

**ACTION 2020-2-21:  
COPERNICUS  
FOR CULTURAL HERITAGE**

# Climate Change Global and European prospective and Forecasting

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Consorzio LaMMA

**13-16.06.2023**

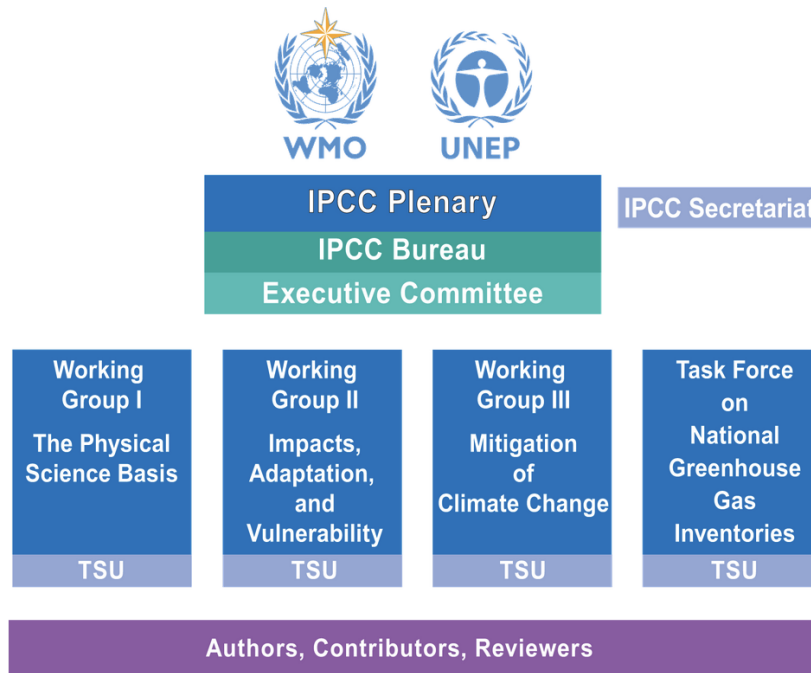
PARCO REGIONALE DELL'APPIA ANTICA  
Ex Cartiera Latina - Via Appia Antica, 42

Created in 1988 by WMO and UNEP

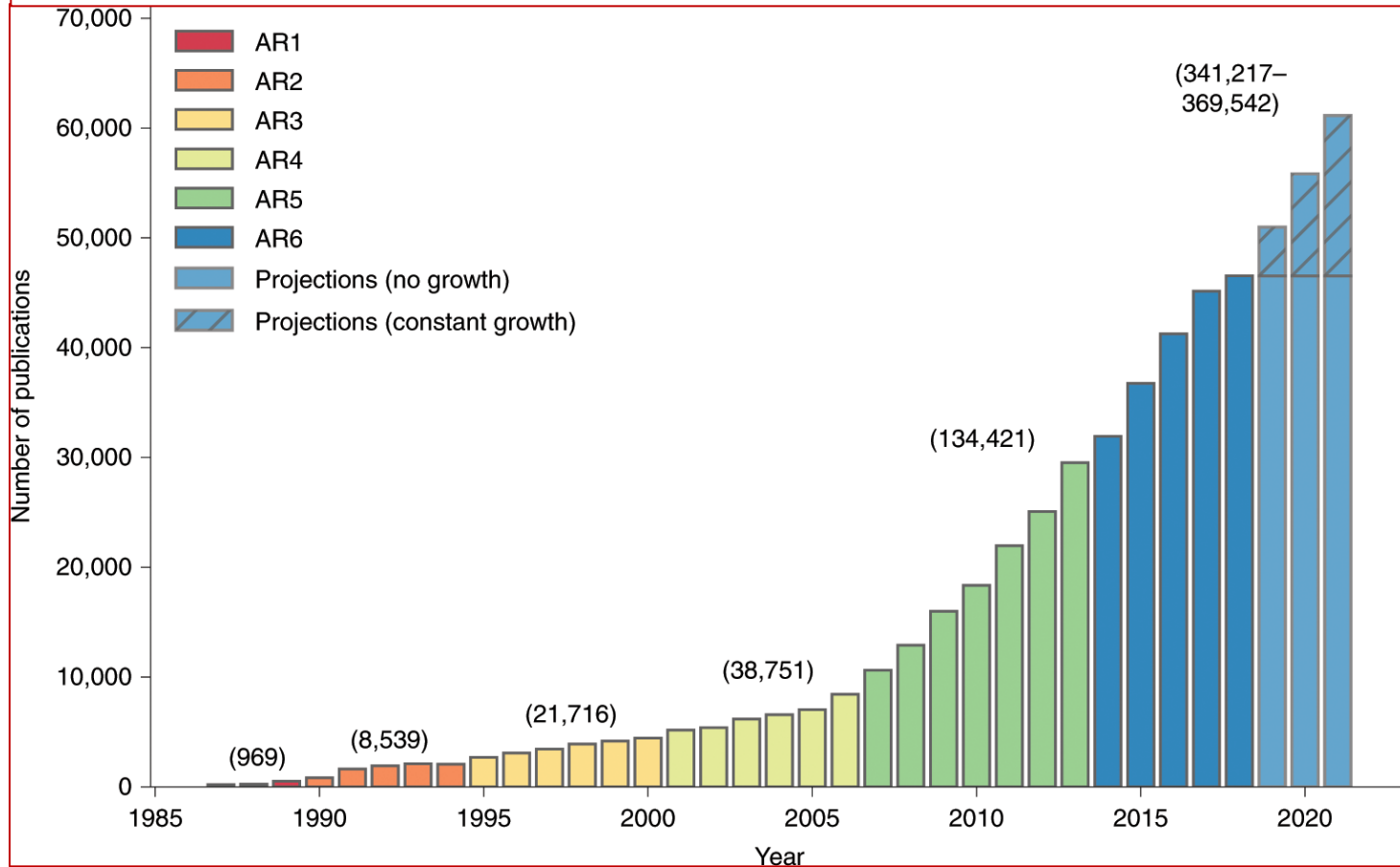
UN and WMO Member Governments (195)

Analyse with a comprehensive, objective, open and transparent approach scientific, technical and socio-economic information to understand the scientific basis of climate change risks

## IPCC Structure



## Number of climate change documents in the Web of Science each year

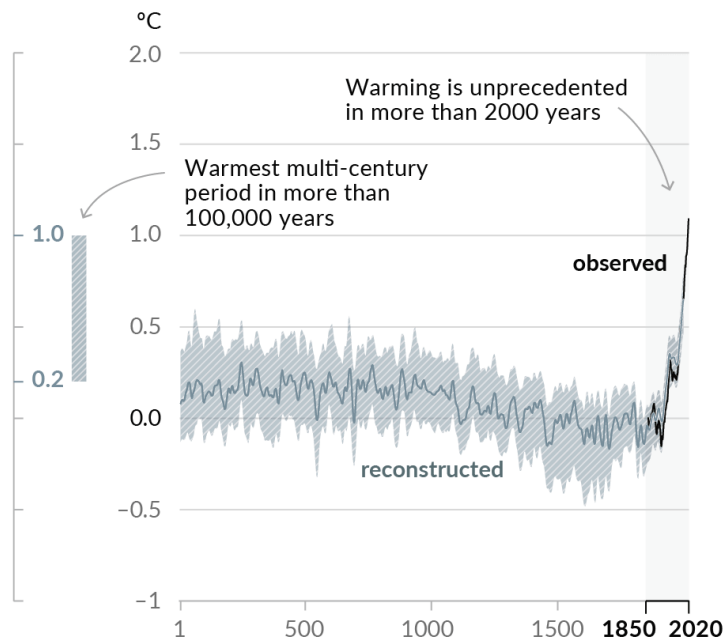


**Global surface temperature around 1.1°C above 1850–1900**  
**land +1.59 °C, ocean +0.88°C**

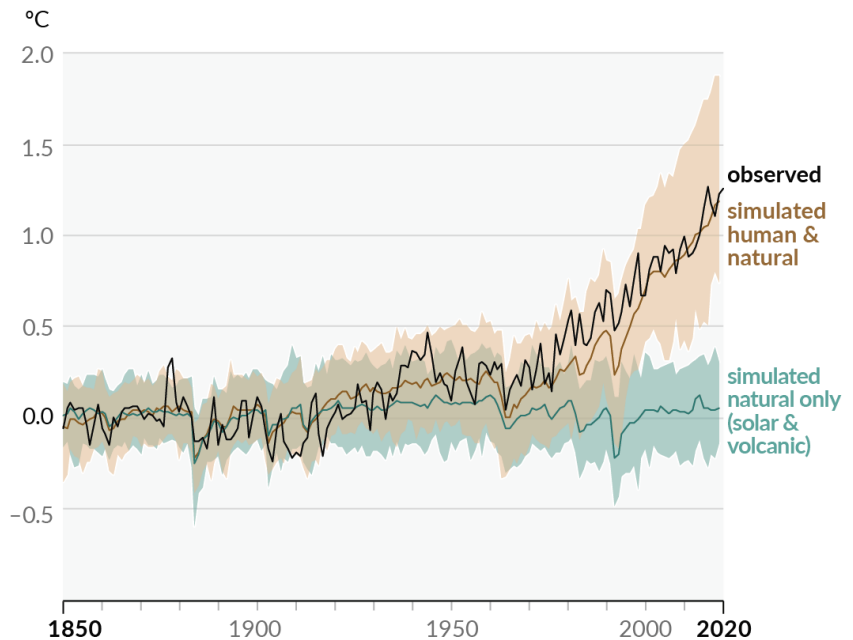
**Human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years**

**Changes in global surface temperature relative to 1850–1900**

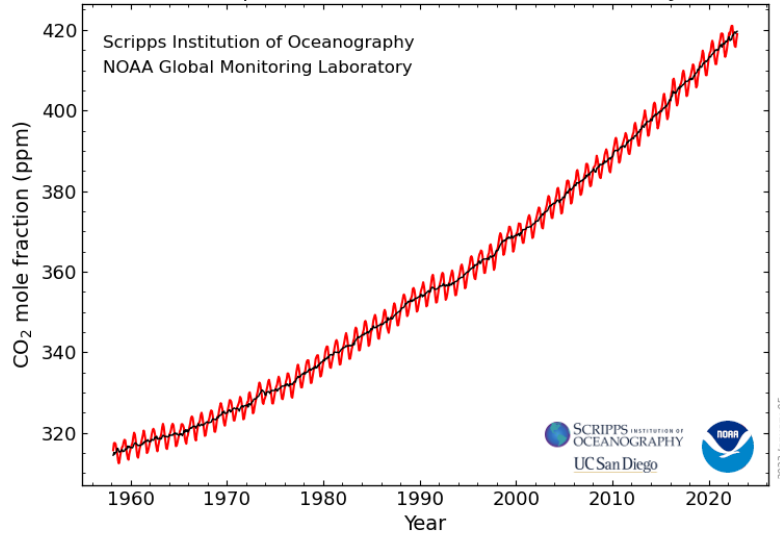
(a) Change in global surface temperature (decadal average) as **reconstructed** (1–2000) and **observed** (1850–2020)



(b) Change in global surface temperature (annual average) as **observed** and simulated using **human & natural** and **only natural** factors (both 1850–2020)



Atmospheric CO<sub>2</sub> at Mauna Loa Observatory



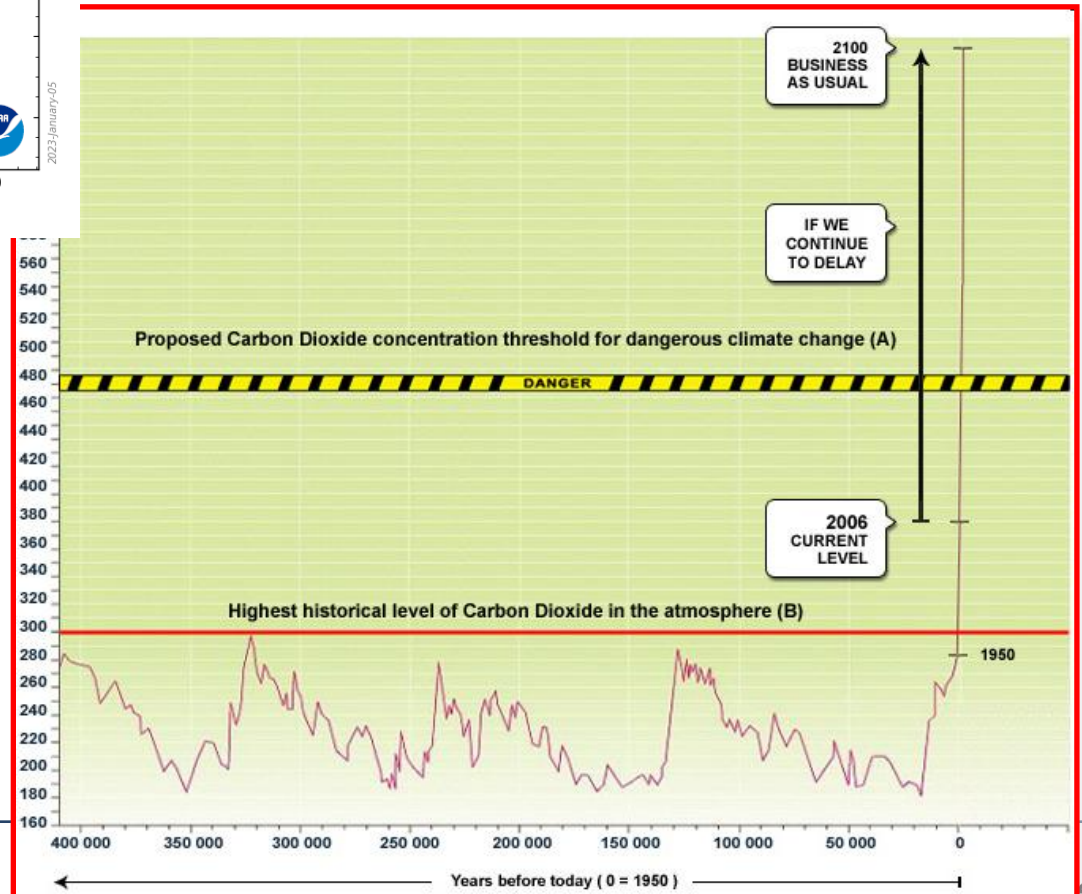
**December 2022: 418.95 ppm**

**December 2021: 416.71 ppm**

*Last updated: Jan 05, 2023*

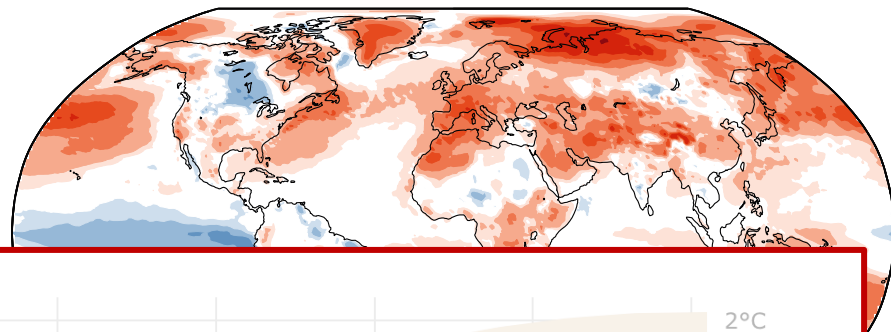
CO<sub>2</sub> concentrations were higher than at any time in at least 2 million years (high confidence),

CH<sub>4</sub> and N<sub>2</sub>O concentrations were higher than at any time in at least 800,000 years (very high confidence).

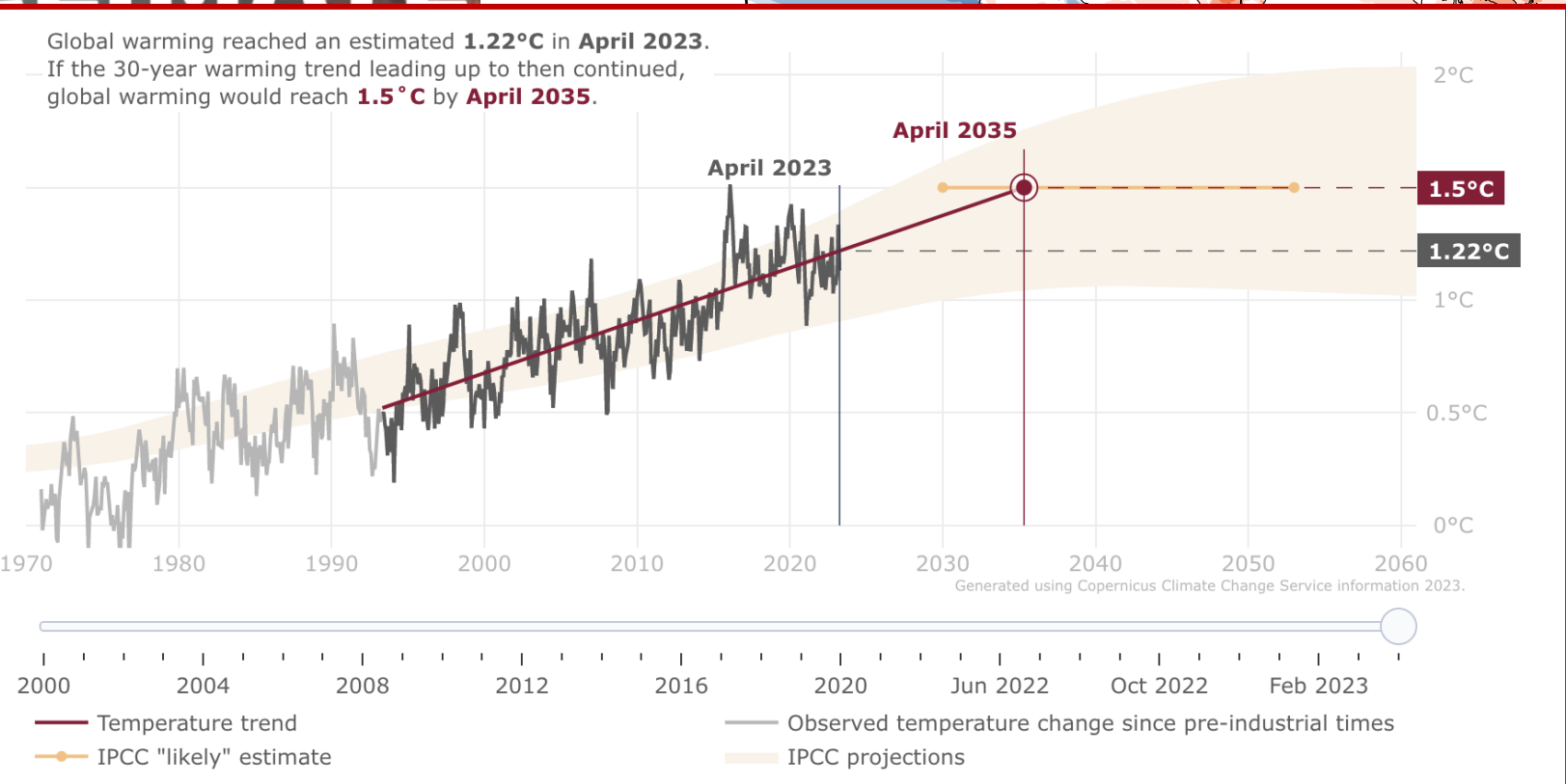


# EUROPEAN STATE OF THE CLIMATE

## 2022 Surface air temperature anomaly



Global warming reached an estimated **1.22°C** in **April 2023**.  
 If the 30-year warming trend leading up to then continued, global warming would reach **1.5°C** by **April 2035**.



<https://...>

Relat  
1991

0.6

0.3

0

-0.3

-0.6

1970 1980 1990 2000 2010 2020 2030 2040 2050 2060

Generated using Copernicus Climate Change Service information 2023.

2000 2004 2008 2012 2016 2020 Jun 2022 Oct 2022 Feb 2023

— Temperature trend — Observed temperature change since pre-industrial times  
 — IPCC "likely" estimate — IPCC projections

1960 1970 1980 1990 2000 2010 2020

Europe's eyes on Earth



# Arctic north pole

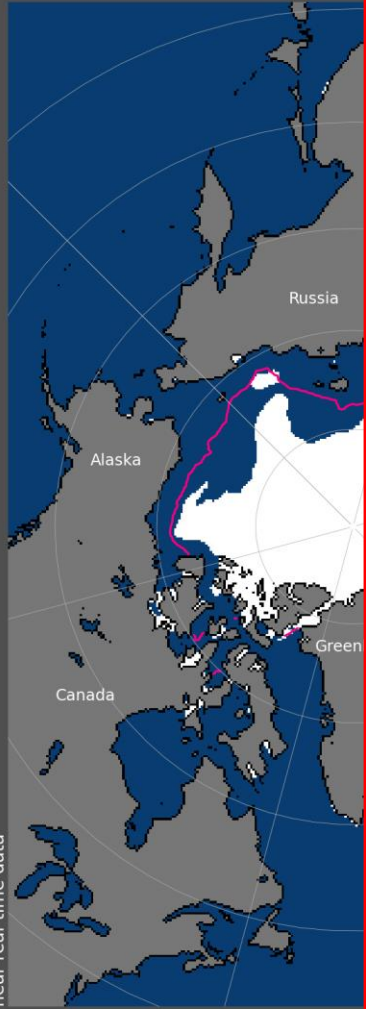
11° lowest extent, record 2012

North-East  
container ship  
ess.

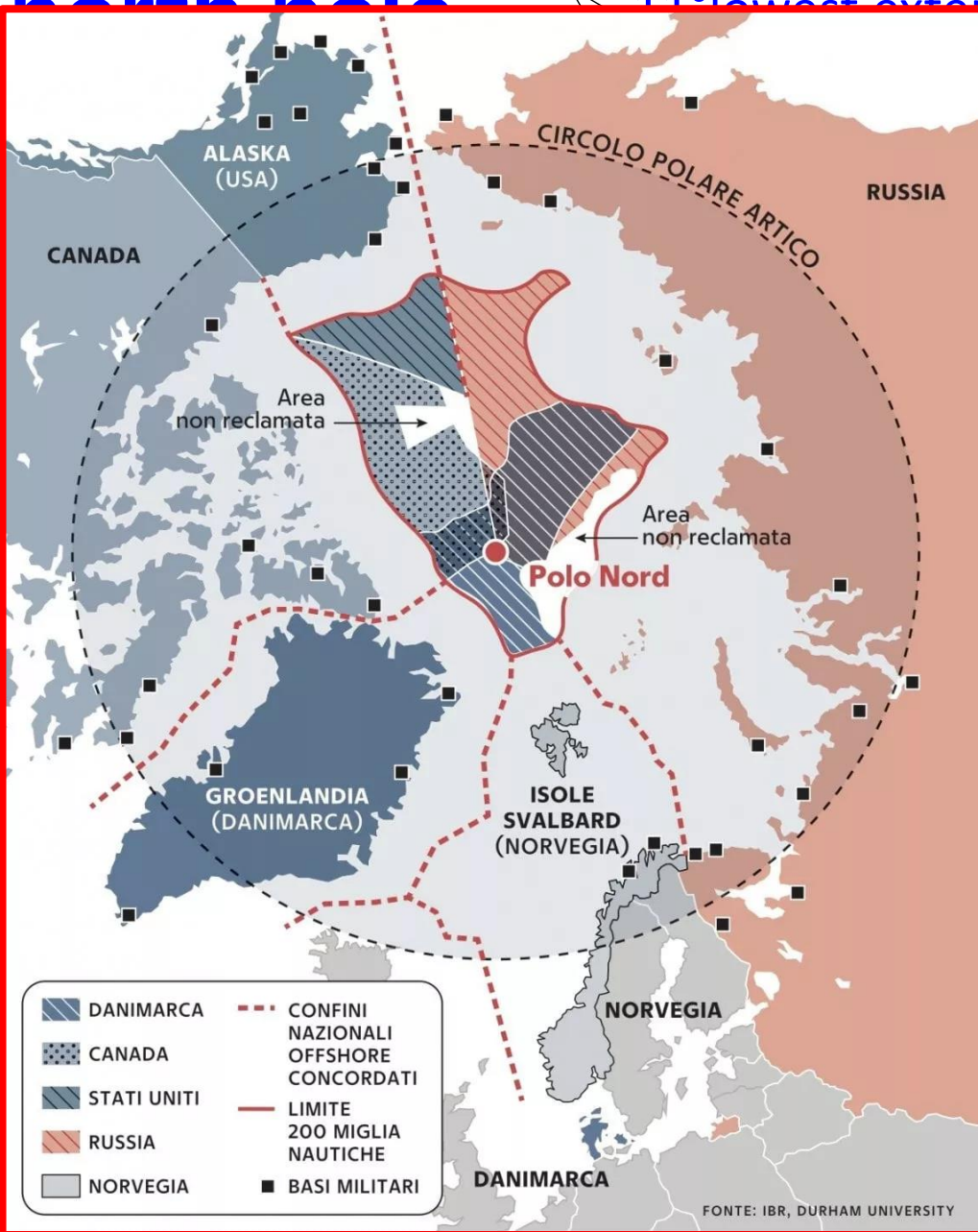
oil, 1/3 natural

ctic Council 8  
rmanent observer

Sea Ice Extent, Sep

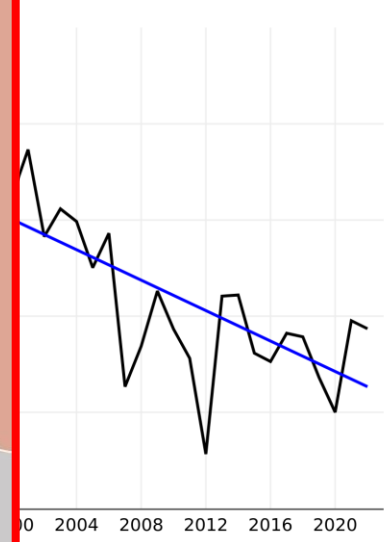


Total extent = 4.9

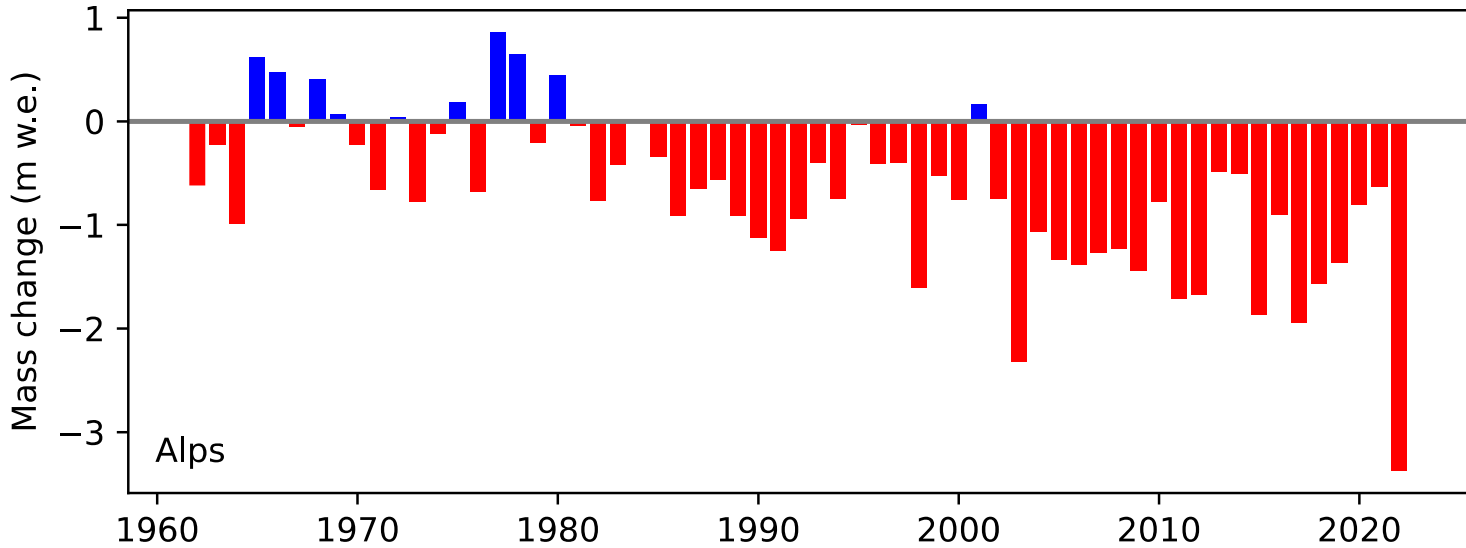
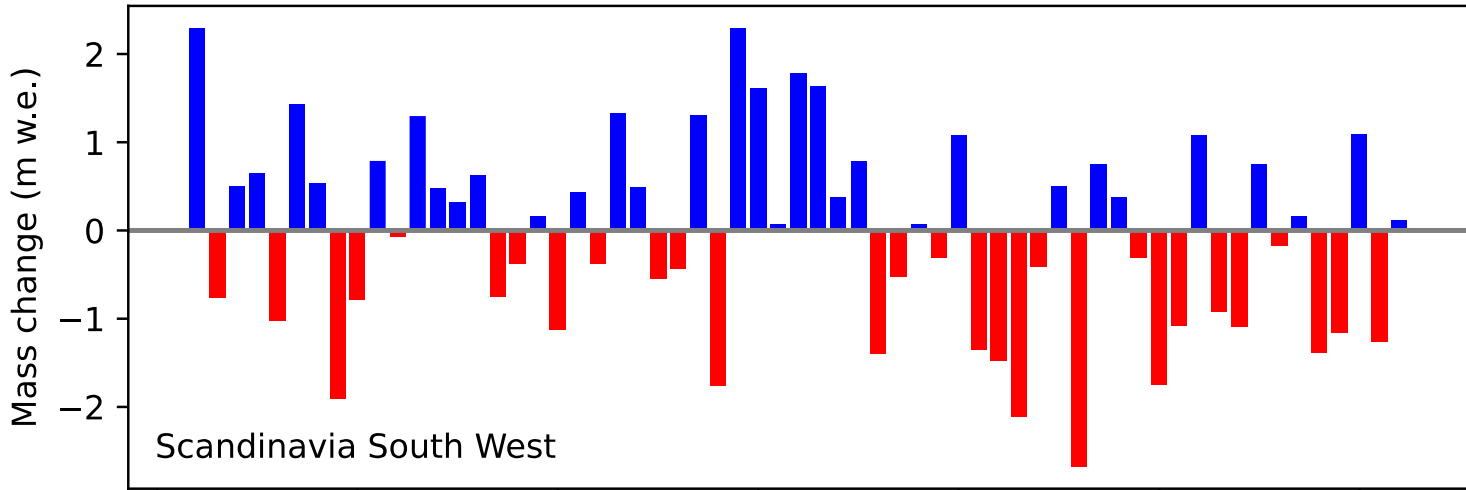
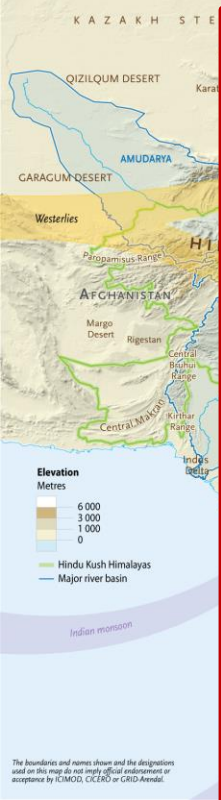


Fonte: IBR, DURHAM UNIVERSITY

Arctic Sea Ice Extent 1979 - 2022



Year



Water  
Grand

ter

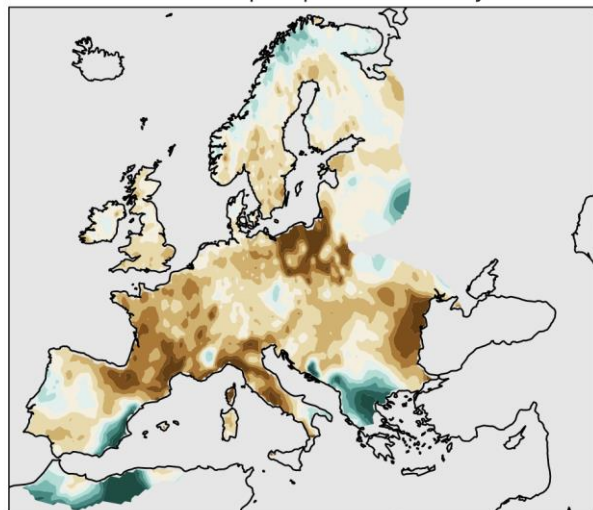


# EUROPEAN STATE OF THE CLIMATE SUMMARY 2022

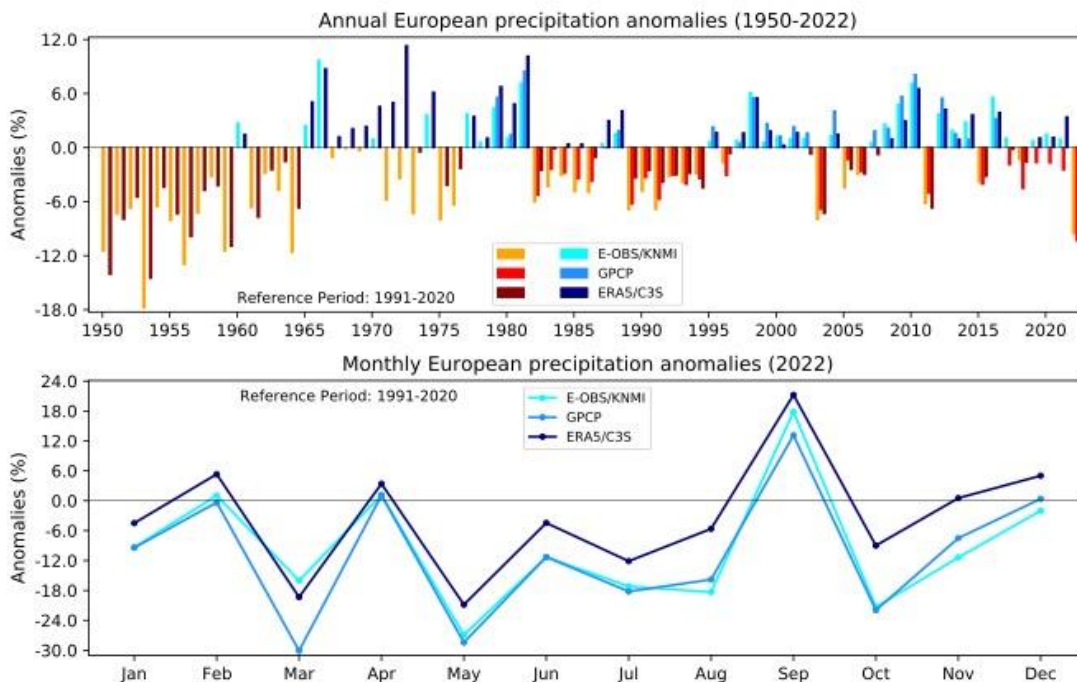


Annual precipitation in 2022 was below the average (1991–2020) from -4% to -10% in the three datasets 2 longest time series – E-OBS and ERA5 – show trends with regional differences, northern Europe becoming wetter and southern Europe becoming drier

2022 mean precipitation anomaly

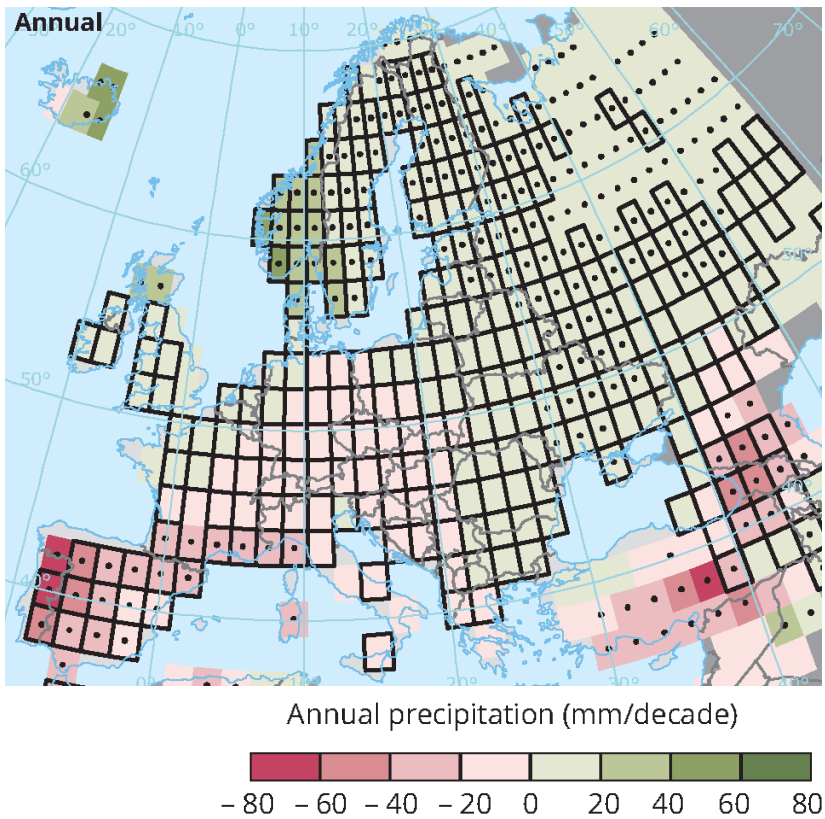


Data source: E-OBS Credit: C3S/KNMI Reference Period: 1991-2020



# CLIMATE CHANGES

## PRECIPITATION IN EUROPE



Fonti: <https://www.eea.europa.eu/data-and-maps/indicators/european-precipitation-2/assessment>

<https://www.eea.europa.eu/publications/europes-changing-climate-hazards-1/wet-and-dry-1/wet-and-dry-mean-precipitation>

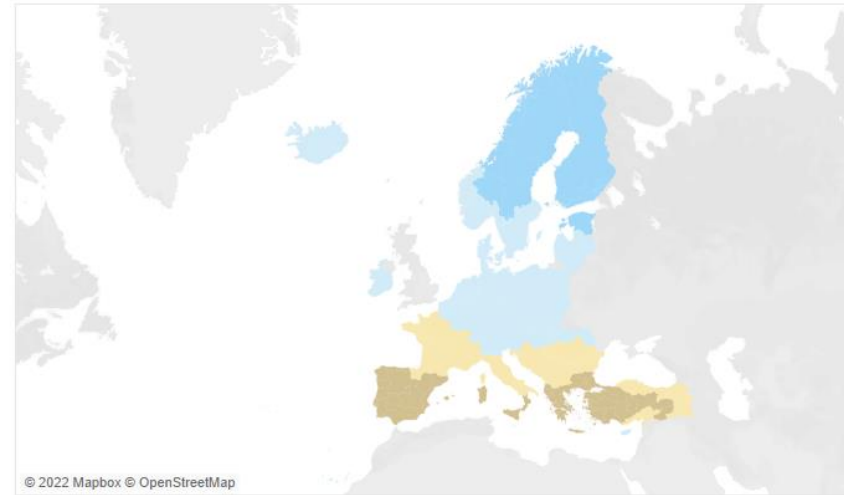
FUTURE SCENARIOS

Projected change in precipitation sum

Time Period  
2041-2070

Season  
Annual

Scenario  
RCP8.5



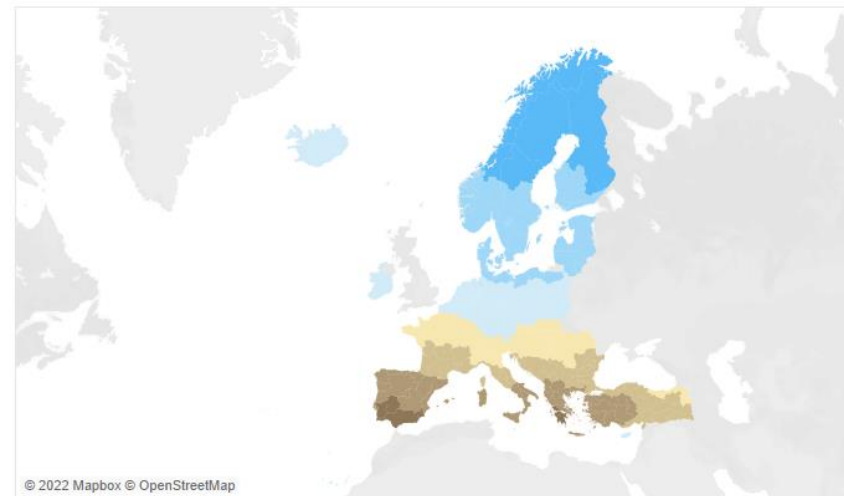
% change

Projected change in precipitation sum

Time Period  
2071-2099

Season  
Annual

Scenario  
RCP8.5



% change

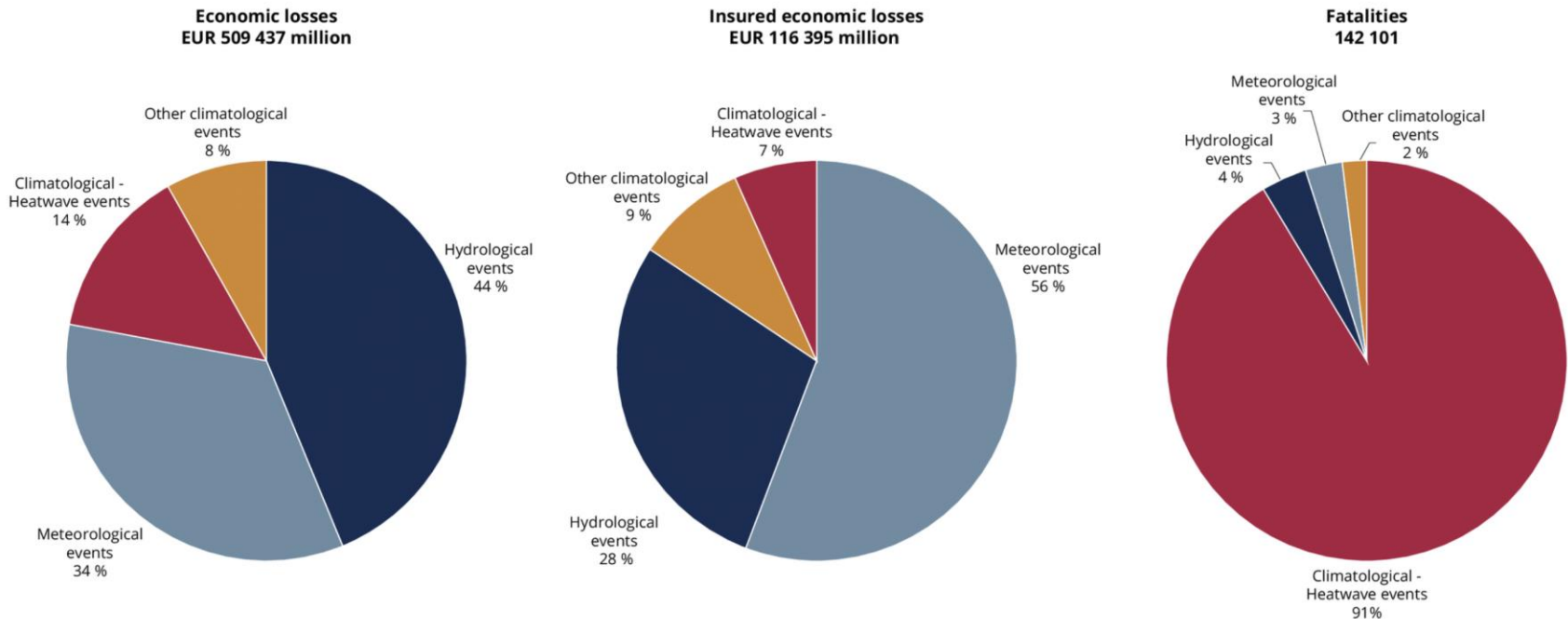
-50,0 50,0



# Climate change adaptation and disaster risk reduction in Europe

## Enhancing coherence of the knowledge base, policies and practices

Figure 2a. Economic damage caused by weather and climate-related extreme events in EEA member countries (1980-2020) - per hazard type based on CATDAT

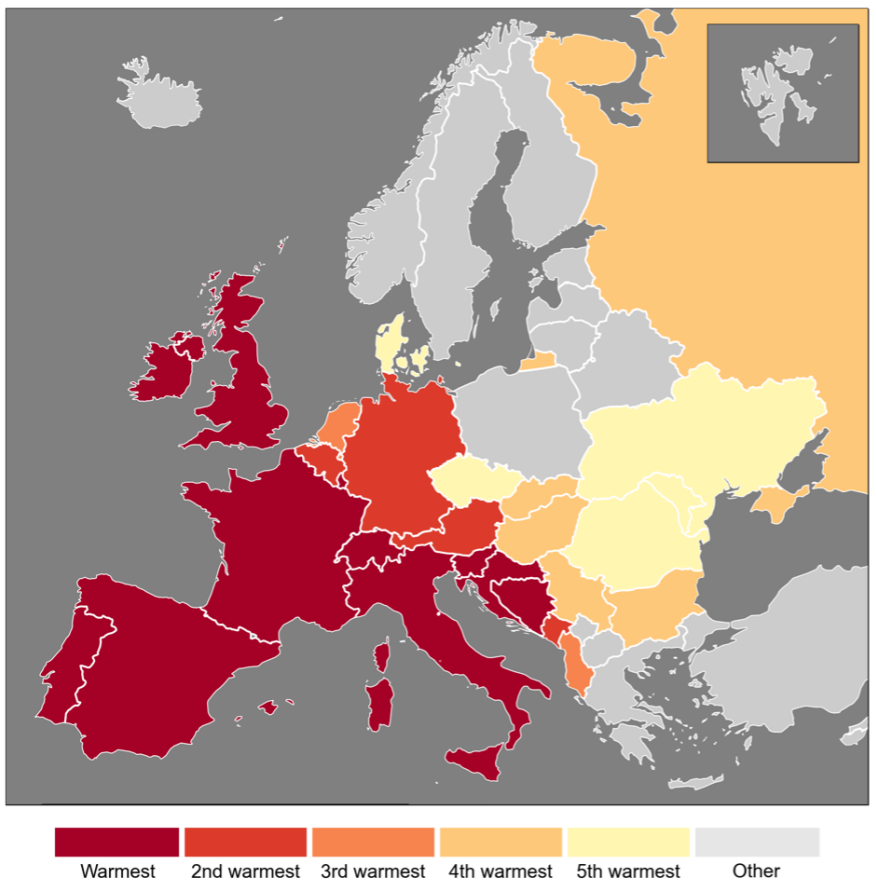


**Germany 107,572, France 98,994, Italy 90,061**  
Million EUR

<https://www.eea.europa.eu/publications/economic-losses-and-fatalities-from>

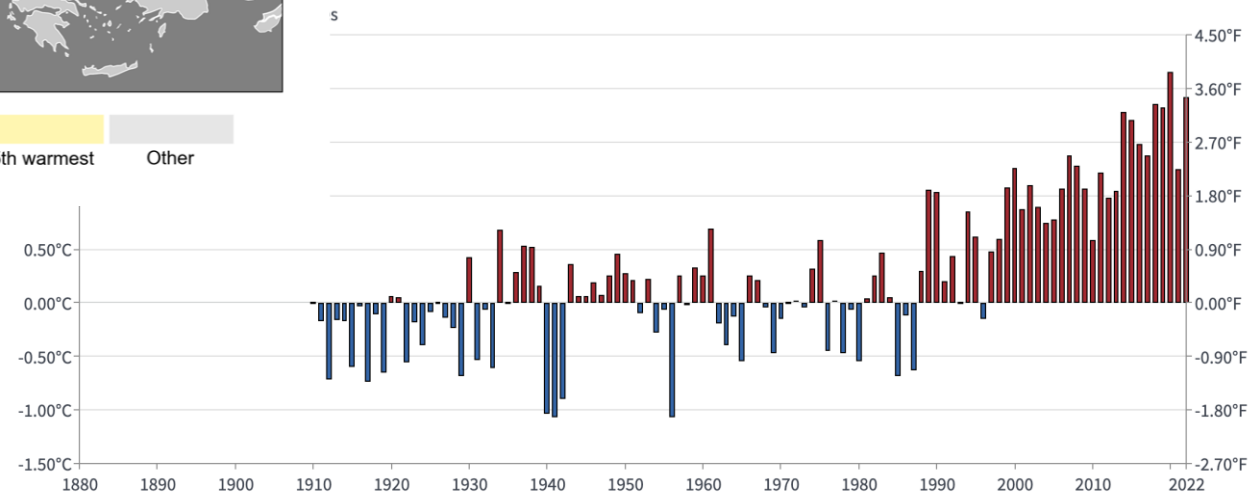
### Ranking of 2022 temperature anomaly by country

Data: ERA5 1950-2022 • Reference period: 1991-2020 • Credit: C3S/ECMWF

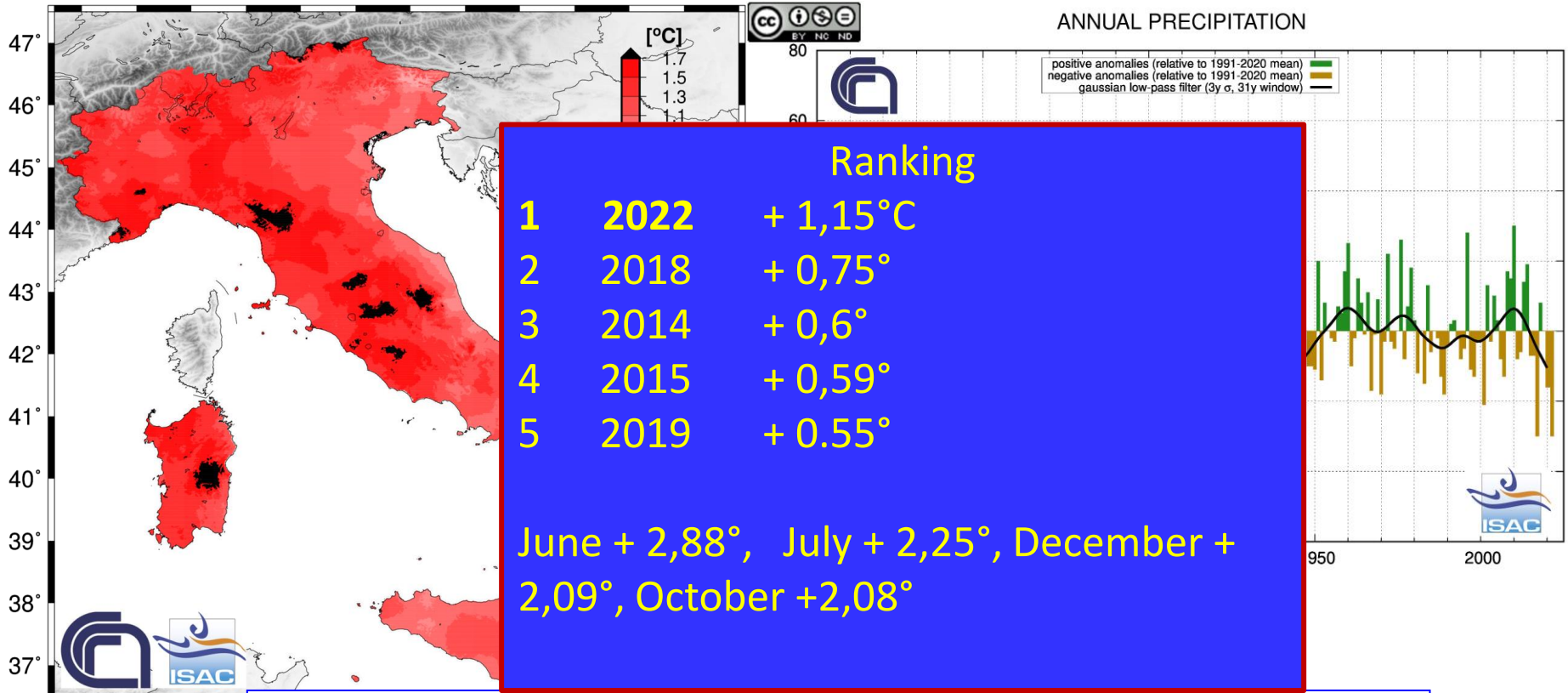


# Europe Temperature 2022

The second  
warmest after  
2020



# ITALY 2022



| Ranking |      |          |
|---------|------|----------|
| 1       | 2022 | + 1,15°C |
| 2       | 2018 | + 0,75°  |
| 3       | 2014 | + 0,6°   |
| 4       | 2015 | + 0,59°  |
| 5       | 2019 | + 0.55°  |

June + 2,88°, July + 2,25°, December + 2,09°, October +2,08°

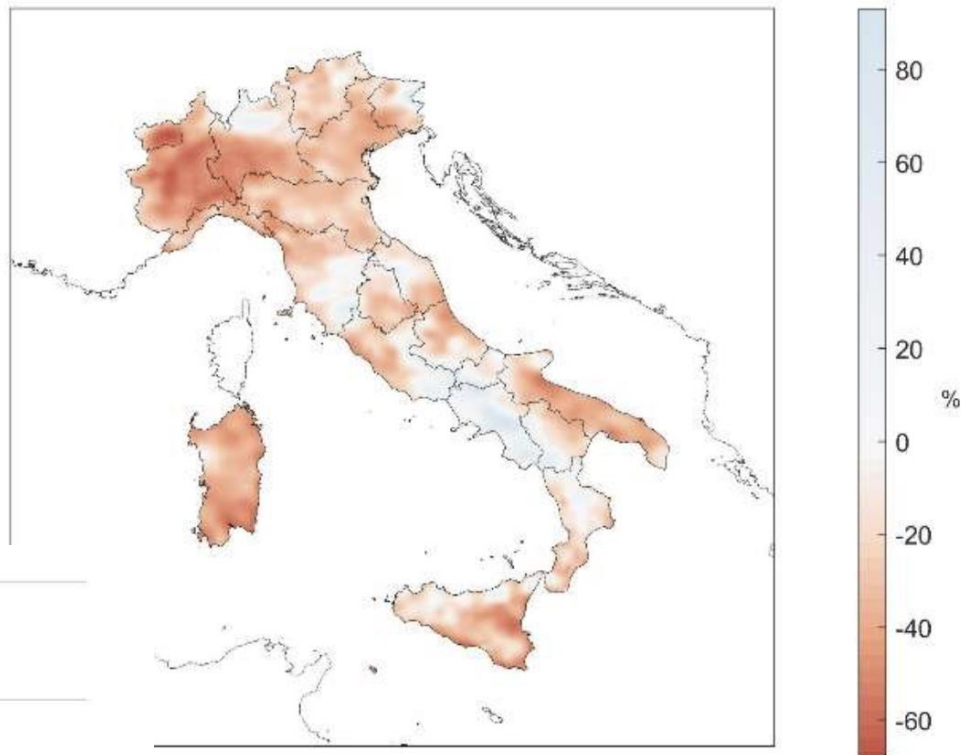
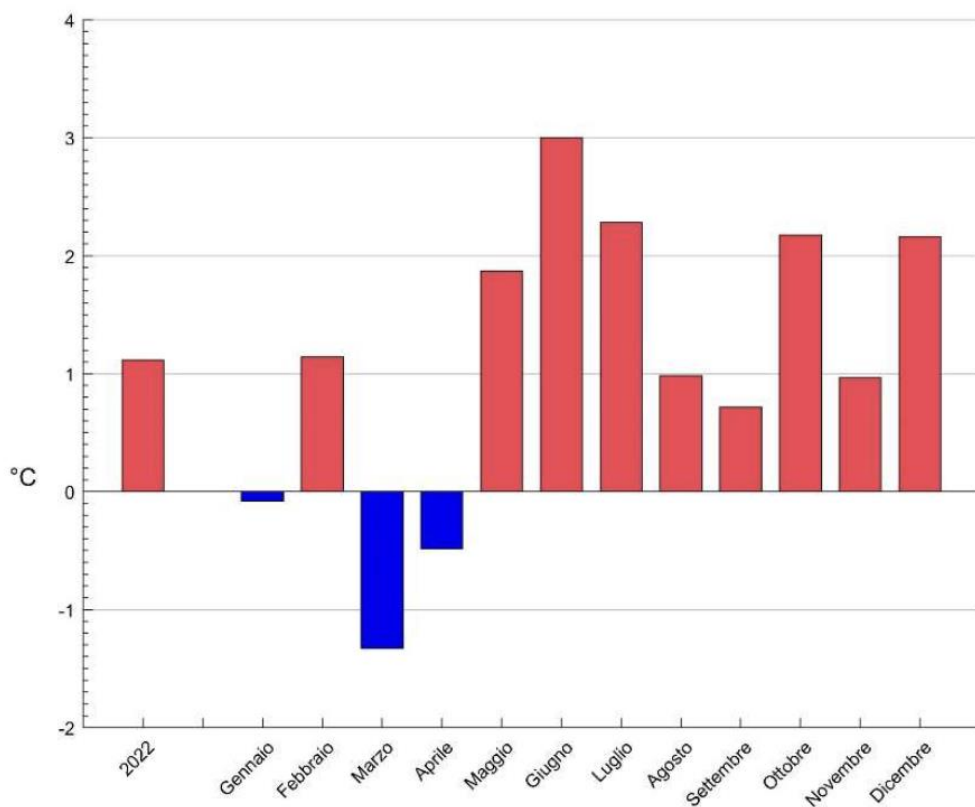
|              |                            |              |
|--------------|----------------------------|--------------|
| <b>2022:</b> | the warmest + 1,15°        | 2018 + 0,75° |
| <b>MAX:</b>  | the warmest + 1,39°        |              |
| <b>MIN:</b>  | the second warmest + 0,70° | 2018 + 0,84° |

Climate calculated over the 1991-2020 period

**2022**

Cumulative precipitation anomaly 2022

2022, - 21%, the driest since 1961



Monthly average temperature anomaly 2022

December + 2,16° record  
May, June, July and October  
the second warmest

# ITALY: Some impacts on agriculture

## News

**Tropical fruits**, 1200 ha, 2021 (Apulia, Sicily, Calabria), tripled in the last 5 years, **bananas, avocados and mangoes** (Messina, Etna and Acireale)

Consumption + 18% mango, + 17% avocado

Papaya, experimental coffees

**Legumes**: chickpeas from 2011 to 2020 chickpea area (dry and arid climates) from 5,643 ha to 18,579 ha, lentils from 1,948 to 5,612 ha

## Internal migrations

**Durum wheat**: between 2006 and 2020 + 90% surface areas in Northern Italy

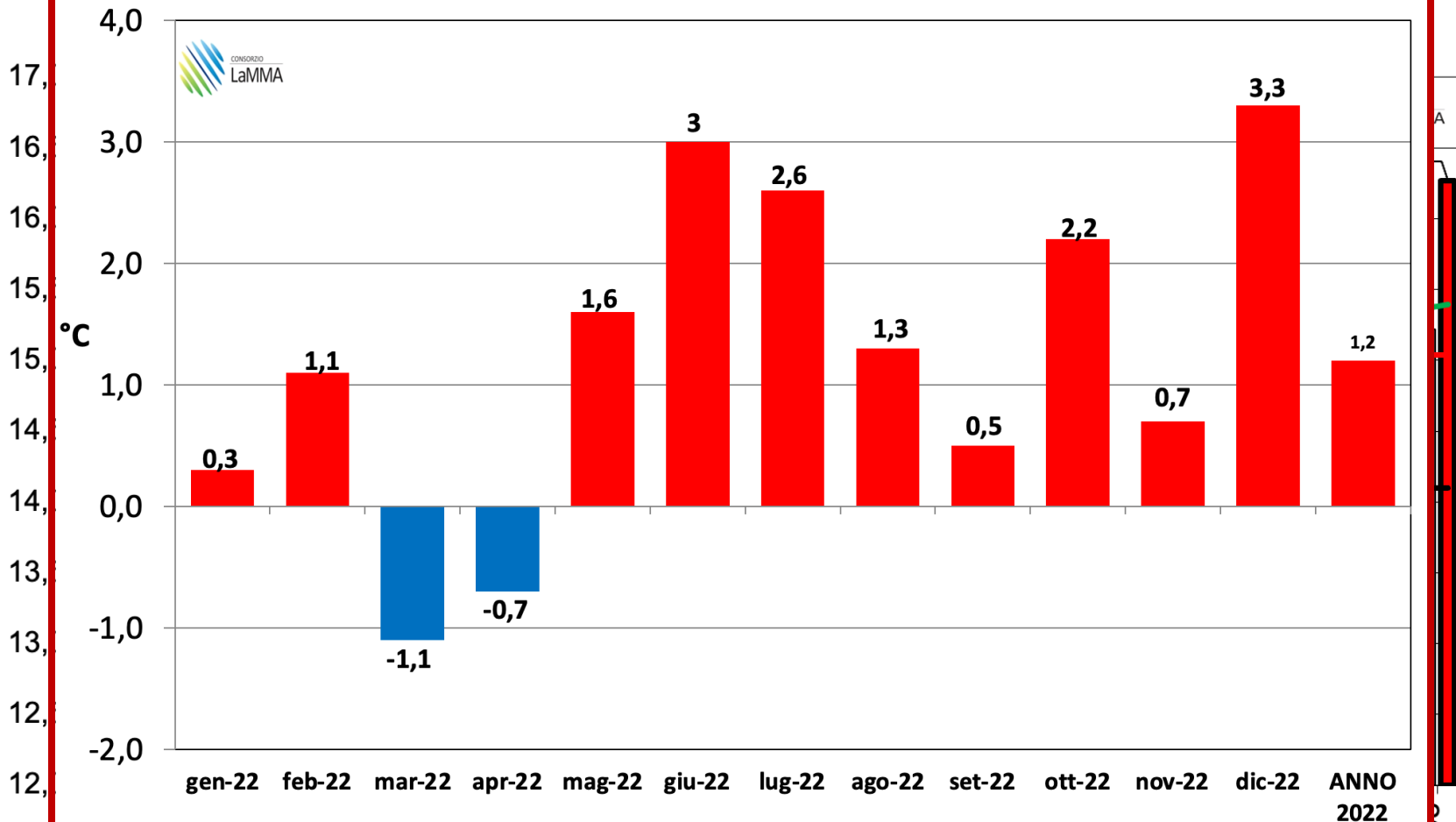
**Industrial tomatoes**: + 27% North, - 17% South, National harvest 49% from the North, 45% from the South

**Olive growing**: +12% North, 4,000 tons of olives in Trentino, 10,000 plants in Valtellina

**Viticulture**: increase in altitude (1,200 metres Aosta), new implantations with drip irrigation

# Average Annual Temperature 1955-2022

Anomalia di temperatura media nel 2022  
(climatologia 1991-2020)



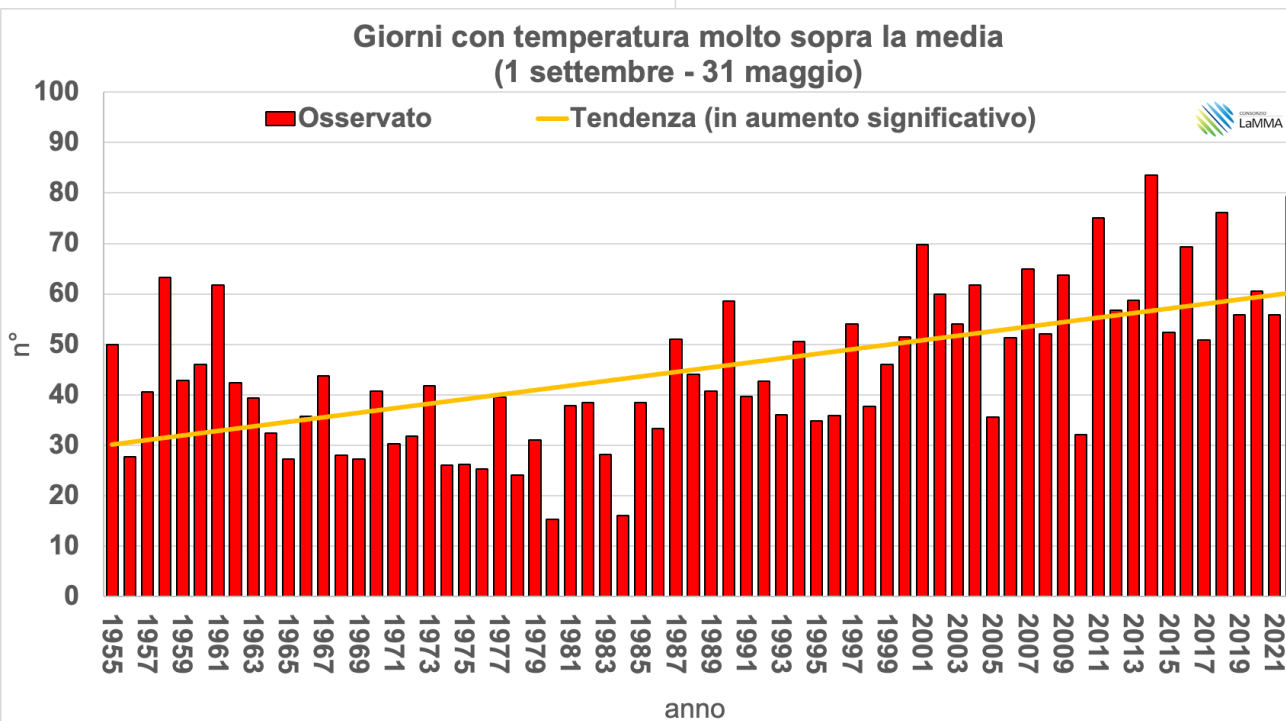
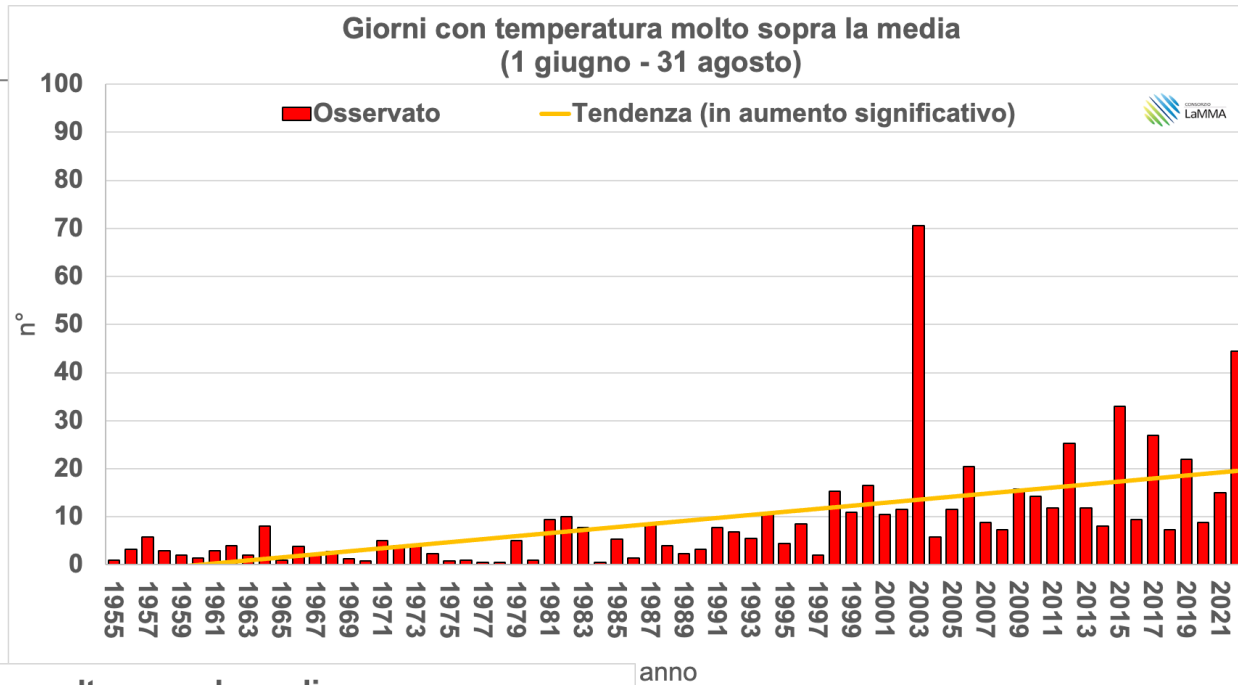
Trend (50 years): Mean +1,2°, Maximum +1,5°, Minimum +0,9°



# Very Hot Days

SUMMER  
1 June-31 August

REST OF THE YEAR  
1 September-31 May

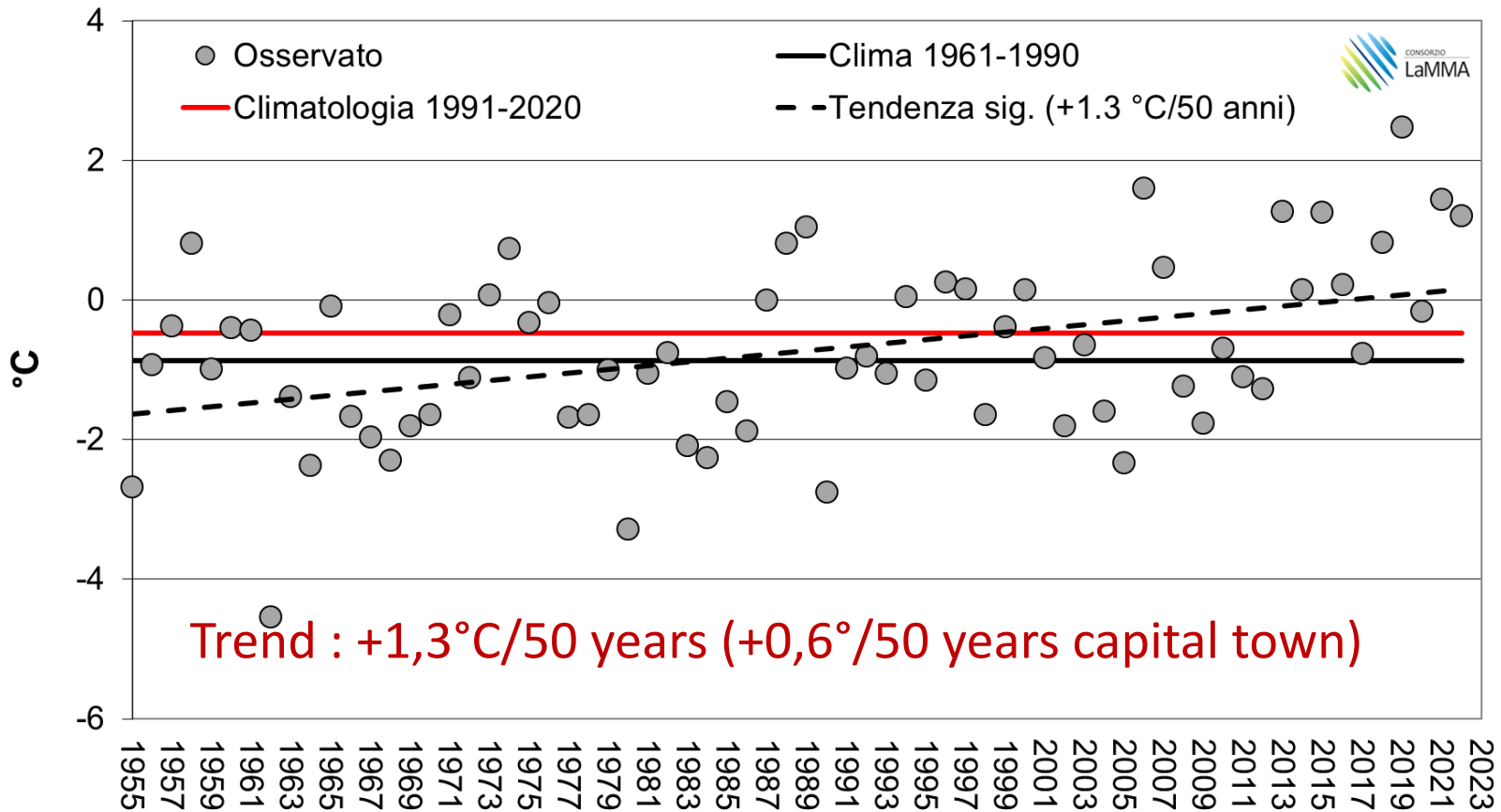


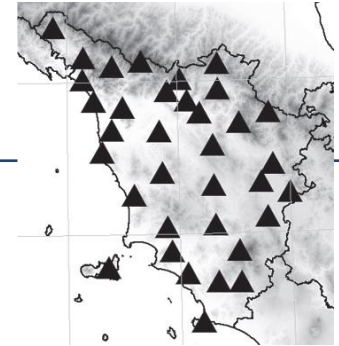
- Variations in phenological phases
- Impact on seasonal cycles of animal species
- Reduction of water resources by evapotranspiration
- New implantations
- Landscape

# WINTER: Average Temperature 1955-2022

## Abetone (1388 m)

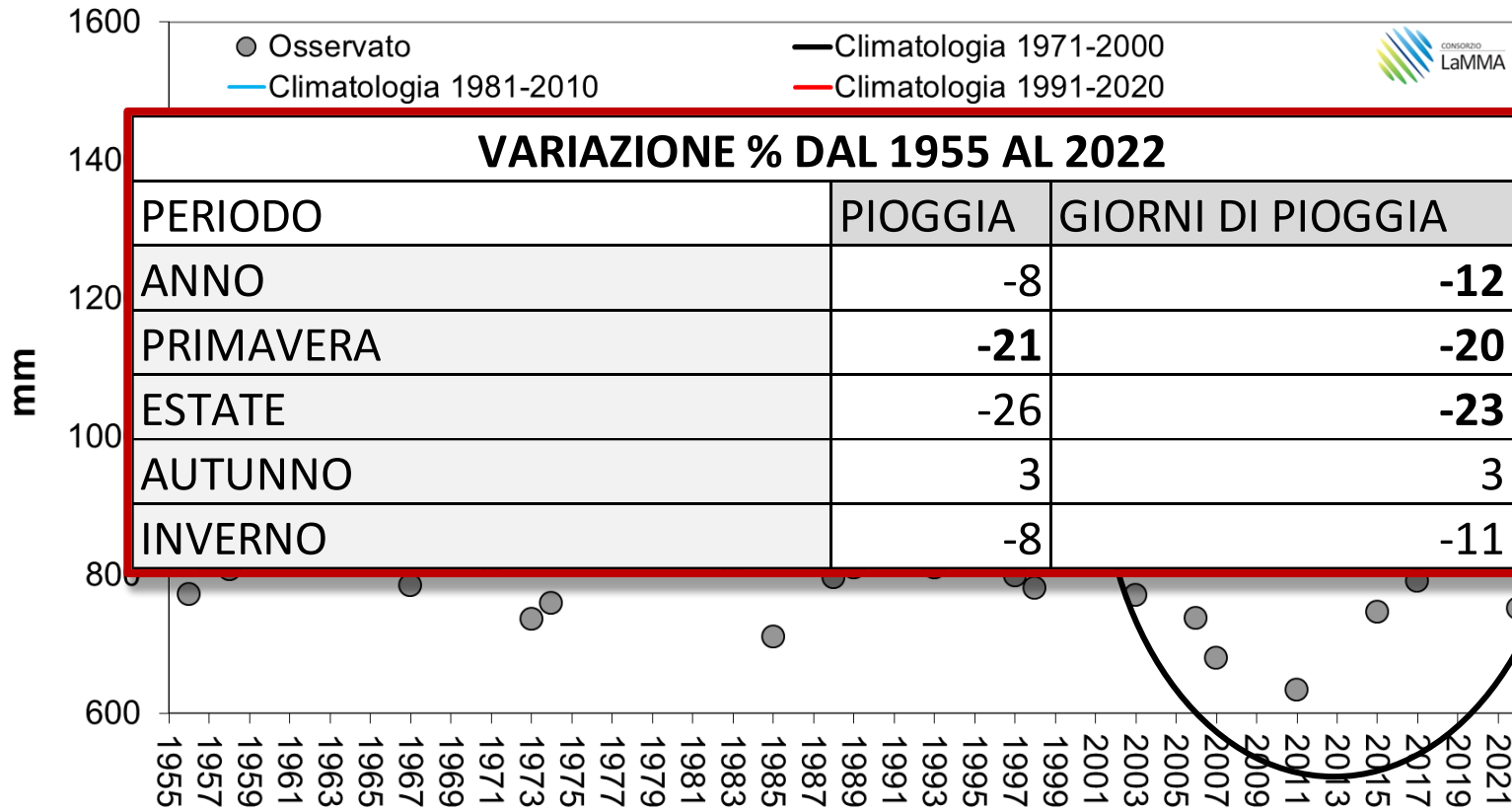
Temperatura media inverno Abetone





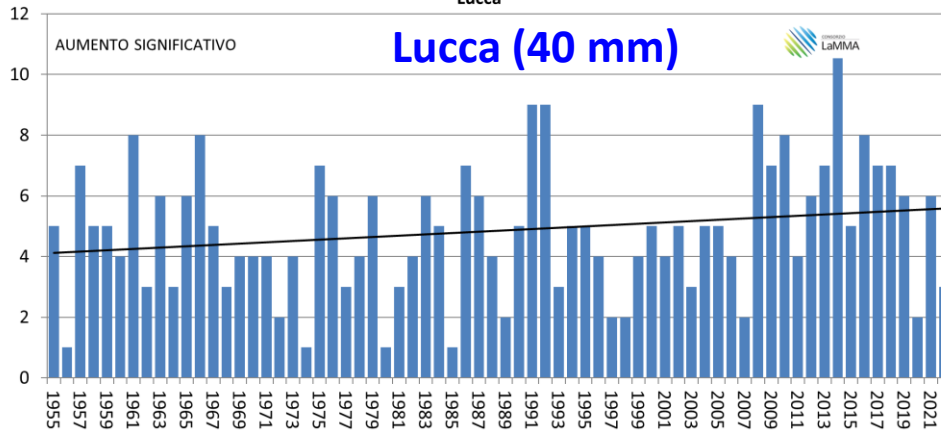
## ANNUAL CUMULATIVE RAINFALL

Pioggia annuale (media capoluoghi)

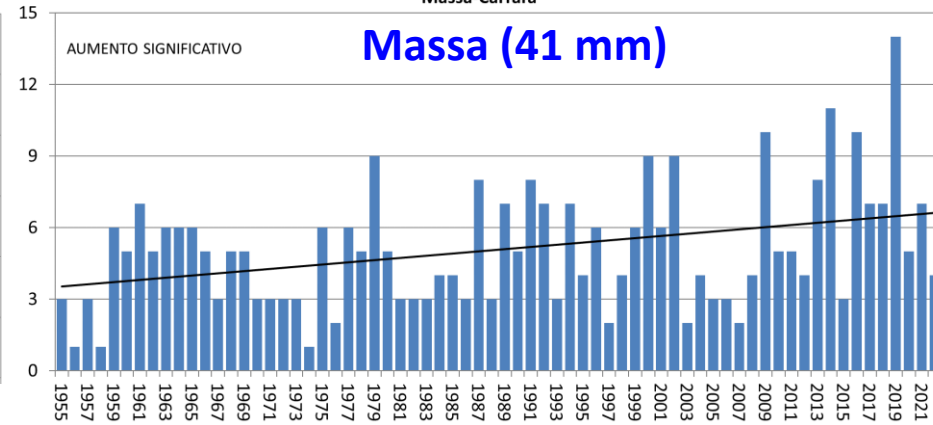


# Number of days with precipitation greater than the 95th percentile 1955-2022

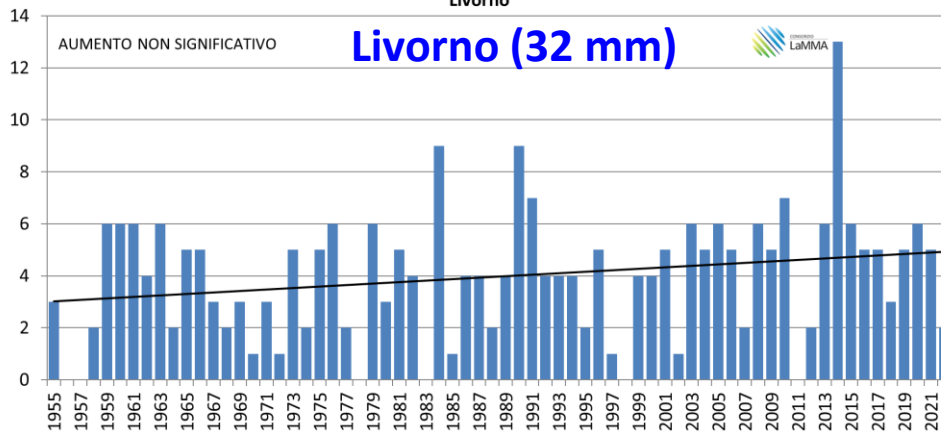
Giorni annui con pioggia giornaliera > 40 mm (95 percentile)  
Lucca



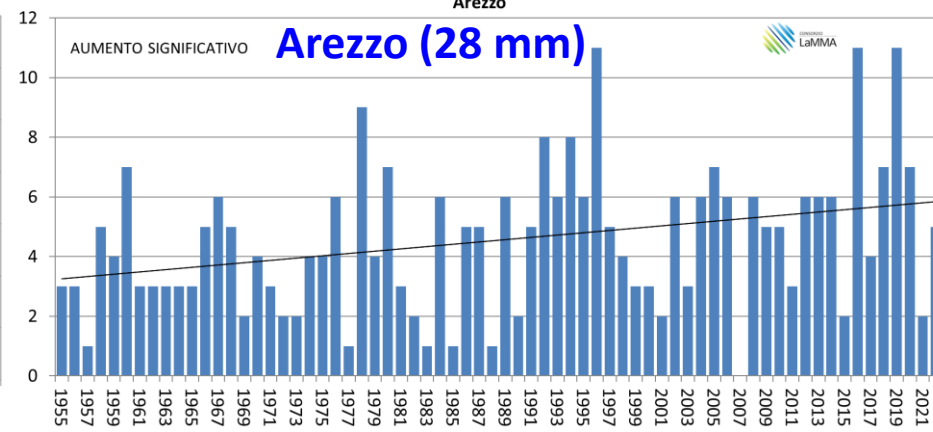
Giorni annui con pioggia giornaliera > 41 mm (95 percentile)  
Massa-Carrara



Giorni annui con pioggia giornaliera > 32 mm (95 percentile)  
Livorno



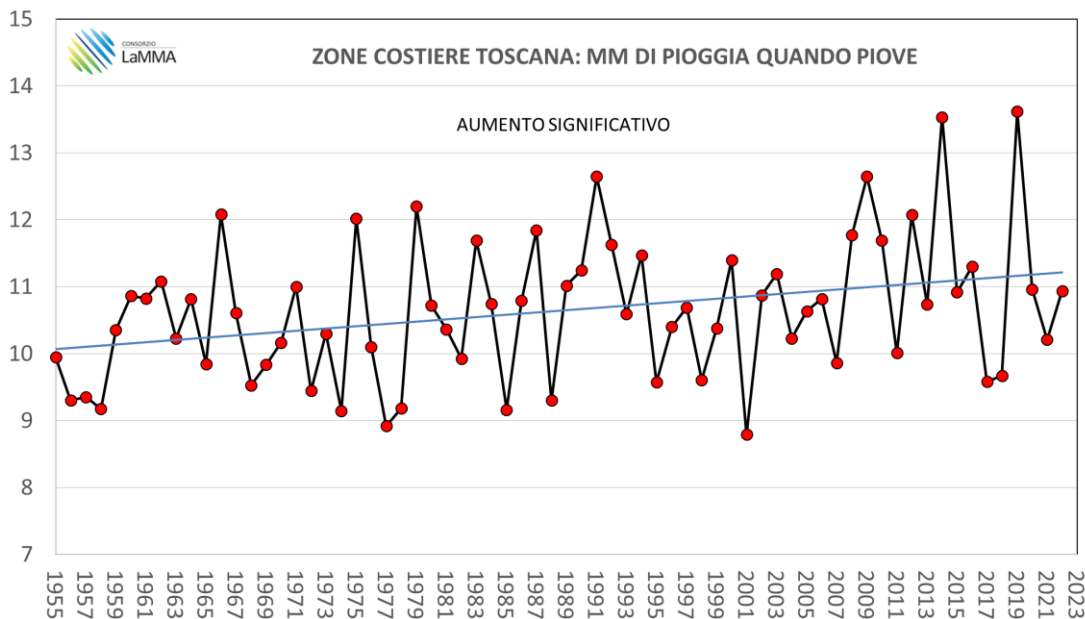
Giorni annui con pioggia giornaliera > 28 mm (95 percentile)  
Arezzo



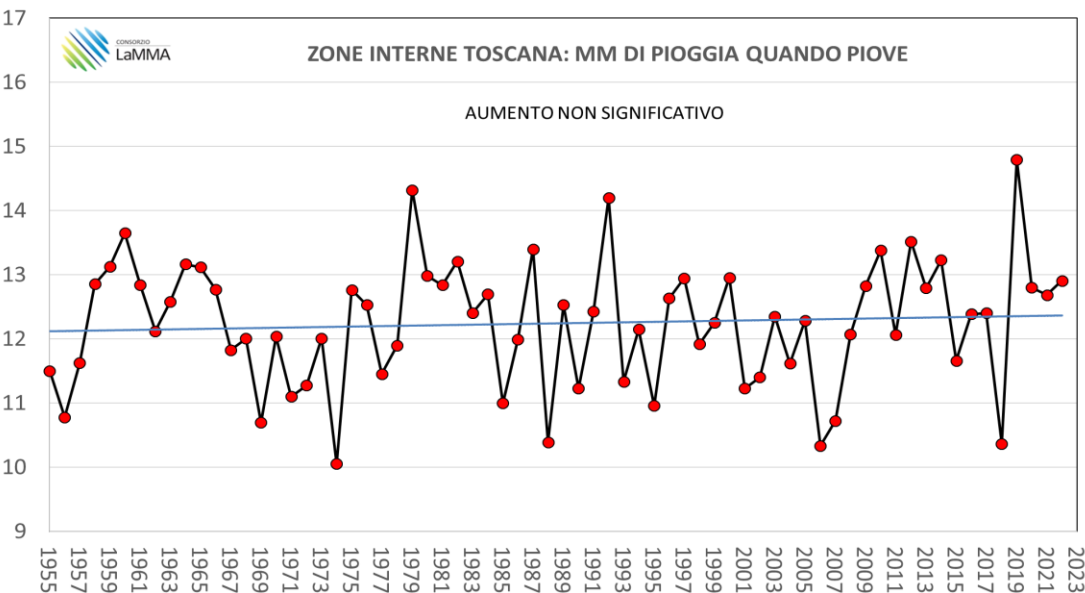
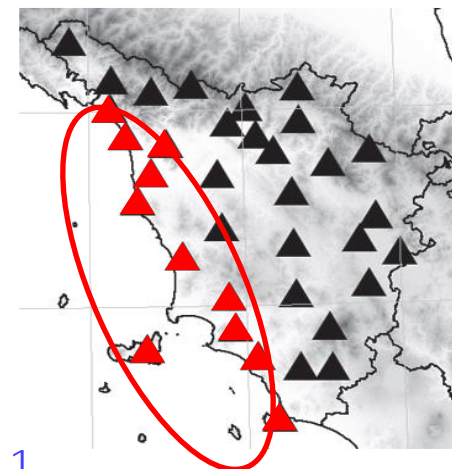
## SIGNS OF INCREASED RAINFALL INTENSITY

# How much it rains when it rains!

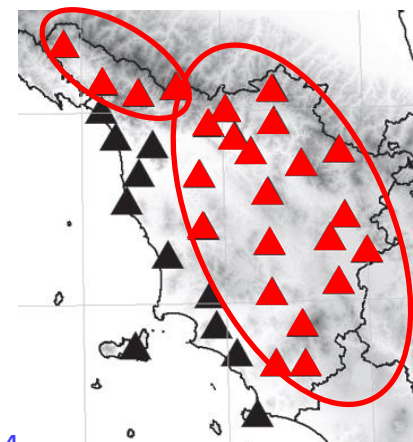
## How much does it rain on an average rainy day (1955-2022)



Coast 11

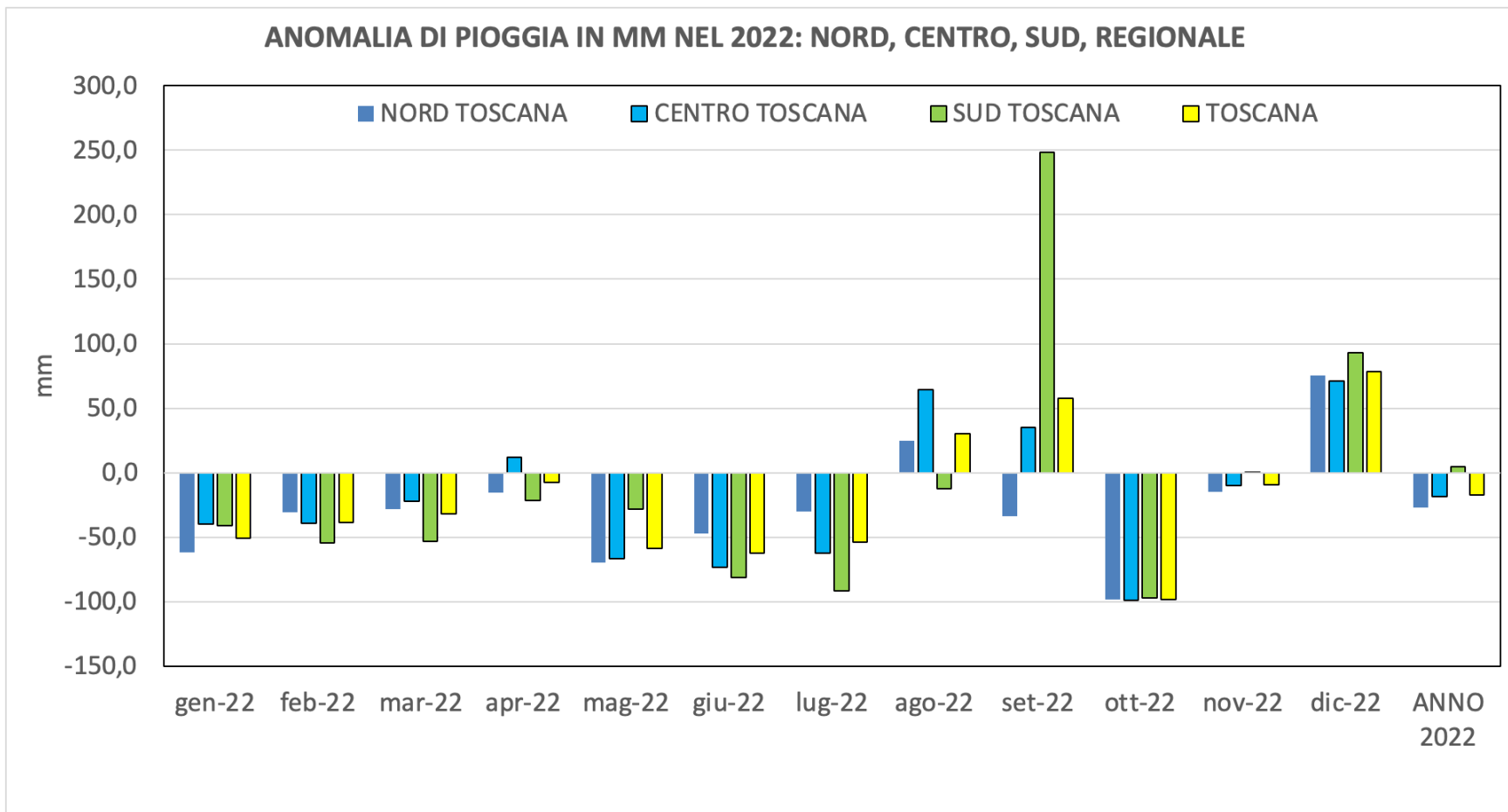


Inside 24



# 2022 Year

## RAINFALL ANOMALY PER MONTH



# TREND ANNUAL DRY DAYS

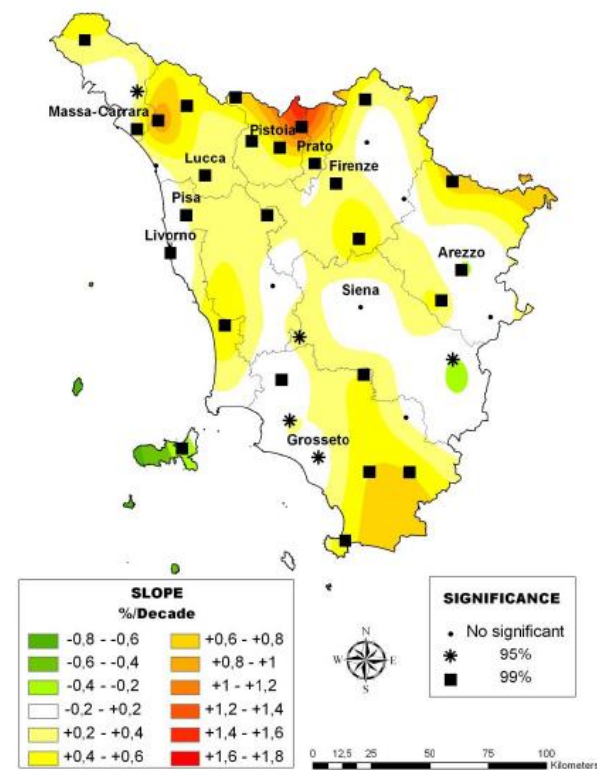
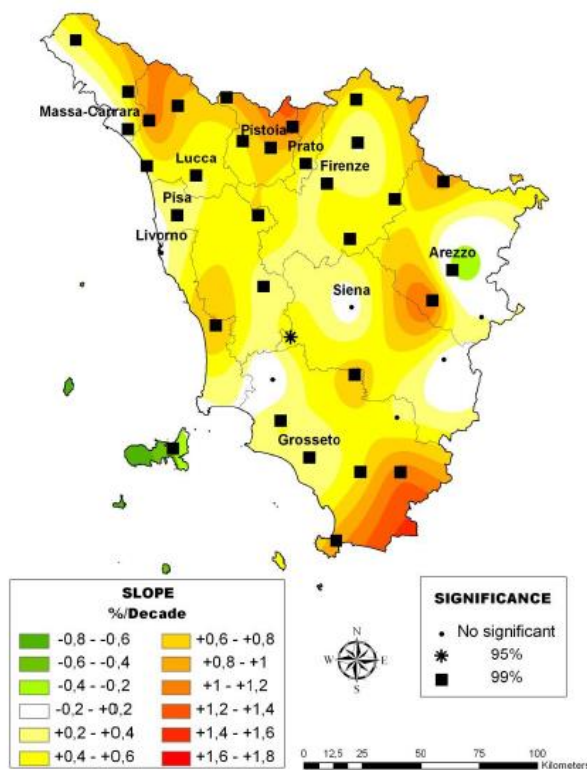
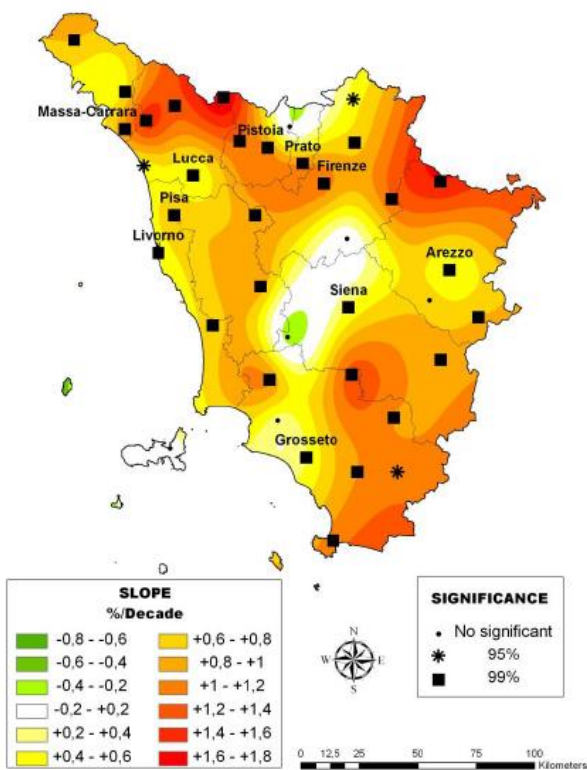
(Threshold 1, 5 and 10 mm)

Trend  
Annual Dry Days

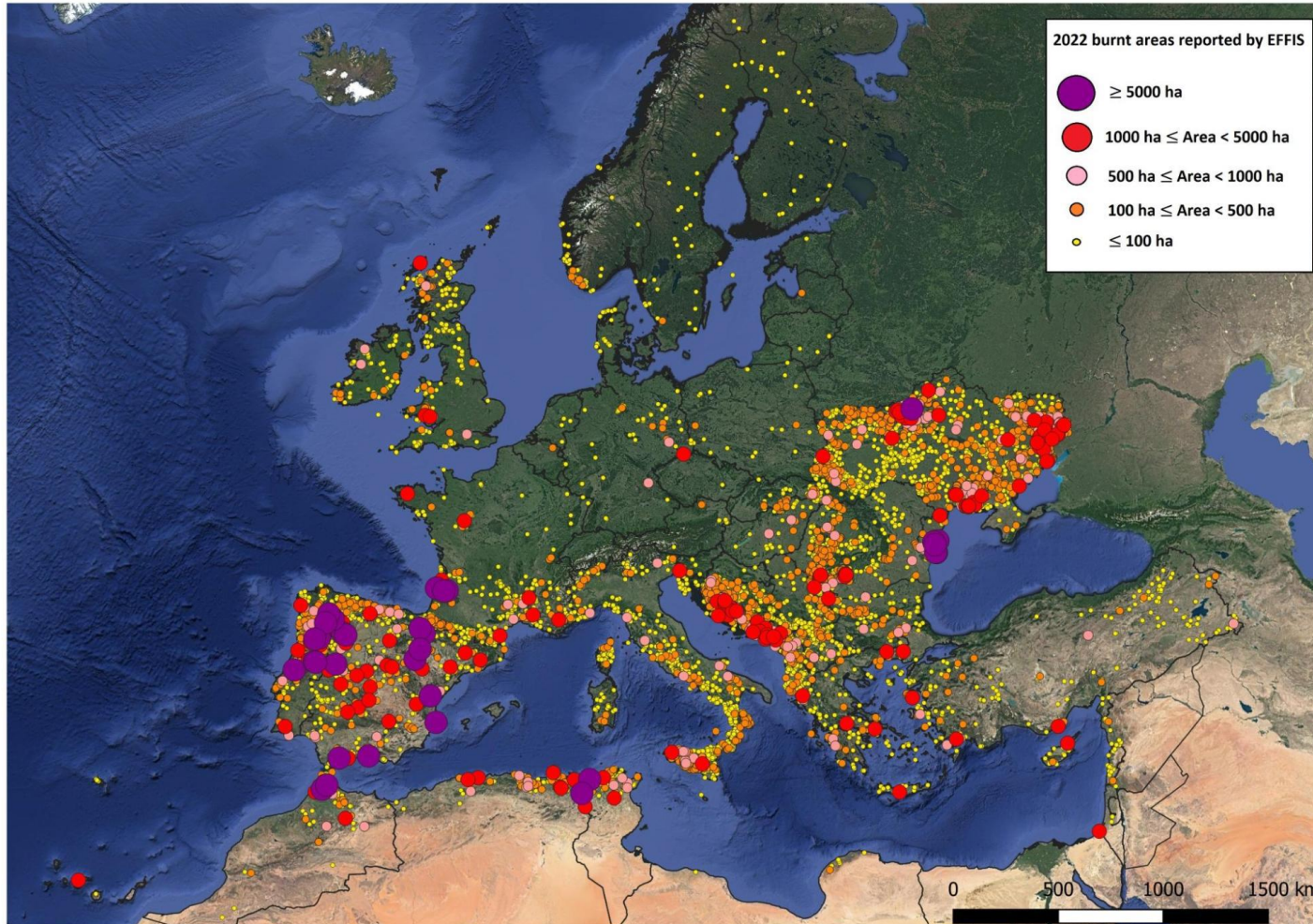
CLIM\_DD\_TREND\_A\_1

CLIM\_DD\_TREND\_A\_5

CLIM\_DD\_TREND\_A\_10



# Forest fires in Europe 2022

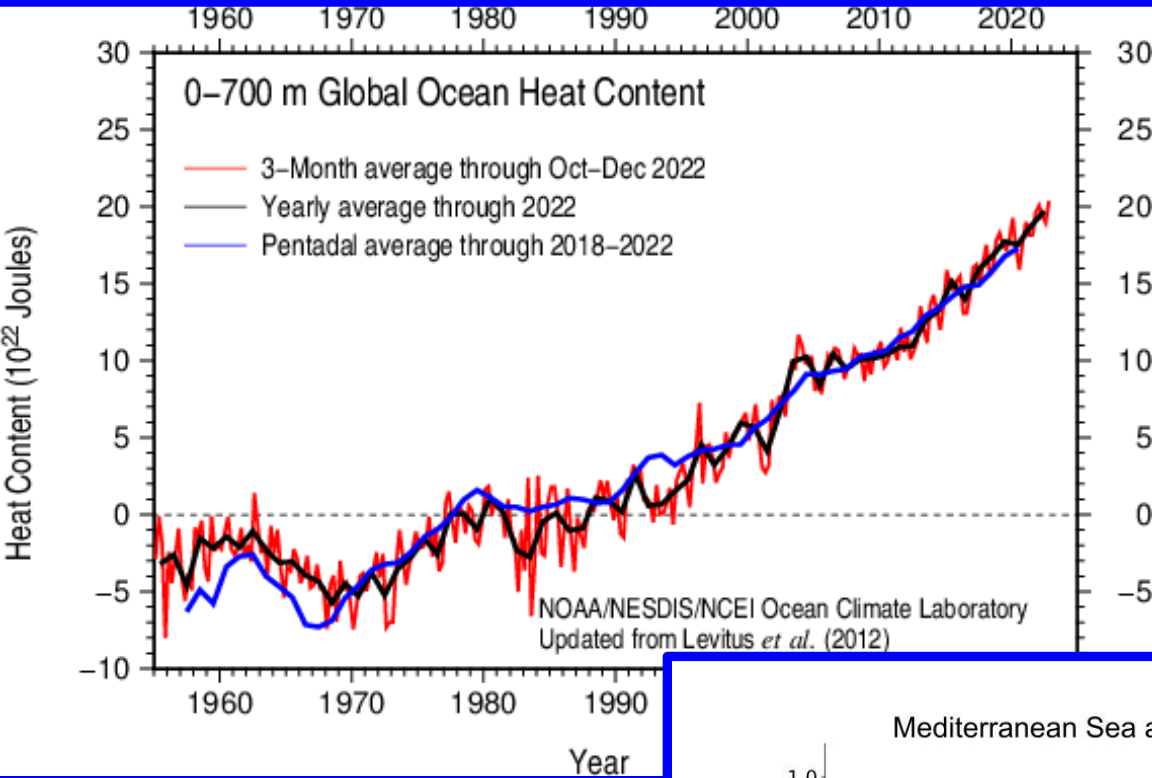


**Numbers for  
Tuscany:  
591 forest  
fires  
2247 ha  
3,5 ha per  
event  
(mean 2015-2021  
was 2,1)**

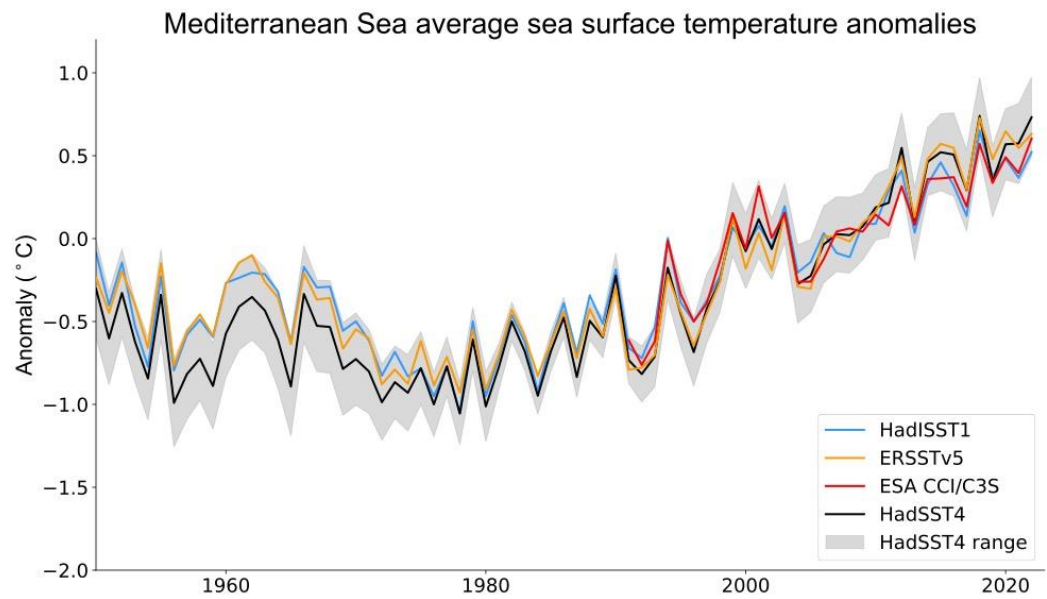


# Sea Surface Temperature

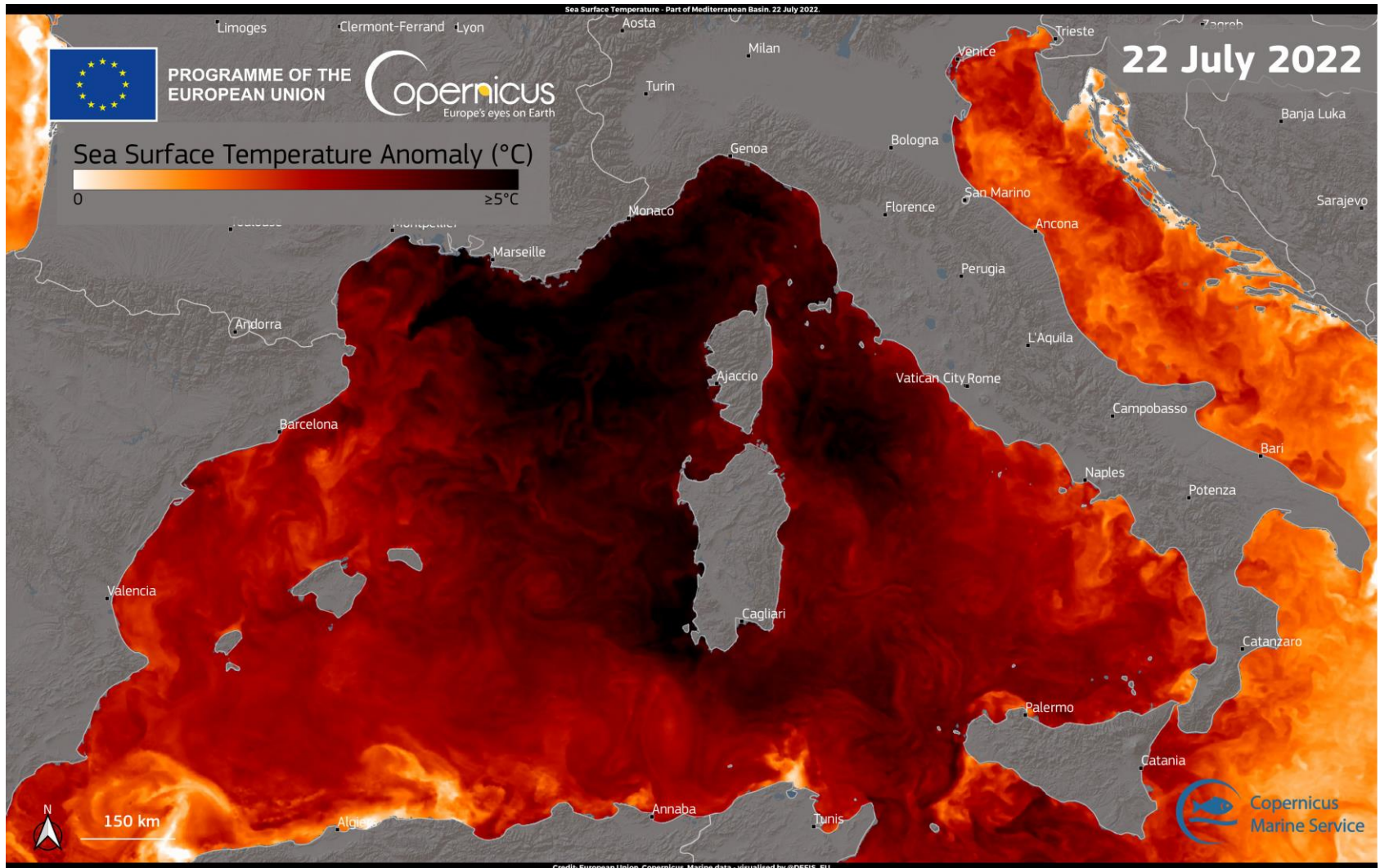
Global Ocean Heat Content 0-700 m



Mediterranean sea surface temp. anomalies



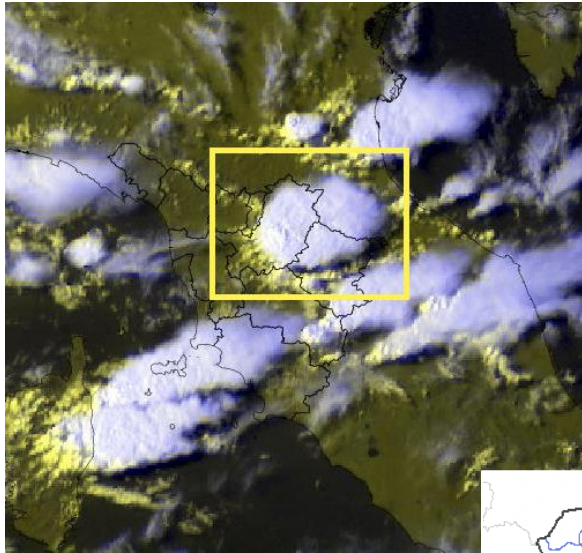
# SEA SURFACE TEMPERATURE



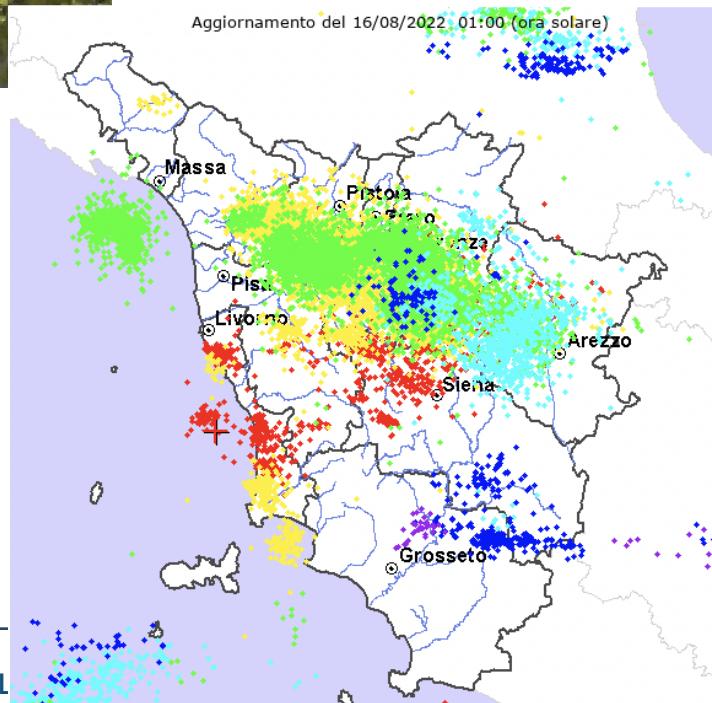
+ evaporation, + energy, + humidity

# 15 AUGUST 2022

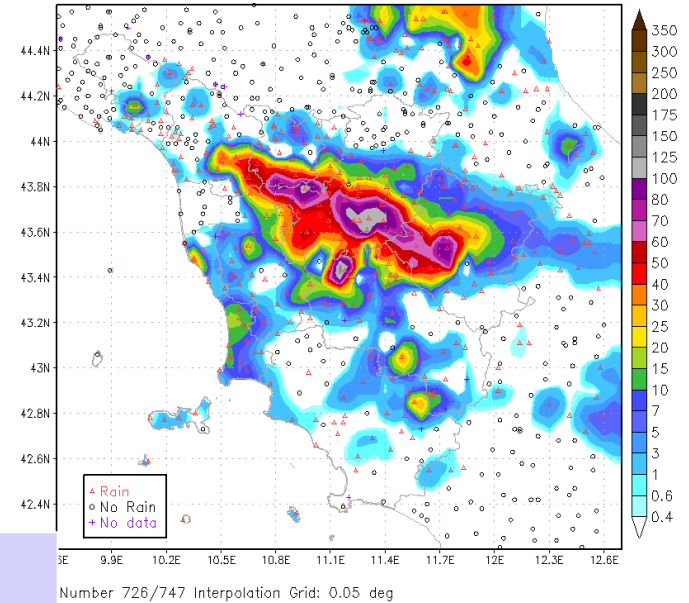
satellite 17:30



17.000 Lightning



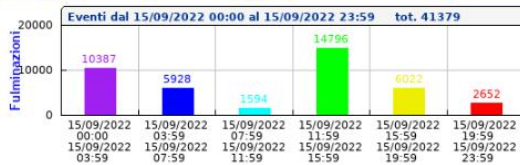
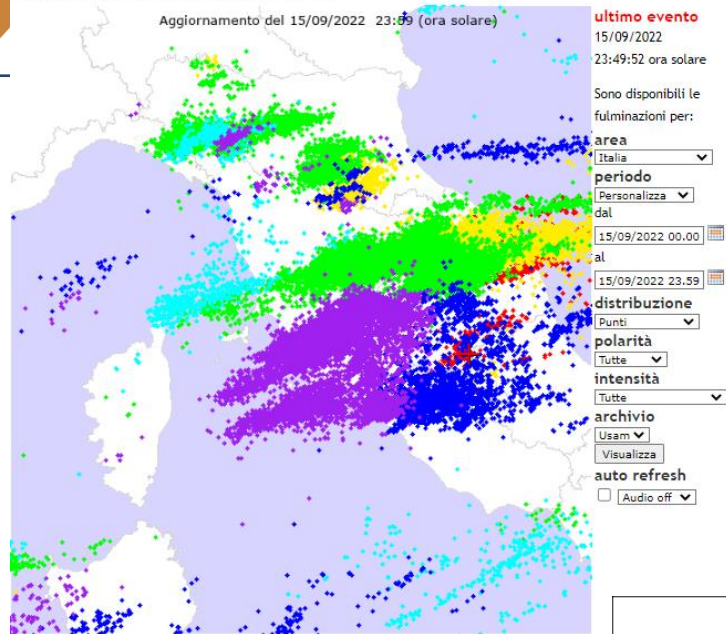
Total Precipitation [mm] cumulated on  
Mon, 15/08/2022



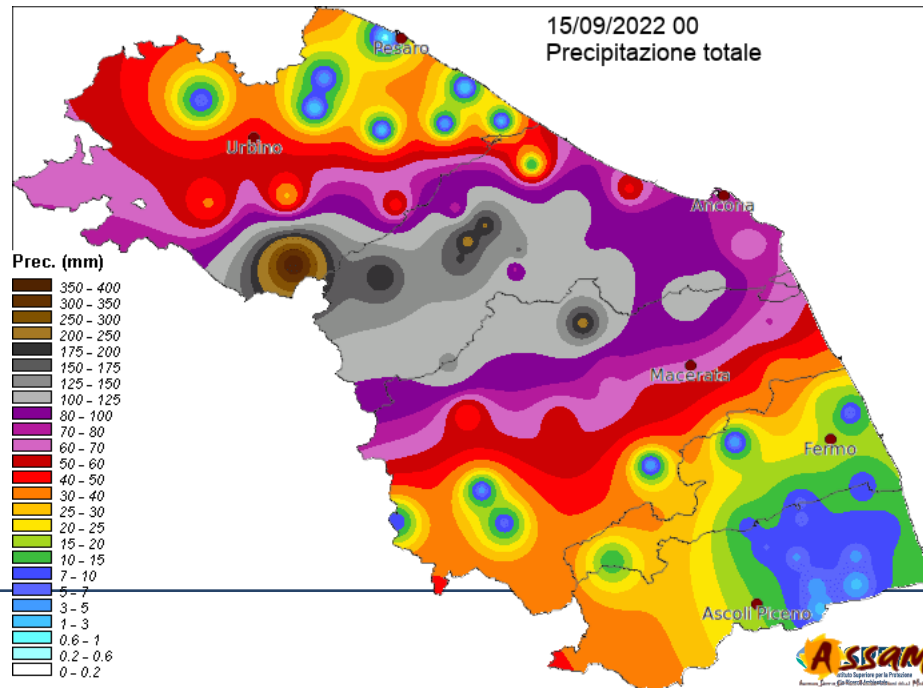
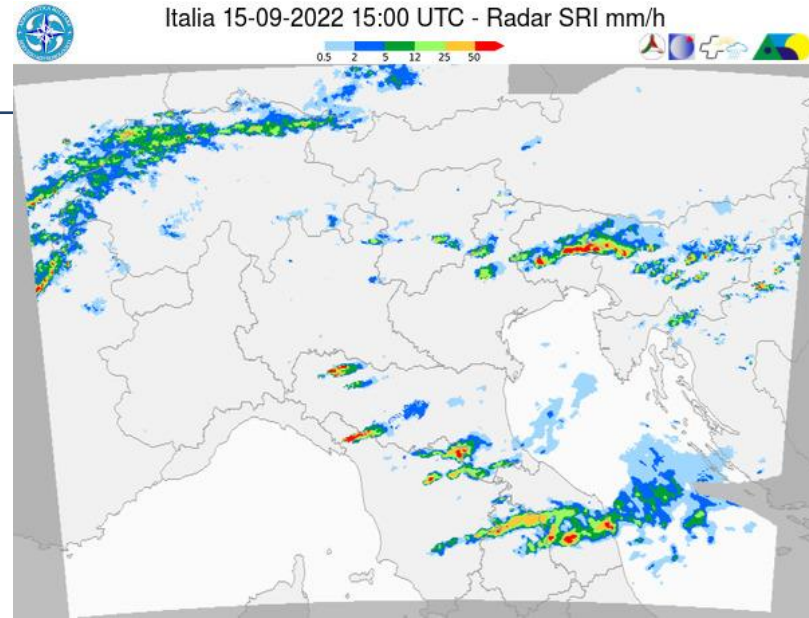
Rainfall 15 of august  
Cumulatives up to 150-170  
mm  
Hourly intensities up to 50  
mm/h

# 15 September 2022

Fulmini nube-suolo rilevati da USAM



Italia 15-09-2022 15:00 UTC - Radar SRI mm/h





**Grazie per l'attenzione**

