PACINAS

Public Adaptation to Climate Change

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18. Österreichischer Klimatag

Vienna, 24 May 2017

A bottom-up climate impact cost assessment for road infrastructure in alpine regions

A regional case study on the province of Salzburg

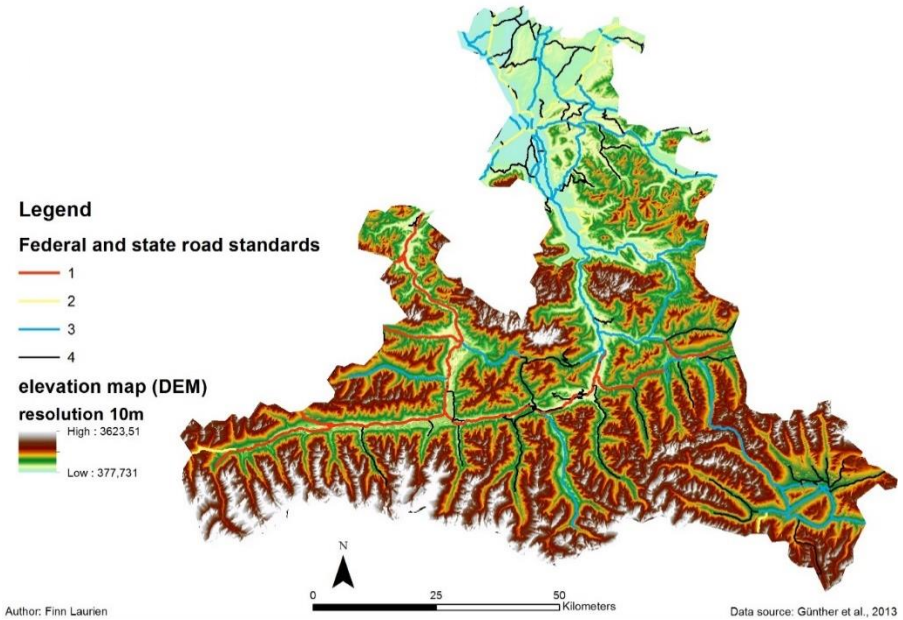
Finn Laurien[1] &

Birgit Bednar-Friedl[1,2]

[1]Wegener Center for Climate and Global Change,

[2]Institute of Economics

University of Graz; Austria



Wegener Center

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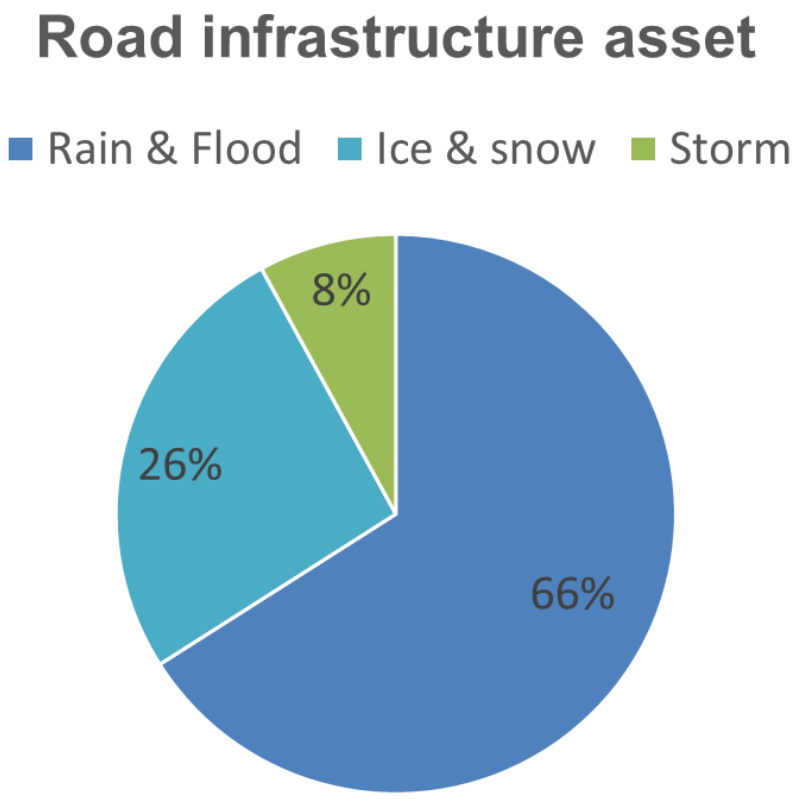
Background

- Weather-related impacts to the European road infrastructure account for more than 955 Mio.€ per year.

(Doll et al 2014 & Nemry and Demirel, 2012)

- The highest risk of landslides and debris flows occurs after rain showers.

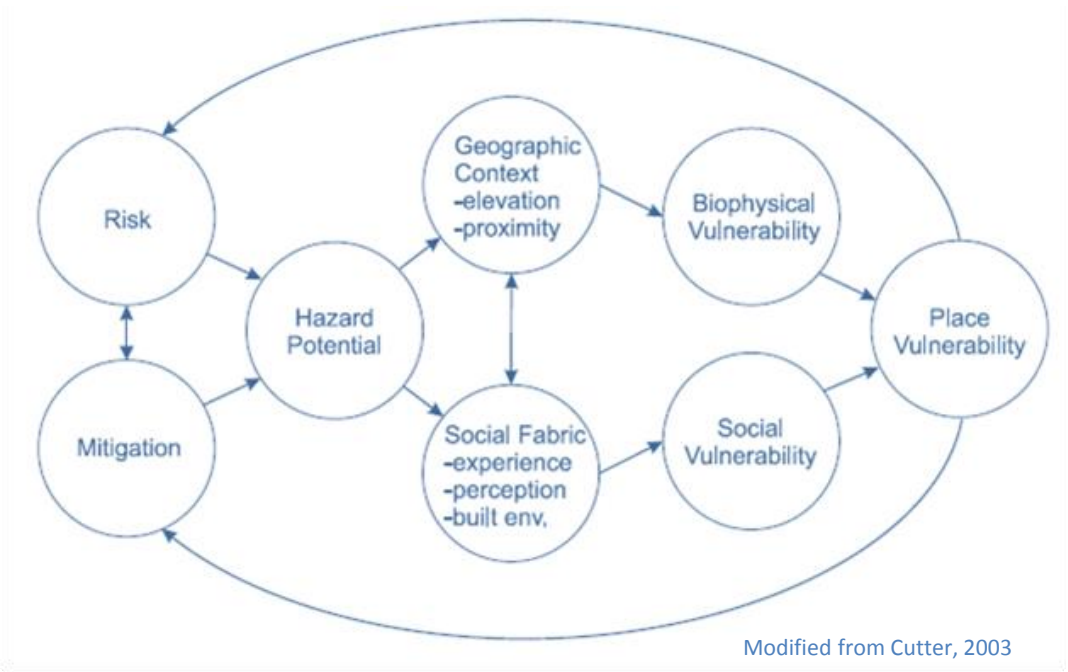
(Enei et al, 2011)



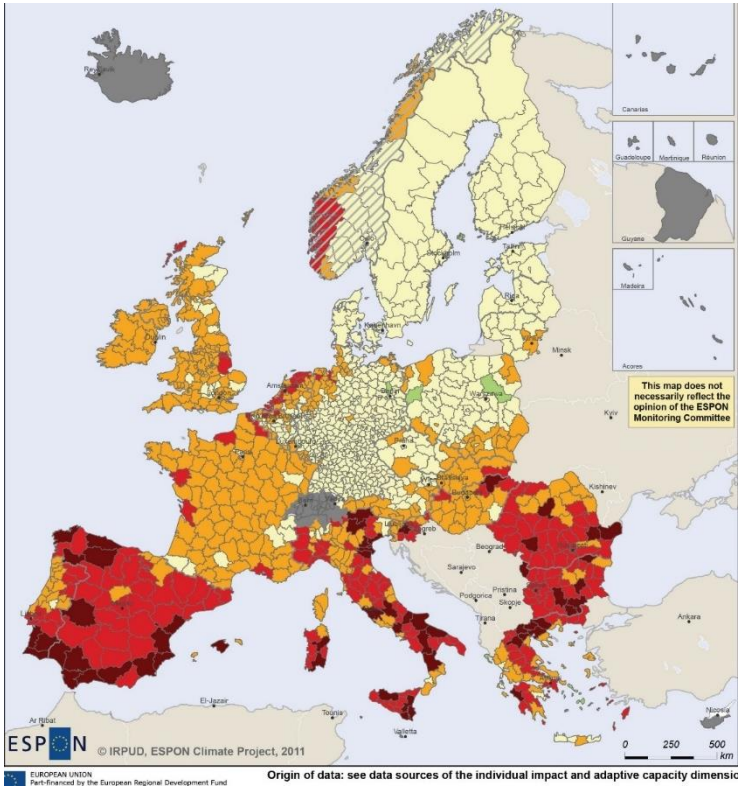
What are the monetary impacts for alpine road infrastructures?

Source: WEATHER project (Enei et al., 2011, p. 61)

GIS-based methodological approaches for impact assessments



Modified from Cutter, 2003



Case study: Province of Salzburg

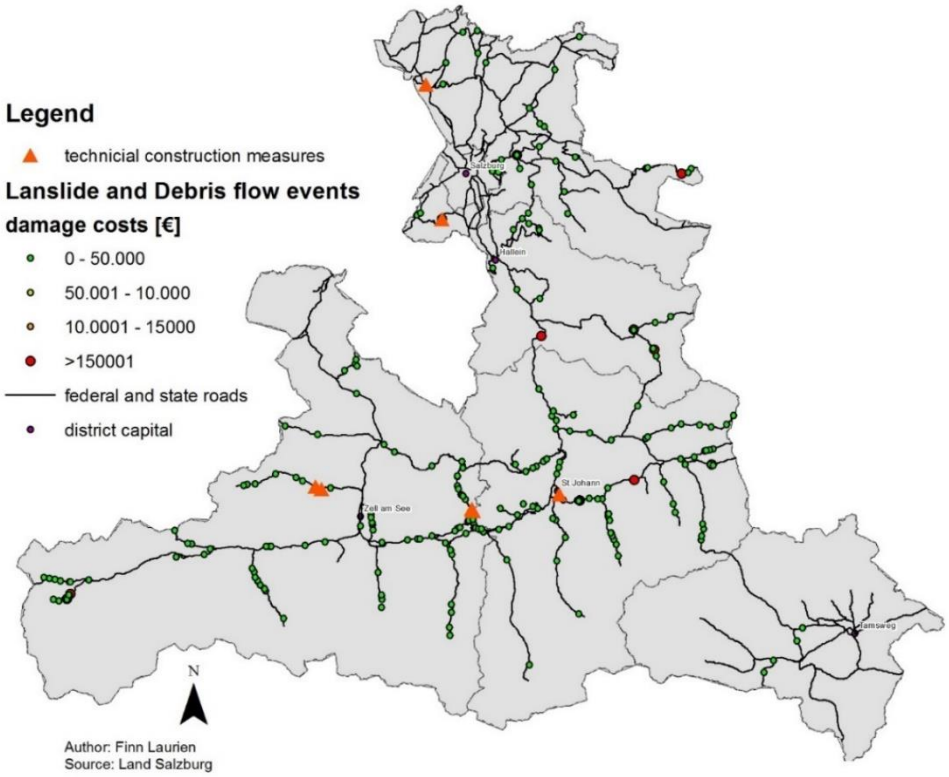
Bottom-up approach

- Each impact event along the road corridor:
  - is classified into a natural hazard type
  - is quantified by an economic replacement cost approach
  - geo-coded by time (2007-2014) and space

- The GIS-based approach considers biophysical & socio-economic indicators depending on time and space.

Note:

The economic replacement cost approach includes personal and material costs for reconstructing the full functionality of the road infrastructure.



List of indicators for assessing road infrastructure impacts

Biophysical exposure indicators

Indicator	Unit	Resolution	Data source
Precipitation indicator	Average of 3 days precip.	Area-wide [1km²]	ZAMG (Haiden et al 2011)
Geomorphological indicator	Soil composition classes	Settlement area [1km²]	EBOD (BFW, 2016)
Slope gradient	Degree	Area-wide [1km²]	JRC (Günther et al., 2014)

Socio-economic sensitivity indicators

Road standards indicator	Classification of roads	Along roads [qualitative ranking]	Land Salzburg (2010)
Traffic intensity indicator	Cars per day	Along roads	Land Salzburg (2010)

Normalization of biophysical indicators

$$FR_{ij} = \frac{DN_{ij}/DN}{R_{ij}/R},$$

$$\text{where } DN = \sum_{i=0}^{I} DN_{ij} \text{ and } R = \sum_{i=0}^{I} R_{ij} \text{ for all j.}$$

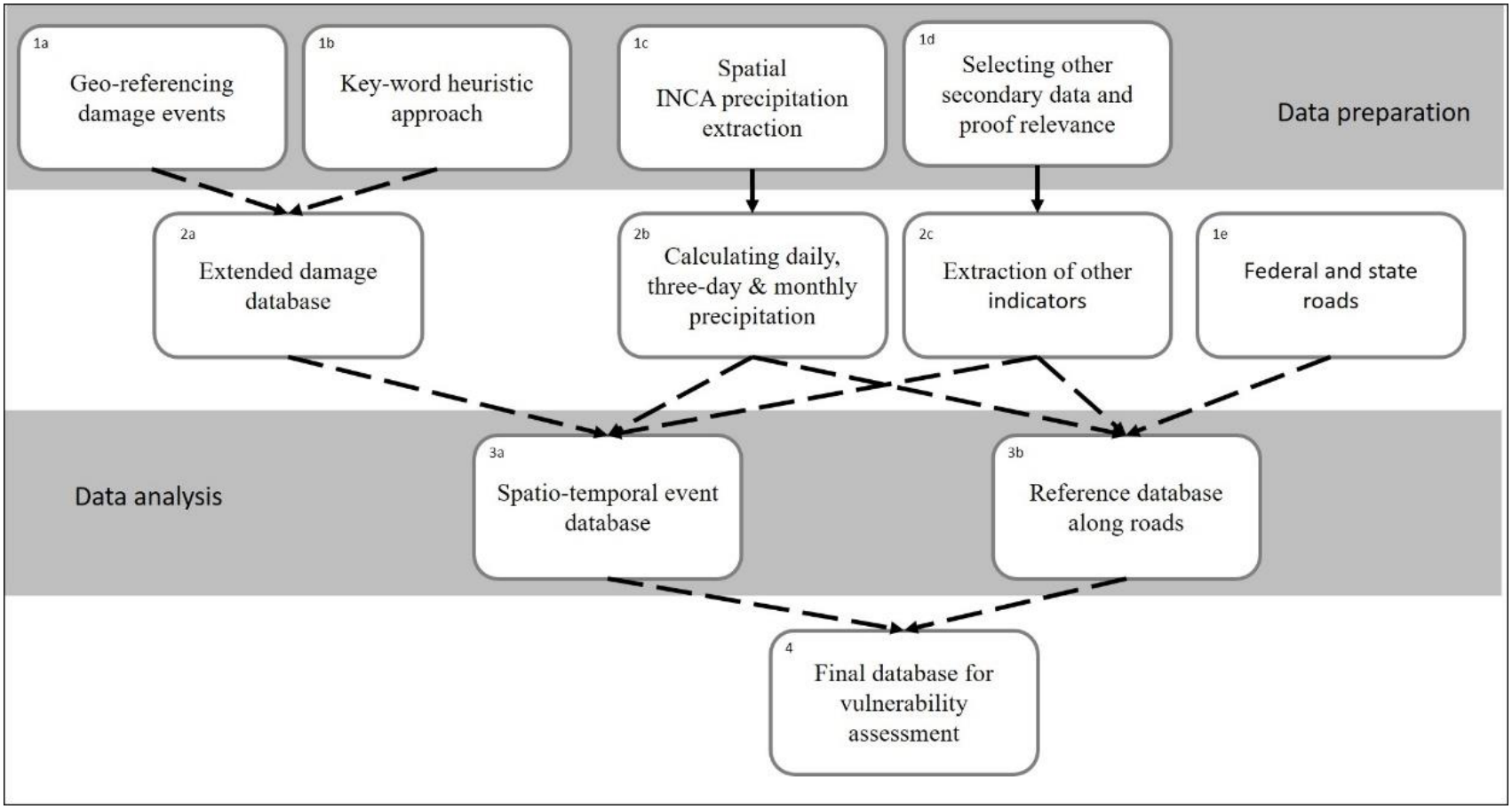
Equal weights for each indicator

High: All indicators
Medium At least 2 indicators
Low: At least 1 indicator

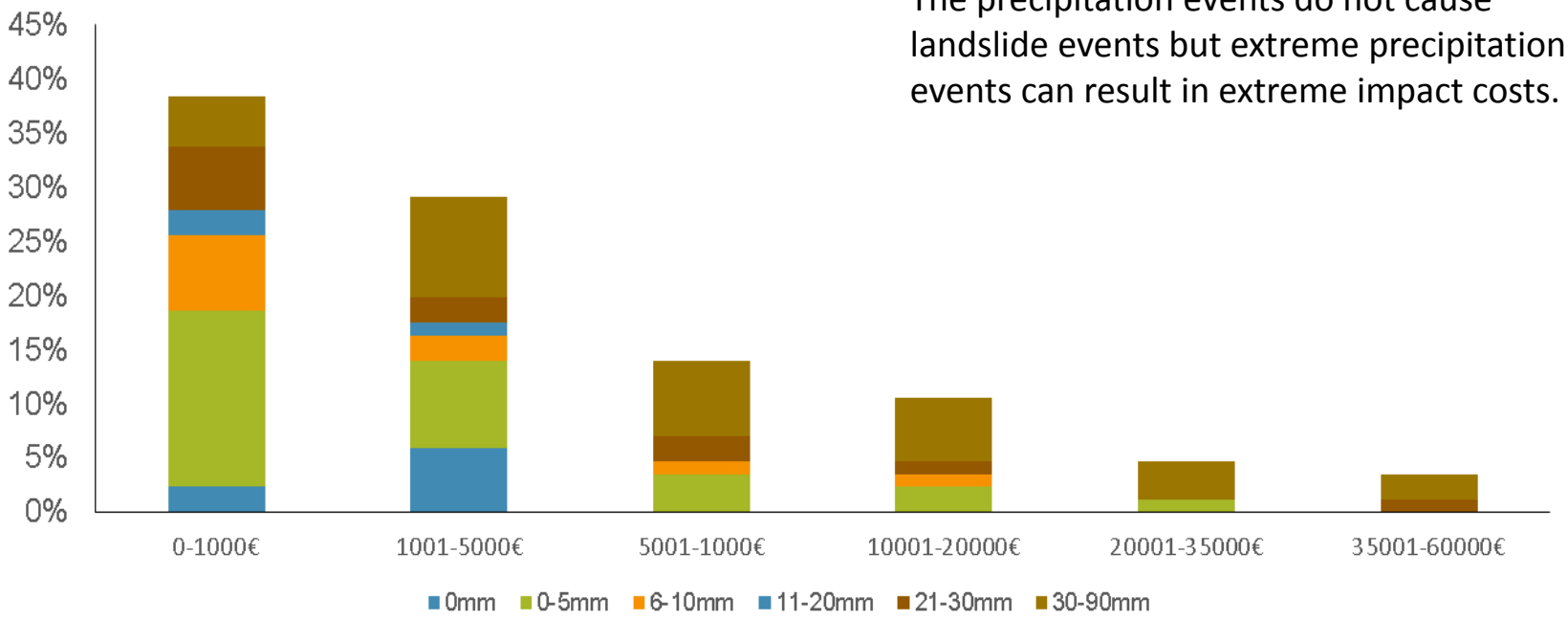
Threshold definition for social indicators

High: more than 10.000 cars and low road standards
Medium: more than 10.000 cars and medium road standards
Low: more than 10.000 cars and high road standards

Technical implementation process



Results based on precipitation indicator

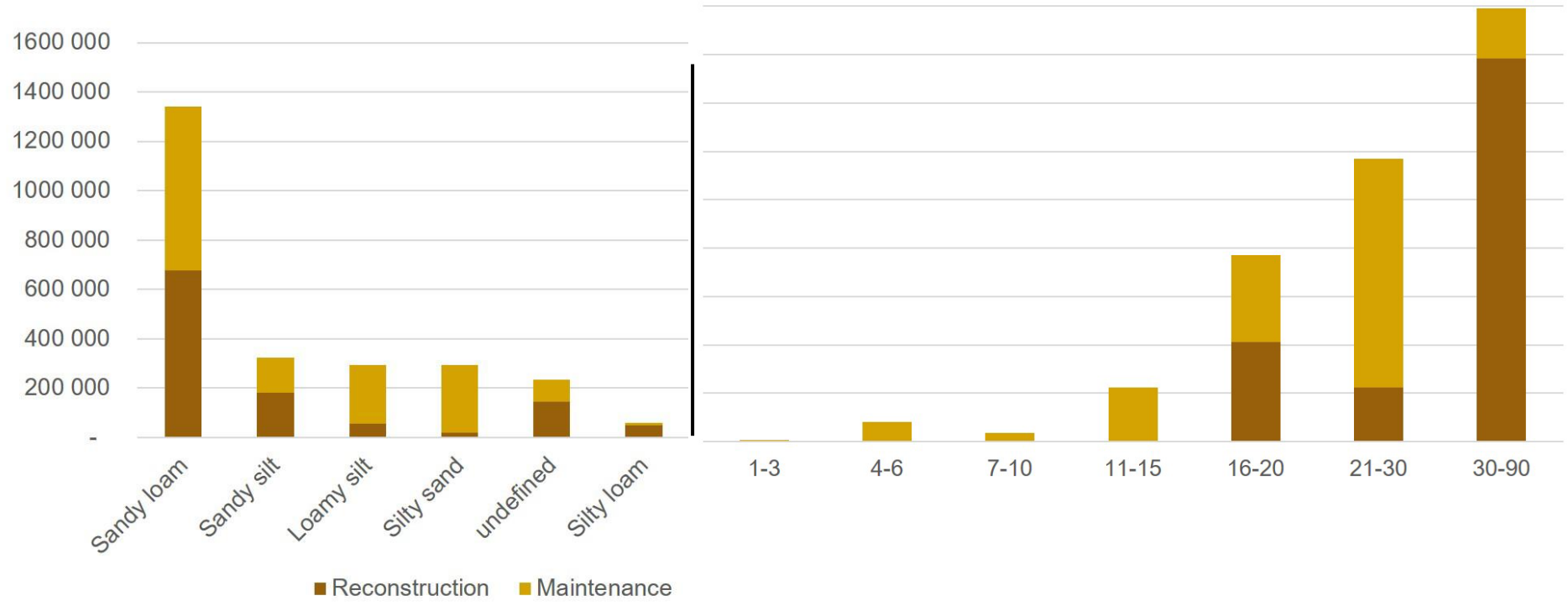


The precipitation events do not cause landslide events but extreme precipitation events can result in extreme impact costs.

Overall costs: 2.6m €

Results based on soil composition and slope gradient

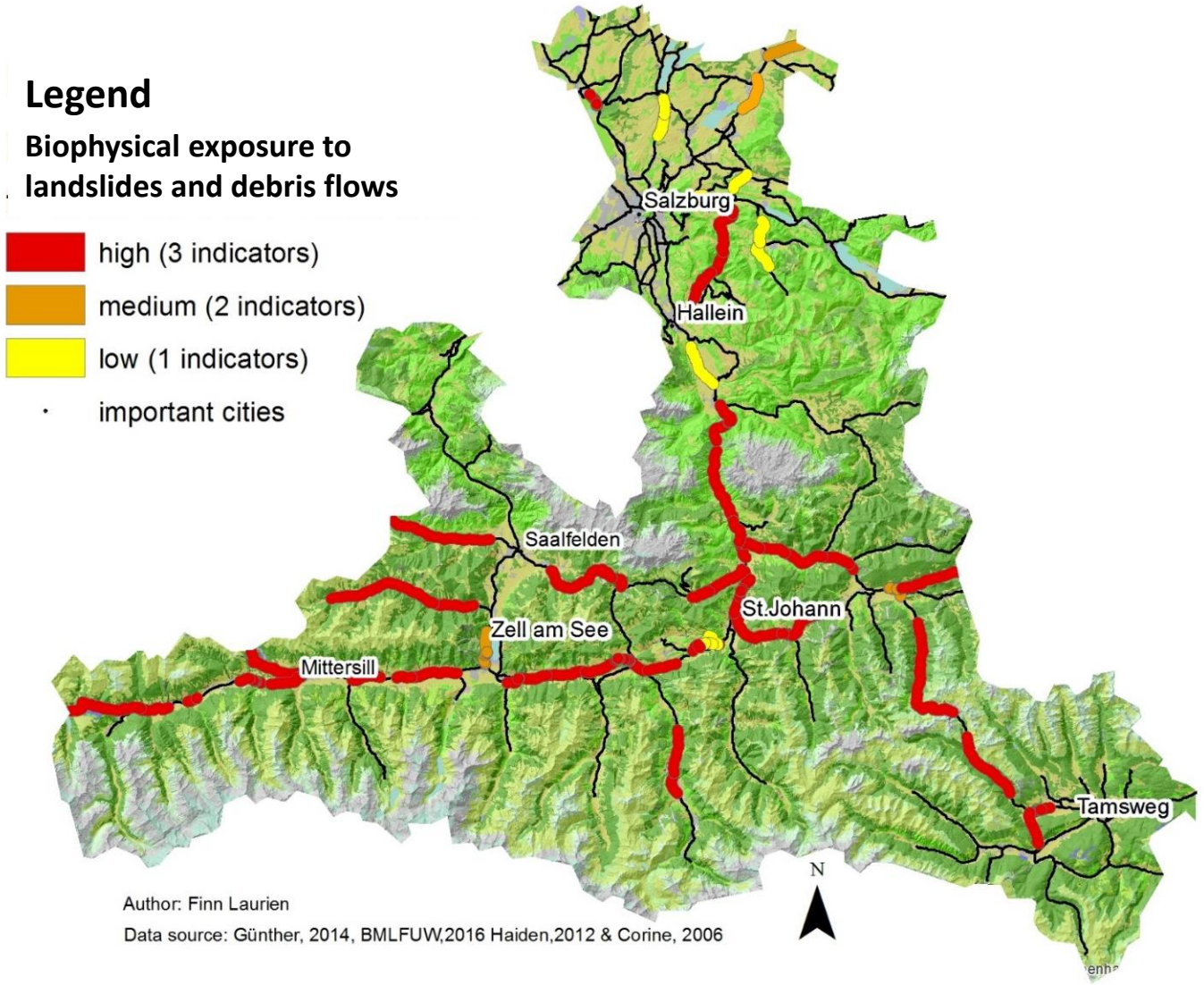
Overall costs: 2.6m €



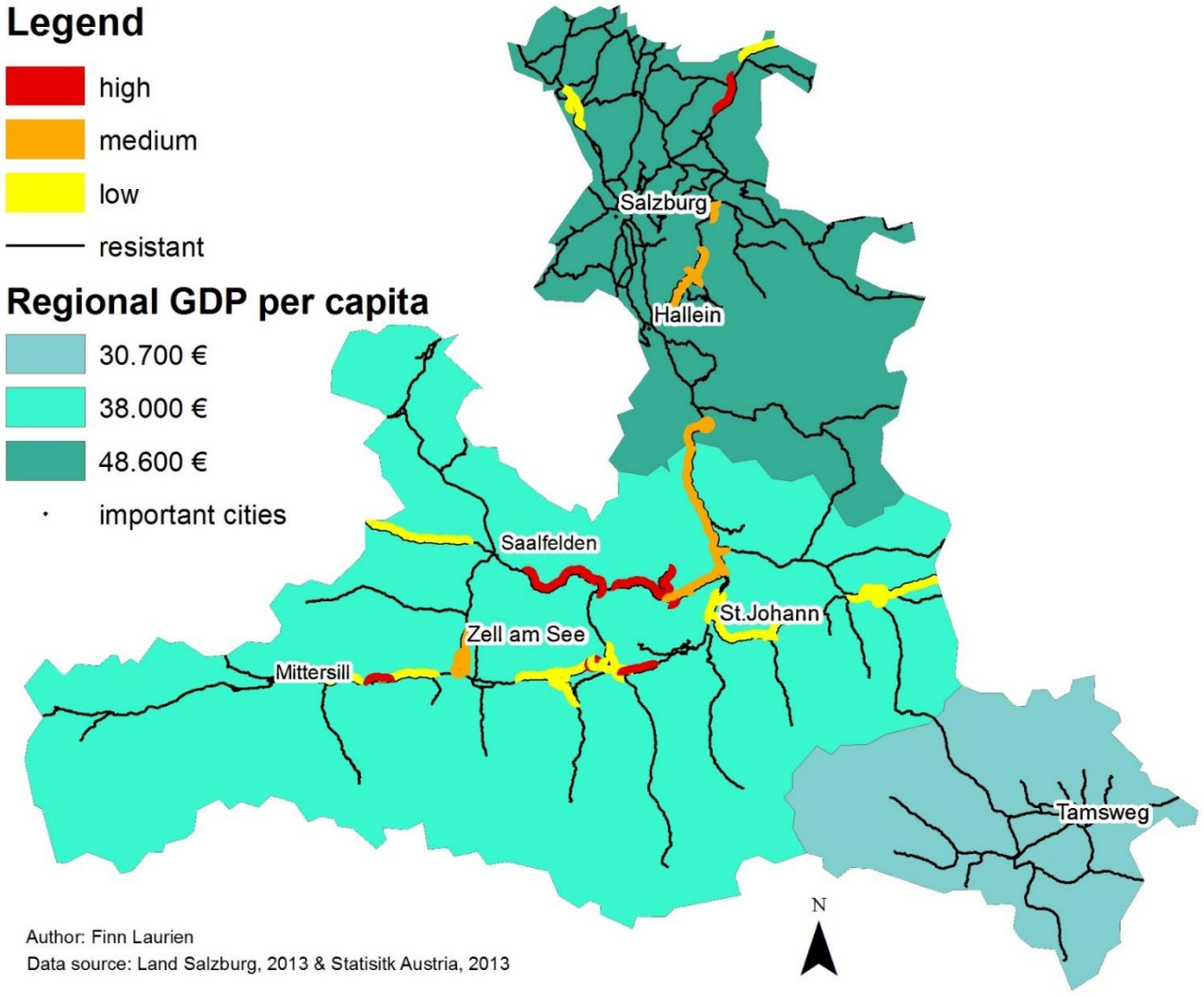
Sandy material are driver for economic impacts

Slope gradient as driver for economic impacts

Biophysical exposure of road corridors



Socio-economic sensitivity of road corridors



Summary

- Meso-level bottom-up assessments are a reasonable approach to provide useful results for decision-makers.
  - GIS-based approaches can help to improve the integration of social and biophysical indicators and support the analysis of its multi-faced dimension.
- The outcome emphasized that spatial planning instruments play an important role as an integrative instrument for disaster risk reduction.
- It influences the socio-economic sensitivity on the road infrastructure and has positive effects on the impact cost reduction.
  - **Local protection measures** (eg. landslide nets) *are best implemented* next to road corridors with a high biophysical exposure in combination with high socio-economic sensitivity areas because of its high construction costs.
  - But **land-use planning instruments** have an *area-wide impact* and can substantially reduce the economic impact.

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