

Practical Approaches to Probabilistic Flood Estimates: an Australian perspective

Rory Nathan

The University of Melbourne

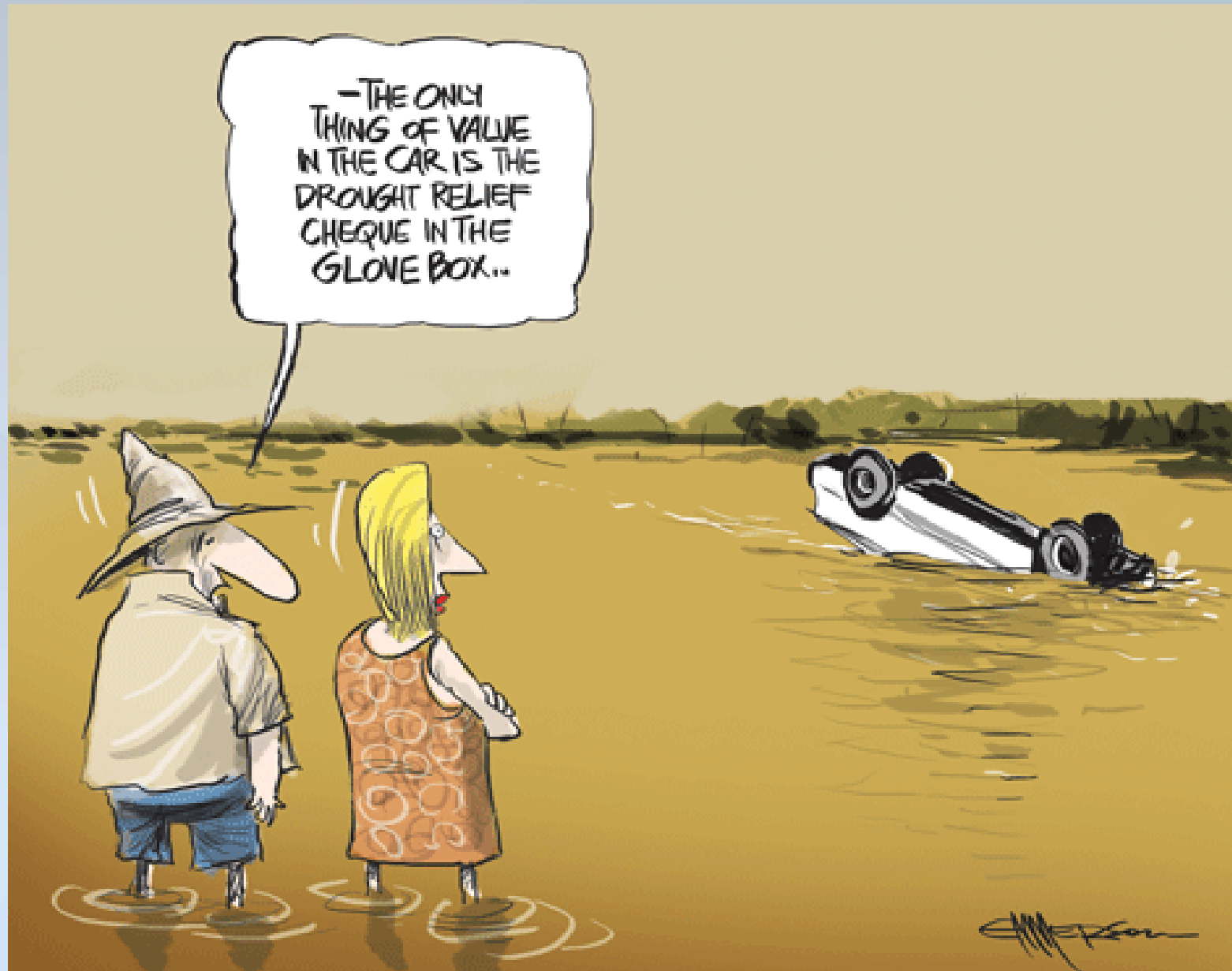


Flash Flooding Toowoomba Jan 2011

Photo: Nicole Hammermeister)

*I love a sunburnt country
A land of sweeping plains
Of ragged mountain ranges
Of droughts and flooding rains*

Dorothea Mackellar (1904)



*I love a sunburnt country
A land of sweeping plains
Of ragged mountain ranges
Of droughts and flooding rains*
bushfires

Dorothea Mackellar (1904)



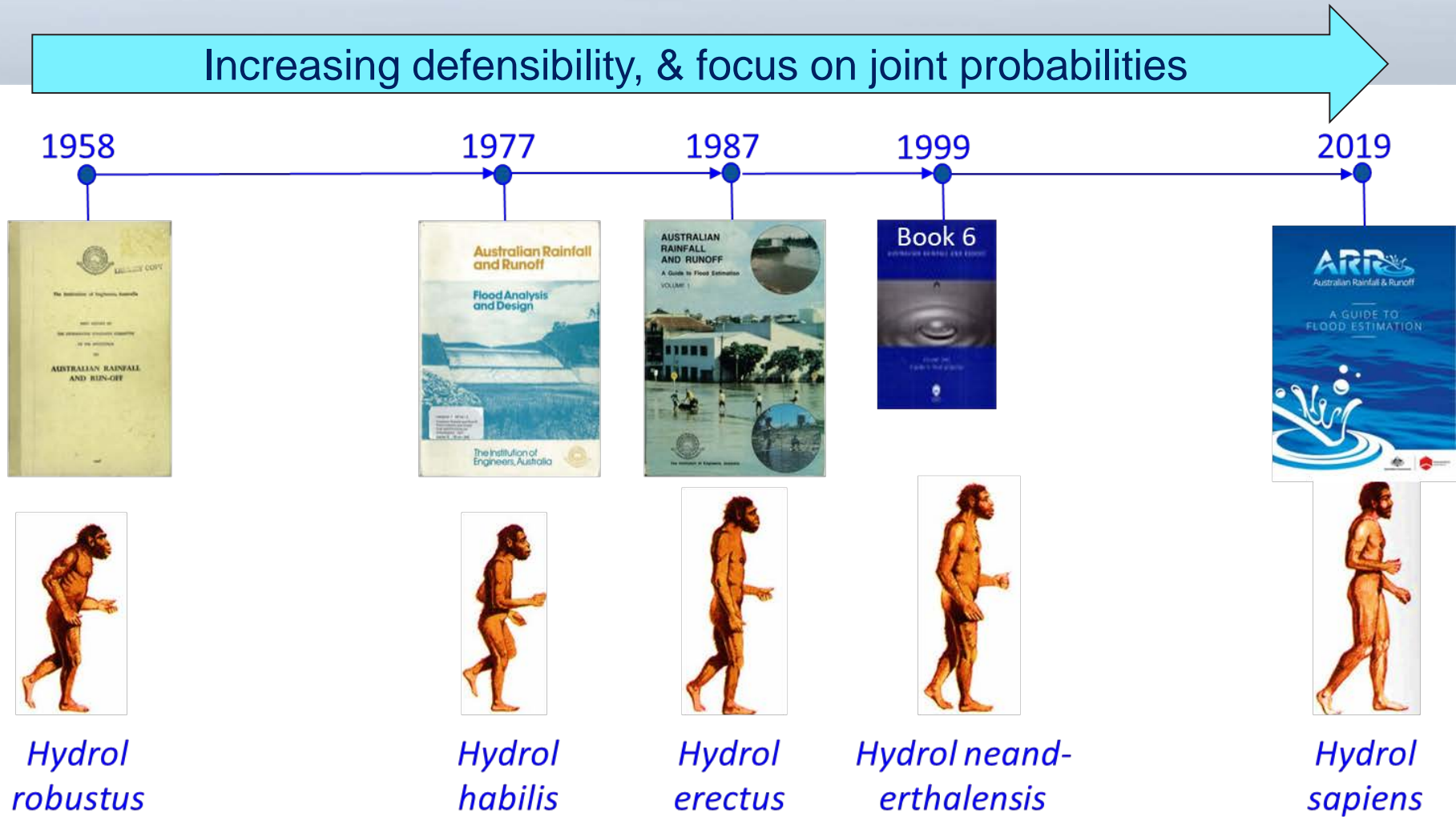



Brisbane City flood, January 2011
Photo: Felicity Wilson
USD\$20 billion damages



Townsville flood, January 2019
Photo: Courier Mail
USD\$4 billion damages

Timeline of “Australian Rainfall and Runoff” national flood guidelines



- 
- 22 research projects
 - 9 books (~1500 pp)
 - ~\$13.5M (& equal in-kind)

Australian Rainfall and Runoff (ARR2019)

<http://arr.ga.gov.au/arr-guideline>



The logo of the Australian Government Geoscience Australia, featuring a coat of arms with a kangaroo and a swan.

Australian Rainfall and Runoff

Search here...

ABOUTARR GUIDELINESNEWSCONTACT US

AUSTRALIAN RAINFALL AND RUNOFF » ARR GUIDELINES

ARR Guidelines

ARR 2019 consists of:

- The Guideline
- Software
- Data

The ARR Guideline

The ARR Guideline is available at the moment in three formats:

- [epub download](#)
- [web-based](#)
- [pdf](#)

Epub is an open e-book format that can be read through many devices. You can access epub documents through iPads and Kindles as well as on your PC with an epub reader. There are many free epub readers that are available for download (one such is Calibre available for download [here](#)).

Detailed reports for the ARR [revision projects](#) are available for interested users.

Subscribe to our eNews

REGISTER

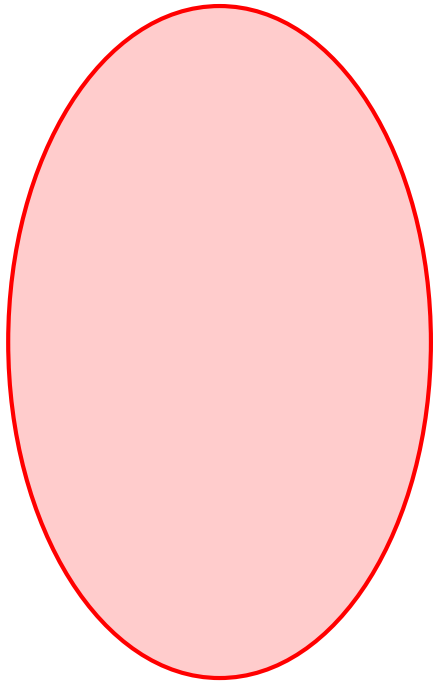
News

21 Nov 2019

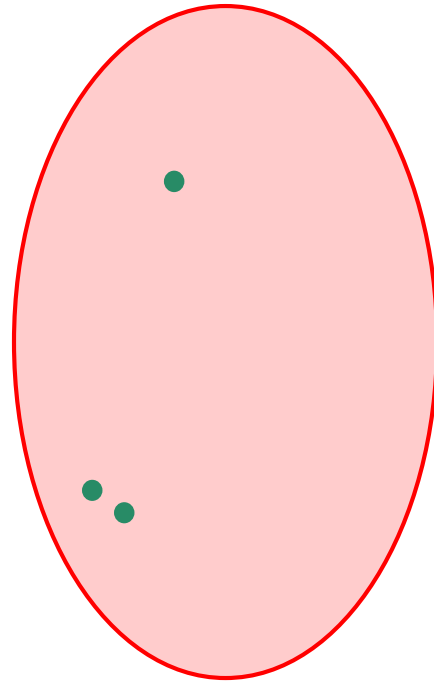
ARR editors and technical committee win national award

[Read more...](#)

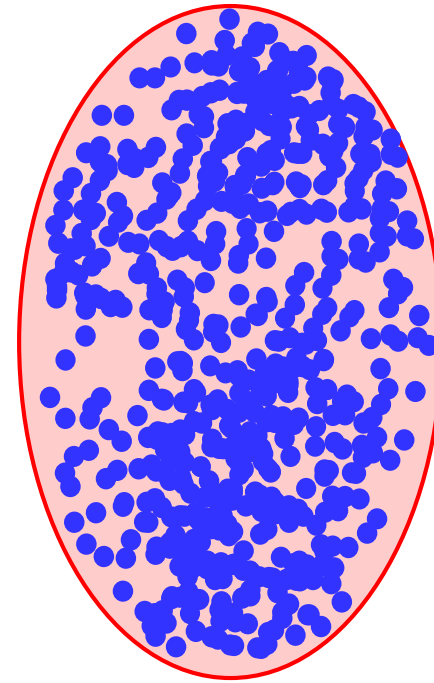
Availability of Data



Where info is
required

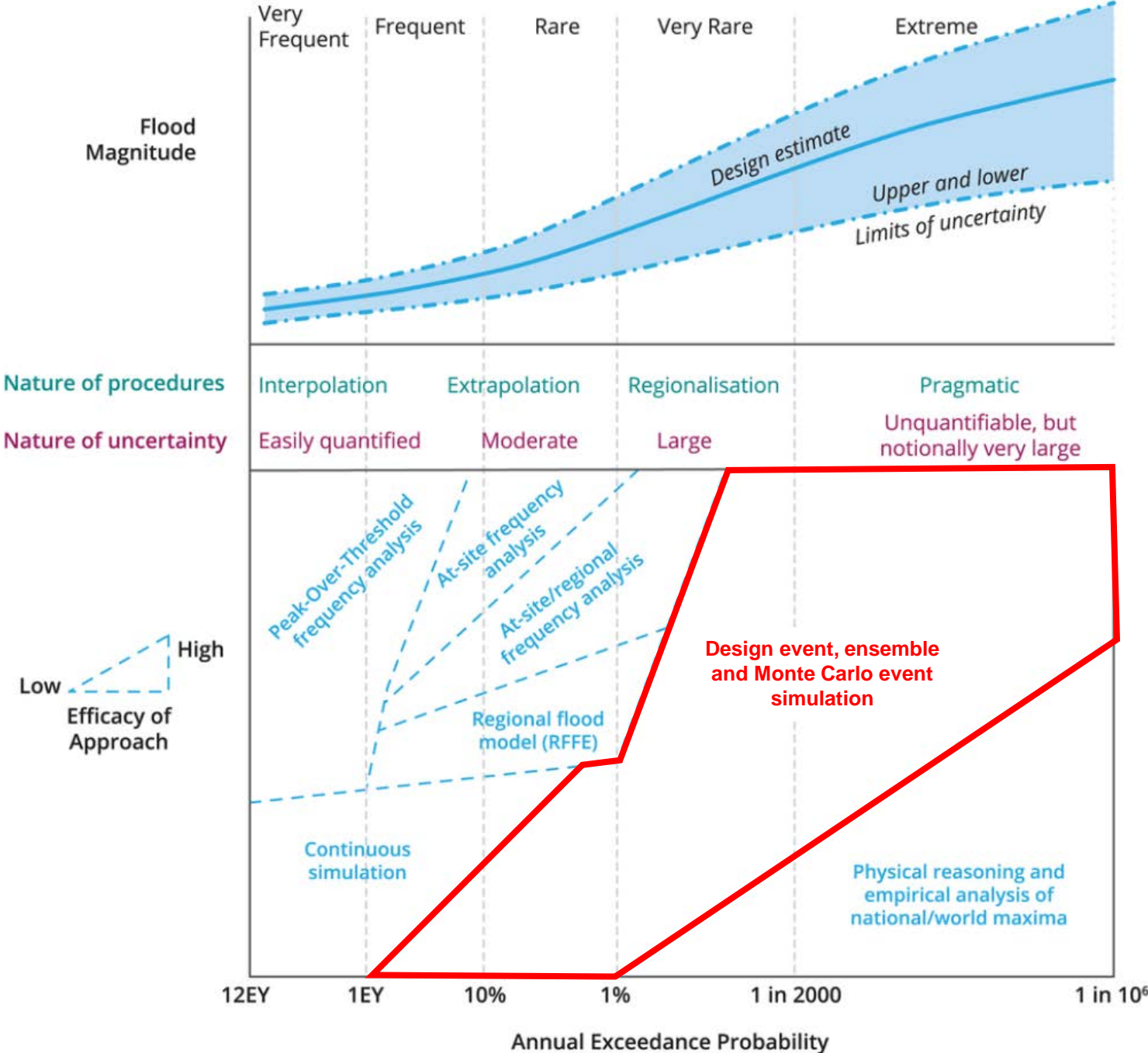


Available
flood data



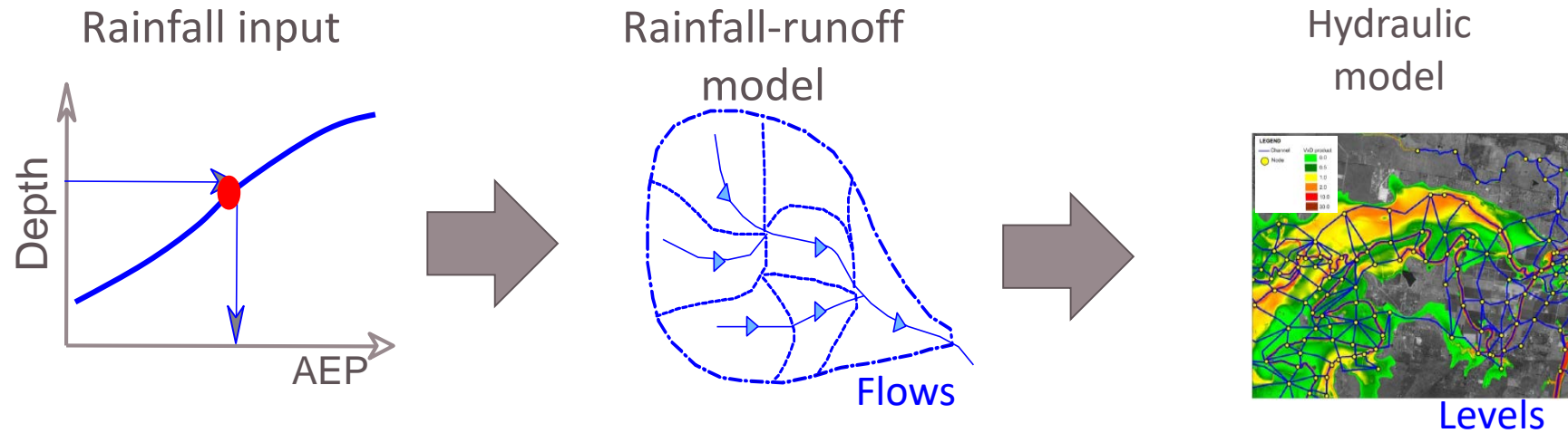
Available
rainfall data

Efficacy of different approaches



ARR2019: Book 1, Ch 3
 Approaches to Flood Estimation
 Nathan and Ball

Rainfall-based methods



- Statistical parameters
- Spatial pattern?
- Temporal pattern?
- Pre-burst?

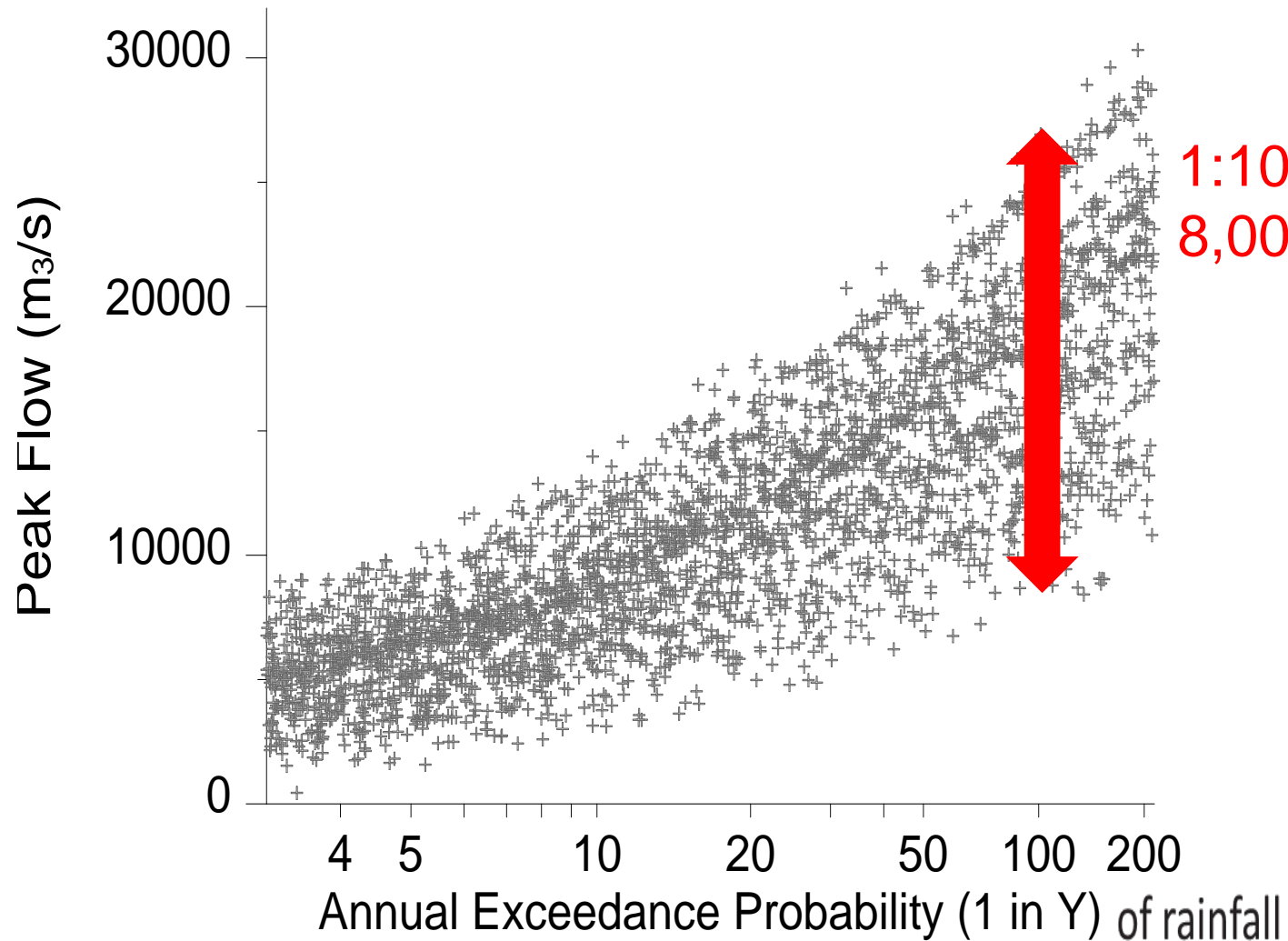
Epistemic uncertainty
(data, parameters)

- Stream network
- Routing params
- Antecedent wetness?
- Event losses?

- Bathymetry
- Floodplain/structures
- Roughness params
- Boundary conditions?

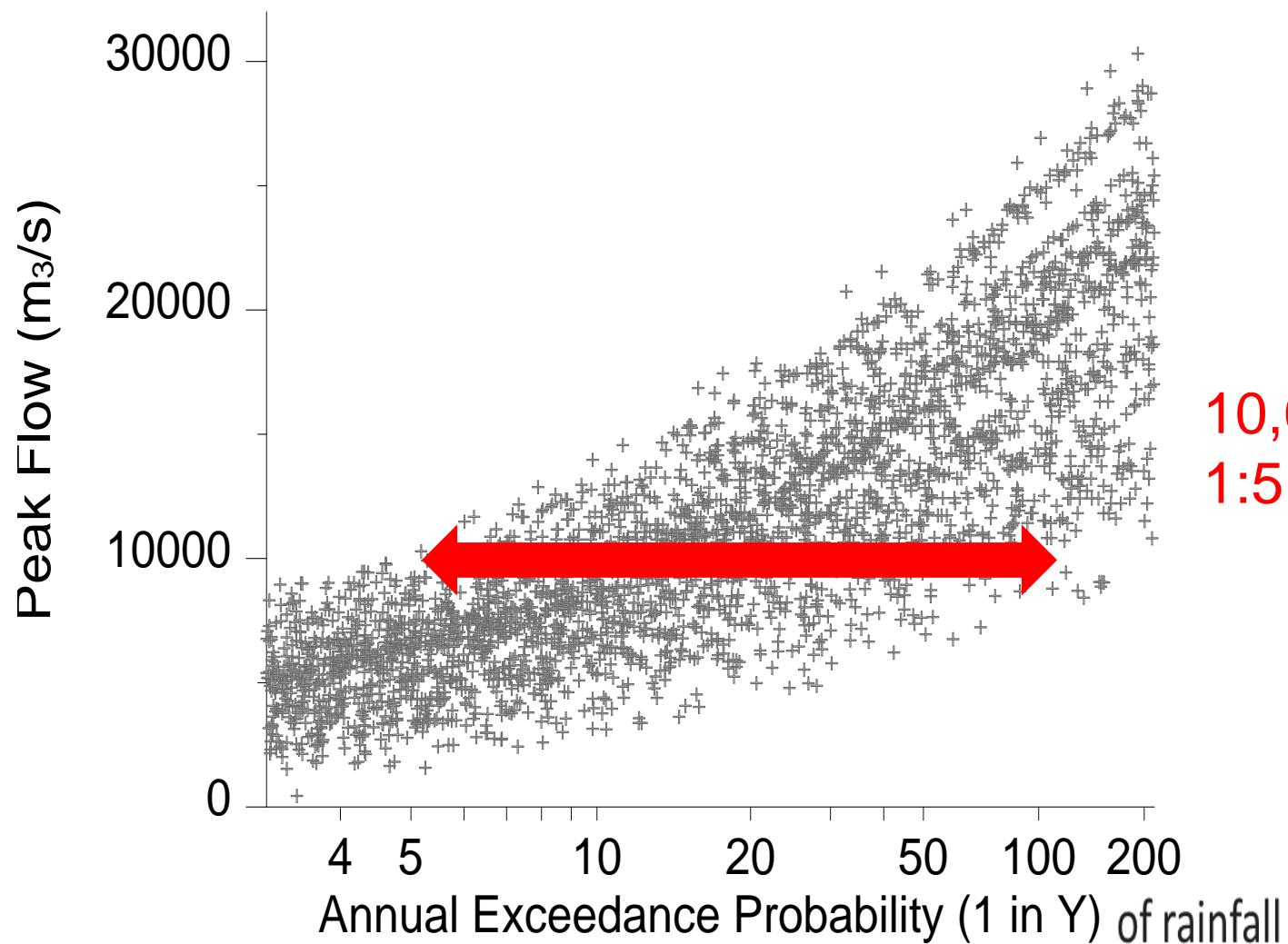
Aleatory uncertainty
(natural variability)

Probability-neutral focus is on aleatory uncertainty with aim of ensuring a 1:Y rainfall yields a 1:Y flood.



1:100 AEP rainfalls:
8,000 → 26,000 m³/s

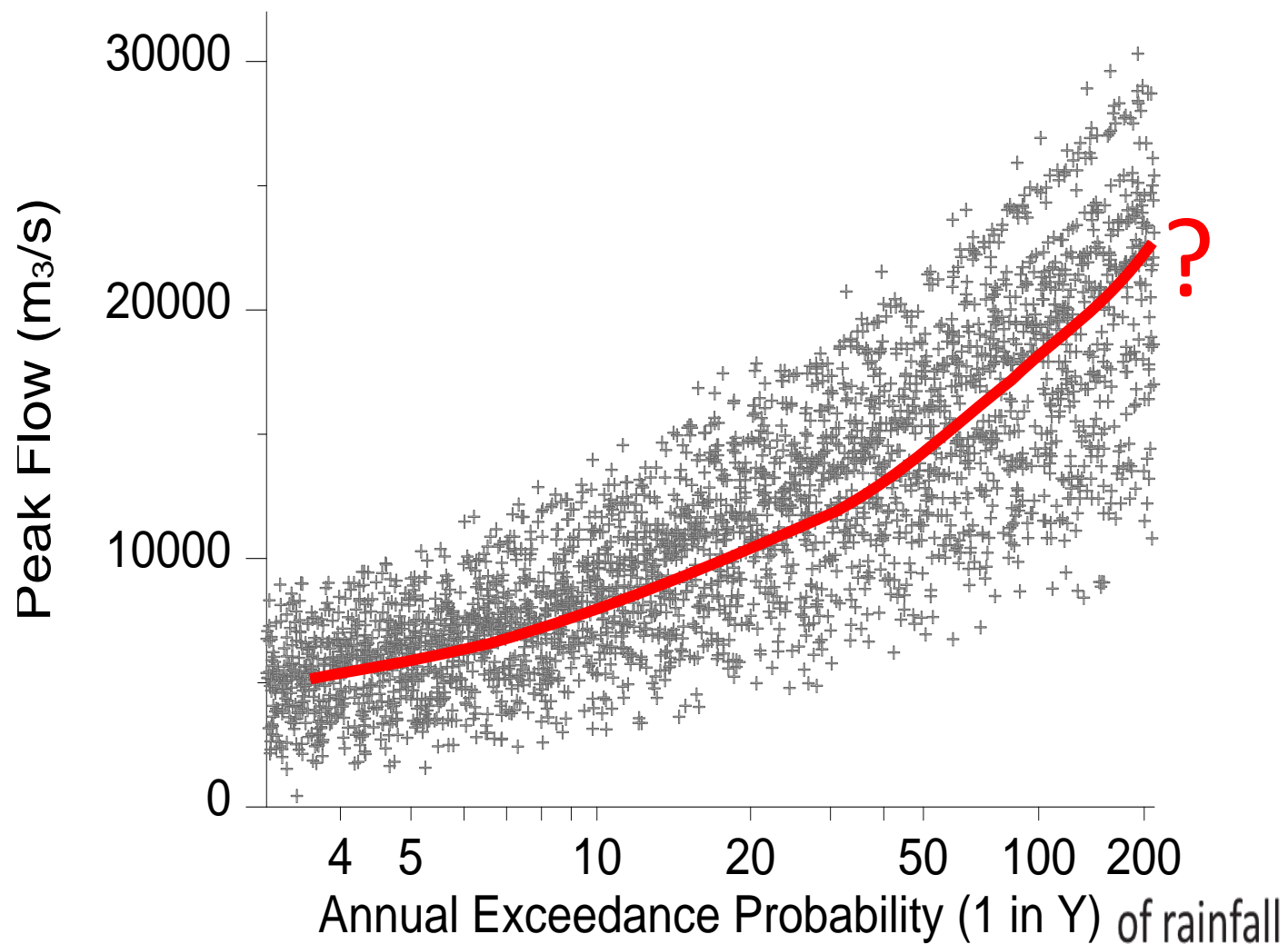
Each flood (+) is the result of the random interaction between rainfall, its temporal and spatial variability, catchment wetness, etc



10,000 m³/s result from
1:5 → 1:100 AEP rainfalls

Each flood (+) is the result of the random interaction between rainfall, its temporal and spatial variability, catchment wetness, etc

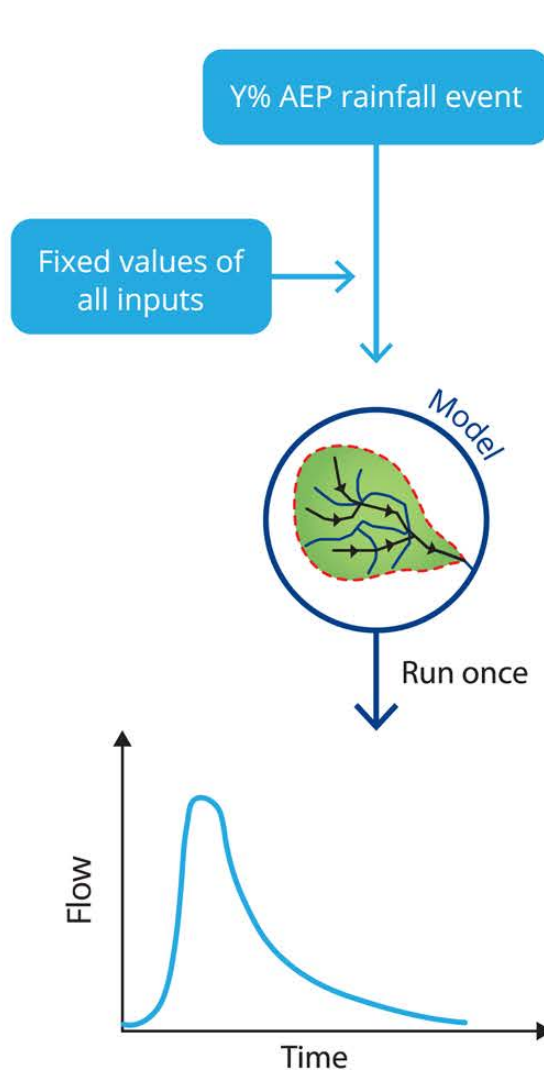
Aleatory Uncertainty



Each flood (+) is the result of the random interaction between rainfall, its temporal and spatial variability, catchment wetness, etc

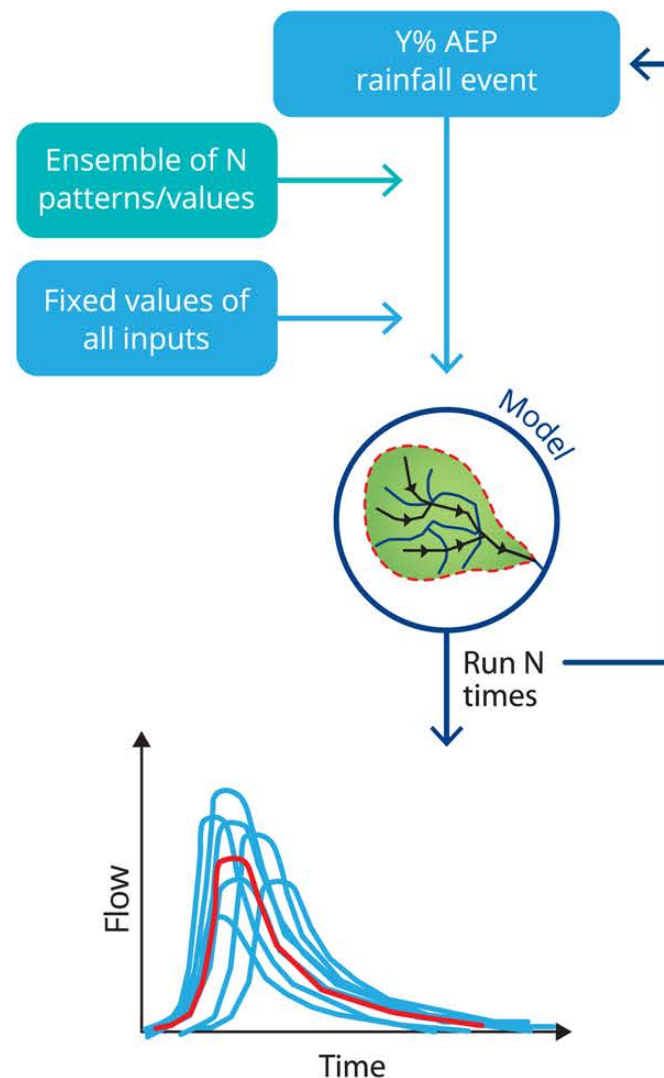
Three approaches of increasing complexity:

Simple event



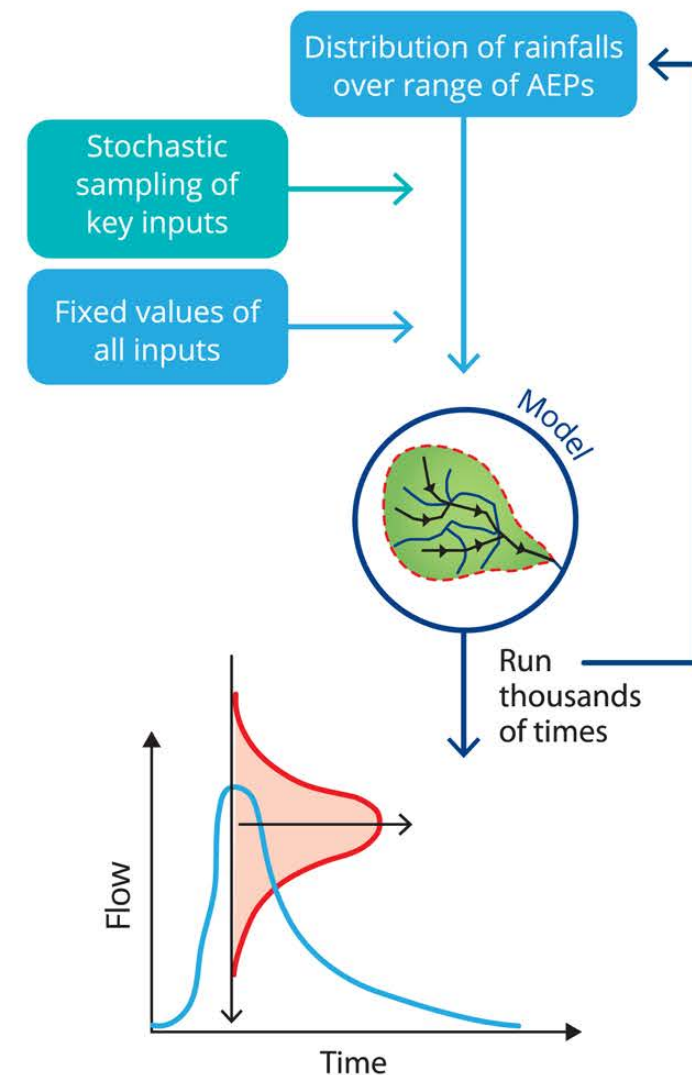
- AEP of peak flow assumed to be Y%

Ensemble event



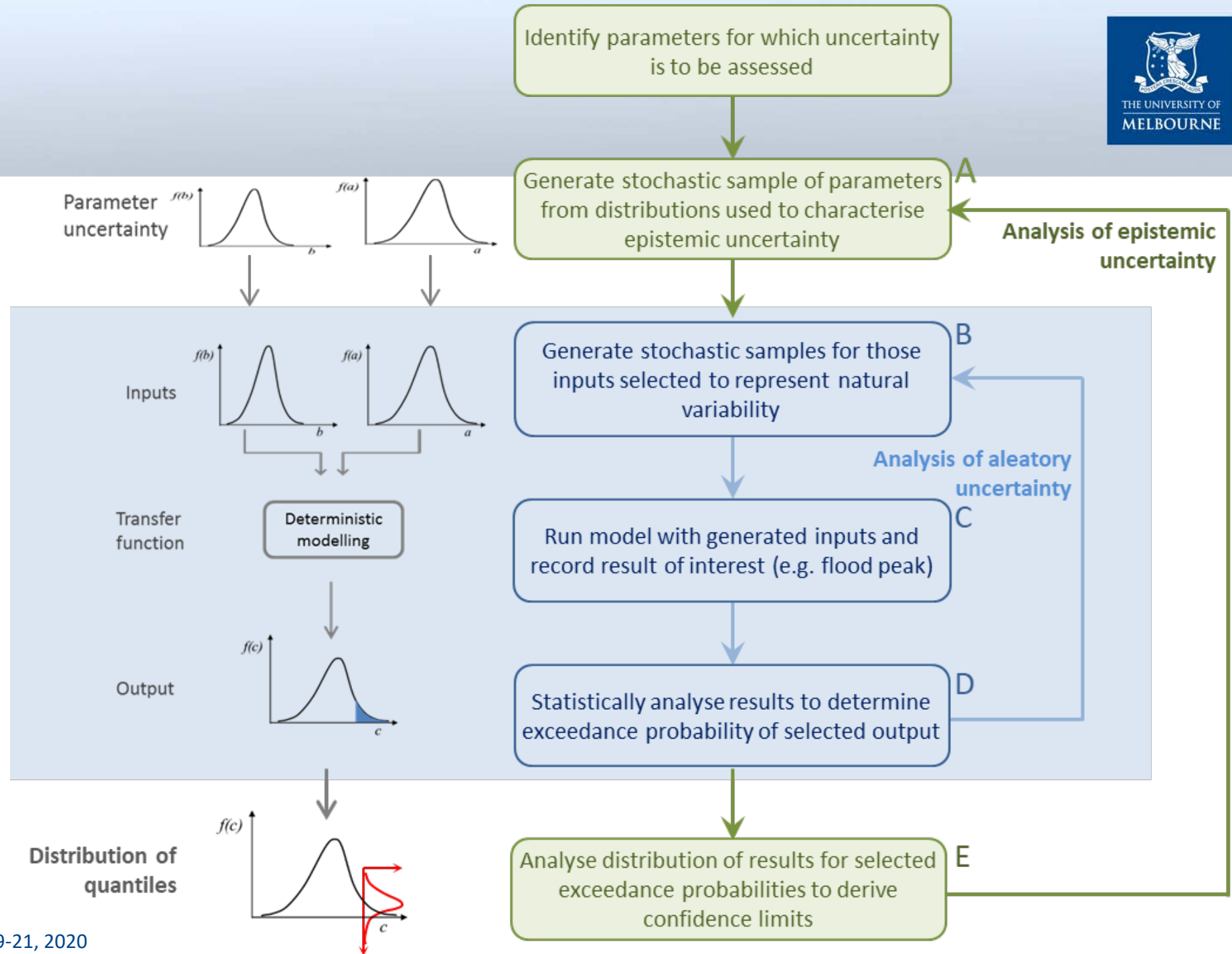
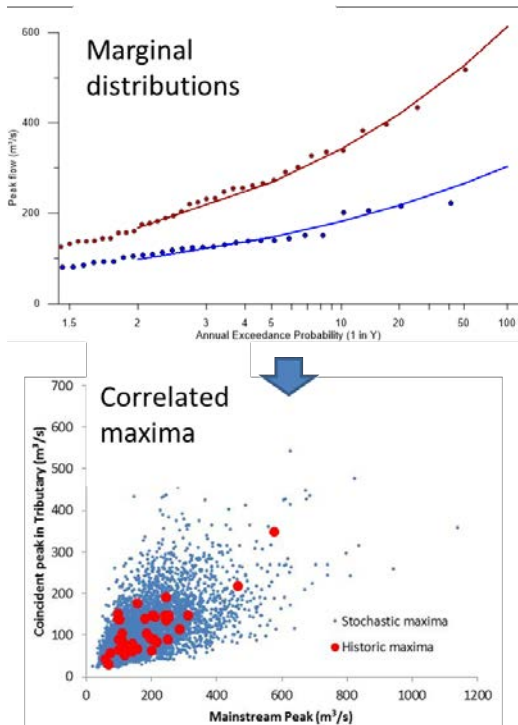
- Peak flow is weighted average of ensemble
- AEP of peak flow assumed to be Y%

Monte Carlo event



- Magnitude and AEP of peak flow determined by statistical analysis

Monte Carlo Simulation




ARR2019: Book 4, Ch 4
Treatment of joint probability
Nathan and Weinmann

Sources of deterministic and aleatory design information

- Probabilistic design rainfalls
(12 EY to 1 in 2000 AEP, 1 min to 7 days
Regional and site specific estimates to 1 in 10^7 AEP)
- Areal reduction factors
- Ensemble temporal patterns (11 regions, 11 durations)
- Pre-burst rainfalls
- Initial and event losses (mean and distribution)
- Baseflow
- Climate change factors
- Regional flood quantiles for ungauged catchments
(with epistemic uncertainty)
- Compound rainfall and storm surge events

ARR Data Hub
Enter coordinates or upload a shapefile


Australian Rainfall & Runoff

ATTENTION: This site was updated 9/05/19
A changelog can be found [here](#)
A legacy site for the ARR Data-Hub has been established <http://data-legacy.arr-software.org/>. It contains a version of the application which was completed in June 2018, and was created for anyone whose requests no longer function with the newer code on the production server.

Longitude
151.205608

Latitude
-33.869929

Upload Shapefile (clear)
 No file chosen

River Region

ARF Parameters

Storm Losses

Temporal Patterns

Area Temporal Patterns

BOM IFD Depths


Median Preburst Depths and Ratios

Other Preburst Depths and Ratios

Interim Climate Change Factors

Baseflow Factors

+
-

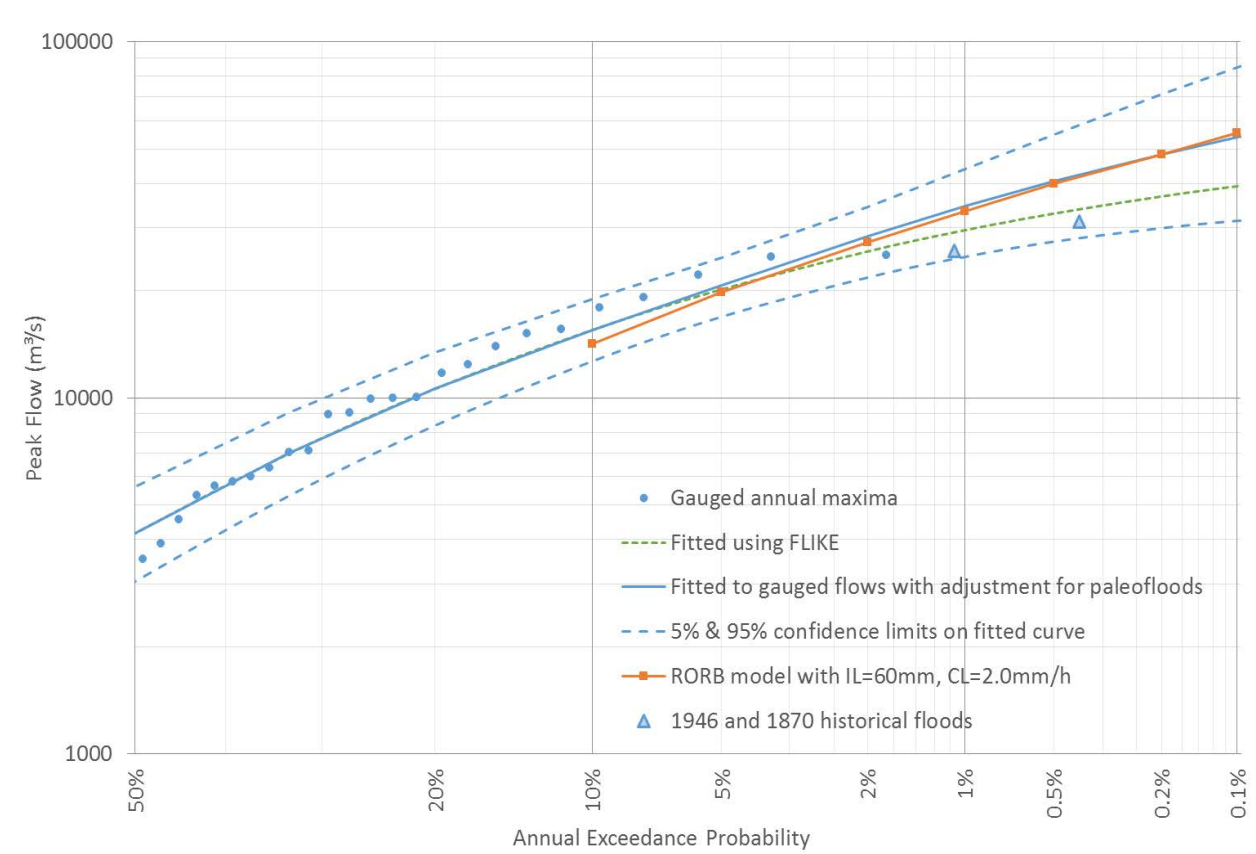


Zoom To Marker

<http://data.arr-software.org/>

Reconciliation/derivation of flood frequency curves

- “Frequent to Rare” flood risk design for floodplain planning and major infrastructure
 - Design risks from 1 in 2 AEP to 1 in 2000 AEP
 - Books 2, 3, 4, 5 & 7
- “Very Rare to Extreme” flood risk design for critical infrastructure and dams
 - Design risks from 1 in 100 AEP to 1 in 10^7 AEP
 - Book 8 (includes PMP \rightarrow PMF)
 - AEP of PMP:
 - Regional - Laurenson-Kuczera (based on area)
 - Site specific - Nathan et al (2016), *J Hydrol* v543, pp706-720
 - Lang et al (2019) ANCOLD conf proc, Auck NZ
- FLIKE – Bayesian flood frequency analysis (Kuczera)
<https://flike.tuflow.com/>
- RORB – storage-routing event-based Monte-Carlo modelling based on stratified sampling
<https://www.harc.com.au/software/rorb/>



Conclusions



- Guidelines finalised in 2019
- Considerable improvement in available design information
- Major methodological shift to joint probability treatment of rainfall, temporal patterns, losses (and storm surge)
- Required extensive engagement with industry
- User-friendly “data hub” repository for regional data sets
- Design information expected to be refined with experience and further testing