

Drought conditions in Europe: characterization and evolution from a local perspective

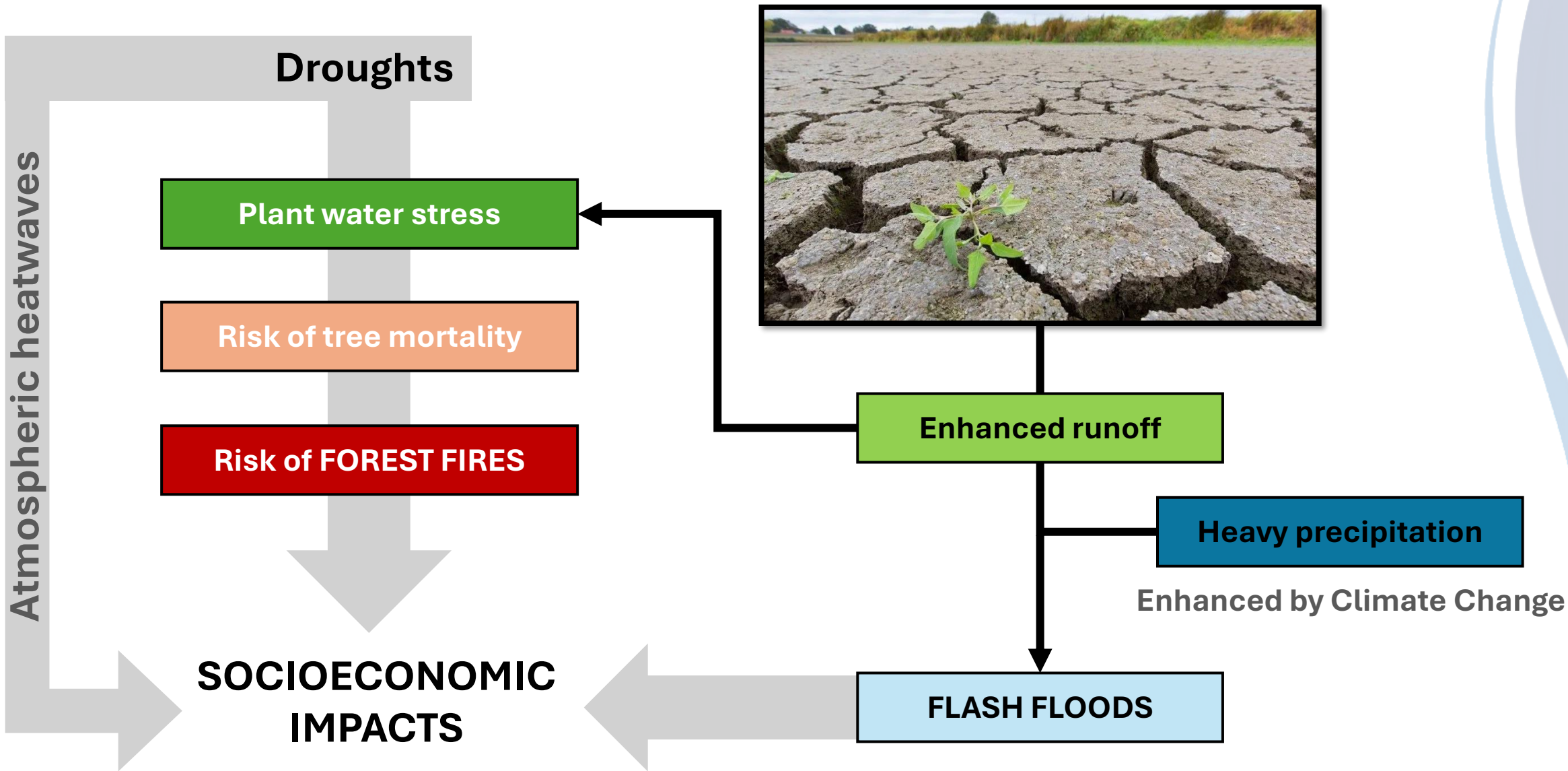
Pau Benetó
pau@ceam.es

Department of Meteorology and Climatology
Mediterranean Center for Environmental Studies (CEAM)



Overview

- *Motivation*
- *Methodology*
- *Results*
- *Summary and further work*



Drought metrics

P-AED	ET-AED	P-ET	SM
<ul style="list-style-type: none"> • Data availability and observations • Supply and demand approach with application to assess plant water stress • It records plant and hydrological stress associated to AED increase e.g. evaporation from reservoirs • Useful to determine both, hydrological and ecological droughts 	<ul style="list-style-type: none"> • It represents a balance between the real water use by plants and the demand • It determines plant water stress accurately 	<ul style="list-style-type: none"> • Reference approach to determine total water availability at the basin scale • Useful to determine both, hydrological and ecological droughts 	<ul style="list-style-type: none"> • Main factor affecting water availability by plants and vegetation stress
<ul style="list-style-type: none"> • It does not provide a water budget approach • it is not a metric of water availability in the soil, particularly in dry regions • AED has always a negative role on water stress 	<ul style="list-style-type: none"> • Data availability and uncertainties in ET • Unuseful to asses hydrological droughts • Temporal homogeneity affected by land cover changes, forest fires, etc 	<ul style="list-style-type: none"> • Data availability and uncertainties in ET • Poor metric of plant water stress, particularly in water limited regions in which it tends to zero • Temporal homogeneity affected by land cover changes, forest fires, etc 	<ul style="list-style-type: none"> • Data availability and uncertainties in ET and soil hydrology • Limitations in water limited regions in which it does not record additional plant stress associated to warming (higher AED)

Vicente-Serrano et al. (2022)

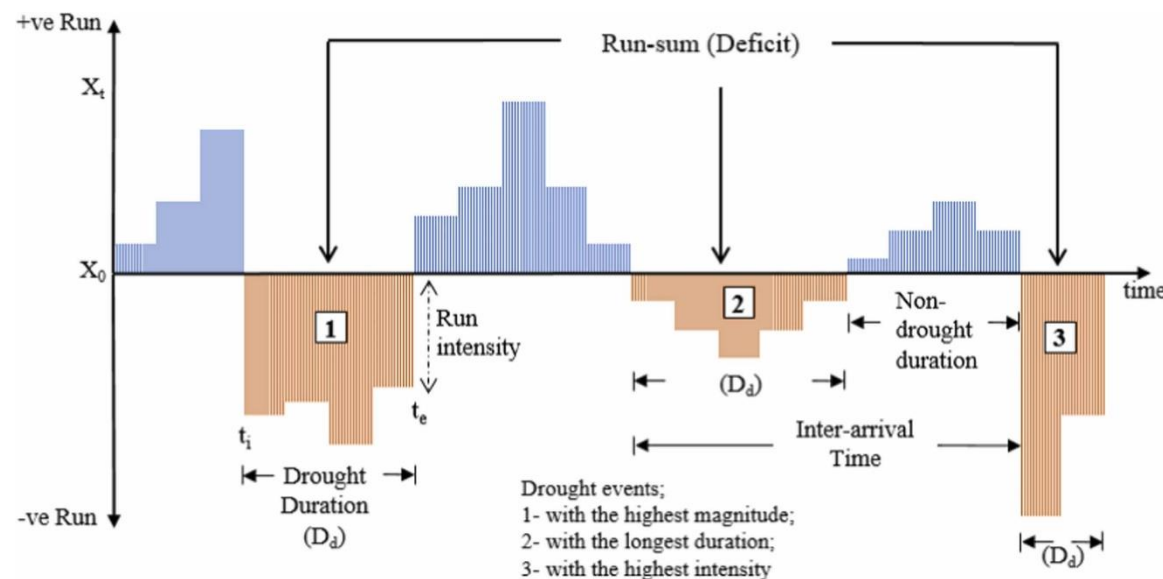
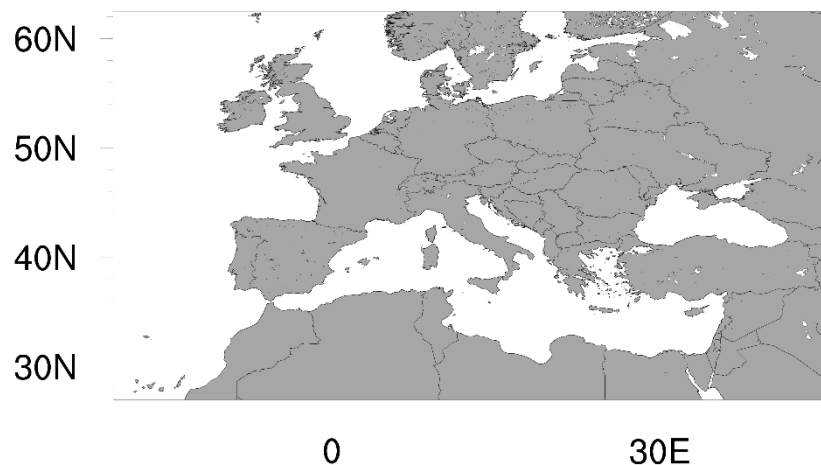


- **SPI and SPEI** mostly used to study meteorological droughts.
- SPEI and SEDI: correlated in regions at some time scale.



Data and analysis:

- Reference Evapotranspiration (ET₀) *METREF*
- Evapotranspiration (ETR) *MDMETv3*
- *Daily resolution*
- *Horizontal resolution of 0.05° with global coverage*
- *Period: 2004-2024**



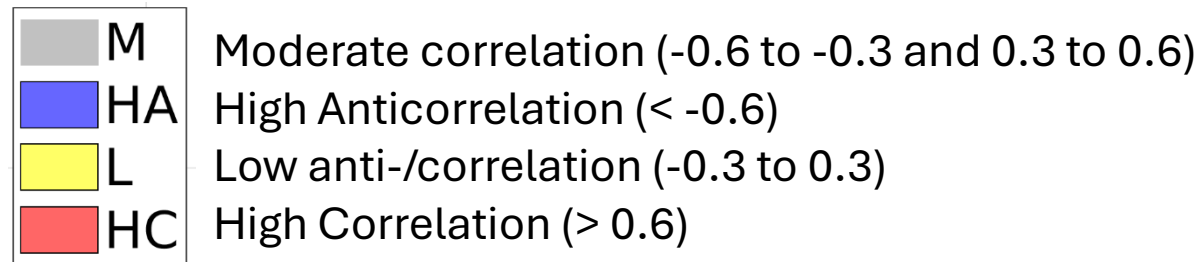
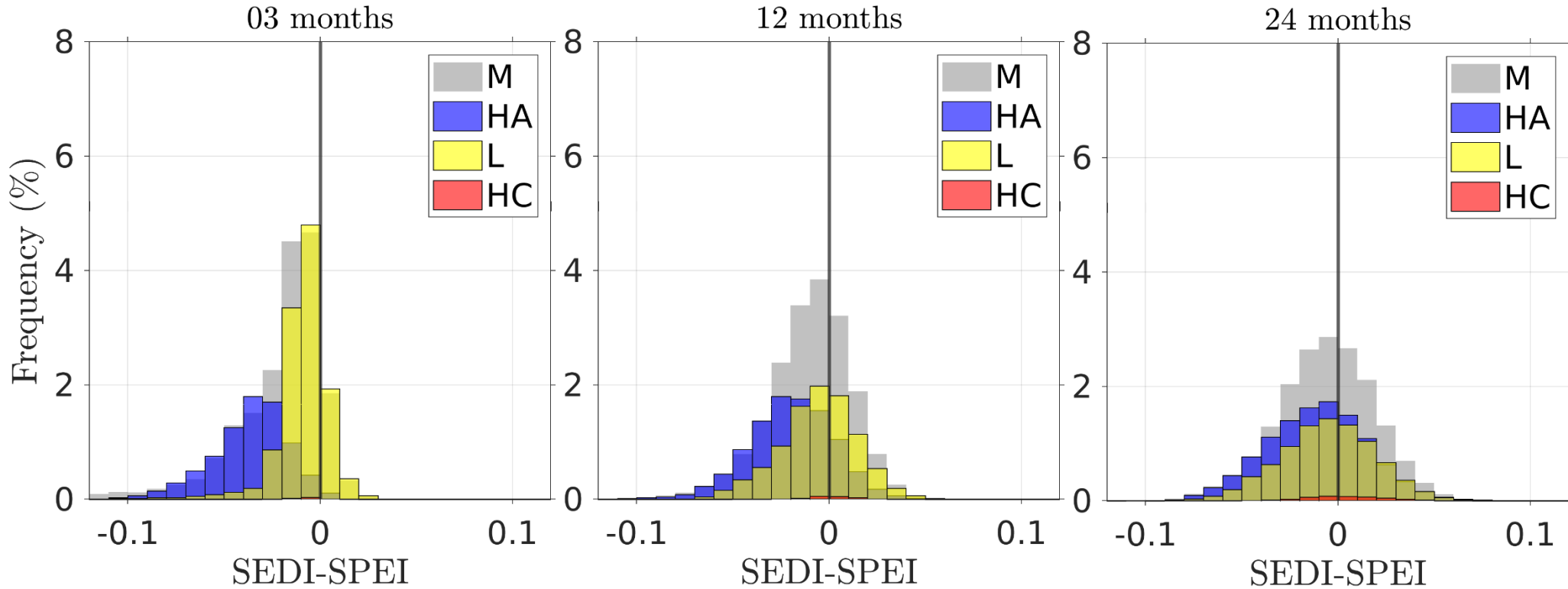
Yildirim et al. (2022)

SEDI	Description	ID
3	Extreme Wet	EW
2	Severe Wet	SW
1	Moderate Wet	MW
0	Normal	N
-1	Moderate Drought	MD
-2	Severe Drought	SD
-3	Extreme Drought	ED



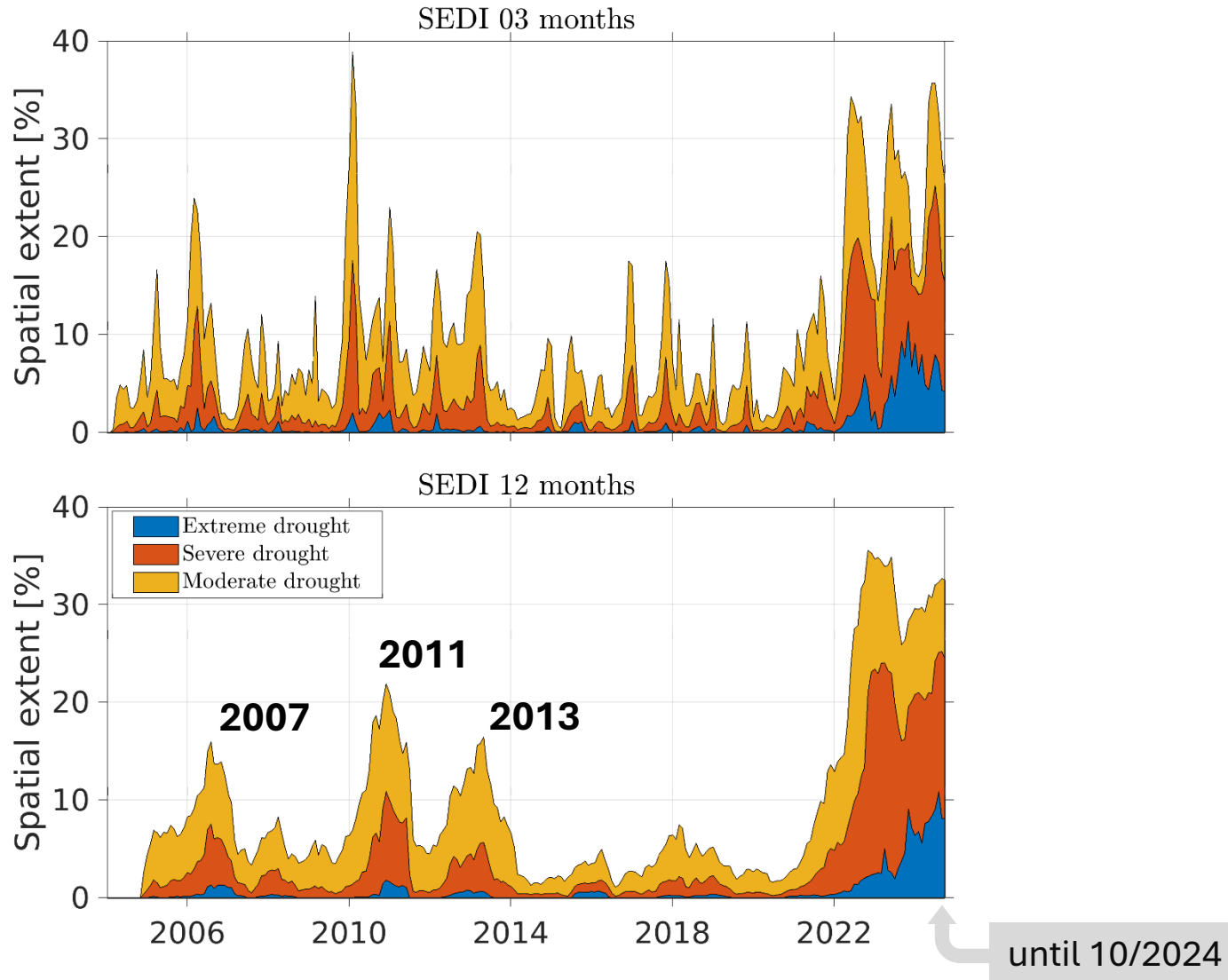


Correlation: SPEI and SEDI



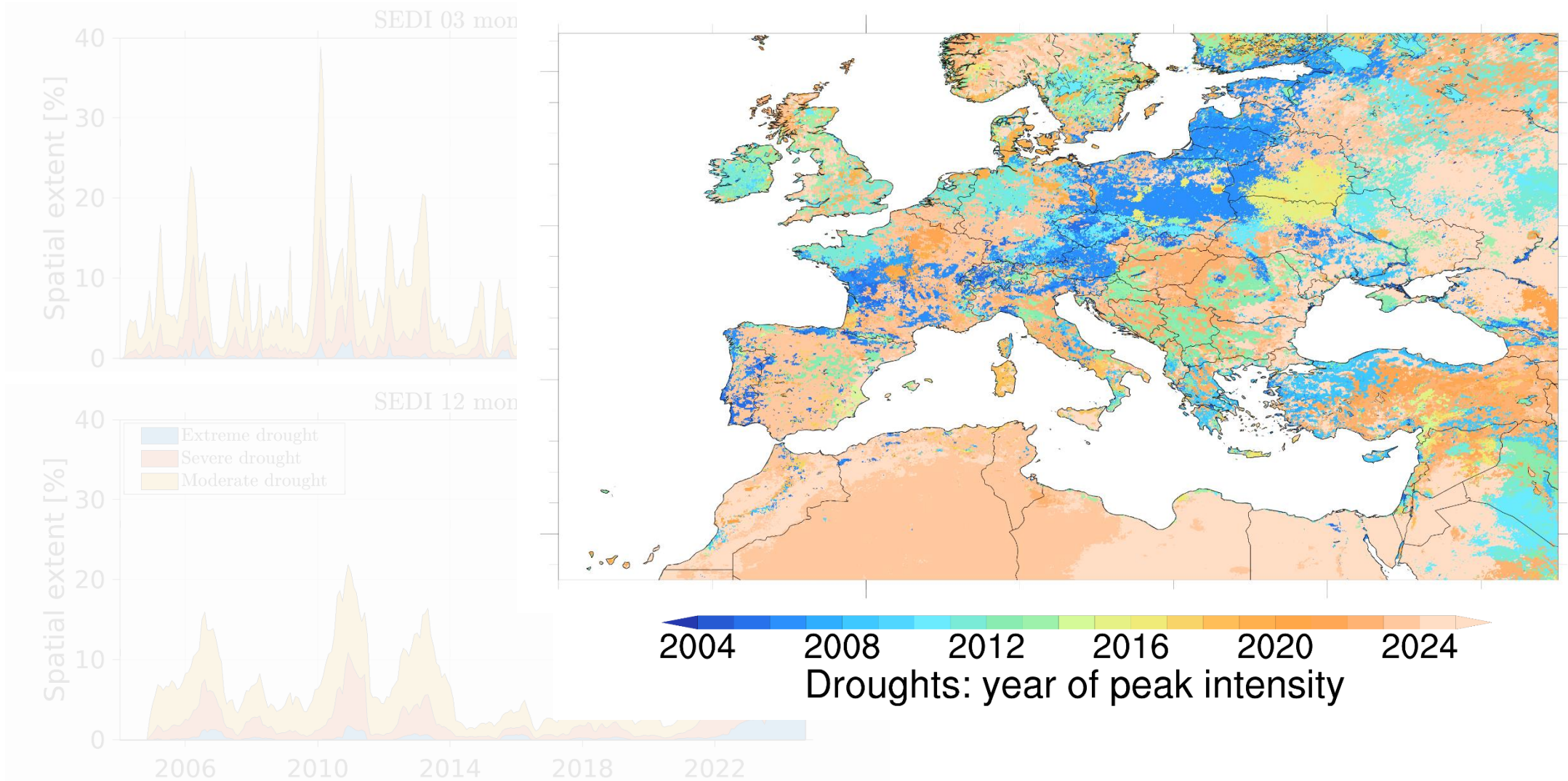
*Analysis conducted with CERRA product for period 2004-2020

Drought conditions

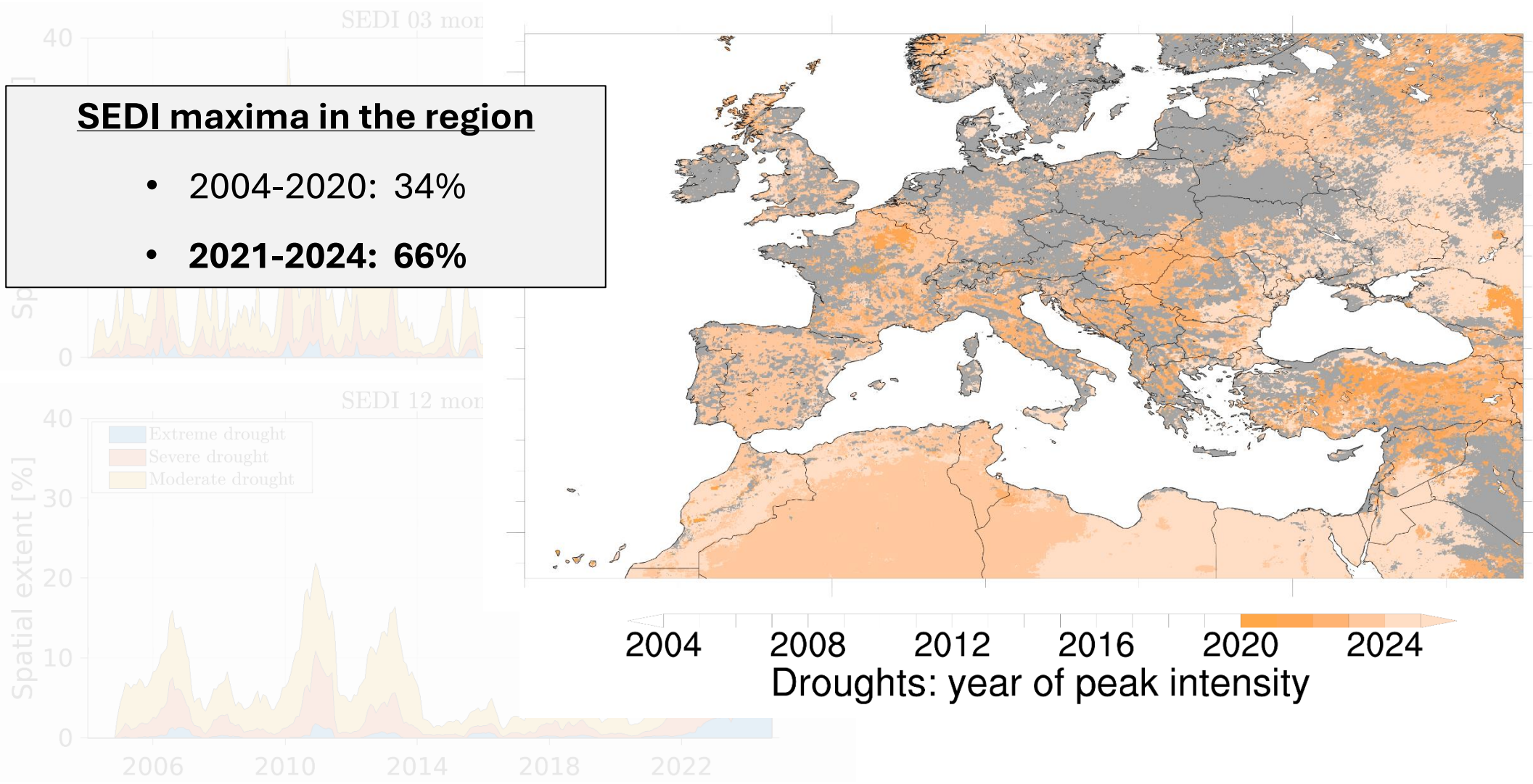




Drought conditions

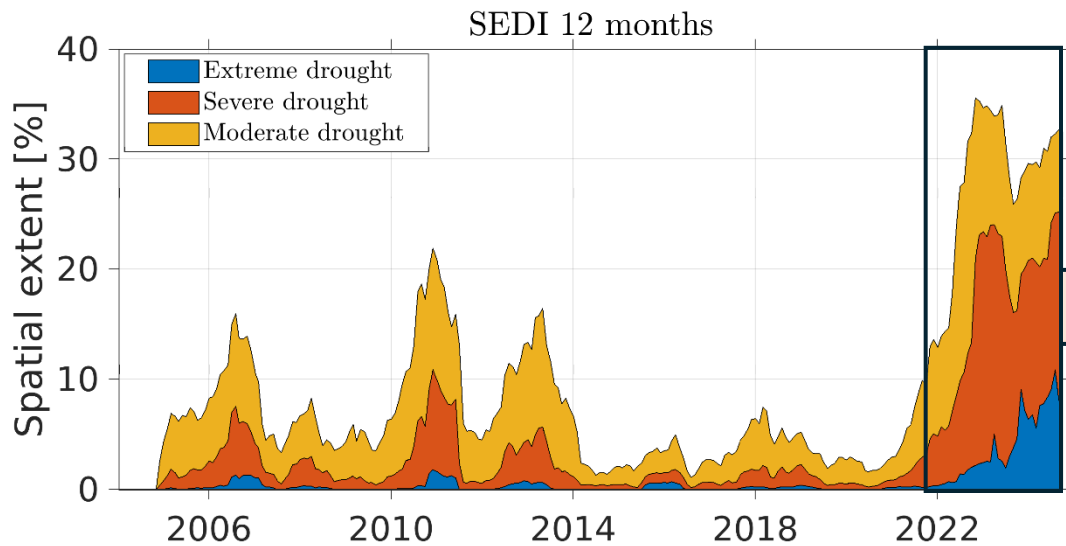
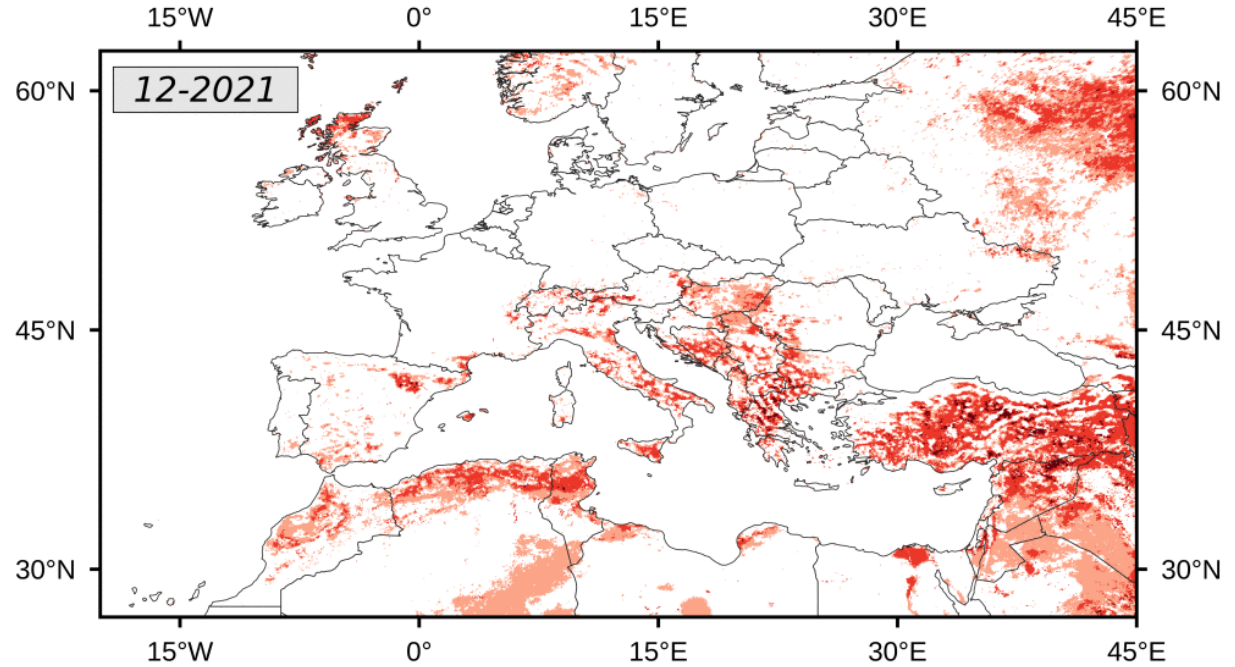


Drought conditions



European *MegaDrought* 2022 – 2023

- Very high peak intensities (SEDI < -6)
- Large spatial extend, up to 60% of the domain
- Long duration



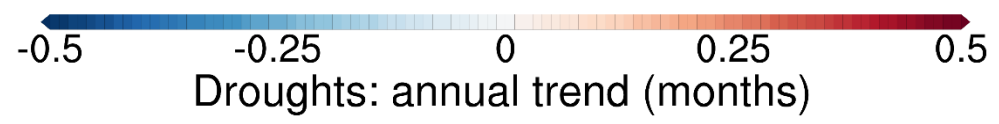
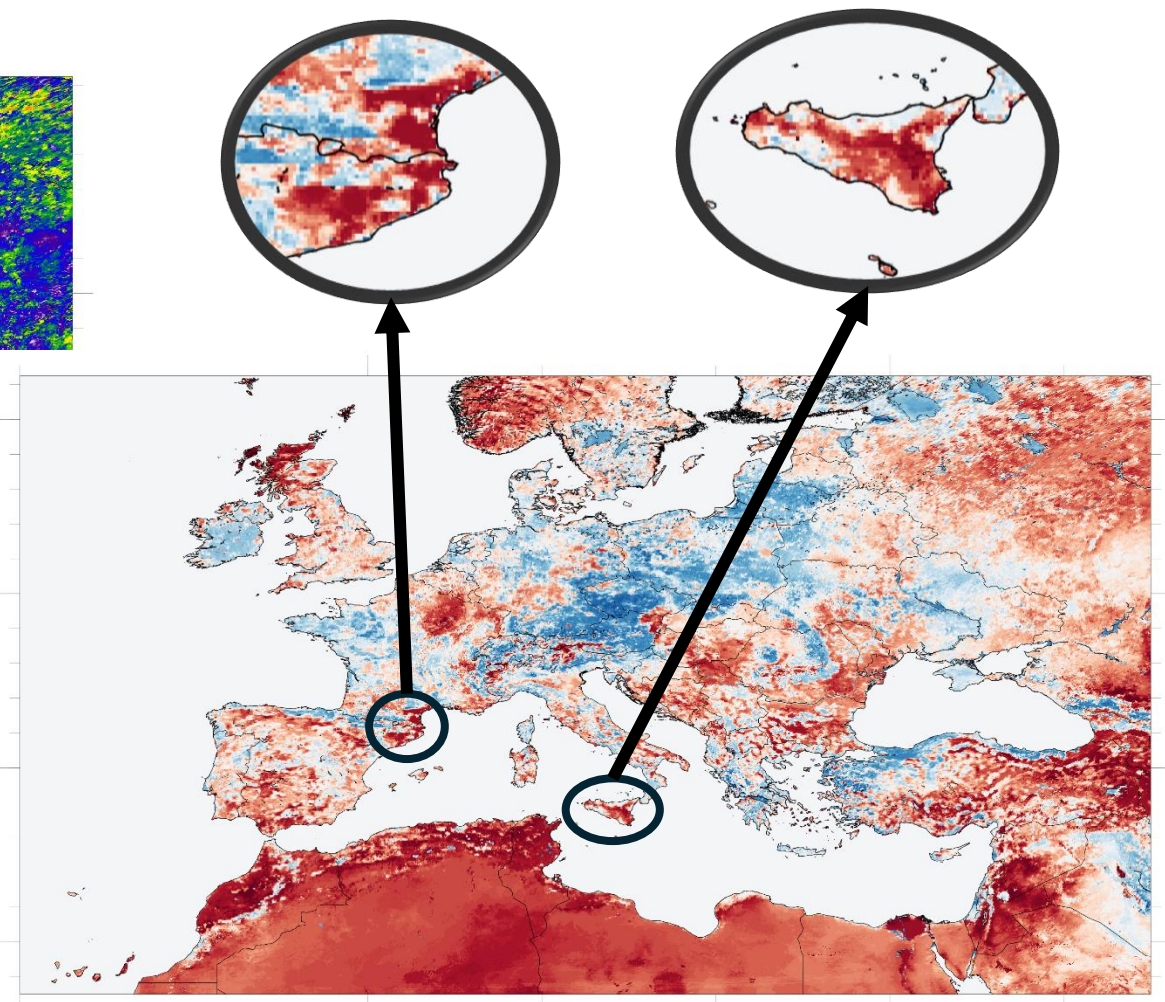
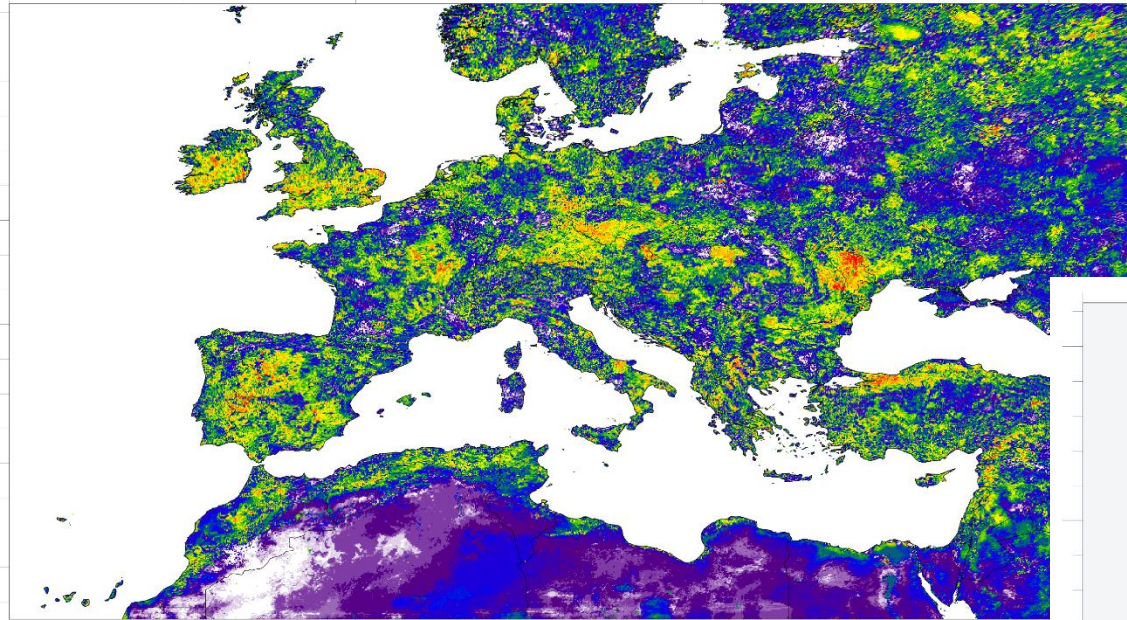
Drought categories

- Extreme Drought (ED)
- Severe Drought (SD)
- Moderate Drought (MD)

Areas under drought conditions in 2024

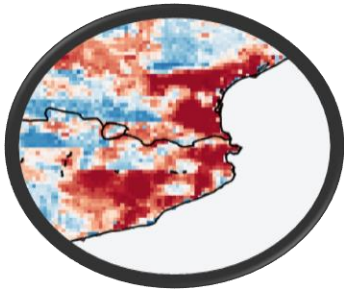


Drought hotspots





Drought hotspots



↑ Spatial extent

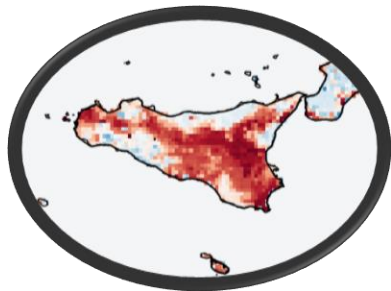
+0.5%

↑ Intensity

+0.3%

↑ Frequency

+0.7%



↑ Spatial extent

+0.1%

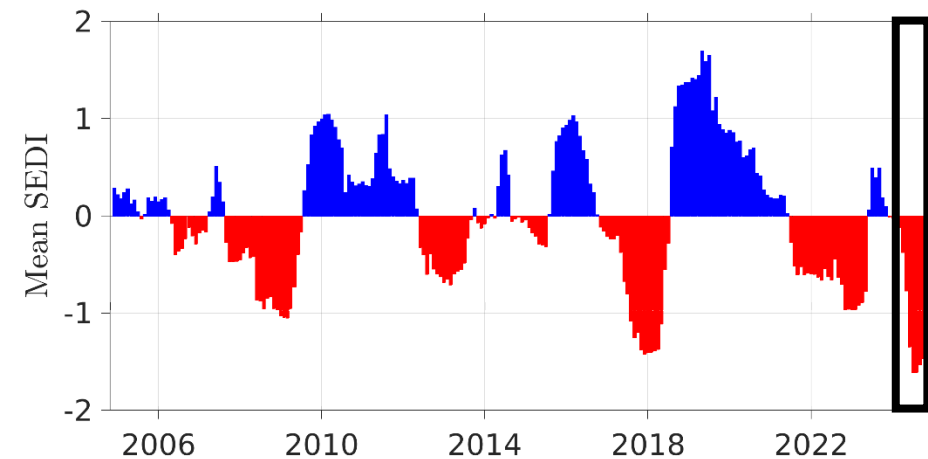
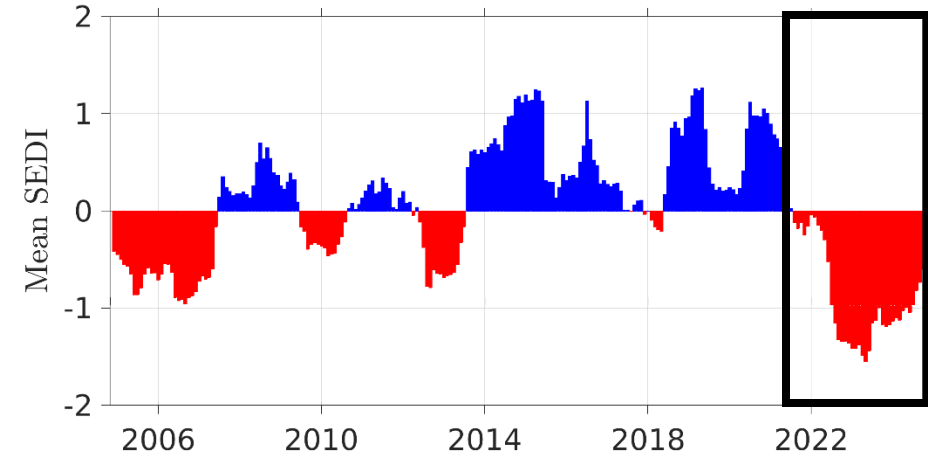
↑ Intensity

+0.8%

↑ Frequency

+0.7%

Importance of drought monitoring



Summary

- SEDI calculated using LSASAF high-resolution products MDMETv3 and METREF over Europe and North Africa.
- Most intense droughts condition detected in past 3 years: occurrence of the *European Megadrought*
- Importance of high-resolution products for detailed analysis of drought conditions and detection of *hotspots*
- Evolution of drought conditions in two Mediterranean locations highly sensitive to climate change
- Importance of drought monitoring to accurately assess risks



Future work

- Analyze relationships between **drought conditions** and other atmospheric variables: air temperature, heavy precipitation, SST, ...
- Case study: analysis of the floods occurred October 29th in the Valencia Region



Thank you for listening!

pau@ceam.es