

# The Compound Unusual Precipitation-Temperature Events

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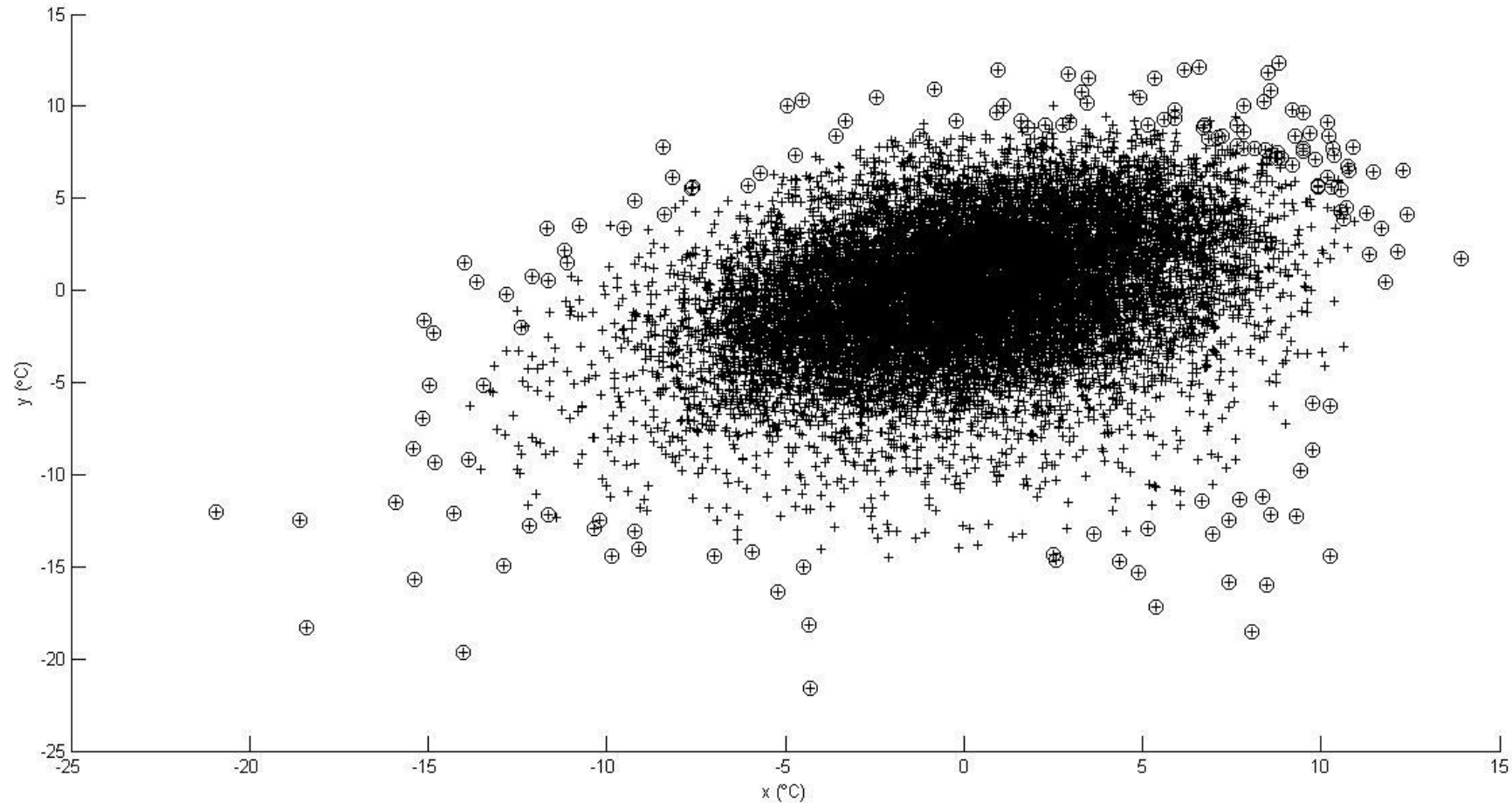
# Outline

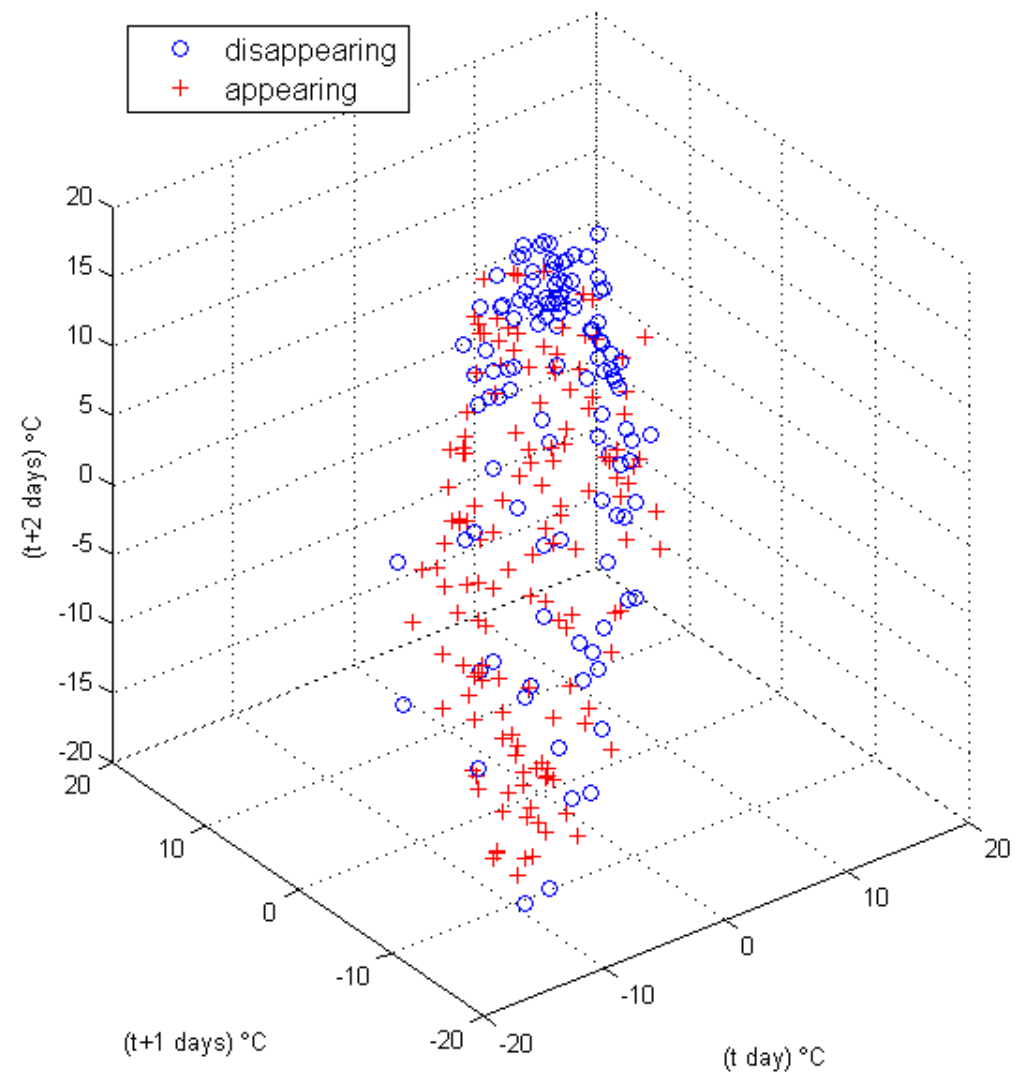
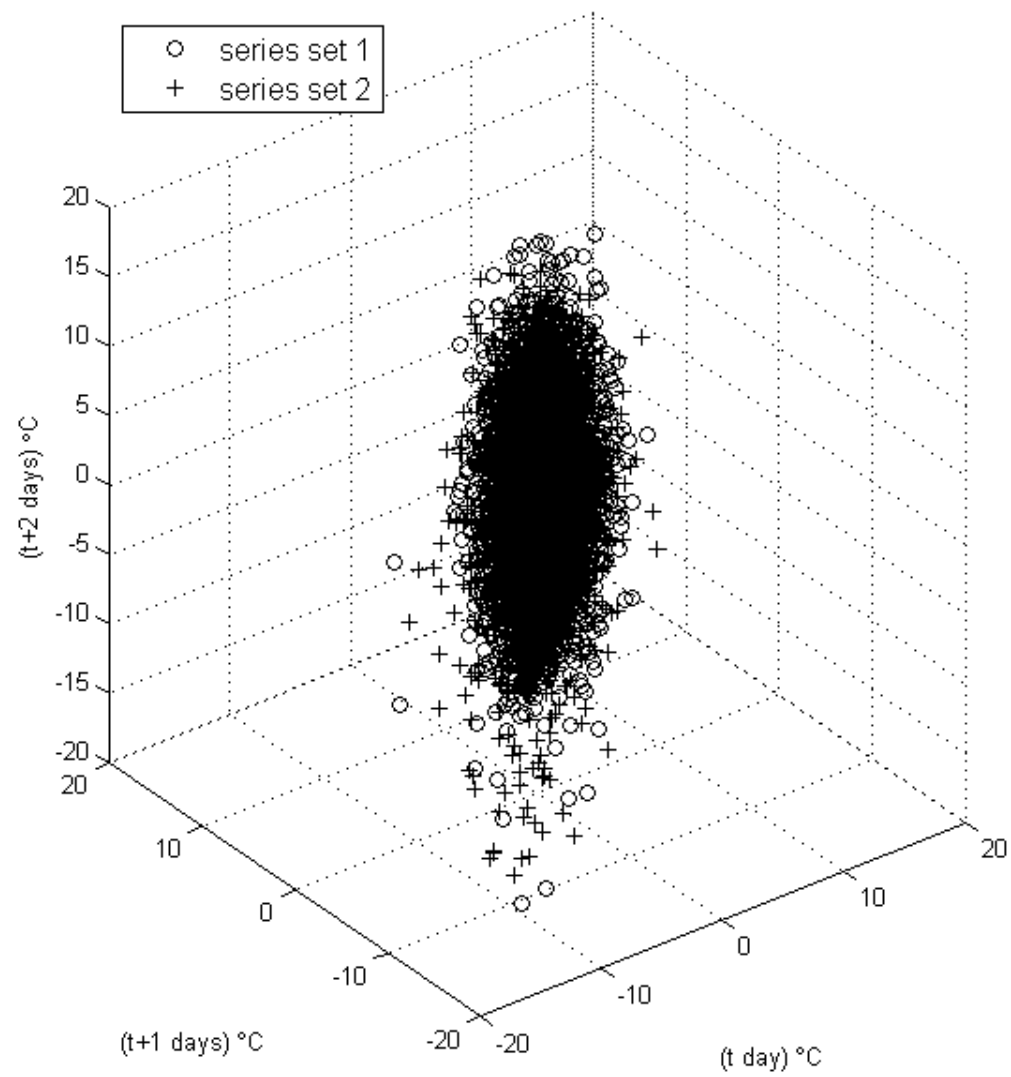
- Introduction
  - Unusual Events
- Methodology
- Results
- Conclusion

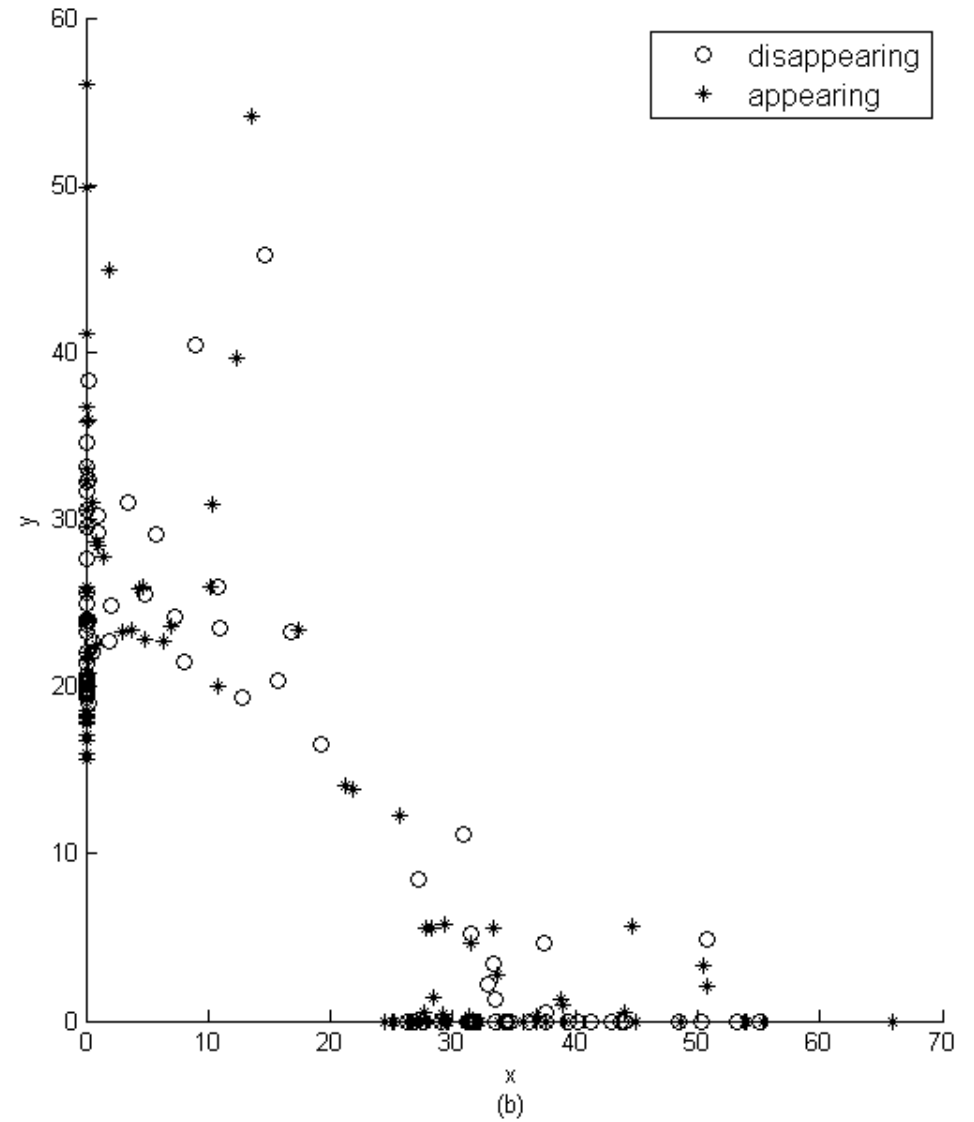
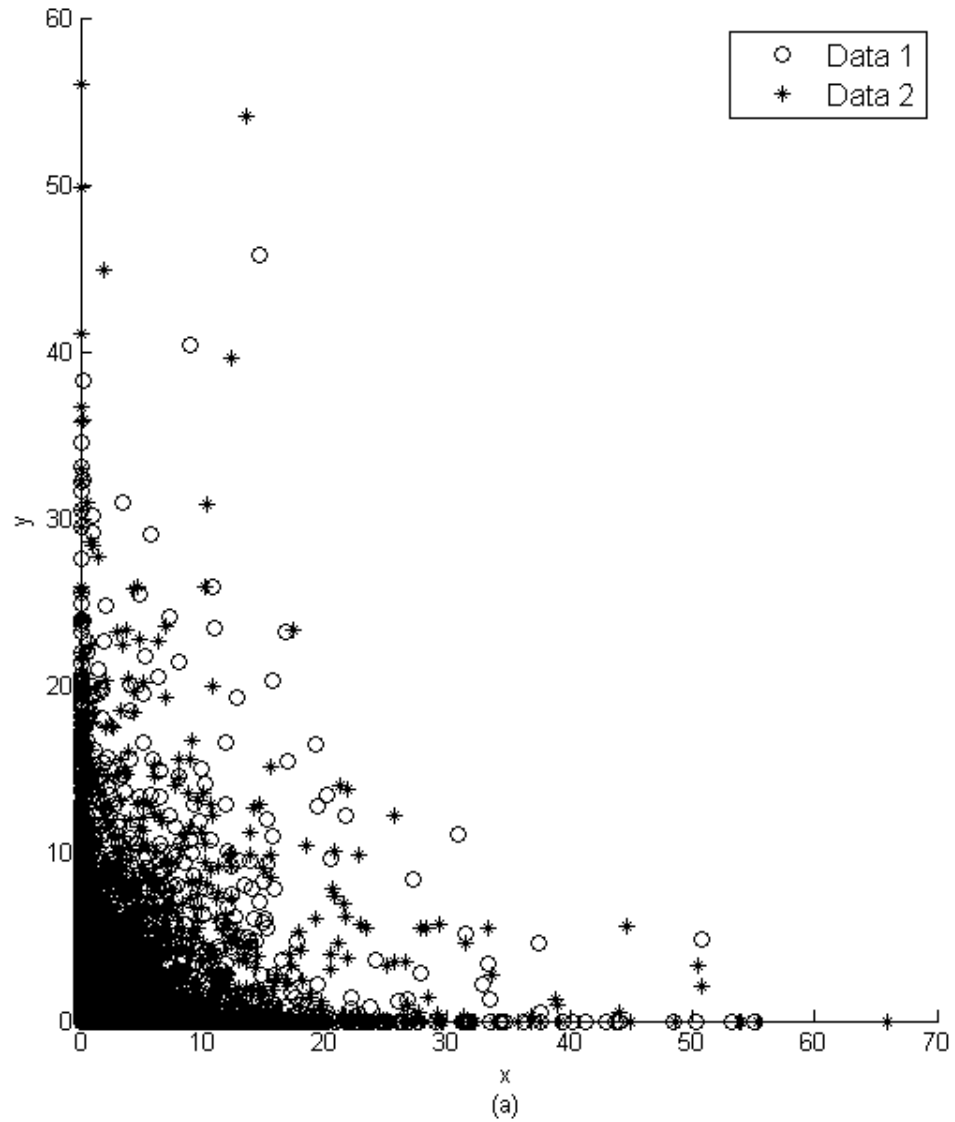
# Introduction

- **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







(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:

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

# 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

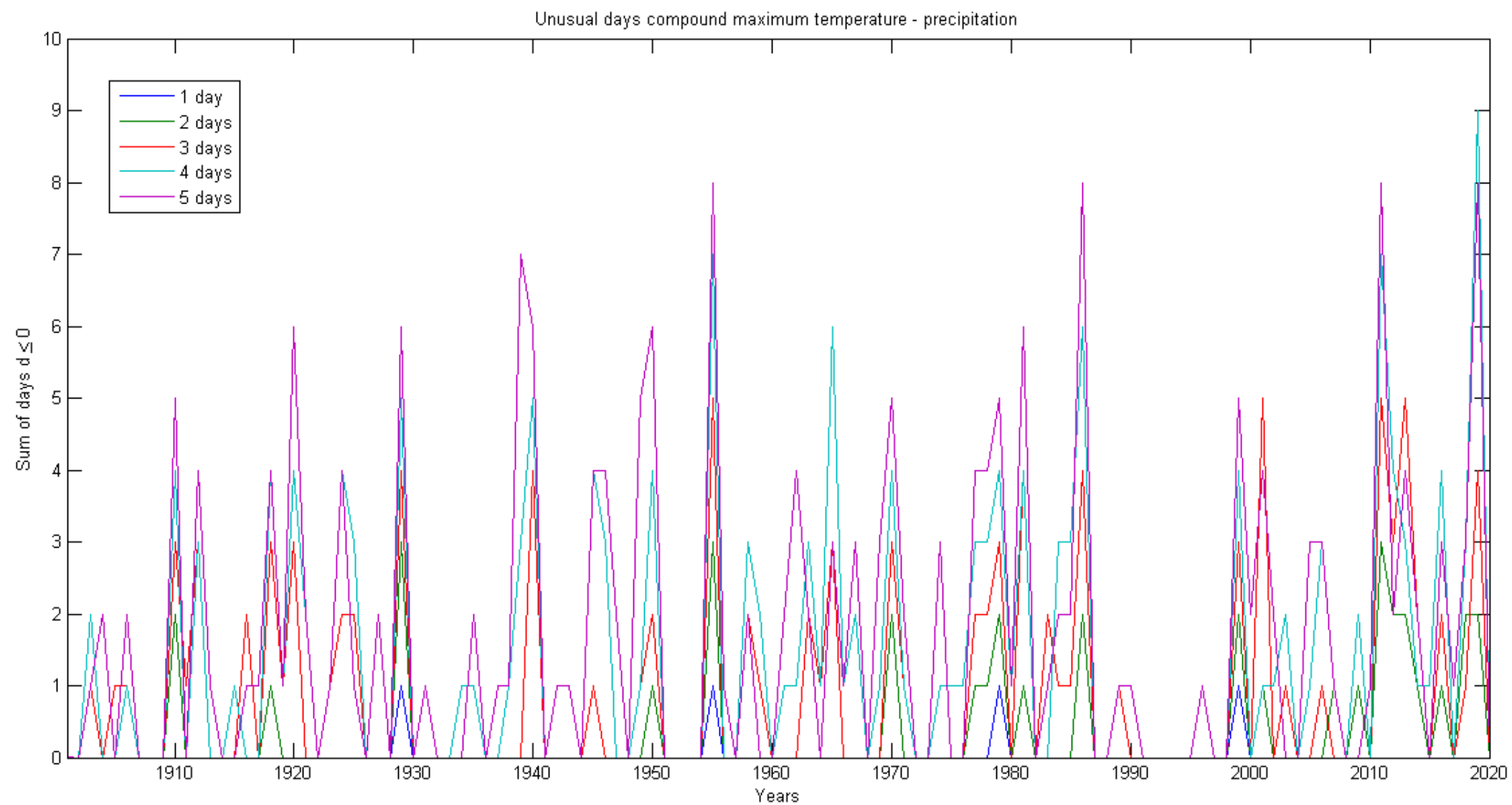
Minimum temperature – precipitation (1901 – 2020)

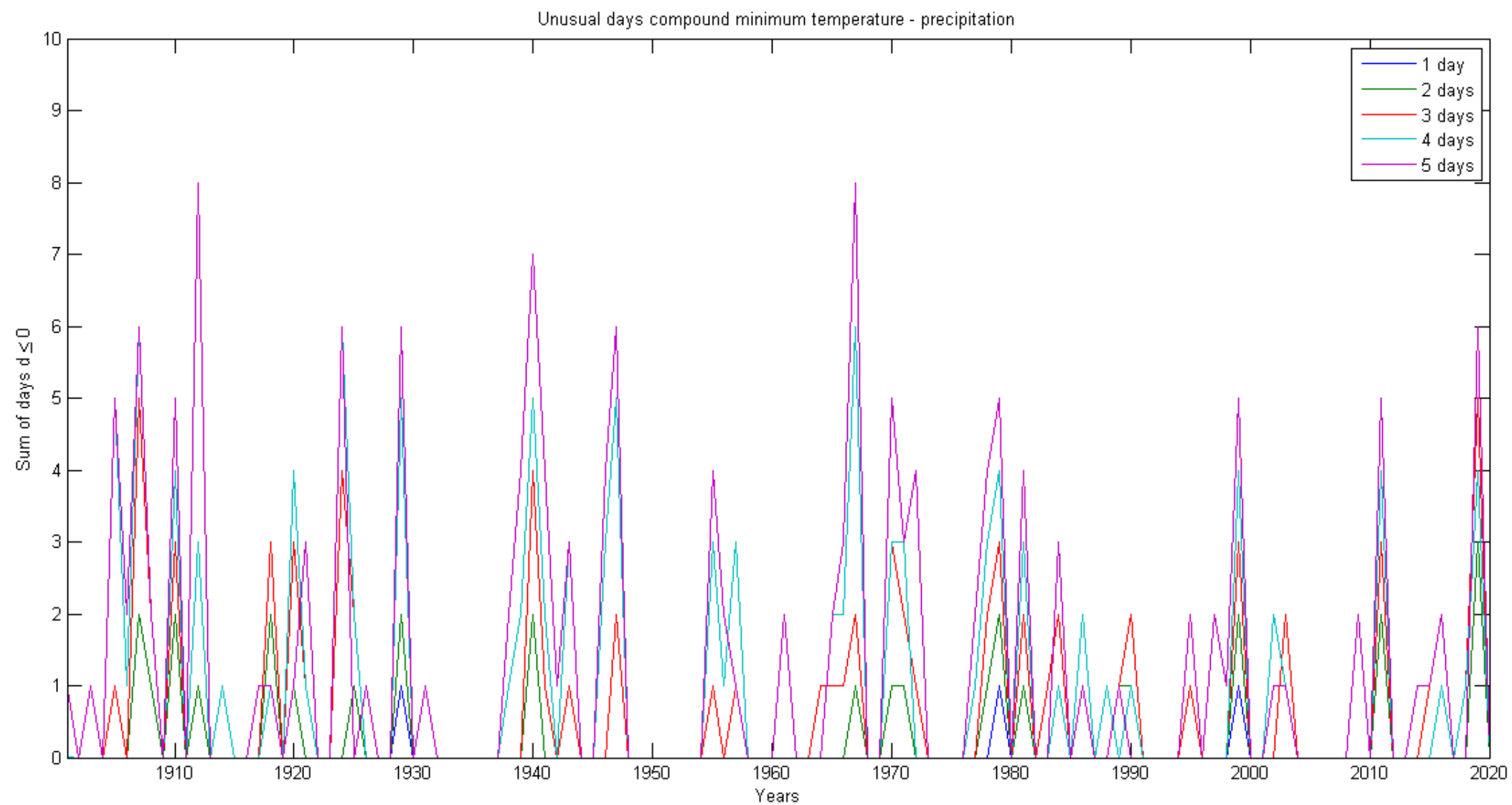
Compound T - P	Number of unusual days	Significance (%)
1 day	3	91
2 days	32	49
3 days	87	61
4 days	120	26
5 days	164	70

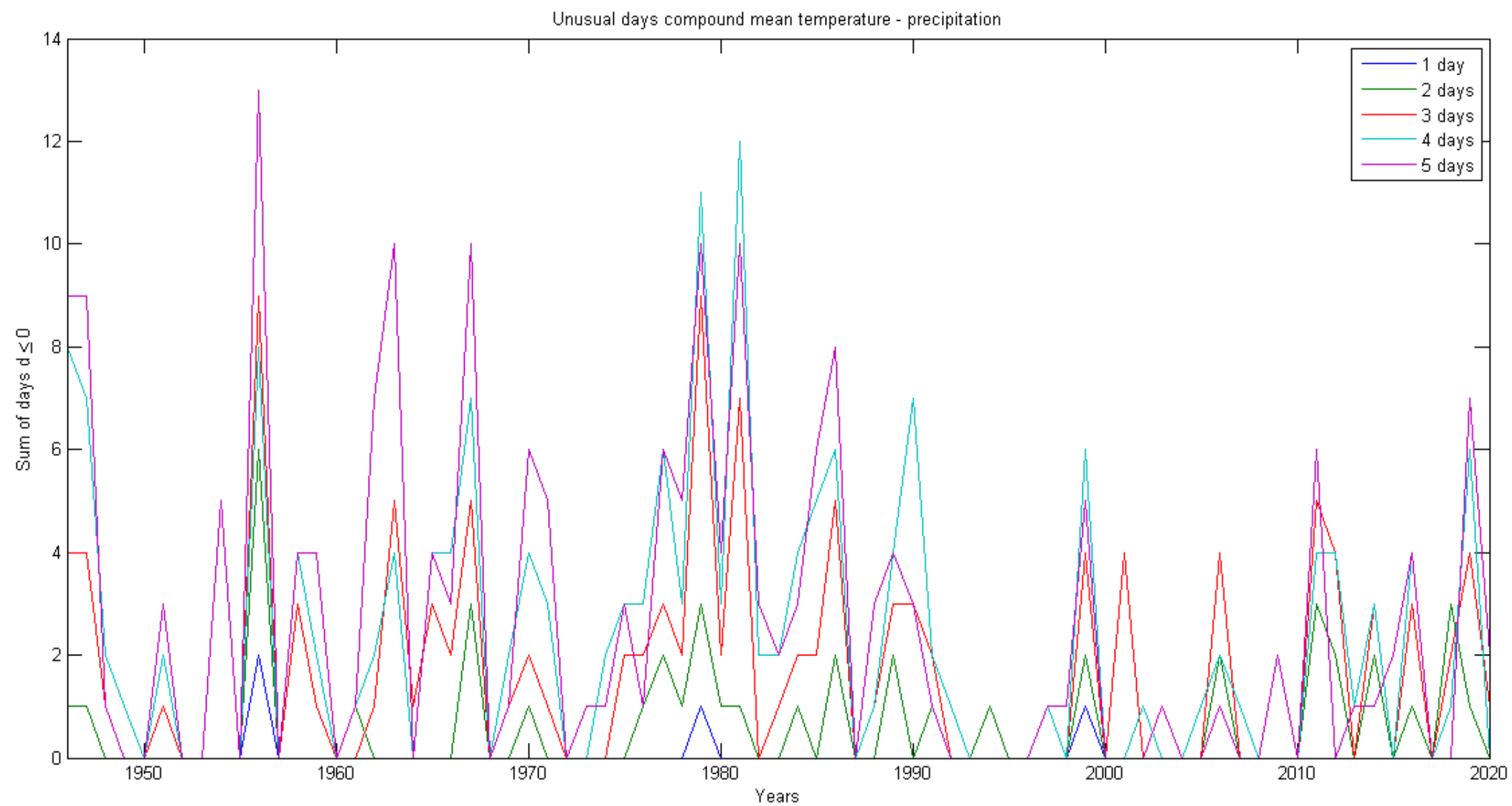
# Results

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







# Conclusion

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



Thank You