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REGIONAL EXPERIENCE ON ASSESSING IMPACTS OF CLIMATE VARIABILITY AND CHANGE IN THE MEDITERRANEAN AREA

Strategic Partnership for the Mediterranean Sea Large Marine Ecosystem
MedPartnership

Together for the Mediterranean

Together for the Mediterranean Sea

UNEP/MAP
Athens, 2014

The Coordinating Unit of The United Nations Environment Programme Mediterranean Action Plan (UNEP/MAP)
Athens, Greece

REGIONAL EXPERIENCE ON ASSESSING IMPACTS OF CLIMATE VARIABILITY AND CHANGE IN THE MEDITERRANEAN AREA (GEF Eligible countries)

Technical Report

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ACRONYMS

AAS	African Academy of Sciences
ACCCA	Advancing Capacity to support Climate Change Adaptation
ACCFP	African Climate Change Fellowship Program
ACCMA	Adaptation aux Changements Climatiques au MAROC
ACMAD	African Centre of Meteorological Application for Development
ACQWA	Assessing Climate impacts on the Quantity and quality of Water
ACRI	Arab Climate Resilience Initiative
ADRICOSM	ADRIatic sea integrated COastal areaS and river basin Management system
AIACC	Assessments of Impacts and Adaptations to Climate Change
AMESD	African Monitoring of the Environment for Sustainable Development
APAL	Agence de Protection et d'Aménagement du Littoral
AR	Assessment Report
ASLR	Accelerated Sea Level Rise
BD	Biodiversity
BiH	Bosnie-Herzégovine
BMBF	Federal Ministry of Education and Research
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
CC	Climate Change
CCAA	Climate Change Adaptation in Africa
CDM	Clean Development Mechanism
CIRCE	Climate change and Impact Research: the Mediterranean Environment
CIRCLE	Climate Impact Research Co-ordination for a Larger Europe
CLIMBIOMEDNET	Scientific assessment of Climate Change effects on lagoons ecosystem in comparison with man-induced changes
ClimDev	Climate for Development in Africa

CLIWASSEC	Climate Induced Changes in Water and Security
COP	Conference of the Parties
CP	Contracting Party
CRASTE-LF	Centre Régional African des Sciences de l'Espace en Langue Française
CRM	Climate Risk Management
DFID	Department for International Development (UK)
DMCSEE	Drought Management Centre for South Eastern Europe
EC	European Commission
EAMNet	Europe-Africa Marine Earth Observation Network
EEA	European Environment Agency
EMWIS	Euro-Mediterranean Water Information System
ENPI	European Neighbourhood and Partnership Instrument
EO	Earth Observation
EQA	Environmental Quality Authority
ESA	European Space Agency
ETC/ACC	European Topic Centre on Air and Climate change
EU	European Union
FAO	Food and Agriculture Organisation
GCOS	Global Climate Observing System
GCM	Global Climate Model
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEOSS	Global Earth Observation System of Systems
GLOWA	Global Change and the Hydrological Cycle
GMES	Global Monitoring for Environment and Security
GOOS	Global Ocean Observing System
GPCC	Global Precipitation Climatology Centre
GPCP	Global Precipitation Climatology Project
GRDC	Global Runoff Data Centre
HYMEX	HYDROLOGICAL CYCLE IN THE MEDITERRANEAN EXPERIMENT
IBRD	International Bank for Reconstruction and Development
ICM	Integrated Coastal Management
ICZM	Integrated Coastal Zone Management
IDA	International Development Association
INC	Initial National Communication

INFO/RAC	Information Regional Activity Centre
IOC	Intergovernmental Oceanographic Commission
IPA	Instrument for Pre-Accession
INC	Initial National Communication
IPCC	Intergovernmental Panel on Climate Change
IRA	Institute of Resource Assessment
IW:Learn	International Waters Learning Exchange and Resource Network
IWC	International Whaling Commission
MAP	Mediterranean Action Plan
MARBEF	Marine Biodiversity and Ecosystem Functioning
MEA	Millennium Ecosystem Assessment
Med-CLIVAR	Mediterranean CLImate VARiability and Predictability
MEFWAFWA	Ministry of Environment, Forest and Water Administration (Albania)
MENA	Middle East and North Africa
Med-HYCOS	Mediterranean Hydrological Cycle Observing System
MDGs	Millennium Development Goals
MSSD	Mediterranean Strategy for Sustainable Development
NAPA	National Adaptation Programmes of Action
NatComs	National Communications
NCSA	*National Center for Supercomputing Applications*
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organisation
NMS	National Meteorological Services
NOS	National Observing Systems
OSS	Sahara and Sahel Observatory
PAPP	Programme of Assistance to the Palestinian People
PAP/RAC	Priority Actions Programme/ Regional Activity Centre
PCs	Participating Countries
PESETA	Projection of Economic impacts of climate change in Sectors of the European Union based on bottom-up Analysis
PML	Plymouth Marine Laboratory
PP	Pilot Project
PPG	Project Preparation Grant
RAC/SPA	Regional Activity Center for Specially Protected area
R&D	Research and Development

REMPE	Regional Euro-Mediterranean Programme for the Environment
RENA	Regional Environmental Network for Accession countries
REReP	Regional Environmental Reconstruction Programme
SEE	Southeast European
SEEVCCC	South East European Virtual Climate Change Center
SESAME	Southern European Seas Assessing and Modeling Ecosystems changes
SLR	Sea Level Rise
SST	Sea Surface Temperature
START	SysTem for Analysis, Research and Training
SUSMAQ	sustainable management of the West Bank and Gaza Aquifers
TACIS	Technical Assistance to the Commonwealth of Independent States
TND	Tunisian Dinar
TWAS	Academy of Sciences for the Developing World
UfM	Union for the Mediterranean
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNECE	Convention of the Protection and Use of Transboundary Watercourses and International Lakes
UNFCCC	United Nations Framework Convention on Climate Change
UNESCO	United Nations for Education, Science and Culture Organisation
UNV	*United Nations Volunteers*
WB	World Bank
WCRP	World Climate Research Programme
WMO	World Meteorological Organization

1. INTRODUCTION

1.1 Context and Objectives of the report

Within the framework of UNEP GEF Project Preparation Grant (PPG) for the project *"Integration of climatic variability and change into national strategies to implement ICZM Protocol in the Mediterranean"* UNEP/MAP requested GEF assistance to finance a full-size project to address the issues of climate variability and change in the coastal zone of the Mediterranean.

The full-size project's objective is to support the implementation of Integrated Coastal Zone Management Protocol in the Mediterranean through development of region wide coordination mechanisms and tools to address climate variability in the Region. The project foresees the participation of the following GEF eligible countries: Albania, Algeria, Bosnia and Herzegovina, Croatia, Egypt, Libya, Morocco, Montenegro, Syria, Tunisia and the Palestinian Authority.

The project outcomes will be achieved through the implementation of four components:

1. Development of regional climate variability monitoring programme which will be:
   - Supported by a web-based regional data platform on climate research.
   - Linked with other data platforms, including MAP's regional activity centre on Information (INFO/RAC)
   - Integrated along with the database into national and regional ICZM monitoring processes.
2. Strengthening of knowledge base by:
   - Ensuring that current models assessing scenarios and impacts of climate variability are applied to the region
   - Assisting countries to more precisely calculate the impacts of climate variability to their marine and coastal zone
   - Focusing on the coastal watersheds, with emphasis on risks to water availability and quality and marine ecosystems (including agriculture and fisheries), and other risks such as coastal erosion and landslides.
3. Strengthening partnerships, capacity and exchange for implementation of the ICZM Protocol in order to enable stakeholders to:

- Conduct at the national level, inter-ministerial committees which will contribute to multi-sectoral dialogues on policy and management processes in the Mediterranean, and facilitate the mainstreaming of the ICZM protocol into national plans
- Create regionally strong platforms for exchange and sharing project experiences within the larger international waters community, through IW:Learn, IWC, IWENS, among others.

4. Project Management.

The purpose of this report is to contribute to the project document for the full-size project "Integration of climatic variability and change into national strategies to implement the ICZM Protocol in the Mediterranean", by providing information on experience in dealing with climate variability and climate change impacts on the coastal zone and vulnerability assessment in the above mentioned GEF eligible participating countries and on needs for improvement of their national capacity for climate change and variability monitoring and impacts assessment.

1.2 The Methodology used for the Desk Review

Based on the terms of reference, the methodology used focused on collecting, collating and analyzing of the existing and new programmes and initiatives on climate variability and climate change impacts and vulnerability assessments in the Mediterranean region. The methodology was based on a range of tools and methods for data collection, including (i) web-based and online databases, (ii) desk studies of publicly available information, (iv) National reports and questionnaires.

The objectives required to achieve the aim of this study are structured into 3 chapters summarized in Table 1.

Table 1: Key chapters and objectives

Chapter	Title	Details
1	Preliminary analysis of existing programmes and data for monitor climate change and variability impacts and proposition of activities for the full-size project.	*- Overview and preliminary of existing monitoring programmes and relevant data and indicators on climate change and variability impacts and their integration into ICZM in the participating countries.* *- List and short description of institutions that are implementing the monitoring programmes in the participating countries.*

		- Preliminary analysis of indicators for monitoring of climate change and variability impacts and use into ICZM *- Preliminary analysis of capacity gaps in the participating countries, that are required to track and monitor climate change and variability impacts and run supporting models.* *- Proposal of activities for the full-size project.*
2	Assessment of existing vulnerability and impact scenarios to climate variability and change for the participating countries and relevant activities proposed for the full-size project.	*- Analysis of existing vulnerability and impact scenarios (models) and available assessment data in the region.* *- Identification and description of the regional most vulnerable sites to Climate variability and change impacts in the participating countries.* *- Proposition of 2-4 zones for which the assessment of environmental and economic impacts would be done within the full size project.* *- Proposal of key requirements in terms of assessment of sites vulnerable to climate variability and change* *- Proposal of National and regional levels training programme*
3	Summary of proposed activities for the full- size project	*Summary of the potential activities that could be undertaken by the participating countries in coastal zones*

1.2.1 Key concepts and definitions

For the purposes of this study, the following concepts and definitions are used:

- *Climate change:* Climate change refers to shifts in the mean state of the climate or in its variability persisting for an extended period (decades or longer). Climate change may be due to natural changes or to persistent anthropogenic changes in the composition of the global atmosphere or in land use.

- ***Climate variability:*** Climate variability refers to variations in the mean state and other statistics (such as standard deviations, statistics of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability) (IPCC, 2007)

- *Climate Impacts* are the consequences of climate variability and change that are likely to affect the environment, including the ecosystems, the economy and the humans as a function of exposure and sensitivity to changes.

- *Sensitivity* describes the degree to which a system is affected, either adversely or beneficially. The effects of climate change may be direct or indirect.

- *Vulnerability*: is defined by the IPCC as “the degree, to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes.” Vulnerability is a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity” (IPCC, 2007). The vulnerability of a given system is a function of the climate variation to which this system is exposed (exposure), its sensitivity, and its adaptive capacity.

- *Risk* is the potential adverse outcome of a particular impact. It represents the combination of the likelihood (probability of occurrence) and the consequences of an adverse event (e.g., climate hazard) (Beer and Ziolkwoski, 1995; USPCC RARM, 1997).

Scenarios: A scenario represents a plausible and simplified description of how the future may develop, based on a coherent and internally consistent set of assumptions about driving forces and key relationships. Scenarios are often based on narrative storylines.

Storylines describe conditions that might be produced by human choices about economic and social policy, reproduction, occupations, and energy/technology use. Storylines are useful tools for policy makers to “vision” alternative future worlds.

Coastal zone: means the geomorphologic area either side of the seashore in which the 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 (Protocol on Integrated Coastal Zone Management in The Mediterranean, 2008).

1.2.2 Monitoring programmes & data bases

Data and information on climate variability and climate change impacts, which are accessible, up to date and relevant, are the key to helping the countries make better decisions on what actions they should take.

Under the monitoring programmes and databases, the inventory presented here provides a compilation of initiatives, projects and actions that are undertaken and/or are planned by single countries, multilateral bodies and agencies and/or international NGOs.
The review was based on available information collected through desktop review, but has also involved, whenever possible, information extracted from the national reports and/or the filled questionnaires sent by the MAP Contracting Parties in response to the request from the MAP. Despite this, the inventory is still far from being exhaustive as it is influenced by availability of data, especially when looking for 'horizontal' subjects such as Climate change programmes, and especially in the south and south eastern Mediterranean countries.

The monitoring programmes were categorized into 3 broad areas namely:
(a) Multilateral processes (Conventions, treaties, Initiatives)
(b) Regional programmes and projects (Balkans, North Africa and Middle East)
(c) National projects

2. PRELIMINARY ANALYSIS OF EXISTING PROGRAMMES AND DATA FOR MONITOR CLIMATE VARIABILITY AND CHANGE IMPACTS AND ACTIVITIES PROPOSED FOR THE FULL-SIZE PROJECT

2.1 Preliminary analysis of existing initiatives and monitoring programmes and projects for climate variability and change impacts

2.1.1 Multilateral processes

Conventions, treaties and initiatives

The main Multilateral Environmental Agreements (MEAs) addressing climate change issues and especially observation and monitoring of climate change impacts are mentioned below:

- *The UN Framework Convention on Climate Change (UNFCCC) (www.unfccc.int),* which sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change.

Under the Article 5 of the Convention (Research and Systematic Observation**)**, and for carrying out their commitments, the Parties shall:

> "(a) Support and further develop, as appropriate, international and intergovernmental programmes and networks or organizations aimed at defining, conducting, assessing and financing research, data collection and systematic observation, taking into account the need to minimize duplication of effort;
>
> (b) Support international and intergovernmental efforts to strengthen systematic observation and national scientific and technical research capacities and capabilities, particularly in developing countries, and to promote access to, and the exchange of, data and analyses thereof obtained from areas beyond national jurisdiction; and
>
> (c) Take into account the particular concerns and needs of developing countries and cooperate in improving their endogenous capacities and capabilities to participate in the efforts referred to in subparagraphs (a) and (b) above."

- The ***Intergovernmental Panel on Climate Change (IPCC)*** **(**www.ipcc.ch), a scientific intergovernmental body was set up by the World Meteorological Organization (WMO)

and the United Nations Environment Programme (UNEP) in 1988, released series of consolidated Synthesis of **Assessment Report** (AR).

The ***UNECE Water Convention***, under which a ***Task Force on Water and Climate Change*** (http://www.unece.org/env/water/water_and_climate.htm) has been established recently (Bonn, 22-23 November 2007) that aims notably to prepare a Guidance Paper.

- *The* ***Barcelona Convention framework*** under which the Regional Activity Centres of UNEP's Mediterranean Action Plan, are leaderships in Integrated Coastal Zone Management (ICZM) (PAP/RAC and Blue Plan), and in biodiversity (RAC/SPA). (http://www.unep.ch/regionalseas/regions/med/t_barcel.htm)

- ***The Integrated Coastal Zone Management (ICZM) Protocol of the Barcelona Convention*** was signed in Madrid on 21 January 2008 and enters into force on 23 March 2011 (http://www.unepmap.org/index.php?module=news&action=detail&id=110). It completes the set of Protocols for the Protection of the Marine Environment and the Coastal Mediterranean Region. It will allow the Mediterranean countries to better manage and protect their coastal zones, as well as to deal with the emerging coastal environmental challenges, such as the climate change. This Protocol is a unique legal instrument on ICZM in the entire international community and could serve as model for other regional seas.

- *International Solidarity for a Strategy on Climate Change in Africa and in the Mediterranean Region.* Tunis, 18-20 November 2007 (http://unfccc.int/files/press/news_room/statements/application/pdf/071118_statement_tunis.pdf**).** The Action Plan adopted at the Tunis Conference stressed on the necessity of improving data collection and monitoring systems, as well as the promotion of technology transfer for analysis and risk assessment for the successful management of water resources in the countries of the region.

The Lisbon Declaration **(**EU-Africa Summit, Lisbon, 8-9 December 2007): This declaration refers to climate change as one of the "key political challenges of our time" (http://europafrica.net/2007/05/20/lisbon-summit/)

The Almeria Declaration*,* adopted at the 15th Ordinary Meeting of the COP to the Barcelona Convention, Almeria, January 2008, stresses the importance of taking into account climate change and its adverse effects "on coastal and marine ecosystems and the environment in general and the negative consequences for sustainable development, particularly for developing countries in the Mediterranean basin". (http://www.emwis.net/documents/PDF/Almeria%20Declaration)

The Marrakech Declaration: adopted at the 16th Ordinary Meeting of the COP to the Barcelona Convention, Marrakech, November 2009: During ministerial discussions, the need for enhanced knowledge and scientific assessment as tools for policy makers to incorporate measures into adaptation plans was underlined. (http://unfccc.int/cop7/documents/accords_draft.pdf).The "Marrakech Declaration" stressed that adaptation to climate change in marine and coastal areas is a major priority for the Mediterranean region and that it requires regional guidance and coordination.

The Mediterranean Climate Change Initiative (Athens, 22 October 2010), is designed to be an autonomous political initiative as well as a projects-based initiative eligible for Union for the Mediterranean (UfM) branding. It aims to accelerate the region's responses to the impacts of climate change. This new initiative is envisaged as both an autonomous Mediterranean political initiative influencing international and regional agreements through common policy positions, as well as an initiative implementing projects under the auspice of the Union for the Mediterranean. The proposed Priority Work Areas for the Mediterranean Climate Change Initiative are as follows (http://www.medclimatechangeinitiative.org/sites/default/files/Joint-Declaration.pdf):

- *Mediterranean Climate Sensitive Development Charter:* Building on existing UNFCCC, EU and national strategies, this document would ensure that the full extents of climate change impacts are fully understood for the region.
- *Sustainable Mediterranean Cities:* Cities, and how they can be a key part of the solution to climate change, will be a major component of the Mediterranean Climate Sensitive Development Charter above.
- *Mediterranean Climate Change Fund:* The Mediterranean Climate Change Fund would attract funding from existing sources – the UN, EU, central governments, development banks, and sovereign and infrastructure funds.

- *Mediterranean Climate Change Service Network***:** The Climate Change Service Network could build on the work of existing scientific research institutes in the region to offer analysis on environmental, economic and social impacts at the regional and local level, assure fast response and facilitate efficient and timely cooperation.

The Southern and Eastern Neighbours Instrument: The European Neighbourhood and Partnership Instrument (ENPI) has been operational since 1st January 2007. (http://ec.europa.eu/europeaid/where/neighbourhood/overview/index_en.htm). The ENPI is the main source of funding for the 17 partner countries[1]. It 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-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.
The ENPI South Regional Indicative Programme 2011-13 foresees actions on climate change under its priority area 3, 'A Sustainable Development for the Mediterranean.'

The 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. (www.logincee.org/file/17974/library). 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.

- ***The New Partnership for Africa's Development (NEPAD)*** (www.**nepad**.org/). The Climate Change programme within NEPAD works to bring together all relevant regional

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

and continental players to co-ordinate, share knowledge and encourage one another in addressing the threat of climate change. The objective of the programme is to assist countries in integrating climate change responses into their national development processes. The programme is also looking to start collecting data and information on climate change mitigation and adaptation on the continent. The objective is to establish a database of relevant climate change information and develop sub-regional climate change frameworks.

- *The Arab Climate Resilience Initiative (ACRI)* (www.**arabclimateinitiative**.org) is based on the *Arab Declaration on Sustainable Development* of the Arab Ministers Responsible for Development, Planning and Environment, of 2002; on the *Arab Ministerial Declaration on Climate Change* issued by the Council of Arab Ministers Responsible for the Environment, of 2007; and on the resolution of the Arab Summit on Climate Change, of 2010. The overall objective of ACRI is to build the foundations of a regional platform to provide support for Arab countries in their processes of building and gaining knowledge related to climate change priorities, develop capacities to respond through strategic programmes and policies, and establish partnerships and other cooperation modalities to undertake joint work to address this challenge that has both local and global effects.

The programming areas of the ACRI framework include the following:

1. Supporting institutional capacity to address the impacts of climate change;
2. Supporting local approaches to climate change adaptation;
3. Enhancing resilience in the three priority areas of water and food security, sea-level rise and coastal erosion, and sustainable energy.

- *MENA Regional Business Strategy to Address Climate Change**:*** The World Bank has committed to assist MENA countries in their efforts to address the climate challenge through a variety of analytical tools and financial services including the Proposed Climate Investment Fund. The proposed business plan is organized around the two following dimensions:

- the World Bank projects (IBRD and IDA) that will serve as “vehicle” to deliver the mitigation or adaptation assistance;
- the additional activities that would help the countries reduce GHG emissions or enhance their resilience to climate change.

(http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/MENAEXT/0,,menuPK:247603~pagePK:158889~piPK:146815~theSitePK:256299,00.html)

Assessments of Impacts and Adaptations to Climate Change (AIACC) in Multiple Regions and Sectors (http://www.aiaccproject.org/) is a global initiative developed in collaboration with the UNEP/WMO Intergovernmental Panel on Climate Change (IPCC) and funded by the Global Environment Facility to advance scientific understanding of climate change vulnerabilities and adaptation options in developing countries. By funding collaborative research, training and technical support, AIACC aims to enhance the scientific capacity of developing countries to assess climate change vulnerabilities and adaptations, and generate and communicate information useful for adaptation planning and action. AIACC is implemented by the United Nations Environment Programme and executed jointly by START and the Third World Academy of Sciences (TWAS). Egypt, Morocco and Tunisia are among the countries that have been involved in AIACC Regional studies.

Global Observing and Monitoring Systems

Global Climate Observing System (GCOS) was established in 1992.This system includes observation in all parts of the climate system – in the atmosphere, ocean, sea and land. (http://www.wmo.int/pages/prog/gcos/index.php)

Global Earth Observation System of Systems (GEOSS) is a new initiative taken with the objective to co-ordinate and enhance all current observing systems on the global level in support of the requirements of user areas: natural disasters, health, energy, climate, water, weather, ecosystems, agriculture and biodiversity. (http://www.earthobservations.org/geoss.shtml)

Global Monitoring for Environment and Security (GMES) (http://www.gmes.info/) GMES is an EU-led initiative; it provides environmental information to policymakers and the public authorities to understand how our planet and its climate are changing and the role played by human activities in these changes, in order to prepare environmental legislation and policies with a particular focus on Climate Change. Users will be provided with information through services dedicated to a systematic monitoring and forecasting of the state of the Earth's subsystems.

A land monitoring service, a marine monitoring service and an atmosphere monitoring service contribute directly to the monitoring of climate change and to the assessment of mitigation and adaptation policies. Two additional GMES services address respectively emergency response (e.g. floods, fires, technological accidents, humanitarian aid) and security-related aspects (e.g. maritime surveillance, border control).

2.1.2 Regional/Sub-Regional Projects and Programmes

European and Euro-Mediterranean

***Sustainable MED program*:** The overall objective of this program is to "integrate environment within the economic development agenda of the Mediterranean following a shared common vision." Climate variability is among the three areas of intervention for the first phase. As regard to the participating countries, projects under implementation are as follows:

• Egypt: Alexandria coastal zone management project
• Croatia: Coastal Cities Pollution Control 2 (Phase II)
• Bosnia and Herzegovina: Neretva and Trebisnjica coastal Management Project
• Syria: Coastal and Orontes River Basins Water Resources Management
• Libya: Integrated Coastal Zone Management for Conservation and Economic Development
• Morocco: Integrated Coastal Zone Management for Lake Nador
http://www.cmimarseille.org/_src/EW1_SustainableMEDProgram_EN.pdf

Know-MED focuses on its initiation phase on water bodies, including climate impacts on water resources, river basins and coastal marine environment. Its objectives are to**:**

- provide targeted and relevant information to public and private decision makers;
- provide wider access to relevant knowledge on environmental stakes and opportunities in the Mediterranean (with a specific focus on improved water resources management, trans-boundary pollution reduction, vulnerability of water resources to climate variability, management of the risk of droughts or floods, and means to enhance resilience to climate change);
- support knowledge transfer by improving the exchanges of information and best practices, promoting the adoption of policies and measures to achieve common objectives through dissemination and capacity building activities.

- *The* ***Regional Euro-Mediterranean Programme for the Environment (REMPE):*** (http://smap.ew.eea.europa.eu/).The SMAP Clearing House - an Internet Portal to navigate the Mediterranean "Sea" of Information on the Environment (including North Africa). The Clearing House aims at providing the REMPE community with a tool for capturing, for each SMAP priority area, the current situation on a wider range of environmental topics, including climate change; Combating desertification and integrated coastal zone management.

The ***Kopernikus programme*** is the world's most intense environmental monitoring project. It plans to launch five satellites to measure several aspects of climate change, the first of which, Sentinel 1, is scheduled to enter into space in 2011.The programme is run by a joint commission between the European Space Agency (ESA) and European member states. The primary objective behind the Kopernikus programme is to offer European governments a comprehensive, coordinated system of observation and monitoring to more accurately report on the state of the earth's health. This is ultimately intended to guide European environmental policy with better and more accurate data. Among the more important climate change aspects Kopernikus is designed to inform about are deforestation, water level rise, wildfires, flooding, water runoff and coastal erosion, as well as Arctic sea ice levels.
(http://www.gsa.europa.eu/go/news/gmes/kopernikus-launches-eo-services)

Europe-Africa Marine Earth Observation Network (**EAMNet)** (www.**eamnet**.eu/) aims to construct a network linking Earth Observation (EO) information providers, user networks and centres of excellence in Europe and Africa in the area of coastal and marine observations towards sustainable development in Africa. The network will undertake capacity building and maintenance and build upon existing infrastructure and expertise in Africa. The overall aim is to improve the exploitation of EO data for coastal and oceanic monitoring towards an Africa-wide observation system (GOOS-Africa). It will provide an interface between European GMES-related core and downstream services and R&D projects (notably MyOcean) and African initiatives (e.g. AMESD) with the emerging GMES-Africa initiative. It will also provide further links with GEO. EAMNet is coordinated by Plymouth Marine Laboratory (PML) with 9 other partners in Africa and Europe. Egypt is Partner to this project.

Balkans Countries

The ADRICOSM Partnership (http://gnoo.bo.ingv.it/adricosm-star/) was launched as a Type II Initiative at the World Summit on Sustainable development in Johannesburg (2002) by the Italian Ministry for the Environment and Territory. It was based upon the implementation of the ADRICOSM Pilot Project (PP) which is implementing the backbone of the Adriatic Sea real time monitoring system, the prediction at the basin level and the coastal areas and the coupling between river basin modeling system and the hydrodynamic modeling of coastal areas. The main objectives of the Partnership are to (i) efficiently organize, evaluate and coordinate multinational research, development and implementation programs that advance the understanding, monitoring and predictive capabilities in the Adriatic Sea area for the establishment of integrated coastal areas and river basin management systems, and (ii) consolidate the monitoring and prediction system by involving users of the research products. Climate change and Disaster management and vulnerability have been treated as secondary themes.

Within the Partnership, three projects are conducted:

- ADRICOSM-EXTension - enlargement of ADRICOSM PP to Albania, Bosnia Herzegovina and Serbia Montenegro.
- ADRICOSM-PULA BAY - application of ADRICOSM Methodology in the Pula Bay (Croatia).
- NERES - assessment and management of the Neretva River (Croatia) Delta area.

Plan for adapting to climate change in Southeast Europe: Five Environmental ministers launched the Southeast European (SEE) Climate Change Framework Action Plan for Adaptation at a conference held in Sarajevo, 14/11/2008, thus making a concrete commitment to regional cooperation in combating climate change.

The five countries agreed to implement systematic observation, improve data exchange, develop climate change scenarios, produce climate change risk maps, establish national early warning systems against harmful effects of weather variables to human health, construct irrigation systems in drought prone areas, rehabilitate the existing and construct new flood protection and drainage systems.

(http://www.global-issues-rtd.info/programmes/2138.html)

- Middle East and North Africa (MENA) Region

- Climate Change Adaptation Support Programme for Action-Research and Capacity Development in Africa (CCAA) programme: Funded by the International Development Research Council (IDRC), Canada, and the Department for International Development (DFID), this programme aims to support African countries in their efforts to address vulnerability, particularly of the poor, to climate change. The programme objectives are:

- To fund and support research to reduce the uncertainty associated with climate change and variability;
- To strengthen the capacity of African scientists, Africa's research organizations, governments, civil society organizations, and international bodies to work collaboratively in assessing vulnerabilities to climate and other stresses, and supporting adaptation by African people, particularly the poor;
- To support adaptation by rural and urban people by supporting research that contributes to a more inclusive policy-making process. (http://www.idrc.ca/uploads/user-S/11913329091CCAA_strategy_document.pdf)

- ***The African Climate Change Fellowship Program (ACCFP)*** offers education, research and training opportunities to African professionals, researchers and graduate students to build their capabilities for advancing and applying knowledge for climate change adaptation in Africa. The ACCFP is jointly administered by START, the Institute of Resource Assessment (IRA) of the University of Dar es Salaam and the African Academy of Sciences (AAS), with generous financial support from the Climate Change Adaptation in Africa (CCAA) Program. (http://accfp.pass-africa.org/)

- *Climate for Development in Africa (ClimDev Africa):* The programme is an integrated, multi-partner programme addressing climate observations, climate services, climate risk management, and climate policy needs in Africa. The user-driven programme will support efforts to achieve the millennium development goals. (http://www.uneca.org/eca_programmes/sdd/events/climate/climdev.pdf). In addition to GCOS, principal partners are the UN Economic Commission for Africa, the African Union, the African Development Bank, the World Meteorological Organization, and potential donors including the UK Department for International Development.

"Drought Management Centre for South Eastern Europe" (DMCSEE) led by the Agency for Environment from Slovenia. (http://www.dmcsee.org/). The mission of DMCSEE is to coordinate and facilitate the development, assessment, and application of drought risk management tools and policies in South-Eastern Europe with the goal of improving drought preparedness and reducing drought impacts. Therefore DMCSEE will focus its work on monitoring and assessing drought and assessing risks and vulnerability connected to drought.

The South East European Virtual Climate Change Center functions related to climate change, vulnerability and adaption (SEEVCCC): Following the call of the World Meteorological Organization to its member countries to take measures, in accordance with their respective capabilities, to strengthen international cooperation through appropriate national, subregional and regional climate centers, at the beginning of 2006, National Hydrometeorological Service of Serbia initiated an establishment of South East European Virtual Climate Change Center (SEEVCCC). (http://www.seevccc.rs/?p=668). Immediately after the adoption of the Belgrade Initiative, in 2008, SEEVCCC was established within the National Hydrometeorological Service of Serbia, with administrative head office in Belgrade. The mission of this center is:

- Fulfilling the needs of SEE countries for information on subregional climate change on permanent basis;
- Providing permanent support for capacity building of national hydrometeorological services in terms of human resources and improvement of products and services in the area of climate change in the sub region;
- Linking science and adaptation planning policy planning, as well as management of climate change risk, and
- Serving as a model partnership between national hydrometeorological services in the region and other interested institutions dealing with climate change, as well as with relevant international organizations, regional climate centers, donors, etc.

- The Climate Change Data Center for the Arab States is a searchable database of up-to-date climate change and environment data on the twenty Arab countries covered by UNDP's Regional Bureau for Arab States.
(http://www.arabclimateinitiative.org/)

- The ***African Centre of Meteorological Application for Development (ACMAD):*** (www.**acmad**.ne/en/homepage.htm). ACMAD's mission is the provision of weather and climate information for the promotion of sustainable development of Africa, in the fields of agriculture, water resources, health, public safety and renewable energy. ACMAD carries out its mission through: capacity-building for the 53 National Meteorological Services (NMSs) of its Member States, in weather prediction, climate monitoring (extreme events…), transfer of technology (telecommunications, computing and rural communication), and in research.

- The ***Sahara and Sahel Observatory (OSS)*** (http://www.oss-online.org/) is an independent international organization based in Tunis, Tunisia. OSS was founded in 1992 to improve early warning and monitoring systems for agriculture, food security and drought in Africa. The OSS work programme in arid, semi arid and sub-humid areas in North, West and East Africa, includes long-term observations and networks focusing on land degradation issues and the identification and collection of a number of biophysical indicators to help to assess the sub-regions needs and vulnerabilities to climate change and thus identify potential action for adaptation.

- The ***Centre Régional Africain des Sciences et Technologies de l'Espace en Langue Française (CRASTE-LF),*** is a training and research institute established in 1998 in Rabat, Morocco under United Nations sponsorship to promote the utilization of space science and technology and develop related national and regional capacity.

2.1.3 National projects

Albania:

The main program working in the country is the UNDP climate change program that is implemented by the UNDP in collaboration with the MEFWAFWA. In this context have been established the Climate Change Unit which tries to coordinate the activities with the government institutions in this field.

- The project "Identification and implementation of adaptation measures for the Drini-Mati deltas" is supported by UNDP and GEF. The deltas of the Drini and Mati rivers 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. A supporting objective aimed to integrate the management of climate change into local development policies.

- On 2006, MEFWAFWA within financial support of GEF/UNDP prepared National Capacity Self Assessment for Global Environmental Management. The objective was to assess capacity needs and priorities with respect to the global environment and within the context of sustainable development so that Albania can meet the requirements of the Global Environmental Conventions in a coordinated and strategic manner. The NCSA took into account the Conventions on Biodiversity, Climate Change and Land Degradation and was focus on cross-cutting issues and synergies between the Conventions. Based on this document, the most vulnerable area is Albania's coastal zone, while the most vulnerable sectors are water resources, agriculture energy and tourism.
- The Integrated Coastal Zone Management for the Southern coast of Albania (WB project) was another attempt to include the climate change effect in the coastal zone development issues. But the project did have some serious problem in the implementation and did not reach it expected results.

Algeria:

- "Elaboration of a National Climate Change Strategy and Action Plan": This UNDP/GEF project assisted Algeria in meeting the reporting requirements of the UNFCCC. The project was also an exercise to enhance general awareness and knowledge of climate change- related issues in Algeria.
- "Climate change enabling activity" (additional financing for capacity building in priority areas): UNEP/GEF: This project focuses on three key areas: technology transfer to address climate change, systematic observation systems, and emission factors. The workshops and activities intended to address these areas are not simply forums for exchange, but working groups make up of specialists and experts.

- CIRCE coastal case studies: Gulf of Oran: Key research issues related to climate change include accelerated coastal zone degradation and marine system modification, and the availability and quality of water resources.

Bosnia and Herzegovina:

- “Preparation of the Initial National Communication to the United Nations Framework Convention on Climate Change – UNFCCC”: This UNDP/GEF project assisted Bosnia and Herzegovina in meeting the reporting requirements of the UNFCCC by: Producing a report on National Circumstances, Producing a National Greenhouse Gas inventories; Preparing programmes containing measures to facilitate adequate adaptation to climate change; Preparing programmes containing measures to mitigate climate change; Assess constraints & gaps, related to financial & capacity needs.

- “Mainstreaming environmental governance: linking local and national action in Bosnia and Herzegovina” : the proposed programme to be jointly implemented by FAO, UNDP, UNEP, UNESCO and UNV aimed to address and overcome barriers to delivering environmental services and management at the local level in BiH, integrate environmental governance into planning, improve environmental management and formulate reliable environmental indicators. (implementation period: January 2008 - December 2010)

Croatia:

- UNEP pilot projects: *"Implications of expected climatic changes for Kaštela Bay Region of Croatia"* and *"Implications of expected climatic changes for the Cres-Lošinj Islands"*: A valuable international project has recently been conducted by the UNDP Office in Zagreb whose results are published in the report “*Climate for Change*”.

The UNDP 2008 Human Development Report for Croatia demonstrated that climate change is happening and that actions must be taken to reduce its impacts and reduce the extent of that change.

- The first five “*National Communications of the Republic of Croatia to the United Nations Framework Convention on Climate Change (UNFCCC)*“ are valuable sources of climate variability and change issues activities published since during last decade i.e. from 2001 to 2010.

Egypt:

- Adaptation to the Impacts of Sea Level Rise in the Nile Delta Coastal Zone (Egypt): 3 year project funded by IRDC, in the framework of CCAA, the objective of

this project is to demonstrate the value of stakeholder participation in evaluating the trade-offs between adaptation options in the stretch between Ras El Bar and Gamasa on the northern coast of Egypt. The project aims to advance the science and technology that underpin preparations for and responses to climate-related events; contribute to information systems that guide policies for public protection; and possibly support the implementation of adaptation measures in the regional context.

- Adaptation of the Nile Delta to climate change through integrated coastal zone management (UNDP-GEF): 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.
- "Climate Change RIsk Management in Egypt": The aim of the proposed joint programme is to help Egypt align its climate risk management and human development efforts in pursuing the achievement of MDGs in the face of climate change and the predicted serious threats to the country. In this context, the project will serve to reduce poverty and mitigate risk by combining mitigation and adaptation under one integrated climate risk management (CRM) banner. The joint programme will build awareness and capacity of key decision makers and development actors to support the systematic integration of climate change as a new variable in key policy, regulatory, institutional and operational frameworks and implement pilot projects. (Implementation period: October 2008 - October 2011)
- CIRCE coastal case studies: Western Nile Delta: Main issues: recent large-scale unplanned developments and poor awareness of environmental issues; direct inundation due to sea level rise, salt water intrusion, and water logging; coastal erosion rates currently exceeding 50 meters per year in some areas; concerns over water resources, agricultural resources, health and economic effects of pollution.

Libya

-“Enabling Activities for the Preparation of Initial National to UNFCCC”: Supported by UNEP and GEF.

Montenegro

- “The Economic Impacts of Climate Change in Montenegro: A First Look”: this study has been funded by UNDP to identify the data and state-of-the-art models and methods needed to estimate the economic impacts of climate change and the benefits and costs of adaptation in agriculture and forests, tourism, water resources and human health in Montenegro, and to use existing data, models and methods available in Montenegro to make some highly preliminary estimates of the economic value of the physical impacts that were identified in the First National Communication.

Morocco

- Initial National Communication (INC 2001): 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): 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.

- Project on “Assessment of Climate Change Impacts and Adaptation in the coastal areas of Morocco”, (2004-2005): Supported by UNEP/GEF in the framework of AIACC Regional studies, this project aimed to: (i) Assess the biogeophysical and socioeconomic impacts of climate change and rising sea level on the coastal zones of Morocco, (ii) Assess the Vulnerability and Adaptation options to the adverse effects of climate change and (ii) Strengthen the scientific and technical capacities of the country in modeling and analysis of climate change impacts.

- Moroccan Coastal Management: Building Capacity to Adapt to Climate Change (ACCMA): 3 year project funded by IRDC, in the framework of CCAA: The project aimed to support capacity building and the development of tools and methods to underpin preparation for and responses to climate-related events in coastal zones,

where much of the population, resources and infrastructure are concentrated. It has identified population vulnerability; develop adaptation strategies and land use guidelines while optimizing the tradeoffs between different stakeholders; and enhance local capacity for participatory planning.

- Coastal Area Management Programme: CAMP Morocco (2008-2010): The CAMP Morocco is a project implemented within the Coastal Area Management Programme (CAMP) of the Mediterranean Action Plan (MAP) – UNEP. The general objective of the project was to contribute to national efforts towards development of the local population of the Rif Central coastal zone, while ensuring protection and sustainable use of coastal resources and to create the conditions for implementation of the planning system and integrated management of resources in the coastal area of Morocco.

- Sustainable MED/Investments and Technical Assistance Projects: Integrated Coastal Zone Management for Lake Nador. The objective of the project is to support integrated coastal zone management in selected areas of Morocco's Mediterranean coast to reduce pollution and loss of biodiversity and to enhance communities' resilience to climactic risk.

Palestine

- Climate Change Adaptation Strategy and Program of Action for the Palestinian National Authority: The program was initiated by Environmental Quality Authority (EQA) and financed by UNDP/PAPP

- GLOWA-Jordan River Project: is an interdisciplinary and international project consisting of hydrologists, climatologists, ecologists, economists from Jordan, Palestine, Israel, and Germany.

It is financed by the German Federal Ministry of Education and Research (BMBF) as part of the GLOWA research initiative: Global Change in Hydrological Cycle. The project is coordinated by the Department of Plant Ecology of the University of Tübingen, Germany.

- SUSMAQ: The project was financed by the British Government and implemented by Palestinian National Authority.

Syria

In the past 10 years, Syria has developed several strategies and introduced measures within existing national policies and plans in order to address adverse effects of human activities on the environment. The main strategies are:

- Coastal Area Management Program - CAMP (1994)
- National strategy for combating desertification (2002);
- Strategy and national action plan for biodiversity (2002);
- Strategy and national environmental action plan (2003);
- National Action Plan for Protection of the Mediterranean Marine Environment from Land-Based Activities in the Syrian Arab Republic (2005);
- The 11th five year social and economic development plan (2011-2015).

As part of the 11th five year social and economic development plan for Syria (2011-2015), it was agreed to incorporate the National Adaptation Plan of Action (NAPA), which was proposed by Syria's 1st Initial National Communication to the UNFCCC (2010). After reviewing available published national developmental polices and environmental strategies, the Syria National Report Concerning Experience in Dealing with Climate Variability and Change (2011) concluded that climate change impacts are directly addressed in the current 11th five year development plan (2011 – 2015).

Tunisia:

- "Implementing the United Nations Framework Convention on Climate Change (UNFCCC) in Tunisia": (2006 to 2011): Project commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ). The project objective is to provide support for measures to reduce anthropogenic greenhouse gas emissions; the main source is Clean Development Mechanism (CDM) financing.

- "Supporting Integrated and Comprehensive Approaches to Climate Change Adaptation in Africa – Promoting Resilient Coastal Development in Tunisia": Funded by the Government of Japan and i*mplemented by* UNDP and the Ministry of Environment and Sustainable Development and Agence de Protection et d'Aménagement du Littoral (APAL). The objective is to strengthen the resilience of development efforts in the face of climate change, particularly in coastal zone.

- CIRCE coastal case studies: Gulf of Gabes: 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.

2.2 Preliminary analysis of capacity gaps that are required to track and monitor climate change and variability impacts

The review of the range of existing monitoring programmes, projects, initiatives and relevant data base for climate variability and change impacts undertaken in the PCs and throughout the Euro-Mediterranean region has allowed a number of key observations on the status of these programmes in the region, and the identification of the main gaps and needs that are required to track and monitor climate change and variability impact in the region.

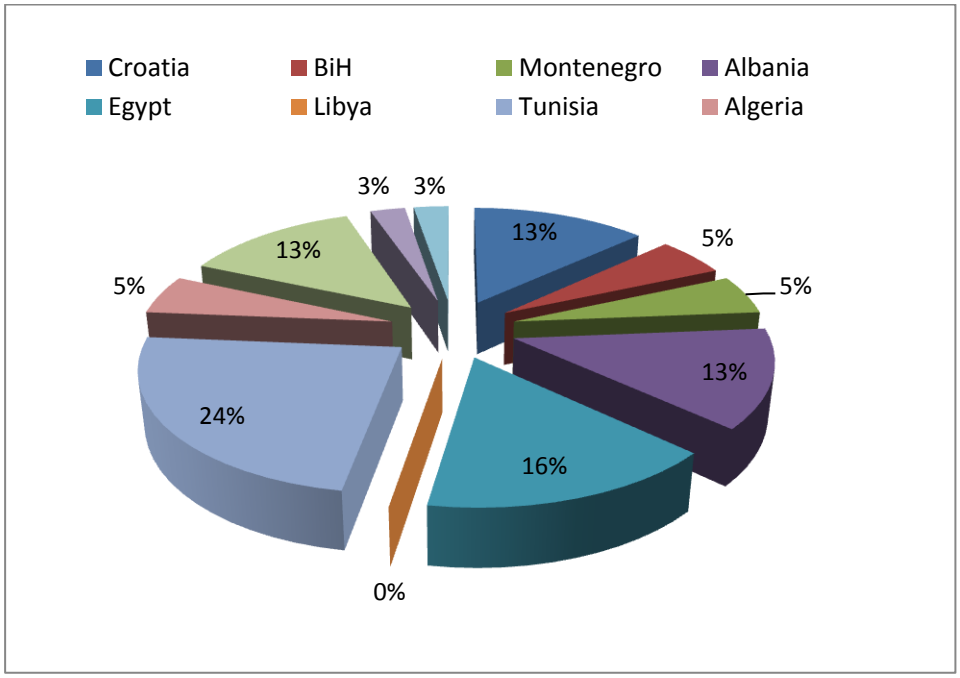
The preliminary analysis of gaps, barriers and constraints, based on the country's National reports and available public information, could be categorised into 3 broad areas: Research; Systemic Observation; and Institutional arrangements.

2.2.1 Research

Research activities included national initiatives as well as participation in international efforts in global research programmes related to climate change.

Even if based on a no-exhaustive inventory, the analysis of the projects and programmes on CC impacts in the region showed (Figure 1) that Tunisia is by far the most involved in regional projects (24%), followed by Egypt (16%), and then Albania, Croatia and Morocco (14%). The least involved are Syria and Libya.

Figure 1: Share of country's contribution in regional projects



Research areas reported by the countries included the impacts of climate variability, climate change and extreme weather events on the hydrological cycle and water resources; agriculture, human health especially vulnerability to diseases and the effect of heat stress, tourism, energy, forests and biodiversity.

The report on “The Economic Impacts of Climate Change in Montenegro: A First Look”, envisioned by UNDP, is the only study that attempted to identify the data and state-of-the-art models and methods needed to estimate the economic impacts of climate change and the benefits and costs of adaptation in agriculture and forests, tourism, water resources and human health in Montenegro.

Few researches are specific to the coastal zone. At national level, probably because of the presence of deltaic zones, known as very vulnerable areas to SLR, Egypt and Albania are the countries that have conducted in-depth assessments of CC impacts on their coastal deltaic zones, through UNDP/GEF funded projects. Tunisia and Morocco have also studies in some low-lying areas of their coasts.

All of the countries mentioned that limited national budgets, inadequate financing, and limited technical support and human capacity are constraints to further research, and expressed a need for more research in several areas including the coastal zone, to allow them to monitor the localized effects of climate variability and climate change.

Overall, the following gaps are among the most common to almost all of the PCs:

- Many of the PCs lack capacity and human resources to conduct integrated assessments to evaluate the impacts of climate variability and change on different priority sectors of the coastal zone.
- Uncertainty in the climate elements and interactions, including nonlinearities, feedback loops, and delays. Weak understanding of the link between CC and extremes events.
- Lack of regional climatic prediction models. Additional capacity-building is requested to improve the downscaling of climate models, the accuracy of precipitation modeling and early warning of extreme events and disasters such as flash floods, tsunamis, dust storms and droughts.
- Socioeconomic data are either unavailable or available in inappropriate form in many of the PCs.
- Lack of cross-sector coordination on issues linking climate change and the coastal zone.
- Scientific results on CC impacts need to be communicated in appropriate form to the relevant national stakeholders so that the necessary actions can be taken.
- Projects and programmes for assessing CC impacts appear to have been initiated and conducted thanks to multilateral funds. Few of the projects have been driven by a national need to deal with CC issues.
- Technical and financial support is urgently needed to establish research programs with teams from existing universities and research institutes.
- University education in most of the participating countries is not providing an adequate education to meet the challenges of CC, coastal zone and water management.

One of the major capacity gaps identified in this analysis is the lack of scientific networks and cooperation among them to promote and conduct good social and ecological science, and develop ways to integrate science into coastal policy making at sub-regional and regional levels.

2.2.2 Systematic observation

Tables 2 and 3 list the national networks of observation stations related to systematic observation of climate change in the different sub-regions. Although several countries did not provide details of their observation stations, almost all of them have synoptic, climatic, meteorological, rainfall and hydrological monitoring stations.

Some countries are participating in international efforts in global observing systems relating to climate change, through collaboration and cooperation with regional and international organizations. These programmes include the Global Climate Observing System (GCOS), and the Global Ocean Observing System (GOOS). Several PCs mentioned technical cooperation with neighboring countries through the sub-regional networks.

Table 2: National networks of observation stations contributing to systematic observation

	Meteorological stations	Climate stations	Synoptic stations	Rain Gauges	Hydrological stations	Marine & coastal stations			Air observing stations	Satellite stations	Other stations
						Tide gauges	SST	Sea water			
Balkans Countries											
Croatia	X	X	X	X	X	X	X				Phenology
BiH	X		X								
Montenegro	X	X	X	X							
Albania	X	X	X	X	X	X	X	X			
North African Countries											
Egypt	X	X	X	X	X	X	X	X	X	X	
Libya											
Tunisia	X	X	X	X	X	X	X	X			
Algeria	X	X	X	X	X			X	X		
Morocco	X	X	X	X	X	X	X	X	X	X	
Middle East Countries											
Syria	X	X		X							
Palestine Authority	X	X		X							

Regarding the coastal zone, some of the countries have observation systems for sea-level and seawater changes (such as Croatia, Albania, Egypt, Tunisia and Morocco), and few of them keeps track of coastal ecosystems and biodiversity changes (such as Albania, Egypt and Tunisia). Countries involved in MedPOL have basic pollution monitoring network.

One of the main barriers that seem to hamper the observation networks is the lack of an integrated coordinated and standard approach in the national arrangements for collection, storing, quality control and dissemination of climate observation data. Several countries stressed on their need to develop, extend and/or modernize their national climate observation systems. They highlighted their limited national budgets, inadequate financing, technical support and limited human capacity for research and observation. Some participating Countries reported a problem of depletion of stocks of instruments and equipment (Balkans, Palestine).

One of the priorities that emerged is strengthening the capacity of institutions involved in the collection, processing and maintenance of data and information relating to areas such as meteorology, hydrology and climatology.

2.2.3 Institutional arrangements

- Most countries reported the involvement of several governmental bodies (ministries of environment and physical planning, national offices of meteorology...), agencies, universities and research institutes in systematic observation.
- In most countries, the meteorological agency is responsible for undertaking and coordinating observations.
- In most of them there is no single body responsible for directing CC research.

Table 5 lists the main institutions involved in national networks relating to systematic observation of climate change.

- Most countries reported on the poor coordination within and/or between government departments and agencies; and in some cases, on the lack of clarity over roles and responsibilities in CC issues.
- Lack of consideration in climate change programmes of universities and research centers in most of the countries;

Summary

In the Participating Countries, there are national monitoring and data collection programmes for a number of the Essential Climate Variables. However, knowledge on climate change impacts is restricted by:

- The quality and continuity of the available data and information, themselves limited by lack of appropriate and modern infrastructure;
- Unsuitability of the resolutions of climate models to the relevant geographical scale
- Low availability and insufficient robustness of data on socioeconomic and biophysical changes of coastal ecosystems;
- Poor coordination within national institutions and poor cooperation and exchange of information between the sub-regions.
- For many climate change impact indicators, there are no regular National or sub-regional monitoring programmes.

Following on from these findings, it appears that there is an urgent need to enhance monitoring, data collection and dissemination, reduce uncertainties in climate and impact modeling, and enhance cooperation and networking among the sub-regions. Other management tools must also be developed, such as impact indicators based on the modifications observed in coastal ecosystems and introduction of indicators for monitoring of achievements of projects and programmes.

Another pressing need is to encourage and enhance collaborative efforts across the sub-regions and identify new programmes that bring together research groups to solve common problems on climate change issues at the national, sub-regional and regional levels.

Table 3: Observation networks and databases (From the NatComs and National reports)

Country	Monitoring /Observation Programmes	Parameters monitored	Responsible Institutions	Remarks
Balkans				
Croatia	41 main, 117 climatological, 336 precipitation and 23 rain storage stations. >100 hydrological 30 phenological 5 marine stations for sea-level including about 30 sea surface temperature gauges	Soil temperature, soil moisture, pan evaporation, solar radiation Sea surface temperature Sea level	Meteorological and Hydrological Service of Croatia	available in electronic ASCI format Data since 1980
Bosnia and Herzegovina (BiH)	In Republic of Srpska: 26 meteorological stations, out of which two are Class 1 weather stations In FBiH: 13 professional weather stations		Ministry of Foreign Trade and Economic Relations of BiH	need to further modernize the network by the introduction of Automatic Weather Stations and their connection into a system of automatic monitoring together with hydrological stations
Montenegro	8 main automatic stations, 20 climatic and 80 precipitation stations	Wind speed and direction, temperature, precipitation and sunshine hours, pressure, sea temperature relative humidity and visibility.	Hydro meteorological Institute of Montenegro	data are stored in the digital Oracle database
Albania	Meteorological network *: 126 stations* Hydrological network *:* 103 stations (6 in seacoast and lagoons)	All meteo parameters water level river discharge tide parameters, wind, water temperature and some chemical elements	Institute of Energy, Water and Environment Ministry of Environment	Data stored in the paper format and only a part of it is in the electronic format. Nowadays they are under the digitizing process.
North Africa				
Egypt	112 stations including surface and atmospheric stations, air pollution, global radiation and agro-meteorological stations Satellite Systematic Earth Observations: 26 agro-meteorological stations 7 Tide gauge stations in the Delta and on the Mediterranean coast	CO, NOX, O3, TSP and SO2 Total coliforms, ISO 56679; Ecoli, ISO 9308-1; Fecal Streptococci, ISO 78992 Depth; salinity; conductivity ; pH; temperature; dissolved oxygen; transparency Nitrite; nitrate; total phosphorus;	Central Agency for Population, Mobilization and Statistics Egyptian Meteorological Authority Egyptian Environmental Affairs Agency (EEAA) Institute of Graduate Studies and Research National Authority of Remote	EEAA has an established a website where these data are published

		total nitrogen; ammonia; reactive phosphate; Chlorophyll–a.	Sensing and Space Sciences Ministry of Water Resources and Irrigation	
Libya				
Tunisia	26 synoptic stations 34 agro-meteorological 54 climatological stations 182 rain stations	All atmospheric parameters Sea level	Institut National de la Météorologie	This network is being automated Database in digital format
Algeria	79 synoptic stations, 40 climatological stations 10 automatic Stations with transmission in real time in the Wilayaof Algiers 125 automatic monthly climatological stations Network of air quality control	All atmospheric parameters water quality (including Bathing waters) Air quality	Office National de la Météorologie Agence Nationale des Changements Climatiques Agence spatiale algérienne	
Morocco	44 Synoptic meteo stations 4 numerical tide gauges recently installed 19 Air quality stations Hydrological network: 265 hydrometric stations, 710 Periodic gauging points; 209 monitoring stations for superficial water and a network of 480 stations for groundwater Flood warning network 188 Radio transceiver posts) Drought Observation Network	All atmospheric parameters water quality (including Bathing waters) Air quality Acidity of rainwater in some cities Sea level	National Meteorology Directorate General Directorate of Hydraulics Directorate of Statistics Department of Environment National Research Institute for Fisheries And other Research Centers	
Middle East				
Syria	Over 30 monitoring stations distributed in the coastal area	temperature, relative humidity and precipitation	General Directorate for Meteorology Other governmental institutions	Most of available monitoring data from existing networks are either not continuous in time and space, and/or with limited accuracy due to the physical state of some monitoring stations.
OtP	12 partially functioning metrological stations in Gaza	temperature, rainfall precipitation, and humidity and wend speed	Palestinian Ministry of Transportation Environmental Quality Authority	Meteo data are available from 1973 to 2010

Table 4: Gaps and Needs

Country	Constraints / Gaps / Needs
Balkans	
Croatia	-Lack of technical and scientific research on vulnerability to climate change and adaptation -Low level of knowledge and lack of funds for research programs -Need to improve the existing system for the collection of data relating to the sea level changes, sea current directions and forecasts of wind waves along the eastern Adriatic coast - Need to prepare detailed scientific and expert studies to estimate the maximum area of the coast that will be overflown or periodically flooded, the population exposed to flooding effects and the penetration of salt water into freshwater reservoirs. - Need for monitoring and recording hydrological and meteorological data assessment of climate change impacts on evapotranspiration and discharge; -Need for preparation of regional studies of expected climate change impacts on water resources. -Implementation of multidisciplinary oceanographic and hydrographic research into the Adriatic Sea and identification of the process of interaction between the climate and marine ecosystems; -Establishment of permanent monitoring of fish species that are biological indicators of changes in hydrographic properties of the sea; -Identification of particularly vulnerable areas by sectors -Strengthening of scientific and research work in the field of vulnerability and adaptation; -Ensuring sustainable management of natural resources and integration of climate change issues; -Education and dissemination of information in order to develop awareness on the impacts of climate change on human health.
Bosnia and Herzegovina	- Lack of experience, insufficient capacity - Inadequate collaboration and exchange of information among institutions - No comprehensive environmental policy at the state level - No institution entirely dedicated to the environmental protection issues - Lack of financial transparency in the environmental sector - Awareness of causes and potential consequences of climate change is low. - Need to assess the implications of development in the context of reduced water resources. - Need to improve the water management system. - Need to assess the impacts of climate change on hydrology and water resources and the water management system. - Assess the socioeconomic effects of ecosystem loss. - Develop the elements of an activity plan for the prevention, decrease and mitigation of negative socioeconomic impacts. - Manage protected areas and special interventions needed at given locations - Educational institutions at the state level should adopt an education strategy on climate change for formal education at all levels - Introduction of indicators for monitoring of achievements

Montenegro	- Lack of technical and scientific research on vulnerability to climate change and adaptation - Exchange of information among different institutions is not satisfactory - Cooperation between the research sector and policy makers is not satisfactory - Level of knowledge and understanding on the impacts of global climate change on terrestrial and marine ecosystems and biodiversity is very limited - Experts, information and knowledge in this field are lacking. - Capacities to assess impacts of climate change on human health are insufficient. - pronounced lack of funds for research programs on vulnerability and adaptation, as well as for support to the work of expert and/or advisory bodies -Strengthen human and technical capacities within overall institutions - Need to strengthen the support to scientific research - Need to improve cooperation /exchange of information among all stakeholders - Need to establish databases by sectors and ensure their regular updating. - Need to collect necessary data for the assessment of impacts of climate change on biodiversity - Need of Training of experts and awareness raising - Need to increase the technical capacities for monitoring and updating basic data sets - Modern tools for vulnerability assessment in almost all vulnerable sectors (hardware, software and training of personnel) - Training of national experts, both for running of climate change scenarios (models) and for assessment of climate change and variability impacts; - Finer resolution of regional climate change models as well as methods for simulation extreme weather events - Development of socio-economic scenario - Production of climate change risk maps.
Albania	- No any monitoring of the climate change effects on coastal area. - lack of understanding of factors determining the resilience and adaptive capacity of ecosystems, including the roles of habitat extent, connectivity and quality, flow regimes, and disturbances; - Need to assess the changes of the coastline and the effect of river basin in this phenomena; - Need to analyses the species, habitats and ecosystems most vulnerable to climate changes; - Need to analyse of present and future social and economic - Improvement of data collection and reporting on activity in the key sectors, -Strengthen the Capacity of research institutions for key climate change issues (energy efficiency, reforestation, agricultural practice, etc.). -Need for Network of automatic meteorological stations - Need for Network of automatic hydrological stations - Need for Monitoring of sea level and shoreline - Need for Modernization of hydraulic laboratories - Need to strengthen capacity in Satellite remote sensing and Geographical Information System (GIS) - Warning system for abnormal phytoplankton blooms - Fast screening tests for detection of bio-toxins in shellfish species.
North Africa	
Egypt	- Vulnerability assessment of the coastal zone in view of adopted scenarios of sea level rise

	- Monitoring, modeling and assessment of impacts of salt water intrusion on soil salinity. - Monitoring, modeling and assessment of potential impacts of climate changes on coral reef and impacts on tourism - Socioeconomic considerations of immigration of vulnerable communities and employment considerations in safe areas - The establishment of proper systematic observation systems, monitoring networks and institutional information systems on sea lever rising to support decision making. - The systems primary objectives would be the identification of vulnerable areas; the building of databases; the development and implementation of measures for resource protection; and the follow up and enforcement of planning regulations - The institutionalization of systematic observations of sea surface temperature, coastal land use and sea level variations, ensuring the availability of results for to the scientific community and policy makers. - The establishment of a network of tide gauges over the Mediterranean, the Red Sea, and Lake Nasser. - The establishment of institutional capacities for monitoring coastal and sea surface temperature variations in the Red Sea, Lake Nasser and Lake Qarun. - Maintaining and strengthening disease surveillance systems for monitoring incidences and prevalence of diseases vulnerable to climate change, including more effective use of remote sensing and non- traditional observing strategies.
Tunisia	-Improve studies on climate variability, its predictability and possible changes; -Assess the ecological and socioeconomic vulnerability of the country to the impacts of climate change -Improve climate modeling -Define the most appropriate way to integrate climate change concerns into all development projects; -Consolidate the National Committee on Climate Change and establish a permanent national unit working on climate change. -Access to the most recent information and scientific knowledge on CC - Acquire know-how in the field of evaluation and monitoring of sea levels, and direct and indirect effects of climate change on natural ecosystems and economic activities such as agriculture and health. -Facilitate access to predictive models used in the field of climatology -Conduct consistent studies in the field of vulnerability and adaptation, especially on aspects related to the economic assessment of vulnerability and adaptation costs.
Algeria	-Improved collection and management of climate data and other relevant data. -Establishment of a monitoring system of changes in sea level, coastal erosion and sea water temperatures. -Establish a dashboard for monitoring the parameters mentioned above in the areas most vulnerable to CC -Improve communication between all structures and stakeholders dealing with climate change impacts studies. -Need for cooperation projects and technology transfer in monitoring and modeling of coastal erosion and vulnerability assessment. -Strengthen local capacity to enable them to participate in systematic observation regional and subregional networks -Strengthen and implement effective information
Morocco	- The existing observing and monitoring networks are not integrated and are weakly optimized - Lack of financial resources for: the systematic observation networks implementation, operation and development -The institutional fragmentation hampers the communication of results on CC projects managed by different implementing institutions - Lack of consistent socioeconomic scenario specific to the local/national context - The use of high resolution models or downscaling techniques is not easy because of their prohibitive cost and/or lack in human capabilities - Need for modernization of information systems and capacity building and skills -Need to strengthen legal, institutional and organizational needs in the field of Research and Development and Systematic Observation

	- Need to improve information exchange and participation in exchange networks; -Need for Training specific to climate change, particularly as regards the use of data from space observation and new technologies information; - Need to develop relevant indicators to characterize the vulnerability to CC impacts in areas that could be affected directly or indirectly at national, regional or local scale. - Need to harmonize the methods of collection, storage and compilation of data.
Middle East	
Syria	-Lack of analytical tools and technical capacity for data processing (data interpretation process for transforming the data into information useful for decision makers). -Lack of data on historic sea level rise along the coastal area. -Lack of data in all main sectors. - Limited expertise in the scenarios models. -The meteorological monitoring networks operated by the various national institutions are not integrated - Missing data in the daily and monthly climatological time series - Permanent problems in operation in monitoring stations, slow modernization of equipment and degradation of the existing monitoring network. - Lack of regional climatic prediction models and downscaling models - Lack of well developed methodologies and tools for undertaking vulnerability and adaptation studies especially for health and socioeconomic sectors. - Lack of financial resources to address needs, conduct research and studies, and implement adaptation measures. - Socioeconomic data are either unavailable or available in inappropriate form. - Need for enhancing technical capacity for monitoring and data collection, data management and updating of basic data sets, and preparation of basic maps and databases. -Capacity building is needed in the area of methodologies, tools and guidelines to conduct V&A studies. - Need to improve meteorological, air quality and water monitoring through modernization of equipment and extension of monitoring networks. - Conduct studies and research to assess adverse impacts and vulnerability to climate change in different sectors of all potentially vulnerable areas of Syria. - Secure and mobilize financial resources to conduct studies and implement adaptation measures. - Need to establish regional models and downscaling models.
Palestinian Authority	-The available data is scattered, and is collected by different institutions without adequate coordination. -The data is not always effectively processed, screened and evaluated, - Limited legal frameworks for disaster risk reduction, which are response-led rather than preventive. - Underdevelopment of policies for disaster preparedness, mitigation, and emergency response - Weak capacity in disaster management and rescue operations. - Need to develop and implement a national monitoring programme of climate variability and change. Mainly for water quality and availability, marine and coastal biodiversity and fisheries. - Strengthening the capacity, for modeling (running scenarios/models) and downscaling to finer resolution of climate change models to be applied for the coast -Strengthening the national institution specialized in climate variability and change especially in monitoring, research and modeling and also strengthening the capacity for climate change monitoring in terms of legislation, institutions, and facilities; -Identifying climate impacts in the oPt by means of environmental monitoring networks and the development of forecasting capacity; -Monitoring the climate vulnerability of sectors and communities at risk; - Sustained access of individuals to sufficient safe water for health and wellbeing in the face of significant climate risks (e.g. water scarcity and reduced quality).

2.3 Proposal of activities for the full-size project for the establishment of Regional Database and Programme and needs to monitor climate variability and change impacts

Previous sections have highlighted a number of key information gaps and barriers that prevented a coordinated regional action to monitor climate variability and change impacts in the coastal zones of the region. The following step is to propose a programme of activities that could be taken at sub-regional and regional level in the full size project activities.

Long-term, high-quality and uninterrupted observations of atmosphere, the land and ocean are vital for all countries, as their economies and societies become increasingly affected by climate variability and change. Observations are also crucial to support the further research needed to refine understanding of the climate system and its changes, to initialize predictions on time scales out to decades ahead, and to develop the models used to make these predictions and longer-term scenario-based projections (GCOS/WMO/IOC, 2010).

The inventory and review of the research and observation programmes in the region has showed that there is a wide range of monitoring and observation networks operative in the region at various spatial scales, among which are:

At regional level:

- the Euro-Mediterranean Information System on know-how in the Water sector (EMWIS)
- the Mediterranean Hydrological Cycle Observing System (Med-HYCOS),
- the Europe-Africa Marine Earth Observation Network (EAMNet)
- Know-MED

At the Balkans level

- the South East European Virtual Climate Change Center (SEEVCCC)
- the Southeast European Climate Change Framework Action Plan for Adaptation
- the Drought Management Centre for South Eastern Europe (DMCSEE)
- the ADRICOSM Partnership,

At MENA level

- Observatoire du Sahara et du Sahel (OSS)
- the African Centre of Meteorological Applications for Development (ACMAD)
- The Climate Change Data Center for the Arab States
- Climate for Development in Africa (ClimDev Africa)

The National Meteorological Services have also crucial role to play in generating climate change scenarios for the region that would not only contribute to the global assessments but also be used as a tool for adaptation, vulnerability assessment and mitigation of climate change and climate variability at the regional and national levels.

All the sub-regional climate centers and systems have climate observation and monitoring, data archiving exchange and sharing, research and building capacity among their missions. However, there is a weak co-operation between them at sub-regional levels (Maghreb, Balkans, MENA) and/or regional level (Euro-Mediterranean). In addition, the different networks have different levels of standard and operability, and use different infrastructures and methods. Consequently, it is not simple to have a synoptic picture of the climate observing systems in the region.

Overall, the region lacks a regional programme of works that can pull together the disparate activities. Moreover, in the inventory of the research and observation programmes in the region, there appeared to be very few that are specific to the coastal zone.

A pressing need is then to establish a central hub or ‘clearinghouse’ within the dispersed climate information infrastructures, and have a defined **Regional Coastal Monitoring Programme**, in order to enhance synergy and minimize duplication and to ensure that the signal of coastal change driven by climate change can be detected and evaluated with respect to broader anthropogenic changes to the coast.

As information alone does not always lead to effective policies, the scope of this unit could be to not only provide climate information but also strengthen the use of such information for decision making, by improving analytical capacity, knowledge management and dissemination activities, and implementing pilot projects demonstrating the value of mainstreaming climate information into development. Networking is then essential for the Euro-Mediterranean scientific community to give

it the boost it needs to make progress. The established framework should be backed by a comprehensive capacity building strategy.

The effort for building up a Regional Coastal monitoring system and database should consider the existing experience and the human capacities, the equipments and the financial means. Through coordinated efforts, from all interested communities, these systems could be improved in a consistent way so as to satisfy the needs of all users, and improve monitoring of CC impacts at a regional level. The Clearinghouse on climate change impacts, vulnerability and adaptation, which could make information widely available to potential users across the region, should be developed consistent with existing observing systems.

One of the objectives to achieve this is, at first, to enhance the capacity of National Observing Systems (NOS) to effectively monitor, detect and predict climate change scenarios in the region to contribute to global assessments at the regional and national levels.

To achieve this end, two sets of actions are proposed for the full size project (Table 6):

Table 5: Proposed actions for the full size project

Components	Proposed actions
Research & Observation	• Promote digitization and historical climate data rescue • Support modernization of meteorological infrastructure in the Participating countries, • Set up a contemporary database of climate change related research on the coastal zone, development and demonstration projects for the region. • Support scientific research in climate change detection, attribution and prediction within the coastal zone of the region, including early warning systems, seasonal forecasting and long term regional and further downscaled climate projections and scenarios. • Support communication, processing systems, as well as dissemination facilities for communicating weather and climate information. • Definition of key climate change indicators and the promotion of improved monitoring and reporting mechanisms. • Accelerate the process of education, training and awareness of climate change and its impacts to speed up the implementation of response actions in all the climate sensitive socio economic

	sectors of the coastal zone. • Access appropriate funds, as feasible, for implementation of the Coastal Monitoring Programme.
Capacity Building	• **Research & Observation:** - Enable human resource development through focused training, mentoring and learning by doing approaches, among other measures; - Enhance observation, research and knowledge management; - Strengthen and use the regional network of information and knowledge sharing; - Develop tools, methods and technologies and support their application - Information and communication - Introduction of Climate Change issues into school curricula; awareness raising and skills training in negotiation skills. - Educational institutions stretching from primary school until PhD, should work together on the design of an 'educational pipeline' for the theme 'Global Change' including coastal change. **- Institutional:** - Establishment of strong institutional management system; - enhancing capacity of institutions in monitoring climate change impacts in the regions; - Enhancing capacity of regional institutions to carry out research on Climate Change issues; **- Technological:** - Technology transfer initiatives geared towards accelerating development, diffusion and transfer of environmental sound technologies targeting mitigation and adaptation. - Exploitation of indigenous technical knowledge.

2.4 Preliminary analysis of indicators for monitoring of climate change and variability impacts and use into ICZM

The multiple linkages between causes and impacts of climate change in the coastal zones are, in many cases, not completely understood. Indicators can help to present and explore these complex relationships to support policy making, by demonstrating the impacts of climate change and extreme events on different environmental and socio-economic sectors. Furthermore, these state and impact indicators could provide early warning signals to policy makers.

Several indicators for monitoring and implementing ICZM are also suitable for monitoring climate change impacts on the coastal zones. This is why in this section a review of indicators for ICZM is presented along with those for climate change impacts.

2.4.1 Review of indicators proposed for the Mediterranean coastal zone

Climate change state and impact indicators have been presented in many reports in the last decades, in particular in the assessment reports of IPCC (IPCC, 2001, 2007). With regard to the coastal zones, several International and Regional organizations (IOC/UNESCO, ETC/ACC, Blue Plan, PAP/RAC, RAC/SPA, etc.), have proposed lists of indicators for sustainable development of the coastal zones.
This section provides a general picture of the main impact indicators on the coastal zone.

1) Categories of indicators proposed for ICZM (IOC/UNESCO)

*The objectives of the IOC project was to d*evelop a common set of indicators - environmental, socioeconomic, governance, performance- to asses and report on the progress and outcomes of ICM programs and to promote result-based approaches, accountability and adaptive management in ICM programs. The 37 indicators grouped in 4 categories (Fig. 2) are all eligible for monitoring climate change impacts.

Figure 2: Categories of indicators for ICAM (Belfiore, 2006)

Governance Dimensions and Indicators

Administrative coordination and coherence	1. Institutional coordination mechanism 2. Enabling legislation (existence and adequacy) 3. Environmental assessment (e.g. EIA, SEA, CCA) 4. Conflict resolution mechanism (functionality)
Management quality and effectiveness	5. Management (ICOM) plans (status and coverage) 6. Implementation of plans (e.g. legal tools, enforcement) 7. Monitoring and evaluation 8. Administrative resources (human, technical, financial)
Knowledge, awareness, and support	9. Inputs from scientific research 10. Stakeholder participation in decision-making 11. NGOs and community involvement 12. Educational and training in ICOM plans
Mainstreaming	13. Enabling technology (incl. environmental) 14. Economic instruments in support to ICOM 15. Incorporation of ICOM into SD strategy

Socioeconomic dimensions and indicators

Healthy and productive economy	1. Total economic value (focus on economic activities) 2. Direct investment 3. Total employment (oceans-related jobs) 4. Sectoral diversification
Healthy and productive environment	5. Human pressure on habitats 6. Pollutants and introductions (impacts on humans)
Public health and safety	7. Diseases and illness 8. Weather and disasters
Social cohesion	9. Population dynamics 10. Marine dependency 11. Public access to the coast
Protecting human life and property	12. Traditional knowledge, innovation and practices 13. Protection of coastal cultural heritage

Ecological dimensions and indicators

Conserving ecosystem structure	1. Biodiversity (genetic, species, ecosystems, invasive) 2. Distribution of species (spatial, trophic level) 3. Abundance of species (biomass, number, density)
Conserving ecosystem functions	4. Production and reproduction (incl., prim./second.) 5. Trophic interactions (e.g. predator-prey relationships) 6. Mortality (incl., fishing, incidental, natural causes)
Conserving ecosystem properties	7. Species health (at-risk, bioaccumulation, pathogens) 8. Water quality (oceanography and variability, sedimentation, contaminants and eutrophication) 9. Habitat quality (types and status, sea level change, sediment quality, land-/bottomscape integrity)

2) Proposed Set of Climate Change State and Impact Indicators in Europe (EEA, 2002)

The European Topic Centre on Air and Climate Change (ETC/ACC), which assists the European Environment Agency (EEA) in its support to EU policy in the field of climate change has selected a preliminary list of indicators that are thought to be suitable to describe the main currently occurring and in some cases expected future trends in climate change and its impacts on ecosystems, human health and socio-economic sectors.

Table 6: Preliminary proposed list of climate change indicators (EEA, 2002)

	Category	Indicators
1	Climate and Atmosphere	- Temperature - Precipitation - Atmospheric CO_2 and other greenhouse gas concentrations - Climate Indices (temperature, precipitation, humidity) - Storms - Lightning Frequency - Cooling and Shrinking of Strato-, Meso- and Thermosphere
2	Cryosphere	- Mountain Glaciers - Arctic Sea Ice - Snow Cover - Lake- and River Ice - Baltic Sea ice - Permafrost
3	Soils and Land Resources	- Net Carbon Uptake - Soil Moisture Availability
4	Agriculture and Forestry	- Crop Suitability - Forest Suitability - Forest Growth - Shifts in the Tree Line - Pests and Diseases
5	Ecosystems and Biodiversity	- Growing Season - Plant Phenology - Changes in Species Behavioural Patterns - Storm Events - Changes in Ecosystem Composition / Biodiversity - Ecosystem Fires - Marine Ecosystems and Biodiversity

6	Hydrology and Water Resources	- Global and Regional Annual River Discharges - Lake Temperatures - River Discharge from Small Undisturbed Watersheds - Frequency of Low and High River Flows - Fresh Water Availability
7	Marine Environment and Coastal Zones	- Sea Surface Temperatures (SST) - Sea Level Rise - Characteristics of Storm Surges - Thermohaline Circulation - Temperature of the Intermediate Layer (Baltic Sea) - Coastal Erosion / Coastal Retreat
8	Economy and Infra-structure	- Energy Consumption for Space Heating in Winter - Number of Weather Related Catastrophic Events / Insurance - Disruption of Transport Services - Tourism / Number of Skiing Tourists - Sales of Seasonal Products
9	Human Health	- Seasonality of Hay-fever - Vector Distribution - Distribution of Vector-Borne Diseases - Catastrophic Weather Related Events - Death Attributable to Heat - Seasonal Peak of Food-/Water-Borne Diseases

All the indicators listed above, except very few of them (specific to Cryosphere or to Land resources) are suitable for monitoring climate change impacts in the coastal zone.

3) *Indicators for the Sustainable Development in the Mediterranean coastal regions (Blue Plan)*

As follow-up of the recommendations of the Mediterranean Commission on Sustainable Development, Blue Plan presented in its Final Report (UNEP/MAP/ Blue Plan, 2002) 130 Indicators for Sustainable Development, grouped according to the thematic framework taken from the MED 21 Agenda and adopted by the Contracting

Parties to the Barcelona Convention in October 1999. Among these indicators, 52 were considered by the Blue Plan to be relevant for the Mediterranean coastal regions among which 43 indicators could be eligible for monitoring the ICZM protocol (Trumbic, 2006):

Examples:

- Coastal urbanization:
  - Urban population growth rate
  - Urbanization rate
  - Loss of agricultural land due to urbanization
- Coastal tourism:
  - Number of tourists per km of coastline
  - Number of moorings in yachting harbors
  - Number of bed places per 100 inhabitants
- Coastal degradation:
  - Coastal erosion
  - Oil tankers traffic
- Coastal protection
  - Coastal protected areas
  - Protection of specific ecosystems
  - Threatened species
- Coastal water treatment
- Solid waste
- Coastal risks
- Response

The Blue Plan indicators have been tested in Croatia and Syria (UNEP/MAP/ Blue Plan, 2002): In Croatia the selection and calculation of the indicators focused on the key issue of Tourism and Aquaculture for the County of Split, where 13 indicators have been calculated, including 10 on the coastal level. For Syria: 28.5 % of Indicators were calculated for the coastal level among the 130 and 40,4% for the coastal level among the 52.

The collaboration of the Blue Plan with PAP/RAC has resulted in the development of methods and tools for systemic analysis and the calculation of some indicators in some CAMPs (Tunisia, Algeria and Morocco).

2.4.2 Proposed Key indicators for the full size project to monitor climate variability and change impacts

Data availability is one of the key issues for a Mediterranean-wide indicator system. As stated before, a number of data sets are already available at national and international organizations that can be used to compile climate change indicators. Often the data has been collected for purposes other than the development of indicators or specifically for climate change.

Based on the existing lists, preliminary possible sets of potential indicators that could be suitable to monitor the main climate change impacts on coastal systems were extracted from:

1. The set of Indicators related to the wider context of sustainable development (MSSD)
2. The set of Indicators related to the context of Climate change
3. The set of Indicators related to the context of ICZM.

The selection of these preliminary indicators (Table 8) was also based on criteria such as: data availability in the Participating countries, the potential relevance to policy makers and the analytical soundness and measurability. These criteria have been considered by ETC/ACC among the most important criteria for climate change impact indicators in Europe.

Table 7: Preliminary proposed list of indicators

	Category	*Sub-category*	*Indicator*
1	***Environment***	Climate and atmosphere	1. Temperature 2. Precipitation 3. Atmospheric CO2 and other GHG concentrations 4. Climate Indices (T, P, humidity) 5. Storms 6. Droughts
		Marine and coastal zones	7. Sea Surface Temperatures (SST) 8. Relative Sea Level Rise 9. Characteristics of Storm Surges 10. Coastal Erosion / Coastal Retreat 11. Thermohaline Circulation 12. Sea water intrusion 13. Coastal setback
		Marine/coastal ecosystems and biodiversity	14. Biodiversity (genetic, species, ecosystems, invasive) 15. Distribution of species (spatial, trophic level) 16. Abundance of species (biomass, number, density) 17. Production and reproduction (incl., prim./second.) 18. Trophic interactions (e.g. predator-prey relationships) 19. Species health (at-risk, bioaccumulation, pathogens) 20. Water quality 21. Habitat quality (types and status, sea level change, sediment quality, land-/bottomscape integrity)
		Terrestrial/ Coastal ecosystems	22. Growing Season 23. Plant Phenology 24. Changes in Species behavioral patterns 25. Storm Events 26. Changes in Ecosystem Composition 27. Ecosystem Fires
		Hydrology and water resources	28. Annual river discharges 29. Frequency of low and high river flows 30. Fresh Water Availability
2	***Socio economic***	Economic sectors	31. Energy Consumption 32. Number of Weather Related Catastrophic Events / Insurance 33. Tourism / Number of Tourists in coastal resorts 34. Infrastructures at risk of inundation

			35. Beaches at risk of erosion 36. Agriculture: Crop suitability; pest and diseases
		Human security	37. Number of Weather Related Catastrophic Events (Floods, droughts) 38. Population at risk of inundation
		Human health	39. Distribution of Vector-Borne Diseases 40. Catastrophic Weather Related Events 41. Death Attributable to Heat 42. Seasonal Peak of Food-/Water-Borne Diseases
3	***Governance***		43. Institutional coordination mechanism 44. Enabling legislation (existence and adequacy) 45. Monitoring and evaluation 46. Administrative resources (human, technical, financial) 47. Incorporation of climate change into ICZM strategy

3. ASSESSMENT OF EXISTING VULNERABILITY AND IMPACT SCENARIOS TO CLIMATE VARIABILITY AND CHANGE FOR THE MEDITERRANEAN COASTAL ZONE AND RELEVANT ACTIVITIES PROPOSED FOR THE FULL SIZE PROJECT

Following the preliminary appreciation on the range of existing programmes and projects to monitor climate change impacts in the region, this chapter analyses the existing climate change vulnerability assessments already undertaken or in progress by countries in the region to provide a critical evaluation of these initiatives in order to derive gaps and requirements for the full size project proposal.

The review summarised here is based on information contained in the NatComs and in the National reports submitted by the PCs for the purpose of this project, as well as on available public information. It covered a range of spatial scales from regional (Mediterranean) national and local. Although, the scope and level of detail of information varied considerably among PCs, this overview is focused solely on vulnerability assessment concerned with the coastal zone.

3.1 Analysis of existing vulnerability and impact scenarios, relevant data and assessments

3.1.1 Impacts of Climate change in the Mediterranean coastal zone

The Intergovernmental Panel on Climate Change (IPCC) defines climate vulnerability as “the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity” (IPCC, 2007).

The Mediterranean has been identified by the IPCC as one of the most vulnerable region to the impacts of climate change, particularly its southern and south-eastern parts. The Fourth Assessment Report (IPCC, 2007) noted that even if global society does succeed in reducing emissions, some climate change impacts are now unavoidable and solutions must be found to adjust to them. Since then, a number of scientists and scientific organizations have published papers suggesting that climate change is happening much faster than the IPCC suggested. Indeed, the main message from the scientific conference held in Copenhagen in March 2009, and where 2,500 researchers from some 80 countries presented their most recent

findings, was that: for many key parameters, the climate system is already moving beyond the patterns of natural variability within which our society and economy have developed and thrived. These parameters include global mean surface temperature, sea-level rise, ocean and ice sheet dynamics, ocean acidification, and extreme climatic events.There is a significant risk that many of the trends will accelerate, leading to an increasing risk of abrupt or irreversible climatic shifts.

Coastal zones are the most appealing asset of the Mediterranean. However, they are submitted to drastic pressures from land-based pollution, urban development, fishing, aquaculture, tourism, extractions of materials, sea pollution, and marine biological invasions. Constructions, which currently cover 40 % of the coastal surfaces and modifications of ecosystems, are detrimental to future coastal resilience. With global warming and sea-level rise, many coastal systems will experience: increased levels of inundation and storm flooding; accelerated coastal erosion; seawater intrusion into fresh groundwater; encroachment of tidal waters into estuaries and river systems; elevated sea-surface and ground temperatures. Other impacts may include changes in chemical (ocean acidification) and physical characteristics (thermal stratification) of marine systems, increased harmful algal blooms, spread of invasive species, habitat loss (especially coastal wetlands), species migrations, and changes in population dynamics among marine and coastal species.These bio-geophysical effects will, in turn, 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 (Nicholls, 2004; Nicholls et al., 2007). Some of these impacts are summarized in figure 3.

All the forecasts concerning the consequences of global warming on biodiversity as a whole are very worrying. Based on a moderate climate change scenario, it is now predicted that 15 to 37% of Mediterranean species will be extinct by 2050 (UNEP-MAP-RAC/SPA, 2008). The impact on fishing resources particularly could be devastating given that most stocks have already been very much reduced by over-fishing.

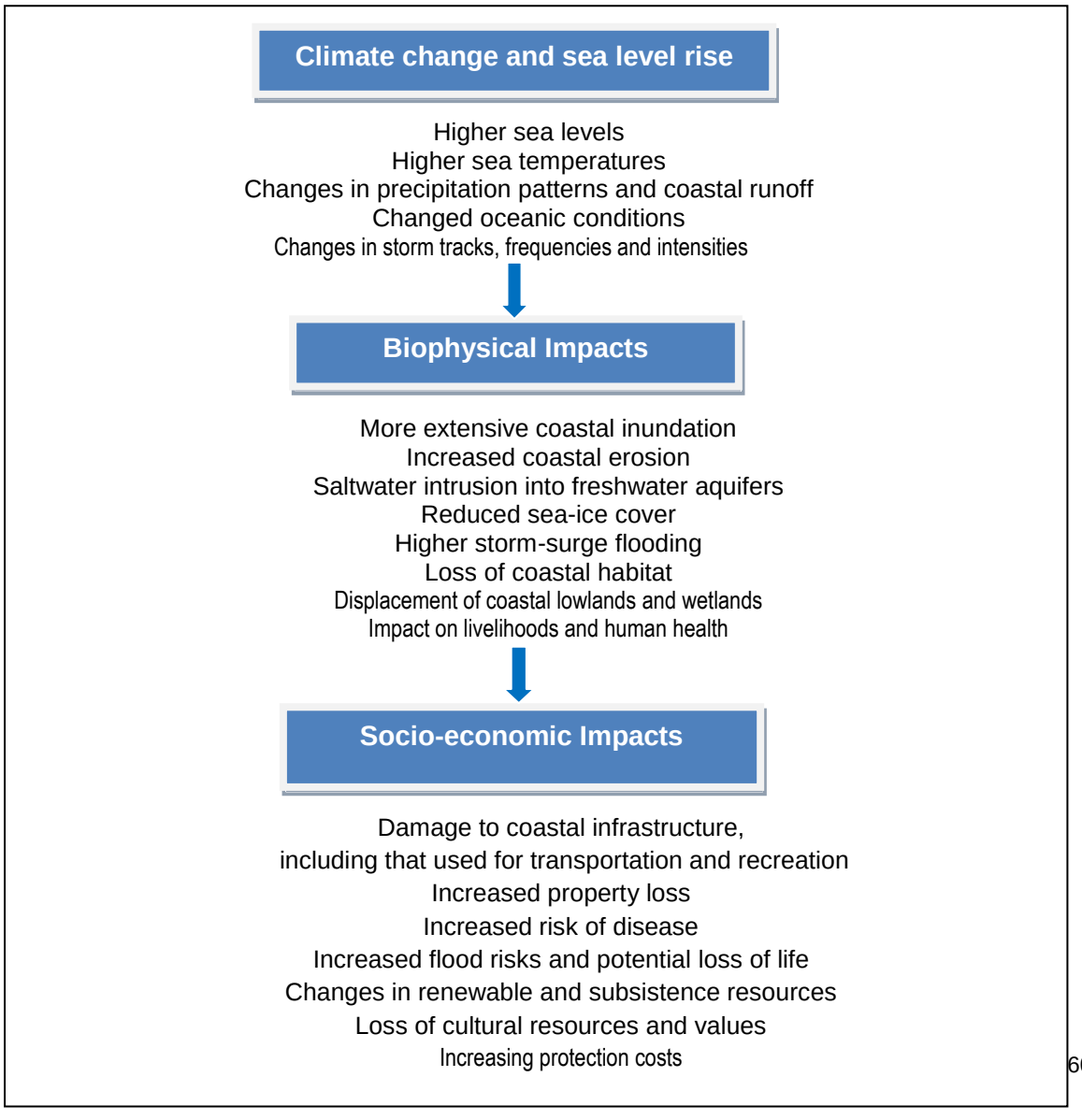
There is a scientific consensus that Mediterranean coastal ecosystems conservation can no longer be achieved without taking into account climate change. But, global and national policies have not yet been developed to address this problem. Several countries have indicated interest in tackling this challenge but they require further support to link the science with management and policy. Furthermore, despite a

growing awareness, communities and local decision makers still have only limited access to the full suite of information needed to protect natural and human coastal communities.

Concerning the water resources, all countries of South and East Mediterranean are presently experiencing water stress. Model simulations show a general decrease in rainfall across North Africa, with median decreases in average annual precipitation of 12 percent and 6 percent projected for the Mediterranean and Saharan regions, respectively (NIC, 2009). This general drying trend for North Africa is punctuated by seasonal variations in projected precipitation that differ by region.

Predicted decreases in average annual rainfall, accompanied by projected increases in the population of the region, may impede access to water for millions of inhabitants. In addition, with decreasing water levels, other ecological effects such as salinity in coastal areas and deterioration of water quality may increase.

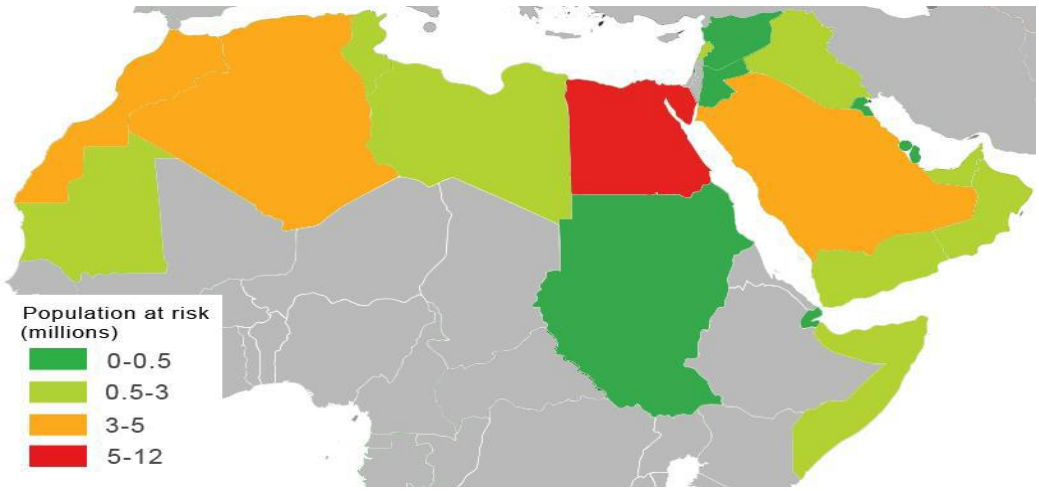
Figure 3: Impacts of climate change in the coastal zone



Simulation for SLR conducted in the North African countries (in Tolba) shows that under the 1 m SLR scenario, approximately 41,500 km2 of the territory would be directly impacted by the rise of the sea level. Projected increases in sea levels will displace a quickly growing population into more concentrated areas. At least 37 million people (~11%) will be directly affected by SLR of 1 meter. In the extreme case of 5 m SLR, such impact will be at its highest, as it is estimated that up to 113,000 km² (0.8%) of the coastal territory would be inundated by sea water Potential impacts of SLR, however, are not uniformly distributed across the Arab region.

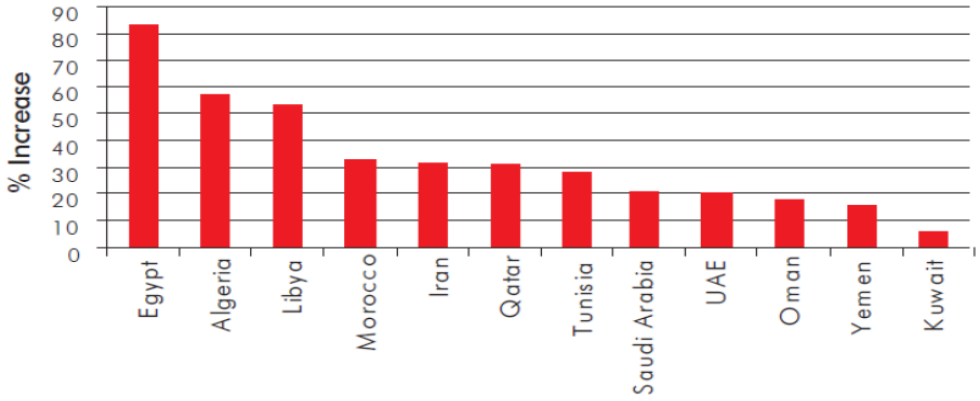
From Figure 4 it is obvious that the SLR impact will be particularly severe in some countries such as Egypt, Algeria and Morocco, whereas it will have a lesser impact on others such as Syria, and Jordan.

Figure 4: Population at Risk at extreme 5 metres Sea Level Rise (Tolba and Saab, 2009)



The analysis carried out by Dasgupta et al. (2009) on the potential impacts of increasing frequencies and severities of storm surges based on best available data of human population, socioeconomic conditions, the pattern of land use and available Shuttle Radar Topography Mission (SRTM) coastal elevation data, indicated that storm surge intensification would cause additional GDP losses in the Middle East and North Africa of $12.7billion. The increase in impact on agricultural areas is significant for the MENA region, mainly because Egyptian and Algerian cropland in surge zones would increase from the existing estimated 212 km² to approximately 900 km² with SLR and intensified storm surges. The percentage increase in surge regions for MENA countries are shown in Figure 5.

Figure 5: Percentage increase of impact of storm surges on the coastal zone of the Arab countries (after Dasgupta et al., 2009)



3.2.2 Vulnerability assessment in the participating countries

With regards to the Institutional arrangements, all the Participating countries under consideration in this project are Contracting Parties to the UNFCC Convention and as such have the obligation to submit national reports on implementation of the Convention to the Conference of Parties (COP).

Except Croatia, which is part of the Annex 1 countries, all the PCs are Non-Annex 1 Parties. With the exception of Libya and the Palestine Authority, all the PCs have submitted their Initial National Communication (NC1). Croatia is the only CP to have currently submitted its fifth communication to the Convention. Five CPs (Albania, Algeria, Egypt and Morocco) have recently submitted their Second National Communication (NC2) (Table 9).

Table 8: UNFCCC PCs Status

Country	Country Status								
	UNFCCC		Kyoto Protocol		National Communications				
	Signature	Entry in to force	Signature	Entry in to force	NC1	NC2	NC3	NC4	NC5
Balkans									
Croatia	1992	1996	1999	2007	2002	2007	2007	2007	2010
Bosnia and Herzegovina	-	2000	-	2007	2010				
Montenegro	-	2007	-	2007	2010				
Albania	-	1995	-	2005	2002	2009			
North Africa									

Egypt	1992	1995	1999	2005	1999	2010			
Libya	1992	1999	-	2006	NS				
Tunisia	1992	1994	-	2005	2001				
Algeria	1992	1994	-	2005	2001	2010			
Morocco	1992	1996	-	2005	2001	2010			
Middle East									
Syria	-	1996	2005	2006	2010				
Palestine Authority					NS				

NC: National Communication; NS: Not submitted

Reporting of the PCs provided some information on the vulnerability assessment to climate change; limitations of methods and tools for analyzing and evaluating vulnerability; problems and difficulties encountered; sectors assessed; the most vulnerable zones and the needs and priorities.

The details of information on the impacts of CC specifically on the coastal zones are varied and depend on each country (table 10). For example Egypt has conducted a detailed study and scenarios on the biogeophysical and socioeconomic impacts of SLR on the Nile delta, while Albania has focused on coastal biodiversity. Croatia has detailed information on 2 pilot sites: *Kaštela Bay and Cres-Lošinj Islands*. Montenegro is the only *country* that has attempted to evaluate the costs of CC damage in the tourism among other sectors.

Almost all of the PCs did not clearly indicate the methods they have used in assessing and analyzing vulnerability. They rather presented the relative degree of sensitivity of their coastal zones to the projected impacts of climate change. Many of them reported that methodologies, tools and guidelines to conduct vulnerability assessment studies are lacking and that “expert judgment” was used to a significant extent. Some countries presented only a list of vulnerable sectors and areas without evaluating or prioritizing them.

PCs used a wide range of sea-level-rise scenarios for different time horizons up to the year 2100. Most of them used the IPCC scenarios of sea-level rise, which assume a 0.5 and/or 1.0 m rise in sea level by 2100. They carried out sensitivity analyses by projecting high- and low-emission scenarios on future sea level changes and predicted impacts on coastal zones and resources.

Countries highlighted the limitations of using general circulation models (GCMs) for developing regional climate change scenarios, due in large part to the large spatial scale and low resolution of the GCM output. Further research and development in this field for downscaling at the lowest possible level and to reduce uncertainties will thus be crucial for more accuracy in the coastal zone management and the planning of risk reduction activities.

While most of the countries favored assessment of physical and ecosystem vulnerability, only few of them have considered a more integrated understanding of vulnerability, taking into account the socio-economic and governance conditions that affect how communities cope with the impacts of climate related hazards. Some PCs also reported that future changes in their socio-economic situation would most likely exacerbate vulnerability to the adverse effects of climate change. The socio-economic changes cited included rapid population growth, high food and water demand, and land and ecological degradation.

Vulnerability assessments of coastal zones and marine ecosystems were based on qualitative and sometimes quantitative analyses of the impacts of climate change and especially sea-level rise. Countries identified the following negative impacts: erosion and setback of coastlines; increase in salinity in estuaries and wetlands; degradation of coastal ecosystems; saltwater intrusion into aquifers; beach and land losses; decrease in productivity of coastal fisheries, etc. Some PCs were concerned most about the economic impacts in the coastal zones, and about loss of land and infrastructure.

The environmental and socioeconomic impacts of climate change on different sectors derived from the national reports, the NatComs and from the available literature are given below per country.

Croatia

Physical Impacts

Sea-level rise is likely to cause inundation in low-lying coastal areas. Many parts may be vulnerable, including the Neretva Delta, some urban areas such as the island of Krapanj, some parts of Split, and natural areas such as Vrana Lake near Biograd and the River Krka. Projections indicate that with 50 cm of sea-level rise, more than 100

km² of the main land will be flooded, and in the case that sea-level rises for 88 cm, additional 12.4 km² will be under water. Historical town centres, the alluvial plain of the Neretva River, and Vrana Lake on the island of Cres would be seriously endangered. (NatComs; National Report, 2011)

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.

If future sea-level rise is significant, several other problems are foreseen among them (UNDP/Croatia, 2008):

- Wetlands and swamps may be damaged - in particular, one of the most recently proclaimed Croatian Nature Park 'Vrana Lake', the only large swamp near the Mediterranean coast – could be directly threatened and potentially destroyed with a sea-level rise of 0.5 meters.
- Coastal erosion may speed up and a number of beaches may be destroyed or become submerged.

Ecosystems and Biodiversity:

Changes in oceanographic and hydrological characteristics will influence the composition of Adriatic ichthyofauna. Biological changes might be:

- Horizontal or vertical migration of cold water species into colder areas;
- Introduction of new organisms that transmit disease or exotic or undesired species;
- Changes in phytoplankton and zooplankton species composition;
- Productivity increase of Adriatic;
- Expansion of thermophilic fish species areas, i.e. through species movement from south to north.

Socioeconomic impacts:

It is probable that changes in the precipitation, temperature, soil moisture, and the frequency of extreme events, will have an impact on some of the most important economic sectors in Croatia. These include:

- The **tourism sector** may face challenges due to uncomfortably hot summers, but also opportunities due to better weather during the spring and autumn. Additional threats may result from damages to particularly important tourist destinations and/ or increases in severe weather related events such as heat waves and forest fires. Since the tourism industry is predominantly seaside-oriented, sea-level rise can

threaten the coastal tourist and cultural sites (hotels, historical sites) and the freshwater springs, water-pipes and sewerage systems.

- **Human health** – especially among older people– will experience increased risks due to heat waves during the summer. However, mild winter temperatures are likely to reduce the health problems caused by cold weather. Additionally, changes in allergen patterns may also cause problems for certain groups.
- **Hydropower production** may decrease due to reduced river flow, and wetlands benefits may be endangered due to less precipitation.
- **Agricultural production** may experience a drop in the yields of various crops.
-The **fisheries and mariculture** industries should benefit from the increased production of certain types of fish and shellfish, although invasive species and sea temperatures may reduce the number of other species.
- **Population**: Climate change will not affect all Croatians equally. Certain groups in society face a greater risk from future climate change. These include residents of certain regions that face the double burden of low incomes and employment in/ reliance on weather sensitive industries. They also include the elderly, who face added health risks due to heat waves. The number of Croatians who are vulnerable to coastal flooding will increase from fewer than 2000 people per year from 1960-1990, to 6000-8000 people per year in the 2080s

- Infrastructures:

- A number of commercial fishing ports and fixed marinas may be affected.
- Sea flooding in shallow and densely populated areas will impact residential and buildings, roads, energy and telecommunication cables and sewage systems.
- Contamination of coastal freshwater springs (salt water intrusion) affecting drinking water supply may occur

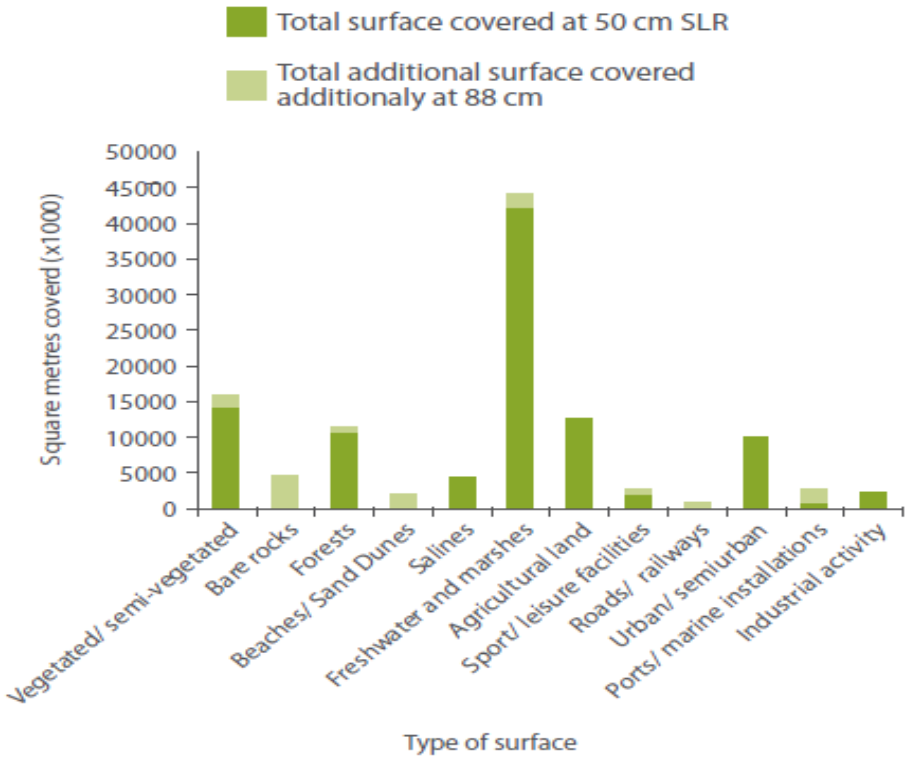
The amount and types of land which would be covered by sea water, or would be at risk, given two sea-level rise scenarios 50 cm and 88 cm is represented in Figure 6. The most vulnerable coastal resources seem to be fresh-water systems and marshes. Additionally urban and agricultural land will be also at risk.

The economic damage due to increased flooding from sea-level rise in Croatia (for both 0.50m and 0.88m) approximates the following:
- Sea-level rise of 0.50 meters: estimated loss of EUR 2.80-6.50 billion (which would be distributed over the next century)

- Sea-level rise of 0.88 meters: estimated loss of EUR 3.22-7.18 billion (which would also be distributed over the next century)

However, this valuation represents only the highest probable loss of land value, and does not reflect the forest, beach and marshland areas that may be lost.

Figure 6: Types of land which would be covered by 50 cm of sea-level rise and the additional amount covered by 88 cm (Source: UNDP/Croatia, 2008).



Bosnia & Herzegovina

Physical impacts: No specific research has been done in BiH regarding the impact of climate change in the coastal zone. This latter has only 26 km length.

Most climate change issues are associated with agriculture, erosion risk and soil deficiency due to sea level rise. One of the main problems, due to the increase of precipitation, for the coastal zone is floods and soil erosion (National Report, 2011).

***Ecosystems and Biodiversity*:**

Ecosystems that will be directly exposed to the impacts of climate change include low coastal areas; e.g., coastal sands, salt marshes and estuaries. Changes in physical, hydro-dynamic, biological and chemical parameters may be expected, with accompanying quality and quantity changes in the components of biocenoses.

Ongoing intrusion of salt water into freshwater habitats in the lower Neretva delta has already caused habitat degradation and habitat loss, and this effect might be increased. In addition, species that are adapted to the freshwater rivers may be threatened or even may disappear.

Socioeconomic impacts:

Significant sea level-increase could endanger numerous commercial and fishing ports, contaminate coastal freshwater sources in karstic zone, disrupt touristic and recreative activities depending on coastal areas.

More intense rainfall will increase the cost of flood protection works, as well as that of associated infrastructure such as roads and storm-water drains. It is predicted that extreme events will occur more often; floods and droughts that previously occurred once in a lifetime, every 50 years, may now occur every 5 or 10 years;

Lower river flows will affect non-reliable water supply, electricity production and tourist activities, as well as resulting in lower water quality caused by flow variations.

The following are some possible risks related to climate change impacts on socio-economic development that should be taken into account in Bosnia and Herzegovina (NatCom, 2009):

- Intensified migration to urban areas;
- Strained resources in urban areas caused by migration,
- Reduction in employment in industries that process agricultural raw materials;
- Changes in the tourist economy;
- Failure to adapt workplaces to extreme weather conditions, which may negatively affect not only the health of employees but also their productivity.
- Increase in the unemployment rate, increased emigration of the young and highly-educated population, increase in stress due to employment instability, and intensive changes in the labor structure of economic sectors;

Montenegro

Physical impacts:

- Reduction of annual precipitation that ranges even up to 20% in certain areas.
- Water resources will be also generally reduced. Analysis shows that the discharge of the Morača water resource through Podgorica will be reduced by 31% during the period 2071-2100 compared to the normal period 1961-1990.

- the river Bojana flow will be stopped much before its current end, which means that this whole part of the area, which is now practically even with the surface of the river Bojana will be flooded (INC Montenegro, 2010).
- The yield of water sources will be reduced, and some springs will dry up or experience intermittent flow.
- The coast is relatively short and narrow, because of the steep, high mountains in the immediate hinterlands and thus less vulnerable to sea-level rise.

- the flow of the river systems that empty into the sea will be distracted so much that the space around the rivers will be flooded and destroyed, and practically lost, especially where the coast is low, as Velika Plaža (The Great Beach).

Ecosystems and Biodiversity:

- Due to expected sea-level rise, large part of the beach area will be reduced, and some beaches will disappear. The Bojana River delta will disappear (National Report, 2011).
- Shifting of vegetation zones; disappearance of certain species; changes in composition of biocenoses; fragmentation of habitats and changes in the functioning of ecosystems.
- Faster eutrophication of shallow and confined parts of the sea waters, as well as the introduction of new thermophilic (invasive) species from southern marine biogeographic zones.
- Possible degradation of plant and animal life in the sea, significant damage to coral reefs, some migration as a result of increasing temperature and temperature amplitudes.

Socioeconomic impacts:

The biophysical impacts will generate strong social and economic consequences. In the first place, the economic and tourism potential of the coast will be reduced, while an investment risk will be increased. Economic activities, such as maritime transport, fisheries, agriculture etc. will constantly be under “stress.” In some years coastal resources will be fully compromised. There are almost no distinctive mechanisms of self-defense and self-adaptation.
-The safety of infrastructure, ports, water breaks, marinas, shipyards, etc. will be endangered.

- The sea water - waves will put a strong pressure on the water sources adjacent to the coast, which are used for water supply, so that a large number of sources will be out of use.

- The increase in temperature, especially in the summer months of JJA will negatively affect the health condition of high-risk groups, while on the other side a temperature increase during the winter will lead to lower morbidity and mortality, particularly for chronic patients.

The economic impacts of Climate Change in Montenegro have been preliminary estimated by Callaway et al. (2010). A summary of the results for all the six case studies are shown in Table 9.

According to the author's findings, short-term climate change may be a good thing for tourism, but eventually – if these models are right – average and peak temperatures will become so high that tourists, in the summer time at least, will shift their beach visits northward.

Table 9: Preliminary Estimates of Average Annual Climate Change Damages Due to Simulated Climate Changes for Selected Case Studies in Different Sectors in Montenegro (millions of €/year).

	A1B NF	A1B FF	A2 FF
Reduced Maize Yields[1]	Reduction in Gross Revenues from Maize Sales		
	0.016	0.043	0.81
Increased Crop Water Needs[2]	Increased Costs of Pumping and Distributing Additional Water to Irrigate Crops on Current and New Land		
	0.074	4.33	4.41
Increased Temperature[3]	Reductions in Tourists Expenditures (HTM analysis)		
	34.20	68.35	85.45
Increased Temperature[4]	Reductions in Tourists Expenditures (PESETA analysis)		
	(13.90)[5]	33.20	33.50
Reductions in Runoff	Reduction Gross Revenues from Electricity Sales from Mratinje Dam		
	6.60	12.80	--
Increases in Temperature[6]	Value of Additional Lives Lost due to Heat-Related Mortality		
	--	--	4.60 to 85.20

[1] Yield reductions are in % terms, not by scenario. Assumed domestic corn price: 60€/MT.
[2] All irrigated lands (new and planned) at 0.15€/Kwh.
[3] Base Case Ave. Annual Temp 16 deg C Base Case tourism levels and expenditures are current average.
[4] Base Case tourism levels and expenditures are current average.
[5] This estimate is in brackets because it is actually a benefit of climate change and not a cost.
[6] Range reflects valuation method (VOLY-VSL)

Albania

Physical Impacts:

- Higher temperatures will shift the snowline upwards; the seasonal patterns of snowfall are likely to change with the snow season beginning later and ending earlier. So, the spring runoff is expected to reduce noticeably.
- Reduction of long term means annual and seasonal runoff for the Drini water basin
- Under reduced surface water flow and increased evaporation, decrease of the storage of reservoirs and reduction in ground water supply.
- Likely increased frequency of extreme events (heavy rains, strong winds, droughts, flooding)
- SLR will result in likely decrease in coastal forest area (Lezha coast) 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* & Biodiversity**

- SLR will result in likely increase in losses of wetland area (around 1 km² by 2100).
- Coastal forest area and low unvegetated wetlands area are likely to decrease. The national parks of Kune-Vain (Lezha District) and Velipoja (Shkodra District) are located along the Drini and Buna river deltas, between 0.8 to 2 m and 0–1.2 m above sea level, respectively.
- Likely enlargement of lagoons is expected to increase the staying capacity of migratory birds and change their composition.
- Change in water fauna and flora in favor of species that like more warmth and salinity is likely as well.
- Expected changes of forest flats due to projected changes in temperature are: The common spruce flat (Picetum) that is likely to disappear after the 2025. The Mediterranean alpine pasture area is expected to reduce more than ten times. According to sea level rise scenarios, the coastal forest area (Lezha coast) is likely to decrease from 1.14 to around 1 km² by 2100.

Scenarios developed to assess the impacts of sea-level rise in the Lezhe area project an increase in losses of wetland area (around 1 km² by 2100), and as a consequence a decrease in total wetland area. It also projects increases in the coastal floodplain area (Table 10) and population (respectively around 66 km2 and

4.6 thousands by 2100). Coastal forest area and low unvegetated wetlands area are likely to decrease (2nd NatCom, 2009).

Table 10: Expected impact of Sea-level rise (Lezhe area) (Sources: 2nd NatCom, 2009)

Table 4-3: Expected Impact of Sealevel Rise (Lezhe area)							
		2025		2050		2100	
Parameter		av.min	av. max	av.min	av. max	av.min	av. max
Net loss of wetland area	km²	0.12	0.20	0.14	0.58	0.41	1.04
People actually flooded	thousands/ year	0.055	0.056	0.019	0.040	0.006	0.007
Coastal floodplain area	km²	55.61	55.91	56.14	59.20	57.19	65.95
Coastal floodplain population	thousands	4.04	4.06	4.14	4.33	3.99	4.61
Total wetland area	km²	4.52	4.44	4.5	4.06	4.22	3.60
Coastal forest area	km²	1.144	1.137	1.14	1.01	1.12	0.91
Low unvegetated wetlands area	km²	3.38	3.30	3.37	3.05	3.10	2.69

Socioeconomic impacts:

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.

Population and infrastructure: The expected climate change and SLR will largely influence the distribution of the residential areas, population, their economic activity in general and **tourism** in particular. Increases in the coastal floodplain area and population (respectively around 66 km² and 4.6 thousands by 2100). At the beach of Shengjin the tourism constructions are all threatened by sea level rise in the coming 50–100 years.

Agriculture: By 2100, the impacts to be expected are: the reduction of the extent of arable land due to soil erosion and alteration; the changes in the growth cycles, harvest time and the quality of the agricultural production, especially along the coastal area owing to an increase in salinity, due to the sea level rise and intrusion of salt water into the soil.

***Public health*:** The increase in summertime temperature is likely to affect the physiological and compensatory system of people. Climate change will further aggravate air quality related health problems in the major cities of Albania as well, but in particular in Tirana.

Egypt

Physical Impacts:

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 (NatCom, 2010., Rapport National, 2011)

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:

There is an expected serious negative effect on birds**.** The expected submerged wetland will form grounds for an increase in rooted aquatic plants, will increase the wintering grounds for migrating birds and can also be used for aquaculture activities. The impact of climate change on coral communities in the Red Sea will include coral bleaching due to increasing temperatures, loss of habitats and loss of biodiversity.

Socioeconomic impacts:

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 (Figure 7). The most affected sectors are expected to the industrial, transportation and urban sectors.

- 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.

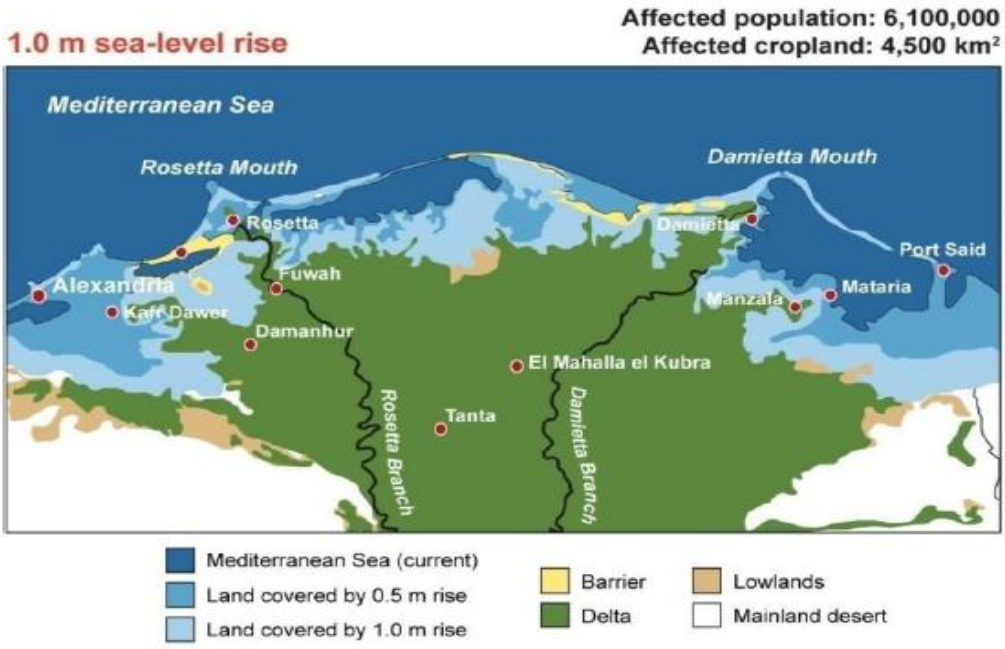


Figure 7: Potential direct inundation of the Nile Delta region with two scenarios of Sea level rise indicating vulnerable cities of the Delta (Fitzgerald et al., 2008)

Water resources; The vulnerability of Egypt's water resources to climate change entails those affecting Nile flows, rainfall (possible 50% reduction of rainfall on Egypt's Mediterranean coast), and ground water (increased levels and salinity due to sea level rise and consequent sea water intrusion). With 4°C warming and 20% reduction in precipitation, Nile flows may decrease by 98%. Water logging and water bogging problems are expected to exacerbate soil salinization which will lead to deterioration of crop quality and productivity. This will in turn lead to increasing health problems and loss of tourism.

***Agriculture*:** climate change studies predict a reduction in the productivity of two major crops in Egypt - wheat and maize - by 15% and 19% respectively by 2050. Losses in crop productivity are mainly attributed to the projected temperature increase, crop-water stress, pests and disease, as well as the inundation and salinization of 12% to 15% of the most fertile arable land in the Nile Delta as a result of sea level rise and salt water intrusion.

-Aquaculture and Fisheries: A slight to moderate SLR may be quite beneficial. Fish production may go up due to an increase in lake area and in more valuable marine fish species. Climate change is expected to increase sea temperature causing fish distribution to shift northwards and to go into deeper waters. In addition, increased water salinity in the coastal lakes in Egypt is expected to affect fish species in these lakes.

Tourism: coral reefs, constituting a major attraction in Red Sea resorts, are highly vulnerable to climate change. On the other hand, sea level rise on the low elevation Mediterranean coast will definitely lead to losses of beaches. In addition the impact of increasing temperatures and frequencies and severity of extreme events are expected to negatively impact the archaeological heritage in Egypt. Heat waves in the summer months are likely to negatively impact on tourism.

Health: For the health sector, climate change will contribute to the burden of diseases through direct effects (heat strokes) and indirect effects (the shortage of water supply and decreased agricultural land area leading to shortage of essential food with the possible emergence of malnutrition).

The ranking of key climate change impacts and vulnerabilities in Egypt (Agrawala, 2004), showed that the severity of impacts are the highest for the coastal resources and water resources (Table 11).

Table 11 : Ranking of key climate change impacts and vulnerabilities in Egypt (Agrawala, 2004)

– Resource/ risk ranking	– Certainty of impact	– Timing of impact	– Severity of impact	– Importance of resource
Coastal resources	High-medium	Medium-low	High	High
Water resources	Medium	Medium	High	High+
Agriculture (indirect impacts - mediated by sea level rise and water resource)	High-medium	Medium-low	High-Medium	High-medium
Agriculture (direct impacts-temperature, rainfall)	Low	Medium-low	Low	High-medium
Energy resources	Medium-low	Medium-low	Medium-low	Medium-low

The results in Table 12 indicate that the most severely affected employment sector will be industry, followed by tourism and agriculture.

Table 12: Area loss, displaced population and loss of employment for each sector under different SLR scenarios in the Alexandria Governorate

	Sea level rise scenarios (m)		
	0.18	**0.3**	**0.5**
Area loss (km^2)	11.4	19.0	31.7
Population displaced (x 1000)	252	545	1,512
Loss of employment			
Agriculture	1,370	3,205	8,812
Tourism	5,737	12,323	33,919
Industry	24,400	54,936	151,200
Total loss of employment	32,507	70,465	195,443

Tunisia

Physical Impacts:

The coast is very fragile and low-lying islands are at particularly high risk. The Study on the impact of SLR on coastal ecosystems and on the economy of threatened coastline areas shows that a 50-cm SLR by 2100 may cause an increase of erosion in a number of low coastal areas. 100 km of coastline are prone to marine erosion, 40 km of which are priority beaches. 53 % of coastal water resources will be lost by salinization due to SLR. Most vulnerable coastal areas are likely to be lagoons, sebkhas, and lowest coastal marshes, which will be inundated by rising sea levels. (NatCom, 2001).

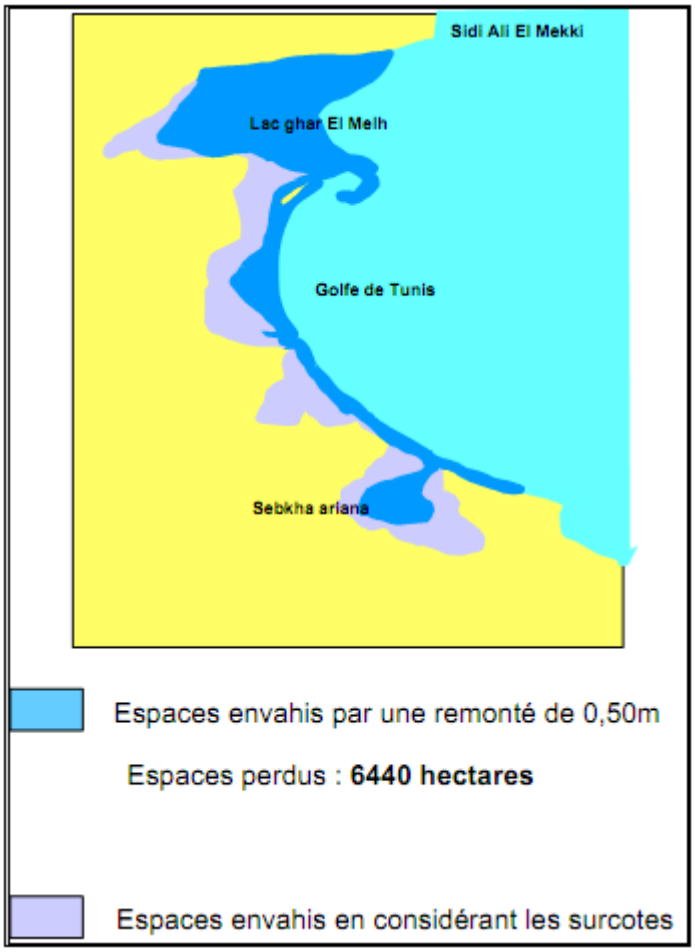


Figure 8: Impacts de l'EANM sur les côtes du golfe de Tunis

Bleu foncé : espaces envahis par une remontée de 0,5 m (espaces perdus 6440 ha)

Bleu clair : espaces envahis en considérant les surcotes

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 most vulnerable areas will be the coastal lagoons, sebkhas, and coastal marshes, which will be in majority annexed to the sea domain.
- In oasis, SLR could result in a retreat of the coastline and an increased salinization of the coastal aquifers, detrimental to the palms growth.
- 50% loss of non-irrigated forested areas in southern Tunisia;

- Drastically increased risk of forest fires; and Substantial increase in the vulnerability of ecosystems.

Socioeconomic impacts:

The expected sea level rise will put not only agriculture but also tourism – a major economic sector in Tunisia – at risk.

Agriculture: would be among the sectors most affected by SLR which will lead to important losses of agricultural lands by erosion or salinization and deterioration of the drainage and irrigation infrastructures. There is projection of a 20% loss in arable cropland by 2030.

Tourism: the beaches which are among the main appeal of the three major tourist poles of the country could be highly affected by SLR.

Livelihoods: 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.

Water resources: Annual water resources losses due to SLR have been estimated to be 152 Mm^3 (Table 13) and annual environmental and economic losses due to SLR have been estimated to be 228 TND, which represent O,63% of the GDP (Table 14) (Slim, 2010).

Table 13: Estimation of loss in coastal water resources due to sea level rise (2100)

Total resources	288 Mm^3/year
Total area	11 000 Km^2
Vulnerable area	1 400 Km^2
Estimated water resources loss due to salinization	152 Mm^3/year
% of salinizated resources	53 %

Table 14: Estimation of annual environmental and economic losses due to sea level rise

Affected activities	Amount in millions TND	GDP %
Economic losses	181	0.5%
- Agriculture / fishing	80	0.2%
- Tourism	101	0.3%
Environmental costs	47	0.13%
TOTAL	228	0.63%

Algeria

Physical Impacts:

Impacts of climate change on the coastal zone of Algeria have not yet been assessed. Only the Cheliff River Basin basin, chosen as study area in the two NatComs, has been analyzed in terms of impacts of Climate Change on the water resources. The study showed a reduction of average flows by 34 and 35 % in winter for all scenarios, and a decrease of the potential of groundwater.

Prospective analysis estimates that Sea-level rise will increase coastal erosion in almost all the sandy beaches (Table 15) (National Report, 2011).

Table 15: Estimates of Coastal erosion due to future SLR in Algeria (National Report, 2011)

Beach Name	Total loss
W Sidi Fredj	100%
E Sidi Fredj	80%
Palm Beach	60-70%
CRF	60-70%
Zeralda	50-70%
Khelloufi II	50-70%
Khelloufi I	40-50%
Familiale	40-50%
CRF	40-50%
Champs de Tir	40-50%
Déca plage	50-60%
Tarfaya	40-50%
El Kadous	50-60%

Ecosystems and Biodiversity:

The impact of climate warming upon coastal and marine ecosystem will intensify the problems of eutrophication and stress on the biological systems. Réghaïa Lake may be affected by these phenomena due its lower depth, slow water exchange and its current eutrophic state (AMIS/SMAP Report -Vol/VII – 2008).

Socioeconomic impacts:

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 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 change, the risks of natural resource degradation are increasing.
Qualitative assessment of climate change effects on Réghaïa basin (AMIS/SMAP Report -Vol/VII – 2008) estimated that water lake volume will not be influenced by global warming directly but form the sea level rise and the following water salinisation. Agricultural water reuse may be compromised. Groundwater salinisation may be a problem for drinking water supply, for industrial water and eventually for other uses (water intake from wells). Water salinisation, eutrophication and the long dry period will reduce the productivity of major crops and increase their water requirements. However, the intense territorial exploitation and the recent urbanization, heavy precipitations, soil loss and coastal erosion must not be forgotten. These factors will be intensified by climate changes.

Morocco

Physical Impacts:

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,

- Different studies on the impact of climate change on some low lying coastal areas (Snoussi et al. 2008; Khouakhi et al., 2008), showed that SLR will likely result to inundation, erosion of sandy beaches and salinization of coastal aquifers. Figures 9 and 10 illustrate two examples of potential inundation due to future SLR.

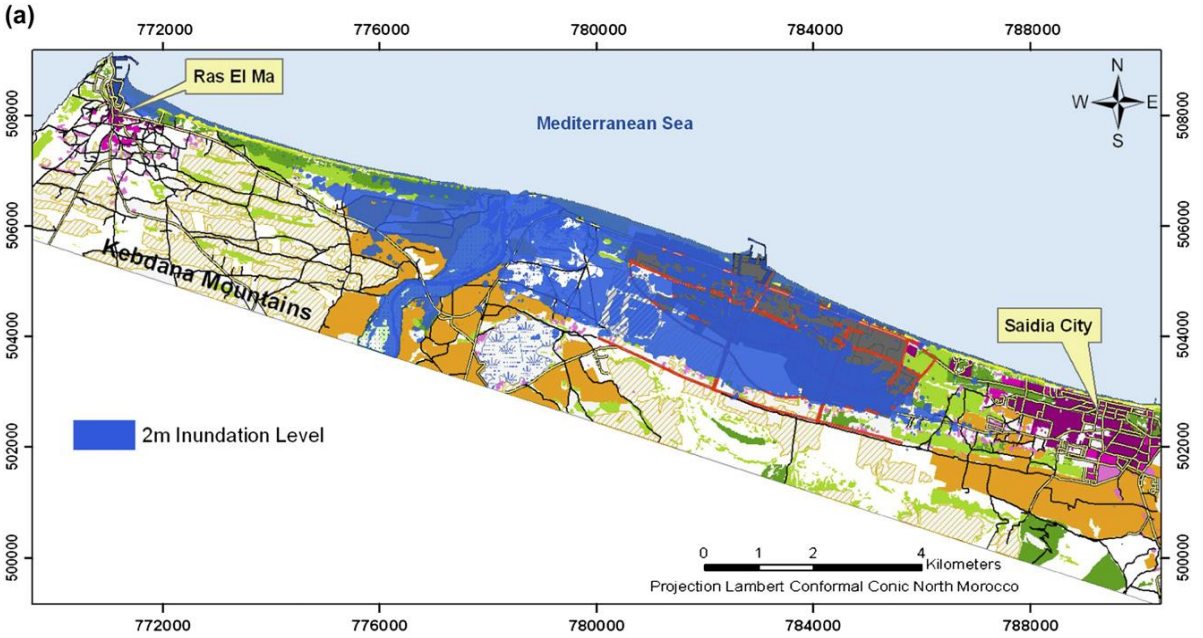


Figure 9: Potential inundated lands due to 2m SLR in the Eastern Mediterranean coast of Morocco (Snoussi et al., 2008)

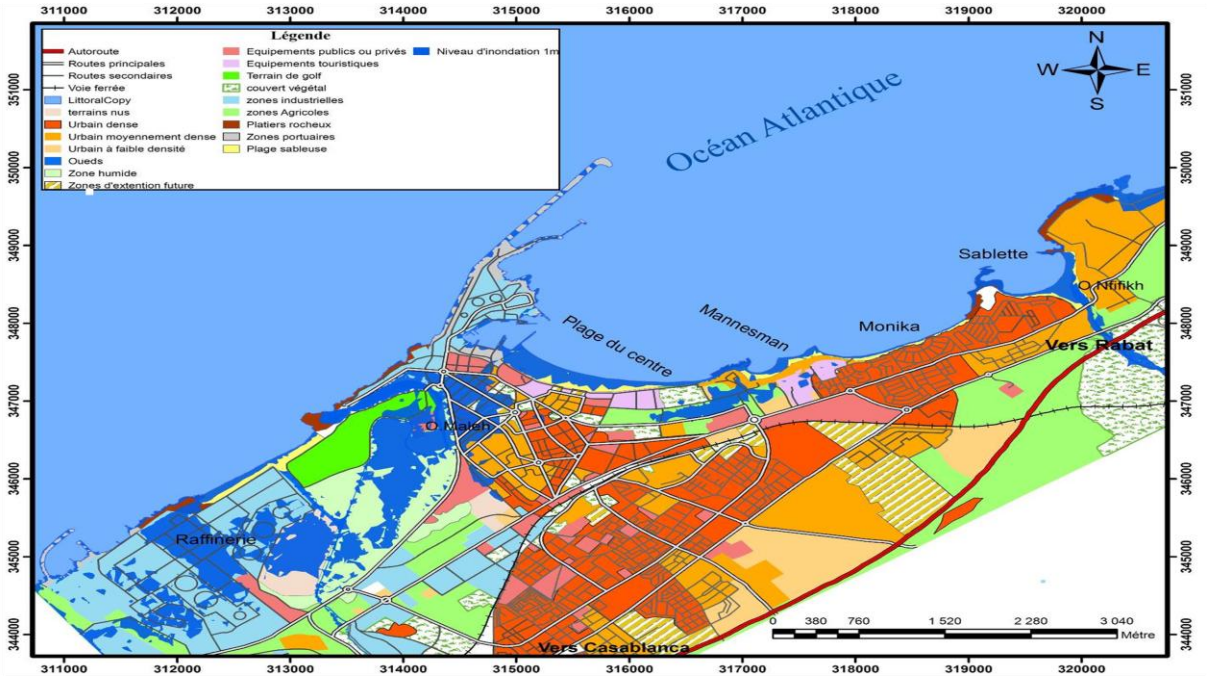


Figure 10: Potential inundation due to 1 m SLR in the Mohamedia coast of Morocco (Khouakhi et al., 2008).

Ecosystems and Biodiversity: Ecosystem destruction and pollution are current management issues, likely to worsen under a changing climate.

-The impact of CC on forests will be marked by desertification who will progress inside the territory, mortality of standing trees, and extinction of some crops and some tree species (such as the Argan)

- 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.

Socioeconomic impacts:

Water resources: The first quantitative estimate of possible CC impacts on water resources in 2020 points to the fact that there would be an average and general decrease in water resources in the order of 10 to 15 %. Morocco's water needs in 2020 are estimated at 16.2 billion m^3, taking into account the expected increase in temperature. However, the harvesting of the 17 billion m^3 that would be theoretically available in 2020 (taking into consideration CC effects), would require great investments (dam construction, drilling of deep wells).

The consequences of this decrease and the disruption of rainfall would be:

- A decrease in dam capacity (concentrated rainfall and accelerated silting up intensified by erosion)
- A disruption of the river flow rates
- A decrease in water levels, leading to a decrease in the natural outlets for water tables and an increase in their salinity in the coastal areas.
- A deterioration of water quality

Livelihoods: A key climate change impact in the coastal zone is erosion, soil and water salinisation and marginalisation due to the harsh inland environment. Development in the coastal strip has been increasing the potential susceptibility to the impacts of climate change

Agriculture: The impacts on agriculture (dominated by cereal cultivation) in 2020 are expected to be as following:

- A decrease of wheat crop yield by 15% to 10% depending on the drainage basin and by 50% in dry years. The need for cereals in 2020 would be in the order of 130 million quintals (85 million of which for human consumption).
- An increase of 7-12% in the needs for the water necessary for irrigated crops
- A reduction in crop cycles; Shift and reduction of the growth period.
- A migration towards the north of the arid zone.
- The appearance of new diseases (for example, the white fly of tomatoes whose infestation is favored by particular climatic conditions).

Population: Given that 33% of the total population and 70% of the poor are expected to live in rural areas in 2020, the agricultural performance will be

determinant for the living conditions of the poorest social strata. CC impacts on the forest, on coastlines and fishing, on tourism and precarious human establishments have not yet become the subject of a specific study. However, it is quite clear that all sectors would be directly or indirectly affected by the increase in temperature and sea level or the decrease in rainfall.

Syria

Physical Impacts:

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.

The likely inundated sea shore area varies between 17.56 km² in a very low risk scenario to 118.90 km² in an extreme risk scenario. Applying the extreme risk scenario shows that nearly 3.8% of coastal populations will be affected by SLR. (Table 16) (INC., 2010).

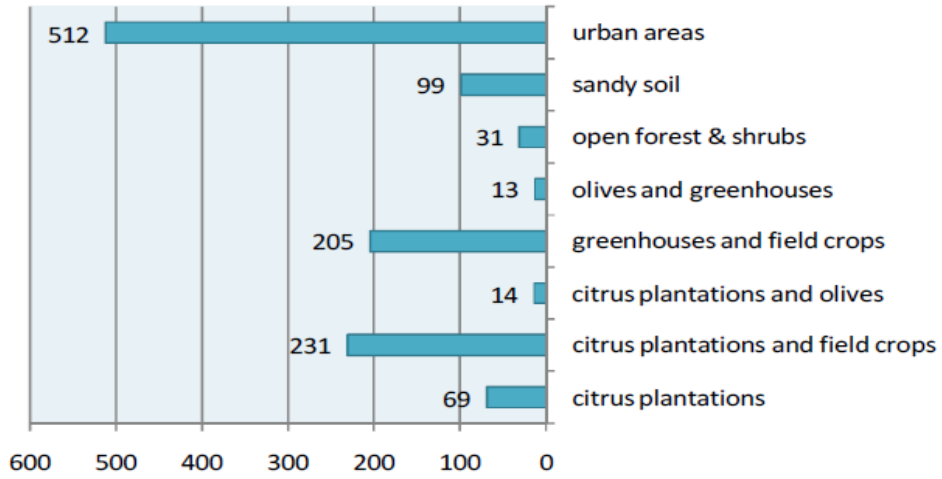
Table 16: Inundated Areas in 2100 according to various scenarios of a Sea-level rise (Source: INC, 2010)

Scenario	Trend (cm/yr)	Variation 2000-2100 (cm)	Inundated area (km^2)
Very low	0.6	60	17.56
Low risk	0.9	90	20.27
Moderate risk	1.3	130	23.89
Intermediate risk	1.9	1.9	27.57
High risk	2.5	250	30.35
Extreme risk	>5	500 up to 750	118.90

Possible physical impacts of a SLR include: (1) inundation and displacement of lowlands and wetlands, (2) increased salinity of coastal aquifers, (3) increased coastal erosion, and (4) increased coastal flooding and damage. One could thus infer that the most vulnerable coastal areas are: flat and low-lying coastal plains (sandy and rocky areas within an elevation of 0–1 m MSL), deltas and estuaries in the coastal plain and sandy shores characterized by a gentle sloping beach face.

Applying the extreme risk scenario shows that nearly 3.8% of coastal populations will be affected by a rise in sea level. The impact of this rise on major land use as a consequence of flooding is illustrated in Figure 11 (INC, 2009).

Figure 11. Impact of SLR on Land-use/Cover (ha) (Source: Meslmani and Faour, 2009).



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. Possible increase in the frequency, intensity and extent of forest fires.

Climate change will exacerbate desertification, water shortages and low forage productivity in marginal steppe and grazing zones. Moreover, it will introduce new threats to herders and livestock owners' wellbeing, rangeland ecosystem services and national economy.

Climate change may add additional pressure on already stressed ecosystems and species, especially wetlands. A further rise in sea water temperature might also increase the rate of the Mediterranean Sea's "tropicalization", contributing to the problematic arrival of invasive species along the Syrian coast.

Socioeconomic impacts:

- 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).

Water resources: Syria obtains 36% of its renewable annual water resources from the Euphrates River. Hence reductions in flow discharge will affect several sectors relying on water derived from Euphrates river flow. The large irrigation projects on the river basin will be most vulnerable to such changes, in terms of quantity and quality

of irrigation water, thereby affecting cropping area and yield. Additionally reducing snow melt flowing through dams will decrease stored water, negatively affecting the potential generation of hydropower. The lowering of water wells by 20 meters will increase the cost of irrigating crops by 5 billion S.P. This implies deeper agricultural wells and additional costs associated with pumping, for an irrigated total area of 812,921 hectares.

The socio-economic and political impact of groundwater decline is of great concern. With the Barada and Awaj basins having the highest quantity of drinking water (24%), the domestic sector living in the basin will be the most vulnerable.

Agriculture: Under the climate change scenario, the crop production will be reduced by 15.7 % for irrigated wheat, 21% for rainfed wheat, 7.5 %, for cotton and 17 % for olive trees.

Public health: Lower quantities of water and a lower quality standard leads to an increase in waterborne diseases. (Leishmaniosis, malaria, etc.) Additionally the incidence of floods, heat waves, droughts and dust storms directly influence public health.

Based on land use categories in the affected areas, a rough examination of economic losses as a result of SLR alone, the amount reaches 50 billion Syrian pounds (Meslmani and Faour, 2009). This figure represents direct average economic losses resulting from permanent disappearance of 4,108 hectares of agricultural and forested areas, 450 hectares of beach and 1,090 hectares of urban area.

However these losses may go down to 10 billion S.P. in case of a SLR of 0.6 m and may reach 84 billion S.P. if the extreme SLR scenario is justified.

Palestine Authority

The assessment of future climate risks for the occupied Palestinian territory (oPt) is limited by significant uncertainty regarding the nature and scope of regional and local impacts. This is a consequence of incomplete data and limited climate modeling within the Palestinian Authority.

The most significant environmental effects of climate change for the people of the, over the course of this century, are projected to be a decrease in precipitation (with significant seasonal variation) and significant warming (National Report, 2011; Abu-Jamous 2009 and Waggoner 1990) (Table 17).

Table 17: Climate change predictions (Abu-Jamous 2009 and Waggoner 1990)

Phenomena	Projection of Probable Global Annual Average Change	Regional Average Distribution of Change	Confidence of Projection for Global (G) and Regional (R) Averages
Temperature	+2 to 5°C	-3 to +10°C	G- High R- Medium
Sea Level	+10 to 100 cm		G- High R- Medium
Precipitation	+7 to 15%	-20 to +20%	G-High R- Low
Evapo-transpiration	+5 to 10%	-10 to +10T	G-High R- Low
Runoff	Increase	-50 to +50%	G-Medium R-Low

Annual precipitation rates are likely to fall in the eastern Mediterranean – decreasing 10% by 2020 and 20% by 2050 – with an increased risk of summer drought. The last eight years have seen reductions in the amount of rainfall received (Average rainfall for the Gaza Strip was 12% below the historic average) and reductions on agricultural production in the West Bank, with problems to winter crops from delayed rains in the Gaza Strip; though agricultural conditions there were impacted more by Israeli military and security activities (UNDP, 2010).

Continuing population growth and predictions for regional climate change – with associated changes in precipitation levels and distribution – will intensify water stress for Palestinians. Indeed, it has been estimated that the oPt will experience a water deficit of 271x106 m3 by 2020.

Drought damages are also expected to increase with the anticipated decrease in water availability, hotter temperatures and shorter winters. Under such conditions, more pests and pathogens will increase crop diseases.

High precipitating events leading to flash floods are of particular significance in contexts in which the regional water management infrastructure lacks resilience.

A 35cm SLR by 2100 will pose a serious threat to the Gaza Strip, through the ‘saline intrusion – livelihoods’ vulnerability path.

3.2 The most vulnerable zones in the Participating Countries

Based on the National reports submitted by the participating countries, the areas identified as most vulnerable to climate change impacts vary according to each country in terms of spatial extent and risk exposure to sea-level rise and storms surges.

Albania

The most vulnerable coastal zones identified are listed below:

Zhuporo (Vlore)

The region is part of the field of Myzeqe, which from the physical-geographical viewpoint includes the fields on the left side of the lower Vjosa (Vlora's Myzeqe). Vlora's Myzeqe lies on the left side of the lower Vjosa including in its territory the hilly area of Panaja. Most of the area of Vlora's Myzeqe is made of the field of Novosele, the field of Akernia, the field of Zhyk – Grykepishe of Poro, etc., which lay between the Vjosa mouth, the Narta Lagoon. Together with the near coast part of the Vlora's Myzeqe and the Fieri's Myzeqe there are considerable resources (some thousands of hectares which due to the very low relief are flooded for parts of the year or for the whole year). In the north of Narta Wetland and along the coast where the quotas of the land surface are lower, on the upper part of the sub argile cover there is a very great collection of salts as a result of which these lands are not cultivated at all or they give very low yields.

Lalzi (Durres)

Lalzi bay is situated in the central part of the Adriatic coast of Albania, between Rodoni cape in the north and Bishti Palles cape in the south. It is boarded in the north and east by a hilly ridge reaching a maximum height of 225 m, while in its south-east it continues with the drained fields of Qerreti and Durresi, formerly salt marshlands. The catchment area of the Lalzi bay is estimated at about 250 km^2. The area is originated from the alluvial sediments of the Erzeni river which meanders across the area. The most of the area is occupied by the agricultural land, while the once well developed hygrophilic flood plain forest has almost disappeared; some small spots of it are still present only along the coastline north of Erzeni river mouth. The area has been subject of extensive reclamation and deforestation during the last 50 years. The actual wetlands of the area are reminiscence of the formerly widely extended marshes. Being situated on the Adriatic coast it is influenced by the Mediterranean climate of hot dry summers and mild winters with abundant rainfall, temperatures range from 38^oC- 2^oC with season exceptions.

Patok Beach

Patoku area is extended in the Rodoni bay that starts north from the mouth of Drini river and ends south at the basis of Rodoni cape. The coastline is about 8 km long. The northern part (6 km) of the area is located in the District of Laçi

and the southern part (2 km) in the District of Durres. Patoku lagoon seems to be endangered since the dune shoreline has locally disappeared and a recent holiday village is now in the sea. However, southwards, a fresh offshore sand bank (1 km long and 500 m large) is protruding from the river mouth parallel to the coast.

Velipoje area (Shkodra)

This area is located in the District of Shkodra, close to the border of Montenegro. The borderline follows lower Buna River. The Velipoja area has about 8 km of coastline and includes Franc Jozefi Island (which is changing frequently in shape, presently joining the coast with a sand bar). Viluni lagoon is in proximity of the hunting reserve of Velipoja. It is characterized by a sandy shore, supplied by Buna River joining Shkodra Lake to the sea. From Shkodra, located 22 km north, one gets to the coastal area through a reclaimed plain with channels, ditches and dams; some marshy remains along the road still attract some waterfowl and waders.

Karpen (Kavaje)

The area is located north of the Lagjit Cape in the ending part of the Durres Bay and is part of Kavaje district. It is very used for the beach tourism and a lot of construction took place. The planted woodland in 1950 is very much damage and some small spring pouring in the sea suffered the human activities impacts. There are some fishery activity in the near that causing water balance problem. The area around is a hilly area covered by partially degraded Mediterranean maquis.

The *delta of Hoxhara Chanel* (Vjose-Seman)

The area includes several types of habitats: sand dunes well developed adjacent to Vjosa river mouth; Mediterranean pine forest of Pishe Poros (Pishe Poro Fier & Pishe Poro Vlore) 930 ha and 1050 ha respectively; old river bed and small coastal wetlands; uncultivated salty land and agriculture land East of the area. The anthropogenetic factor influence in the dunes is pretty scarce.

Egypt

The coastal zone of Egypt is seriously vulnerable to the effects of sea level rise and changes in weather patterns from both the physical and the socio-economic points of view. The following areas on the Mediterranean coast have been identified as

particularly vulnerable to sea level rise: Coastal cities of Alexandria, Port Said, Rosetta, Marina, Matruh and Arish; South of Abo Qir bay; and Brullus village.

The region covers the coastal area of Abu Qir Bay starting and including the Rosetta branch of the River Nile and Lake Edku. This area hosts many high density urban areas such as Rosetta and Edku Cities and Abo Qir Town and includes high land cover/land use diversity. The area suffers from a number of major problems including shortage of institutional capacity, excessive rates of erosion, sea level rise and waterlogging, poverty, shortage of awareness and high rates of unemployment.

Croatia

The areas, which will probably be most vulnerable to a sea level rise at the Croatian coast, were identified as follows;

• Cities: Nin, Zadar, area of Šibenik, Split, Stari Grad on the island of Hvar and Dubrovnik

• Rivers: the Raša, the Cetina, the Krka, the Zrmanja and the Neretva

• Lakes: Vransko lake on the island of Cres and Vransko lake near Biograd

• Western Istrian coast

• The island of Krapanj.

Montenegro

According to the current state of knowledge, the most vulnerable areas in the coastal zone are:

the river Bojana and Velika plaža – with the sea level rise of 35 cm, natural flow of the river Bojana will be disabled until its estuary into the sea, delta of the river Bojana will disappear, inflow of the river systems which flow into the sea will be disturbed and a big part of the space around rivers will be flooded and lost, particularly where the sea shore is low, like Velika plaža in Ulcinj;

the course of the river Bojana will be stopped much before, than it is the case today, which means that the whole part of that area, which is now practically on the same level with the river Bojana, will be flooded;

due to huge quantities of precipitations in inland mountain areas, enormously big inflow of fresh water is expected in the waters of **the Bokakotorska Bay**. Almost all that water reaches the sea through the surface outflows or underground channels and occupies the upper layer of water. Due to the presence of fresh water in the colder part of the year, when the temperatures

are under 0^0C, regular process of frosting-icing of the sea will occur which will create enormous consequences for this resource;

the sea water – waves will make a strong pressure on **water springs near the coast** which are used for water supply and a big number of springs will be out of use because they will contain salty water.

Palestine

The most vulnerable areas of Gaza Strip are the coastal zone with an elevation less than two meters. These areas can be affected by the raise in sea level. That could further contaminate the nearby aquifers such as the coastal aquifer of Gaza that should provide water to 1.6 million Palestinians.

Syria

Vulnerable areas along the Syrian coastline can be classified depending on the nature of impact from climatic changes and variability including erosion, sea level rise, and saltwater intrusion.

The areas of *Joun Jablah (south of Lattakia)* and *Al Hamidiah, (south of the City of Tartous)* are specifically vulnerable to **sea-level rise**, as the slope of these areas is very gentle where a small rise in sea level produces a large inland shift of the shoreline. *Al-Hamidiah* has a 12 km long shoreline about 4 to 10 meters above sea level. The uniqueness of these two areas makes them worthy to account for when dealing with any adaptation measure to combat the negative effects of sea level rise. It is expected that sea level rise will cause devastation to coastal properties especially when associated with strong storms. Strong storms and winds, associated storm surges will increase dramatically as a result of climatic changes. Storms as strong as 10 Force on the Beaufort scale already occur a few times per year along the Syrian coast.

Erosion is most pronounced in the northern part of the lower coastal plains between *Oum Al Tiur* and *Ras Al Bassit* area, north of Lattakia. This area is characterized by lateral promontories running directly from the coastal mountains down to the sea. The large number of rivers and streams, combined with the sandy structure of soil (on the shoreline and in the lower coastal plain) make the land susceptible to various levels of erosions, especially where the coastal mountains steeply project towards the sea.

Concerning **saltwater intrusion,** a balance exists between the coastal groundwater and seawater throughout the Syrian coastline most of the year. However, saltwater may seep into the coastal aquifers in specific areas affecting critical water supplies. Saltwater intrusion is evident in the coastal plains at *Al Hamidyeh* close to the border with Lebanon, *AlBassa* near *Banias,* and *Dimsarko* north of *Lattakia*. Saltwater intrusion occurs mainly during the dry months of the year due to uncontrolled overexploitation of the limited amount of freshwater confined into the coastal aquifer. A serious impact could be the eastward migration of saltwater up the coastal rivers of *AlKabir AlShimaly, AlHussein, and AlKabir Al Janoubi Rivers.* As a result, land salinisation is evident and soil salinity has reached levels by which agricultural production may be severely affected.

Morocco

The most vulnerable coastal areas are as follow:

-The low lying areas, especially estuaries and lagoons (coastal plains of Cabo Negro, Martil, Lao, Ghiss, Neckor, lagoon Marchica, Moulouya Delta);

- The coastlines, subjected to dynamic erosion associated with high pressure from urbanization (Bay of Tangier, Bay of Al Hoceima, Mdiq-Fnideq cornice, Saidia coast).

Algeria

The area most vulnerable to erosion remains the central part of the Bay of Algiers between the mouth of the Oued El Harrach and Mohammedia (51.6m and 24.4m of sandy beaches lost between 1959 and 1999)

Tunisia

Major zones at risk to Sea-level rise identified in Tunisia are the coastal segments that belong to the city of Bizerte and its lakeside system, to the northern and central parts of the Gulf of Tunis, to the oriental coast of the Cap Bon peninsula, to different segments of the Gulf of Gabes, and to the low islands of the eastern coast.

The coast of the Gulf of Tunis shows many forms of weakness caused by natural factors and also by the conjunction of numerous anthropogenic interventions throughout a relatively long history. Moreover, the coasts configuration, and the importance of the low-lying areas make different sectors of this zone very vulnerable to SLR, especially those hosting the most important urban and industrial

concentration of the country. The most exposed beaches to erosion are those of the Gulf of Hammamet and from El Kantaoui port, going toward Sousse and Mahdia where some touristic hotels have even lost an important part of their sandy beaches. The Kerkenna islands, which are especially characterized by their low topography, made by a succession of flat lands, occupied by some sabkhas, appear like one of the places most threatened by SLR. With the scenario of 0.50 SLR, the archipelago risks even to be transformed in a great number of small islands.

3.3 Proposed key requirements in terms of assessment of sites vulnerable to climate variability and change

The main requirements needed to assess sites vulnerable to climate variability and change in the Participating Countries could be categorized, according to the type of effects on the coastal zone as: Bio-geophysical Impacts or Socio-economic Impacts (Table 18).

Table 18: **Proposed key requirements in terms of assessment of sites vulnerable to climate variability and change**

Effects on the Coastal zone		Key Requirements
Bio-geophysical Impacts	Coastal inundation	Develop or Improve the existing sea level monitoring system Investigate the geological behavior of certain coasts (uplift/subsidence) (e.g. in Croatia or Egypt) in order to assess the potential impact of a relative increase in the sea level and create the model of the coast flooding and economic valuation of possible damage. Monitoring, modeling and assessment of impacts of salt water intrusion on soil salinity. Assessment of the potential loss of land and infrastructure due to coastal inundation. Socioeconomic considerations of immigration of vulnerable coastal communities and employment considerations in safe areas
	Coastal erosion	Analyze historical coastline changes (Diachronic analysis of aerial photographs and satellite images, aerial videotape-assisted vulnerability assessment,…) for developing sea-level-rise scenarios Monitoring of current shoreline changes Establishment of setbacks lines Sediment budget and historic records
	Coastal Ecosystems & Biodiversity	Monitoring, modeling and assessment of potential impacts of climate changes on coastal lagoons and wetlands and impacts on biodiversity Monitoring, modeling and assessment of potential impacts of climate changes on coral reef and impacts on tourism Improve analysis on the resilience of wetlands and water resources to climate change
Socio-economic Impacts	Water resources	Advanced research of improved water use efficiency and water demand management as no- regret solutions to cope with climate change. Analysis of the high water losses from leakage
	Coastal agriculture	Develop genetic engineering applications and new cultivars tolerant to heat, salinity and water stresses. Better data on crop yields and the economics of farms Additional data about the impact of various economic factors on agriculture, such as the price of fertilizers, water

		inputs, labour and market prices Detailed cost-benefit analysis should be carried out to address current problems related to soil moisture. Comprehensive cost-benefit analysis of the Government's current irrigation programme as well as other programmes, such as increasing the carbon content in soils, changing tilling methods or organic farming, as possibilities for addressing water shortages.
	Tourism	Develop better information for decision-makers about future climate change and its likely effect on the natural systems that impact the tourism sector.
	Fisheries	Develop a Warning system for abnormal phytoplankton blooms, fast screening tests for detection of bio-toxins in shellfish species Improve data collection, monitoring and further research in order to improve understanding about impacts
	Settlements & coastal infrastructure	Assessment of weather-dependent industries, their employment structures and their regional distribution, to provide a better understanding of potential climate impacts. Understanding of the impact of weather-dependent industries on income and relative access to benefits For particular coastal areas that may be vulnerable to sea-level rise, more detailed analysis is advisable in planning any major infrastructure investments.
	Health	Develop a Health information system (alert system) Water quality monitoring system (bacteria and virus containment control) A better understanding of direct health effects from climate extremes for vulnerable groups, such as the elderly Better understanding of the relationship between weather and climate and pollen transmission.

Capacity building in terms of Modeling and tools is also required. The proposed requirements are presented as follow:

Modeling and tools	- Building capacities for regional models development and operation so as to allow the assessment of predicted temperature and precipitation conditions in coastal zones - Building capacities for downscaling global climate models (GCMs) and GCM-based scenarios to regional climate models will be helpful in a variety of sectors (agriculture, precipitation patterns, changes in river flow and physical impacts on tourist destinations, wetlands and fisheries) - Building capacities for modeling and early warning of extreme events and disasters such as flash floods, tsunamis, dust storms and droughts. - Building capacities for macro-economic model of the agricultural sector and the national economy. This would help the Governments to better understand the impacts of current changes in prices on the economy, employment and poverty levels. - Building capacities in coupled physical impact studies with economic analyses which could provide the basis for developing adaptation measures. - Carry out hazard and risk assessment including risk matrices and mapping for present and future climate and a century ahead - Building a data base necessary for proper ICZM and evaluation of extreme climatic events in the most vulnerable areas - Developing a decision support system for development of the coastal zone - Building a GIS for the vulnerable zones through analysis of satellite imagery and change detection analysis - Capacity building is needed in the area of methodologies, tools and guidelines to conduct Vulnerability assessment. - Improve data availability, quality, archiving and updating and standardize methodologies and Models - Research to advance understanding of the linkages between the behaviour of vulnerable systems, climatic changes, and non-climatic drivers and positive and negative feedbacks.

3.4 Proposed National and regional levels training programmes

There is general agreement within countries about the need for enhanced regional and local climate change scenarios and improved coupling of climate and socioeconomic models. Uncertainties need to be reduced and more knowledge is needed to distinguish the consequences of climate change and of natural climate variability. There is also a need for research to advance understanding of the linkages between the behavior of vulnerable coasts, climatic changes, and non-climatic drivers and positive and negative feedbacks.

Furthermore, there is also a need for capacity building and technology transfer in the field of hydro-meteorological and SLR data collection and interpretation and shoreline monitoring. This would enhance disaster preparedness in case of extreme weather

events such as flashfloods, storms and even droughts. Regional cooperation in this field of research and science would be of benefit to the countries that face similar problems.

To address the capacity gaps identified in this report, a sustained training strategy for regional and national experts and coastal decision-makers is required to help address the ongoing need for informed decisions regarding climate change.

Training needs could include:

Objective: *To enhance the capacity of National Meteorological Services to effectively monitor, detect and predict climate change scenarios in the region to contribute to global assessments at the regional, national and local levels.*

- Regional workshop on: scientific research in climate change detection, attribution and prediction within the coastal zone of the region, including early warning systems, seasonal forecasting and long term regional and further downscaled climate projections and scenarios. Training of national experts for running of climate change scenarios (models).

- Regional workshop on: communication, processing systems, dissemination facilities for communicating weather and climate information.

Objective: To strengthen the capacity of National experts to track and monitor SLR impacts on the coastal zone.

- Regional/National workshop on: SLR data collection and interpretation and shoreline change monitoring. Methods and tools to assess land at risk of inundation and erosion. Storm surge - sea level rise linked inundation models. Shoreline change modeling based on sea level rise projections. Technical training in shoreline delineation, mapping, and vertical and horizontal reference datum. Establishment of setback lines. Guidance is also needed for modeling local/regional-scale effects of storm events coupled with rainfall, river flooding, and sea level rise projections.

- Regional/National workshop on: Impacts of SLR on biodiversity and ecosystems. Environmental/habitat changes associated with sea level rise

(e.g. coastal wetlands, salt wedge migration). Improved models that predict the migration and/or vertical accretion of coastal wetlands and beaches in response to accelerated sea level rise. Further information, research and guidance on issues like freshwater resources invasive species introductions, ocean acidification, etc. Specific training on the use of data from space observation and new technologies information.

- Regional/National workshop on: Potential impacts of SLR and extreme events on the coastal economic and cultural resources, such as public infrastructure, historic and cultural sites, shoreline property values, coastal tourism activities, coastal water resources, health. Integration of Climate models and socioeconomic models.

Objective: Integrating the climate change dimension into ICZM

- Regional/National workshop on: Defining the most appropriate way to integrate climate change concerns into all development projects. Definition of key climate change indicators and promotion of improved monitoring and reporting mechanisms. Awareness on climate change and its impacts to speed up the implementation of response actions in all the climate sensitive socio economic sectors of the coastal zone.

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5 ANNEXES

Annex 1: Examples of Climate change projects and programmes involving the participating countries

Title	Countries involved	Time frame	Focus / case studies	Funder	Main Objectives
Med-CLIVAR: Mediterranean CLImate VARiability and Predictability http://www.medclivar.eu/			Regional	WCRP IOC/UNESCO WMO ESF and others	- Description of climate past evolution - Assessment of climate variability at different space and time scales - Understanding the mechanisms responsible for the observed climate variability - Identifying trends and providing climate prediction in relation to future emission scenarios. - Study of the occurrence of extreme events and climate change impacts
CIRCE: Climate Change and Impact Research: the Mediterranean Environment http://www.circeproject.eu/	Algeria Egypt Tunisia	2007-2011	Regional Gulf of Oran (Algeria) Gulf of Gabes (Tunisia) Western Nile Delta (Egypt)	Commission of the European Union	CIRCE aims at developing for the first time an assessment of the climate change impacts in the Mediterranean area. The objectives are: 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.
PESETA - Projections of Economic Impacts of Climate Change in Sectors of Europe Based on Bottom-up Analysis http://peseta.jrc.ec.europa.eu/index.html	Croatia	2006-2007	Cross Sectoral	EC's Joint Research Centre (JRC)	The objective of PESETA is to make a multi-sectoral assessment of the impacts of climate change in Europe for the 2011-2040 and 2071-2100 time horizons. The project focuses on the impacts of climate change on the following sectors: Coastal systems, Human health, Agriculture, Tourism, and Floods.
CIRCLE : Climate Impact Research Co-ordination for a Larger Europe http://www.circle-		2005 - 2009	Regional Cross Sectoral	Commission of the European Union	CIRCLE-2 is a European Network committed to fund research and share knowledge on climate adaptation and the promotion of long-term cooperation among national and regional climate change programmes. It aims: To coordinate European transnational research funding on Climate Change Impacts, Vulnerability and Adaptation (CCIVA)

era.eu/np4/home.html					and to facilitate the transfer of research outcomes that European and national decision makers need to design effective yet economically efficient Adaptation initiatives and strategies; To share experiences and lessons learnt on CCIVA research funding and management and to encourage international cooperation with non-European countries and organizations as well as the involvement of countries with less diverse CCIVA research programmes.
CIRCLE –MED: CLIMATE IMPACT RESEARCH COORDINATION FOR A LARGER EUROPE - MEDITERRANEAN GROUP http://www.circle-med.net/					CIRCLE-MED is a geographical group in the frame of CIRCLE ERA-Net. It aims at creating a Mediterranean research community network through collaborative research projects on Climate Change Impact Research, with the objective to bring the results of this research to policy and decision-makers.
SESAME: Southern European Seas Assessing and Modeling Ecosystems changes http://www.sesame-ip.eu/	Croatia Egypt Tunisia	2007-2011		EU-fp6 Integrated project	Objectives: to understand and to explain how climate will change in the Mediterranean area; to predict and to quantify physical impacts of CC in the Mediterranean area; the society and the •to evaluate the consequences of CC for the society and the economy of the populations located in the Mediterranean area; •to develop an integrated approach to understand combined effects of CC n collaboration with •to identify adaptation and mitigation strategies in collaboration with regional stakeholders.
MEDEX: CYCLONES THAT PRODUCE HIGH IMPACT WEATHER IN THE MEDITERRANEAN http://medex.aemet.uib.es/		2000-2005 and 2006-2010	Regional	WMO THORPEX	MEDEX is a Mediterranean project focused on cyclogeneses and high impact weather in and around the Mediterranean area. It aims to better understanding and improved forecast of Mediterranean severe storms, through better understanding and improved forecast of cyclones that produce severe storms; the identification of the most sensitive areas in which an improvement of the observation leads more clearly to a better forecasting and the evaluation of the societal impact of the hazardous weather and the establishment of ways to translate the scientific achievements to the operational meteorological community.
HYMEX: HYDROLOGICAL CYCLE IN THE MEDITERRANEAN EXPERIMENT http://www.hymex.org/		2008-2020	Regional	not yet determined	HYMEX aims at a better understanding and quantification of the hydrological cycle and related processes in the Mediterranean, with emphasis on high-impact weather events, inter-annual to decadal variability of the Mediterranean coupled system, and associated trends in the context of global change.
CLIMBIOMEDNET: Climate change influence	Albania and Tunisia	2008-2010	Coastal Lagoons	MEEDDM CII Galicia	Main objective: Scientific assessment of Climate Change effects on lagoons ecosystem in comparison with man-induced changes

on biodiversity, goods and services of Mediterranean lagoons					The project has three main aims: (1) to contribute to reinforce the theoretical background linking climate changes to community and ecosystem level responses in Mediterranean lagoons; (2) to test the expected relationships with already existing data; (3) to develop experimental protocols to evaluate the actual influence of climate changes on the Mediterranean lagoon ecology, in comparison with human activity induced changes.
CANTICO: Climate and local Anthropogenic drivers and impacts for the Tunisian coastal area	Tunisia	2008-2010	Coastal Zone Gulf of Gabes.		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.
ACIDBIV: The integrated impacts of marine acidification, temperature and precipitation changes on bivalve coastal biodiversity and fisheries: how to adapt?	Adriatic and Golf of Tunis coastal areas	2008-2010	Adriatic and Golf of Tunis coastal areas		Objective: Scientific assessment of ocean acidification impacts on bivalves and Proposal of adaptation measures for bivalve's aquaculture.
CLIMWAT: Assessing and managing the impact of climate change on coastal groundwater resources and dependent ecosystems		2008-2010	Coastal aquifers		Objective: Determine sustainable yields for groundwater use to prevent degradation of aquifers and dependent ecosystems. Develop bioindicators to monitor the state of coastal wetlands.
INTERMED: The impact of climate change on Mediterranean intertidal communities: losses in coastal ecosystem integrity and services	Croatia	2008-2010	Coastal Ecosystems	IMEP IMELS	Objective: Scientific assessment of impacts of Climate Change on coastal ecosystem and socio-economic consequences.
AQUIMED: Participatory design of adaptive groundwater management strategies and instruments in Mediterranean coastal water scarce areas as a	Morocco	2008-2010	Coastal water resources and livelihoods	FCT MEEDDM	Objective: 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.

response to climate change					
MEDCODYN: Climate change impacts in transitional water systems in the Mediterranean	Morocco	2008-2010	Coastal Ecosystems	MEEDDM IMELS	Objective: Scientific assessment of coastal ecosystems vulnerability to climate and anthropogenic modifications. Explore adaptation measures.
RAB: *Building capacity in the Maghreb to respond to the challenges and opportunities created by national response to the FCCC*	Algeria Morocco Tunisia	1995-2003	Sub Regional Maghreb Region	UNDP; GEF Medium size project <750k	Objective: To build and reinforce capacity within the Maghreb countries, to advance regional interest related to CC and to enhance 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.
BEACHMED 3 : Strategic Resources for the Adaptations of Mediterranean littorals to climate change					
ClimateCost: : the Full Costs of Climate Change http://www.climatecost.cc/		2008-2011	European	Commission of the European Union (FP7)	The objective of the project is to advance knowledge in three areas: -Long-term targets and mitigation policies. -Costs of inaction (the economic effects of climate change). -Costs and benefits of adaptation.
Climate Water: Bridging the gap between adaptation strategies of climate change impacts and European water policies http://www.climatewater.org		2008-2011	European	Commission of the European Union (FP7)	The overall objective is to study European and international adaptation measures and strategies related to climate change impacts and how these are taken into account in water policies. The project will bring together scientific and policy experiences on the existing and/or missing links between climate change and water management and will help to identify research needs on climate change impacts on water cycle and resources; develop and apply methodologies for adaptation measures to climate change, and develop scenarios of water demand and to potential implementation on water policies.
Climate Change and the Mediterranean: Environmental & socio-	Croatia	1990-1996	Coastal areas and infrastructure	UNEP	Croatian Adriatic coast: two pilot-projects for the Islands Cres and Lošinj (North Adriatic) and for the Kaštela Bay (Middle Dalmatia).

economic Impacts of Climate Change and Sea-level Rise in the Mediterranean Region					
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.
ClimDev Africa: Climate for Development in Africa http://www.wmo.int/pages/prog/gcos/index.php?name=ClimDevAfrica					The Climate for Development in Africa Programme is an integrated, multi-partner programme addressing climate observations, climate services, climate risk management, and climate policy needs in Africa. The user-driven programme will support efforts to achieve the Millennium Development Goals. In addition to GCOS, principal partners are the UN Economic Commission for Africa, the African Union, the African Development Bank, the World Meteorological Organization, and potential donors including the UK Department for International Development.
The **ACQWA** Project (Assessing Climate impacts on the Quantity and quality of WAter) http://www.acqwa.ch/		2008-2012	Regional	Commission of the European Union (FP7)	The goal of the project is to use advanced modeling techniques to quantify the influence of climatic change on the major determinants of river discharge at various time and space scales, and analyze their impact on society and economy, also accounting for feedback mechanisms. The focus will be on continuous transient scenarios from the 1960s up to 2050.
DESURVEY : A Surveillance System for Assessing and Monitoring of Desertification http://www.desurvey.net/		2005-2010	Regional	Commission of the European Union (FP6)	The ambition of the DeSurvey consortium is to deliver a compact set of integrated procedures of desertification assessment and forecasting, with application and tutorial examples at the EU and national scales. The performance of DeSurvey in other desertification threatened areas of UNCCD regional Annexes will be also tested against other expertise and available procedures CRU are developing much of the observational datasets for the assessments across Europe.
ENSEMBLES http://www.ensembles-		2004 - 2009	European	Commission of the European	This EU integrated project on ENSEMBLE based predictions of climate changes and their impacts uses the collective expertise of 66 institutes to develop a reliable

eu.org/				Union (FP6)	quantitative risk assessment of climate change and its impacts on timeframes ranging from seasonal to decadal and longer, at global, regional, and local spatial scales. Research themes encompassed data analysis, downscaling, extreme events, impacts, communication and dissemination activities and treatment of uncertainty. An ENSEMBLES web portal provides briefing material for developers and users of regional climate information, together with links to relevant datasets and tools, including the ENSEMBLES downscaling portal.
Climate Change and Balkan Biodiversity Conference	Albania Bosnia and Herzegovina Serbia and Montenegro	Dec. 2007 to July, 2008		Sub Regional/ Balkans	To further increase the existing knowledge and awareness about, and capacity to deal with, the impact of climate change on biodiversity and ecosystem services in the priority countries - in order to assist them in identifying and implementing realistic solutions that will help to maintain the quality of their biodiversity and to avoid, where possible, further damage to ecosystem services on which people are dependent.
Adaptation of the Nile Delta to climate change through integrated coastal zone management	Egypt	Sept 2009 - June 2014	Coastal areas, all sectors	UNDP-GEF	The main objective is to integrate the management of SLR risks into the development of Egypt's Low Elevation Coastal Zone (LECZ) in the Nile Delta.
Identification of adaptation response measures in the Drini - Mati River Deltas http://www.ccalb.org/	Albania	May 2008 - May 2012	Drini - Mati River Deltas	UNDP/GEF	The overall development goal of this Medium Size Project is to assist Albania in establishing a mechanism by which strategies to moderate, cope with, and take advantage of the consequences of climate change are enhanced, developed, and implemented.
ADRICOSM-STAR ADRIatic sea integrated COastal areaS and river basin Management system: Montenegro coaSTal ARea and Bojana river catchment http://gnoo.bo.ingv.it/adricosm-star/	Montenegro, and Albania	2007-2010	Montenegro coastal area and Bojana river catchment	The Italian Ministry of Environment, Territory and Sea *and the Italian Ministry of Foreigner Affairs.*	The project aims at the development and partial implementation of an integrated coastal area and river and urban waters management system that considers both observational and modeling components. The project develops innovative components such as studies of climate change impacts on the water resources and sediment transport.
ADRICOSM-EXT http://gnoo.bo.ingv.it/adricosm-ext/	Croatia, Albania, Bosnia-Herzegovina and Serbia-Montenegro		Sub-Regional/Adriatic	the Italian Ministry of Foreign Affairs and implemented by IOC-UNESCO	The main objectives are: To activate the participation of Bosnia-Herzegovina, Serbia-Montenegro and Albania in the activities of ADRICOSM; To continue and further enhance of the ADRICOSM observational network with the active participation of the new entering countries; To expand and implement a data management system for real time exchange and historical data archiving; and Activate training courses and workshops on different aspects of real time monitoring and forecasting.

MARBEF: Marine Biodiversity and Ecosystem Functioning Effects of climate change on the Mediterranean http://www.marbef.org/wiki/Effects_of_climate_change_on_the_Mediterranean			Regional European	European Union	MarBEF, a network of excellence funded by the European Union and consisting of 94 European marine institutes, is a platform to integrate and disseminate knowledge and expertise on marine biodiversity (including the impacts of climate change), with links to researchers, industry, stakeholders and the general public.
CLIWASSEC: Climate Induced Changes in Water and Security http://www.cliwasec.eu/home/home.php	Tunisia Egypt	2010-2013		European Union (FP7)	In order to better assess the manifold consequences and uncertainties in climate impact on man-environment systems, a coordinated topic has been programmed between Theme 6 ('Environment (incl. climate change)') and Theme 8 ('Socio-Economic Sciences and Humanities') in the 3rd FP7 call for proposals (2009). CLICO (SSH) with WASSERMed (ENV) and CLIMB (ENV), all started in early 2010, are now establishing a research cluster for scientific synergy and improved policy outreach.
CLIMB Project : "Climate Induced Changes on the Hydrology of Mediterranean Basins-Reducing Uncertainty and Quantifying Risk through an Integrated Monitoring and Modeling System" http://www.climb-fp7.eu/home/home.php	Tunisia Egypt Palestine	2010-2013	Chiba Watershed in Cap-Bon (Tunisia) and Gaza Strip (Palestine)	European Union (FP7)	The strategy of CLIMB is aiming to employ and integrate advanced field monitoring techniques, remote sensing analyses and retrievals, climate models auditing and integrated hydrologic modeling and socioeconomic factor assessment in a new conceptual framework to significantly reduce existing uncertainties in climate change impact analysis. It will create an integrated risk assessment tool for adaptive water resources management and best agricultural practice under climate change conditions. Cases study : Chiba Watershed in Cap-Bon (Tunisia) and Gaza Strip (Palestine)
CLICO Project: Climate Change, Hydro-Conflicts and Human Security http://www.clico.org/	Egypt Morocco	2010-2012	Alexandria, Egypt Morocco- Andalusia Biosphere:	European Union (FP7)	A large dataset – the first of its kind – of domestic hydro-conflicts in the Mediterranean, Middle East and Sahel will be regressed against climatic, hydrological and socio-economic variables. The resilience of international treaties in the region to deal with climatic variability will be addressed and national and international policies will be evaluated, the aim being the development of a suitable international institutional framework for dealing with the human security implications of hydro-climatic hazards. Case studies: **Alexandria, Egypt:** The study will systematize the conflict lines and the different implications of climate change related hazards and hydro-conflicts. the case study will also provide a good basis to explore how urban and regional development plans could take into account actual and future hydro-conflicts, climate change and vulnerability

					reduction. **Morocco- Andalusia Biosphere**: CLICO will try mapping these external pressures and evaluate the risk degree for the local population and the possible conflicts that could motivate an increase of vulnerability to climate change. In this way, this case study will contribute to two main themes of CLICO research, namely consider the specificities of a hazard, its interactions with vulnerability and the causal routes between vulnerability, impacts, conflicts and security; and explore the determinants of vulnerability and adaptive capacity under multiple stressors.
WASSERMed project "Climate Induced Change on Water and Security" http://www.wassermed.eu/	Tunisia Egypt	2010-2012	Merguellil catchment (Tunisia) The Rosetta area, Nile Delta (Egypt)	European Union (FP7)	The project analyses, in a multi-disciplinary way, ongoing and future climate induced changes in hydrological budgets and extremes in southern Europe, North Africa and the Middle East under the frame of threats to national and human security including the assessment of changes in mean flows, frequency and magnitude of extreme precipitation (intensity and duration), surface run-off, stream flows ground water balance, as well as social and economic factors.
Project on Climate Change Impacts and Adaptation Assessment in the coastal areas of Morocco	Morocco	2004-2005	Coastal zones of Saïdia and Tangiers Bay	UNEP/GEF AIACC	Assess the biogeophysical and socioeconomic impact of climate change and rising sea level on the coastal zones of Morocco Assess the Vulnerability and Adaptation options to the adverse effects of climate change Strengthen the scientific and technical capacities of the country in modeling and analysis of climate change impacts.
Climate Change Adaptation and Natural Disasters Preparedness in the Coastal Cities of North Africa	Egypt Morocco Tunisia	2008-2010	Coastal Cities Alexandria Casablanca BouRegreg Valley Tunis	World Bank and other partners	This project aims to: assess the climate change and natural disaster vulnerabilities of 4 urban areas in North Africa: Alexandria (Egypt), Tunis (Tunisia), Casablanca and Bouregreg Valley (Morocco), and formulate related action plans to improve their adaptation to climate change and preparedness for natural disasters.
MY OCEAN: Ocean Monitoring and Forecasting http://www.myocean.eu.org	Morocco	2009-2012	Euro-Mediterranean	EU	MyOcean aims at providing a sustainable service for Ocean Monitoring and Forecasting validated and commissioned by users. The MyOcean information includes observations, analysis, reanalysis and forecasts describing the physical state of the ocean and its primary biogeochemical parameters. It also contributes to research on climate by providing long time-series of reanalyzed parameters

Annex 2: Impacts of Climate Change in the PCS (from the NatComs)

Country	Sectors assessed (From NC)	Projected CC	Potential impacts
Balkans Countries			
Croatia	Hydrology and Water Tourism Health Energy Agriculture Coastal Area Biodiversity	-**Temp**: increase ranging from 2.0 °C to 2.8 °C in the coastal and mountainous area, and from 2.4 °C to 3.2 °C in the lowland areas **-Rainfal**l: Annual precipitation could increase between 4 and 10% in the coastal and mountainous area and between 8 to 10% in the lowland area and in Istria.	It is probable that changes in the precipitation, temperature, soil moisture, and the frequency of extreme events, will have an impact on some of the most important economic sectors in Croatia. These includes: - The **tourism sector** may face challenges due to uncomfortably hot summers, but also opportunities due to better weather during the spring and autumn. Additional threats may result from damages to particularly important tourist destinations and/ or increases in severe weather related events such as heat waves and forest fires. - Many parts of the coastline may be vulnerable to sea-level rise, including the Neretva Delta, some urban areas such as the island of Krapanj, some parts of Split, and natural areas such as Vrana Lake near Biograd and the River Krka. - **Human health** – especially among older people– will experience increased risks due to heat waves during the summer. However, mild winter temperatures are likely to reduce the health problems caused by cold weather. Additionally, changes in allergen patterns may also cause problems for certain groups. - **Hydropower production** may decrease due to reduced river flow, and wetlands benefits may be endangered due to less precipitation. - **Agricultural production** may experience a drop in the yields of various crops. The **fisheries and mariculture** industries should benefit from the increased production of certain types of fish and shellfish, although invasive species and sea temperatures may reduce the number of other species. - **Population**: Climate change will not affect all Croatians equally. Certain groups in society face a greater risk from future climate change. These include residents of certain regions that face the double burden of low incomes and employment in/ reliance on weather sensitive industries. They also include the elderly, who face added health risks due to heat waves.
Bosnia and Herzegovina		**Temp:** increase from 0.7 to 1.6°C per 1°C of global increase during the period 2031-2060. Average rise in temp. 1 and 2°C along the coast **Rainfall** : reduction and a decrease in precipitation	No specific research has been done in BiH regarding the impact of climate change in the coastal zone Likely potential impacts: Erosion risk and soil deficiency due to sea level rise. Ecosystems that will be directly exposed to the impacts of climate change include low coastal areas; e.g., coastal sands, salt marshes and estuaries. Changes in physical, hydro-dynamic, biological and chemical parameters may be expected, with accompanying quality and quantity changes in the components of biocenoses Significant sea level-increase could endanger numerous commercial and fishing ports, contaminate coastal freshwater sources in karstic zone, disrupt touristic and recreative activities depending on coastal areas.
Montenegro	Water resources Coastal area	**-Temp**: are moving in the range of 0.60°C to 1.3°C,	***Climate and Water:*** Reduction of annual precipitation that ranges even up to 20% in certain areas. Water resources will be also generally reduced. Analysis shows that the discharge of the Morača water resource through Podgorica will

	Biodiversity Public health	depending on the season and the area of Montenegro with 0,5°C to1°C in coastal areas (2001-2030) Along the coastal area the temperature increased by approximately 2.4°C (2071-2100). **-Rainfall**: decrease in precipitation	be reduced by 31% during the period 2071-2100 compared to the normal period 1961-1990. ***Biodiversity*** : shifting of vegetation zones- disappearance of certain species- changes in composition of biocenoses; fragmentation of habitats and changes in the functioning of ecosystems Due to expected SLR: the water will continuously flood a large part of the coast; large part of the beach area will be reduced, and some beaches will disappear. The Bojana River delta will disappear. Faster eutrophication of shallow and confined parts of the sea waters, as well as the introduction of new thermophilic (invasive) species from southern marine biogeographic zones. The economic and tourism potential of the coast will be reduced, while an investment risk will be increased. - ***Public Health*****:** the increase in temperature, especially in the summer months of JJA will negatively affect the health condition of high-risk groups, while on the other side a temperature increase during the winter will lead to lower morbidity and mortality, particularly for chronic patients.
Albania	Water resources Agriculture Ecosystems Tourism Health Population and settlement. Coastal zone	**Temp:** Annual increase in temperature: 0.8 to 1.1 (2025)1.7 to 2.3 (2050), 2.9 to 5.3 (2100) **Rainfall:** Decrease in precipitation up to -3.4 to –2.6% (2050); –6.9 to –5.3%(2050); –16.2 to –8.8%(2100)	***Climate****:* Higher temperatures will shift the snowline upwards; the seasonal patterns of snowfall are likely to change with the snow season beginning later and ending earlier. So, the spring runoff is expected to reduce noticeably. Likely increased frequency of extreme events (heavy rains, strong winds, droughts, flooding) ***Water resources:*** - reduction of long term mean annual and seasonal runoff for the Drini water basin - Under reduced surface water flow and increased evaporation, decrease of the storage of reservoirs and reduction in ground water supply. ***Agriculture:*** By 2100, the impacts to be expected are: the reduction of the extent of arable land due to soil erosion and alteration; the changes in the growth cycles, harvest time and the quality of the agricultural production, especially along the coastal area owing to an increase in salinity, due to the sea level rise and intrusion of salt water into the soil. ***Ecosystems* & Biodiversity** - SLR will result in likely increase in losses of wetland area (around 1 km² by 2100). Coastal forest area and low unvegetated wetlands area are likely to decrease. The national parks of Kune-Vain (Lezha District) and Velipoja (Shkodra District) are located along the Drin and Buna river deltas, between 0.8 to 2 m and 0–1.2 m above sea level, respectively. Likely enlargement of lagoons is expected to increase the staying capacity of migratory birds and change their composition. Change in water fauna and flora in favor of species that like more warmth and salinity is likely as well. - Expected changes of forest flats due to projected changes in temperature are: The common spruce flat (Picetum) is likely to disappear after the 2025. The Mediterranean alpine pasture area is expected to reduce more than ten times. According to sea level rise scenarios, the coastal forest area (Lezha coast) is likely to decrease from 1.14 to around 1 km² by 2100. ***Public health*****:** The increase in summertime temperature is likely to affect the physiological and compensatory system of people. Climate change will further aggravate air quality related health problems in the major cities of Albania as well, but in particular in Tirana. ***Population:*** The expected climate change and SLR will largely influence the distribution of the residential areas, population, their economic activity in general and **tourism** in particular. Increases in the coastal floodplain area and population (respectively around 66 km²and 4.6 thousands by 2100). At the beach of Shengjin the tourism

			constructions are all threatened by sea level rise in the coming 50–100 years.
North African Countries			
Egypt	Water resources Agriculture coastal zone Aquaculture and fisheries Tourism	**Temp:** 2°C- 4°C increase in temperature by 2020 - **Rainfall:** 10-20% decrease	***Water resources;*** The vulnerability of Egypt's water resources to climate change entails those affecting Nile flows, rainfall (possible 50% reduction of rainfall on Egypt's Mediterranean coas)t, and ground water (increased levels and salinity due to sea level rise and consequent sea water intrusion). With 4°C warming and 20% reduction in precipitation, Nile flows may decrease by 98%. Water logging and water bogging problems are expected to exacerbate soil salinization which will lead to deterioration of crop quality and productivity. This will in turn lead to increasing health problems and loss of tourism. ***Agriculture*:** climate change studies predict a reduction in the productivity of two major crops in Egypt - wheat and maize - by 15% and 19% respectively by 2050. Losses in crop productivity are mainly attributed to the projected temperature increase, crop-water stress, pests and disease, as well as the inundation and salinization of 12% to 15% of the most fertile arable land in the Nile Delta as a result of sea level rise and salt water intrusion. ***-Coastal zone**:* 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, but also because of the impacts on water resources, agricultural resources, tourism and human settlements. ***-Aquaculture and Fisheries:*** A slight to moderate SLR may be quite beneficial. Fish production may go up due to an increase in lake area and in more valuable marine fish species. Climate change is expected to increase sea temperature causing fish distribution to shift northwards and to go into deeper waters. In addition, increased water salinity in the coastal lakes in Egypt is expected to affect fish species in these lakes. ***Biodiversity:*** there is an expected serious negative effect on birds**.** The expected submerged wetland will form grounds for an increase in rooted aquatic plants, will increase the wintering grounds for migrating birds and can also be used for aquaculture activities. The impact of climate change on coral communities in the Red Sea will include coral bleaching due to increasing temperatures, loss of habitats and loss of biodiversity. ***Tourism:*** coral reefs, constituting a major attraction in Red Sea resorts, are highly vulnerable to climate change. On the other hand, sea level rise on the low elevation Mediterranean coast will definitely lead to losses of beaches. In addition the impact of increasing temperatures and frequencies and severity of extreme events are expected to negatively impact the archaeological heritage in Egypt. Heat waves in the summer months are likely to negatively impact on tourism. **Health**: For the health sector, climate change will contribute to the burden of diseases through direct effects (heat strokes) and indirect effects (the shortage of water supply and decreased agricultural land area leading to shortage of essential food with the possible emergence of malnutrition).
Tunisia	Water resources Agriculture Coastal zone Ecosystems Tourism	**Temp:** increase of 1.3 to 2.5°C in temperature at the 2100 horizon	**Impacts of SLR:** The Study on the impact of SL on coastal ecosystems and on the economy of threatened coastline areas shows that a 50-cm SLR by 2100 may cause an increase of erosion in a number of low coastal areas. 100 km of coastline are prone to marine erosion, 40 km of which are priority beaches. 53 % of coastal water resources will be lost by salinization due to SLR. Annual environmental and economic losses due to SLR have been estimated to be 228 TND, which represent O,63% of the GDP. ***Ecosystems:*** the most vulnerable wetlands will be the coastal lagoons, sebkhas, and coastal marshes, which will

			be in majority annexed to the sea domain. In oasis, SLR could result in a retreat of the coastline and an increased salinization of the coastal aquifers, detrimental to the palms growth. ***Agriculture:*** would be among the sectors most affected by SLR which will lead to important losses of agricultural lands by erosion or salinization and deterioration of the drainage and irrigation infrastructures. ***Tourism:*** the beaches which are among the main appeal of the three major tourist poles of the country could be highly affected by SLR.
Algeria	Climate Water resources	- Rising temperature: 0.65 to 1.1°C according to the season by 2020 and 0.95 to 2.2°C by 2050. - Reduced precipitations: 5% to 13% by 2020 and 10% to 22% by 2050.	Only the Cheliff River Basin basin, chosen as study area in the two NatCom, has been analyzed in terms of impacts of CC on the water resources. The study showed a reduction of average flows by 34 et 35 % in winter for all scenarios, and a decrease of the potential of groundwater. Tourist activity is extremely important along the 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 change, the risks of natural resource degradation are increasing. Coastal zone not dealt with specifically in NatComs.
Morocco	Water resources Agriculture Forestry Coastal zone Fisheries Health Tourism	**Temp:** increase in annual average (between 0.6°C and 1.1°C in the horizon of 2020). - **Rainfall**: Decrease in annual average volume of about -5.7% by 2020 about -18.2% by 2050 and 27.9% by 2080.	-Decrease in water resources by 10% to 15% -Decrease of wheat crop yield by 15% to 10% depending on the drainage basin and by 50% in dry years. -Irrigated crops will require an increase of water from 7 to 12%. -The impact of CC on forests will be marked by desertification who will progress inside the territory, mortality of standing trees, and extinction of some crops and some tree species (such as the Argan) -The health vulnerability to climate change can be explained by the presence of endemic foci of disease that may be exacerbated by climate change. -Different studies on the impact of climate change on some low lying coastal areas showed that SLR will likely result to inundation, erosion of sandy beaches and salinization of coastal aquifers, which will impact negatively on tourism, coastal agriculture and coastal settlements and infrastructures.
Middle East Countries			
Syria	Water resources Agriculture Ecosystems Energy Public health Coastal zone	**Temp:** Average warming for the year 2041 will be higher than the global average. The greatest increase (2.0-2.1°C) will occur in the north-west and the southeast, while the most moderate increase (1.0-1.2°C) will occur all over the country.	***Water resources:*** Syria obtains 36% of its renewable annual water resources from the Euphrates River. Hence reductions in flow discharge will affect several sectors relying on water derived from Euphrates river flow. The large irrigation projects on the river basin will be most vulnerable to such changes, in terms of quantity and quality of irrigation water, thereby affecting cropping area and yield. Additionally reducing snow melt flowing through dams will decrease stored water, negatively affecting the potential generation of hydropower. The lowering of water wells by 20 meters will increase the cost of irrigating crops by 5 billion S.P. This implies deeper agricultural wells and additional costs associated with pumping, for an irrigated total area of 812,921 hectares. ***Agriculture:*** Under the climate change scenario, the crop production will be reduced by 15.7 % for irrigated wheat, 21% for rainfed wheat, 7.5 %, for cotton and 17 % for olive trees. ***Ecosystems:*** possible increase in the frequency, intensity and extent of forest fires Climate change will exacerbate desertification, water shortages and low forage productivity in marginal steppe and

		-**Rainfall:** The highest increase in precipitations will occur in summer and autumn in all regions.	grazing zones. Moreover, it will introduce new threats to herders and livestock owners' wellbeing, rangeland ecosystem services and national economy. Climate change may add additional pressure on already stressed ecosystems and species, especially wetlands. A further rise in sea water temperature might also increase the rate of the Mediterranean sea's "tropicalization", contributing to the problematic arrival of invasive species along the Syrian coast. ***Impacts of SLR***: The likely inundated sea shore area varies between 17.56 km² in a very low risk scenario to 118.90 km² in an extreme risk scenario. Applying the extreme risk scenario shows that nearly 3.8% of coastal populations will be affected by SLR. Based on land use categories in the affected areas, a rough examination of economic losses as a result of SLR alone shows that the amount reaches 50 billion Syrian pounds. This figure represents direct average economic losses resulting from permanent disappearance of 4,108 hectares of agricultural and forested areas, 450 hectares of beach and 1,090 hectares of urban area. ***Public health:*** Lower quantities of water and a lower quality standard leads to an increase in waterborne diseases. (Leishmaniosis, malaria, etc.) Additionally the incidence of floods, heat waves, droughts and dust storms directly influence public health.
Palestine Authority*	Water resources Agriculture Public health Settlements Coastal zone	Projection of Probable Global Annual Average Change : Temperature: +2 to 5ₒC, Precipitation: +7 to 15% Sea Level: +10 to 100 cm,	The most significant environmental effects of climate change for the people of the occupied Palestinian territory, over the course of this century, are projected to be a decrease in precipitation (with significant seasonal variation) and significant warming. Annual precipitation rates are likely to fall in the eastern Mediterranean – decreasing 10% by 2020 and 20% by 2050 – with an increased risk of summer drought. The last eight years have seen reductions in the amount of rainfall received (Average rainfall for the Gaza Strip was 12% below the historic average) and reductions on agricultural production in the West Bank, with problems to winter crops from delayed rains in the Gaza Strip; though agricultural conditions there were impacted more by Israeli military and security activities. Continuing population growth and predictions for regional climate change – with associated changes in precipitation levels and distribution – will intensify water stress for Palestinians. Indeed, it has been estimated that the oPt will experience a water deficit of 271x106 m3 by 2020 Drought damages are also expected to increase with the anticipated decrease in water availability, hotter temperatures and shorter winters. Under such conditions, more pests and pathogens will increase crop diseases. High precipitating events leading to flash floods are of particular significance in contexts in which the regional water management infrastructure lacks resilience. A 35cm SLR by 2100 will pose a serious threat to the Gaza Strip, through the 'saline intrusion – livelihoods' vulnerability path.