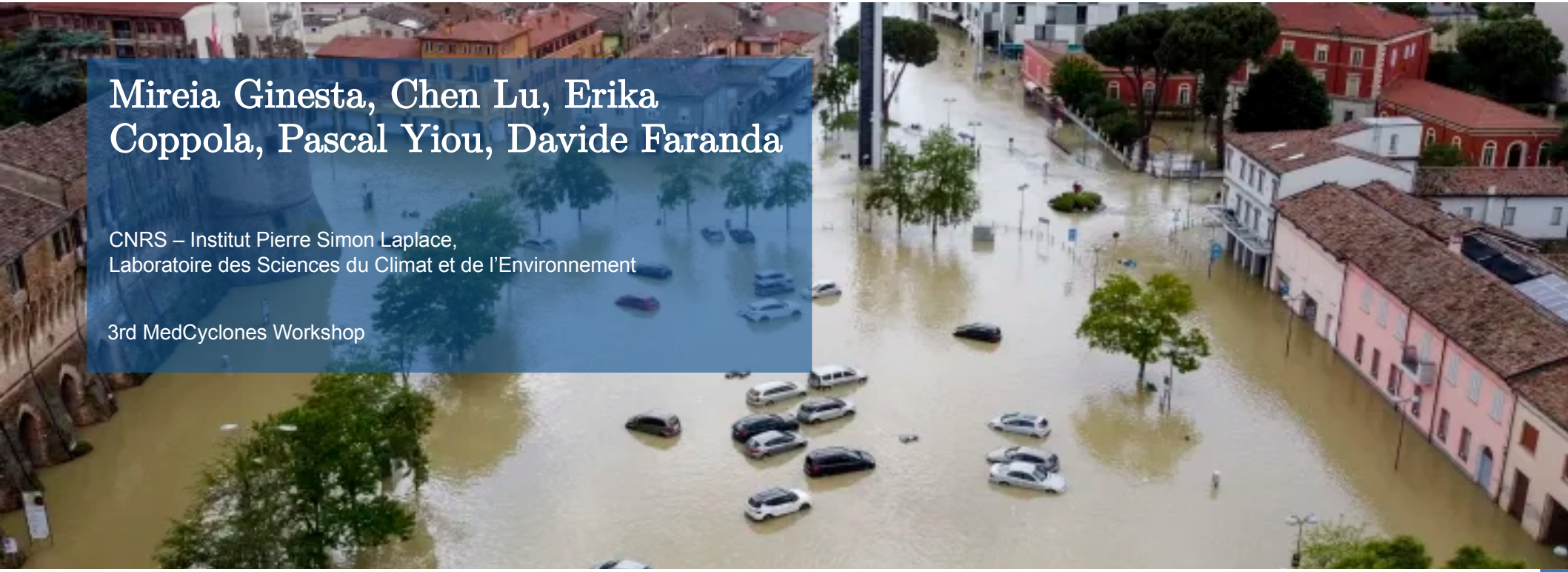
Climate change fingerprint on the 2023 Emilia Romagna floods



Mireia Ginesta, Chen Lu, Erika Coppola, Pascal Yiou, Davide Faranda

CNRS – Institut Pierre Simon Laplace,
Laboratoire des Sciences du Climat et de l'Environnement

3rd MedCyclones Workshop

EMILIA ROMAGNA FLOODS 2023

- May 2023
- Clustering of three extratropical cyclones (2^{nd}, 10^{th}, and 16^{th} of May)
- 18 fatalities
- 10 bn $
- Rivers overflow and landslides

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EMILIA ROMAGNA FLOODS 2023

Source: ESA

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EMILIA ROMAGNA FLOODS 2023

Source: ESA

May 2023

Clustering of three extratropical cyclones (2^{nd}, 10^{th}, and 16^{th} of May)

18 fatalities

10 bn $

Rivers overflow and landslides

Did **climate change** play a role in altering the severity of each cyclone?

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EMILIA ROMAGNA FLOODS 2023

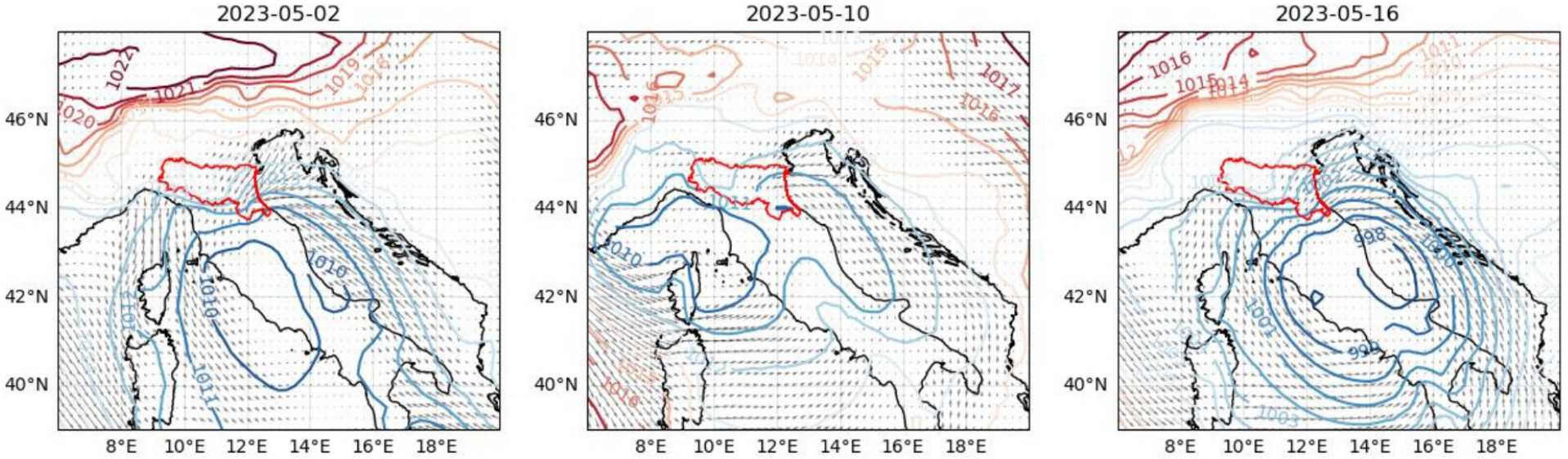

Figure from Barnes et al. 2023

→ Event defined as **accumulated precipitation over 21 days** from April to June
They found **no role of climate change** in altering the likelihood or intensity

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DATA AND METHODS

We find **analogues** (i.e. similar events) in two different climate periods and compare the hazards associated to the analogues

ERA5 reanalysis

Daily data

March – April – May – June

20 analogues

PAST

[1950-1985]

20 analogues

PRESENT

[1987-2022]

→ Faranda et al. 2022, Ginesta et al. 2023, CLIMAMETER: analogues of **sea level pressure** pattern

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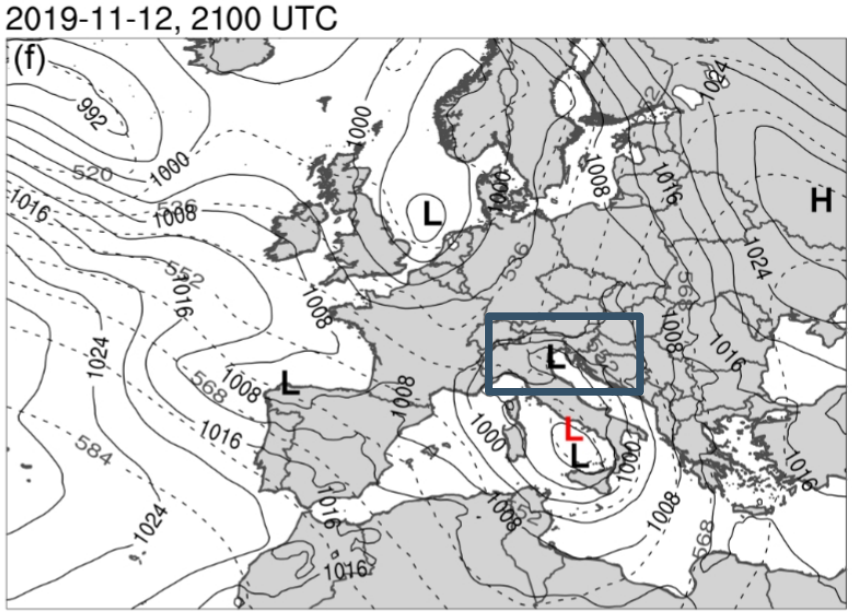

Source: Miglietta et al. (2023)

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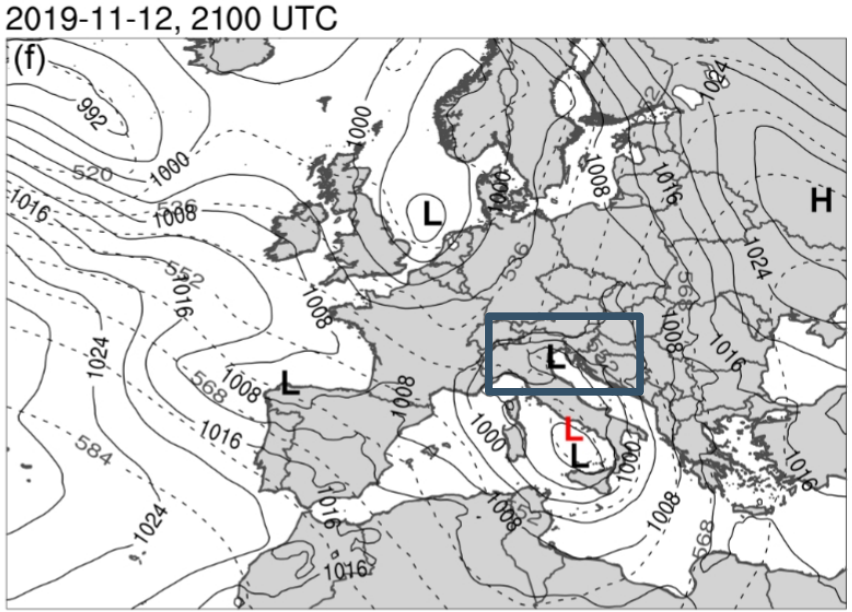

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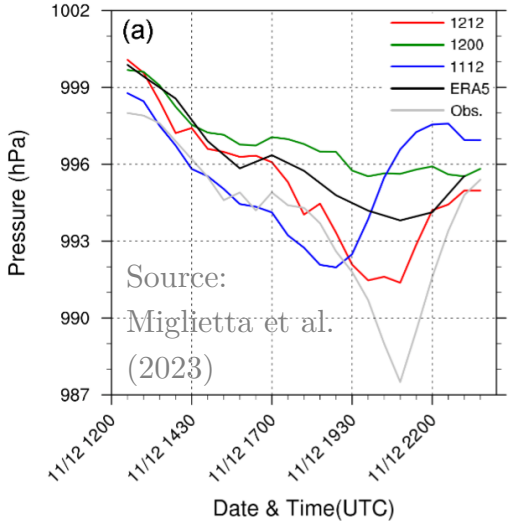

Mesoscale circulation not resolved by ERA5

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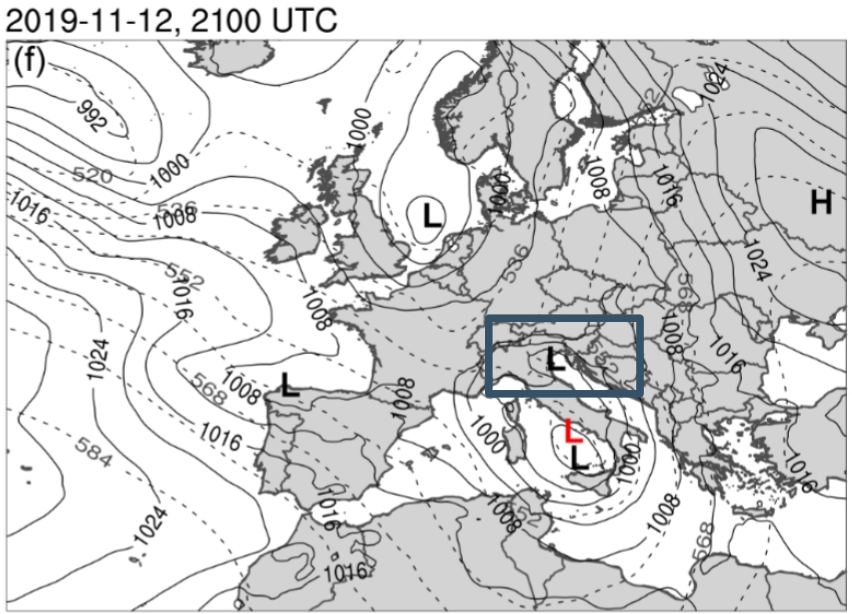

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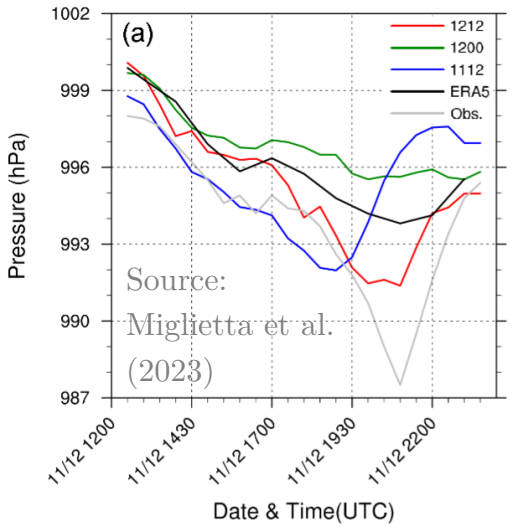

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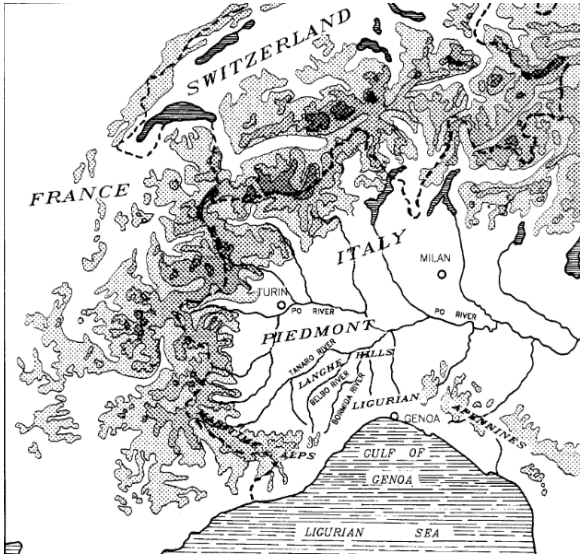

Complex topography modifies flow (Buzzi et al 1998)

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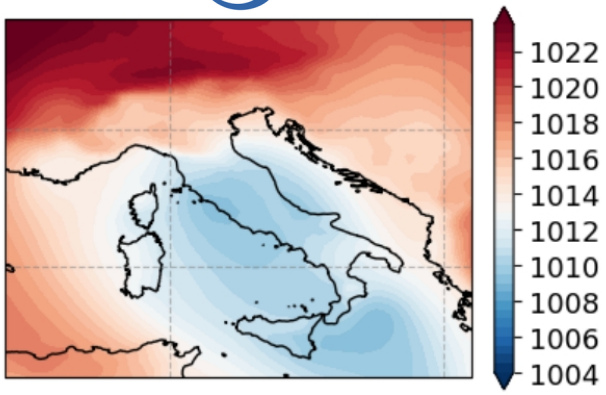
DATA AND METHODS

A MULTIVARIATE APPROACH

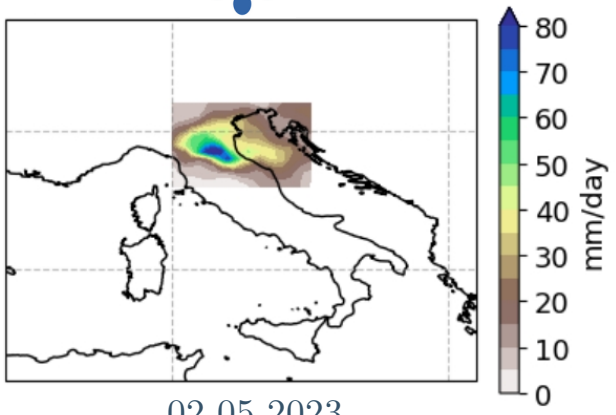
→ Faranda, D., Ginesta, M., et al. "Attributing Venice Acqua Alta events to a changing climate and evaluating the efficacy of MoSE adaptation strategy." npj climate and atmospheric science 6.1 (2023): 181.

DYNAMICS



02-05-2023

REGIONAL HAZARDS



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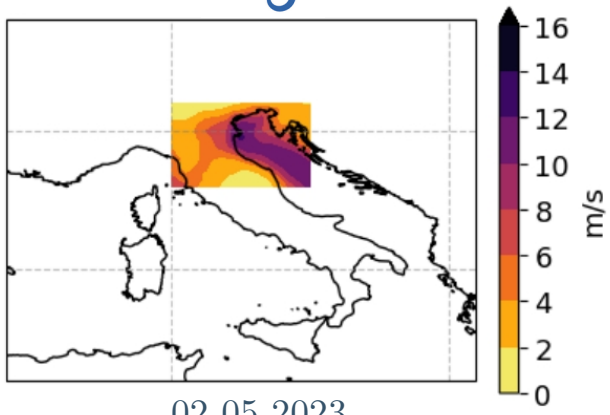

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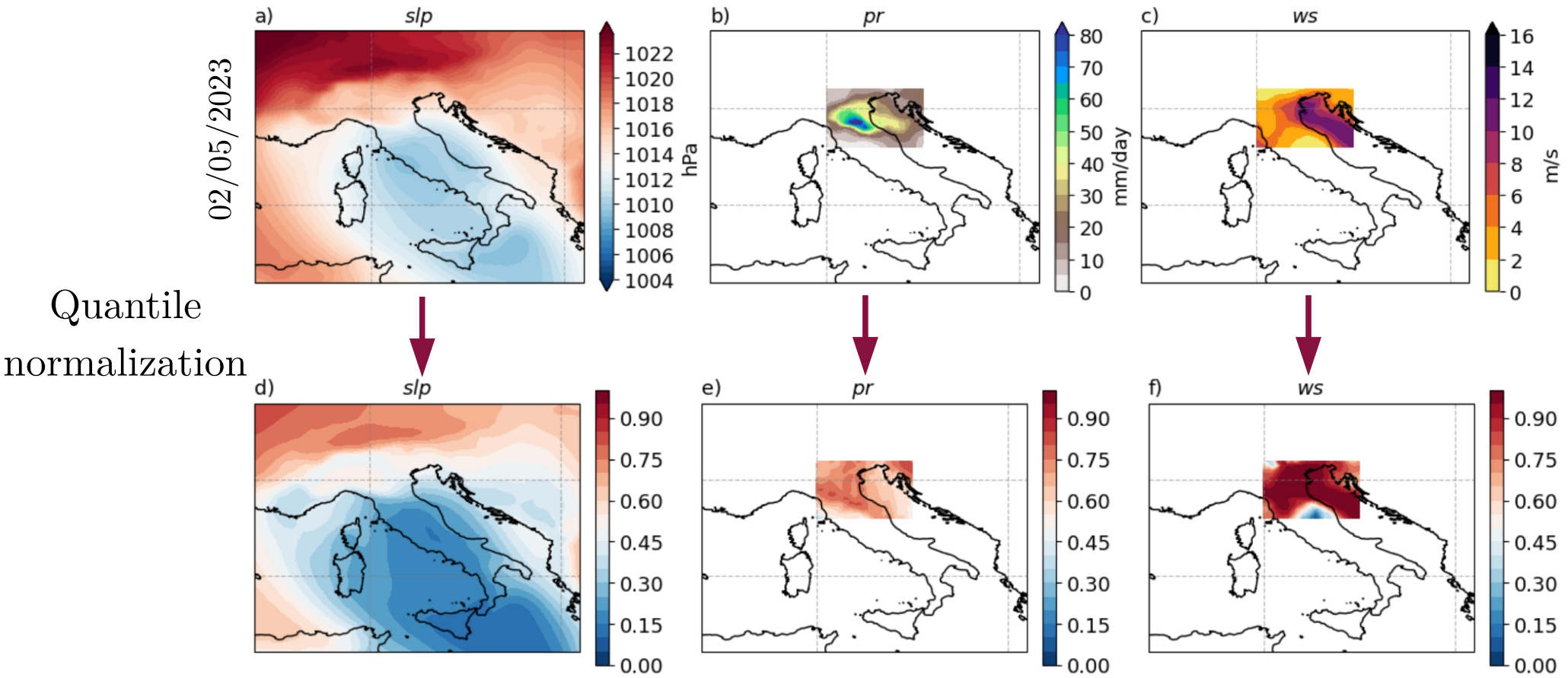

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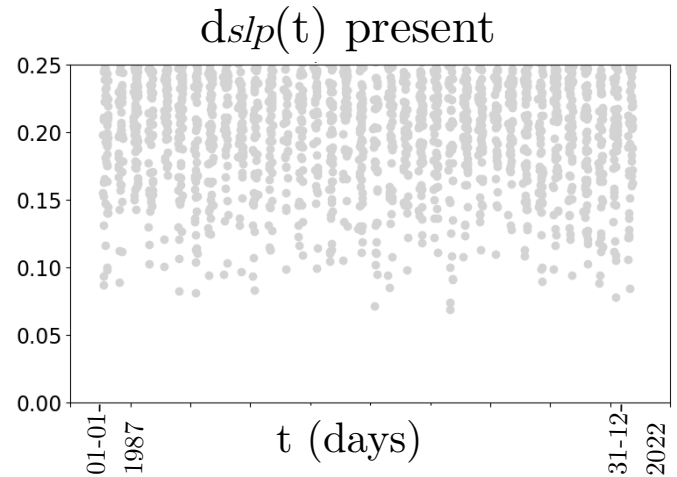

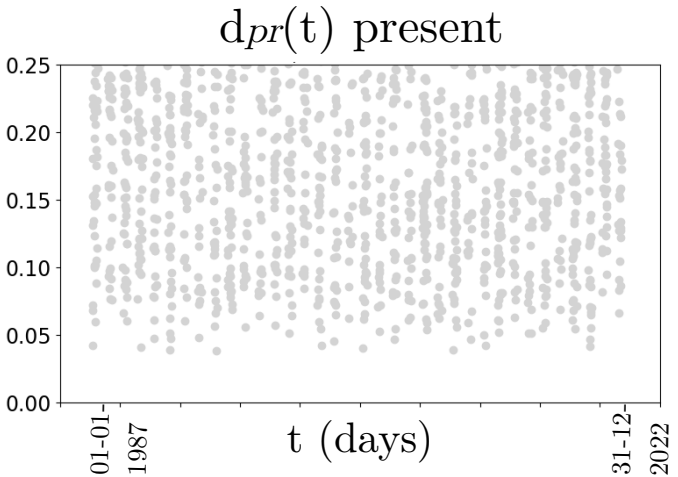

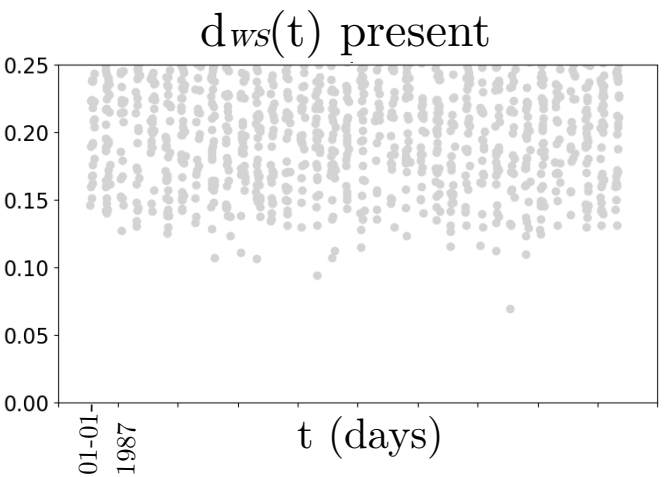

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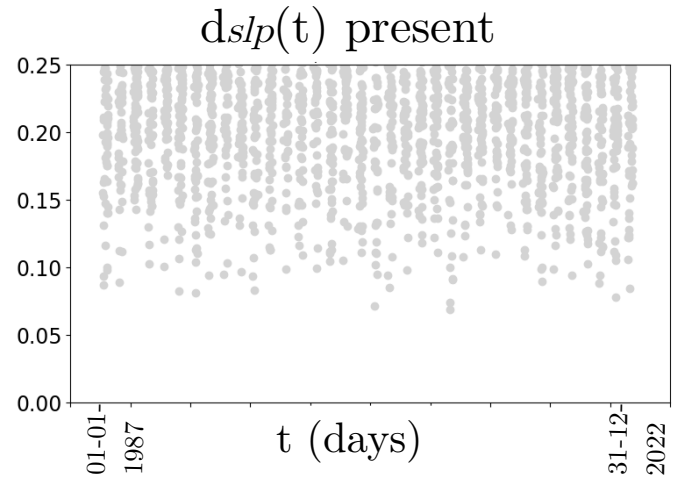
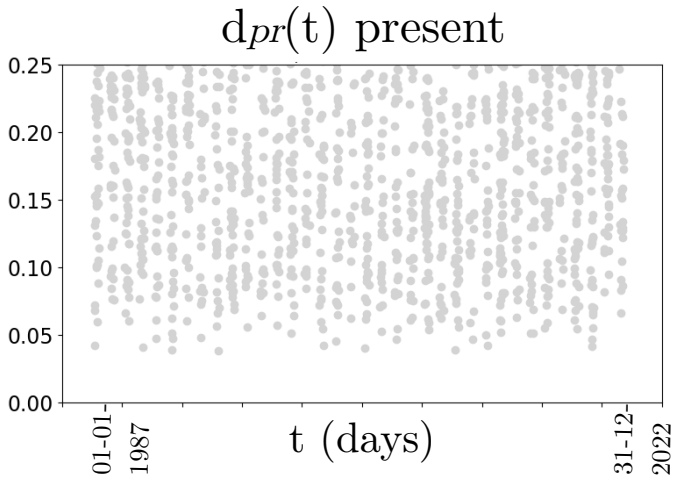
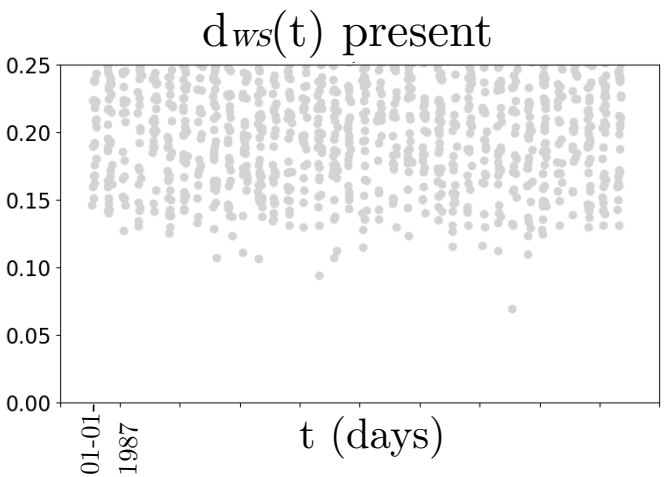
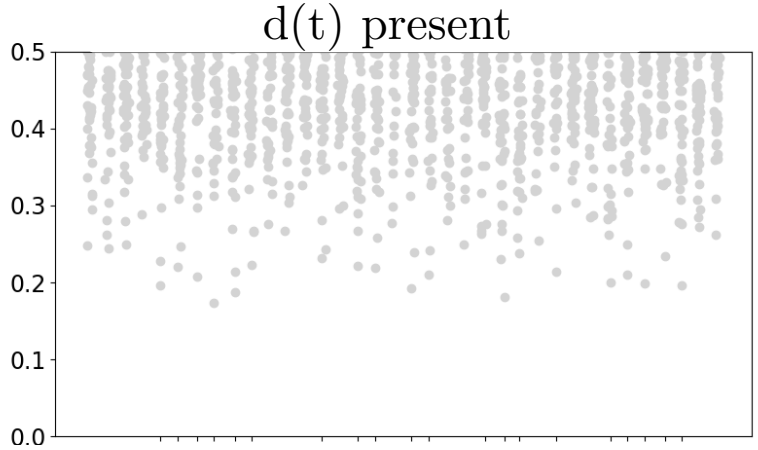






$$d(t) = \sqrt{d_{slp}(t)^2 + d_{pr}(t)^2 + d_{ws}(t)^2}$$



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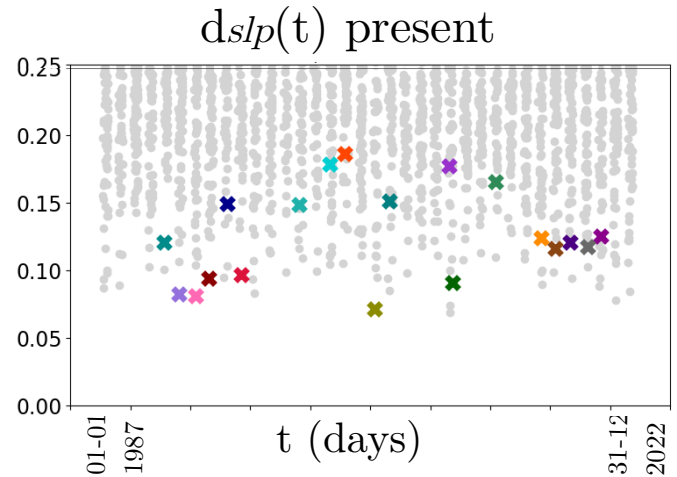

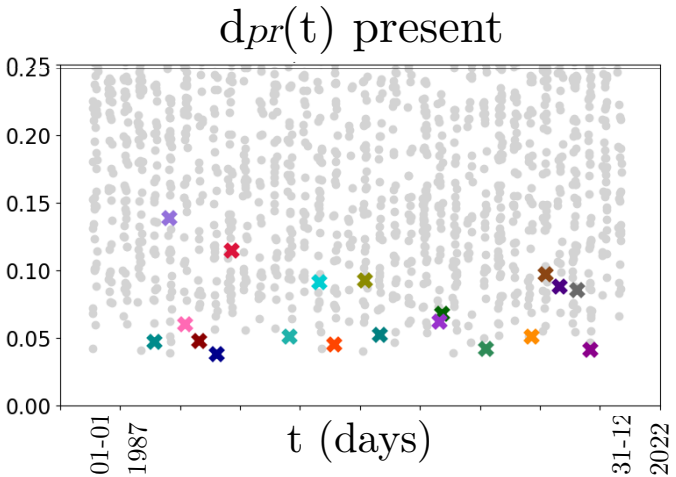

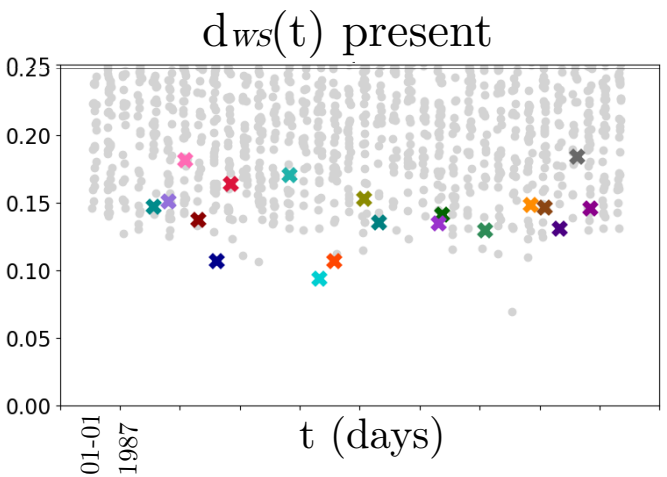

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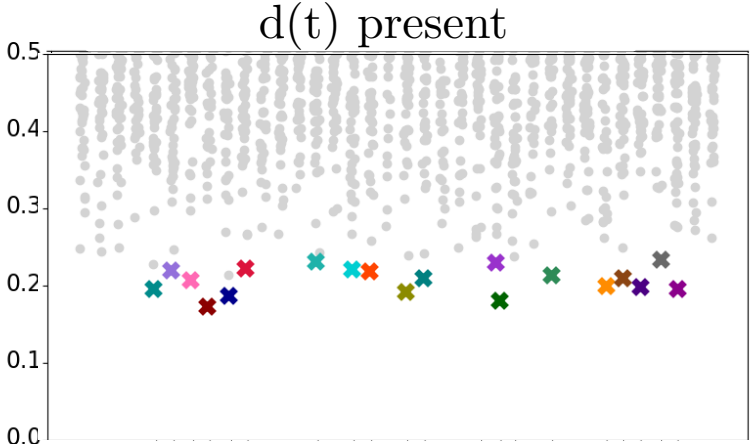

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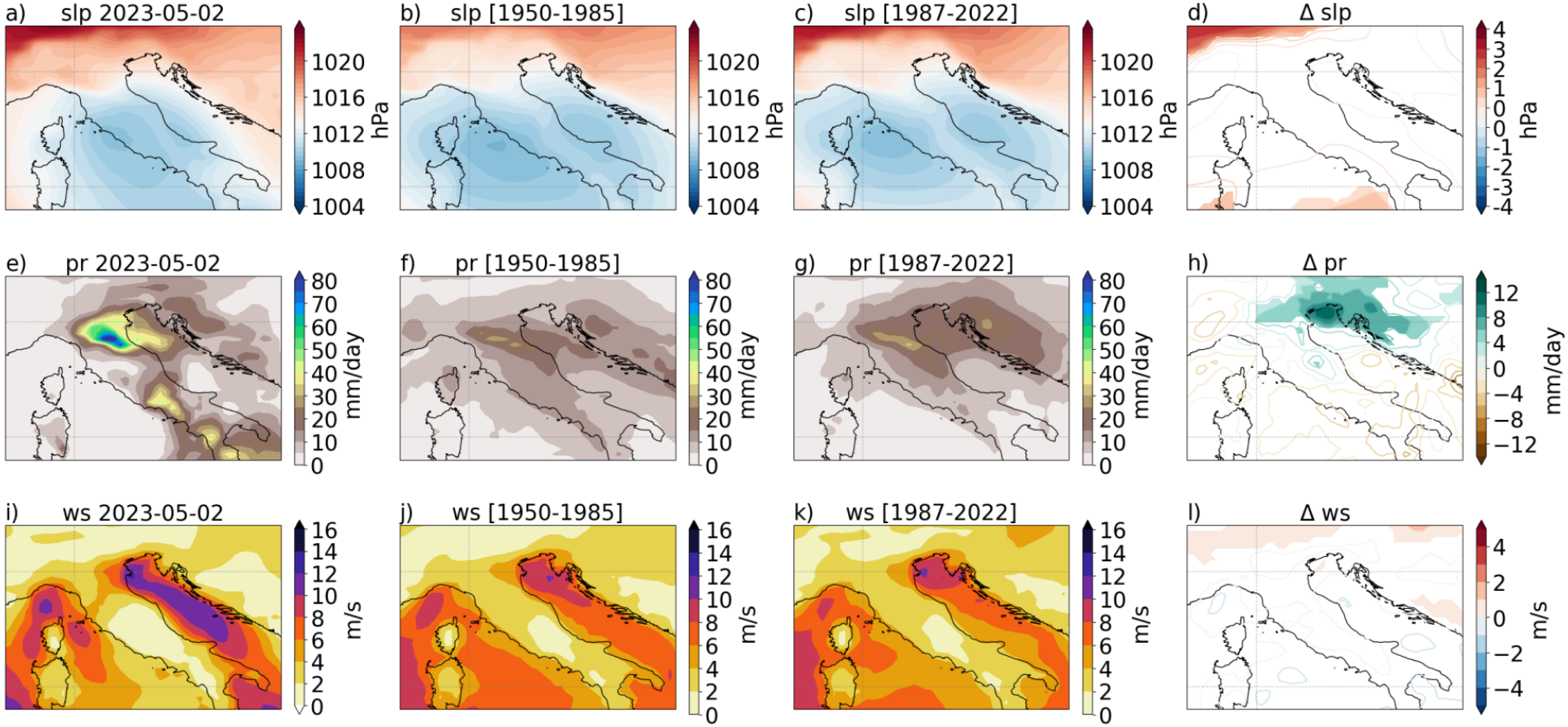
DETECTED CHANGES IN ERA5



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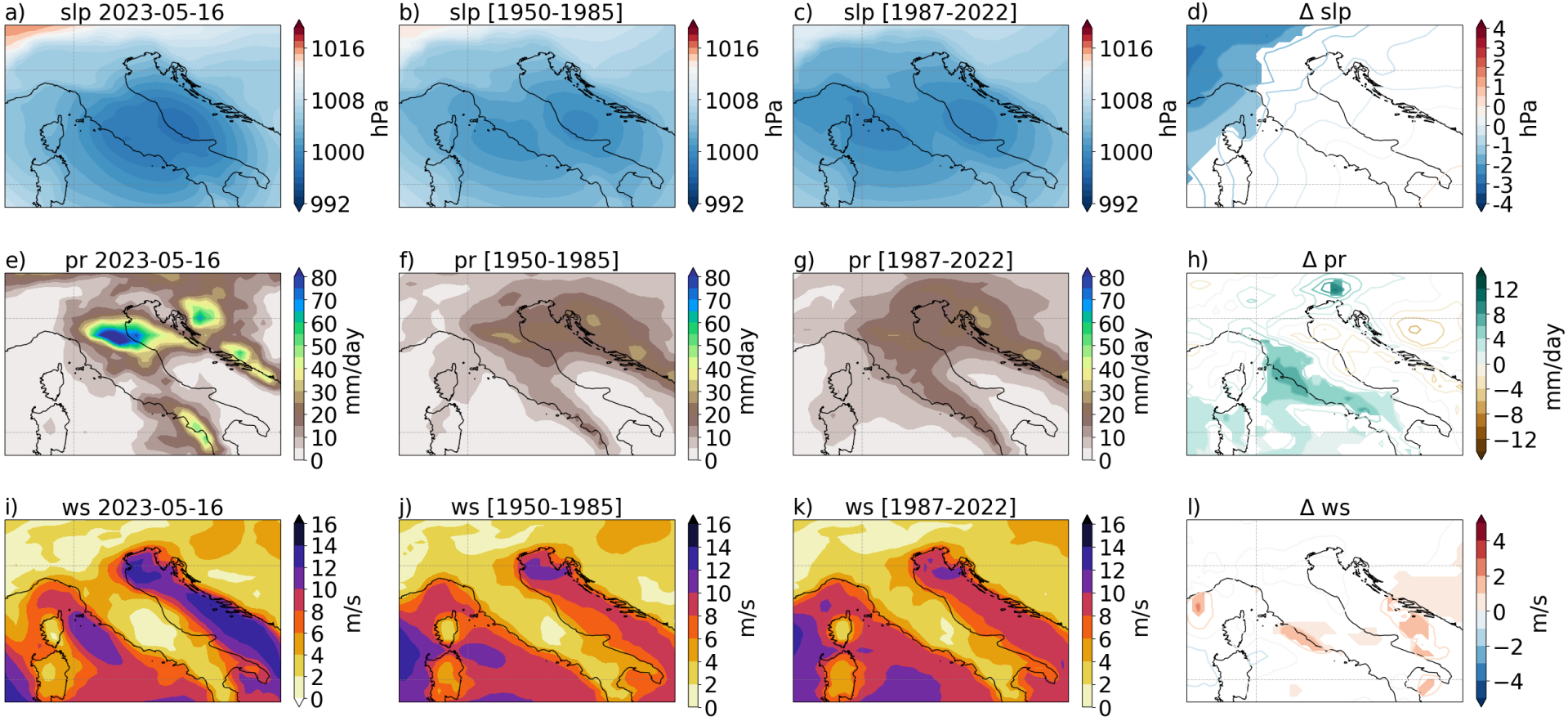

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Is the signal going to hold in future decades?

FUTURE PROJECTIONS

19 **EURO-CORDEX** simulations at 0.11° (12 km)

- Historical [1970-2000]
- Future [2070-2100] (RCP8.5)

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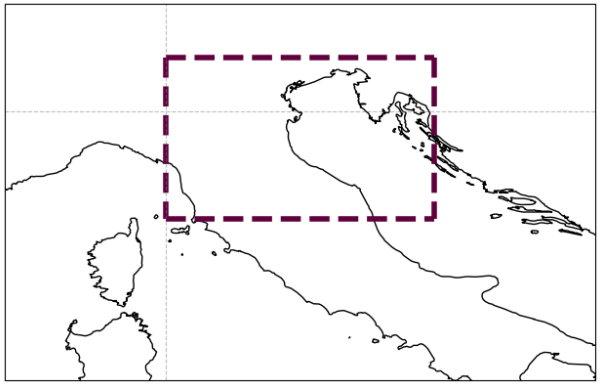
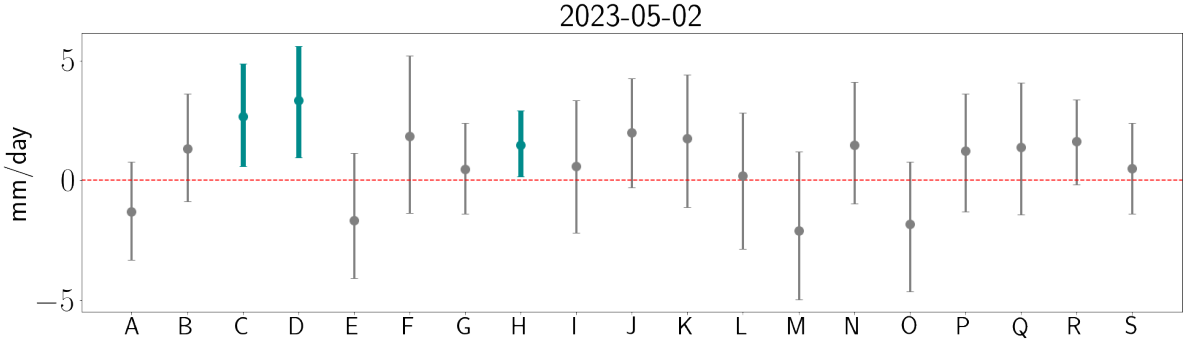
FUTURE PROJECTIONS IN EURO-CORDEX

Future – historical differences in PR





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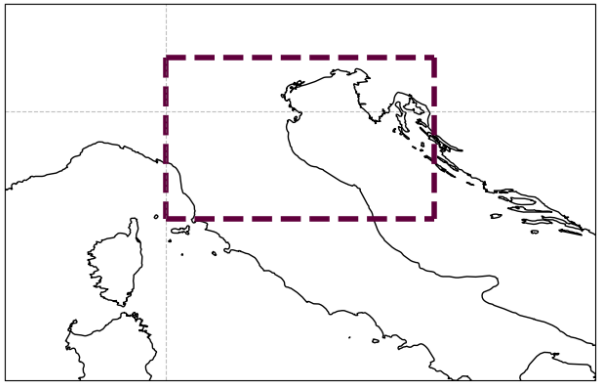

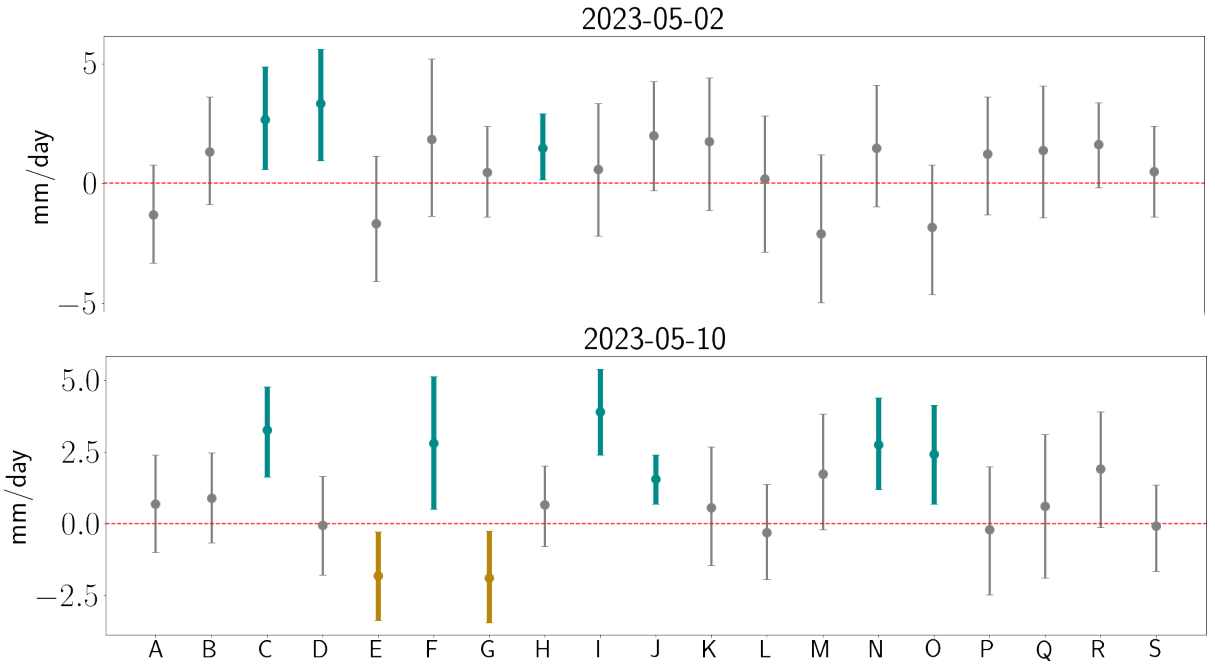

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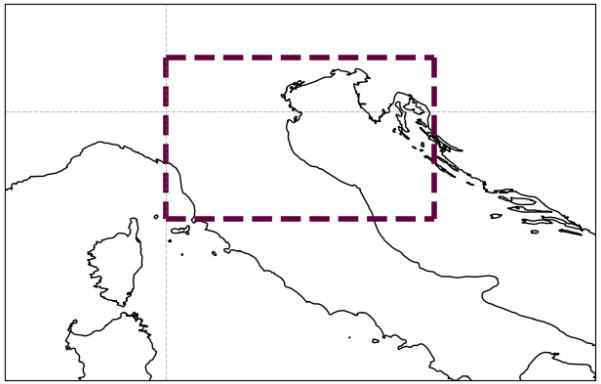

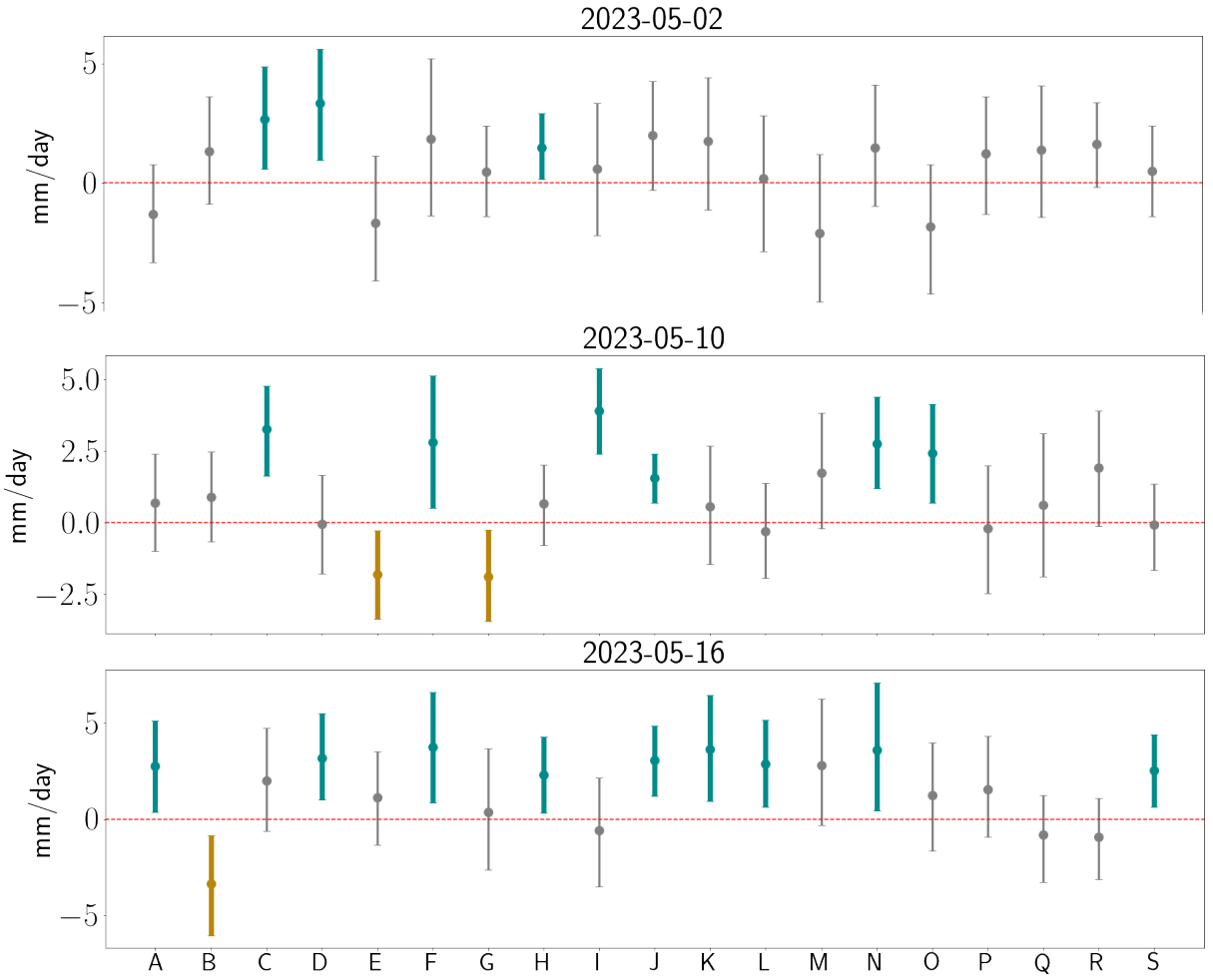

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Limitations

- ⚠ Number of analogues
- ⚠ Difficulty of isolating climate change signal from internal variability
- ⚠ Models ability to reproduce the event

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- ⚙ Regionalization of the analogues approach
- ⚙ Possibility of using more variables (e.g. compound events)

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THANK YOU!

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