



# Περιφερειακό Σχέδιο για την προσαρμογή στην κλιματική αλλαγή (Πε.Σ.Π.Κ.Α.) Περιφέρεια Αττικής



## Η παγκόσμια απειλή της κλιματικής αλλαγής

*Χρήστος Ζερεφός  
Ακαδημαϊκός*

Ακαδημία Αθηνών  
21 Φεβρουαρίου 2020



# Evidence of sea level changes in the Mediterranean in the past 22 thousand years

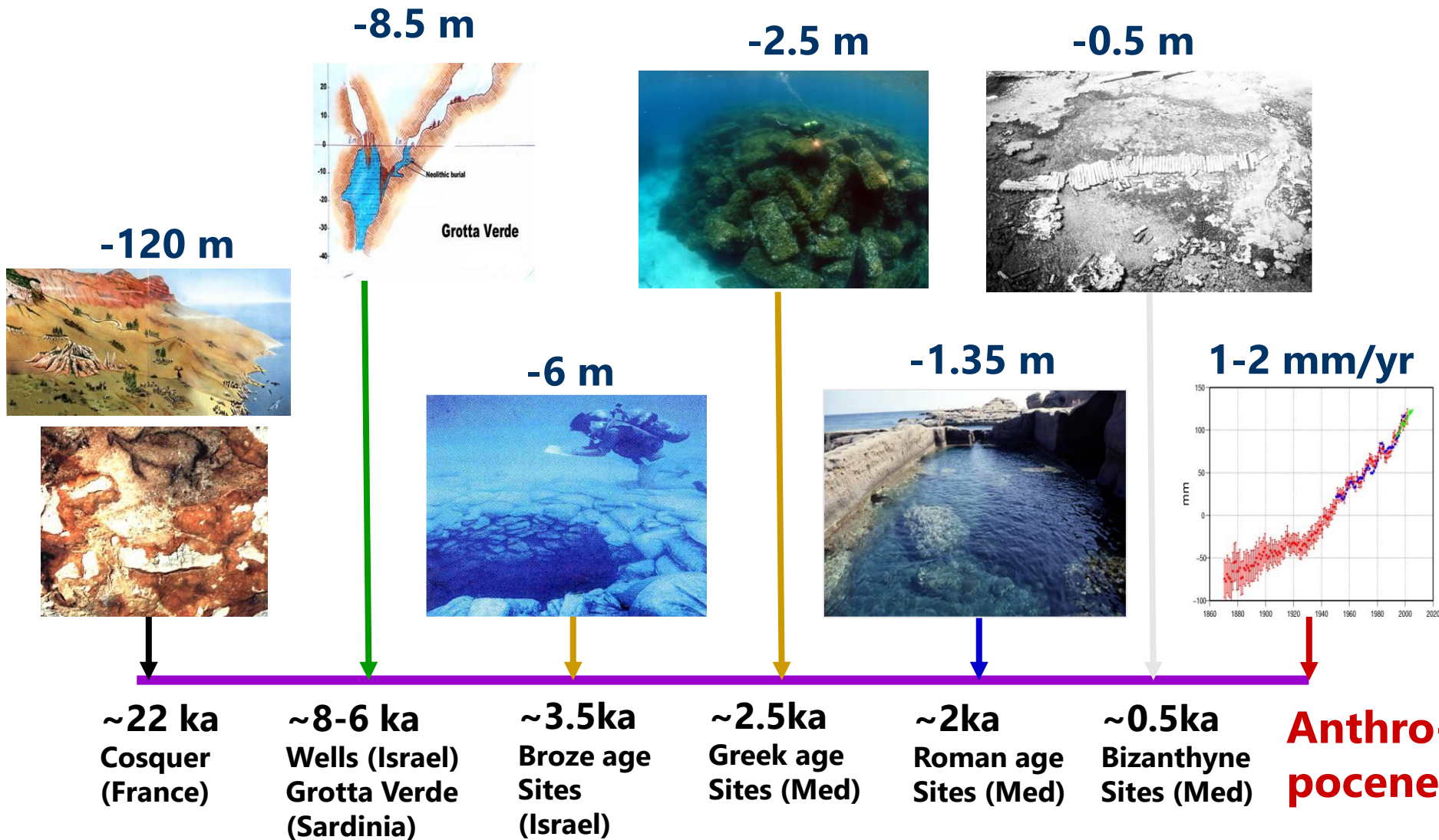
M. Anzidei



ΑΚΑΔΗΜΙΑ



ΑΘΗΝΑΝ



~22 ka  
Cosquer  
(France)

~8-6 ka  
Wells (Israel)  
Grotta Verde  
(Sardinia)

~3.5ka  
Broze age  
Sites  
(Israel)

~2.5ka  
Greek age  
Sites (Med)

~2ka  
Roman age  
Sites (Med)

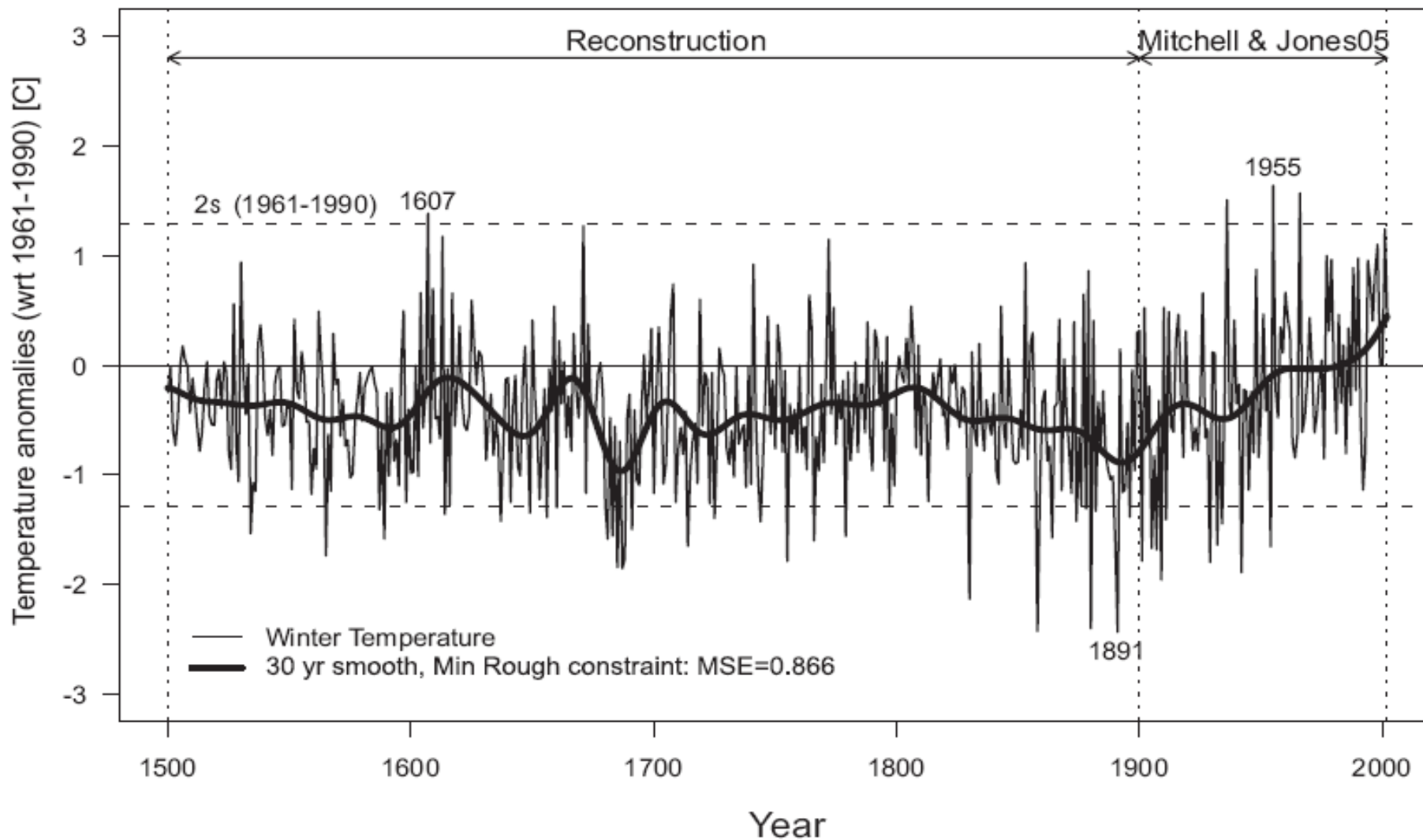
~0.5ka  
Bizanthyne  
Sites (Med)

**Anthro-  
pocene**

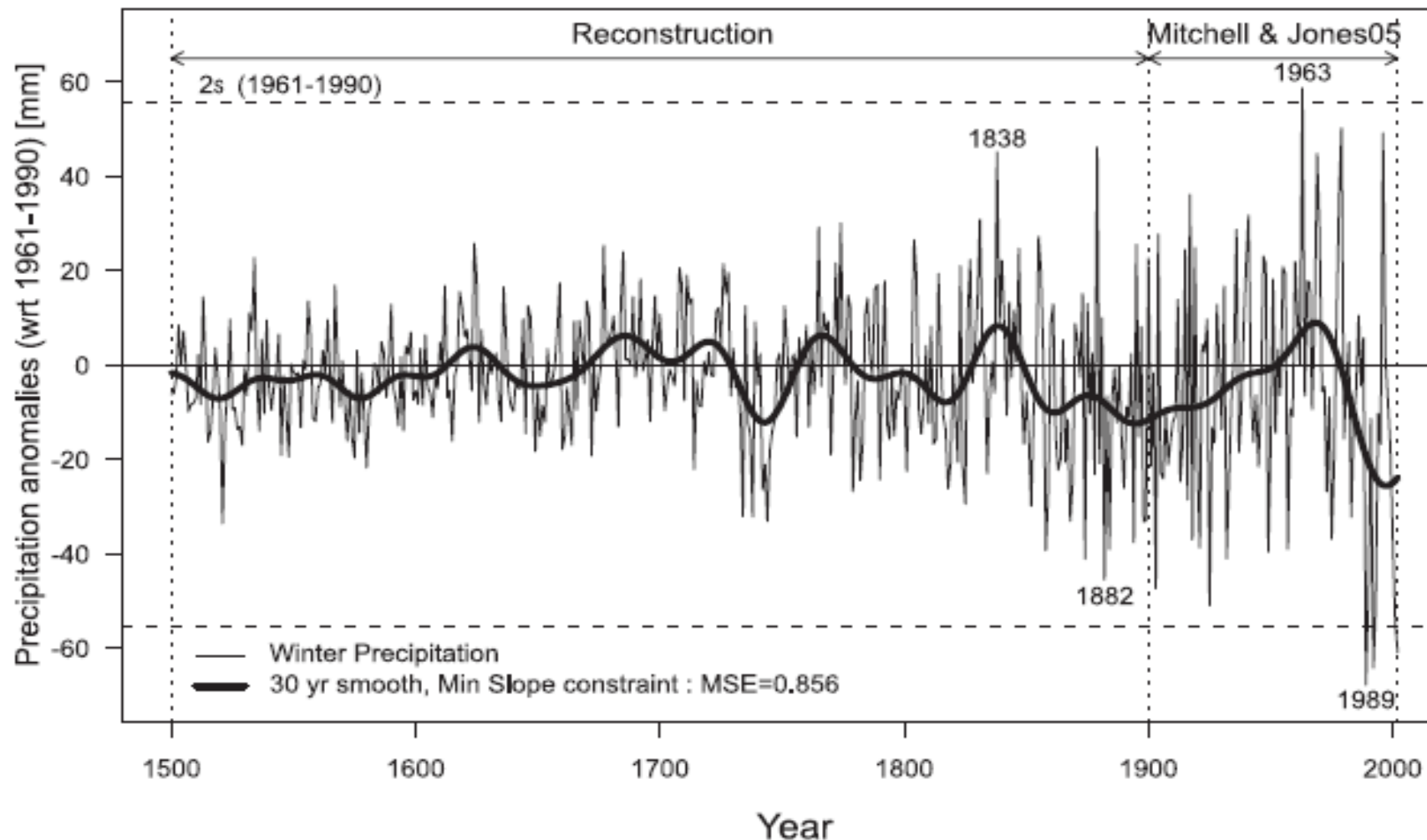


Με τη συγχρηματοδότηση της Ελλάδος και της Ευρωπαϊκής Ένωσης





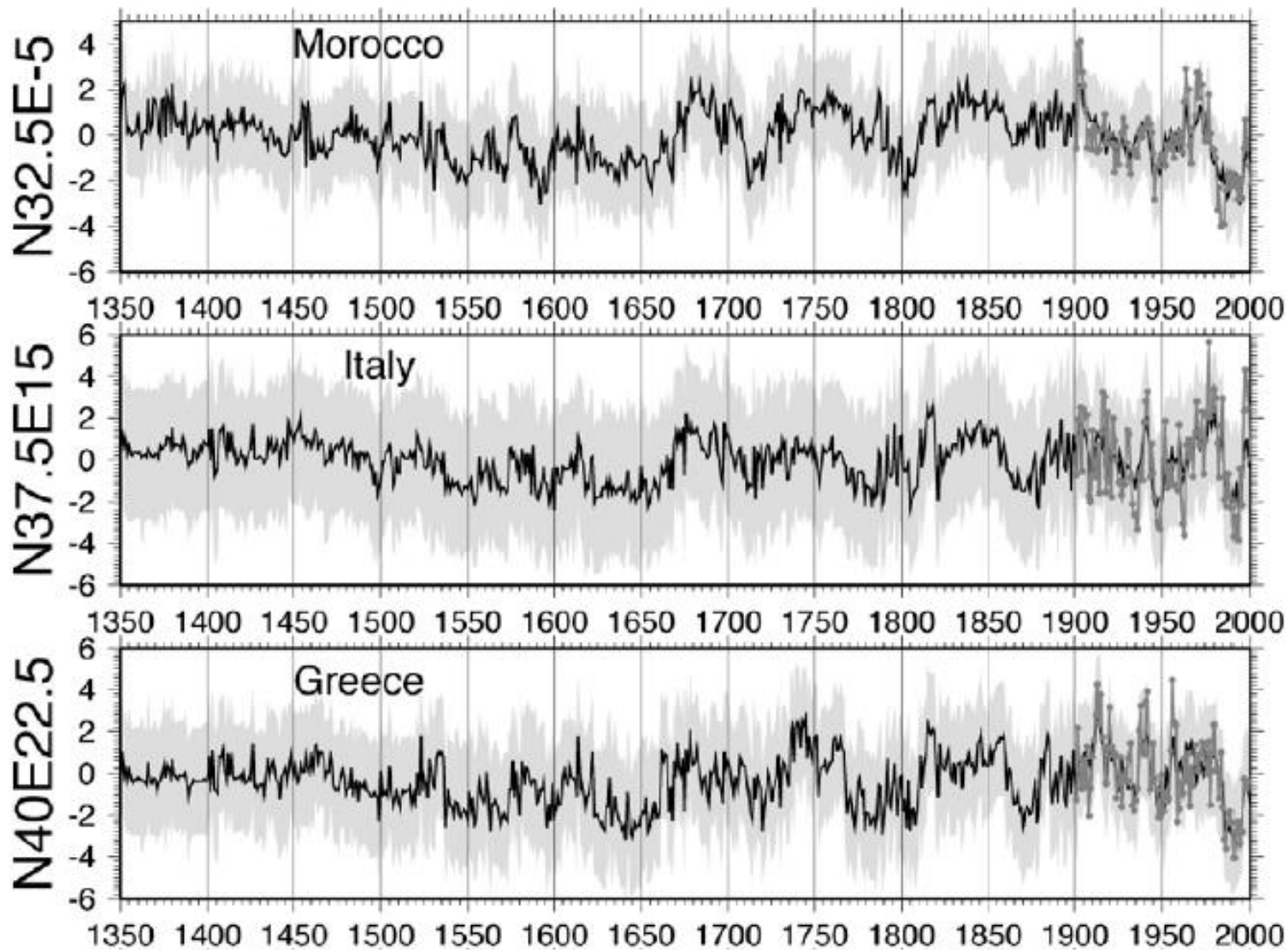
Winter (DJF) averaged-mean Mediterranean Temperature anomalies (with respect to 1961-1990) from 1500 to 2002, defined as the average over the land area 10°W to 40°E and 35°N to 47°N (thin black line). (Luterbacher et. al., 2006)



Winter (DJF) averaged-mean Mediterranean precipitation anomalies (with respect to 1961-1990) from 1500 to 2002, defined as the average over the land area 10°W to 40°E and 35°N to 47°N (thin black line). The values for the period 1500 to 1900 are reconstructions (Pauling et al., 2005); data from 1901 to 2002 are derived from Mitchell et al. (2004) and Mitchell and Jones (2005). (Luterbacher et. al., 2006)



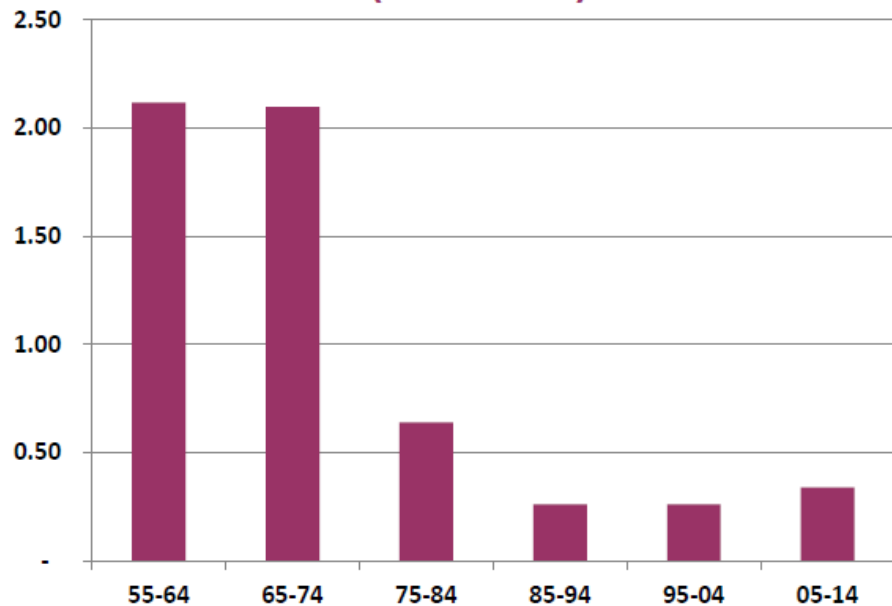
# Winter Drought Reconstruction in Mediterranean region



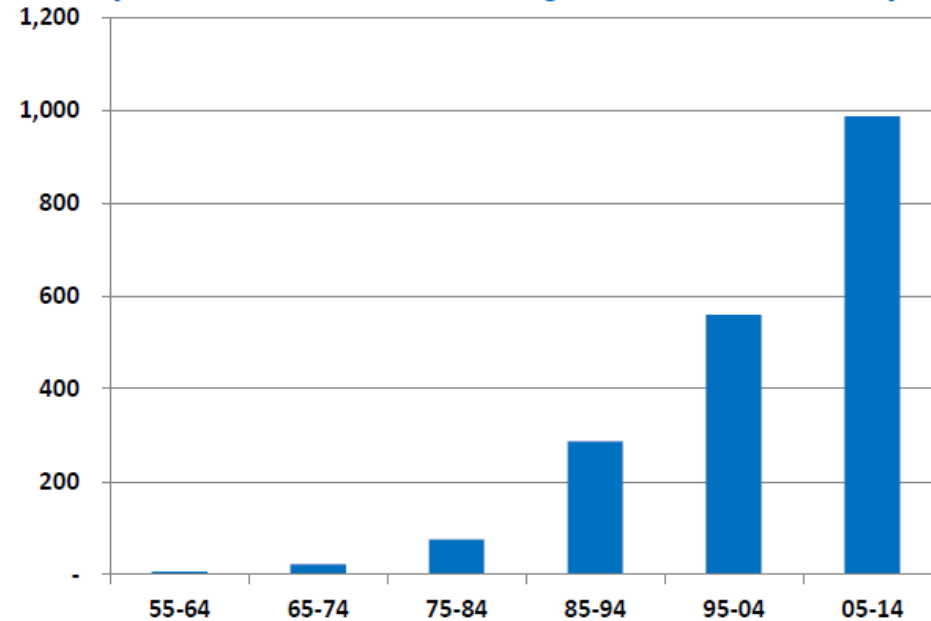


# Impacts of hydrometeorological and climatological hazards (1955–2014)

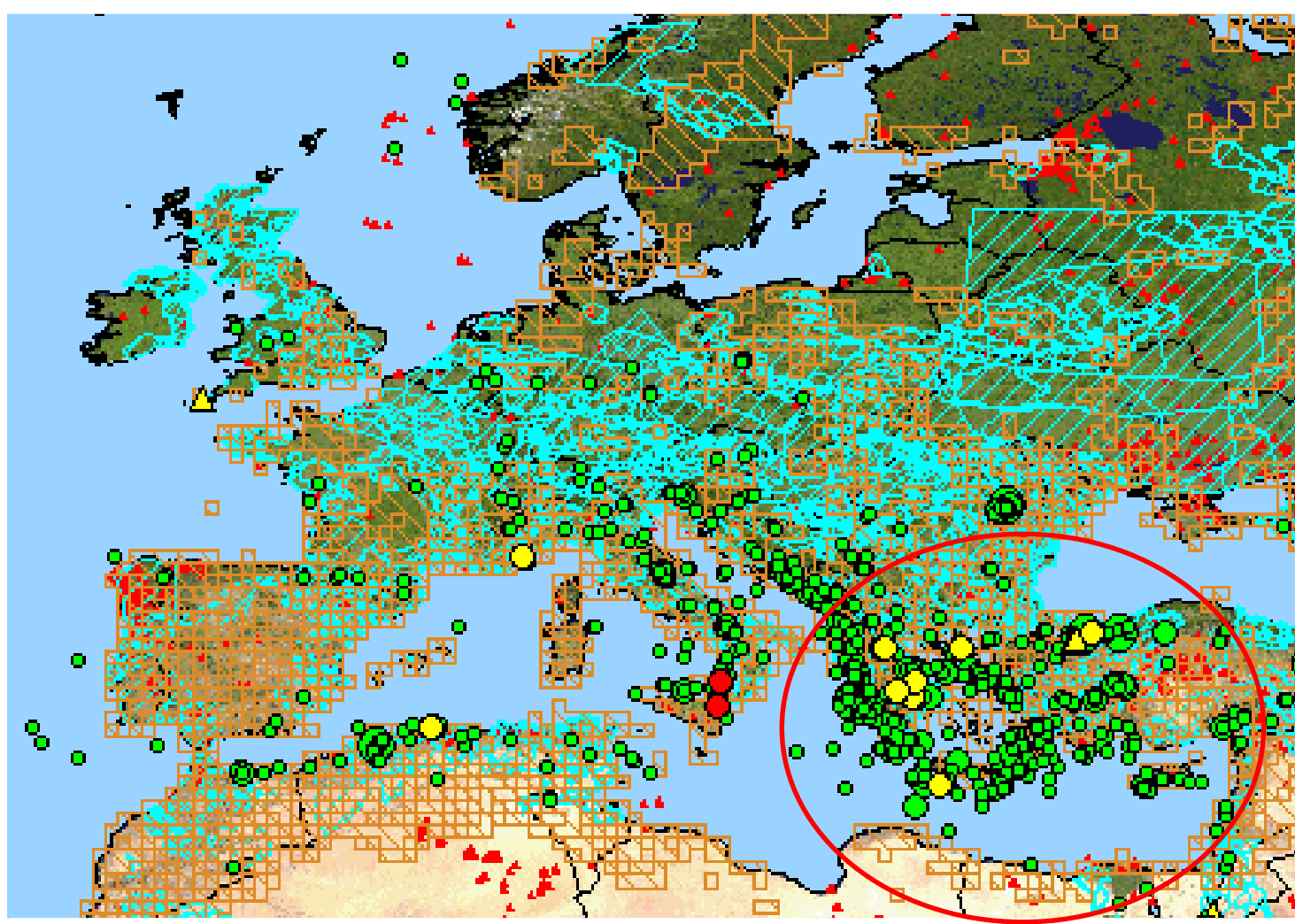
## Human losses by decade (millions)



## Economic losses by decade (billions of US\$ adjusted to 2013)



**Reduction of the number of victims thanks to greater effectiveness of early warning systems and prevention measures**



Natural disasters during the last 25 years (Fires only for 2006)



Earthquakes (Mg)

5-5.9 6-6.9 >7

Tsunamis

Origins Impact locations

Volcanoes (VEI)

2-3 4-6

Droughts

floods

Fires

Europe map of selected natural hazards for the last 25 years (wild fires are presented only for the year 2006).



Ευρωπαϊκή Ένωση  
Ευρωπαϊκό Ταμείο  
Περιφερειακής Ανάπτυξης



Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης

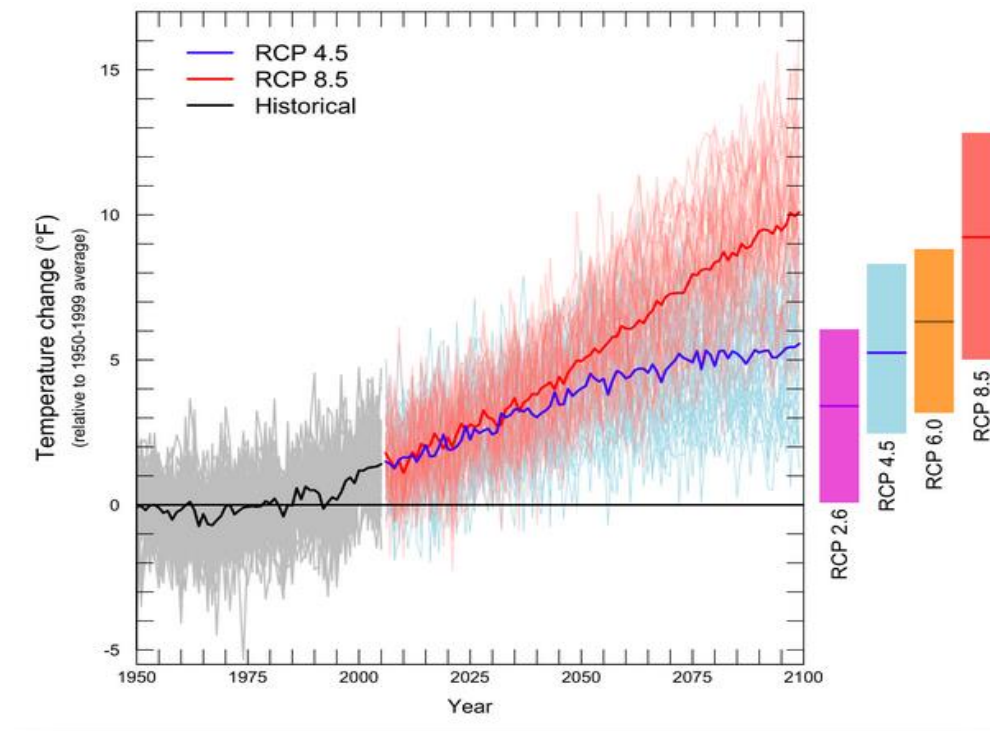
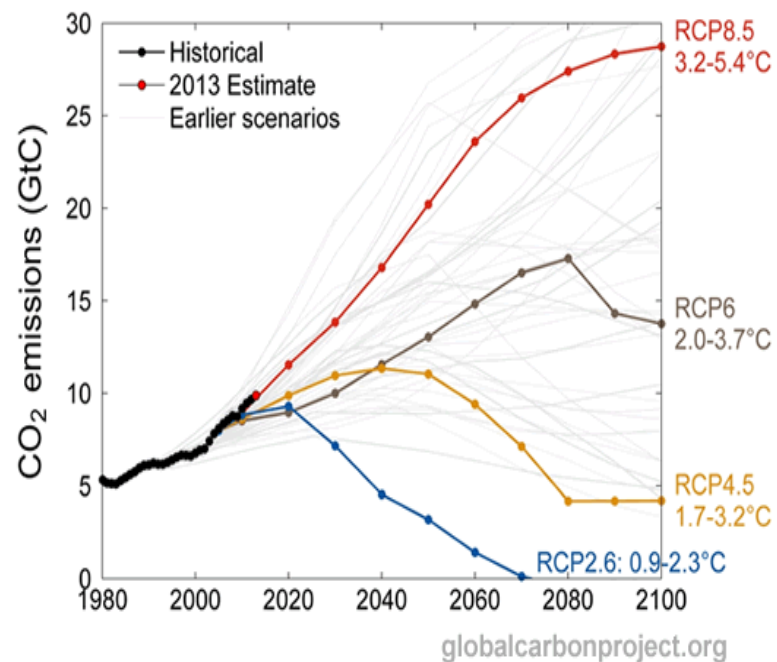


ανάπτυξη - εργασία - αλληλεγγύη



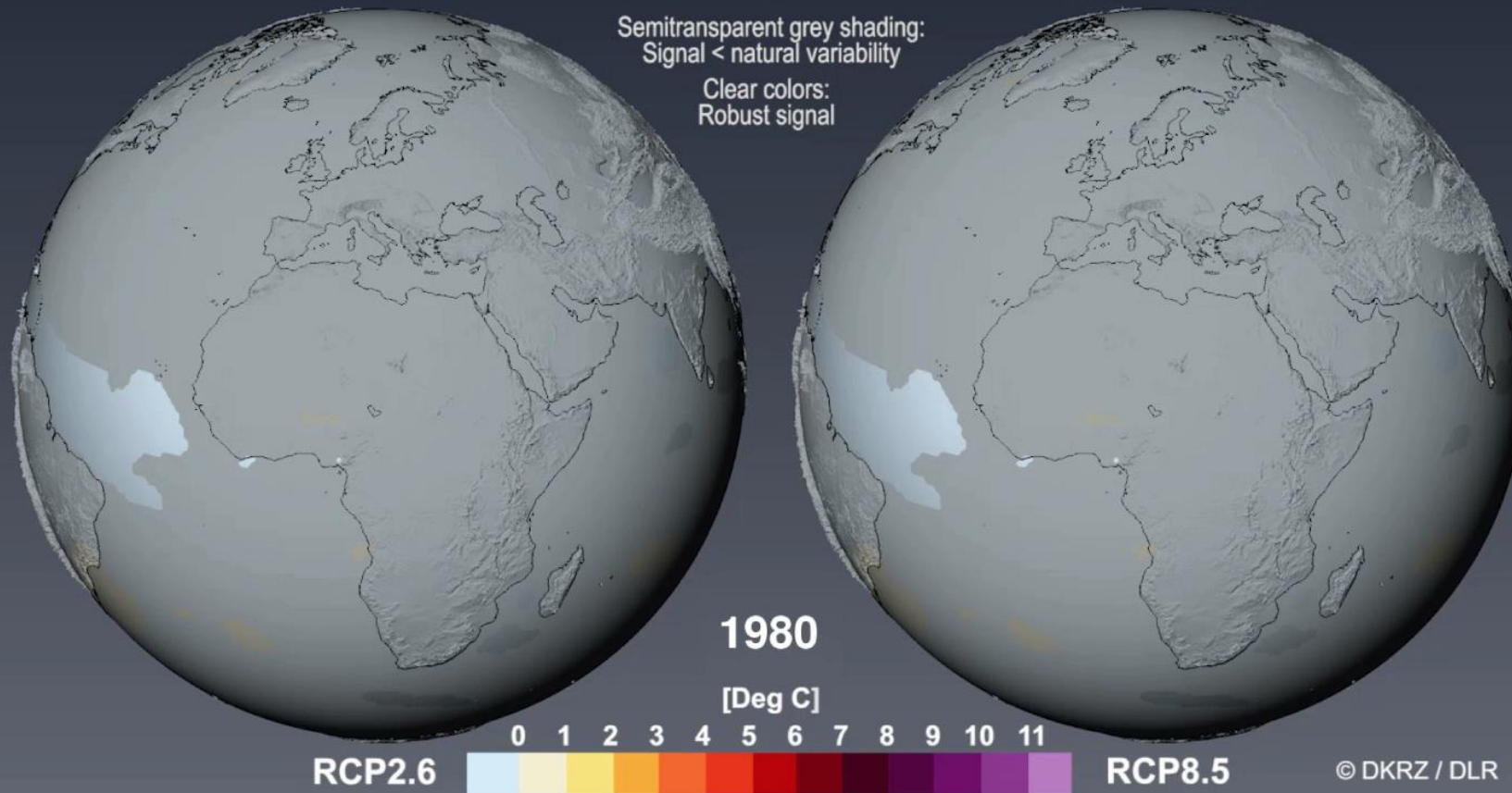
# Climate warming from two CO<sub>2</sub> emission scenarios

### Observed Emissions and Future Scenarios





# CMIP5 Multi Model Ensemble: 2m Temperature Anomaly relative to 1986-2005

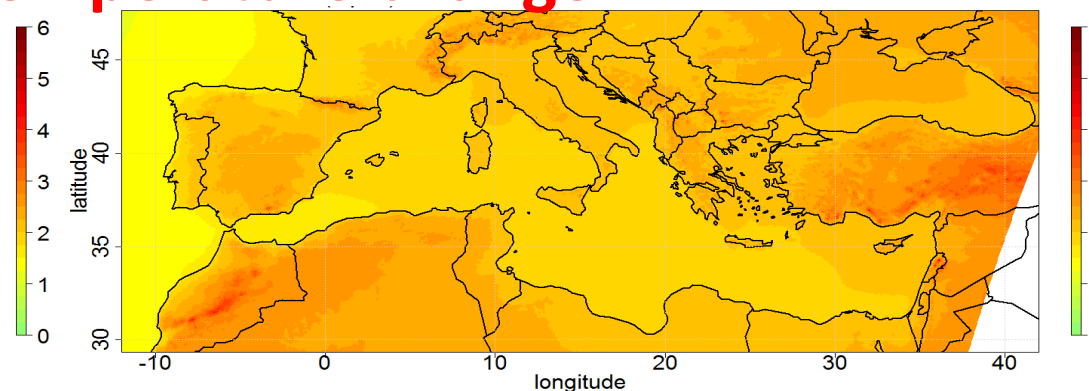
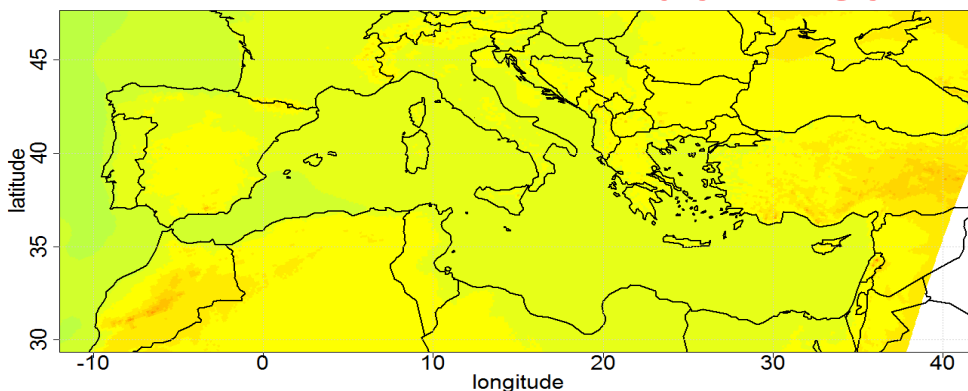


Brasseur, 2019



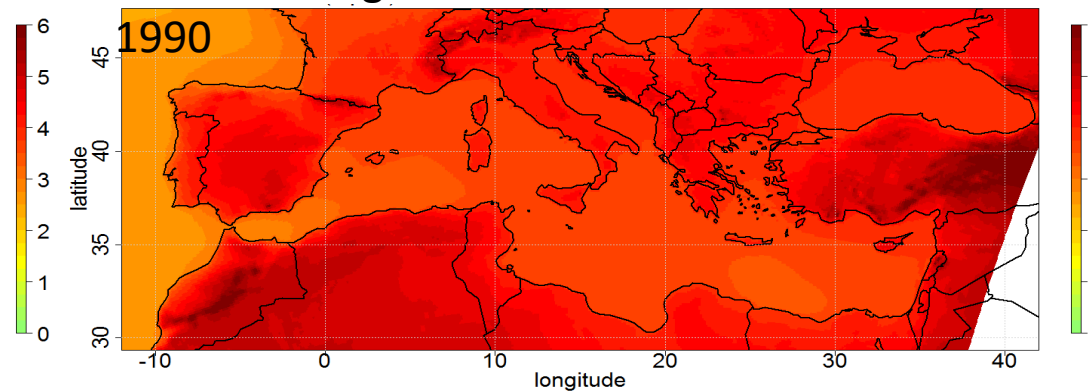
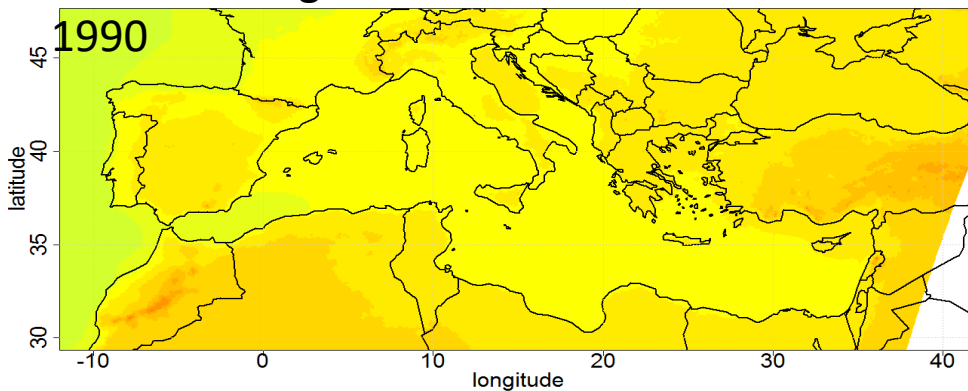


# Annual mean Temperature change



RCP45: Change Between 2021-2050 and 1961-1990

RCP85: Change Between 2021-2050 and 1961-1990



RCP45: Change Between 2071-2100 and 1961-1990

RCP85: Change Between 2071-2100 and 1961-1990



Ευρωπαϊκή Ένωση



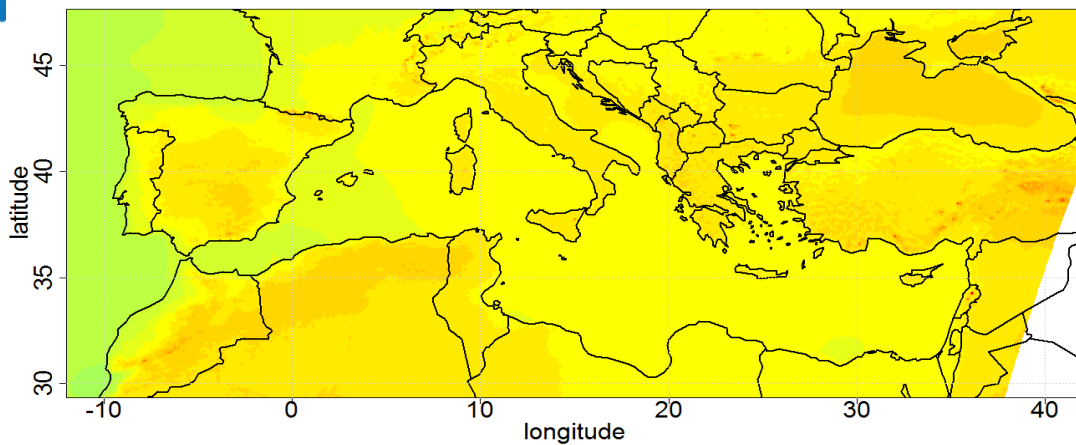
ΠΕΡΙΦΕΡΕΙΑΚΟ ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΠΡΟΓΡΑΜΜΑ ΑΤΤΙΚΗΣ



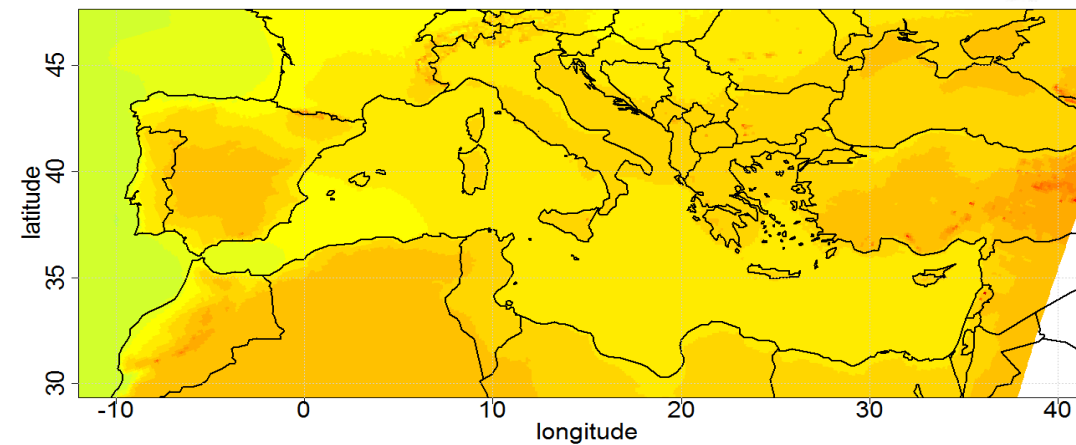
ΕΣΠΑ 2014-2020

ανάπτυξη - εργασία - αλληλεγγύη

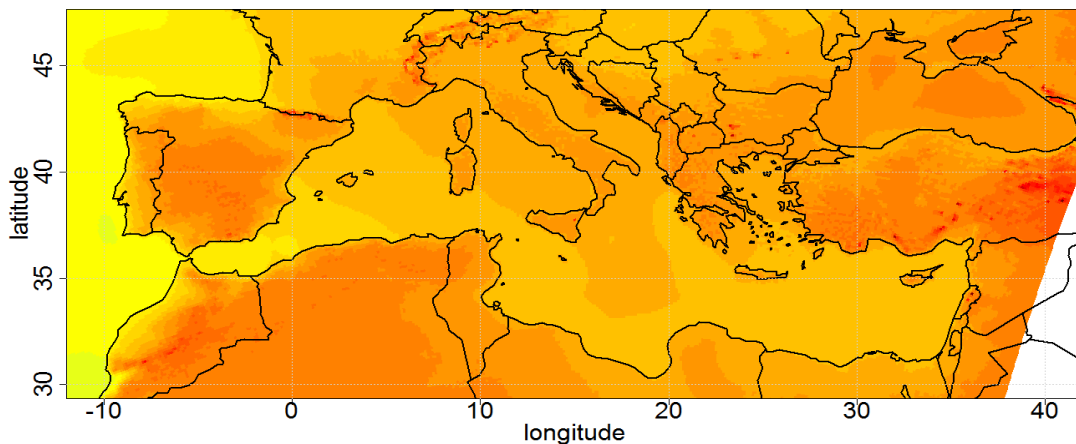
# Summer mean Temperature change



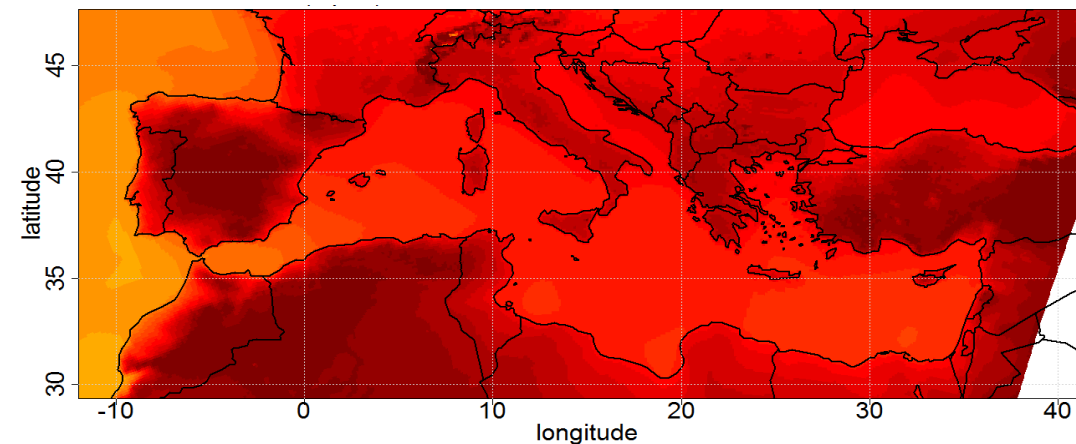
RCP45: Change Between 2021-2050 and 1961-1990



RCP85: Change Between 2021-2050 and 1961-1990



RCP45: Change Between 2071-2100 and 1961-1990



RCP85: Change Between 2071-2100 and 1961-1990



Ευρωπαϊκή Ένωση



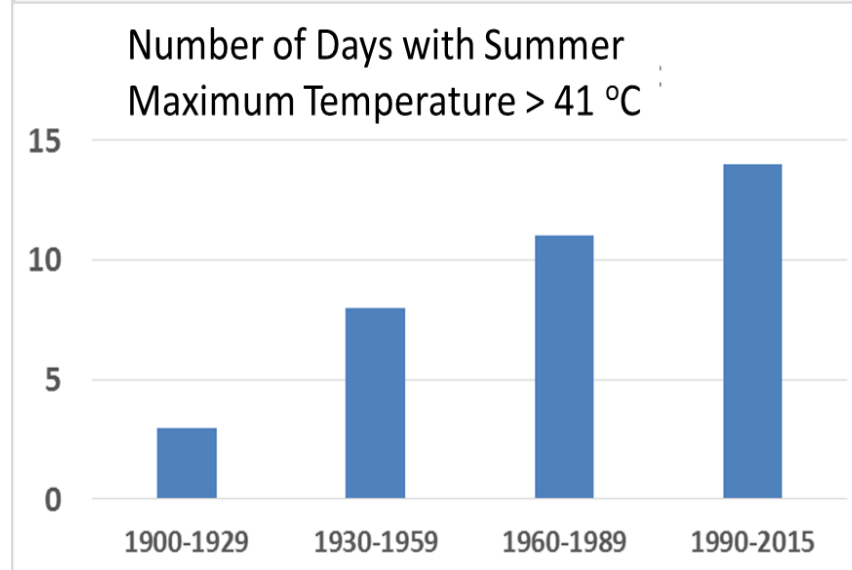
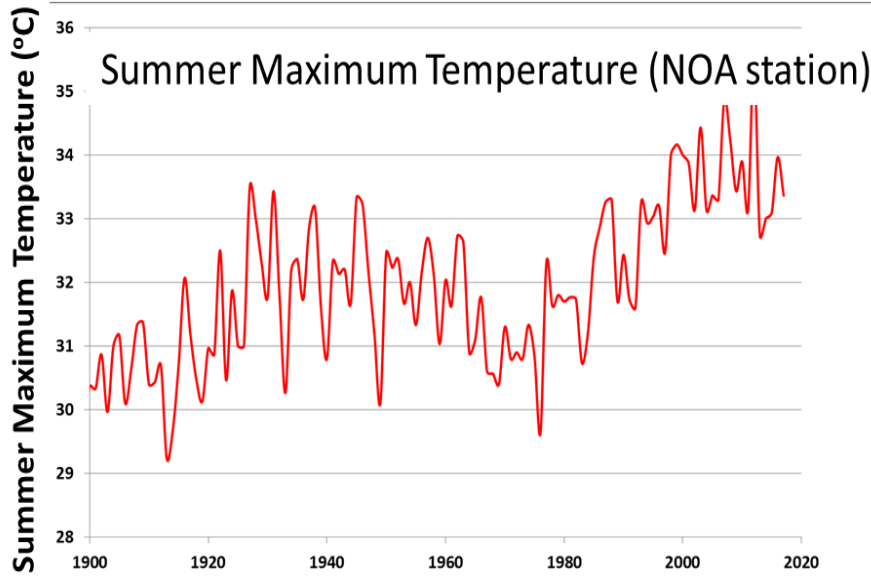
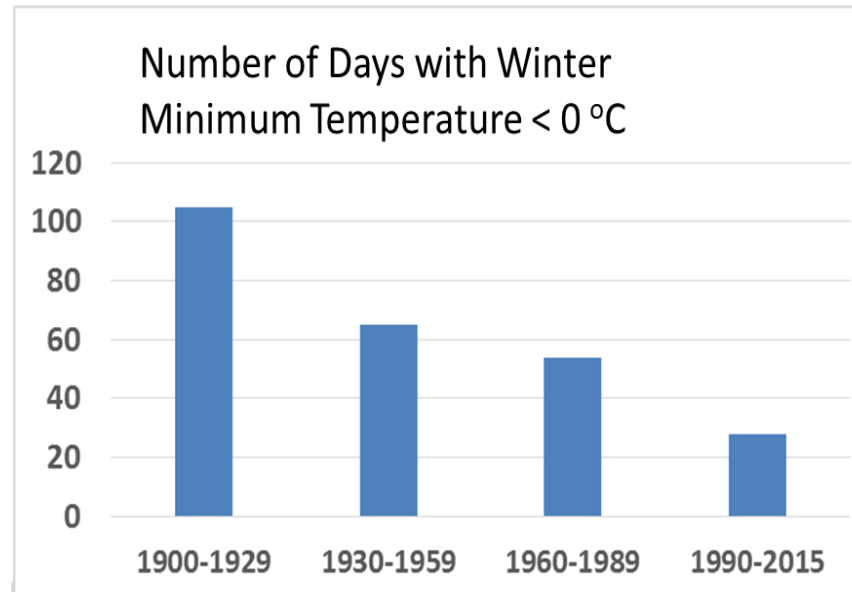
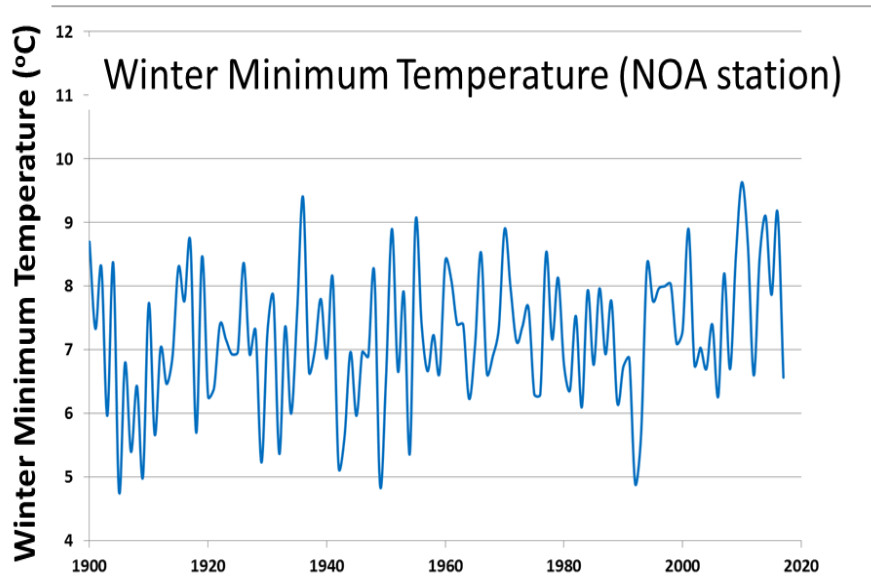
ΠΕΡΙΦΕΡΕΙΑΚΟ  
ΕΠΙΧΕΙΡΗΣΙΑΚΟ  
ΠΡΟΓΡΑΜΜΑ  
ΑΤΤΙΚΗΣ



ανάπτυξη - εργασία - αλληλεγγύη



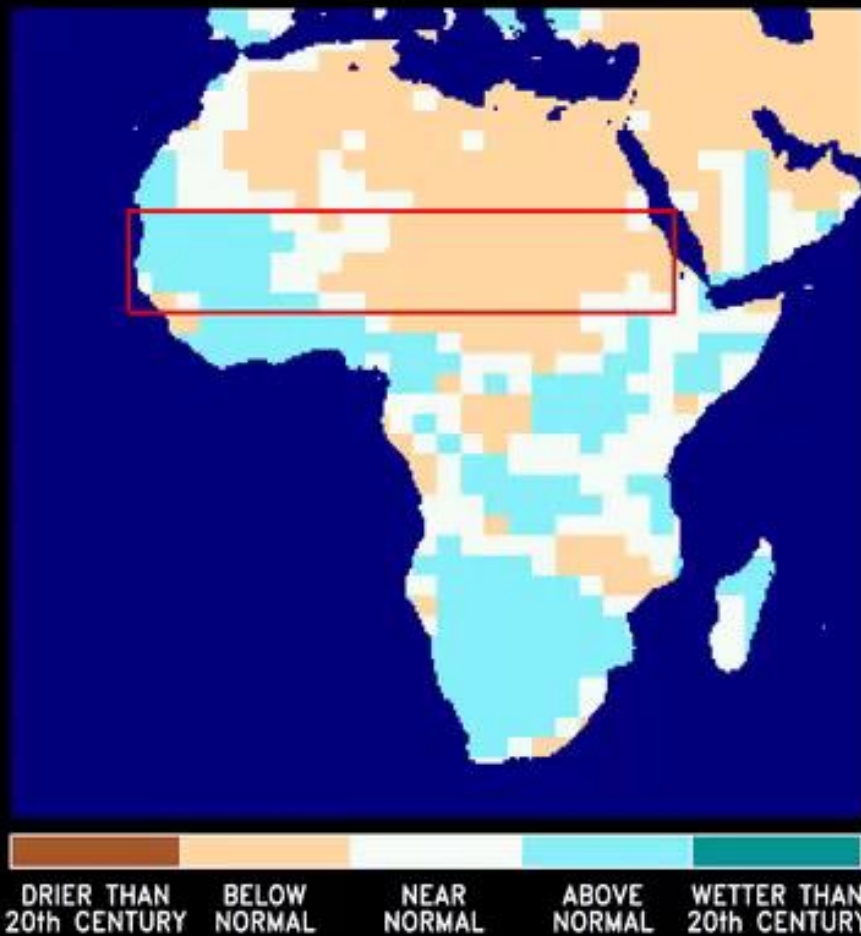
# Changes in Temperature extremes (last 100 years at Athens)



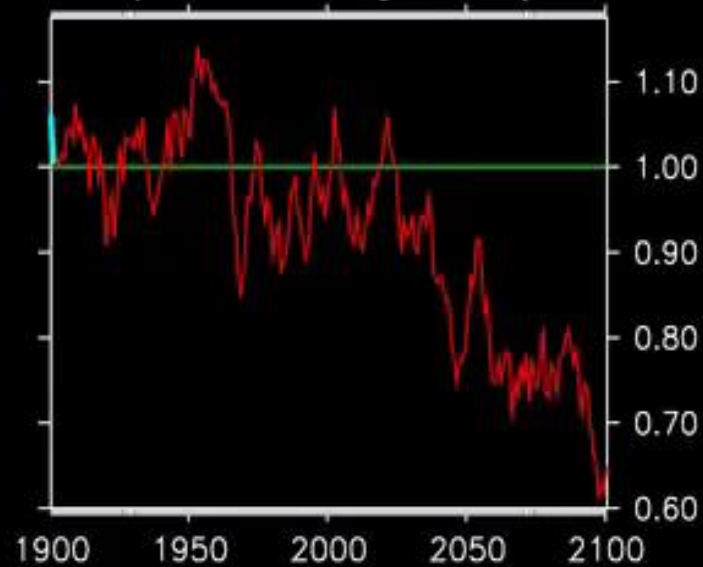
Zerefos and Kapsomenakis, 2019



### 5 YEAR AVG PRECIPITATION CATEGORIES



### SAHEL ANNUAL RAINFALL vs. TIME ( 1901-2000 avg. = 1.00)

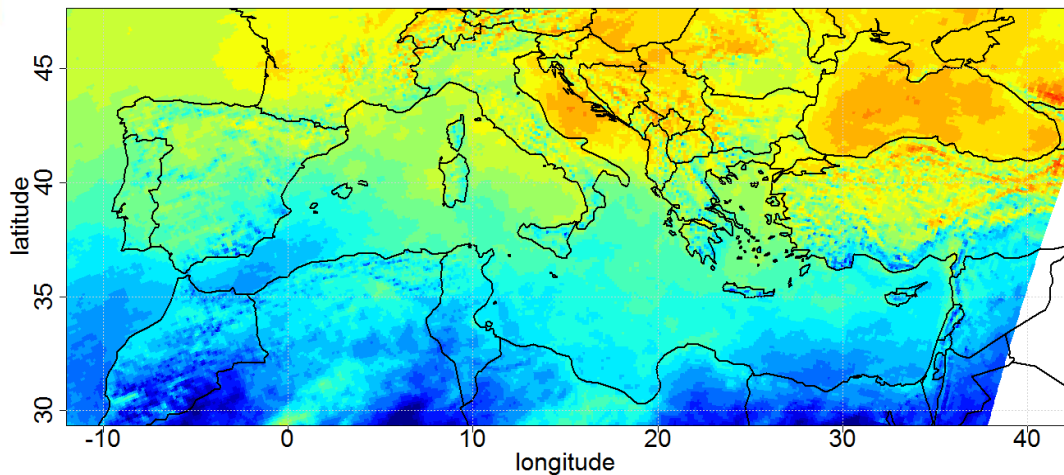


1901

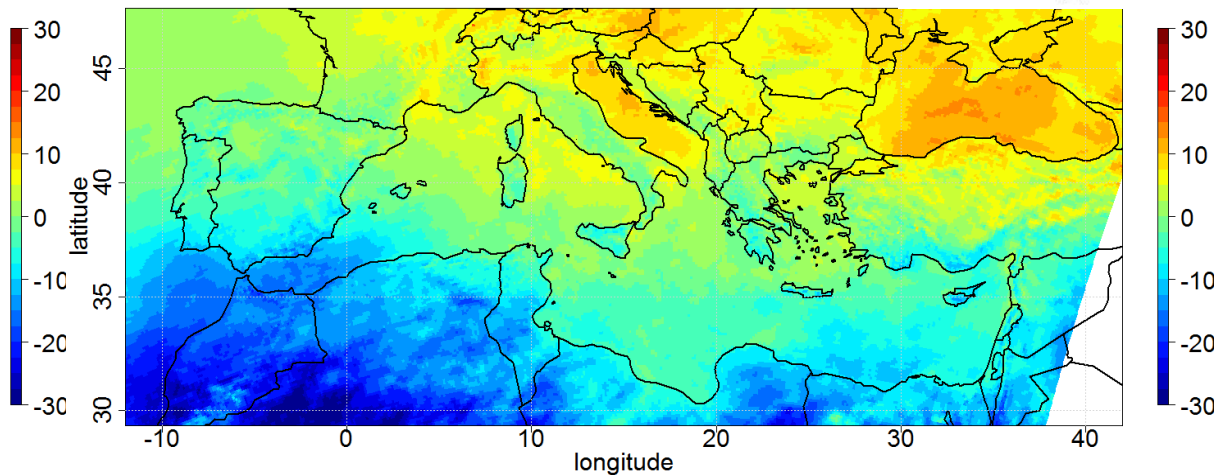
NOAA GFDL CM2.0 MODEL  
20C3M + SRES A1B Scenario



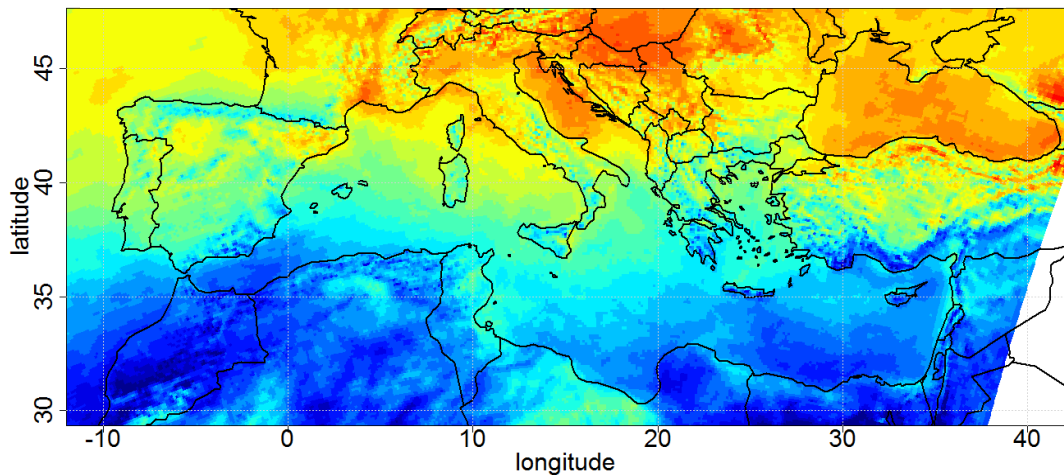
# Rainy Season Precipitation change (%)



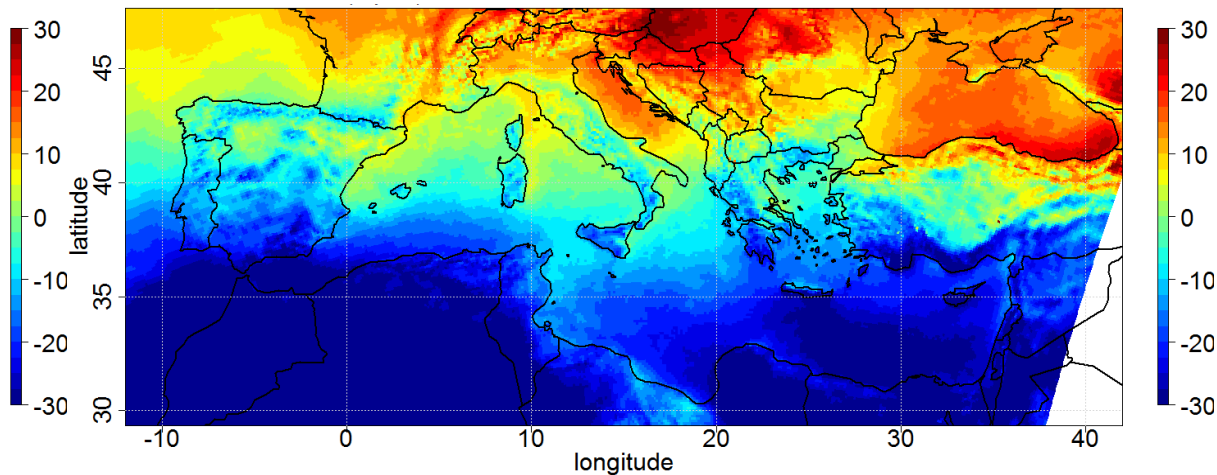
RCP45: Change Between 2021-2050 and 1961-1990



RCP85: Change Between 2021-2050 and 1961-1990



RCP45: Change Between 2071-2100 and 1961-1990



RCP85: Change Between 2071-2100 and 1961-1990



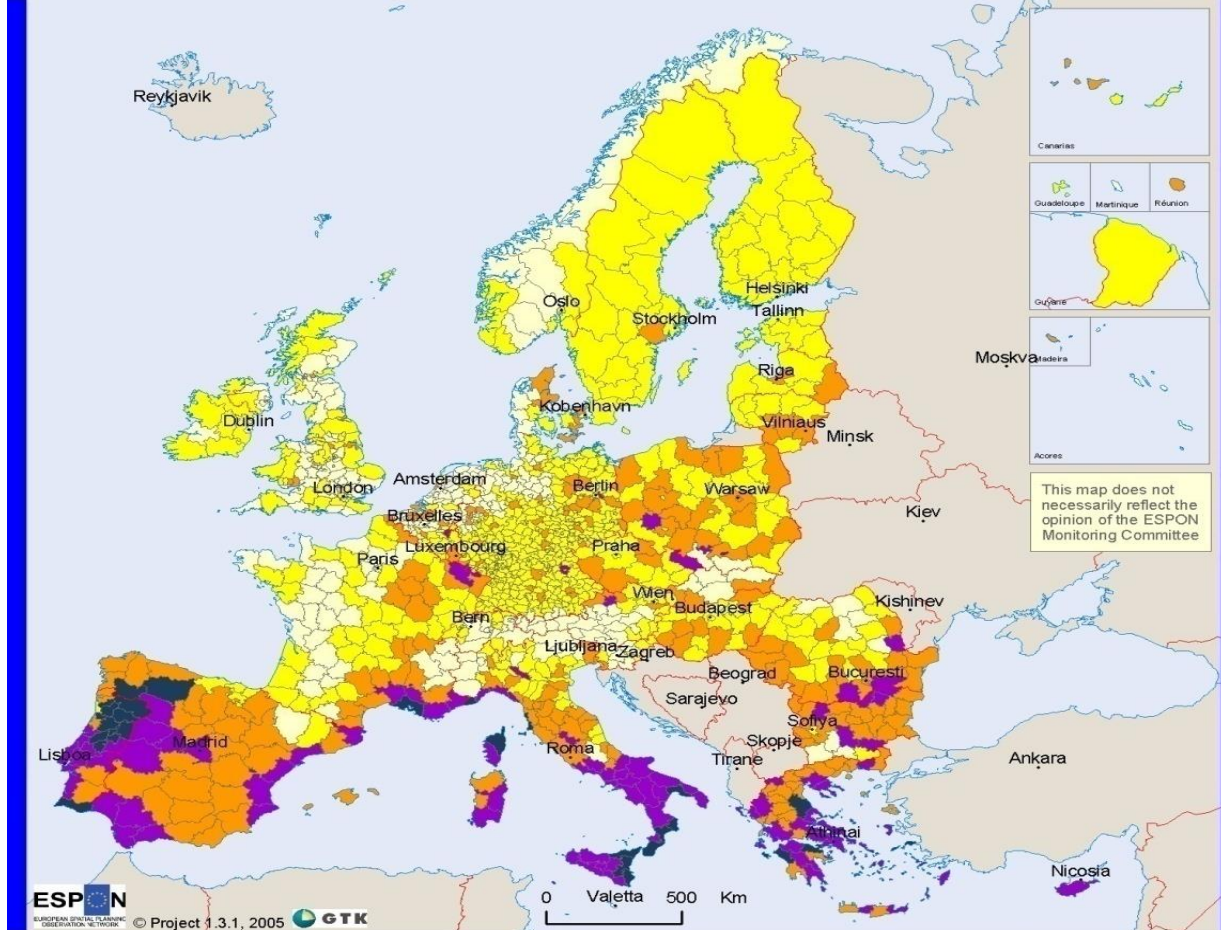
Ευρωπαϊκή Ένωση



ΠΕΡΙΦΕΡΕΙΑΚΟ ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΠΡΟΓΡΑΜΜΑ ΑΤΤΙΚΗΣ



ΕΣΠΑ 2014-2020  
ανάπτυξη - εργασία - αλληλεγγύη



## Spatial distribution of the forest fires hazards over Europe (1997-2003)



Origin of the data: © EuroGeographics Association for the administrative boundaries  
 Number of fires 1997-2003: ATSR World Fire Atlas European Space Agency - ESA/ESRIN  
 Biogeographic regions: EEA  
 Source: ESPON Data Base

**The classification of the forest fire hazard is based on a combination of the numbers of observed fires per 1000 sq. km 1997-2003 (ATSR) and the map of biogeographic regions in Europe (EEA).**

**The number of observed fires per 1000 sq. km 1997-2003:**

- 1 = No fires
- 2 = <1 fires
- 3 = 1-5 fires
- 4 = 5-10 fires
- 5 = >10 fires

**Biogeographic regions:**

- 1 = Alpine and Arctic
- 2 = Atlantic
- 3 = Boreal
- 4 = Continental, Black sea, Pannonian and Steppic
- 5 = Mediterranean

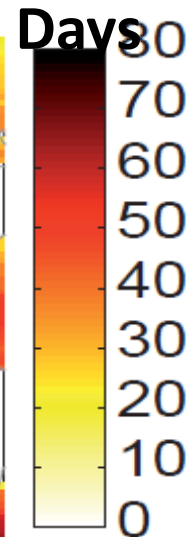
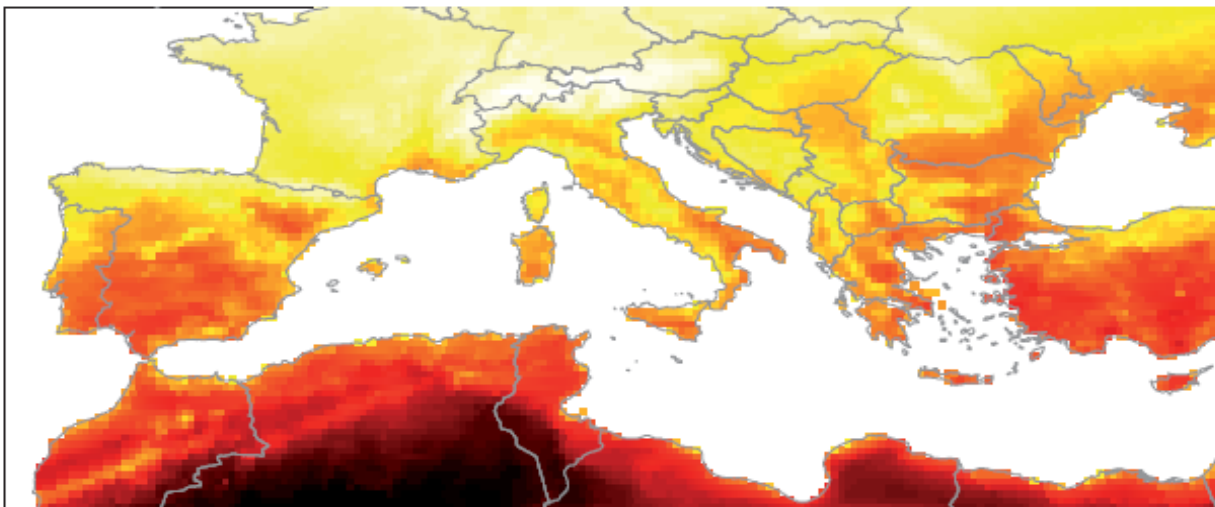


# Example of satellite forest fire monitoring (from MODIS) Greece summer 2007





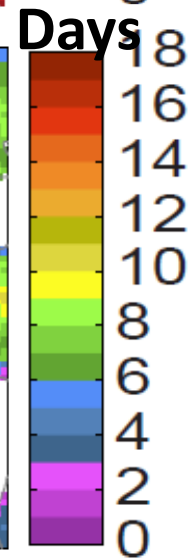
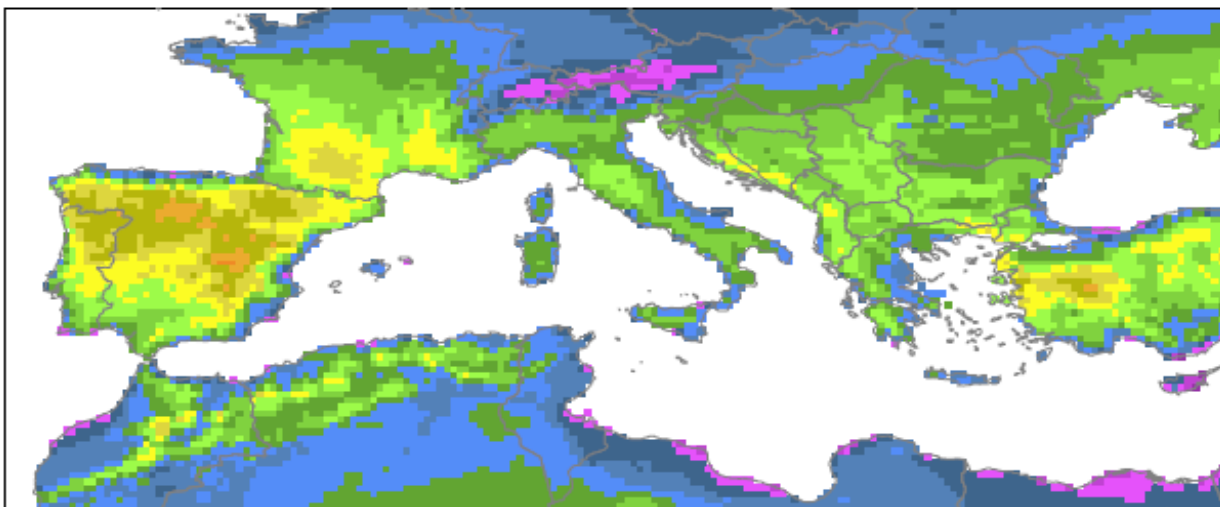
FWI



Number of Day  
with High Fire weather risk

**Control  
1971-2000**

FWI



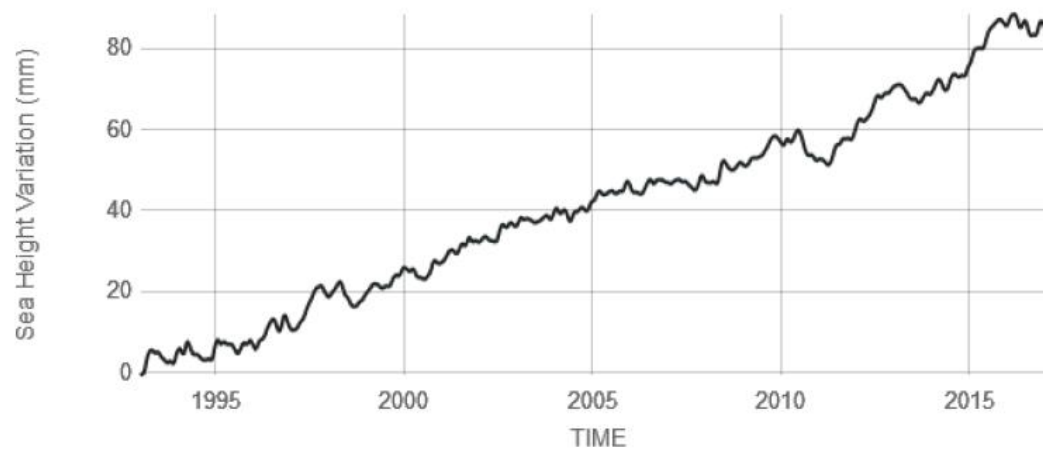
**Change between  
2071-2100 and 1971-  
2000**

J. Bedia et al, 2013

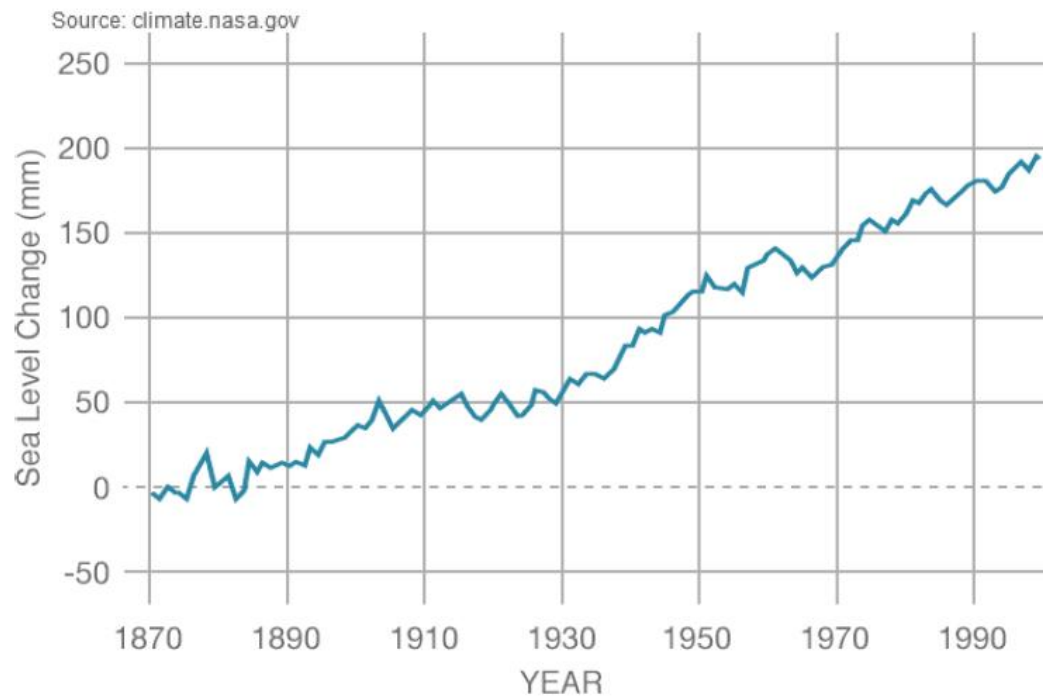


# Global sea level rise: + 26 cm 1870-2017

NASA-EUMETSAT  
Satellites  
(1993-present)



Tide gauges  
(1870-2000)





# In conclusion: Climate Change over the Mediterranean can be summarized as follows

- Mediterranean mean Air temperature rose about 1 ° C over last 100 years. Is expected to increase 3,0° C (RCP 4,5) / 5,0° C (RCP 8.5) till 2100. The increase is higher during summer months.
- To already observed Rainy Season Precipitation over the Mediterranean of 15% within last 100 years, is expected to continue even more 15% (RCP 4,5) / 30% (RCP 8.5) till 2100.
- Sea level rose by about 25 cm since 1880 (IPCC, 2017). is projected to be between 0.3 m and 0.6 m (RCP 4.5) / 0.4 m and 0.8 m (RCP 8.5) by 2100.
- Extreme weather events (such as heat waves, floods, droughts, forest fires) are expected to intensify over the coming decades.