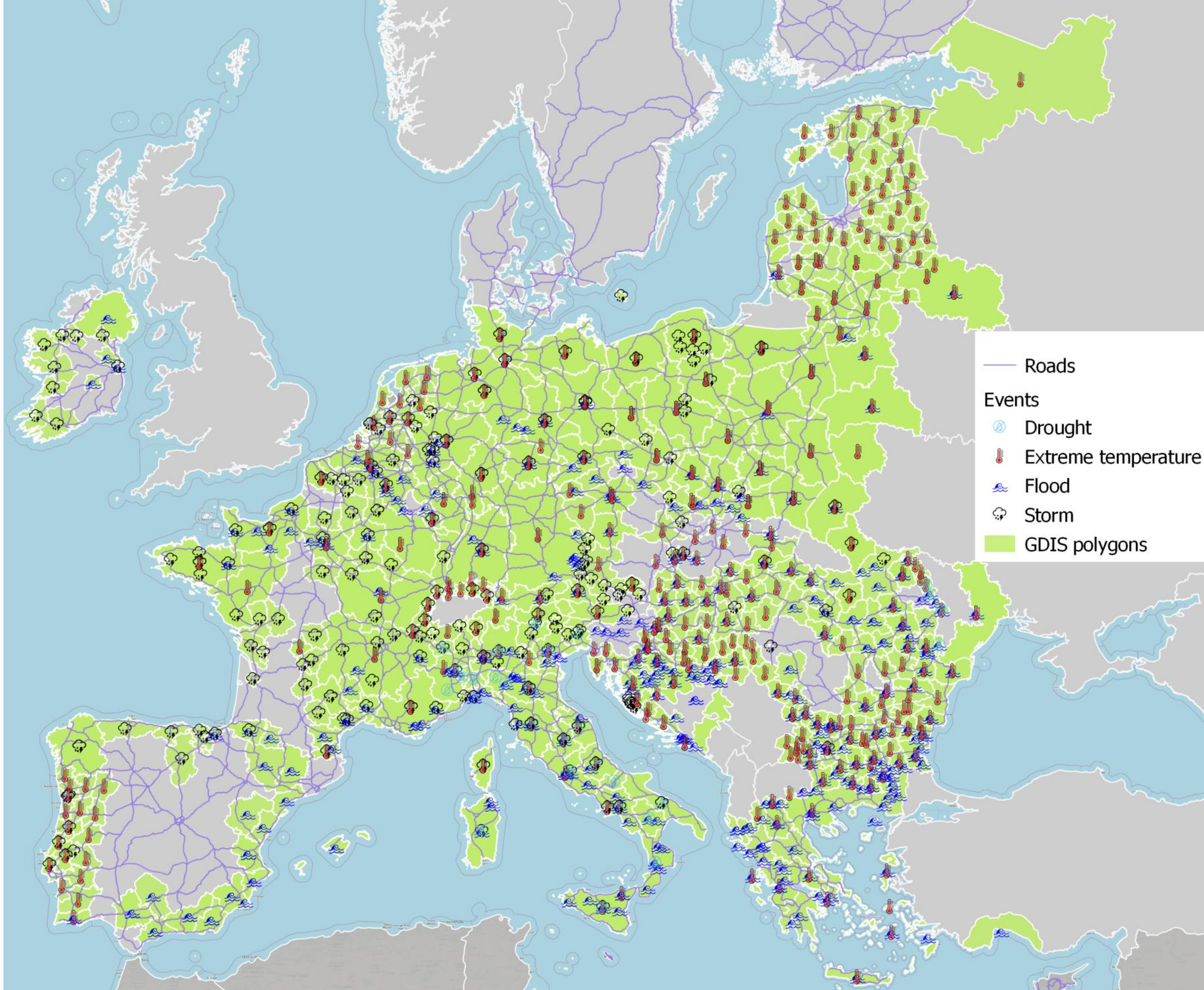
Germany, 15 july 2021
(Source: Sebastian Schmitt)

Is Europe's transport infrastructure ready to face Climate Change?

Dr. Cristina Deidda

Wim Thiery, Wolfgang Schade, Arpita Asha Khanna

European transport infrastructure faced multiple climate extremes between 2010-2018



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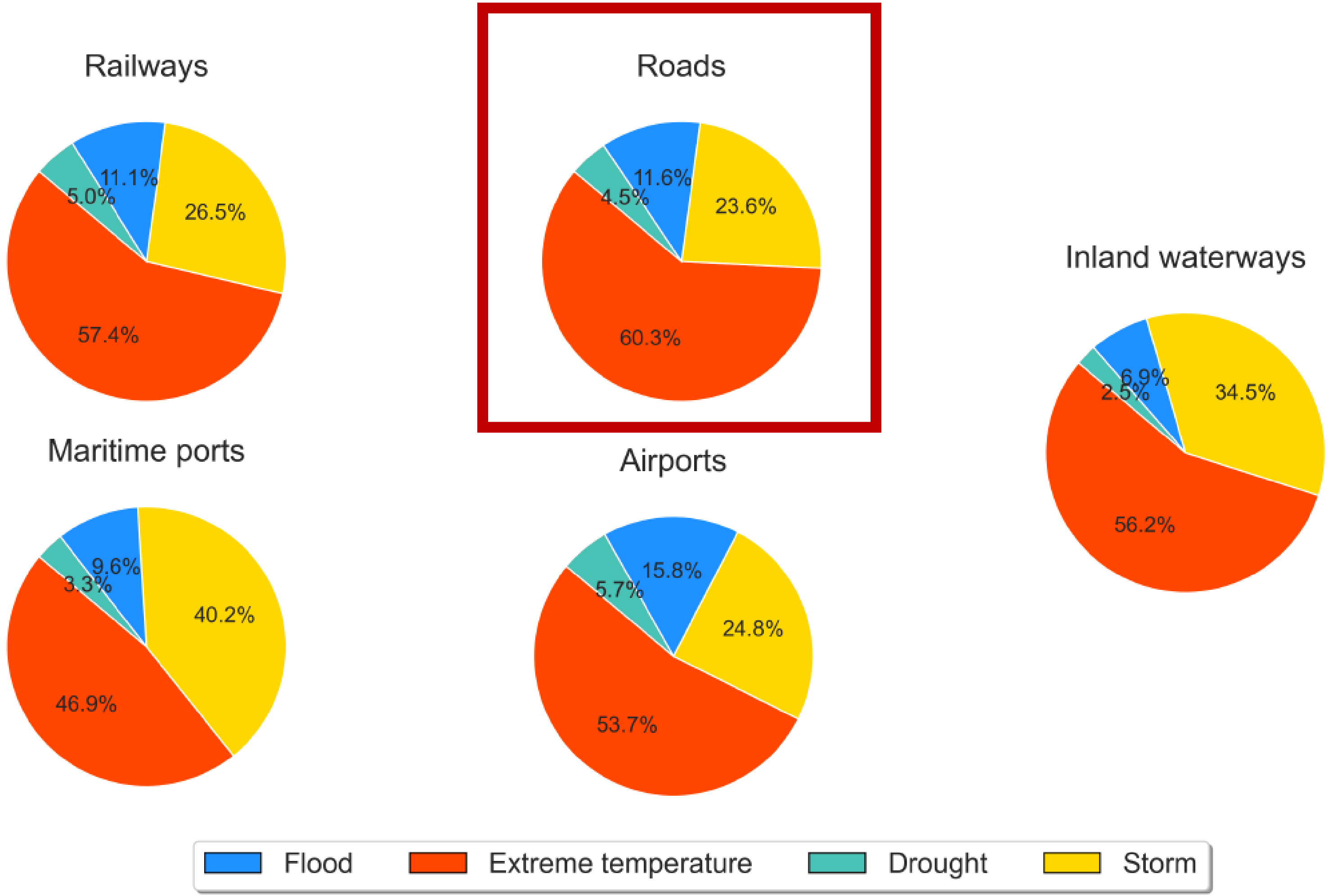
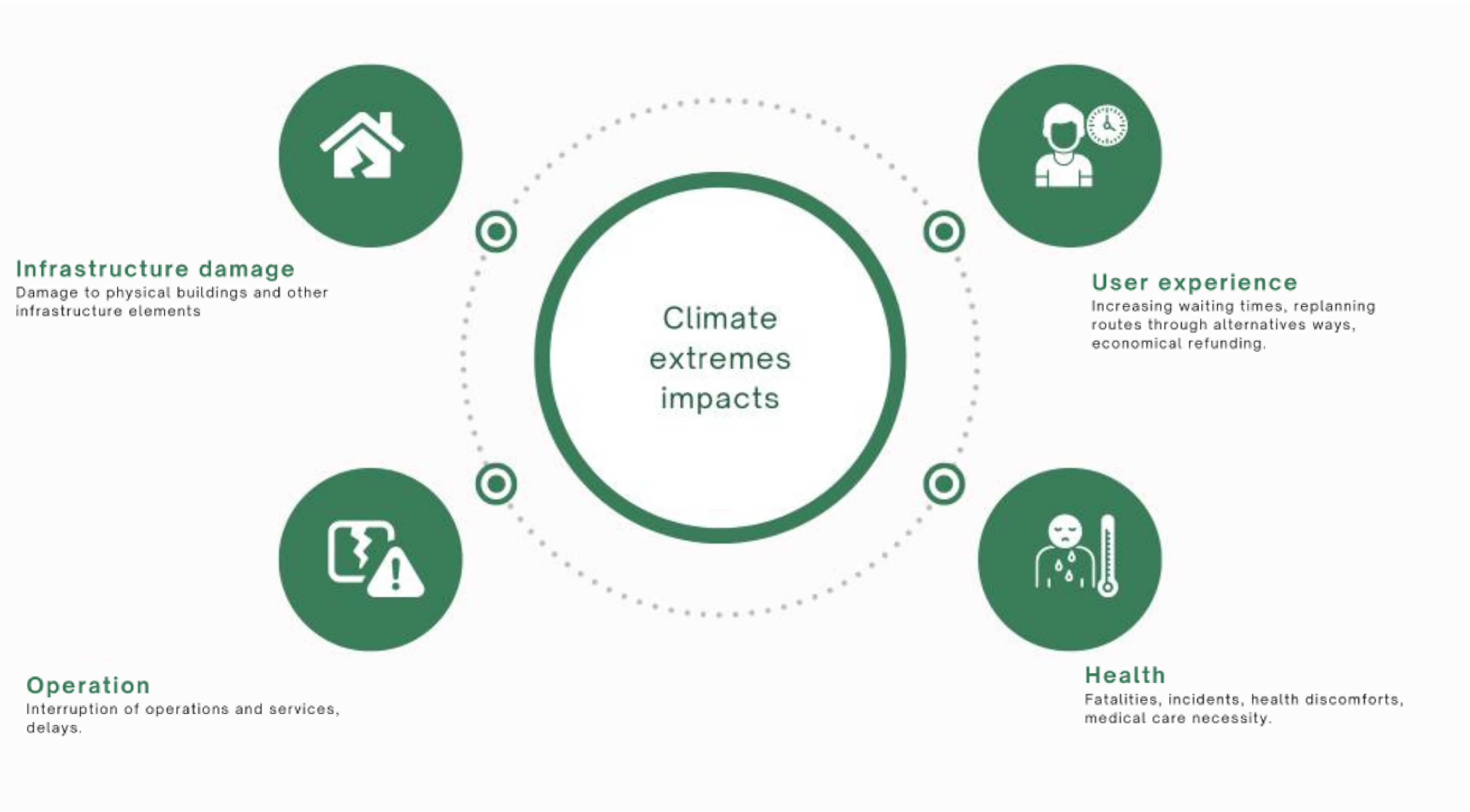
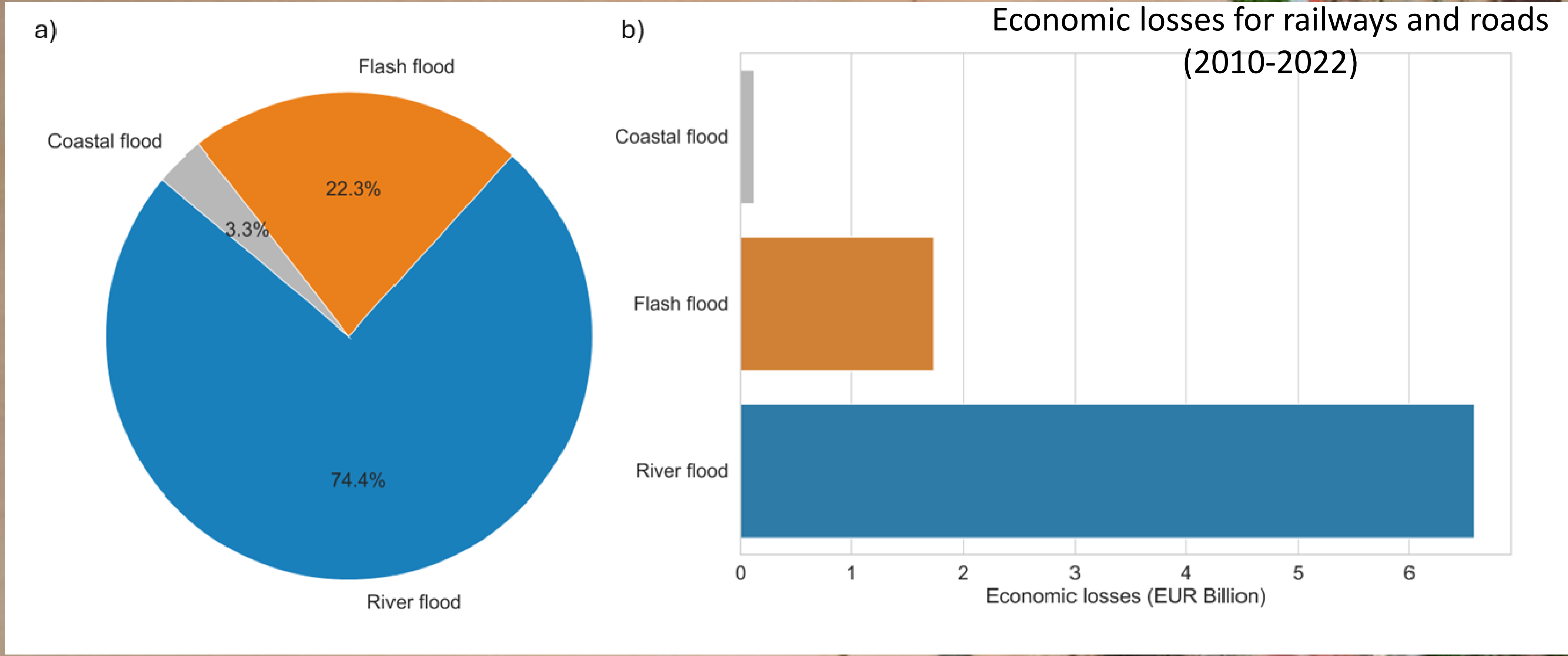

Railways
11.1%
5.0%
26.5%
57.4%
Roads
11.6%
4.5%
23.6%
60.3%
Inland waterways
6.9%
2.5%
34.5%
56.2%
Maritime ports
9.6%
3.3%
40.2%
46.9%
Airports
15.8%
5.7%
24.8%
53.7%
Flood
Extreme temperature
Drought
Storm


Infrastructure damage
Damage to physical buildings and other infrastructure elements
Climate extremes impacts
User experience
Increasing waiting times, replanning routes through alternatives ways, economical refunding.
Operation
Interruption of operations and services, delays.
Health
Fatalities, incidents, health discomforts, medical care necessity.

Underpass in Southern Athens
14 October 2021

Heraklion
Crete, Greece, 15 October 2022


Storm ‘Daniel’, in Piniada, near Trikala,
Thessaly, Greece, 7 September 2023
Photo: EPA-EFE/HATZIPOLITIS NICOLAOS



‘Daniel’ hit Piniada, near Trikala, Thessaly, Greece, 7 September 2023. Photo: EPA-EFE/ACHILLEAS CHIRAS

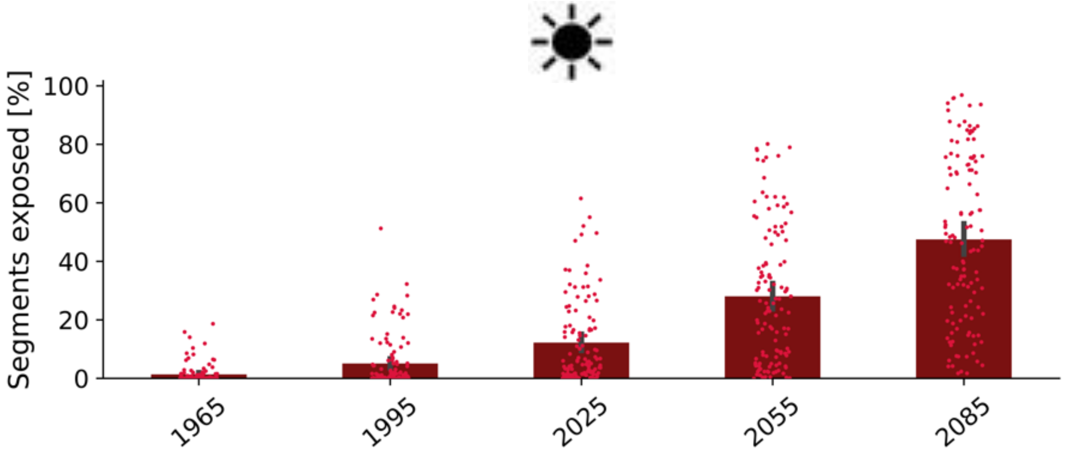
Sections of Germany’s concrete motorways have broken apart after several days of hot weather. Temperatures above 30 °C caused some sections of the autobahns to crack.

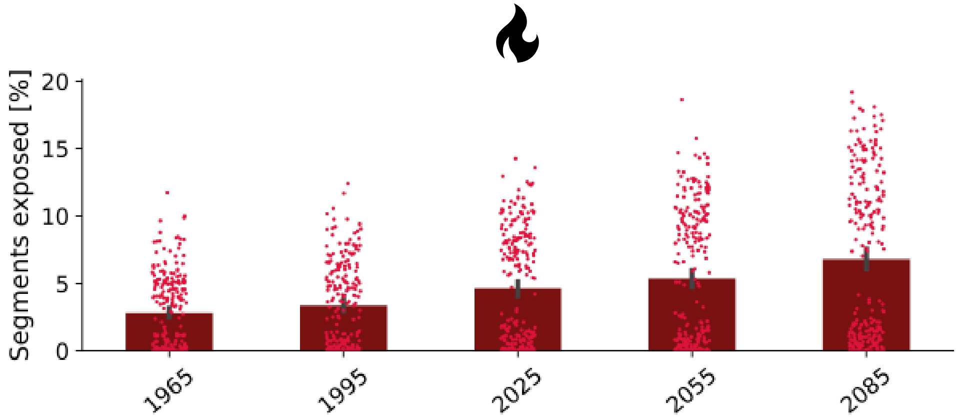
06/02/2018

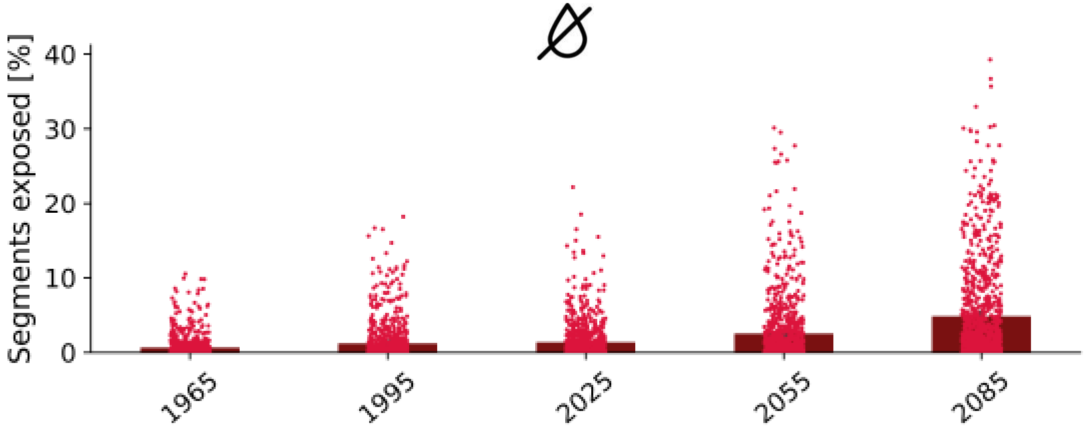
Palermo airport 2023

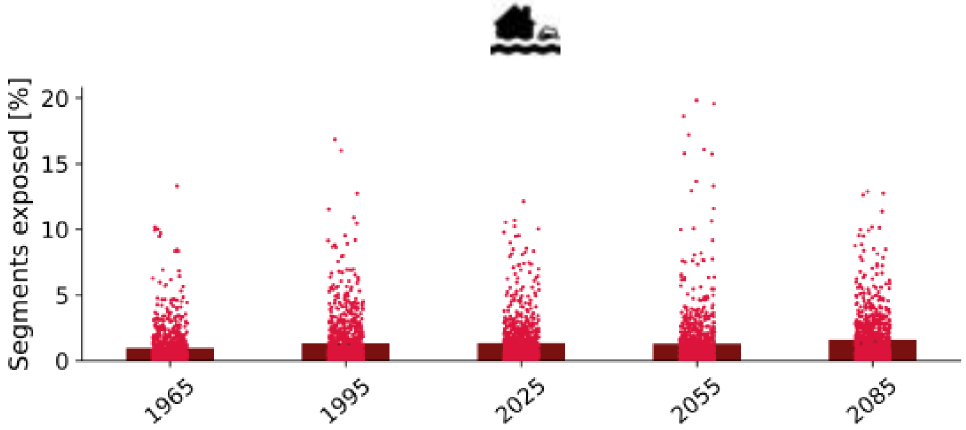
Future projections

medium-high emission scenario





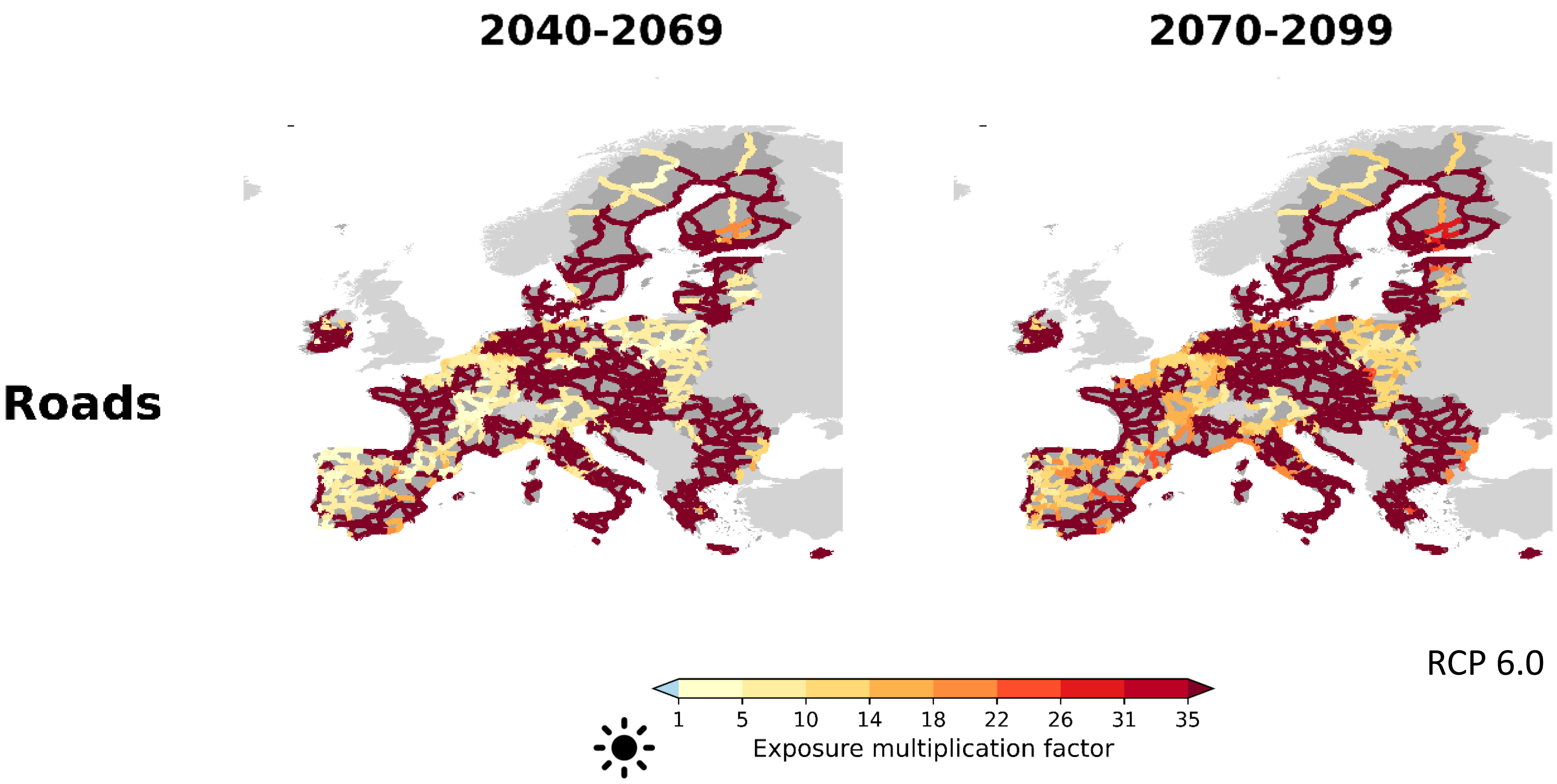




RCP 6.0

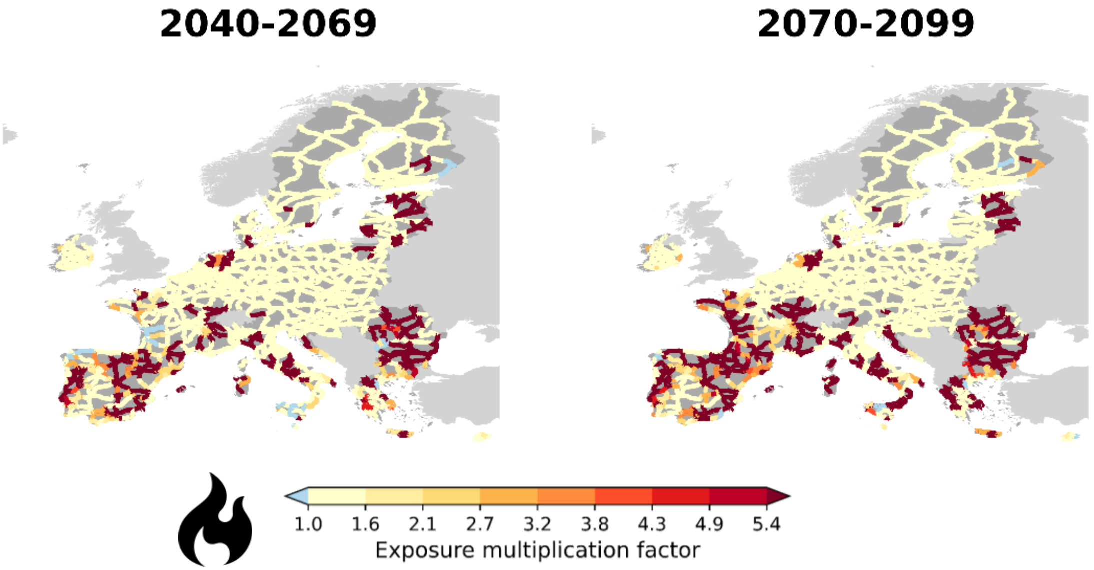
Future projections

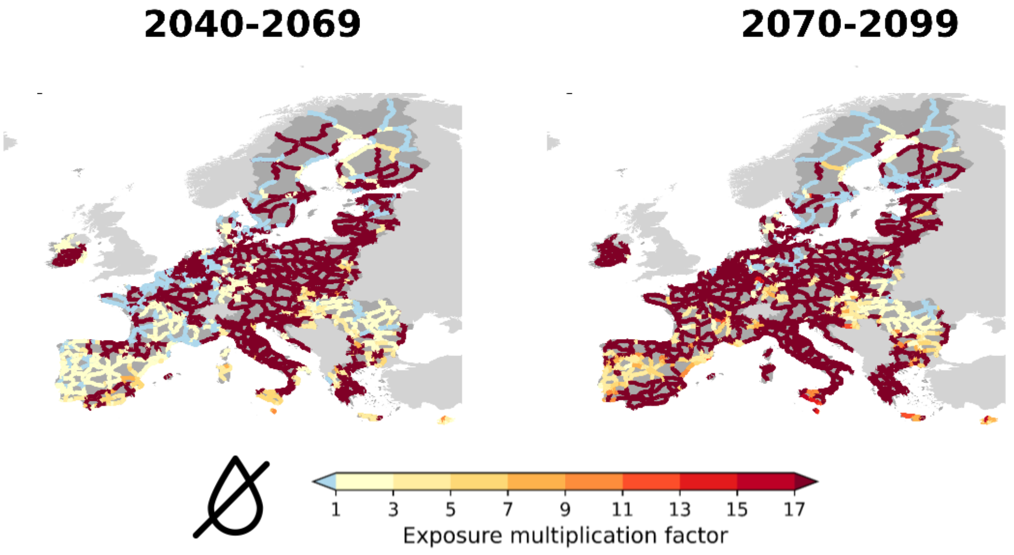
medium-high emission scenario



Future projections

medium-high emission scenario





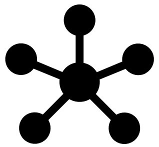
From Evidence to Action

Database of
impacts-costs
of past
extremes

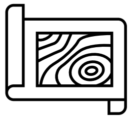
Risk Assessment and Adaptation Measures

Multi-hazards

Interconnectivity



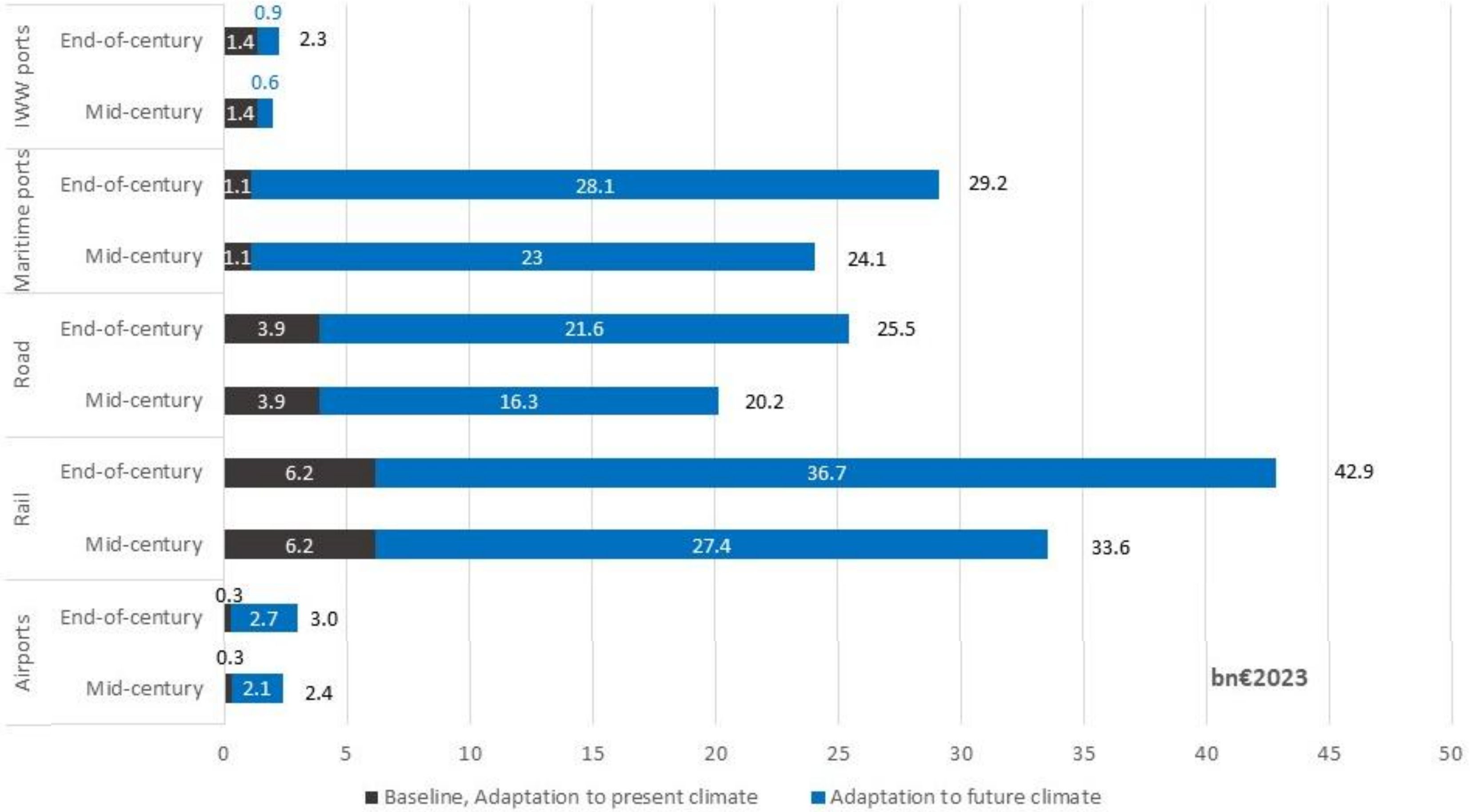
Unprecedent impacts



past *future*

Adaptation investment needs

medium-high emission scenario



Support study on the climate adaptation and cross-border investment needs to realise the TEN-T network

(source: M-Five)

Thank you for your attention!

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Preprint

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Abstract | Discussion | Metrics

17 Apr 2025

Status: this preprint is open for discussion and under review for Natural Hazards and Earth System Sciences (NHESS).

Is Europe's transport infrastructure ready to face climate change?

Cristina Deidda, Arpita Khanna, Wolfgang Schade, and Wim Thiery

Abstract. Climate extremes are intensifying in frequency and severity, posing escalating risks to Europe's transport infrastructure. Over the past two decades, these events have caused physical damages, economic losses, user delays, and rising health emergencies. Here, we first review observed impacts of selected climate extremes on Europe's transport network. We then present a multi-hazard analysis, designed to be intuitive and accessible for policymakers, to quantify the increasing exposure of four transport modes to river floods, heatwaves, droughts, tropical cyclones, and wildfires. We find that climate extremes are already affecting all transport modes across large parts of Europe, with billions euro worth of economic damage even for single events. For example, the 2018 Rhine River drought, which resulted in EUR 2.4 billion in economic losses in Germany. Under a

Adaptation strategies

Mode	Hazard	Measures
Roads	Heat waves	• **Heat-resistant paving materials** • Heat tolerant street and highway landscaping • Heat protection of urban transport systems (e.g., road shading)
	Coastal flooding	• Elevation of streets, bridges, and rail lines • Addition of drainage canals near coastal roads • Elevation and protection of bridge, tunnel, and transit entrances • Additional pumping capacity for tunnels • Nature-Based solutions for coastal highway resilience (e.g. marshes and seawalls) • **Levees, seawalls, and dikes**
	Flooding	• **Upgrading of road drainage systems** • Protection of bridge piers and abutments with riprap • Increases in culvert capacity • Increases in pumping capacity for tunnels • Addition of slope retention structures and retaining facilities for landslides
	Tropical cyclones	• Changes in bridge design to tie decks more securely to substructure and strengthen foundations • Increases in drainage capacity for new transportation infrastructure or major rehabilitation projects (e.g., assuming more frequent return periods) • Removal of traffic bottlenecks on critical evacuation routes and building of more system redundancy • Adoption of modular construction techniques where infrastructure is in danger of failure including modular traffic features and road sign systems for easier replacement
	Wildfires	• **Nature-based solutions (e.g. landscaping)**