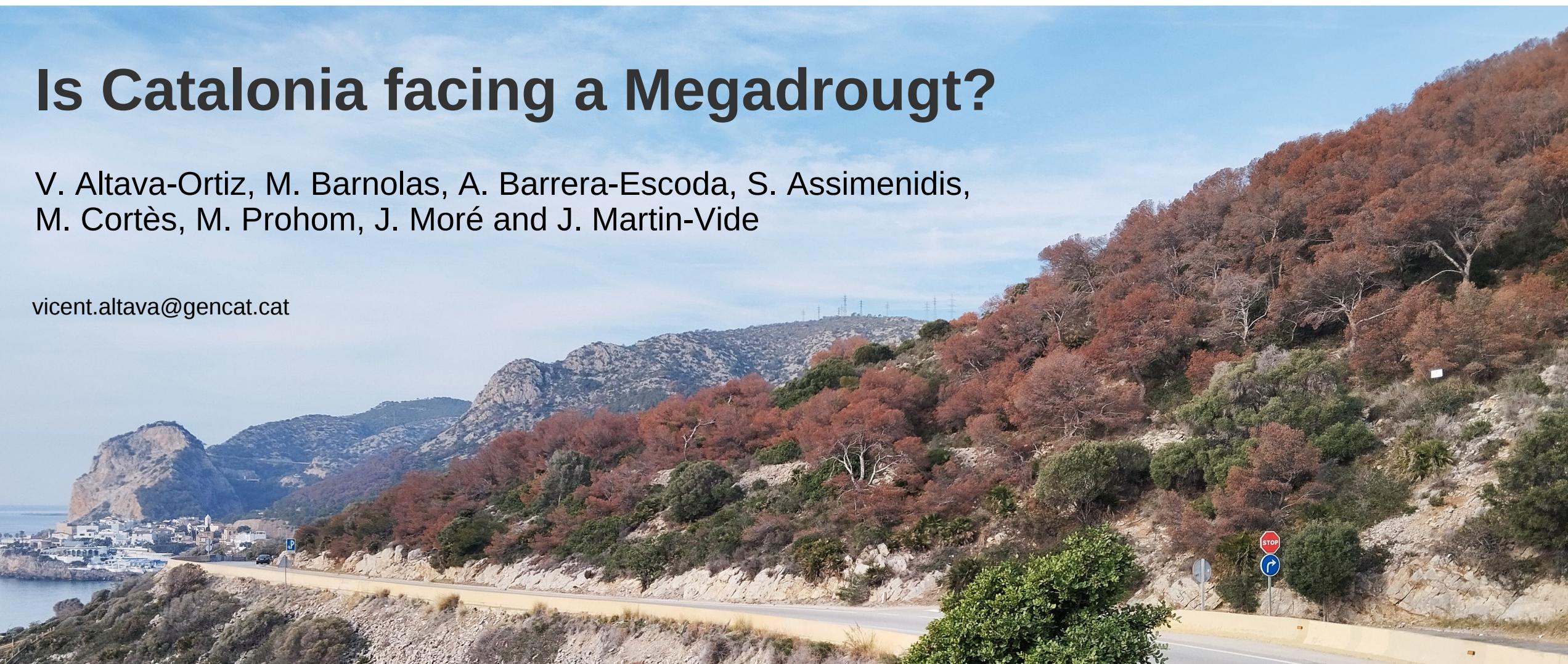


Is Catalonia facing a Megadrought?

V. Altava-Ortiz, M. Barnolas, A. Barrera-Escoda, S. Assimenidis,
M. Cortès, M. Prohom, J. Moré and J. Martin-Vide

vicent.altava@gencat.cat



25
YEARS

EMS Annual Meeting, 02-06 Sep 2024, Barcelona



Servei
Meteorològic
de Catalunya



Generalitat
de Catalunya

Drought 2021-2024?

An event of extraordinary persistence and intensity

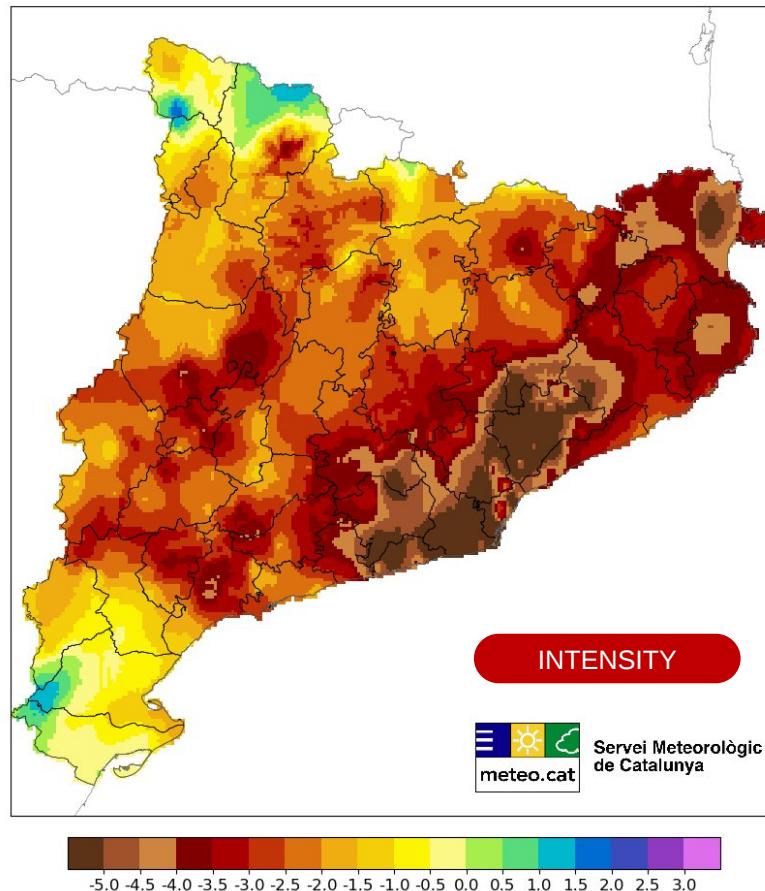
SPI

2021-2024
episode is the
**strongest on
record** in
Catalonia (1915)
SPI-36 < -5.0 !!!!!

UNITS: STD. DEVIATION

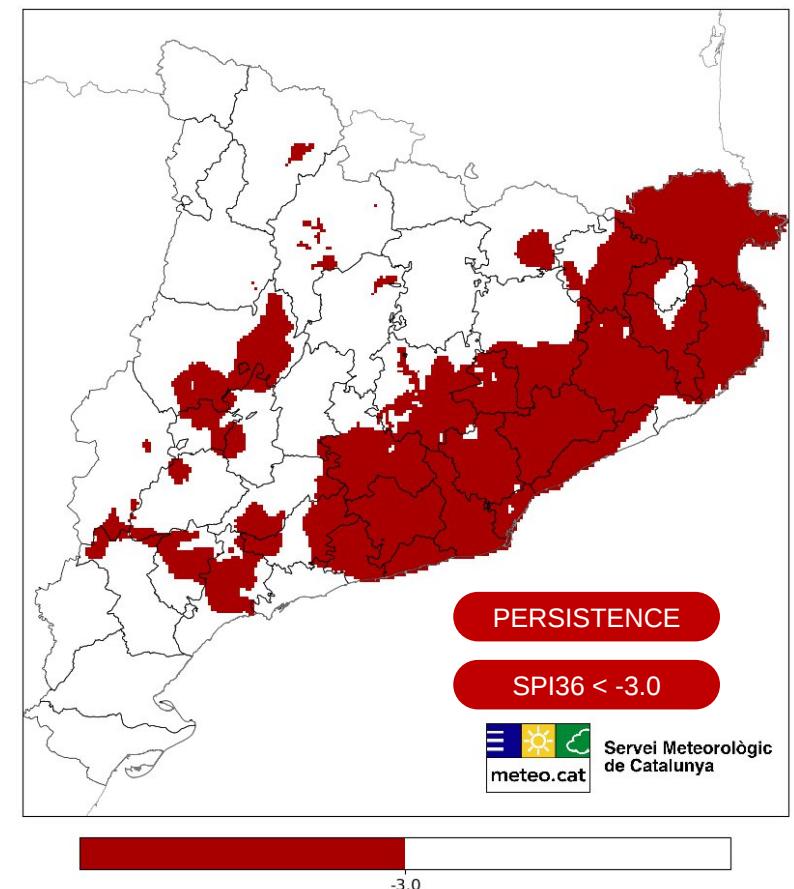
INDEX DE PRECIPITACIÓ ESTANDARD IPE36

31/12/2023

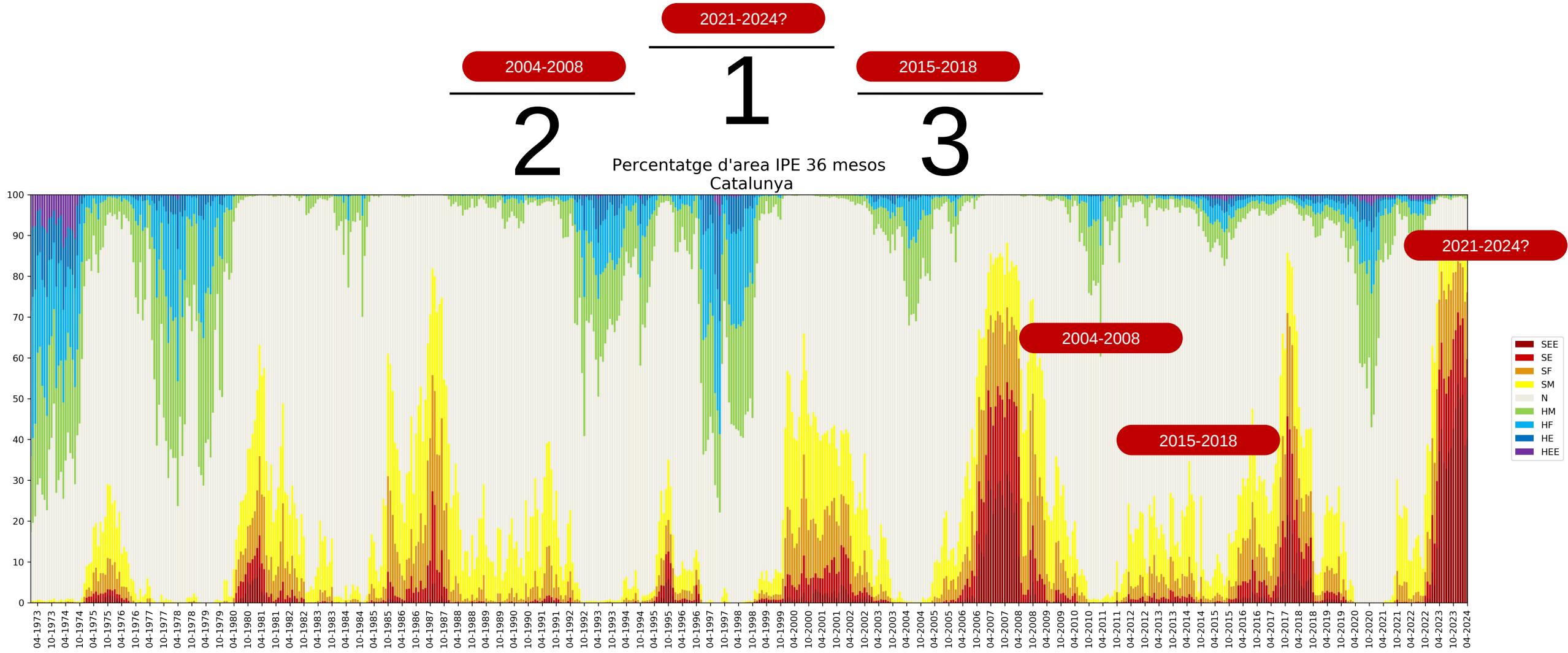


INDEX DE PRECIPITACIÓ ESTANDARD IPE36

31/12/2023

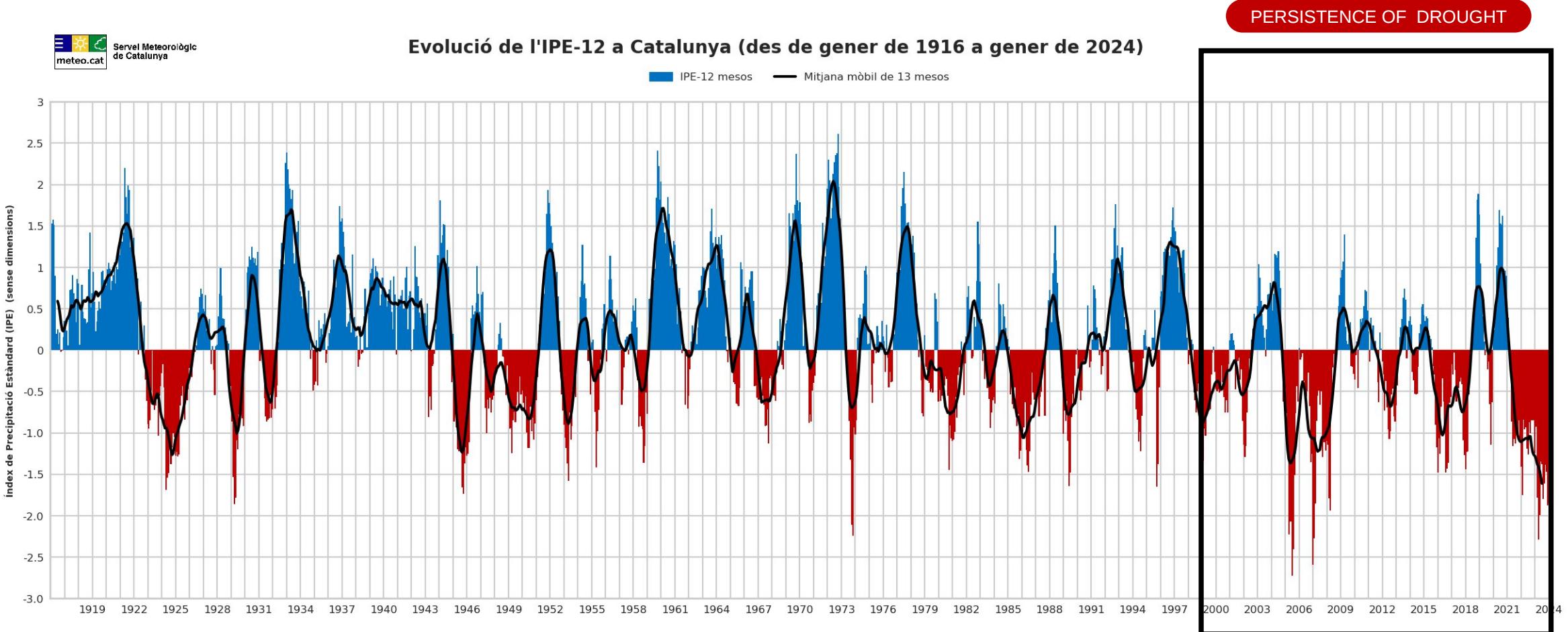


Drought/pluvial episodes in the last 60 years



Drought (SPI12) temporal evolution in Catalonia 1915-2024

Persistence of drought conditions since the end of the XXth c.



1

What is a MEGADROUGHT?

Megadrought characteristics

Cook et al, 2022. *Nature*

LENGTH

UNUSUAL

Rainfall deficits can last for decades

NEW SCENARIO

CLIMATE CHANGE

Human induced CC can lead to new Megadroughts
Irreversibility

INTENSITY

BREAKING RECORDS

Unprecedent low precipitation accumulations

Regional pattern

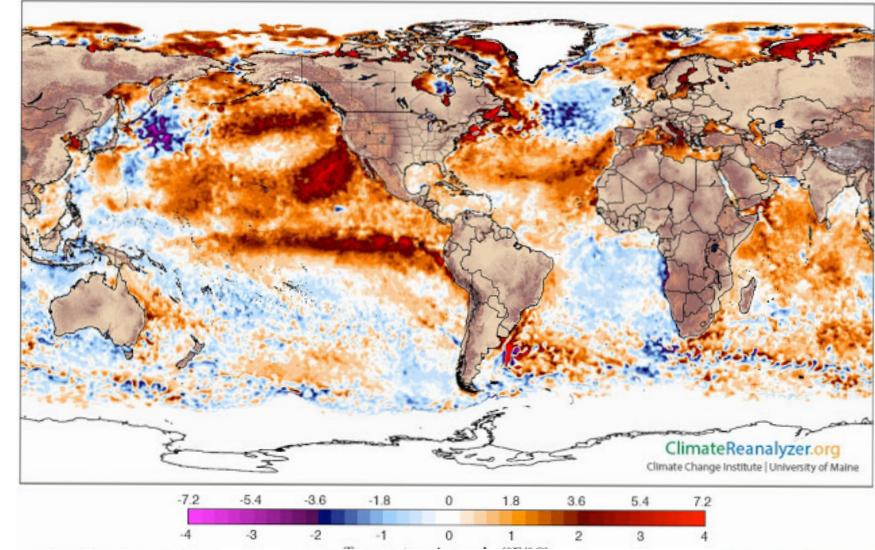
FORCED

OCEAN/ATMOSPHERE

Anomalous SST are associated with the drought lifetime

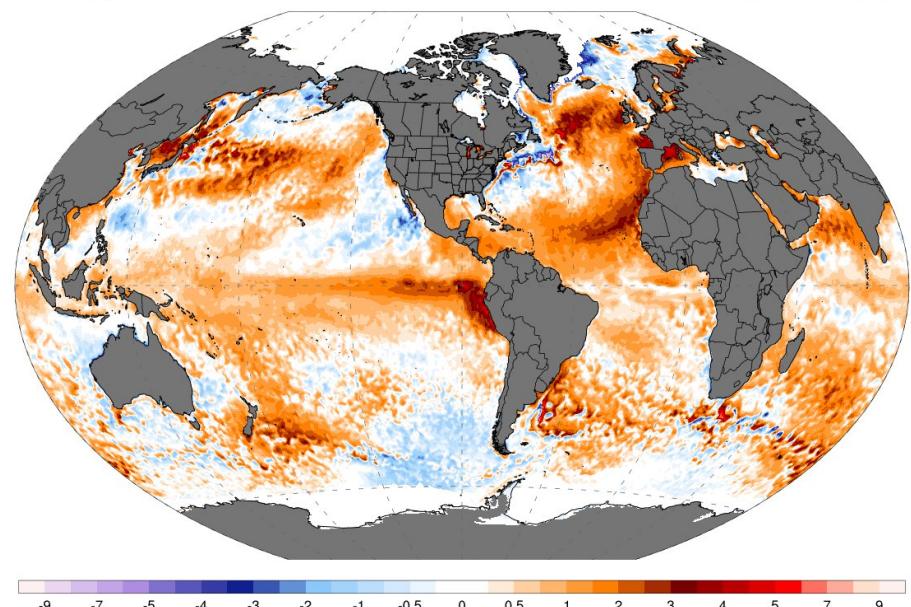
Atmospheric patterns

SST Departure from Average
NOAA OISST V2



Monday, Aug 31, 2015
Daily Average

ClimateReanalyzer.org
Climate Change Institute | University of Maine

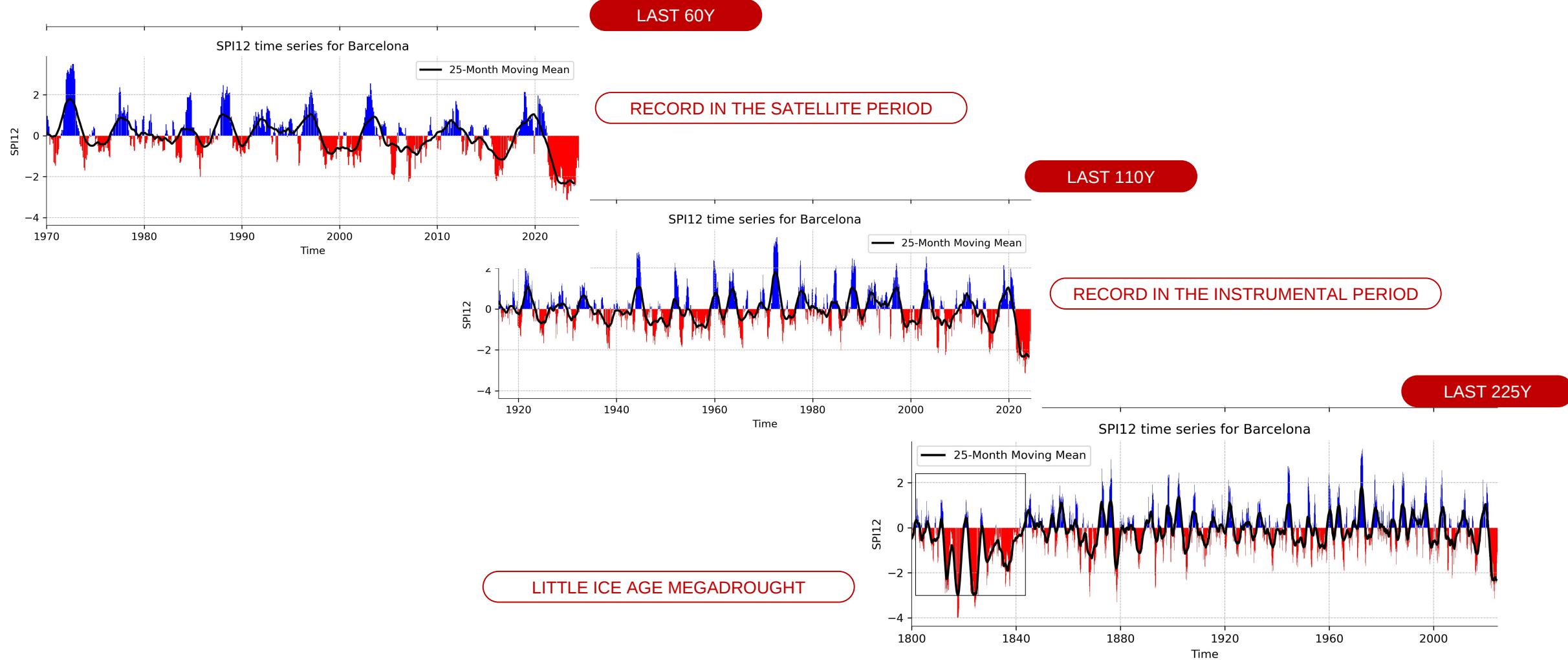


2

TEMPORAL AND SPATIAL PERSPECTIVE

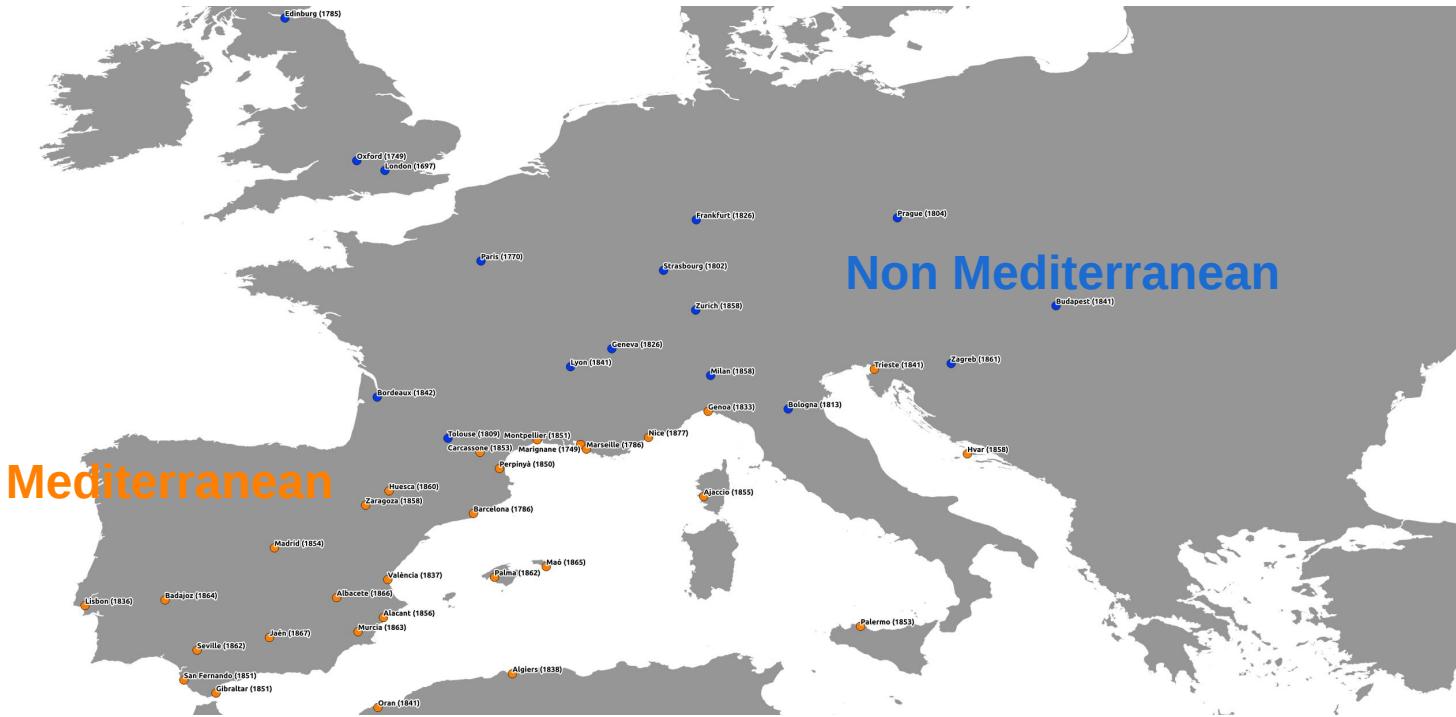
Temporal perspective

Barcelona has one of the longest precipitation time series in Europe

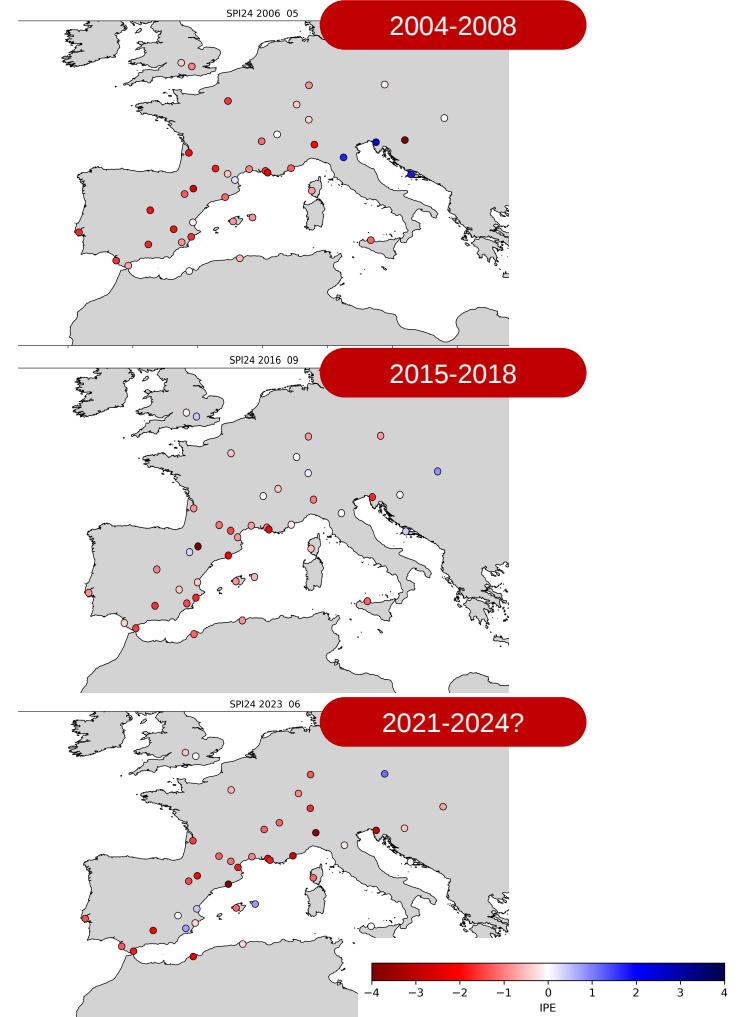


Spatial perspective

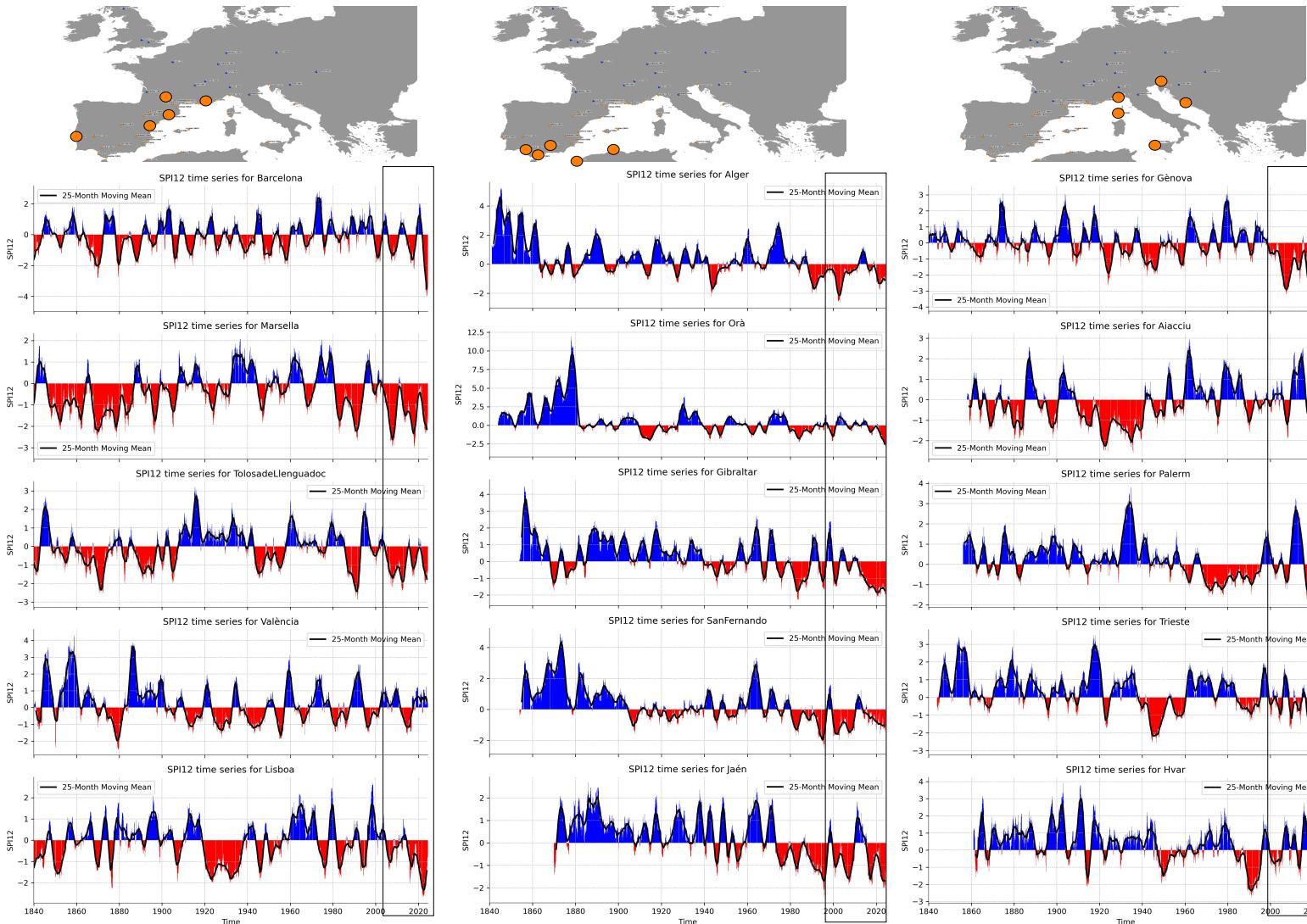
The last 3 Catalan droughts are a local representation of a Med. drought pattern



Mediterranean



Drought/pluvial episodes in Western Mediterranean



Persistence of drought conditions since the end of the 20 century



High variability

However, there is persistence of drought conditions since the 21th c. across the western Med. basin

DRYING

Western Mediterranean Droughts

1800-1840

LIA DRY PERIOD

1850s

MOST STATIONS START AT 1850s

1850-1980

Dry/Wet periods
alternate

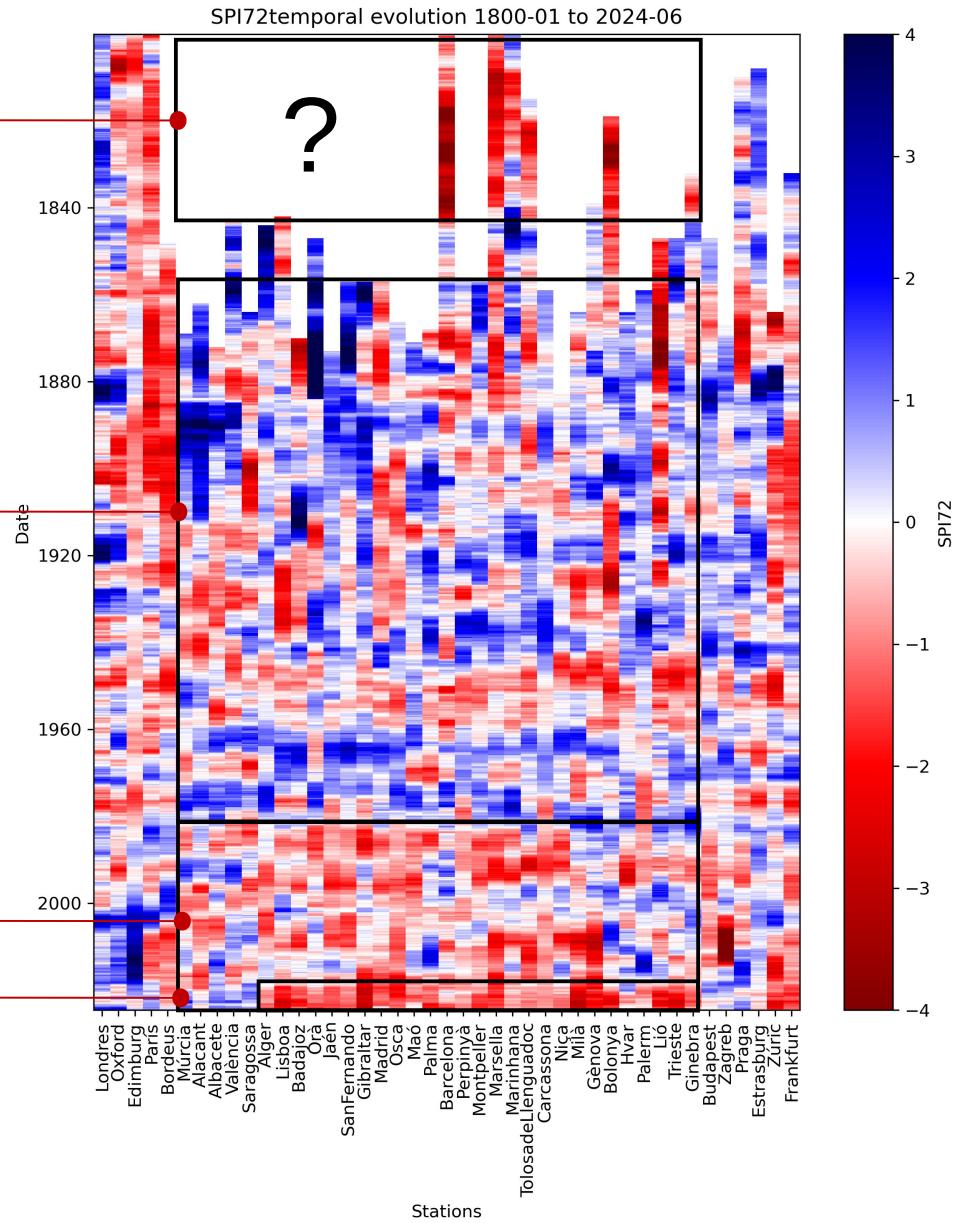
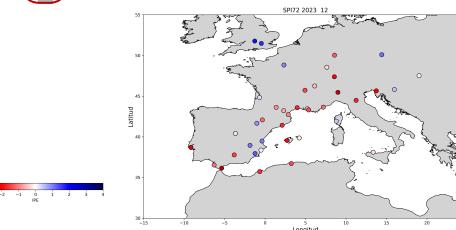
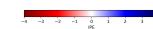
Regional differences
across the basin

1980s

BEGINS A DRY PERIOD ACROSS BASIN

2021-

CURRENT DROUGHT

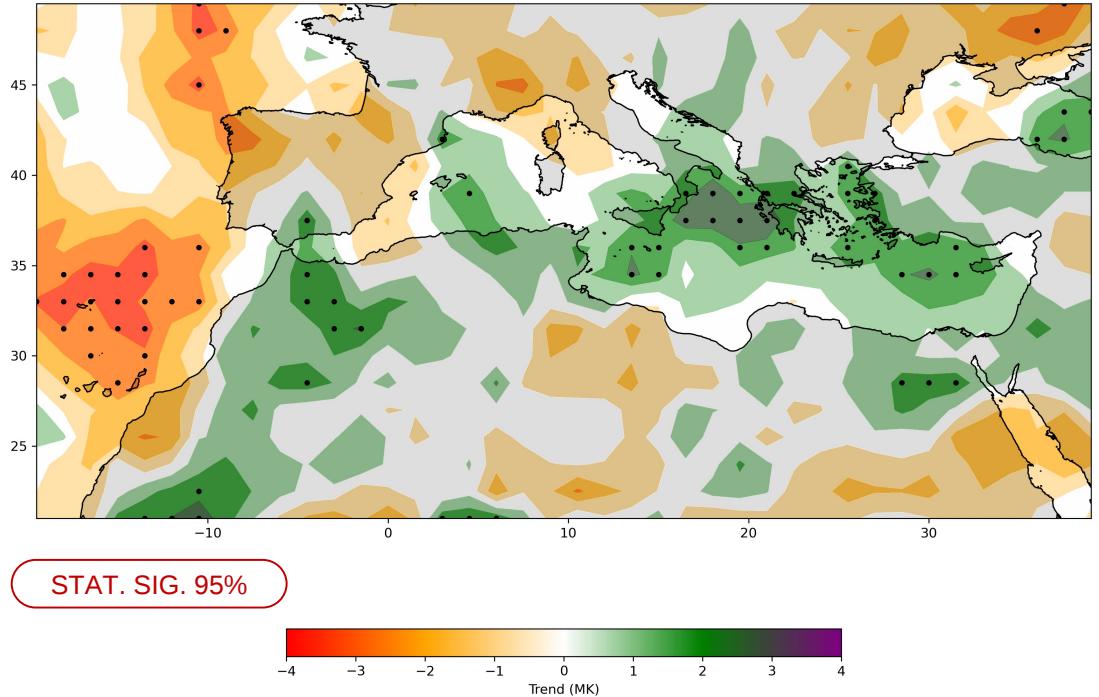


2

CYCLONIC ACTIVITY

Cut of Low evolution 1979-2020 (ERA5)

Cut of Low at 500hPa trend (MK) 1979-2020



Saurral et al, in press

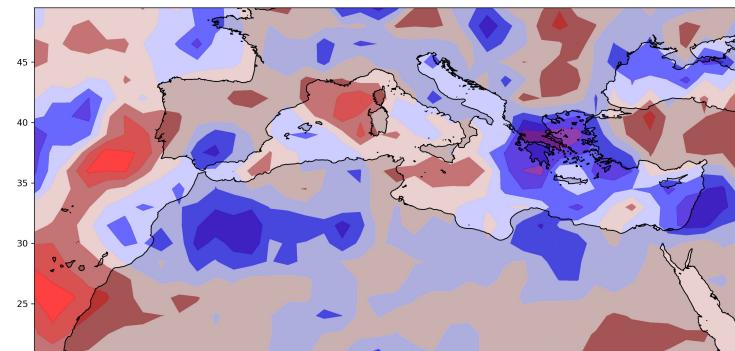


Spatial flavours of the Trend pattern

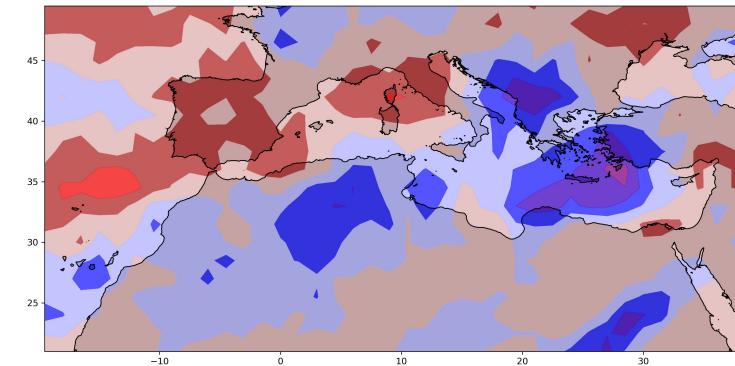
Some years of
the last 3
drought
episodes are
sharing a similar
pattern of COL
reduction

SIMILAR
PATTERNS

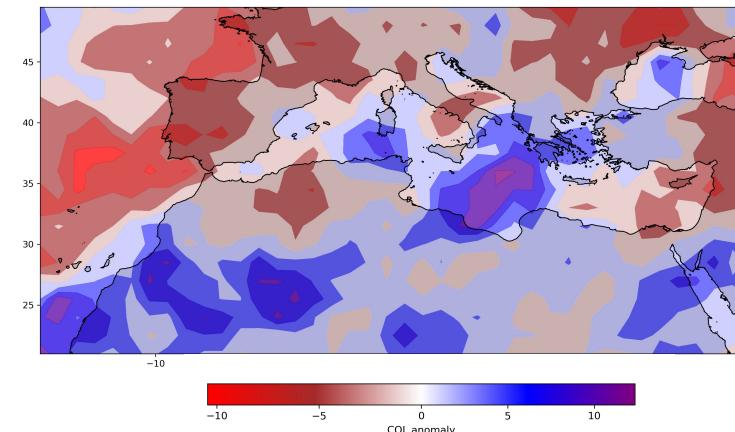
2006 Cut of Low at 500hPa anomaly



2017 Cut of Low at 500hPa anomaly

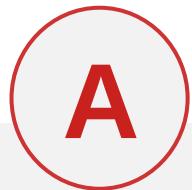
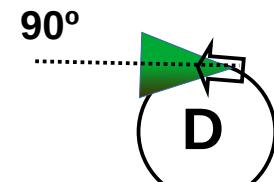
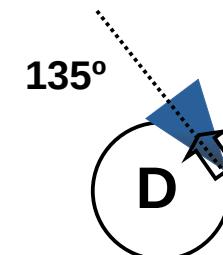
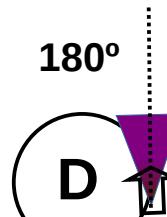
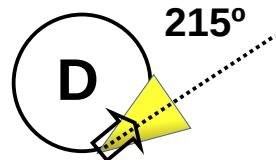
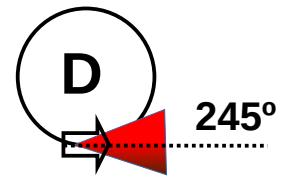
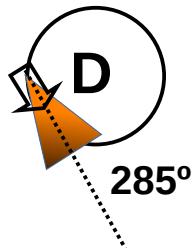


2023 Cut of Low at 500hPa anomaly



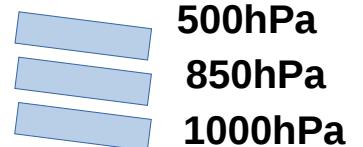
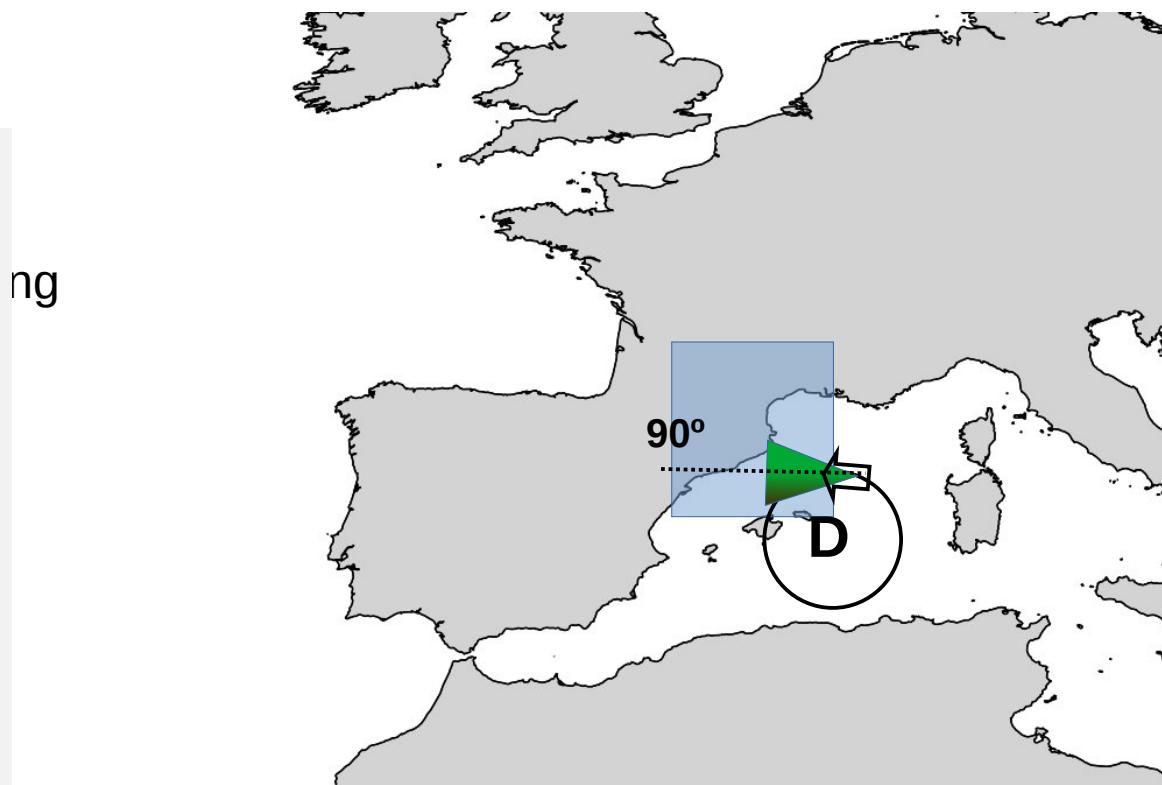
Cyclonic activity in Catalonia 1950-2023 (ERA5)

1971-2023 PERIOD

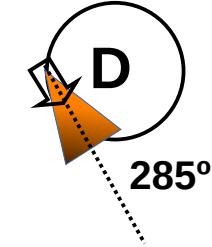
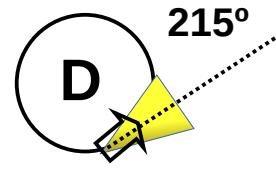
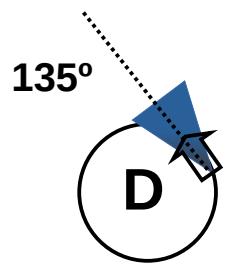


Anticyclons

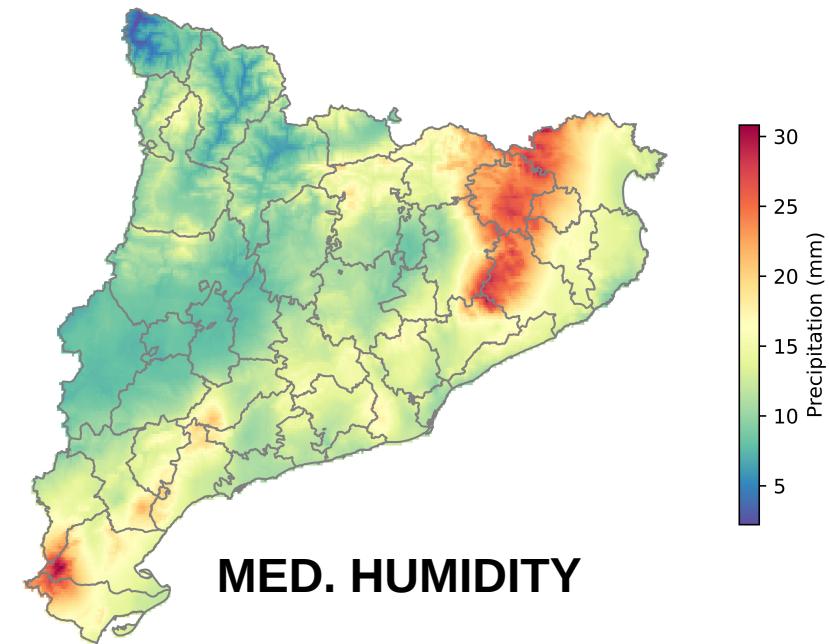
We are not
analyzing the
anticyclonic
circulation types!



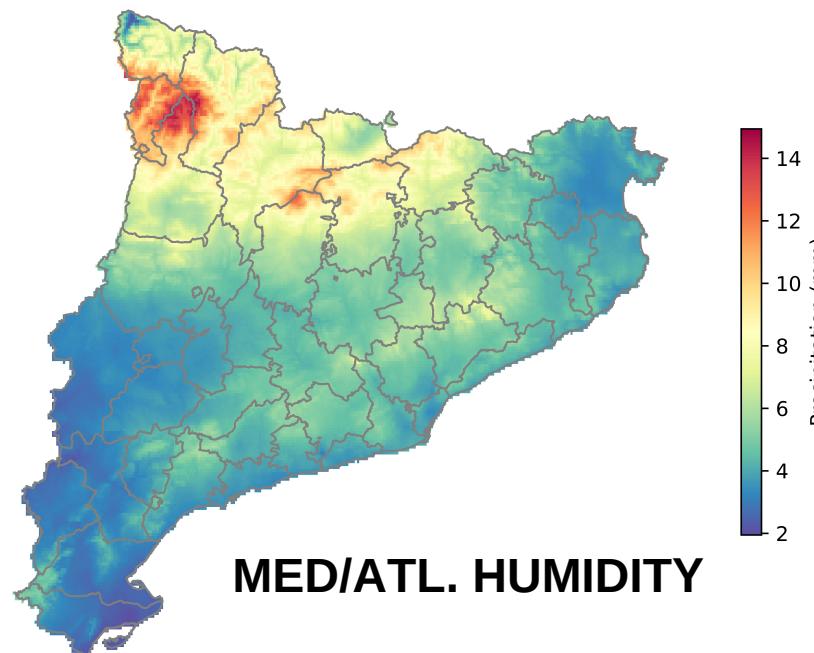
Precipitation footprint related to cyclonic circulation



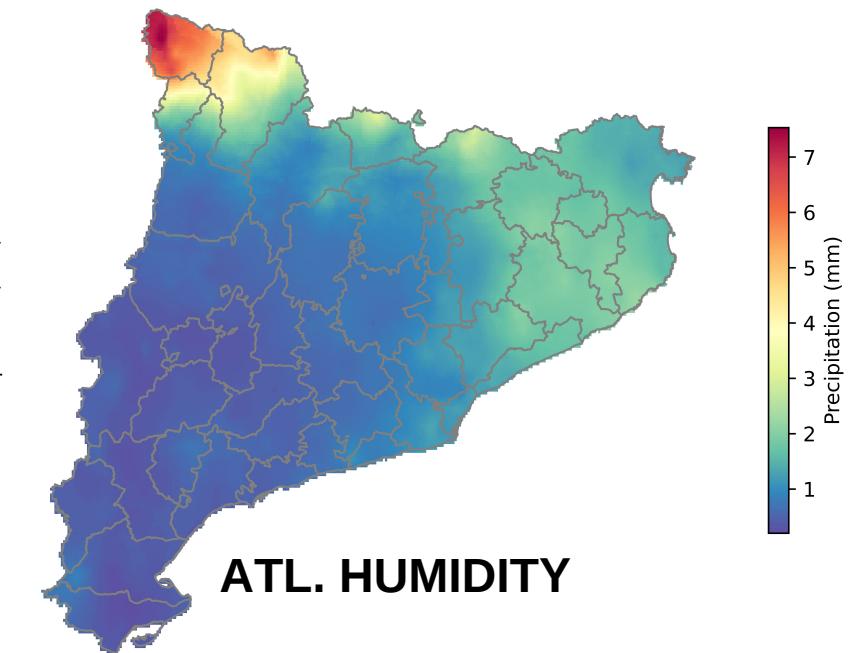
Mean precipitation SE-Cyclons



Mean precipitation SW-Cyclons



Mean precipitation NW-Cyclons



Cyclonic activity temporal evolution in Catalonia 1950-2023 (ERA5)

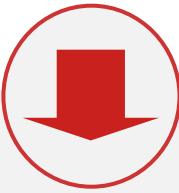
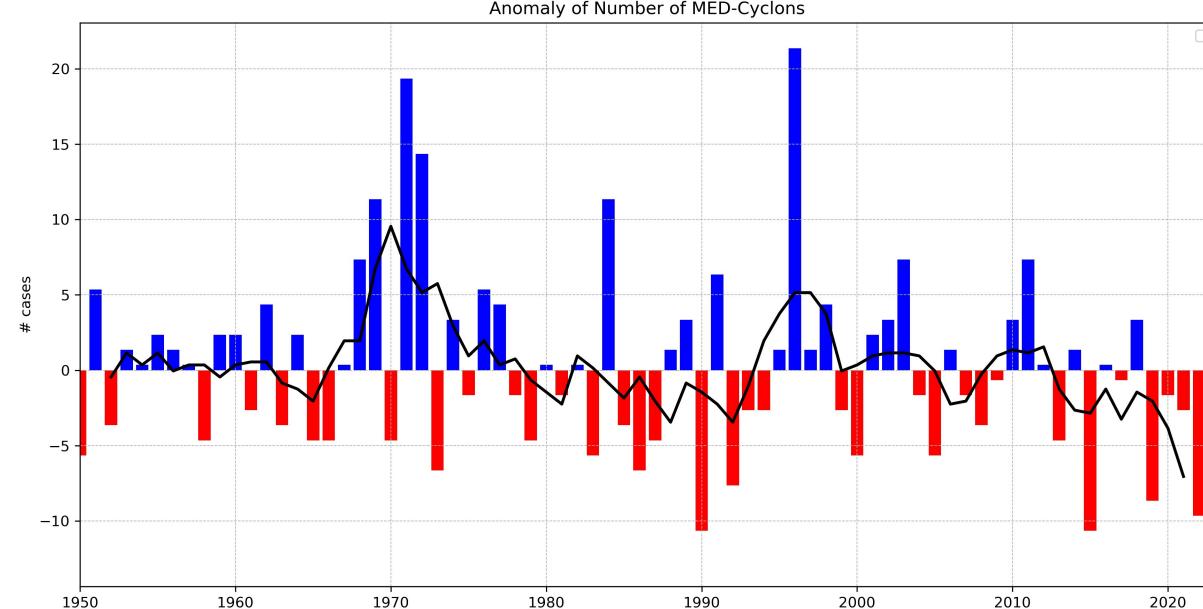
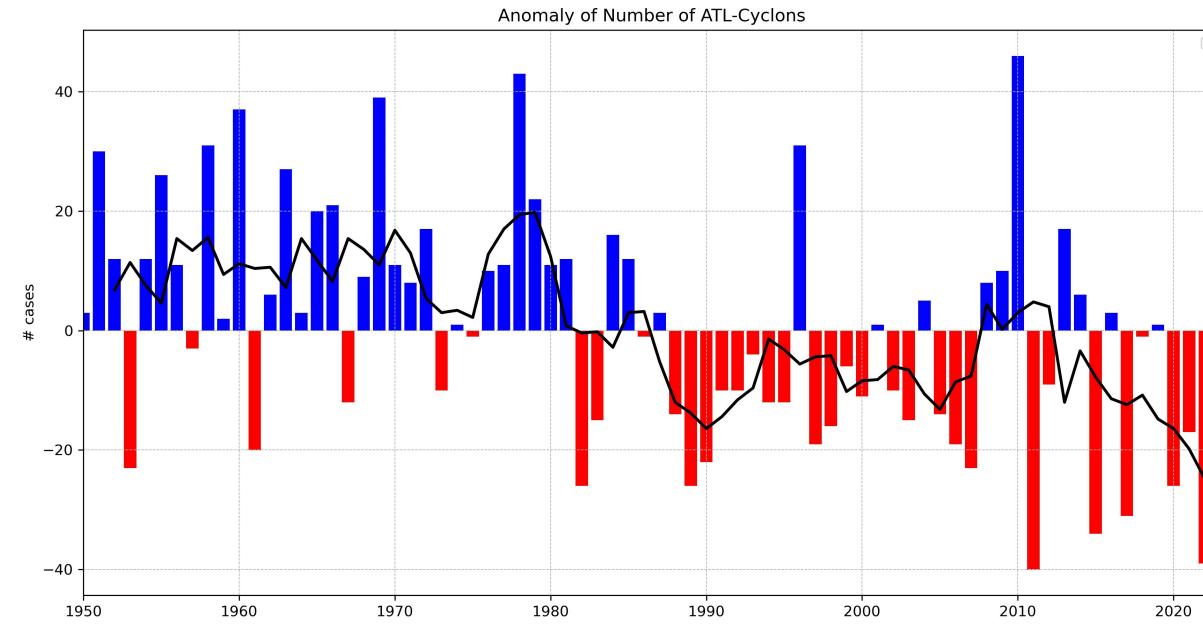


MED-Cyclons

Negative trend but not significant.

Strong negative anomalies during last decade.

NO SIGNIFICANT



ATL-Cyclons

Atl-cyclonic circulation at Catalonia has decrease clearly since 1980s.

SIGNIFICANT

3

CONCLUSIONS

Conclusions

1

Record Drought

2021-2024
Catalan drought
is the stronger
and more
persistent
drought on
record

CATALONIA

2

LIA megadrought

The intensity of
the last drought
is comparable
with the LIA
event (Barcelona
time series)

CATALONIA

3

Western Med. pattern

- The last 3
droughts in
Catalonia are
part of a drought
pattern across
the western
Mediterranean

WESTERN MED.

4

COLs reduction

- Cut of Lows at
500hPa show a
decreasing
trend in the
Atlantic sector in
the vicinity of
the Med. Basin

WESTERN MED.

5

Cyclonic circulation at Catalonia

- Indeed, there is
a diminution in
the cyclonic
activity around
Catalonia since
1980s

CATALONIA.

2021-2024 drought in Catalonia has characteristics of MEGADROUGHT by intensity

Last 3 Drought episodes in Catalonia (only?) are the consequence of a drying pattern in Western Med.

Cyclonic activity in Catalonia (only?) is decreasing in recent decades probably due to anomalous circulation in the North-Atlantic



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