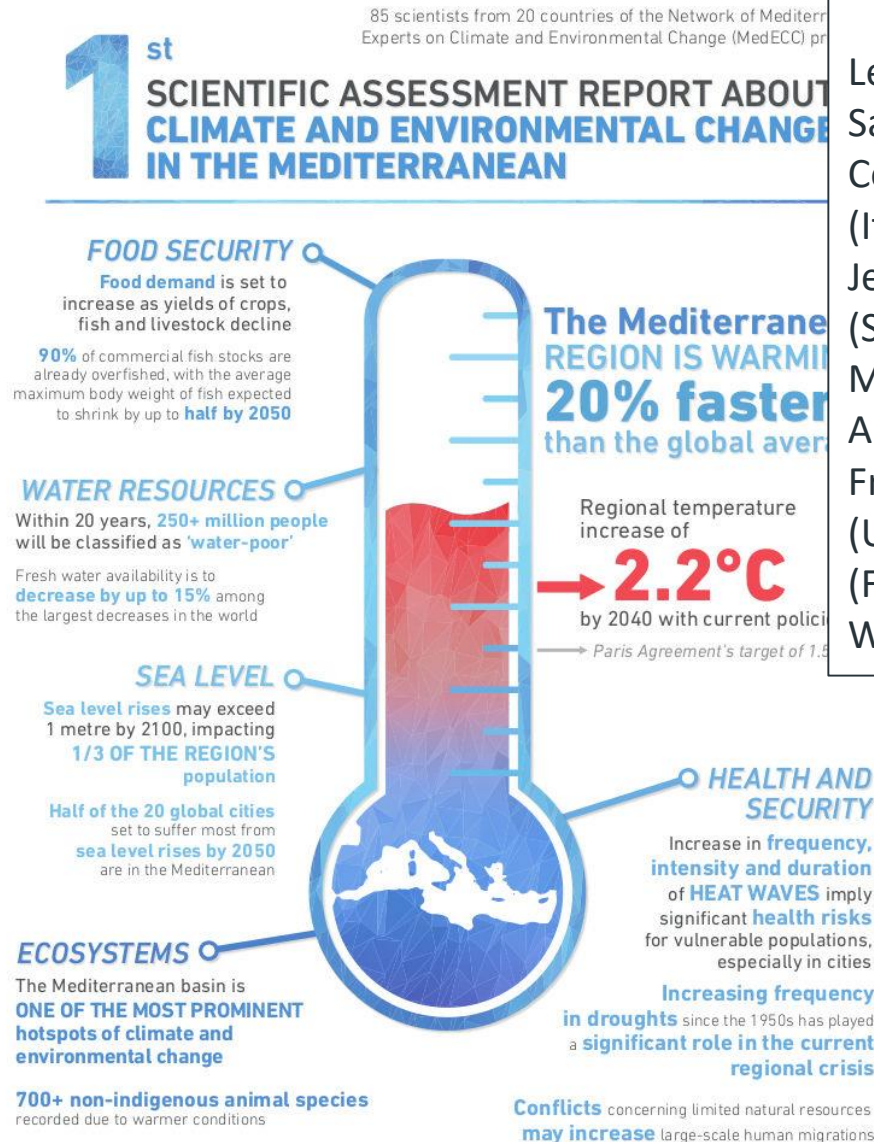


Climate change in the Mediterranean

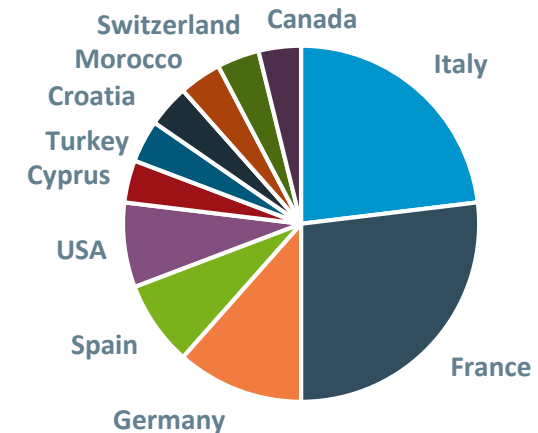


Piero Lionello
Univ. of Salento (I)
climatologist



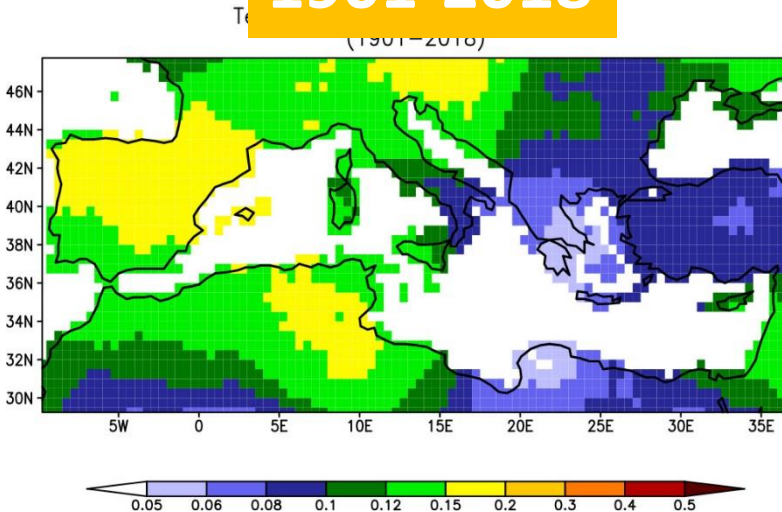
Section 2.2 Climate change

Leading Authors: Piero Lionello (Italy), Filippo Giorgi (Italy), Samuel Somot (France), Georgios Zittis (Cyprus)
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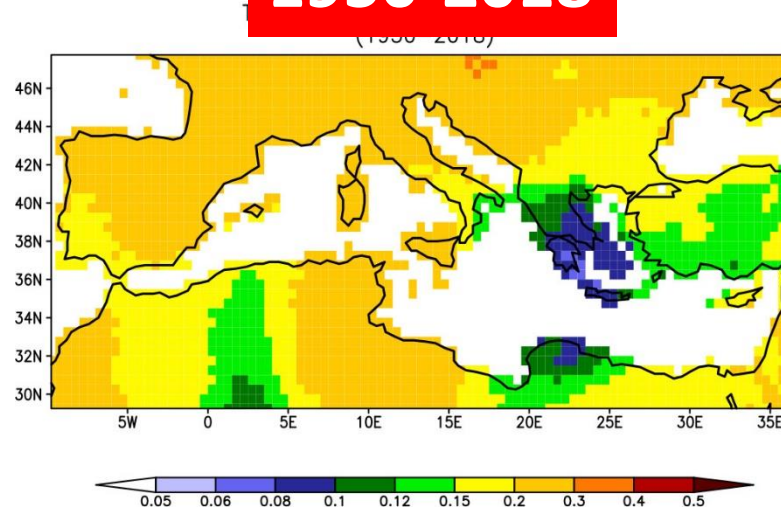


Observed trends of mean temperature (°C/decade)

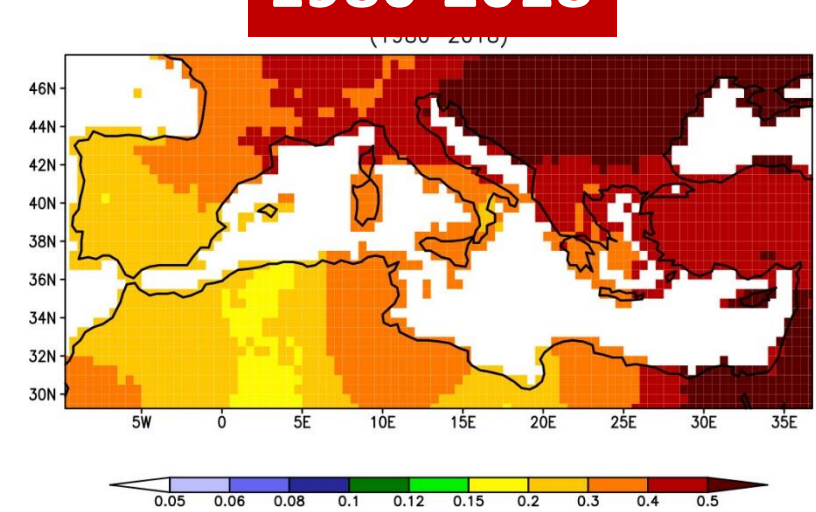
1901-2018



1950-2018



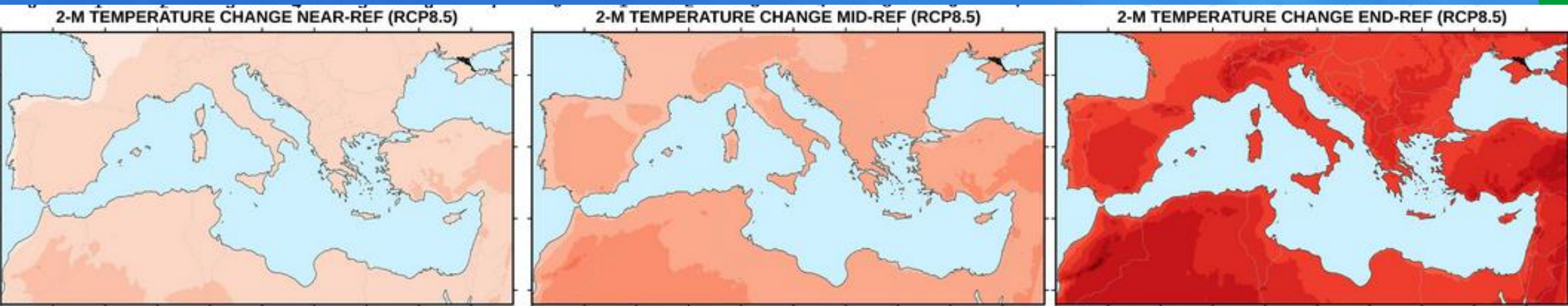
1980-2018



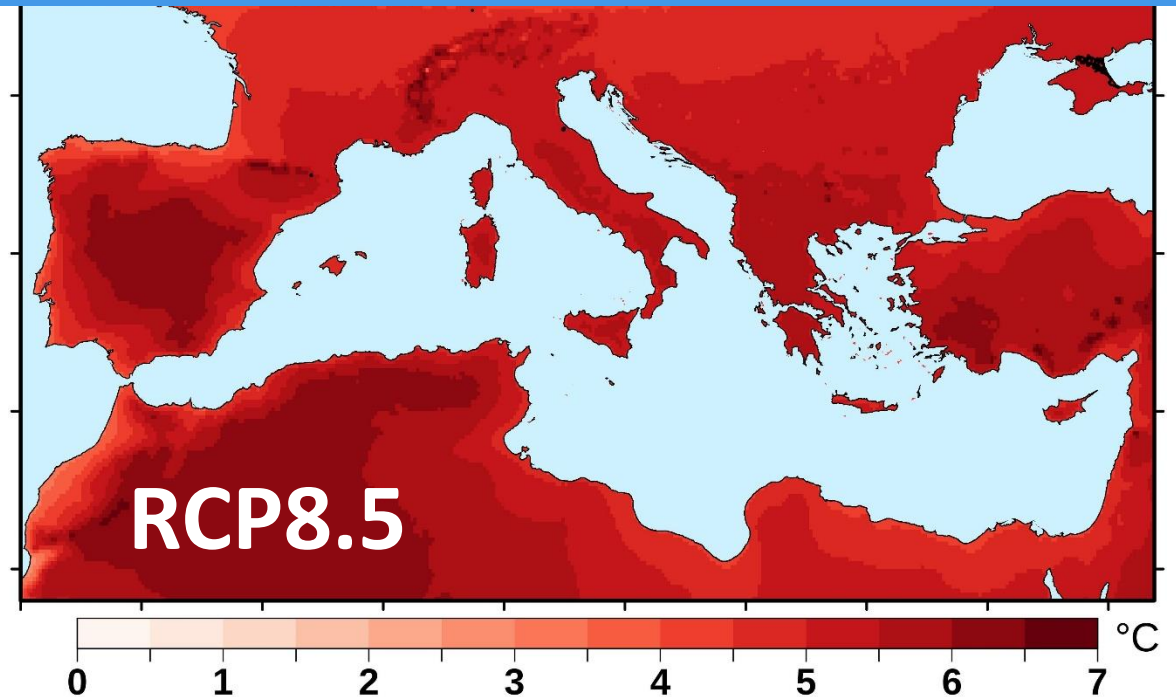
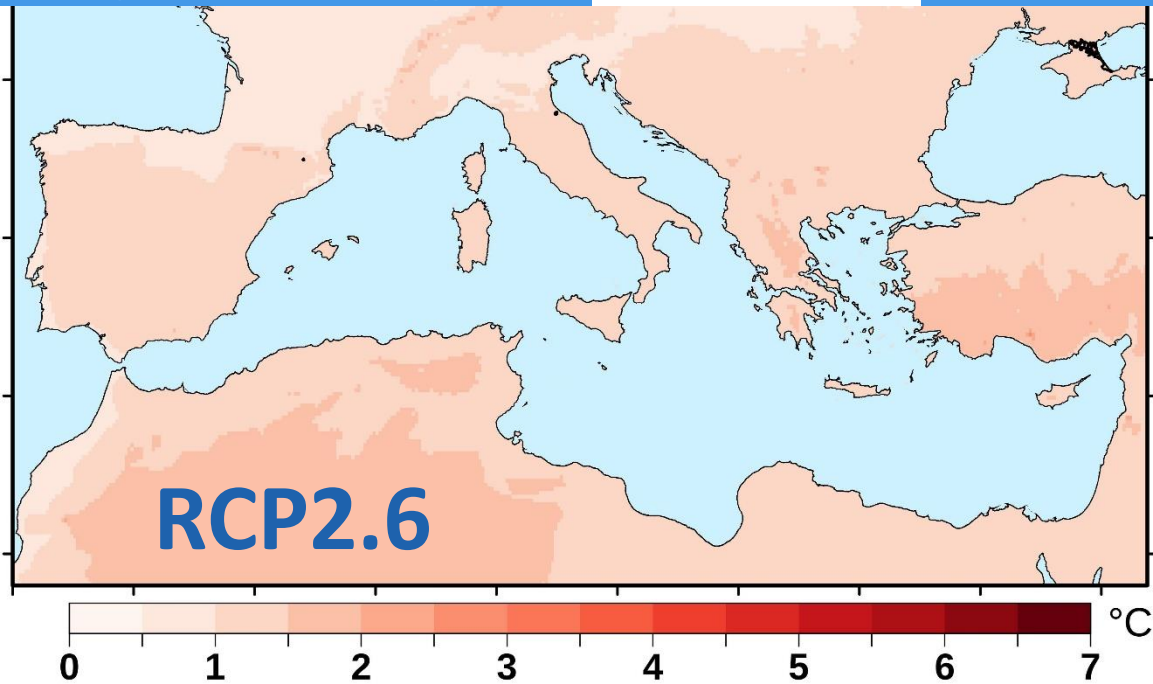
Observed temperature trends over land for the Mediterranean based on the Climatic Research Unit (CRU) gridded observations:

- The Mediterranean region is about 1.5°C warmer than in the pre-industrial
- Warming is accelerating

projected changes of **annual** mean 2-m temperature between the recent past (REF: 1980-1999) and future (NEAR: 2020-2039, MID: 2040-2059, END: 2080-2099)



projected changes of **Summer** mean 2-m temperature: END of 21st century 2080-2099



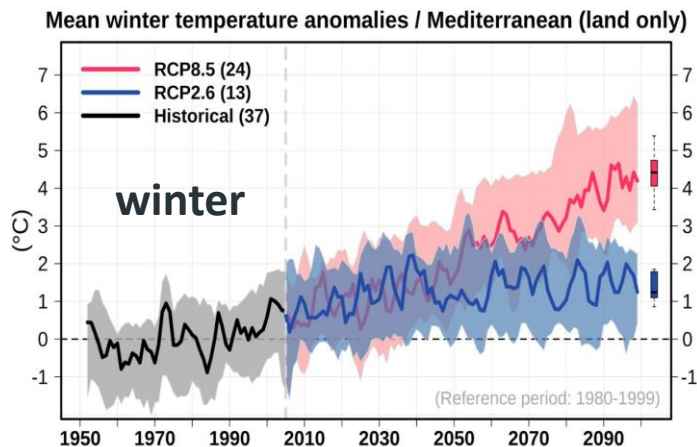
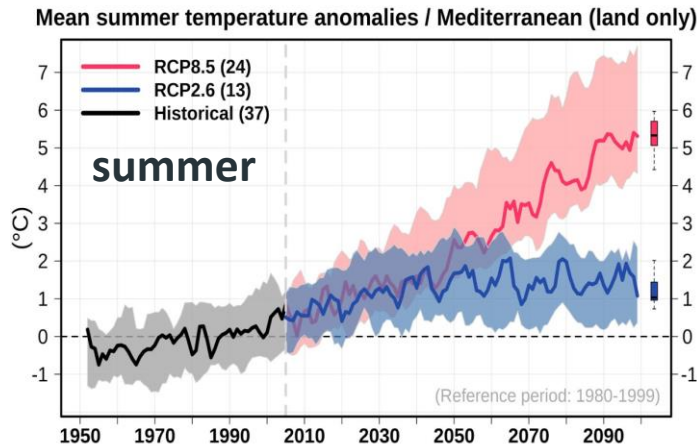
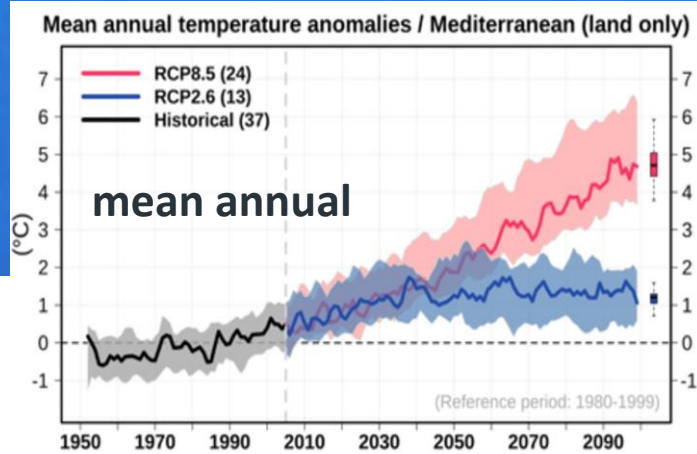
Temperature projections (°C) averaged over the Mediterranean



based on EURO-CORDEX 0.11° simulations for **historical times (black curve)** and future pathways **RCP2.6 (blue curve)** and **RCP8.5 (red curve)**. Solid lines indicate the ensemble means and shaded areas the spread of the simulations.

In the future

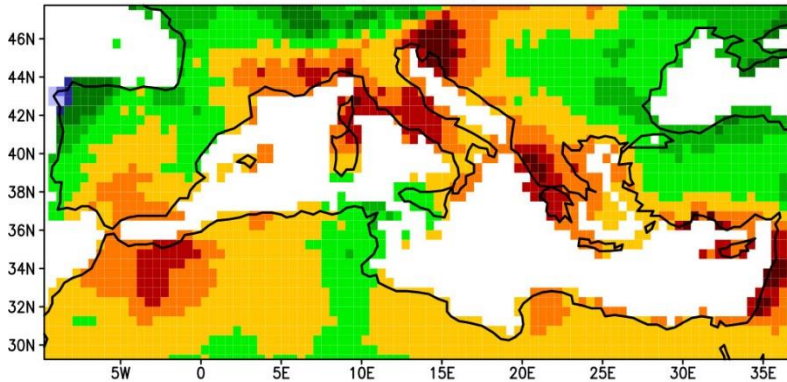
- The Mediterranean region is expected to warm 20% more than the global annual mean
- Summer is expected to warm 50% more than the global annual mean
- Mitigation can effectively reduce future warming



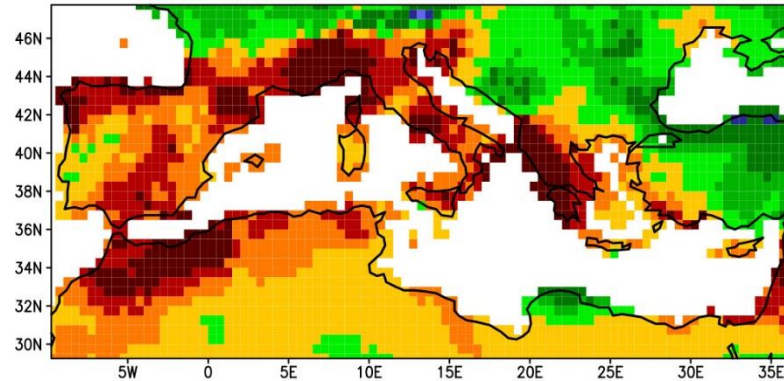
Observed trends of total precipitation (mm/day/decade) based on the Climatic Research Unit (CRU) gridded observations

1901-2018

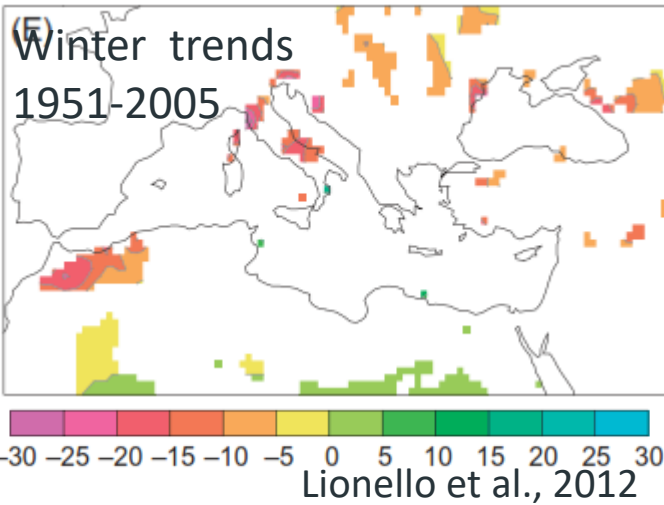
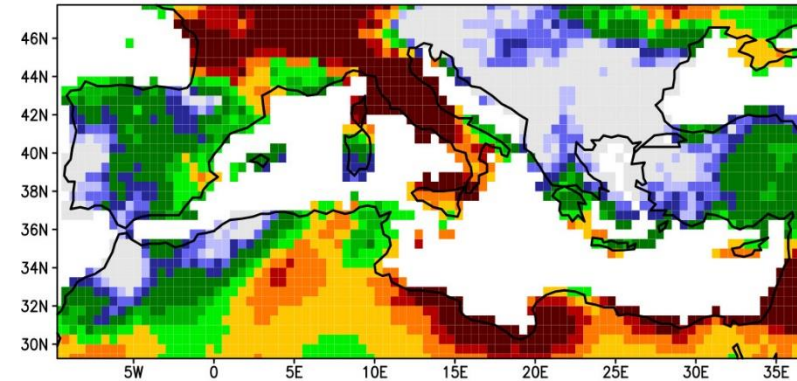
(1901-2018)



1950-2018

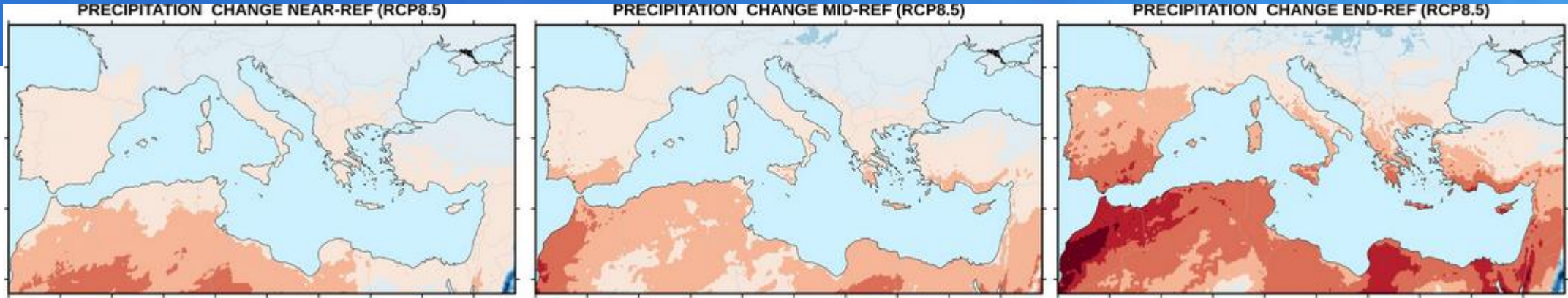


1980-2018

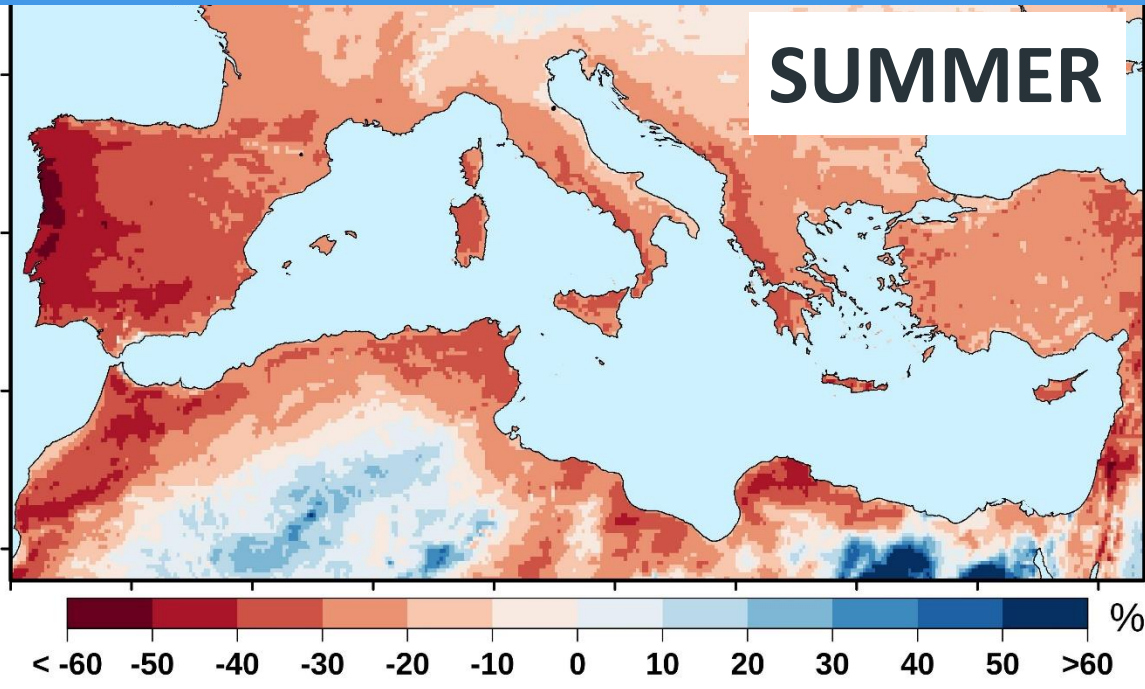
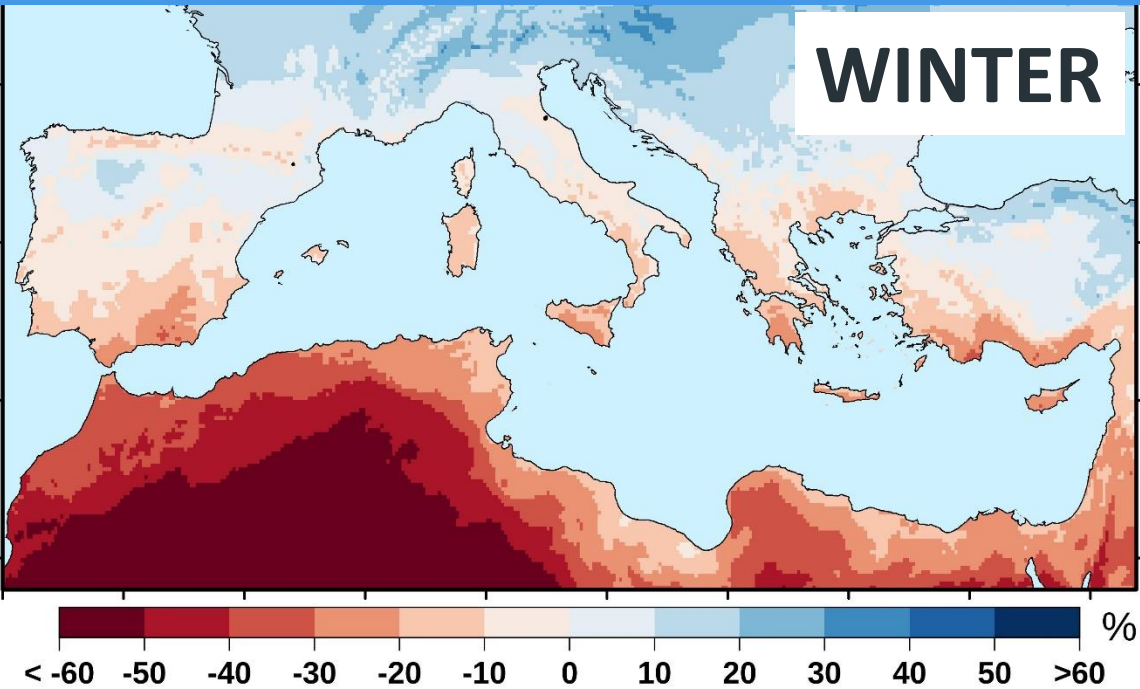


The sign and magnitude of observed land precipitation trends show pronounced spatial variability, depending on the time period and season considered so that the confidence in the detection of trends and their attribution to anthropogenic trends in rainfall for the historical past is low.

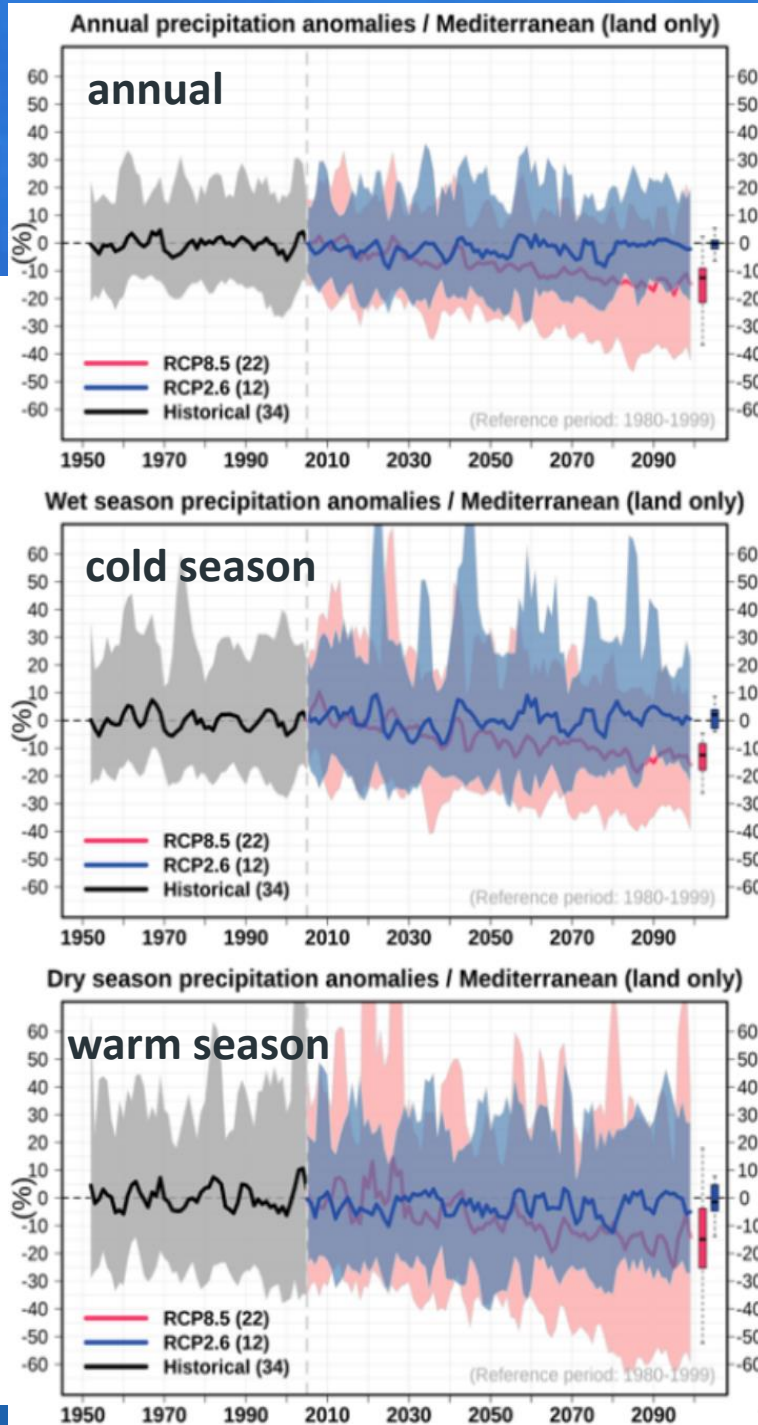
Projected changes of total precipitation (%) between the recent past (REF: 1980-1999) and future (NEAR: 2020-2039, MID: 2040-2059, END: 2080-2099)



projected changes of seasonal total precipitation: RCP8.5 END of 21st century 2080-2099



precipitation projections (%) averaged over the Mediterranean



based on EURO-CORDEX 0.11° simulations for **historical times (black curve)** and future pathways **RCP2.6 (blue curve)** and **RCP8.5 (red curve)**. Solid lines indicate the ensemble means and shaded areas the spread of the simulations.

- For a high emission scenario, model projects a consistent decrease of precipitation for the entire Mediterranean Basin during the warm season, and
- a decrease for most of Mediterranean, except for the northernmost regions during the cold season, where wetter conditions are projected
- The mean rate of land annual precipitation decrease among models is about 4% per each degree of global warming

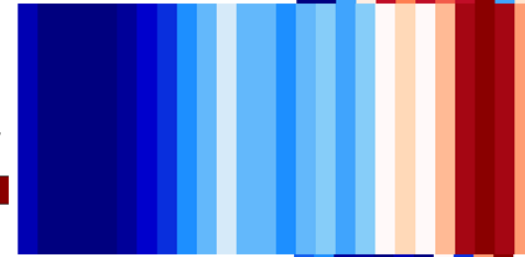
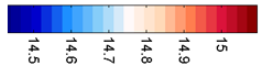
Mediterranean sea warming



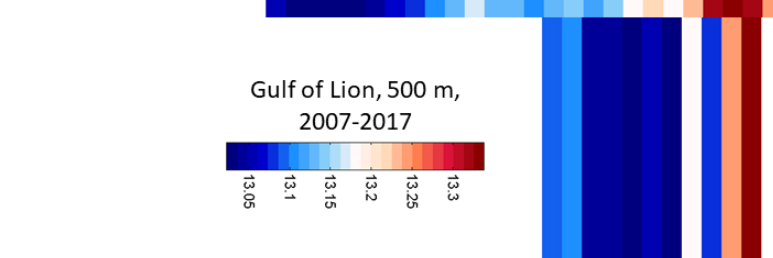
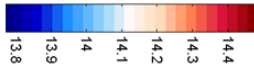
Observed warming of intermediate and deep water from long-term mooring. Color stripes shows annual temperatures of intermediate water (from east to west) and the deep water (in the Gulf of Lion)

Intermediate Water warming stripes

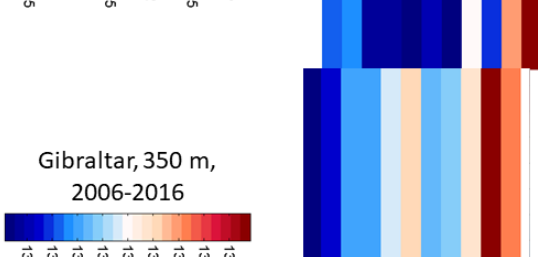
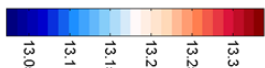
Eastern Ionian, 400 m,
2007-2018



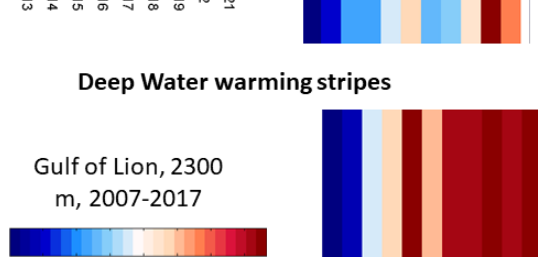
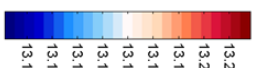
Sicily channel, 400 m,
1993-2018



Gulf of Lion, 500 m,
2007-2017

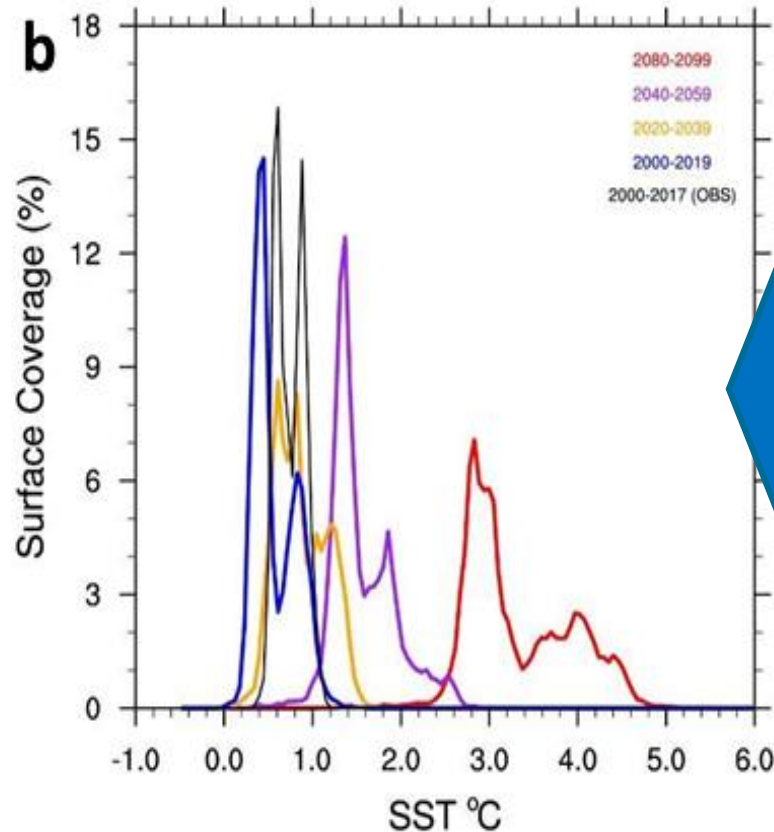
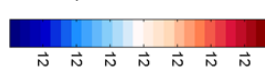


Gibraltar, 350 m,
2006-2016



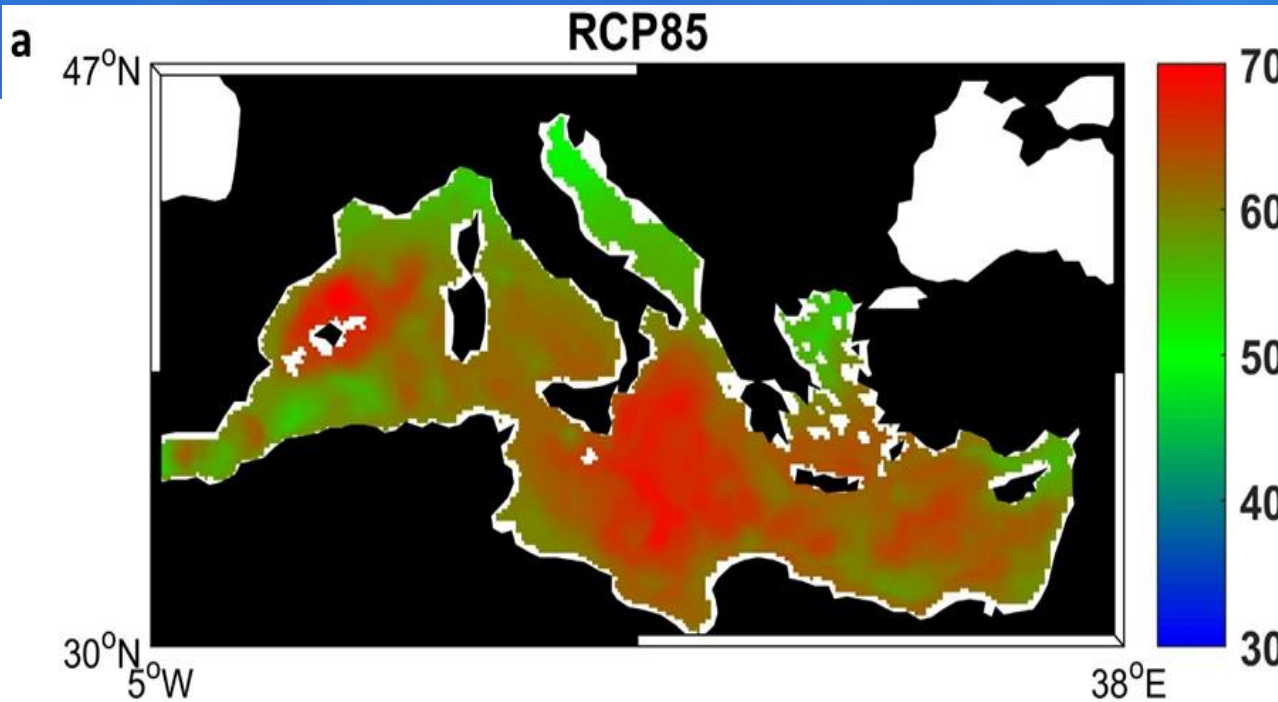
Deep Water warming stripes

Gulf of Lion, 2300
m, 2007-2017

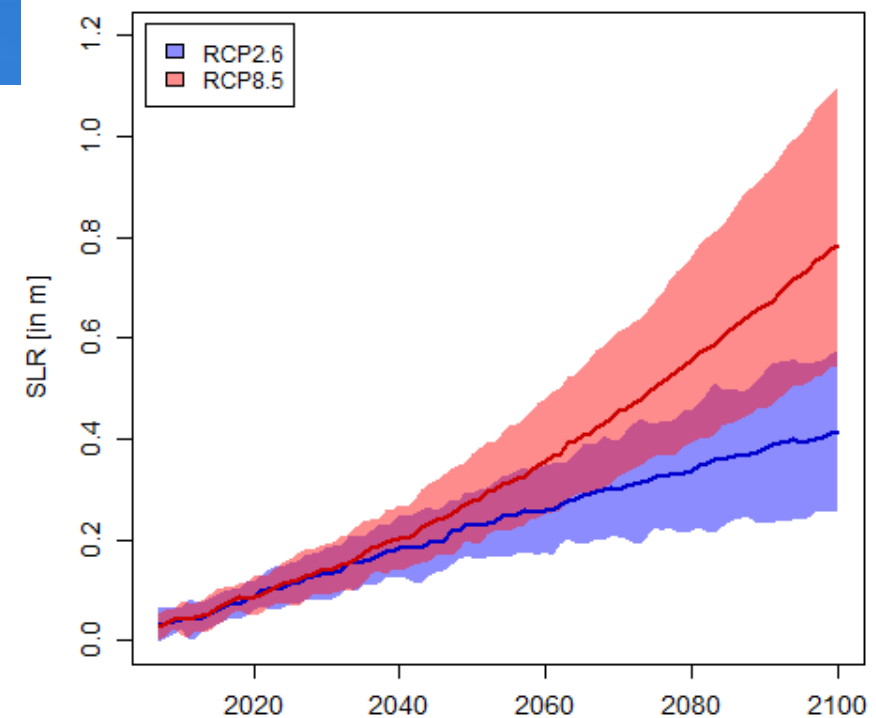


Fraction of the Mediterranean Sea surface (in %) experiencing a given sea surface temperature change value (in °C), compared to the reference period (1980-1999) for various periods and for the scenario RCP8.5 (right) using the envelope of the results of 5 Med-CORDEX coupled regional climate system models

Mean sea level projections



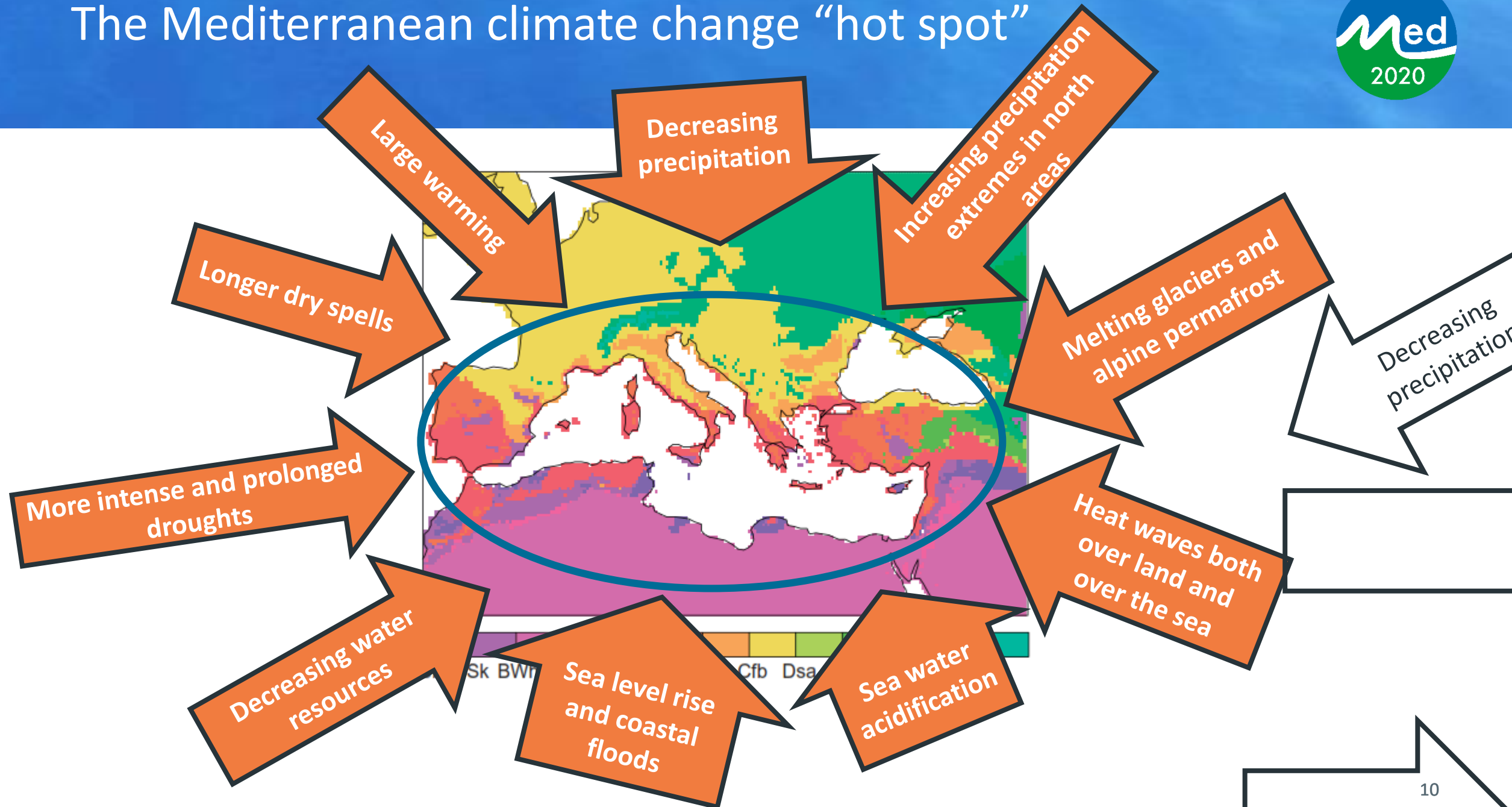
Projected Mediterranean sea level rise averaged in (2080-2099) with respect to present climate (1980-1999) under scenario RCP8.5.



Projected Mediterranean sea level under scenario **RCP2.6 (blue)** and **RCP8.5 (red)**. Solid lines indicate the ensemble means and shaded areas the ensemble spread (Figure by R. Thieblemont)

Mean sea level rise averaged for the Mediterranean basin will be similar to the North-East Atlantic

The Mediterranean climate change “hot spot”



Climate change in the Mediterranean



Cherif S, Doblas-Miranda E, Lionello P, Borrego C, Giorgi F, Iglesias A, Jebari S, Mahmoudi E, Moriondo M, Pringault O, Rilov G, Somot S, Tsikliras A, Vila M, Zittis G, 2020. Drivers of change. In: Climate and Environmental Change in the Mediterranean Basin – Current Situation and Risks for the Future. First Mediterranean Assessment Report [Cramer W, Guiot J, Marini K (eds.)] Union for the Mediterranean, Plan Bleu, UNEP/MAP, Marseille, France, 128pp, in press
http://www.medecc.org/wp-content/uploads/2020/11/MedECC_MAR1_2_Drivers.pdf

2.1 Introduction

2.2 Climate change

2.2.1 Framing

2.2.2 General circulation and dynamics

2.2.3 Radiation, clouds and aerosols

2.2.4 Temperature and related extremes

2.2.5 Precipitation, related extremes and the water cycle

2.2.6 The cryosphere

2.2.7 Ocean hydrology

2.2.8 Sea level, storm surges and wave heights

2.2.9 Ocean acidification

2.3 Pollution

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2.4 Land and sea use changes .

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2.5 Non-indigenous species

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2.6 Interactions among drivers.

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2.7 Mediterranean socioeconomic scenarios

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