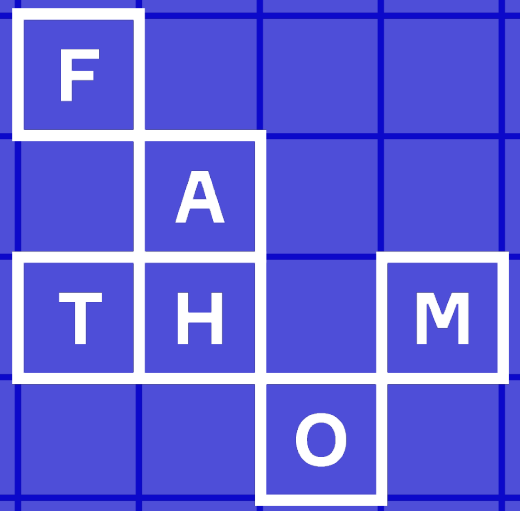
Flood Modelling Methodology: Choices & Consequences



Dr. Oliver Wing, Fathom

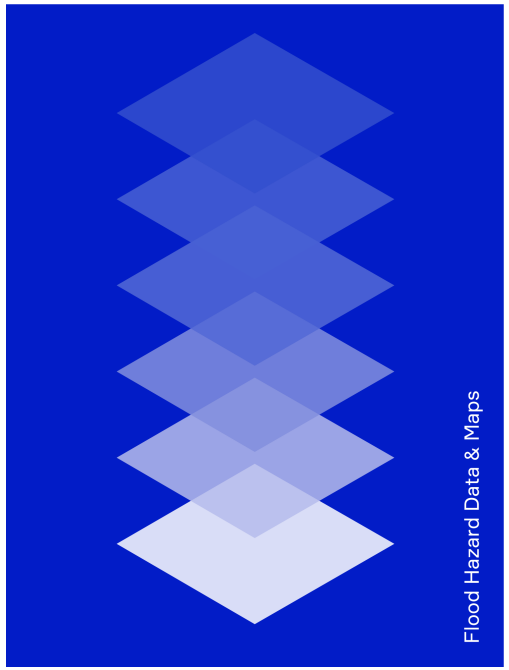
Formed out of the University of Bristol Hydrology Research Group in 2013.

Co-founded by a team of world-leading flood scientists.

Aiming to provide comprehensive water risk intelligence for the entire planet.

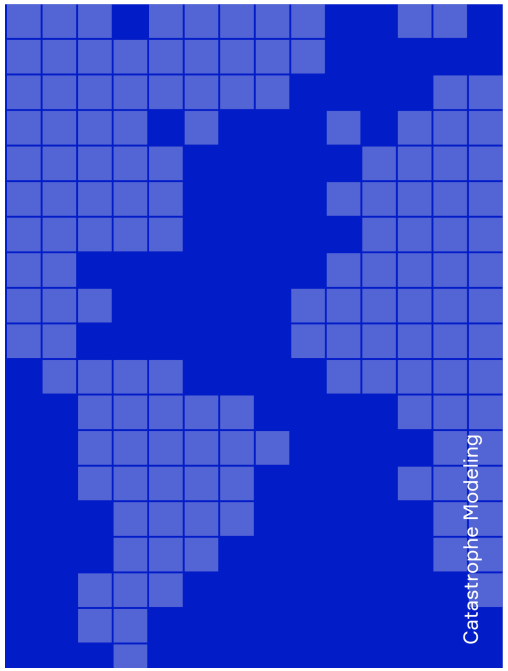
Open methods and academic research are inviolable tenets of our foundation.

Current products



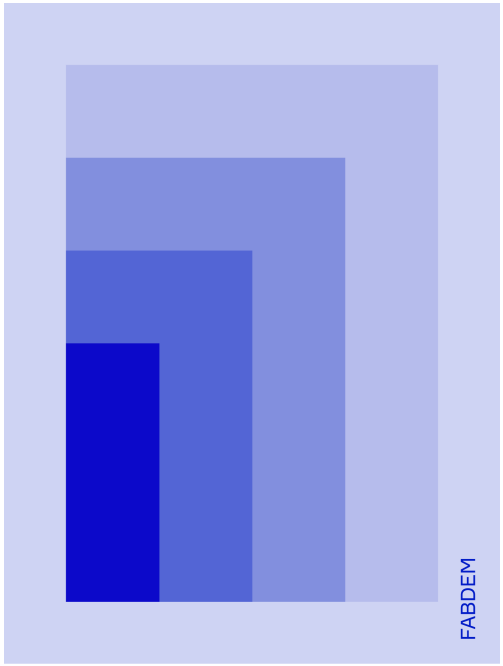
Flood maps

- Global Flood Map
- US Flood Map
- UK Flood Map
- Japan Flood Map



Catastrophe models

- US Flood CAT
- UK Flood CAT



Terrain data

- Global Terrain Data - FABDEM

Peer-reviewed research papers

Savage et al. (2016), *Hydrol. Process.* 30, 2014-2032.

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Things we know from the literature:

- Elevation data accuracy dictates model skill
  - Good LiDAR coverage in UK; low coverage globally
  - Accuracy ≠ Precision: grid resolution is generally not limiting when higher than 20–50 m

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  - Convey the bulk of flood flows
  - Grid resolution and manual labour much more important without sub-grid channels
  - Choice of bankfull frequency extremely sensitive

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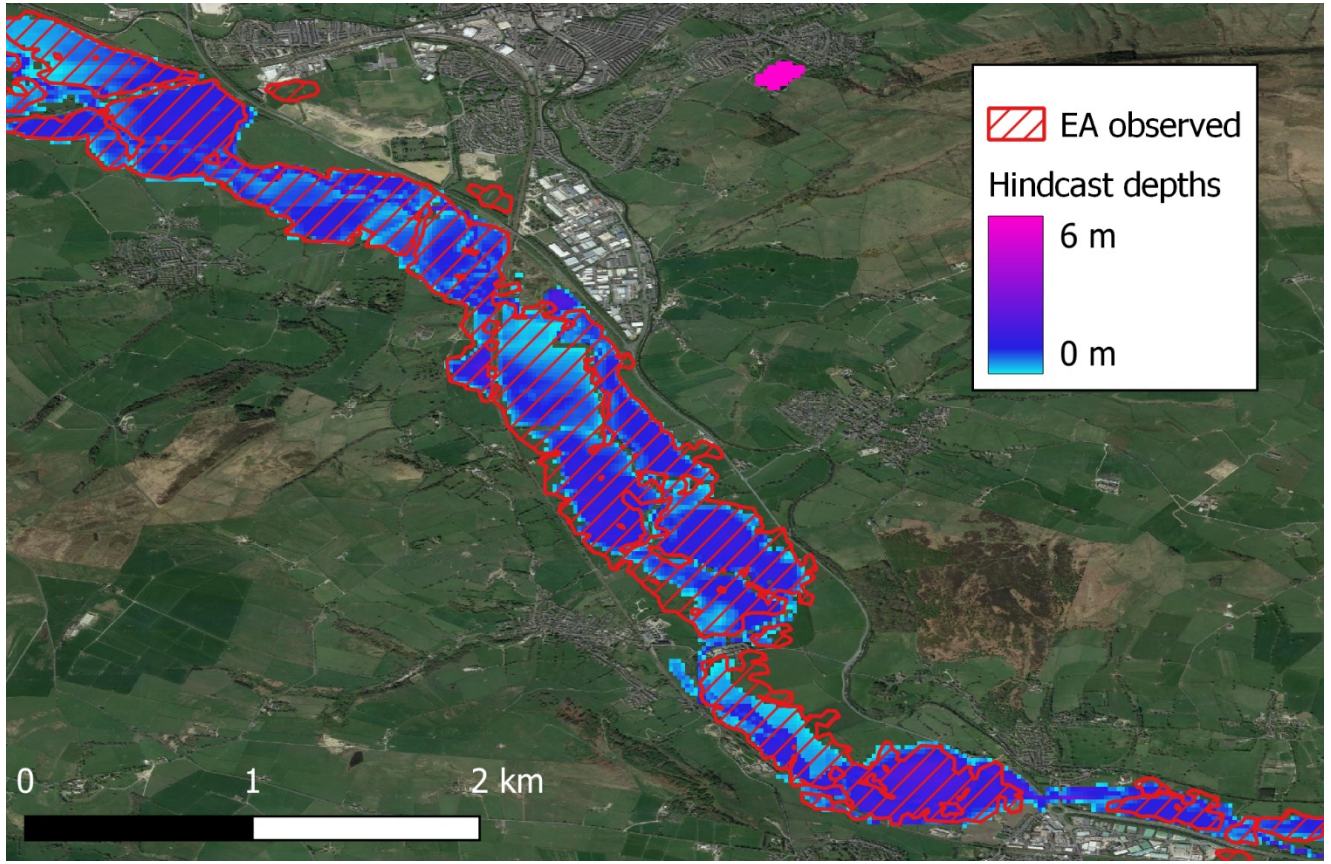
- You need to solve some form of the shallow water equations
  - Which form doesn't matter too much
  - GIS / HAND / planar approximations don't really work

Storm Ciara

Hazard validation should be commonplace given data availability

- Automated event hindcast built with AXA against observations



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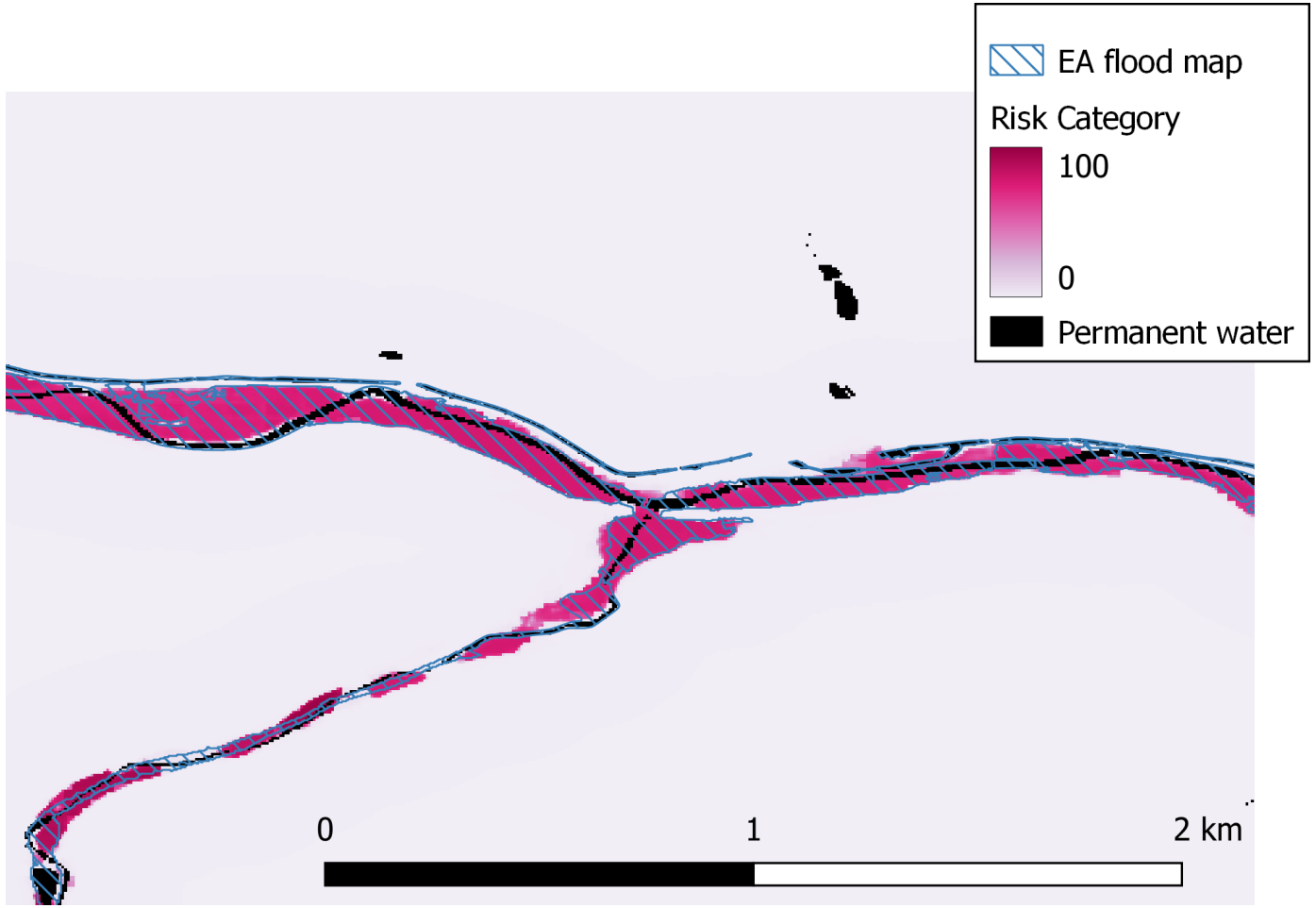
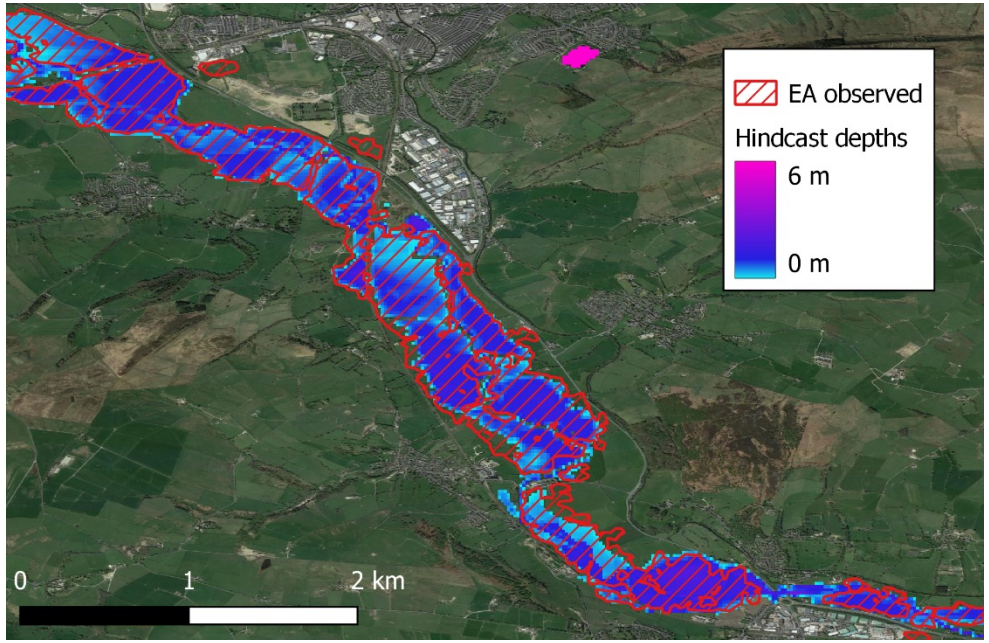
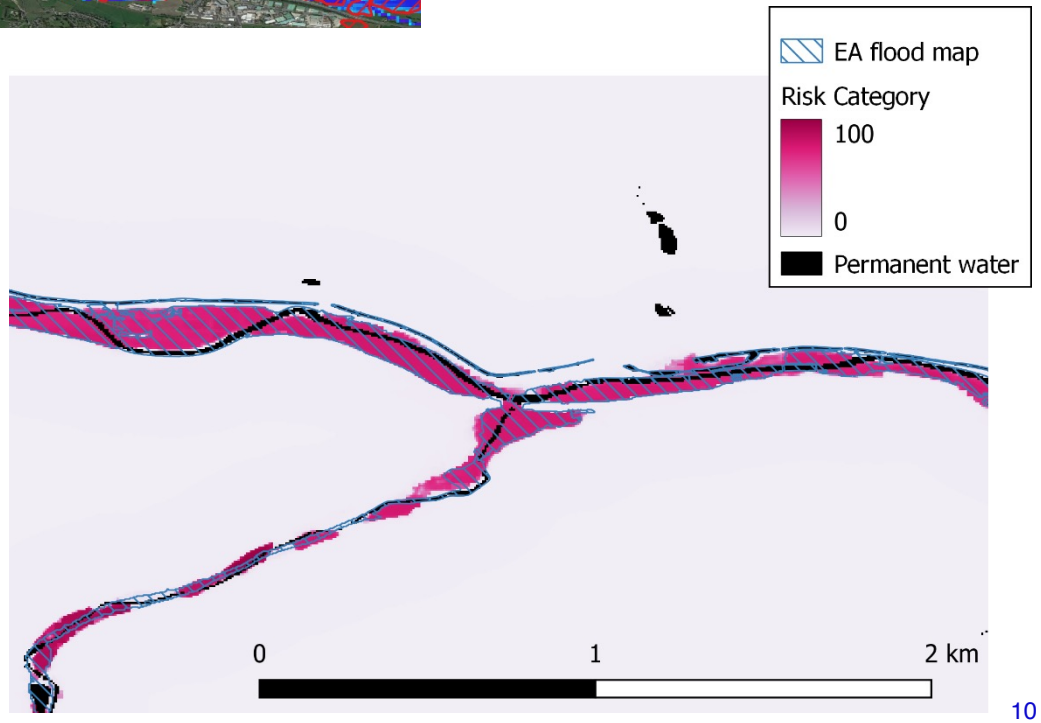
- Risk Categories against local models



Methods well suited for river floods

- Dominated by terrain rather than surface features
- Less sensitive to microtopography: higher resolutions not so important
- Defence structures generally better understood in UK
- Channel solver properly conveys flow
- No need to drive hydraulics with rainfall data or runoff models
- Smaller climate signal

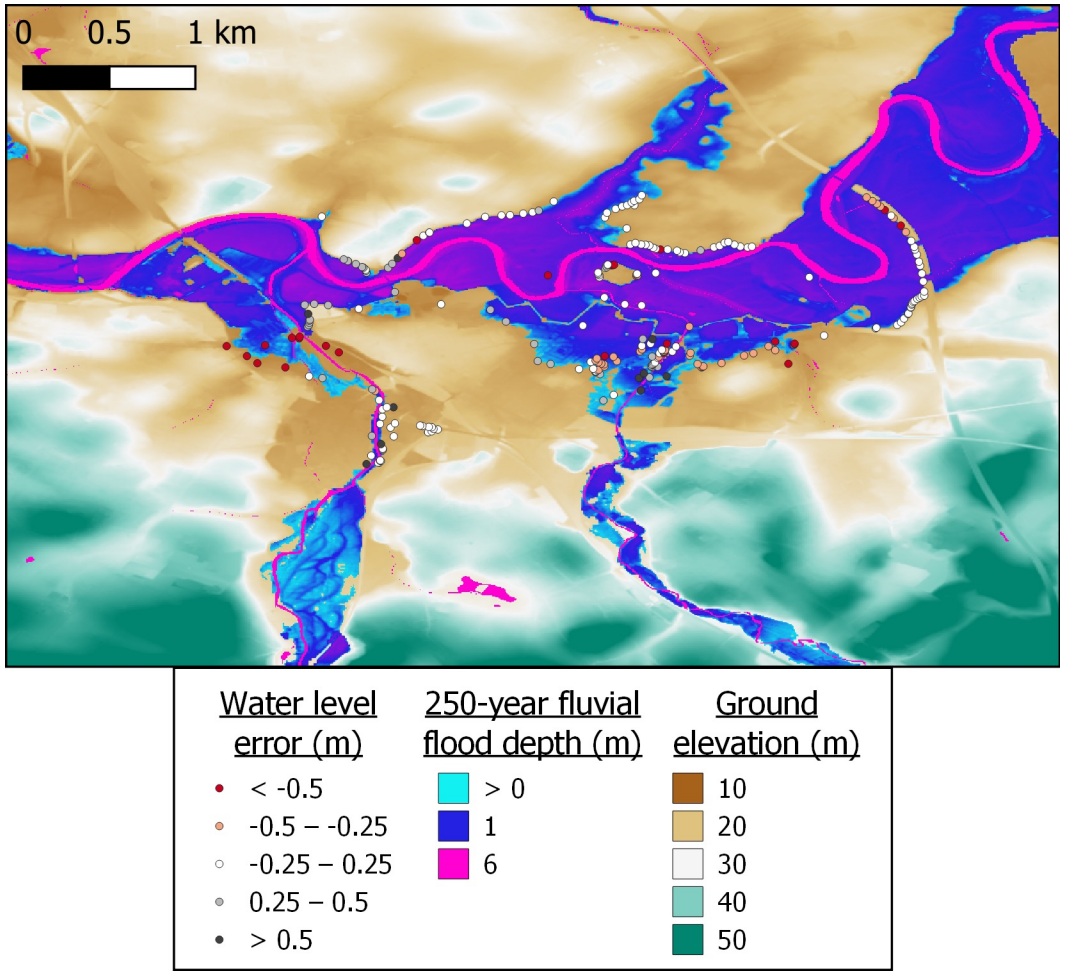




Hazard validation

Carlisle (2005) high-water marks

- Error: 30 – 40 cm
- Bias: -4 cm



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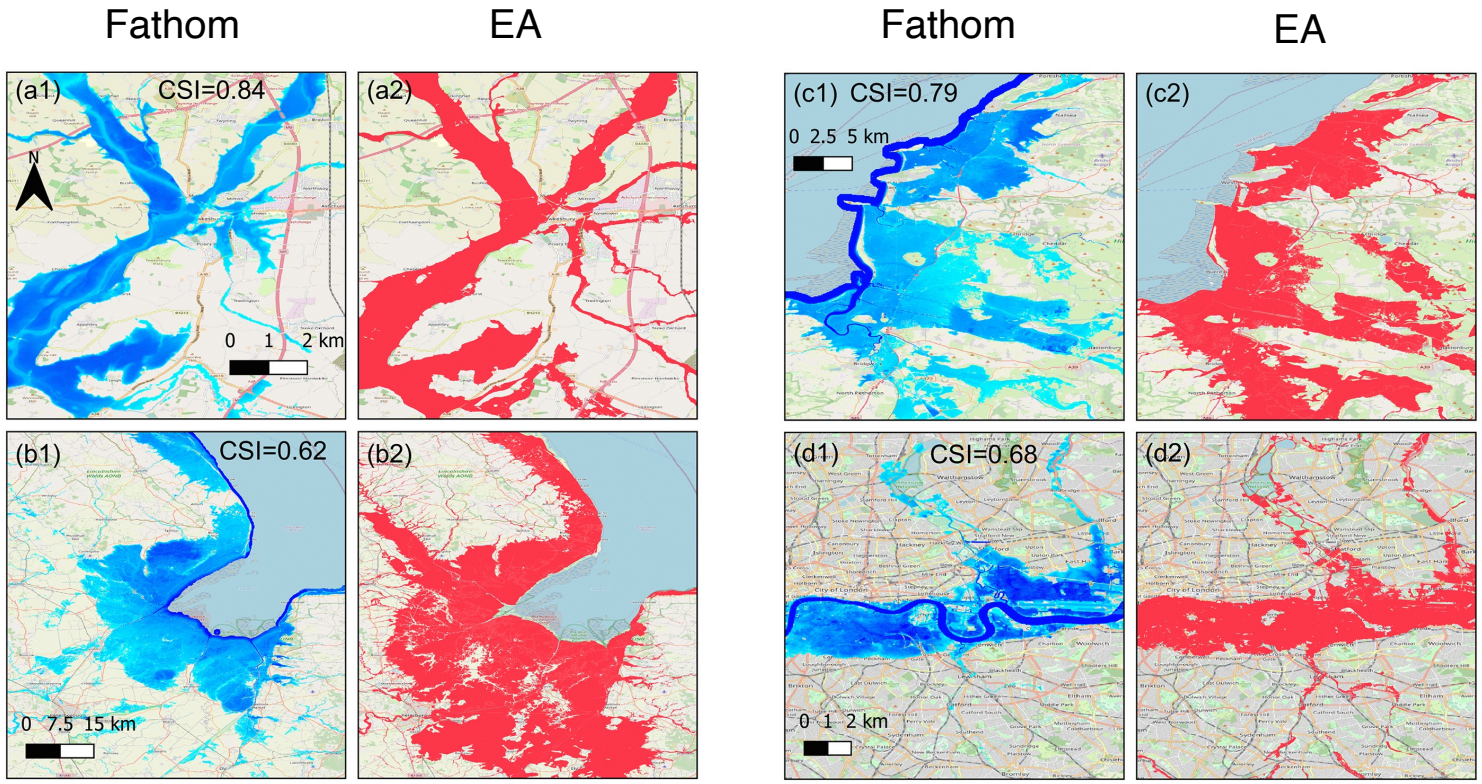
National flood maps (CSI = Critical Success Index):

- England: 0.65
- Wales: 0.76



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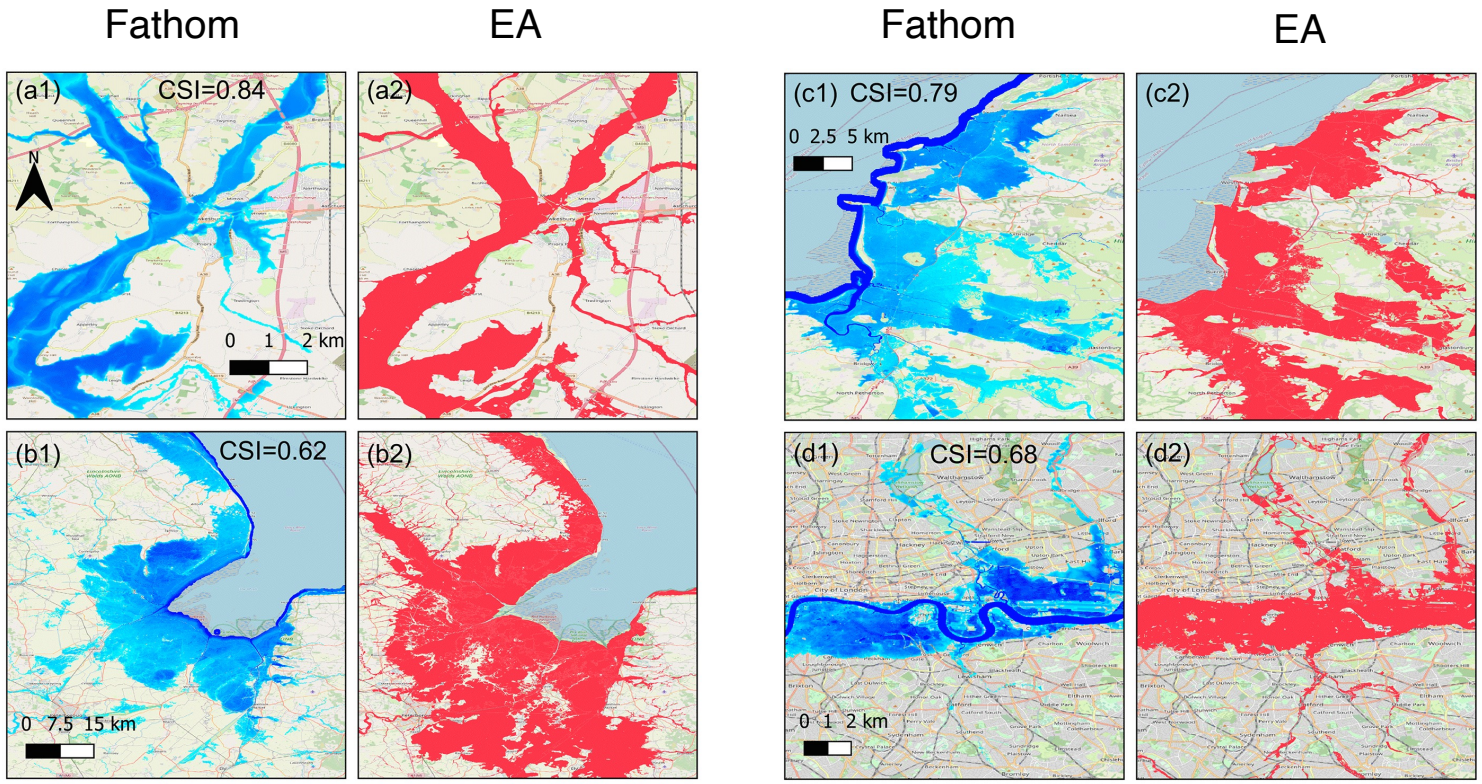
Difficult to validate high-frequency events



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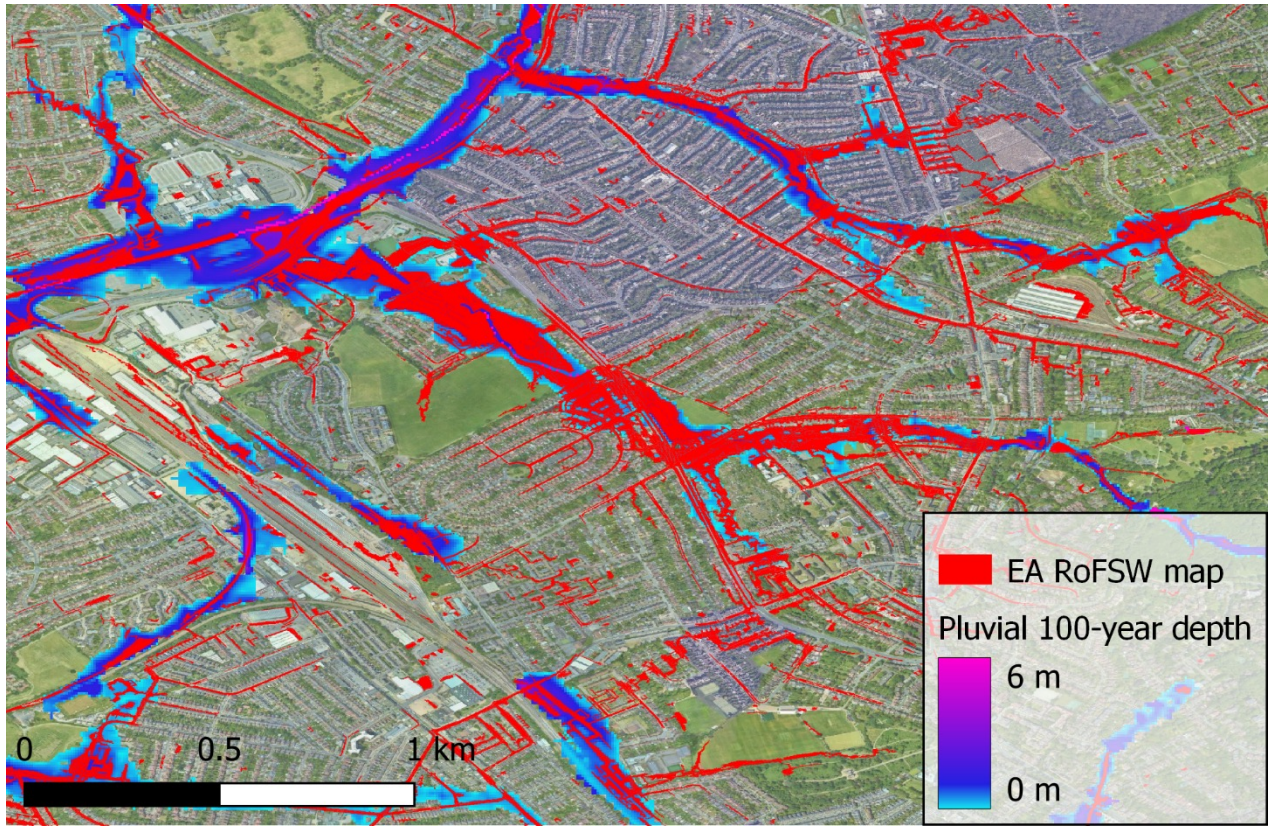
London surface water floods

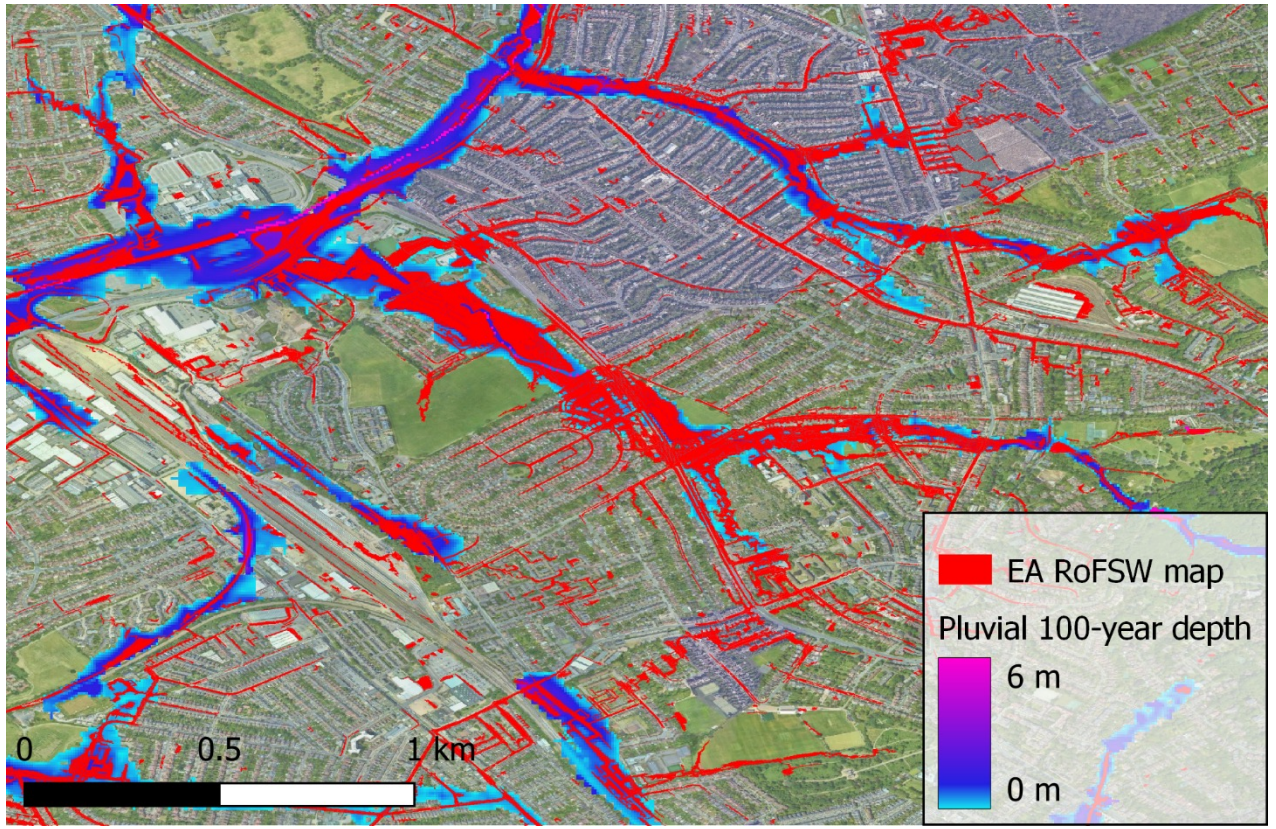
Pluvial hazard more tricky to validate

- EA surface water flood maps differ to Fathom pluvial flood maps



Large-domain models struggle for urban pluvial floods

- Grid resolution more important, though needs to be consistent with other components
- Fine grids are misleading if representation of buildings, streets, culverts, storm drains is poor
- Localised rainfall extremes are poorly observed
- Climate signal invalidates observations anyway



Subjectivity amidst data scarcity

Some of the very sensitive choices:

Hazard

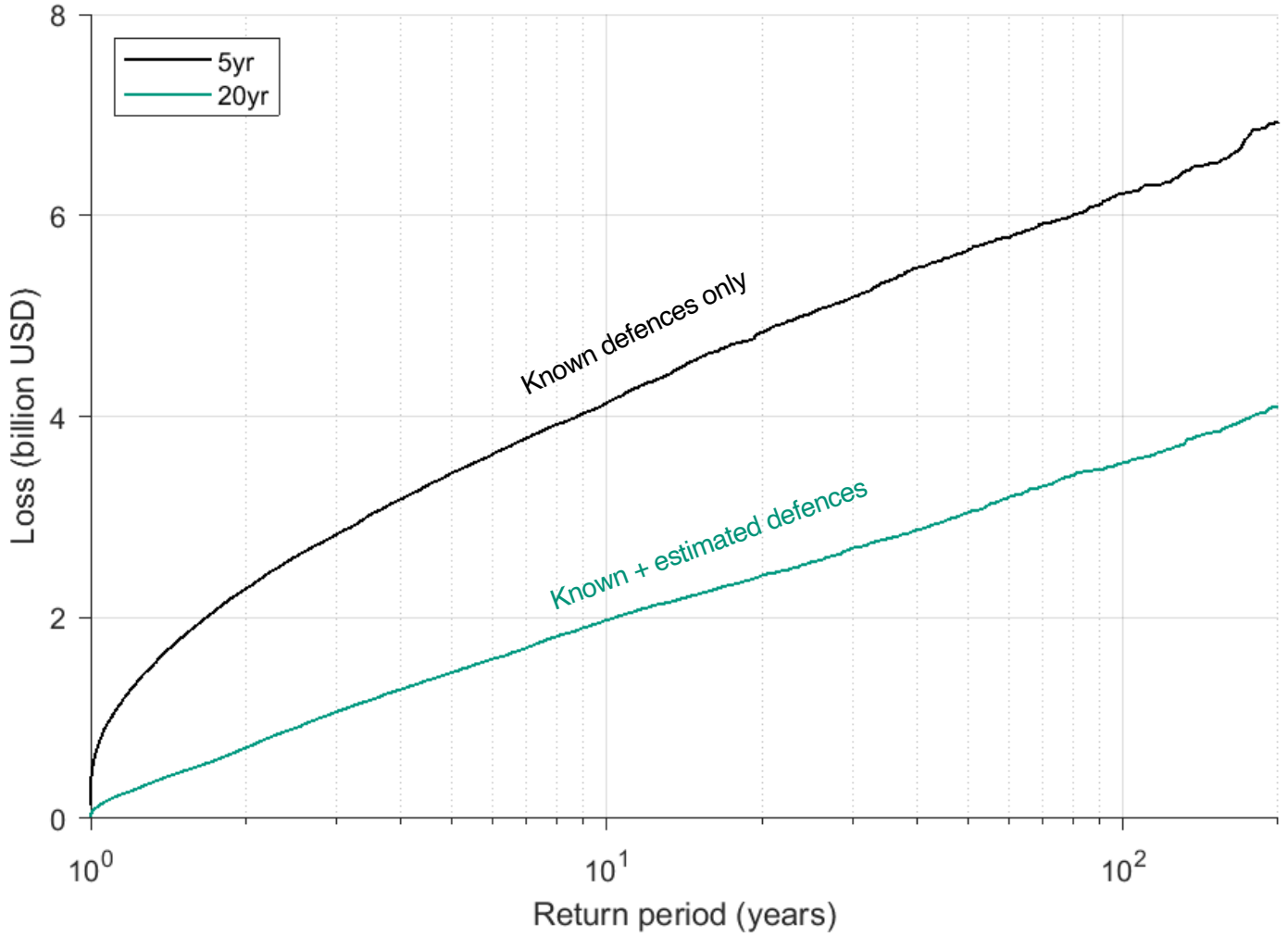
- Bankfull discharge frequency
- **Defence assumptions**
- Surface water thresholding

Exposure

- Default ground floor heights

Vulnerability

- Very wide range of plausible damage functions



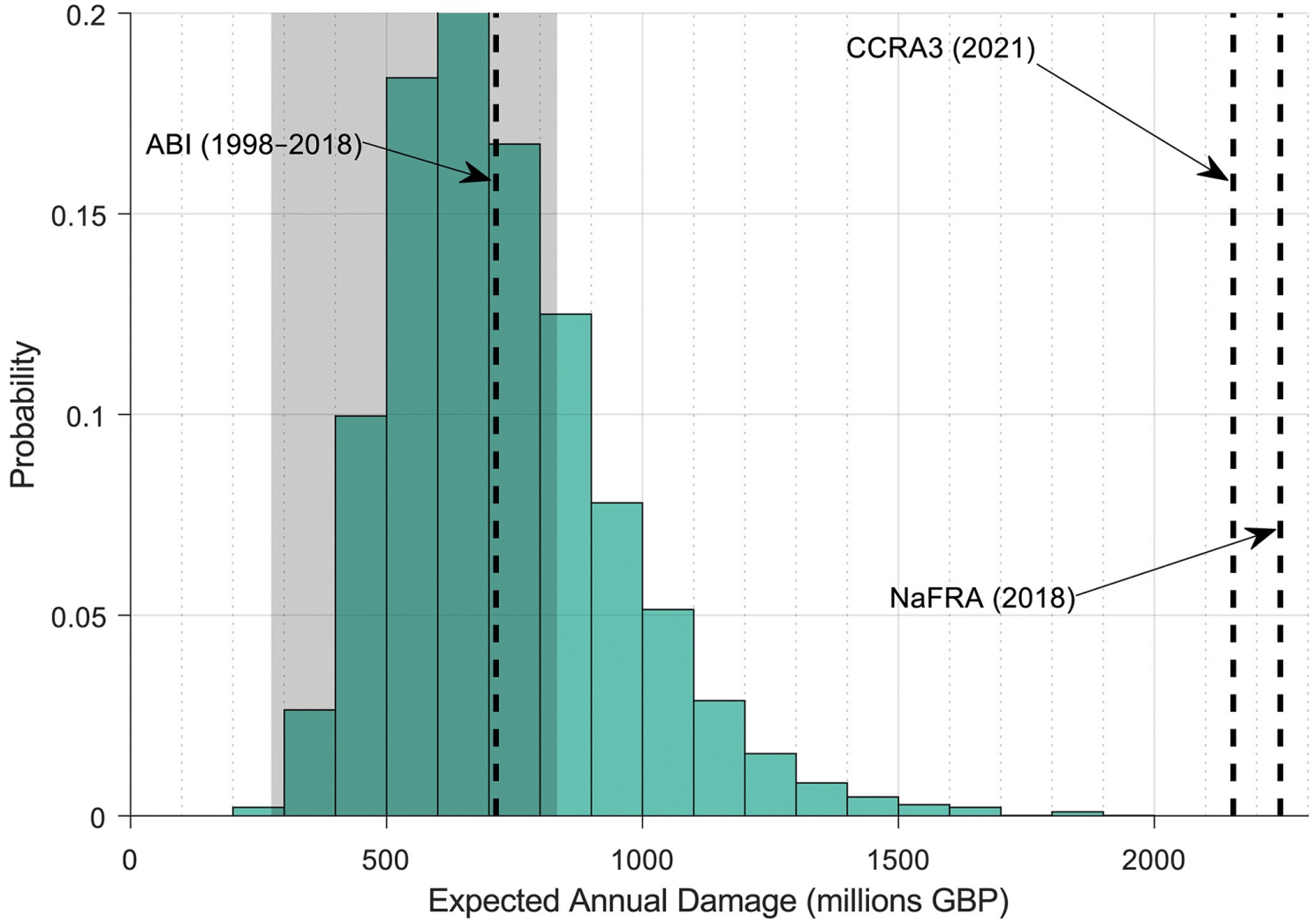
Loss calibration

Tweak unconstrained parameters within likely bounds to reproduce loss experience

The short history we experienced could have taken many forms – so which version do you calibrate to?

A **choice** to reproduce recent historical averages

– would it be equally as justifiable to target ~50–200% of the average?



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Conclusions

- Flood catastrophe modelling is undergoing a revolution – but it is still young
- Plenty of skill in *relative* terms – *absolute* bias can be difficult to quantify
  - Calibration swaps model bias for observation bias
- Value judgements often masquerade as objective decisions
- Mistrust breeds model misuse – true transparency through academic best practices helps
- We don’t know everything, but we know enough to make good decisions

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