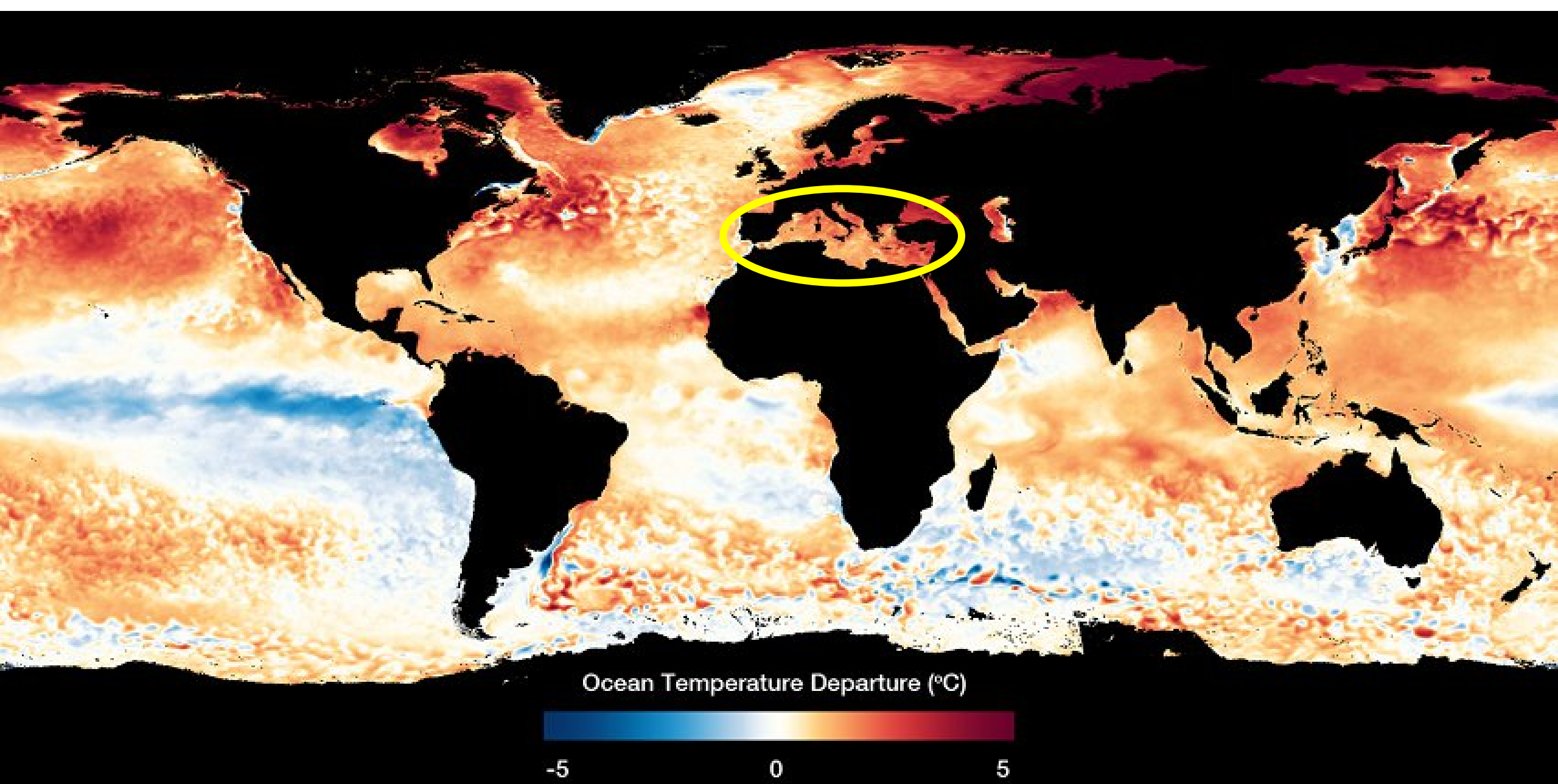


Spatio-temporal Variability of the Marine Heatwaves in the Mediterranean Sea over 39 years, and their Possible Physical Drivers

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Sea surface temperature anomalies measured in September 2020. Red shows where sea surface temperature is warmer than its long-term average (1981 to 2010). © NOAA

MARINE HEATWAVES

MHW are extended periods of regional ocean warming. They have major impacts on marine life and human society.

EXTREME WEATHER

Warm waters increase tropical storms and hurricanes



INCREASED OCEAN STRESSORS

- Stratification
- Acidification
- Deoxygenation



BIODIVERSITY & HABITAT LOSS

- Habitat compression
- Food web disruption
- Species migration
- Mass mortalities



ECONOMIC LOSS

Increased mortality of economically important species



10x intensity compared to pre-industrial times

50% increase in MHWs in the past 10 years

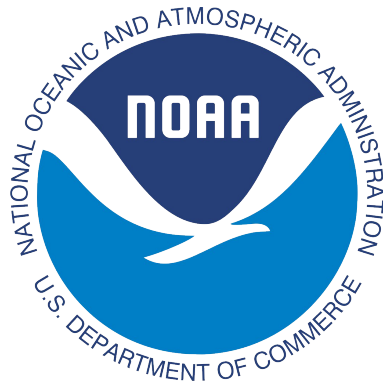
20-50 more MHWs by 2100

THE MAIN OBJECTIVES:

- 1- Investigate the **spatiotemporal variability of marine heatwaves** in the Mediterranean Sea over a 39-year period (1982 - 2020).
- 2- Compare the distribution of **MHWs in the eastern and western Mediterranean basins**.
- 3- Investigate the **relationship between the occurrence of MHWs and heat flux, different atmospheric variables, and mixed layer variability**.

THE DATA SOURCES

Sea Surface Temperature (SST)
data



Atmospheric variables data and
heat fluxes

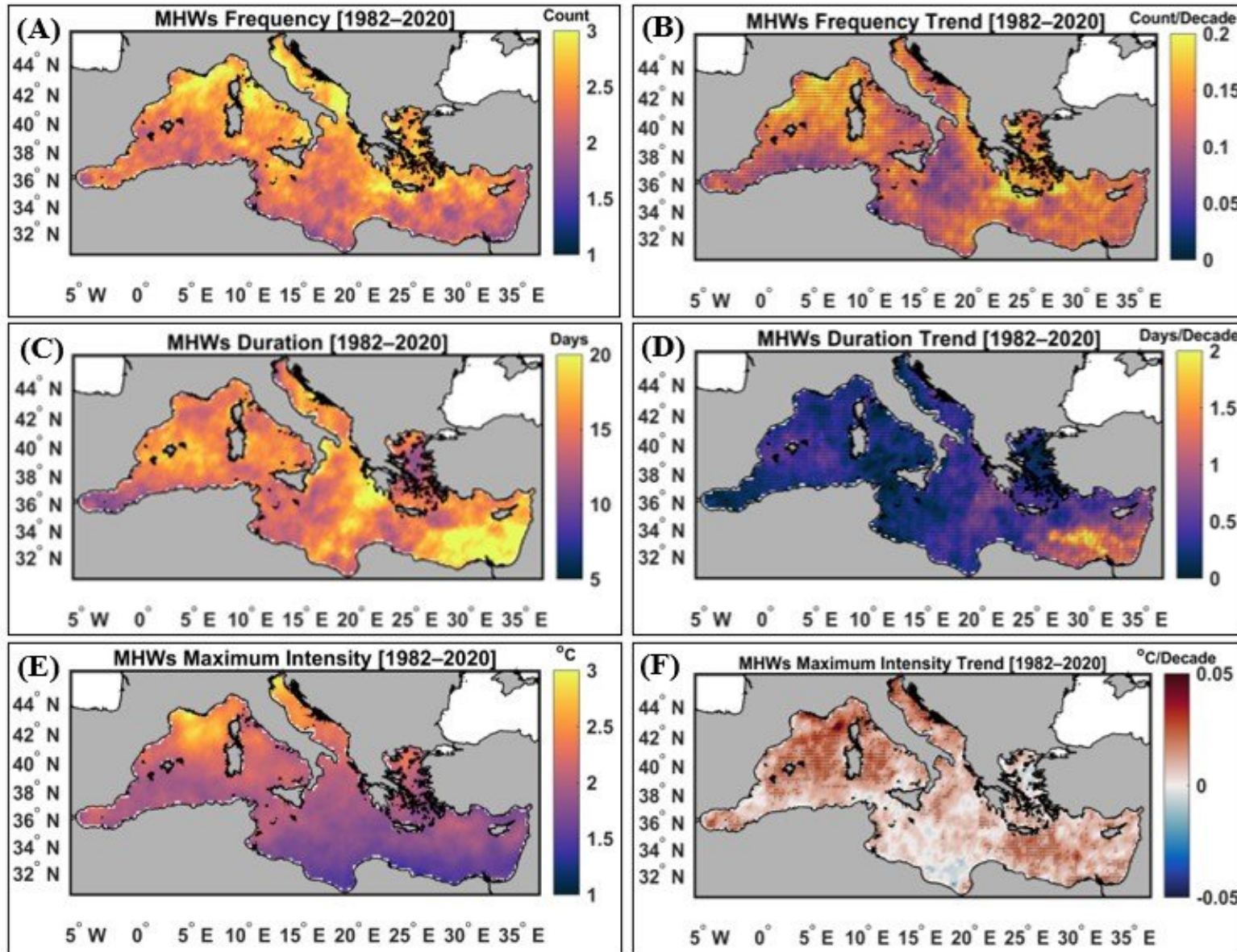


Mixed Layer Depth (MLD)



MAIN RESULTS

The spatial variability of the Mediterranean Sea MHWs from 1982 to 2020



Between 1982 to 2020

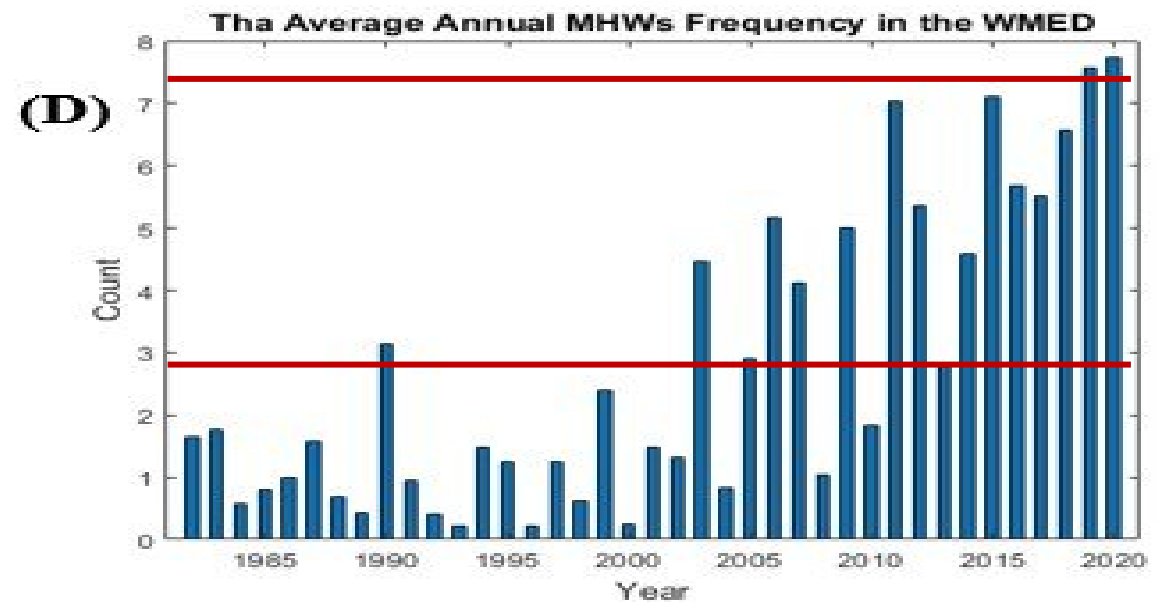
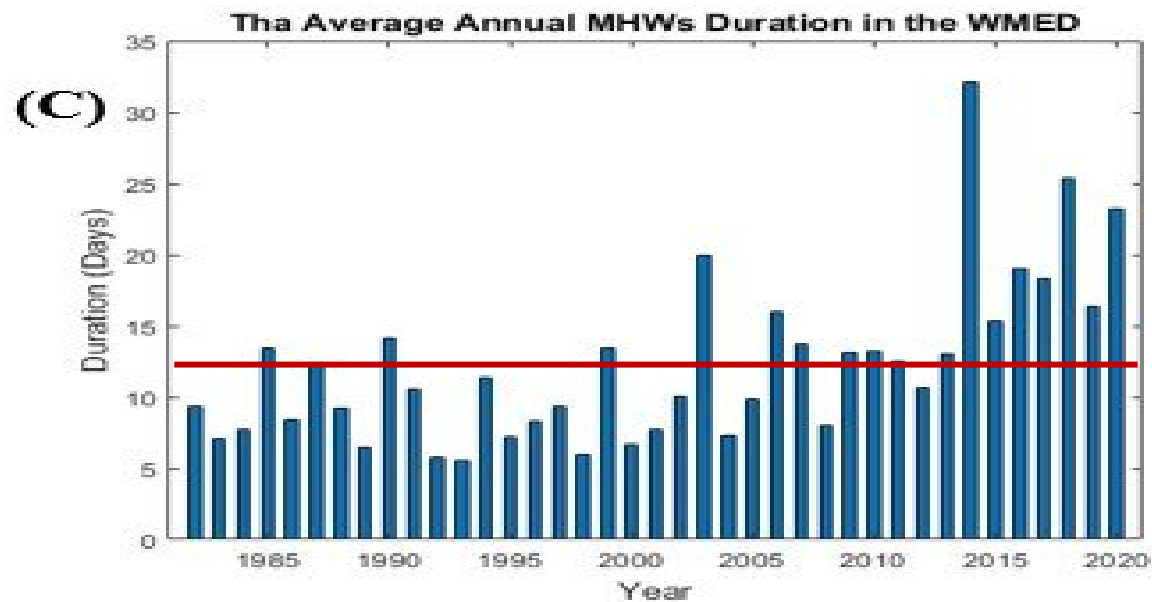
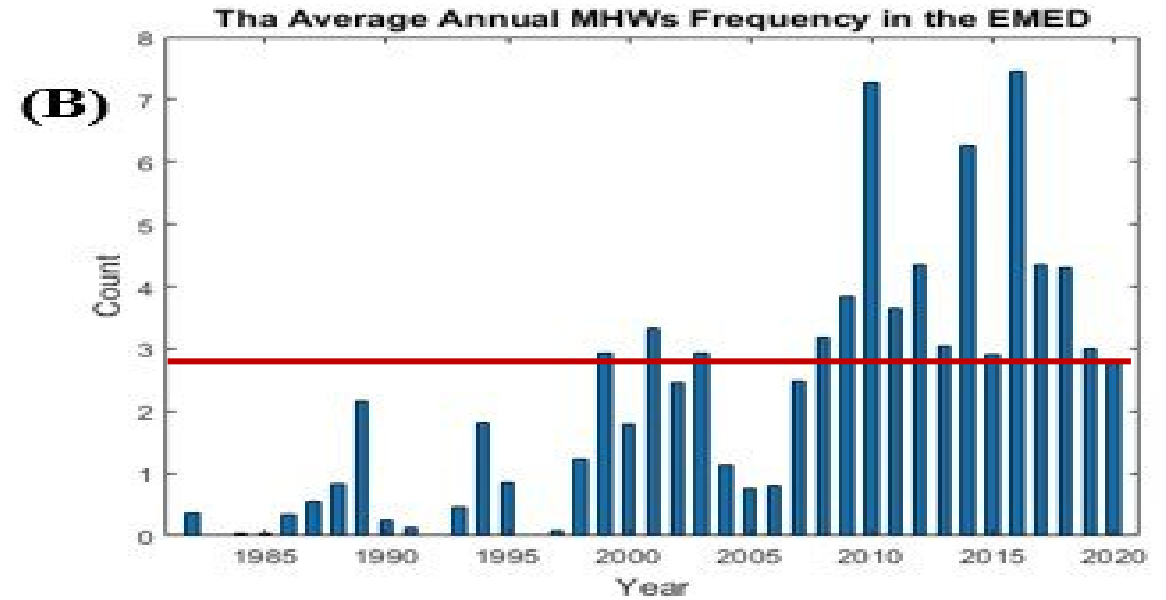
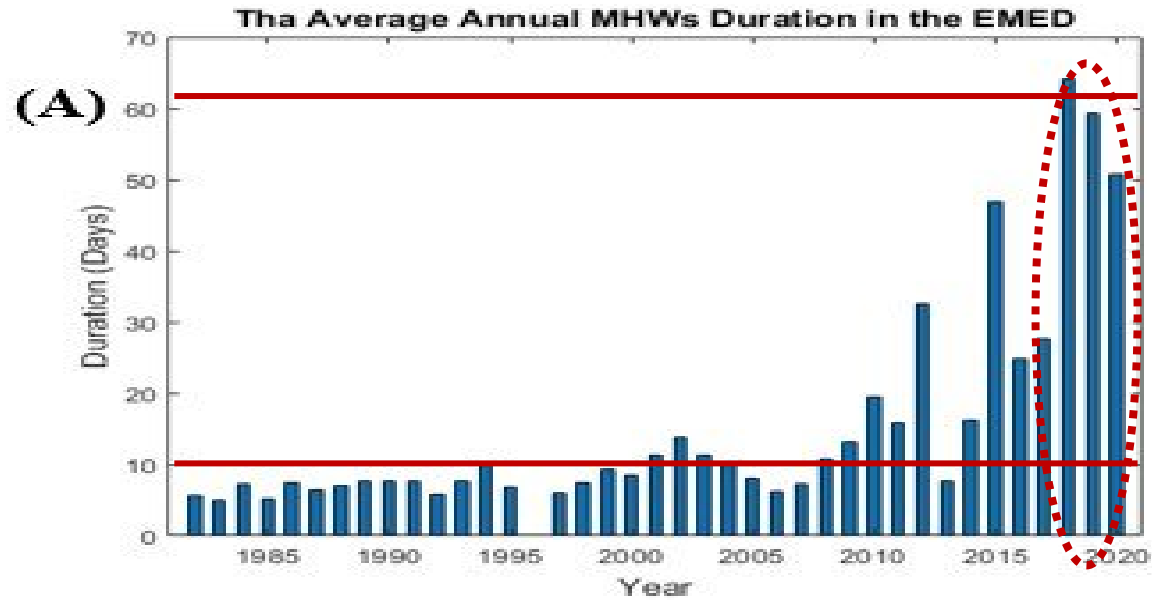
- The **average MHW frequency** was between 1 and 3 events.
- The **duration** ranged from 5 to more than 20 days.
- i_{\max} fluctuated between 1 and 3 °C.

There is dissimilarity between MHWs in the EMED and the WMED

- **WMED** marine heatwaves were **frequent and intense**.
- **EMED** marine heatwaves were **long**.

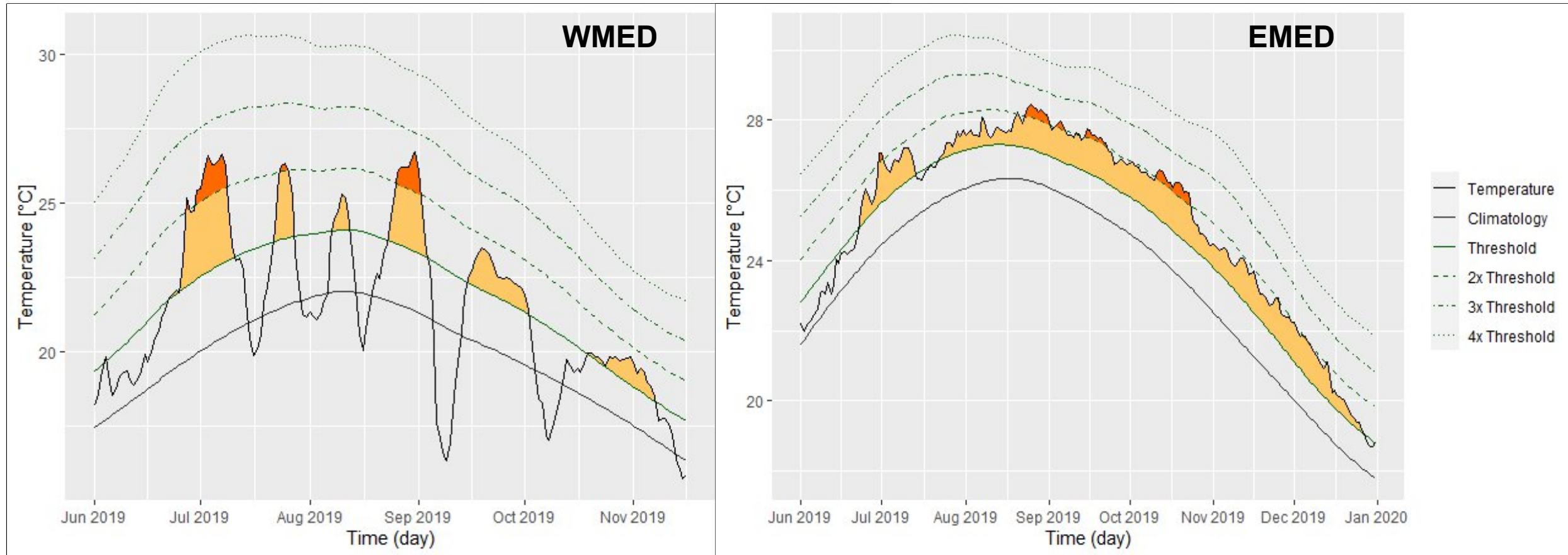
MAIN RESULTS

The temporal variability of the Mediterranean Sea MHWs from 1982 to 2020



MAIN RESULTS

The 2019 MHW events in the WMED and EMED basins



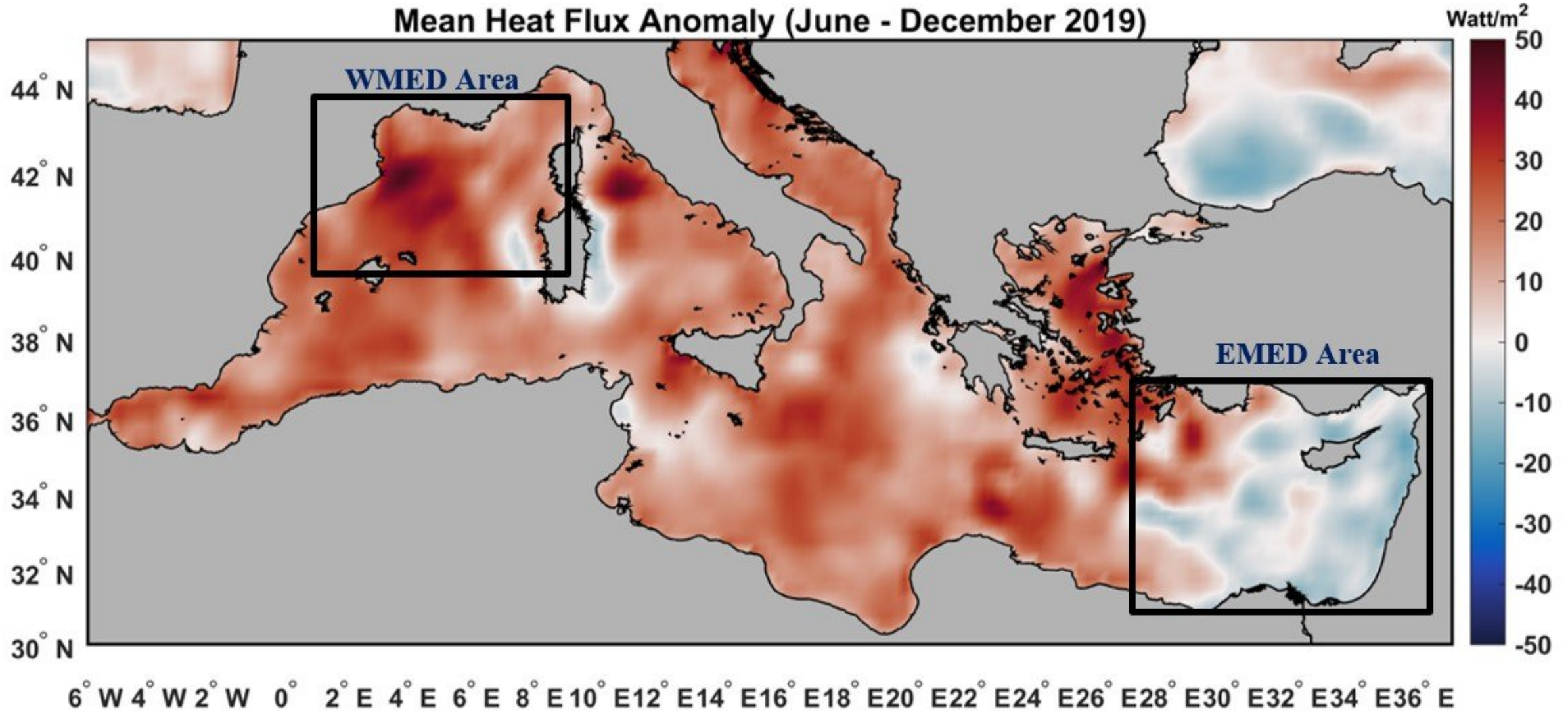
MAIN RESULTS

The 2019 MHW events in the WMED and EMED basins

Loc.	Event no.	Onset_Day	Peak_Day	End_Day	Duration (days)	Max. Intensity (°C)	Mean Intensity (°C)	MHW Category	Qi_anom (W/m ²)
WMED	1	26-06-2019	03-07-2019	10-07-2019	15	6.42	5.27	II Strong	15.77
	2	22-07-2019	25-07-2019	27-07-2019	6	4.80	4.14	II Strong	13.63
	3	08-08-2019	10-08-2019	12-08-2019	5	3.29	2.85	I Moderate	45.2
	4	24-08-2019	31-08-2019	03-09-2019	11	5.38	4.18	II Strong	78.32
	5	15-09-2019	19-09-2019	02-10-2019	18	3.26	2.64	I Moderate	6.98
	6	19-10-2019	31-10-2019	07-11-2019	20	2.25	1.81	I Moderate	-102.58
EMED	1	23-06-2019	30-06-2019	13-07-2019	21	2.68	1.96	II Strong	-47.33
	2	22-07-2019	23-10-2019	27-12-2019	159	2.69	1.91	II Strong	36.99

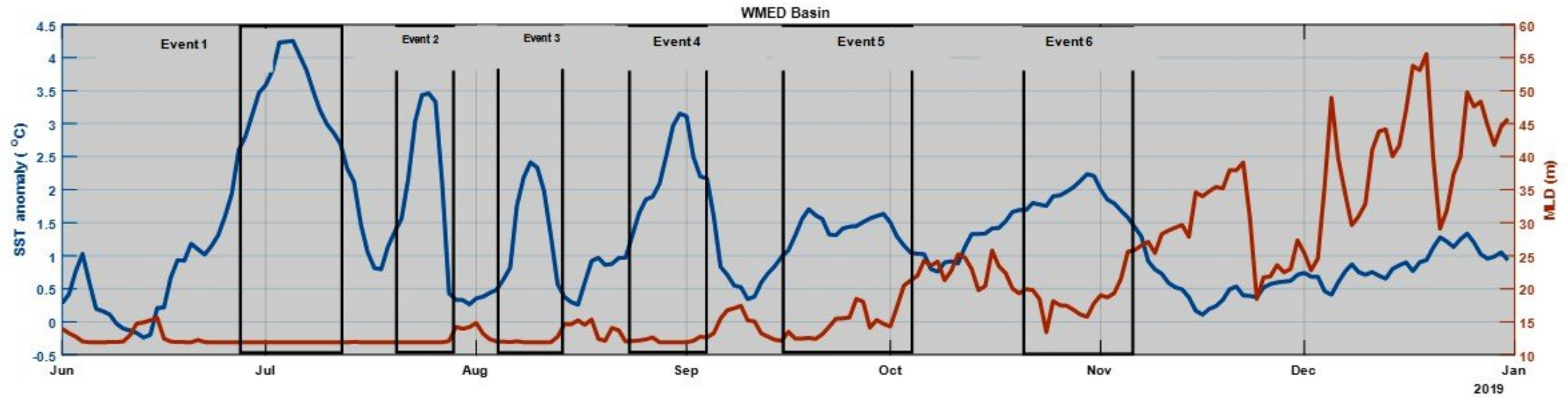
MAIN RESULTS

Heat Flux Anomaly



MAIN RESULTS

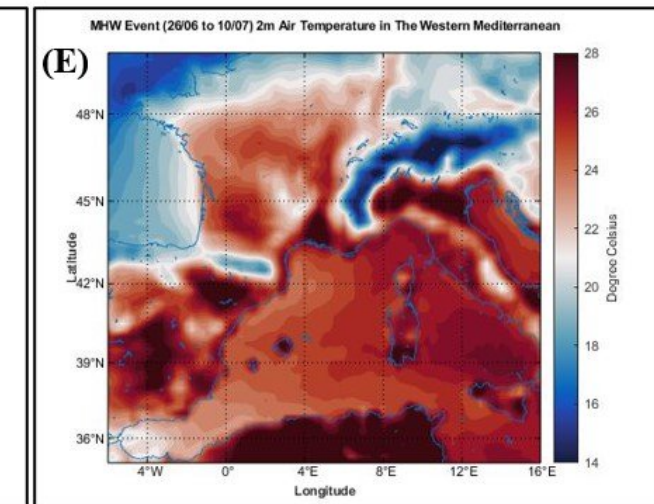
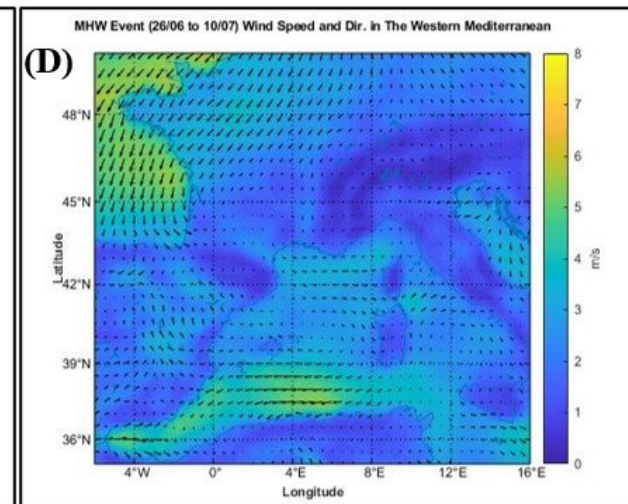
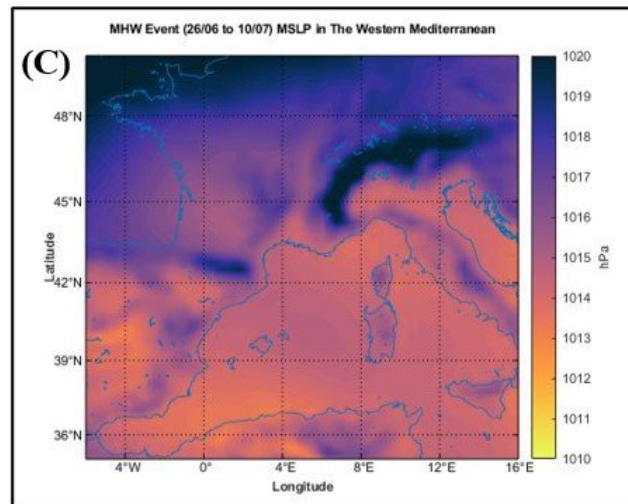
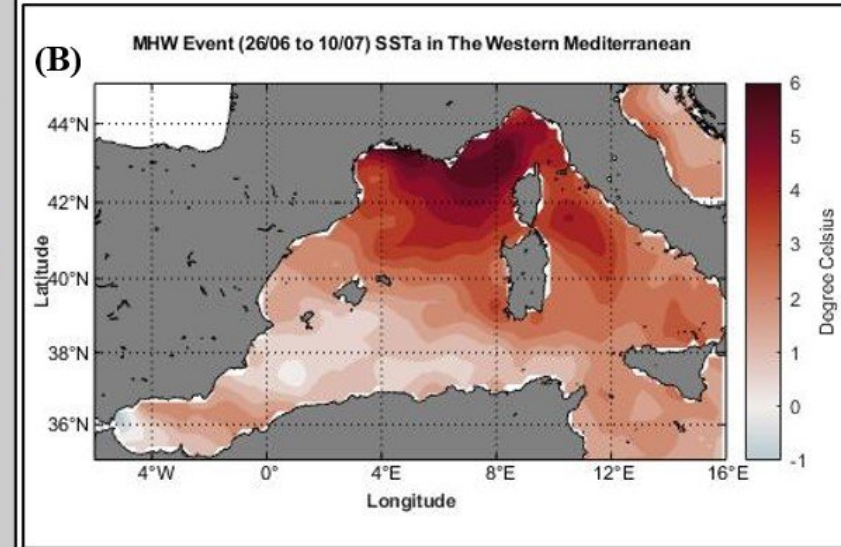
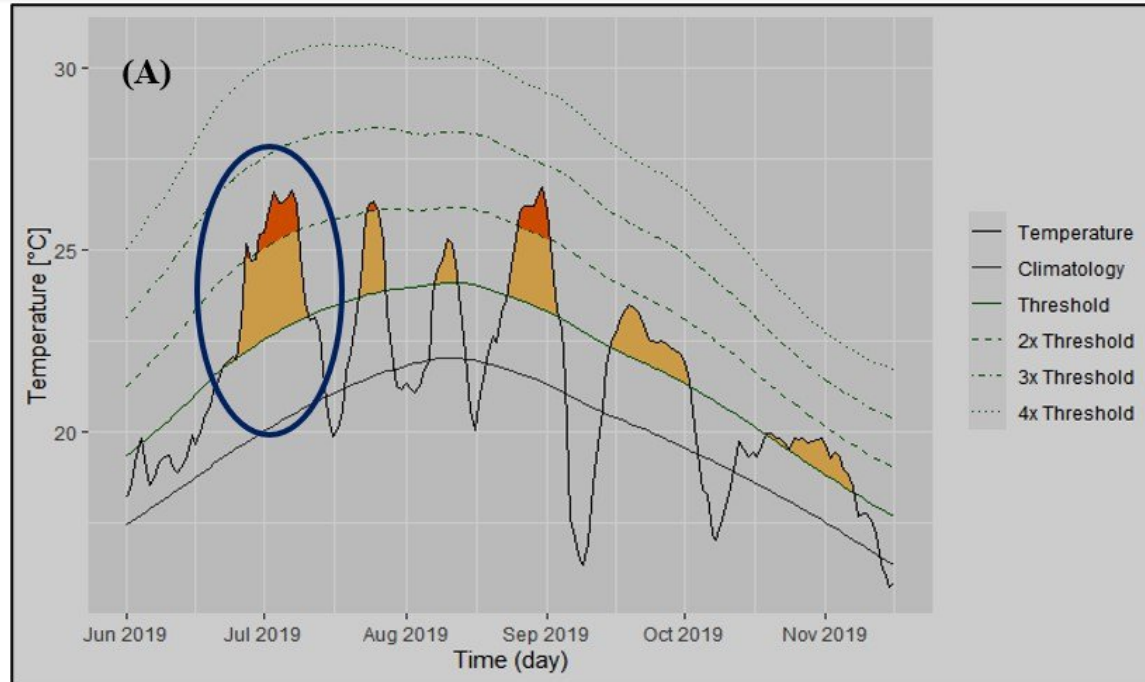
MLD and SST anomaly



— SST — MLD

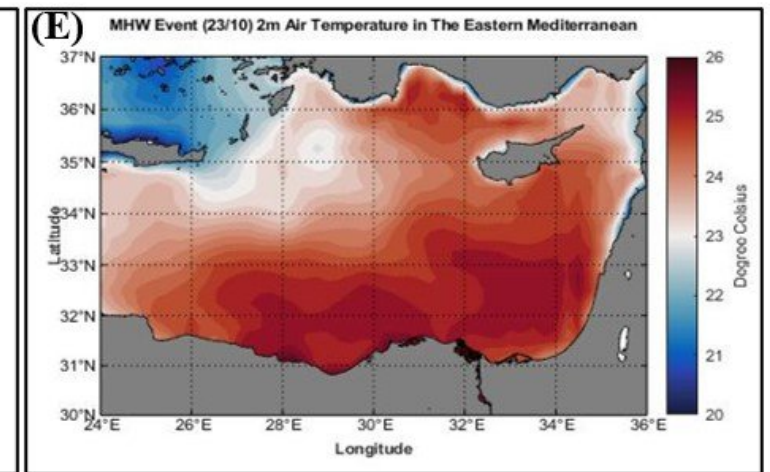
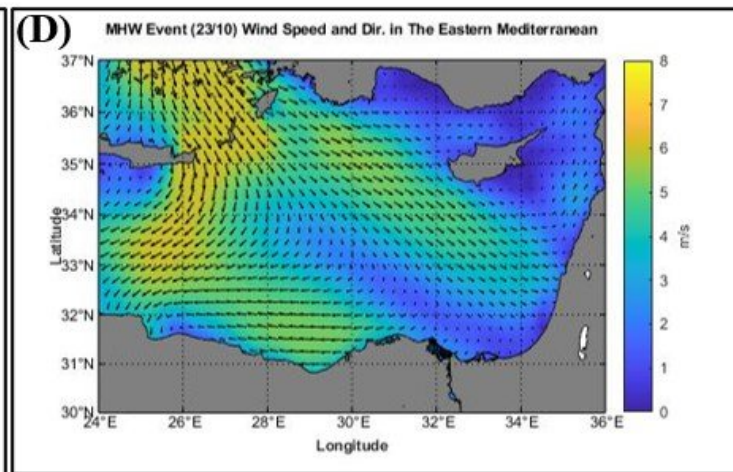
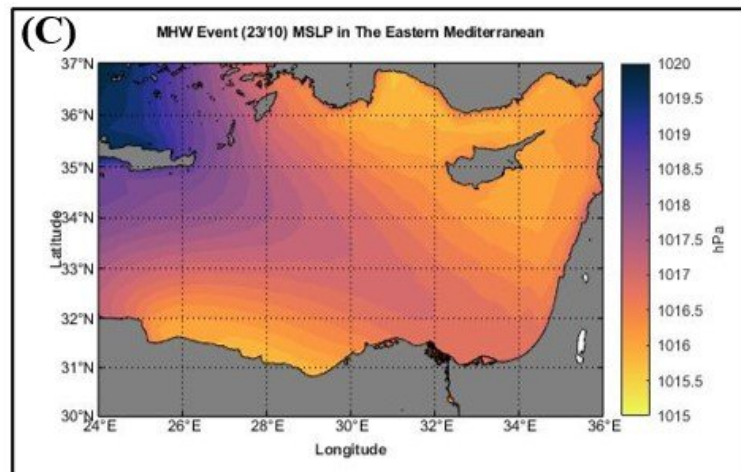
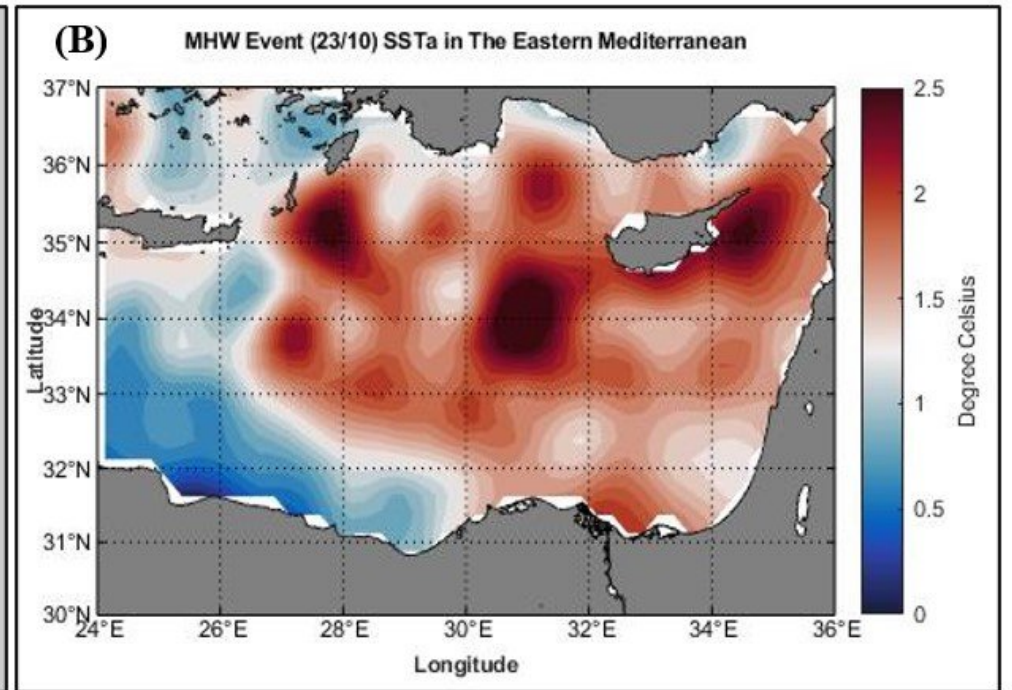
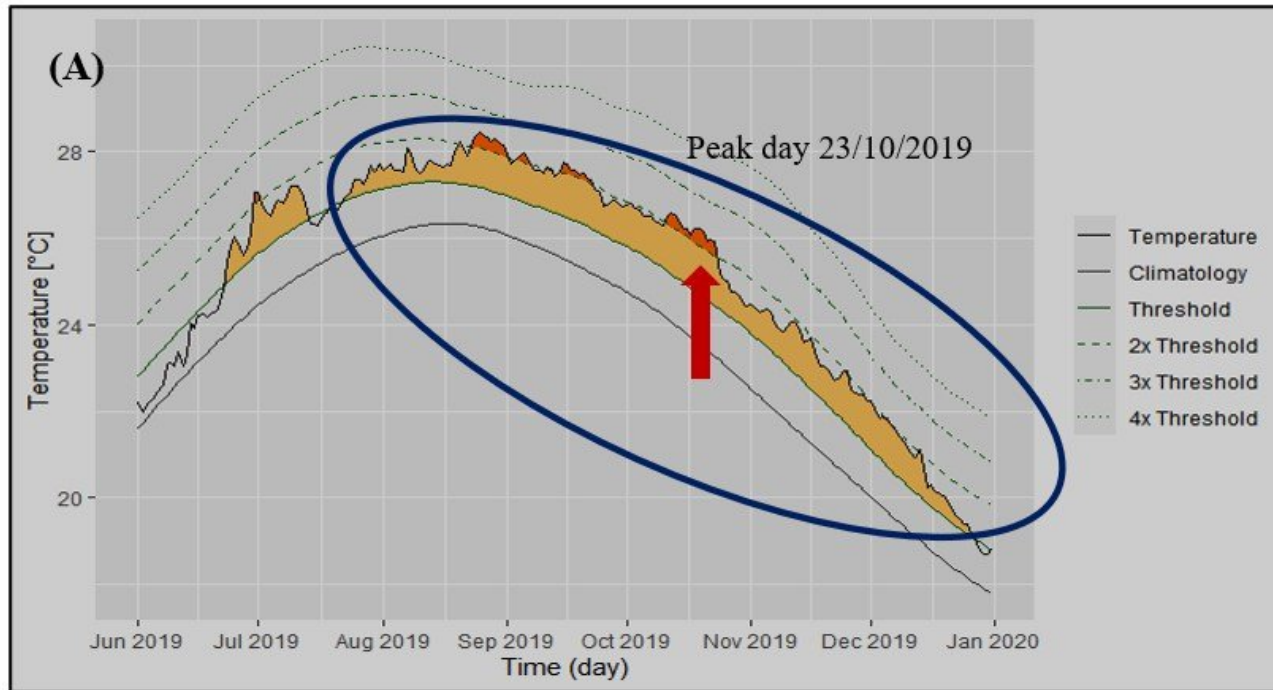
MAIN RESULTS

Atmospheric variables and MHWs in the WMED



MAIN RESULTS

Atmospheric variables and MHWs in the EMED



CONCLUSIONS

	Western Mediterranean	Eastern Mediterranean
MHWs Characteristics	Intense and Frequent	Long
Average Heat Flux Anomaly Associated to the MHW Events	+ ve	- ve
Mixed Layer Thickness Associated to the MHW Events	Shallower Mixed Layer Depth	
Atmospheric Condition Associated to the MHW Events	High Air Temperature (> 25 °C), High Mean Sea Level Pressure (> 1014 hPa), and Low Wind Shear.	

THANKS FOR YOUR ATTENTION