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Climate Change in Coastal Zones of the Mediterranean

Background Paper

coastal zone management pilot

Priority Actions Programme
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Acronyms

ACCCA Advancing Capacity to support Climate Change Adaptation
ADB Asian Development Bank
ALM Adaptation Learning Mechanism
AR4 Fourth Assessment Report
ASLR Accelerated Sea Level Rise
AWG-LCA Ad-hoc Working Group on Long-Term Co-operative Action
BD Biodiversity
CAM Coastal Area Management
CAMP Coastal Area Management Project
CANTICO Climate and local ANthropogenic drivers and impacts for the Tunisian Coastal area
CARICOM Caribbean Community (Caribbean Planning for Adaptation to Global Climate Change)
CBAMPIC Capacity Building for the Development of Adaptation Measures in Pacific Island Countries Project
CCA Climate Change Adaptation
CIRCE Climate change and Impact Research: the Mediterranean Environment
CLIMBIOMEDNET Scientific assessment of Climate Change effects on lagoons ecosystem in comparison with man-induced changes
CMCC Centro Euro-Mediterraneo per i Cambiamenti Climatici
CNR Consiglio Nazionale delle Ricerche (Italian National Research Council)
CO Carbon monoxide
CO2 Carbon dioxide
COP Conference of the Parties
CP Contracting Party
DEFRA Department of Environment, Food and Rural Affairs
DIACT Interministerial Agency for Spatial Planning and Competitiveness (France)
EC European Commission
EEA European Environment Agency
EEZ Exclusive Economic Zone
EIA Environmental Impact Assessment
EIT Economies in Transition
ENEA Italian National Agency for New Technologies, Energy and Sustainable Economic Development
ENPI European Neighbourhood and Partnership Instrument
EPOCA European Project on Ocean Acidification
ERDF European Regional Development Fund
EU European Union
EUCC European Union for Coastal Conservation
FCT Foundation for Science and Technology (Portugal)
FGA First General Agreement
FISR Fondo Integrativo Speciale per la Ricerca (Italian Integrated Research Fund)
GCCA Global Climate Change Alliance
GDP Gross Domestic Product
GEF Global Environment Facility
GHG Green House Gas (emission)
GMES Global Monitoring for Environment and Security
GTZ Deutsche Gesellschaft für Technische Zusammenarbeit (German Technical Corporation)
ICARM Integrated Coastal Area and River Basin Management
ICM Integrated Coastal Management
ICZM Integrated Coastal Zone Management
IDDRI Institute for Sustainable Development and International Relations
IDS Institute of Development Studies
IMELS Italian Ministry of Environment, Land and Sea
IMEP Israelian Ministry of Environmental Protection
IWRM Integrated Water Resources Management
IPA Instrument for Pre-Accession
INC Initial National Communication
INGV Istituto Nazionale di Geofisica e Vulcanologia

INTERREG European Union INTERREGional Co-operation Programme
IPCC Intergovernmental Panel on Climate Change
IT Information Technology
IUCN World Conservation Union (International Union for the Conservation of Nature and Natural Resources)
JRC-IES EC Joint Research Centre
LDC Least Developed Countries
MAP Mediterranean Action Plan
MAAP French Ministry of Food, Agriculture and Fishing
MEA Millennium Ecosystem Assessment
MDGs Millennium Development Goals
MEEDDM French Ministry of Ecology, Energy, Sustainable Development and Sea
MFF Mangroves for the Future
MIPAAF Ministero delle Politiche Agricole Alimentari e Forestali
MPA Marine Protected Area
MSSD Mediterranean Strategy for Sustainable Development
MATTM Ministero Dell'ambiente e della Tutela del Territorio e del Mare
MUR Ministry of University and Research
NAO North Atlantic Oscillation
NAPA National Adaptation Programmes of Action
NAS National Adaptation Strategy
NGO Non-Governmental Organisation
NRM Natural Resource Management
ODA Official Development assistance
OECC Oficina Española de Cambio Climático
OECD Organisation for Economic Co-operation and Development
ONERC Observatoire National sur les effects du réchauffement climatique (French National Observatory on the effects of global warming)
PAP/RAC Priority Actions Programme/ Regional Activity Centre
PESETA Projection of Economic impacts of climate change in Sectors of the European Union based on bottom-up Analysis
PICs Pacific Island Countries
PoWs Programmes of Work
RENA Regional Environmental Network for Accession countries
REReP Regional Environmental Reconstruction Programme
SBI Subsidiary Body for Implementation
SBSTA Subsidiary Body for Scientific and Technological Advice
SGP Small Grants Project
SIDS Small Island Developing State or States
SLR Sea Level Rise
SNC Second National Communication
SPA Specially Protected Area
SRES Special Report on Emission Scenarios
SST Sea Surface Temperature
UKCIP United Kingdom Climate Impacts Programme
UN United Nations
UNDP United Nations Development Programme
UNEP United Nations Environment Programme
UNFCCC United Nations Framework Convention on Climate Change
US United States
USAID United States Agency for International Development
V&A Vulnerability and Adaptation
VECTOR **V**uln**E**rabilità delle **C**oste e degli ecosistemi marini italiani ai cambiamenti clima**T**ici e loro ruol**O** nei cicli del ca**R**bonio mediterraneo
WGs Working Groups

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1. Introduction

The current report provides background information towards the production of a **Position Paper**[1] on coastal climate change in the Mediterranean region (Figure 1). The Priority Actions Programme/Regional Activity Centre (PAP/RAC) of the United Nations Environment Programme's (UNEP) Mediterranean Action Plan (MAP) mandated this work[2] following the recent addition of climate change adaptation to their Programme of Work for the next 5 years[3].

Although the MAP has not traditionally tackled the issue of coastal climate change as a discrete programme, it has a well-established track record of supporting Integrated Coastal Zone Management (ICZM) in conjunction with Contracting Parties (CPs)[4] primarily through the activities of the PAP/RAC. In light of this, the MAP and PAP/RAC are ideally positioned to adopt a leadership and mentoring role through the region as countries attempt to adapt to the inevitable impacts of a changing coastal climate. In addition, the recently agreed ICZM Protocol provides an important tool for which climate change adaptation can be mainstreamed.

Before MAP may commence with detailed planning of its upcoming vulnerability and adaptation supporting initiatives it will be necessary to undertake a review exercise to determine the policies and strategies and projects and programmes active in the region at a range of temporal and spatial scales. This is the key aim of the current report. Additionally, an overview of impacts, threats and consequences of coastal climate change in the Mediterranean is provided with a summary of the status of coastal adaptation initiatives around the globe presented to highlight best practice. The overall purpose of the review is to inform the process of climate change adaptation for subsequent activities in the Mediterranean coastal zone.

[1] The *Position Paper* has been prepared as a separate document. This Background Paper provides the baseline information that supported the development of recommendations on potential technical assistance that PAP/RAC can provide to countries to adapt to climate change in coastal zones. The recommendations are presented in the Position Paper.
[2] The MAP was the first Regional Seas Programme established by UNEP in 1975. It has 22 Contracting Parties (CPs) with vested interest in the Mediterranean coastal zone and is governed by the Barcelona Convention.
[3] At the recent MAP COP 16 held in Marrakesh, the Marrakesh Declaration explicitly addressed the need for MAP CPs to address climate change adaptation, incorporating this issue into its mandate for the first time.
[4] Contracting Parties to the Barcelona Convention – 21 countries with Mediterranean coast and the European Union.

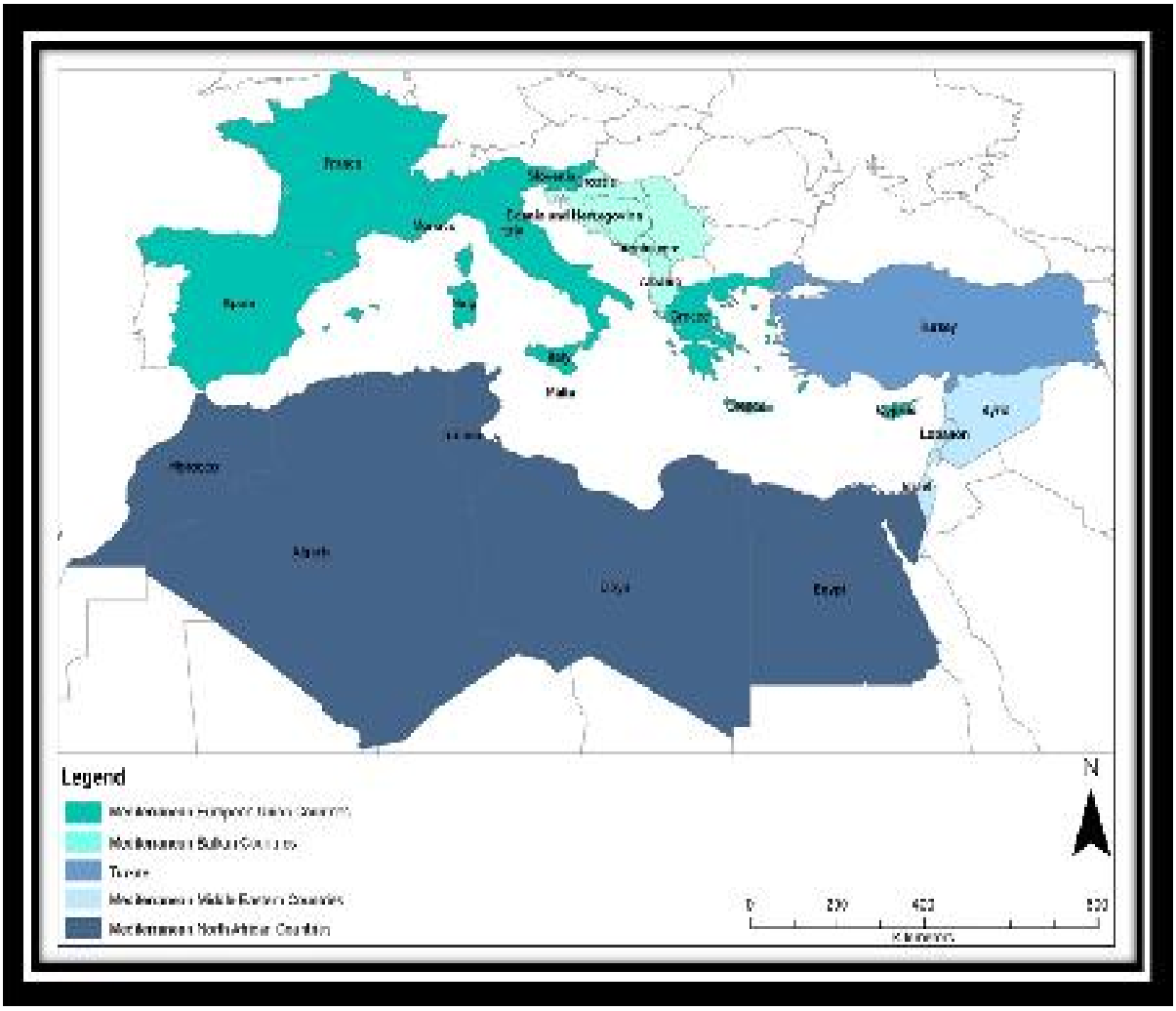

Figure 1: The Mediterranean Region

In addition to the information summarised in Table 1, ***Sections 1.1 & 1.2*** that follow provide important background information on the role and overall mandate of the MAP and PAP/RAC and requirements of the ICZM Protocol. A brief overview of the contemporary state of the Mediterranean Environment is also provided in ***Section 2*** as a background to the subsequent discussion on potential impacts as a result of a changing climate.

The work reported on here was carried out between December 2009 and February 2010. Information contained in this document was collated through desktop review, focused on publicly available information. While the executive of the PAP/RAC was consulted through the formulation of the report, direct contact with Contracting Parties to MAP was beyond the scope of the investigation. This will be a key next step to build on the preliminary information presented here and summarised in the accompanying Position Paper.

The specific objectives of the work undertaken are summarised in Table 1, as follows:

Table 1: Key Objectives per Section

Objective	Description	Section
1	Overview at a strategic level the main threats/impacts/consequences of climate change to Mediterranean coastal areas	**Section 3 & 4**
2	Profile the coast; climate change vulnerability assessment and adaptation initiatives already undertaken or in progress by the Mediterranean countries using existing published information	**Section 5**
3	Summarise the status of the experience from other regions/countries with respect to Section 4	**Section 6**

1.1. Motivation

According to the fourth report from the Intergovernmental Panel on Climate Change (IPCC) published in 2007, the Mediterranean region is likely to be affected by climate change in the course of this century, even if the efforts expected from the international community to stabilise atmospheric greenhouse gas concentrations eventuate. Atmospheric temperature is expected to rise significantly and major impacts will be unavoidable, particularly in terms of increased temperature and reduced rainfall.

The impacts of climate change will be felt in natural and human systems. These impacts will include increased extreme water-related phenomena like floods and persistent droughts, enhanced water scarcity and increased desertification, threatened food production as a result of increased irrigation demands and more numerous incidents of plant diseases. In marine and coastal areas water scarcity will likely lead to further salt water intrusion and insufficient freshwater flushing in estuaries. Researchers have also become increasingly concerned about ocean acidification linked with the absorption of carbon dioxide in seawater and the impact on shellfish and marine life.

The Mediterranean coastal zone is densely populated and highly urbanised, with 40% of land used for human activity. While the socio-economic costs of climate change have not yet been fully assessed for the region, major sectors such as agriculture and tourism are predicted to suffer decline from the aforementioned likely drought conditions, water shortage and increased occurrence of storms. Sea level rise and coastal erosion impacts on ports and other coastal infrastructure are also a concern while recent episodes of human health affected by undesirable organisms such as algal blooms and jellyfish may further multiply as a consequence of higher temperatures.

The need for some form of adaptation to climate change is now a consensus view in light of the inevitability of impacts on already pressurised coastal zones.

1.2. What is Adaptation?

Adaptation as defined by the Intergovernmental Panel on Climate Change (IPCC) is an "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities". There are multiple types of adaptation, including anticipatory, autonomous and planned adaptation (FCCC/SBSTA/2008/6, paragraphs 50–54) (Table 2). The focus of this paper is on planned adaptation, i.e. adaptation that requires some level of organisational or policy intervention. While such planned adaptation relates to "hard" structural options, such as seawalls; it also applies to socio-institutional issues and adaptive capacity-building, "soft" structural options such as soft engineering, and the integration of sectoral policies and spatial planning.

Table 2: Description of types of adaptation (IPCC, 2007)

Adaptation Type	Description
Anticipatory	Adaptation that takes place before impacts of climate change are observed
Autonomous	Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems
Planned	Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state

Different frameworks have been developed and applied to assess climate change vulnerability and support adaptation decision-making around the globe (Carter et al., 2007). All frameworks listed in Table 3 support planned adaptation; however, the specific framework selected for application will depend on the key policy question to be addressed. The output of analysis is an understanding of the sensitivity, impact or risk to the system, which can support the development of adaptation recommendations in the form of adaptation options, measures, and actions.

Table 3: Themed approaches to vulnerability and adaptation (Lu, 2006)

Approach	Policy Questions	Methods, Tools and Data
Sensitivity analysis	Does climate change really matter?	Trend analysis, synthetic scenarios
Impact assessment	What are the potential impacts of unmanaged climate change?	Top-down, scenario driven, sectoral assessment, climate change non-climate scenarios
Risk assessment	How do we effectively manage climate change?	Critical threshold, coping range, stakeholder analysis, uncertainty, communication and management, integrated scenarios (including mitigation and adaptation scenarios)

In any approach to adaptation it is important to understand the conceptual link between climate change impact, vulnerability and adaptation (Figure 2). Adaptation strategies can address both climate change impacts (that result from system exposure to climate changes and the physical sensitivity of the system) and adaptive capacity (that results from socio-economic and institutional capacity to adapt and willingness to adapt).

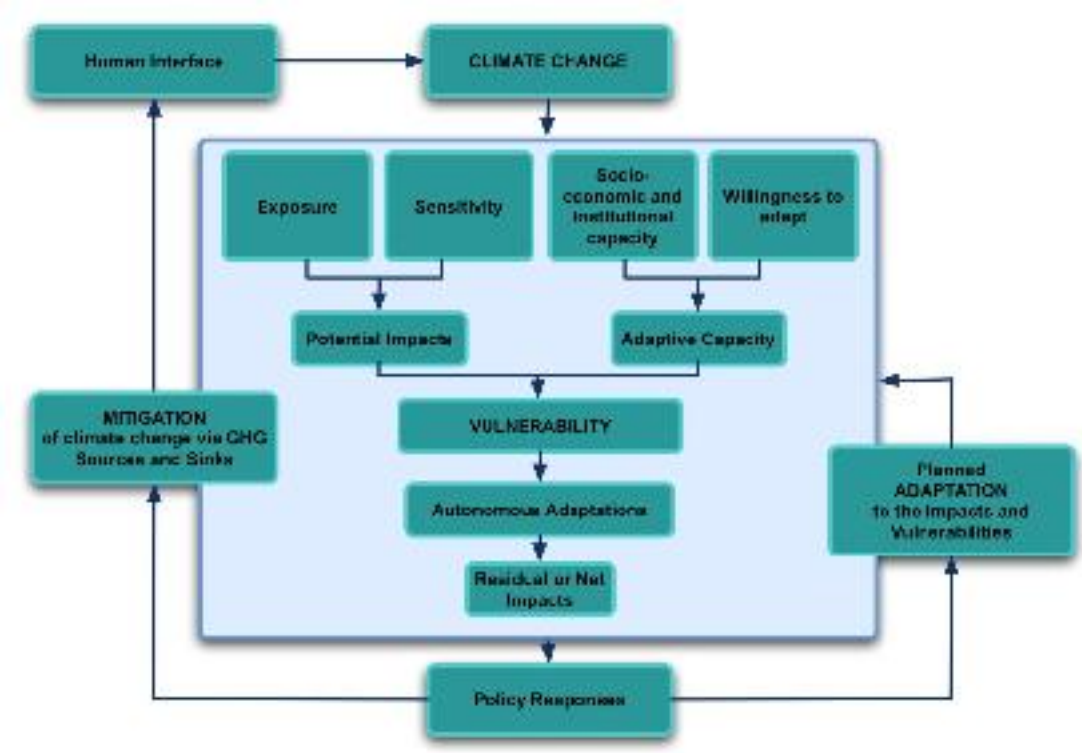

Figure 2: Conceptual diagram showing the interrelation between climate change impacts, vulnerability and adaptation

1.3. The Mediterranean Action Plan and Climate Change Adaptation

1.3.1. What is MAP?

The Mediterranean Action Plan (MAP) was the first-ever Regional Seas Programme under the United Nations Environment Programme (UNEP) umbrella (Figure 3). It came about in 1975, three years after UNEP's establishment by the Stockholm Ministerial Conference, and was initially adopted by 16 Mediterranean countries and the European Union.

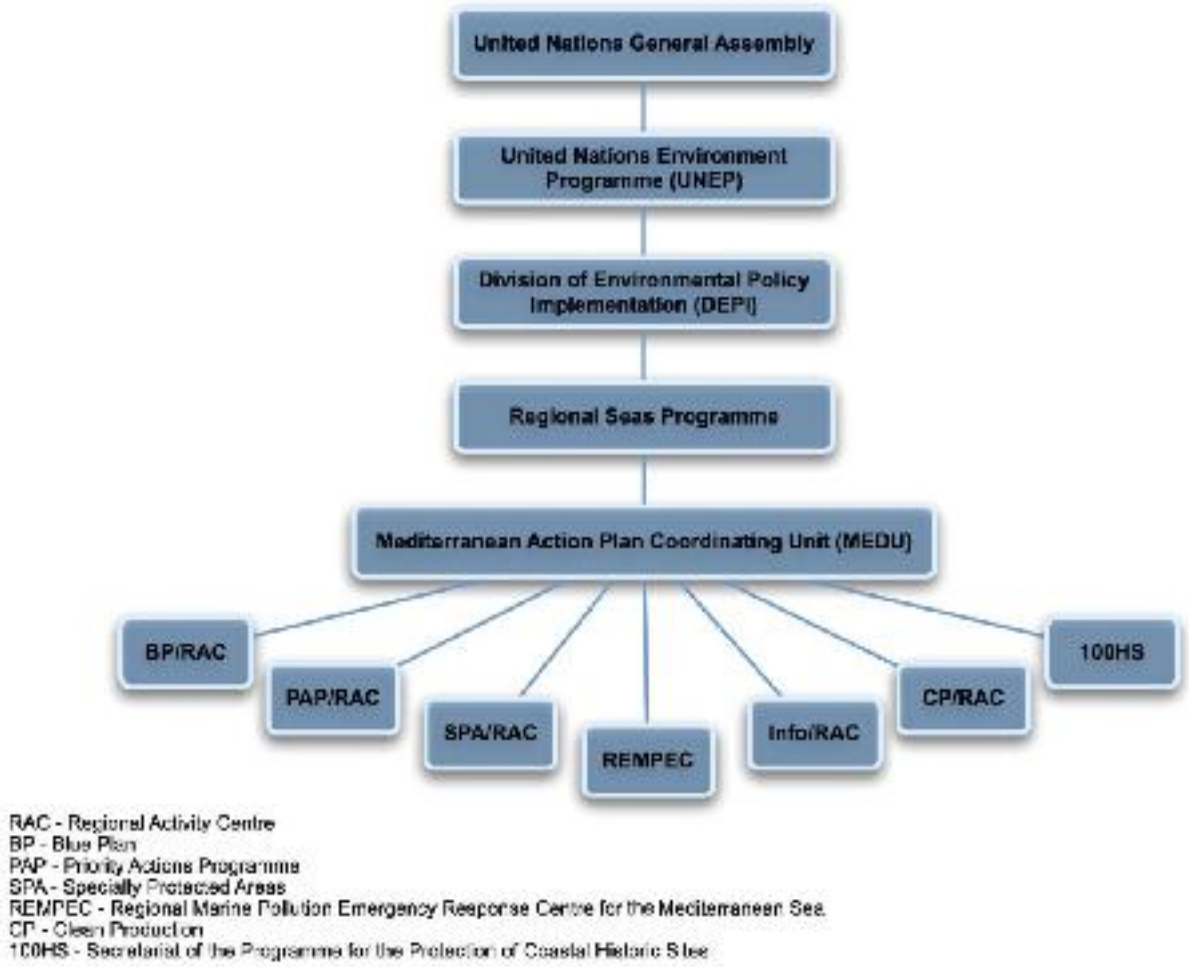

Figure 3: Organisational Structure of MAP within the UN System

On its creation, the main objectives of the MAP were to assist the Mediterranean countries in the assessment and to control of marine pollution; formulation of their national environment policies; improvement of the ability of governments to identify better options for alternative patterns of development, and optimisation of choices for allocation of resources.

Although the initial focus of the MAP was on marine pollution control, experience confirmed that socio-economic trends, combined with inadequate development planning and management, were the root of many environmental problems. Consequently, the focus of MAP gradually shifted to include Integrated Coastal Zone Planning and Management as the key operational tools (Figure 4).

Today, MAP involves 21 countries bordering the Mediterranean as well as the European Union[5]. Through the MAP, these Contracting Parties to the Barcelona Convention and its Protocols are determined to meet the challenges of protecting the marine and coastal environment while boosting regional and national plans to achieve sustainable development.

[5] The 22 Contracting Parties to the Barcelona Convention are: Albania, Algeria, Bosnia and Herzegovina, Croatia, Cyprus, Egypt, the European Union, France, Greece, Israel, Italy, Lebanon, Libya, Malta, Monaco, Montenegro, Morocco, Slovenia, Spain, Syria, Tunisia and Turkey.

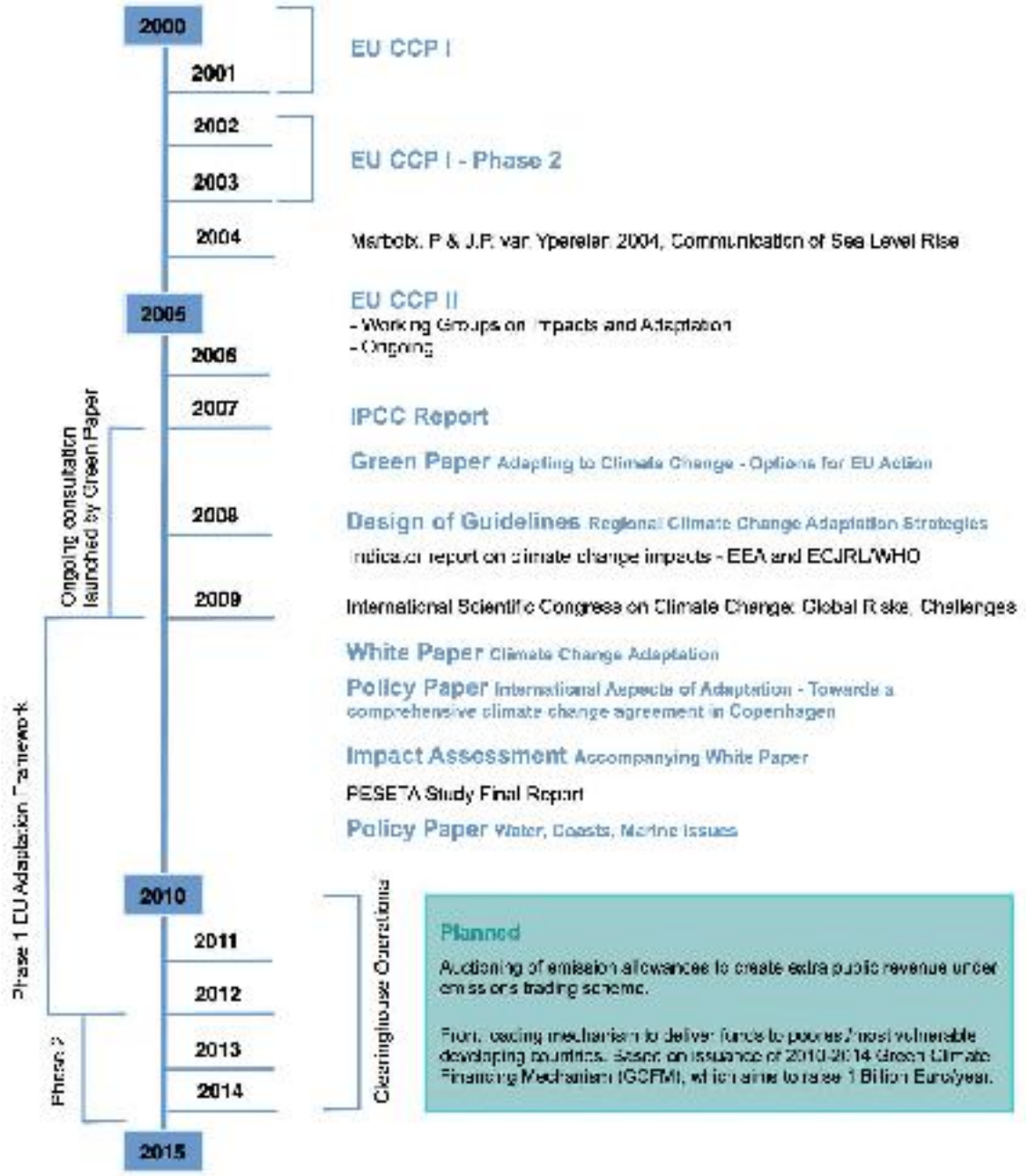

Figure 4: History and Evolution of MAP with Respect to Climate Change Adaptation

1.3.2. The Priority Actions Programme/Regional Activity Centre

The specific objective of PAP/RAC is to contribute to sustainable development of coastal zones and sustainable use of their natural resources. In this respect, PAP/RAC's mission is to provide assistance to Mediterranean countries in: the implementation of Article 4(i) of the Barcelona Convention; meeting their obligations under the ICZM Protocol; implementing the Mediterranean Strategy for Sustainable Development (MSSD), 2005; and by carrying out, in particular, the tasks assigned to it in Article 32 of the ICZM Protocol, 2008.

PAP/RAC's main fields of action for the achievement of the sustainable development of coastal zones consist of:

- Assisting the Contracting Parties in formulating and implementing national strategies for action plans under the ICZM Protocol;
- Assisting countries in the region in strengthening their capacities with a view of facilitating the sustainable development of coastal zones by ensuring that environment and landscapes are taken into account in harmony with economic, social and cultural development; preserving coastal zones and their integrity; ensuring the sustainable use of coastal natural resources; and achieving coherence between public and private initiatives and between all decisions by the public authorities at all levels that impact the coastal zones;
- Assisting countries in the implementation of demonstration/pilot coastal management projects (such as Coastal Area Management Programme - CAMP) in selected local Mediterranean coastal areas to demonstrate the application of ICZM as a major tool, with a view to implementing specifically the ICZM Protocol. CAMP projects have the goal to develop relevant implementation instruments and procedures for sustainable development in project areas; to identify and apply relevant methodologies and tools; to contribute to capacity building at the local, national and regional levels; and to secure the broad use of the results achieved;
- Developing regional co-operation in the field of capacity building and awareness raising of the importance of the integrated management of coastal zones through the organisation of training, education and awareness-raising activities, networking, publications and the dissemination of information; and
- Developing ICZM methodologies and tools as well as addressing specific sectoral issues with a coastal focus in the framework of ICZM, such as urban development, natural resources management, sustainable tourism, landscape and heritage protection, coastal and soil erosion, infrastructure and transport, pollution and waste, climate change, and specific coastal ecosystems.

These fields of action are summarised further in Figure 5.

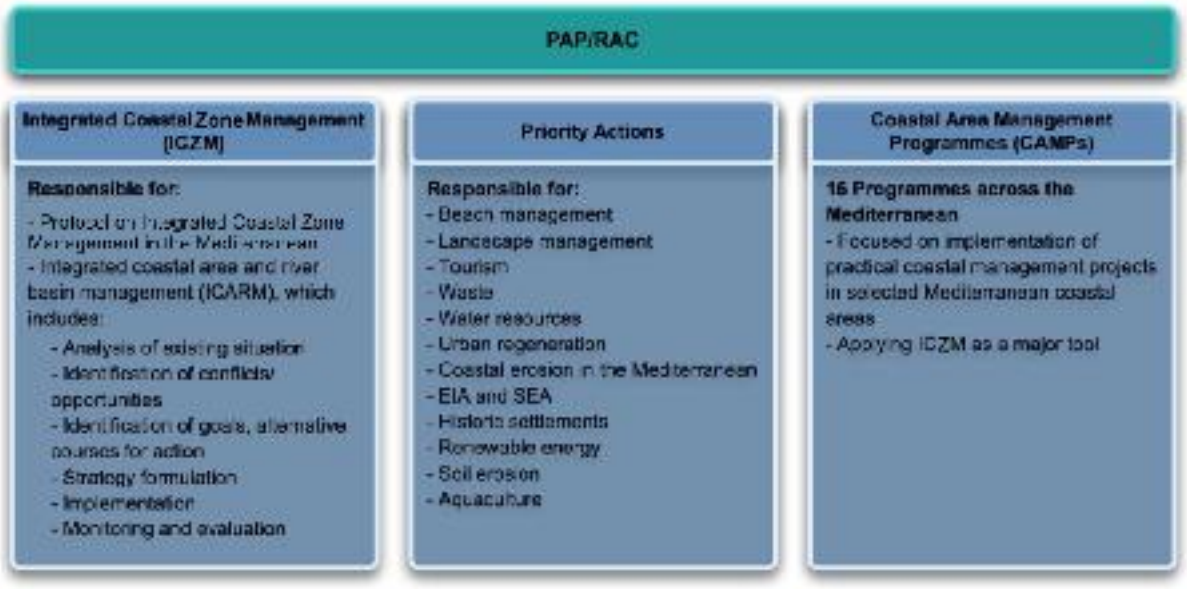

Figure 5: Fields of action of PAP/RAC

1.3.3. MAP'S role in Mediterranean Climate Change Adaptation

The impacts of climate change are trans-boundary in nature. Consequently, there is added value for countries of the Mediterranean to closely co-ordinate their policies and programmes to apply the best available knowledge and tools to plan and implement adaptation measures.

MAP, as a regional organisation dealing with the marine and coastal environment and sustainable development, can assist in this process of addressing climate issues in line with its mandate and capacity, by facilitating regional co-ordination and exchange of information and providing assistance to countries in terms of knowledge (such as climate change models for vulnerable areas) and tools and guidance for adaptation, particularly in marine and coastal areas.

During the 16th Meeting of the Contracting Parties to the Barcelona Convention and its Protocols, held in Marrakesh in November 2009, a ministerial segment focused its discussions on issues that were high on the Mediterranean and international agenda. Adaptation to climate change in the Mediterranean coastal and marine environments was one issue identified as influencing the implementation of the Barcelona Convention and its Protocols. Accordingly, climate change adaptation in the coastal zone has been incorporated into the "Marrakesh Declaration" on Adaptation to Climate Change *(UNEP(DEPI)/MED IG.19/8 Annex I)* and the proposed five-year Programme of Work of UNEP/MAP *(UNEP(DEPI)/MED IG.19/8 Annex III / Appendix 1).*

It is generally recognised that the key tool for implementation of adaptation initiatives within the Mediterranean Region under the UNEP/MAP[6] structure will be the Protocol on Integrated Coastal Zone Management in the Mediterranean (the "ICZM Protocol") (See Section 1.3.4 for details). UNEP/MAP's Priority Actions Programme/Regional Activity Centre (PAP/RAC) will, in turn, be responsible for the implementation of the Protocol across the 22 MAP Contracting Parties.

Key Terms (UNEP-MAP/PAP, 2008)

Coastal Zone: the geomorphologic area either side of the seashore in which interaction between the marine and land parts occurs in the form of complex ecological and resource systems made up of biotic and abiotic components coexisting and interacting with human communities and relevant socio-economic activities.

ICZM: a dynamic process for the sustainable management and use of coastal zones, taking into account at the same time the fragility of coastal ecosystems and landscapes, the diversity of activities and uses, their interactions, the maritime orientation of certain activities and uses and their impact on both the marine and land parts.

1.3.4. Requirements of the ICZM Protocol

The ICZM Protocol was developed in response to increasing pressure in the Mediterranean coastal zone and the lack of legally binding commitments that would support progress in coastal management. The existing guidelines, recommendations, action plans and white papers developed to support coastal management were not binding, and there was a recognition that without such binding commitments, on-ground progress in ICZM would be limited.

[6] United Nations Environment Programme/Mediterranean Action Plan (UNEP/MAP) was the original Regional Seas Programme and was established in 1975.

A feasibility study on a regional legal instrument for sustainable coastal management[7] proposed three options for the resultant legal instrument (the Protocol): (i) a Protocol with general content; (ii) a Protocol with detailed content; and (iii) an Intermediate Protocol. An Intermediate Protocol was selected, on the understanding that a final option would be generated through consensus in the consultation process. Following extensive consultation the resultant ICZM Protocol was signed in January 2008. It became the 7th Protocol in the framework of the Barcelona Convention. The Protocol was viewed as a crucial milestone that would allow countries to better manage their coastal zones and deal with emerging coastal environmental challenges, such as climate change (PAP, 2009). A summary of the content of the Protocol is presented in Table 4 that follows.The Protocol contains seven parts:

1. General provisions: objectives, principles and coverage of the Protocol;
2. Elements of ICZM: requirements to achieve ICZM;
3. Instruments for ICZM: tools and approaches to support ICZM;
4. Risks affecting the coastal zone: current and future risks and priority management concerns;
5. International co-operation: to build capacity, collect information and co-ordinate management actions;
6. Institutional provisions: governance structures to support implementation; and
7. Final provisions: relationship of the Protocol with the Convention and third parties; and processes for ratification, acceptance and entry into force.

The elements of ICZM (as presented in Part 2 of the Protocol) are based on ICZM objectives, such as co-ordination, sustainable management, protection of coastal ecosystems, inclusive decision-making and awareness raising. The instruments (Part 3) to support ICZM can be divided into two primary categories: (i) information collection, storage and dissemination; and (ii) strategies, plans and guidelines. Tools to support information collection, storage and dissemination will provide the knowledge required to ensure management efforts are consistent and focussed throughout the Region. In addition, a common regional framework for ICZM will ensure that national strategies, local policy and financial instruments align to a regionally consistent approach.

Risks affecting the coastal zone are described in the Protocol as current risks, future risks and priority management issues. Current risks are managed through effective management and response to natural disasters, future risks are to be addressed through vulnerability and adaptation assessment, while coastal erosion is identified as a key management issue.

International co-operation is highlighted in the Protocol as vital to build capacity in ICZM through information sharing, technology transfer and the development of best practice guides. It also ensures that a consistent approach to ICZM can be achieved through co-ordination and consultation in all phases of plan, programme and project development.

Implementation of the Protocol is to be guided by the principles of ICZM as outlined in Table 5. Finally, the Protocol describes the institutions responsible for managing implementation, supporting implementation and reporting on implementation as presented in Figure 6.

[7] The feasibility study was approved by the Contracting Parties in 2001 and undertaken in 2002/03.

Table 4: Content of the ICZM Protocol

Part	Summary
Requirements	Article 8: Extensive co-ordination in order to: avoid sectoral approaches and facilitate comprehensive approaches; ensure alignment between marine and land management; ensure consistent coastal strategies, plans and programmes across all levels of operation (national, regional and local); and support collaboration and thus strengthen the coherence and effectiveness of established coastal strategies, plans and programmes. Sustainable use and management of coastal zones to preserve the coastal natural habitats, landscapes, natural resources and ecosystems, in compliance with international and regional legal instruments. This entails incorporating criteria for sustainable use of the coastal zone within national legal instruments. The criteria must take into account specific location conditions. Article 9: Ensure economic activities are managed in conformity with the objectives and principles of this Protocol ICZM. This entails ensuring that the various economic activities in the coastal zone minimise the use, and impact upon, natural resources and consider intergenerational equity. This can be supported through the development of indicators to monitor ecosystem change and codes of good practice to support best use of marine resources. Article 10: Take measures to protect the characteristics of certain specific coastal ecosystems, including: wetlands and estuaries; marine habitats; coastal forests and woods; and dunes. Article 11: Ensure protection of coastal landscapes regardless of their classification as protected areas, through effective legislation, planning and management and regional and international co-operation. Article 12: Accord special protection to islands. Article 13: Preserve and protect cultural heritage of coastal zones, including underwater cultural heritage, in conformity with national and international instruments. Article 14: Adequate participation of all stakeholders in the formulation, and implementation of coastal and marine strategies, plans, programmes and/or projects. Article 15: Carry out national, regional and/or local level awareness-raising activities, training programmes, and research on integrated coastal zone management.
Instruments	Article 16: Strengthen existing, or create new, monitoring and observation mechanisms; prepare and update national inventories based on an agreed format and process for data collection; promote exchange of scientific experience, data and good practices through participation in the Mediterranean coastal network; ensure public access to collected information. Article 17: Define a common regional framework for ICZM to be implemented through regional action plans, national strategies and other operational instruments. Article 18: Strengthen or formulate national coastal strategies for ICZM and coastal implementation plans and programmes that are consistent with the common regional framework. The national coastal strategy should contain a summary of the existing situation, a rationale for management priorities, and an implementation schedule of measures to be taken and implementation details (cost, institutional structures instruments). Define indicators to evaluate the effectiveness of strategies, plans, and programmes and the progress of implementation of the Protocol. Article 19: Environmental impact assessments consider the sensitivity of the environment and the inter-relationships between marine and terrestrial parts of the coastal zone and the cumulative impacts on the coastal zone in respect to coastal carrying capacities. Article 20: Adopt land policy instruments and measures (i.e. planning, acquisition, cession, donation, or transfer of land) to ensure the sustainable management of public and private land of the coastal zones. Article 21: Adopt financial, economic or fiscal instruments to support the implementation of national coastal strategies, plans and programmes.
Risks	Article 22: Undertake vulnerability and hazard assessments of coastal zones and take prevention, mitigation and adaptation measures to address the effects of natural disasters, in particular of climate change. Article 23: To prevent or mitigate the negative impacts of coastal erosion adopt the necessary measures to maintain or restore the natural capacity of the coast to adapt to changes, including the rise in sea levels. When considering the development of coastal or marine structures, take into account the potential negative effects of coastal erosion and the direct and indirect costs that may result. Anticipate the impacts of coastal erosion through integrated management of activities and adopt special measures for coastal

Part	Summary
	sediments and coastal works. Share scientific data to improve knowledge on the state, development and impacts of coastal erosion. Article 24: Undertake international co-operation to respond to natural disasters and take measures to ensure a timely response. Co-ordinate use of the equipment for detection, warning, and communication and make use of existing mechanisms and initiatives to ensure the transmission as rapidly as possible, of urgent information concerning natural disasters. The Parties will notify the organisation of authorities competent to issue and receive such information in the context of relevant international mechanisms. Promote mutual co-operation in the delivery of humanitarian assistance in response to natural disasters affecting the Mediterranean coastal zone.
International Cooperation	Article 25: Co-operate in the training in the field of ICZM to strengthen capacity, develop scientific and technical research, promote centres specialised in ICZM, and promote training programmes for local professionals. Research into ICZM should be founded on strong exchange of scientific and technical information and the co-ordination of research programmes. Article 26: Co-operate for the provision of scientific and technical assistance, including access to environmentally sound technologies and their transfer and other possible forms of assistance, to Parties requiring such assistance. Article 27: Co-operate in the exchange of information on environmental best practice; in particular: define coastal management indicators; establish and mainstream up-to-date assessments and use of the coastal zone; carry out activities of common interest, such as demonstration projects. Article 28: Co-ordinate national coastal strategies, plans and programmes related to contiguous coastal zones. Relevant domestic administrative bodies shall be associated with such co-ordination. Article 29: Co-operate through notification, exchange of information and consultation in assessing the environmental impacts of plans, programmes and projects, prior to authorisation. To this end, co-operate in the formulation and adoption of guidelines to establish procedures to support the notification, exchange of information and consultation at all stages of plan, programme and project formulation.
Institutional provisions	Article 30: A designated country Focal Point will serve as liaison on technical and scientific aspects of the implementation of the Protocol and disseminate information at the national, regional and local level. The Focal Points shall meet periodically to carry out functions deriving from the Protocol. Article 31: Parties shall submit at ordinary meetings of the Contracting Parties, reports on the implementation of this Protocol, including measures taken, their effectiveness and problems encountered in their implementation. Article 32: The organisation (UNEP) shall be responsible for co-ordinating the implementation of the Protocol. To achieve this, it shall receive support from the Centre (PAP/RAC) to: assist the Parties to define a common regional framework for ICZM in the Mediterranean; prepare a regular report on the state and development of ICZM with a view to facilitating implementation of the Protocol; exchange information and carry out activities of common interest (as per Point 3, International Co-operation); assist the Parties to (i) participate in the Mediterranean Coastal zone network, (ii) prepare and implement their national strategies for ICZM, (iii) co-operate in training activities and scientific and technical research programmes, and (iv) co-ordinate the management of transboundary coastal zones; organise meetings of the Focal Points; carry out other functions assigned to it by the Parties. To implement this Protocol, the Parties, the Organisation and the Centre may jointly establish co-operation with non-governmental organisations the activities of which are related to the Protocol. Article 33: Meetings of the Parties of the Protocol shall occur in conjunction with the ordinary meetings of the Contracting Parties to the Convention. The functions of the meetings to this Protocol shall be: to review the implementation of the Protocol; to ensure this Protocol is implemented in co-ordination and synergy with other Protocols; to oversee the work of the Organisation and the Centre relating to the implementation of the Protocol and providing policy guidance for their activities; consider the efficiency of the measures to be adopted for the implementation of this Protocol ICZM and the need for other measures, in particular in the form of annexes or amendments to this Protocol; to examine proposals made by Focal Points.

Table 5: Principles of Integrated Coastal Zone Management (UNEP/MAP/PAP, 2008)

Principle	Description
(a)	The biological wealth and the natural dynamics and functioning of the intertidal area and the complementary and interdependent nature of the marine part and the land part forming a single entity shall be taken particularly into account.
(b)	All elements relating to hydrological, geomorphological, climatic, ecological, socio-economic and cultural systems shall be taken into account in an integrated manner, so as not to exceed the carrying capacity of the coastal zone and to prevent the negative effects of natural disasters and of development.
(c)	The ecosystem approach to coastal planning and management shall be applied so as to ensure the sustainable development of coastal zones.
(d)	Appropriate governance allowing adequate and timely participation in a transparent decision-making process by local populations and stakeholders in civil society concerned with coastal zones shall be ensured.
(e)	Cross-sectorally organised institutional co-ordination of the various administrative services and regional and local authorities competent in coastal zones shall be required.
(f)	The formulation of land-use strategies, plans and programmes covering urban development and socio-economic activities, as well as other relevant sectoral policies, shall be required.
(g)	The multiplicity and diversity of activities in coastal zones shall be taken into account, and priority shall be given, where necessary, to public services and activities requiring, in terms of use and location, the immediate proximity of the sea.
(h)	The allocation of uses throughout the entire coastal zone should be balanced, and unnecessary concentration and urban sprawl should be avoided.
(i)	Preliminary assessments shall be made of the risks associated with the various human activities and infrastructure so as to prevent and reduce their negative impact on coastal zones.
(j)	Damage to the coastal environment shall be prevented and, where it occurs, appropriate restoration shall be effected.

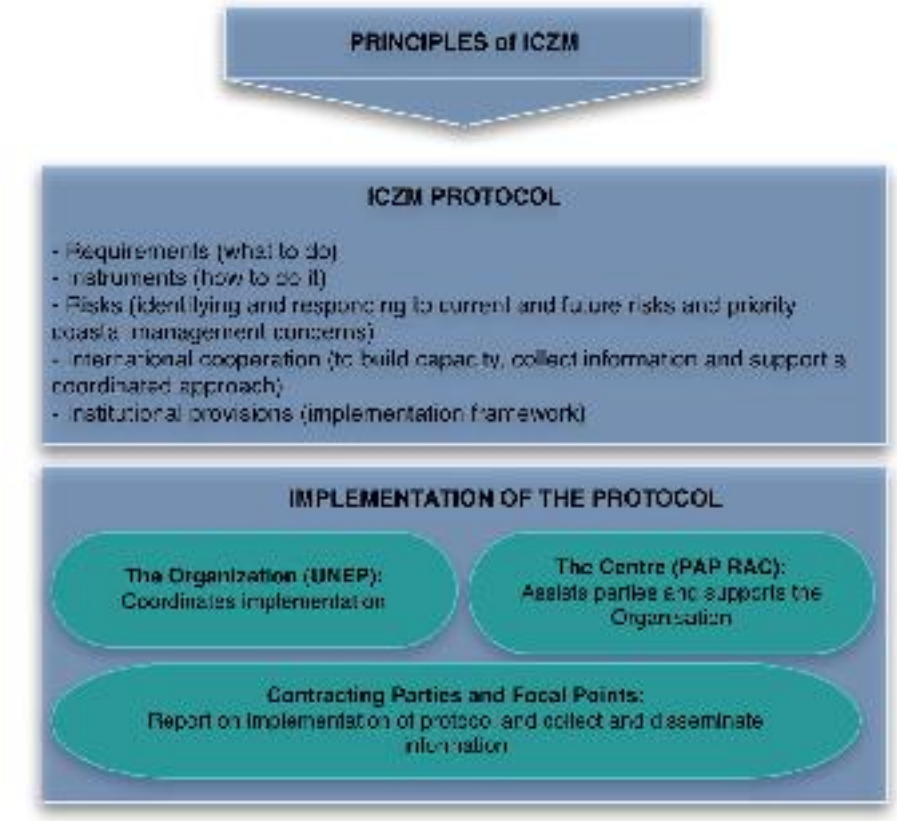

Figure 6: The ICZM Protocol, components and implementation framework

Top image: Dubrovnik, Croatia (Lachlan Black); Bottom image: Split, Croatia (Lachlan Black)

2. Regional Setting

The Mediterranean coastline is approximately 46,000 kilometres long, with nearly 19,000 kilometres of island coastline. The coastal geography is extremely diverse incorporating sandy shores, sebkhas, wetlands, estuaries, lagoons, deltas, reefs and rocky cliffs. The region is a biodiversity hotspot, accounting for 10% of known higher plant species, and 7% of marine species in less than 0.8% of its total ocean area. The socio-economic characteristics are also complex. The region contains: 7% of the world's population with 460 million inhabitants; 31% of international tourism, with 275 million visitors every year; and 30% of international maritime freight traffic and some 20 to 25% of maritime oil transport transits the Mediterranean Sea. In addition, the vulnerability of the region to anticipated climate change is high, with the region containing 60% of the population of the world's "water-poor" countries, and a vast area of low-lying coastal land.

This Section provides a brief overview of the national circumstances of Mediterranean countries, focused on the physical, ecological and socio-economic conditions in the coastal zone. It sets the context for a discussion of climate change projections and impacts in the Mediterranean (as outlined in Section 4). Further detail on the physical, ecological and socio-economic conditions of the Mediterranean region is available in UNEP/MAP-Plan Bleu (2009).

2.1. Environment

2.1.1. Meteorology and Coastal Climate

The Mediterranean climate is characterised by hot dry summers and mild winters. The Mediterranean Basin lies at the transition between the arid climate of North Africa and the temperate and rainy climate of central Europe and is affected by interactions between mid-latitude and tropical processes. Because of the interactions of processes at a wide range of spatial and temporal scales, the climate of the Mediterranean is characterised by a great diversity of features, resulting in a variety of climate types and great spatial variability (Lionello et al., 2006a).

The westward movement of storms originating over the Atlantic, together with storms generated within the region, dominate winter climate. In summer, high pressure prevails, leading to dry conditions, particularly over the southern Mediterranean. Climate variability in summer is linked with both Asian and African monsoons (Alpert et al., 2006) and with strong anomalies over central Europe (Xoplaki et al., 2004; Trigo et al., 2006).

The region's climate is also affected by local processes induced by its complex physiography and the presence of a large body of water (the Mediterranean). For example, the Alpine chain is a strong factor in modifying travelling synoptic and meso-scale systems and the Mediterranean is an important source of moisture and energy for storms (Lionello et al., 2006a,b). The complex topography, coastline and vegetation cover of the region modulate the climate signal at small spatial scales (e.g. Lionello et al., 2006a). In addition, anthropogenic and natural aerosols of central European, African and Asian origin can reach the Mediterranean, possibly influencing its climate characteristics (Alpert et al., 2006).

2.1.2. Geography

The Mediterranean Sea is one of the world's largest semi-enclosed seas covering an area of 2,542,000 km^2 with a coastline of 46,000 km (Grennon and Batiste, 1989). 54% of that coastline is rocky and 46% is sedimentary coast that includes important and fragile ecosystems such as, reefs, lagoons, swamps, estuaries and deltas. The Mediterranean

Basin is a tectonically active area that lies in the collision zone between Africa and Europe and can be separated into two major basins, the eastern and western (Dardis and Smith, 1997). It is marked by young orogenic systems exhibiting high, rugged and faulted mountains. The Mediterranean coastline displays a high diversity of habitats including sandy beaches, sekhbas, salt marshes and coastal plains (UNEP/MAP/PAP 2001).

In addition to the diverse regional variability in coastal geography, country level coastal variability is also high. The Coastal and Marine Union (EUCC) has undertaken an assessment of the diversity of coastal landscapes, formations and habitats, as well as some important physical characteristics, to develop an ecological network for European countries. The output is a detailed understanding of coastal form at country level (see Figure 7 for example). Whilst this information is not available for all Mediterranean countries, it remains an important database.

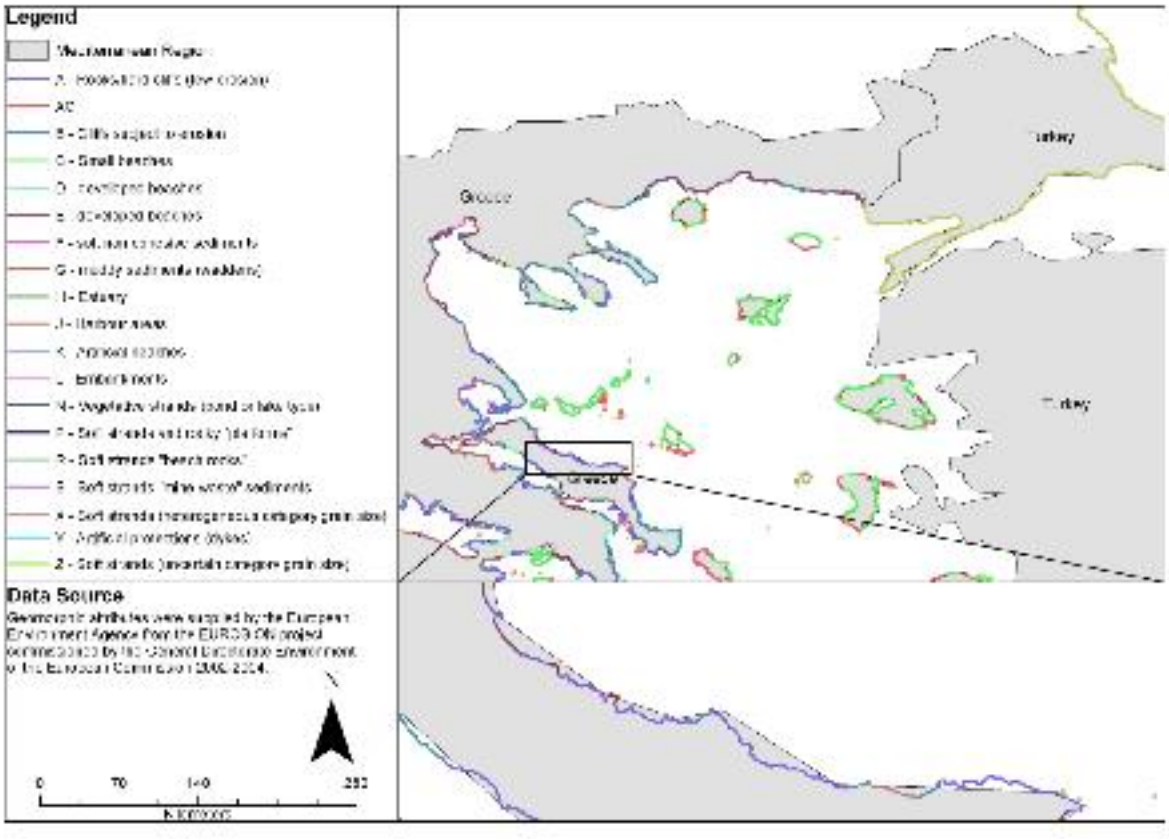

Figure 7: Coastal attributes, Greece

2.1.3. Ecology

The Mediterranean is characterised by striking floristic, faunistic and landscape diversity and has one of the world's highest number of plant species and levels of endemism (PAP/RAC, 2005). As such, it is often referred to as a biodiversity hotspot and is characterised by the following ecological attributes (UNEP/MAP-Plan Bleu, 2009):

- 60% flora endemic;
- 30% fauna endemic;
- 7% of all the marine species known world-wide; and
- Nearly 19% of assessed species to date are considered threatened with extinction.

From a marine perspective, the Mediterranean Sea is one of the world's 25 hot spots for biodiversity. Over 12,000 species have been described with over 25% of these species are endemic (only found in the Mediterranean Sea). This exceptional wealth of flora and fauna is relatively unequally distributed, depending on distance from the coast, longitude and depth. There is greater diversity, for example, in the western basin, whatever the taxonomic group being considered. Similarly, at bathymetric level, almost 90% of the known benthic plant species and over 75% of fish species are to be found in the shallow waters (from 0 to 50 m) although they account for a mere 5% of Mediterranean waters.

At Mediterranean level, the latest edition of the IUCN red lists shows that, generally speaking, 19% of Mediterranean Sea known species are endangered and 1% are already extinct at a regional level. Looking only at the species in Annex II of the Protocol concerning Specially Protected Areas and Biodiversity (SPA/BD), it appears that 63% of the fish and at least 60% of the mammals on the list have endangered status, according to the IUCN's most recent assessments.

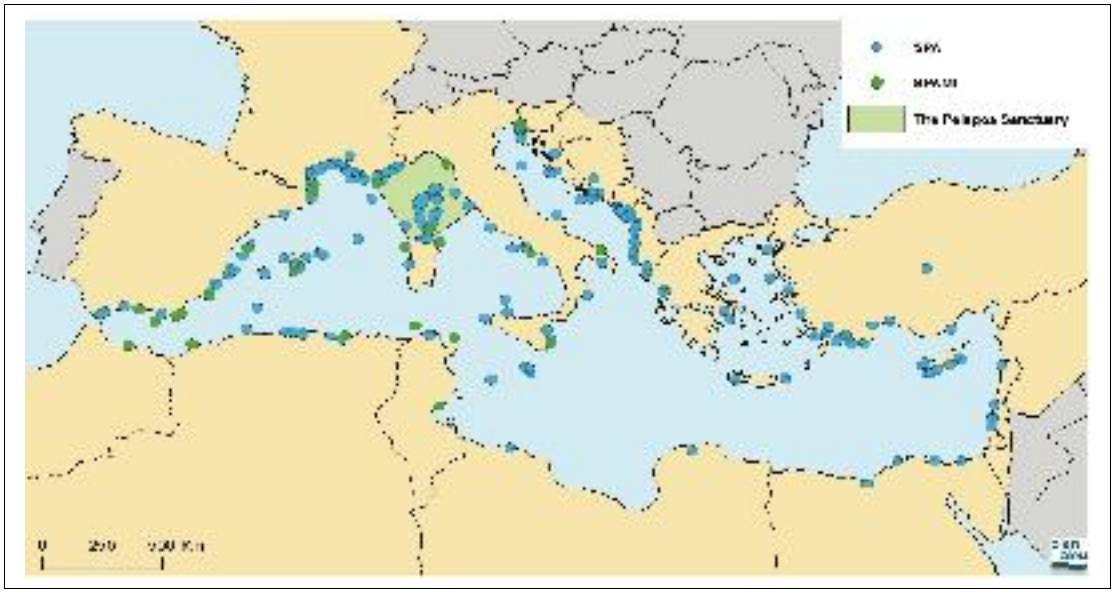

Figure 8: Specially Protected Areas (SPAs) and Specially Protected Areas of Mediterranean Interest, 2009 (UNEP/MAP-Plan Bleu)

Wetlands (deltas, lagoons, marshes) support an outstanding biodiversity and provide a wealth of environmental services to Mediterranean societies. To date, no exhaustive inventory of the Mediterranean wetlands has been developed; however, MedWet has identified 13,500 wetlands in 12 Mediterranean countries.

While protected areas are extremely important, for preserving biodiversity from human threats and climate change, they are very limited in some countries (see Figure 8 above). They are characterised mostly by wetlands, coastal habitats and shallow-water seas and are very unevenly distributed throughout the region with 82% of Marine Protected Areas located in the West Mediterranean Basin *versus* 18% in the East Mediterranean Basin. Further, there are 712 Special Protected Areas in the EU *versus* 131 SPAs in non-EU countries

2.1.4. Socio-Economic Setting

In 2008, the permanent population of the Mediterranean coastal states was approximately 460 million (Figure 9), with a projected growth to 520 million by 2025. Projections for the coastal regions are approximately 186 million by 2025.

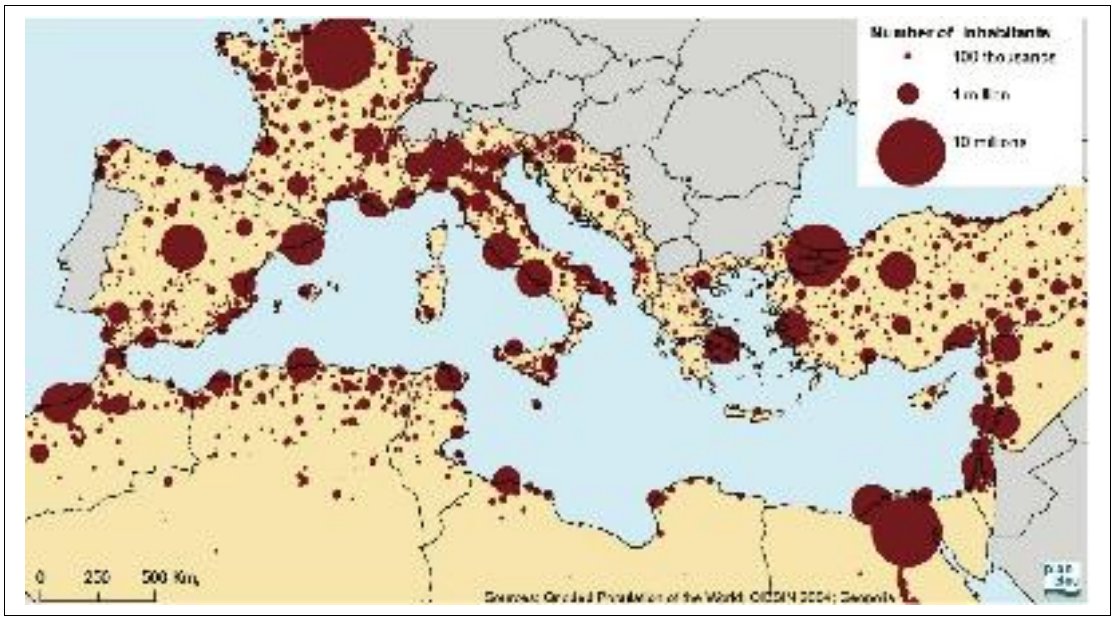

Figure 9: Population distribution, 2004 (UNEP/MAP-Plan Bleu, 2009)

In addition, a number of activities such as fisheries, industry, agriculture and tourism have been established and rapidly developed along the Mediterranean coastline. Such intensified urbanisation and tourism development has led to significant pollution threats: inventories showed that there are 101 priority pollution hotspots, mainly resulting from land-based sources. In addition, there are approximately 200 large oil tankers navigating in the Mediterranean Sea daily, posing another threat to marine life in the Mediterranean.

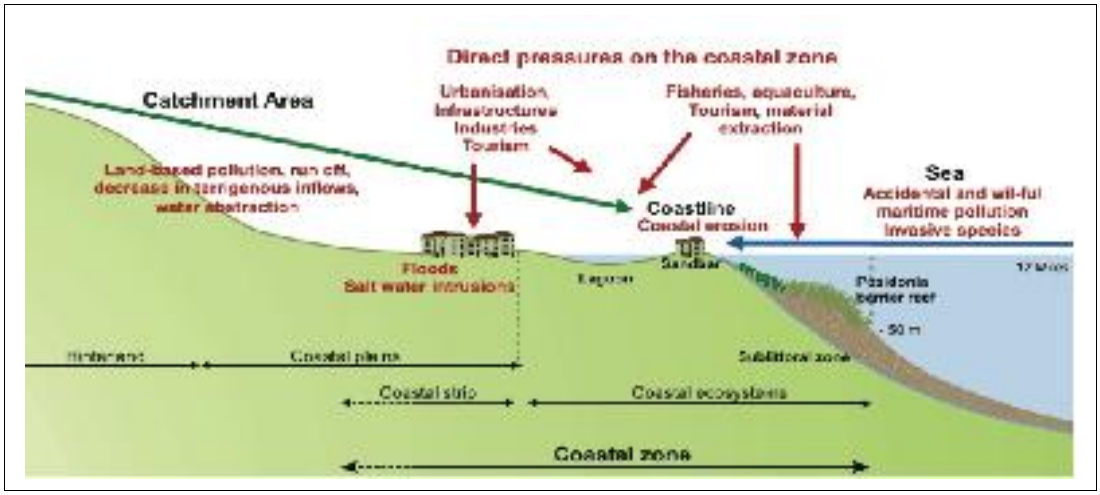

Figure 10: The pressures in the coastal zone (UNEP/MAP-Plan Bleu, 2009)

Mediterranean landscapes have been shaped by natural disturbance and intense human impacts from early times to the present (Allen, 2003). This has resulted in a wide diversity of landscapes along a gradient of human impacts from relatively untouched and natural to highly modified and threatened.

The coastal zone of the Mediterranean, in particular, suffers from increasing pressure (see Figure 10 above). Many major cities and ports are located along the coast with much industrial and tourist development coastally located. It is estimated that 50-70% of the population in Mediterranean countries live within 60 km of the coast and this proportion is increasing (Caffyn et al., 2002). Other pressures that have increased in recent years include intensification of agriculture, pollution and the introduction of alien species (Grenon & Batisse, 1989; Di Castri et al.,1990). The latter carries great risks to natural ecosystems and resources. In particular, afforestation with alien species has caused problems to dune habitats.

Linearity of coastal urbanisation in the Mediterranean is an important issue. Studies have shown the benefits of conservation over development and cluster over ribbon development (Markandya et al., 2007). However, nearly 40% of the total length of coastal area is already occupied and the rate of urbanisation is expected to grow from 62% (1995) to 72% (2025). This equates to an increase from 67% to 69% in the north and 62% to 74% in the south.

It is recognised that many people prefer to reside and recreate in the coastal zone. Coastal facilities are higher in value compared to facilities distant from coast. House prices and motel room rates are much higher when situated close to ocean. For example, unobstructed ocean views add 59% to house prices; while in Israel accommodation within 2 km of coast is charged at 39% higher rate than similar classes further inland. Consequently, the push for ribbon development, which will increase proximity to the coastal zone, is likely to continue.

3. Climate Change Projections

This Section summarises the projections for global climate change followed by regional climate change with a focus on key climate drivers in the coastal zone. The discussion sets the context for a review of the potential impacts of climate change in the Mediterranean, as outlined in Section 4.

3.1. Global Projections

Climate projections are established based on emission scenarios and socio-economic scenarios, applied to model the future evolution of the greenhouse effect at the global scale. The IPCC uses "standard" scenarios to simplify the comparison of results from different climate models (defined in Nakicenovic and Swart, 2000), known as the "SRES scenarios" (Special Report on Emissions Scenarios) – see Table 6. Four families of socio-economic scenarios (A1, A2, B1 and B2) represent different world futures in two distinct dimensions: economic versus environmental, and global versus regional development patterns. Selected global non-climatic environmental and socio-economic trends relevant to coastal areas for each of these families are outlined in Table 7 that follows. The projections are **not** predictions, but rather a set of assumptions applied to forecast potential futures.

Table 6: IPCC Special Report on Emission Scenarios (SRES) (IPCC, 2000)

Scenario	Description
A1	The A1 storyline describes a future world of very rapid economic growth, a global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building and increased cultural and social interactions, with a substantial reduction in regional differences in *per capita* income. The A1 storyline develops into three scenario groups that describe alternative directions of technological change in the energy system. They are distinguished by their technological emphasis: fossil intensive (A1FI), non-fossil energy sources and technologies (A1T), or a balance across all sources (A1B).
A2	The A2 storyline describes a very heterogeneous world. The underlying theme is self reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing population. Economic development is primarily regionally oriented and *per capita* economic growth and technological change more fragmented and slower than other storylines.
B1	The B1 storyline describes a convergent world with the same global population as in the A1 storyline (one that peaks in mid-century and declines thereafter) but with rapid change in economic structures toward a service and information economy, with reductions in material intensity and the introduction of clean and resource efficient technologies. The emphasis is on global solutions to economic, social and environmental sustainability, including improved equity, but without additional climate initiatives.
B2	The B2 storyline describes a world in which the emphasis is on local solutions to economic, social and environmental sustainability. It is a world with continuously increasing global population, at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the scenario is also oriented towards environmental protection and social equity, it focuses on local and regional levels. An illustrative scenario was chosen for each of the six scenario groups – A1B, A1FI, A1T, A2, B1 and B2. All were considered equally sound by the IPCC.

Table 7: Selected global non-climate environmental and socio-economic trends relevant to coastal areas for the SRES storylines (Nicholls et al., 2007)

Environmental and socio-economic factors	Non-climatic changes and trends for coastal and low-lying areas (by SRES Future)			
	A1 World'	'A2 World'	B1 World'	'B2 World'
Population (2080s) (billions)	1.6 to 2.4	8.2 to 8.2	1.6 to 2.4	2.5 to 3.4
Coastward migration	Most likely	Less likely	More likely	Least likely
Human-induced subsidence	More likely		Less likely	
Terrestrial freshwater/sediment supply (due to catchment management)	Greatest reduction	Large reduction	Smallest reduction	Smaller reduction
Aquaculture growth	Large increase		Smaller increase	
Infrastructure growth	Largest	Large	Smaller	Smallest
Extractive industries	Larger		Smaller	
Adaptation response	More reactive		More proactive	
Hazard risk management	Lower priority		Higher priority	
Habitat conservation	Low priority		High priority	
Tourism growth	Highest	High	High	Lowest

Six "marker" scenarios have been developed out of these four families: one each for the A2, B1 and B2 worlds, and three scenarios for the A1 world: A1T (non-fossil fuel sources); A1B (ballanced fuel sources); and A1FI (fossil-intensive fuel sources)[8]. Each of these scenarios result in a differing range of climate change impacts summarised in Table 8 that follows. B1 produces the lowest emissions and A1FI produces the highest emissions.

The major climate change factors relevant to the coastal zone include storms, waves, sea level, temperature, CO_2 concentration and runoff (Figure 11). Global mean projections for sea level rise (SLR), sea surface temperature (SST) and pH for the six SRES scenarios are presented in Table 8 that follows. Globally, CO_2, SST, sea level and storm intensity are set to increase; however, there is likely to be significant regional variability for all except CO_2.

Global trends in storm frequency, storm track and wave climate are uncertain, with all experiencing significant regional variability. Thus, it is more useful for this assessment to focus on regional predictions for climate change in relation to coastal areas.

Table 8: Projected global mean climate parameters relevant to coastal areas at the end of the 21st century for the six SRES scenarios (Nicholls et al., 2007)

Climate driver			B1	B2	A1B	A1T	A2	A1FI
Surface ocean p (baseline today: 8.1)			8.0	7.9	7.9	7.9	7.8	7.7
SST rise (°C) relative to 1980-1999			1.8	-	2.8	-	3.4	-
Sea-level rise relative to 1980-1999	Best estimate (m)		0.28	0.32	0.35	0.33	0.37	0.43
	Range (m)	5%	0.19	0.21	0.23	0.22	0.23	0.28
		95%	0.37	0.42	0.47	0.44	0.50	0.58

[8] The SRES scenarios do not include additional climate initiatives, which means that no scenarios are included that explicitly assume implementation of the United Nations Framework Convention on Climate Change or the emissions targets of the Kyoto Protocol, or any other greenhouse-gas emission reduction policies and programmes.

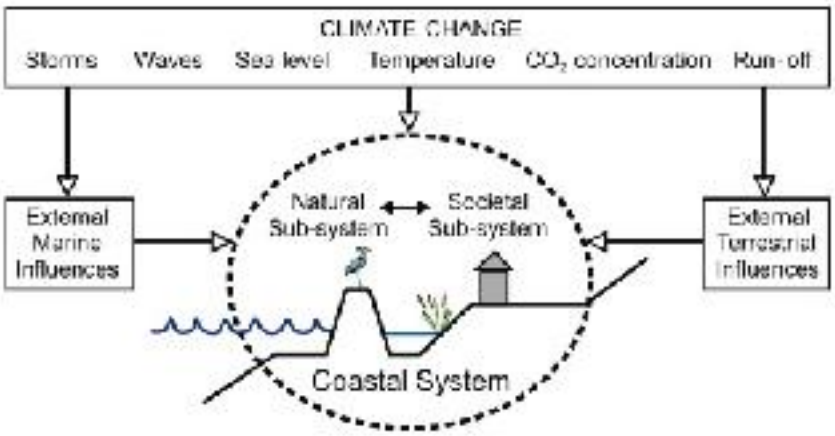

Figure 11: Climate change and the coastal system showing the major climate change factors, including external marine and terrestrial influences (Nicholls et al., 2007)

It is important to note that since the projections (as outlined in Table 8 above) were published in 2007, the growth of greenhouse gas has been slightly greater than the most pessimistic IPCC emissions scenarios (IDDRI, 2009). Consequently, it is useful to review recent scientific studies examining projections for change in mean sea level, which have concluded:

- Dynamic processes, such as loss of shelf ice that buttresses outlet glaciers, can lead to more rapid loss of ice than melting of the top layer of ice alone. The IPCC AR4 does not take into account glacial melting or permafrost, only thermal expansion and linear ice melt are included in the projections. This is due to the remaining uncertainties is rates of glacial melting. Consequently, very recent research suggests that 1.1 m sea level rise (SLR) by the end of the century may not reflect the upper end of potential risk, and risk assessments could be informed by even higher levels of SLR.
- Analysis combining thermal expansion and potential rates of ice melt show that the probabilistic distribution is skewed towards the upper end and that using the high end scenario to inform decision making is justified.
- Nearly all of the uncertainties in SLR projections operate to increase (not lower) estimates of SLR.
- SLR projections from the Climate Change Science Congress in Copenhagen (March 2009) ranged from 0.75 to 1.9m by 2100, with 1.1 to 1.2m being mid-range.
- SLR will continue after 2100. The lag between emission reductions and climate stabilisation means that sea levels could keep rising up to 1000 years after emissions stabilised.
- At the high end of projections, complete collapse of the Greenland ice sheet would result in an additional global SLR of 6 metres; partial to complete melting of west Antarctic ice sheet would add a further 3 m SLR; whilst there is also the potential for loss from East Antarctic ice sheet. Timing of these losses is very uncertain and varies from 100s to 1000s years.

3.2. Regional Projections

Globally, projections indicate a rise in sea surface temperature, sea level and storm intensity, however, as outlined in Section 3.1, there is likely to be significant regional variability in the degree of change. Consequently, an overview of the regional projections for change in key climate drivers (temperature, precipitation and sea level) is provided here.

Projections for 2100 suggest that temperature in Europe will have risen by between 2 to 6.3 °C above 1990 levels. Sea level is projected to rise, and a greater frequency and intensity of extreme weather events are expected. Even if emissions of greenhouse gases stop today, these changes would continue for many decades and, in the case of sea level, for centuries. This is due to the historical build up the gases in the atmosphere and time lags in the response of climatic and oceanic systems to changes in the atmospheric concentration of greenhouse gases.

Downscaling of global models to the regional scale (either by nesting, variable mesh grids, or empirical/statistical downscaling) allows global processes to be taken into account in projecting smaller scale regional climate changes. However, there are many sources of uncertainty and limitations, including computational power, the ability to represent natural phenomena in computer models, incomplete scientific understanding of the complex biogeophysical processes and interactions, and the ability to predict future socio-economic trends. In addition, the long-term unpredictability of natural climate variability, especially regarding the North Atlantic Oscillation (NAO), which has particular influence on the Mediterranean region (modification of precipitation zones and the inversion of marine currents) remains. This phenomena is predictable in the relatively short term (a year or so in advance), but it remains impossible to make accurate predictions over several decades (IDDRI, 2009).

On these scientific bases, and keeping in mind the uncertainties, three main components of the ocean/atmosphere system are vulnerable to major future climate evolutions: temperatures (air and sea), precipitation regimes, and sea level.

3.2.1. Temperature (Air and SST)

Over the 20th century and with a clear acceleration since 1970, South-Western Europe (the Iberian Peninsula, South of France) recorded an increase in temperature of almost 2°C. The same increase can also be noticed for the North of Africa, although a lack of data makes it more difficult to estimate. The only exception is Greece, which until the early 2000s saw its temperatures falling.

By the end of the century, the average annual temperature increase for the region is likely to be between 2.2°C and 5.1°C for 2080-2099, compared with 1980-1999. The probability of temperatures rising by between 3 and 4°C is estimated at 50% (Figure 12). Seasonal changes in temperature between 2031-2060 are outlined in Figure 13, indicating an increase in summer temperatures of between 1 and 5°C; while projections for change in extreme temperature presented in Figure 14, for the same period, show general trend in rising temperatures.

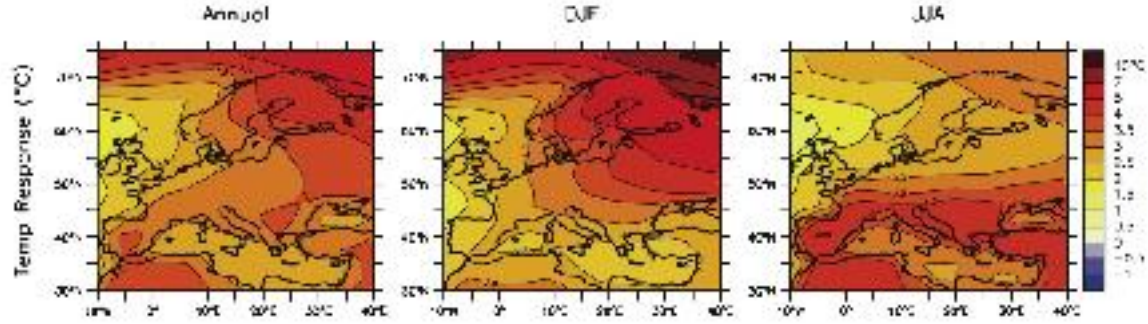

Figure 12: Temperature changes over Europe (A1B scenario) between 1980 to 1999 and 2080 to 2099 (Christensen et al., 2007)

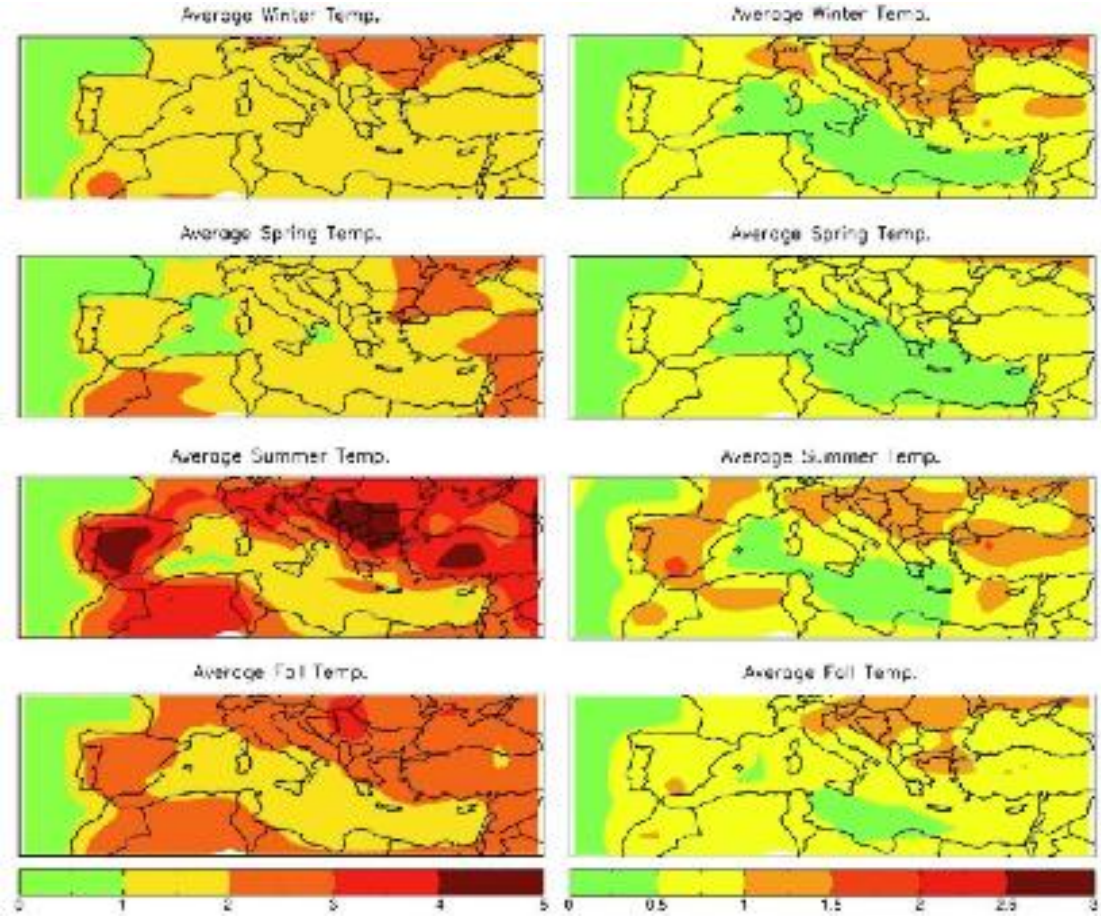

Figure 13: Left column: Difference in mean (a) winter, (b) spring, (c) summer and (d) autumn temperatures between 2031-2060 and 1961-1990. Right column: corresponding 95% confidence range (Giannakopoulos et al., 2009*)*

From 1993 to 2003, the mean surface temperature of the Mediterranean increased 0.75°C (five times more than other seas and oceans); during the 1980s, the increase was 0.3 °C over a decade. The effects of sea level rise in the Mediterranean are unequally distributed (Klein & Lichter, 2009). During the 20th century, overall sea level rise was similar to the global average, although this was not consistent throughout the whole of the period (Klein & Lichter, 2005). Rising air pressure has, at times, depressed sea level rise. However, from 1990, extremely high sea-level rise of 5 to 10 times the 20th century average and notably higher than the global average has been observed. There is also an indication that the western basin of the Mediterranean has already warmed by 1 degree. The expected rise in surface temperature varies from one region to the next. In the Sub-Saharan regions it could well be as much as 4°C in summer. On the other hand, on the Northern shores, the rise is likely to be more marked in winter, at around 3°C.

At the scale of the Mediterranean basin, it is probable that the growth of the average annual temperature will be slightly higher than that of the world level (Hallegatte et al., 2007; Van Grunderbeeck and Tourre, 2008). When considering all the SRES scenarios, this average increase is estimated to be between about 2°C and 6.5°C by the end of the century (compared with a global mean increase between 1.1°C and 6.4°C for the same period). Seasonal variation is projected to remain significant, even if temperature increases are more marked in winter than summer. Finally, infra-regional variations must also be considered: in autumn for example, the western Mediterranean basin is likely to be characterised by a temperature elevation that is slightly higher than for the rest of the basin, whereas over the summer this trend is likely to be inversed, effecting southern and eastern countries.

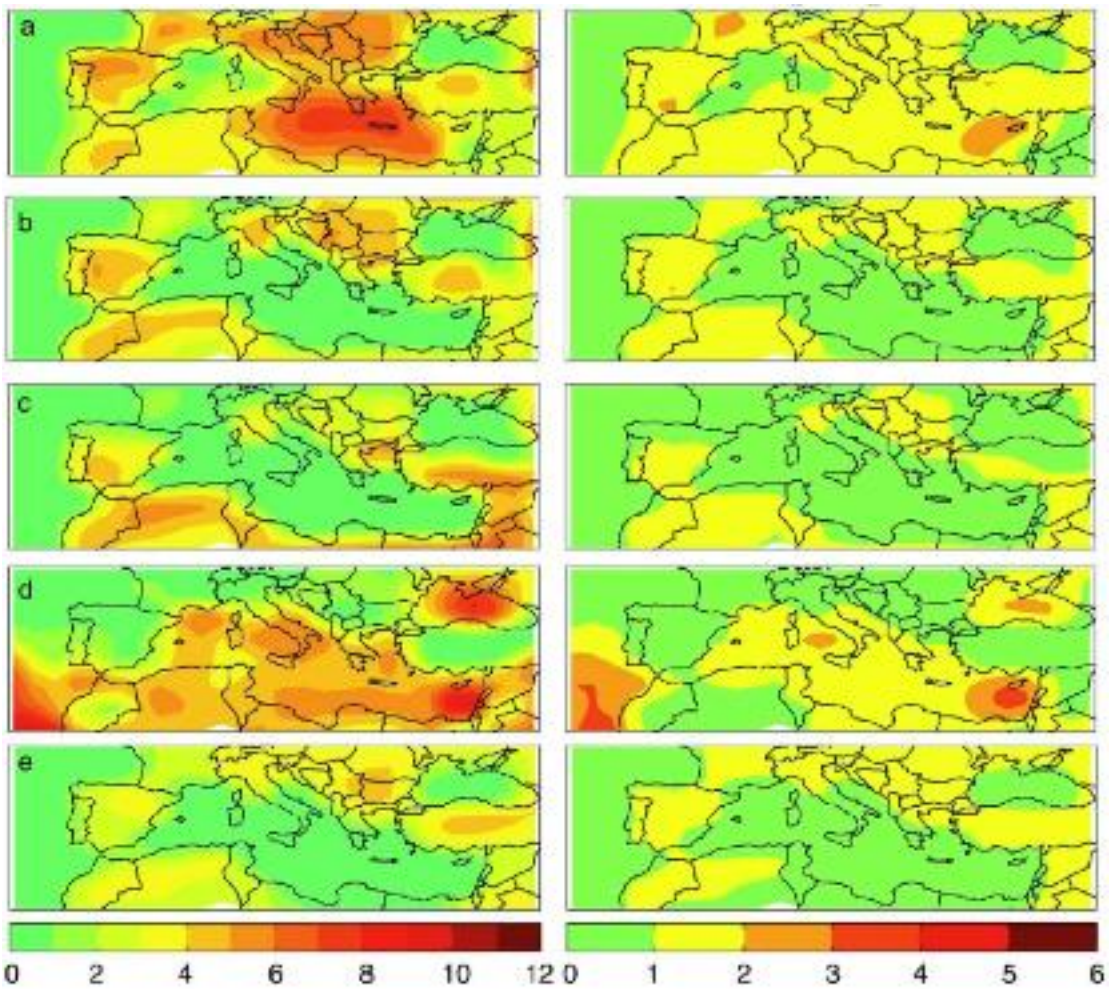

Figure 14: Left column: increase in the number of (a) summer days, (b) hot days, (c) heatwave days, and (d) tropical nights, and (e) decrease in the number of frost nights between 2031-2060 and 1961-1990. Average numbers are considered and units are weeks. Right column: the corresponding 95% confidence range in weeks (Giannakopoulos et al., 2009)

The increase of average temperature will have repercussions partly on the evolution of the sea's surface temperature, with implications on the dynamics of the lower atmosphere (interaction of depressions and anticyclones) and indirectly on precipitations and natural habitats. Although the warming of the sea's surface is also affected by the circulation of water masses and will be lower than the warming of air temperature (the thermal inertia of sea is larger than that of air), the expected average increase will still be around +2°C to +4°C by the last quarter of the 21st century (Hertig and Jacobeit, 2007; Somot et al., 2007, based on the A2 scenario) (Figure 15 that follows). This universal warming will influence the general volume of Mediterranean Sea masses, then indirectly the coastal and marine habitats and associated ecosystems. However, there are also some differences to be considered, notably the increase in average temperatures will be greater for the Adriatic and Aegean Seas, and lower at the level of the Levantine basin.

Additionally, the coupled growth of average temperatures of air and sea will influence, and simultaneously be influenced by, the regional and local precipitation regimes. This highlights the importance of the level of interaction between the components of the ocean/atmosphere system, and therefore demonstrates the necessity to take both into account in order to identify the effects caused by climate change on ecosystems, societies and Mediterranean territories.

Projections for average annual sea surface temperature suggest that the Mediterranean could be 1.1°C warmer by the period 2030-39, rising to 3.6°C by 2090-99 (Brochier & Ramieri, 2001). This will increase thermal expansion of seawater, causing further sea level rise. According to the AR4 and a number of local models, the temperature will continue to grow in the Mediterranean region at the speed higher than the average in Europe. On the seasonal scale the biggest increase is expected in winter.

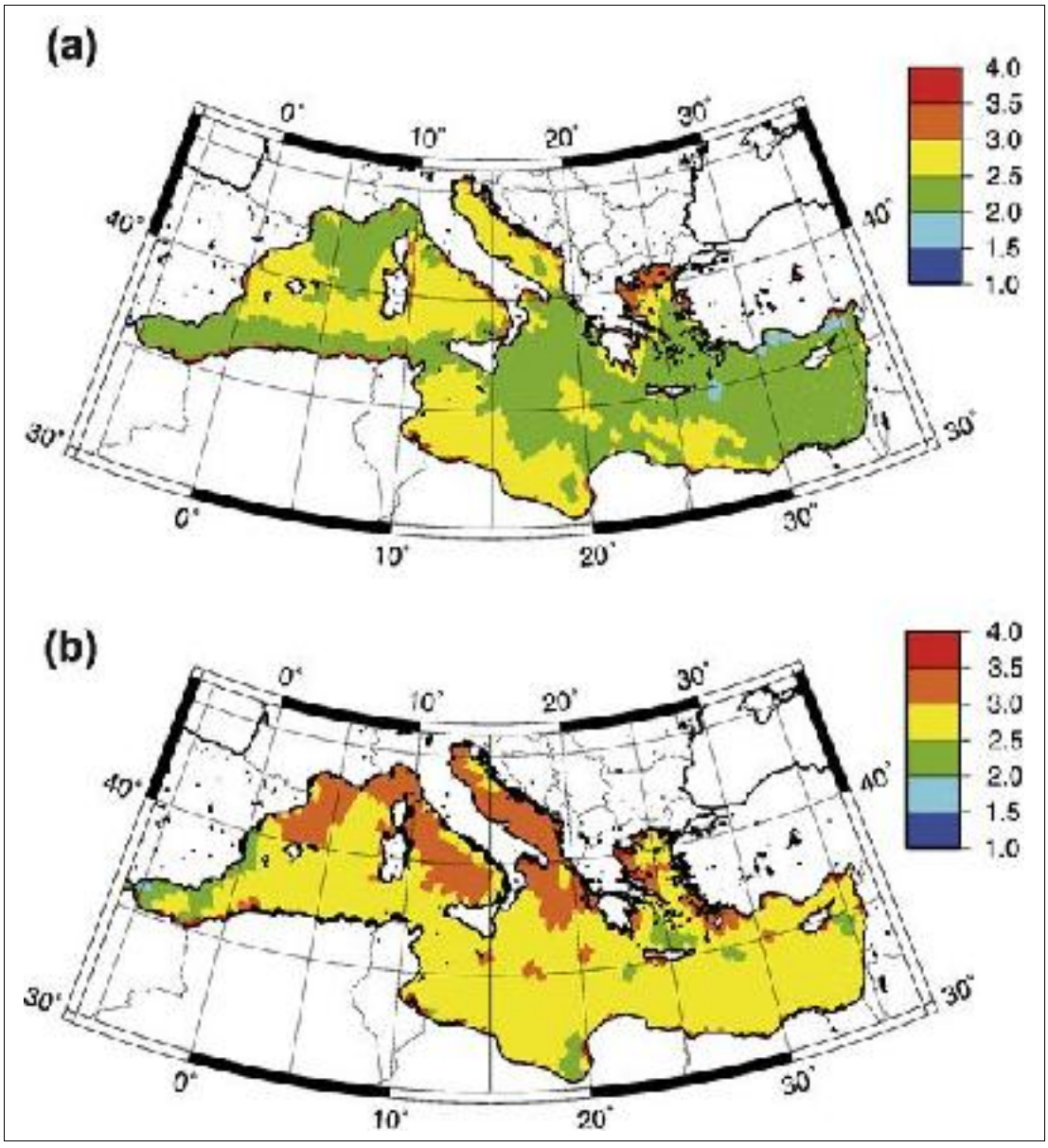

Figure 15: Foreseeable changes in sea surface temperature in winter (a) and summer (b) from 2070 to 2099 compared to 1961 to 1990 (Source: Somot et al., 2007)

3.2.2. Precipitation

Regional projections of the precipitation regimes for the coming centuries, according to the different SRES scenarios, are difficult to ascertain, mainly because they depend – to an even greater degree than temperature – on the specific conditions in the Mediterranean

basin. Despite this, model projections indicate a clear increase in continental drought (fewer rainy days, longest periods without rain becoming even longer). Thus river-flow is likely to decrease on average despite a possible seasonal redistribution (more water in winter, less in spring and summer).The greater frequency of extreme events will also lead to increased flooding (both in terms of occurrence and intensity).

Globally, comparison between what is likely to happen in the two last decades of the 21st century, and the events in the two last decades of the 20th century, suggest that there will be a reduction of the regional average precipitation, within the range of -4 % on the northern coasts, to -27% on the southern coasts (scenarios A1B) (Christensen et al., 2007). More recent projections show a similar trend in annual precipitation decline, with the northern Mediterranean experiencing a slightly lower rate of decline than the south, between 2031-2060 (Figure 16).

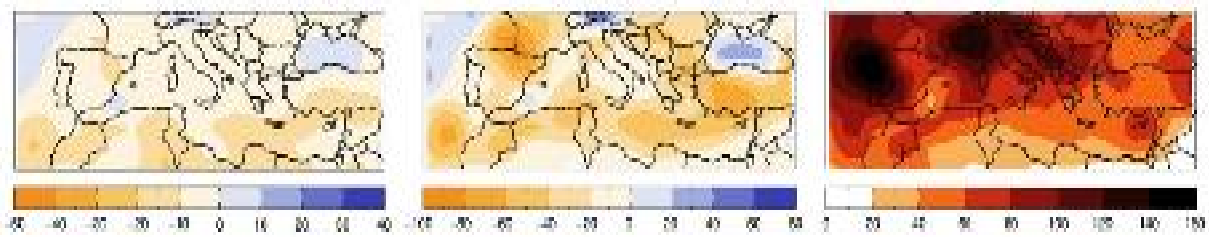

Figure 16: Projections for change in rainfall. Left column: Percentage change in annual rainfall between 2031-2060 and 1961-1990. Centre column: Same as left column but in absolute changes. Right column: corresponding 95% confidence range (Giannakopoulos et al., 2009)

However, the decrease is not expected to be homogenous throughout the whole year, with the summer period likely to be more affected than the winter: from June to August, between almost -5% in the southeast and more than -30% at the far west and in the northwest; over the months from December to February, more than -20% in the southeast of the basin and a slight increase of the averages in the northwest (Figure 17). As a result, the risk of summer drought is heightened for the whole of the basin: indeed it is estimated that by 2080 to 2099, almost one year out of two could be considered as dry.

In parallel, Figure 17 shows that major spatial variations will operate at infra-regional scales. For instance, while the reduction of precipitation will affect all the countries of the Mediterranean basin in summer, a north/south gradation occurs in winter, with the north of the basin being less affected. At an even more precise scale, these variations will probably be accentuated or attenuated due to the influence of topography and microclimatic phenomena, however we do not yet know enough about the effect of these influences.

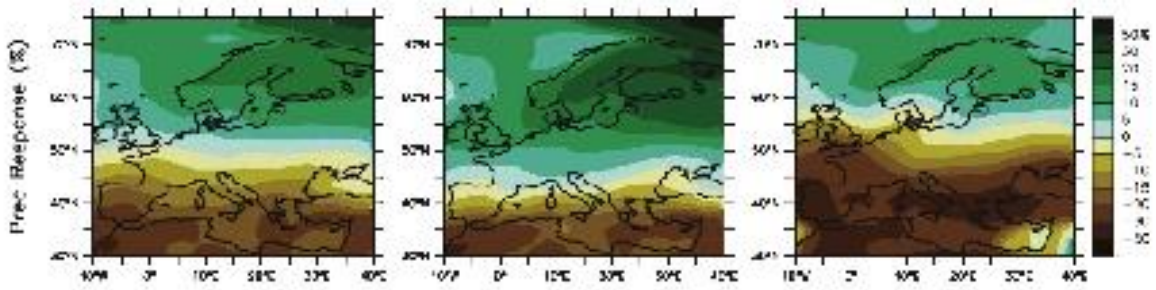

Figure 17: Precipitation changes over Europe (A1B scenario) between 1980 to 1999 and 2080 to 2099. Percent change in precipitation (i) annual, (ii) DJF and (iii) JJA (Source: Christensen, et al., 2007)

Decreases in precipitation will result in annual runoff decreases in the Mediterranean (Chang et al., 2002; Etchevers et al., 2002; Menzel & Burger 2002; Iglesias et al., 2005). Projected decreases in relative runoff are presented in Figure 18 for northern Mediterranean countries. However, it is important to note that the hydrological impact studies presented in Figure 18 are based on global rather than regional climate models.

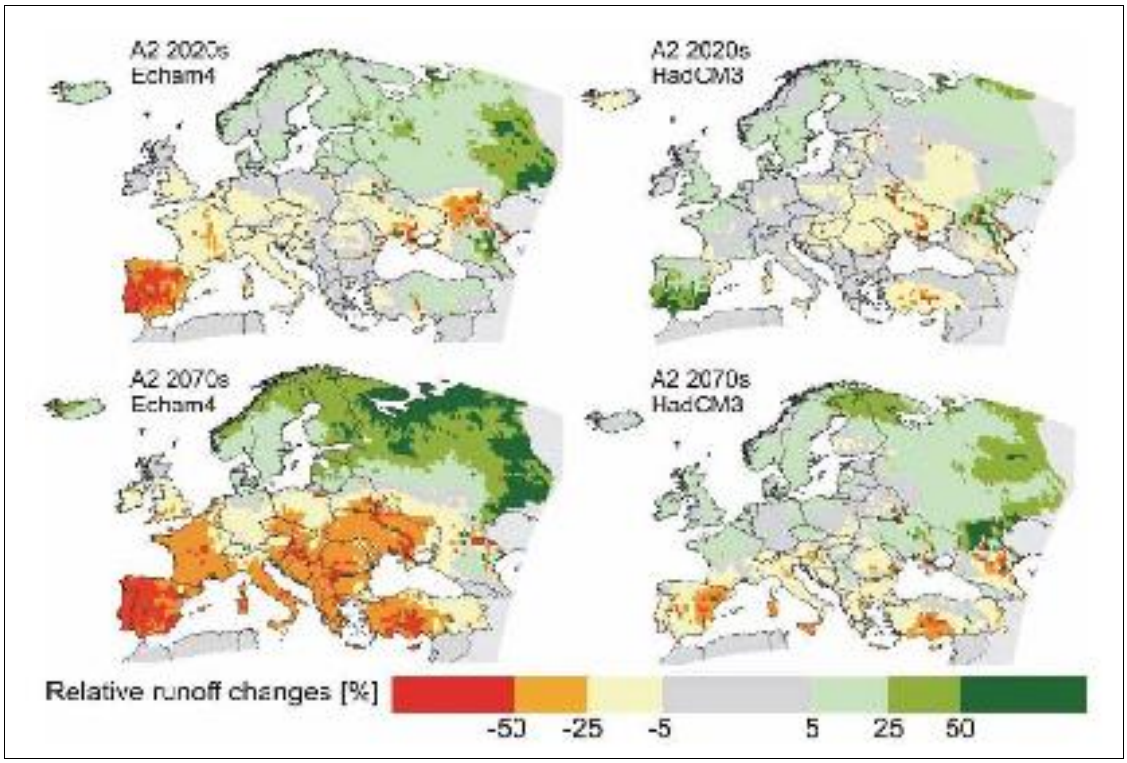

Figure 18: Change in annual river runoff between the 1961-1990 baseline and two future time slices (2020s and 2070s) for the A2 scenario (Alcamo et al., 2007)

3.2.3. Sea Level

Projections for the elevation of sea level are uncertain, although it is one of consequences of climate change that receives the most attention, especially in the Mediterranean where the coasts play a crucial role in the development of the surrounding countries. While the Earth has experienced multiple episodes of sea level variations during its history, the changes expected in the coming decades are typical in that they will take place extremely rapidly (on a global scale). The IPCC global models project elevation in mean sea level ranging, between 18 cm and 59 cm by 2100, while during the entire 20th century the Mediterranean has only experienced elevations between 11 cm and 13 cm. However, the margins of uncertainty remain extremely high, particularly concerning the rate of ice melt and its contribution to rise in mean sea level.

Indeed, some hypotheses also mention, on the basis of sound scientific reasoning, a sea level elevation at the global scale of more than one metre during the current century, and up to tens of metres over longer time scales (Hansen, 2007; Rahmstorf et al., 2007).

Global mean sea-level rise scenarios are based on thermal expansion and ice melt. Local (or relative) changes in sea level depart from the global mean trend due to regional variations in oceanic level change and geological uplift/subsidence: it is relative sea-level

change that drives impacts and is of concern to coastal managers. Furthermore, coasts subsiding due to natural or human-induced causes will experience larger relative rises in sea level, especially significant in locations such as deltas and coastal cities.

Today, it would therefore appear wise to consider that “no solid estimation can be given for the Mediterranean Sea” (Hallegatte et al., 2007). Thus, here we will only take into account the figures provided by the IPCC.

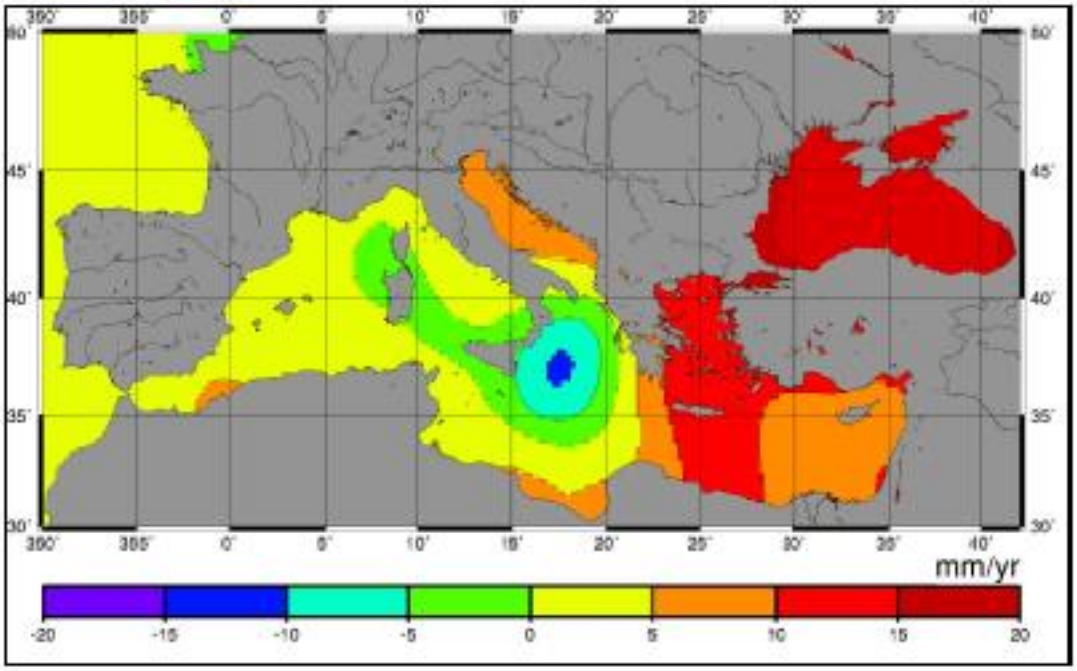

Figure 19: Sea level variations observed between 1992 and 1998 by the TOPEX/Poseidon programme (Source: LEGOS-GRGS-CNES)

Regarding the Mediterranean basin, the main point is not so much the actual numerical value of the regional average, but rather the infra-regional differences. These differences are due to two main reasons: the first is that differences in the marine levels at an in-basin scale may already be observed (see Figure 19 above), with an elevation rate in the short term that is more significant in the eastern part of the basin (for example, between +5 and +15 mm per year, compared to less than +5 mm per year in the western region); the second reason lies in a set of characteristics that are specific to the Mediterranean Sea, which will also be affected by climate evolution, leading to a modification of the general conditions and therefore to changes in volume. Factors of particular importance include: salinity, the action of atmospheric pressure, water balance (evapotranspiration, water input from rivers, exchanges with the Atlantic) or the influence of dominant currents (Hallegatte et al., 2007).

3.2.4. Secondary Climate Factors

Increases in extreme sea levels, due to rise in mean sea level, combined with change in storm characteristics are of wide-spread concern across the region. Future wave climates are uncertain, although extreme wave heights will likely increase with more intense storms. Results of the modelling for storm-induced waves and floods are preliminary at this stage, but may be expected to be less of a risk if projections for decreased numbers of depressions and associated winds hold through.

Change in mean wind speed is highly sensitive to the differences in large-scale circulation that can result between different global models (Raisanen et al., 2004). From regional simulations based on ECHAM4 and the A2 scenario, mean annual wind speed decreases over Mediterranean Europe (Raisanen et al., 2004; Pryor et al., 2005).

Climate simulations indicate a decline in storminess and wind intensity eastwards into the Mediterranean from 2010 to 2030, but with localised increased storminess in parts of the Adriatic, Aegean and Black Seas.

Clearly, warmer air temperatures will lead to an increase in average temperatures of the sea surface, and indirectly a change in the movement of water masses. The movement of air masses from the lower atmosphere will also be subject to change (Tsimplis et al., 2007) and this is likely to translate into an intensification of the winds. However, it is not currently known whether the present direction of the prevailing winds will change.

The evolution of precipitation will disrupt average hydrological regimes, mainly through a change in water volume received by the Mediterranean, which will in turn affect the flow of rivers and also the areas of water retention (lakes, for example). When rain falls at a steep gradient and in an irregular manner (torrential rain), another effect will be the accentuation of flooding and soil erosion.

Top image: St Cyr, France (www.panoramio.com); Bottom image: Istanbul, Turkey (www.greenpeace.org)

4. Impacts on the Coastal Zone

In the previous Section projections for change in key climate parameters, including temperature, rainfall and mean sea level, and the associated secondary climate factors, were reviewed. In this Section, the projections for climate change have been considered to ascertain regional and local impacts in the coastal zone. The discussion of potential impacts is based on existing published material. Consequently, information on the scale and severity of impacts across Mediterranean countries is not provided herein. Rather, the focus is on identifying the range of impacts that countries could potentially be susceptible to[9].

4.1. Global

Sea level rise as a result of climate change will have a number of different physical and ecological effects on coastal systems: inundation, flood and storm damage, loss of wetlands, erosion, saltwater intrusion, and rising water tables. Other effects of climate change, such as higher sea water temperatures, changes in precipitation patterns, and changes in storm tracks, frequency, and intensity, will also affect coastal systems, both directly and through interactions with sea level rise. Rising surface water temperatures, for example, are likely to cause increased coral bleaching and the migration of coastal species toward higher latitudes. Changes in precipitation and storm patterns will alter the risks of flooding and storm damage.

These bio-geophysical effects in turn will have direct and indirect socio-economic impacts on tourism, human settlements, agriculture, freshwater supply and quality, fisheries, financial services, and human health in the coastal zone (McLean et al., 2001; Nicholls, 2002). The resident population of the coastal zone (present or projected levels) could be affected by increased flooding or, ultimately, the need to move because of frequent flooding, inundation or land loss from erosion. There would also be changes in marketed goods and services, such as land, infrastructure, and agricultural and industrial productivity.

Assessments of the vulnerability of coastal resources to the impacts of climate change should distinguish between *natural system vulnerability* and *socio-economic system vulnerability*, even though they are clearly related and interdependent. Both are dependent on sensitivity, exposure and adaptive capacity (see Smith et al., 2001). A proper analysis of socio-economic vulnerability to sea level rise, however, requires a prior understanding of how the natural system will be affected. Hence, analysis of coastal vulnerability starts with the natural system response. In addition, other climatic and non-climatic stresses should be acknowledged in a vulnerability analysis, because sea level rise cannot easily be isolated from other coastal processes and coastal systems evolved because of factors other than sea level rise.

The six most important biophysical effects from a societal perspective are:

- Increased flood-frequency probabilities;
- Erosion;
- Inundation;

[9] It is recognised that to undertake informed adaptation planning an understanding of the scale and severity of potential impacts of climate change is vital. However, to establish such information, it is necessary for Mediterranean countries to undertake nationally relevant impact assessments, based on their unique circumstances, but applying a regionally consistent approach. Whilst some Mediterranean countries have undertaken such reviews (i.e. through production of the First National Communication or National Adaptation programme of Action), a consistent approach to evaluation has not been applied. Consequently, regional analysis of the "scale and severity" of climate change impacts in the Mediterranean cannot be established.

- Rising water tables;
- Saltwater intrusion; and
- Biological effects.

The potential socio-economic effects of sea level rise are:

- Direct loss of economic, ecological, cultural and subsistence values through loss of land, infrastructure and coastal habitats.
- Increased flood risk to people, land and infrastructure and the values stated above.
- Other effects relating to changes in water management, salinity and biological activity, such as loss of tourism, loss of coastal habitats and effects on agriculture and aquaculture.

Globally, coasts are already experiencing the adverse consequences of hazards related to climate change and sea level. Through the 20th century, global rise of sea level contributed to increased coastal inundation, erosion and ecosystem losses, but with considerable local and regional variation due to other factors. Coasts will be exposed to increasing risks, including coastal erosion, over coming decades due to climate change (Table 9).

Table 9: Main climate drivers for coastal systems, their trends due to climate change and their main physical and ecosystem effects (Nicholls et al., 2007)

4.2. Impacts on the Mediterranean Coastal Zone

Sea-level rise can have a wide variety of impacts on Europe's coastal areas; causing flooding, land loss, salinisation of groundwater and destruction of built property and infrastructure (Devoy, 2007; Nicholls and de la Vega-Leinert, 2007). Over large areas of formerly glaciated coastlines the continued decline in isostatic land uplift is bringing many areas within the range of sea-level rise (Smith et al., 2000). In areas of coastal subsidence or high tectonic activity, as in the low tidal range Mediterranean and Black Sea regions, climate-related sea-level rise could significantly increase potential damage from storm surges and tsunamis (Gregory et al., 2001). Sea-level rise will also cause an inland migration of Europe's beaches and low-lying, soft sedimentary coasts (Sánchez-Arcilla et al., 2000; Stone and Orford, 2004; Hall et al., 2007).

Marine ecosystems and biodiversity, already under pressure from pollution and overfishing, will be affected by warmer temperatures and acidification, with changes in species reproduction, feeding and with changes in distributions of marine organisms, more frequent

algae blooms and shifts in plankton communities. Relevant marine and coastal ecosystems services may also be lost with coastal wetlands disappearing.

Delta areas are most vulnerable to a sea level rise because of their particular topography, which means that they are only just above sea-level and are scattered with ponds and lagoons. The existence of dams upstream prevents the normal circulation of sediment, which cannot reach the delta to consolidate it. This is occurring in the major Mediterranean deltas (for example, Nile and Rhône).

In addition, many Mediterranean regions will be increasingly exposed to a major risk of submersion and erosion, affecting several parts of the coast in Mediterranean states. The main consequences are as follows:

- Worsening flooding along low-lying coasts, particularly in delta areas, lagoon coasts, tideland and some islands;
- Accelerated cliff and beach erosion;
- Increased salination in the estuaries; and
- Shrinkage of freshwater water-tables and saltwater infiltration in the aquifers as well as groundwater salination issues.

Further impacts in the Mediterranean coastal zone, by sector include:

- Fisheries and aquaculture – sea-level rise, glacier melting, ocean acidification and changes in precipitation, groundwater and river flows will affect wetlands, rivers, lakes and estuaries significantly, as well as coastal and offshore waters and a range of sensitive marine habitats such as coral reefs. Such changes will require adaptive measures in order to exploit opportunities and to minimise negative impacts on fisheries and aquaculture systems.
- Infrastructure and building - intense precipitation events, increased flood risk, and sea level rise may increase the risk of infrastructure damage. The greatest impact on transportation systems will be flooding of roads, railways and transit systems. Critical coastal infrastructure, communities situated close to the coast as well as sea ports will be exposed to coastal flooding, and storms may provoke impacts on maritime transport and related infrastructure.
- Tourism - problems of water supply are becoming increasingly common in Europe's tourist areas. The island of Cyprus for example has suffered from a chronic shortage of water for a number of years where rising demand and dwindling rainfall has put pressure on limited water resources. Coastal tourism will also be affected as a consequence of accelerated coastal erosion and changes in the marine environment and marine water quality, with less fish and more frequent jelly fish and algae blooms.
- Water supply and sanitation services - climate change affects the function and operation of existing water infrastructure, including hydropower, structural flood defences, drainage and irrigation systems, as well as water management practices.

Overall, the priority risks of climate change in the Mediterranean coastal region are freshwater shortage and sea level rise. Sea level rise is likely to affect parts of the coastline situated below 5 m elevation, resulting in a modest risk of coastal flooding. Up to 30% of the coastline may be affected by erosion. Large areas could be affected by saltwater intrusion; with dry periods projected to increase in length and frequency, this would put additional pressure on freshwater availability.

Figure 20 presents the examples of coastal environment and human interface. A summary of the physical, ecosystem and biodiversity and livelihood impacts of climate change in the Mediterranean is provided in Table 10 below.

Figure 20: The coastal environment and human interface

Table 10: Climate change impacts in the Mediterranean (following UNEP/MAP-Plan Bleu, 2009)

Category	Impacts
Physical	Shoreline erosion, flooding, unstable shorelines (rock and sandstone cliffs).
Ecosystems and biodiversity	Observed temperature rises and changes in precipitation patterns already affect various aspects of the Mediterranean's natural systems. Projected climate change is expected to lead to considerable losses of species and habitats throughout the region.
Livelihoods	*Social:* Changes in frequency and intensity of extreme weather and climate events could pose a serious threat to human health. These threats may either be direct, such as heat waves and flooding, or indirect, for example by the spread of tick-borne diseases. Particularly vulnerable sections of the population are elderly people with limited access to health care services. There are already major Water Source Shortages in some areas, and these will increase due to climate change (rainfall and runoff decreases, SLR, saline intrusion of groundwater) as well as population increases. A growing share of water demand is being met through the over-exploitation of groundwater, prompting seawater seepage (which, among other problems, leads to soil salination problems when this water is used for irrigation). This problem will be exacerbated with SLR. *Economic:* Fisheries - The structure and dynamics of fish stocks on the Mediterranean continental shelf are likely to react both to the effects of human activity (fishing) and to climate change (warming, sea level rise, decreased rainwater run-off, etc.), with consequences for the fisheries which rely on them. Forestry – increased risk of forest fires and parasites (forest production, and impacts of fires on people and economy and environment). Tourism - If heat-waves and summer temperatures increase, the Mediterranean regions could become less attractive to the benefit of more northern destinations. Extreme natural events or a significant rise in the cost of transport relating to global warming prevention programmes could also harm tourist activity as could potential clashes with other users over scarce water resources. Further, biodiversity and quality of natural environment are strong attractors of tourism, and these may be negatively effected by climate change. Economy-wise the most vulnerable sectors are beach tourism and fisheries.

4.2.1. Local coastal impacts in Mediterranean countries

The vulnerability of marine and nearshore waters and coasts is dependent on local factors (Smith et al., 2000; EEA, 2004b; Swift et al., 2007). Low-lying coast lines with high population densities and small tidal ranges will be most vulnerable to sea-level rise (Kundzewicz et al., 2001). Coastal flooding related to sea-level rise could affect large populations (Arnell et al., 2004). Under the SRES A1 FI scenario up to an additional 1.6 million people each year in the Mediterranean, northern and western Europe, might experience coastal flooding by 2080 (Nicholls, 2004). Approximately 20% of existing coastal wetlands may disappear by 2080 under SRES scenarios for sea-level rise (Nicholls, 2004; Devoy, 2007). Impacts of climate warming upon coastal and marine ecosystems are also likely to intensify the problems of eutrophication and stress on these biological systems (EEA,2004b; Robinson et al., 2005; SEPA, 2005; SEEG, 2006).

Impacts will not affect all the regions of the Mediterranean, and not in the same way or with the same intensity. Tectonic phenomena, for example, may work to raise certain coasts (e.g. in Algeria, Italy, Greece or Turkey), which in turn will tend to mitigate the consequences of sea level rise; therefore, we must address the issue of climate change impacts in the Mediterranean with caution and be aware of the limits of over generalisation.

Consequently, a review of projected climate impacts, by country, was undertaken (Table 11 that follows). The assessment is limited in scope[10]; however, the differential impacts across key categories (physical environment, ecosystems and biodiversity and livelihoods) demonstrate the variable nature of climate change impacts in the Mediterranean.

In Europe, PESETA (Projection of Economic impacts of climate change in Sectors of the European Union based on bottom-up Analysis) is contributing to a better understanding of the possible physical and economic effects of climate change in Europe over the 21st century. The assessment provides country level impact data (erosion, flood risk, coastal wetland loss/change, and salinisation) for European countries (see for example Figure 21 and Figure 22). Such analysis provides a valuable tool to support climate change adaptation, where activities can be focussed in the most vulnerable areas.

Whilst such detailed information is not available for the Mediterranean at this time, an understanding of the variable impacts across key categories can provide an insight into country level sensitivity to projected climate changes. Consequently, the country level information (as summarised in Table 11) was analysed to ascertain country level sensitivity across three primary impact categories: physical environment; ecosystems and biodiversity; and livelihoods. The output is an understanding of country level sensitivity to coastal climate change.

This is a qualitative evaluation based on readily available information and is not an exhaustive analysis of the projected impacts of climate change per country. The evaluation process entailed a review of each impact type and a qualitative analysis to assign a prioritisation of impact level relative to other Mediterranean countries. It is important to note that the prioritisation is based on “country level” exposure, rather than total loss/impact. For example, the average percent of land affected, or percent of population impacted, per country, was evaluated to qualitatively evaluate countries according to level of sensitivity. For example, the sensitivity of Slovenia is perceived as low due to the small proportion of

[10] The review is based on available printed information and has not involved consultation with relevant MAP Contracting Parties. As such, the detail presented in the table, in relation to the projected impacts of climate change in the coastal zone, per country, is variable. While this is a limitation, it has been an unavoidable gap due to the necessary scope of this first-pass position paper.

coastal area in country, whilst Egypt's sensitivity is high due to the high proportion of population, ecosystems and coastal land area sensitive to the projected impacts of climate change.

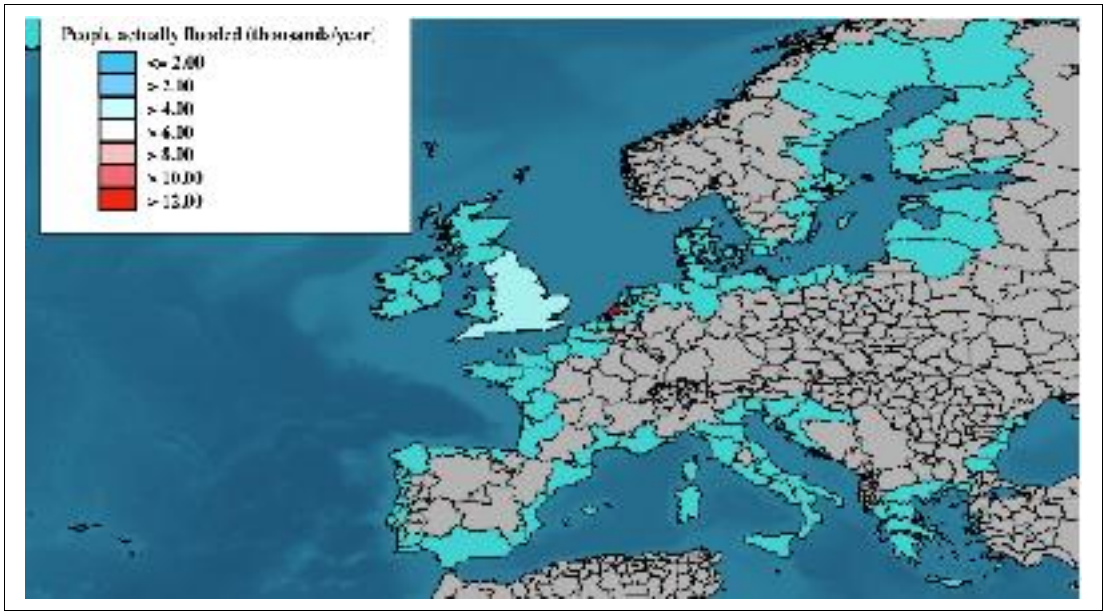

Figure 21: Baseline result for people flooded (thousands/yr) across Europe (present day) (Richards and Nicholls, 2009)

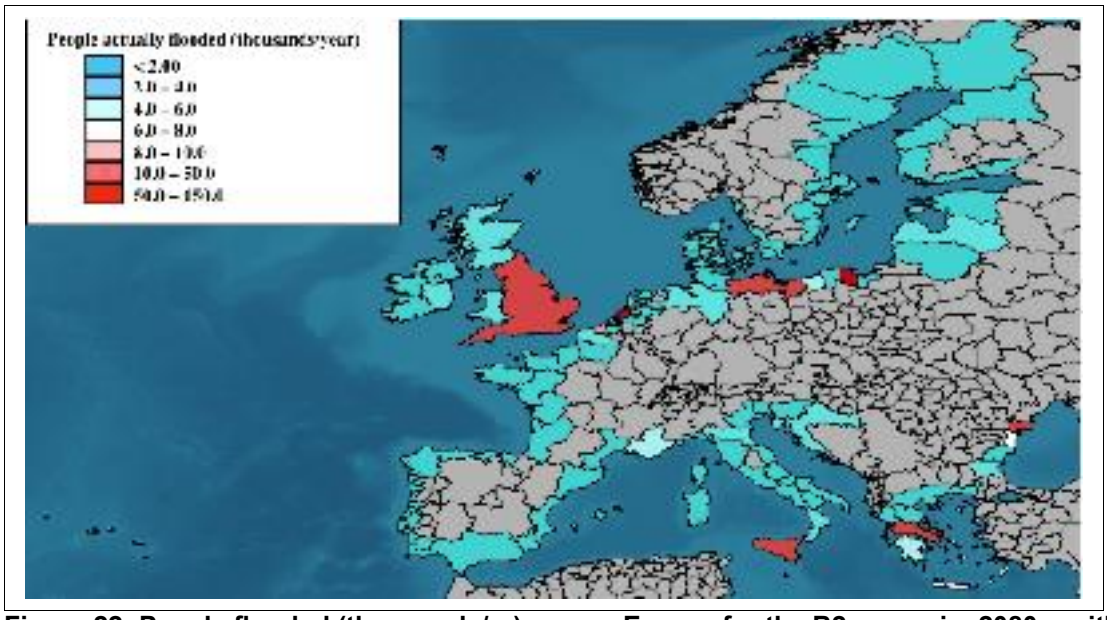

Figure 22: People flooded (thousands/yr) across Europe for the B2 scenario, 2080s, without adaptation (Richards and Nicholls, 2009)

The analysis indicates that the countries least sensitive to the projected impacts of climate change include Slovenia, Bosnia and Herzegovina and Montenegro (Figure 23). While countries most sensitive to climate change include Libya, Tunisia and Egypt. It is important to re-state that the evaluation is based on readily available printed information, and as such, the prioritisation is influenced by access to information. For example, information on the coastal characteristics and impacts of climate change in Montenegro and Bosnia and

Herzegovina was limited and this has, by necessity, resulted in a lower sensitivity rating than assigned to other countries.

This information will be considered in the context of adaptive capacity at a country level in Section 6.

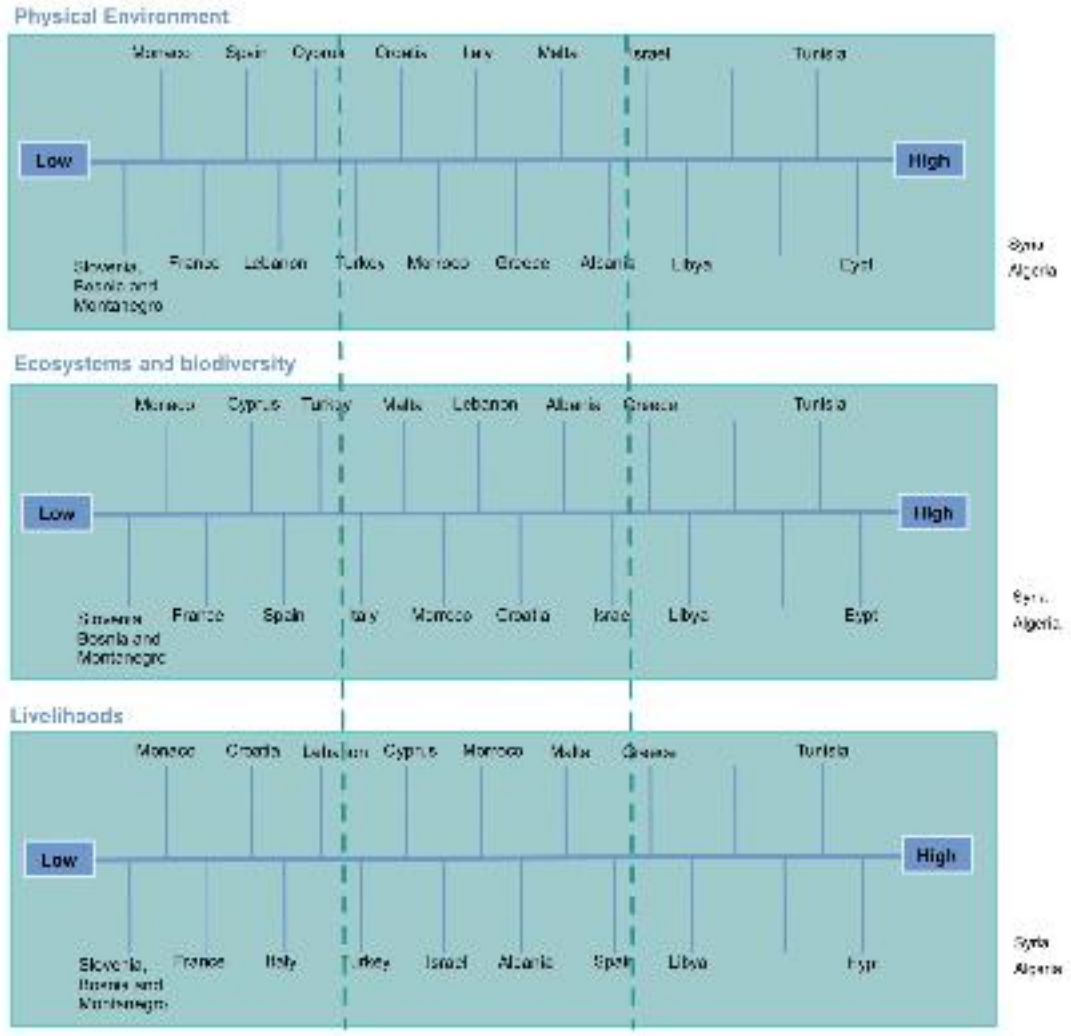

Figure 23: Sensitivity of Mediterranean Countries to the Impacts of Coastal Climate Change[11]

[11] This diagrammatic representation of the relative degree of sensitivity of Mediterranean countries to the projected impacts of climate change is based on available literature and not a detailed examination of vulnerability. This is used for discussion purposes only and should be applied in any other contexts.

Table 11: Coastal climate change impacts, per Country

Country	Impacts
Spain	Physical Environment: Heterogeneous coast with mixture of eroding rocky cliffs and soft shorelines – some soft eroding cliff lines along Algarve coast and sandy beaches with sediment deficits. Sea level rise will cause flooding and permanent inundation of some coastal areas and exacerbate erosion (See BEACHMED and EUROSION for further details). Ecosystems Function and Biodiversity: Loss of biodiversity in highly developed coastal zone already susceptible to climate variability; no buffer for inland migration of wetlands; current over-exploitation exacerbated by impacts of climate change. Livelihoods: Big problems in terms of impacts of climate change on tourism in the coastal zone. Planning and development has occurred in an *ad-hoc* manner resulting in development situated in high-risk locations. Erosion and land loss are major coastal climate change issues for Spain.
France	Physical Environment: Sea level rise is likely to have an impact on road network due to the extensive distribution along France's coast. Exacerbated impacts on areas of coast currently subject to erosion (approximately 40% of total coastline including Atlantic seaboard). It is a mixture of rocks/hard cliffs, developed beaches, small beaches, and some cliffs subject to erosion. Ecosystems Function and Biodiversity: Main impacts outlined in national communications concern forestry. Heterogeneous Mediterranean ecosystems will be pressurised due to sea level rise and erosion, and in many places issues will be related to the fact that there is no scope for landward migration of process boundaries due to highly developed nature of many coastal areas. Livelihoods: the largest impact of climate change in the coastal zone will be impacts on the tourism industry.
Italy	Physical Environment (erosion and inundation): Sea level rise will imply higher risks for the Italian coastal areas. About 4,500 square kilometres of coastal areas and plains would be at risk of sea flooding; floods might be frequent and distributed over all the Italian coasts. The coastal zone is largely low lying and experiences a low tidal range. The coast is highly fragmented and instability of the coast will increase in under projected rises in mean sea level. The eastern coastline is more susceptible to the impacts of climate change than the west coast. Cyprus. ??? Ecosystems Function & Biodiversity: Under the mainstream scenarios, the reduction in the number of stable plant species in 2100, compared to 1990, might range between, 60÷80% in the Mediterranean area. Valuable endemic species (i.e. posidonia) are situated in the region. Livelihoods: Since about 40% of tourists come to Italy during summer, the hot weather conditions can play a very important role in determining the quality of a vacation. Furthermore, the extreme hot conditions may represent a risk factor for tourists, especially among the elderly and those who are affected by chronic diseases. However, conditions in spring and autumn will improve. The availability of water supply could become a major constraint and the quantity and quality of water available may not be sufficient to satisfy future tourist demand.
Malta	Physical Environment: The most obvious effect of sea level rise is the inundation of low-lying coastal areas. Such areas include all sandy beaches and the gently sloping rocky coasts mostly along the north-eastern shoreline. Biodiversity: Apart from the actual loss of land area, these locations also support rare and localised habitats containing highly specialised organisms. In general terms, the ecosystems spread over the Maltese islands will be affected in a number of ways. Most of the bays and the north-eastern shores are expected to experience submergence, shifting zone patterns landward. Specialised and rare habitats such as wetlands will be mostly under threat, some of

Country	Impacts
	which will be facing complete obliteration. Existing infrastructure may serve to reduce the extent of inundation, but can also restrain the inland transfer of the threatened habitats. Livelihoods: Moderate to high economic vulnerability; impacts on fish stocks will decrease the viability of fisheries and tourism may also experience negative impacts which have implications for the service industries.
Greece	Physical Environment: Possible impacts of climate change on Greek coastal areas are far reaching given the geomorphology of the country and the high percentage of population living in these areas. The coastline of Greece is over 16,500 km in length (including islands), thus being the largest coastline in the Mediterranean region. The potential impacts include accelerated erosion of susceptible areas of coast and inundation of low lying areas due to sea level rise and flooding. The current rate of coastal erosion is estimated at 1.2 mm *per annum*. Ecosystems and Biodiversity: Climate change has a very important impact on the marine environment of Greece. Many of the environmental mechanisms controlling growth, abundance, distribution, composition, diversity and recruitment success of Mediterranean species that are quite abundant in the Greek seas, like anchovy (*Engraulis encrasicolus*) or sardine (*Sardinella aurita* and *Sardina pilchardus*), include: regional temperature variations, riverine inputs and wind-induced mixing, which influences sea surface temperature and salinity, hydrographical features as well as nutrient enrichment and planktonic production. Livelihoods: The coastal zone plays an important role in the economy, housing 80% of industrial activity, 90% of tourism activity; and 35% of agricultural and productive land. The increased temperatures during summer can lead to the gradual decrease of summer tourism in the Mediterranean, but in increase during spring and autumn. Studies have shown that climate change will lead to the prolongation of the touristic period in Greece and Spain up to 2030, in a way that the arrival of tourists can be allocated more homogenously, decreasing the intensity of the water scarcity and energy consumption issues in the islands during summer. Attica and Heraclio (Crete) are the touristic areas that will experience the higher rate of water change that might result to shortages that would affect touristic activities, while the islands of the Aegean, and especially the Cyclades, seem to keep their cool climate, indicating that the impact of the sea is very important in the moderation of increased temperatures. Tourism in Greece is largely nature based and is therefore highly vulnerable to climate change.
Cyprus	50% of population live along the coastline hosting 60% of GDP and 90% of tourism. Several developments along the coast that could potentially be under threat, for e.g. airport, ports desalination centre refinery station, energy plants, industries and archaeological sites. Main pressures on the coast are intense urbanisation, and uncontrolled development of tourist activities. Exacerbation of erosion on already problematic coastline; impacts on coastal defence structures and degradation of illegally built and often sub-standard structures. Livelihoods: Big problems of very severe socio-economic and environmental impacts. Lack of water resources is the primary climate change issue –.this will affect economic and environmental impacts, agriculture, forests, tourism and energy.
Slovenia	Physical Environment: Slovenia only has a very small coast line, 46 km in length. Consequently, coastal management is not a priority in terms of climate change adaptation for the region. Despite this, some broad generalisations regarding potential impacts of climate change in the coastal zone have been

Country	Impacts
	made. It is noted that a rise in sea levels and sea temperature will threaten coastal areas. Ecosystems and Biodiversity: Higher temperatures, different water balance and more frequent extreme weather events increased stress, will threaten biodiversity. Livelihoods: The threat of floods will increase and there will be problems ensuring the supply of drinking water.
Croatia	Physical Environment: Croatian Adriatic coast mainly consists of rocks and is at high elevation, therefore, not seriously endangered by the rising of sea level. However, inundation will be an issue in low-lying coastal areas covered with alluvial or flish deposits and sandy beaches. Projections indicate that over 100 km2 of the mainland will be flooded due to rising sea levels. However, due to the variable nature of the coastal zone, with high elevation rocky coast and low-lying sandy coast, the inundation will be localised in low-lying areas. Ecosystems and Biodiversity: Changes in oceanographic and hydrological characteristics will influence the composition of Adriatic ichthyofauna. The number of immigrant thermophilous fish species in the Adriatic is increasing and the findings of the Red Sea and Indo-Pacific species are increasingly frequent. Some of the immigrant fish species represent an alternative for exploitation in commercial fishing and mariculture. Changes in spawning sites and in distribution of fish populations affect the fishing industry considerably. Livelihoods: Sea flooding in shallow and densely populated areas will impact residential and harbour buildings, roads, energy and telecommunication cables and sewage systems. Infiltration of salt water could increase salinity of the freshwaters in the coastal zone. Rise in temperature extends the tourist season in the coastal zone from the present three to five months.
Bosnia & Herzegovina	Physical Environment: Small coastal zone. Most climate change issues are associated with agriculture, limited examination of the projected impacts of coastal climate change. Ecosystems and Biodiversity: No information available. Livelihoods: No information available.
Montenegro	Physical Environment: Coast stretches from the entrance to the Bay of Kotor, Boka Kotorska to the mouth of the Bojana River. The coast is relatively short and narrow, because of the steep, high mountains in the immediate hinterlands. Ecosystems and Biodiversity: No information available. Livelihoods: No information available [Tourism Key focus in coastal zone].
Albania	Physical Environment: SLR will result in likely decrease in coastal forest area (Lezha coast) is likely from 1.14 to around 1 km2 by 2100. Beach erosion at Shengiin and inundation of coastal cities in areas where dwellings were built on low-lying swamps. Ecosystems and Biodiversity: Likely enlargement of lagoons will increase holding capacity for migratory birds and change the species present. Change in water fauna and flora in favour of species that like more warmth and salinity, is also likely. Livelihoods: The expected climate change and sea level rise will largely influence the geographical distribution of the residence areas, population, their economic activity in general and tourism in particular. Along the coastal areas of the valley of “Drini i Bashkuar” river (from Kukesi to “Vau i Dejes”). Likely changes are: (i) increase in temperature from 2.8 to 5.6°C during summertime; (ii) increase in surface air temperature and humidity - these increases are projected to be largest mainly in the low-lying areas and are likely to influence especially the health conditions of population; (iii) increased frequency of

Country	Impacts
	extraordinary events (heavy rains, strong winds, droughts, flooding); and (iv) coastal tourism is expected to suffer consequences of sea level rise. At the beach of Shengjin the tourism constructions are all threatened by sea level rise in the coming 50–100 years. After 1990, a considerable number of population moved from the high mountainous areas of Albania towards the coastal area. They are settled in existing coastal cities and in areas where there were no dwellings before (mainly in the state properties of the ex-swamps which were drained in the period 1950–1960). These areas are situated close to sea level or sometimes below sea level, so they are continuously threatened by flooding due to sea level increase or rivers overflowing.
Turkey	Physical Environment: Coastal erosion, flooding and inundation along Turkish shorelines are problems of national significance, particularly in the middle and eastern Black Sea, the northern Aegean Sea and eastern Mediterranean. A majority of the coastline is "hard" coast, however, the coast of the Northern Aegean and Eastern Mediterranean are subject to erosion and inundation. Ecosystems and Biodiversity: The increased risk of drought is likely to be the biggest climate change impact felt by Turkey which will exacerbate loss of biodiversity in coastal ecosystems already under pressure due to other climate-related factors. Livelihoods: Tourist and coastal cities are particularly under threat. Many "flagship" cultural sites would also be damaged or destroyed by Accelerated Sea Level Rise (ASLR) like ancient cities of Phaselis and Patara on the south-western coasts of Turkey. Some of them could be destroyed by increased wave activity, whereas burial by more active sand dunes is also possible (e.g. the ancient city of Pompeipolis [Viransehir] on the Mediterranean coast has recently been covered by sand dunes). Because of the large number of ruins, relocation is impossible in practical terms, and it may change their character and context, as well.
Syria	Physical Environment: A narrow coastal plain runs from the Turkish border to Lebanon. A 250 km-long Jebel Ansariyya mountain range runs along its entire length. Squeezed between the highland and the sea is a narrow coastal strip that widens towards the south. This area will be susceptible to accelerated erosion and flooding and inundation as a result of sea level rise and an increase in wave height and extreme events. Ecosystems and Biodiversity: Narrow coastal strip is extremely fertile and agriculturally rich; no space for landward migration of ecosystems with sea level rise due to existence of backing high mountain range. Livelihoods: 67% of population lives in urban regions due to internal migration from remote areas to major cities such as Damascus, Homs, Hama, Aleppo and other cities along the coastal strip. There is a threat to main sea port at Lattakia and associated impacts on livelihoods. Tourism is also a high source of revenue in this area with beach resorts and ruined ancient city of Ugarit (Ras Shamra).
Lebanon	The major pressures on coastal zones will be related to development rather than the direct result of climate change. Erosion in the coastal zone will be exacerbated and areas already under pressure due to intensive sand extraction are likely to be most negatively impacted. Ecosystems and Biodiversity: Changes in water temperature will potentially impact Phytoplankton populations, for example, the phytoplankton populations in Jounieh Bay, species responsible for bloom at late winter and at the beginning of spring like *Skeletonema costatum, Nitzschia spp., Leptocylindrus denicus* and *L. minimus* and others could start earlier. Both density and timing of spring blooms will be altered in some regions. The taxonomic composition of the phyto- and zooplanktaton may change influenced by the change of ocean structure. *Clupeidae* which is very sensitive to the gradient of temperature

Country	Impacts
	will reproduce also earlier. Changes in plankton productivity associated with greater temperature and greater stratification of the water column may favour pelagic as opposed to demersal fish communities.
Israel	Physical Environment: Dominated by a flat, sandy coastal zone, with sandstone coastal cliffs. Vermetid reefs, found in several rocky beaches are expected to mitigate coastal erosion by decreasing the direct impact of waves on the shoreline. Ecosystems and Biodiversity: 300-500 km northward shift of Mediterranean Biomes will mean that the Negev ecosystems may be expected to replace Mediterranean ecosystems in Israel. Habitat fragmentation and natural limitations on migration may lead to a loss of natural populations or even species. Sensitive ecosystems in Israel include the coral reefs of the Red Sea and the coastal wetlands, and isolate mountain ecosystems such as the Hermonn, Mron and Carmel mountains. The most dramatic changes in ecosystem structure and composition are likely to occur in the semi-arid region of Israel, the non-desert/desert ecotone. Plant and animal communities will not be able to migrate or expand eastward due to lack of suitable habitats. Aquatic ecosystems within rivers as well as terrestrial ecosystems along the coastline will be endangered by sea level rise and by seawater infiltration of ephemeral river basins. Livelihoods: Sea level rise may erode coastal structures, adversely affect harbour and other coastal structures and lead to collapse of the coastal beach cliff in the central sector of Israel shoreline. Increase in storm frequency and changes in wind directions may enhance coastline erosion and retreat. Isreal's heavily populated coastal plain is most vulnerable to coastal erosion. Sea level rise may lead to the loss of valuable lands, buildings and tourist facilities in close proximity to the sandstone coastal cliffs.
Egypt	Physical Environment: The coastal zone of the Nile Delta in Egypt is perceived as vulnerable to the impacts of climate change, not only because of the impact of sea level rise (SLR), but also because of the impacts of climate change on water resources, agricultural resources, tourism and human settlements. Several studies were undertaken, to assess climate change impacts on low land areas in Alexandria, Beheira, Port-Said and Damietta governorates. For Alexandria, a scenario involving a sea level rise of between 0.5 m and 1.0 m over the next century is assumed, if no action is taken, an area of about 30% of the city will be lost due to inundation. Ecosystems and Biodiversity: ???? Livelihoods: The Nile delta covers 5.5% of Egypt's land area, but contains 95% of the country's population. For Rosetta city, the expected economic loss as a result of an estimated 0.5 m sea level rise show that 1/3 of the employment in the city will be affected and a loss of about $2.9 billion is expected over the next century. The most affected sectors are expected to the industrial, transportation and urban sectors. Agriculture in non-coastal areas is not projected to be highly affected because it is mainly found in the suburbs and thus will not be affected by sea level rise. However, it is noted that SLR will have a significant impact on human habitat and settlements with a projection of at least two million people migrating from the Delta coastal areas due to the inundation and loss of fertile land. Careful assessments are required to examine the socio-economic impact of this migration and determine the costs of resettlement, finding new jobs, new habitats, etc.
Libya	Physical Environment: high risk of erosion and sea level rise along low-lying coastal plains where most of population are concentrated. Ecosystem and Biodiversity: Mangroves and currently endangered species at risk from climate change. Livelihoods: High concentration of population in coastal zone due to population movement from rural areas to the capital city.

Country	Impacts
	There is a high area of land close to the coastline that is situated below sea level and therefore highly vulnerable to the sea level rise. 90% of the population is in the coastal zone. Agriculture is only supported in the coastal zone, due to the reliance on rainfall (no irrigation systems) and can not locate further inland due to the harsh arid environments. Saltwater intrusion due to sea level rise is also a major issue.
Tunisia	Physical Environment: The coast is vey fragile and low-lying islands are at particularly high risk. Sea level rise would damage the aquifer coastal formations and other underground water reserves where anthropogenic pressure is already very high. Most vulnerable coastal areas are likely to be lagoons, sebkhas, and lowest coastal marshes, which will be inundated by rising sea levels. Erosion of the shoreline along lagoon coasts is also likely. Water resources are projected to decline by 28% where the loss of groundwater reserves in particular will be problematic. Loss of land to sea water, particularly on some islands (KerKenna Islands) and swamps (Maritime swamps and Sebkhas). Ecosystems and Biodiversity: The findings, which were presented in a report published in February 2007, illustrate the dramatic effects of climate change in Tunisia, including 50% loss of non-irrigated forested areas in southern Tunisia; Drastically increased risk of forest fires; and Substantial increase in the vulnerability of ecosystems. Livelihoods: The expected sea level rise will put not only agriculture but also tourism – a major economic sector in Tunisia – at risk. 60% of the population live within the coastal zone; and 70% of the economy is based in the coastal region, including over 90% of tourist accommodation and agriculture. There is projection of a 20% loss in arable cropland by 2030.
Algeria	Only information located was NatCom in French – requires translation for final draft – coastal zone not dealt with specifically in NatCom. Two thirds of population live along coastline – problems with waste dumped into the sea with no prior treatment and industrial activities concentrated along the coast. Tourist activity is extremely important along the Mediterranean coast and is already degrading the quality of coastal waters. The degradation of natural resources in the region is reaching its limits. Due to climate changes, the risks of natural resource degradation are increasing.
Morocco	Physical Environment: In Morocco, the examination of the last three decades (1970-2000) show revealing signs of climate change: the frequency and intensity of droughts, unusually devastating floods, the decrease in the snow cover period on the peaks of the Rif and the Atlas mountains, the modification of spatial-temporal rainfall distribution, changes of itinerary and passage dates of migrating birds, the appearance of certain species of birds in the Rabat region that only used to be seen in the south of Marrakech. Ecosystems and Biodiversity: Ecosystem destruction and pollution are current management issues, likely to worsen under a changing climate. Livelihoods: A key climate change impact in the coastal zone is erosion and marginalisation due to the harsh inland environment. Development in the coastal strip has been largely *ad-hoc* increasing the potential susceptibility to the impacts of climate change.

5. Status of V&A in the Mediterranean Region

Numerous initiatives focused on climate change adaptation have been developed at a range of scales throughout the Mediterranean in recent years. Various stakeholders including international organisations, governments, research institutions and local communities have instigated these initiatives. While vulnerability and adaptation (V&A) initiatives have been directed at a range of different sectors and themes (e.g. agriculture, water), only those concerned with the coastal zone are of relevance to the current Background Paper and are discussed further here. In addition, owing to the explicit focus of this Background Paper on future coastal adaptation in the Mediterranean coastal zone vulnerability assessments are not directly dealt with in this section. Rather, discussions are centred on (i) strategies and plans and (ii) projects and programmes that have adaptation as their main objective. It is also important to remember that as parties to the Barcelona Convention, each of the 22 MAP CPs have associated aims and objectives that relate indirectly to their ability to adapt to future climate change; and with the planned amendment of the Mediterranean Strategy for Sustainable Development to include climate change adaptation, this will become a more direct focus.

Overall, the "types" of adaptation initiatives undertaken within the region may be considered within two main categories:

1. Institutional Arrangements (e.g. Policy, Plans and Strategies)
2. Projects and Programmes

The review of initiatives also considered a range of spatial scales[12]:

- Regional – relates to all MAP Contracting Parties (CPs)
- Sub-regional – a discrete group of MAP CPs (e.g. EU countries)
- National – whole of country scale
- Sub-national – regional within country
- Local – community level

5.1. Regionally/Sub-Regionally Relevant Institutional Arrangements

On a global stage, all Contracting Parties (CP) to MAP are signatories of the UNFCCC and have ratified the Kyoto Protocol. As such, they have indicated their commitment to combating climate change and have accepted an associated suite of obligations, the extent of which is dictated by their respective Status (Table 12 that follows). That is, the UNFCCC divides countries into three main groups according to differing commitments: Annex I Parties include the industrialised countries that were members of the OECD (Organisation for Economic Co-operation and Development) in 1992, plus countries with economies in transition (the EIT Parties), Non-Annex I Parties are mostly developing countries and are recognised by the Convention as being especially vulnerable to the adverse impacts of

[12] The range of spatial scales was largely relevant to projects and programmes. Institutional arrangements relevant to the current review were considered from a regional/sub-regional and national level only. While all CPs are impacted by the institutional arrangements defined by the Barcelona Convention and its associated Mediterranean Strategy for Sustainable Development and more recent ICZM Protocol, this is implicit and is considered further in subsequent sections of the report.

climate change, including countries with low-lying coastal areas and those prone to desertification and drought. The range of issues that are being addressed by Parties under the various Convention bodies of the UNFCCC can be grouped as follows:

- Enhanced action on adaptation as part of the Bali Action Plan under the Ad-hoc Working Group on Long-Term Co-operative Action under the Convention (AWG-LCA).
- Nairobi work programme on impacts, vulnerability and adaptation to climate change, development and transfer of technologies, research and systematic observation under the Subsidiary Body for Scientific and Technological Advice (SBSTA).
- Issues related to implementing, including national adaptation programmes of action (NAPAs), and supporting adaptation through finance, technology and capacity-building under the Subsidiary Body for Implementation (SBI).

The Bali Action Plan, adopted at COP 13 in Bali, December 2007, identifies adaptation as one of the key building blocks required for a strengthened future response to climate change to enable the full, effective and sustained implementation of the Convention through long-term co-operative action, now, up to and beyond 2012. Most recently in Copenhagen, Parties decided to extend the mandate of the AWG-LCA and requested it to present the outcome of its work to COP 16 in Mexico. In addition, the COP took note of the Copenhagen Accord, in which Heads of State, Heads of Government, Ministers and other heads of delegations stress the need to establish a comprehensive adaptation programme. The signatories agree that enhanced action and international co-operation on adaptation is urgently required and that developed countries shall provide adequate, predictable and sustainable financial resources, technology and capacity-building to support the implementation of adaptation action in developing countries.

Parties to the Convention must submit national reports on implementation of the Convention to the Conference of the Parties (COP). The required contents of national communications and the timetable for their submission are different for Annex I and non-Annex I Parties. This is in accordance with the principle of "common but differentiated responsibilities". National communications for both Annex I and non-Annex I Parties are information on national circumstances, vulnerability assessment, financial resources and transfer of technology, and education, training and public awareness.

Of the 21 CPs under consideration here, 13 are Non-Annex I Parties and 8 are Annex I Parties. The European Union also has Annex-I status. Five MAP CPs with non-Annex I status have yet to submit their initial national communication (Cyprus, Bosnia and Herzegovina, Montenegro, Syria and Libya). The remaining Annex I Contracting Parties have all submitted an initial national communication (INC) between 1999 and 2002 with the exception of Malta, whose INC was not completed until 2004. Albania is the only non-Annex I MAP CP to have currently submitted its Second National Communication (SNC). Five of the eight Annex I Contracting Parties have recently submitted their fifth communication to the Convention (Spain, Greece, France, Croatia and the EU). Of the remaining three Annex I CPs, Italy and Slovenia have submitted their 4th national communication in 2007 and 2006, respectively. While Turkey has only submitted one national communication (2007), it has been granted special consideration under the Convention.

Table 12: UNFCCC Country Status

Country	Country Status								
	UNFCCC		Kyoto Protocol		National Communications				
	Signature	Entry in to force	Signature	Entry in to force	NC1	NC2	NC3	NC4	NC5
EU Countries									
Spain	1992	1994	1998	2005		1997	2002	2006	2009
France	1992	1994	1998	2005	1994	1997	2001	2006	2009
Italy	1992	1994	1998	2005	1995	1999	2003	2007	
Malta	1992	1994	1998	2005	2004				
Greece	1992	1994	1998	2005	1995	1997	2003	2006	2010
Cyprus	1992	1998	-	2005					
Slovenia	1992	1996	1998	2005	2002	2004	2004	2006	
Monaco	1992	1994	1998	2006	1994	1997	2001	2006	
Mediterranean Balkan Countries									
Croatia*	1992	1996	1999	2007	2002	2007	2007	2007	2010
Bosnia and Herzegovina	-	2000	-	2007					
Montenegro	-	2007	-	2007					
Albania	-	1995	-	2005	2002	2009			
Turkey**	-	2004	-	2009	2007				
Middle East									
Syria	-	1996	-	2006					
Lebanon	1992	1995	-	2007	1999				
Israel	1992	1996	1998	2005	2000				
Mediterranean North African Countries									
Egypt	1992	1995	1999	2005	1999				
Libya	1992	1999	-	2006					
Tunisia	1992	1994	-	2005	2001				
Algeria	1992	1994	-	2005	2001				
Morocco	1992	1996	-	2005	2001				

* Declaration: "The Republic of Croatia declares that it intends to be bound by the provisions of the Annex I, as a country undergoing the process of transition to a market economy."

** Turkey is an Annex I country with Special Considerations

Annex I countries appear without shading while those whose status is Annex II are shaded in Turquoise

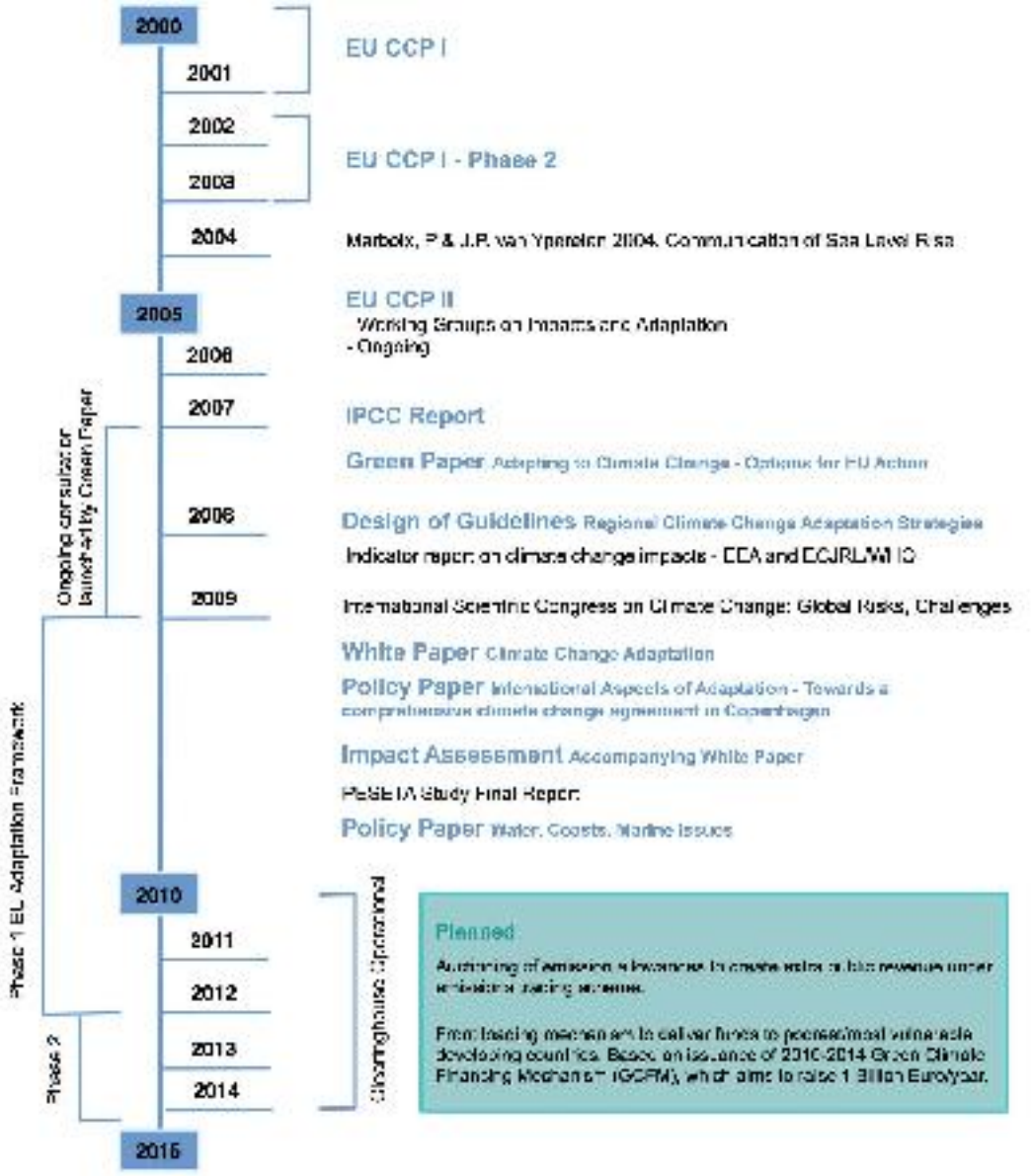

Figure 24: Chronology of initiatives relevant to climate change adaptation at an EU level since 2000

At a sub-regional level, seven Mediterranean countries belong to the EU (Cyprus, France, Greece, Italy, Malta, Slovenia and Spain) with a further two (Croatia and Turkey) currently under consideration for admission. As members of the EU, countries are also impacted by a range of policies relating to the environment and, more recently, climate change.

Over the last few years, the EU has made significant progress in incorporating climate change adaptation in development policy and programmes and has taken action to integrate climate change adaptation into development co-operation with the adoption of the EU Action Plan on Climate Change and Development (2004 to 2008) - see Figure 24 above. The aim of the Action Plan was to assist “EU Partner countries” (including the remaining MAP CPs who are not members of the EU) meet the challenges posed by climate change through supporting them to implement the UNFCCC and the Kyoto Protocol.

The General Affairs and External Relations Council adopted the Action Plan in November 2004. In 2007, a review of the progress of the Action Plan concluded that the European Union (EU) donors had not yet adequately addressed integrating climate change systematically in the context of development co-operation and that enhanced efforts were necessary to make progress in this area. With the launch in 2007 of the Global Climate Change Alliance (GCCA) the European Commission renewed its commitment to integrate climate change into its co-operation programmes with developing countries. The implementation of the Action Plan has been given new impetus by the creation of the GCCA of which it forms a core element.

Since the IPCC 4AR publication in 2007, the European Commission (EC) has adopted a more co-ordinated approach on adaptation policy development and has published a White Paper on adaptation to climate change to define the policy direction of the EC in the forthcoming years. The EC is currently working on the design of an Adaptation Framework to reduce the EU's vulnerability to the impacts of climate change. This framework will complement and strengthen the actions taken by the EU Member States. The White Paper states that climate change adaptation will be integrated into all EU policies, and clearly reflected in its foreign policy in the future. This has important implications, both for the nine MAP CPs under consideration in the current review and the remainder of MAP CPs who wish to co-operate and co-ordinate their environmental management and subsequent development within the region.

In many EU member countries adaptation measures are either planned or taking place at a National level. Those that have been identified are discussed further from a National Perspective below. However, in its recent 5th national communication to the UNFCCC the EU recognised that an increased effort is required to reduce the vulnerability of different regions of the EU and mainstream adaptation in EC policies. Several projects and programmes are currently underway to support this process and are discussed further in Section 5.3 below.

While several other regional alliances exist between groups of MAP CPs with common issues, overriding objectives and geographies these are not accompanied by supporting policy or strategies to deal with adaptation to climate change at present and are thus not considered further in this review of existing initiatives in the region.

5.2. National Adaptation Plans and Strategies

At the time of production of this report, only three of the MAP CPs had adopted national adaptation plans or strategies (Spain, France and Tunisia) and are discussed further here. While it is recognised that several CPs may be in the process of formulating their National Adaptation Strategies (NAS), a review of “pipeline” activities was beyond the scope of this strategic, desktop study.

Spain: National Plan for Adaptation to Climate Change (2006)

A National Climate Change Adaptation Plan was approved in Spain in 2006. The plan provides a reference framework for the co-ordination of government activities on impact assessment, vulnerability and adaptation at a range of scales. While the overall framework itself is strategic and thus “top-down” in nature, it advocates a participatory approach to adaptation through a decentralised and “bottom-up” approach. It supports the generation of data, tools and information relevant to the development of impact assessments. The Oficina Española de Cambio Climático (OECC) is responsible for implementation of the plan, which also stresses the importance of synergies with other environmental issues and standard

planning instruments at a national level. In this respect, the integration of discrete climate change polices into existing public policies as a whole, is considered essential.

France: National Strategy for Adaptation to Climate Change (2006)

France's national adaptation strategy was developed through widespread consultation, conducted by the National Observatory on the effects of global warming (Observatoire National sur les effects du réchauffement climatique - ONERC). The strategy, validated by the Inter-ministerial Committee for Sustainable Development in November 2006, addresses four key areas:

- Security and public health;
- Social aspects: unequal exposure to risk;
- Cost minimisation; and
- Preservation of natural heritage.

Some courses of action are proposed as prerequisites for the future development of a national plan for adaptation, which aim to identify a group of specific measures to be decided at different levels.

Tunisia: National Strategy for the adaptation of Tunisian agriculture and ecosystems to climate change (2007)

Tunisia, assisted by the GTZ (German Gesellschaft für Technische Zusammenarbeit), has established a national strategy for adaptation to climate change that is specific to the agricultural sector and integrates concern for ecosystems. Production of the strategy, in conjunction with production of the initial communication of Tunisia to UNFCCC, has provided Tunisian ministries with an in-depth report on the regional implications of climate change.

The strategy was formulated in consultation with all sectors and a wide range of institutions. This process also helped to raise awareness of the fact that the problems facing agriculture cannot be solved in this sector alone. Rather, their resolution requires a broader approach incorporating the issues of other sectors and stakeholders. The resultant adaptation strategy offers detailed guidelines and concrete measures to the institutions involved, on the way in which adaptation must be considered and implemented. It is intended that the approach adopted towards the agriculture sector will be applied to health, coastal protection and tourism sectors.

5.3. Regional/Sub-Regional Projects and Programmes

A summary of the Projects and Programmes relating to coastal climate change in the Mediterranean is presented in Table 13. In addition, a number of these initiatives are discussed briefly in the Sections that follow. Overall, at a regional level, few of the research programmes assessing the implications of potential climate change impacts or support of adaptation planning are coastal or Mediterranean specific. Consequently the information provided here gives a brief summary of relevant EU activities and outlines a relevant set of coastal projects (BEACHMED, BEACHMED e and BEACHMED 3):

In 2004, the European Commission initiated the development of a European action programme on flood risk management, including a possible future Floods Directive. In this context, climate change has been mentioned as a key issue. Then, in October 2005, the Commission launched the second phase of the European Climate Change Programme. This programme is primarily aimed at identifying additional measures to reduce greenhouse gas

emissions in order to achieve the Kyoto Protocol targets. Here, for the first time, it was agreed to address adaptation issues.

New research programmes and reports by the European Environment Agency (EEA), the EC Joint Research Centre (JRC-IES) and EC funded projects from the Framework Programme for Research have provided new evidence that climate change will have significant implications across Europe and beyond[13]. A number of new research programmes are being funded to improve understanding of adaptation. The EC is in the process of setting up a long-term sustainable system for observing the planet through the Global Monitoring for Environment and Security initiative[14] and the European Marine Observation and Data Network[15].

The EU has proposed that a Clearing House Mechanism be established as a platform for discussion on the impacts of climate change and best practices by 2011. This clearing house will be a forum for up-to-date and state-of-the-art information - an information technology (IT) tool and database on climate change impact, vulnerability and best practices on adaptation.

5.3.1. EU Project Examples

Several projects have been funded by the EC to identify and assess the bio-physical impacts of climate change. Some of these projects focus on the impacts of climate change on specific environmental components (such as water) and processes, while others aim to assess the impacts on specific regions. Part of these projects also includes an analysis of the socio-economic consequences and implications of climate change. A sample of relevant EC projects on the impacts of climate change from a Mediterranean coastal perspective is provided below.

EPOCA http://epoca-project.eu

With a budget of €9.7 million (€6.5 million from FP7), the project called European Project on Ocean Acidification (EPOCA), which started in May 2008 and will last until April 2012, aims to fill gaps in understanding of the effects and implications of ocean acidification, which is both a consequence and an indicator of climate change. In particular, this project aims to document the changes in ocean chemistry and biogeography across space and time and determine the sensitivity of marine organisms, communities and ecosystems to ocean acidification.

[13] For more information on the past and current activities of the Joint Research Centre (JRC) see: http://ccu.jrc.ec.europa.eu/home.php#. For more information on the support provided by JRC to EU climate change policy see: http://ccu.jrc.ec.europa.eu/doc/2287_07- EUR21855en.pdf. For more information on the European Research Framework Programme see: http://ec.europa.eu/research/environment/pdf/cop-15.pdf. Details can be found at http://cordis.europa.eu/fp6/dc/index.cfm?fuseaction=UserSite.FP6HomePage for projects funded under the 6th Framework Programme and http://cordis.europa.eu/fp7/ for projects funded under the 7th Framework Programme.

[14] Global Monitoring for Environment and Security (GMES): we care for a safer planet, Brussels, 12.11.2008, COM(2008) 748 final.

[15] Building a European marine knowledge infrastructure: Roadmap for a European Marine Observation and Data Network, SEC (2009) 499 (final), 4th April 2009.

Table 13: Example of coastal V&A projects and programmes in the Mediterranean region

Title	Area	Timeframe	Focus	Funder	Comments
PESETA - Projections of Economic Impacts of Climate Change in Sectors of Europe Based on Bottom-up Analysis	Regional	2006-2007	Cross Sectoral	EC's Joint Research Centre (JRC)	Impacts of climate change on coastal systems, energy demand, human health, agriculture, tourism, and floods, and costs of climate change, based on bottom-up or sectoral physical assessments, given the state-of-the-art of today's methods and knowledge on the physical impacts of climate change Web site: http://peseta.jrc.es/index.htm
CIRCE: Climate Change and Impact Research: the Mediterranean Environment	Regional	April 2007 to March 2011	Cross Sectoral; Case studies in coastal zones of Algeria, Spain, Egypt and Tunisia (see below for details)	CIRCE funded by Commission of the European Union (Contract No 036961 GOCE)	Focus of research: climate change and climate change impacts in the Mediterranean area Aim: to develop for the first time an assessment of the climate change impacts in the Mediterranean area. In particular: · to predict and to quantify physical impacts of climate change in the Mediterranean area; · to evaluate the consequences of climate change for the society and the economy of the populations located in the Mediterranean area; · to develop an integrated approach to understand combined effects of climate change; · to identify adaptation and mitigation strategies in collaboration with regional stakeholders. Leader Institution: INGV, Italy, Web site: http://www.circeproject.eu/
CIRCE coastal case study – Gulf of Valencia	Spain		Coastal area; biodiversity – sensitive marine ecosystem	CIRCE funded by Commission of the European Union (Contract No 036961 GOCE)	Within the Gulf of Valencia (Spain), the Ebro Delta and Cullera Bay are presented as examples of coastal features subject to a range of environmental pressures and vulnerable to the impacts of climate change.

Title	Area	Timeframe	Focus	Funder	Comments
CIRCE coastal case study: The Gulf of Gabes	Tunisia		Coastal area; biodiversity – sensitive marine ecosystem	CIRCE funded by Commission of the European Union (Contract No 036961 GOCE)	The Gulf has extensive marine habitats and is highly biologically productive; as a consequence it is home to a fishing industry of national importance. However, the marine ecosystem faces threats on two fronts: industrial discharge, and atmospheric warming resulting in raised seawater temperatures and changes in circulation. The region is primed for rapid expansion in tourism activities, but the low-lying coastline and islands are extremely vulnerable to coastal erosion and inundation from even a moderate rise in sea level.
CIRCE coastal case study: The Gulf of Oran	Algeria	2008-	Coastal area; biodiversity – sensitive marine ecosystem	CIRCE funded by Commission of the European Union (Contract No 036961 GOCE)	Key research issues related to climate change include accelerated coastal zone degradation and marine system modification, and the availability and quality of water resources http://www.circeproject.eu/
CIRCLE: Climate Impact Research Co-ordination for a Larger Europe	Regional	October 2005 to September 2009	Cross Sectoral	Most projects financed by the European Framework Programme(s) (FP4/5/6 and now FP7), some by other funding mechanisms like for e.g. INTERREG	Co-ordination and co-operation of research activities carried out at national or regional level. Focus of research: national programmes and initiatives on climate change impacts assessment, vulnerability, adaptation Aim: to co-ordinate European research on climate change impact assessment and adaptation to facilitate the research needed by European and national decision makers to design effective yet economically efficient and feasible adaptation strategies. Web site: http://www.circle-era.net

Title	Area	Timeframe	Focus	Funder	Comments
CANTICO: Climate and local ANthropogenic drivers and impacts for the Tunisian Coastal area	Tunisia	2008-2010	Coastal Zone		Aim: To develop a pilot study to establish a conceptual model tool to integrate the complex interaction of climate and anthropogenic impacts on vulnerable Mediterranean coastal areas; Downscaling for the Gulf of Gabes.
CLIMBIOMEDNET Scientific assessment of Climate Change effects on lagoons ecosystem in comparison with man-induced changes	Med. Region	2008-2010	Ecosystems	MEEDDM CII Galicia	This project involves 5 partners, three from contributing countries, i.e. Italy, France and Spain (Galicia), and two from other Mediterranean countries that will be considered as subcontractors, i.e. Albania and Tunisia, respectively from Italy and France. The duration of the project is of 24 months.
The impact of climate change on Mediterranean intertidal communities: losses in coastal ecosystem integrity and services	Italy, Croatia, Malta, Israel	2008-2010	Ecosystems	IMEP IMELS	Scientific assessment of impacts of Climate Change on coastal ecosystem and socio-economic consequences.
Participatory design of adaptive groundwater management strategies and instruments in Mediterranean coastal water scarce areas as a response to climate change	Morocco, Portugal, France	2008-2010	Coastal water resources and livelihoods	FCT MEEDDM	Develop capacity building methods for water users to define and discuss possible strategies of adaptation to future changes including climate change; Support definition of ground water management strategies and practices through improved participation of irrigation farmers.
Climate change impacts in transitional water systems in the Mediterranean	Morocco, France, Spain	2008-2010	Coastal Ecosystems	MEEDDM IMELS	Scientific assessment of coastal ecosystems vulnerability to climate and anthropogenic modifications. Explore adaptation measures.
Inter ministerial working group for assessing impacts, adaptation and associated costs	France	2007-	Multi-sectoral	MEEDDM, with the aid of various ministerial departments (MAAP, Health, DIACT)	Impacts have been assessed by comparing climate models at horizons 2030, 2050 and 2100 (created by Météo-France and the Institut Pierre Simon Laplace).

Title	Area	Timeframe	Focus	Funder	Comments
Venice Safeguard Project	Italy	1984 - ?	Coastal areas, infrastructure	Multiples	Multiples
The Strategic Programme for Sustainable Development and Climate Change (Programma strategico “Sviluppo Sostenibile e Cambiamenti Climatici”)	Italy	2006-	Multi-sectoral	Funded through the FISR by the MATTM, MUR and MIPAAF.	Vulnerability assessment research includes coastal areas and marine ecosystems. The managing organisation of the National Programme is the MUR.
VECTOR: Vulnerabilities of Italian coastal areas and marine ecosystems and their role in the oceanic organic carbon cycles	Italy	2006 - 2009	Coastal areas; tourism, agriculture & fisheries	FISR - Fondo Integrativo Speciale per la Ricerca	Possible future impacts scenarios for Italian coasts Key considerations: Changes in the length of coastal areas, morphology of emerged beaches, the structure of the water column, long-shore transport, transport of aerosols from the sea to the coastal areas, and the relative impacts on structures and settlements areas on freshwater layer of coastal plains.
Euro-Mediterranean Centre for Climate Change (CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici)	Italy	2005 - onward	Cross Sectoral	Funded through the FISR by the MATTM, MUR and MIPAAF	The research activities developed by the CMCC divisions follow the following lines: - technologies, grid applications and operations; - evaluation and diagnostics of the impacts of climate change on agriculture; - numerical applications; - models and socio-economic scenarios; - impact evaluation and diagnostics; - special projects. Web site: http://www.cmcc.it

Title	Area	Timeframe	Focus	Funder	Comments
Sustainability of terrestrial and aquatic systems (Sostenibilità dei sistemi terrestri e acquatici)	Italy	2006 to 2008	Environmental Systems – Coastal zone sustainable management	Department Earth and Environment (Dipartimento Terra e Ambiente) of the CNR	Aim: to define the functioning of environmental systems and their responses to human activities, in order to set up methods and standards allowing a sustainable management. Research lines including climate change issues are (3 of 8): - inner water sustainable management; - environmental modelling for sustainability; - coastal zone sustainable management. Status of Research: set up of innovative instruments for a sustainable use of marine resources and of databases for the hydrologic balance in Mediterranean environment. http://www.cnr.it/commesse/dipartimenti-progetti/1/TA-P04.html
Valuing the costs of climate change in Italy: the case of Sangro, Abruzzo (Valutazione dei costi dei cambiamenti climatici in Italia: il caso di Sangro, Abruzzo)	Italy	May 2005 to May 2006	Coastal Zone	ENEA	Case study to test methodological approach for climate change cost assessment and climate change control policies in the Italian costal area, the Sangro area, located in the Abruzzo Region. Status of Research: completed Web site: currently not available. Information is available at: http://www.feem.it/Feem/Pub/Programmes/Climate+Change/Activities/200601- ENEA.htm
National Observatory of Athens (NOA) Atmospheric Chemistry and Climate Change Modelling (http://www.meteo.noa.gr)	Greece	2010	All Sectors	UNFCCC	Future CC predictions and vulnerability and adaptation measures discussed for the coastal zone under headings of Sea Level Rise; Ecosystems, water availability and erosion and flooding.

Title	Area	Timeframe	Focus	Funder	Comments
					Ministry of Environment, Energy and Climate Change has planned, in the context of the National Strategic Reference Framework for the period 2007-2013, the following projects to be implemented: • Study of the vulnerability of the Greek coastal areas & proposals of appropriate adaptation policies and measures. • Study of the impacts of climate change per geographical prefecture.
Climate Change and the Mediterranean: Environmental & socio-economic Impacts of Climate Change and Sea-level Rise in the Mediterranean Region	Croatia	1990-1996	Coastal areas and infrastructure	UNEP	Croatian Adriatic coast two pilot-projects for the Islands Cres and Losinj (North Adriatic) and for the Kastela Bay (Middle Dalmatia).
Adaptation of the Nile Delta to climate change through integrated coastal zone management	Egypt	Sept 2009 - June 2014 (5 years)	Coastal areas, all sectors	UNDP-GEF	Ministry of Water Resources and Irrigation
Vulnerability and adaptation project for the Maghreb region	Sub Regional - Maghreb Region (Algeria, Morocco, Tunisia)	Proposed 3 year project		UNDP; GEF Medium size project <750k	Targeted 3-year vulnerability and adaptation project for the Maghreb region. The end-of-project situation will be an enhanced capability to implement adaptation strategies in the Maghreb region through institutional capacity strengthening, development of national adaptation plans, project portfolio and pilot project development and the deepening of public awareness of the risks of climate change

Title	Area	Timeframe	Focus	Funder	Comments
Non Annex 1; INC 2001 Initial Communication was prepared simultaneously within the framework of two Global Environment Facility projects: the capacity building regional project (RAB/94/G31) and the enabling activities national project (MOR/99/G32)	Morocco	2001	Multiple Sectors – focus on water and agriculture with reference to coastal zone	GEF	The first diagnosis of Morocco's vulnerability to the CC impacts highlighted a dozen adaptation projects in the sectors of water and agriculture as well as seven accompaniment projects. Research project will develop capacity for, and contribute to, policy and decision-making for strategic coastal land-use planning and management, to reduce the vulnerability of coastal communities to the impacts of sea level rise, coastal flooding, and related extreme weather events. The project will advance the science and technology that underpin preparations for, and responses to climate -related events, and contribute to the information systems that guide policies of public protection.

CIRCE http://www.circeproject.eu

As mentioned above, a number of projects focus on the impacts of climate change on specific areas. For instance, with a budget of almost €13.7 million (€10 million from FP6), the project called *Climate change and impact research: the Mediterranean environment* (CIRCE), which started in April 2007 and will last until March 2011, aims to understand how climate will change in the Mediterranean area and to assess the resulting impacts. In particular, the main objectives of the project are to:

- Predict and to quantify physical impacts of climate change in the Mediterranean area;
- Evaluate the consequences of climate change for the society and the economy of the populations located in the Mediterranean area;
- Develop an integrated approach to understand combined effects of climate change; and
- Identify adaptation and mitigation strategies in collaboration with regional stakeholders.

Among the projects that aim to assess the economic impacts of climate change, an interesting example is **CLIMATECOST**. With a budget of €4.6 million (€3.5 million from FP7), this project, which started in January 2009 and will last until August 2011, aims to assess the full economic costs of climate change. In particular, the project aims to:

- Identify and develop consistent climate change and socio-economic scenarios, including mitigation scenarios;
- Quantify (both from a physical and economic perspective) the costs of inaction for these scenarios;
- Update the cost figures for GHG emission reductions under medium and long-term reduction targets and/or stabilisation goals; and
- Quantify (both in physical and monetary terms) the ancillary air quality benefits of GHG emission reduction measures, in Europe as well as in other regions.

A number of projects deal with the impacts of climate change on specific sectors of the economy. **EDEN**, which integrated research between forty-two leading institutes from twenty-three countries, was organised into a series of vertical sub-projects linked by a series of integrative activities, including:

- Biodiversity monitoring;
- Environmental change detection;
- Disease modelling;
- Remote sensing and image interpretation; and

- Information and communication.

A last project to mention is the **"Study on the economics of climate change adaptation in EU coastal areas" (May 2009)**, which was recently conducted by the Commission in the framework of the series of "Socio-economic studies in the field of Maritime Affairs". The study provides insights into the state-of-play and financial dimension of the actions, plans and policies undertaken to prepare Europe's coastal zones as well as the outermost regions for the effects of climate change.

Furthermore, this study compares the different climate change adaptation aspects from an empirical perspective with results drawn from dedicated scientific literature. The study includes 23 specific reports for each of the 22 coastal Member States and the Outermost Regions. A comprehensive compilation of documentation on climate change adaptation in coastal and marine areas can be found in a CIRCA library, including specific information for each coastal Member State and the Outermost Regions.

The **CIRCLE-ERANET** provides climate impact analysis by networking and aligning national research programmes in 19 European countries, with the final aim to implement a European Research Area in the field of climate change. Co-ordination and co-operation of research activities carried out at national or regional level is the key aim of the initiative. The overall focus of research is on national programmes and initiatives on climate change impacts assessment, vulnerability, and adaptation. Of key relevance to the MAP Contracting Parties are the range of CIRCLEMED initiatives being undertaken in the region (the relevant coastal elements that apply to CPs are summarised in Table 8).

EU Programmes relevant to Mediterranean Countries (not included in EU)

Instrument for Pre-Accession (IPA)

The IPA contributes funding to the working group on climate change of the Regional Environmental Network for Accession countries (RENA), to be launched in 2010. RENA is aimed at Albania, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Kosovo and Turkey with an EC contribution of €5,900,000 from 2010-2012. Its objective is to enhance regional co-operation in the Western Balkans and Turkey in the field of environment in the prospect of accession to the European Union. RENA will build on the results achieved so far by the Regional Environmental Reconstruction Programme (REReP), which ended in 2009. One of the Working Groups will focus on capacity building, information exchange and *ad hoc* assistance in relation to the implementation by RENA beneficiaries of EU requirements on Climate Change.

Southern and Eastern Neighbours Instrument

The European Neighbourhood and Partnership Instrument (ENPI) has been operational since 1st January 2007. The ENPI is the main source of funding for the 17 partner countries[16]. The ENPI replaces the co-operation programmes TACIS for the Eastern EuropeanNeighbours and MEDA for the Mediterranean Partner Countries. The ENPI provides continuity with enlarged objectives of the former TACIS and MEDA programmes. The main purpose is to create an area of shared values, stability and prosperity, enhanced co-operation and deeper economic and regional integration by covering a wide range of co-

[16] Algeria, Armenia, Azerbaijan, Belarus, Egypt, Georgia, Israel, Jordan, Lebanon, Libya, Moldova, Morocco, Occupied Palestinian Territory, Russia, Syria, Tunisia and the Ukraine.

operation areas. For the period between 2004 and 2007, €120 million were allocated to climate change related activities, with a focus on the energy sector.

BEACHMED Initiative

The **BEACHMED** project (Interreg IIIB - Medocc) was officially launched in July 2005 and ended in June 2008. Its total budget of €7,668,366.50, was partly financed by FEDER (54%), and partly co-financed (46%) by project partners. The main aim of BEACHMED was to investigate sand sources in the region with a view to combating problems of coastal erosion.

A subsequent **BEACHMED-e** Project, a Regional Framework Operation between Italy, Spain, France and Greece based on the criteria fixed by the INTERREG IIIC Programme, built on the outcomes of the BEACHMED project. It aimed to build more focused research on issues that were previously considered from a strategic perspective. In this respect, results are potentially useful over the entire European territories. The main objective of the project was to improve technical and administrative tools for strategic management of coastal defence, in order to achieve sustainable development of the Mediterranean coastal zones.

An important outcome of this work was the development of organisation structures capable of managing these issues at a European level. Within the European coastal zones policy (Note of the European Commission to the Council and to the European Parliament on the integrated management of coastal zones: a strategy for Europe - COM/2000/547), attention has been focused on the need to use integrated planning models that take into account the many problematic factors within this territory. An overview of BEACHMED-e is presented in Table 14.

BEACHMED-3 represents a new operative step forward of the "BOLOGNA CHARTER", which was adopted during the 5th Steering Committee and Conference of the Beachmed-e Regional Framework Operation (www.beachmed.eu).The focus of this emerging project, still in its infancy, is coastal zone protection and adaptation to climate change in the Mediterranean Basin. A "First General Agreement" (FGA) ratified the shared principles concerning Mediterranean coastal erosion and other risks, due to climate change effects. The specific relevance of this proposed project to a consideration of climate change activities in the region from a MAP prospective is that it applies to the European Union as well as to all the countries involved in the Union for the Mediterranean.

Table 14: Overview of BEACHMED-e

Phenomena linked to development	Vulnerabilities on the coastal zones	Active types of actions	Passive types of actions
CO2 increase	Increase of medium sea level Meteo-marine event of major intensity	(NOT CONSIDERED IN BEACHMED-E)	Increase of coastal areas due to sand nourishment
Diminished contribution of the rivers transport load	Coastal erosion Deepening of sea bottom denaturalisation along the coastline	Total or partial restoration of natural load transportation	Total or partial restoration of natural solid load transportation
Breaking down of natural defence structures	Sea bottom erosion Denaturalisation of sea bottom along the coastline	Reconstruction of dune zones and of sea-grass prairies	Protection measures for dune zones and sea-grass prairies
Construction of	Coastal erosion	Design with special attention to	Coastal protection by means of soft

coastal infrastructures	Denaturalisation of the coastal sea bottom along the coastline	the erosive phenomenon artificially introduced	and protected nourishment Re-use of intersected sandy material

5.4. National Project & Programme Examples

Albania: Identification and implementation of adaptation measures for the Drini-Mati deltas (UNDP-GEF) http://www.undp.org.al/index.php?page=projects/project&id=177

The deltas of the Drini and Mati rivers on the Adriatic Sea have a biodiversity that may be significantly degraded by climate change. The project aims to develop and implement strategies to moderate, cope with, and make the most of the impacts of climate change, by increasing the adaptive capacity and resilience of ecosystems and local communities.

To achieve this goal, the project will develop community and institutional capacities to document and respond to climate change impacts in the river deltas (Figure 25). A supporting objective will aim to integrate the management of climate change into local development policies. Finally, this project will seek to promote learning by experience and also encourage adaptive forms of management and assessment.

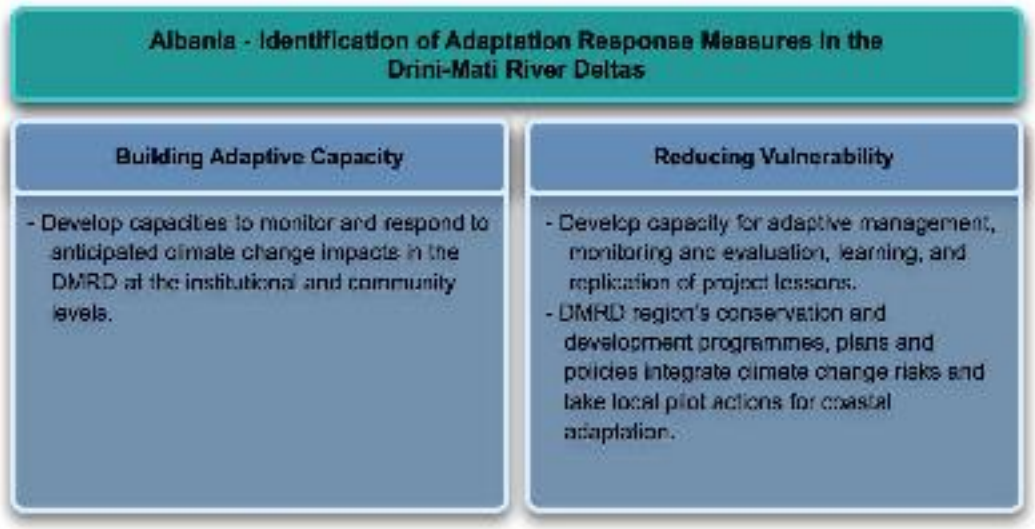

Figure 25: GEF funded Albanian V&A Project

Egypt: Adaptation of the Nile Delta to climate change through integrated coastal zone management (UNDP-GEF)http://gefonline.org/projectDetailsSQL.cfm?projID=3242

A large proportion of Egypt's infrastructure and economic activity is concentrated in the Nile Delta and its coastal zone. As a result, floods and salinity intrusion due to rising water levels will have a direct and crucial impact on the economy as a whole. Despite the measures implemented by the government, there are still many constraints to the effective implementation of integrated coastal zone management and adaptation to the rise of sea level. The project aims to improve Egypt's resilience and reduce its vulnerability to climate change (Figure 26). To do this, the objective is to integrate the management of risks associated with rising sea levels into the development policies of the Nile Delta.

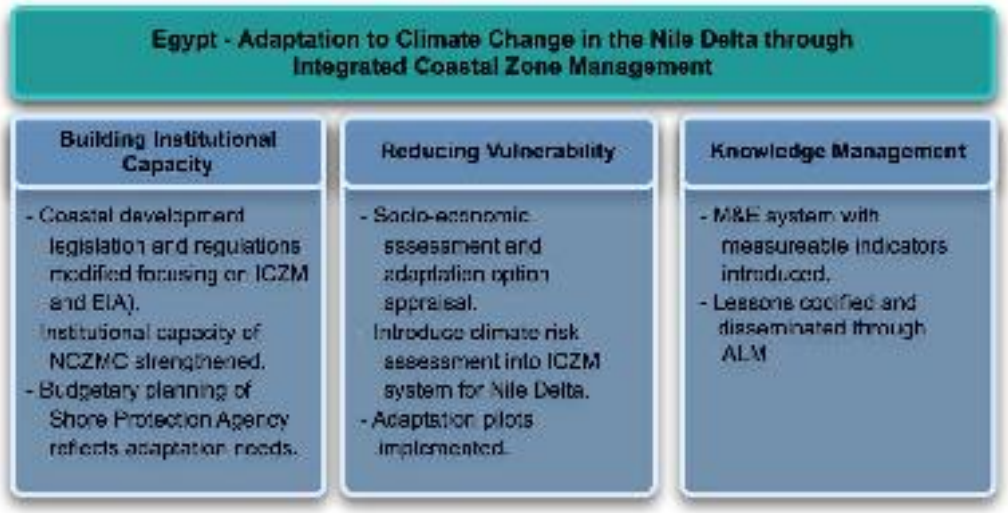

Figure 26: GEF funded Nile Delta Project

Italy: VECTOR Vulnerabilities of Italian coastal areas and marine ecosystems and their role in the oceanic organic carbon cycles

Coastal areas; tourism, agriculture & fisheries: This project ran from 2006-2009 and was concerned with future impact scenarios for Italian coasts and was organised into a series of discrete Working Groups (WGs) (Figure 27). Key considerations were:

- Changes in the length coastal areas;
- Morphology of emerged beaches;
- The structure of the water column;
- Long-shore transport;
- Transport of aerosols from the sea to the coastal areas; and
- The relative impacts on structures and settlements areas on freshwater layer of coastal plains.

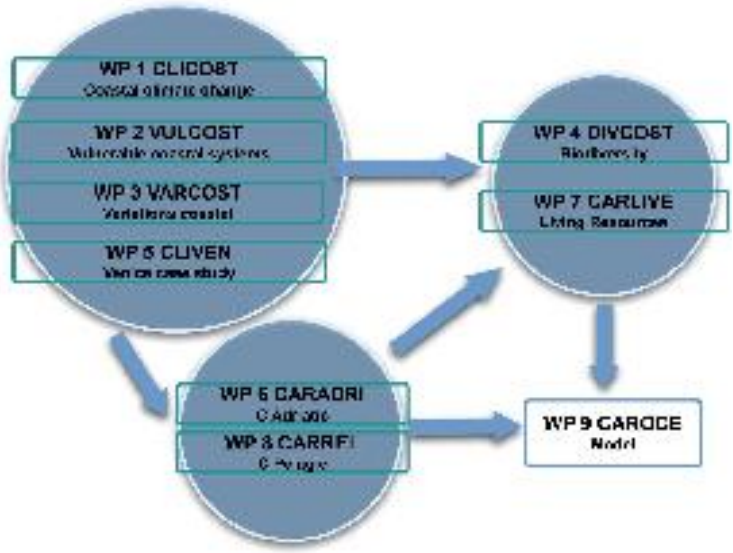

Figure 27: Italy VECTOR Project Working Groups

At a more localised level the following projects have also been identified within CPs under consideration:

Venice: Protection of the lagoon against the rise in water level www.salve.it

The lagoon and the city of Venice are highly vulnerable to rising water levels. In response to the increased frequency of floods, the Consorzio Venezia Nuova launched an intervention plan in 1984 to defend Venice against high tides and storms and restore the lagoon's structure, and the quality of the water and sediment. The construction of the main protection facility, a set of three mobile barriers to block the high waters outside the lagoon, began in 2003 and should be completed in 2014. The plan also includes a programme of street elevation, coastal protection infrastructure, and an urban maintenance programme.

CIRCE coastal case studies http://www.circeproject.eu

The main objectives of CIRCE are to predict and to quantify the physical impacts of climate change in the Mediterranean, and to assess the most influential consequences for the population of the region. All the knowledge, data and modelling provided by the CIRCE research need to be integrated with studies of climate change impacts and their combined effects. The best way to examine if the CIRCE assessment is compatible with the real world is considering specific regional case studies. Focusing on three selected categories (urban, rural and coastal), the case studies represent a practical method to test adaptation and mitigation strategies. The case-study areas include North African, Middle Eastern and European locations. A brief overview of the coastal case studies relevant to the current review is provided here:

Gulf of Valencia (Spain)

- affected by subsistence;
- coastal regression due to reduction of riverine sediment inputs and changes in storminess;
- progressive salinisation of the River Ebro;
- high pressure of use from tourism, agriculture and aquaculture ;
- specific areas of concern include Cullera Bay, which is suffering particularly from high freshwater inputs of fertilizers and pesticides and untreated effluent from a shallow marine outfall.

Gulf of Oran (Algeria)

- existence of three important harbours (Oran, Arzew and Mostaganem);
- increasing population and almost complete absence of treatment of domestic and industrial effluent;
- existence in Arzew of the biggest petrochemical complex in Africa constituting a major risk of marine and atmospheric pollution;
- phytoplankton growth restricted by large quantities of nutrients transported by the Cheliff and Macta rivers.

Gulf of Gabes (Tunisia)

- the most pronounced annual cycle of water temperature in the Mediterranean, along with the highest tidal range (1.8 m);
- recent indications of ecosystem changes, e.g. appearance of new species of shrimps and successive Sirocco episodes in recent summers causing red coloured waters;

- toxic industrial discharges, although phosphate discharges from the chemical industry are decreasing;
- economically valuable nursery and fishing area, e.g. for Crevette Royal;
- several fragile salt lakes or Sebkhats, the lagoon of Boughrara and a number of very low-lying islands, including the tourist destination of Djerba.

Western Nile Delta (Egypt)

- recent large-scale unplanned developments and poor awareness of environmental issues;
- direct inundation due to sea level rise, salt water intrusion, and waterlogging;
- coastal erosion rates currently exceeding 50 meters per year in some areas;
- concerns over water resources, agricultural resources, health and economic effects of pollution.

5.5. Summary of Adaptation Activities in the Region

Consideration of the range of projects in the region provides an overview of the diversity of issues that require attention. For example, future climate change, current climate variability, but also other environmental stresses (deterioration of biodiversity) and human stresses (unsustainable paths of development) (IDDRI, 2009). A wide range of projects and programmes have been launched in the Mediterranean, but interestingly, these initiatives are not all conducted on the same basis; sectoral, intersectoral and territorial actions are carried out.

The information gained in the review of adaptation activity in the region has been used to infer a level of adaptation maturity associated with each of the MAP CPs under consideration for the purposes of the current report. That is, the level of adaptation action currently underway for each CP in terms of plans, strategies, projects and programmes was considered as a surrogate for “current capacity”. A further level of information used to inform this exercise was an appraisal of the coastal-specific legislative maturity within each CP. This was carried out due to the fact that, in the absence of discrete climate change adaptation strategies and protocols, the key instruments to enable adaptation will be these legal frameworks.

A summary of adaptation activities in the Region is presented in Table 15 that follows.

Table 15: Summary of Adaptation Activities per country and inferred Adaptation Maturity

	Global	Regional	National			KEY REGIONAL PROJECTS						Other Projects and Programmes			
Country	UNFCCC NC	EU	Coastal Specific Legal Framework	Specific Coastal Law	NAS	Beach Med	Beach Med e	Beach Med 3	CIRCE	CIRCLE MED	PESETA	Regional	National	Sub-national	Local
EU Countries															
Spain	5	x	x	x	x		x	x	x	o,p	x				
France	5	x	x	x	x	x	x	x	p	x,p	x		1		
Italy	4	x	x			x	x	x	p	x,p	x	1	2		2
Malta	1	x	x	x				x		o,p	x				
Greece	5	x	x	x	x	x	x	x	p	x	x		1		
Cyprus	0	x	x					x			x				
Monaco		x	x	x				x							
Slovenia	4	x	x					x			x				
Mediterranean Balkan Countries															
Croatia	5				x			x		p	x				2
Bosnia and Herzegovina	0							x							
Montenegro	0							x							
Albania	2							x						1	
Middle East															
Syria	0							x	p						
Lebanon	1			x				x							
Israel	1				x			x	p	x					
Mediterranean North African Countries															
Egypt	1							x	x, p					1	
Libya	0			x				x							
Tunisia	1			x	x			x	x, p	p					
Algeria	1			x				x	x, p						
Morocco	1							x		p				1	
Turkey	1							x		o					

Key: NAS = National Adaptation Strategy; X = policy, plan or project is active in country;

From the table above it is clear that the Annex I EU countries have the most established adaptation "architecture" of all CPs under consideration. Conversely, the non-Annex I Mediterranean Balkan countries and Middle Eastern Mediterranean countries have a much lower number of projects, programmes, policies and strategies pertaining to climate change adaptation in the coastal zone. It is important to remember that the presence/absence of a project in a region cannot be directly translated into a measure of capacity. For example, Albania may only have one active project, but this project is extensive and is serving to build capacity both at regional and national levels. Rather, an appreciation of the existence of specific policy and programme initiatives in conjunction with their overriding aims and objectives has been used here to create the following groupings of countries in terms of their capacities to adapt to coastal climate change:

1. EU Annex I countries (France, Italy, Spain, Greece, Slovenia and Monaco*);
2. Annex 1 non EU countries (Croatia and Turkey);
3. Non Annex I EU countries (Malta and Cyprus);
4. Non EU Balkan countries(Bosnia and Herzegovina, Montenegro and Albania);
5. Middle East countries (Syria, Lebanon and Israel); and
6. North African countries (Egypt, Libya, Tunisia, Algeria and Morocco).

This information will be considered in subsequent sections of this report, in conjunction with an overview of "exposure" to climate change impacts to inform a preliminary, first pass prioritisation for the focus of subsequent adaptation initiatives within the Mediterranean region. The preliminary prioritisation is presented in Table 16 that follows. It is important to note that within these groupings there are subtleties in the categorisation due to (i) the countries UN status and reporting position; and (ii) current projects underway in a country. For example, Albania and Egypt have large-scale GEF projects underway, which enhance their adaptive capacity, despite their grouping with other countries that do not have such projects. Further, Syria for example is more vulnerable than Lebanon and Israel due to its narrow coastal zone backed by mountain ranges, which inhibit landward ecosystem migration and migration of agriculture activities. Despite these subtleties, an understanding of the range of adaptive capacities in the Mediterranean can support the development of recommendations for action.

Table 16: Categorisation of countries by level of vulnerability (incorporates a consideration of capacity to adapt and exposure to projected climate changes)

Prioritisation ID *	Grouping	Description
1	EU Annex 1 countries	These countries have developed national adaptation strategies and/or completed a number of National Communications. They possess a heightened understanding of their vulnerability to climate change. *While Monaco is not currently a member of the EU, its status in terms of vulnerability and capacity necessitate its inclusion in this group.
2	Annex 1 non EU countries	Croatia and Turkey are Annex 1 countries, but are assigned special considerations. They are also candidate countries of the EU, and are therefore aligning themselves to EU policies and strategies. Consequently, EU CCA developments, such as the EU policy of CCA, have relevance to these countries, in more of a way than other non-EU countries.
3	Non Annex 1 EU countries	These countries are highly sensitive to the projected impacts of climate change. While they are EU countries, their geographical nature disposes them to high impacts of climate change (they are small island nations). In addition, the countries have existing coastal management issues (such as erosion and water shortages) that are likely to be exacerbated by climate change. Finally, they are also very dependent upon tourism, which is likely to be highly affected by climate change.
4	Non EU Balkan countries	These countries have not completed an initial national communication. Therefore, the understanding of their vulnerability to the projected impacts of climate change is not as well understood as in other Mediterranean countries.
5	Middle East countries	Countries are grouped, but on the recognition that Syria has not completed a national communication.
6	North African	Whilst these countries are grouped together, Morocco is slightly less vulnerable to climate change because it has an active funded coastal adaptation project in the coastal zone and is also less physically susceptible to climate change due to geographic nature of the coast. Tunisia is very sensitive. All countries have issues of drought and desertification on top of all the other issues they have to deal with. The countries differ from European countries in that adaptation efforts are more development focused.

**Prioritisation is presented from highest adaptive capacity (1) to lowest adaptive capacity (6).*

6. Status of Global Adaptation Initiatives

An overview of the status of global adaptation initiatives is presented in this Section (Section 6.2). Before conducting this exercise, it was necessary to categorise the range of approaches, measures, options and actions currently employed to tackle climate change adaptation as a tool to evaluate the broad spectrum of activities being reviewed (Section 6.1). In addition, the principles of effective adaptation were outlined to supplement evaluation criteria.

An outcome of the global review was the selection of a number of "case-studies" to highlight the range of initiatives employed at a range of temporal and spatial scales dealing with a wide suite of issues and associated capacities to deal with them (Section 6.3). Experience from the "show-cased" studies is intended to demonstrate examples of good practice in coastal climate change adaptation for subsequent application in the Mediterranean region (Section 6.4).

6.1. Adaptation Project Overview

6.1.1. Theoretical Building Blocks

A study by the World Resources Institute, the International Institute for Sustainable Development and the Stockholm Environment Institute (McGray et al., 2007) captured the complexity of adaptation by representing adaptation as a continuum of activities. At one end, adaptation involves directly responding to the potential impacts of climate change; at the other end it involves addressing the underlying drivers of vulnerability. Following this framework, categories of adaptation approaches, measures and options were established for the purposes of the review exercise reported on here to support evaluation of a broad range of adaptation initiatives. Adaptation approach, measures and options are terms used to define the hierarchy of adaptation terminology (Figure 28). *Approach* refers to the overarching adaptation framework (i.e. ecosystem based), *measure* refers to the focus of the initiative, *option* refers to the category of adaptation action, while *action* refers to the activity undertaken to adapt.

The categories do not provide detail on a particular adaptation approach (i.e. ecosystem based approach) or adaptation measure (i.e. planned retreat). Rather, the categories enable the "objectives" of the adaptation approach, measure or action to be evaluated, in terms of whether they are focussed on reducing vulnerability (the development end of the adaptation continuum) or reducing impacts (the adaptation end of the continuum). This is important as it ensures that the objective of adaptation is at the forefront of the evaluation of international adaptation initiatives. This ensures a broad coverage of the range of adaptation approaches, measures and options as they align to vulnerability reduction or climate change impact reduction. These categories are not specific to adaptation in the coastal realm. The objective was to ensure a broad categorisation that enabled a variety of approaches that may be implemented in the coastal zone but are not necessarily specific to coastal adaptation. Definitions for each category of adaptation approach and measure are shown in Table 17.

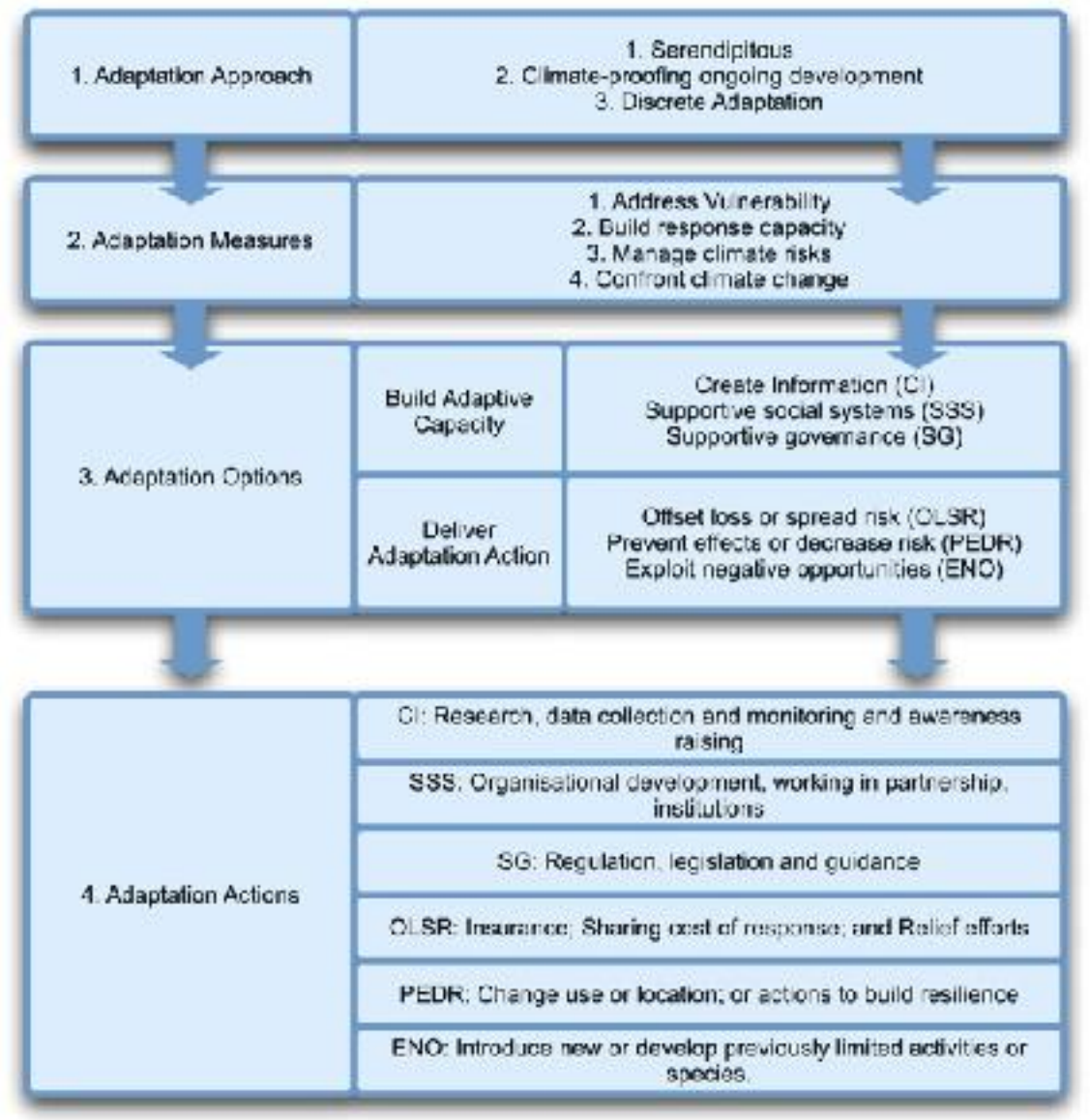

Figure 28: Hierarchy of adaptation terminology, incorporating example adaptation actions

Table 17: Adaptation terms and definitions (following McGray et al., 2007)

Term	Definition
Adaptation Approach	
Serendipitous Adaptation	Activities undertaken to achieve development objectives incidentally achieve adaptation objectives.
Climate-Proofing of Ongoing Development Efforts	Activities added to an ongoing development initiative to ensure its success under a changing climate - adaptation thus serves as means to achieve development ends.
Discrete Adaptation	Activities undertaken specifically to achieve climate adaptation objectives.
Adaptation Measure	
Addressing the Drivers of Vulnerability	At the development end of the spectrum, activities reduce poverty and address other fundamental shortages of capacity that make people vulnerable to harm. Very little attention to specific climate change impacts is paid during these interventions, although they help to buffer households and communities against climate trends or shocks.

Term	Definition
Building Response capacity	Adaptation activities focus on building robust systems for problem solving. These capacity-building efforts lay the foundation for more targeted actions, and overlap substantially with many institution-building and technological approaches familiar to the development community. Examples include the development of robust communications and planning processes, and the improvement of mapping, weather monitoring, and natural resource management practices.
Managing climate risk	Climate information is incorporated into decisions to reduce negative effects on resources and livelihoods, accommodating the fact that often the effects of hazards within the historic range of climate variability. Examples include disaster-response planning activities, drought-resistant crops, and efforts to "climate-proof" physical infrastructure.
Confronting climate change	Actions focus almost exclusively on addressing impacts associated with climate change, typically targeting climate risks that are clearly outside historic climate variability, and with little bearing on risks that stem from anything other than anthropogenic climate change. Examples include communities that relocate in response to sea-level rise.

However, it is important to understand, how coastal specific climate change adaptation options, align to this framework – so that when discussing coastal specific adaptation options, it is clear where these fit along the development-adaptation continuum. The USAID (2009) guidebook for coastal climate change adaptation outlines a range of adaptation options that can be undertaken to support different coastal management goals (Table 18). Hierarchy of adaptation terminology, incorporating example adaptation actions. The coastal management goals are aligned to the development-adaptation continuum (Figure 29). This provides guidance on the coastal specific adaptation options that align to the development-adaptation continuum. For example, Figure 29 indicates that coastal adaptation options that deliver functioning and healthy coastal ecosystems (i.e. marine protected areas and coastal wetland protection and restoration) contribute to increasing the adaptive capacity of a community and buffering climate change risks.

The adaptation options outlined herein are not specific to addressing climate change. They are measures currently applied in the field of coastal management. However, when the options are adopted with a climate change lens, they provide the opportunity to be strategic and proactive and thus achieve sustainable coastal development despite a changing climate. Additional adaptation actions that are not explicitly coastal specific, but which can be applied in the coastal zone to address the potential impacts of climate change, are shown in Table 19, aligned to each category of adaptation option. All categories of adaptation have been mapped along the continuum of adaptation and development, to demonstrate the alignment between initiative type and focus (Figure 29).

Table 18: Coastal adaptation options aligned to coastal management goals (USAID, 2009)

Adaptation options	Description
Functioning and Healthy Coastal Ecosystems as a Primary Goal	
Coastal wetland protection and restoration	Provides nursery habitats for fisheries, ecosystems services for communities and their livelihoods; serves as a natural water filter, buffer against coastal ecosystems. Climate change mitigation and adaptation measure.
Marine conservation agreements	Formal or informal agreements between parties to exchange benefits, take or refrain from certain actions, transfer certain rights and responsibilities in order to restore and protect fragile coastal and marine ecosystems.
Marine protect areas	Intertidal or sub-tidal terrain areas, their waters, flora, fauna, and cultural and historical features, of which part or all is protected. An overarching management

Adaptation options	Description
	approach or strategy that can be used to bundle a series of measures.
Payment for environmental services	Financial instruments under which beneficiaries of ecosystem services compensate the suppliers as a means to fund sustainable environmental management policies and actions. No-regrets against services option.
Built environment is less exposed as a primary goal	
Beach and dune nourishment	Process of adding sand to enlarge and enhance coastal beach and dune features as well as, in many cases, planting grasses and native vegetation. Level and rate of nourishment can be adjusted to adapt to rising sea levels.
Building standards	Delineate the minimum technical and safety requirements for the design and construction of residential and commercial structures as a means to promote occupant health, welfare and safety. Can be prescriptive or objective-orientated.
Coastal development setbacks	Set distance from a coastal feature within which all or specific types of development are prohibited: often includes a buffer. Useful within an overarching coastal management programme.
Living shorelines	Management practice involving strategic placement of plant, stones, sand fill and other materials to achieve the duel goal of long-term protection/restoration/enhancement of shorelines habitats and the maintenance of natural processes.
Structural shoreline stabilisation	Shoreline hardening or armouring; ranges from technically complex structures to the placement of construction debris serving as, for instance, bulkheads, revetments and seawalls. Not a long-term strategy, but option of last response.
Diversified livelihoods as a primary goal	
Fisheries sector good practices	Adapting fisheries management and strengthening capacity to deal with long-term climate-related effect on relevant habitats and ecosystems. Can apply to productions, infrastructure, operations and/or ecosystem protection.
Mariculture best management practices	Largely self-enforced measurers to better efficiency and cost in the mariculture sector in order to increase the derived benefits and promote development.
Tourism best management practices	Actions that enable the tourism section to improve services and business while minimising the adverse effects on the environment and local communities. Can serve as a climate change mitigation and adaptation measure.
Human Safety and Safety Enhanced as a primary goal	
Community based disaster risk reduction	An overarching management approach or strategy consisting of structural and non-structural measures that prevent, mitigate and/or help prepare for the effects of natural hazards. Can be used to bundle a series of measures.
Flood hazard mapping	Conducted in areas adjacent to water bodies to ensure land owners, insurers and regulators have relevant information on flooding risks.
Overarching planning and governance as a primary goal	
Coastal watershed management	Integrated water resources management (IWRM) in the coastal context, which takes into consideration watershed and estuary management. An overarching approach or strategy that can be used to bundle a series of measures.
Integrated coastal management	An overarching management approach or strategy involving planning and decision-making geared to improve economic opportunities and environmental conditions for coastal people. Can be used to bundle a series of measures.
Special area management planning	An overarching management approach or strategy for a geographic area of critical concern, usually within the context of a coastal resources management programme. Can be used to bundle a series of measures.

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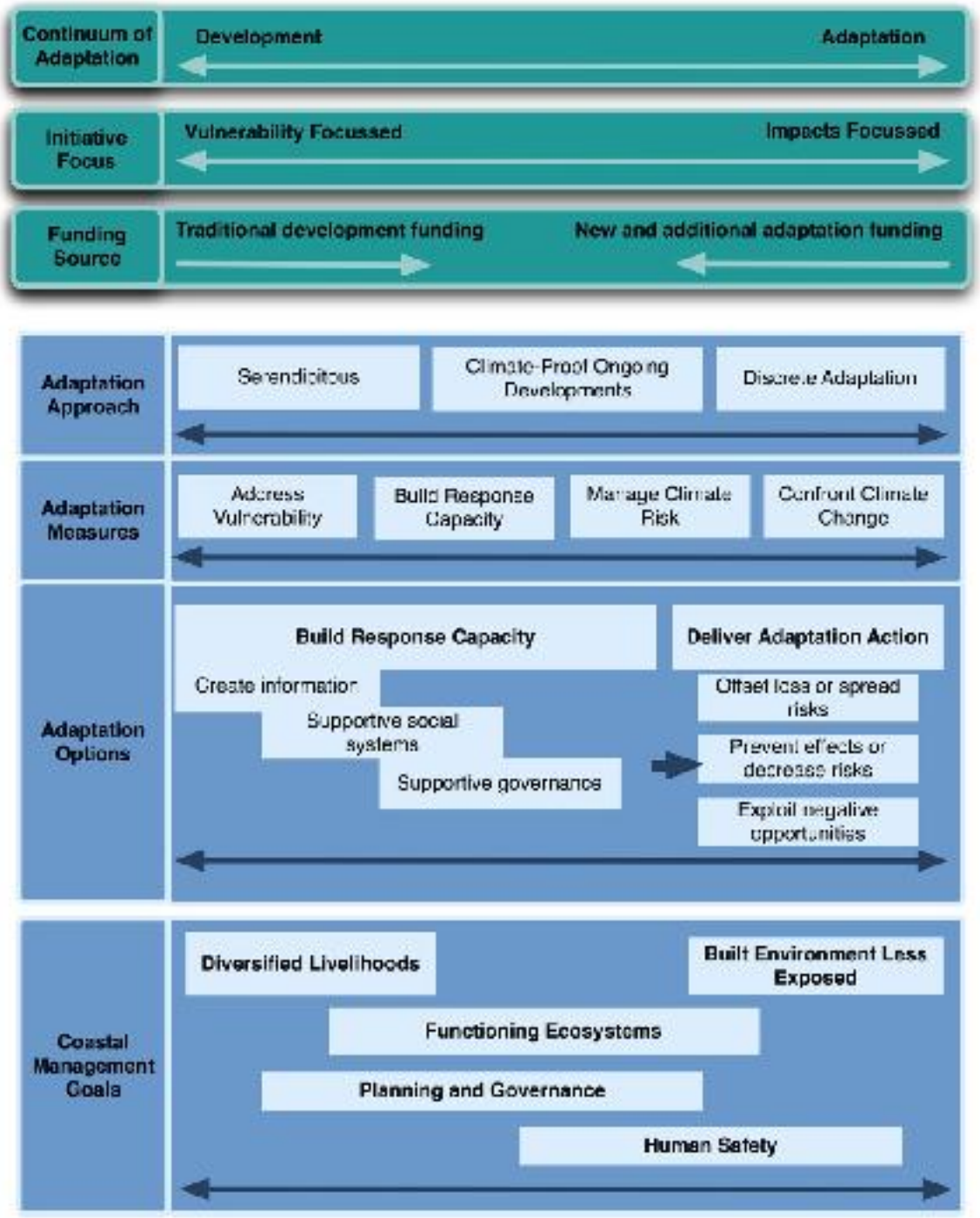

Figure 29: Adaptation types along the development-adaptation continuum, incorporating coastal management goals

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Table 19: Adaptation options and actions (following UKCIP and McGray et al., 2007)

Adaptation Option	Example Adaptation Actions
BUILDING ADAPTIVE CAPACITY	
Creating information	Activities may include: Research; Data collection and monitoring; and Awareness raising. For example:
	ESTABLISHING MONITORING/EARLY WARNING SYSTEMS: Emphasises the importance of creating, implementing, and/or maintaining monitoring and/or early warning systems.
	VULNERABILITY ASSESSMENT: Undertaking research to identify key vulnerabilities (sectors and regions) to support adaptation planning.
	RAISING AWARENESS: Raises stakeholder awareness of climate change, specific climate impacts, adaptation strategies, or the environment in general.
Supportive social systems	Activities may include: Organisational development; Working in partnership; and Institutions. For example:
	EMPOWERING PEOPLE: Emphasises training and skill development to support adaptation. Can also include literacy, gender empowerment, or the creation of income generation opportunities as a basis for adaptation.
	BUILDING INSTITUTIONS: Creates new or strengthens existing institutions (e.g., establishing committees, identifying mechanisms for sharing information across institutional boundaries, training staff responsible for policy development).
Supportive governance	Activities may include: Regulation; and Legislation and Guidance. For example:
	PROMOTING POLICY CHANGE: Promotes establishing a new policy or adjusting an existing policy.
	LAUNCHING PLANNING PROCESSES: Sets in motion a specific process for adaptation planning, for example, plans to adopt altered NRM practices (but not the implementation of altered practices - see 2b). Includes use of Pilot Projects to trial adaptation options/processes.
DELIVERING ADAPTATION ACTIONS	
Offset loss by sharing or spreading risks or losses	Activities may include: Insurance; Sharing cost of response; and Relief efforts. For example:
	PROVIDING INSURANCE MECHANISMS: Create, modify or plan an insurance scheme.
Preventing effects	Activities may include: Change use or location; or actions to build resilience. For example:

Adaptation Option	Example Adaptation Actions
or decreasing risks	IMPROVING INFRASTRUCTURE: Focuses on creating or improving built infrastructure (e.g., roads, sea walls, irrigation systems). Pilot projects that include the implementation of adaptation actions to prevent effects or decrease risks of climate change are included here.
	RELOCATION: Moving people and/or property away from high risk areas
	CHANGING NATURAL RESOURCE MANAGEMENT PRACTICES: Emphasises new or different natural resource management practices (e.g., for managing land use, protected areas) as adaptation strategies.
Exploit positive opportunities	Activities include: Introduce new or develop previously limited activities or species. For example:
	PROMOTING TECHNOLOGY CHANGE: Promotes implementation or development of a technology new to the location (e.g., communications technology).
Accept the impacts or bear loss	

6.1.2. Principles of Effective Adaptation

The principles for effective adaptation should be considered when designing an approach to coastal adaptation in the Mediterranean. This will ensure that each issue has been considered and potentially acted upon to achieve the best benefits from climate change adaptation. The approach to reviewing adaptation projects at a global scale adopted here involved delineation of a set of "principles" against which to evaluate discrete initiatives. In formulating these principles the key question to be considered was: "What elements should a project/programme have to ensure that it is effective in adapting to the potential impacts of climate change?". Information sources considered included a number of reports, papers and guidelines that either directly explored principles of effective climate change adaptation; or outlined an approach to coastal climate change adaptation. The outcome of this exercise was the identification of 8 principles for effective adaptation to be applied to the subsequent review of initiatives, namely:

- Mainstreamed;
- Integrated;
- Flexible;
- Ecosystem based;
- Systems approach;
- Prioritised;
- Locally owned; and
- Place specific.

The principles were selected based on the frequency of reference to each principle in the reviewed documents. In addition to the principles, or elements, that contribute to effective adaptation, there are a number of barriers that will influence the selection of an adaptation approach (finance, capacity, information). The barriers to effective adaptation must be considered when developing an adaptation initiative, programme or project (Figure 30).

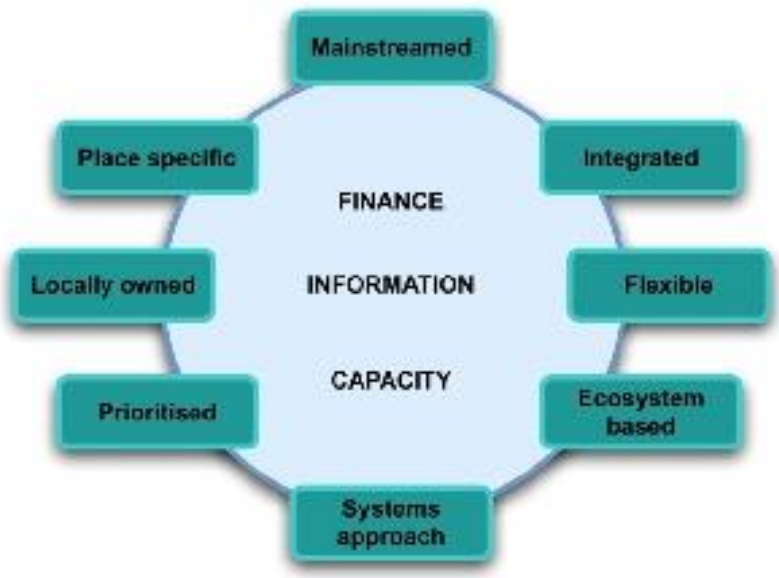


Figure 30: Principals of effective adaptation

The principles for effective adaptation are expanded briefly as follows:

Mainstreamed

Mainstreaming is used to describe the integration of policies and measures to address climate change into ongoing and new development policies and plans (ADB, 2005). The aim of mainstreaming is to increase the effectiveness, efficiency and longevity of initiatives directed at reducing climate-related risks, while also contributing to sustainable development and improved quality of life (ADB, 2005). Mainstreaming is increasingly advocated as a necessary approach to support development and implementation of effective adaptation measures. Ministries, governments, NGOs and other institutions are recommended to integrate climate change in their planning and budgeting in all levels of decision-making. Thus providing climate change adaptation with the funding and authority to take place (USAID, 2009).

Good practice mainstreaming taps into existing platforms and frameworks to reduce duplication of effect and enhance efficiency. This ensures that climate change adaptation responses and development efforts are closely integrated. Importantly, there is a need for a strong basis on which to mainstream climate change adaptation. From coastal perspective, ICZM frameworks provide a platform to mainstream climate change adaptation. If an ICZM framework does not exist, development of a broader coastal management framework will be required before coastal climate change adaptation activities will be sustainable in the long term, and as a result effectively mainstreamed.

Integrated

Integrated adaptation aligns closely to mainstreamed adaptation, however, it moves beyond mainstreaming policies, plans or projects into national policy through written documentation, to encompass broader communication channels such as consultation and information sharing. It is widely recognised that adapting to climate change will require adjustments and changes at all levels, from international, national to community (UNFCCC, 2007). Therefore, linkages between levels of decision-making (international, national, regional and local) must be enhanced to facilitate information sharing and support effective adaptation. This can be achieved through, for example, regional or national programmes that incorporate local pilot programmes; thus ensuring that community-based activities are couched within a broader management framework/regional approach.

Flexible

Climate change adaptation is a long-term process that must commence now on the basis of the current understanding of impacts, despite uncertainties in projecting future environmental and social conditions and/or the effectiveness of selected adaptation strategies in addressing the potential impacts. Consequently, effective adaptation requires in-built flexibility to address inherent uncertainty and to respond to new information and changing circumstances (Parliament of Australia, 2009). Risk management approaches allow for flexibility through regular review of the effectiveness of adaptation strategies and updated risk profile (see “Prioritised” for more details on role of risk based approach in effective adaptation).

Ecosystem based

Functioning natural ecosystems are essential for coastal development. They provide the facilities and services needed to support society and the economy. In addition, they play a pivotal role in climate regulation. Consequently, ecosystems significantly contribute to community resilience – both in terms of reducing impacts from unavoidable climate change

and through climate change mitigation.[17] Therefore, coastal adaptation efforts should focus on enhancing the capacity of natural systems to increase resilience by buffering climate risks.

Systems Approach

Knowledge on the linkages among sectors and ecosystem processes is required to ensure unsustainable or destructive production systems are not supported by adaptation activities (Dick et al., 2009). An assessment of the linkages among sectors and ecosystem processes should be based on a "whole of system" approach. Focussing exclusively on one spatial location, or one sector, will not provide an adequate representation of a coastal system.

Prioritised

Adaptation efforts should be focussed in most vulnerable systems (biophysical, human settlements or economic systems with high exposure to climate change impacts and low adaptive capacity to manage identified impacts). Vulnerability assessments and risk assessments are tools to support the identification of systems most at risk from climate change. Adaptation actions and strategies can then be focussed on those priorities.

Current methods for coping with climate risks should be built upon in the adaptation strategy (policy, plan, or project). Such an approach will ensure that locally specific adaptation strategies are recommended and that existing factors contributing to vulnerability are addressed. Finally, any adaptation initiative will only be effective if it addresses agreed levels of risk, including their tolerability. Consequently, establishing agreed levels of risk (through consultation with local stakeholders) should be undertaken at the outset of the adaptation initiative.

Locally owned

Local ownership of adaptation programmes is critical to their success. Dick et al. (2009) suggest that implementation of adaptation programmes should be managed by host countries and communities; and that country and community-level institutions should be accountable for programme outcomes. Multi-stakeholder participatory programmes are critical in addressing the needs of vulnerable populations. Citizens should be engaged in decisions regarding all aspects of adaptation and development programmes, from analysis of problems to design, implementation, management and impact assessment. In the absence of local ownership, programme/project sustainability is unlikely.

Place specific

A consideration of local circumstances including biophysical setting, economic, institutional, legal and socio-economic conditions, is critical to implementing effective adaptation (IPCC, 2000). A "one size fits all" approach will be ineffective.

Additionally, the following key barriers should be considered in further detail:

[17] UNEP (2009) Ecosystem Based Adaptation and Mitigation http://www.grida.no/_res/site/file/publications/blue-carbon/split/9- ECOSYSTEM%20BASED %20ADAPTATION%20AND%20MITIGATION.pdf World Bank (2010) Convenient Solutions for an Inconvenient Truth: Ecosystem-based Approaches to Climate Change http://issuu.com/world.bank.publications/docs/9780821381267

Finance

Lack of financing can be a key barrier to adaptation. To address this barrier, participating member countries can access funds through the United Nations Framework Convention on Climate Change (UNFCCC) and a significant increase in adaptation funding was recently put forward as part of the Copenhagen Accord. In addition, Annex 1 national governments are committed to supporting Non-Annex 1 nations in adapting to the potential impacts of climate change. Establishing a clearinghouse of funding opportunities may enhance access to finance through these and other established mechanisms.

Information

Access to climate information is critical to support effective climate change adaptation. In order to make informed and effective decisions about adaptive strategies (which can be facilitated through vulnerability and risk assessment activities), individuals, businesses, communities and governments need accurate estimates of climate change projections and their various environmental and socio-economic effects. In addition, information on local context, i.e. historic exposure to risk and current coping strategies, is vital in supporting effective adaptation.

Capacity

Strengthening capacity at all levels, from local to transnational, is a priority to provide the skills, capacity and local leadership required to manage implementation of adaptation projects/programmes and to ensure that individuals, households and communities have the capability to manage climate hazards and to recover quickly from negative impacts. A long-term, systemic approach to building regional capacity and capability, that assists sharing of best-practice within the region and strengthening institutions in country for on-ground decision making, is required.

The alignment of ecosystem objectives to best practice principles and the alignment between principles of good practice adaptation and reviewed reports are presented in Table 20 and Table 21, respectively.

Table 20: Ecosystem Objectives Aligned to Best Practice Principles

Principle of Adaptation	Principles of the Ecosystem Approach (Colasimone, 2009)
Mainstreamed	Ecosystem approach should involve all relevant sectors of society and scientific discipline.
Integrated	The ecosystem approach should be undertaken at the appropriate scales.
Flexible	Management must recognise that change is inevitable. 8. Objectives for ecosystem management should be set for the long term.
Ecosystem based	Recognising the potential gains from management there is usually a need to understand and manage the ecosystem programme in an economic context. Any such ecosystem-management programme should: reduce those market distortions that adversely affect biological diversity, align incentives to promote biodiversity conservation and sustainable use; and internalize costs and benefits in the given ecosystem to the extent feasible. Conservation of ecosystem structure and functioning, in order to mainstream ecosystem services, should be a priority target of the ecosystem approach. Ecosystems must be managed within the limits of their functioning.
Systems Approach	Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.
Prioritised	The ecosystem approach should seek the appropriate balance between an integration of conservation and use of biological diversity. The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.
Locally owned	The objectives of management of land, water and living resources are a matter of societal choices. Management should be decentralised to the lowest appropriate level.

Table 21: Alignment between principles of good practice adaptation and reviewed reports

	Report 1	Report 2	Report 3	Report 4	Report 5	Report 6	Report 7	Report 8	Report 9	Report 10	Report 11
Integrated approach											
Community based											
Flexible/adaptive management											
Equitable											
Sustainable											
Holistic											
Addresses Barriers											
Vulnerability assessment											
Information provision											
Ecosystem based											
Work at multiple levels											
Prioritise adapt options											

References

Report 1: IDS (2008)
Report 2: IPCC (2000)
Report 3: USAID (2009b)
Report 4: Interaction (2009)
Report 5: Dick et al. (2009)
Report 6: Burton et al. (2004).
Report 7: DEFRA (2008)
Report 8: Parliament of Australia (2009)
Report 9: UNFCCC (2007)
Report 10: Kay (2010)
Report 11: Elrick (2010)

6.2. Overview of Status of Global Initiatives

A range of adaptation programmes and initiatives are reviewed here to explore the status of experience in coastal climate change adaptation globally. The approach to this review involved a preliminary screening assessment to identify examples of coastal climate change adaptation, implemented globally, that would provide "lessons learned" to guide good practice approaches to climate change adaptation in the Mediterranean. To achieve this, a review of global adaptation projects, both completed and ongoing, was undertaken. The review focussed on ensuring a broad coverage of adaptation projects across different geographic scales, regions and, countries; whilst also ensuring a variety of different adaptation approaches, measures and options were considered.

The criteria applied in the review are presented in Table 22 and follow the adaptation approaches, measures and options outlined above. The criteria ensured a broad representation of the spectrum of adaptation categories. In all cases, only **coastal** adaptation projects were considered.

Adaptation projects, programmes and initiatives for inclusion in the database were sourced from adaptation information sharing platforms and adaptation project databases. A list of adaptation platforms and information sharing mechanisms is published on WikiADAPT. The list of platforms was analysed to identify global projects, programmes and initiatives that could provide case study examples of best practice in climate change adaptation[18]. The following platforms were reviewed:

- GEF evaluations database;
- UNFCCC Adaptation Practices Interface;
- WikiADAPT;
- Advancing Capacity to support Climate Change Adaptation (ACCCA);
- Adaptation Learning Mechanism;
- UNDP Small Grants Programme; and
- ADB Climate Change Programme Co-ordination Unit.

In addition, McGray et al. (2007) recently undertook a comprehensive review of adaptation projects in developing countries. The adaptation projects classified as "coastal" in this review were included in the database.

[18] Climate change adaptation legislation and policy were not analysed in this review. The review focussed solely on projects, programmes and initiatives.

Table 22: Criteria applied to categorise adaptation projects

Category	Criteria	Definition
Geographic Scale	Local	Locally based (village or region)
	Sub-national	Sub-national scale
	National	Nation-wide scale
	Multi-national	Incorporates multiple nations
UNFCCC Position	Annex 1	Annex 1 to the UNFCCC Convention
	Non Annex 1	Non Annex 1 to the UNFCCC Convention
	SIDS	Small Island Developing States
	LDC	Least Developed Country
Region	See appendix 1	Applies the regional categorisation of the United Nations[19]
Adaptation Approach	Serendipitous Climate proofing ongoing development Discrete adaptation	See Table 17
Adaptation Measure	Addressing the Drivers of Vulnerability	See Table 17
	Building Response capacity	
	Managing climate risk	
	Confronting climate change	
Adaptation Options	See Table 19	

The criteria in Table 22 above enabled the identification of a range of adaptation projects, programmes and/or initiatives covering a range of scales and adaptation categories. A sample of the review is presented in Table 23 that follows. The review is not exhaustive. It was confined to an analysis of readily available information (web sourced); and the collection of projects for inclusion in the database ceased once projects that covered the range of evaluation criteria had been obtained. The objective was not to evaluate all coastal adaptation initiatives globally, but rather gather a broad representation of such projects. A total of 66 projects/initiatives were collected in the final database.

[19] http://unstats.un.org/unsd/methods/m49/m49.htm

Table 23: Sample from the database of adaptation projects

Geographic Scale	UNFCCC Position	Region	Country	Project Title	Adaptation Measures	Adaptation Options	Adaptation Approach	Impacts	Case Description and Link
Local	LDC	Southern Asia	Bangladesh	Community Adaptation to Salinity and Cyclones in the Southwest Coastal Region	Addressing Vulnerability Drivers; Building Response Capacity	Resources Empowerment; Planning; Agriculture	Discrete Adaptation	Coastal Inundation or Erosion; Damage to Human Settlements; Water Shortages; Agriculture impacts	SouthSouthNorth and partners are implementing a suite of adaptation measures (e.g. agricultural diversification, aquaculture promotion, disaster risk reduction) in coastal areas to deal with sea level rise and storms. http://www.southsouthnorth.org/country_home.asp?country_id=11#113
Multinational	SIDS (Fiji)/ LDC (Tanzania)	Middle Africa East AfricaMelanesia,	Multinational (Fiji, Cameroon, Tanzania)	Mangroves and Coral Reef Conservation	Climate Risk Management	Resources Planning; Technology; Institutions	Climate-Proofing of Development Efforts	Biodiversity loss	WWF is testing methods to restore degraded mangrove forests to make them resilient to climate change. http://www.panda.org/about_wwf/what_we_do/climate_change/problems/global_warming/scientific_proof/ipcc_report/cameroon.cfm
Regional		South Eastern Asia	Multinational	Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand	Building Response Capacity	Planning; Institutions	Serendipitous Adaptation	Biodiversity loss	The overall goals of this project were: to create an environment at the regional level in which collaboration and partnership in addressing environmental problems of the South China Sea, between all stakeholders and at all levels, is fostered and encouraged; and to enhance the capacity of the participating governments to integrate environmental considerations into national development planning. http://www.unepscs.org/

6.3. Case Study Examples: Showcasing Good Practice

Following the identification of adaptation projects that covered a range of spatial scales, adaptation approaches, measures and options, the next step was to select a number of case studies that represented these different categories of adaptation and evaluate how the complexity of coastal climate change adaptation (as discussed at the beginning of the current Section) had been addressed globally. The complexity of coastal climate change adaptation is captured in the principles of effective adaptation as discussed above. These principles were used to draw lessons learned from each of the case study projects.

The case studies were selected based on the variety of adaptation strategies implemented, the scale of assessment, and the socio-economic context in which the project, programme or initiative was implemented. The review of case studies is presented in Table 24.

In some cases, the authors have first hand knowledge of a case study projects implementation and outcomes. In other cases, the evaluation of good practice is based solely on review of project profiles and other available on-line information. Consequently, the case studies were evaluated for the "presence" or "absence" of good practice principles. If the principle was not incorporated within project documentation, it was implied that it was not incorporated within the project. Further, the effectiveness of the actions undertaken in implementing the good practice principle was not implied. For example, MFF has mainstreamed climate change adaptation into the initiative. Therefore, in the evaluation table it is noted as incorporating mainstreaming as a good practice element. However, mainstreaming in the MFF initiative is a recent activity and therefore the effectiveness of the approach to mainstreaming cannot be evaluated at this time. Consequently, the evaluation is not exhaustive.

A project was considered as "locally specific" if pilot projects were a component of project design. However, it is recognised that this does not necessarily infer that the pilot project explicitly considered the local context of the pilot site upon implementation. Details to achieve such evaluation were not available in the project documents reviewed. In addition, a project was considered "flexible" if it contained multiple phases. A multi-phased approach was considered flexible as it is assumed that outcomes from primary phases will be used to inform subsequent activities. However, the monitoring/evaluation processes applied to ensure a flexible approach, or the ability or individual projects to be "flexible", could not be inferred from the project documentation.

A project profile was created for each case study. The profiles outline the focus issue, background to the project/initiative, project/initiative objectives and outcomes, and key message or lessons learned. An example of the case study profiles is shown in the boxes below. A summary of each case study is presented in Table 25. The case study profiles provide the detail required to draw key lessons learned from the range of coastal climate change adaptation initiatives implemented globally.

Table 24: Evaluation of effectiveness of case study projects/programmes/initiatives

Id	Geographic Focus							IPCC		Effectiveness									Adaptation Measure				Adaptation Approach			Adaptation Options[20]					
	Global	Regional	National	Sub-National	Local	Initiative vs Project	Budget (US$ millions)	Includes SIDS/LDC	Annex 1	1. Mainstreamed	2. Integrated	3. Flexible	4. Ecosystems based	5. Systems Approach	6. Prioritised	7. Locally owned	8. Place specific	Addresses Barriers	Address Vulnerability	Build Response Capacity	Manage Climate Risk	Confront Climate Change	Serendipitous	Climate proofing	Discrete Adaptation	1a	1b	1c	2a	2b	2c
1		x			x	P	13.73	x		x	x						x			x	x	x			x	x	x	x			
2			x			I	?		x		x				x					x	x				x	x	x	x			
3				x	x	P	3.992			x							x	x		x	x	x			x	x	x	x		x	
4		x				P	6.825	x		x	x	x					x	x		x	x				x	x	x	x			
5		x				I	0.01 - 0.3	x		x			x		x	x	x		x	x			x	x		x	x	x			
6			x		x	P	3.73	x		x	x	x			x		x	x		x	x	x			x	x	x	x		x	
7			x		x	P	0.07									?	x	x		x					x		x				
8			x			P	9.336	x		x	x				x					x	x	x			x			x		x	
9		x			x	P	1.3	x		x	x	x			x	x	x	x	x	x		x			x	x	x			x	
10	x				x	I	<0.05	x	x			x	x			x	x	x		x					x	x	x				
11			x			I	?		x			x			x	x		x			x				x	x	x				

[20] Adaptation actions (2a, 2b, 2c) are commonly trialled in pilot projects. If the adaptation actions refer to actions taken to reduce risk, beyond policy, planning or institutional change (i.e. road construction, seawall construction) then they are noted against criteria 2b. If pilot measures are policy or institutional based, they are noted against criteria 1b or 1c.

Case Study ID Key:

1. Adaptation to Climate Change - Responding to Shoreline Change and its human dimensions in West Africa through integrated coastal area management
2. National Climate Change Adaptation Initiative
3. Implementing Pilot Climate Change Adaptation Measures in Coastal Areas of Uruguay
4. Caribbean Planning for Adaptation to Global Climate Change (CARICOM)
5. Mangroves for the Future Initiative
6. Kiribati Adaptation Project
7. Community-led climate adaptation programme for Sustainable livelihoods in coastal areas of south western Nigeria
8. Integration of Climate Change Risks into the Maldives Safer Island Development Programme
9. Capacity Building for the Development of Adaptation Measures in Pacific Island Countries Project
10. GEF Small Grants Programme
11. UK Climate Impacts Programme

Adaptation Actions ID Key:

Build Adaptive Capacity

1a. Creating Information: research; data collection and monitoring; awareness raising, i.e. establishing monitoring and early warning systems, vulnerability assessment and raising awareness

1b. Supportive Social Systems: Organisational development; Working in partnership; Institutions. For example: empowering people and building institutions

1c: Support Governance: regulation, legislation and guidance. For example, promoting policy change, launching planning processes

Deliver Adaptation Actions

2a: Offset less by sharing or spreading risks and losses: insurance, sharing cost of response. For example, providing insurance mechanisms

2b: Preventing effects or decreasing risks: change use or location, actions to build resilience. For example: improving infrastructure, relocation, changing natural resource management practices

2c: Exploit positive opportunities: introduce new or develop previously limited activities or species. For example, promote technology change

Table 25: Features Case Study Summaries

ID	Project Title	Description and Link
1	Adaptation to Climate Change: Responding to Shoreline Change and its human dimensions in West Africa through integrated coastal area management	This project was selected as a case study due to its focus on mainstreaming climate change into an existing coastal management/planning system to manage the potential impacts of sea level rise. The project entails the collection of technical information to support policy formation. The focus is on creating capacity to ensure coastal planning is based on up-to-date technical information (i.e. change in mean sea level). This is innovative and may provide lessons learned for the Mediterranean region. In addition, the project incorporates pilot adaptation actions that are trialled in a local context, but apply a national and regional approach to manage shoreline change. In this way, the project ensures an integrated approach to coastal planning is achieved. http://www.gm.undp.org/projects_environ_accc.htm
2	Australian National Climate Change Adaptation Initiative	The case study showcases a national framework for climate change adaptation that incorporates a wide spectrum of sectors and issues. The framework is based on the recognition that climate change adaptation will require contributions from governments at all levels, businesses, communities and individuals and that governments play an important role in creating the appropriate framework and in providing information to support adaptation. The framework: • Sets a national framework that incorporates action at local scales; • Concentrates on knowledge generation to promote effective adaptation; • Incorporates a national vulnerability assessment to prioritise areas for most immediate action. The framework is applied at the national level, but contains elements that guide and support localised adaptation planning. To this end, the framework is focussed on building understanding and adaptive capacity and reducing vulnerability in key sectors. The framework aims to ensure that local scale actions follow a "nationally" consistent approach. http://www.climatechange.gov.au/government/initiatives/climate-change-adaptation-program.aspx
3	Implementing Pilot Climate Change Adaptation Measures in Coastal Ares of Uruguay	Managing the potential impacts of sea level rise in the low-lying coastal environments, whilst maintaining biodiversity, through the promotion of local-level decision making within the context of national policy. The approach to facilitate local-level decision making is based on the incorporation of strategies of territorial zoning and climate risk management into municipal plans. The approach is piloted in priority coastal zones, and concentrates on implementation of adaptation measures necessary to preserve and restore coastal wetlands, and the sustainable use of coastal resources. Consultation and engagement is critical to promote change at the local level results. Efforts to engage stakeholders in the development of the proposed pilot adaptation projects target multiple levels of governance (local, municipal and national). In addition, a four-step approach to support

ID	Project Title	Description and Link
		knowledge transfer is adopted to ensure dissemination of project outcomes beyond the Pilot sites. http://www.adaptationlearning.net/project/implementing-pilot-climate-change-adaptation-measures-coastal-areas-uruguay
4	Caribbean Planning for Adaptation to Global Climate Change (CARICOM)	The case study provides a good practice example of adaptation to sea level rise and demonstrates the long-term nature of climate change adaptation, particularly capacity building and climate change mainstreaming. Capacity building and climate change mainstreaming are widely advocated as tools to support effective climate change adaptation. However, the ability of projects to achieve increased capacity and climate change mainstreaming are not widely explored. In some cases, if climate change is incorporated in policy this is advocated as "mainstreamed" climate change. However, mainstreaming must move beyond "written" evidence, to practical evidence. How does incorporation of climate change "text" within policy translate to increase adaptation on ground? This project provides a practical example of the need for continued action to support capacity building and climate change mainstreaming. The initial actions are taken in Project 1, and these actions are expanded and consolidated through successive projects. In addition, the project activities cover the primary objectives of the Mediterranean ICZM Protocol and thus provide an example of how the ICZM Protocol can be implemented to achieve both ICZM and coastal climate change adaptation. For example, project activities include: monitoring; identifying vulnerable areas; training and institutional strengthening; and assessing policy options. http://www.caricom.org/jsp/projects/macc%20project/cpacc.jsp
5	Mangroves for the Future Initiative	The case study demonstrates an approach to incorporating climate change into an established initiative. The MFF initiative supports Countries impacted by the 2004 Tsunami to increase their resilience to climate variability through an integrated ocean wide approach to coastal zone management. At commencement, the initiative did not explicitly incorporate climate change within its Programme of Works. However, it was widely recognised that climate change will have potential impacts on the actions/projects funded through the initiative. Consequently, an approach to mainstream climate change into the initiative has been endorsed. This case study moves beyond project specific climate change adaptation and provides an example of programme/initiative wide climate change mainstreaming to support sustainability investments in ecosystem based coastal zone management. http://www.mangrovesforthefuture.org/
6	Kiribati Adaptation Project	The Kiribati Adaptation Project is the largest climate change adaptation project in the Pacific region. The project is in the final stage of its second phase of implementation and has a number of lessons learned drawn from the initial phases of the project. These include a strong consideration of project scope in project design; the need to move beyond mainstreaming of climate change into project documentation towards mainstreaming that supports on ground action; and the importance of a ensuring the existence of strong environmental

ID	Project Title	Description and Link
		management and social management systems in which climate change adaptation can be incorporated. The lessons learned provide guidance to the development of future adaptation projects both in the Pacific and elsewhere. The three-phased approach has enabled a flexible approach to project implementation. For example, the scope of the project has been refined to target priority areas and ensure effective management of key deliverables. In addition, key areas of success can be built on in later phases of the project to ensure continued momentum in priority areas. http://www.adaptationlearning.net/project/kiribati-adaptation-project
7	Community-led climate adaptation programme for Sustainable livelihoods in coastal areas of south Western Nigeria	This study combines two approaches to climate change adaptation, (i) vulnerability approach and (ii) sustainable livelihood framework, to deliver a bottom-up approach that focuses on identifying and managing community-relevant vulnerability to climate change. Consultation and communication with local populace (through in-depth interviews, focus groups and other methods) is the primary tool to identify current copy strategies and how these may be adapted to support proactive adaptation to projected flood risks. In addition, the findings are communicated to key decision makers and planners to ensure community-level adaptation actions are aligned to, and supported by, national and local policy. http://www.acccaproject.org/evolution/modules/knowledgebox/external2/view.php?id=288&kbid=5
8	Integration of Climate Change Risks into the Maldives Safer Island Development Programme	This case study outlines an approach to implement the “deliver adaptation action” adaptation option, addressing the need for migration or movement of populations from high-risk areas. Population migration and re-settlement is an adaptation action that is not commonly addressed due to the political and social difficulties associated with implementation of this action and also to the time-lag before significant impacts will be felt. However, in many low lying nations where the potential impacts of sea level rise are significant, such adaptation action must be considered in a proactive and planned manner. http://www.adaptationlearning.net/project/integration-climate-change-risks-maldives-safer-island-development-programme
9	Capacity Building for the Development of Adaptation Measures in Pacific Island Countries Project (CBAMPIC)	This case study provides a practical example of ‘delivering adaptation action’ at local scales. The project implemented an innovative approach to increase the resilience of 16 communities in four Pacific Island countries to the potential impacts of climate change. The project successfully applied a framework of action that fused top-down and bottom-up approaches to climate change vulnerability and adaptation assessment and action. The approach provides useful guidance to deliver adaptation action in communities where access to technical climate change information and data may be limited. It is focussed on community engagement and addressing the current vulnerabilities of communities to increase resilience to climate change. Adaptation actions include: construction of sea walls, population movement out of high-risk areas, and implementation of water harvesting

ID	Project Title	Description and Link
		infrastructure. The project is completed and provides detailed lessons learned that provide valuable guidance in the design and deliver of climate change adaptation projects in the Pacific and elsewhere. http://www.sprep.org/climate_change/cdbmpic.htm
10	GEF Small Grants Programme	The GEF small grants programme contains good practice examples of projects that deliver locally driven climate change adaptation within budget constraints. The effectiveness of the programme is in part attributed to the decentralised nature of project delivery, which promotes increased ownership and investment in project outcomes. The delivery of the small grants programme provides a good practice example of an approach to achieve the primary objectives of the adaptation, whilst also achieving broader environmental objectives, building capacity, and creating ownership. www.sgp.undp.org
11	UK Climate Impacts Programme	This case study provides an example of an adaptation support programme that has been implemented in an Annex 1 nation. The UK climate impacts programme is a national programme established to support climate change adaptation at national, regional and local levels in the United Kingdom. The programme focuses on providing the information and support tools required to support adaptation. As per Case study 2, the National government plays a lead role in information provision and support to ensure cross sectoral engagement at all levels, including government, private and local entities, to ensure a holistic approach to climate change adaptation is achieved. http://www.ukcip.org.uk/

Case Study 2. Australian National Climate Change Adaptation Initiative

The case study showcases a national framework for climate change adaptation that incorporates a wide spectrum of sectors and issues. The framework is based on the recognition that climate change adaptation will require contributions from governments at all levels, businesses, communities and individuals and that governments play an important role in creating the appropriate framework and in providing information to support adaptation. The framework:

Quick Facts	
Region:	Australia
Scale:	National
Finance:	Not available
Timeframe:	5 – 7 years
Implementing Agency	Government of Australia
Executing Agency	Government of Australia
Adaptation Approach:	Discrete Adaptation
Adaptation Measures:	Build response capacity Manage climate risk
Adaptation Options:	1a, 1b, 1c

- Sets a national framework that incorporates action at local scales;
- Concentrates on knowledge generation to promote effective adaptation;
- Incorporates a national vulnerability assessment to prioritise areas for most immediate action.

The framework is applied at the national level, but contains elements that guide and support localised adaptation planning. To this end, the framework is focussed on building understanding and adaptive capacity and reducing vulnerability in key sectors. The framework aims to ensure that local scale actions follow a "nationally" consistent approach.

Background:

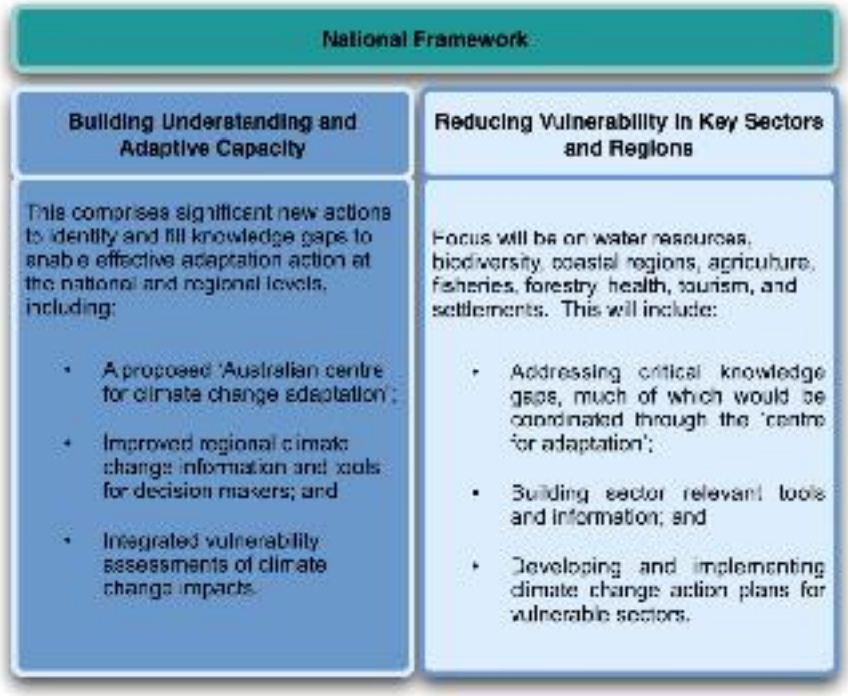
The Council of Australian Governments requested the development of a National Adaptation Framework in February 2006 as part of its Plan of Collaborative Action on Climate Change. The Framework outlines the future agenda of collaboration between governments to address key demands from business and the community for targeted information on climate change impacts, and to fill critical knowledge gaps, which currently inhibit effective adaptation. A key focus of the Framework is to support decision-makers understand and incorporate climate change into policy and operational decisions at all scales and across all vulnerable sectors.

Objectives:

The long-term goal of the Framework is to position Australia to reduce the risks of climate change impacts and realise any opportunities. In the medium term (5-7 years), targeted strategies in this Framework will focus on building capacity to deal with climate change impacts and reduce vulnerability in key sectors and regions. The framework has two priority areas for potential action: (i) Building understanding and adaptive capacity; and (ii) Reducing vulnerability in key sectors and regions. The potential actions in each priority area are national in focus, can be achieved or well advanced in five years, and provide a solid foundation for future adaptation actions.

Anticipated Outcomes:

Increased awareness of areas at highest risk from the potential impacts of climate change and knowledge on approaches to manage the identified risks.



National Climate Change Adaptation Framework

Key Message/Lessons Learned:

The programme is in its initial stages of implementation. However, lessons learned thus far include:

- The need for flexibility at the local scale: Whilst it is important to set a national framework, to ensure consistency in application and outputs, there is also the need to understand that priority questions for climate change adaptation will differ depending on the local context in which the framework is applied. Consequently, there is the need to ensure frameworks are available for multiple priority questions, or that there is greater flexibility in built into the framework to ensure modification at the local scale.
- Programme management is at the Federal level. Consultation with State and Local government and private organisations to set programme objectives and direction is currently limited.
- The programme is "stand alone" and is not mainstreamed into existing policies and/or, practices.

Alignment along continuum of adaptation:

Case Study 5. Mangroves for the Future Initiative

The case study demonstrates an approach to incorporating climate change into an established initiative. The MFF initiative supports countries impacted by the 2004 Tsunami to increase their resilience to climate variability through an integrated ocean wide approach to coastal zone management.

Quick Facts	
Region:	Southern Asia; South Eastern Asia; East Africa; SIDS
Scale:	Regional
Finance:	Range from: $10,000 to $300,000 US dollars
Timeframe:	Initial phase: 2006 - 2009 Second Phase: 2010 – 2012.
Implementing Agency	Variable
Executing Agency	MFF
Adaptation Approach:	Serendipitous, climate proofing
Adaptation Measures:	Address vulnerability Build response capacity
Adaptation Options:	1a, 1b, 1c

At commencement, the initiative did not explicitly incorporate climate change within its Programme of Works. However, it was widely recognised that climate change will have potential impacts on the actions/projects funded through the initiative. Consequently, an approach to mainstream climate change into the initiative has been endorsed.

This case study moves beyond project specific climate change adaptation and provides an example of programme/initiative wide climate change mainstreaming to support sustainability investments in ecosystem based coastal zone management.

Background:

The Mangroves for the Future Initiative (MFF) is a multi-agency, multi-country initiative launched in December 2006, which aims at the long-term conservation and sustainable management of coastal ecosystems such as coastal forests, coral reefs, wetlands, beaches and sandy shores. It focuses on the countries worst-affected by the tsunami - India, Indonesia, Maldives, Seychelles, Sri Lanka, and Thailand, and its long-term management strategy is based on identified needs and priorities for long-term sustainable coastal ecosystem management.

MFF seeks to achieve demonstrable results in influencing regional co-operation, national programme support, private sector engagement and community action. Five Programmes of Work (PoWs) have been designed to tackle key aspects of long-term sustainable coastal management. All financed initiatives must demonstrate alignment to one of more of the PoWs. The PoWs are grouped under three cross-cutting themes: building knowledge, strengthening empowerment, and enhancing governance. PoWs are implemented through a series of projects that are spread geographically across the region based on national and regional priorities. The programmes are implemented through/or in partnership with national governments, UN agencies, Non-Governmental Organisations (NGOs), community organisations, relief and development organisations, as well as the private sector.

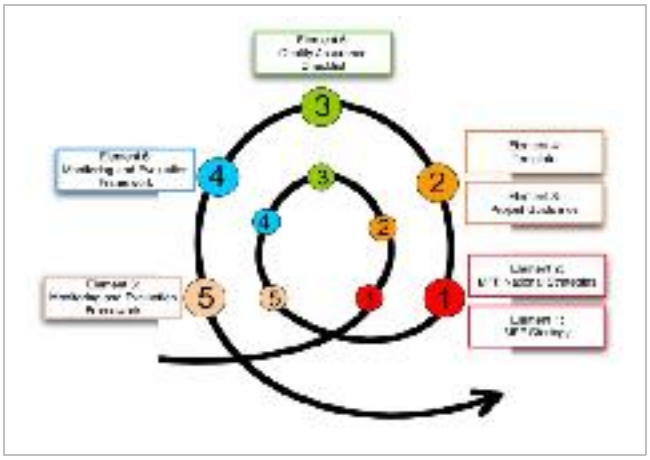
In early 2009, UNEP, in collaboration with UNDP, took the lead in the preparing an integrative climate proofing method, to ensure that climate change adaptation considerations were included into all phases of MFF initiative and projects.

Objectives:

The objective was to mainstream climate change into the MFF initiative to ensure sustainability of programme investments. To achieve this objective, climate change was mainstreamed into the project cycle, through the creation of tools to support climate change mainstreaming matched to stages of the project cycle.

Anticipated Outcomes:

The key outcome will be increased sustainability of programme investments. The projects adopt an ecosystem-based approach to coastal management, whilst considering the potential impacts of climate change, and developing strategies to reduce potential impacts of climate change on the project.



Source: MFF, 2009

Summary:

This case study provides an example of mainstreaming climate change that is focussed on mainstreaming at the “initiative” level. Mainstreaming climate change into the MFF initiative is a recent undertaking and therefore the effectiveness of the approach in achieving the anticipated outcomes cannot be evaluated at this stage.

Despite this, the case study provides an example of the ability to incorporate climate change into existing programmes, focussed on an ecosystem-based approach to coastal zone management. Programme activities are prioritised by their alignment to MFF criteria, which incorporates a consideration of the potential impacts of climate change. Therefore, whilst climate change adaptation is not the focus, the case study provides a good example of ensuring that an “ecosystem based” initiative directly considers the potential impacts of climate change on its investments. In summary, the movement beyond project specific to programme specific climate change adaptation is advantageous as it enables a holistic approach to adaptation.

Alignment along continuum of adaptation:

The case studies address different approaches, measures and options of coastal climate change adaptation. A quick view of the alignment of each case study along the development-adaptation continuum is presented in Figure 31 that follows. This provides a snap shot of the different focus of each of the case studies. Some, for example Case Study 9, cover a broad spectrum of adaptation options, whilst others are focussed towards the development (i.e. Case Study 5) or adaptation (i.e. Case Study 8) end of the development-adaptation spectrum.

A limited number of the selected case studies “address vulnerability” as the primary focus of the adaptation initiative. This is due to the focus on a selection of case studies that explicitly demonstrate climate change adaptation (CCA). Therefore, projects where CCA was not the primary objective (i.e. development focused projects) were not incorporated in the list of case studies. Similarly, a limited number of the case studies have “serendipitous” or “climate proofing” as the overriding adaptation objective. Those that do, for example Case Study 5, are focused on climate proofing on-going development efforts. Case Study 5 provides a valuable example of an approach to mainstream climate change into programmes or initiatives that are focussed on achieving broader environmental or development objectives.

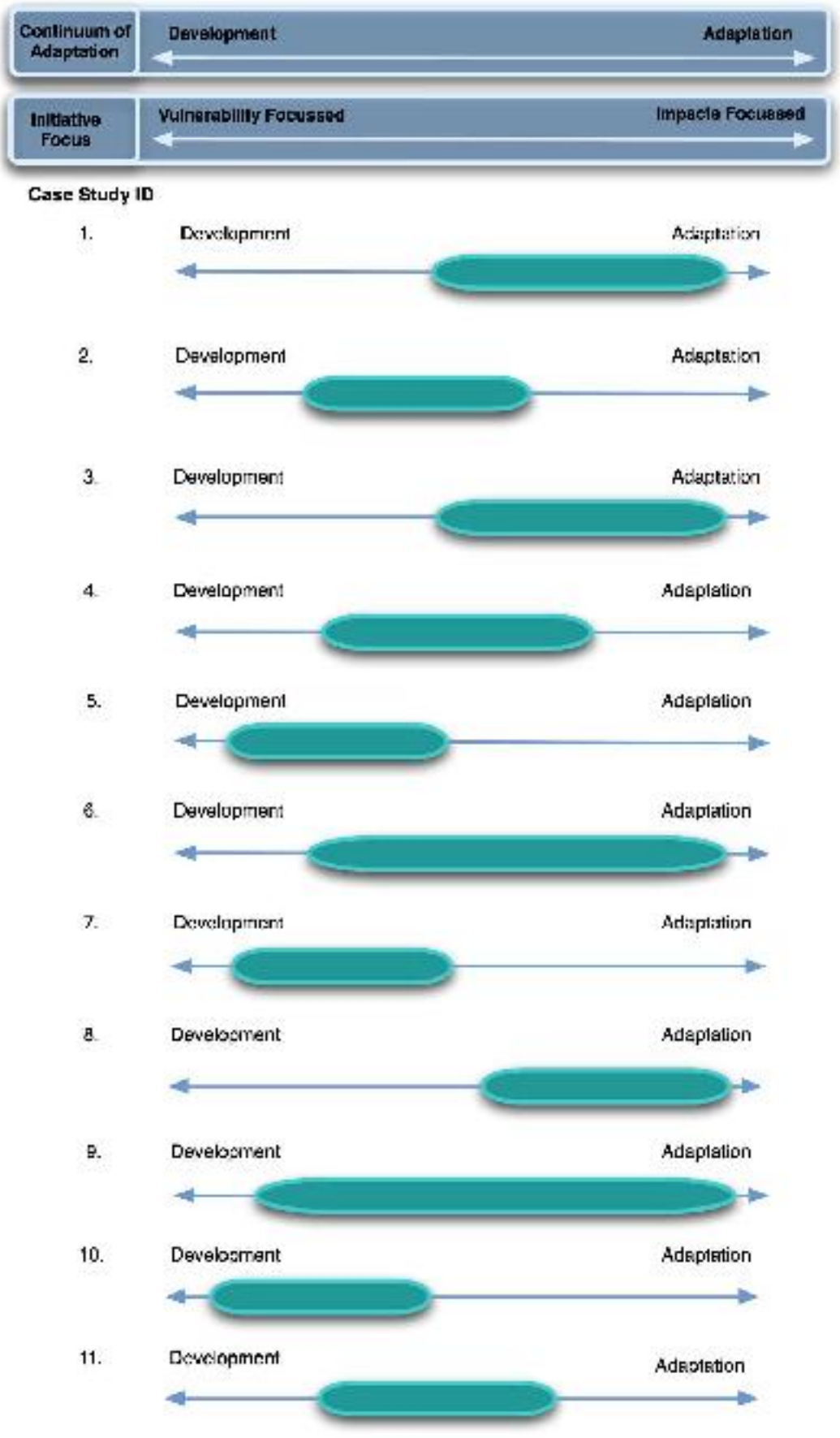


Figure 31: Project Adaptation Continuum

6.4. Overview of Key Findings

An overall finding of the review conducted for this project was the identification of the need for a good baseline in which to couch climate change adaptation. That is, a need for a strong approach to ICZM in which climate change adaptation can be mainstreamed. Without such a baseline, climate change adaptation may be viewed as an "additional" activity, when it should be viewed as integral to achieving sustainable development objectives, i.e. Case Study 6.

The case studies reviewed demonstrate that most projects aim to achieve a broad range of adaptation objectives, for example capacity building, information sharing and mainstreaming, among others. However, it is noted that the most effective projects are focussed, based on the realisation that climate change adaptation is a long-term process and it is unrealistic to achieve all objectives at the outset.

A national framework is useful in ensuring a consistence approach to adaptation. However, whilst it is very valuable to set a national framework, there must be caution in applying a one size fits all approach. For example, Case Study 2 applied a set "tool", a risk assessment framework, which was not effective for all targeted stakeholders. A recommendation would be to support countries in identifying local (regional) needs and establishing more flexible frameworks.

There is no need to rewrite the book, existing frameworks and approaches should be utilised where possible. Case Study 5 provides a good practice example of an approach to mainstream climate change into an ecosystem based coastal management initiative. In this case study, existing project management frameworks were updated to incorporate (mainstream) climate change (Figure 32).

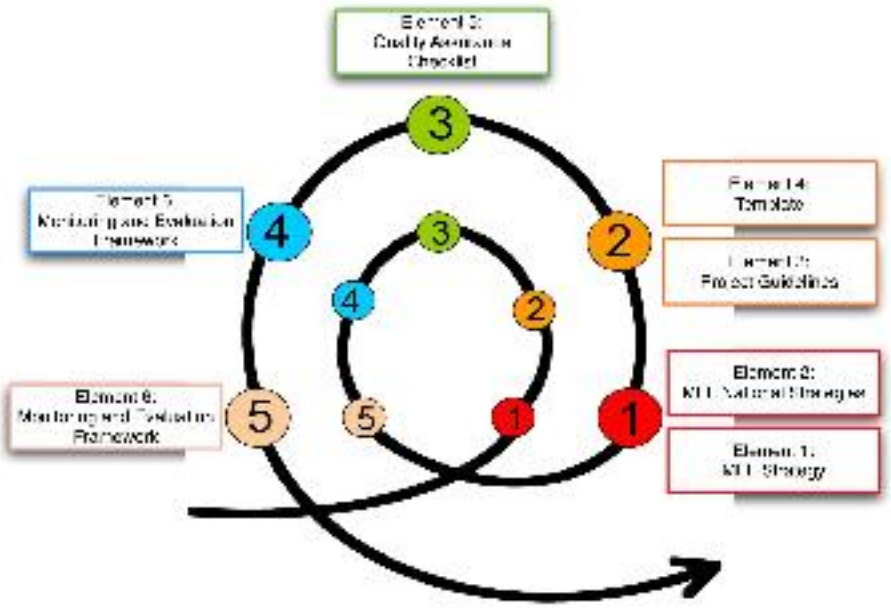


Figure 32: MFF project cycle elements, in which climate change has been mainstreamed

The key to effective **Pilot projects** is **knowledge management and dissemination** to ensure that lessons learned in the pilot project can be widely shared to promote uptake beyond the pilot site. Case study 3 incorporates a four step approach to support knowledge

transfer, update and replication of successful experiences both within the project country and across the adaptation community of practice in general. The 4 components of knowledge transfer fit within two adaptation options: (i) Create Information; and (ii) Support social systems (Figure 33).

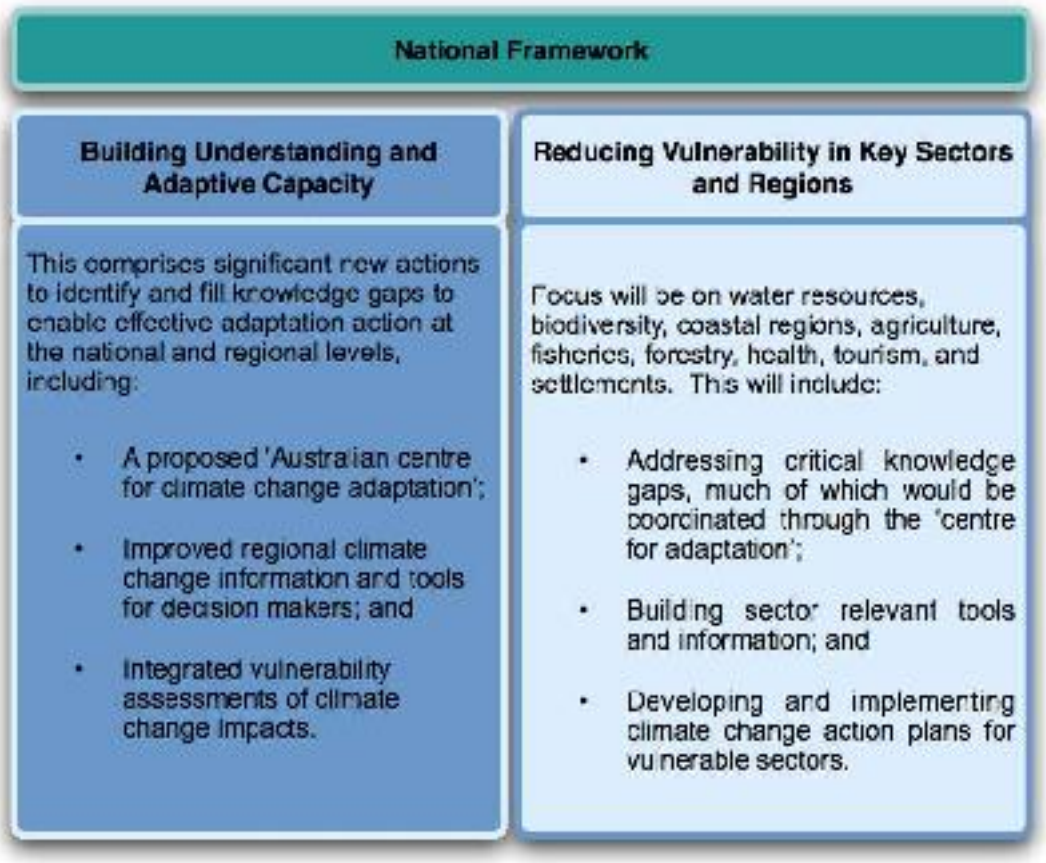


Figure 33: Components of the knowledge transfer, management and evaluation system applied in Case Study 3

Capacity building and climate change mainstreaming are widely advocated as tools to support effective climate change adaptation. However, the ability of a project to achieve increased capacity and climate change mainstreaming is not widely explored. In some cases, if climate change is incorporated in policy it is advocated as “mainstreamed” climate change. However, mainstreaming must move beyond “written” evidence, to practical evidence. How does incorporation of climate change “text” within policy translate to increase adaptation on ground? Case Study 4 provides a practical example of the need for continued action to support capacity building and climate change mainstreaming. It demonstrates that capacity building and climate change mainstreaming require **long-term investments** that extend beyond a single project. It has been successful in sustaining the momentum generated through project-based funding activities, to build the adaptive capacity of Caribbean communities.

Adaptation at the **local level** is useful in countries that do not have the **required facilities** to implement a “top-down” approach. Any approach to adaptation should combine “top-down” and “bottom-up” approaches (Figure 34). Case study 9 developed a framework to fuse “top-

down" and "bottom-up" approaches – the objective was to ensure local action could be undertaken immediately to increase the resilience of communities in high risk areas, whilst climate change would also be mainstreamed at national level. The outcome was a focus on addressing current climate variability, and thus increasing resilience, couched within a framework that would ensure future climate change was incorporated within decision making at the national level.

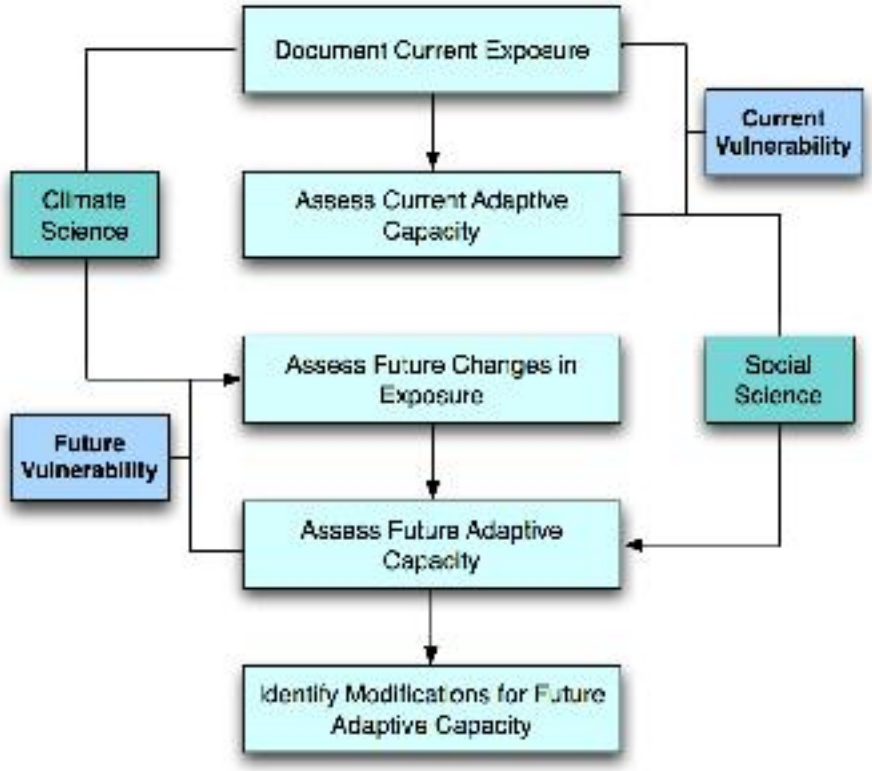


Figure 34: Components of the Climate Vulnerability and Adaptation Process applied in Case Study 9 (source: Nakalevu, 2006)

Effectiveness of local scale adaptation projects is enhanced through **decentralisation** of project management and delivery (Figure 35). Case Study 10 provides a funding delivery model for small-scale adaptation investments that promotes ownership and investment in project outcomes at the local level. All phases of project delivery and management are informed, owned and implemented by local people, from the National Steering Committee that overseas the funding programme, to the Non-Governmental Organisations that support implementation. The approach aligns to the principles of effective adaptation by ensuring adaptation is ecosystems based, locally owned and place specific.

There is a need for **proactive adaptation.** Some adaptation issues will be difficult to face. Therefore, good practice necessitates that "stepping stones" be implemented immediately, to support broader transition into the future as climate changes. Case Study 8 provides an example of a model that supports adaptation to current climate variability, and that will also support long-term climate change adaptation. This case study provides a framework for addressing the potential impacts of sea level rise on high-risk populations, by providing an approach to manage impacts that address current climatic variability (storms and inundation events) as well as setting preliminary action for addressing long-term climate change

impacts. The two-phased approach, where, in the first instance, action is mainstreamed into existing policy to manage current climate variability, is valuable in that it can address both current and future impacts. The use of such an approach will facilitate transition to managing population migration and displacement on larger (and potentially more permanent) scales in the future.

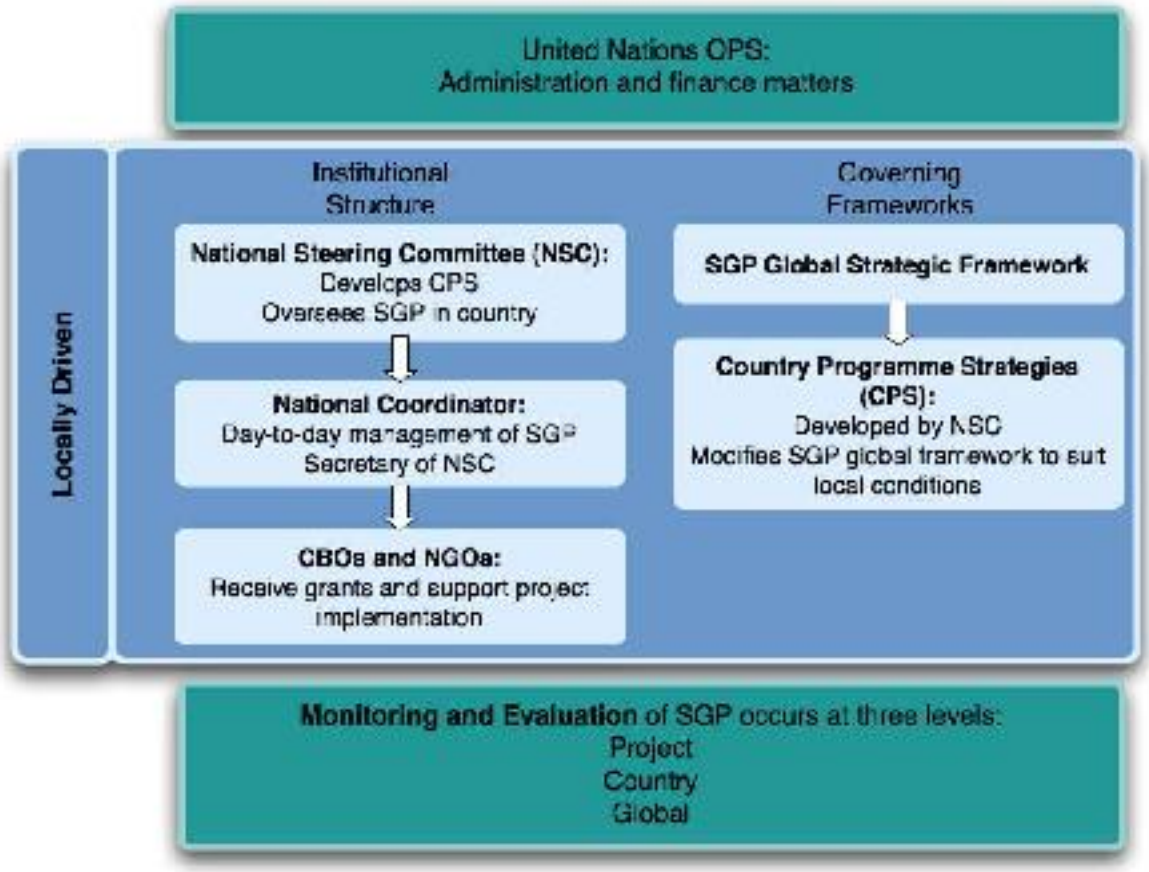


Figure 35: Case Study 10, Small Grants Project (SGP) delivery model

Case Study 10 and Case Study 5 provide good practice examples of achieving the primary objectives of adaptation, whilst also achieving broader environmental objectives, building capacity, and creating ownership.

6.4.1. Summary

The adaptation activities undertaken differ based on situational context in which adaptation is undertaken. Whilst patterns in adaptation globally cannot be pulled from a strategic assessment such as this, we can highlight key issues and lessons learned from global adaptation projects to date. For example:

- Projects should be focused; aim to achieve realistic goals;
- Adaptation is a long-term process;

- Local ownership is critical; and
- Mainstreaming is essential to support implementation.

There is a clear trend in the type of adaptation activities undertaken and the adaptive capacity of the country in which the initiative is focussed. Whilst the subtleties of country characteristics for each of the case study projects have not been evaluated, their UNFCCC status provides a broad indication of their adaptive capacity. Non-annex 1 parties to the Convention have less adaptive capacity than Annex 1 parties. Further SIDS and LDC have, by nature, lower adaptive capacity than non-annex 1 countries.

These broad classifications allow trends in adaptation type/objective and lessons learned to be gathered:

Annex 1 countries, such as Australia and UK, focus on providing the information and tools to support a broad range of stakeholders in country, i.e. government and private organisations, adapt to the potential impacts of climate change. The focus is on information gathering and provision, and providing a framework that will promote a consistent approach to adaptation.

Non Annex 1 and SIDS/LDC: Case study 3 is the only example of a Non-Annex 1 country focussed project. The other Case studies that support Non-Annex 1 countries (i.e. Case Study 5 and 10) also support SIDS or LCDs. Therefore, trends in adaptation approach can not be drawn from this case study alone. Rather, it is clear that adaptation in Non-Annex 1 countries, SIDS and LDCs ranges from resilience building to managing the impacts of climate change. The adaptation approach appears to be governed by the level of financing rather than the location in which the project is implemented. Large financed projects (over $1 million US) tackle a range of adaptation approaches from building adaptation capacity to delivering adaptation actions. Whilst smaller budget projects (<0.05$US million) concentrate on the preliminary actions that will support adaptation (i.e. capacity building, and resilience building).

Understanding the adaptive capacity of the location in which an adaptation action is to be implemented will provide guidance on the type of adaptation support that is required as a priority. In this regard, the lessons learned from a consideration of the case studies presented here will be considered in conjunction with the projected climate change impacts (Section 4) and adaptive capacity of MAP CPs (Section 5), in order to inform recommendations for the Mediterranean region presented in Section 7.

7. Summary and Conclusions

The foregoing review of coastal climate change in the Mediterranean proceeded through a series of systematic steps:

The first step involved a review of the current national circumstances of MAP Contracting Parties, terms of their physical environment, their major ecosystems and their socio-economic status. This information was subsequently considered in the context of predictions for changes in coastal climate to establish a broad indication of sensitivity. In this respect, sensitivity was considered to be a product of a countries exposure to potential physical changes and the subsequent threats, consequences and impacts to livelihoods arising from this exposure.

The next step was a consideration of the current status of vulnerability and adaptation initiatives across MAP Contracting Parties (CPs). This involved a review of the range of plans and strategies and projects and programmes operative in the region at various temporal and spatial scales. The purpose of the review exercise was to establish a broad measure of the potential adaptive capacity associated with specific CPs. That is, the status, or maturity of a countries institutional and operational capacity to adapt to the potential impacts of climate change was determined at a strategic level for each of the 21 countries under consideration.

This review of vulnerability and adaptation initiatives in the Mediterranean region was accompanied by a concurrent overview of the status of coastal vulnerability and adaptation initiatives at a global scale. Through the course of this exercise, a number of approaches to coastal adaptation were show-cased with a view to highlighting best practice for subsequent application in a Mediterranean context. The measures, options and actions associated with discrete “types” of adaptation were discussed to inform the identification of the most relevant approaches for the complex range of climate change issues to which the MAP CPs are susceptible.

The review has identified a number of key issues and information gaps that inhibit a proactive and co-ordinated approach to climate change adaptation in the Mediterranean coastal zone. For example:

- Assessment of the impacts of climate change throughout the Mediterranean is driven by local priorities. Consequently, the assessments do not apply a consistent approach and therefore regional comparisons of relative impact cannot be produced. Therefore, it is difficult to prioritise activities or investments to address priority areas.
- The development of adaptation architecture differs throughout Mediterranean countries. While countries residing in the EU have access to a range of policies and programmes to support climate change adaptation, a similar framework is not available for other countries in the region. Understanding the differential progression in adaptation can provide insights into what should be the key focus of adaptation initiatives.

Overall, the information contained within this report provides the necessary background information to develop recommendations for PAP/RAC, to support adaptation to climate change impacts in coastal zones.

Top Image: Tirana, Albania (apnews.net) Bottom Image: Alpes Maritimes, France (www.panoramic.com)

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