The Compound Unusual Precipitation-Temperature Events

Yulizar Yulizar[1,1]

[1]Universitas Pertamina

January 20, 2023

Abstract

The compound extremes of hydrometeorological variables might not only affect as an extreme from a single variable, but might also result due to their interaction in time and space. This occurrence is called compound unusual events. A statistical approach based on the data depth function is being used to identify these occurrences in the multivariate dataset. To illustrate the methodology, the daily historical series of precipitation and mean temperature series from several selected observation stations in Germany will be used. The zero values of precipitation and the anomalies of mean temperature are used in this study. This study will help in answering the occurrence of unusual events for both variables on temporal and spatial scales.

The Compound Unusual Precipitation-Temperature Events

Yulizar Yulizar

Universitas Pertamina, Indonesia

NH33B – 04
AGU 2021

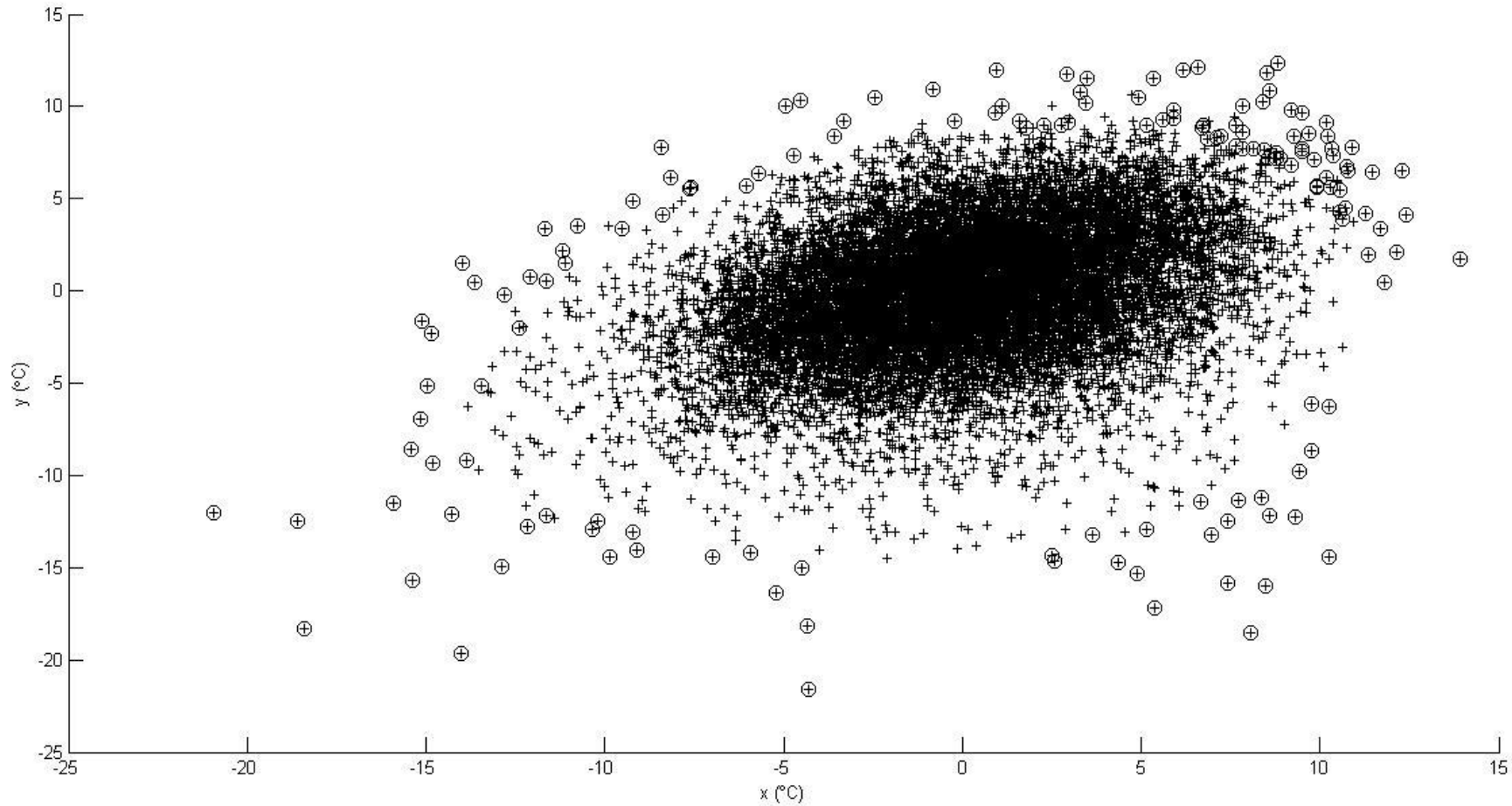
Outline

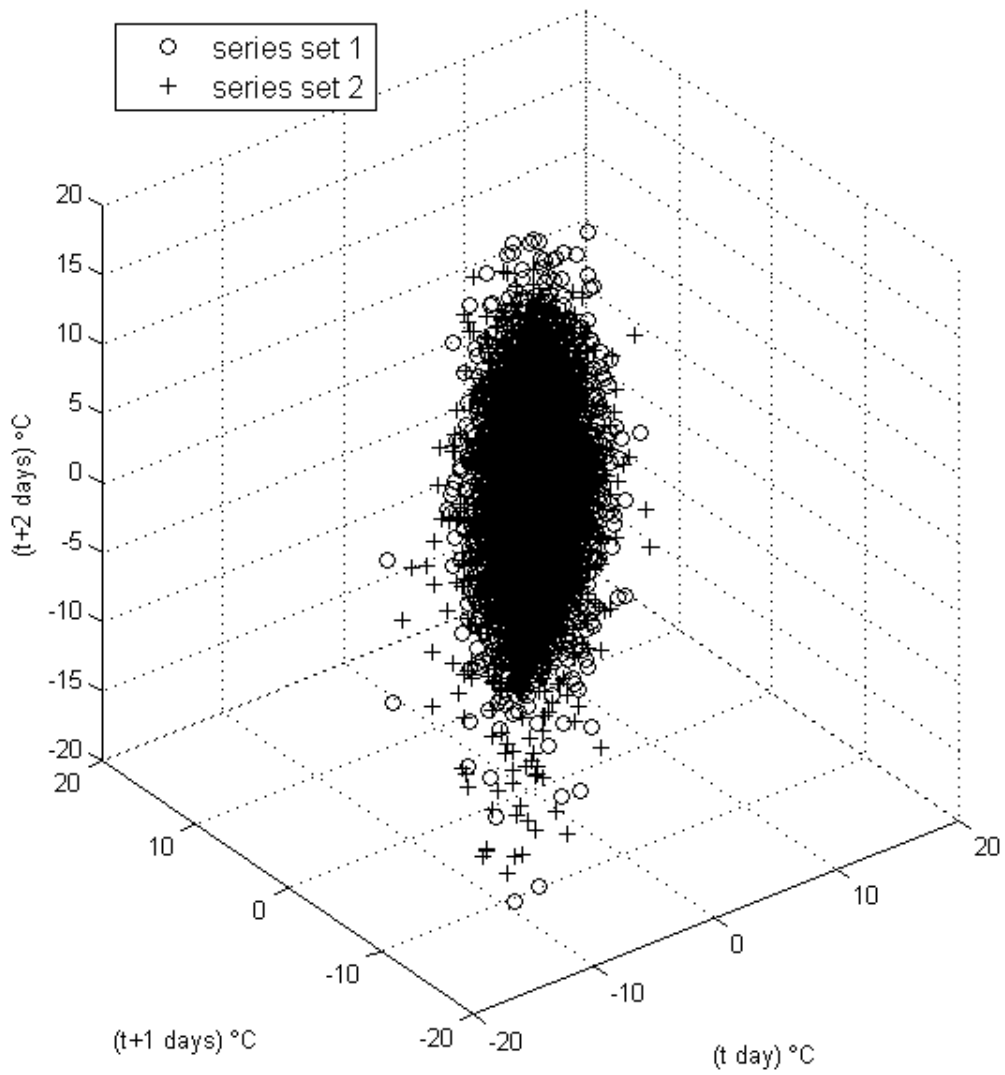
- Introduction
  - Unusual Events
- Methodology
- Results
- Conclusion

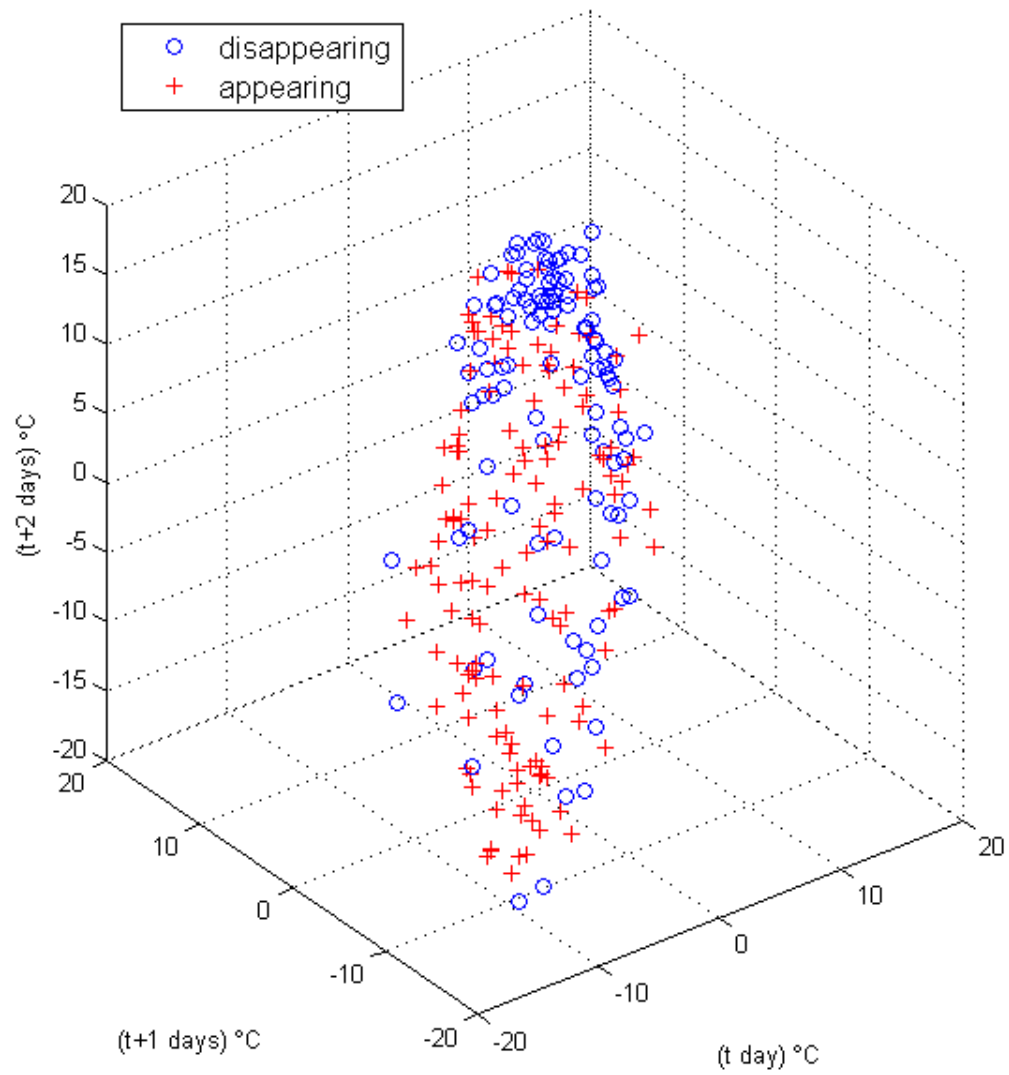
Introduction

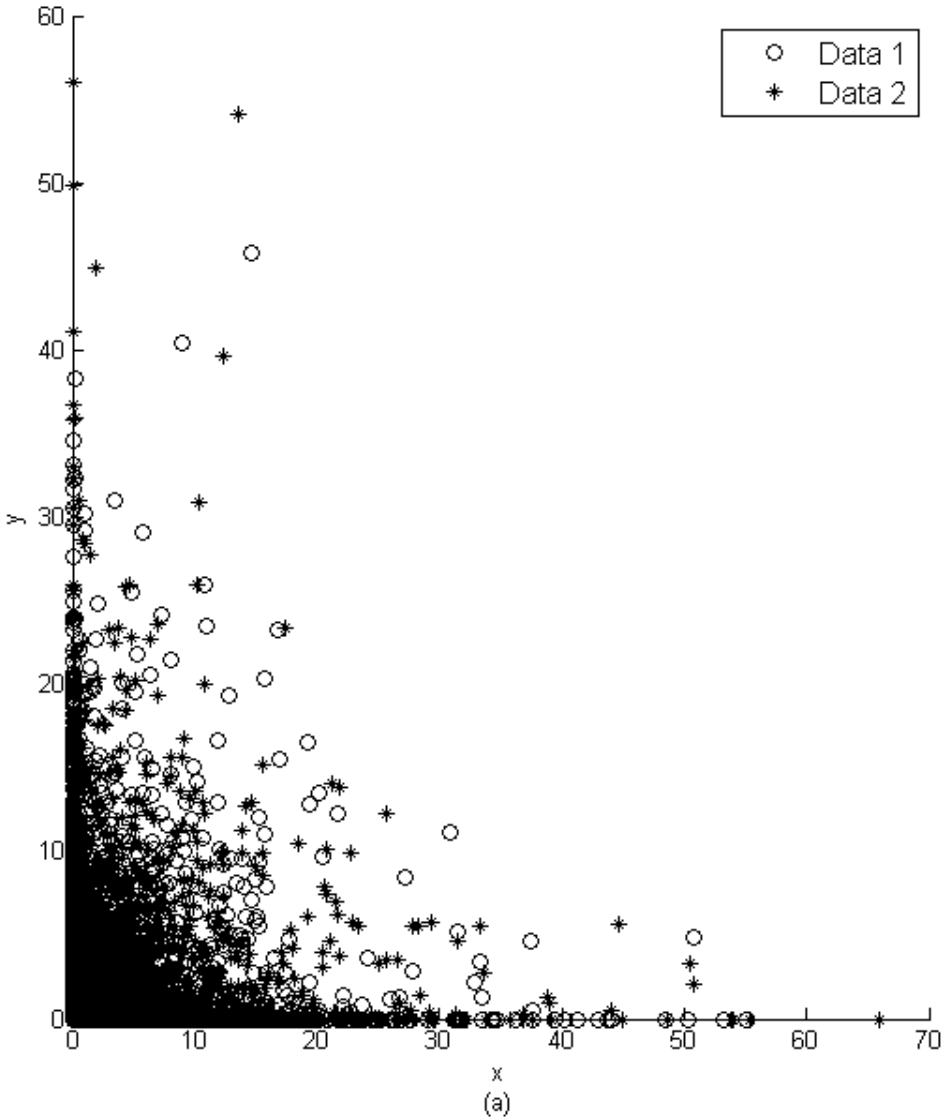
- **Changes in series**
- **Univariate statistics for single stations**
  - Changes in the multivariate sense
  - “Extremes” in multivariate sense are the unusual observations
  - Multivariate =
    - Multisite
    - Multiple days in sequence
- **What is Unusual?**

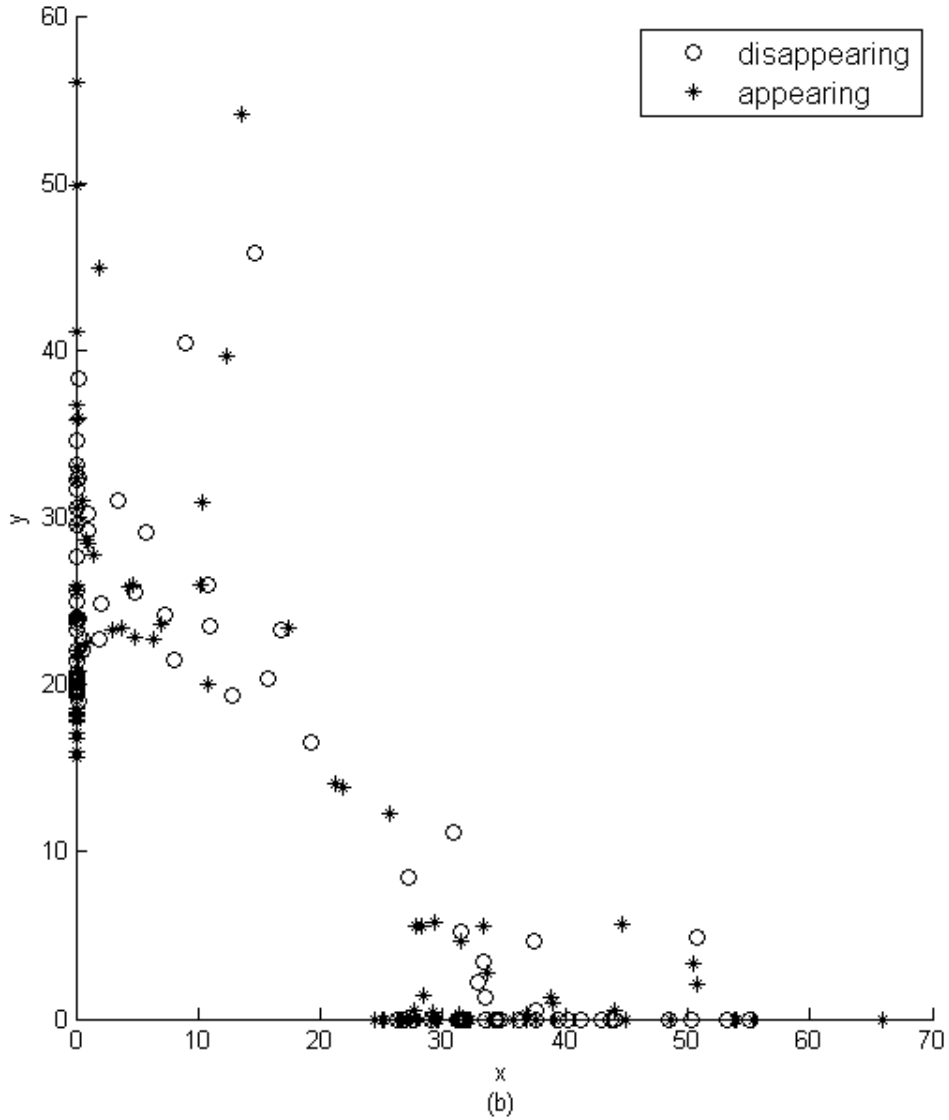
Unusual events are those events which on or near the boundary of the multivariate set




series set 1
series set 2
(t+2 days) °C
(t+1 days) °C
(t day) °C


disappearing
appearing
(t+2 days) °C
(t+1 days) °C
(t day) °C





(Yulizar and Bardossy, 2020)

Methodology

- How to identify unusual events in D>2 dimensions
  - Data depth function
- Depth function
  - how ‘central’ the point is, with respect to a ‘D’ dimensional data set
- Daily temperature and precipitation series 1901 – 2020 in Hohenpeissenberg (Germany)

Methodology

- Different sequence days (1 – 5)

  e.g. 1 day T – 1 day P,

  2 days T – 2 days P

- Calculate depth (*d*)

  $d \leq 0$

Methodology

Significance testing

Bootstrap:

- Permuate years
- Calculate depth
- Repeat 1.-2. N times
- Compare observed and randomly generated numbers of unusuals

Results

Maximum temperature – precipitation (1901 – 2020)

Compound T - P	Number of unusual days	Significance (%)
1 day	4	91
2 days	41	31
3 days	109	47
4 days	170	51
5 days	212	58

Results

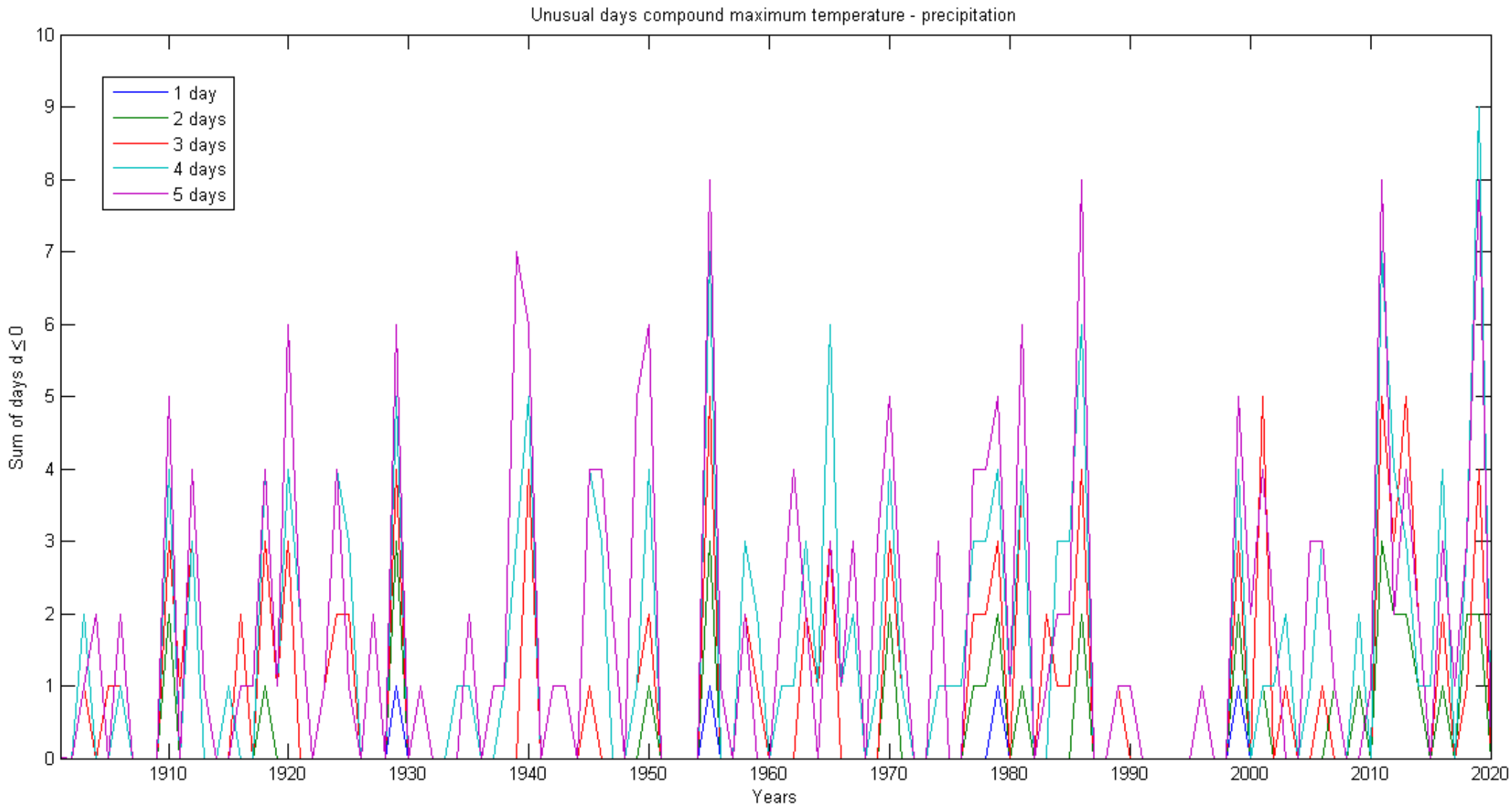
Minimum temperature – precipitation (1901 – 2020)

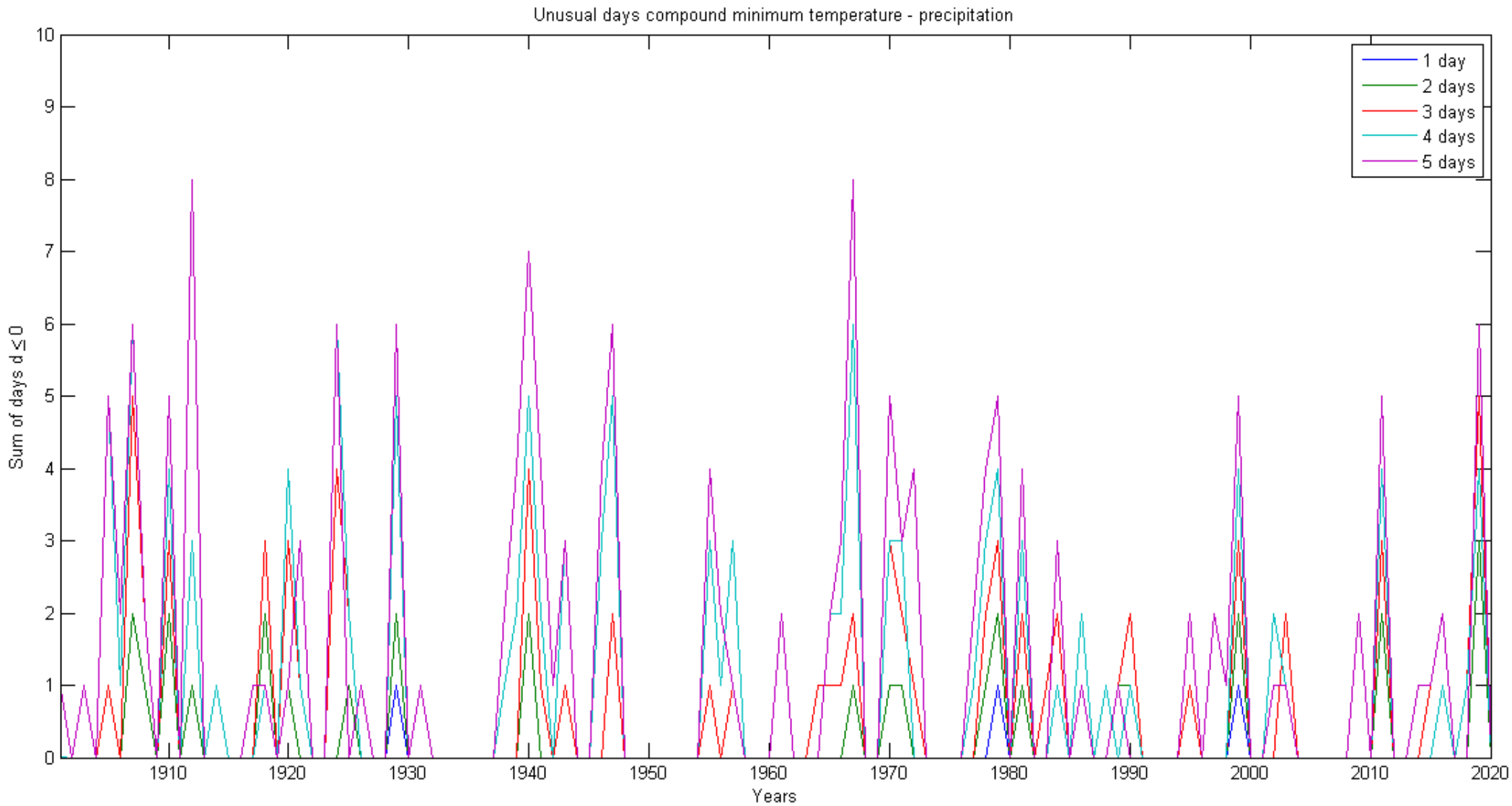
Compound T - P	Number of unusual days	Significance (%)
1 day	3	91
2 days	32	49
3 days	87	61
4 days	120	26
5 days	164	70

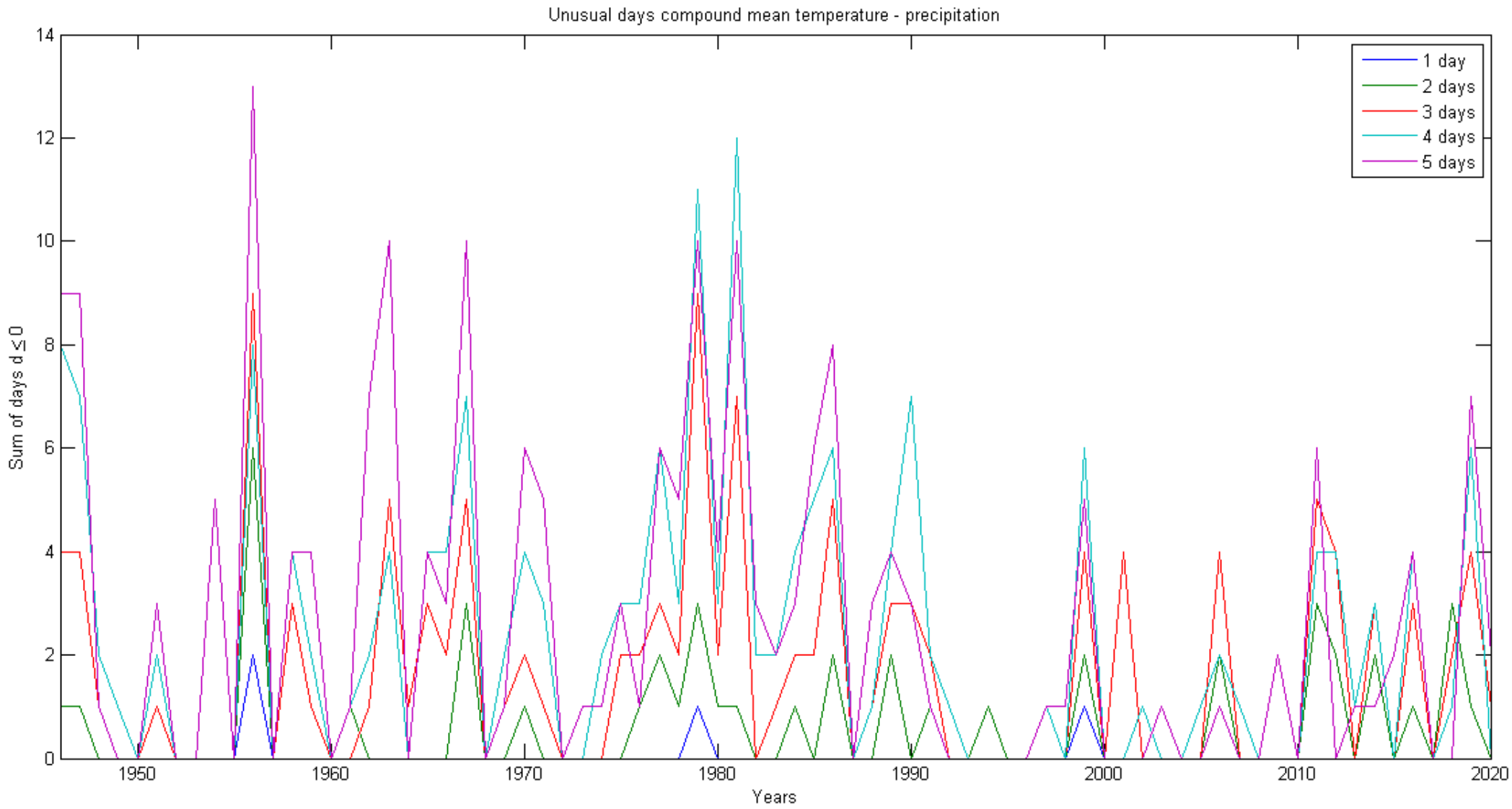
Results

Mean temperature – precipitation (1946 – 2020)

Compound T - P	Number of unusual days	Significance (%)
1 day	4	100
2 days	50	34
3 days	124	31
4 days	179	48
5 days	203	42


Unusual days compound maximum temperature - precipitation
1 day
2 days
3 days
4 days
5 days
Sum of days d ≤ 0
Years
0
1
2
3
4
5
6
7
8
9
10
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020


Unusual days compound minimum temperature - precipitation
Sum of days d ≤ 0
Years
1 day
2 days
3 days
4 days
5 days
0
1
2
3
4
5
6
7
8
9
10
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020


Unusual days compound mean temperature - precipitation
Sum of days d ≤ 0
Years
1 day
2 days
3 days
4 days
5 days
0
2
4
6
8
10
12
14
1950
1960
1970
1980
1990
2000
2010
2020

Conclusion

- Unusual events were defined using data depth
- ‘Detection’ of heat wave?
- Further study (e.g. land surface heat fluxes – atmospheric)

Thank You