

CONTRIBUTING TO SUCCESSFUL ADAPTATION TO CLIMATE CHANGE IN MEDITERRANEAN COASTAL AREAS

Global climate models concur in identifying **the Mediterranean Sea region as a climate change 'hot spot'**, i.e. a highly responsive area to climate change. The Mediterranean Sea climate will evolve more rapidly and drastically than the global climate change, aggravating already alarming unsustainable trends in the use of natural resources. The Mediterranean Basin has already experienced: (1) a significant increase in its mean air temperature from +0.4 °C to +1.5 °C between 1901 and 2012; (2) a decrease in precipitation reaching up

to -50 mm/year per decade between 1951 and 2010; and (3) a continuous rise in sea level of 1.7 ± 0.3 mm/year over the period 1901–2010. And these trends are expected to continue, impacting directly and indirectly societies, economic activities and ecosystems. While the implementation of mitigation policies and measures will help attenuating the impacts of climate change, it is necessary to anticipate, and to adapt to, these impacts accounting for the social, economic and environmental characteristics of Mediterranean coastal areas.

Main vulnerabilities to climate change and opportunities in Mediterranean coastal areas

Since the Mediterranean Sea basin is located in a transition zone between the arid climate of North Africa and the temperate and rainy climate of central Europe, it is

sensible to interactions between mid-latitude and tropical processes. For the 21st century, climate experts anticipate significant changes in climate and related physical impacts as presented in Table 1 (based on IPCC 2007, scenario A1B¹).

¹ Scenario A1B is close to Representative Concentration Pathway (RCP) 6 in the Fifth Assessment Report (2014). The new 'extreme' scenario (RCP 8.5) is higher than the former A2 scenario.

Air temperature	An increase in air temperature from +2.2 C° to +5.1 C° for the period 2080–2099 as compared to the period 1980–1999.
Rainfall	A significant decrease in rainfall, ranging between -4% and -27% over the same periods of time.
Extreme events	Increase in drought periods and in the frequency of days during which the temperature would exceed 30 °C. Extreme events, such as heat waves, droughts or floods, are likely to be more frequent and violent.
Sea acidity	At the present rate of greenhouse gas emissions, the Mediterranean's acidity is expected to rise by +30% and +150% by 2050 and 2100, respectively.
Sea surface temperature	An average sea surface temperature rise of +0.75°C is expected at the scale of the Mediterranean Sea from 2000–2010 to 2030–2040.
Sea level rise	According to RCP 6, a mean and likely range of +0.33 to +0.63 m in the period 2081–2100

Table 1: Main physical impacts of climate change expected in the Mediterranean sea basin.

In parallel to climate change, the Mediterranean Sea basin will experience a significant population increase, with 100 million more inhabitants expected in 2025 (as compared to 420 million inhabitants today, equivalent to 7% of the world population and 13% of the world GDP), essentially in cities of the Southern Mediterranean countries. As illustrated in Figure 1, key sectors which will most likely be affected by climate change include: water management; agriculture; fishing; energy (cooling of power plants and hydropower production) and industry sectors; tourism; infrastructure and urbanism (affected by exposure to the action of waves, coastal storms and other extreme weather events, and sea level rise); health.... Vulnerabilities, exposures and hazards to climate change will be particularly significant in **coastal areas** that are **largely urbanized** and which infrastructures and land planning are not adapted to climate change challenges.

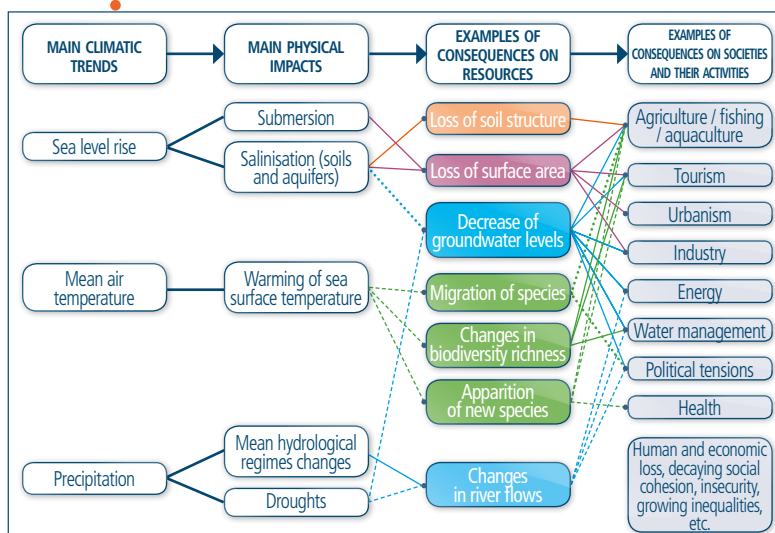


Figure 1: Examples of chains of impacts, from climatic trends to societies and activities (adapted from IDDRI, 2009)

Also, while **precipitation has decreased** in most parts of the Mediterranean Sea basin since 1901, a situation that has worsened between 1951 and 2010, the region will also experience an increase in the number of intense rainfall episodes, as illustrated in Figure 2.

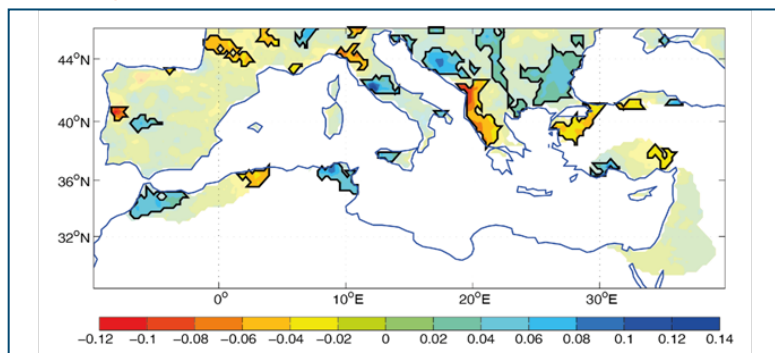


Figure 2: Average evolution of the number of intense precipitation events (superior to percentile 95 total) per wet season (September to April) in the Mediterranean basin for the period 1950-2013 (E-obs data). Source: F. Raymond, A. Ullmann and P. Camberlin, 2016

Much attention in the assessment of the potential climate change impacts, and the search for solutions to adapt to climate change, is given to **vulnerabilities**, and on the perceived negative impacts on economic sectors and ecosystems. **Opportunities** to seize in the context of climate change (e.g. with the possibility to grow new crops or to seize new opportunities for tourism development) receive indeed very limited attention today.

Mainstreaming adaptation to climate change within decision making processes

How to do so?

Adaptation to climate change is defined by the Intergovernmental Panel on Climate Change in its fifth report as 'the process of adjustment to actual or expected climate and its effects' (IPCC, AR5). The implementation of adaptation policies and measures face two main issues.

- The first issue concerns the most appropriate mechanism for making adaptation a reality—be it via the development of specific strategies dedicated to adaptation to climate change, or the integration of climate change issues in **existing sectoral strategies and policies (e.g. water management, agriculture, biodiversity, marine resources...)**. While the former might help enhancing the visibility of climate change issues in the political agenda, the second might be more effective in accounting for climate change;
- The second issue refers to the **spatial** scale (from the local to the Mediterranean Sea basin scale) at which adaptation to climate change can be considered, and how. Some Mediterranean countries have developed national adaptation strategies, mostly in the North-Western part of the basin. In parallel, accounting for climate change **can take place at the level of 'local' development and management plans** (e.g. climate change and energy plans, spatial and urban planning documents, tourism strategies, integrated coastal zone management tools, water management plans, etc.). Indeed, all these local plans present opportunities for integrating adaptation into local decision-making. In the context of the Mediterranean Sea, the international character of the sea basin adds a level of complexity, some climate change vulnerabilities requiring a coordinated framework for actions at the regional sea level.

Integrating climate change issues and adaptation within existing sector strategies and policies requires that climate change 'finds its place' at each step of the planning process cycle, as illustrated in Figure 3.

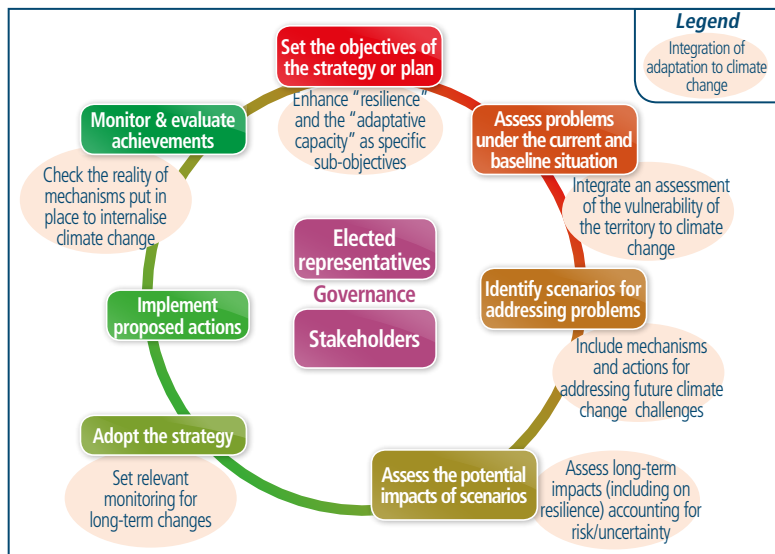


Figure 3: Planning cycle and integration of adaptation to climate change (source: authors)

Main constraints & factors for success

Integrating climate change issues into decision-making requires addressing many challenges, among which:

- The long-term horizon of climate change projections as compared to the short-term horizon accounted for in the majority of decisions;
- The uncertainty attached to climate change and to its social, economic and environmental impacts (in particular at local scales), and the need to integrate (and make explicit) risk and uncertainty in decision-making;
- The encompassing nature of climate change that affects directly or indirectly many of all components of society (different economic sectors and policies, different regions, etc.);
- The need to involve strategic stakeholders (e.g. the banking and insurance sector) in planning processes...

The main issues, along with potential solutions to overcome them, are synthesized in the following table.

ISSUES	SOLUTIONS
How to make decisions about long term and uncertain events and impacts?	Integrating climate change into decision making requires accounting for higher uncertainty in the frequency, magnitude and impacts of future events. This might need: <ul style="list-style-type: none"> • New (ex-ante) assessment methods, such as robust decision making² or real option analysis³. These can help comparing projects or policy options accounting for uncertainty in a more comprehensive and rigorous manner as compared to sensitivity analyses performed traditionally for cost-benefit or multi-criteria assessments of strategies and projects; • Changes in decision making processes – with new stakeholders involved (e.g. representatives of insurance companies) or additional steps to review (intermediate) decisions at regular intervals on the basis of new knowledge and information.
How to communicate about climate change and adaptation to climate change?	Presenting success stories in adapting to climate (change); illustrating climate change with situations that already exist today; focusing on areas of interests that are shared by, and common to, many; simplifying scientific results and presenting them in easily understandable figures and diagrams... are components of communication initiatives that can make climate change information more easily understandable and accessible to stakeholders and local decision makers.
How to prepare for the effective and successful implementation of adaptation?	The involvement of those who need to change and adapt, as opposed to their representatives, in the development of adaptation actions and/or strategies can help accounting for their constraints and opportunities. The signing of a charter (as a sign of personal commitment) at the launching of an adaptation plan can help confirming commitment and increase involvement in its practical implementation. The creation of a neutral third party for managing the plan, with a long term mandate and no political colour, could help supporting its long-term implementation. It could provide an objective insight on its effectiveness, and it could have influence over spatial planning decisions for instance. Involving an external facilitator could help maintain interest among all concerned parties, and ensure effective interaction between all bodies participating in the adaptation plan development process.
How to support the private sector in accounting for climate change?	Private operators need to account for climate change challenges in their (investment and development) decisions. However, companies are usually not keen in sharing potentially sensitive information. Strengthening experience-sharing among socio-economic stakeholders (that already exists in some countries via representative organisations such as Chambers of Commerce and Industry) could help establishing "climate change adaptation" recommendations that could be followed by all, ensuring their interests are preserved and avoiding any unfair or disloyal competition.
How to finance climate change adaptation?	National strategies and plans to tackle climate change issues exist in many countries. However there is usually no budget dedicated to adaptation actions or recommendations. It is important then to ensure that the budget allocated to individual sector policies and strategies (e.g. water, agriculture, urban development, etc.) include specific provisions for adaptation actions and initiatives. Options for bringing additional financial resources to climate change adaptation include: <ul style="list-style-type: none"> • Mobilizing funds allocated to research and innovation to climate change/adaptation issues and challenges, so as to speed up the development of new methods and tools for addressing climate risk and uncertainty (see for example the EU Climate-KIC⁴); • Establishing a climate disaster and prevention fund for addressing extreme climate change events, and supporting private and public sectors in risk-reducing measures and projects; • Using emerging financial tools such as micro-investing and crowd funding for supporting (local) adaptation initiatives

²Robust decision making is a method used to assess the relevance of a strategy or a plan under different futures. See Lempert RJ, Groves DG, Popper SW, Bankes SC (2006). A general, analytic method for generating robust strategies and narrative scenarios. *Management Science* 52:514-528.

³Real Options Analysis quantifies the investment risk associated with uncertain future outcomes. See Watkiss, P., Hunt, A., Blyth, W. (2013). *Briefing Note Series: Summary of Methods and Case Study Examples from the MEDIATION Project. Funded by the EC's 7FWP.*

⁴Climate-KIC is Europe's largest public-private innovation partnership focused on climate innovation to mitigate and adapt to climate change.

We are just starting! Further efforts to make climate change adaptation a reality

There are many initiatives addressing climate change and adaptation at different scales and for different sectors in the Mediterranean Sea basin. However, climate change is far from being fully accounted for in decision making in coastal areas of the Mediterranean Sea. Initiatives that would contribute to making climate change adaptation a reality include:

- Setting up an **information and knowledge sharing virtual (web-based) platform** at the regional Mediterranean Sea basin level, that would help: (a) sharing (successful and unsuccessful) experiences in addressing climate change in the region; and, (b) facilitating the access to experiences, methods and tools applied in the Mediterranean Sea basin and elsewhere for addressing climate change and adaptation;
- Supporting **networking among scientists and experts** (e.g. the Mediterranean Experts on Climate and Environmental Changes, MedECC), as a mechanism for developing new scientific initiatives that will deliver innovations and new services in the field of climate change adaptation. New research, innovation and services addressing climate change adaptation within the wider Water, Agriculture and Energy Nexus are seen as of particular interest;
- Strengthening the **interface between scientists, experts, stakeholders and decision makers**, via the organization of events, the development of specific information and communication tools, or the establishment of a 'Climate Change Open Science Platform' (CCOSP) for addressing, and finding operational solutions to, questions decision makers at different scales might have in the field of climate change adaptation;
- Strengthening the links between the **Barcelona Convention, UNEP/MAP Coordination Unit and its Regional Activity Centers** and the **Union for the Mediterranean** so as to develop joined initiatives and synergies that support most cost-effectively the emergence of sound climate change adaptation strategies and initiatives in coastal areas of the Mediterranean Sea basin;
- Supporting the development and sharing of knowledge on climate change adaptation by the **private sector**, and establishing synergies and partnerships for enhancing integration between public and private strategies and initiatives.

Moreover, developing an understanding of how climate conditions affect **agricultural markets and thus food security** has been identified as a key issue. An integrated approach such as the Water, Energy and Food nexus offers a way to understand and anticipate crisis under climate change.

In terms of process, the use of **flexible approaches** (as described under IPCC AR5) and adaptation pathways need to be understood and integrated when addressing climate change adaptation in strategies and plans, as actions are not always required in the present day and knowledge on impacts is expected to evolve in time.

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This work is based on the results of the ADAPT-Med project funded under the ERA-NET CIRCLE-2 and the Mediterranean workshop entitled "Adaptation to climate change in Mediterranean coastal zones: Is current decision-making in coastal zone management adapted to mainstream adaptation options?" organized by the project's French partner ACTeon in collaboration with Plan Bleu (Marseilles, 25 and 26 May 2016). The authors thank the workshop participants for their kind contributions which inspired this Policy Brief.

