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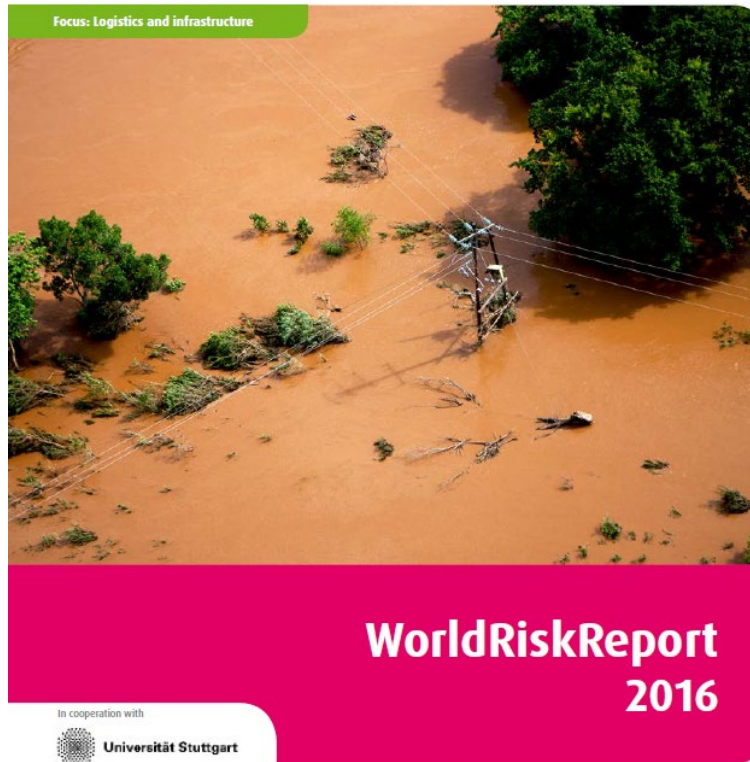


Climate change impact on safety and performance of existing and future infrastructure

AMRO NASR, IVAR BJÖRNSSON, DÁNIEL HONFI, OSKAR LARSSON IVANOV, JONAS
JOHANSSON, ERIK KJELLSTRÖM

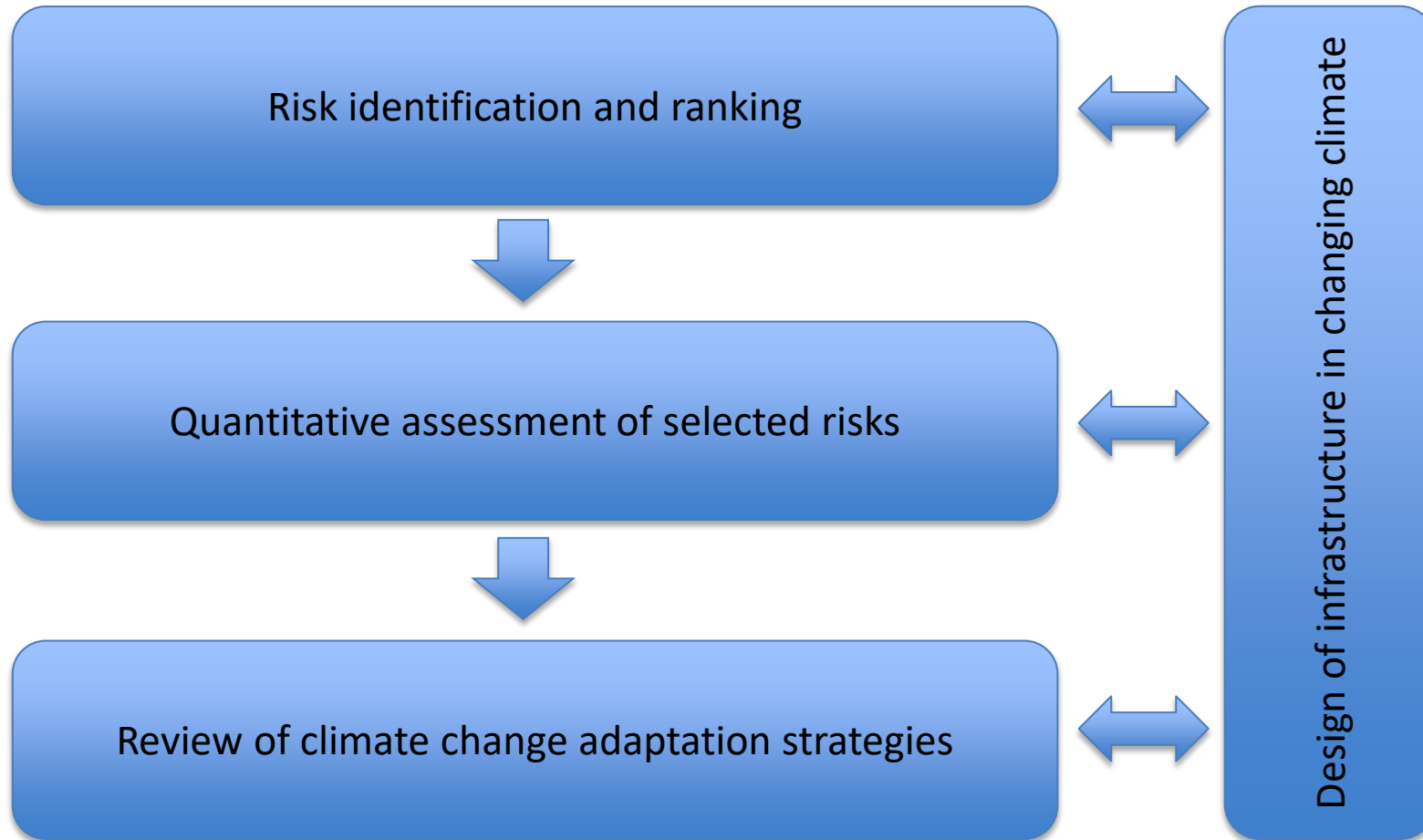


Climate change impacts to infrastructure



- Well-functioning and resilient infrastructure are critical, especially in times of crises and natural disaster
 - Evolving risk of climate change further highlights this need!
- What climate change related risks are relevant and how can our infrastructure be adapted/designed with this in mind?

Overview of PhD project



Financing:



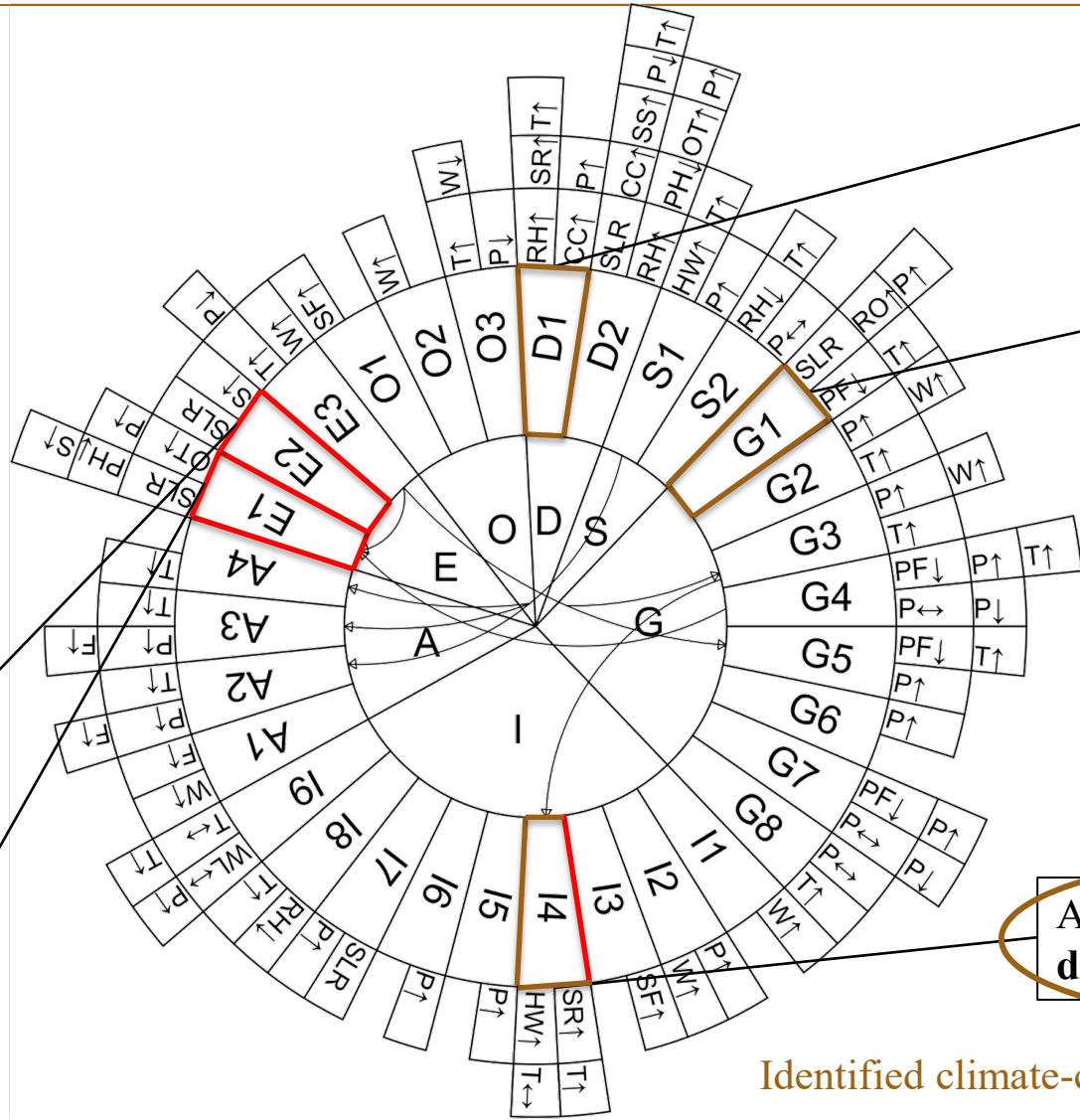
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Results – risk identification

- D- Durability risks
- S- Serviceability risks
- G- Geotechnical risks
- I- Increased demand risks
- A- Accidental loads risks
- E- Extreme natural hazards risks
- O- Operational risks



Accelerated **deterioration** rates

Higher **scour** rates



Higher frequency/intensity of **storms**

Higher **flooding** risks / Permanent **inundation** due to SLR

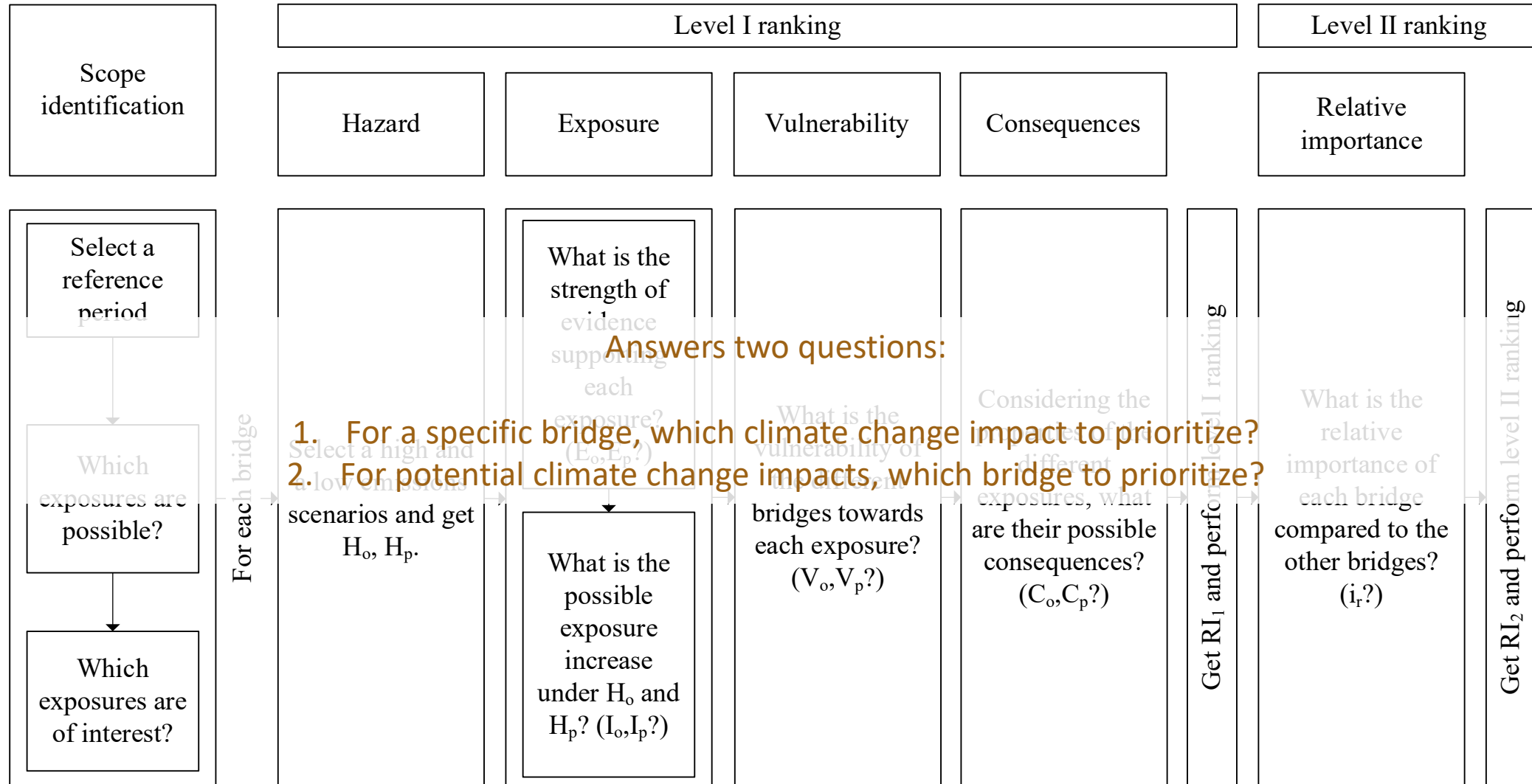
Additional demand on **deformation capacity**

Identified climate-change risks on bridges.



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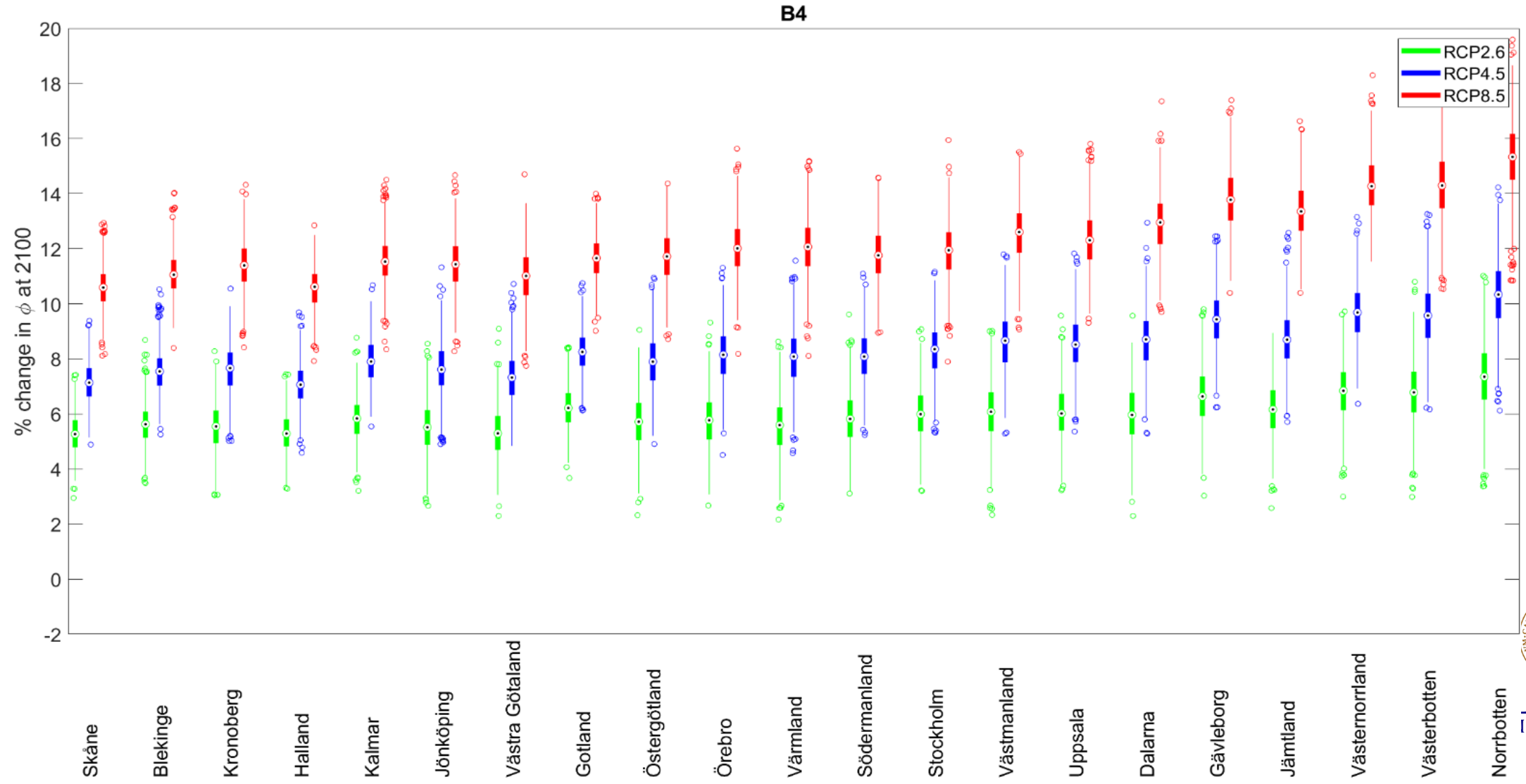
Results – risk ranking



Results – quantitative assessment of some risks

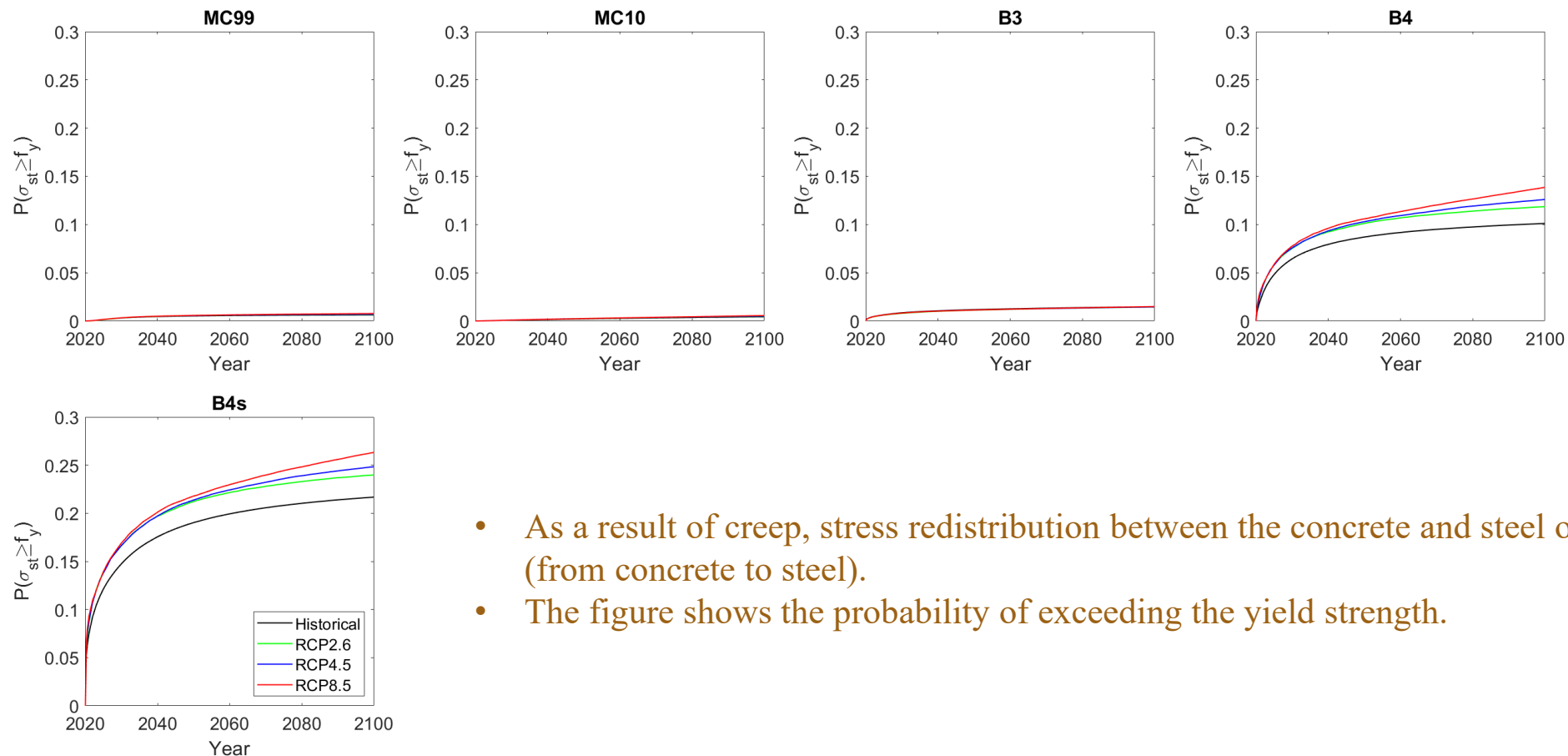
- Using climate change projections to quantify climate change impacts
 - Concrete creep
 - Decay of timber
 - Thermal loads for bridges (expansion)

Results – quantitative assessment of some risks (creep)



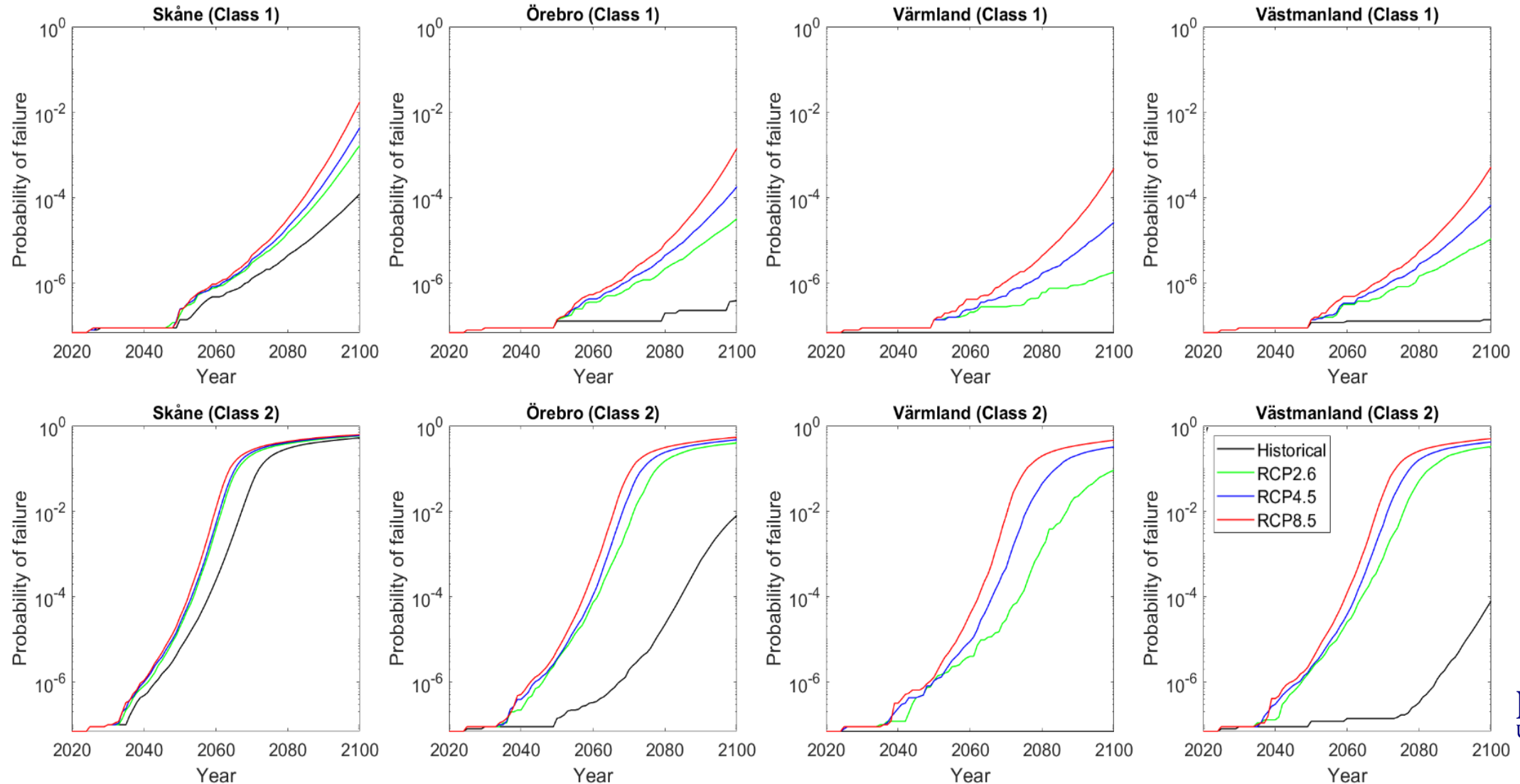
Results – quantitative assessment of some risks (creep)

- The results depend significantly on the creep model used.



- As a result of creep, stress redistribution between the concrete and steel occurs (from concrete to steel).
- The figure shows the probability of exceeding the yield strength.

Results – quantitative assessment of some risks (timber decay)

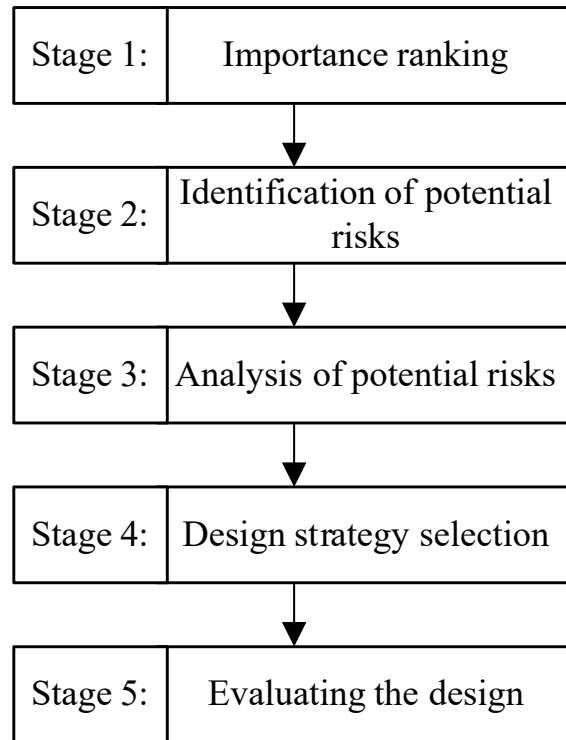


Results – adaptation techniques

R	$=$	$P(H)$	\cdot	$P(E H)$	\cdot	$P(D E \cap H)$	\cdot	$C(D)$
description		Hazard: The probability of a climatic hazard (e.g. increased storm activity)		Exposure: The probability of an adverse impact on the bridge as a result of the hazard (e.g. increased storm surge heights)		Vulnerability: The probability of a damage resulting from the increased hazard and exposure		Consequences: The consequences of such a damage
possible risk management measures		Reduction of GHG emissions (by e.g., introducing more strict regulations, reducing VMT through land use and urban planning strategies, etc.)		Regional adaptation measures, e.g.: <ul style="list-style-type: none"> • Storm surge barriers • Improved land use planning (e.g. relocation) 		Local adaptation measures, e.g.: <ul style="list-style-type: none"> • Increase bridge elevation • Insert holes in the bridge superstructure • Improve span continuity • Use tie-down, restrainers, or anchorage bars 		Adaptation measures for cascading effects: <ul style="list-style-type: none"> • Increase robustness • Increase network resilience • Improved emergency and disaster preparedness • Improved understanding of interdependencies



Results – design for climate change



- Design strategies: build to repair, planned adaptation or design based on selected scenario
- Some significant challenges:
 - Deep uncertainties in climate projections
 - Incorporating adaptability in design
 - Establishing acceptance criteria
 - Going from research to practice
 - ...



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