



University of Stuttgart

Institute for Modelling Hydraulic and Environmental
Systems

Spatio-temporal determination of the similarity of extreme floods in the Neckar catchment

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Introduction

Key finding

A new method for determining the spatiotemporal similarity of extreme floods was developed

- The maximum absolute difference among CDFs was combined with an Agglomerative Hierarchical Cluster, and a new tree based on clustering distribution properties was constructed.

Motivation

Floods

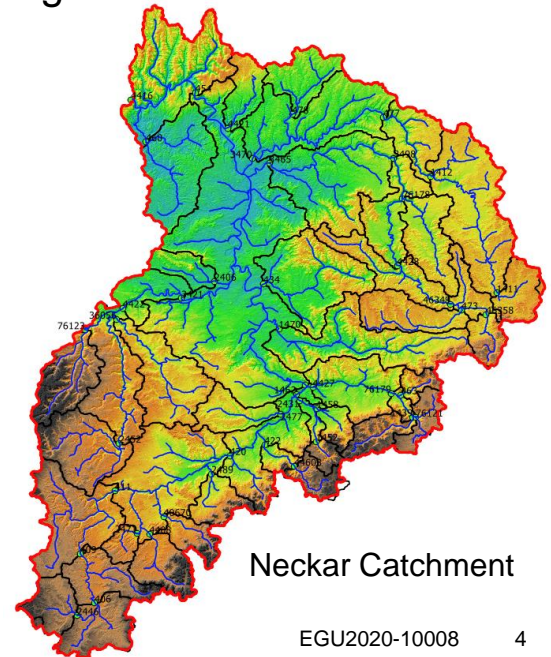


- Large scale precipitation or snowmelt
- Occurrence frequency and magnitude of floods (Univariate statistics)
 - ➔ Independent from causing mechanism
- Spatio-Temporal features of flood generating mechanism
- Multivariate statistical methods ✓
 - ➔ Investigate the biggest flood events
- Flood behavior based on distribution similarity

Overview

Neckar catchment & Time series

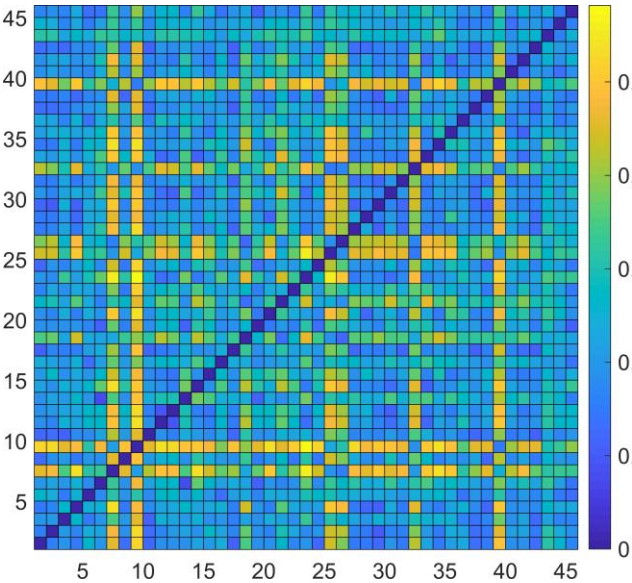
- 46 Stations of the Neckar Catchment - Area: 13748 km²
- Catchment areas vary from 58.4 km² to 13748 km²; 17 catchments are smaller than 200 km² and 12 catchments are larger than 1000 km².
- Elevation: 97-851 m
- 55 years data between 1961 – 2015
- Resolution of the time series is daily.



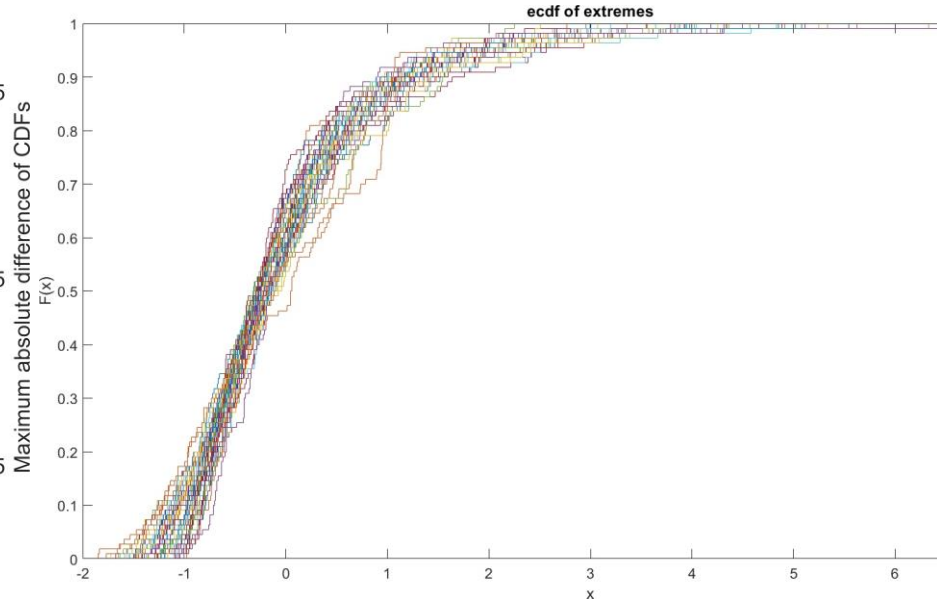
The Algorithm

- Find two biggest peaks per year in the timeseries (Discharge)
 - These two events have to be independent from each other – [5 days window]
- Standardize series of selected floods
- Calculate empirical CDF of each series
- Calculate maximum absolute difference based on previous step
- Construct the hierarchical cluster tree
 - Distict linkage methods: Complete + Average + Weighted + Ward + Single
- Cluster the floods according to the K-S test matrix and plot the result in dendrogram form
- Plot clusters on a map

Empirical Cumulative Distribution Function

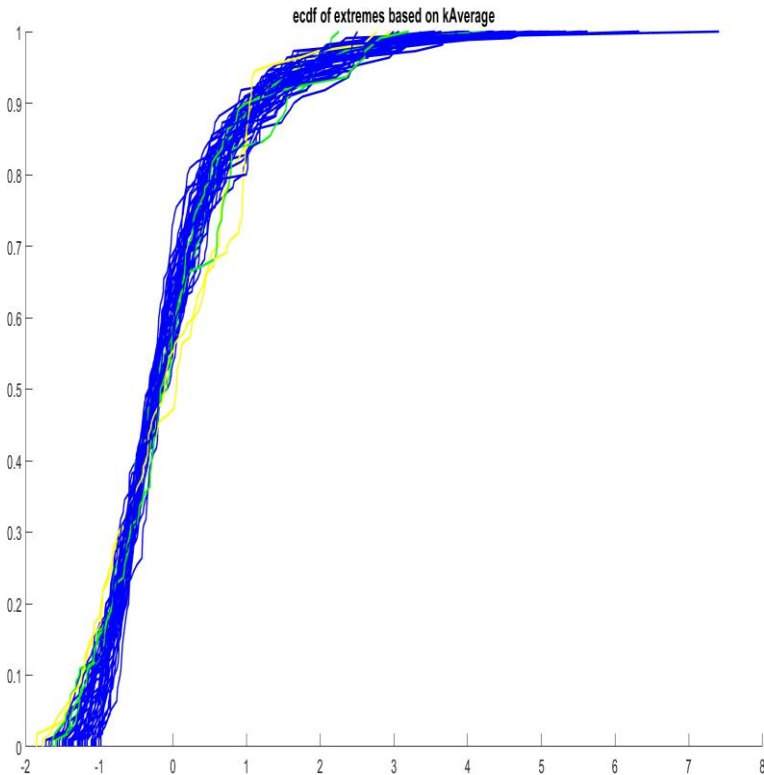


Matrix of similarities by KS test

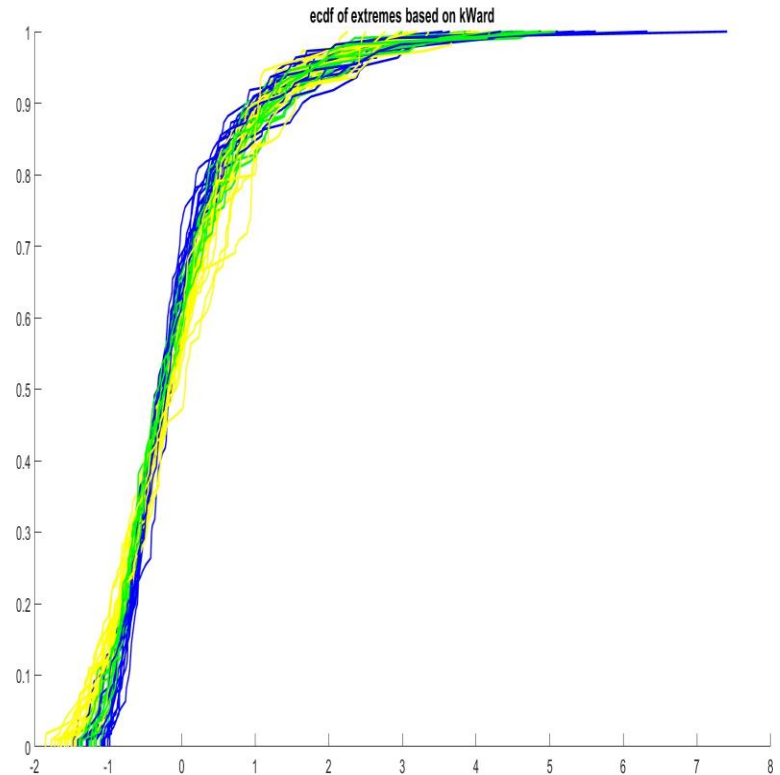


Empirical CDFs of extreme series

CDFs clustering



Clustering the CDFs of biggest flood event by the Average linkage method

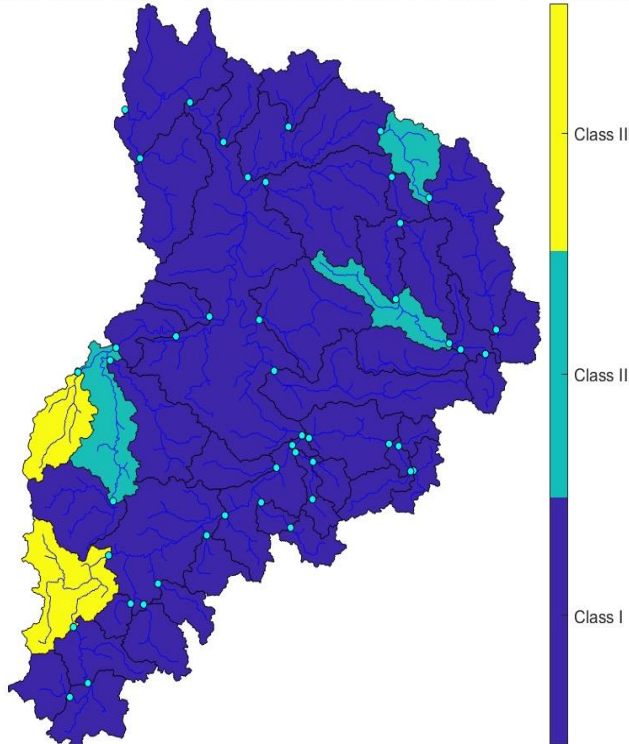


Clustering the CDFs of biggest flood event by the Ward linkage method

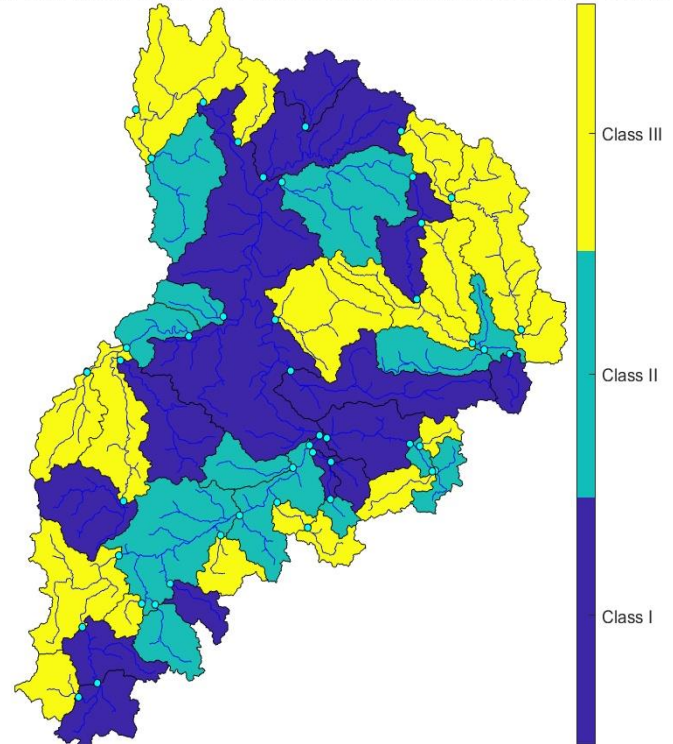
Agglomerative Hierarchical Cluster Tree (AHCT)

Mapping

Clustering of peak discharge of Complete timeseriesbased on KS test - kAverage



Clustering of peak discharge of Complete timeseriesbased on KS test - kWard



Clustering the behavior of biggest flood event based of maximum absolute difference of CDFs by the Average linkage method

Clustering the behavior of biggest flood event based of maximum absolute difference of CDFs by the Ward linkage method

Summary & Conclusion

- Analysis of extreme events shows how floods behave on the catchment
- Flood identification methods could be different
 - Peak Over Threshold (POT)
 - Not Time domain
 - Threshold
 - A varied range of peaks in a year (instead of two – one or three)
- Non-particular pattern for flood occurrences in the Ward linkage method
- The Average linkage method based on the maximum absolute difference of CDFs has more hydrogeological meaning in this area



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Thank you!

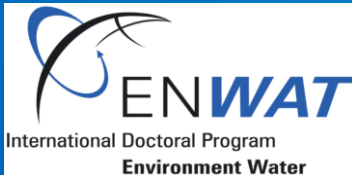


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