Practitioner Friendly Introduction to <u>Bayesian</u> Flood Frequency Analyses

Henry H. Hansen & Joshua L. Erickson

RiBES

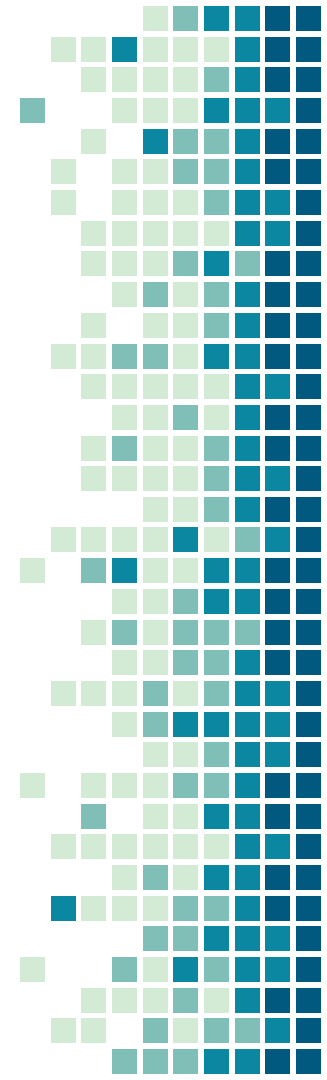KARLSTADS UNIVERSITET

What is Bayesian Statistics?

$$P(A \mid B) = \frac{P(B \mid A) \cdot P(A)}{P(B)}$$

A, B = events

$P(A|B)$ = probability of A given B is true

$P(B|A)$ = probability of B given A is true

$P(A), P(B)$ = the independent probabilities of A and B

A Bayesian example from a galaxy far far away…

SIR, THE POSSIBILITY OF SUCCESSFULLY **NAVIGATING** AN ASTEROID FIELD IS APPROXIMATELY 3720-TO-1.

NEVER TELL ME THE ODDS.

Idea from: Bayesian Statistics the Fun Way

Simplified Bayes Theorem

Posterior Probability   Likelihood   Prior Probability

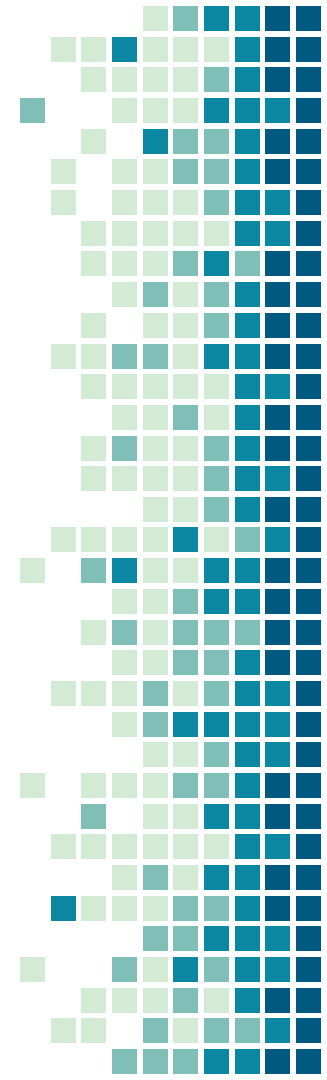$$p(\theta|y) \propto p(y|\theta) \; p(\theta)$$
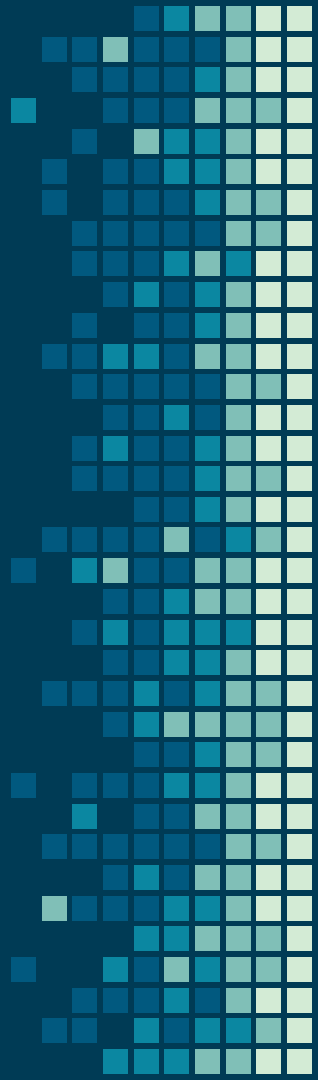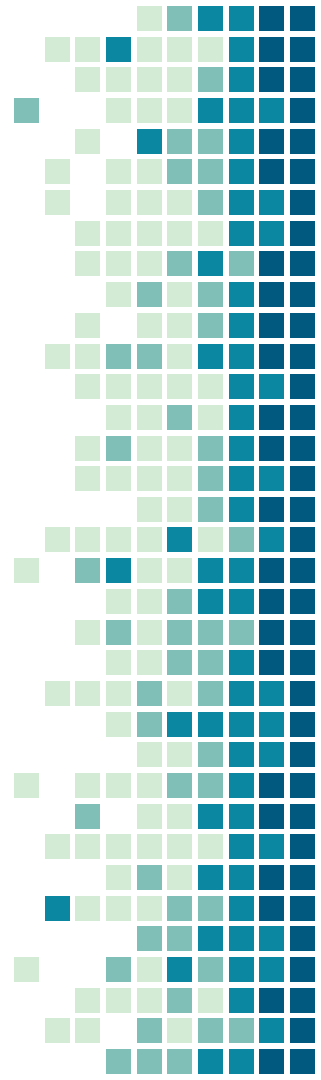
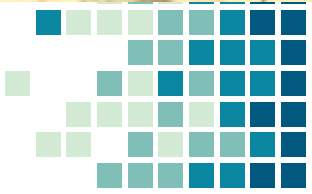Understanding   Evidence   Beliefs

Bayes lets us update our world view

The Klarälven

https://varmlandskindustrihistoria-wordpress-com
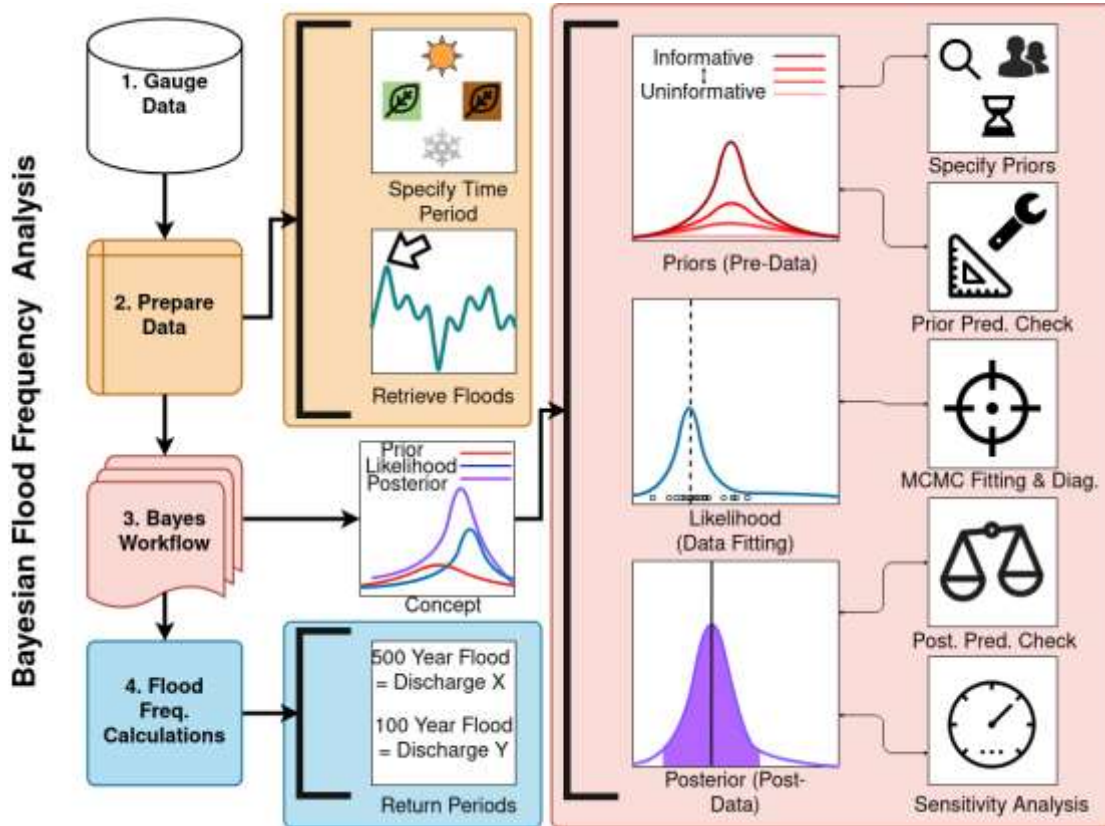https://sv.wikipedia.org/wiki/Klar%C3%A4lven

The Klarälven used to flood a lot!

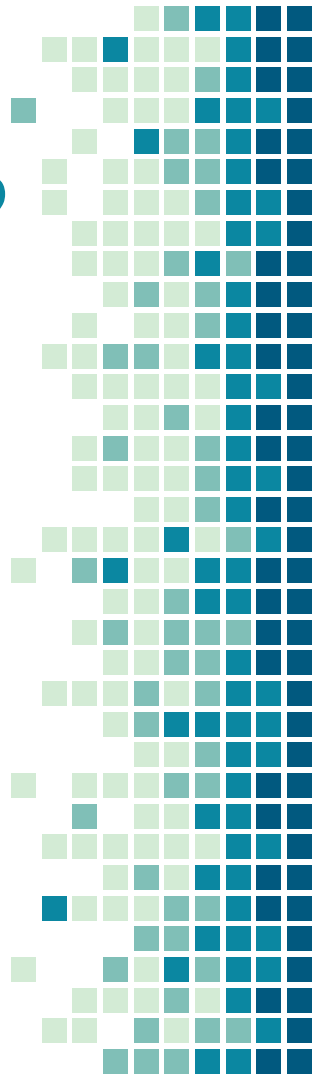# How do we model floods in a Bayesian way?

How do we model floods in a Bayesian way?

Evidence

50 years of gauge station discharge measurements

Prior Beliefs

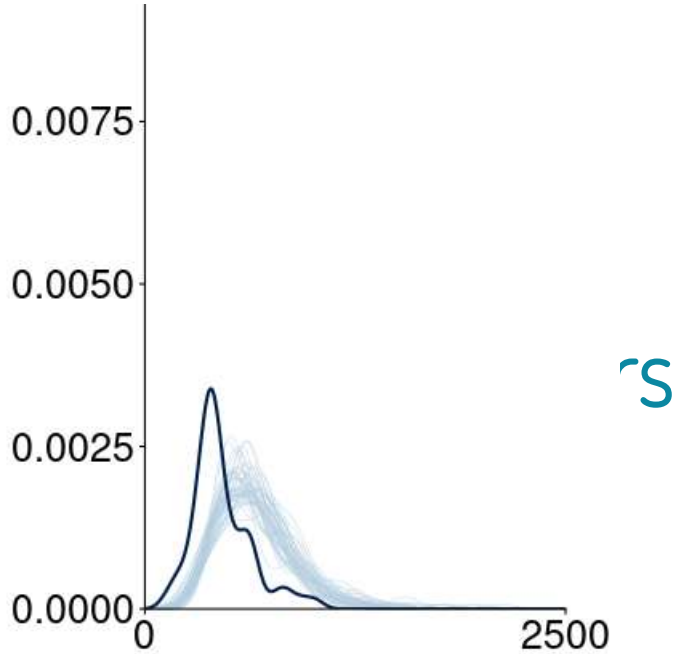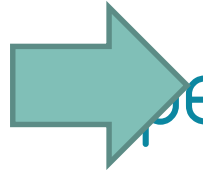A single figure visualizing discharge data from 1889-1949 published in 1956
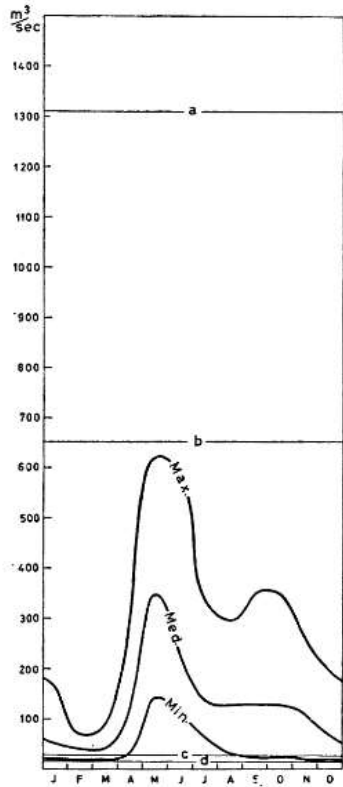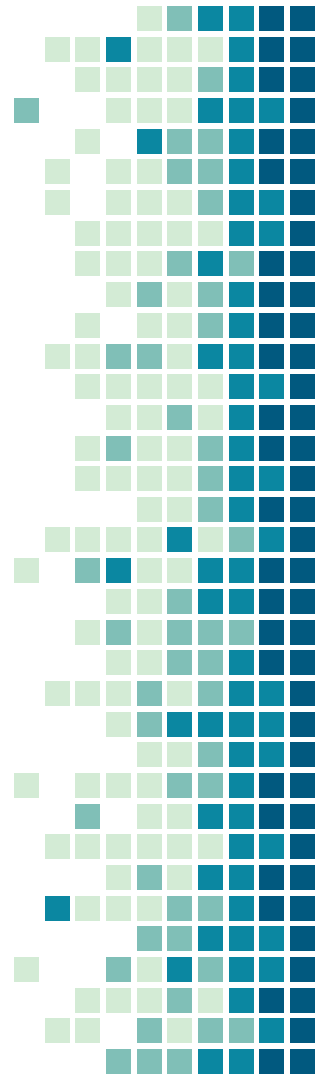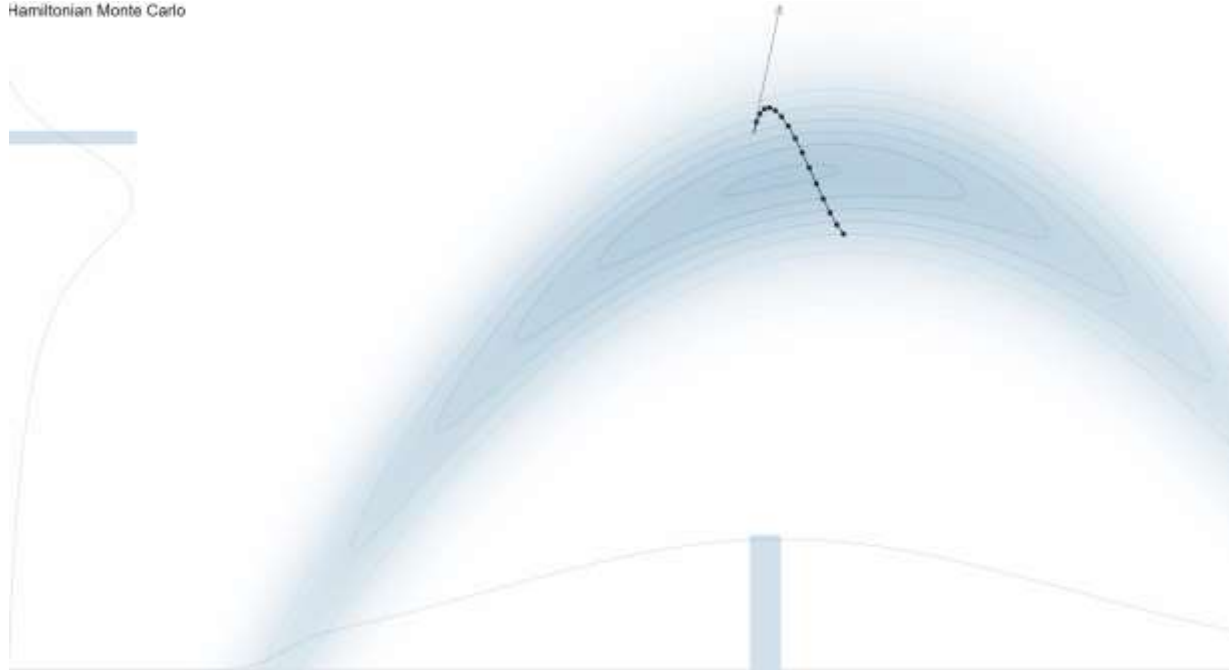
Fig. 33. Run-off characteristics at Edebäck.
Max.: highest monthly mean values recorded.
Med.: normal monthly mean values. Min.:
Lowest monthly mean values recorded. a:
highest discharge recorded. b: normal high-
water discharge. c: normal low-water discharge.
d: lowest low-water discharge recorded.
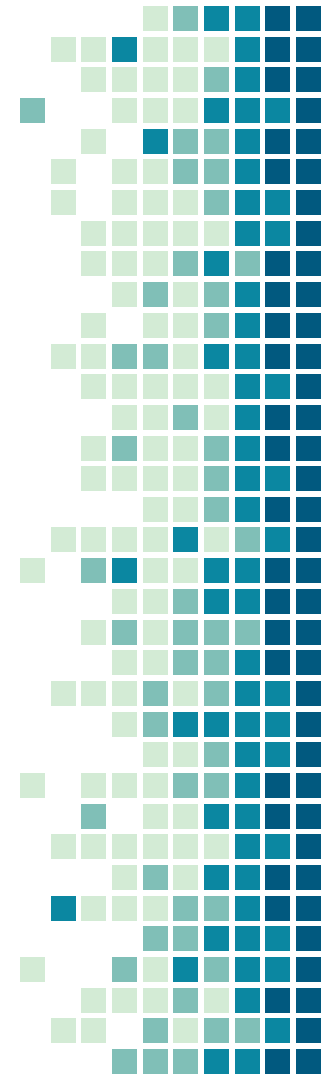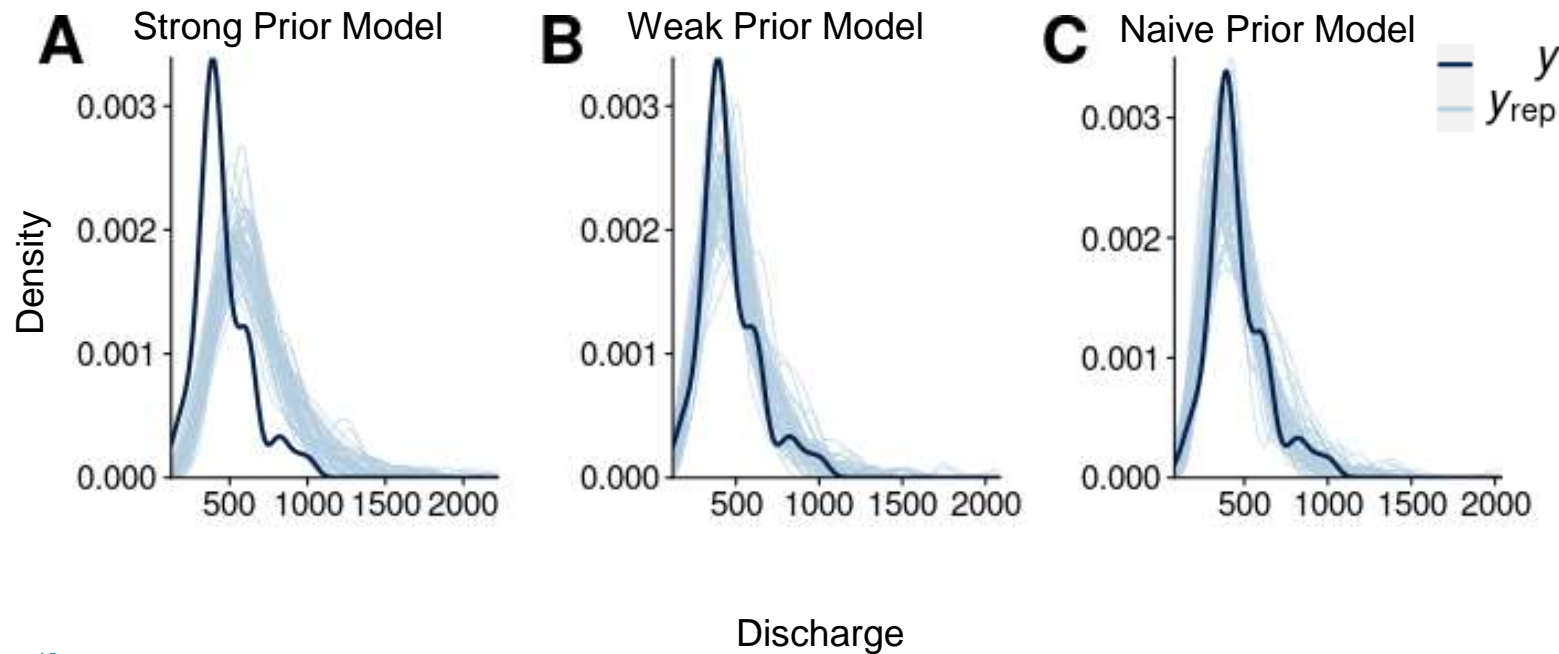
And checking them!

Fit models with MCMC
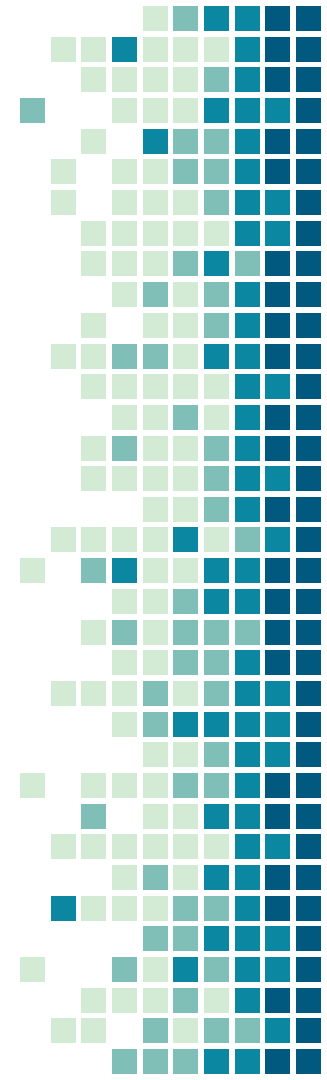
And Interpret them!

Hamiltonian Monte Carlo

Checking Posteriors

And assess sensitivity!

A Strong Prior Model **B** Weak Prior Model **C** Naive Prior Model
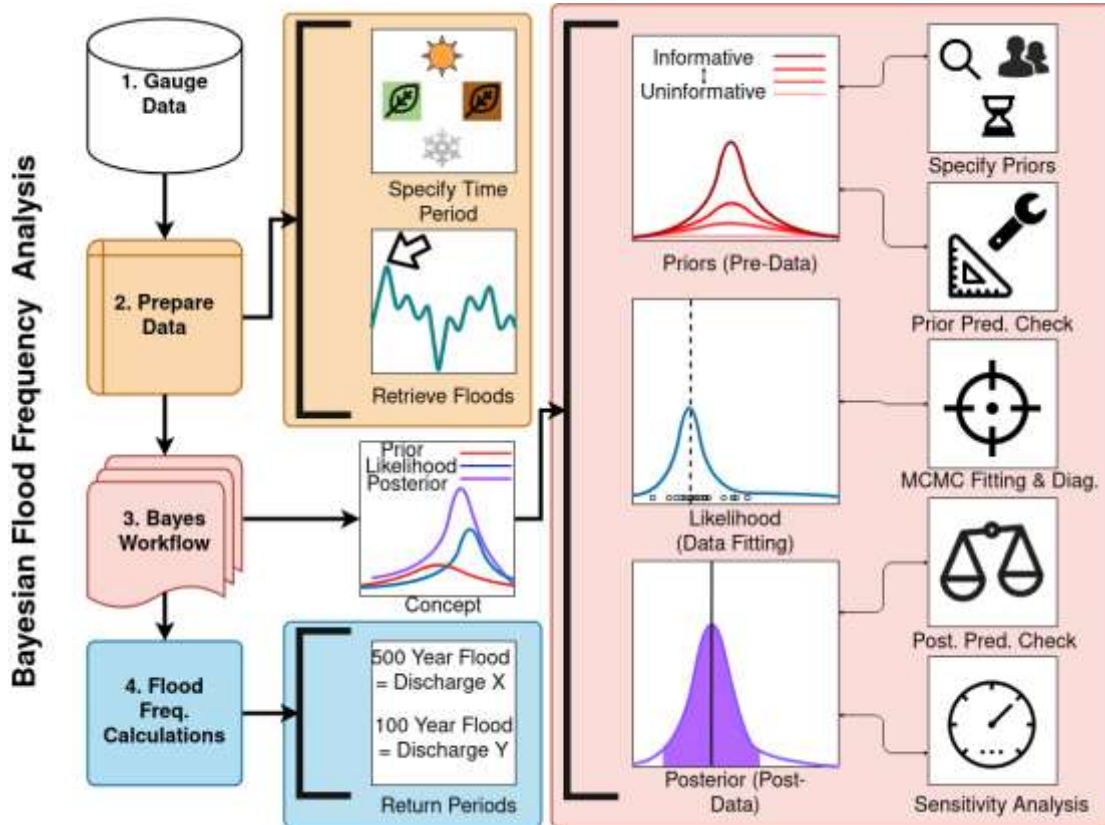
Density

Discharge

y

y_{rep}

When to be Bayesian!

- You work with small datasets
- You have lots of previous understanding of your system
- You hate p-values and everything they stand for

How do we model floods in a Bayesian way?

This paper's code is on Zenodo!

https://zenodo.org/record/7808948

April 7, 2023

Workflow | Open Access

Practitioner Friendly Introduction to Bayesian Flood Frequency Analyses

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Code and data for the publication - Practitioner Friendly Introduction to Bayesian Flood Frequency Analyses
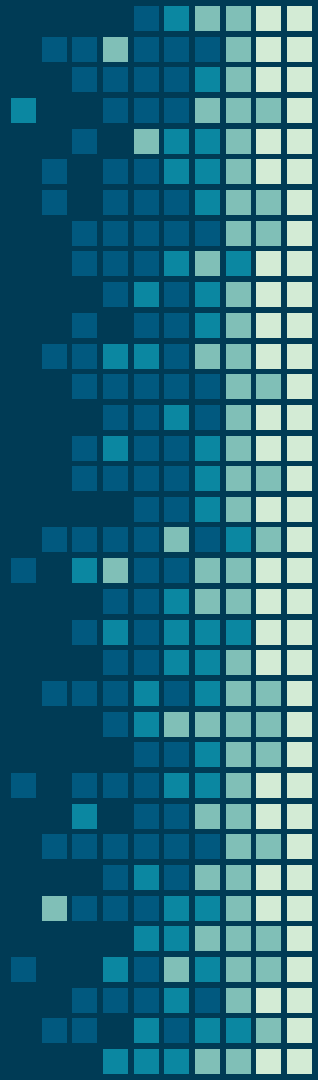
THANKS!

Any questions?

You can find me at:

@henryhhansen

Henry.hansen@kau.se

Other Helpful Resources

- Interactive Bayesian Tutorial :
  - https://seeing-theory.brown.eduInteractive

- MCMC visualizer :
  - http://chi-feng.github.io/mcmc-demo/app.html