

# Changes in convective precipitation characteristics during the warm season in the Czech Republic

Romana Beranová (rber@ufa.cas.cz), Zuzana Rulfová (rulfova@ufa.cas.cz)

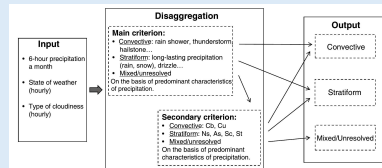
Institute of Atmospheric Physics, Czech Academy of Sciences



## Station data

- 19 SYNOP stations across the Czech Republic.
- Elevation range: 241 - 1322 m a.s.l.
- Study period: 1982-2021, warm season: April – September.
- Precipitation totals subdivided into convective and stratiform types using an algorithm based on hourly weather state data and cloud type information.

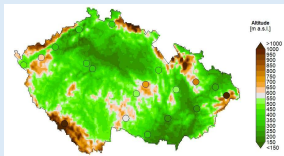
## Scheme of the algorithm



## Convective precipitation characteristics

Name	Description	Unit
Sum	Total amount of convective precipitation per season	mm
RDays	Number of rainy days: the number of days per season with convective precipitation >1 mm	days
RII	Rain intensity index: calculated as the mean convective precipitation amount on RDays	mm/day
P98	98th percentile of convective precipitation from all days in season	mm
Rmax	Seasonal maximum of 1-day convective precipitation amounts	mm
CF	Convective fraction: calculated as the ratio of Sum to the total (convective + stratiform) precipitation amount per season	

## Elevation of meteorological stations



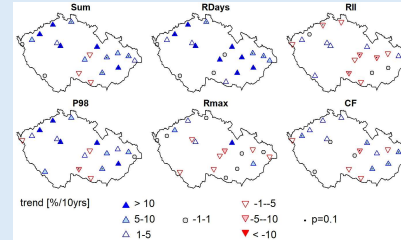
## Mean characteristics of convective precipitation

	average	min	max	P98	average	min	max
Sum [mm]	164.9	106.7	260.5	[mm]	11.1	7.8	16.2
RDays [days]	20.8	13.6	30.0	Rmax [mm]	29.4	25.4	39.2
RII [mm/day]	7.5	6.3	9.1	CF	0.41	0.31	0.51

## Trends in convective precipitation characteristics

- Sum:** A statistically significant positive trend is found at nine stations, while only three stations show a slight decrease. The average trend across all stations is approximately +8 % per decade.
- RDays:** A similar pattern is observed, with statistically significant positive trends at 11 stations. The average increase is nearly +9 % per decade.
- P98:** The index shows a pronounced positive trend, with an average increase of about +6 % per decade.
- CF:** The convective fraction exhibits a prevailing positive trend, although it is less pronounced.
- Rmax:** The signal is less consistent. Although the average trend is +1.2 % per decade, more stations show negative than positive trends.
- RII:** A clear prevailing negative trend is observed, with an average of -1.2 % per decade. Negative trends occur at 10 stations, of which 4 are statistically significant.

## Trends in convective precipitation characteristics



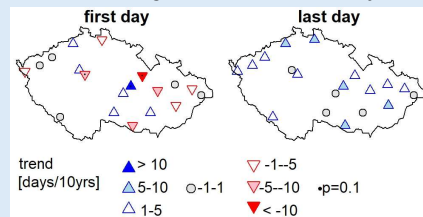
**Summary:** A prevailing positive trend is observed for all characteristics, except RII.



## Days with heavy convective precipitation (HCP)

- A day is classified as HCP when convective precipitation exceeds the mean P98 threshold at a given station.
- Duration of the HCP season is defined by the first and last HCP day in each year. Trends are estimated for the timing of these dates.
- The mean P98 across stations is 11.1 mm, ranging from 7.8 to 16.2 mm.
- On average, the first HCP day occurs on 29 May and the last on 18 August.
- Trends in the timing of the first HCP day vary across stations, with an average shift of -0.8 days per decade, indicating an earlier onset.
- The last HCP day shows a consistent trend across stations, shifting later by +3.7 days per decade.

## Trends in the timing of the first and last HCP day

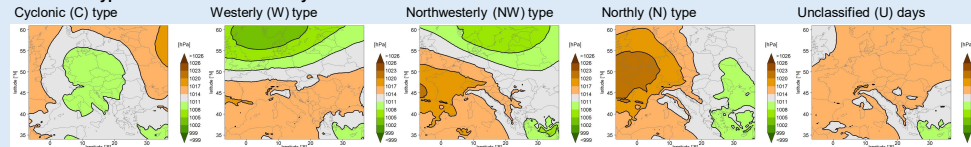


## Relationship between HCP and atmospheric circulation

- Circulation types (CTs) classified using the Jenkinson and Collins (1977) method.
- Based on sea-level pressure data from ERA5 reanalysis.
- A total of 11 CTs defined using three indices: flow direction, strength and vorticity.
- CTs include strongly cyclonic (C) and anticyclonic (A) types, eight directional types (N, NE, E, SE, S, SW, W, NW), and unclassified (U) days.
- Circulation-type ratio (Rc) = ratio of the probability of HCP occurring under a given CT to the overall seasonal probability of HCP.
- Rc > 1.1 indicates that a CT is conducive to HCP.

Circ. types	Freq. [%]	Rc
A	5.3	0.2
C	20.2	2.3
SW	7.1	0.9
W	13.6	1.3
NW	18.7	1.3
N	17.8	1.2
NE	6.5	0.9
E	2.3	0.7
SE	1.2	0.4
S	1.7	0.4
U	5.7	1.7

## Circulation types connected with HCP days



**Summary:** The heavy convective precipitation season is lengthening, with an earlier onset and a later end.

**Summary:** The most frequent CTs on HCP days are C (20.2 %), NW (18.7 %), N (17.8 %), and W (13.6 %), all with Rc > 1.1, indicating that they are conducive to HCP. Elevated Rc values are also found for the U type, which occurs on 5.7 % of HCP days.

