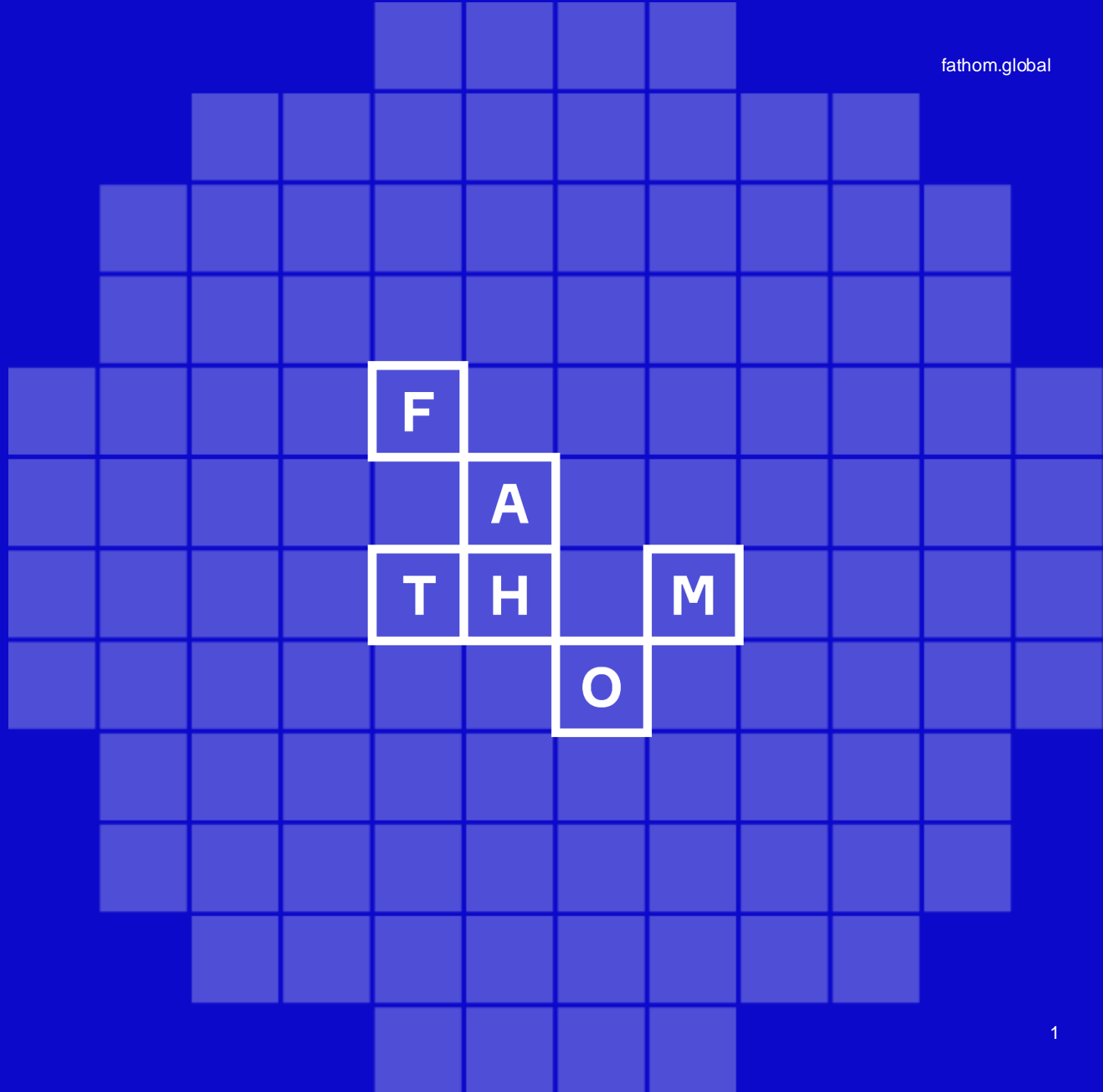


# UK flood losses: with and without flood protection

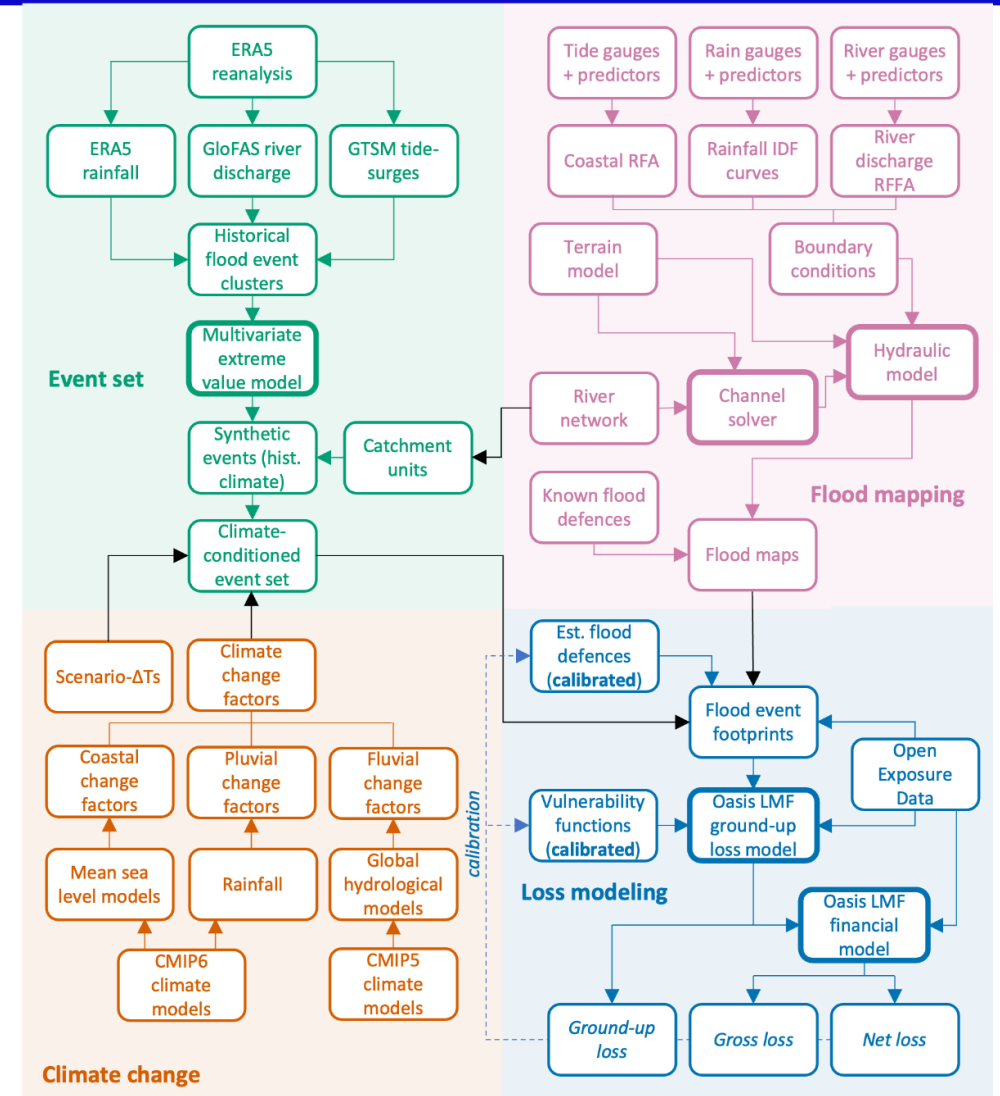


# The value of flood protection in the United Kingdom

- This research focuses on two different scenarios of UK flood risk:
  - “Defended” – a best estimate of flood losses including the mitigatory effect of current flood protection infrastructure
  - “Undefended” – a theoretical estimate of flood losses where fluvial flood protection measures are not included
- We find the Average Annual Loss (AAL) to residential buildings in the UK is £0.64bn in the defended scenario, rising to £1.79bn in the undefended scenario
- The 0.5% Annual Exceedance Probability (AEP) loss is £8.0bn for defended and £21.2bn for undefended scenarios
- In this analysis, *loss* is defined as the direct damage from inland flooding to residential buildings and their contents in England, Scotland, Wales, and Northern Ireland
- Fathom’s [Global Flood Cat](#) model is used to simulate the damage to a market residential buildings portfolio arising from 10,000 synthetic years of flood events in current conditions

# Model and simulation details

- For this study, Fathom's Global Flood Cat v1.0.0 model simulated the ground-up loss due to fluvial and pluvial flooding to a UK residential buildings portfolio
- The model is based on 10,000 years of plausible flood events defined by a multivariate extreme value model fitted to historical reanalysis data
- Event depths are generated via sampling from Fathom's Global Flood Map ([Wing et al., 2024](#))
- The hazard data are referenced to a 2010–2030 climate period
- Probabilistic vulnerability functions, calibrated to observed UK flood losses, vary by building type
- Fluvial floods are simulated on rivers with a time to concentration of greater than 6 hours, while pluvial flooding is generated via the direct effect of rainfall durations up to 6 hours



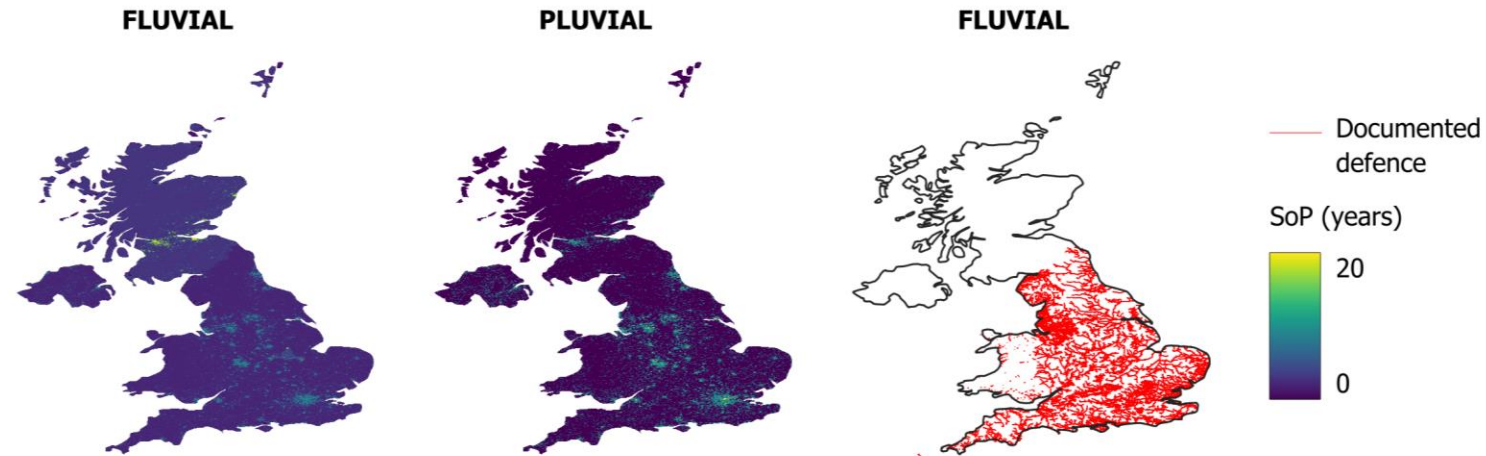
# Model and simulation details

## Exposure

- The 2024 PERILS UK Industry Exposure Database defines (insured) residential building and contents replacement values per UK postcode area
- PERILS values are up-rated by 8.6% to represent an entire market (including uninsured) residential portfolio, based on a [DEFRA \(2022\)](#) survey of insurance penetration for flood-exposed residences in England and Wales
- Postcode area values are disaggregated to the resolution of the hazard grid (1 arc sec) using the residential Global Human Settlement Layer built-up volume dataset

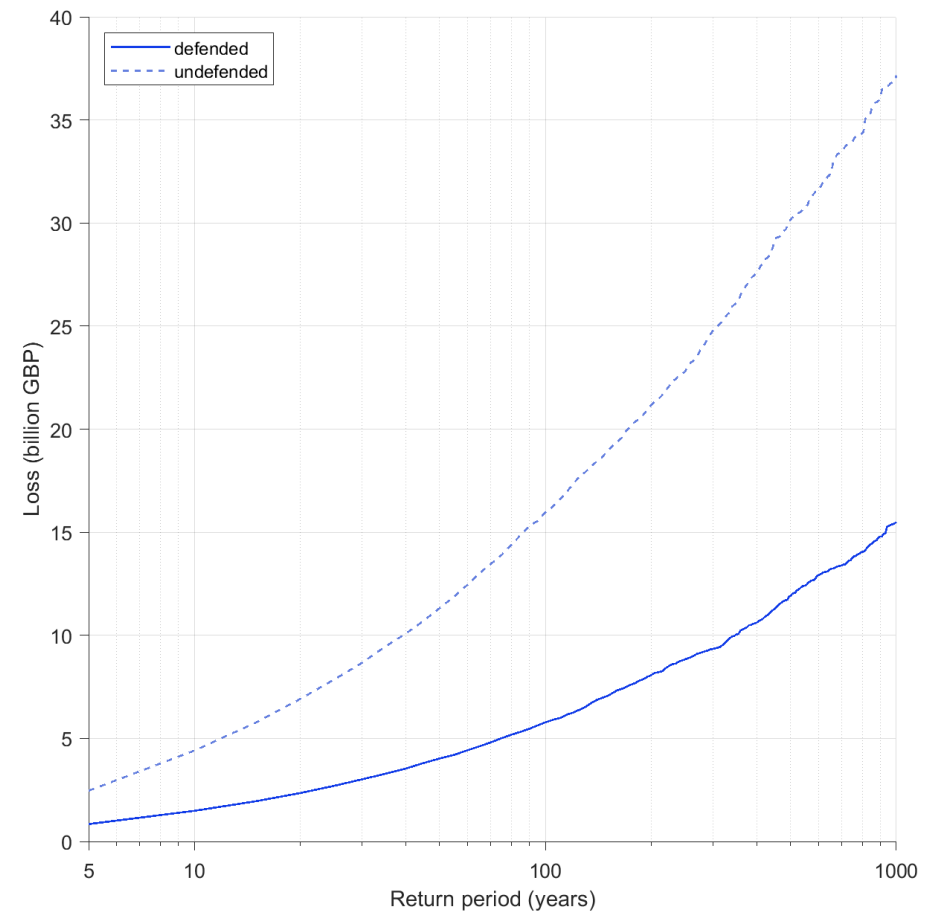
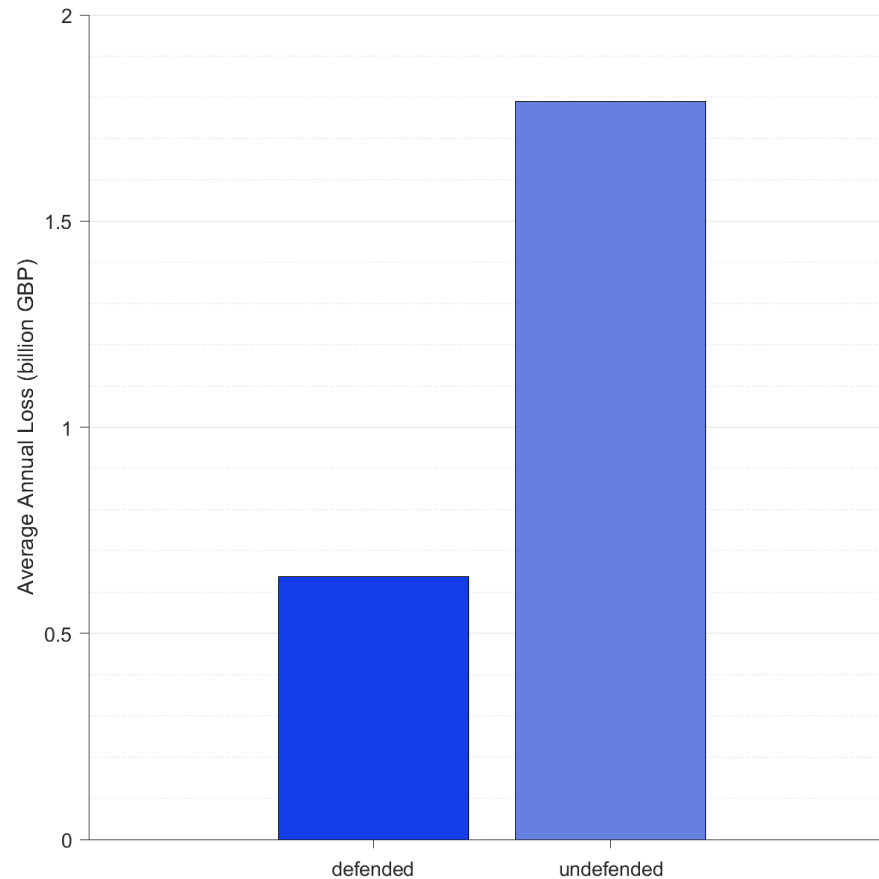
## Flood protection

- Structural flood protection measures are sourced from the Environment Agency and Natural Resources Wales
- Fluvial floods smaller than the local standard of protection are masked out, while those larger overtop
- Data scarcity (especially in Scotland and NI) necessitates additional flood protection assumptions which are also calibrated such that the model can reproduce past loss experience
- Drainage design standards in urban areas are also estimated for the pluvial model



# Results

- The defended AAL (£0.64bn) is 64% (£1.15bn) lower than the undefended AAL (£1.79bn)
- Flood protection averts a 13% AEP loss on average every year
- The loss which is expected to occur every 200 years (£5.78bn) would instead occur every 26 years in the absence of flood protection



# Limitations

- The location and design standard of flood protection structures is only partially documented by the relevant national government agencies. The necessity for further protection estimates thus makes the results presented here sensitive to subjective assumptions.
- Exposure disaggregation only partially mitigates discretization error, and we assume the 2022 DEFRA survey-based insurance penetration rate is robust and applicable UK-wide
- The relationship between depth and damage is [notoriously uncertain](#) and means models require calibration to loss observations
- National-scale models generally lack important local details including measured channel bathymetry, drainage infrastructure, and the impact of buildings. Finer grid resolutions (in isolation) do not address these issues.
- The undefended scenario still includes any impact of river and floodplain engineering on elevation data and flood frequency analysis
- This analysis does not include losses to commercial, industrial, and agricultural properties; indirect damages such as alternative accommodation costs and business interruption; or coastal flooding. Although not quantified here, these also benefit from losses avoided by flood defences.

# Conclusions

- Fluvial flood protection prevents £1.15bn in UK residential property damage every year
- Annual flood losses to households would be 2.8x higher without current levels of flood protection
- In an extreme loss year (0.5% AEP) flood protection measures would reduce losses by £13.2bn
- These results underscore the importance of investments in flood defence infrastructure as risks continue to rise