COMPARING DISPERSION MODELLING AND FIELD INSPECTION FOR ODOUR IMPACT ASSESSMENT IN THE VICINITY OF TWO ANIMAL HUSBANDRY FARMS

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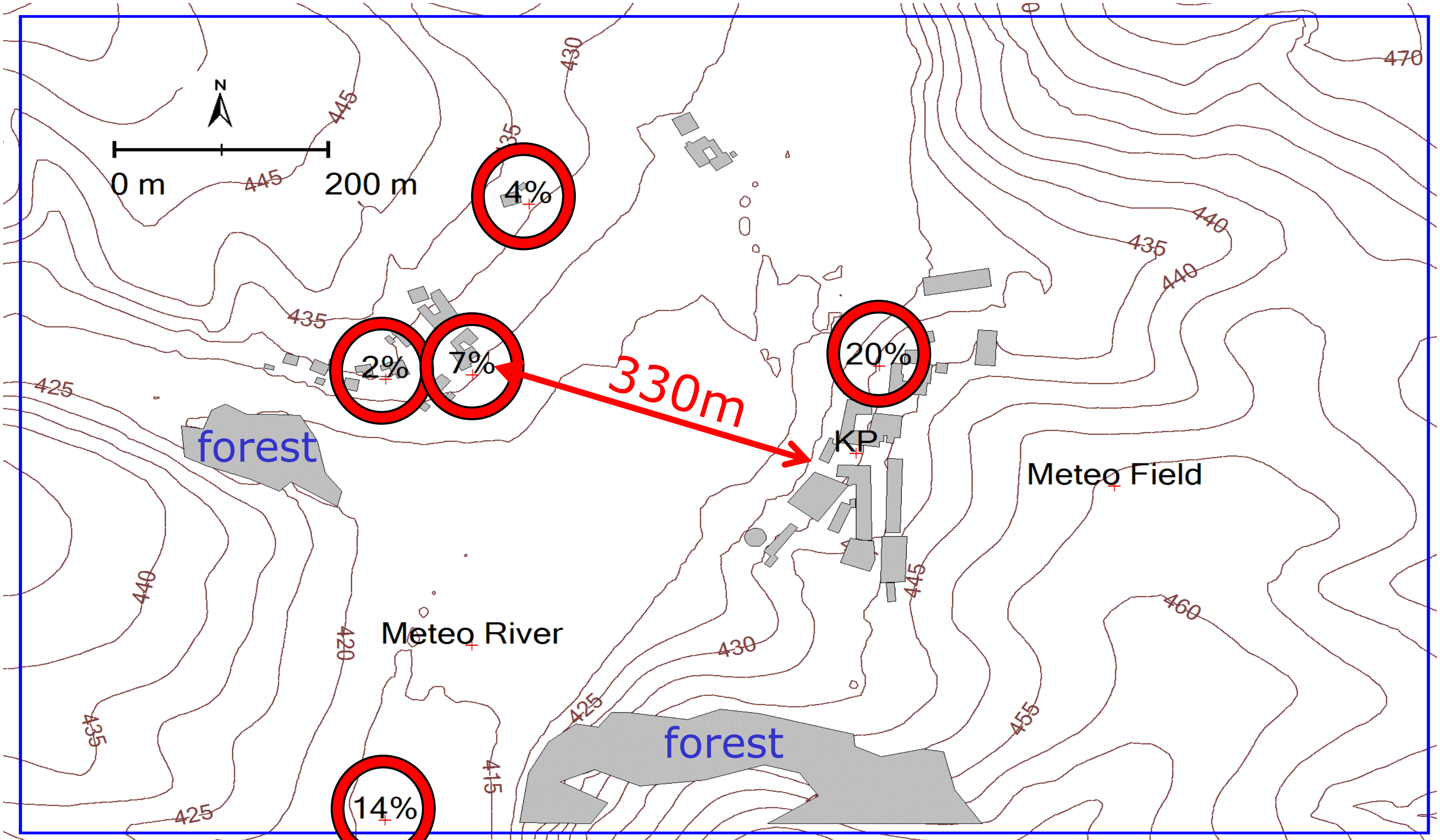
Data set A


N
0 m
200 m
4%
2%
7%
20%
14%
330m
KP
Meteo Field
Meteo River
forest
forest
470
445
445
435
435
440
435
440
430
425
440
420
430
445
460
425
435
425
415
455

Data set A

- 1.600 fattening pigs
  - Multi-phase feeding -> 20% reduction of emission factor according to VDI 3894-1
  - Ventilation by multiple chimneys

- 17.000 broilers
  - Ventilation via horizontal openings

- Open manure tank
- Open maize silage

➢ Total emission rate: 55 MOU/h

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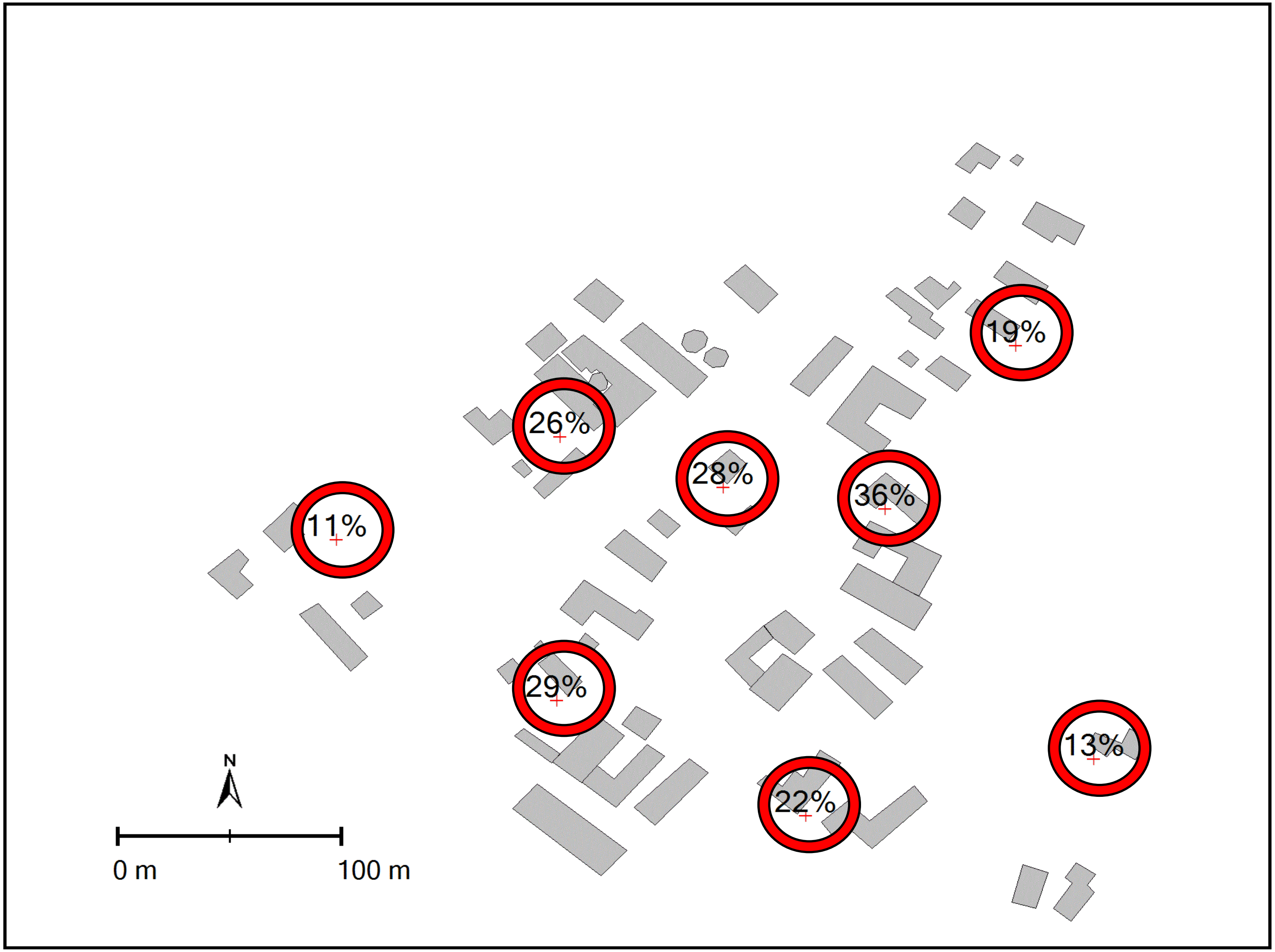
Data set B



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Data set B

- 2.000 fattening pigs
- 600 piglets
- 150 breeding sows
  - Ventilation either via chimneys or open windows
  - Emission factors were reduced by 50 % in case of open windows due to low ventilation rates

- Several solid manure storages

➢ Total emission rate: 55 MOU/h

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Lower emission factor in case of ventilation via open windows

Dependency of emission factors on the normalized ventilation rate according to KTBL (2012):

$$e = e_0 V_n^{c_V}$$

c_V = 0.32 (Schauberger et al., 2012)

When assuming V_n to be about 90 % lower in case of non-forced ventilation via open windows compared to forced ventilation via chimneys, emission rates are lower by about 50 % compared to the standard values listed in VDI 3894-1.

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Field inspections: methodology

- Carried out by the Environmental Advocacy of Upper Austria
- Role-model: VDI 3940-1 (**CEN/TC264/WG27**)
  - Odour frequencies were evaluated solely at specific receptor points
  - Only **two** panellists instead of **ten** performed the inspections in both case studies

- Average olfactory sensibilities for *n*-butanol of the two panellists were for
  - data set A: 84 µg/m³
  - data set B: 189 µg/m³

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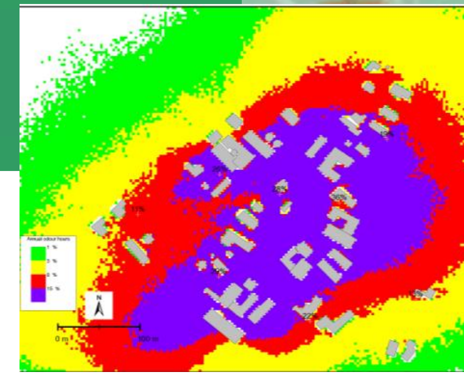
Modelling: methodology



- Lagrangian particle model GRAL 15.7
  Accounts for plume rise due to buoyancy and exit velocity

- Effects of orography in data set A:
  Mesoscale, prognostic, non-hydrostatic model GRAMM
  100m x 100m x 10m

- Influence of obstacles:
  Microscale, prognostic, non-hydrostatic flow field model
  implemented in GRAL 3m x 3m x 1.5m

- Odour hour: ≥6 minutes odour perception
  90 Percentile / 1h mean = 4 : 1

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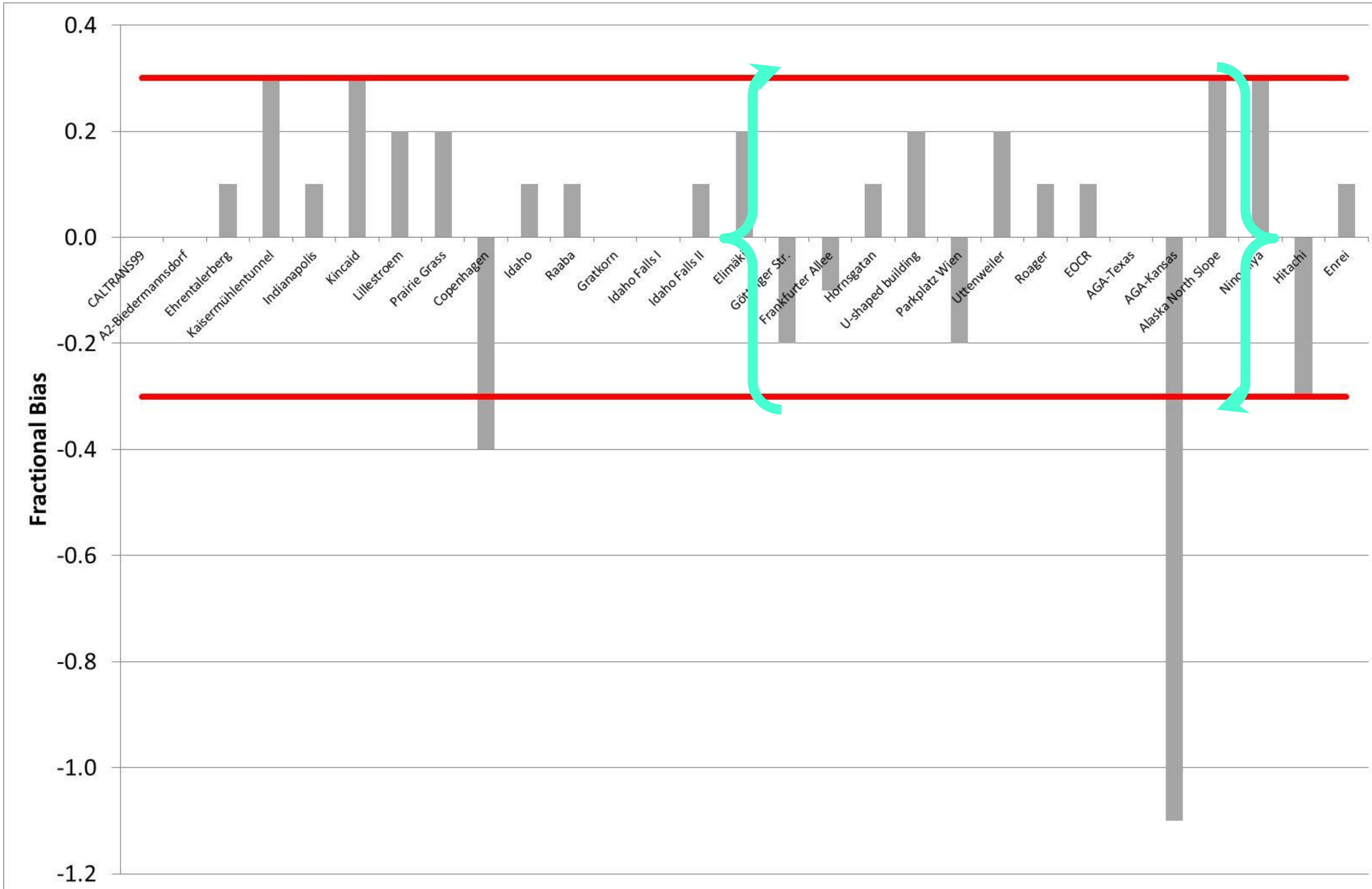
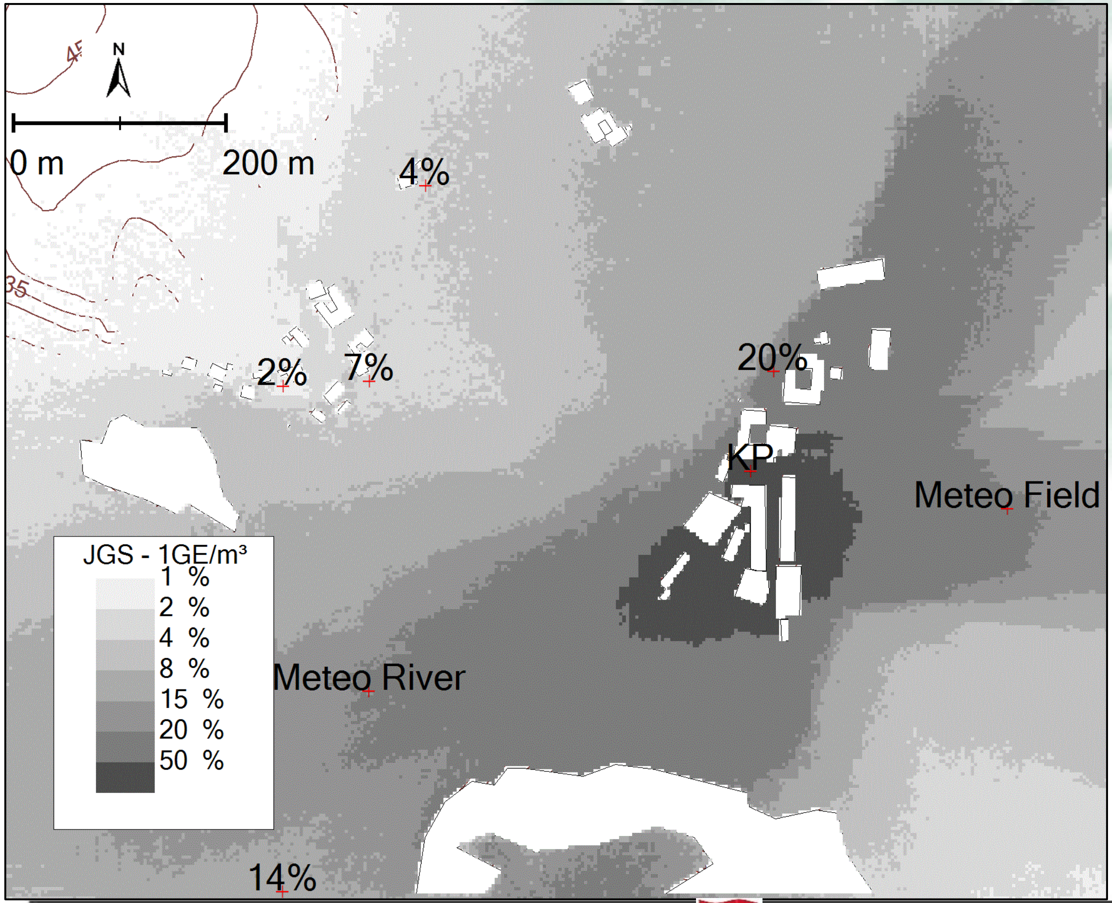
Modelling: quality assurance



Results: data set A – 1 OU/m³

Receptor	1	2	3	4	5
Field inspection	14%	2%	7%	4%	20%
Model	13%	2%	5%	4%	25%



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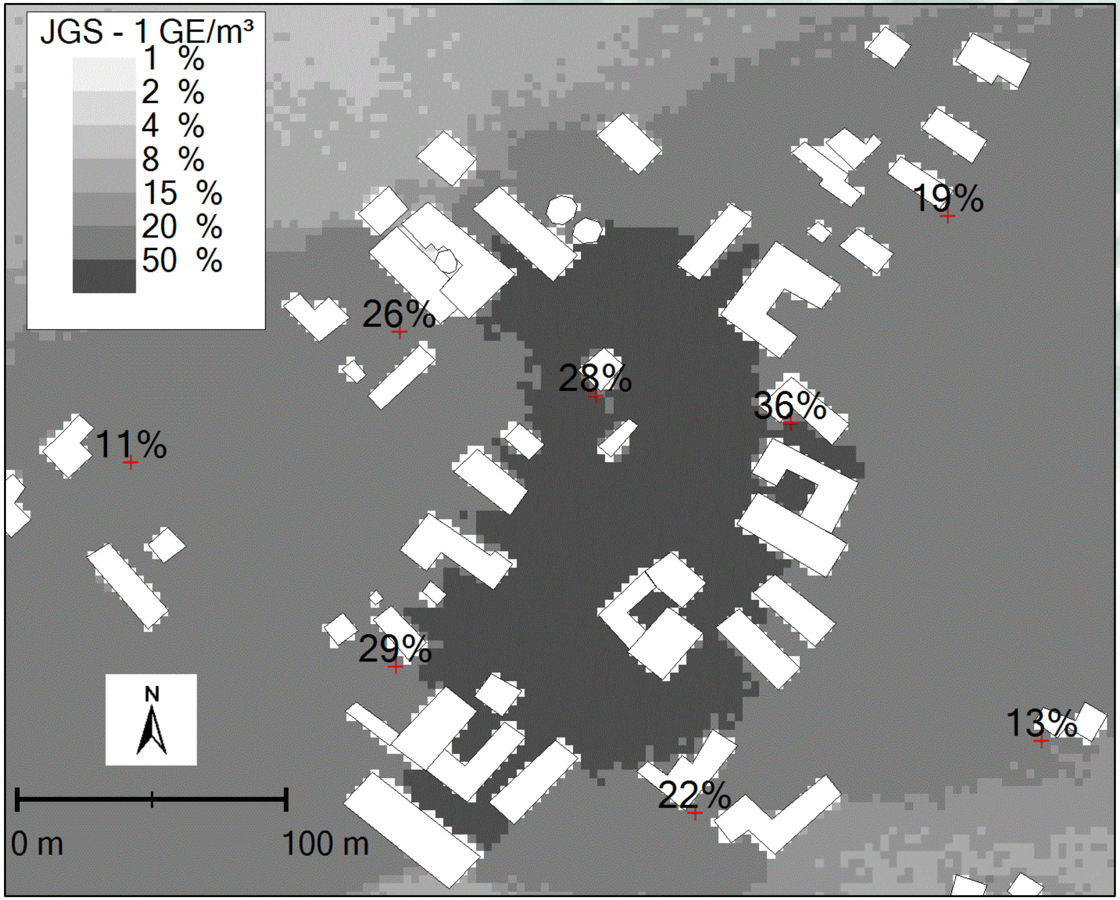
Results: data set B – 1 OU/m³

Receptor	1	2	3	4	5	6	7	8
Field inspection	13%	22%	29%	11%	26%	28%	36%	19%
Model	23%	30%	38%	30%	32%	58%	60%	37%



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The problem of odour adaption

What exactly is the threshold for odour perception?

- Literature says: 2 - 5 OU/m³
- According to VDI 3940-1 panellists need to sniff at each location exactly 10 minutes
- Simulations according to the German GIRL standard is based on an odour threshold of 1 OU/m³
- Is this the reason for model overestimations as discussed in previous studies? (e.g. Mueller und Riesewick 2013; Grotz and Zimmermann 2015; Hartmann and Borcherding 2015)

Assumption: odour threshold 2 OU/m³

- Remember: Different olfactory sensibilities
  - data set A: 84 µg/m³
  - data set B: 189 µg/m³
- Allowed range: 64 – 256 µg/m³ (mean: 160 µg/m³)
- If 10 panellists had participated, the average olfactory sensibility would have been 160 µg/m³
- Correction factors:
  - data set A: 84/160 = 0.53
  - data set B: 189/160 = 1.18
- "Effective odour threshold":
  - data set A: 0.53 * 2 OU/m³ = 1.05 OU/m³
  - data set B: 1.18 * 2 OU/m³ = 2.36 OU/m³

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Results: odour threshold – 2 OU/m³

Data set A:

Receptor	1	2	3	4	5
Field inspection	14%	2%	7%	4%	20%
Model	13%	2%	5%	4%	25%

Data set B:

Receptor	1	2	3	4	5	6	7	8
Field inspection	13%	22%	29%	11%	26%	28%	36%	19%
Model	11%	19%	27%	17%	22%	23%	23%	23%

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Conclusions

- The current criterion of the allowed range for the olfactory sensibility (64 – 256 µg/m³ for *n*-butanol) seems to be too high.
- It might be better to define a smaller range applicable to the average olfactory sensibility of all participating panellists in field inspections.
- Increasing the odour threshold in dispersion models might improve the comparability between simulations and field inspections according to VDI 3940-1 (**CEN/TC264/WG27**)

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