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Environment

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Flood risk estimation using probabilistic scenarios

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Environmental Studies




climate changes spatial planning

Background question



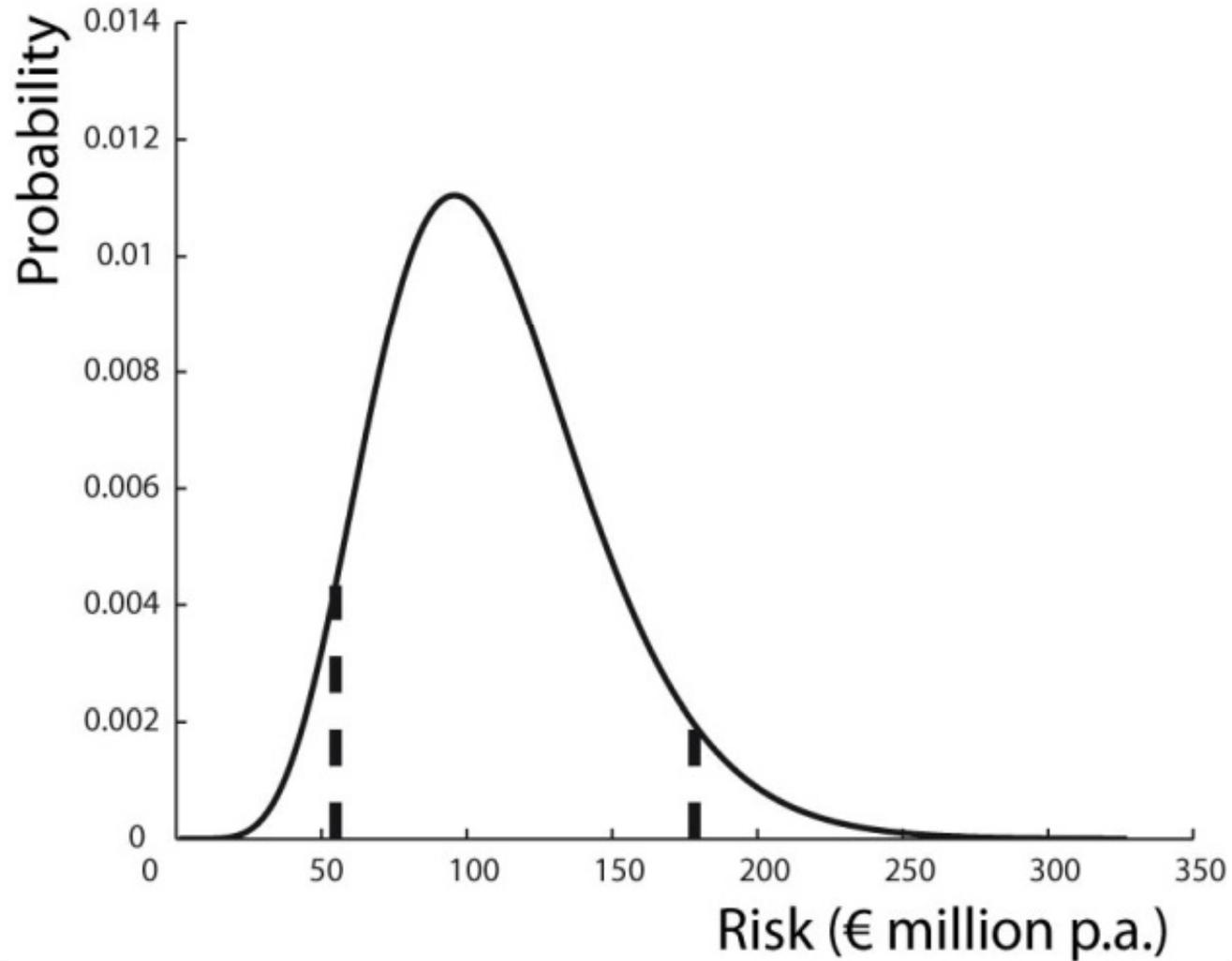
Question:

What is the chance that future flood risk will be more than (or double, or triple, etc) current flood risk?

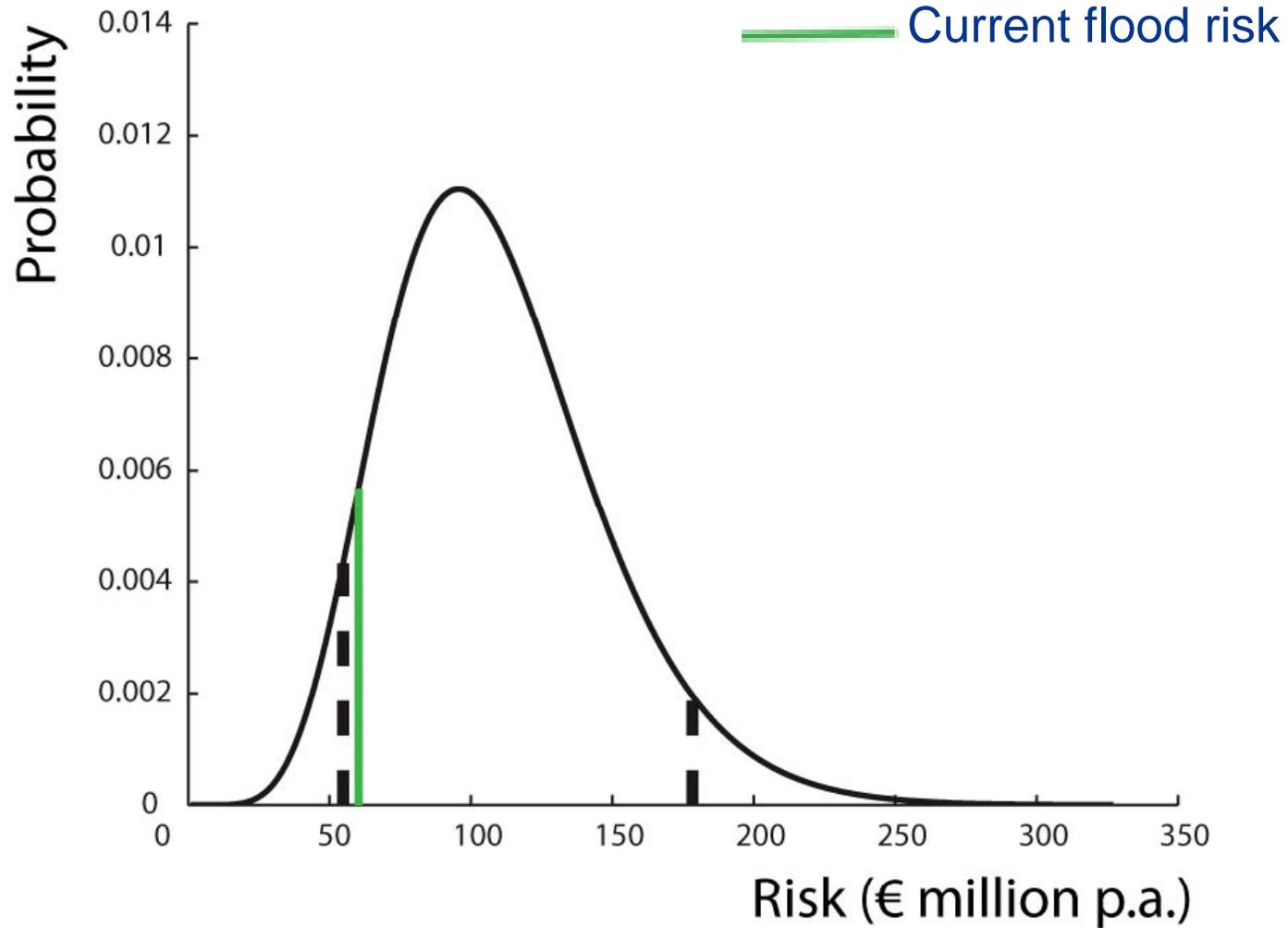
Research goal:

To demonstrate a framework for producing probabilistic estimates of flood risk under climate change.

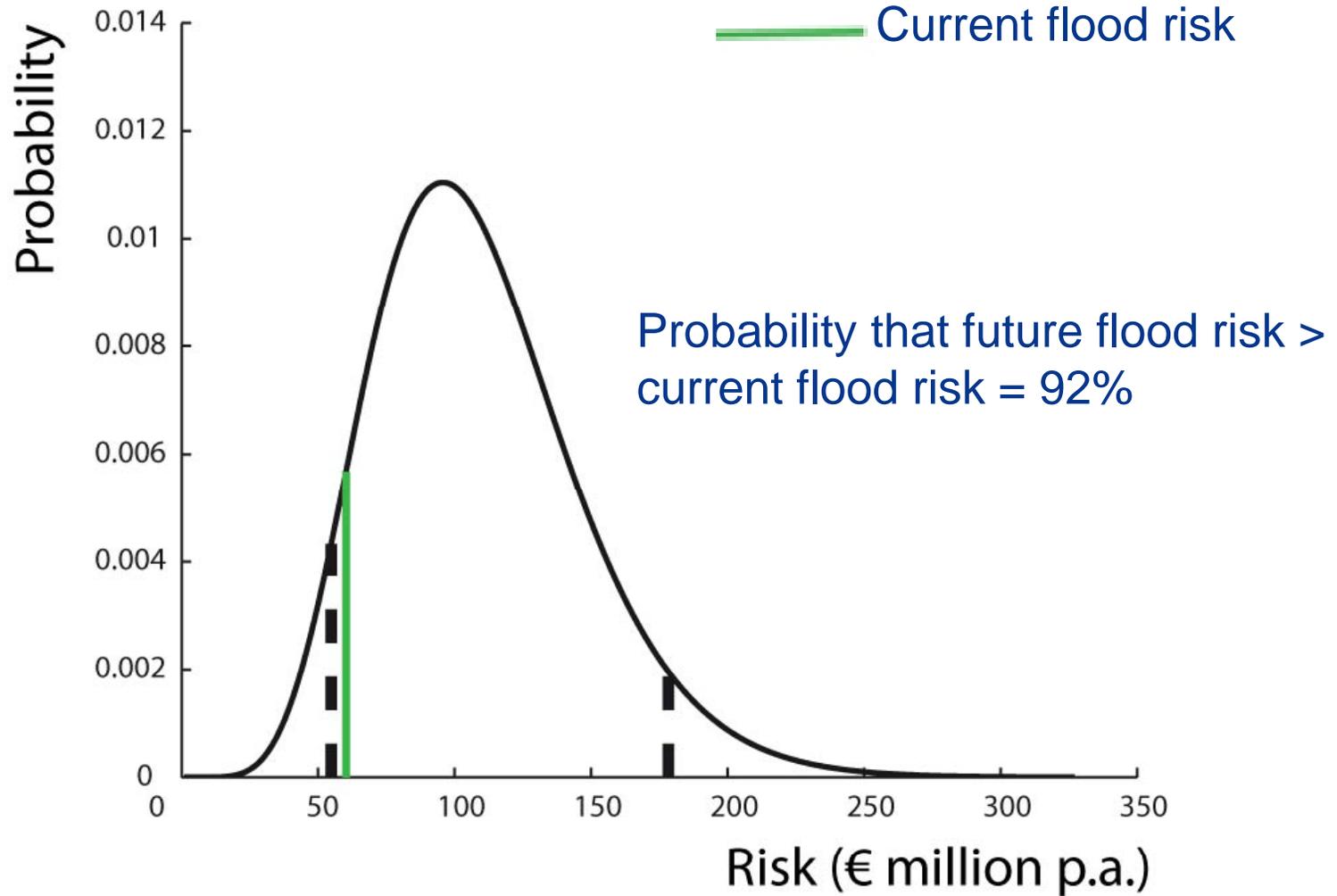
Probabilistic flood risk estimates



Probabilistic flood risk estimates

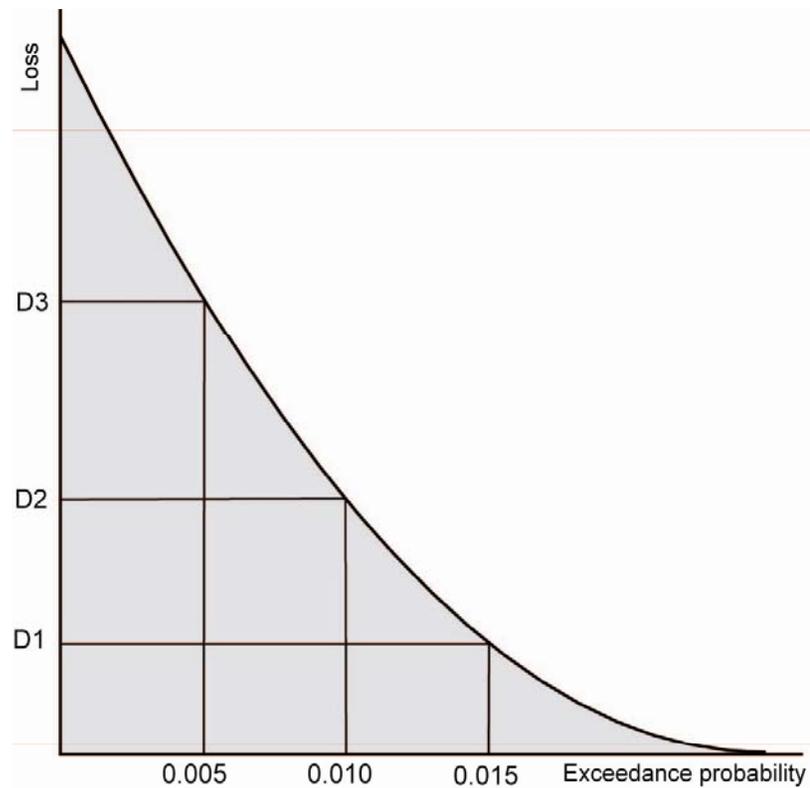


Probabilistic flood risk estimates



Flood risk: discrete-scenarios

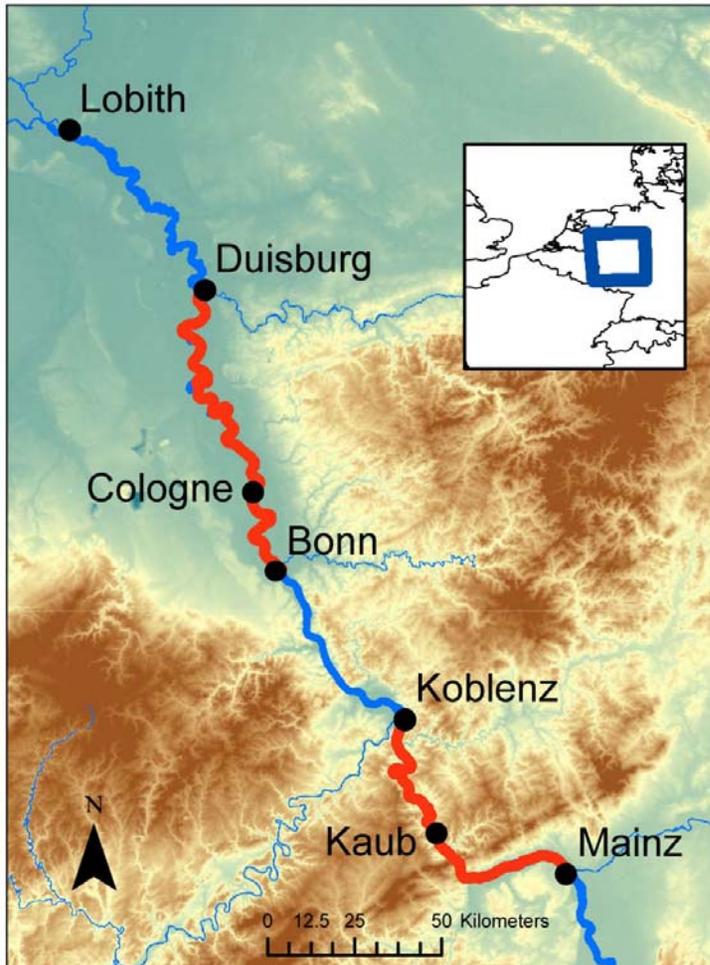
Scenario	Q10 (m ³ s ⁻¹)	Q100 (m ³ s ⁻¹)	Q1000 (m ³ s ⁻¹)	Flood risk (€ million/year)
Control	9,500	13,000	16,000	60



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Control	9,500	13,000	16,000	60
B1	10,500	14,500	17,500	100
A2	11,000	15,500	18,500	130

Methods



- (a) Estimate extreme discharge values for large climate model ensemble;
- (b) Simulate inundation extent and depths as function of return period;
- (c) Estimate flood damage;
- (d) Estimate flood risk and probability distributions of flood risk

Methods: (a) Extreme discharge values

(a) Climate model simulation downscaling

- 6 RCMs / 12 GCMs
- A1B scenario (IPCC SRES)
- Control: 1961-1995 / Future : 2071-2100
- Downscaled and resampled to 3000 year daily time-series

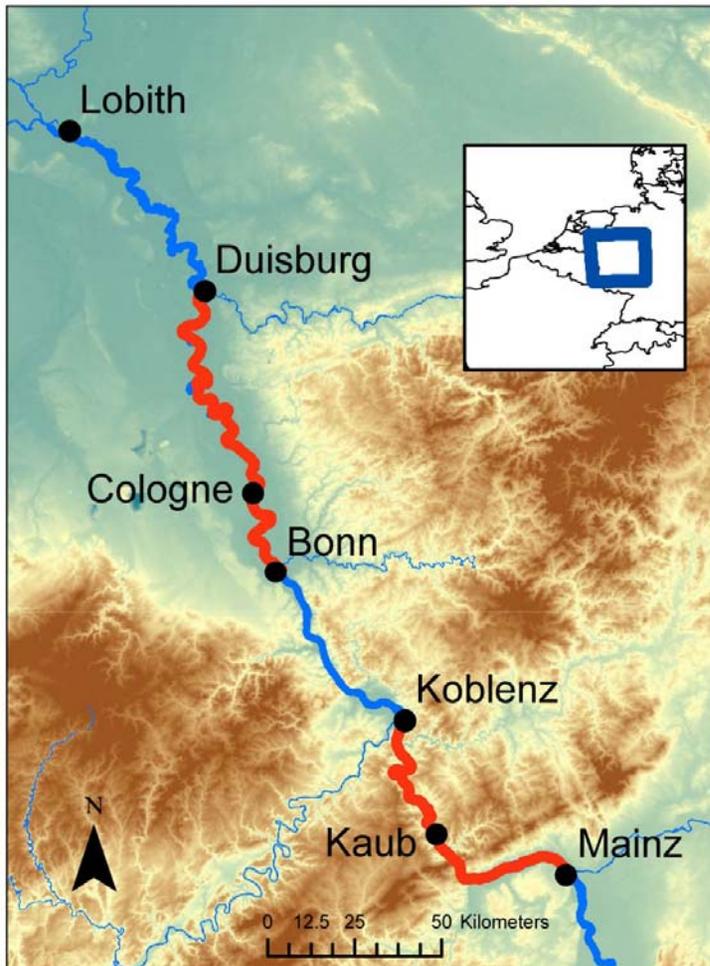
(b) Hydrological model simulations

- HBV-96
- 3000 year daily discharge time-series

(c) Estimating extreme discharges

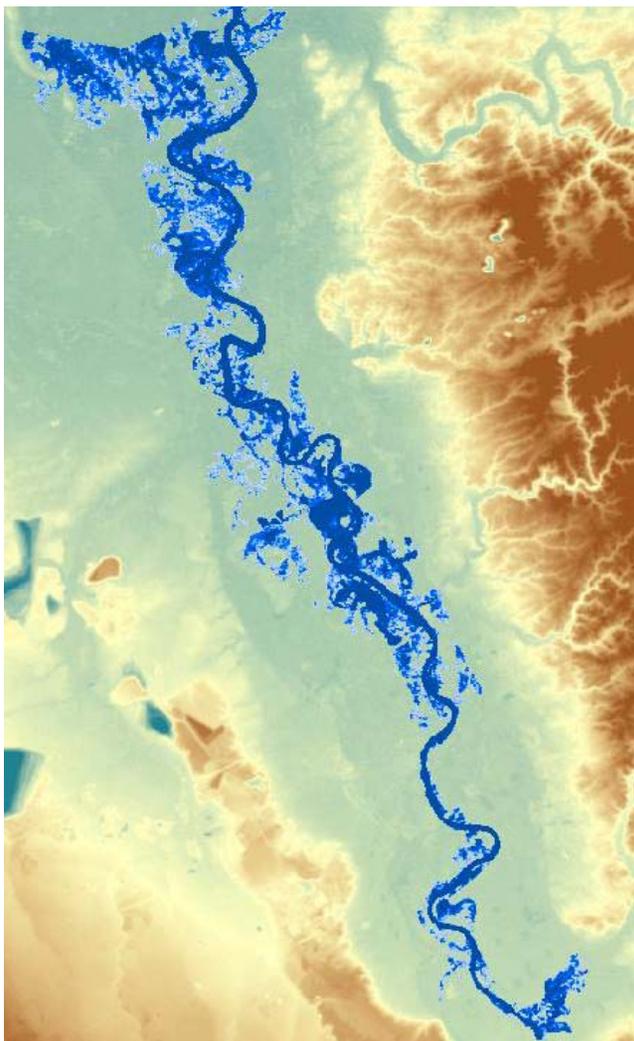
- Extreme value statistics (Weissman)

Methods



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Methods: (b) Simulate inundation extent and depths

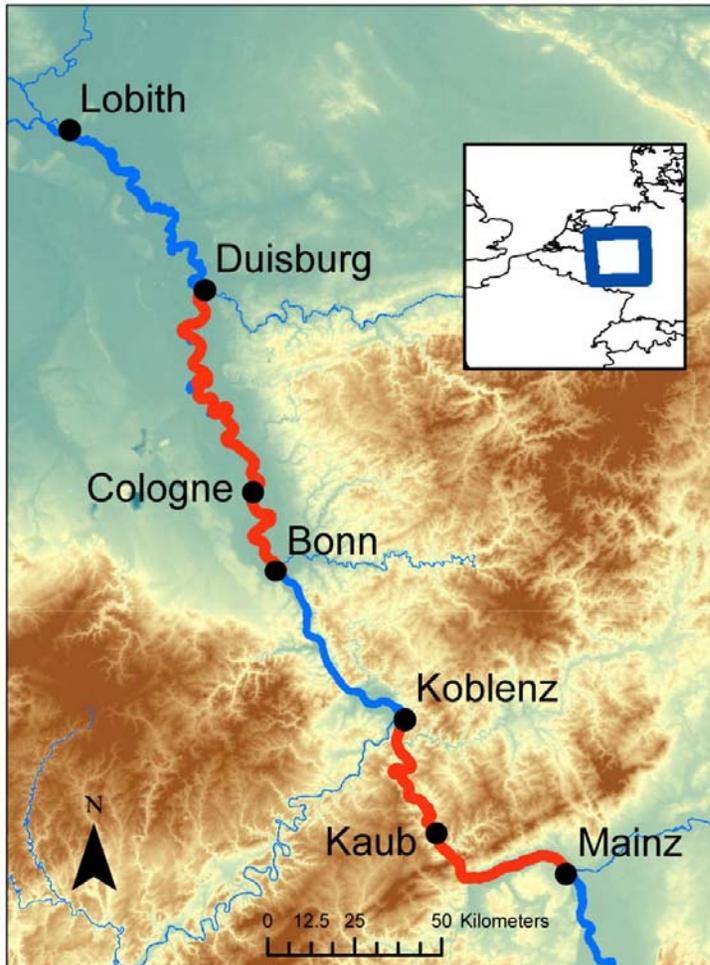


(a) Inundation map for ALL return periods
From RP = 2 \rightarrow RP = 3000 years

(b) Developed simple inundation model

- Q-h relationships per river kilometre
- Simulate planar water level surface
- Subtract planar water level from DEM
- 50 m x 50m

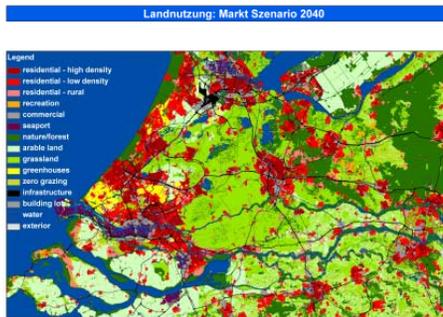
Methods



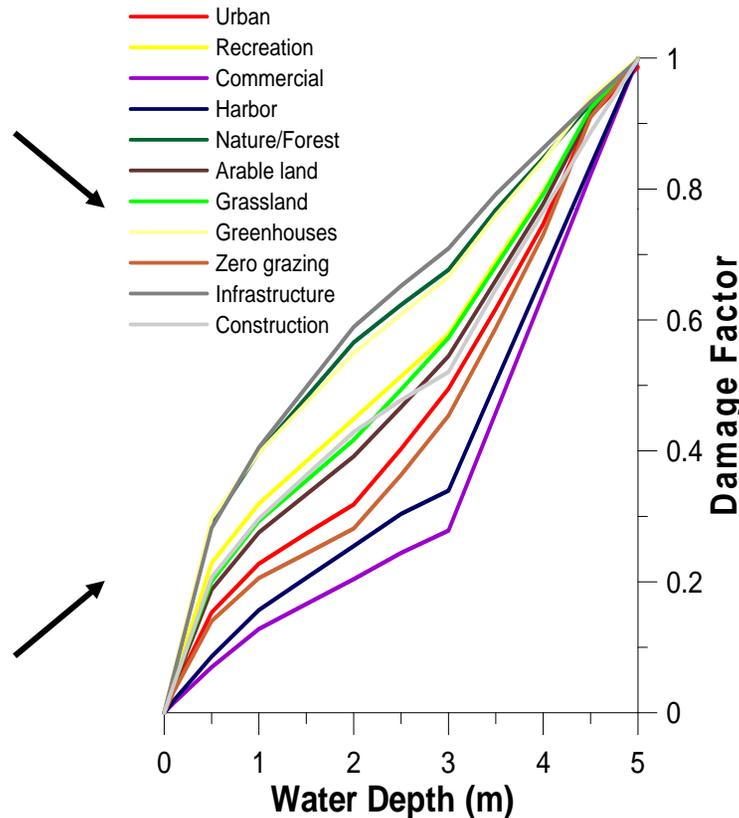
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- (b) Simulate inundation extent and depths as function of return period;
- (c) **Estimate flood damage;**
- (d) Estimate flood risk and probability distributions of flood risk

Methods: (c) Estimate damage (Damagescanner)

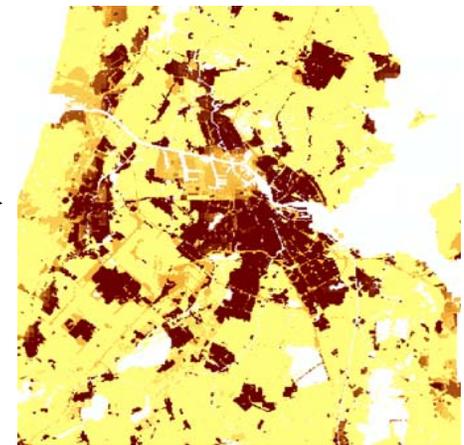
Land-use map



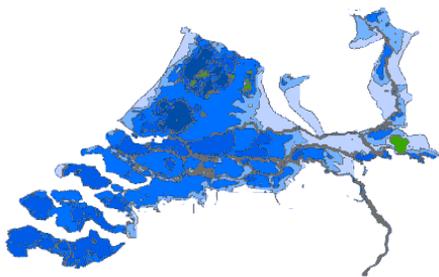
Stage-damage functions



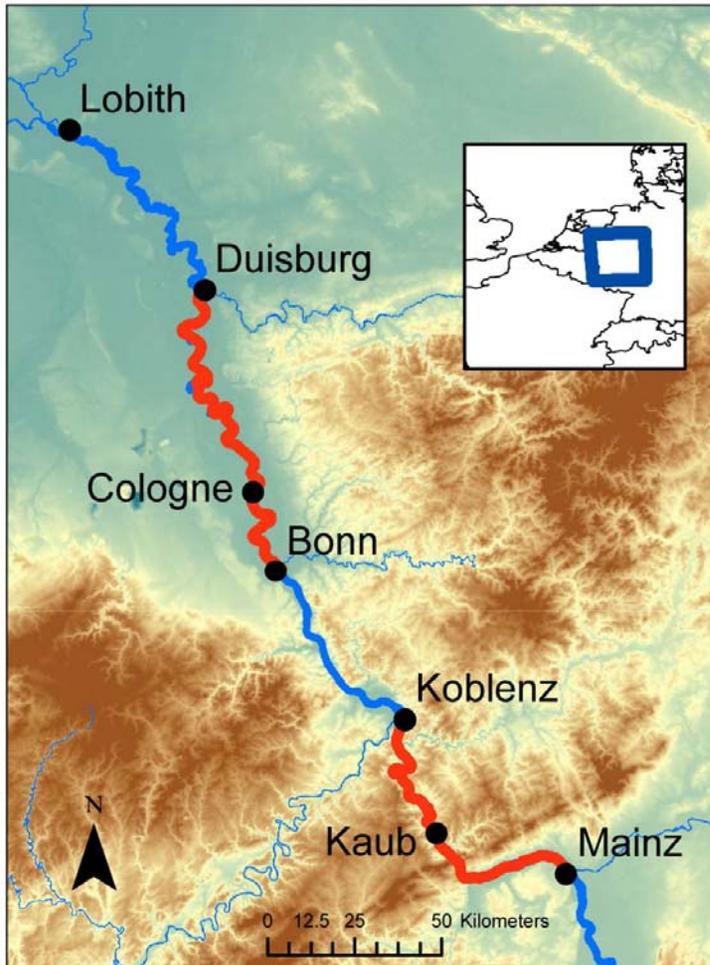
Damage maps



Inundation map

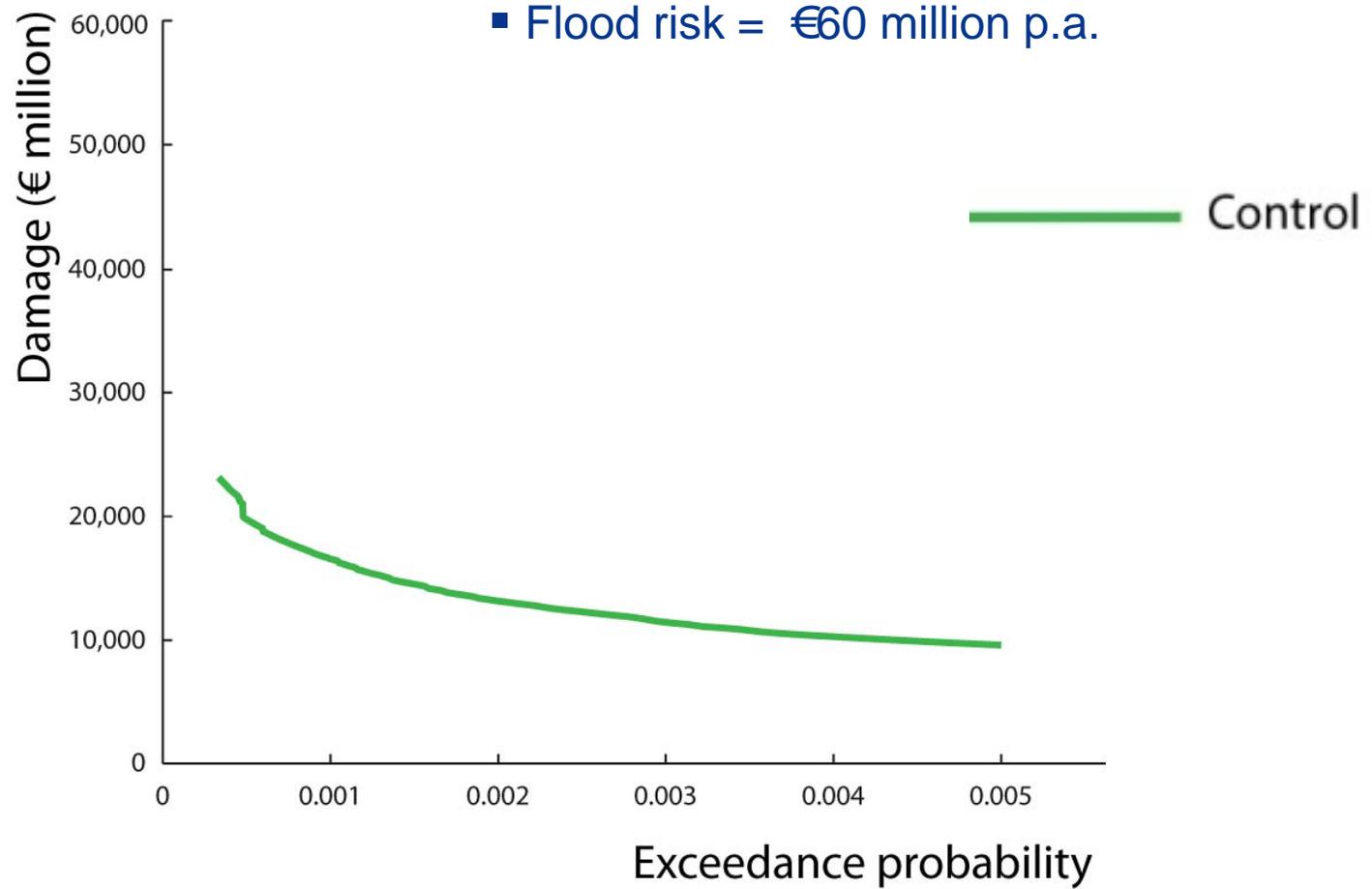


Methods

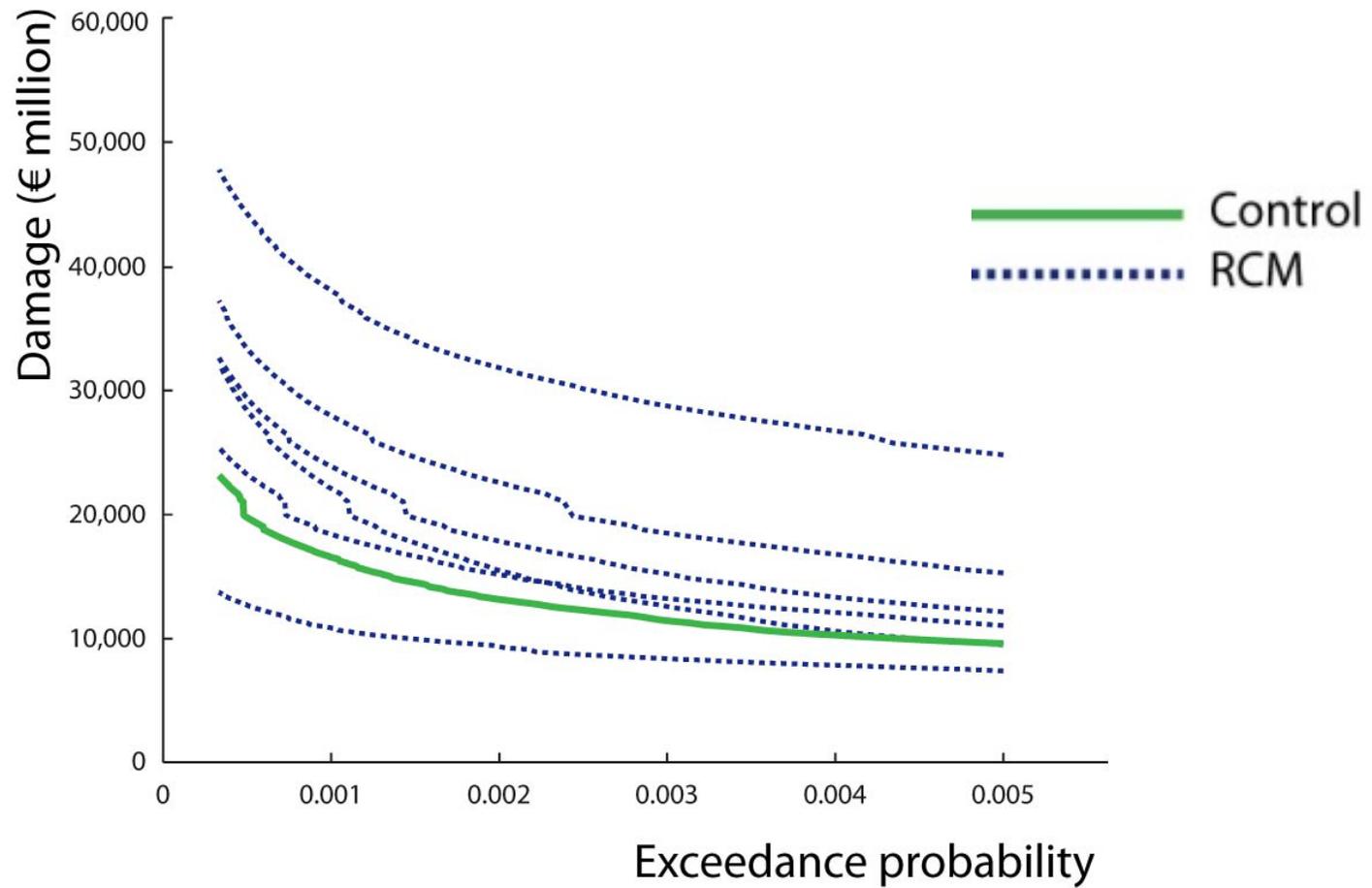


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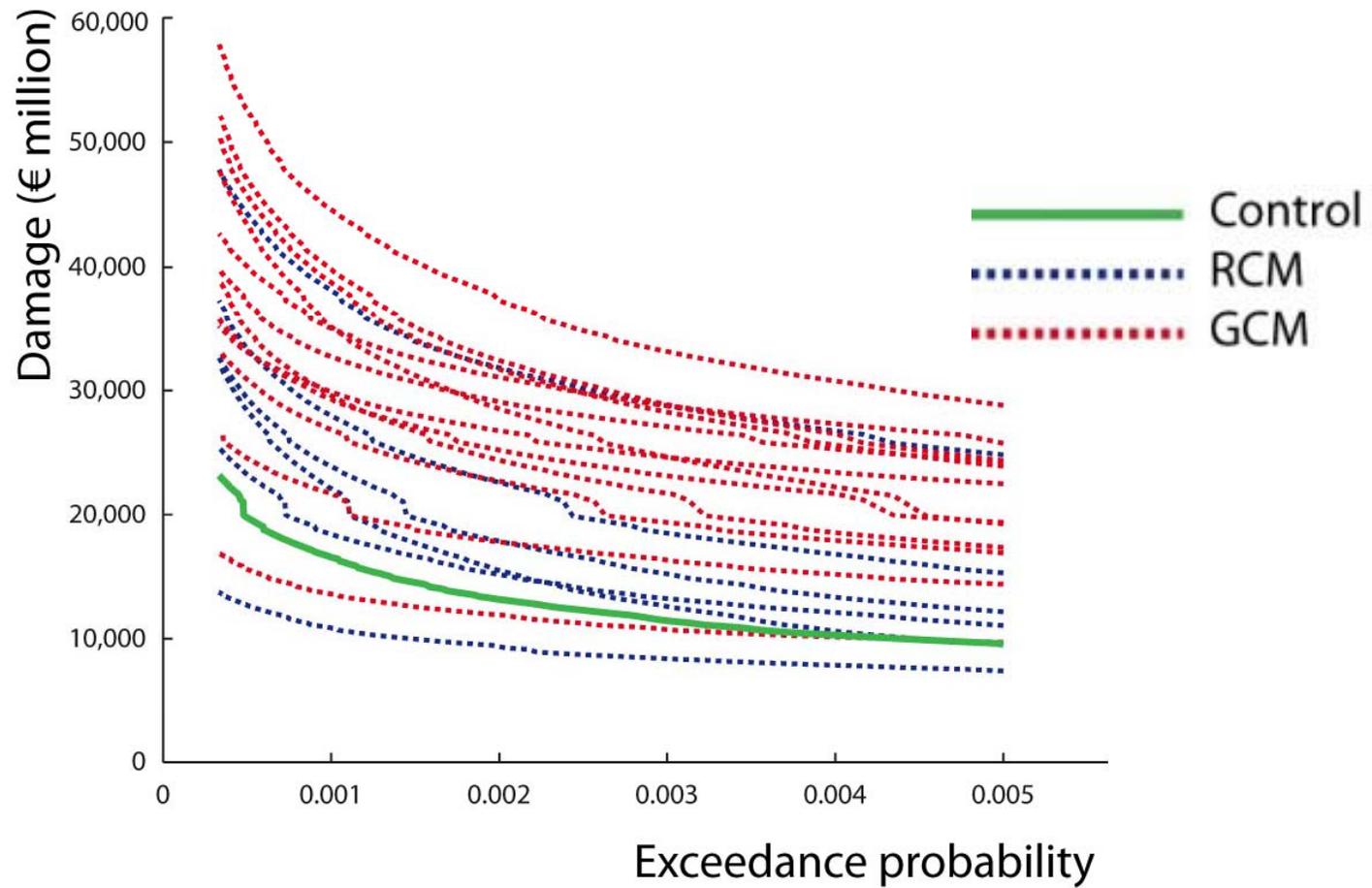
Results: Current flood risk



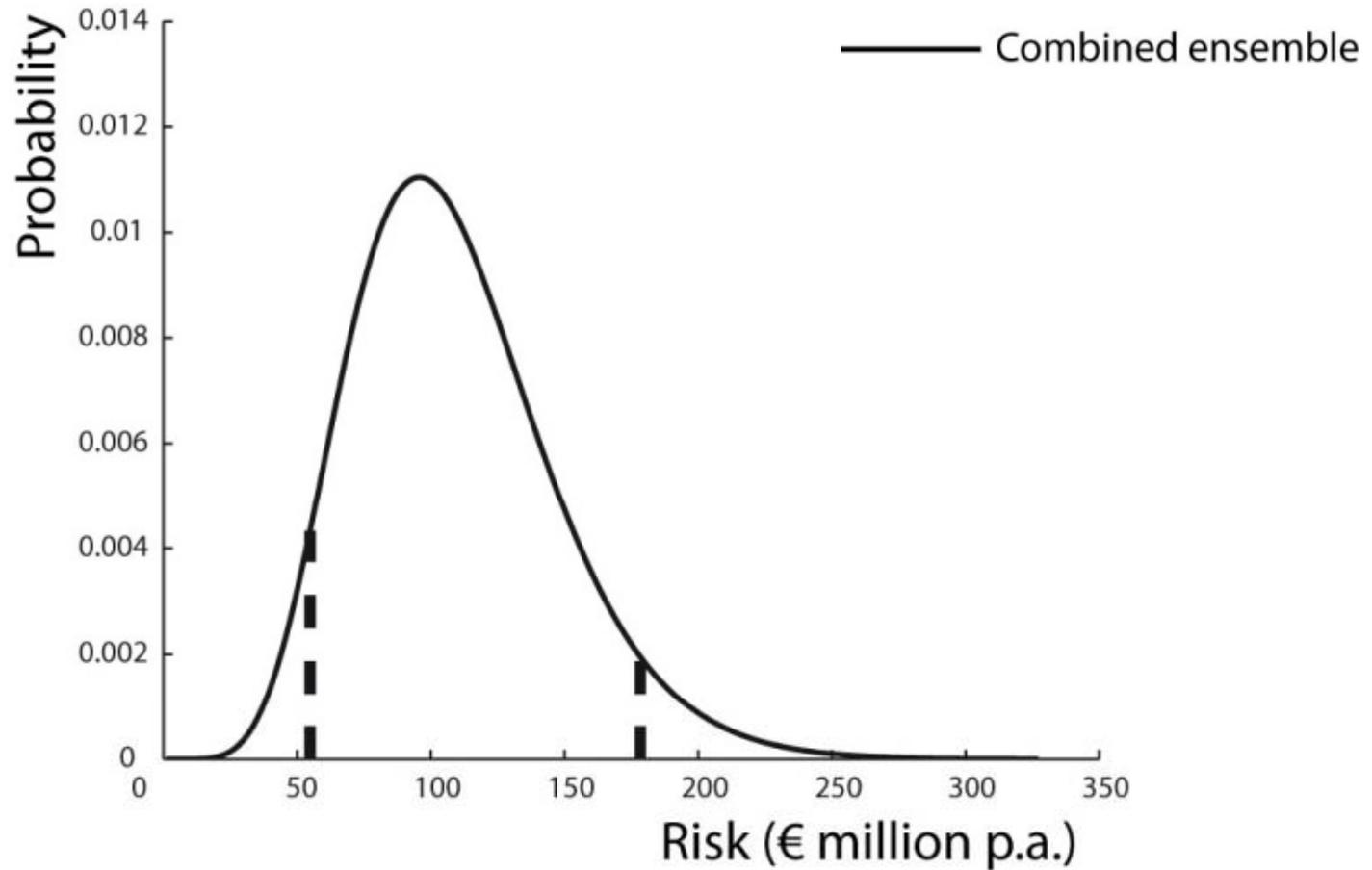
Results: Future flood risk (RCMs)



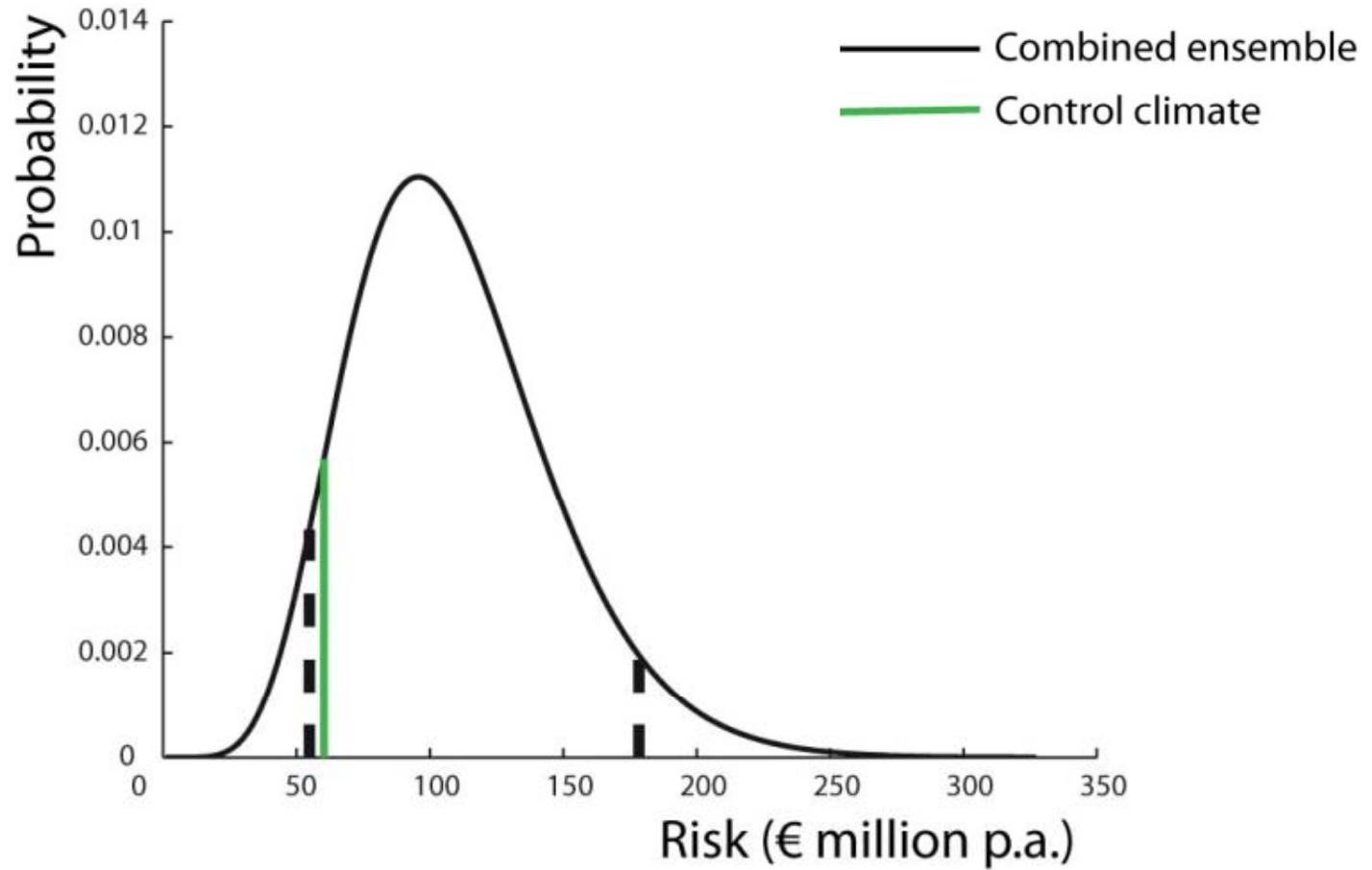
Results: Future flood risk (RCMs & GCMs)



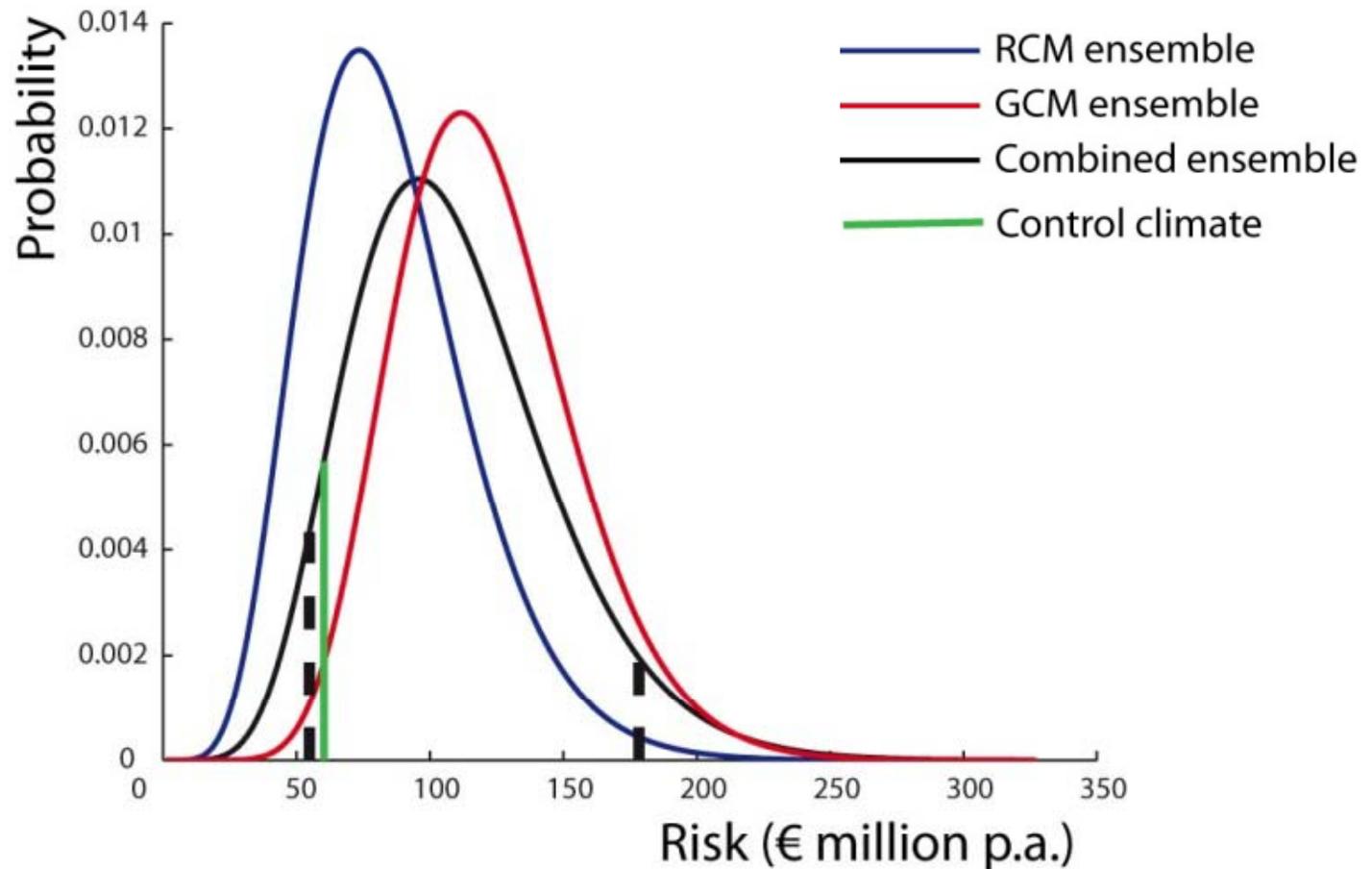
Results: Future flood risk (PDF)



Results: Future flood risk (PDF)



Results: Future flood risk (PDF)



Conclusions

- A first attempt to assess future flood risk under climate change in probabilistic framework
- Can be used for assessing the *chance* of extreme flood risk in future
- Largest climate model ensemble yet for flood risk estimation
- Rapid inundation modelling essential

Limitations / future work

- Demonstration of methods
- More: climate models, scenarios, realisations
- No weighting of models
- How can information be used by stakeholders?

Thank you!

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www.floodrisk2012.net