



Trend in precipitation and drought extremes in southern lowland regions of Europe



Alexandra Berényi, Rita Pongrácz and Judit Bartholy

Department of Meteorology, Eötvös Loránd University, Budapest, Hungary
e-mails: berenyia@student.elte.hu, pongacz.rita@ttk.elte.hu,
bartholy.judit@ttk.elte.hu

Live vPICO presentation: Tue, 27 Apr, 09:00–15:00 (CEST)



1. Study area and methodology

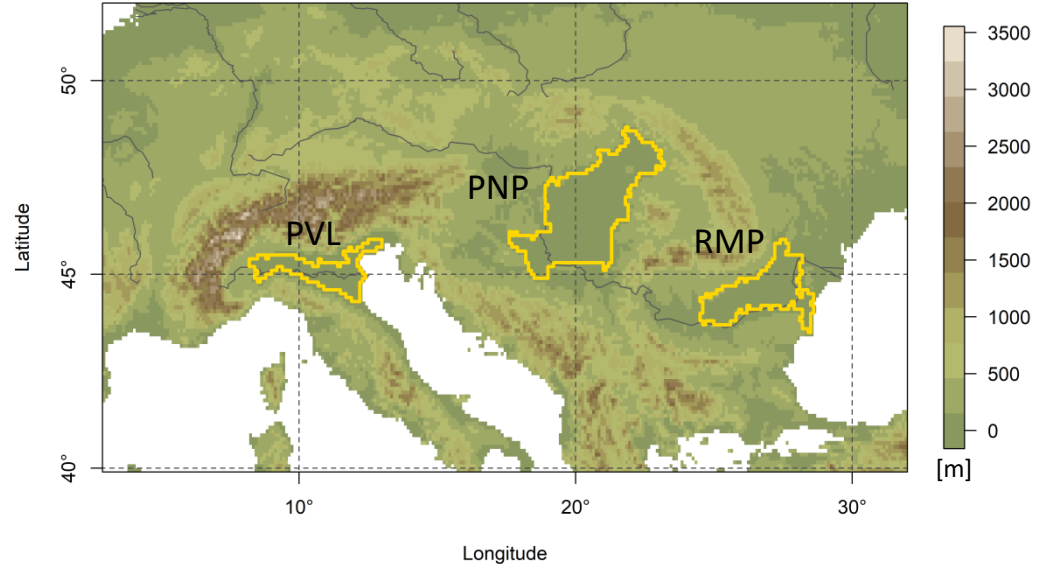
Precipitation time series are used from the E-OBS v.22¹ datasets on a 0.1° regular grid. Datasets are based on station measurements from Europe and are available from 1950 onward with daily temporal resolution, and updated regularly.

For choosing the plains and their spatial representations we used an objective method. The pre-selected regions have to fulfill two criteria, namely:

- Elevation remains under 200 m throughout the entire defined area
- Difference between the neighboring gridpoints within the plain region does not exceed 50 m

Locations of the selected plains.

Detailed information about the selected regions. The table contains the covered countries, the number of gridpoints in the domain and the average elevation with the maximum deviation.



Region	Abbr.	Countries	Station / 1000 km ²	Number of gridpoints	Average elevation (maximum deviation)
Po Valley	PVL	Italy	5.13	265	31 m (133 m)
Pannonian Plain	PNP	Hungary, Romania, Croatia, Slovenia, Slovakia, Ukraine	0.13	897	97 m (66 m)
Romanian Plain	RMP	Romania	0.13	308	52 m (106 m)

2. Climate indices

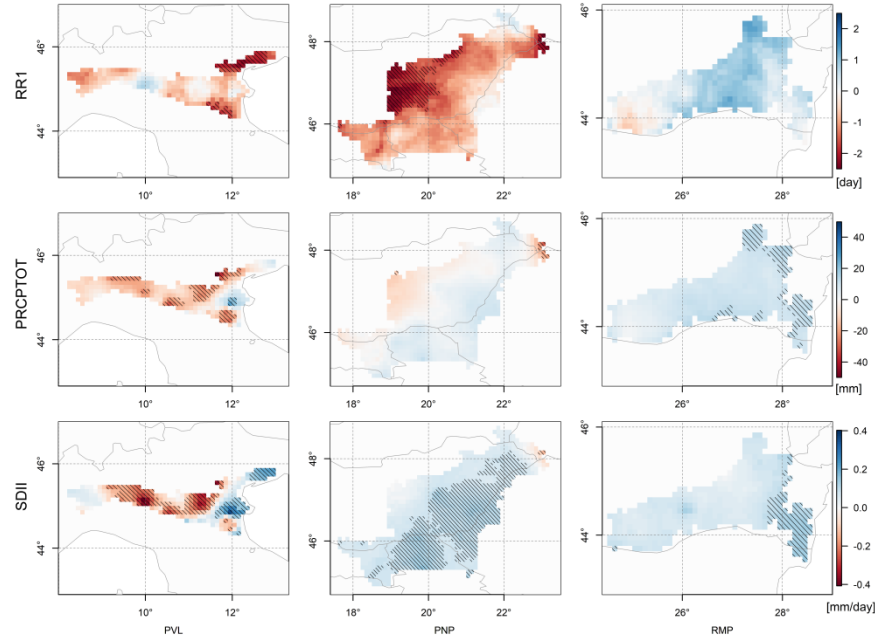
The range values in the table were calculated with multiple statistical tools. First, yearly time series were determined with spatial averaging for each region, then the median of the time series were calculated.

The list of the indices used in this study with their definitions.

Index	Definition	Unit	Range
Precipitation related indices			
RR1	Number of wet days, i.e. daily precipitation exceeding 1 mm ($R_{\text{day}} > 1 \text{ mm}$)	day	73.1 – 92.5
RR5	Number of days with precipitation exceeding 5 mm ($R_{\text{day}} > 5 \text{ mm}$)	day	35.8 – 49.5
RR10	Number of heavy precipitation days ($R_{\text{day}} > 10 \text{ mm}$)	day	10.4 – 24.0
RR20	Number of extremely heavy precipitation days ($R_{\text{day}} > 20 \text{ mm}$)	day	1.0 – 6.3
RRX1	Maximum 1-day precipitation ($\text{Max}(R_{\text{day}})$)	mm	21.9 – 40.3
RRX5	Maximum consecutive 5-days precipitation ($\text{Max}(\sum_{i=1}^5 R_{\text{day}})$)	mm	50.2 – 79.2
R90p	The 90th percentile of daily precipitation amount	mm	10.5 – 17.9
R95p	The 95th percentile of daily precipitation amount	mm	13.0 – 23.0
R95N	Number of days exceeding the 95th percentile of daily precipitation amount	day	3.2 – 4.1
PRCPTOT	Annual precipitation	mm	460.2 – 686.9
SDII	Simple daily precipitation index	mm/day	5.5 – 8.9
Drought related indices			
CDD	Maximum number of consecutive dry days $\text{Max}(R_{\text{day}} < 1 \text{ mm})$	day	28.1 – 36.2
DD	Number of dry days ($R_{\text{day}} < 1 \text{ mm}$)	day	272.5 – 291.9
DS5	Number of dry spells with length above 5 consecutive days	-	19.1 – 20.7
DS10	Number of dry spells with length above 10 consecutive days	-	8.5 – 10.3
DS95p	The 95th percentile of the length of DS5	day	20.9 – 27.1
DS5N	Number of dry days in DS5	day	211.5 – 248.8

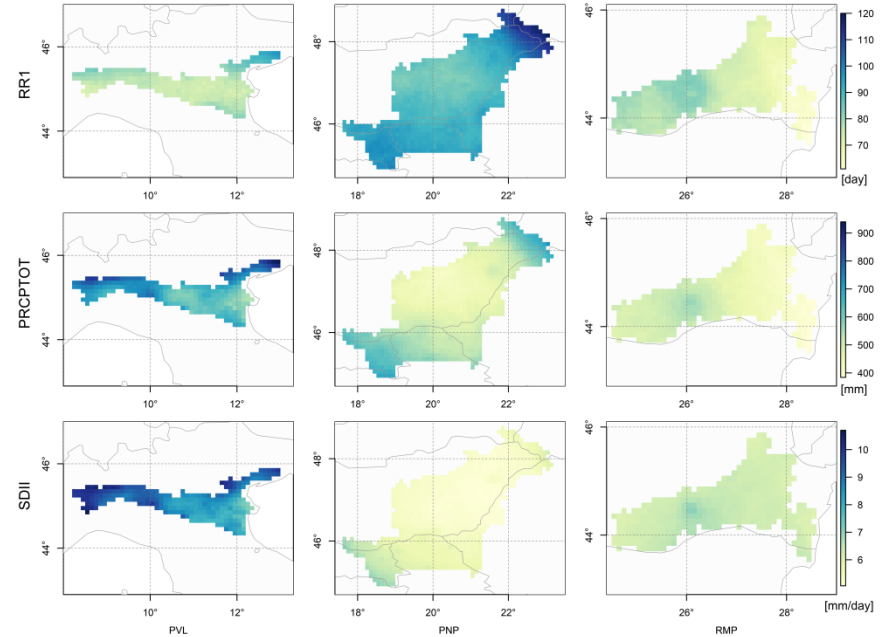
4. Changes in main precipitation indices

- A significant decrease of RR1 days can be observed in the Po Valley and the Pannonian Plain.



Decadal trends of the selected indices. Hatched areas indicate significant change.

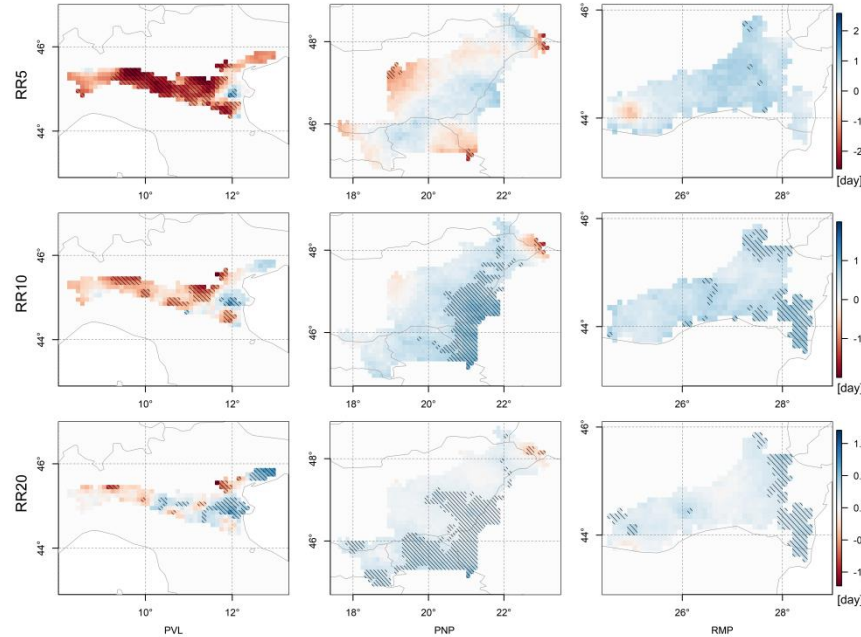
- Increasing, however not significant PRCPTOT trend in the Pannonian Plain and the Romanian Plain → significant increase of SDII
→ Increase of extreme precipitation events and intensity



Median values calculated as the median of the time series in every grid point.

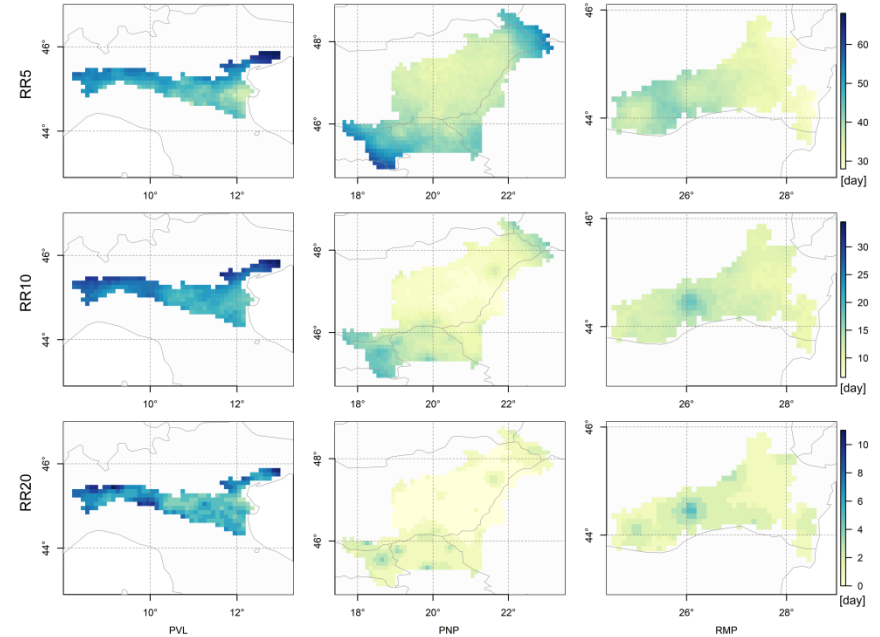
5. Changes in extreme precipitation indices based on fixed threshold

- Increasing trends of fixed threshold indices can be observed in all three regions.



▲ Decadal trends of the selected indices. Hatched areas indicate significant change.

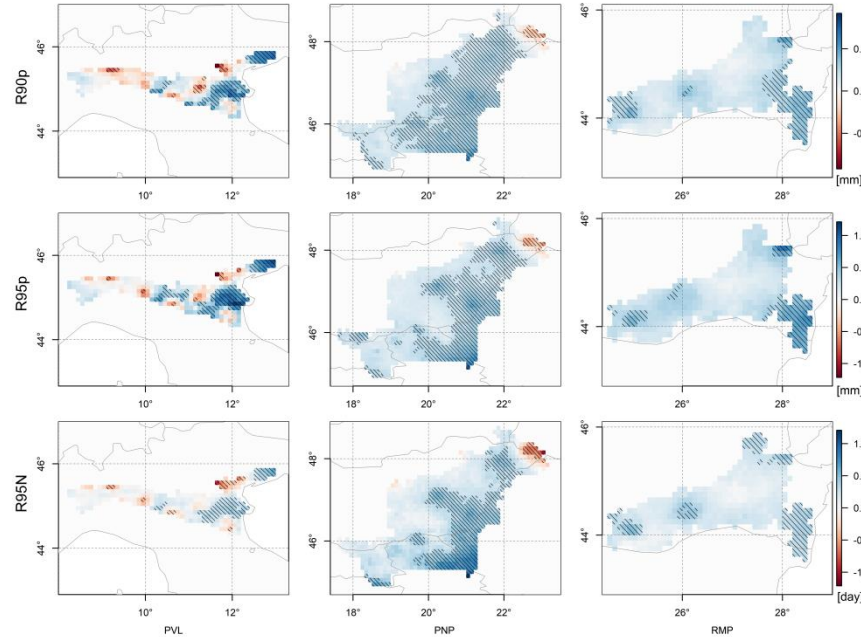
- The decrease of RR5 in the Panonian Plain and the Po Valley, and the decrease of RR10 in the Po Valley indicate a shift towards more extreme precipitation events, which can be more severe in the future.



▲ Median values calculated as the median of the time series in every grid point.

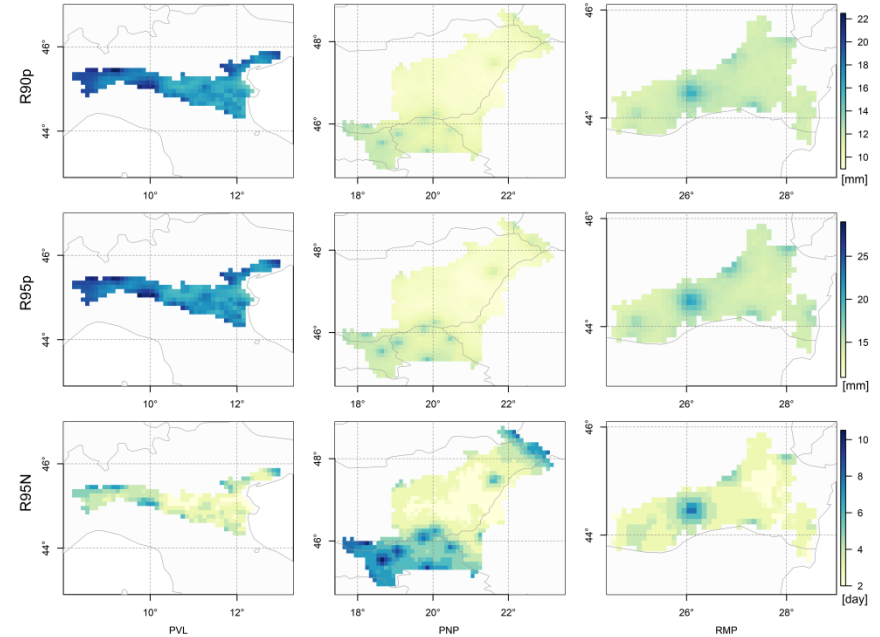
5. Changes in percentile based extreme precipitation indices

- Increasing trends of percentile based indices can be observed in all three regions, which indicate the shift from moderate precipitation events to extreme events.



▲ Decadal trends of the selected indices. Hatched areas indicate significant change.

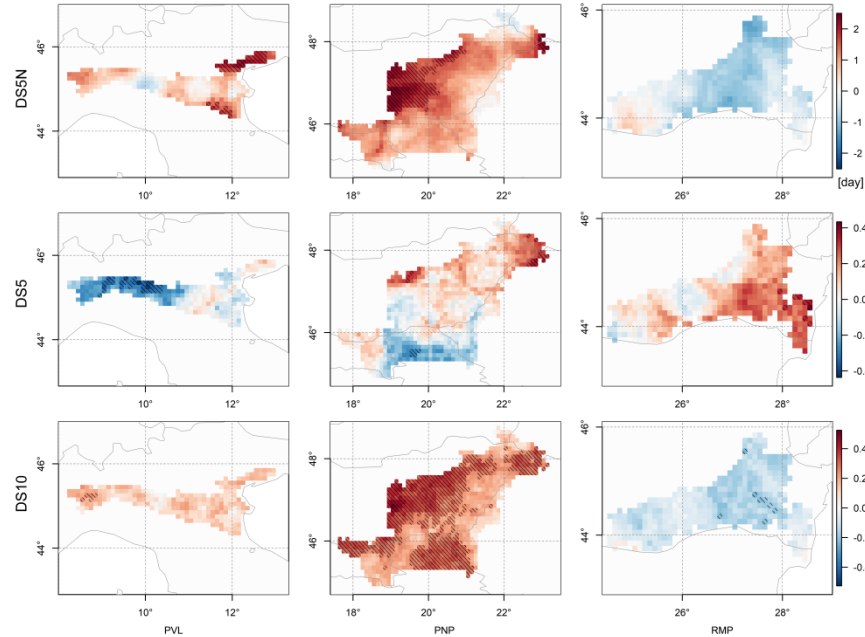
- Increasing trends of maximum indices (RX1 and RX5) also can be observed in all regions (not shown).



▲ Median values calculated as the median of the time series in every grid point.

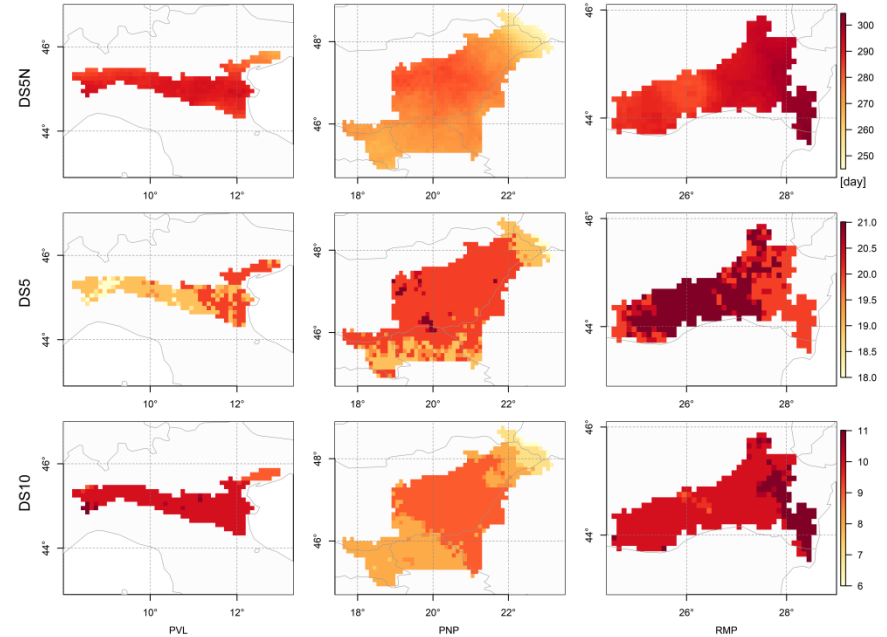
5. Changes in drought related indices

- The increase of longer dry periods can be seen in the Po Valley and the Pannonian Plain, altogether with the increase of DS5N index.



▲ Decadal trends of the selected indices. Hatched areas indicate significant change.

- As the possible number of dry periods within a year is limited, the longer dry periods and the decrease of DS5 also can be seen in the Po Valley and the Pannonian Plain, while the Romanian Plain shows opposite trends.



▲ Median values calculated as the median of the time series in every grid point.

6. Conclusion

- The occurrence and intensity of extreme precipitation events increased in all regions, while the number of RR1 days decreased in two regions. These results imply the general intensification of all precipitation events.
- The significant increase of DS10 and DS5N indices in two regions imply the occurrence of longer dry periods.

Precipitation events in these regions occur less often and become more severe. The longer dry periods altogether with the extreme precipitation events result in higher natural and hydrological hazards.

7. Acknowledgement

Research leading to this paper has been supported by the Hungarian Ministry of Human Capacities under the ELTE Institutional Excellence Program (TKP2020-IKA-05), and the Hungarian National Research, Development and Innovation Fund under grants K-120605 and K-129162. We also acknowledge the E-OBS dataset from the EU-FP6 project UERRA (<http://www.uerra.eu>) and the Copernicus Climate Change Service, and the data providers in the ECA&D project (<https://www.ecad.eu>)

8. References

1. Cornes, R., G. van der Schrier, E.J.M. van den Besselaar, and P.D. Jones., 2018: An Ensemble Version of the E-OBS Temperature and Precipitation Datasets, J. Geophys. Res. Atmos., 123. doi:10.1029/2017JD028200