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## The Mediterranean Region under Climate Change. A Scientific Update: Abridged English/French Version

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# Conclusion. The Mediterranean Basin, climate change and our common future. Engaging future research efforts to support policy

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# Conclusion

## The Mediterranean Basin, climate change and our common future Engaging future research efforts to support policy

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Taken together, the chapters of this book constitute a rich fount of knowledge, drawing on the work of a large number of experts on climate change and its impacts in the Mediterranean basin. The observations and analyses contained in these pages prove once again that this region is a genuine hive of diversity, both in terms of its natural environment and the living conditions of the societies that surround it. It is therefore no surprise that the adaptive capacities and ability to mitigate climate change are also highly variable both between and within countries. Yet the Mediterranean countries are strongly linked by a common sea, which has always favored the exchanges of people and ideas, so the slogan ‘our common future under climatic change’ rings particularly true.

Over several millennia, human societies and their natural environment have co-evolved in the Mediterranean Basin. Paleoclimatological studies demonstrate that the Holocene witnessed regular abrupt climatic changes leading to important droughts, which probably played a significant role in the cultural evolution of Mediterranean societies. Even if the last millennium started with a warm period (Medieval Climate Anomaly) considered relatively similar to the recent warming, the megadroughts of the past decades are probably without precedent. Recent

warming has proceeded faster than global averages, especially for summer temperatures. There is also a general increase in extreme conditions for temperature and precipitation and these trends will likely accelerate in the future. But the detailed spatial distribution of these changes remains uncertain. The warming of the Mediterranean Sea is well documented but the future of its circulation patterns is still a matter for debate.

Direct risks to people and infrastructure in the Mediterranean are linked to the water cycle and notably to hydrometeorological extremes, such as heavy rainfall leading to flash floods, but also the large swells and storm surges. Heat waves and droughts reduce crop productivity in some years and also enhance the risk of forest fire. By their nature, these extremes are difficult to study with respect to temporal trends, but knowledge has advanced substantially in recent years thanks to the development of databases and dedicated research programs.

Climate change interacts with air and water pollution and other human pressures (urbanization, agricultural intensification, expanding industry and transportation). Throughout the Mediterranean Basin, air quality continues to deteriorate. The detrimental effects of air pollution on human health are known, but better observations are needed in many regions. Although Mediterranean countries have always been highly exposed to dust storms and wildfires, their specific effects have been insufficiently studied.

The Mediterranean Sea is a major reservoir of marine biodiversity. Millions of people directly or indirectly depend on the ecosystem services it provides, in particular the provisioning of fisheries resources. Although uncertainties remain with regard to the magnitude of expected ecological changes, projections based on IPCC scenarios all confirm that climate change, through warming and acidification, is a serious threat for the biodiversity and sustainable exploitation of fishing resources in the Mediterranean Sea. The terrestrial biodiversity is also exceptional, especially in the forests, on the numerous islands and along the entire coastal zone. Risks to the functioning of these ecosystems originate do not from climate change alone but also from the destruction and unsustainable use of the landscape.

Along the coasts, the major challenge is related to sea level rise and the induced risks related to flooding and shoreline retreat, which increase substantially above 2°C warming. Many human, cultural, industrial and environmental assets are concentrated near the coasts. A comprehensive risk study has shown that the most vulnerable shores are in the poorest and less developed countries, which depend on significant economic and technological transfer from the most developed regions.

Freshwater resources are naturally sparse in much of the region. While warming, increased evaporation and decreased precipitation create additional shortages, stability of soils may also be affected by erosion due to increased flash floods. The problems are linked and intensified by unsustainable groundwater extraction and the intensification of agriculture. The highly variable climate of the Mediterranean region has enabled the development of a rich range of agricultural

practices. This diversity might, if conserved, provide solutions for adaptation in the future. The Mediterranean diet is famous for its nutritional value and health advantages. Projections reveal important risks for food production in parts of the basin. Despite the fact that agriculture originated in the Fertile Crescent, modern farmers are not necessarily able to sustain long and intense droughts, especially if social and economic conditions cause additional stress, as illustrated by the 1998-2010 drought in Syria. It is currently unclear to which degree Mediterranean soils can be managed more sustainably in order to revert decades of degradation. However such strategies would not only enhance food security but also mitigate carbon losses.

Few quantitative research studies have explored the health impacts of climate change in the Mediterranean, and where available, they have been geographically limited to some specific areas within the basin. The connection between warming, new vectors, air pollution and other factors requires a new strongly interdisciplinary approach that integrates medicine, toxicology, natural and social science and engineering.

Given the multiple existing natural hazards, some of which may be enhanced by climate change, risk prevention is an acute issue throughout the region. Important progress has been made in weather and flood observation and forecasting methods. Improved communication of the population and rescue services is important for efficient adaptation measures. While catastrophic events cannot be fully avoided, improved warning systems can significantly limit their consequences.

The Mediterranean is a border and a crossing point between several highly contrasting regions in both economic and social terms – a situation which currently induces a migration influx from south to north, associated with immense human suffering and the loss of many lives. Among the multiple social and economic driving forces for this migration, climate change also plays a role that researchers are only beginning to understand.

Most contributions to this book illustrate clearly that climate change cannot be understood without deeper consideration of the human-environment co-evolution. This is true in most parts of the world but it appears that in the Mediterranean region, the problem of interdisciplinary assessment of change must reach a higher level of complexity, due to the age and intensity of the human imprint. There are indications that, given the multiple changes and large disparities, it may not have been fully realized how important the social issue of climate change is for future generations in the Mediterranean region. Climatic change affects not only nature, but also the entire economic, political and social fabric of Mediterranean society.

Action to reduce greenhouse gas emissions and enhance adaptive capacity will have to be borne by all countries and all social actors in them, in close international cooperation. Despite a great wealth of knowledge and observations, notably in the north, there is currently no state-of-the-art assessment of basin-wide risks and adaptive potential. Such an assessment would include the

outcomes of regionalized modelling activities of emissions, climate and impacts, but it should also consider local knowledge and specific experience with adaptation to climate variability in the region. Most importantly, it would have to be built on a comprehensive north-south and east-west partnership in the Mediterranean basin.

Such a bridge between scientists and society is the aim of the Mediterranean group of Experts on Climatic change (MedECC) which aims:

- 1) To bring together the scientific community working on climate change in the whole Mediterranean basin. This includes building a bridge between existing research structures and programs and facilitating data-sharing through existing or new fora and platforms.
- 2) To update and consolidate the best scientific knowledge about climate and environmental changes in the Mediterranean basin and render it accessible to policy-makers, key stakeholders and citizens.
- 3) To contribute to future assessments of international bodies (IPCC, IPBES and others) in the Mediterranean basin.
- 4) To bridge the gap between research and decision-making, contributing to the improvement of policies at national, regional, and local level by providing consolidated scientific assessments on particular issues and by responding to requests by decision-makers.
- 5) To identify possible gaps in the current research on climate change and its impacts in the Mediterranean and interact with funding agencies for the development of new research programs to fill these gaps.
- 6) To help build the capacity of scientists from all Mediterranean Countries, encouraging training, research and development through collaboration.

As a regional network, MedECC expects to have enhanced abilities to produce comprehensive “state of the art” reports about climate and environmental change for the entire Mediterranean basin, which also include local knowledge from different languages and “grey literature”. Based on such assessments, national and international research efforts, such as the French MISTRALS program which has inspired a part of the work reported in this book, will hopefully enhance integrated research on environmental changes in the Mediterranean Basin.