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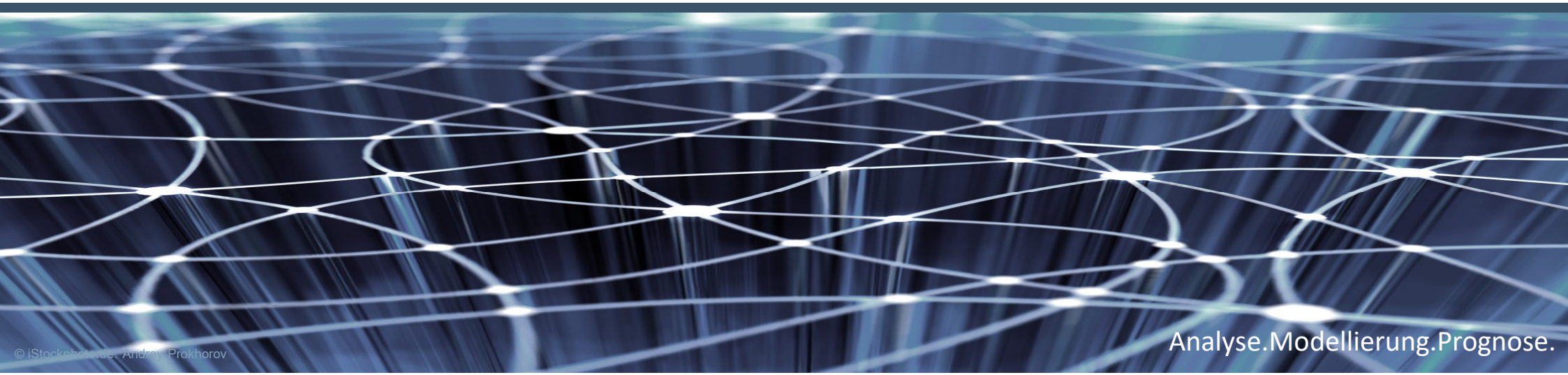
Limits to growth in modelling – implications, impacts and challenges

Günter Haag



A challenge in the 70th

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„Club of Rome (1972)“
MIT System Dynamics
(Jay Forrester)

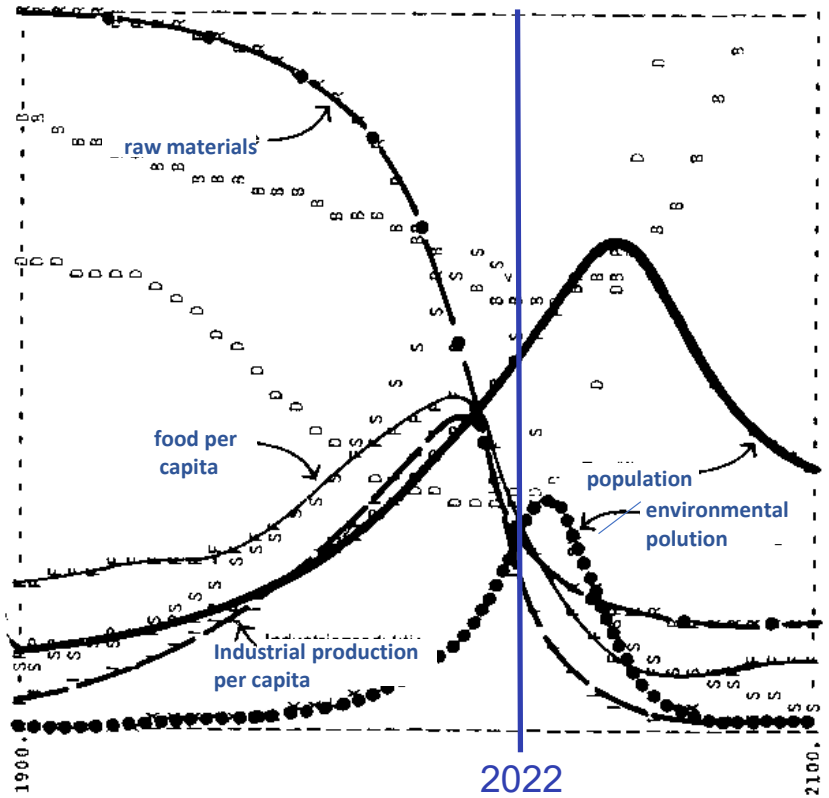
→ Dynamics of Growth in a Finite World (Meadows et. al)

MIT Boston (1990)
World model (about 160.000 equations,
95% of the world economy)

IAB-Inforge (2000) (Meyer, Osnabrück)
Modul of the German economy (MITI (Japan)),
about 30.000 equations. Development of the German economy (NUTS 1, NUTS2)

We need a spatially disaggregated model (Koller, IAB)

IAB-STASA (2002) (Stuttgart, Nürnberg)
Evolutionary model of German economy (NUTS 3), districts (about 1.600 equations)



A few limitations

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Uncertainties

uncertainties and outliners in the data
uncertainties in the initial conditions
uncertainties in the parameter estimation

Complexity

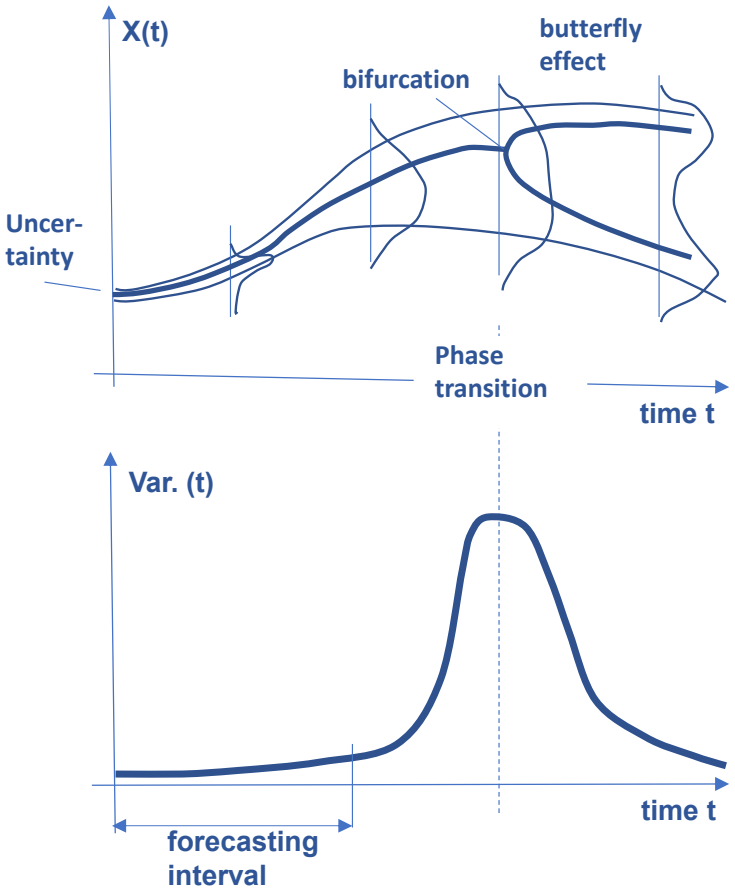
non linearities in the system may create phase transitions
new up to now unknown variables may appear (P. Allen)
social systems are capable of learning
unexpected events (Ukraine war)

What can we do?

scenarios technology - simulation of different possible events (best, expected, worst)
simulation of uncertenties (Monte Carlo procedure)

Conclusion

not only one trajectory but a bundle of trajectories
length of forecasting periode is limited



Appropriate Modelling: Looking for Structural Similarities

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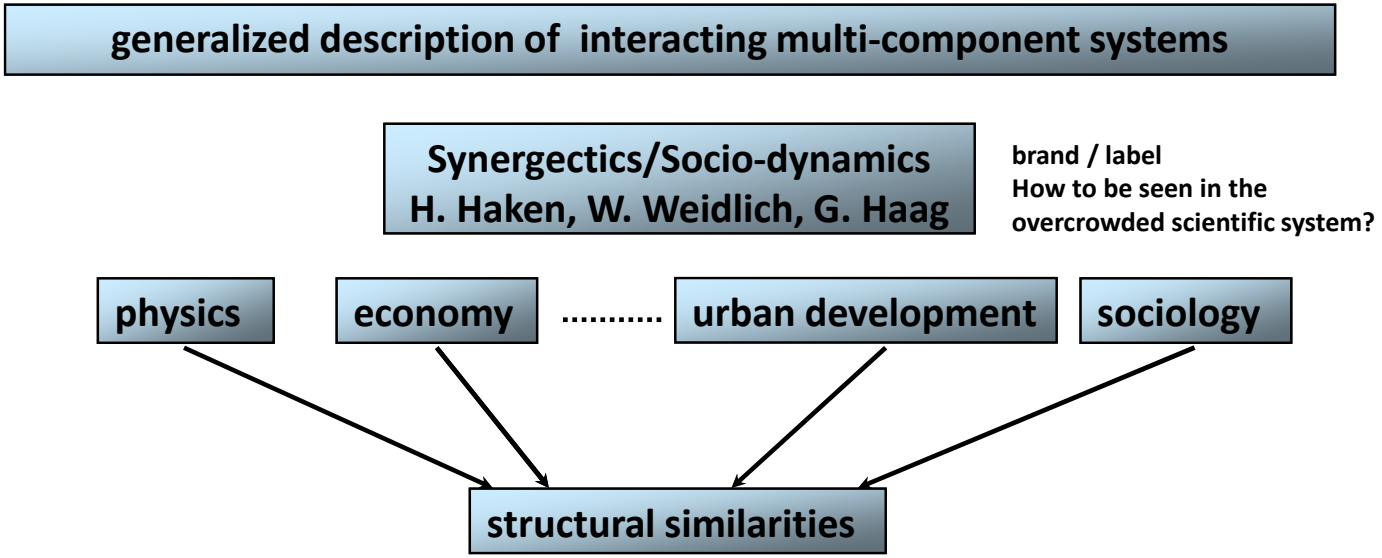

- universality (mathematics of stochastic processes)
- many subsystems
- interactions different on the micro-level beside structural similarities
- non-linearity (self-organisation)
- fluctuations
- space-time features
- open or closed systems

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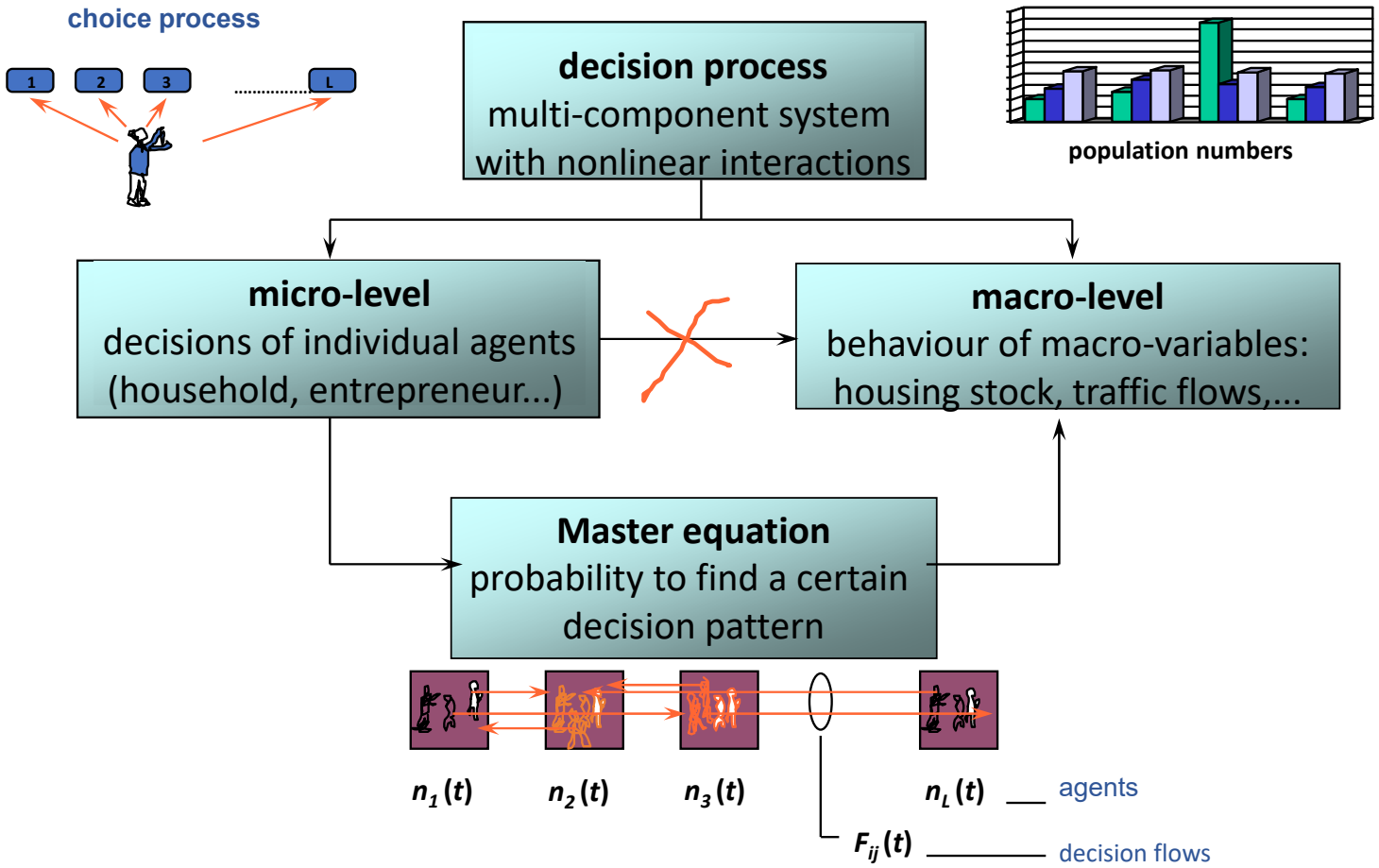
Synergetics/Sociodynamics – The framework



Spatial preferences (total population): districts (401)

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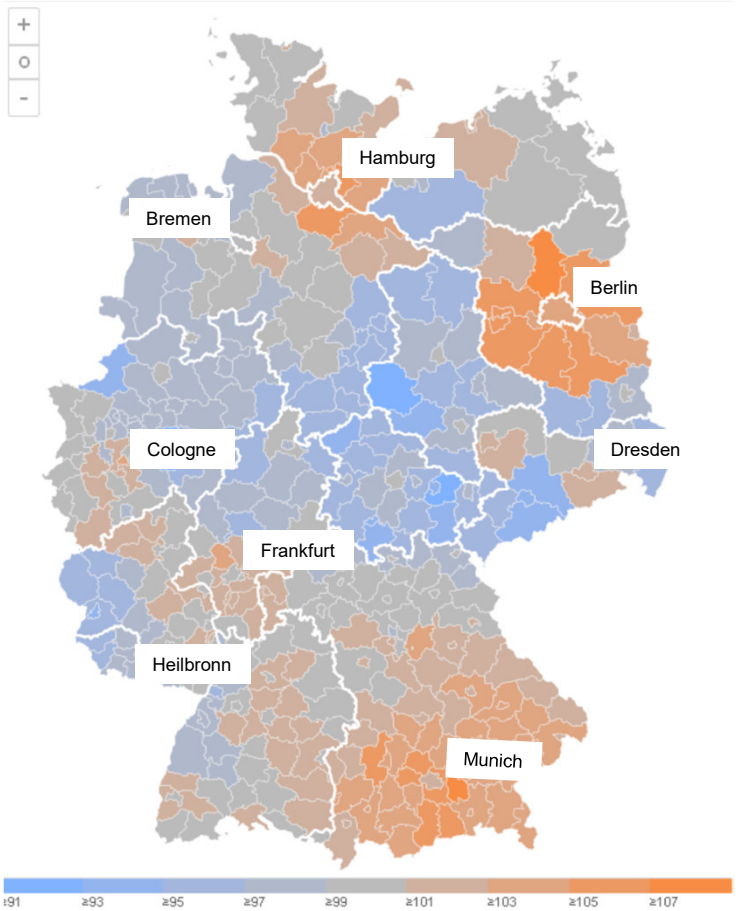

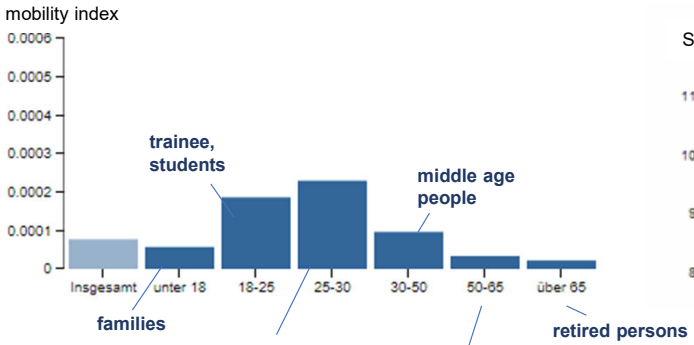

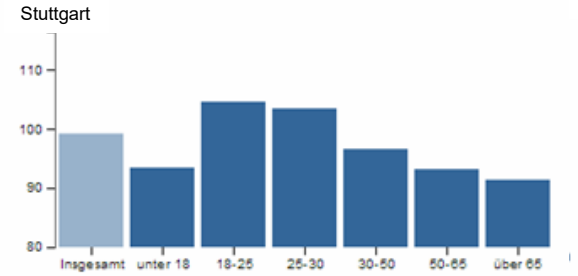

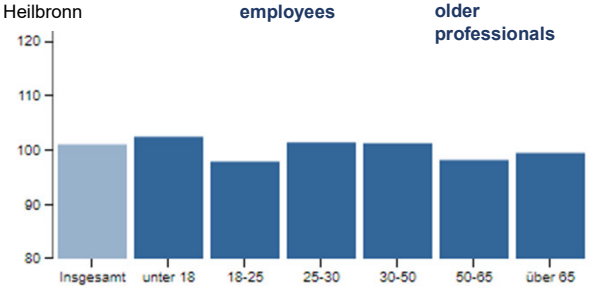

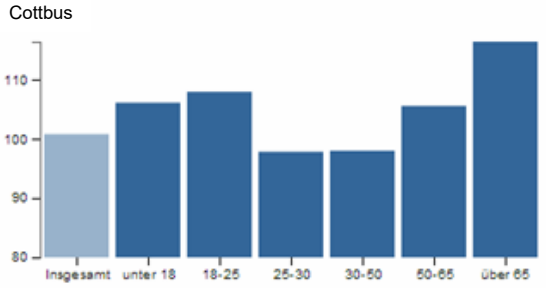

attractiveness
for young people
below average

Strength of spatial interaction: Cities of Heilbronn (left) and Stuttgart (right) with other districts

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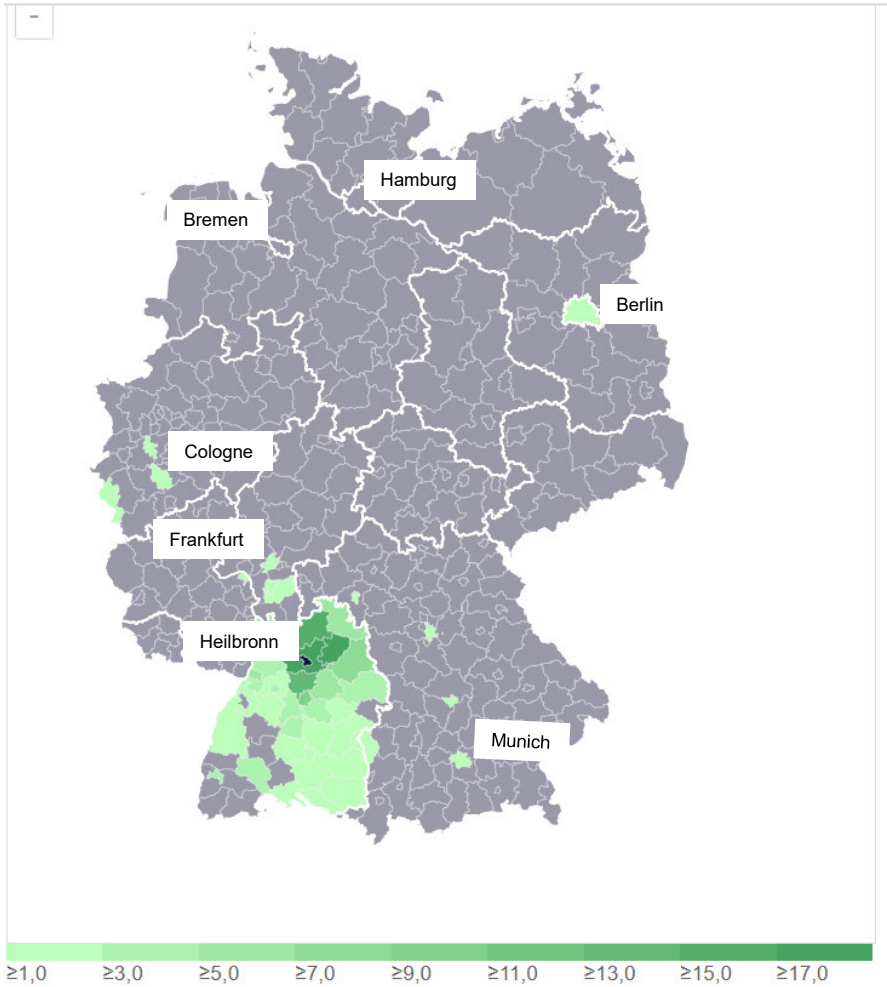

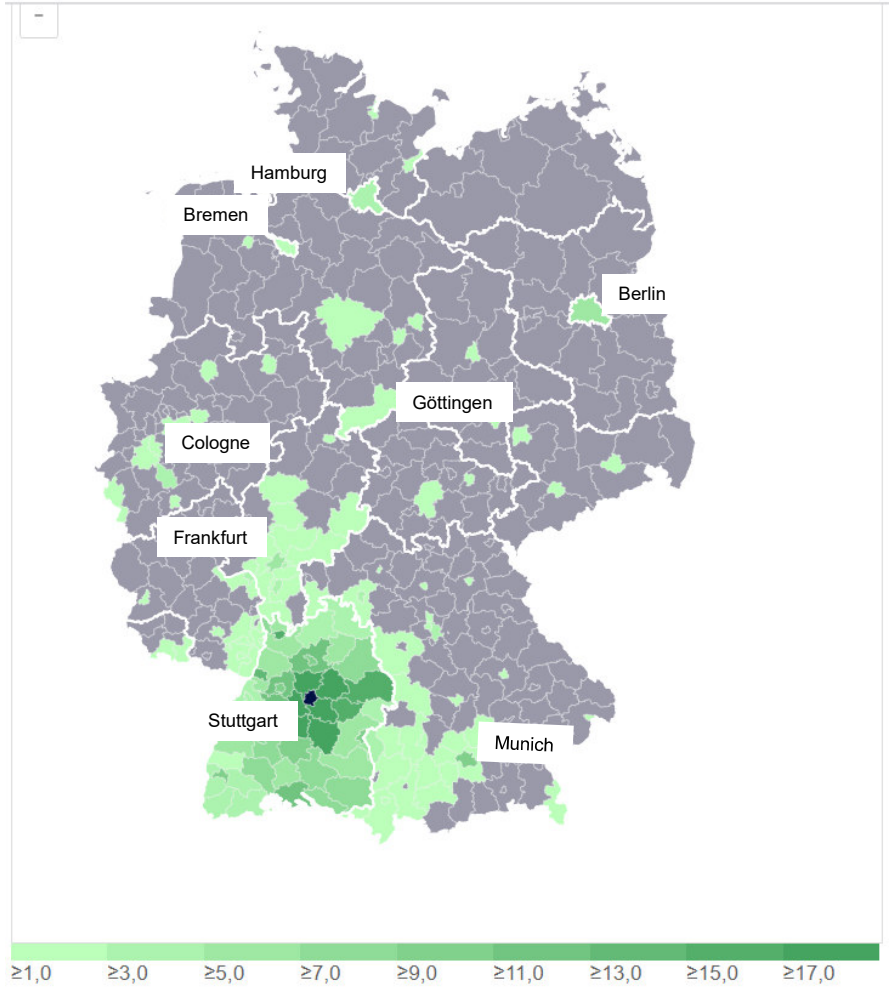

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Thank You for your attention