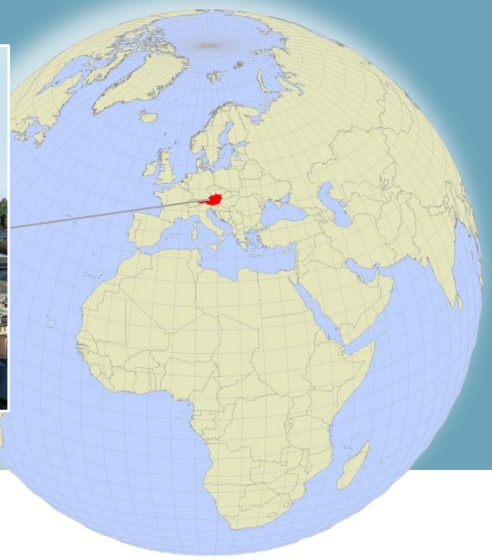
ZGIS
DEPARTMENT OF GEOINFORMATICS

UNIVERSITY of SALZBURG

Spatial information on bicycle crash risk for evidence-based interventions on the city-scale



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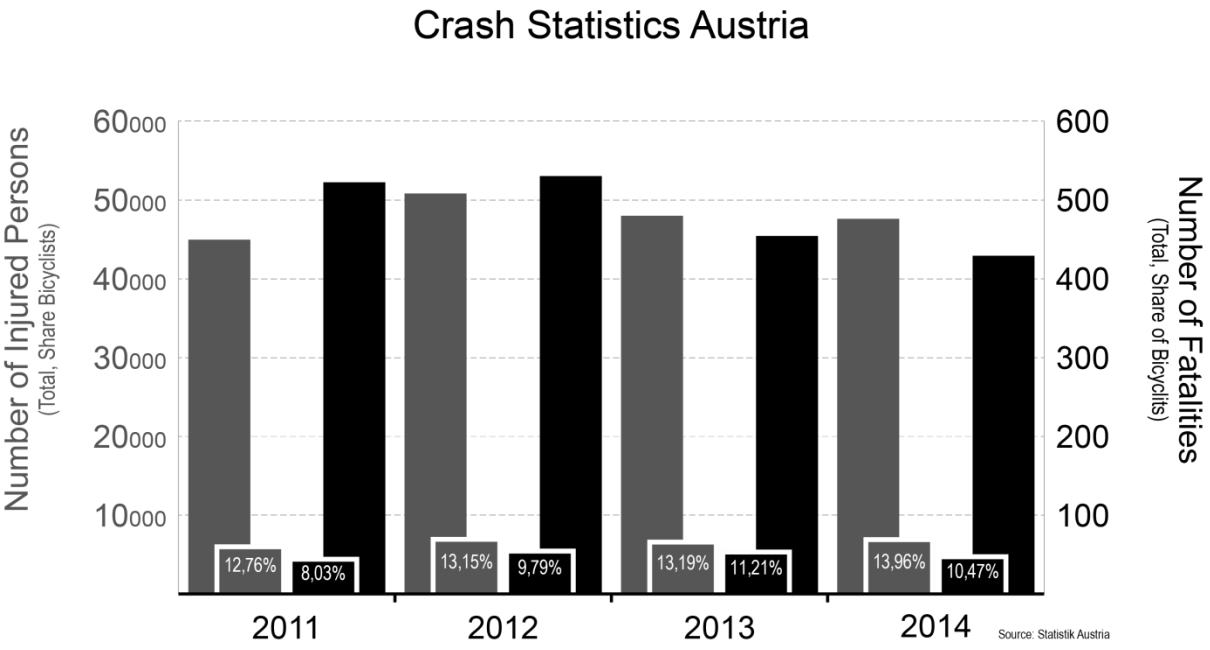
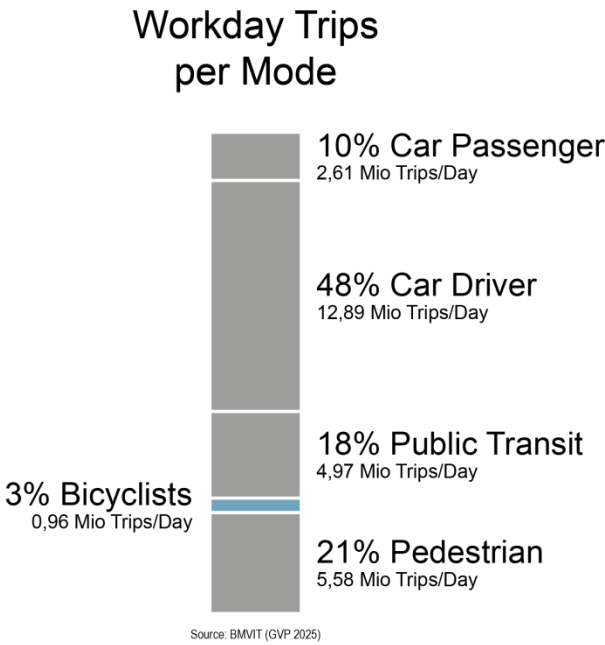
Is Cycling Dangerous?





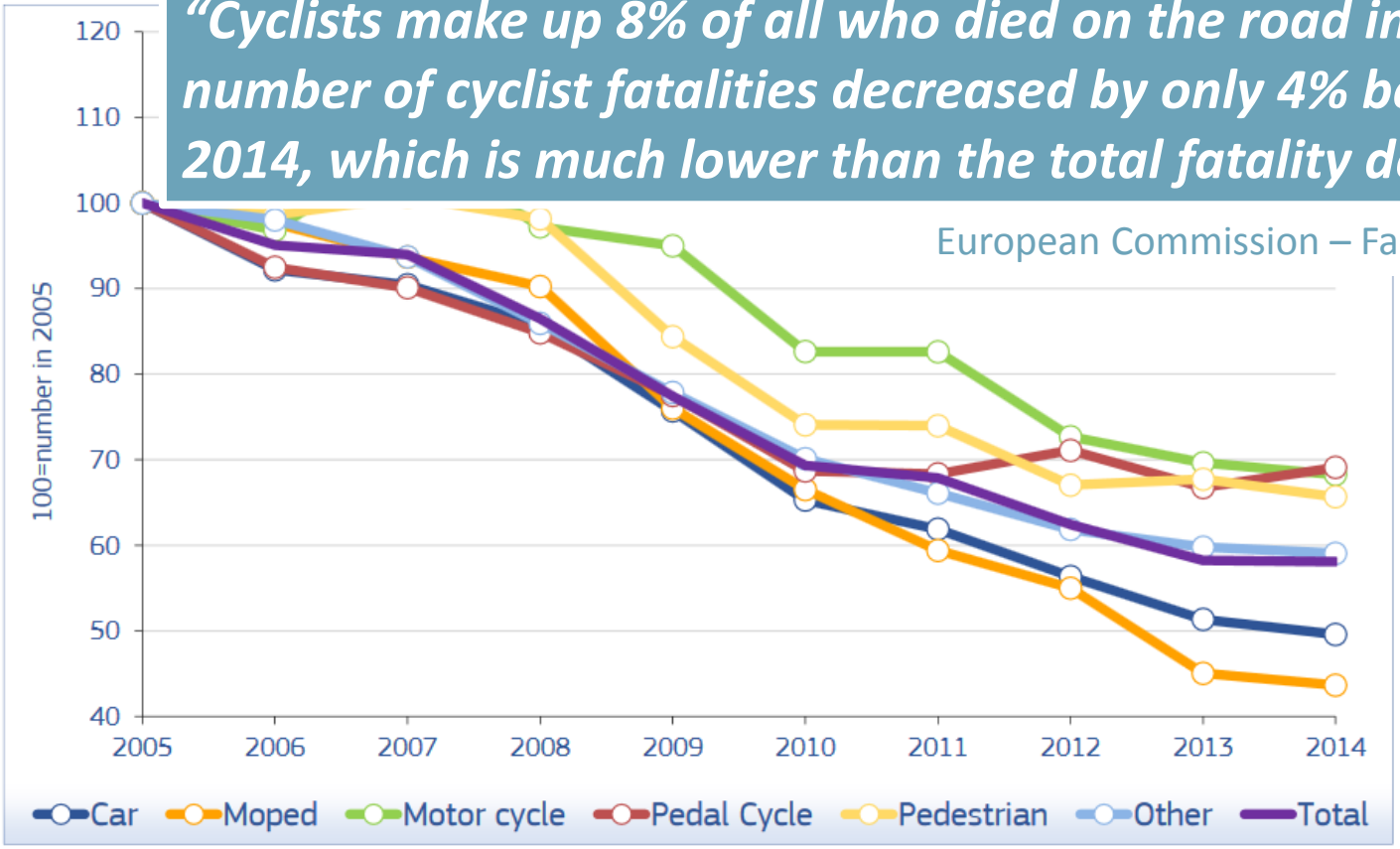
Cyclists are overrepresented in Austrian crash statistics: 10.47% (fatalities) : 3% (modal split)

Is Cycling Dangerous?

Figure 14: Index (2005=100) of road fatalities by mode of transport, EU, 2005-2014

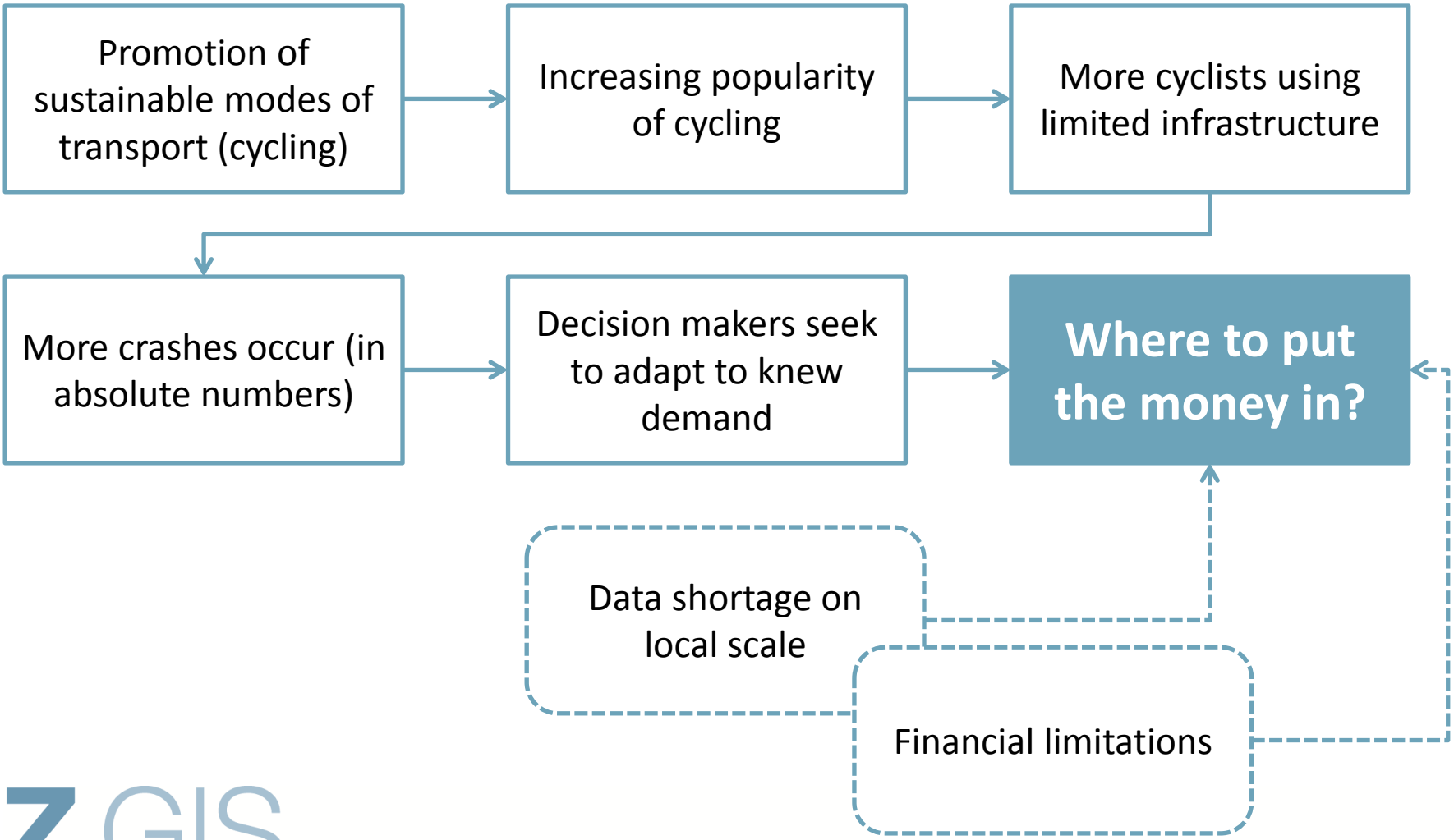
"Cyclists make up 8% of all who died on the road in the EU. The number of cyclist fatalities decreased by only 4% between 2010 and 2014, which is much lower than the total fatality decrease (18%)."

European Commission – Fact Sheet, 31st March 2016



Source: CARE database, data available in May 2016

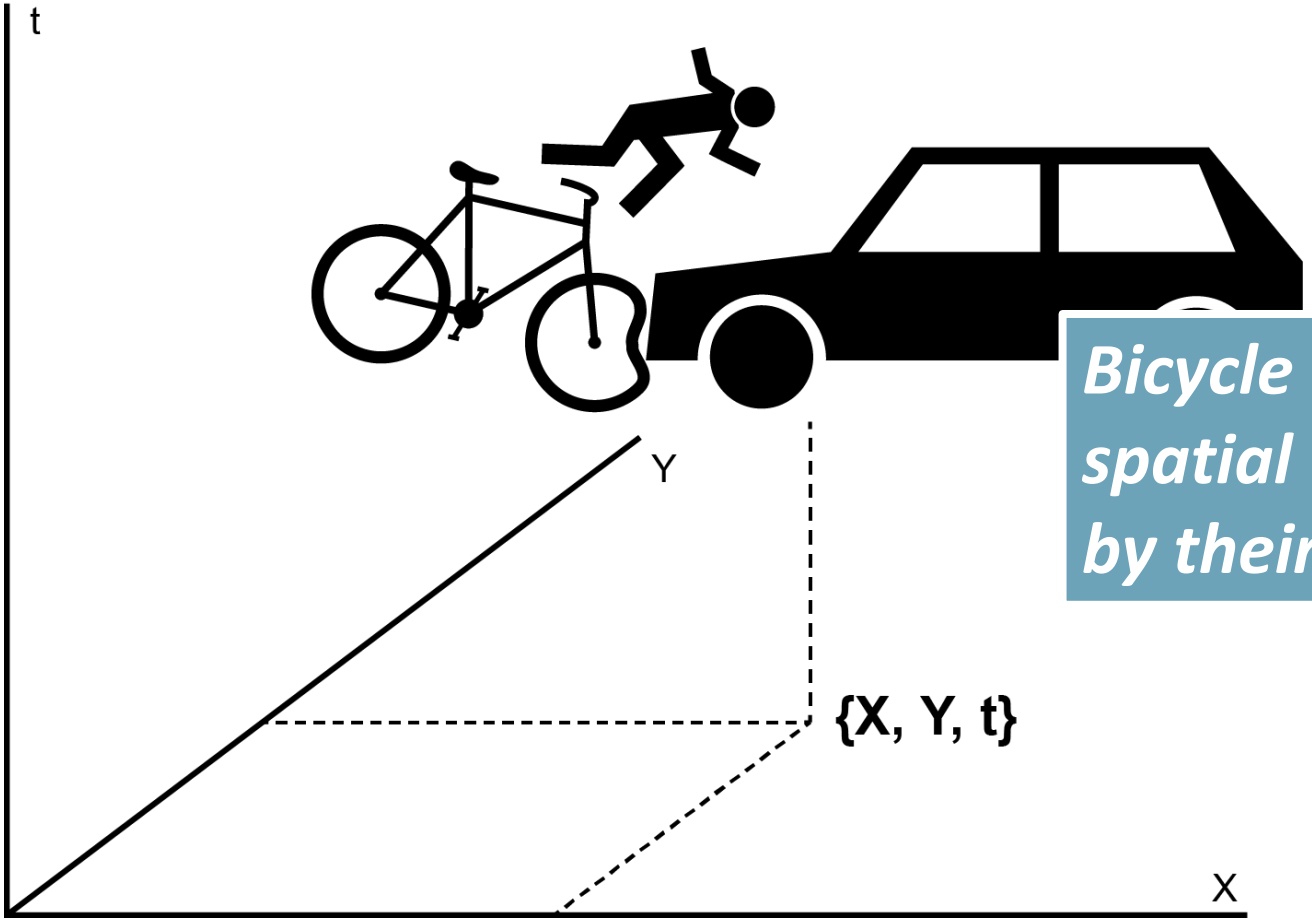
Problem Statement



GIS for Evidence-based Decisions

- Required: evidence-base on the local scale = where measures are implemented
- Geographical Information Systems (GIS) facilitate …
  - Spatial and spatio-temporal analysis
  - Spatial models
- Where and when do bicycle crashes occur?
  - Patterns and dynamics
- What is the risk (probability) to get involved in a crash?
  - Incidences / exposure

GIS in Crash Analysis



Bicycle crashes are spatial (and temporal) by their very nature.

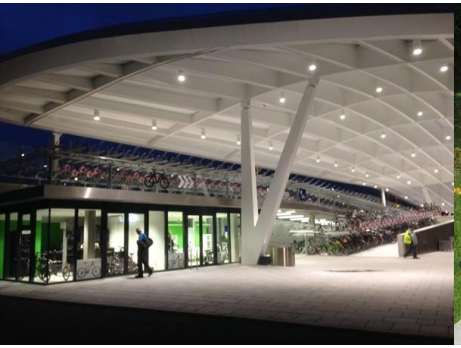
Examples from Salzburg (Austria)

- 3,048 geo-located crash reports 2002/01 – 2011/12
  - Police reports only (» underreporting!)
- City of Salzburg (148,000 inhabitants): modal split ≈ 20%

Crash analysis
(Loidl et al. 2016a)

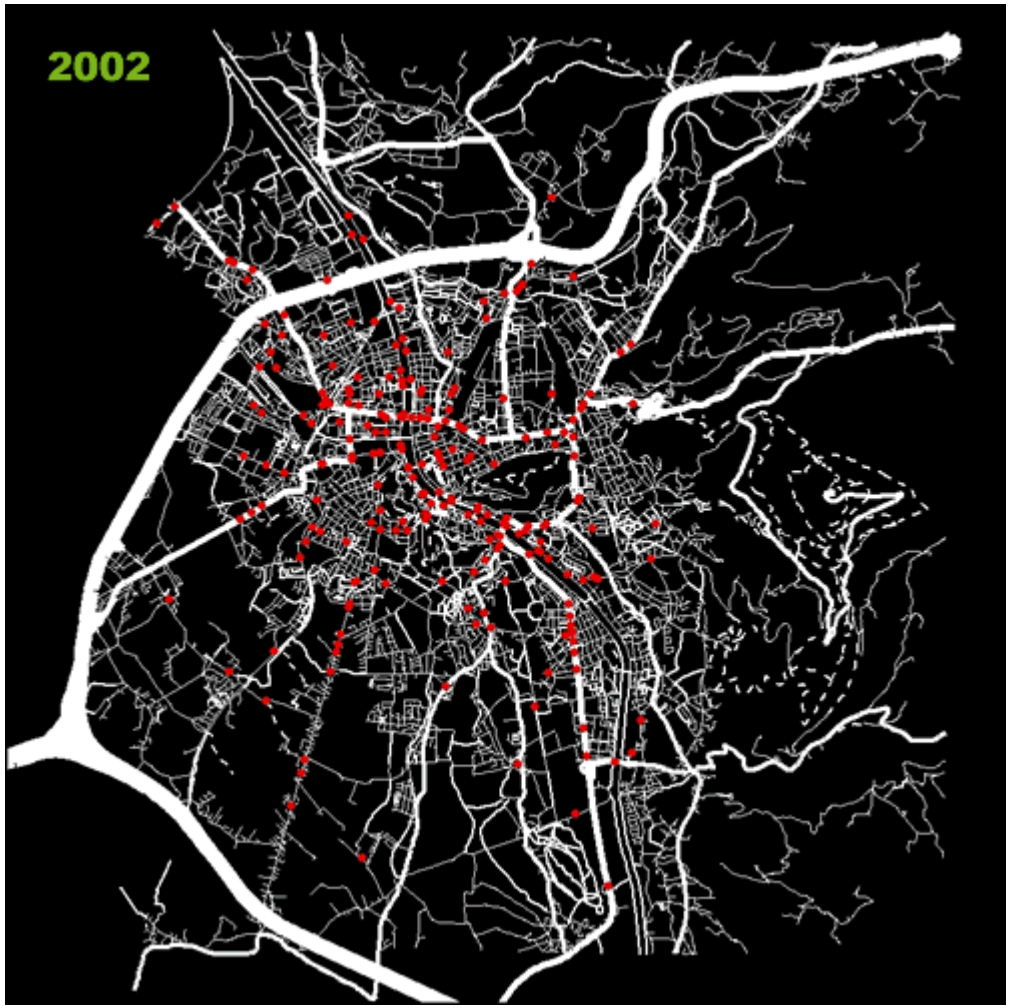
Bicycle flow model
(Wallentin & Loidl 2015)

Risk estimation on local scale
(Loidl et al. 2016b)

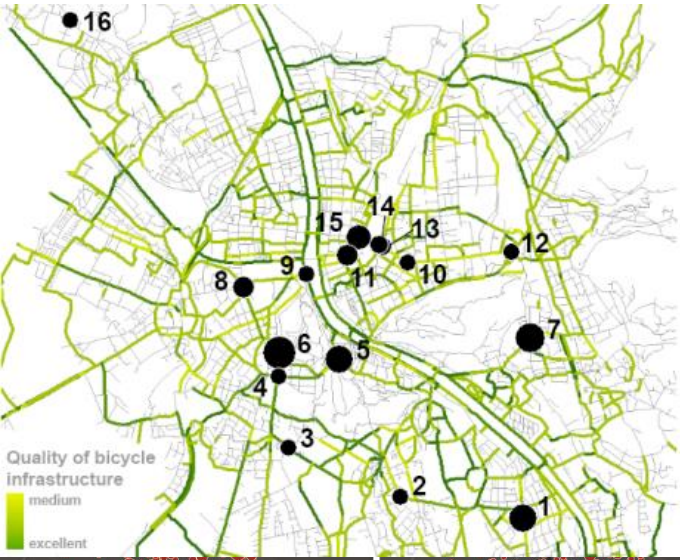


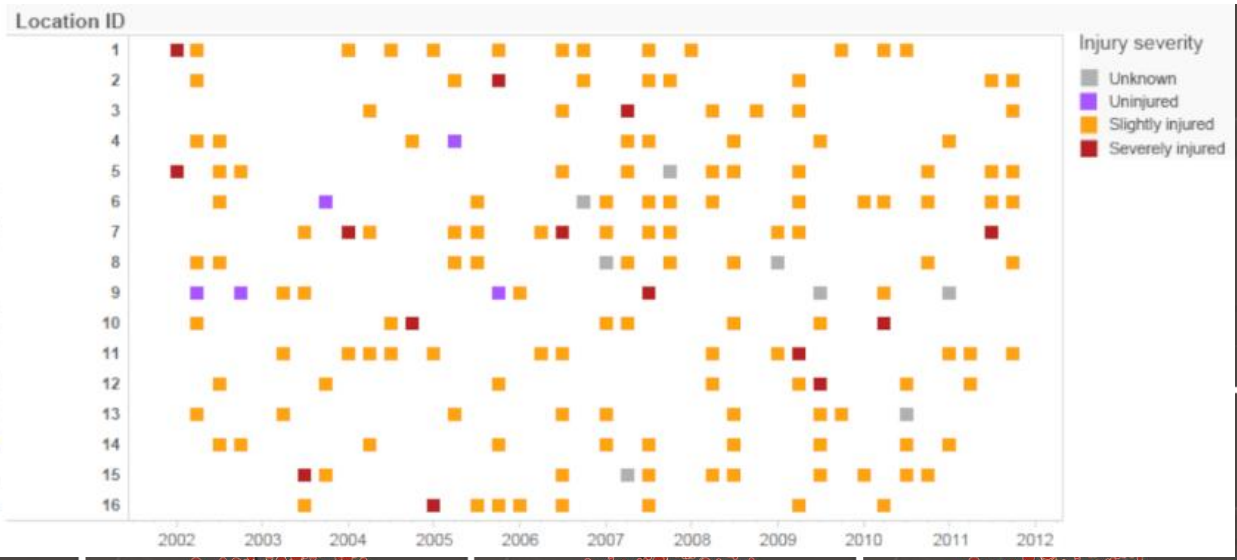
Pictures © Stadtgemeinde Salzburg

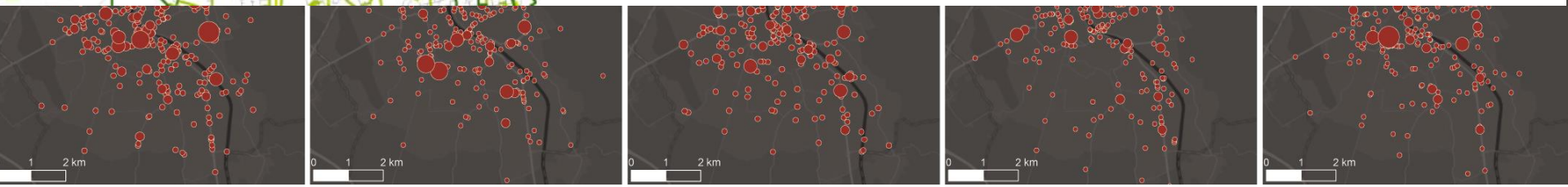
Dynamics



Dynamics & Patterns

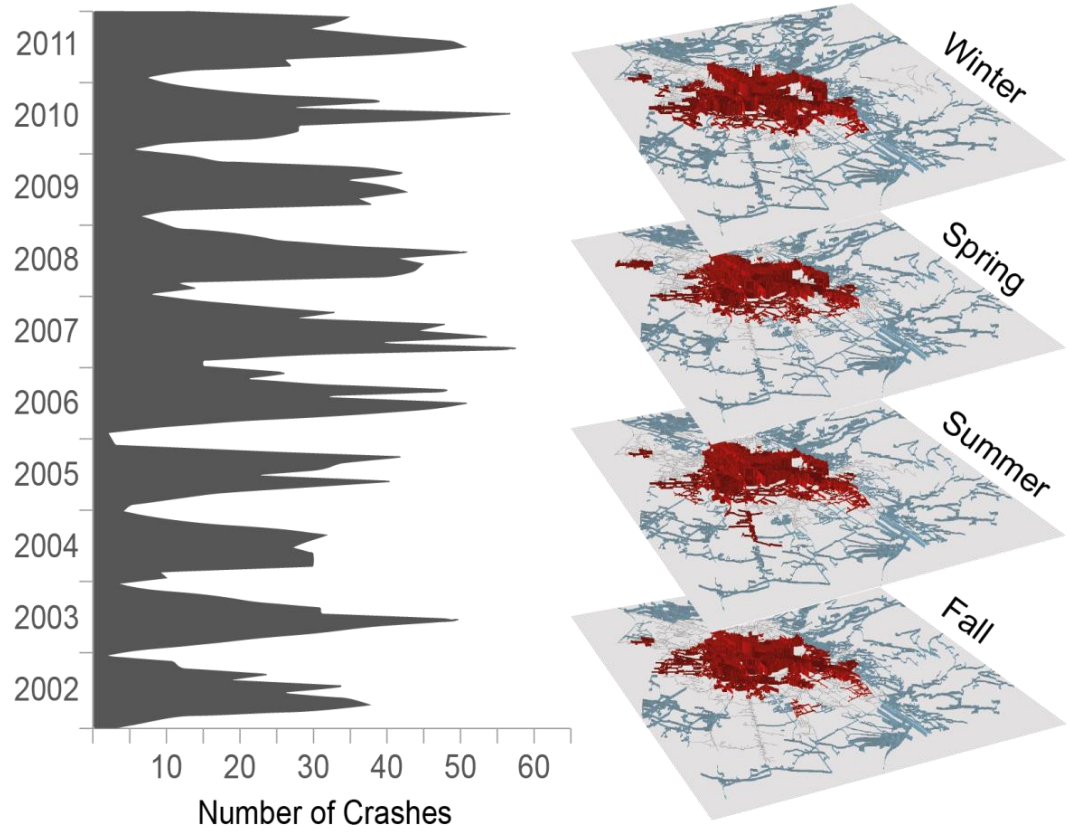


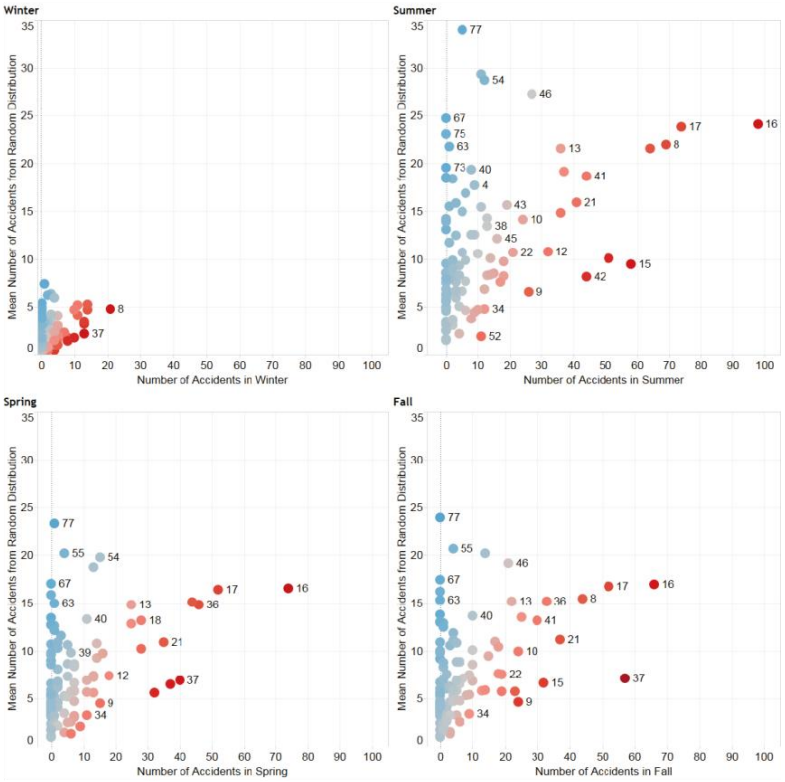


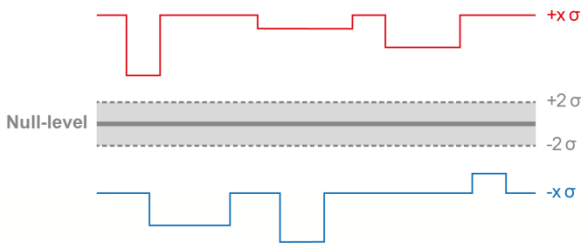


3,048 crashes at 1,865 locations (1,379 single crash locations)
16 locations with > 10 crashes (6.5% of all crashes)

Seasonality

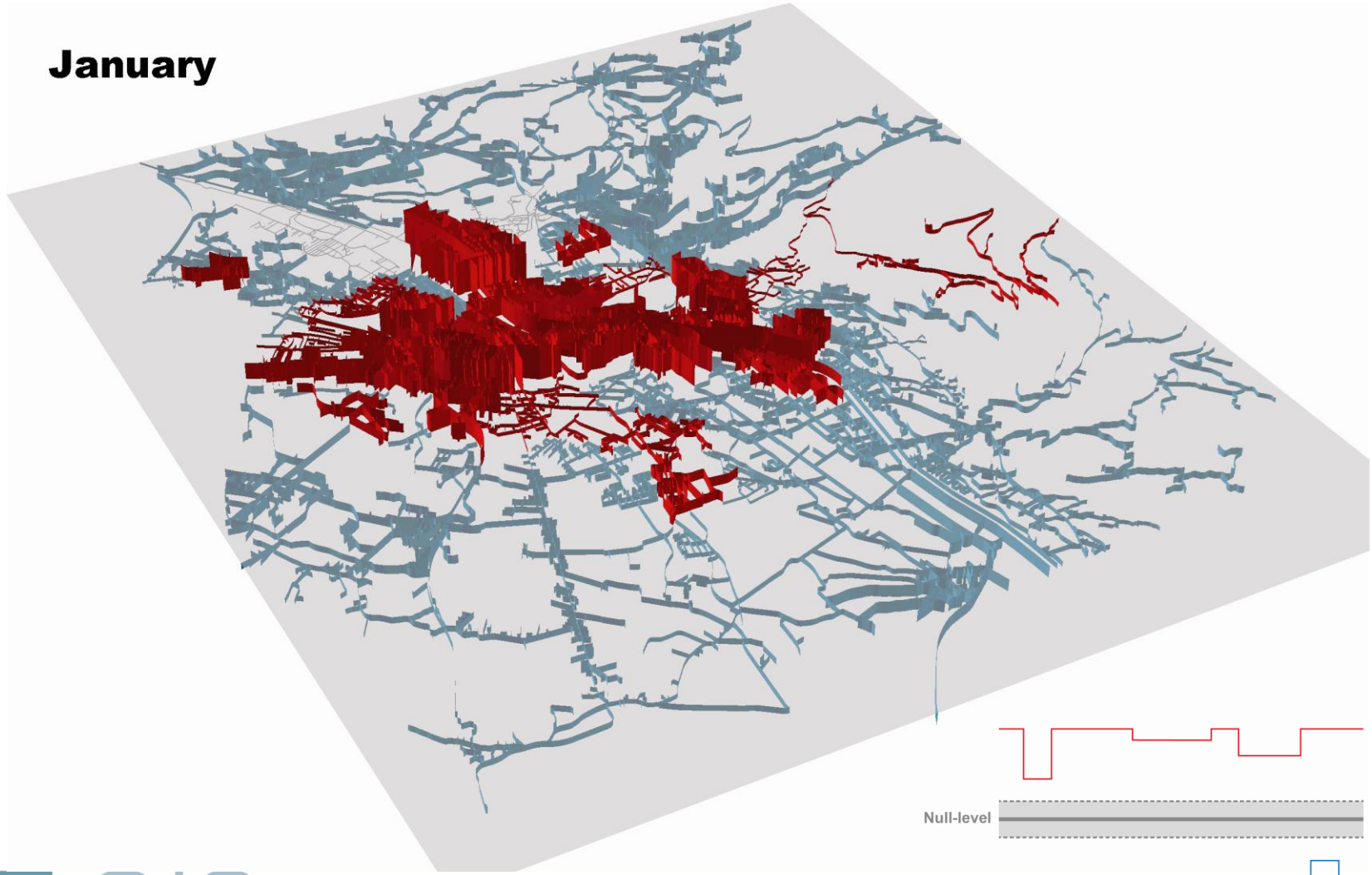






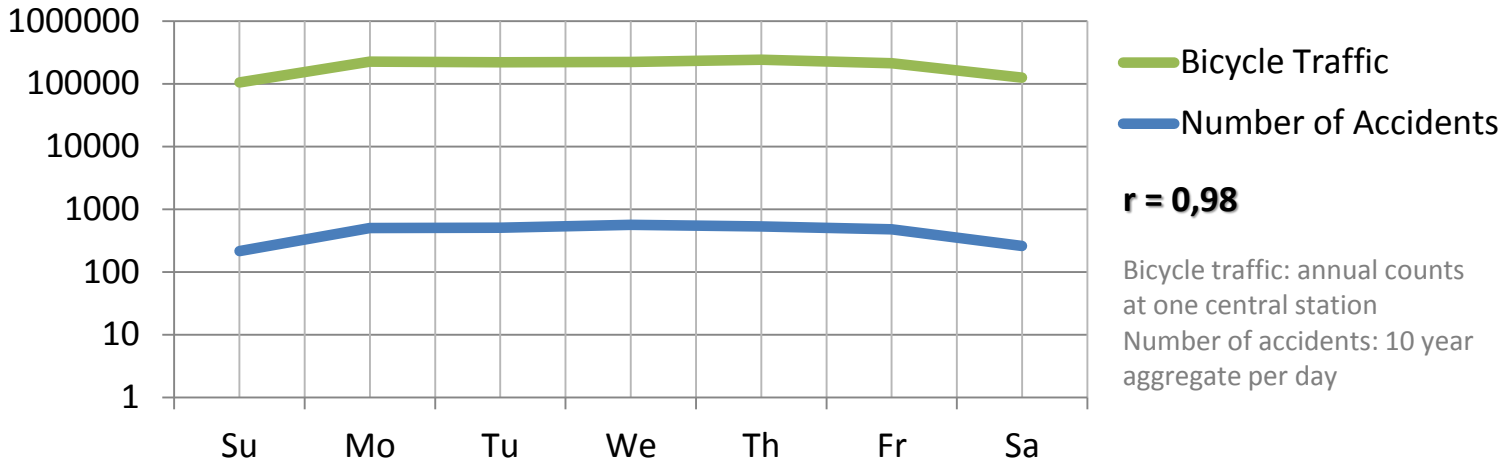
LOIDL, M., TRAUN, C. & WALLENTIN, G. 2016. Spatial patterns and temporal dynamics of urban bicycle crashes—A case study from Salzburg (Austria). *Journal of Transport Geography,* 52**,** 38-50.

Spatio-temporal Seasonality



Absolute Number vs. Risk

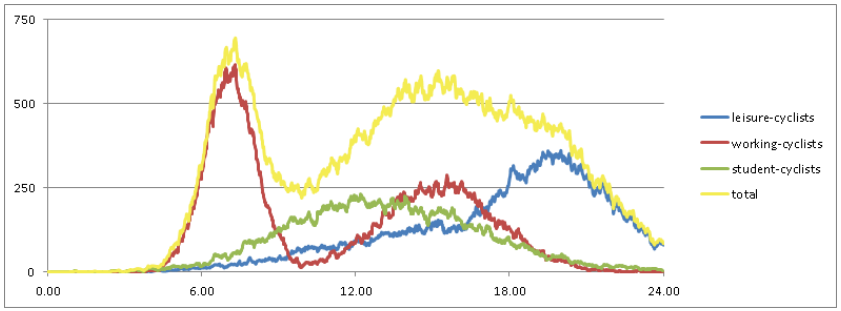
- Globally high correlation **bicycle volume – crash occurrences**



- Spatial distribution and variation beyond scale level of whole city?

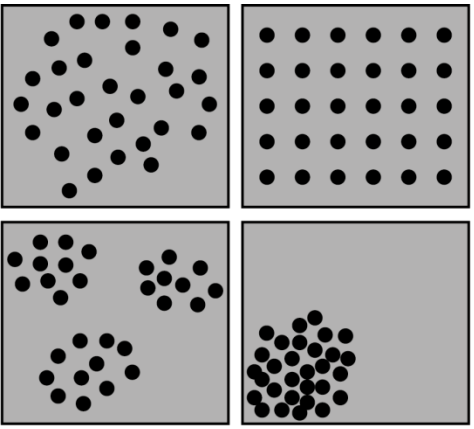
Risk Estimation

- Problem of **exposure variable** → flow model for bicycles
  - Agent-based model for simulation of bicycle flows:
  - WALLENTIN, G. & LOIDL, M. 2015. Agent-based bicycle traffic model for Salzburg City. GI_Forum – Journal for Geographic Information Science, 2015, 558-566.

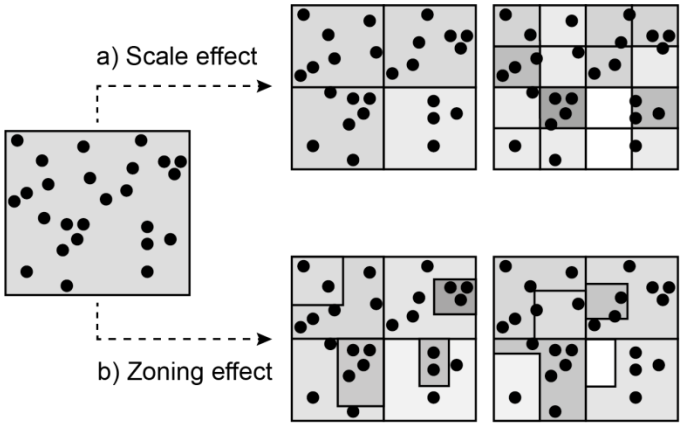


Risk Estimation – Spatial Implications

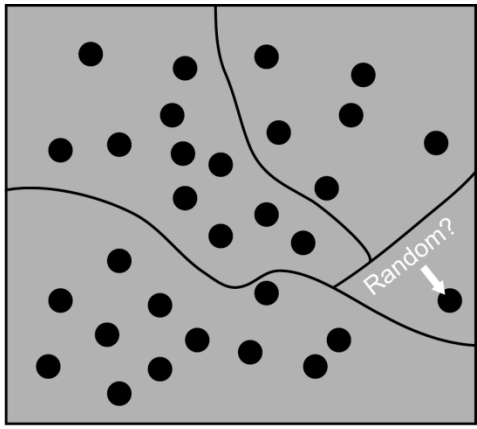
- Bicycle crash risk = number of incidents / distance travelled
- Spatial implications:



Spatial heterogeneity:
variability within reference unit



Modifiable areal unit problem:
different patterns due to scaling and zoning effects

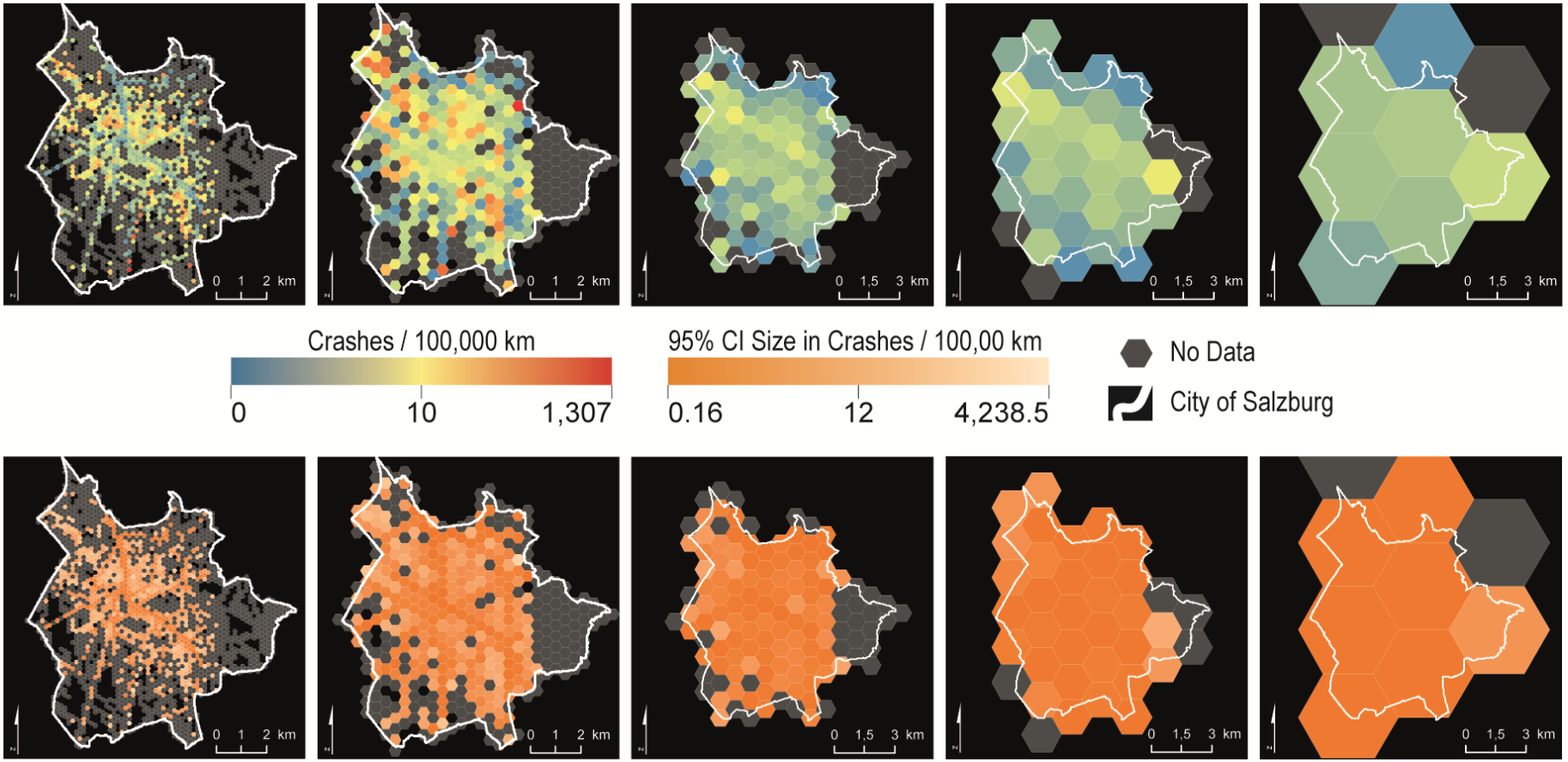


Statistical robustness:
confidence interval for calculated rates

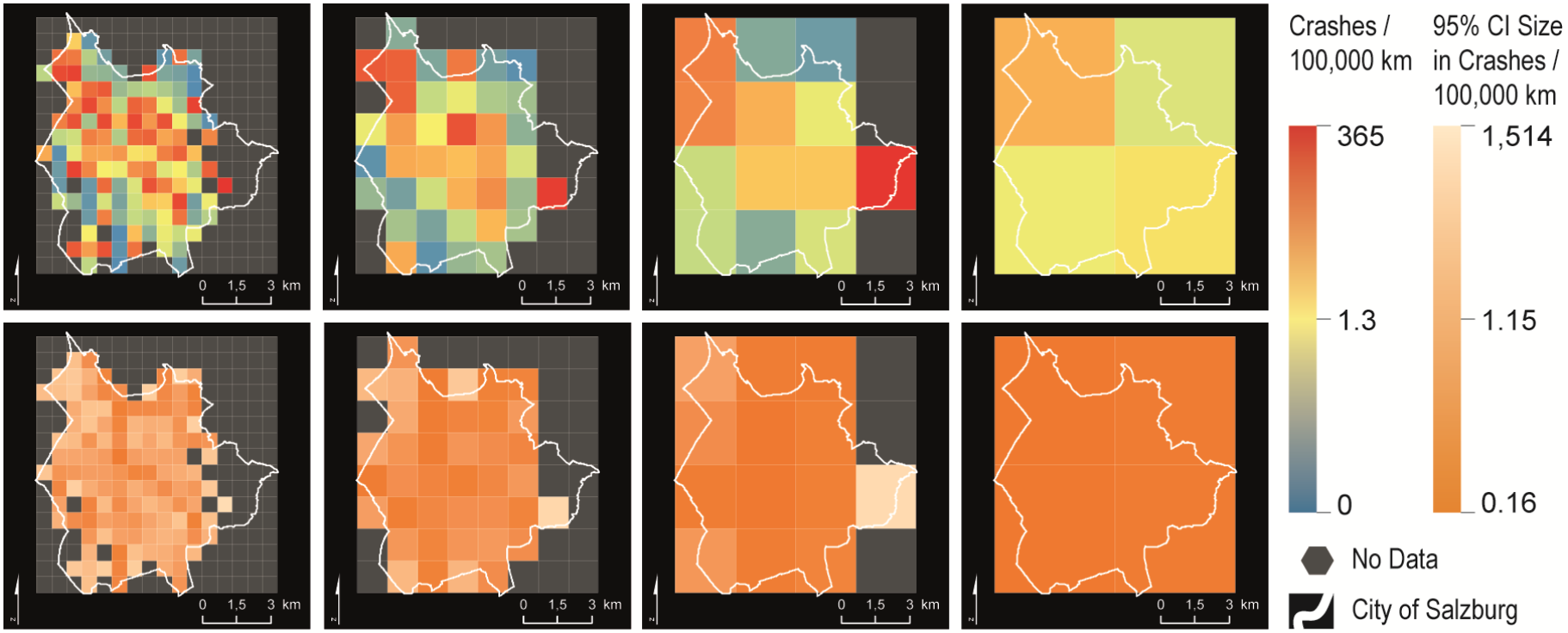
Reliability:
Confidence interval for calculated rates

Detail:
Account for spatial heterogeneity

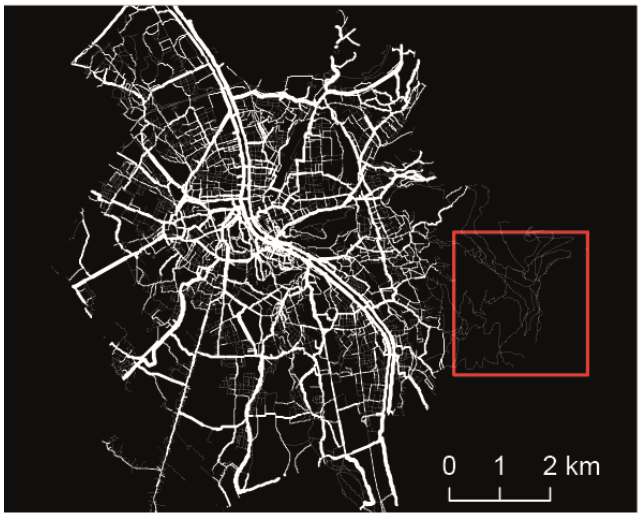
Risk on Local Scale

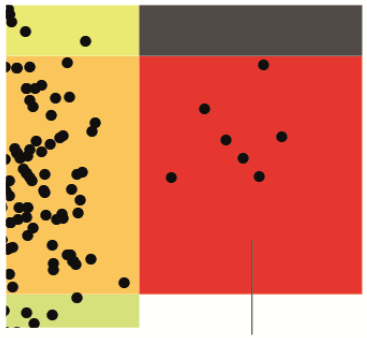


Risk on Local Scale

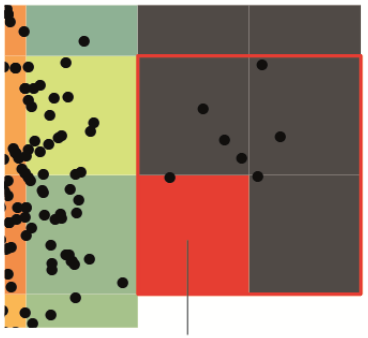


Examples: MAUP

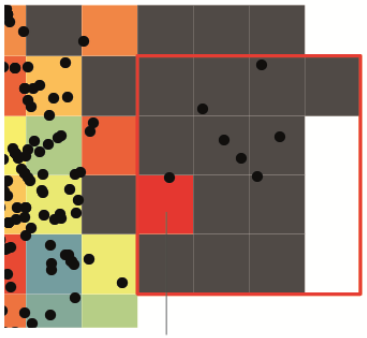




Square grid 7.44 km²



Square grid 1.86 km²



Square grid 0.46 km²

LOIDL, M., WALLENTIN, G., WENDEL, R. & ZAGEL, B. 2016. Mapping Bicycle Crash Risk Patterns on the Local Scale. Safety, 2, 17.

Thank you for your attention!

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Lessons Learned

- Analysis of bicycle crashes on the local scale unveil patterns and dynamics that are hidden in epidemiological studies.
  - High risk at intersections (mainly due to poor infrastructure design)
  - High spatio-temporal variability (e.g. seasonal effects)
  - Number of incidents ≠ risk
- Definition of spatial reference units » emerging patterns (MAUP, spatial heterogeneity)
- Data availability and quality
  - Increasingly important with higher level of detail (e.g. flow model, crash and near-miss data)
  - Investment pays of » evidence base for informed decisions
- Evidence base for decision making: prioritization, targeted measures, monitoring etc.