Spatial-temporal Analysis of Precipitation Extremes Over China During 1961-2019

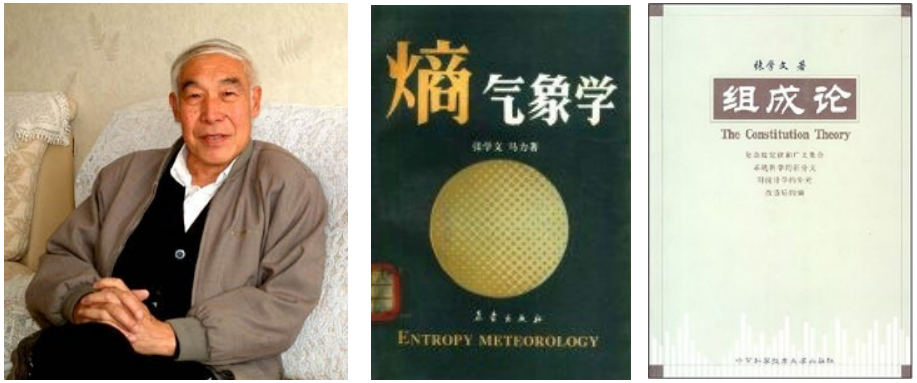
Shangkun Liu[†], Guxiao Chang

Dayu College
Hohai University

Correspondence: liskelleo@hhu.edu.cn

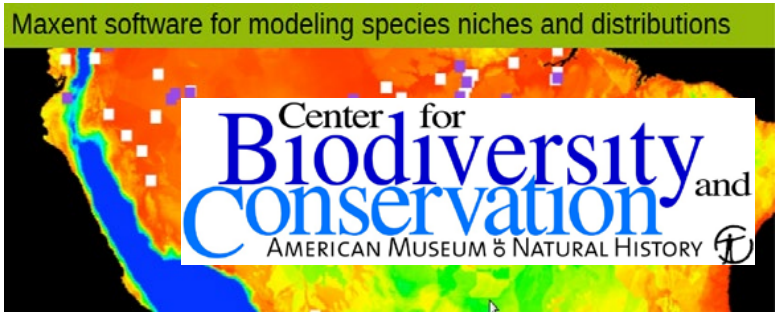
Introduction

- The principle of maximum entropy is actually the automatic maximization of system complexity.
- The entropy principle has not been fully utilized in weather modeling and climatic analysis.



Xuewen Zhang and his publications
(left: 1992; right: 2003)

In order to avoid the significant modelling complexity introduced by intricate factors, this study used **precipitation-only** data and applied the Maxent model to explore the potential distribution patterns of precipitation extremes.



the open source project of Maxent
(*AMNH* and *AT&T-Research*, 2017)

Dataset

PANGAEA.

Data Publisher for Earth & Environmental Science

Not logged in

SEARCH SUBMIT HELP ABOUT CONTACT

Qin, Rongzhu; Zhang, Feng (2022): HRLT: A high-resolution (1 day, 1 km) and long-term (1961–2019) gridded dataset for temperature and precipitation across China [dataset]. *PANGAEA*, https://doi.org/10.1594/PANGAEA.941329

Always quote citation above when using data! You can download the citation in several formats below.

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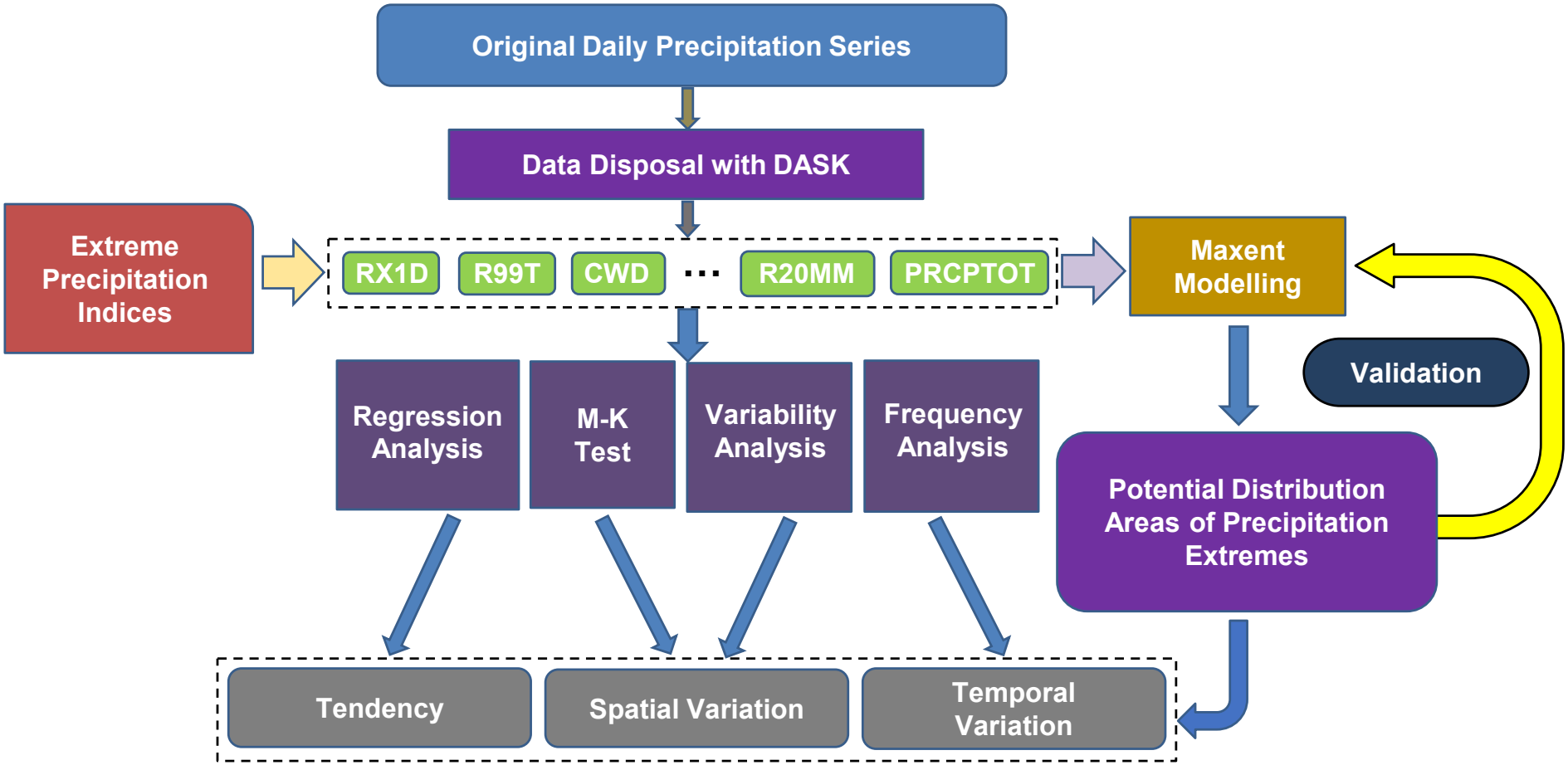
Change history:

2022-03-21T11:21:42 – Data files were reuploaded. The data type was transformed from integer to float, and the missing value was changed from the error of -327.68 to NA.

Contribution: Data inspection.

Technical route

Based on the high-resolution daily precipitation dataset and according to the characteristics of precipitation changes in China, the technical route is shown as:



Data processing

Build of the DASK parallel framework on Jupyter Notebook

Obtain gridded precipitation dataset HRLT from 1961 to 2019 from PANGAEA. (https://doi.org/10.1594/PANGAEA.941329)

↓

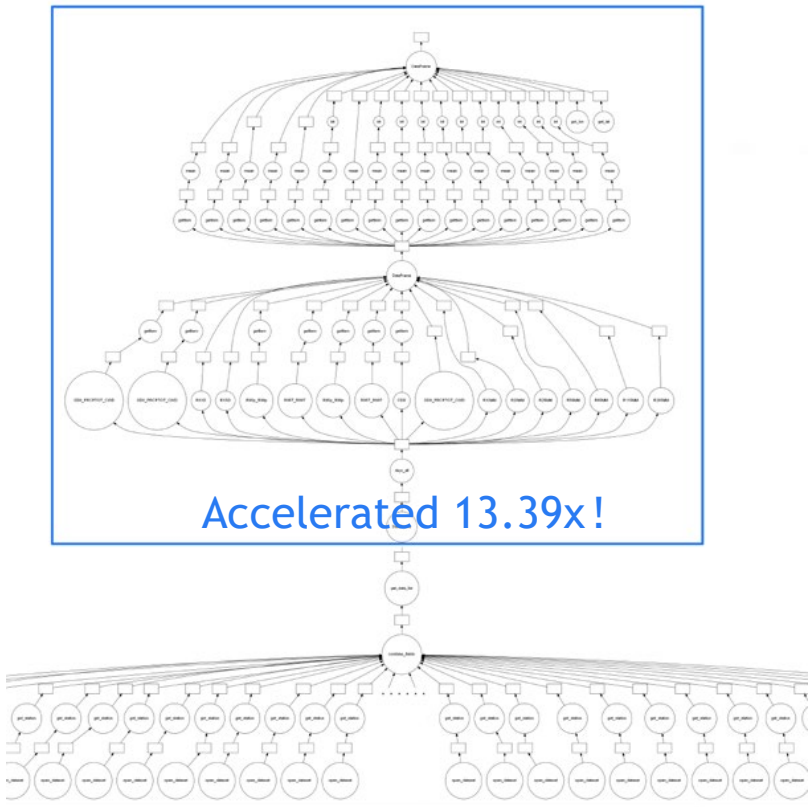
Extract the data from **nc** files by using *Dask* and exported its format to **csv**, where all data points were selected except for the data points containing null value.

↓

Calculate the indices of precipitation extremes at the annual scale for each selected point in the study region (i.e. China) using *Dask delayed objects*, where files were saved in **csv** format and each file contains complete records of annual indicators for a total of 59 years.

ANACONDA. jupyter dask

Directed Acyclic Graphs (DAGs) of Data Streams



Maxent modelling

$$\max_{p(y|x)\in\mathbf{P}} \quad H(p) = -\sum_{x,y} \underbrace{\tilde{p}(x)p(y|x)}_{p(y,x)} \log p(y|x)$$

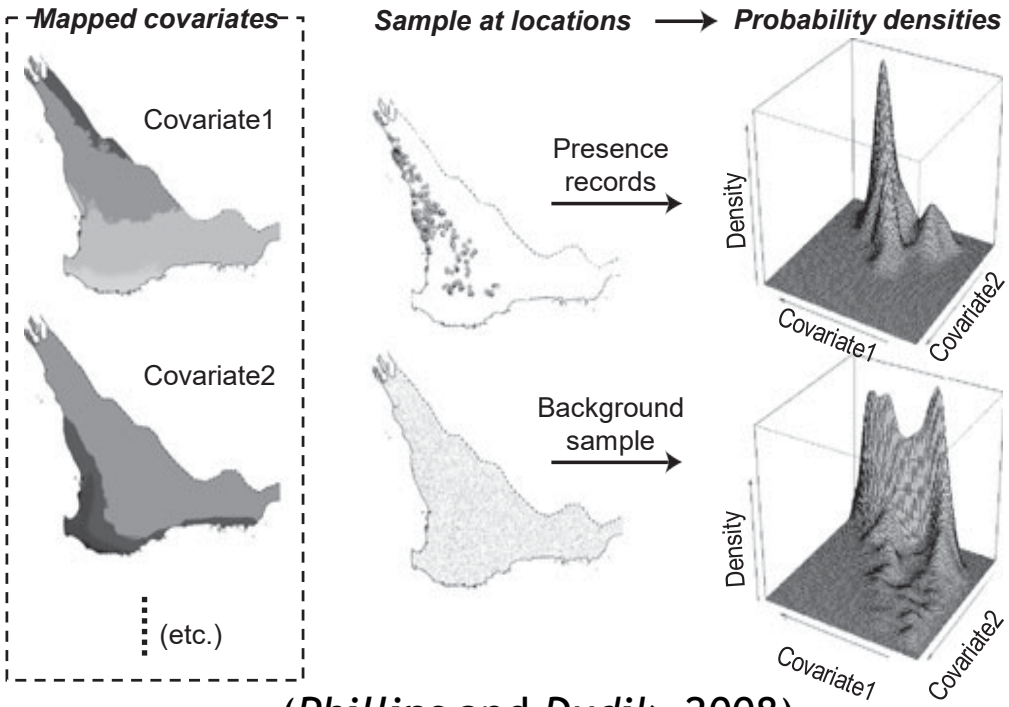
$$\text{s.t.} \quad E_p(f_i) = E_{\tilde{p}}(f_i) \qquad i = 1, 2, \cdots, n$$

$$\sum_{y\in\mathbf{Y}} p(y|x) = 1$$

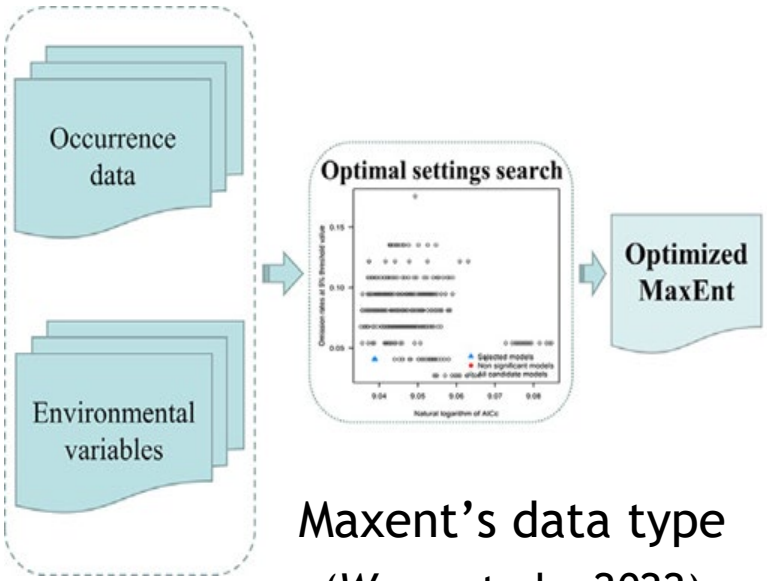
(*Adam Berger*, 1996)

Mathematical expressions demonstrate that the basis of this approach is to connect the problem with information entropy and then take the maximum information entropy as a useful hypothesis.

Statistical interpretation



(*Phillips* and *Dudik*, 2008)



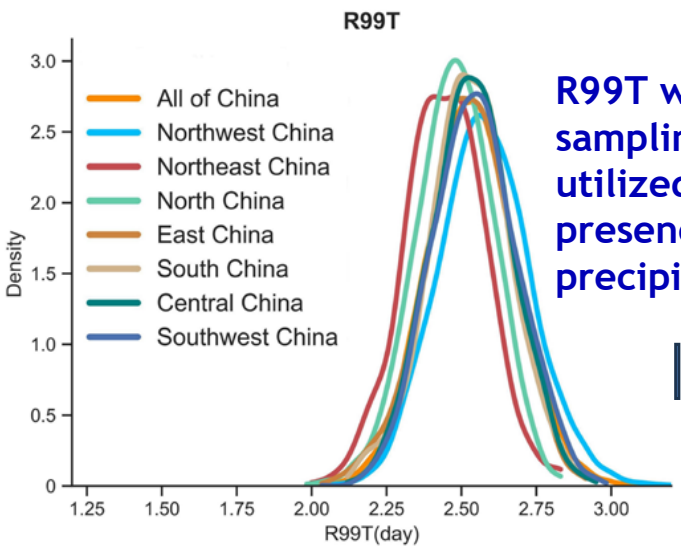
Maxent's data type

(*Wang* et al., 2022)

Highlights

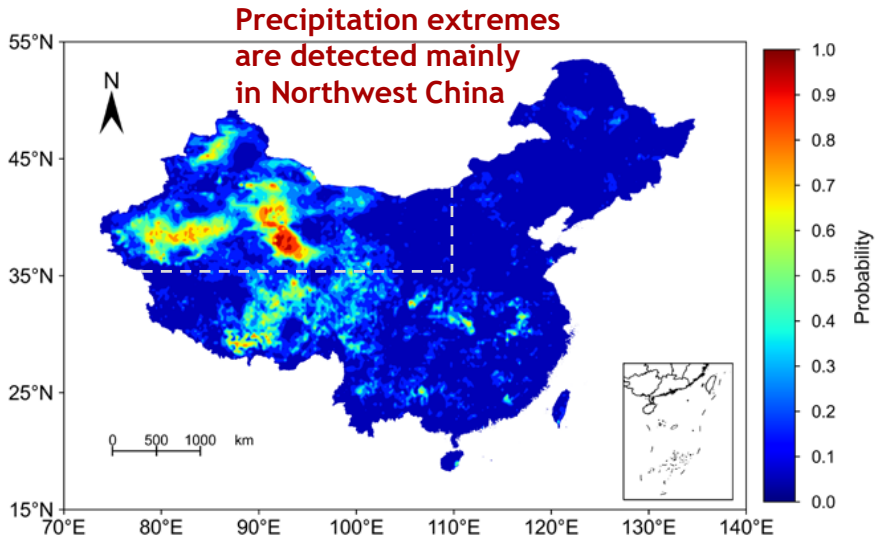
- R99T (annual total days > 99th percentile of precipitation) is found to be the most unbiased index to define precipitation extremes in different regions over China.

- By employing Maxent, high-frequent precipitation extremes mainly occur in Northwest China, especially in its basin areas.



R99T with the smallest sampling error was utilized to generate presence-only data of precipitation extremes

Maxent



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GitHub

https://github.com/Liskelleo/Spatialtemporal-Analysis-of-Precipitation-Extremes-Over-China-During-1961-2019