

Project Objectives



- Generation of a **cross-border spatial GIS-database** comprising lightning activity, lightning damage, topography, settlement structures etc.
 - Evaluation of **spatiotemporal coherences** between lightning activity and topographic properties
 - Development of a cross-border approach for the **derivation of hazard zones** as an indicator for the optimization of preventive measures
- Results: Decision support for lightning prevention, risk management, spatial planning, civil protection

Project duration: 1.1.2009 – 31.9.2011

www.reblaus-interreg.eu



Project partners



Research Studios Austria Forschungsgesellschaft mbH, Studio iSPACE / Prof. Keul



Austrian Electrotechnical Association (ÖVE), dept. ALDIS



Max-Planck-Institute for Plasma Physics, Project Energy and System Studies

Funding authorities



Austrian Insurance Association (VVO)



lebensministerium.at

Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW), dept. V/4, Air Pollution Control and Climate Protection



Bavarian State Ministry of the Environment and Public Health (StMUG), dept. 76, Plant Safety and Incident Prevention, Energy Efficiency



City of Salzburg, dept. 5 Spatial Planning and Building Authority

Supporter



Government Office of Land Salzburg, dept. 7 Spatial Planning, dept. 16 Environmental Protection

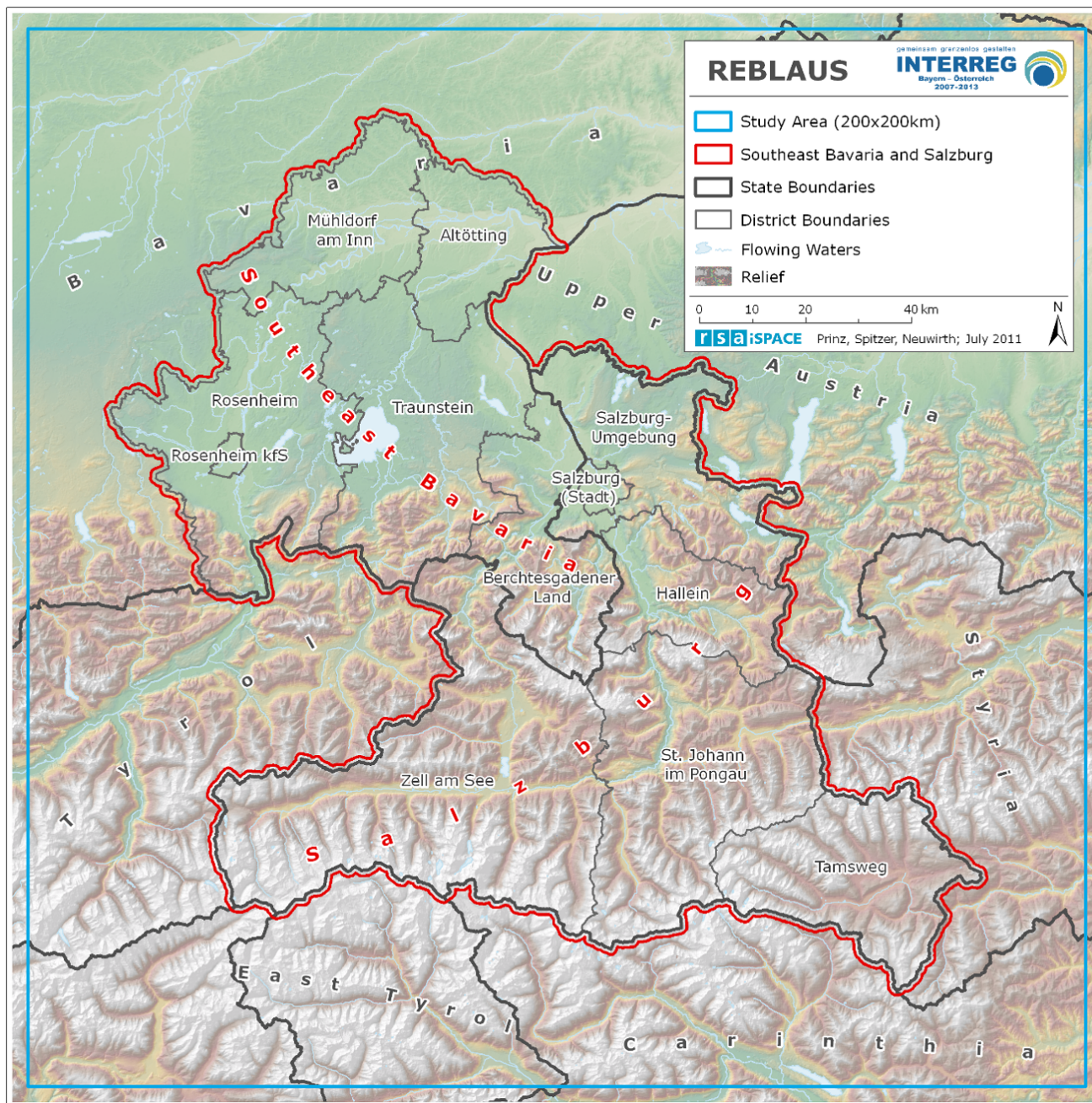


EuRegio Salzburg – Berchtesgadener Land – Traunstein

Study area

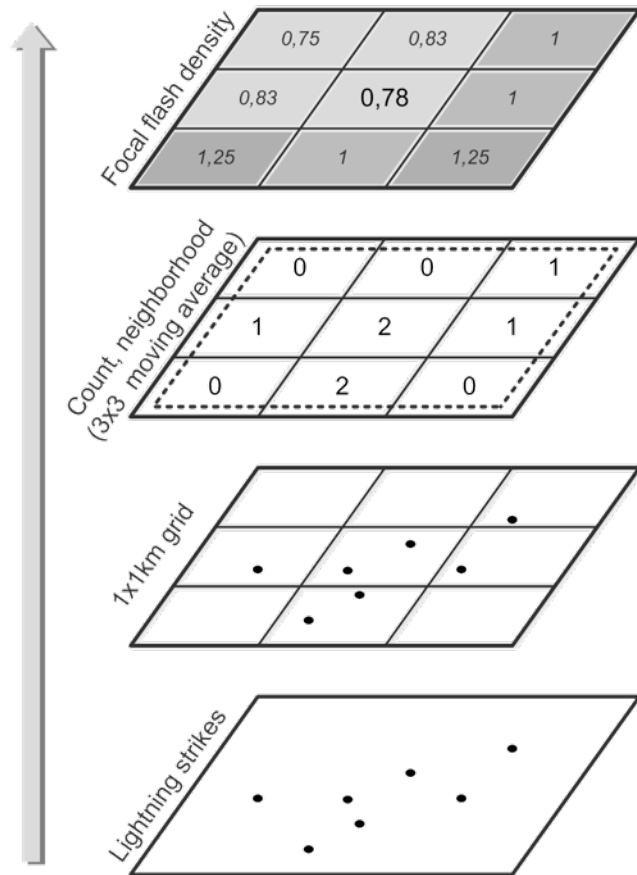
- Cross-border
(Germany – Austria)
- Southeast Bavaria
- province Salzburg
- 200x200km
- Various topography and land use
(~250m – 3800m)

Area		
CG Lightning Flashes 1998-2009	1.076.151	330.854
Annual Lightning Density (per km ²)	2,24	2,22

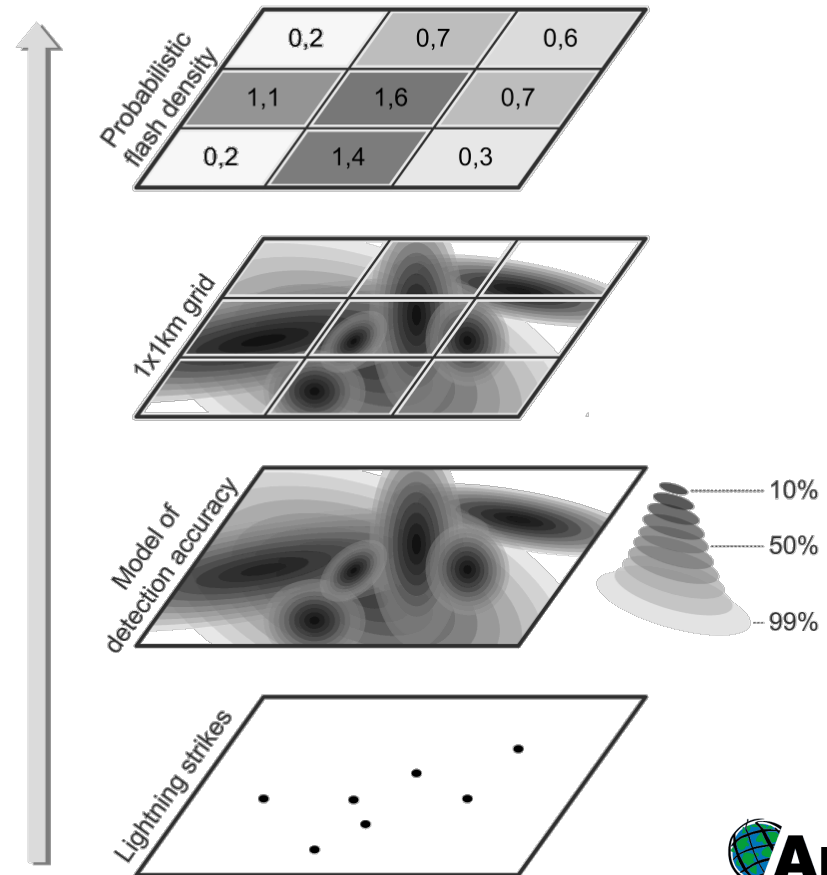


Modelling of lightning density in GIS

Focal flash density (Ø 3x3 moving window)



Probabilistic flash density explicit consideration of detection accuracy

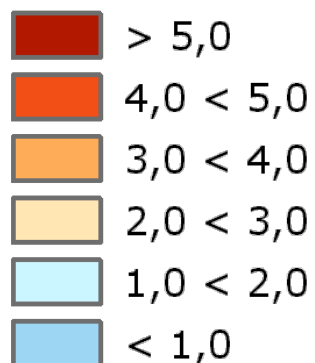


compare: Campos & Pinto 2007

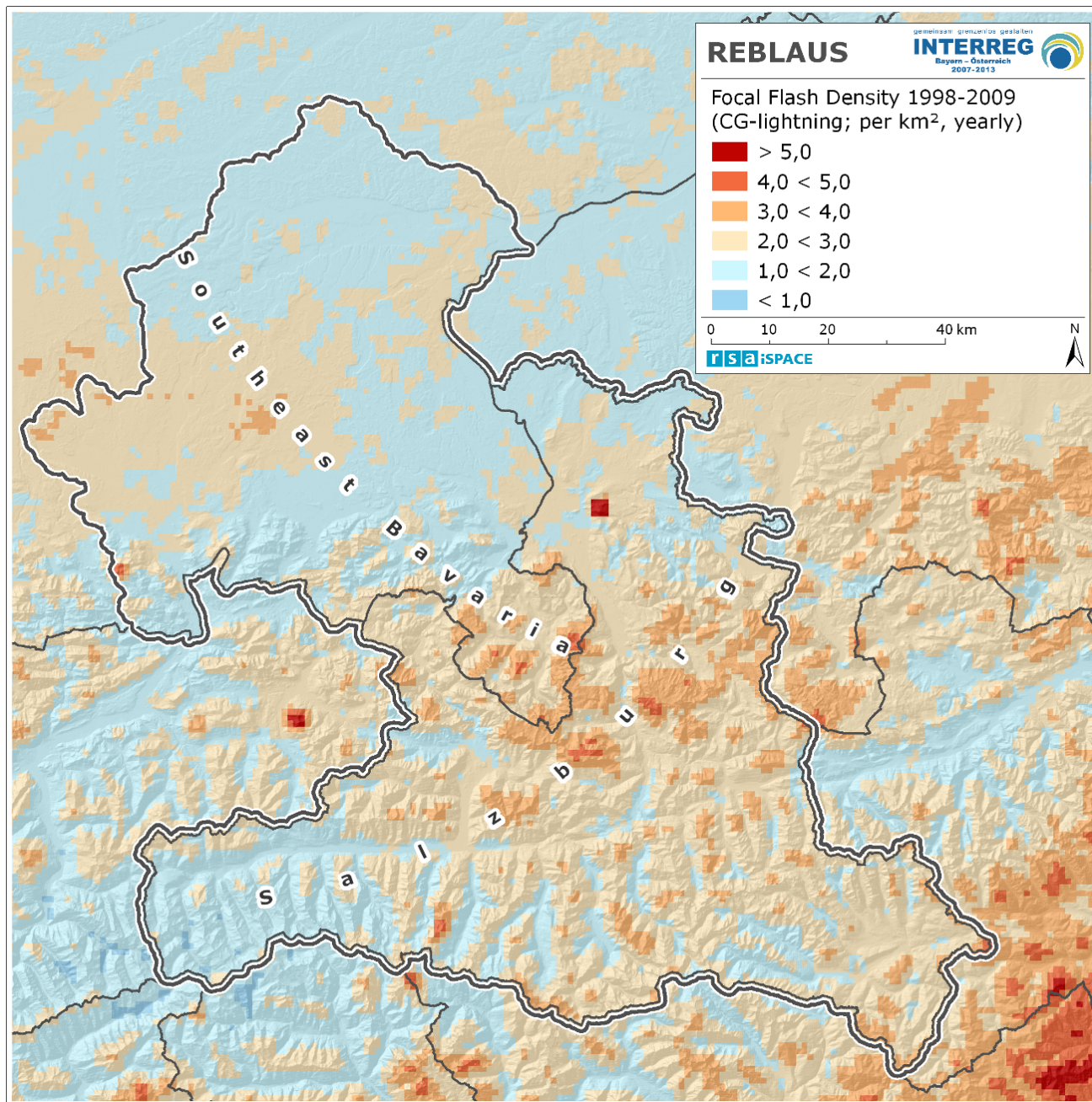


Focal flash density

Flashes / km² / Year

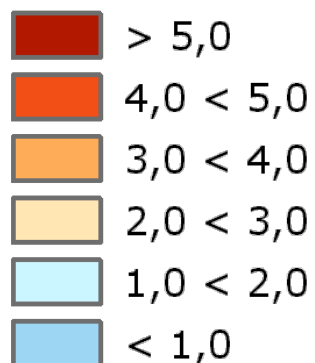


Min.	Max.	μ	σ
0,73	6,37	2,24	0,63

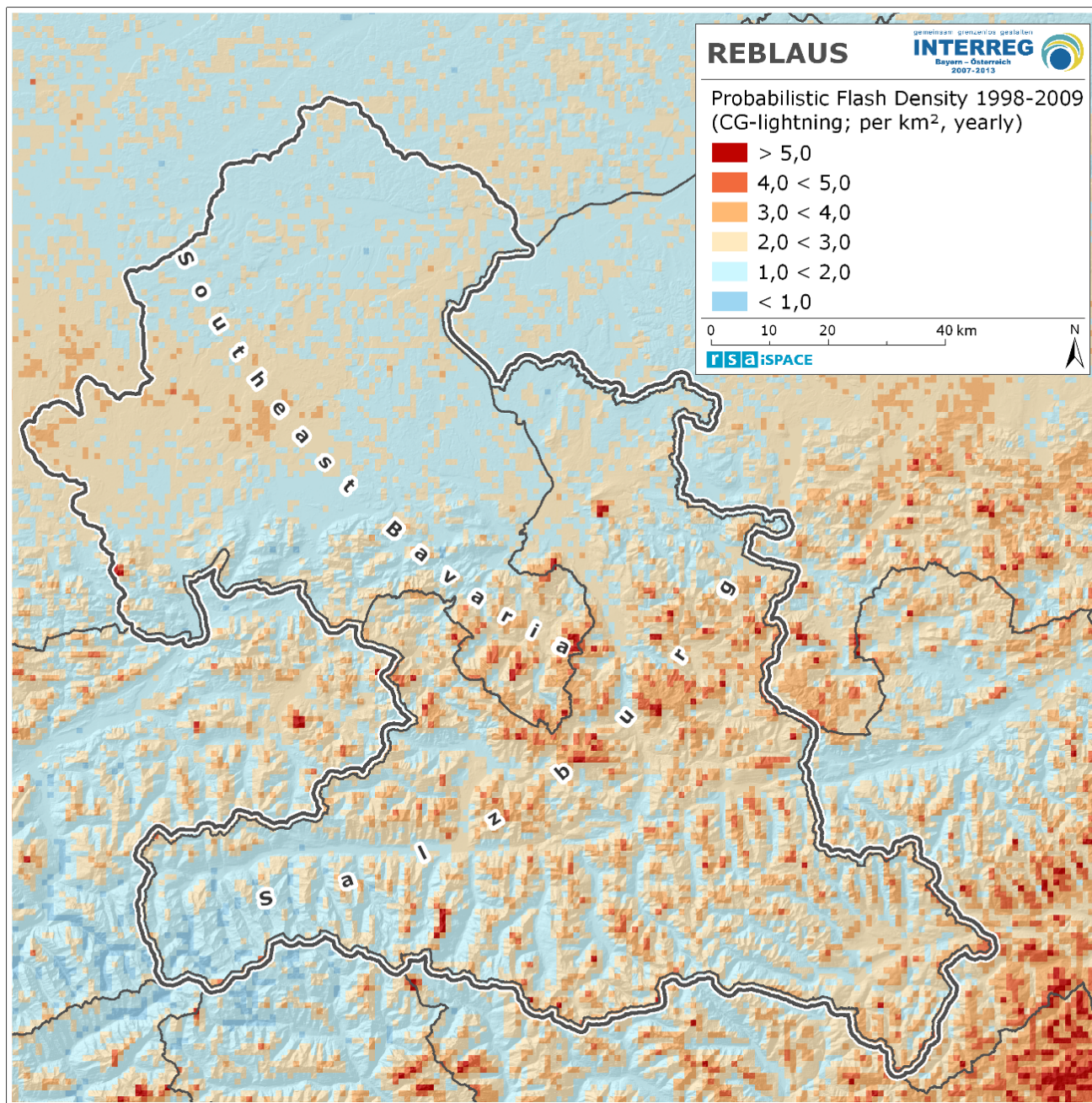


Probabilistic flash density

Flashes / km² / Year



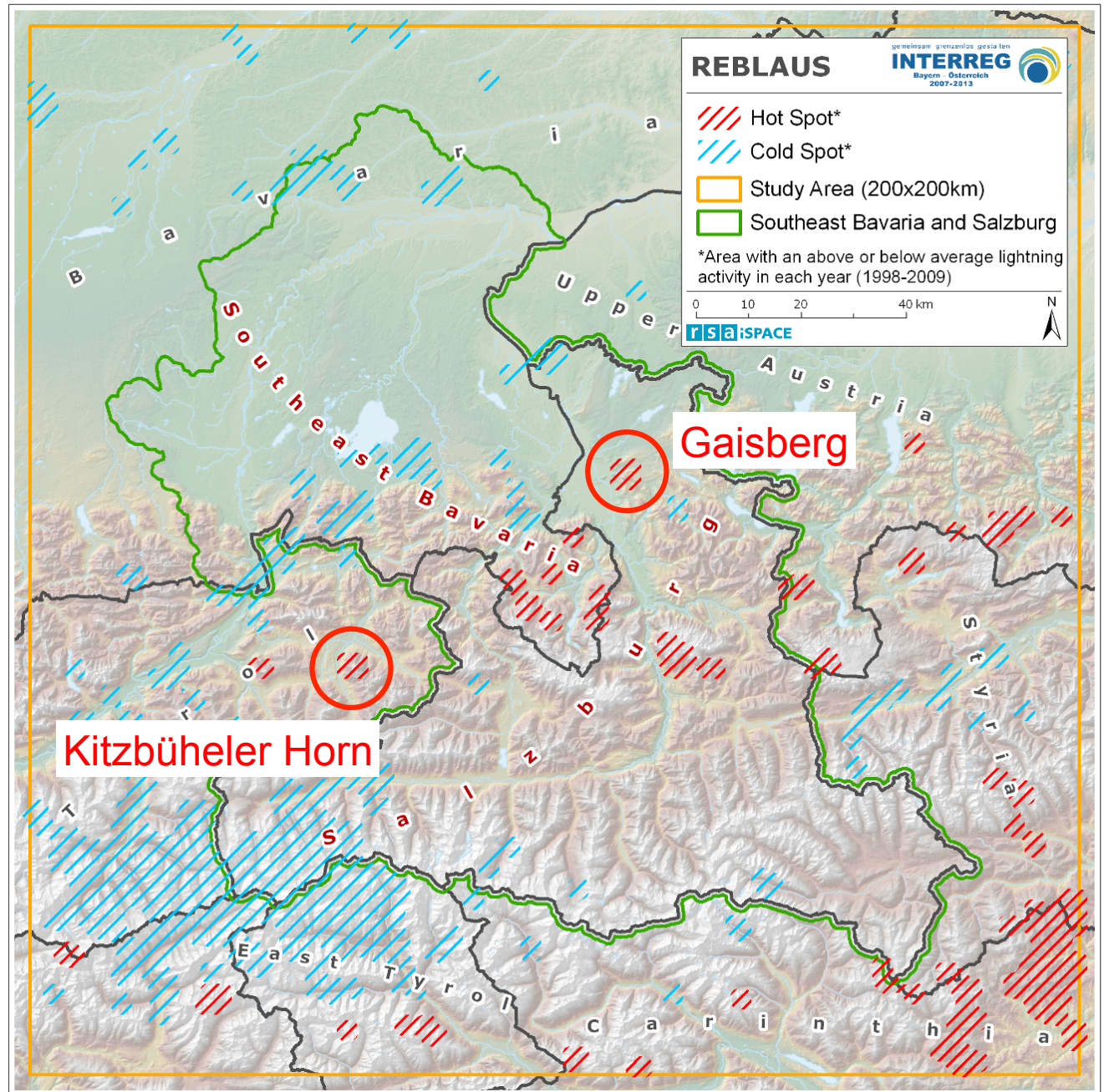
Min.	Max.	μ	σ
0,57	22,53	2,24	0,77



Every year hot spots

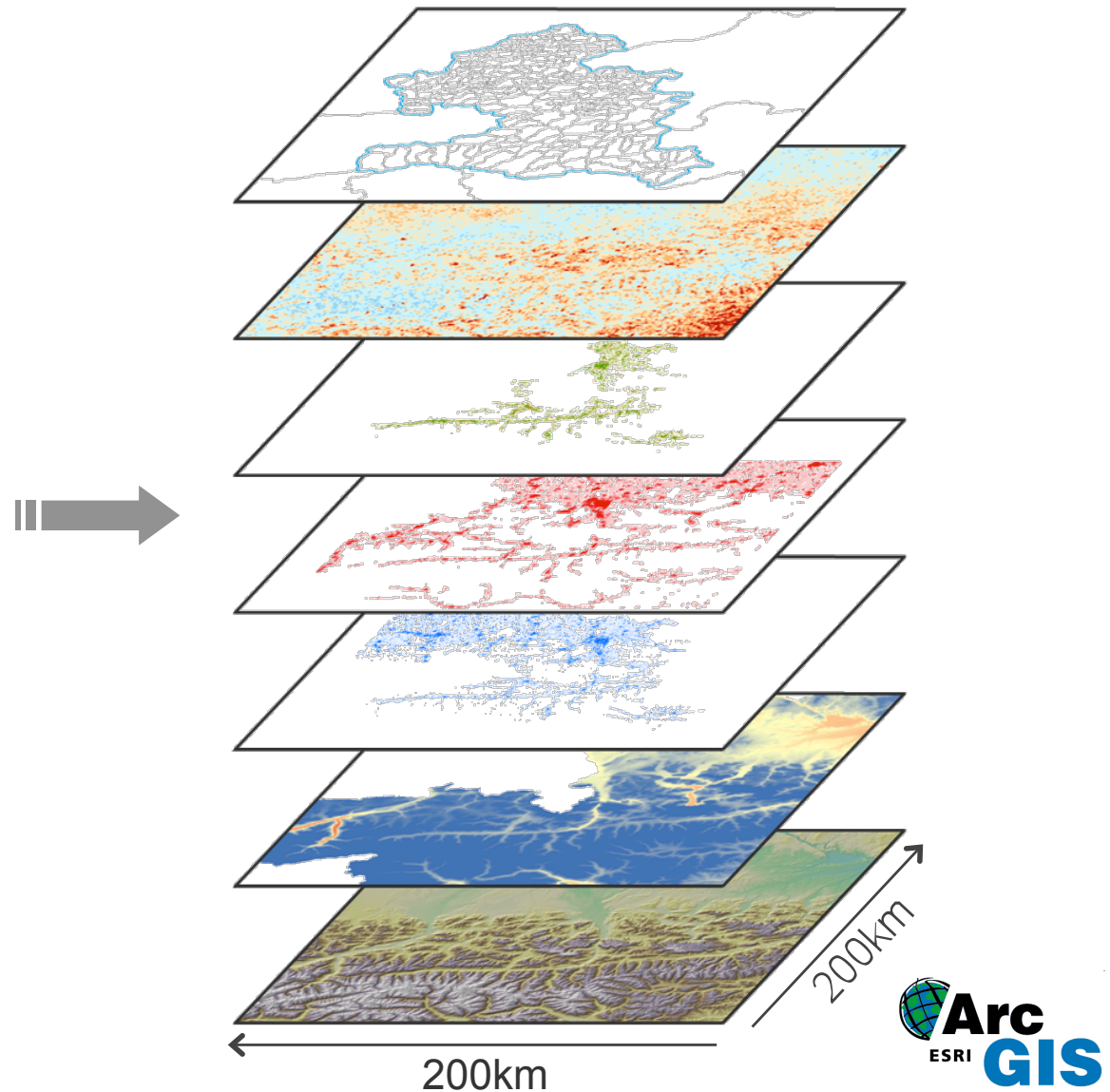
CG Density > annual Ø
→ Mountains and ridges

Hot Spot*
Cold Spot*



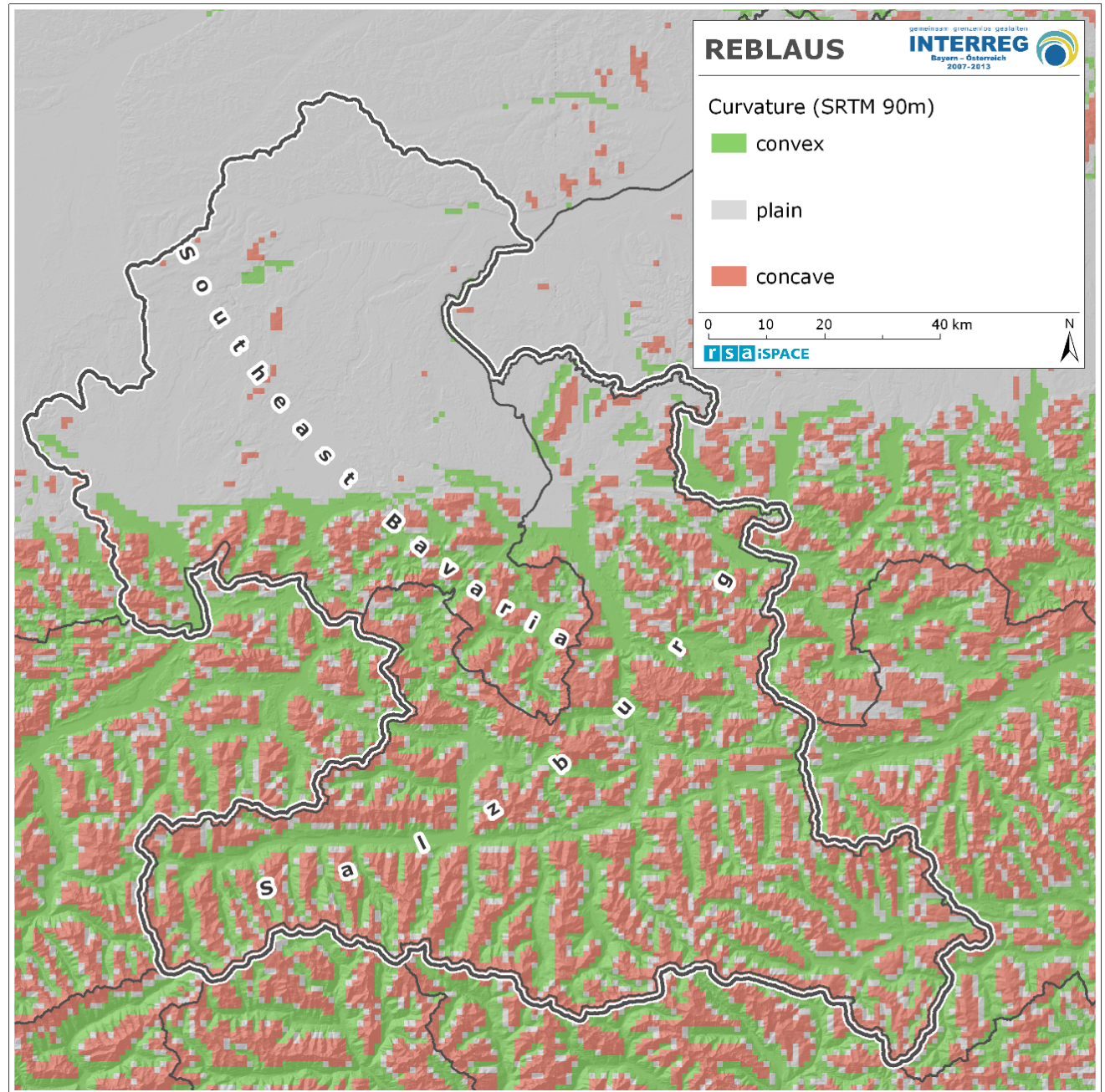
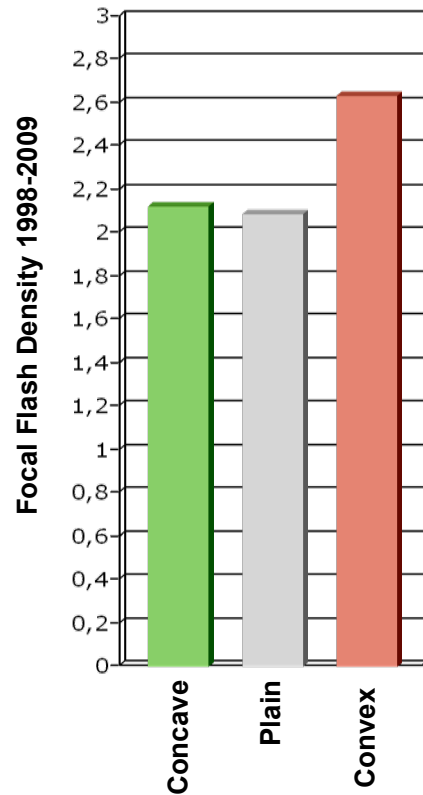
Cross-Border Spatial GIS-Database

- CG-Lightning
- Cadastral data
- Regional statistics
- Spatial planning data
- Land cover
- Elevation model
- Lightning damages
- ...
- *Grid 1x1km*



Lightning and land forms

- SRTM 90m:
 - Concave surfaces
 - Plain surfaces
 - Convex surfaces

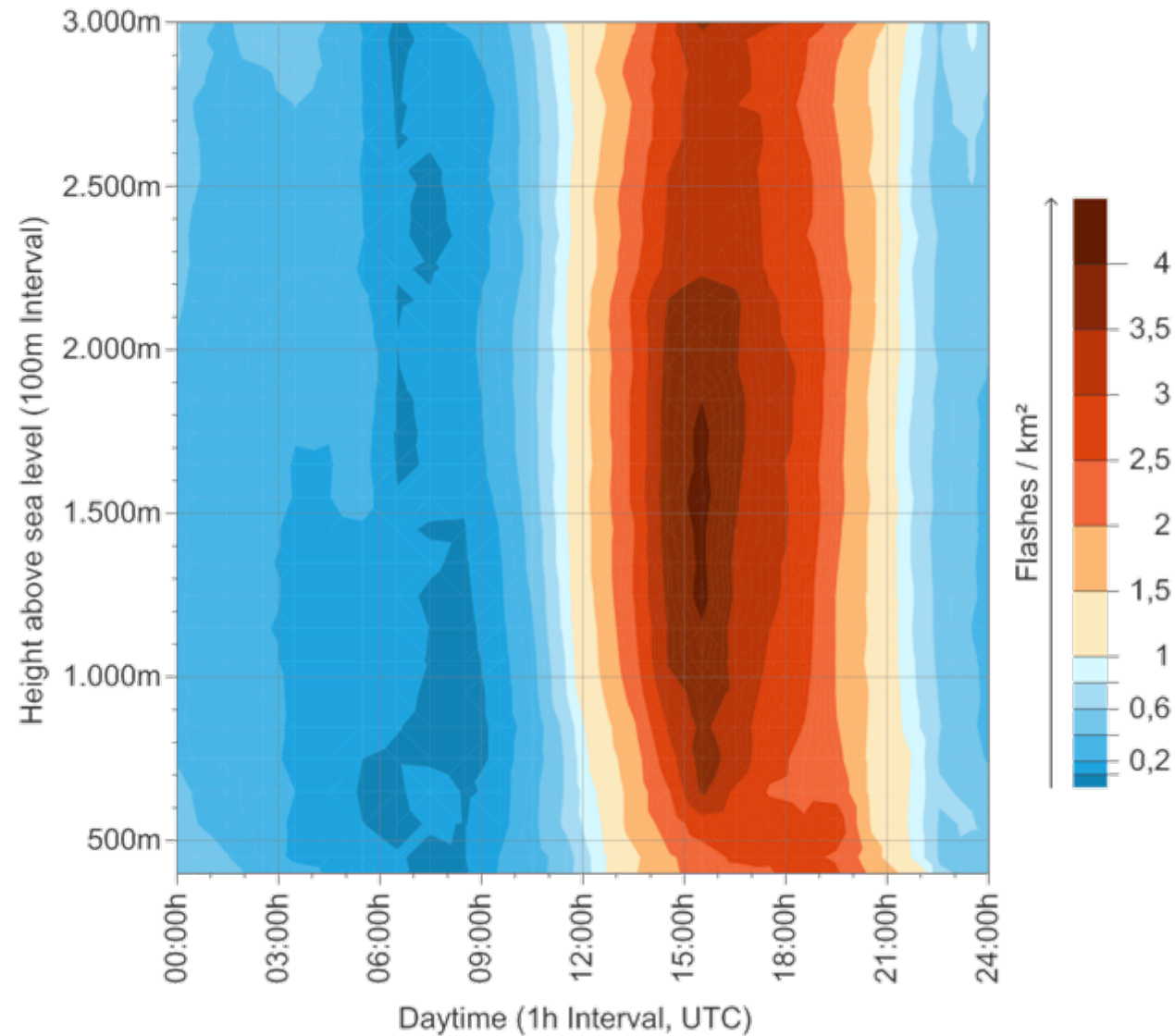


Lightning density, altitude and daytime

Maximum:

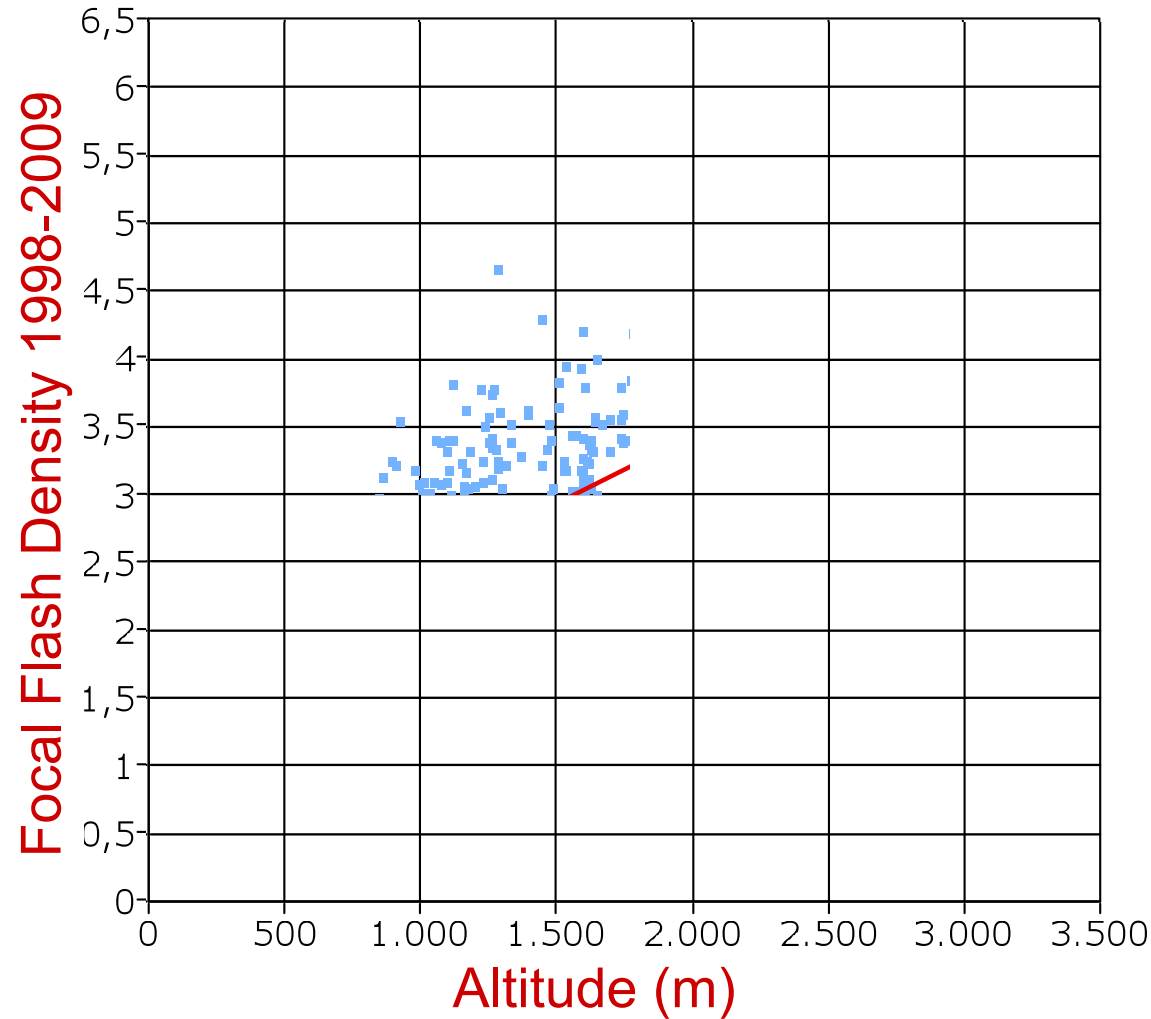
→ 1.500m (+/-)

→ 16:00 UTC



Lightning density ↔ altitude

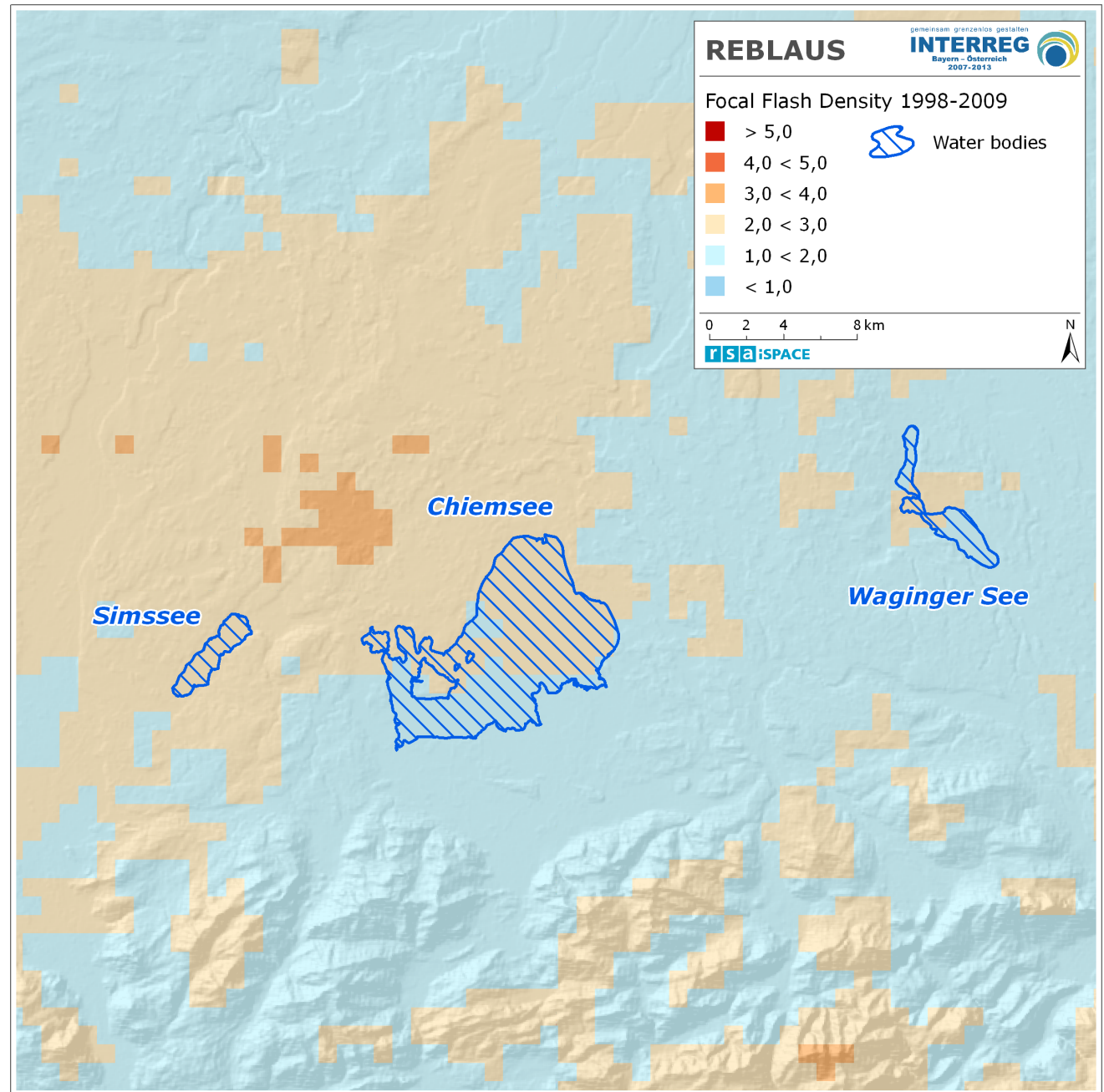
District Berchtesgadener Land



Lightning and land cover

- Topographical height affects the results
- No clear correlation between lightning and land cover
- Water does not seem to „attract“ lightning!

	FFD
Water bodies	2,15
Normalized area	2,07

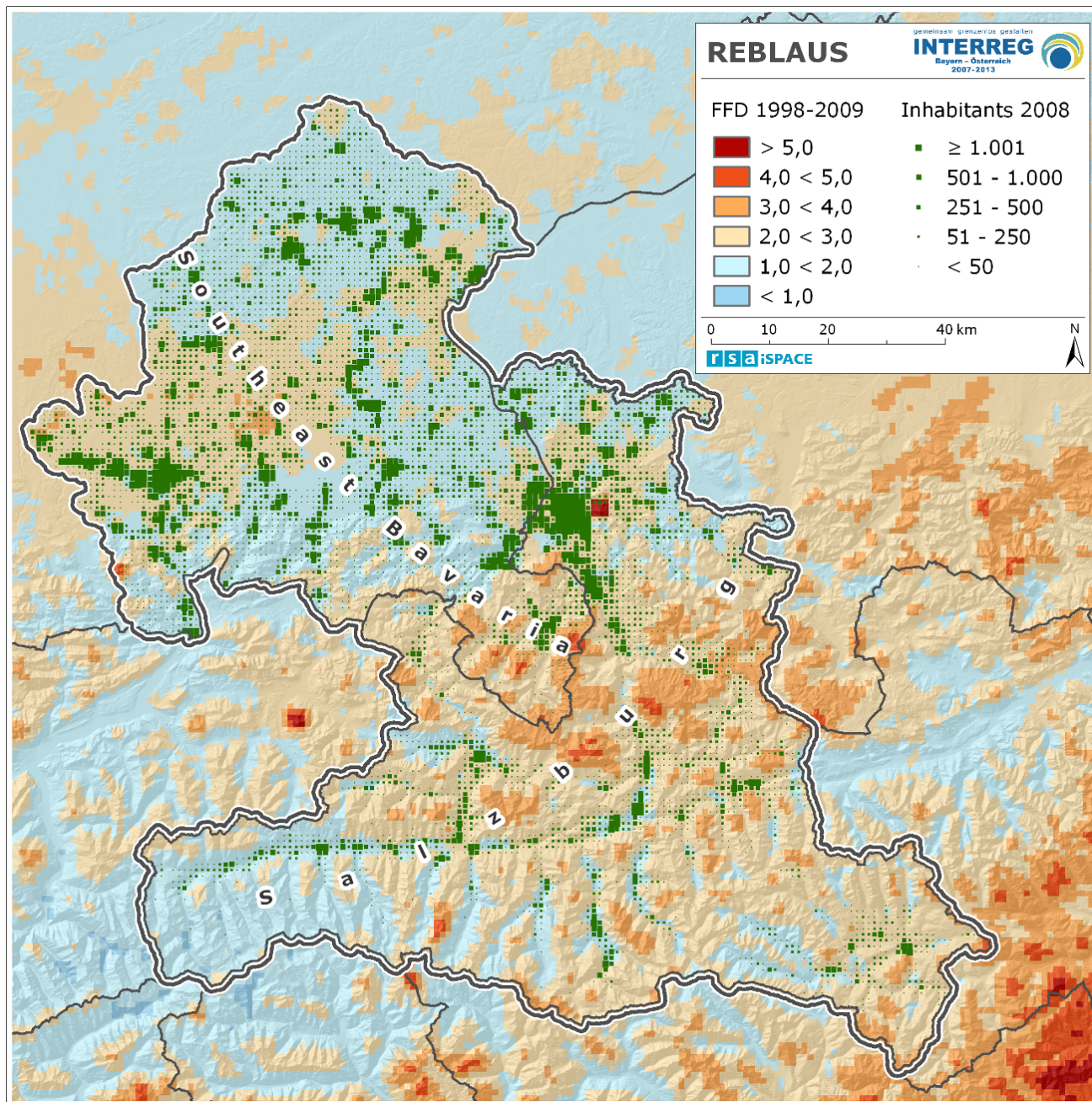


Lightning and settlements

Inhabitants 2008

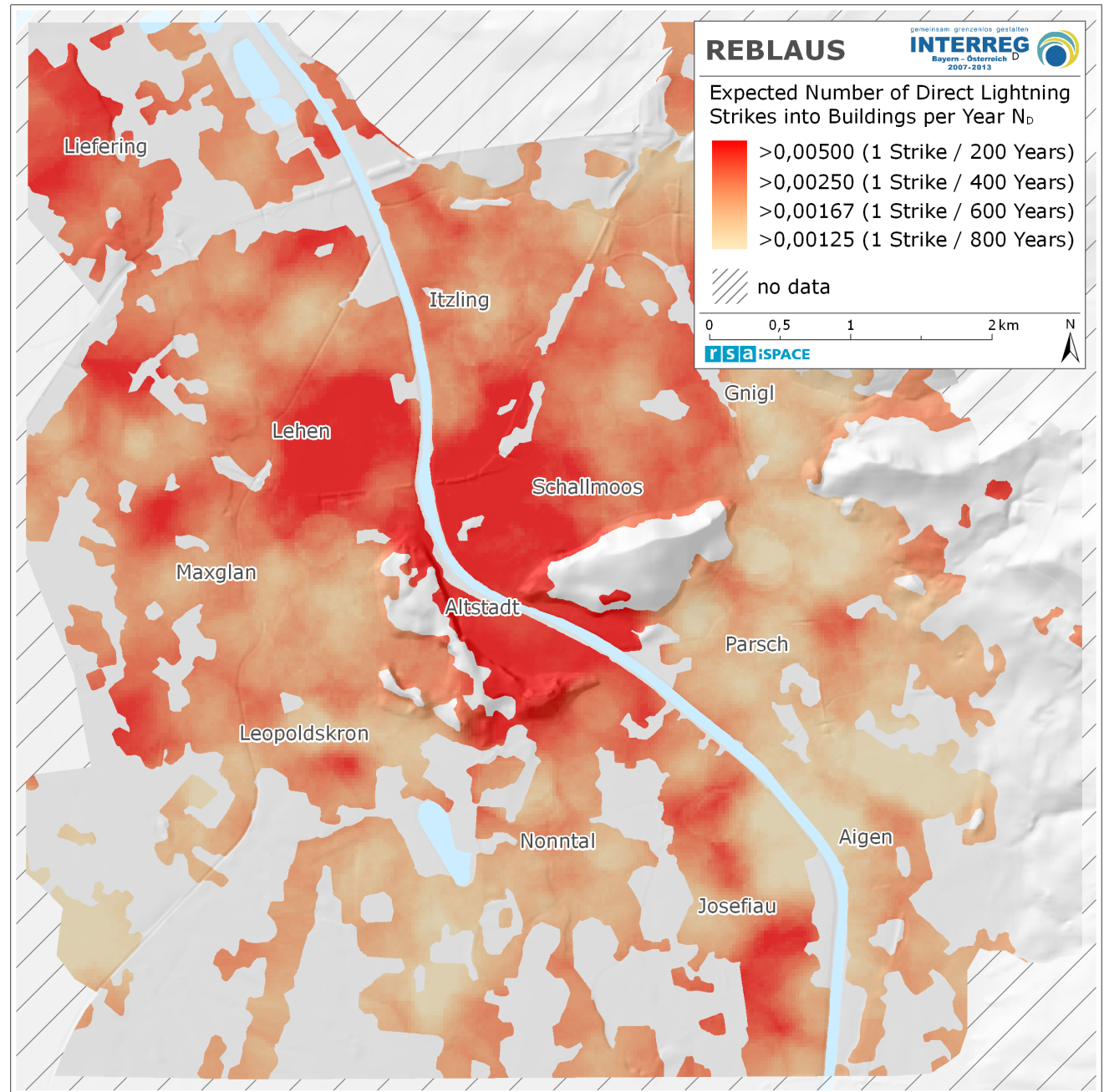
- ≥ 1.001
- 501 - 1.000
- 251 - 500
- 51 - 250
- < 50

FFD	Inhabitants	Settlement area (km ²)
< 1	-	-
$1 \leq 2$	655 039	321.1
$2 \leq 3$	659 575	309.9
$3 \leq 4$	9 783	6.9
$4 \leq 5$	32	-
> 5	688	0.1
Σ	1 325 117	638.3



Direct lightning strikes into buildings (expected)

- referred to EN 62305
- Modeling example Salzburg City
- Estimation of N_D



Conclusions / future research

- Coherence between topography and CG lightning density (altitude, curvature)
- No clear relationship to aspect / slope / land use
- Settlement structure primarily in low flash density areas
- Resulting damage density depends on damage potential
- Integration in Riskmap HORA

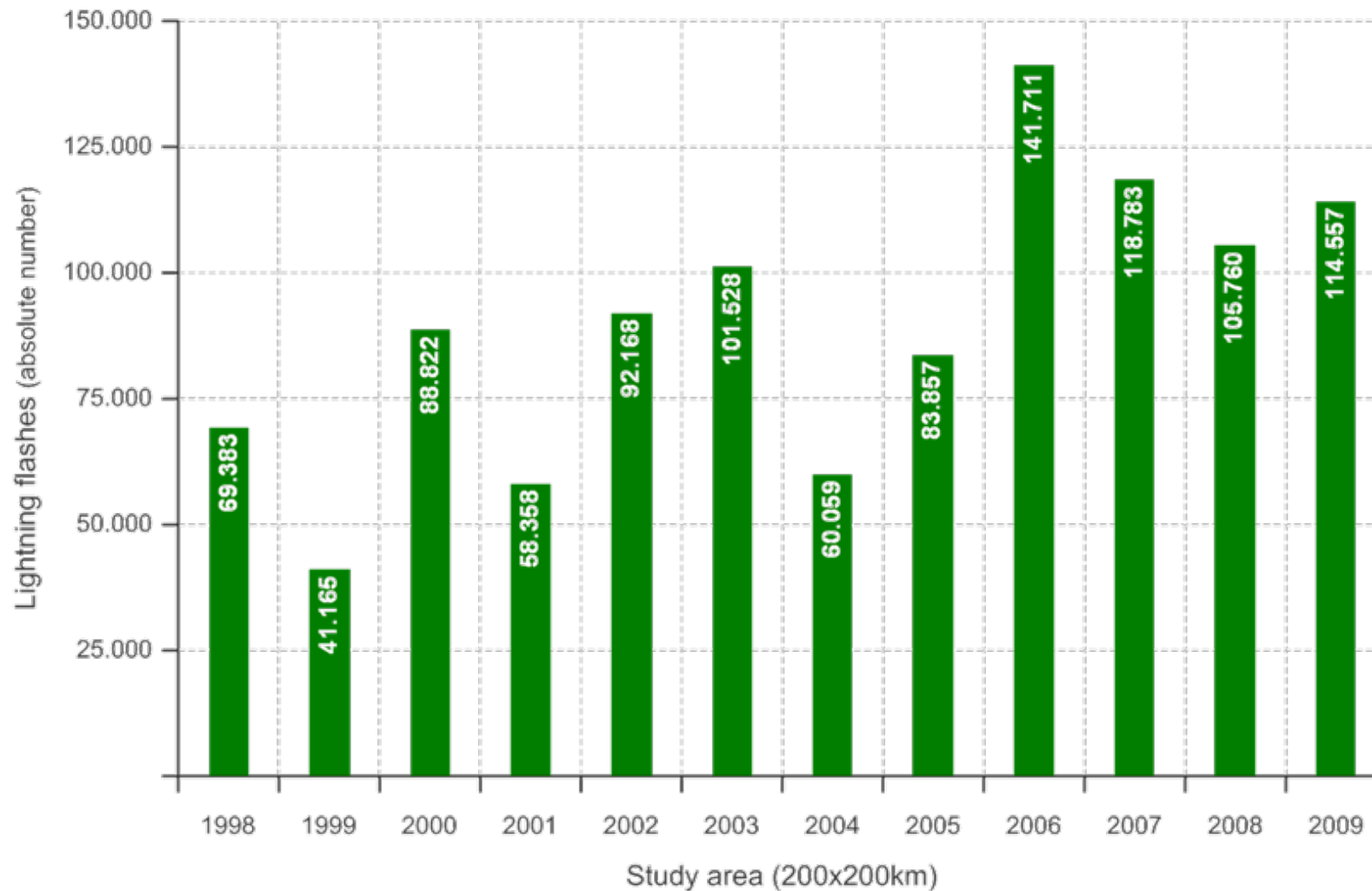
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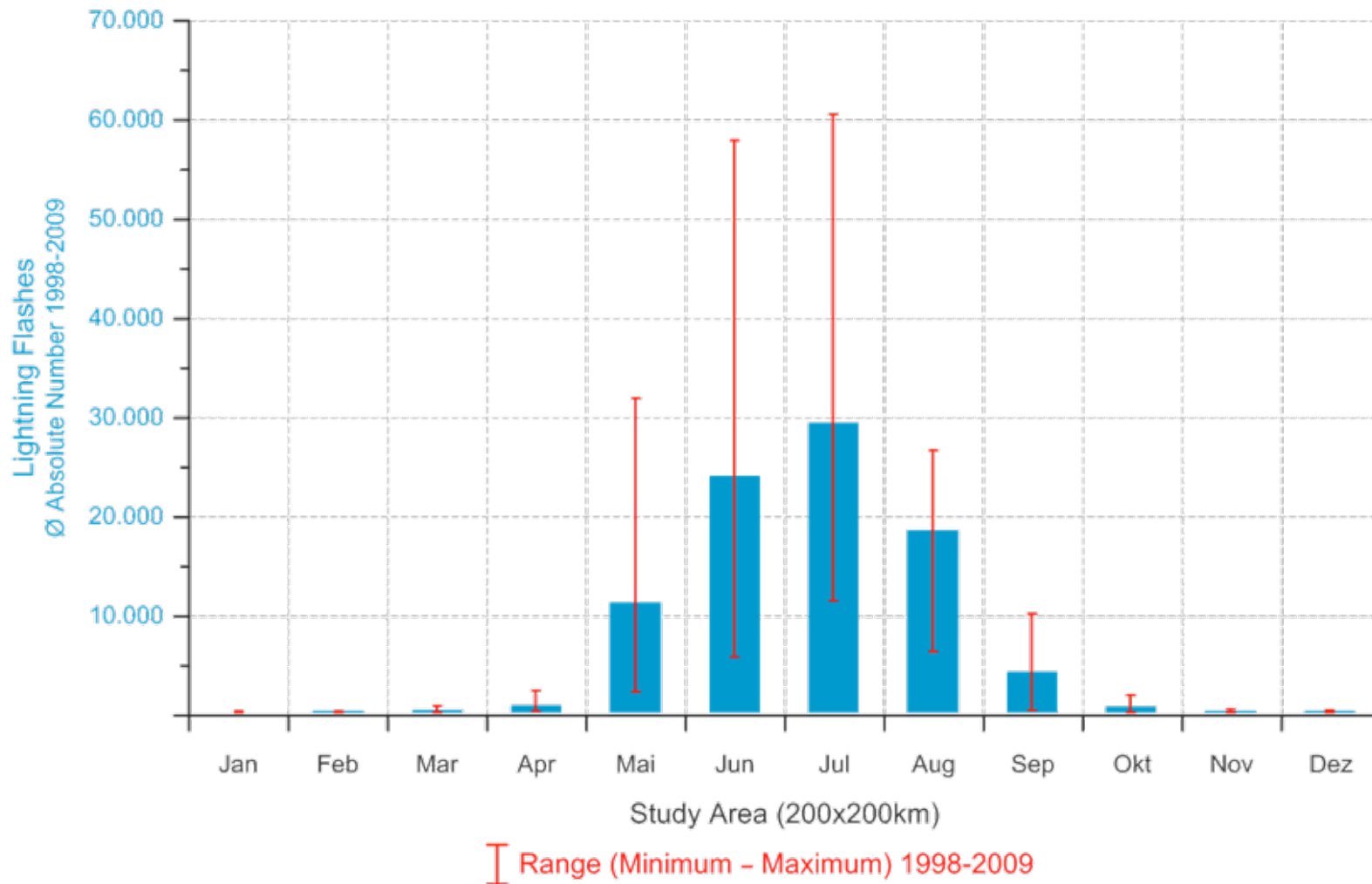
Annual lightning activity 1998-2009

- Cloud to ground lightning within the study area (200x200km)



Annual cycle of lightning activity

- Cloud to ground lightning within the study area (200x200km)



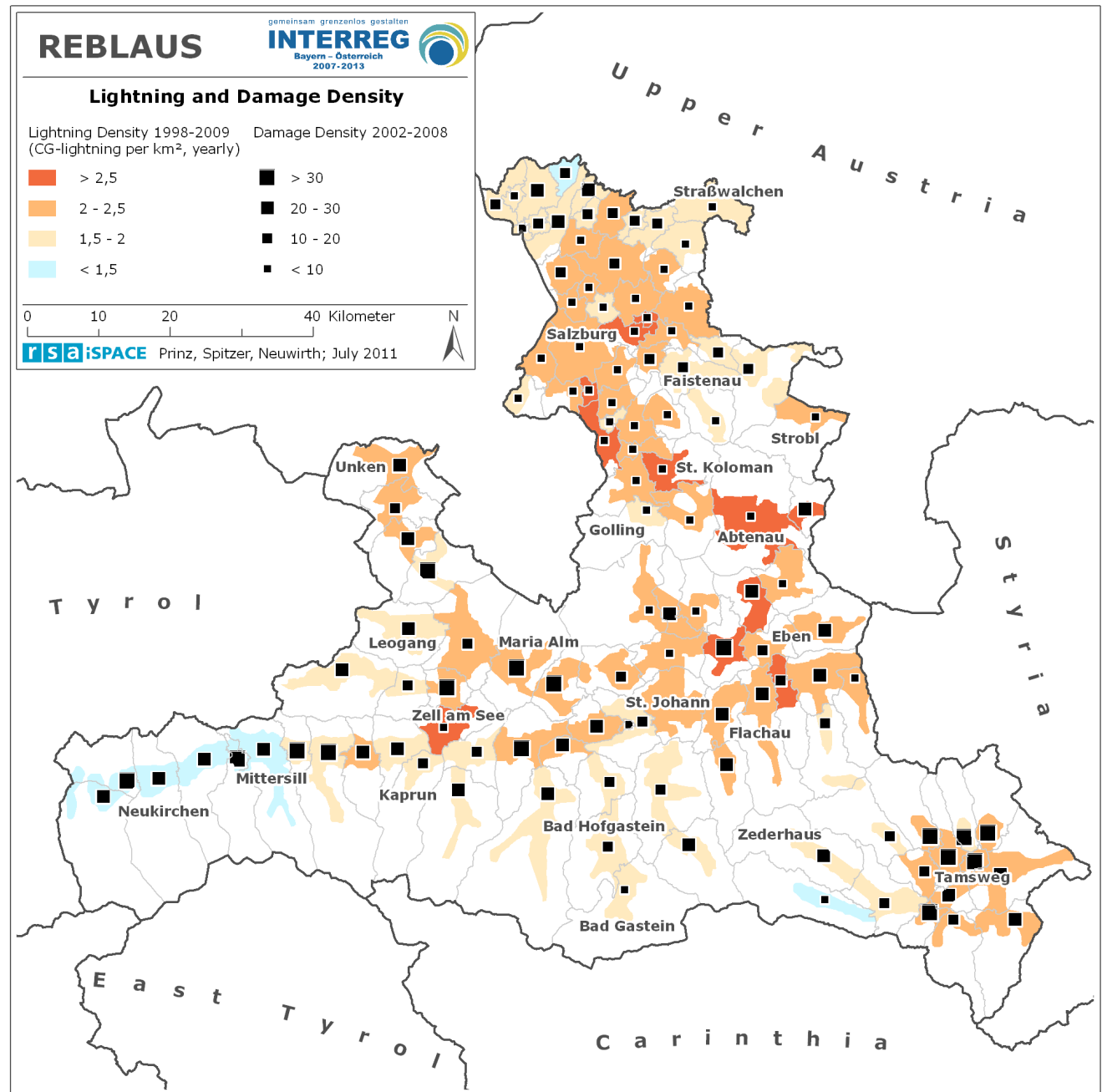
Damage Statistics

- Damage Density 2002-2008
Damages per 1.000 inhabitants/workplaces on municipal level

→ Depending on damage potential

Damage Density 2002-2008
(Damages per 1.000 inhabitants and workplaces)

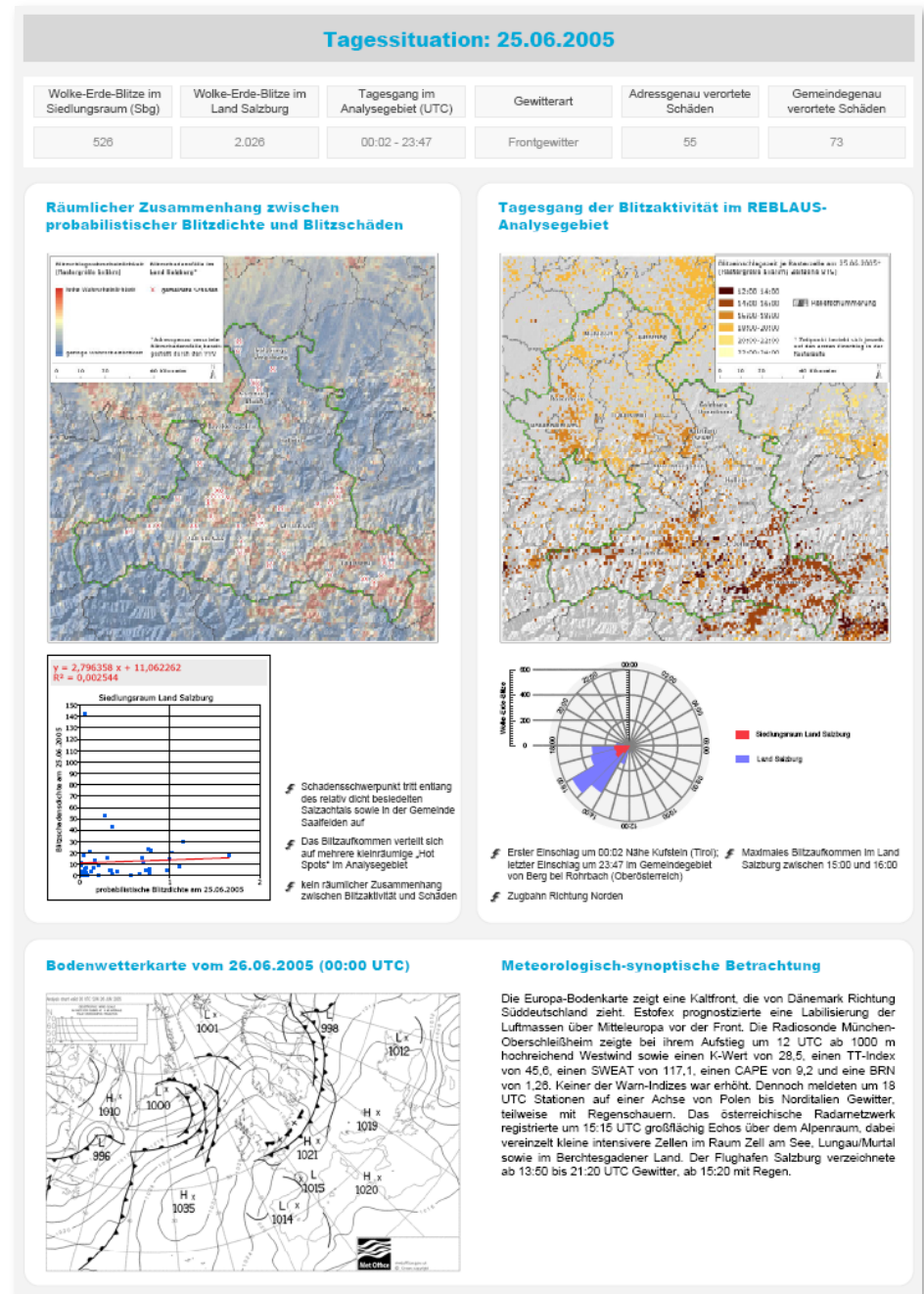
- > 30
- 20 - 30
- 10 - 20
- < 10



Evaluation of single day situations

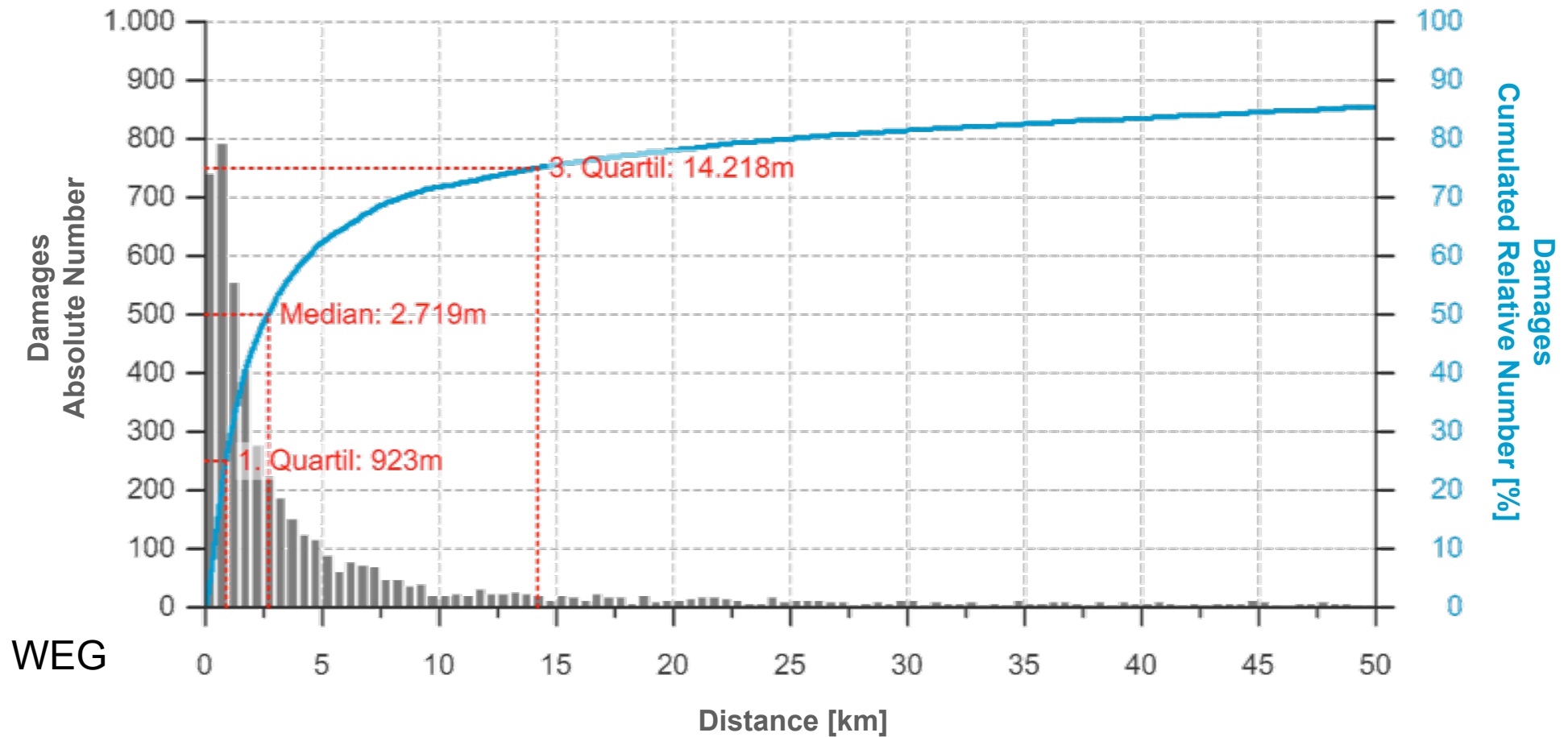
5 major-damage thunderstorms

- CG lightning flash density map
- Damage density map
- Spatiotemporal movement of thunderstorms
- Several indices of weather situation
- Example 6. July 2006: 15.880 lightnings



Distance: lightning strike ↔ Damages

- Spatiotemporal neighbours (daily linkage)



Lightning density $\leftrightarrow$ altitude

