Transferring Research knowledge of Climate Change Uncertainty in Flood Risk Management in Scotland

Lila Collet, Lindsay Beevers, Michael Stewart

l.f.collet@hw.ac.uk

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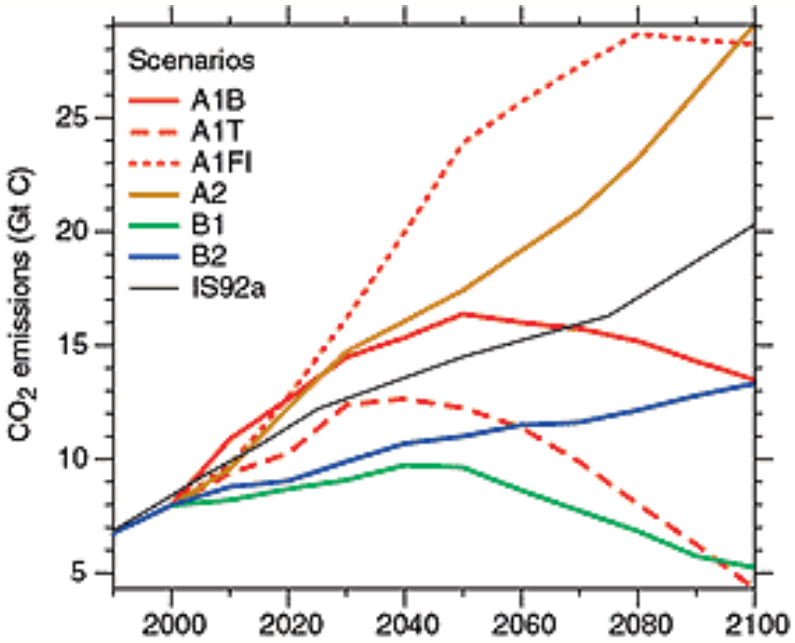
Need to account for Uncertainty in Climate Change Impact Assessment

- Floods in the UK: causing over £5Bn of damage since 2000, up to £1Bn / year for flood defences maintenance
- Flood Risk Assessment in the UK: deterministic approach
- UKCP09: national downscaled probabilistic dataset

→ develop a statistical framework for uncertainty analysis in FRA

The Independent, 01/2016



Research

AIM:

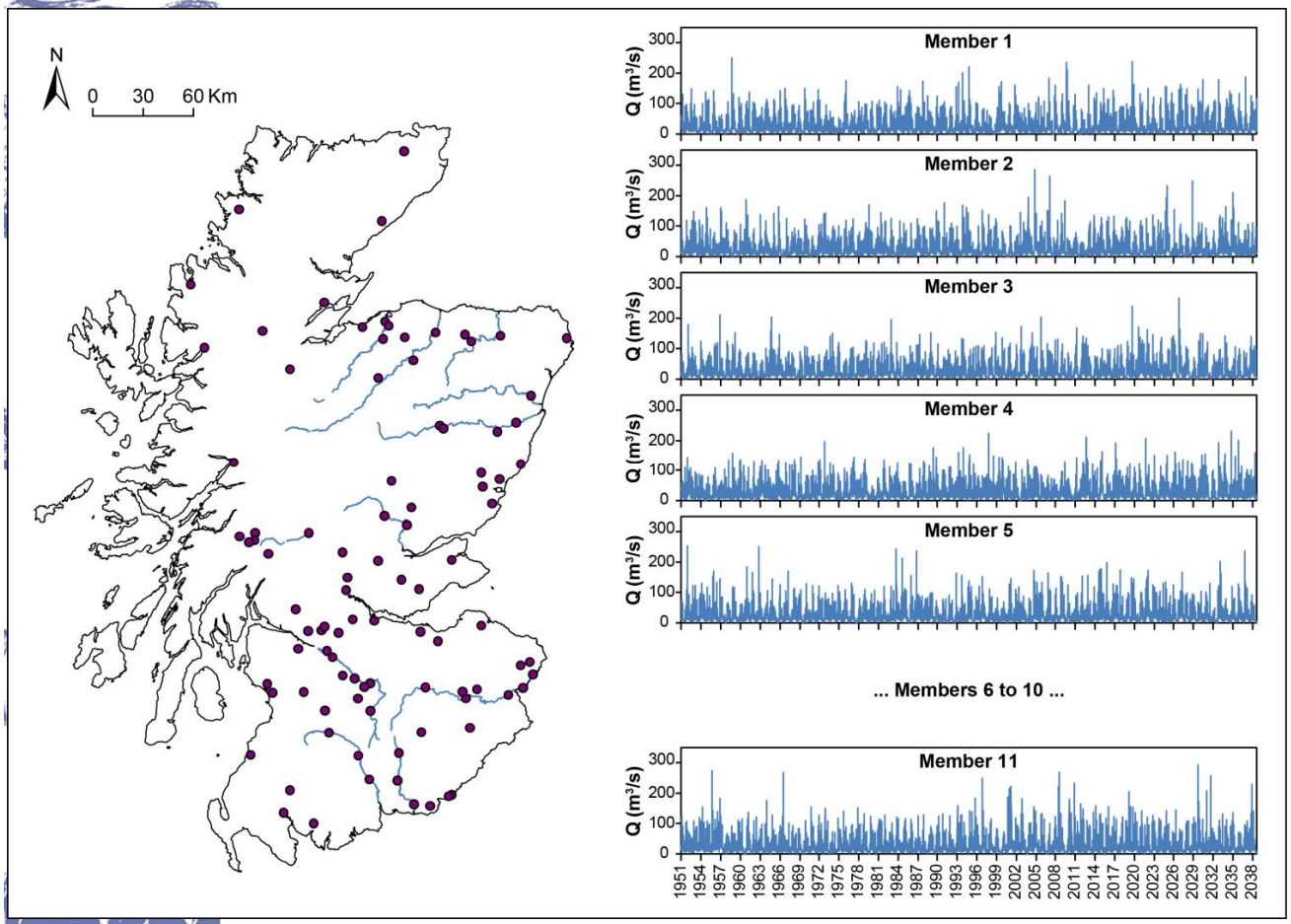
Assess the impact of climate change uncertainty on peak flows for extreme events, and investigate the impact of this change to future inundation extents

Structure:

- Introduce Future Flows Hydrology dataset
- Change to extreme event magnitude across Scotland by 2080s (+uncertainty)
- Regionalisation approach for ungauged catchments
- Implications for design and planning?

Future Flow Hydrology (CEH)

→ Affords Uncertainty in RCM parameterisation



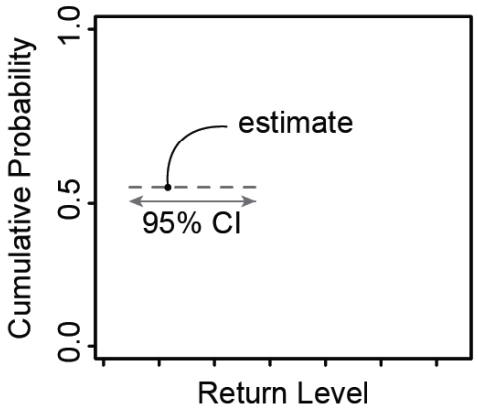
- Spatially coherent projections
- 95 Scottish stations
- A1B emission scenario
- One climate model
  - 10 variants
  - 11 ensemble climate members
- Daily river flow time series (1951-2098)
  - baseline (1961-1990)
  - 2080s (2069-2098)

Application of the FEH Method

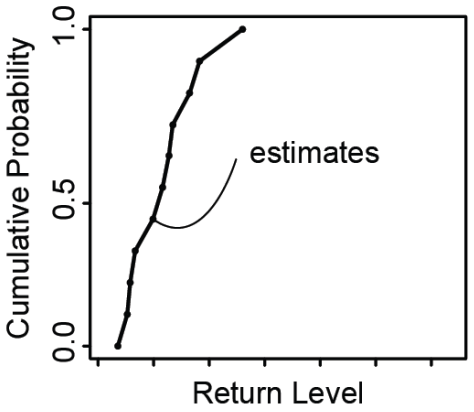
For GEV and GL distribution functions with the L-Moments method.

Automatically compute on each gauging station for the 1:2, 1:5, 1:10, 1:30, 1:50, 1:100 and 1:200-yr RPs.

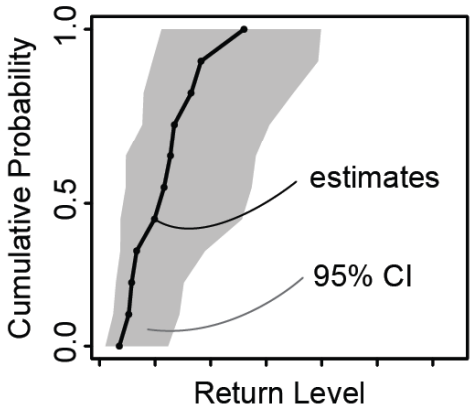
(a) For 1 ensemble member and the EV confidence interval



(b) For 11 ensemble members



(c) For 11 ensemble members and the EV confidence intervals



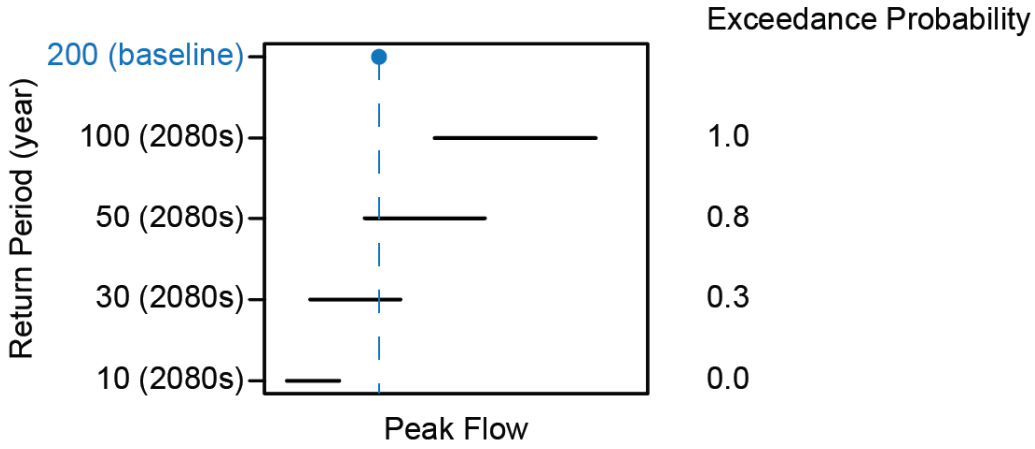
→ Database of 11 peak flows and the associated 95% confidence intervals for GEV and GL at each gauging station.

Investigating probability of future exceedance

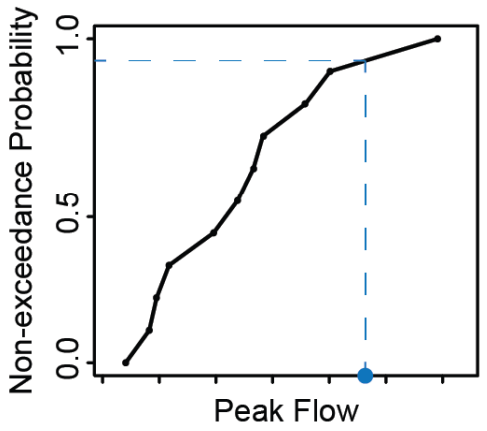
What is the change to frequency?

- What might a 1:200 year event now be the future?
- A 1:100 year event, a 1:50 year event?

(a) Comparison of the median baseline 1:200-year RP flow with future low RPs across the 11 ensemble-members

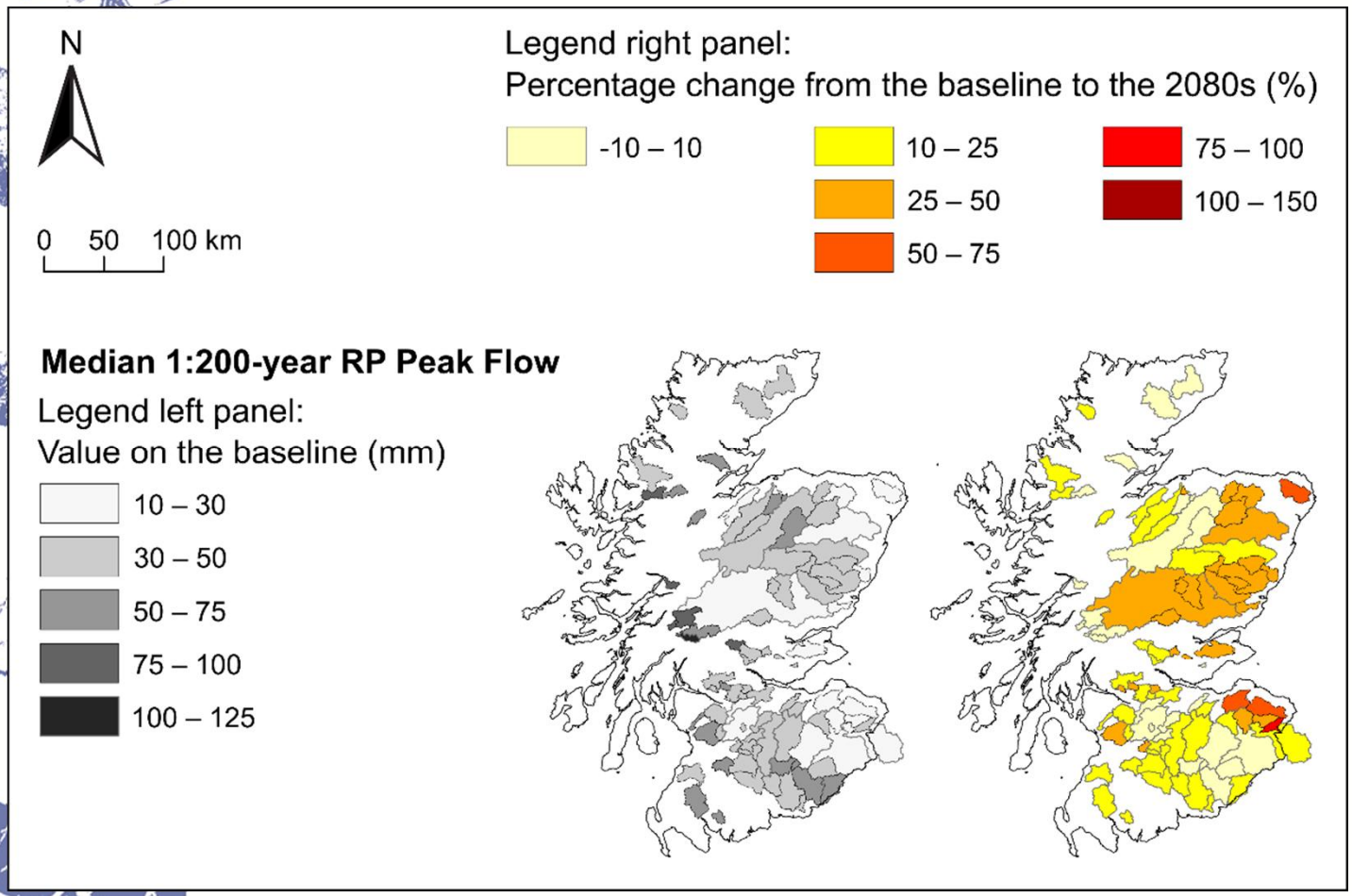


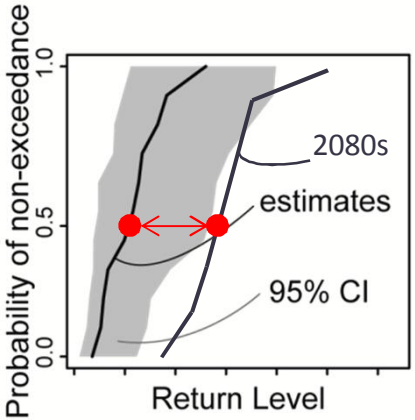
(b) Cumulative Distribution Function



Median 1:200-yr RP flow on the baseline
CDF of a low-RP flow on the 2080s

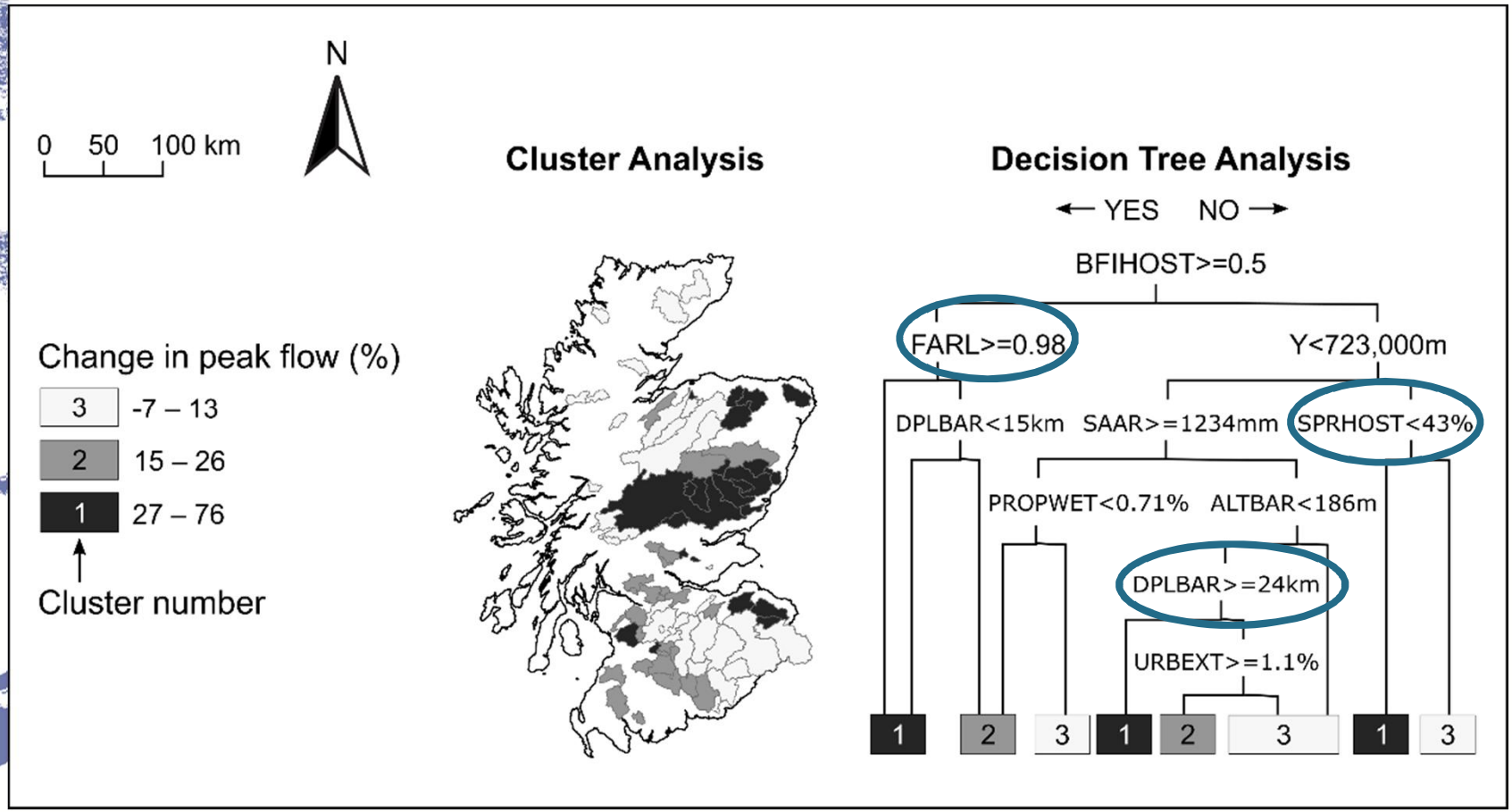
Results:
Median 200-yr return period flow (1/2)



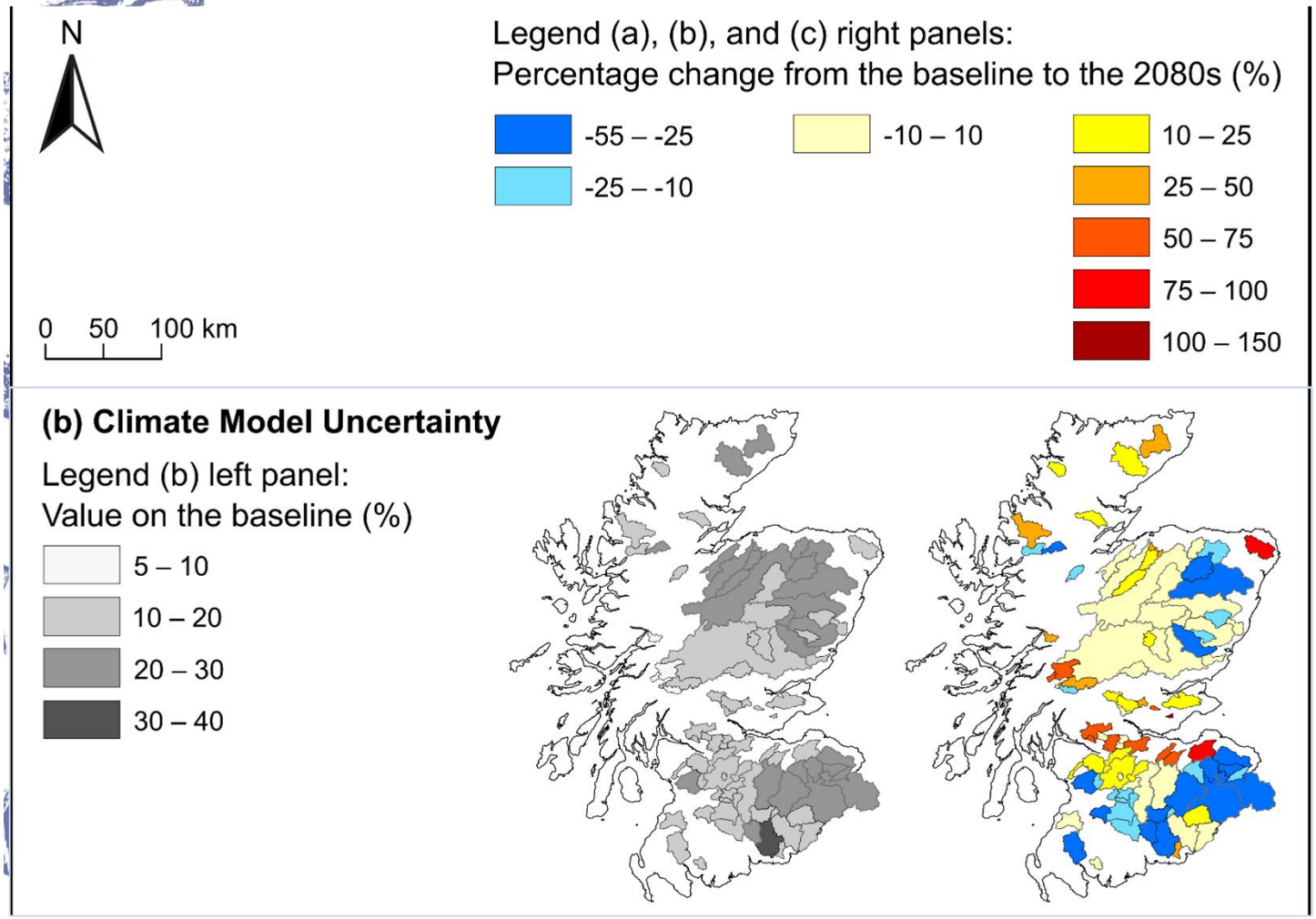


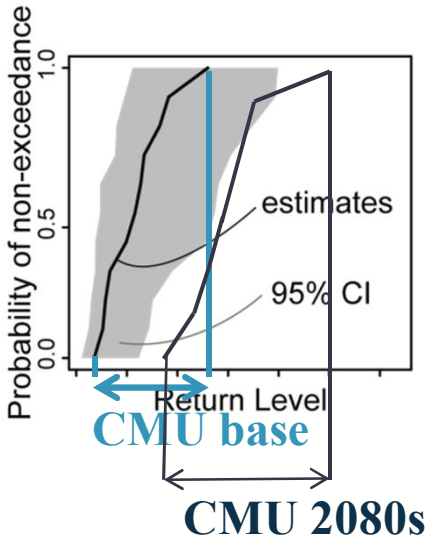
Results:
Median 200-yr return period flow (2/2)

Increase: large attenuation from lakes and reservoirs, large catchments, low standard percentage runoff



Results:
Climate Model uncertainty (CMU) (1/2)



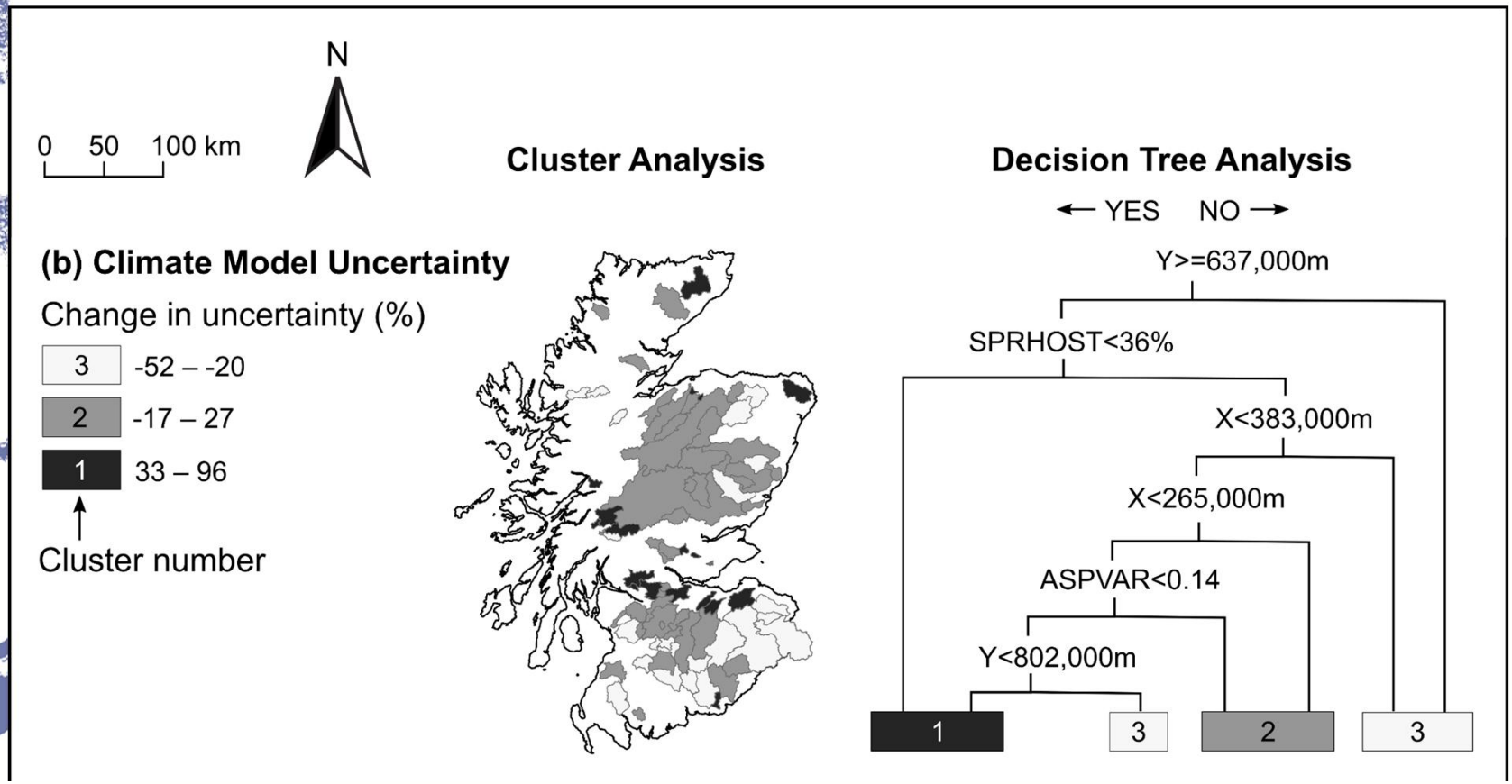


CMU: relative standard deviation

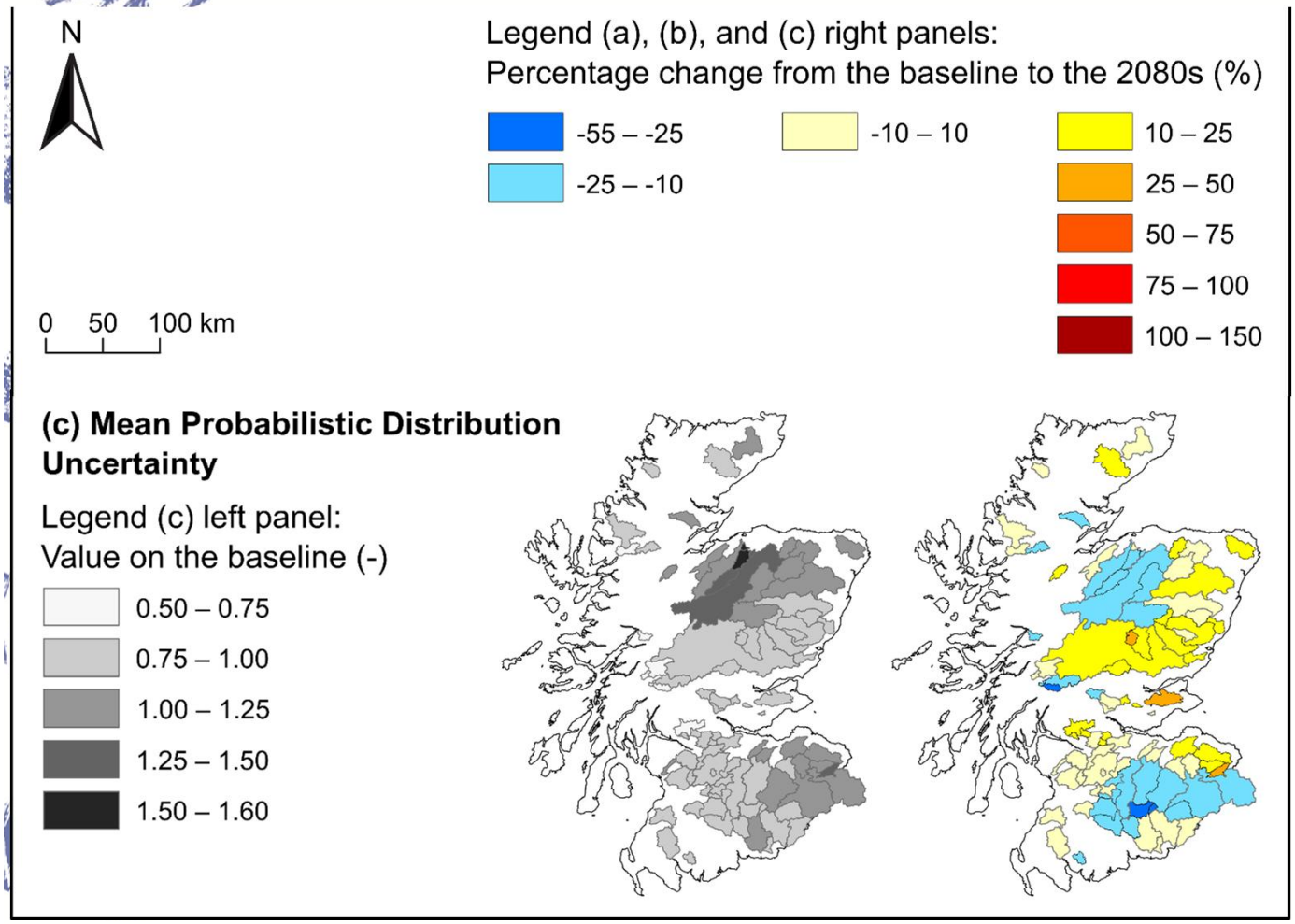
RSD=σ/μ

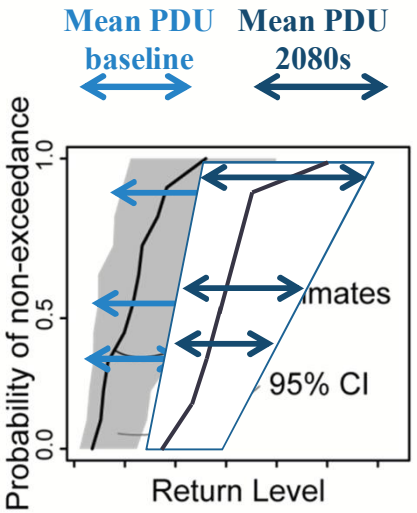
Results:
Climate Model uncertainty (CMU) (2/2)

Strong geographical control



Results: Probabilistic Distribution uncertainty (PDU) (1/2)



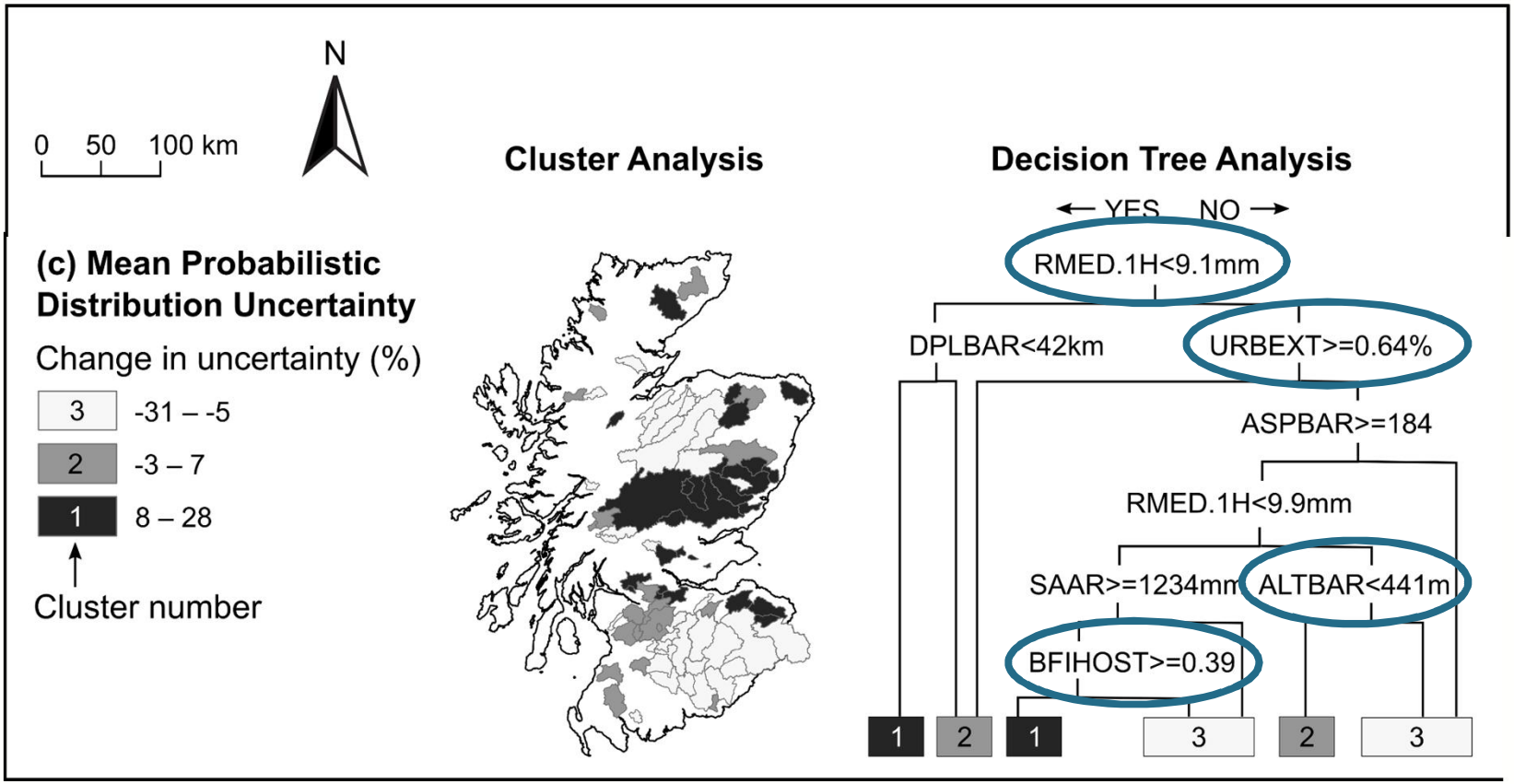


PDU: mean relative coefficient of uncertainty

$RCU=(CI_{up} - CI_{low})/Estimate$

Results: Probabilistic Distribution uncertainty (PDU) (2/2)

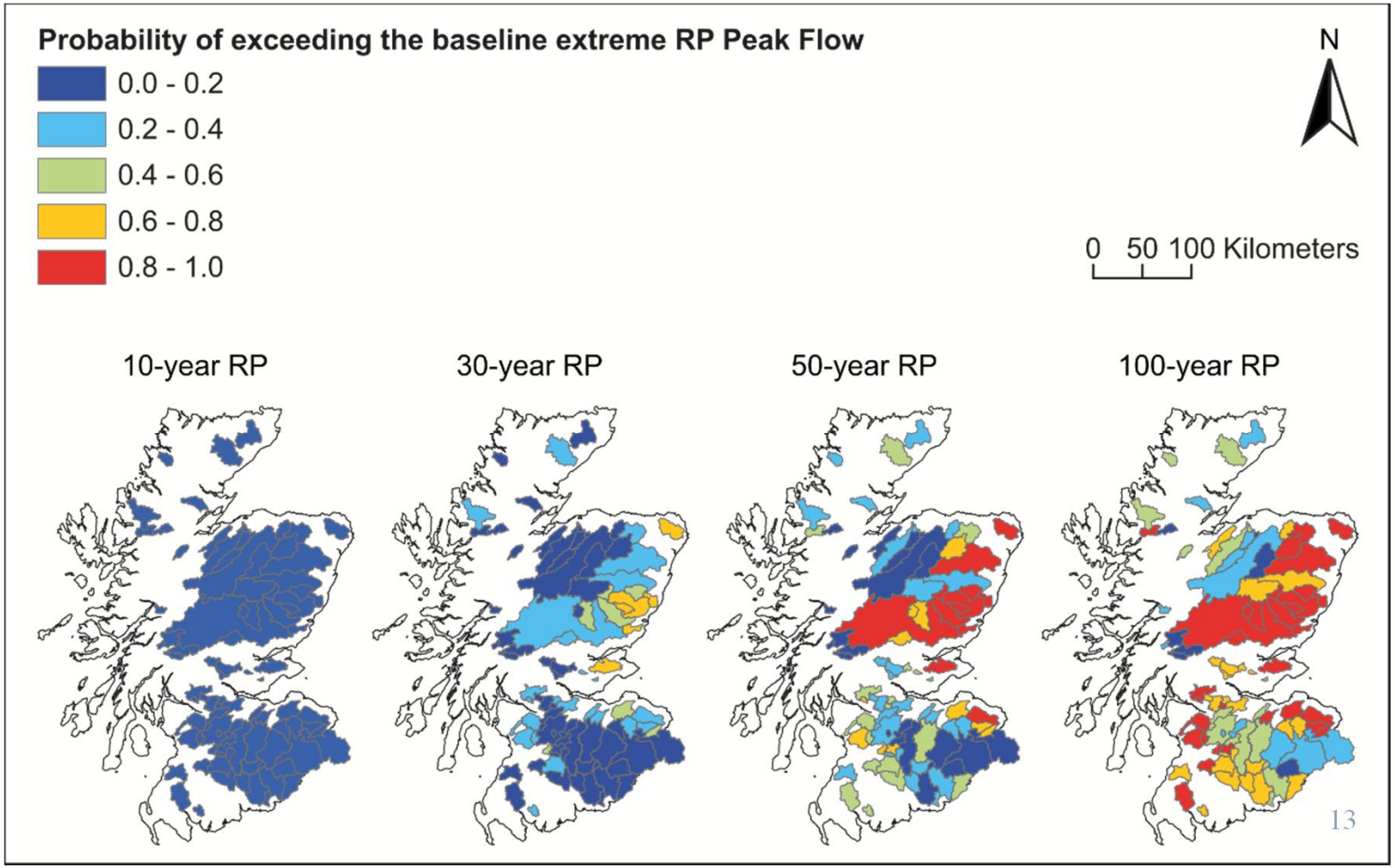
Decrease: high 1-hour rainfall depths, low urban extents, high altitudes or little influence from groundwater.



Results:
Probabilistic Maps

→ Some catchments: 4 times more likely

→ Some catchments: twice as likely

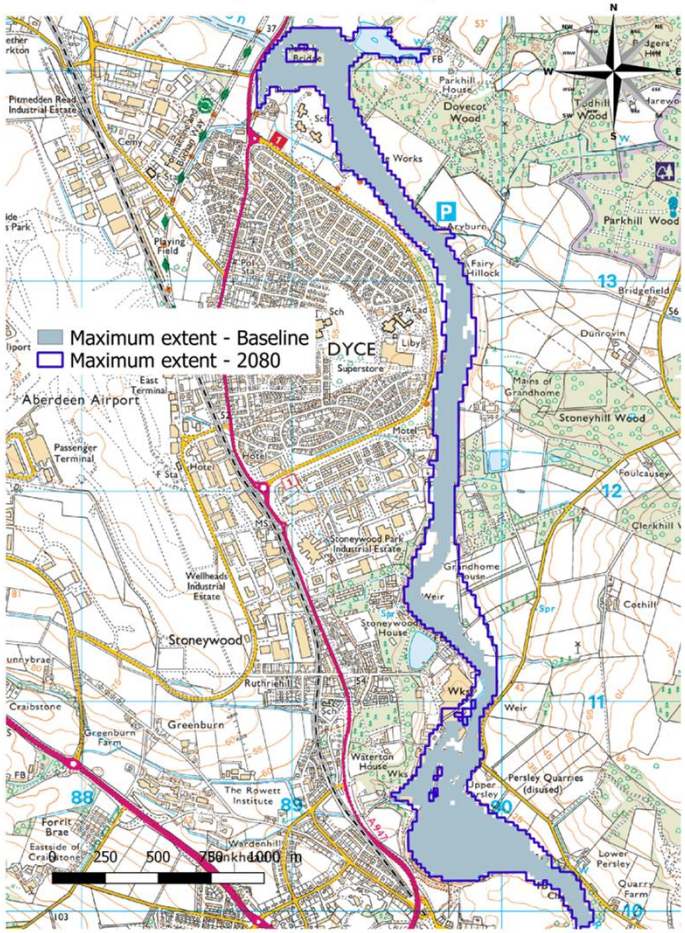


Conclusions & Perspectives

- Climate change projections affect return level flows in the future
- Different impacts regionally across Scotland
- +20% will not always capture this
- Uncertainty in projections are high

- Cascade the uncertainty domain to probabilistic flood mapping

River Don (Abderdeen) - Maximum extents from the probabilistic maps



Sources: SEPA, Digimap Edina, Future flow Database

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Thank you