Marine and atmospheric heatwaves concurrence: a major impact of climate change

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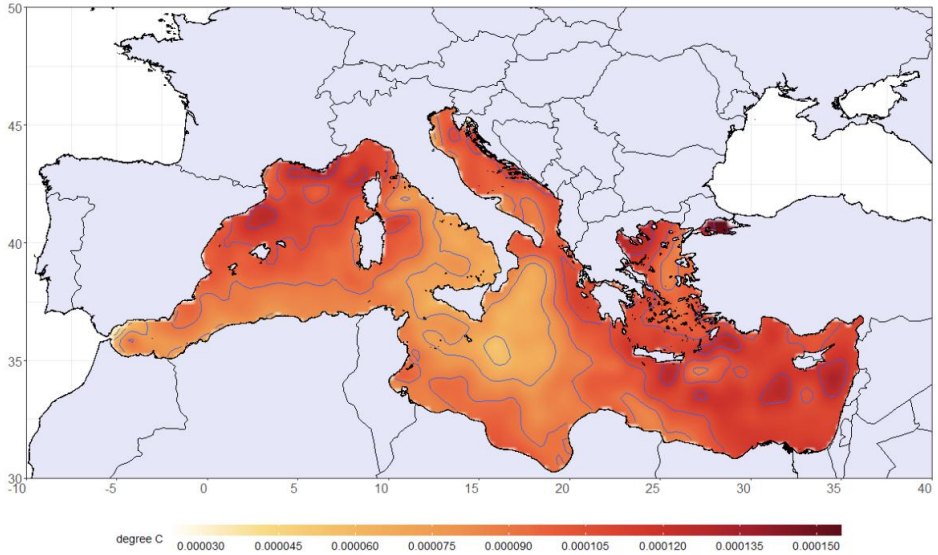
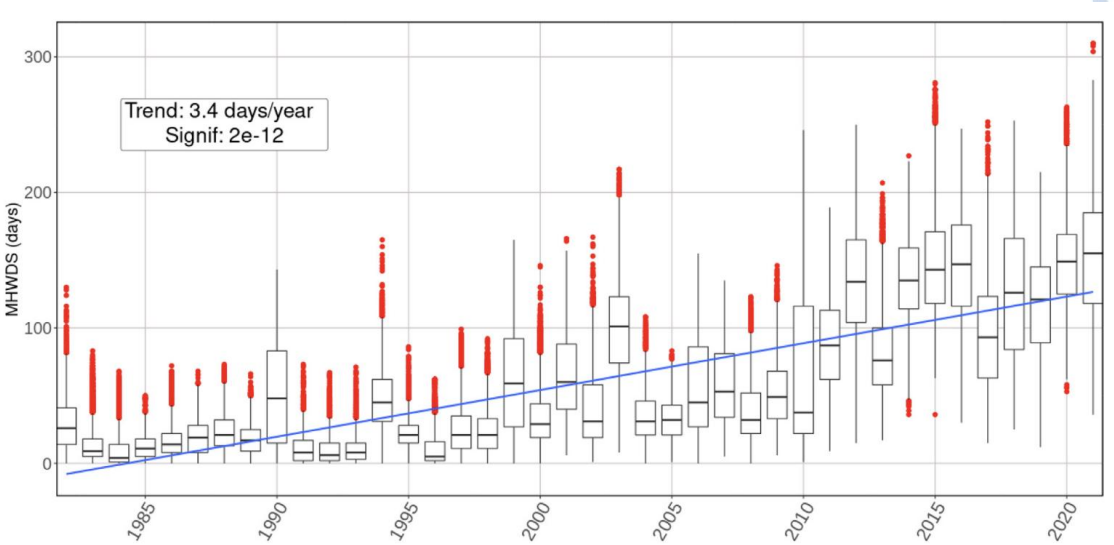
SST warming in the Mediterranean



Daily warming trend from 1982 to 2019. Contours denotes a change of 1.5×10^{-5} ºC/day.

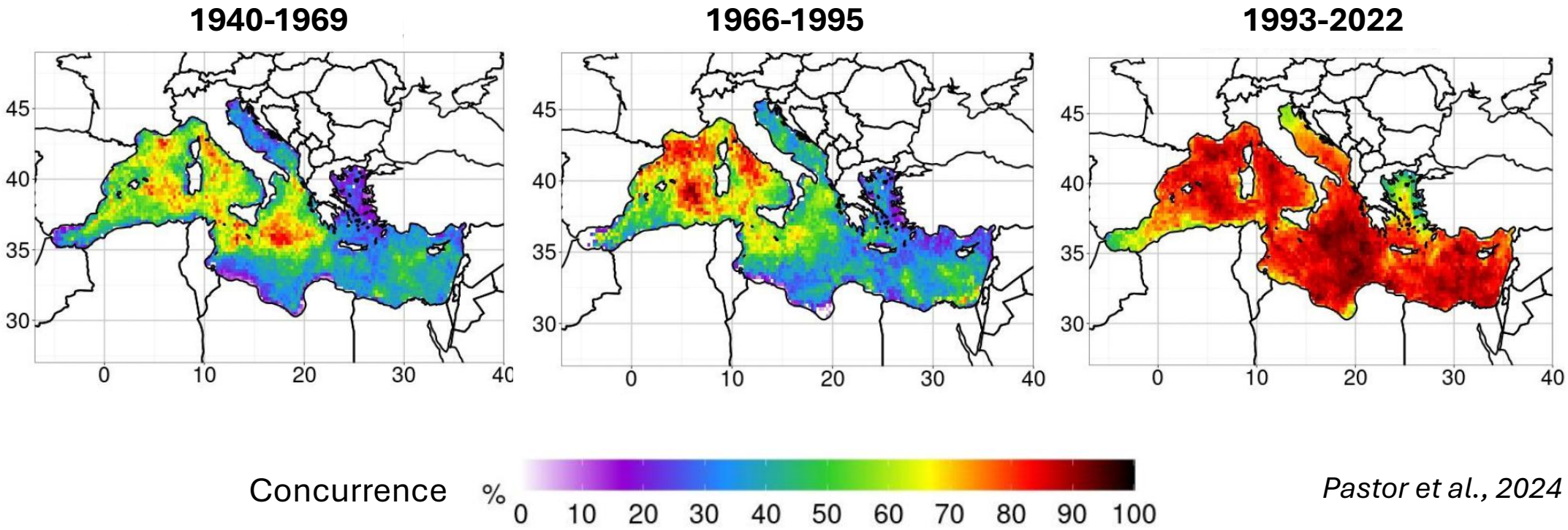
Pastor et al., 2020

Growing number of marine heatwaves



Annual number of marine heatwave days across all grid points in the Mediterranean.

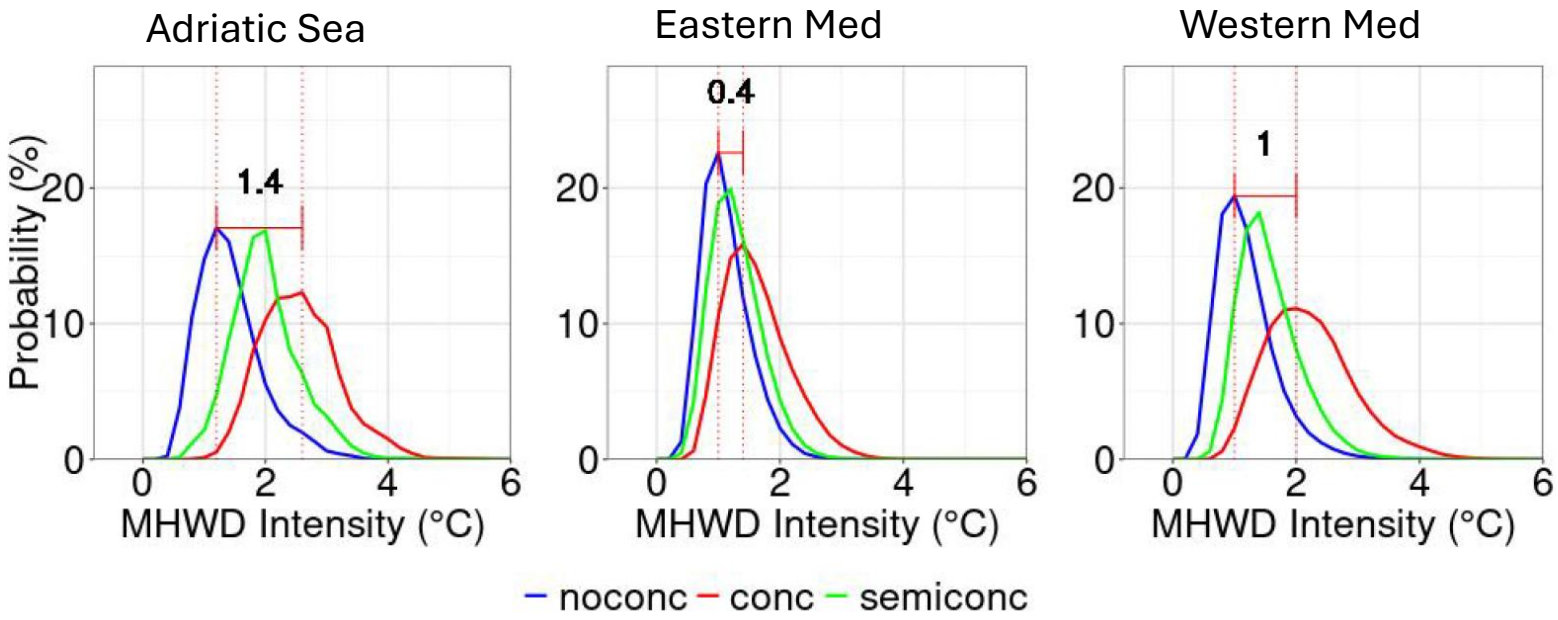
Pastor and Khodayar al., 2023



Pastor et al., 2024

Increasing concurrence with AHWs in the Mediterranean Sea

Introduction



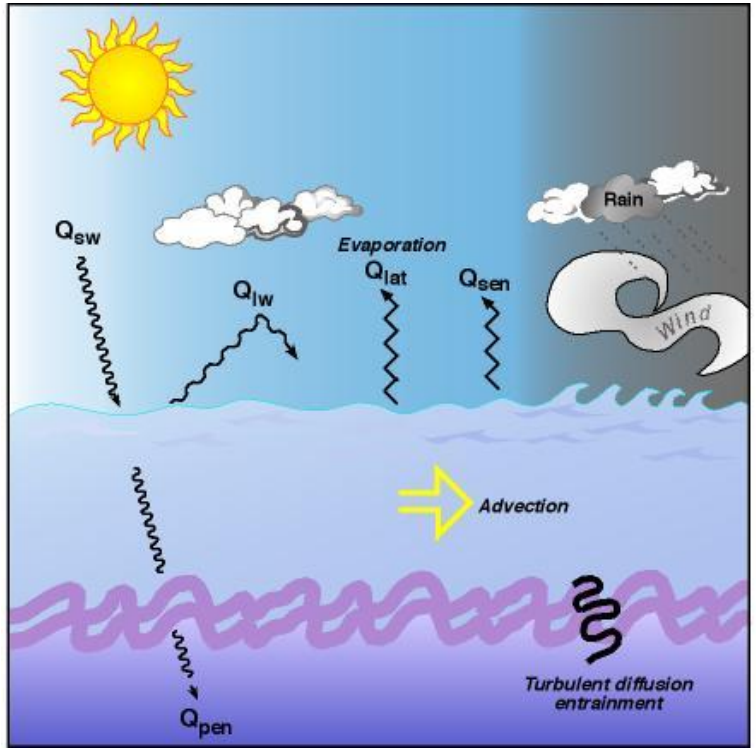
Probability distribution of the MHW intensity for concurrent (red), non-concurrent/blue), and semi-concurrent (red).

Pastor et al., 2024

Concurrent MHWs are more intense

Heat fluxes are an important factor that controls air-sea heat exchanges

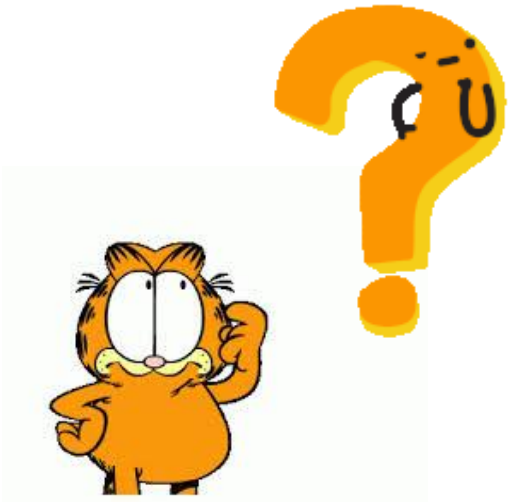
$$Qnet = LH + SH + LWR + SWR$$



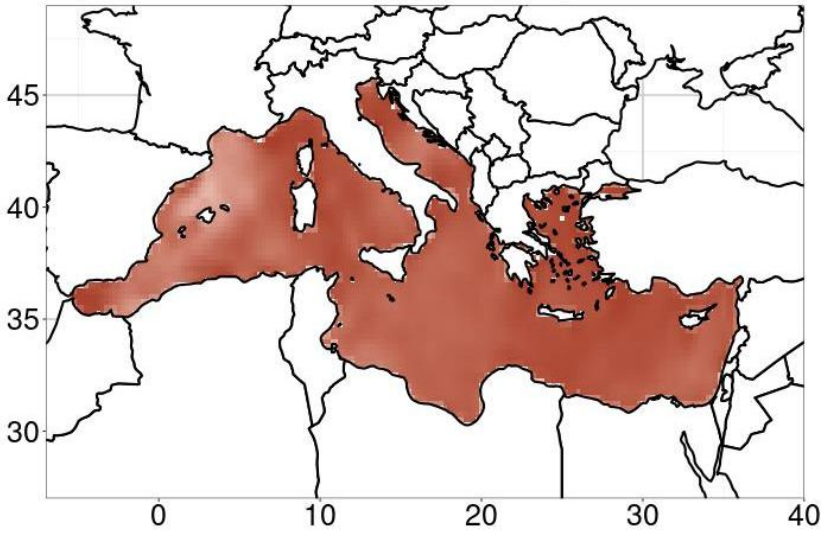
Objective

- Understand the impact of the AHW-MHW concurrence on the air-sea heat flux balance

- Is this impact related to MHW intensification during concurrence?



Mediterranean Sea



May-September 1940-2022

Reanalysis data ERA5

Regular grid 0.25ºx0.25º grid spacing
Hourly records

- T2m air temperature: AHW identification
- SST: MHW identification
- Heat fluxes: Qnet, LH, SH, LWRnet, SWRnet

Atmospheric heatwaves (AHW)

At least 3 consecutive days with

T2m > P95 climatology

(AEMET, Spanish MetService)

Marine heatwaves (MHW)

At least 5 consecutive days with

SST > P90 climatology

(Hobday et al., 2016)

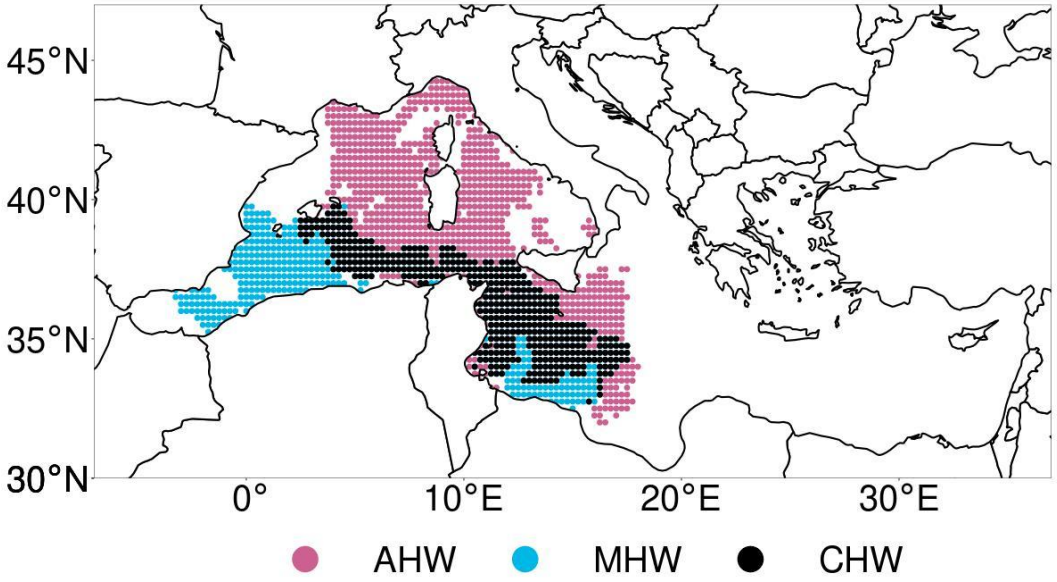
Concurrent heatwaves

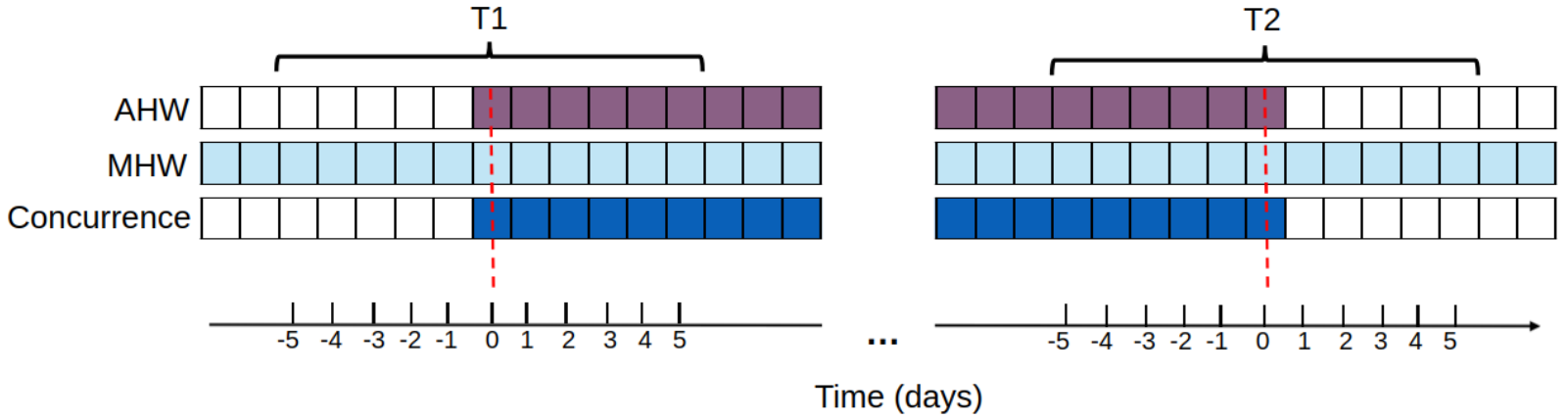
At least 3 days of co-occurring

events in the same gridpoint

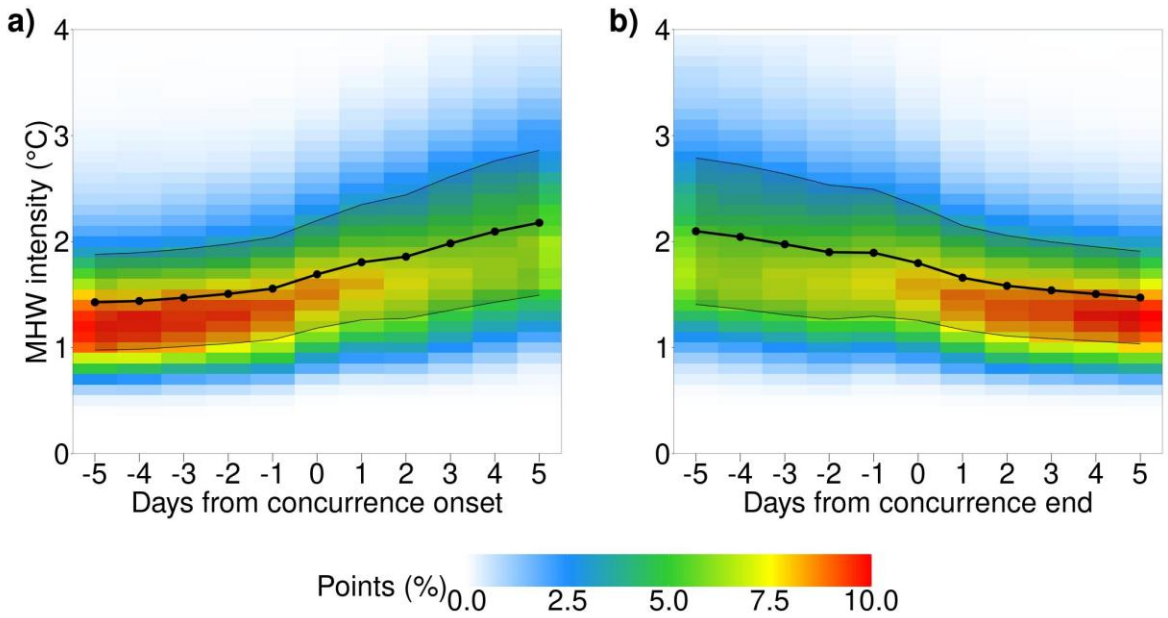
108 concurrent MHW

Methodology

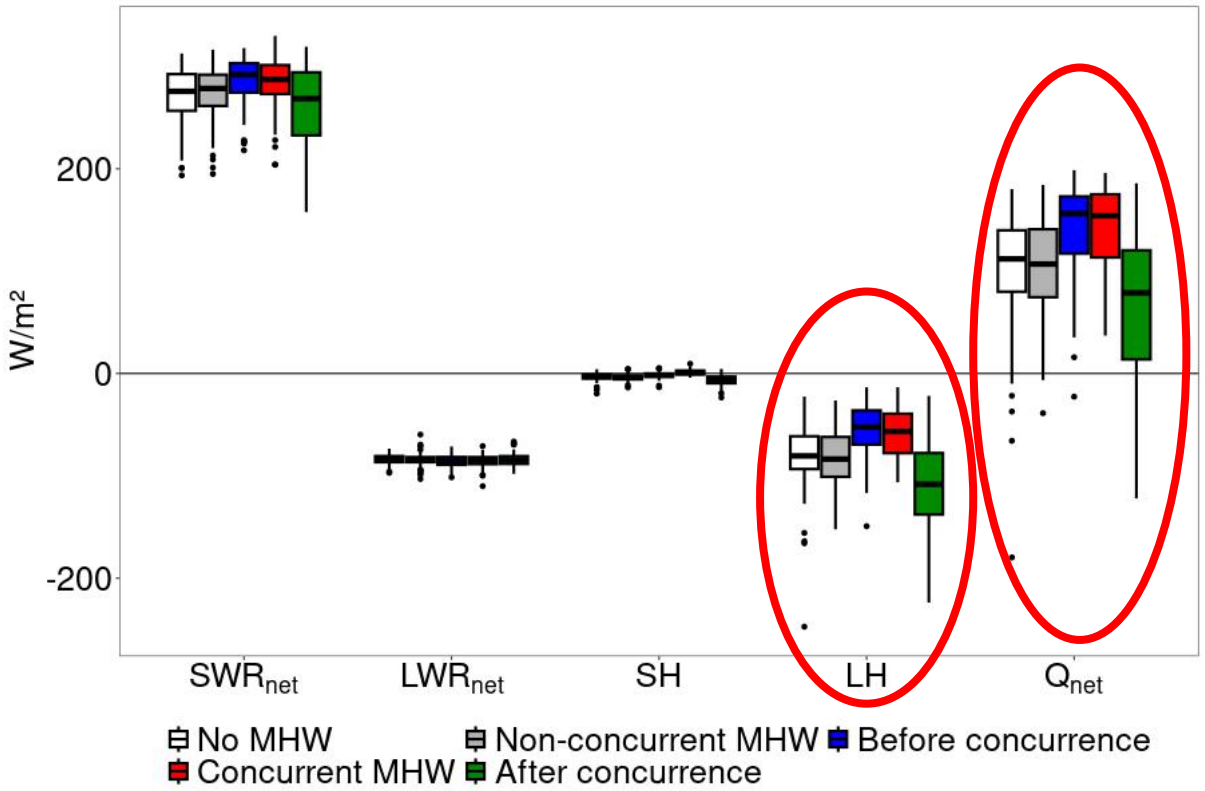




MHW 60% intensification is progressive



Results

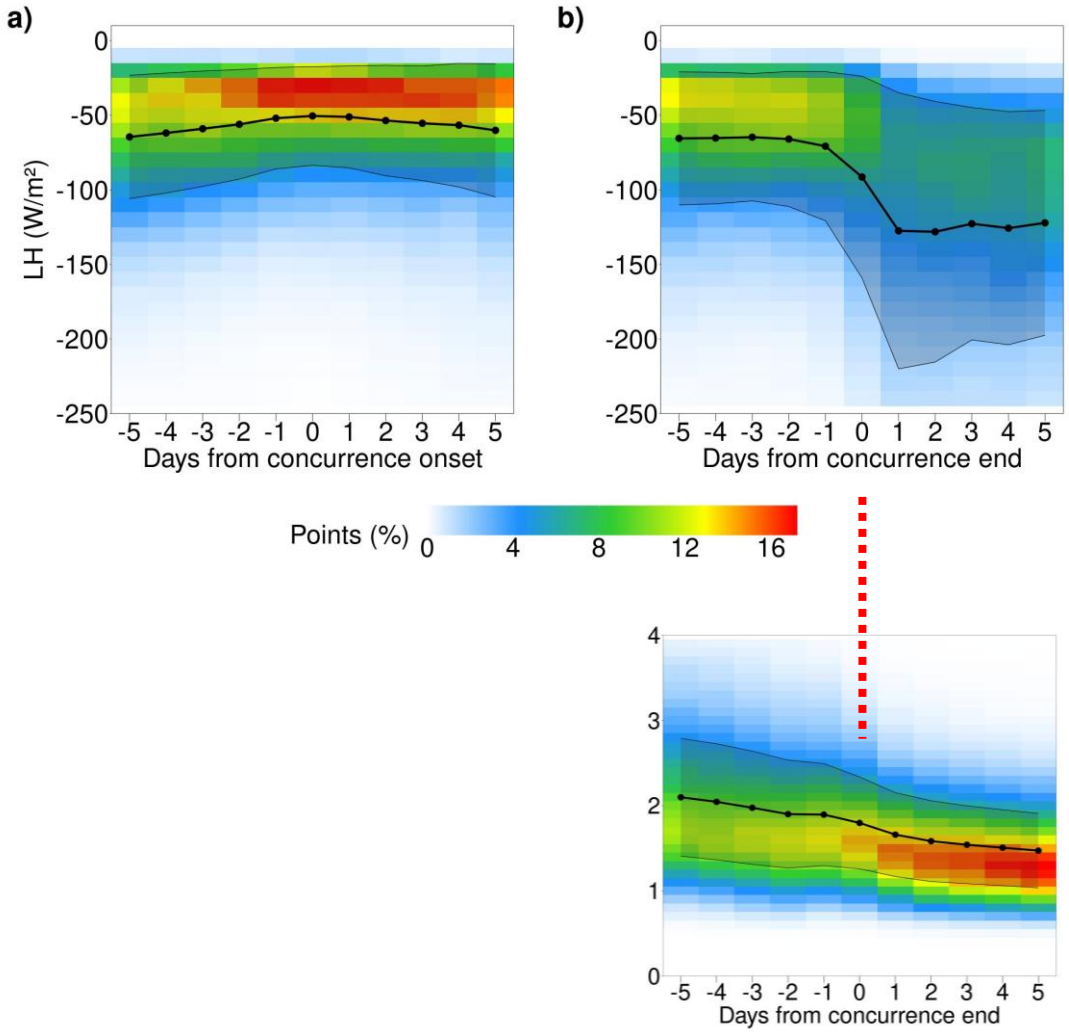


Changes in the total air-sea heat flux (Qnet)

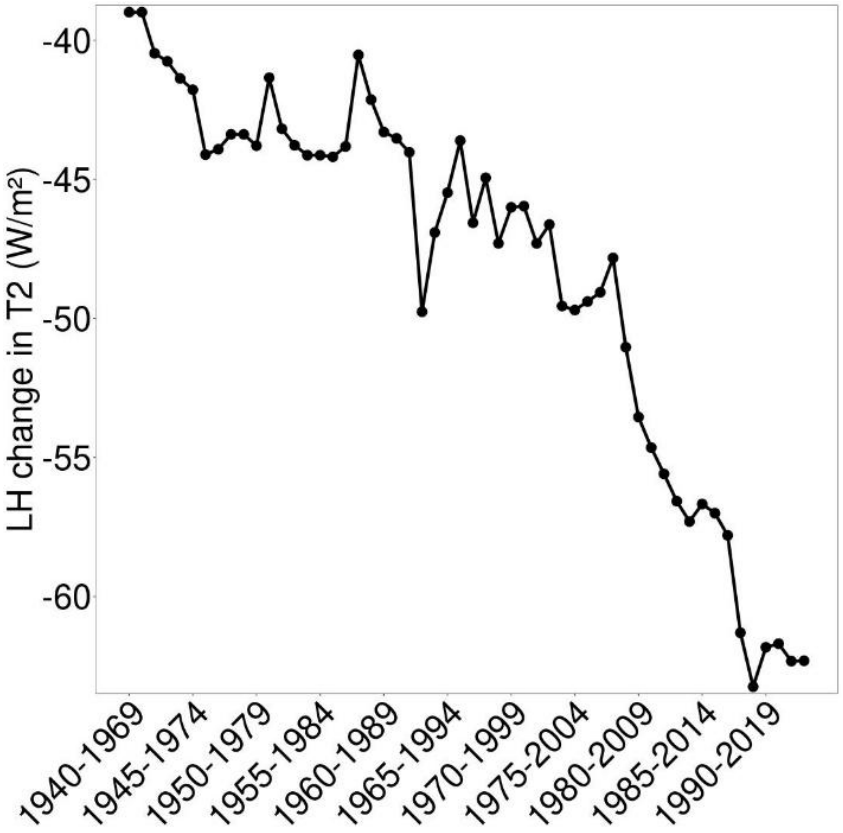
-32% (27W/m^2) LH release during concurrence

+93% (53W/m^2) LH release after concurrence

Increased LH release parallel to MHW intensification

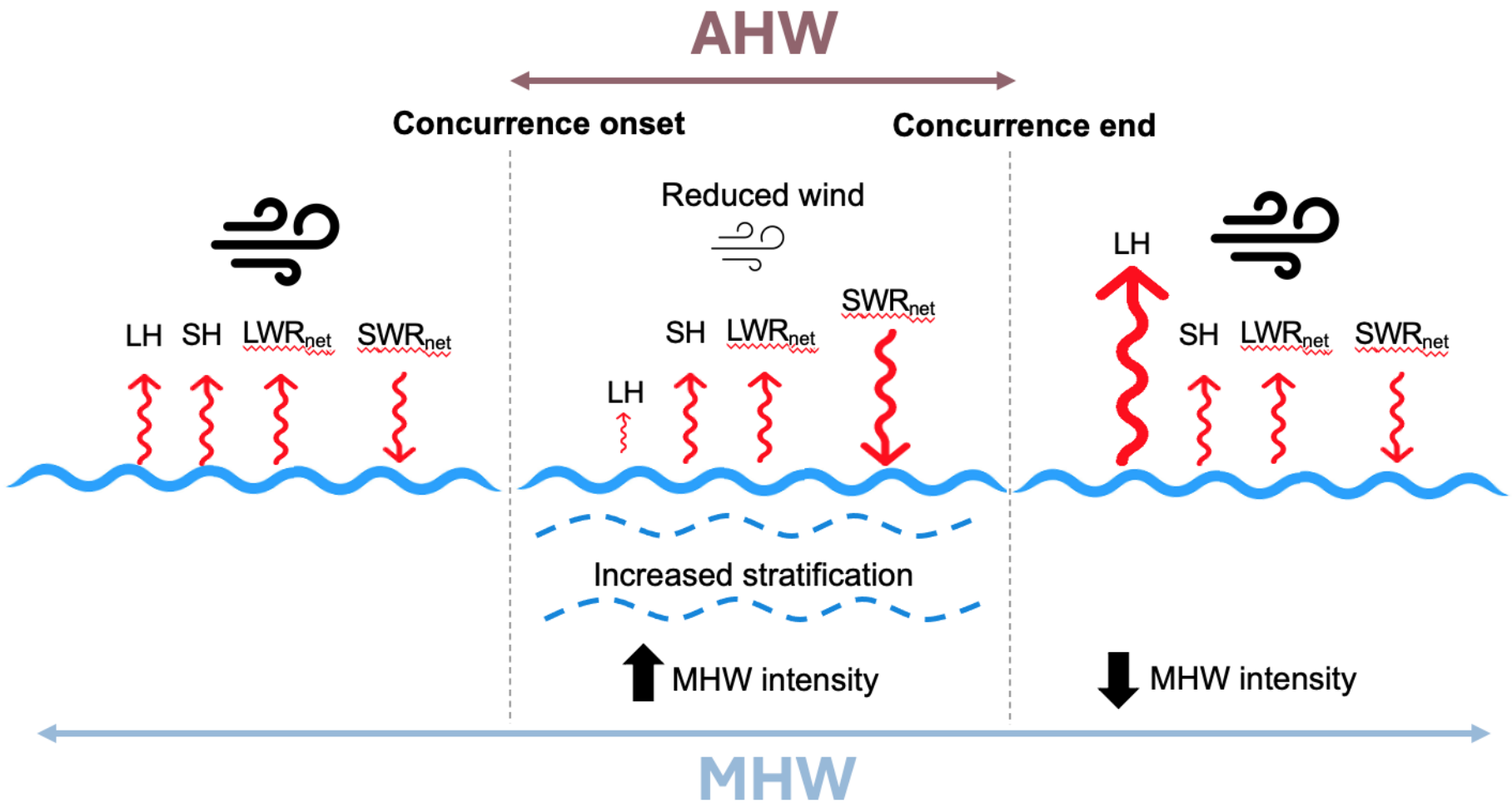


Results



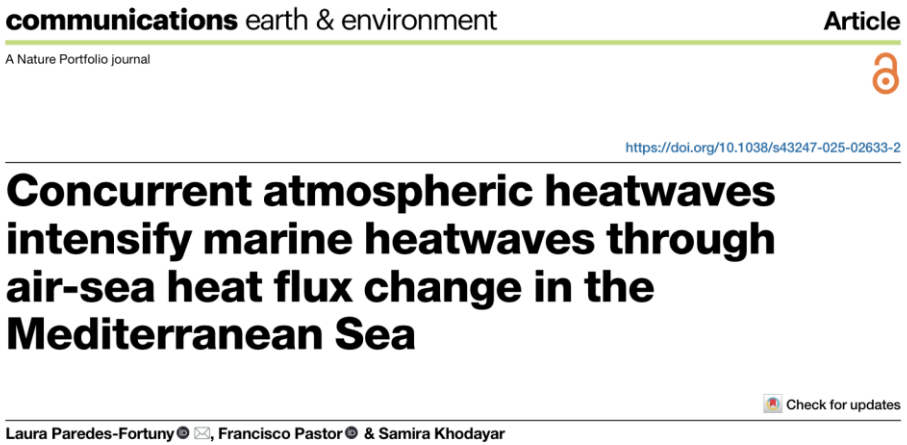
The LH increased emission after concurrence has increased from 1940 to 2019

Discussion


AHW
Concurrence onset
Concurrence end
Reduced wind
LH
SH
LWRnet
SWRnet
LH
SH
LWRnet
SWRnet
LH
SH
LWRnet
SWRnet
Increased stratification
MHW intensity
MHW intensity
MHW

Conclusions

- MHW intensification during concurrence is **progressive** during the first days of concurrence onset
- AHW-MHW concurrence **impacts air-sea heat fluxes**
- **Increased latent heat release** after concurrence



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