Impact of ensemble and joint probability techniques on design flood levels

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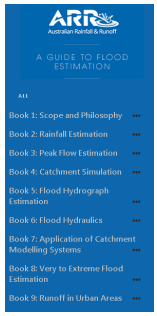
Introduction

- What are the implications of ARR2016 for floodplain management?
- Review of ensemble and joint probability techniques
- How do these techniques impact design flood estimates?
- What are the practical challenges implementing these techniques?

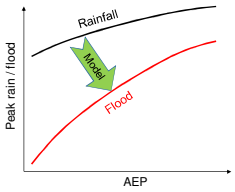
ARR2016

- New data sets
  - Design rainfalls
  - Areal reduction factors
  - Temporal patterns
- New modelling techniques
  - Ensemble of temporal patterns
  - Monte Carlo



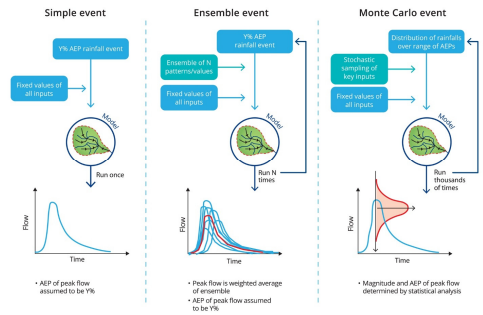
Modelling techniques

- Simple design event
  - Uses single value of initial loss
  - Bias for wet or dry catchment?
  - Uses single AVM temporal pattern
  - How representative is this of natural variability?
  - Hard to know if design floods are biased high or low



Modelling techniques

- Simple design event "*suited to derivation of preliminary estimates*"
- Better ways to simulate hydrologic variability
  - Ensemble of 10 temporal patterns based on recorded data from the region
  - Monte Carlo approach where key inputs such as TP, losses etc are sampled in a randomized manner

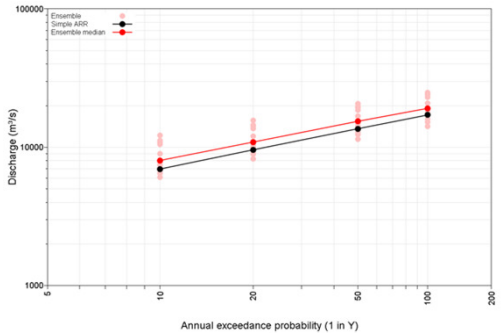


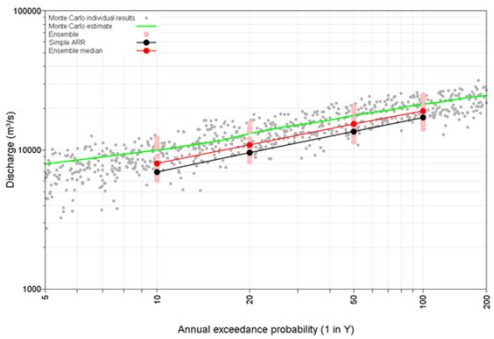
Case study

- Three methods applied to the Brisbane River catchment
  - ARR87 AVM temporal pattern, single value of losses
  - Ensemble of 15 temporal patterns derived from local data
  - Monte Carlo sample of space-time patterns, losses and seasonality

Case study

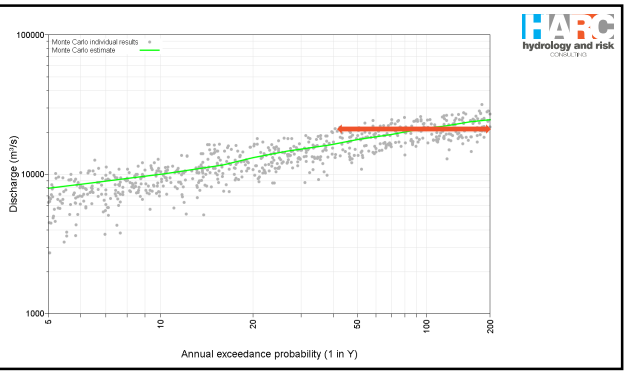
- Hydrological model
  - RORB hydrologic model of the catchment
  - Calibrated to numerous historic events
  - Note – no Wivenhoe or Somerset – results not comparable with BRCFS
- 1D 'fast' model from BRCFS
  - Calibrated to detailed 2D model
  - Ability to run many thousands of simulations in reasonable time frame





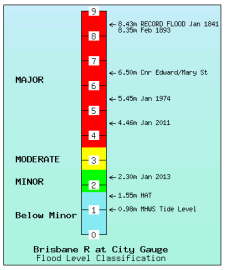
Implications

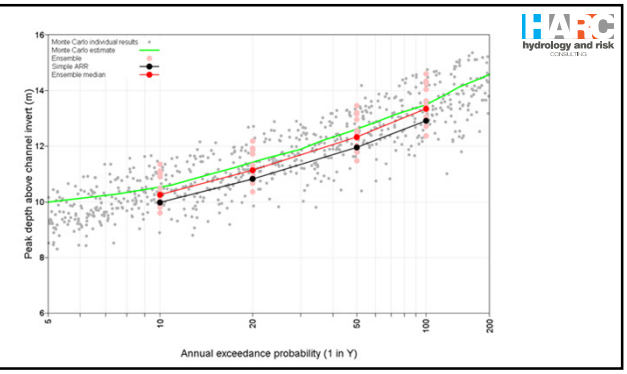
- Important to account for hydrologic variability
- Simple event approach biased low – in this case
- Ensemble results tend to bracket the majority of variability
- Temporal pattern is important!
- MC results give greater assurance that transformation of design rainfall to design flood is not biased
- Can get this wrong over a large range



Impacts on flood levels

- Hydrologic model outputs run through 1D 'fast' model
- Peak water level extracted
- Results demonstrate close to 3 m variability at Brisbane





Implementation

- Ensemble and MC routines in many popular hydrologic models
- Challenge remains treating these in 2D models
  - Flow vs volume
  - Run time
  - Enveloping of results
  - Tidal boundaries

Implementation

- Four main options:
  - Select a single ensemble or MC run which is probability neutral
  - Run all ensembles and envelope
  - Run all or a random subset of MC results and fit frequency curve
  - Incorporate hydraulic variability in hydrologic model

Conclusions

- ARR2016 recommends ensemble or MC approaches for flood studies
- Can have a significant impact on design flood flows, volumes and levels
- Aim is to ensure neutral conversion of probabilities
- Challenges in implementation with 2D models