

# MED MARITIME INTEGRATED PROJECTS Med-IAMER

## Western Mediterranean ecoregion (WME)

# Climate Change on Coastal Zones

### Definition

Climate change refers to a system's exposure to climate variations altering land and sea temperatures as well as precipitation quantity and patterns, resulting in the increase of global average sea level, risks of coastal erosion and an expected increase in the severity of weather-related natural disasters (ESPON Climate, 2011; CEC, 2009).

### Regional context – *How will climate variability & change affect coastal areas?*

Med-IAMER considers climate change study as an important driver for the region due to its environmental and socio-economic impacts. The impacts of climate change can be observed at different stages.

Sea level rise is considered as one of the main pressures related to climate change in the region that cause significant impacts on coastal ecosystems. According to the 2007 projections (GIEC), considered optimistic, sea level could rise between 23 and 47 cm by the end of the 21<sup>st</sup> century in this region. Many Mediterranean regions would, therefore, be subject to a significant risk of flooding and soil erosion, including Venice, the archipelagos of Kerkennah and Kneiss in Tunisia.

Among many others, major potential consequences related to sea level rise in the region include the following:

- Aggravated floods on low-lying coasts, especially in deltas, coastal lagoons in salt marshes and some islands;
- Accelerated erosion of cliffs and beaches;
- Increased salinization in estuaries;
- Reduction in the amount of fresh water aquifers.

### Related Pressures

#### Changes in thermal and salinity regimes

On average, shallow waters of the Mediterranean Sea have already been warmed by almost 1°C since the 1980s and sea surface temperatures are expected to be approximately 2.5 °C

warmer by 2100. By the end of the 21<sup>st</sup> century the combined effects of declining precipitation and increased evaporation are likely to cause an increase in the sea's freshwater deficit (by approximately 15 cm per year), which in turn will contribute to progressively higher seawater salinity (SSS) in the order of 0.5 units over the next 100 years. These changes, in both temperature and salinity, may affect other oceanographic processes and be reflected by changes in thermohaline circulation (density-driven water circulation caused by temperature and salinity), lower intensity of upwellings and reduced formation of deep-water masses.

### Decline in biodiversity

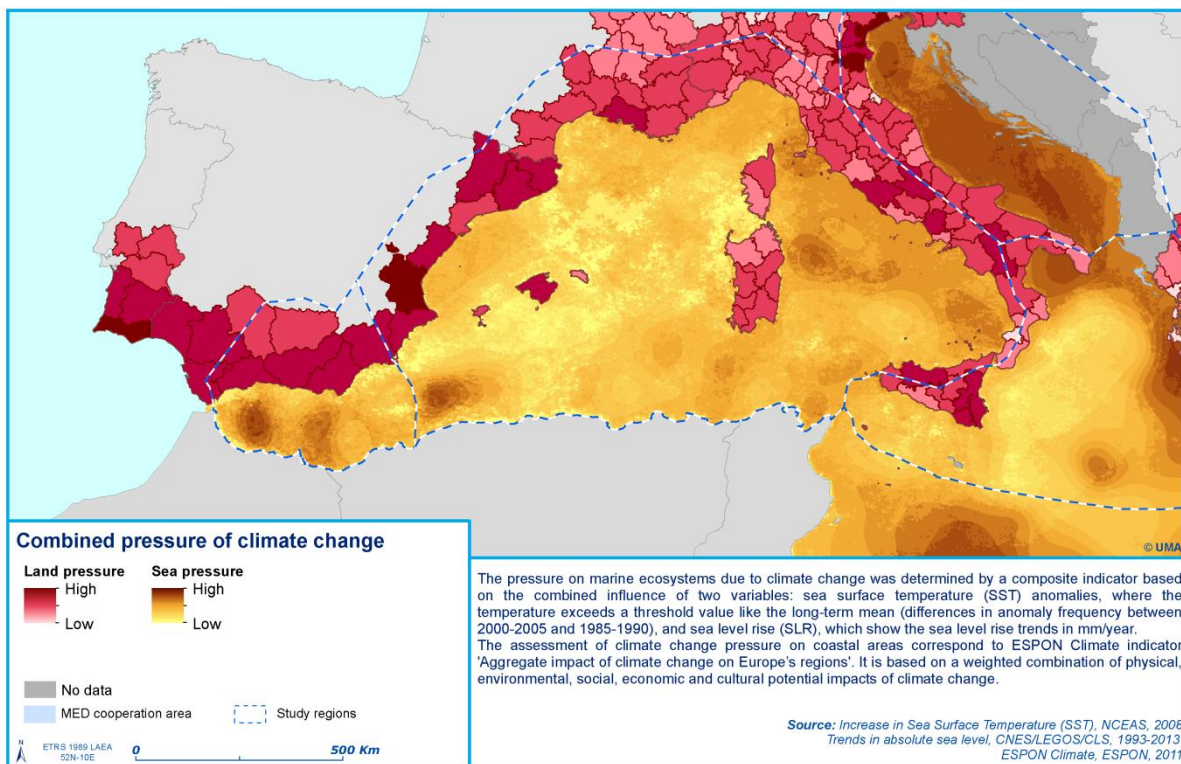
Mediterranean ecosystems are among the most threatened on Earth. By 2100, the Mediterranean biome is projected to experience the largest proportional loss of biodiversity of all biomes due to its

significant sensitivity to individual climate related threats and to their interactions (Klausmeyer & Shaw, 2009).

### Introduction of non-indigenous species and translocations

Shifts in the distribution of marine populations are the most commonly reported effects associated with changing climate conditions. In the Mediterranean, the long-term temperature increase showed to have effects on the boundaries of biogeographical regions, with some warm-water species extending their geographical ranges and colonizing new areas. Warm-water species, more abundant in the southern and eastern Mediterranean, are increasing in abundance and extending their ranges northwards due to the increase in water temperature.

The Mediterranean Sea is subject to a continuous influx of alien or exotic species arriving through the Suez Canal



or the Strait of Gibraltar, often transported by international shipping among other vectors. The majority of these alien species are thermophilic (warmth-requiring species) and the warming sea temperature is favoring their rapid spread northwards and westwards in the Mediterranean. In their report, Abdul Malak et al. (2011) have identified around 80 fish species as invasive or vagrant species in the Mediterranean Sea, the majority of which have come from the Red Sea.

Climate change is thus not only enabling some existing exotic species to spread into other areas, but it is likely to create welcoming conditions for new invaders or serve as a trigger for these exotics to become invasive.

### Data/Indicator used

Two indicators were developed to assess the impacts of climate change on the WME ecoregion:

- the indicator on climate change pressure on the Sea,
- the indicator of climate pressure on coastal areas (land).

The indicator assessing the pressure on marine environment due to climate change is determined by a composite indicator calculated from two single sub-indicators:

- Indicator 1: Change in sea surface temperature (SST) from NCEAS measure as the frequency of temperature anomalies, where temperature exceeds a threshold value like the long-term mean (differences in anomaly frequency between 2000-2005 and 1985-1990). The relevance of this indicator lies in the SST influence in the marine ecological processes at different latitudes.

- Indicator 2: Mean sea level rise (SLR) along the European Coasts. This indicator is land based and, using data of CLS/Cnes/Legos. It shows the impact of sea level rise trends observed by satellite altimetry.

The sub-indicator of climate change pressures on coastal areas is taken from the ESPON Climate indicator “Aggregate impact of climate change on Europe’s regions” (ESPON 2011).

### Gaps

The indicator on climate change effects on marine environment (SST) in the WME does not present spatial gaps. Nevertheless, the spatial resolution of the indicator is coarse as it uses global datasets. Whenever available, the use of regional datasets is recommended.

The indicator used to assess the impact of climate change on coastal areas is limited to the Mediterranean countries from EU27 (Data on Croatia are not available). Therefore, it presents spatial gaps in the North African countries within the WME. Despite the good quality of the ESPON Climate analysis, it is important to mention the limitation of the scale of study to NUTS3 level. As a recommendation for future improvements of the indicator, we suggest the development of an indicator of these characteristics with a higher spatial resolution.

### Limits of methodology

Climate change pressure on marine environment is calculated based on the combination of indicators [SST] and [SLR]. The values of each indicator are normalized and summed using equal weight. The resulting assessment ranges

between 1 and 10, representing low to high pressures.

For coastal areas, the ESPON Climate indicator “Aggregate impact of climate change on Europe’s regions” was used (ESPON 2011). This indicator was not modified and the classification and categories assigned are kept the same as calculated by the ESPON project.

### List of proposed indicators

The following table lists the indicator developed and mapped within Med-IAMER on the impacts of climate change on coastal (land) and marine environments. **All maps, identified by the indicator ID, can be found at the project’s web page:**

<http://www.medmaritimeprojects.eu/section/med-iamer-redirect/outputs>

ID	Indicator description
CC01	Combined pressure of climate change (Sea level rise + Sea surface temperature anomalies)
CC02	Pressure in coastal regions due to climate change (exposure to coastal storm surge events and coastal erosion trends)
CC03	Pressure of river flooding on population due to climate change
CC04	Pressure of summer heat on population due to climate change

### Bibliography

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Protocol On Integrated Coastal Zone Management In The Mediterranean - <http://www.pap-thecoastcentre.org/razno/PROTOCOL%20ENG%20IN%20FINAL%20FORMAT.pdf>

IUCN/MedPan/WWF (2012) “A changing Mediterranean coastal marine environment under predicted climate-change scenarios” <http://www.medpan.org/documents/10180/0/Climat-e+change+impacts+brochure/e1c0a57a-1835-4739-931d-5cd15328d88b?version=1.1>

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CEC (2009) WHITE PAPER-Adapting to climate change: Towards a European framework for action, Brussels, COM(2009) 147 final, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0147:FIN:EN:PDF>

ESPON Climate (2011) Climate Change and Territorial Effects on Regions and Local Economies, Final report, ISBN 978-2-919777-04-4 [http://www.espon.eu/export/sites/default/Documents/Projects/AppliedResearch/CLIMATE/ESPON\\_Climate\\_Final\\_Report-Part\\_B-MainReport.pdf](http://www.espon.eu/export/sites/default/Documents/Projects/AppliedResearch/CLIMATE/ESPON_Climate_Final_Report-Part_B-MainReport.pdf)

Klausmeyer, K. R., & Shaw, M. R. (2009). Climate Change, Habitat Loss, Protected Areas and the Climate Adaptation Potential of Species in Mediterranean Ecosystems Worldwide. PLoS ONE, 4(7), e6392. doi:10.1371/journal.pone.0006392