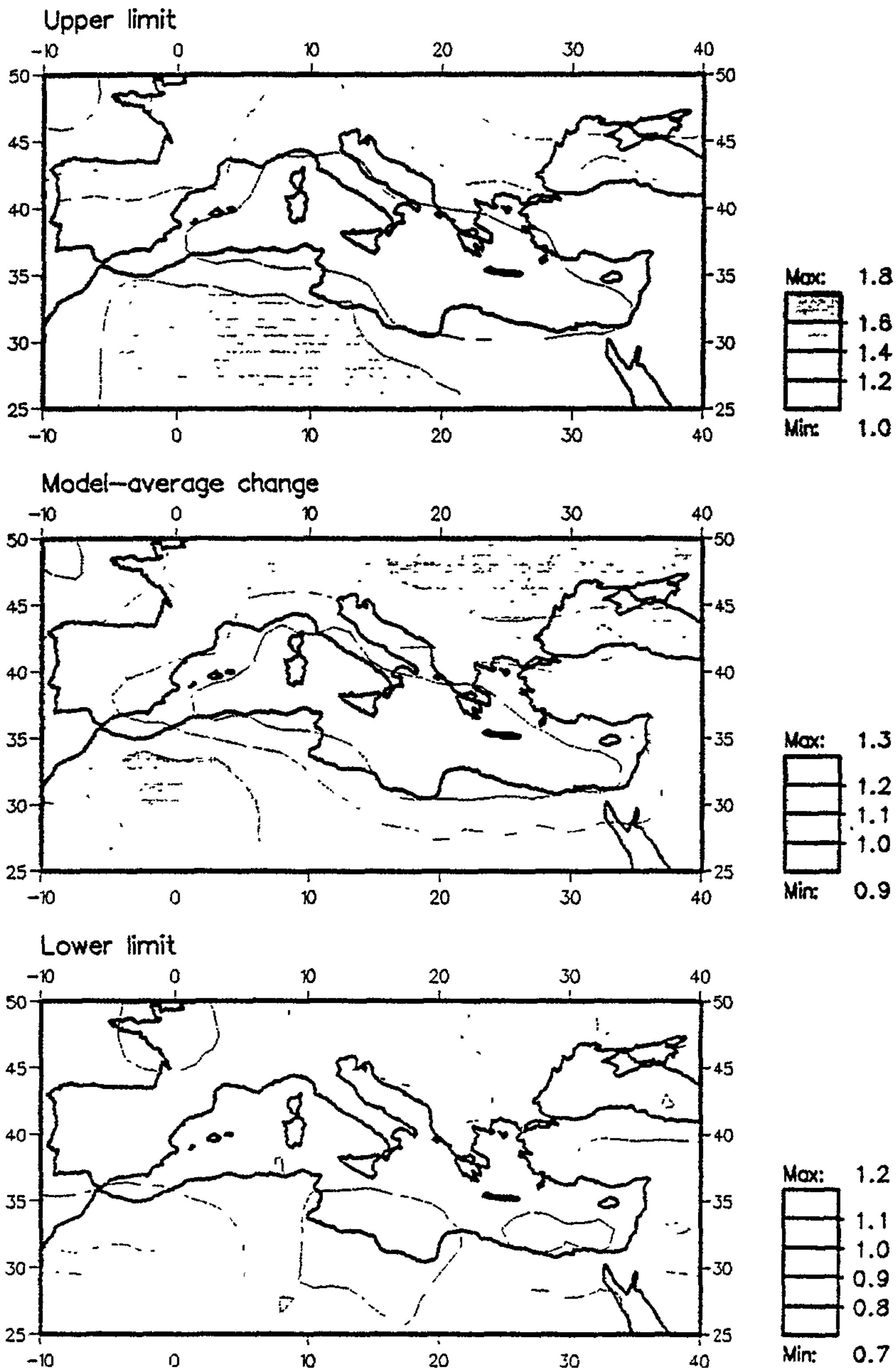


Fig. 3.1 Annual standardized model-average temperature change per °C global change, shown with the upper (above) and lower (below) 90% confidence limits (°C)

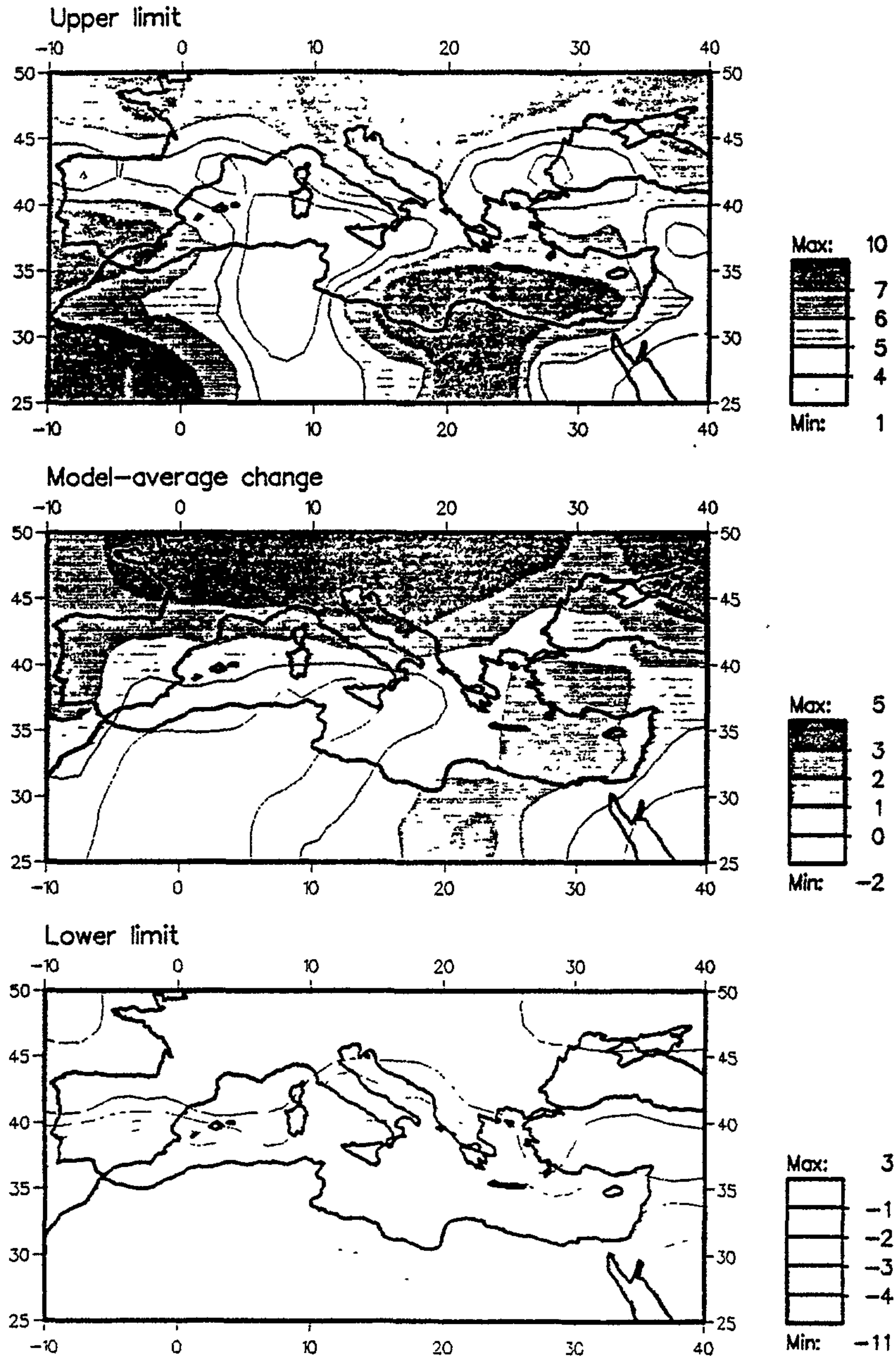
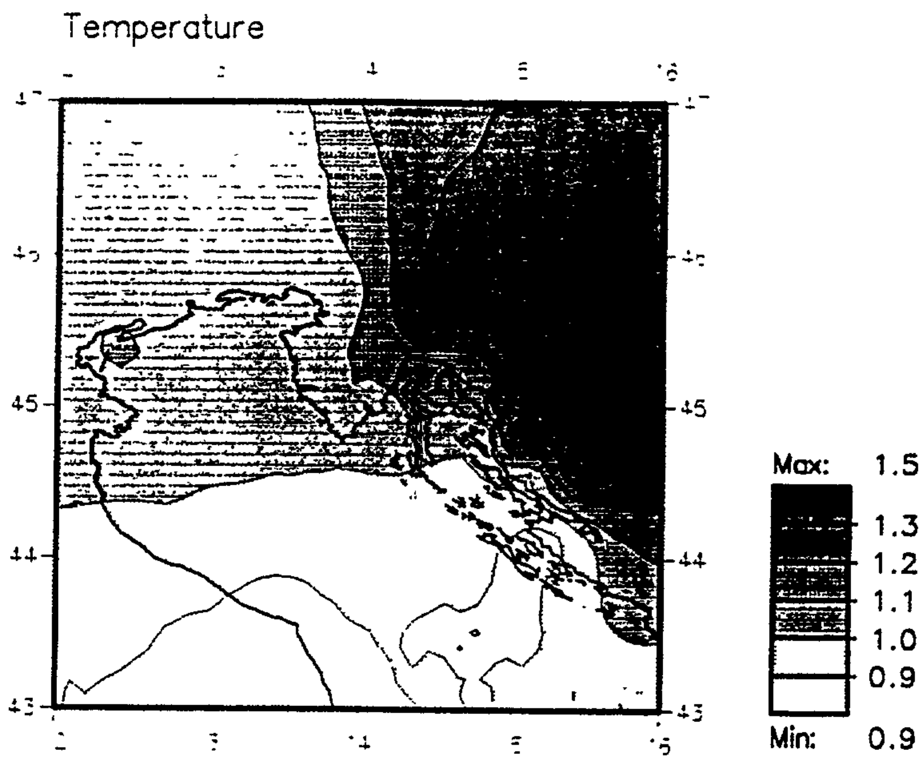
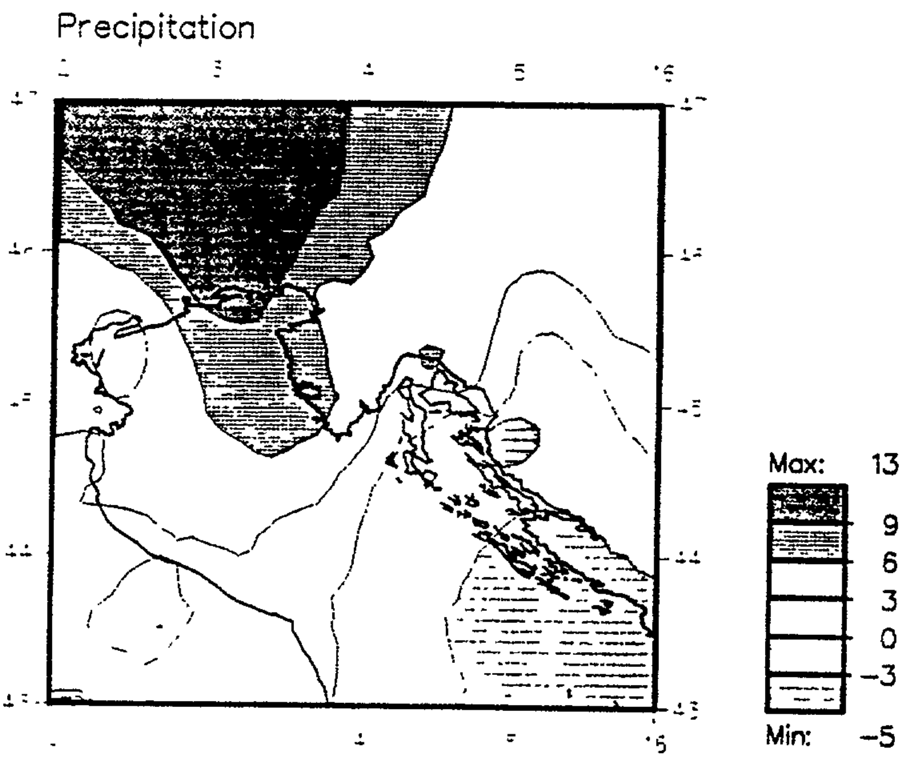


Fig. 3.7 Winter standardized model-average precipitation change per °C global change, shown with the upper (above) and lower (below) 90% confidence limits (mm)


Temperature
45
44
Max: 1.5
1.3
1.2
1.1
1.0
0.9
Min: 0.9


Precipitation
Max: 13
9
6
3
0
−3
Min: −5

ANNEX V

ACTIVITIES OF THE COASTAL AREA MANAGEMENT PROGRAMME (CAMP) FOR THE ALBANIAN COAST

1. PROSPECTIVE ANALYSIS

1.1 Systemic and prospective analysis, development/environment scenarios for Albania (Coordinator Mr A. Gjebrea)

2. DEVELOPMENT AND IMPLEMENTATION OF LEGAL INSTRUMENTS

2.1 Development of environmental legislation (Coordinator Mr G. Lulo)

2.2 Inventory of land-based sources (LBS) of pollution, implementation of LBS and Dumping protocols (Coordinator Mr E. Gjika)

2.3 Development of a national system for preparedness and response to marine accidental pollution (Coordinator Mr S. Bebi)

2.4 Specially protected areas (SPA) and implementation of SPA protocol (Coordinator Mr L. Gjiknuri)

2.5 Monitoring of marine pollution (Coordinator Mr G. Deliu)

3. SECTORIAL STUDIES

3.1 Programme for training for the development of agriculture and forestry

3.2 Physical planning in seismically active zones

3.3 Implications of expected climatic change in the coastal region (Coordinator Ms E. Demiraj)

3.4 Protection and management of historic settlements

4. INTEGRATED MANAGEMENT OF COASTAL AND MARINE AREAS WITH PARTICULAR REFERENCE TO THE DURRES-VLORE REGION

4.1 Integrated coastal and marine area management of the Durres-Vlore region (Coordinator Mr G. Katmilo)

4.2 Water resources management study for the watershed of the Erzen and Ishen river basins (Coordinator Mr R. Eftimi)

4.3 Geographical Information System (GIS)

4.4 Carrying capacity assessment for tourist activities (Coordinator Mr G. Metolu)

4.5 Environmental Impact Assessment (EIA)

ANNEX VI

TEMPERATURE AND PRECIPITATION SCENARIOS FOR ALBANIA

TEMPERATURE AND PRECIPITATION SCENARIOS FOR ALBANIA

Report to the UNEP Co-ordinating Unit for the Mediterranean Action Plan

February 1994

CLIMATIC RESEARCH UNIT
School of Environmental Sciences
University of East Anglia
Norwich, NR4 7TJ
England

TEMPERATURE AND PRECIPITATION SCENARIOS FOR ALBANIA

Report to the UNEP Co-ordinating Unit for the Mediterranean Action Plan

(in alphabetical order)
X. Guo, J.P. Palutikof and T.M.L. Wigley

Climatic Research Unit
School of Environmental Sciences
University of East Anglia
Norwich NR4 7TJ
U.K.

February 1994

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SUMMARY

We have applied the methods developed by Kim et al. (1984) and Wigley et al. (1990) to construct high-resolution scenarios of climate change for Albania. Regression equations were developed to predict station temperature and precipitation anomalies from regionally-averaged climate anomalies. Using the output from four General Circulation Models, we then substituted perturbed-run minus control-run values of temperature and precipitation in the regression equations to obtain a prediction of the change due to the greenhouse effect at each station. The results were scaled by the equilibrium temperature of each of the four GCMs, and an average for the four models obtained. The procedure was repeated for every station in the data set, and the results contoured to produce a scenario for Albania.

Annual and seasonal scenarios for both temperature and precipitation change were produced. The scenario of annual temperature change shows an increase in the amount of change from south to north along the coast, and from the coast inland. Thus, in the southern coastal region the suggested annual change is 0.7-0.9°C per 1°C global warming (i.e. the warming will be less than the global level). Although further north along the Albanian coast the warming is shown to be greater (0.9-1.0°C per degree global warming), the indications are that it should not exceed the global rate of warming. In the extreme east of the country, however, temperature changes greater than the global level (i.e.above 1.0°C per 1°C global warming) are suggested. This annual pattern is reflected at the seasonal scale.

The scenarios for annual precipitation change indicate wetter conditions in the north of Albania as a result of global warming, and drier conditions in southern areas. The changes are quite small. At the seasonal level, this annual pattern is most clearly replicated in autumn. Precipitation in winter shows an increase due to global warming over most of the country, apart from a small area centred on 41°N at the coast, where a reduction in precipitation is indicated. In spring, the models indicate that rainfall should increase as a result of global warming over the whole of Albania. However, along the coast the increase is shown not to exceed 7% of present-day values, per 1°C global increase in temperature. The summer pattern is one of increased rainfall inland and along the southern coast, but with lower rainfall along the northern coast as a result of global warming.

The problems associated with the construction of regional scenarios of climate change due to the enhanced greenhouse effect are discussed at length by Palutikof et al. (1992) in their report to UNEP on the construction of climate change scenarios for the whole Mediterranean region. The confidence that we can place in sub-grid-scale scenarios of precipitation is particularly low. In consequence, these scenarios should be considered only as indicators of changes that might occur.

1. THE USE OF GCMS IN REGIONAL SCENARIO DEVELOPMENT

It is generally accepted that the results from General Circulation Models (GCMs) offer the best potential for the development of regional climate scenarios. They are the only source of detailed information on future climates which can extrapolate beyond the limit of conditions which have occurred in the past.

GCMs are complex, computer-based, three-dimensional models of the atmosphere which have been developed by climatologists from numerical meteorological forecasting models. The results used here are taken from GCM equilibrium response experiments. That is, the model is first run with a nominal "pre-industrial" atmospheric CO_2 concentration (the control run) and then rerun with doubled (or sometimes quadrupled) CO_2 (the perturbed run). In both, the models are allowed to reach equilibrium before the results are recorded.

The fact that the GCMs are run in equilibrium mode must in itself be regarded as a potential source of inaccuracy in model predictions. It can be argued that the predicted regional patterns of climate change will differ from those that will occur in a real, transient response world. Results are becoming available from transient response predictions, where the CO_2 concentration increases gradually through the perturbed run and where oceans are modelled using ocean GCMs, and which therefore should provide a more realistic estimate (see Gates et al., 1992). These indicate that the large-scale patterns of change are similar to those obtained from comparable equilibrium experiments, scaled down by an appropriate factor. Differences do exist, largely because equilibrium model runs ignore important oceanic processes such as ocean current changes, differential thermal inertia effects between different parts of the oceans and between land and ocean, and changes in the oceanic thermohaline circulation. These differences are greatest in areas where ocean thermal inertia is large, such as the North Atlantic and high southern latitudes (Mitchell et al., 1990). They are relatively small in most regions (and in the Mediterranean Basin in particular).

The four GCM experiments used to construct the scenarios are from the following research institutions: the U.K. Meteorological Office model (abbreviated here to UKMO; the model version used here is as described by Wilson and Mitchell (1987)); the Goddard Institute of Space Studies model (GISS; Hansen et al., 1984); the Geophysical Fluid Dynamics Laboratory model (GFDL; Wetherald and Manabe, 1986); the Oregon State University model (OSU; Schlesinger and Zhao, 1989). The models vary in the way in which they handle the physical equations describing atmospheric behaviour. UKMO, GISS and OSU solve these in grid-point form whereas GFDL uses a spectral method. All models have a realistic land/ocean distribution and orography (within the constraints of model resolution); all have predicted sea ice and snow; clouds are calculated in each atmospheric layer in all models.

One problem with the application of GCMs to the study of climate impacts is the coarse resolution of the model grid. The grid scale of the four models listed above ranges from 4° latitude x 5° longitude (OSU) to 7.83° latitude x 10° longitude (GISS). GCMs of this generation, therefore, have a spatial resolution of several hundreds of kilometres, which is inadequate for many regional climate change studies, especially in areas of high relief. We present here a set of high resolution scenarios for Albania, based on the statistical relationship between grid-point GCM data and observations from surface meteorological stations.

2. CONSTRUCTION OF SUB-GRID-SCALE SCENARIOS

Kim et al. (1984) looked at the statistical relationship between local and large-scale regionally-averaged values of two meteorological variables: temperature and precipitation. They then used these relationships, developed using principal component analysis techniques, to look at the response of local temperature and precipitation to the predicted change at GCM grid points. The area of study was Oregon State. Although the paper contains certain statistical flaws, the underlying idea of relating local and large-scale data statistically is sound. The method of Kim et al. has been extended and refined by Wigley et al. (1990) and by Wilks (1989).

The methods of Kim et al. and Wigley et al. have been modified for application in the Mediterranean region. In the model validation exercise carried out for the Mediterranean region by Palutikof et al. (1992), it was established that no single GCM can be identified as being always the best at simulating current climate. This being the case, there is little merit in presenting scenarios based on only one model. Presentation of scenarios for each of the four models avoids the issue, since the task of deciding which model is 'best', and/or of synthesizing the information to obtain a best estimate, is left to the impact analyst. We have therefore combined the information from the four models into a single scenario for each variable, according to the method described below.

The problem with scenario construction based on a number of models is that the results may be biassed by the different equilibrium responses of the individual models. The global warming due to $2xCO_2$ for the four GCMs ranges between 2.8°C for the OSU model and 5.2°C for the UKMO model run. We would therefore expect that the warming indicated by the UKMO GCM for the Mediterranean Basin will be greater than that suggested by the OSU model, even though the sensitivity of the region to climate change when compared to the global sensitivity might be the same. The individual model perturbations have therefore been standardized by the equilibrium (global annual) temperature change for that model, prior to the calculation of the four-model average.

We required a generalized computer program that would be applicable throughout this geographically complex area, and could be used with meteorological records of variable length and density. After investigating a number of approaches to the problem, we adopted the procedure summarized below.

1. Data sets of monthly mean temperature and total precipitation have been compiled for the area surrounding the Mediterranean Basin. Stations used in this study of Albania are listed in Appendix 1. Where possible, each record should be complete for the period 1951-88. Any station with a record length less than 20 years in the period 1951-88 for over six months out of twelve was immediately discarded.

2. Then, for every valid station, the temperature and precipitation anomalies from the long-term (1951-88) mean were calculated. For this part of the work, which is the first step in the construction of the regression equations (the calibration stage), only the data for 1951-80 were used The 1981-88 data were retained to test the performance of the regression models (the verification stage, see Palutikof et al., 1992). For the calculation of the temperature anomaly At_{ij}, the simple difference was used:

$$At_{ij} = t_{ij} - T_j$$

where t_{ij} is the mean temperature of month j in year i, and T_j is the long-term mean for month j. The precipitation anomaly Ap_{ij} was expressed as a ratio of the long-term mean:

$$Ap_{ij} = (p_{ij} - P_j)/P_j$$

where p_{ij} is the monthly total precipitation in month j of year i, and P_j is the long-term mean for that month. If P_j is less than 1mm, then this equation is modified to:

$$Ap_{ij} = (p_{ij} - P_j)/1.0$$

3. The individual station anomalies are used to calculate regionally-averaged anomalies. The procedures described from here to the end of Point 6 are station-specific, and must be repeated for each station in the data set.

   A 5° latitude x 5° longitude square is centred over the station for which regression equations are to be developed (the predicted station). All the stations which fall within this square are used to calculate the regional averages. If the number of stations is less than three, for temperature, or four, for precipitation, the procedure is halted. For temperature, the anomalies from all stations in the 5° x 5° square are averaged month-by-month to produce an area-average time series. For precipitation, the substantial degree of spatial variability makes it advisable to area-weight the station anomalies before calculating the regional mean for each month. To do this, the 5° x 5° region is divided into 20 x 20 smaller squares. The precipitation anomaly value assigned to a particular square is that of the station nearest to it (with the restriction that the distance separating a square from its nearest station should be no greater than 1° - where the distance is greater the square is ignored). The area average is then the mean of the values in the 400 (or fewer, if any fail the minimum distance criterion) squares. This method is similar to the standard Thiessen polygon method.

4. Regression analyses were performed using station temperature and precipitation anomalies as the predictands. These analyses were carried out on an annual and seasonal basis: winter (December, January, February), spring (March, April, May), summer (June, July, August) and autumn (September, October and November). By considering the monthly values as separate observations within each season, we were able to extend the number of observations and so preserve a high number of degrees of freedom. The predictor variables are the regionally-averaged anomalies of temperature and precipitation.

5. In order to determine the perturbation due to the greenhouse effect at each station, the results from GCMs were employed. It is assumed that a GCM grid-point temperature or precipitation value is equivalent to a regionally-averaged value derived from observational data. For each of the four GCMs (GFDL, GISS, OSU and UKMO), the perturbed run and control run grid-point temperature (t) and precipitation (p) values are interpolated to the station position. Then, we obtain, for temperature:

$$Atm_i = t_i(2 \times CO_2) - t_i(1 \times CO_2)$$

   where Atm is the perturbation due to CO_2 or the 'temperature anomaly' for model i and, for precipitation:

$$Ptm_i = [p_i(2 \times CO_2) - p_i(1 \times CO_2)] \times 100/p_i(1 \times CO_2)$$

   where Ptm is the standardized perturbation due to CO_2, or the 'precipitation anomaly'.

   The values for Atm and Ptm for each GCM are then substituted in the regression equations to obtain a prediction for the station perturbation of temperature (°C) and precipitation (%) due to CO_2.

6. The predicted change in temperature and precipitation for each model is divided by the equilibrium (global mean) temperature change for that model. The results are then averaged across the four models to obtain a composite value.

7. The procedures from Points 3 to 6 is repeated for each station throughout the Mediterranean. The results can then be plotted and contoured to obtain a map of the expected patterns of temperature and precipitation change due to the greenhouse effect.

In order to arrive at this procedure, a rigorous investigation of the validity of the method has been carried out. In particular, we have looked at:

- the use of other predictor variables in the regression equations
- performance and verification of the regression equations
- autocorrelation in the data
- multicollinearity in the predictor variables.

These aspects are discussed in detail by Palutikof et al. (1992).

3. CLIMATE CHANGE SCENARIOS FOR ALBANIA

The sub-grid-scale scenarios, constructed according to the method outline in Section 2, are shown in Figs. 1-5. The temperature perturbations are presented as the model average change, in degrees Celsius, per °C global annual change. The precipitation perturbations are shown as the percentage change for each 1°C global annual change. This procedure is described in greater detail, and the approach justified, in Section 2.

The scenarios are presented as the regional change in a particular climate variable to be expected in response to a 1°C change in mean global temperature. As such, they do not provide any information on when such changes might be expected to occur. However, such information can be extracted from scenarios presented in this form. The results from four transient response GCMs presented in IPCC92 (Gates et al., 1992) show a constant rate of warming in the later decades of around 0.3°C per decade. This is in line with the findings of IPCC90, based on the 'business-as-usual' CO_2 forcing scenario and an energy balance atmospheric model coupled to an upwelling-diffusion ocean model (Bretherton et al., 1990). Although the impossibility of placing calendar dates on this figure must be emphasized, it suggests that a 1°C temperature change may be achieved in a period of around thirty years.

It should be noted that the figure of 0.3°C per decade does not take into account possible opposing anthropogenic influences, in particular the forcing from sulphate aerosols and stratospheric ozone depletion. Wigley and Raper (1992) made temperature projections based on IPCC92 emissions scenario IS92a (Leggett et al., 1992), taking into account the ozone-depletion feedback and best-guess sulphate aerosol effects. They used their upwelling-diffusion energy-balance climate model (as used in IPCC90, see above) and found the warming between 1990 and 2100 to be in the range 1.7-3.8°C.

The results from these time-dependent experiments can be combined with the scenarios of the magnitude of change presented in this report, and superimposed on a baseline (present-day) climatology in order to arrive at a scenario of climate for a particular future time. A recent example of the application of this approach to the development of 'snapshot' scenarios for Europe is the ESCAPE project (CRU, 1992). This approach requires that the spatial pattern of the enhanced greenhouse signal remains constant with time, but the available model evidence suggests that this is a reasonable assumption to make (Mitchell et al., 1990; Gates et al., 1992).

Annual scenarios of climate change

The scenarios for changes at the annual level are presented in Fig. 1. The temperature change for Albania is indicated to increase from south to north along the coast, and from the coast inland. Thus, in the southern coastal region the suggested change is 0.7-0.9°C per 1°C global warming (i.e. the warming will be less than the global level). Although further north along the Albanian coast the warming is shown to be greater (0.9-1.0°C per degree global warming), the indications are that it should not exceed the global rate of warming. In the extreme east of the country, however, temperature changes greater than the global level (i.e.above 1.0°C per 1°C global warming) are suggested.

For annual precipitation, the models show a reduction in the south of the country. However, the suggested amounts are small· less than 2% per 1°C global warming. Rainfall in the north of Albania shows an increase due to global warming.

Seasonal scenarios of climate change

In the winter months of December, January and February (Fig. 2), the change in temperature due to global warming for Albania broadly reflects the annual pattern. Along the whole coastline the increase indicated by the models is less than the global increase, in the extreme south falling to below 0.8°C per degree global change Inland, increases greater than the global level are shown, rising to above 1.2°C per degree global change in the extreme east. The spring pattern (March, April, May, shown in Fig. 3) is broadly the same as that seen in winter, except that there is a small area of warming along the coast which exceeds the global increase. Summer patterns are complex (Fig. 4) and, for the first time, we see an extensive area of warming along the coast which is greater than the global amount. This area is in the south; along the northern coast the pattern of warming less than the global level is preserved. The autumn pattern (Fig. 5, for September, October and November) is again similar to the annual pattern, although there are isolated areas along the coast where the warming is greater than the global amount.

Precipitation in winter (Fig. 2, lower map) shows an increase due to global warming over most of the country, apart from a small area centred on 41°N at the coast, where a reduction in precipitation is indicated. In spring (Fig. 3), the models indicate that rainfall should increase as a result of global warming over the whole of Albania. However, along the coast the increase is shown not to exceed 7% of present-day values, per 1°C global increase in temperature. The summer pattern is one of increased rainfall inland and along the southern coast, but with lower rainfall along the northern coast as a result of global warming. with a reduction in rainfall in the south of Albania, and an increase in the north. In autumn, the indicated precipitation changes closely follow the changes suggested by the models at the annual scale: higher rainfall for the northern half of the country as a result of global warming, whereas southern areas show a decrease.

Fig. 1 Regional climate scenarios for Albania annual Upper map shows change in temperature (°C per °C global change) and the lower map shows change in precipitation (% per °C global change)

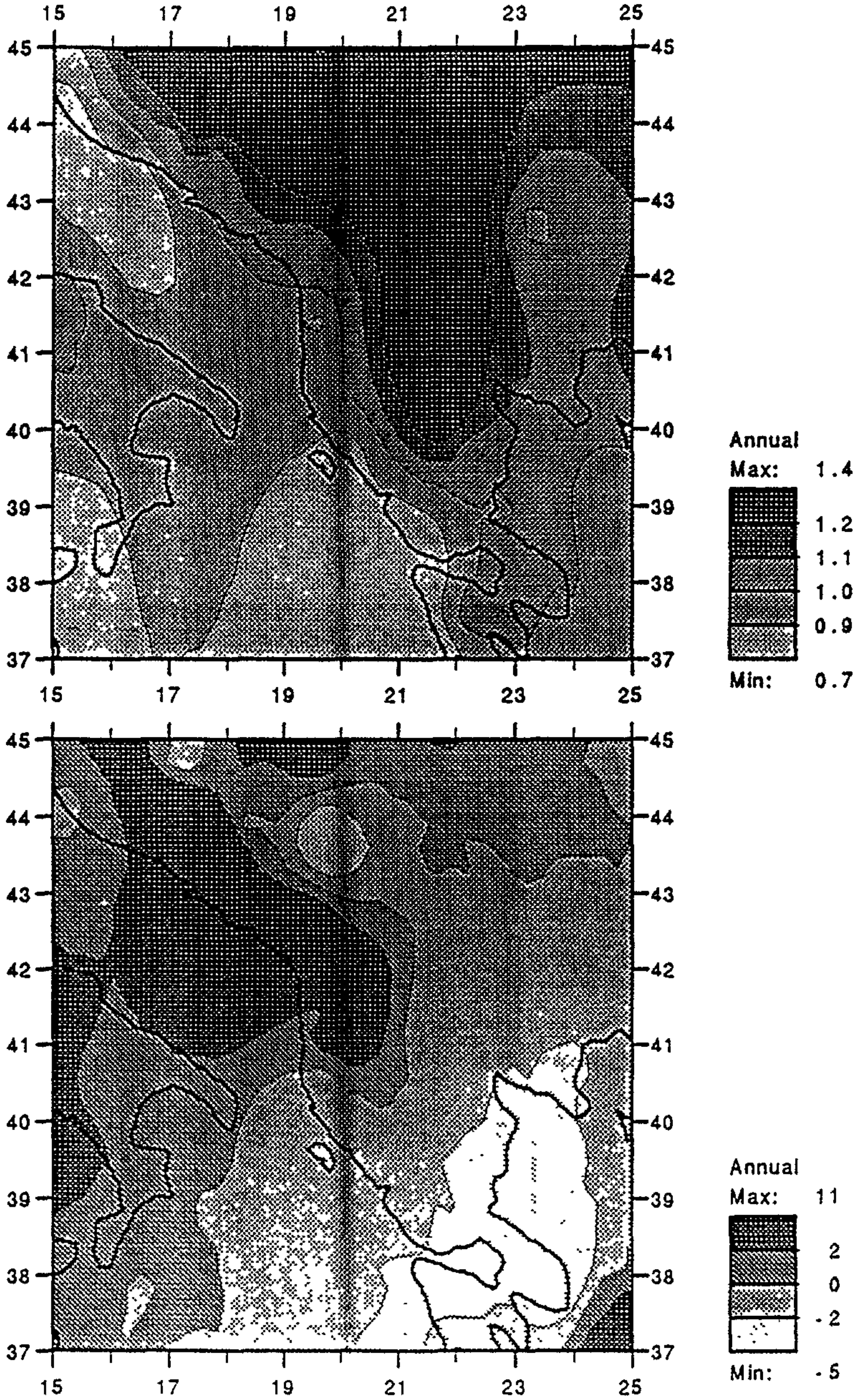


Fig. 2 Regional climate scenarios for Albania winter. Upper map shows change in temperature (°C per °C global change) and the lower map shows change in precipitation (% per °C global change)

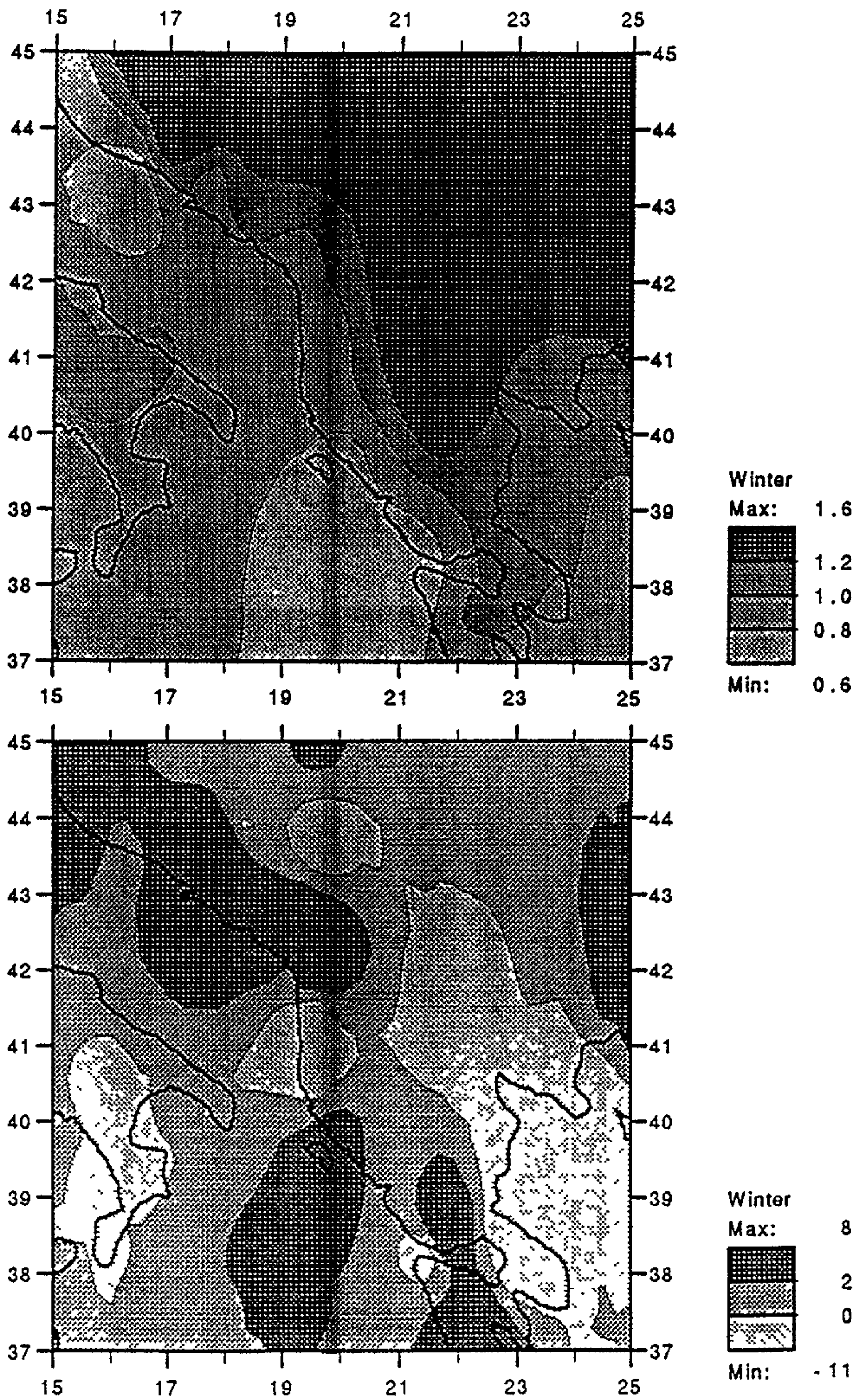


Fig. 3 Regional climate scenarios for Albania spring Upper map shows change in temperature (°C per °C global change) and the lower map shows change in precipitation (% per °C global change)

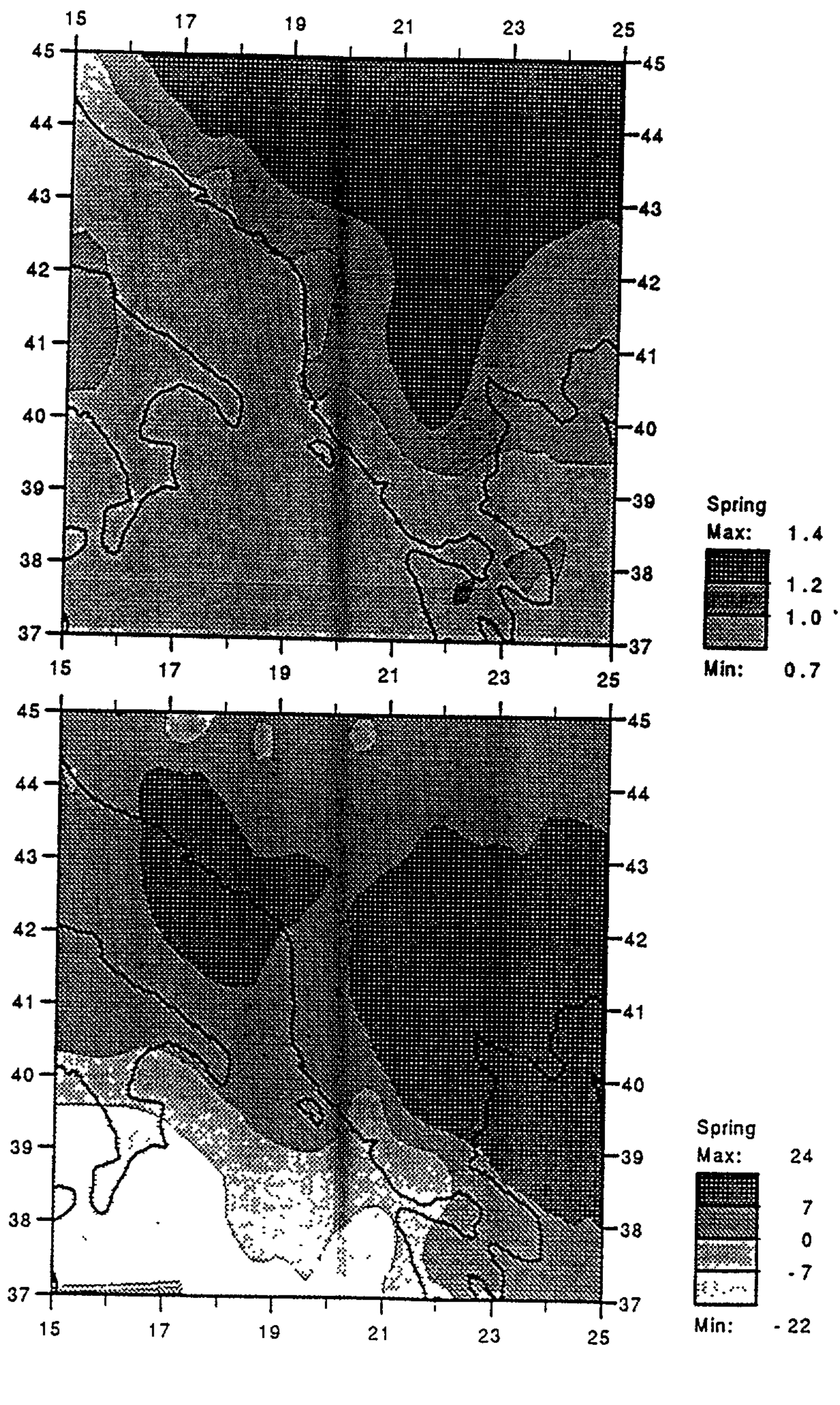


Fig. 4 Regional climate scenarios for Albania summer Upper map shows change in temperature (°C per °C global change) and the lower map shows change in precipitation (% per °C global change)

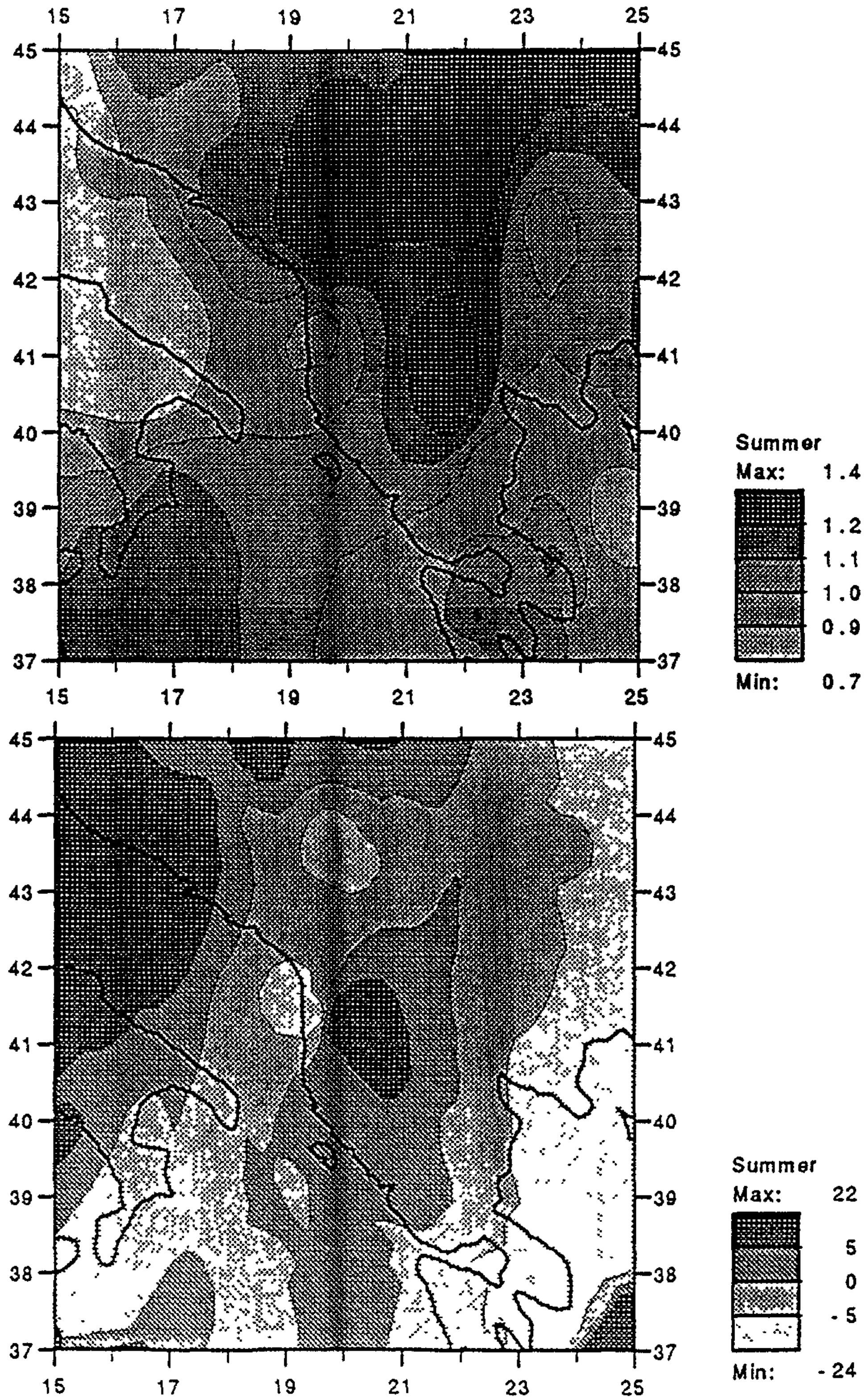
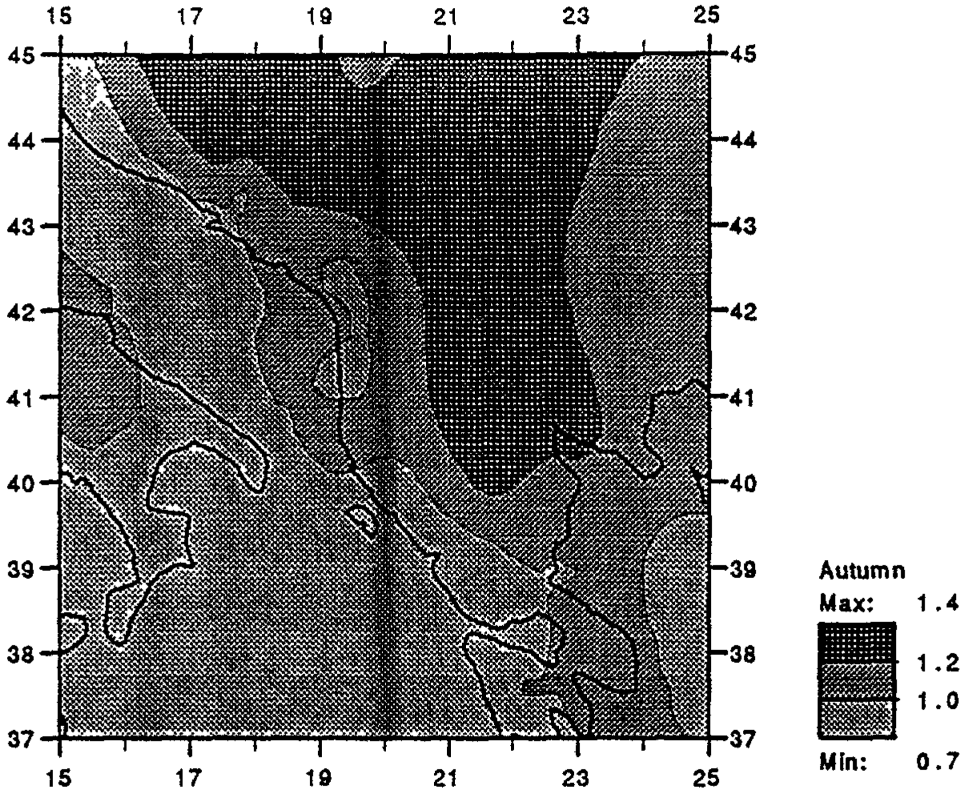
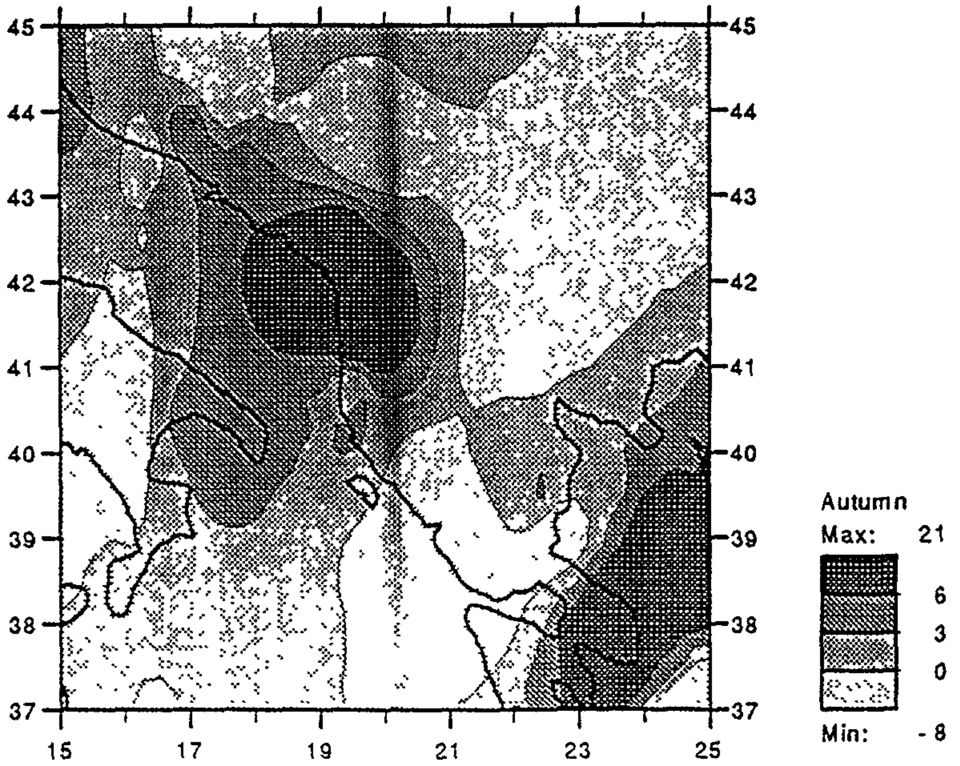


Fig. 5 Regional climate scenarios for Albania autumn Upper map shows change in temperature (°C per °C global change) and the lower map shows change in precipitation (% per °C global change).





4. CONCLUSIONS

We have applied the methods developed by Kim et al. (1984) and Wigley et al. (1990) to the problem of constructing sub-grid-scale climate change scenarios for Albania. Regression equations were developed to predict station temperature and precipitation anomalies from regionally-averaged climate anomalies. We proceeded to substitute GCM perturbed-run minus control-run values of temperature and precipitation in the regression equations to obtain a prediction of the change due to the greenhouse effect at each station. The results were scaled by the equilibrium global temperature change of each of the four GCMs, and an average change per °C global change obtained, calculated from the results for the four models. The procedure was repeated for every station in the data set, and the results contoured to produce scenarios for Albania.

Annual and seasonal scenarios for both temperature and precipitation change were produced. The scenario of annual temperature change shows an increase in the amount of change from south to north along the coast, and from the coast inland. Thus, in the southern coastal region the suggested annual change is 0.7-0.9°C per 1°C global warming (i.e. the warming will be less than the global level). Although further north along the Albanian coast the warming is shown to be greater (0.9-1.0°C per degree global warming), the indications are that it should not exceed the global rate of warming. In the extreme east of the country, however, temperature changes greater than the global level (i.e.above 1.0°C per 1°C global warming) are suggested. This annual pattern is reflected at the seasonal scale.

The scenarios for annual precipitation change indicate wetter conditions in the north of Albania as a result of global warming, and drier conditions in southern areas. The changes are quite small. At the seasonal level, this annual pattern is most clearly replicated in autumn. Precipitation in winter shows an increase due to global warming over most of the country, apart from a small area centred on 41°N at the coast, where a reduction in precipitation is indicated. In spring, the models indicate that rainfall should increase as a result of global warming over the whole of Albania. However, along the coast the increase is shown not to exceed 7% of present-day values, per 1°C global increase in temperature. The summer pattern is one of increased rainfall inland and along the southern coast, but with lower rainfall along the northern coast as a result of global warming. with a reduction in rainfall in the south of Albania, and an increase in the north.

The problems associated with the construction of regional scenarios of climate change due to the enhanced greenhouse effect are discussed at length by Palutikof et al. (1992), in their report to UNEP on the construction of climate change scenarios for the whole Mediterranean region. The confidence that we can place in sub-grid-scale scenarios of precipitation is particularly low. These scenarios should be considered only as indicators of changes that might occur.

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APPENDIX 1

STATIONS USED IN SCENARIO CONSTRUCTION FOR ALBANIA

Note that not all these stations will necessarily be used in the final scenario construction. They must first fulfill the criteria for acceptance laid down in Section 2 of this report, and by Palutikof et al. (1992).

ALBANIA

Station	E	N	HT	PRN	TEM	P%	T%
1. SHKODRA	19.5	42.1	28	1951-1988	1951-1988	100	100
2. TIRANA	19.8	41.3	89	1951-1988	1951-1988	100	100
3. VLORA	19.5	40.5	1	1951-1988	1951-1988	100	100
4. DURRES	19.5	41.3	15	1951-1988	1951-1988	100	100
5. FIER	19.5	40.7	12	1951-1988	1951-1988	100	100

BULGARIA

Station	E	N	HT	PRN	TEM	P%	T%
6. VRATZA	23.5	43.2	360	1951-1970	1951-1970	92	92
7. LOM	23.2	43.8	33	1961-1989	1961-1979	43	41
8. PLEVEN	24.6	43.4	75	1951-1970	1951-1970	92	92
9. KOLAROVGRAD	26.9	43.3	198	1951-1971	1951-1971	89	90
10. VARNA	27.9	43.2	41	1961-1989	1961-1979	44	39
11. SOFIA	23.3	42.7	564	1951-1989	1951-1979	67	72
12. PLOVDIV	24.8	42.2	160	1951-1970	1951-1970	92	92
13. BOURGAS	27.5	42.5	28	1951-1989	1951-1979	63	70

GREECE

Station	E	N	HT	PRN	TEM	P%	T%
14. KERKYRA	19.9	39.6	2	1955-1987	1951-1988	100	96
15. YANENA	20.7	39.6	-999	1956-1987	-	100	0
16. AGRINION	21.7	38.6	47	1956-1987	-	99	0
17. ARAXOS	21.4	38.2	23	1955-1987	1951-1970	100	100
18. ZAKYNTHOS	20.9	37.8	8	1956-1982	1951-1982	89	79
19. KOZANI	21.8	40.3	627	1955-1987	1955-1987	100	100
20. MIKRA	23.0	40.5	61	1951-1989	1951-1987	96	100
21. LARISSA	22.4	39.6	74	1955-1987	1951-1987	100	100
22. AGXIALO	22.8	39.0	-999	1956-1987	1956-1987	100	100
23. TRIPOLIS	22.2	37.6	660	1957-1987	1957-1987	100	100
24. KALAMATA	22.1	37.0	5	1951-1989	1951-1988	92	95
25. METHONI	21.7	36.8	34	1951-1987	1951-1987	100	99
26. TANAGRA	23.5	38.3	-999	1957-1986	1957-1986	99	99
27. ATHENS	23.7	38.0	107	1951-1986	1951-1988	100	97
28. HELLENIKON	23.7	37.9	10	1951-1989	1951-1987	97	100
29. KYTUIRA	23.0	36.2	-999	1955-1987	1955-1987	100	100
30. SKYROS	24.6	38.9	5	1955-1987	1955-1987	100	100
31. MILOS	24.5	36.7	-999	1955-1987	1955-1987	99	99
32. ALEXANDROUPOLI	25.8	40.9	3	1951-1987	1951-1987	100	100
33. MITILIA	26.4	39.2	-999	1955-1987	1955-1987	100	100
34. NAXOS	25.5	37.1	9	1955-1987	1955-1987	100	100
35. SOUDA	24.1	35.6	161	1958-1986	1958-1986	97	97

36. ANOGIA	24.9	35.3	-999	1951-1985	-	96	0
37. HIRAKLION	25.2	35.3	48	1955-1986	1951-1988	100	97
38. IERPETRA	25.8	35.0	-999	1956-1987	1956-1987	99	99
39. SITIA	26.1	35.2	28	1951-1985	-	87	0
40. KARPATHOS	27.2	35.5	20	1971-1988	1971-1988	95	95
41. RHODES	28.1	36.4	12	1955-1988	1955-1988	99	100

ITALY

Station	E	N	HT	PRN	TEM	P%	T%
42. TRENTO	11.1	46.1	312	1951-1976	-	100	0
43. UDINE	13.2	46.0	92	1967-1989	1967-1980	93	95
44. VERONA	10.9	45.4	67	1961-1989	1961-1985	98	100
45. PADUA	12.0	45.4	13	1951-1974	-	100	0
46. VENEZIA	12.4	45.4	17	1951-1989	1951-1988	98	100
47. TRIESTE	13.8	45.7	20	1951-1989	1951-1988	98	100
48. PARMA	10.3	44.8	56	1951-1977	1951-1976	100	100
49. PISA	10.4	43.7	2	1961-1989	1961-1980	97	100
50. FLORENCE	11.3	43.8	75	1951-1977	1951-1970	100	100
51. ANCONA	13.5	43.6	104	1951-1978	1951-1978	98	98
52. PESCARA	14.2	42.4	9	1961-1989	1961-1980	97	100
53. ROME	12.2	41.8	2	1951-1989	1951-1988	98	99
54. NAPOLI	14.3	40.9	88	1961-1987	1961-1987	99	99
55. BRINDISI	18.0	40.7	15	1961-1989	1961-1980	98	100
56. MARINA	16.9	40.4	12	1967-1989	1967-1980	96	95
57. MESSINA	15.6	38.2	51	1961-1989	1961-1980	98	100
58. TRAPANI	12.5	37.9	79	1961-1989	1961-1980	98	100
59. CATANIA	15.1	37.5	65	1961-1987	1961-1987	98	99
60. AVEZZANO	13.6	42.0	-999	1951-1970	-	100	0
61. BOLZANO	11.3	46.5	241	1961-1985	1961-1985	99	100
62. GROSSETO	11.1	42.8	5	1961-1985	1961-1985	99	100
63. PERUGIA	12.5	43.1	208	-	1967-1985	0	97
64. FALCONARA	13.4	43.6	12	-	1961-1985	0	96
65. CAMPOBASSO	14.7	41.6	793	1961-1985	1961-1985	99	100
66. BARI	16.8	41.1	34	-	1961-1985	0	99
67. POTENZA	15.8	40.6	823	1961-1985	1961-1973	99	96
68. CROTONE	17.1	39.0	155	-	1961-1985	0	100
69. PALERMO	13.1	38.2	21	-	1961-1985	0	100

LIBYA

Station	E	N	HT	PRN	TEM	P%	T%
70. ZUARA	12.1	32.9	3	1951-1988	1954-1988	98	72
71. GHARIAN	13.0	32.2	-999	1951-1988	-	96	0
72. HOMS	14.2	32.6	-999	1951-1989	-	92	0
73. TRIPOLI	13.2	32.7	84	1951-1989	1951-1988	90	91
74. MISURATA	15.1	32.4	6	1951-1988	1954-1988	100	95
75. TUMMINA	15.1	32.2	-999	1951-1989	-	36	0
76. BENINA	20.3	32.1	132	1951-1989	1951-1988	85	88
77. BENGHAZI	20.0	32.1	10	1951-1973	-	100	0
78. SHAHAT	21.9	32.8	625	1951-1988	-	98	0
79. DERNA	22.6	32.7	9	1951-1988	1951-1988	31	56
80. TOBRUQ	24.0	32.1	14	1951-1973	-	100	0

MALTA

	Station	E	N	HT	PRN	TEM	P%	T%
81.	LUQA	14.5	35.9	80	1951-1989	1951-1988	96	99

RUMANIA

	Station	E	N	HT	PRN	TEM	P%	T%
82.	ORADEA	21.9	47.1	135	1951-1970	1951-1970	100	99
83.	BISTRITA	24.5	47.1	366	1951-1988	1951-1980	98	99
84.	IASI	27.6	47.2	103	1951-1988	1951-1980	98	99
85.	CLUJ	23.7	46.8	415	1951-1988	1951-1980	98	99
86.	TIMISOARA	21.3	45.8	91	1951-1988	1951-1980	98	99
87.	SIBIU	24.3	45.8	452	1951-1988	1951-1980	98	99
88.	SULINA	29.7	45.2	9	1951-1988	1951-1980	98	99
89.	BANEASA	26.1	44.5	92	1951-1984	1951-1980	78	76
90.	FILARET	26.1	44.4	82	1951-1988	1951-1980	74	85
91.	CONSTANTA	28.7	44.2	32	1951-1970	1951-1970	100	100

TUNISIA

	Station	E	N	HT	PRN	TEM	P%	T%
92.	TUNIS	10.2	36.8	3	1951-1988	1951-1988	100	97
93.	KAIROUAN	10.1	35.7	60	1951-1988	1964-1974	100	95
94.	SFAX	10.7	34.7	21	1951-1988	-	100	0
95.	GABES	10.1	33.9	4	1951-1988	1951-1974	100	95
96.	DJERBA	10.6	33.8	0	1951-1988	-	100	0
97.	MEDENINE	10.3	33.3	117	1951-1972	-	100	0

TURKEY

	Station	E	N	HT	PRN	TEM	P%	T%
98.	EDIRNE	26.6	41.7	48	1929-1989	1929-1988	96	98
99.	CANAKKALE	26.4	40.1	3	1951-1989	1951-1988	96	98
0.	IZMIR	27.3	38.4	25	1929-1989	1929-1988	97	98
1.	MUGLA	28.4	37.2	646	1951-1989	1951-1988	94	96
2.	ISTANBUL	29.1	41.0	40	1929-1989	1912-1988	98	99
3.	BURSA	29.1	40.2	100	1951-1989	1951-1980	95	97

YUGOSLAVIA

	Station	E	N	HT	PRN	TEM	P%	T%
4.	PULA	13.9	44.9	30	1951-1980	1951-1980	100	100
5.	ZADAR	15.2	44.1	1	1951-1980	1951-1980	100	100
6.	HVAR	16.4	43.2	20	1951-1980	1951-1980	100	100
7.	VARAZDIN	16.4	46.3	169	1951-1980	1951-1980	100	100
8.	DARUVAR	17.2	45.6	161	1951-1980	1951-1980	100	100
9.	BANJA-LUKA	17.2	44.8	160	1951-1980	1951-1980	100	100
10.	BUGOJNO	17.5	44.1	562	1951-1980	1951-1980	100	100
11.	MOSTAR	17.8	43.4	99	1951-1980	1951-1980	100	100
12.	TUZLA	18.7	44.6	305	1951-1980	1951-1980	100	100
13.	SREMSKA	19.6	45.0	81	1951-1980	1951-1980	100	100

14.	ZRENJANIN	20.4	45.4	82	1951-1980	1951-1980	100	100
15.	ZLATIBOR	19.7	43.7	1029	1951-1980	1951-1980	100	100
16.	ULCINJ	19.2	41.9	30	1951-1980	1951-1980	100	100
17.	NIS	21.9	43.3	196	1951-1980	1951-1980	100	100
18.	PRILEP	21.6	41.3	661	1951-1980	1951-1980	100	100
19.	ZAGREB	16.0	45.8	163	1951-1989	1951-1988	98	99
20.	SISAK	16.4	45.5	98	1951-1970	1951-1970	100	100
21.	BEOGRAD	20.5	44.8	132	1951-1989	1951-1988	98	97
22.	SPLIT	16.4	43.5	129	1951-1989	1951-1988	98	99
23.	LIVNO	17.0	43.8	730	1951-1970	1951-1970	100	100
24.	SARAJEVO	18.4	43.9	637	1951-1989	1951-1988	97	99
25.	TITOGRAD	19.3	42.4	33	1951-1989	1951-1988	97	98
26.	SKOPJE	21.5	42.0	240	1951-1989	1951-1988	97	98

E - latitude
N - longitude
HT - height above sea level (m)
PRN - length of precipitation record
TEM - length of temperature record
P% - percentage of precipitation record present
T% - percentage of temperature record present

ANNEX VII

OPERATIVE SCENARIOS FOR TEMPERATURE, PRECIPITATION AND SEA-LEVEL RISE FOR TIME-HORIZONS 2030 AND 2100 TO BE USED BY THE TASK TEAM

Temperature change

IPCC92 (page 17) gives a warming of 0.3 E C per decade for IPCC90 Scenario A. However, this figure does not include the effects of sulphates and stratospheric ozone depletion. These effects are incorporated by Wigley and Raper (1992). They give a warming of 2.5 E C between 1990 and 2100, which works out at 0.23 E C per decade, for IPCC92 Scenario IS92a. There appear to be some modifications required to their carbon cycle model, which are currently being carried out. Changes to the carbon cycle model appear to lower the rate of global warming. This is interesting, since the warming rates given by Wigley and Raper (1992) are already lower than those of IPCC92. In a paper by Wigley (in press) it would appear that the quoted warming between 1990 and 2100 will be 2.25 E C as opposed to 2.5 E C over the same period in Wigley and Raper (1992). However, the Wigley (in press) figure should not be used since it could well undergo further modification prior to publication.

This leaves a certain dilemma: whether to use the IPCC92 figure, which omits the effects of sulphates and stratospheric ozone depletion, or whether to use the Wigley and Raper (1992) figure, which is expected to undergo modification. On balance, the Wigley and Raper (1992) figure should be used.

Findings from IPCC95 can be expected to cast further light on this subject shortly.

On this basis, global warming figures are as follows:

1990-2100 2.5 E C
1990-2030 0.9 E C.

This assumes the changes are linear which, particularly in the case of IS92a, is reasonable (see upper diagram of Fig. 5, Wigley and Raper (1992)).

Sea level change

IPCC92 (page 17) gives a figure of 2 to 4 cm/decade, but this is due only to oceanic thermal expansion (which admittedly is expected to be the largest contributor). Wigley and Raper (1992) incorporate land-based ice sheets and small glaciers also. They arrive at a figure of 48 cm increase between 1990 and 2100, based on IS92a. When scaled linearly, this gives a figure of +17 cm between 1990 and 2030. However, linear scaling is less valid in the case of sea level change (see lower diagram in Fig. 5, Wigley and Raper (1992)). A figure of +16 cm is more appropriate.

The best-guess figures, based on Wigley and Raper (1992) appear to be:

1990-2100 +48 cm
1990-2030 +16 cm.

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UEA Scenarios for Albania

These are based on inspection of the maps presented in the report "Temperature and Precipitation Scenarios for Albania", produced by the Climatic Research Unit, University of East Anglia. The area of interest is the eastern coast of the Adriatic, between about 39.38 N and *The changes given below are per 1 E C global warming*.

Annual	Temperature Precipitation	0.8 to 1.0 E C -2 to +5%
Winter	Temperature Precipitation	0.8 to 1.0 E C -11 to +2%
Spring	Temperature Precipitation	0.7 to 1.1 E C 0 to +7%
Summer	Temperature Precipitation	0.7 to 1.1 E C -24 to +5%
Autumn	Temperature Precipitation	0.7 to 1.2 E C 0 to 21%

OPERATIVE SCENARIOS FOR TIME HORIZONS 2030 AND 2100

		Time horizon	
		2030	2100
Annual	Temperature Precipitation	0.7 to 0.9 E C -2 to+5 %	2.0 to 2.5 E C -5 to +13 %
Winter	Temperature Precipitation	0.7 to 0.9 E C -10 to +2 %	2.0 to 2.5 E C -28 to +5 %
Spring	Temperature Precipitation	0.6 to 1.0 E C 0 to +6 %	1.8 to 2.8 E C 0 to +18 %
Summer	Temperature Precipitation	0.6 to 1.0 E C -22 to +5%	1.8 to 2.8 E C -60 to +13%
Autumn	Temperature Precipitation	0.6 to 1.1 E C 0 to +19 %	1.8 to 3.0 E C 0 to 53 %
Sea level change		+ 16 cm	+ 48 cm

ANNEX VIII

BASIC FACTS ABOUT ALBANIAN COAST

Geographical position and population

Albania lies on the west side of the Balkan peninsula.To the north and northeast Albania is bounded by former Yugoslavia and to the south and southeast by Greece. To the west and southwest it is bordered by the Adriatic and Ionian Seas.

Albania extends over an area of 28,748 square kilometres; the population for 1990 was estimated at 3.2 million (see Figure). More recent estimates indicate that the 1992 population was 3.3 million.

Relief

Albania is mainly a mountainous country; 76.6% of the land is mountains and hills, while the plains up to 200 metres above sea level occupy only 23.4% of the land.

Albania's coastline is 450 km long. Along the coastline are many lagoons, sand belts and sand dunes. Three main climax vegetation zones can be recognized in the coastal region: xeromediterranean sclerophyllic maquis (Karaburun peninsula and Sazan Island), eumediterranean evergreen forest (mainly in the central coastal area), and submediterranean xeric broadleaves forest (mainly in the northern coast). Extensive pine forests have been planted along the sandy coastal strips. A series of valleys, which lie across the country, link its coasts with the interior of the country. The lowlands of the Adriatic coastline, previously covered with marshes and swamps, have now been converted into arable land.

The Adriatic section of the coastline is under constant dynamic change due to river inputs and the seismic profile of the area and is considered as accumulative. The Ionian coast is rocky with small beaches and limited sandy areas. The majority of freshwater sources in the Ionian section of the coastline are underground with outlets directly to the sea.

Climate

Albania is situated in the Mediterranean climatic belt, with a hot dry summer, a generally mild winter and abundant rainfall.

The climate is warmest in the southwestern part which is mainly under the influence of the warm air masses from the sea. The winter is moderate with average temperatures rarely falling below zero and the summer is hot (absolute maximum July temperature recorded is 44 EC). The climate is coldest in the northeastern part which is mainly under the influence of continental air masses. The winter is cold with frequent minus temperatures (absolute minimum temperature recorded is -35 EC).

Rainfall in Albania is abundant. Average annual rainfall is over 2,000 mm in the Alps in Northern Albania and 650-700 mm in the valleys of the interior. 40% of the annual precipitation falls in the winter. Summer droughts are more pronounced towards the southwest.

Rivers and lakes

Due to the rugged relief of the land, rivers are torrential with a high erosive power. Rivers originate from the high mountain regions, open out into the plains and flow into the Adriatic Sea.
The normal river flow is an average of 33 litres per second. The longest rivers are the Drin river, on the eastern coast of the Adriatic (285 km long), Mat, Shkumbin, Seman and Vjosa.

The rivers of Albania constitute an important source of hydroelectric power. Three hydro-power stations have been constructed on the Drin river while it is intended to turn the river into a series of lakes to serve the already existing hydro-power plants or those to be constructed on it. Hydro-power plants have also been constructed on the Mat and Bistrica rivers.

The lakes are of varying origin: glacial lakes in the highlands, karstic lakes on the hills, tectonic lakes (Shkodra, Ohri and Prespa) which are the largest and most important in terms of fisheries, and lakes of the lagoon type which are large fishing reserves.The lakes of the hills and highlands are also used for irrigation purposes.

Specially protected areas

Eleven coastal protected areas are known for Albania:

Kune; Vaini; Rushkull; Fushë Krujë; Pishë Poro; Pish Poro; Karaburun Liogara; Diviakë; Velipojë; Nartë; Butrinti.

Rare, endangered and endemic species

The Albanian flora and fauna includes a considerable number of endemic and sub-endemic species.

Most rare and threatened species of plants belong to the *Ranunculacae Compositae* and *Orchidaceae* families.

With regard to vertebrates available information is scarce for defining their present status.

The Dalmatian pelican (*Pelecanus crispus sterna albinforms*) is a threatened species and the world population is assessed to be 700-1,100 individuals. The Karavastasë lagoon is the only nesting site in Albania with about 50 nests in 1992.

The curlew (*Numenius sp.*) is very rare in the Mediterranean and seems confined to Albania. It was sighted on several occasions in the Fushe-Kuqe Patok Nature Reserve.

The pygmy cormorant (*Phalacrocorax pygmaeus*) nests in the Cekë and Merxhani lagoons, and in "Franc Josef" Island (close to the outlet of the Bunë River) among mixed colonies of night herons (*Nycticorax nycticorax*), little egrets (*Egretta garzetta*) and glossy ibis (*Plegadis falcinellus*).

The presence of sea turtles is well established along the Albanian coast. The existing population number may be grossly underestimated. The loggerhead turtle (*Caretta caretta*) has been sighted along the Ionian coast (Karaburun peninsula). The presence of the green turtle (*Chelonia mydas*) is not excluded.

The brown bear (*Ursus arctos*) seems to inhabit mainly the high forests throughout the country; the most important populations are recorded in the following areas: Lurë (Peshkopi), Germenjë (Kolonjë), Cangonj (Korçë), Hondisht and Llengë (Pogradec).

The population of the wolf (*Canis lupus*) is assessed at about 400 individuals distributed mainly in the Albanian Alps. This carnivore is hunted because it seems to cause damage to livestock.

The jackal (*Canis aureus*) is rare and seems to have disappeared from the coastal plain.

The otter is widespread throughout most of the country but the animals' range is restricted to the central area, the coastal plain and the Korçë Plain. It occurs mainly in the uplands but considerable populations are also encountered in some lowland areas and coastal marshes (Lezhë Lagoons).

The polecat (*Mustela putorius*) is becoming rare and the pine marten (*Martes martes*) seems to be scattered in range (from the Albanian Alps to the Gramsh district). The weasel (*Mustela nivalis*), stone marten (*Martes foina*) and badger (*Meles meles*) are rare.

The lynx (*Lynx lynx*) and wild cat (*Felis silvestris*) are rare and very restricted in range; for the first species the Theth National Park and surrounding area seem to maintain the best population. About 50 lynxes have been observed.

The monk seal (*Monachus monachus*) was sighted in the '80s in the Butrintit and Karavastasë lagoons. It is possible that resting and breeding sites are present along the coastline between the Vlorë gulf (Karaburun peninsula) and Sarandë gulf. There seems to be a colony of between 5 and 10 individuals at the level of the Karaburun peninsula.

Sites of historic interest

Albania has a rich cultural heritage and several monuments and objects of archaeological interest are scattered throughout the country.

Archaeological finds are much diversified and include prehistoric settlements, burial sites, monuments, dwellings and necropoles of Illyrian towns, and ruins of castles of the early Albanian Middle Ages.

The most important prehistoric finds have been excavated close to the built-up area of Maliq, Tren, Podgorie, Vashtëmia, Dunaveç, Kamnik, Barç Kuçi i Zi, Prodan and Rehova, in southest Albania. Excavations have been carried out in graves of Kruma, Këneta and Cinamak in northeast Albania, of Cakran and Patos in the coastal plain, and of Vajza, Dukat, Xara and Cuka in southern Albania.

Several necropoles of the ancient Illyrian period have been discovered in Ploça (Amantia), Antigonia, Krotina (Dimallum), Hecal (Byllis), Selca, Poshtëme, Apollonia, Durrës (Epidamnos, Dyrrachium), Butrintit (Butrorum) etc. In Byllis, one of the biggest Illyrian towns, a theatre of about 7,500 sets has been discovered.

As regards early Middle Age settlements, important finds have been found in Lezhë, Koman, Krujë, Berat, Ballsh, Kosine, Peshkopi etc.

Agriculture

Agriculture is the Albanian economy's most important sector in terms of value added and employment. In recent years the sector accounted for about 20% of exports and 50% of employment. In 1990 about 705,000 people were employed in agriculture and forestry and an additional 100,000 in related sectors.

Emphasis is placed on the production of cereals. Major crops include sugar beet, cotton, grains, beans and sunflower seeds. The olive tree is also considered as a most suitable exportable product. The country possesses around 6 million olive trees of which the 4 million are productive. Livestock provides almost half the value of production.

During the period from July 1991 to March 1992 the agricultural sector was severely affected by input and foreign exchange shortages, social upheavals linked to the privatization of cooperative land and assets throughout the country, and disruptions caused by the absence of alternative distribution and allocation mechanisms to replace the collapsing centrally planned system. Social and economic chaos led to rapidly falling living standards for the vast majority of the population, especially in poor rural areas. Agricultural surpluses dwindled to almost nothing as Albania's 380,000 new private farmers concentrated on ensuring the subsistence of their families.

Industry

Industry in Albania is predominantly small-scale with a bias towards engineering, chemicals, construction materials, food processing and other agro-allied industries.

Until the recent political and economic crisis, the industrial sector was, along with agriculture, one of the main contributors to the Albanian economy, accounting in 1990 for 23% of the total employment and 58% of the gross national output. At that time, heavy industry, the food industry and light industry accounted for about 31%, 28% and 20% respectively of the total industrial production.

The chemicals sector which includes 5 main factories producing soda and PVC, nitrogenous fertilizers, pesticides, pigments and paints uses outdated Chinese and Albanian equipment and technology with a low performance due to design faults, poor maintenance and shortages of national and imported raw materials. Several of the chemical plants, in particular the phosphate fertilizer and caustic soda plants are hazardous to their workforce and release significant amounts of gaseous and liquid wastes loaded with toxic substances into the environment.

Oil extraction and refining is very important for the national economy, employing about 20,000 workers. At present there are about 3,500 operational oil wells out of which 2,000 are concentrated in the onshore oil fields near Patosi (Fier). The oil produced has a high density (0.94 to 1.0) and quite a high sulphur content. The aggregate capacity of the four refineries at Ballsh, Fier, Kucova and Cerik is about 2.7 million tons per year although the present level of utilization averages 23%. Most of the refined products are for domestic use.

Despite considerable efforts to revive the industrial sector after April 1992 which resulted in the rehabilitation of several enterprises, the Albanian industry remains in the grip of financial collapse due to heavy debts.

Tourism

Tourism in Albania is only at a very early stage of development. However, the country exhibits considerable potential for the development of tourism due to the extensive coastline, the interesting scenery of Albanian lakes and mountain regions and the generally pristine countryside.

Without excluding the possibility of the development of large-scale tourism, the potential for the development of high quality small-scale tourist villages to be harmoniously integrated with existing villages and for the development of eco-tourism is being considered.

Several contracts for the construction of hotels and tourist villages including the construction of a tourist port and airport have already been signed with major Austrian, French and Italian companies involving investments of up to 280 million US$ and the prospect of a further investment of 50 million US$ through a contract with a Swiss company. Negotiations are also under way with American, German, Kuwaiti and other companies.

Energy

The electric power system of Albania is supplied mainly by hydroelectric power plants, which account for about 85% of generating capacity and 95% of total generation. The total generating capacity is 1,662 MW of which 1,444 MW are hydroelectric.

Ten hydro-power plants are currently in operation. The three largest power plants form a cascade system on the river Drin in northern Albania.

The major thermal power plants are fueled either with crude oil or natural gas although the supply of natural gas has been almost non-existent since 1983 due to a serious accident and fire at an oil well which produced associated natural gas. The present supply of crude oil has a very high sulphur content.

Several smaller thermal units for combined heat and power generation are located in the cities, including Tirana. Such plants generally burn brown coal. The reported sulphur content of brown and bituminous coals is 3-5% and about 7% respectively. The risk of air pollution is therefore very high.

Summary of the present state of the economy

Albania ranks as one of the poorest countries in Europe. Low levels of productivity and capital investments combined with shortages of skilled labour are major constraints of the growth.

The economy in Albania is in the midst of a deep crisis with an annual inflation rate in 1992 of 300%, a foreign debt exceeding 800 million US$, an output decline of 75% compared to 1989 and a budget deficit three times larger than in 1991. Of the estimated 364,641 jobless in the beginning of 1993, about 20% of the labour force, 3.5% were university graduates, 45% had completed high school and 51% had only eighth grade education indicating that at least 80% of the unemployed lack basic training.

There are more than 400,000 spread throughout Europe and in other parts of the world each having provided substantial amount of foreign currency to their families in Albania over the past two years.

Agricultural surpluses have dwindled to almost nothing as the 380,000 new private farmers have concentrated on ensuring the subsistence of their families. The industrial sector is functioning at a very low level of production with most of the plants presently out of production, with very limited possibilities of being put again into operation and competing in the "free market" economy. At the same time the Albanian industry also remains in the grip of financial collapse due to heavy debts.

Overview of major known environmental problems

There are no restrictions on the use of chemical herbicides, pesticides and fertilizers in agriculture resulting in the contamination of rivers, canals and groundwater.

Waste waters of industrial origin are usually directly discharged into rivers and the sea with very little, if any, treatment.

Waste waters of urban origin are also directly discharged into canals and rivers due to the lack of sewage treatment facilities.

Damage to aquatic life and incidents of eutrophication have been reported due to the improper disposal of industrial wastes into the aquatic environment and unsustainable agricultural practices.

Preliminary results of the National Monitoring Programme indicate that the microbial quality of bathing waters is inadequate in a number of locations along the Albanian coast.

Air quality is a very serious environmental concern particularly around industrial settlements and urban areas. Thermal power plants, coke plants and electric furnaces are hot spots of air pollution. Very high concentrations of soot, sulphur dioxide and carbon monoxide in the atmosphere exist as a result of a combination of the bad quality of raw materials, polluting technologies adopted in the industrial process and a lack of pollution control.

Gases from the smelting process containing high concentrations of sulphur dioxide are damaging the forests over a wide area. Rainwater may reach a high level of acidity, thereby magnifying the effect of deforestation for fuelwood and cultivation. Albania has lost about 20% of its forest land in the last 20 years and soil erosion is becoming a major concern.

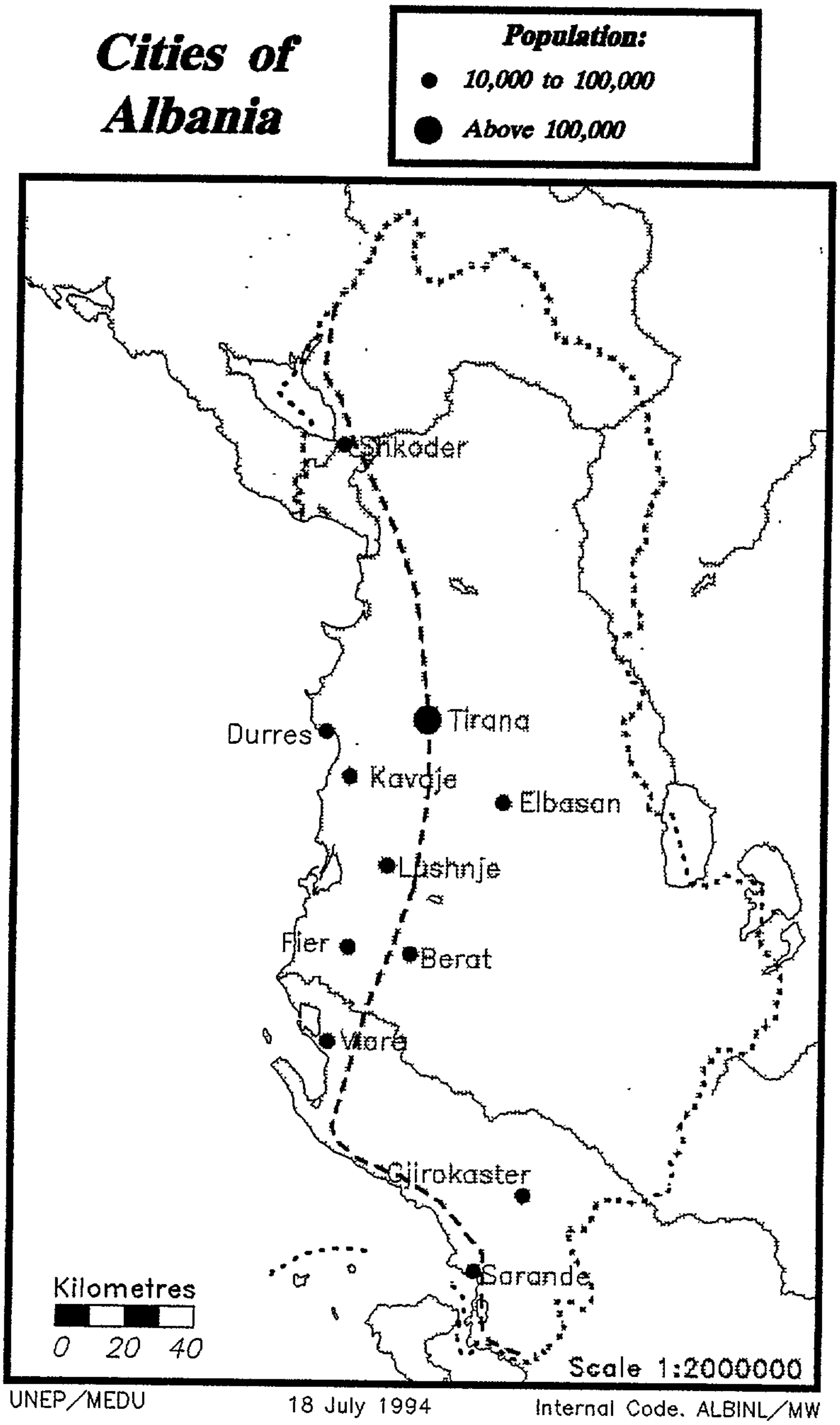
Hazardous industrial wastes are disposed of along with domestic waste, or stored, without any procedure for the protection of the surrounding environment.

Fishing practices which are prohibited in other Mediterranean countries, such as the use of drift nets, are occurring in Albanian waters, mainly by foreign trawlers.

Most of the Albanian nature reserves and national parks situated near the coast are used for shooting by foreign hunters and are liable to some poaching mainly from local people. No national laws refer to the protection of endangered species except from a list of 27 protected species, in relation to shooting regulations, which does not seem to apply any more.

ANNEX IX

MAP OF THE STUDY AREA



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ANNEX X

OBJECTIVES, ASSUMPTIONS AND OUTPUTS OF THE STUDY

OBJECTIVES

Long-term objectives:

Sound environmental management and planning of the sustainable use of resources (in particular land-use) in the coastal region of Albania in changed climate conditions.

Short term objectives:

- to identify and assess the 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, systems and activities which appear to be most vulnerable to the expected climate changes;
- to give recommendations for planning and management of coastal areas and resources, as well as for planning and design of major infrastructure and other systems; and
- to provide an input into other projects and developments relevant to the subject of the study.

The findings of the study should serve for:

- development of strategies for the coastal region of Albania in the changed climate conditions;
- furthering the work on coastal zone management studies in the framework of CAMP supported in Albania by UNEP/MAP, and other coastal zone management studies, such as the one supported by the World Bank; and
- information for the general public, economists, managers, policy- and decision-makers.

ASSUMPTIONS

For the specific purpose of the study two time horizons will be considered (years 2030 and 2100), and the following will be taken into account:

- the best available information, knowledge and insights into the problems relevant to the coastal region of Albania including major projects, planned or under consideration;

- warming figures of 0.9 E C (1990-2030) and 2.5 E C (1990-2100) and sea level change of + 16 cm (1990-2030) and + 48 cm (1990-2100) (see Annex VI);

- the results of the University of East Anglia's "Temperature and Precipitation Scenarios for Albania.

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 predictable consequences of expected climatic change;

- development strategies for the coastal region of Albania in the changed climate conditions.

ANNEX XI

OUTLINE OF THE REPORT

ANNOTATED OUTLINE OF THE PART OF THE REPORT
(Executive summary, 1. Introduction and 2. Identification of present situation and trends)
with the indication of the person responsible for the preparation of the
individual sections of the report

EXECUTIVE SUMMARY (E. Demiraj)

A 2-3 page summary intended as message to high-level policy-makers and managers. It should cover in a concise and non-technical terms (a) the main features of expected climate changes relevant to the coastal areas of Albania; (b) the major ecological and socio-economic impacts identified as the likely consequences of the expected climate changes; and (c) the principal recommendations for the mitigation of, or the suitable adaptation to, the identified negative impacts.

1. INTRODUCTION (E. Demiraj)

1.1 Background (E. Demiraj). A short reference to the: (a) origin of the expected greenhouse effect, with basic information on the magnitude of its expected consequences for the study area; (b) importance for timely preparation of studies on the possible impacts of climate changes; and (c) organic link between the study and the CAMP being prepared for the coastal areas of Albania. Repeat the objectives and the expected outputs of the study, as they appear in Annex X to this report.

1.2 Basic facts about the coastal region of Albania (E. Demiraj). A shorter and updated version of Annex VIII to this report, with emphasis on facts relevant to the objectives of the study.

1.3 Methodology and assumptions used in the study (E. Demiraj). Reference to the creation of the Task Team, the climate scenarios specifically developed for the study area, the inputs from individual members of the Task Team into the study and their interdisciplinary interaction, the meetings of the Task Teams, the links with the relevant Task Teams established in the framework of the CAMP, and UNEP/MAP's support provided for the work of the Team. Repeat the basic assumptions used in the preparation of the study, and in the operative climate scenarios, as they are listed in Annexes VI and X to this report. Identify, as the area covered by the study, the whole length of the Albanian coastal zone consisting of littoral area, coastal strip and its adjacent sea area, with the understanding that the on/off shore axis extends seawards and landwards as far as necessary to approach a particular coastal problem.

1.4 Temperature and precipitation scenarios for Albania (E. Demiraj). Summary of the scenarios appearing in Annex VII to the present report, keeping in mind that the full text of the scenarios, as they appear in Annex VI to the present report, will be an annex to the final report of the Task Team.

2. IDENTIFICATION OF PRESENT SITUATION AND TRENDS (E. Demiraj)

2.1 Climate conditions and atmosphere (L. Gjoka Muçaj and V. Mustaqi)

2.1.1 Climate conditions. Using the existing data from continuous observations during the last three decades on the Albanian meteorological stations, the variations of climate-related parameters (atmospheric pressure, air temperature, precipitation, wind, sunshine, solar radiation, cloudiness) will be analyzed. Yearly, seasonal and daily averages, maximums and minimums, as well as return periods will be calculated whenever feasible. The frequency and intensity of extreme conditions (e.g. drought, storms), and some rear phenomena (e.g., snow, fog, frost) will be determined.

2.1.2 Atmospheric conditions. Recognizing the nonexistence of a suitable database, the section will be based on qualitative description of atmospheric conditions (e.g., smog, dust) relevant to the study.

2.2 Litosphere (P. Hoxha)

2.2.1 Geology. The geological structure and geomorphology of the coastal area will be described, with reference to tectonic conditions. A geological map of the coast, with some geological profiles, will be provided. The type of sea-shores, and their extent along the coast will be identified, and the shore dynamic (sea-level changes, accretion, subsidence, erosion, etc.) will be analyzed on the basis of historic and recent data and observations.

2.2.2 Soils. The distribution and main properties of soil types in the coastal area will be identified. A soil map of the coastal area will be provided, with the indication of areas now affected by, or vulnerable to, desertification and salinization.

2.3 Hydrosphere (F. Hoxha and M. Bicja)

2.3.1 Surface waters. The total flux, and its seasonal variations, of all surface waters into the Adriatic and Ionian seas will be provided. An estimate will be made for the quality of the waters (e.g., state of pollution) and for the amount of suspended matter carried by the rivers into the sea.

2.3.2 Ground waters. The distribution, boundaries and magnitude of coastal ground water reservoirs, and their hydrological dynamics, will be described on the basis of available data and observations.

2.3.3 Marine waters. Variations in sea level (see also section 2.2.1) and patterns of dynamic processes (currents, waves, etc.) will be described. The extent of coastal lakes and lagoons, as well as their hydrodynamic relation to marine or surface waters, will be presented.

2.4 Natural ecosystems (J. Vangjeli and L. Gjiknuri)

2.4.1 Terrestrial ecosystems. Information will be provided on the principal coastal ecosystems and habitats, including on their present and past natural boundaries, vegetation types, species composition, biodiversity and their dependence on geomorphology and soils (see also sections 2.2.1 and 2.2.2). Special reference will be made to: (a) endemic, rare, and endangered species; (b) anthropogenic influences on terrestrial ecosystems; (c) economic and other values (e.g., habitats of migratory species) of the ecosystems, habitats and species; (d) status of protected areas; and (e) plans for the restoration of damaged ecosystems and for the extension of protected areas.

2.4.2 Freshwater ecosystems. Description to follow the general approach outlined for section 2.4.1, taking into account the specifics of freshwater ecosystems (e.g., information on hydrological conditions and water quality).

2.4.3 Estuarine and lagoon ecosystems. Description to follow the general approach outlined for sections 2.4.1 and 2.4.2, taking into account the specifics of estuarine and lagoon ecosystems.

2.4.4 Marine ecosystems. Description to follow the general approach outlined for section 2.4.1, taking into account the specifics of marine ecosystems.

2.5 Managed ecosystems (A. Pulluqi, M. Selfo and D. Habili)

2.5.1 Agriculture (A. Pulluqi). Identification of the past, present and foreseeable main agricultural activities and products in the coastal areas. The commercial value of the products, and the importance of agriculture in the national economy, will be assessed. Reference will be made to land-use patterns and to agricultural practices which may be affected by the consequences of climate change (e.g., increased soil erosion and salinization)

2.5.2 Fisheries (M. Selfo). The main fisheries resources will be identified and an estimate will be provided, on the basis of fishery statistics, about the past trends and present level of their exploitation (commercial, subsistence, export). The main fishing methods (techniques and technologies), and the status of stocks (e.g., over- or under-exploited), will be highlighted.

2.5.3 Aquaculture (M. Selfo) The present status and the past trends in the development of coastal aquaculture (marine, freshwater, estuarine and lagoonal) will be described (e.g., geographic distribution of sites, cultivated species, annual harvests, types of aquaculture, commercial value of the harvest, etc.). Foreseeable trends in development of aquaculture, and possible conflicting interests with other development sectors (e.g., tourism, settlements, industry) will be identified.

2.5.4 Silviculture (D. Habili). The past and present areas covered by silviculture in the coastal area will be determined. The main crops (cultivated species), their use and commercial value, and the prevailing silviculture practices (e.g., exploitation of natural forests on sustainable basis, plantations) will be described.

2.6 Energy and industry (E. Gjika)

2.6.1 Energy. The past and present levels of energy requirements in the coastal area will be given, by main sources of energy (e.g., hydroelectric, thermoelectric) and principal user sectors (e.g., industry, households, tourism, etc.). The future energy requirements of the coastal area will be assessed, using data from other sectors of this report (e.g., 2.6.2, 2.7,and 2.10.2).

2.6.2 Industry. An inventory will be prepared of the main industrial installations in the coastal areas. Installations away from the coast will be listed only if they have a significant influence on the coastal areas (e.g., by polluting the area, requiring harbour or coastal/maritime transport facilities). The present status and foreseeable future of the listed installations will be indicated.

2.7 Tourism (S. Kongoli). The past trends and present status of tourism in Albania will be described (i.e., sites, number of hotels, beds, tourists; revenue from tourism; type of tourism: catering for international or domestic market, camping). The future prospects for the development of tourism will be assessed.

2.8 Transport and transport-related services (S. Bebi). The section will describe the present status and past trends in: (a) road traffic in coastal areas; (b) maritime transport associated with Albanian harbours, and transit through Albanian coastal waters, including harbour installations and waste disposal facilities associated with harbour activities; (c) railway transport, including railway stations and installations and facilities associated with their operations; and (d) air transport, including airports and facilities associated with their operations. Future trends in the development of these transport means, their significance in the context of Albania's socio-economic development, and their potential environmental impact, will be assessed.

2.9 Sanitation and health aspects (A. Shehi)

2.9.1 Sanitation. The present status of sanitary conditions in the urban, rural and touristic areas will be reviewed, with support of statistical data and information. The review will specifically include references to: (a) freshwater supply for human consumption; (b) housing conditions; (c) disposal and treatment of domestic liquid and solid waste; and (d) vector control programmes (e.g., for the control of malaria).

2.9.2 Health aspects. Data and information will be provided on the past and present distribution patterns and frequencies of main illnesses, and causes for death, with special reference to illnesses and death which may be directly or indirectly associated with climate conditions (e.g., respiratory, cardiovascular, cataracts, skin cancer, malaria).

2.10 Populations and settlements (S. Kongoli)

2.10.1 Populations. The past trends in population dynamics relevant to the coastal area will be described and their causes highlighted (e.g., natural growth of coastal population, movements from the hinterland, emigration). The trends foreseeable in future population movements, and the main likely driving forces in these trends (e.g., better climate conditions than in inland; job opportunities in industry, tourism and services; availability of infrastructure ensuring higher living standards and quality of life).

2.10.2 Settlements. A review will be provided of the evolution (growth) of settlements along the coast of Albania, with an analysis of the main factors which contributed to this growth. The adequacy of the present infrastructure supporting the settlements will be assessed. The likely future trends in the evolution of coastal human settlements will be estimated.

ANNEX XII

WORKPLAN AND TIMETABLE *

-	Nomination of the Co-ordinator of the Task Team	November 1993
-	Establishment of the Task Team	December 1993
-	Preliminary outline of the first draft of the report	February 1993
-	First (preparatory) meeting of the Task Team	July 1994
-	Collection of data and relevant documentation	July-December 1994
-	Analysis and evaluation of data and documentation collected	July-December 1994
-	Presentation of the preliminary analysis at the second meeting of the Task Team (first draft of the final report)	December 1994/January 1995
-	Finalization of the draft report	January/May 1995
-	Presentation of the final draft of the report at the third meeting of the Task Team	May 1995
-	Finalization and publication of the report and presentation to the national and local authorities	July 1995

* 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.