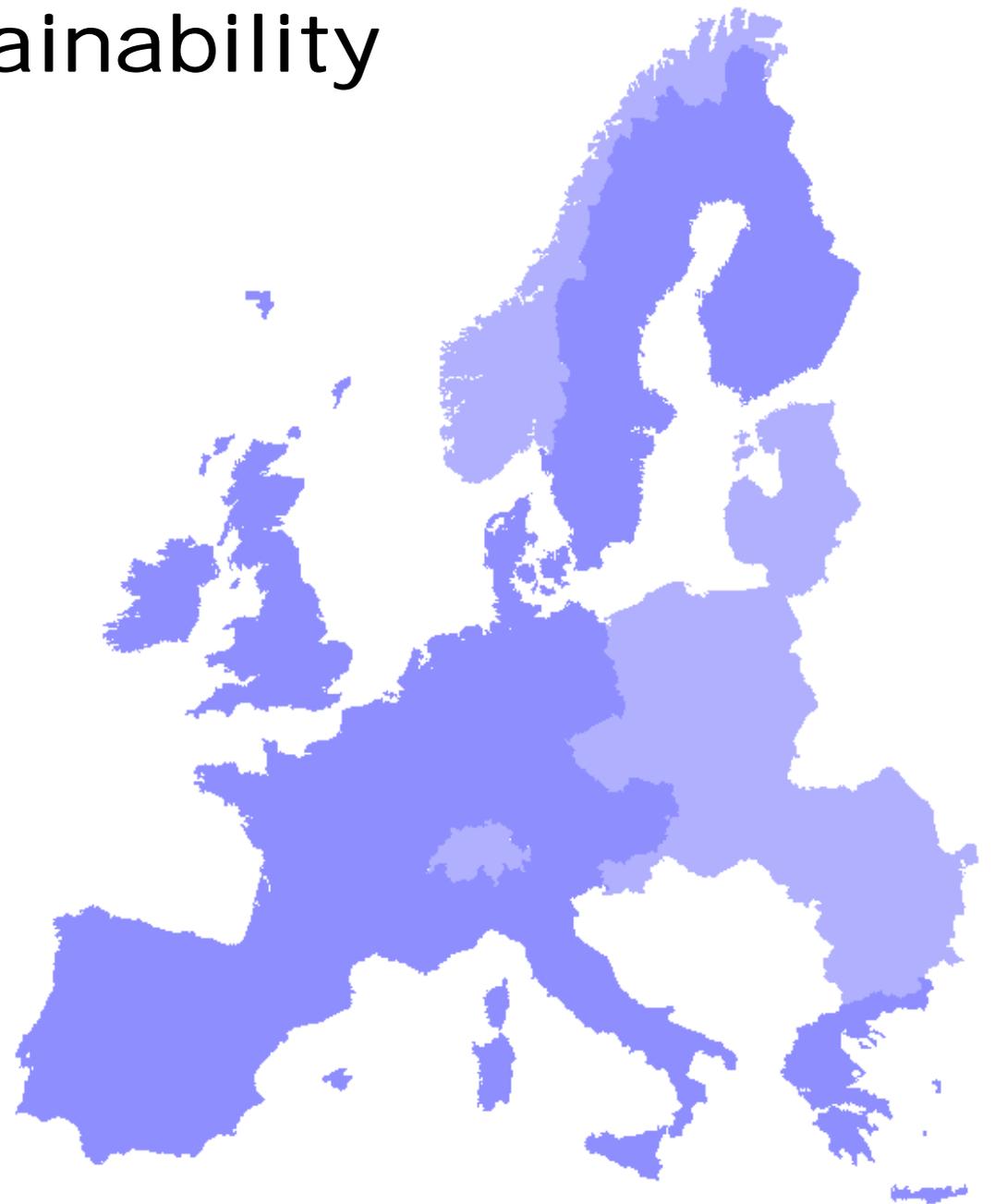# Modelling Sustainability in Europe

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Institute of Spatial Planning
University of Dortmund

3rd Oregon Symposium
on Integrated Land Use
and Transport Models
Portland, 23-25 July 2002

Sustainability issues in Europe

Europe is **different** *from* North America:

- **One sixth** of area but **one third more** population.

- Population density **four times** as high.

- **30%** of motorway km and **40%** of total km per capita per year.

- **40%** less cars per capita

- **50%** of urban trips public transport or walk.

- Percent people exposed to **traffic noise** >65 dBA twice as high.

- Common tradition that **public transport** is a responsibility of government and deserves to be subsidised.

Sustainability issues in Europe

Europe is *similar* to North America:

- Pesonbal mobility **doubled** since 1970.

- Nearly all extra mobility **by ca**r.

- **Freight** traffic has almost tripled.

- Freight traffic **by rail** declined from 32% to 16%.

- Southern Europe: urban-rural migration: **unregulated** sprawl.

- Northern Europe: welath-generated suburbanisation.

- Consequences:
  - **longer** trips, more **car** trips
  - more **congestion**
  - more **greenhouse gases**, more **air pollution**
  - more loss of **open space** and **natural habitats**.

Sustainability issues in Europe

This trip pays!

»For these prices and this huge choice I would drive anywhere. The travel costs are easily recovered!«

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Sustainability issues in Europe

Policy responses:

- *Local* policies:
  - *car restraint* schemes in residential areas (NL)
  - extensive networks of **cycling lanes** (NL)
  - *pedestrianised* shopping centres (NL)
  - area-wide **speed limits** of 30 km/h (D)
  - *public-transport oriented* land use planning (NL, GB, DK, S)
  - local government **land management** (NL)

- *Government* policies:
  - *fuel price*s four times higher than in the US
  - European **road pricing** for lorries planned
  - *emission control* legislation lagging behind North America
  - proclaimed **emission reduction goals** not achieved

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Sustainability issues in Europe

European *policy documents* (selection):

- *'Green Book'* Sustainable Urban Development (1998):

  "... to protect and improve the urban environment: towards local and global sustainability" by "more environmental sustainable cities: avoid imposing costs of development to their immediate environment, surrounding rural areas, regions, the planet itself and future generations".

- Protocol to the UN Climate Change Convention (1997):

  ... reduce emission of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 by 8% of 1990 levels by 2012.

- Developing the citizens' network (1998):

  "... support the role of local and regional passenger transport in contributing to economic development and employment, reducing congestion, using less energy, producing fewer pollutants, making less noise, reducing social exclusion and improving quality of life".

Sustainability issues in Europe

Twenty experts familiar with the location behaviour of households and firms and with urban real-estate markets were interviewed in 2001.

The experts represented views from seven countries

- Belgium (2)
- Finland (4)
- Germany (3)
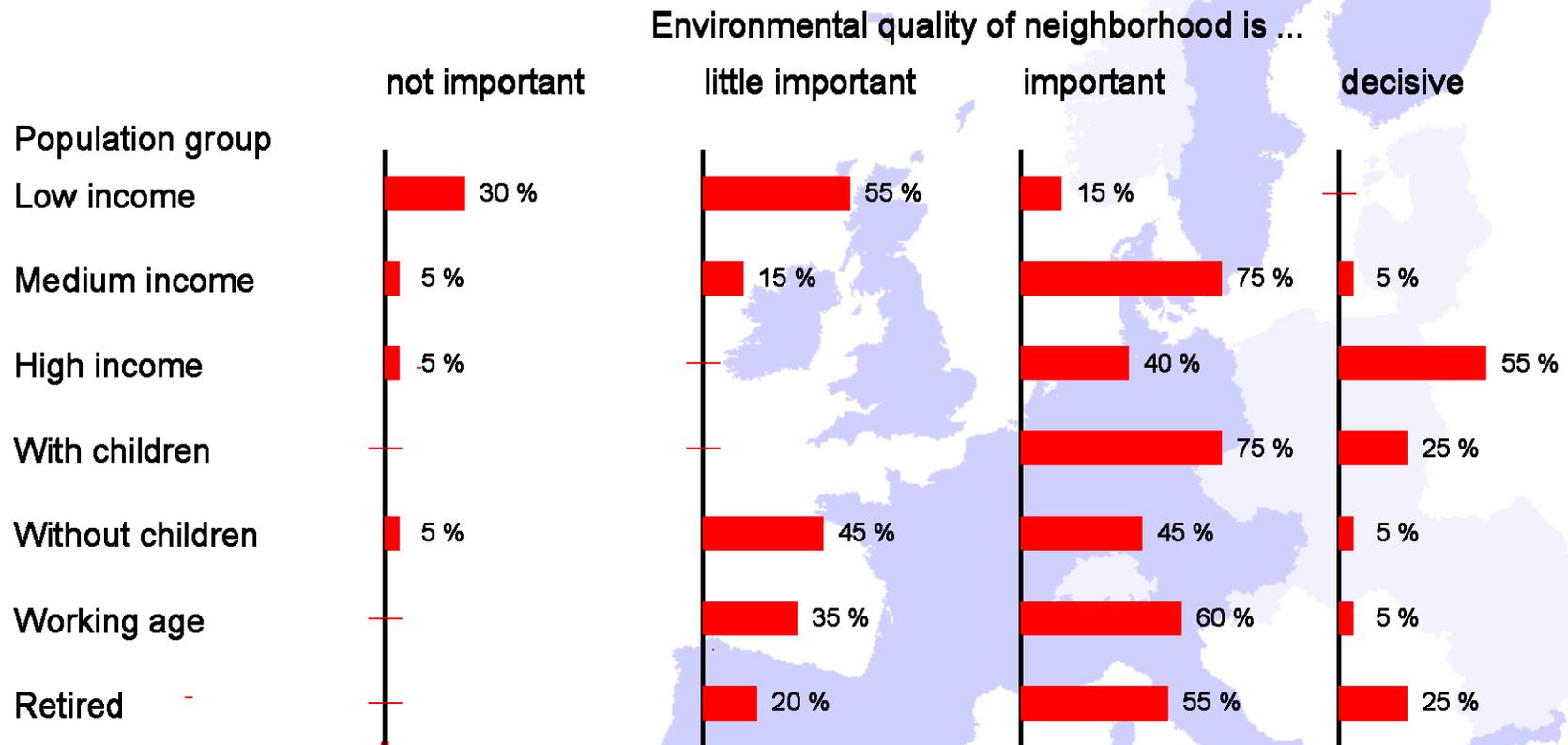- Italy (5)
- Spain (4)
- United Kingdom (2)

and from the following fields or professions:

- public administration (7)
- real estate (4)
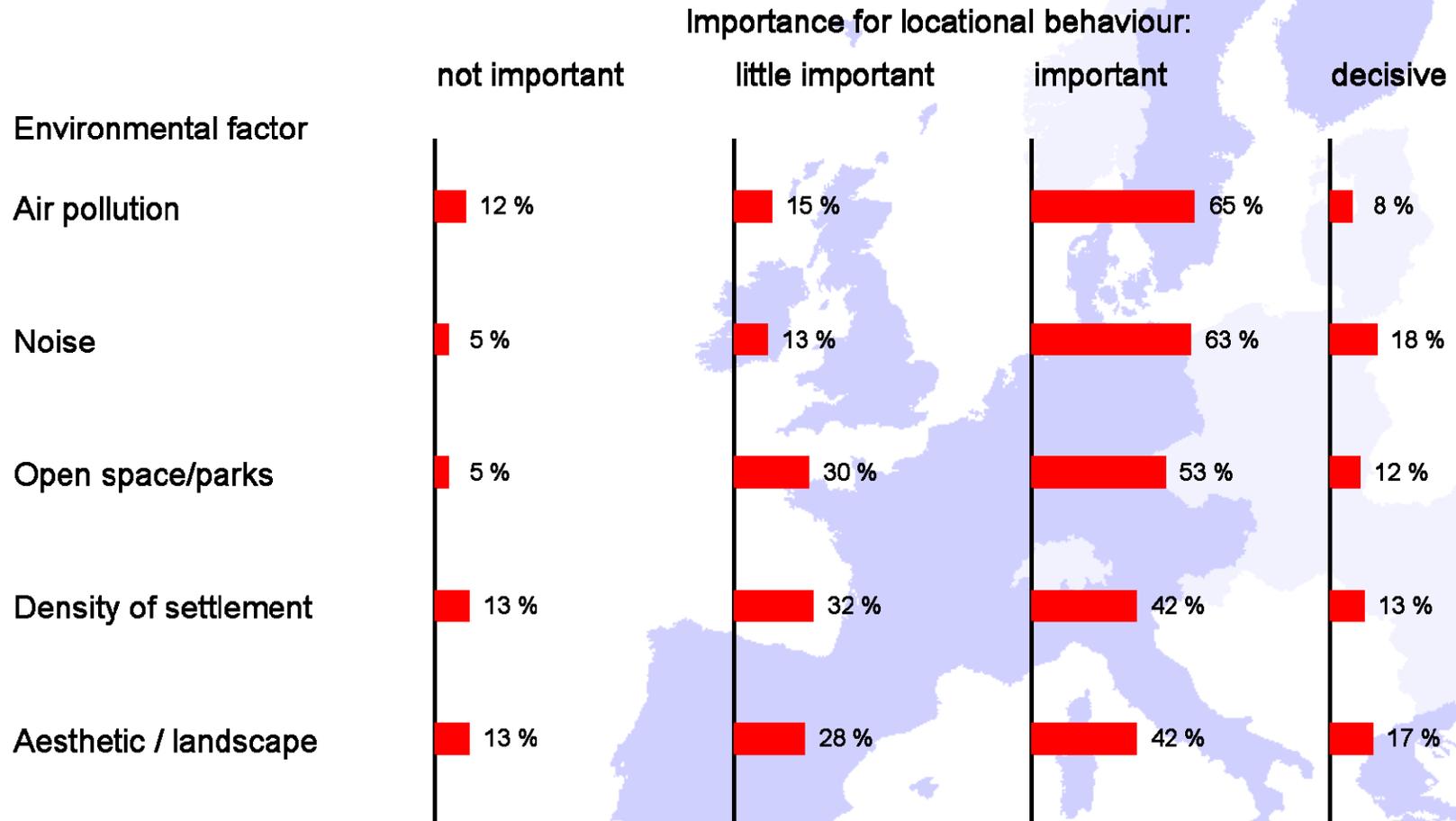- consulting (5)
- university (5)

Sustainability issues in Europe

Environmental quality of the neighbourhood is *important* or *decisive* for the location choice of households.
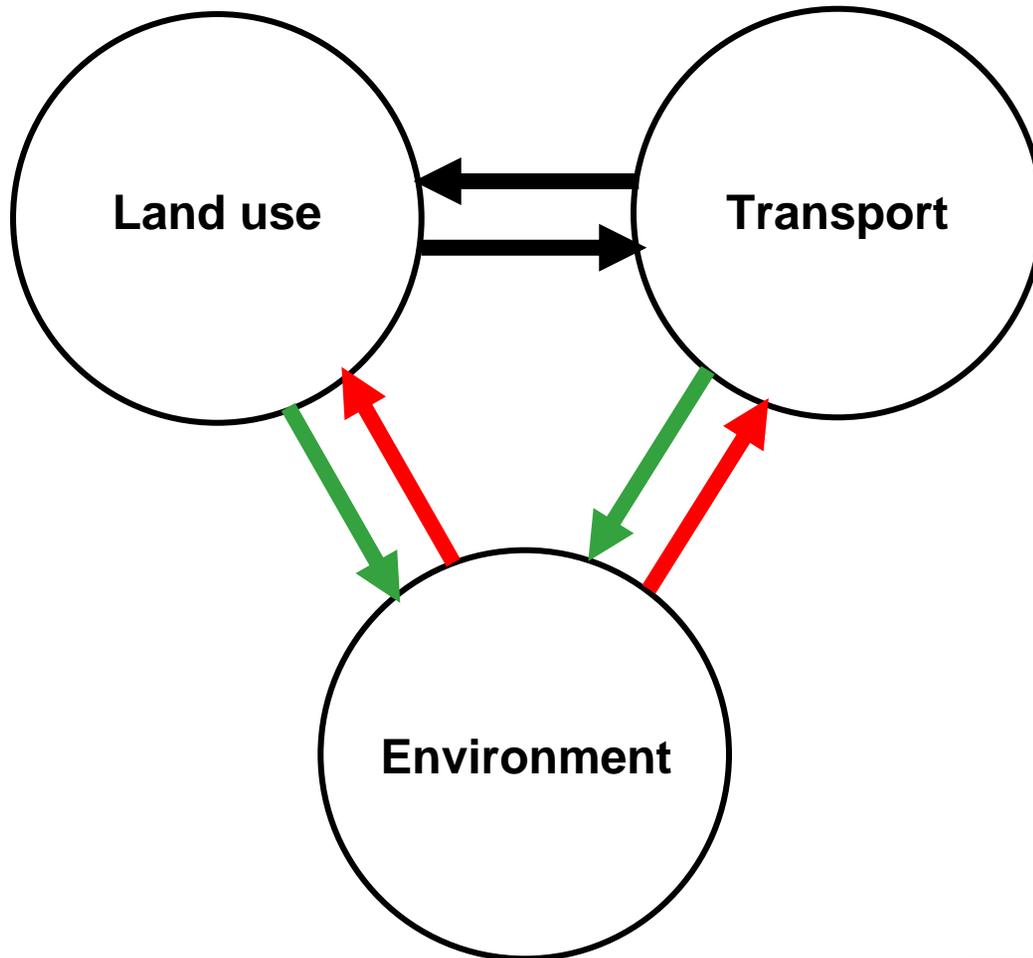
Environmental quality of neighborhood is ...

Population group	not important	little important	important	decisive
Low income	30 %	55 %	15 %	
Medium income	5 %	15 %	75 %	5 %
High income	5 %		40 %	55 %
With children			75 %	25 %
Without children	5 %	45 %	45 %	5 %
Working age		35 %	60 %	5 %
Retired		20 %	55 %	25 %

Sustainability issues in Europe

Clean air, ***absence of noise*** and ***good access to open space*** are the most important environmental factors for households.

Importance for locational behaviour:

Environmental factor	not important	little important	important	decisive
Air pollution	12 %	15 %	65 %	8 %
Noise	5 %	13 %	63 %	18 %
Open space/parks	5 %	30 %	53 %	12 %
Density of settlement	13 %	32 %	42 %	13 %
Aesthetic / landscape	13 %	28 %	42 %	17 %

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Modelling sustainability

Land use

Transport

Environment

Environmental impacts

Environmental feedback

Modelling sustainability

Evironmental impacts

○ weak impact

● strong impact

Evironmental feedback

○ weak impact

🔴 strong impact

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Cause \ Effect	Land use	Transport	Energy	Water	Land	Vegetation	Wildlife	Microclimate	Greenhouse gases	Air pollution	Water pollution	Soil contamination	Solid waste	Noise	Air quality	Surface water flows	Ground water flows	Noise propagation
Land use	●	●	●	●	●	●	●	●	●	●	○	●	●	●	●	●	●	●
Transport	●	●	●		●	○	○		●	●	○	○	○	●	●			●
Energy	○	○	●						●	●					●			
Water				●												●	●	
Land (open space)	🔴			●	●	●	●	●								●	●	○
Vegetation	○			○		●	●	●	●									●
Wildlife							●											
Microclimate	○					○	○	●										
Greenhouse gases									●									
Air pollution								●		●					●			
Water pollution				●		●					●					●	●	
Soil contamination	○			●	●	●					●	●						
Solid waste	○			○	○								●	●		●		
Noise														●				●
Air quality	🔴					●	○	●		○	○				●			
Surface water flows				●	●	●	●	●								●	●	
Ground water flows				●	●	●	●	●								●	●	
Noise propagation	🔴							●										●

Column groups: Resources (Energy, Water, Land, Vegetation, Wildlife, Microclimate); Emissions (Greenhouse gases, Air pollution, Water pollution, Soil contamination, Solid waste, Noise); Immissions (Air quality, Surface water flows, Ground water flows, Noise propagation).

Row groups: Resources; Emissions; Immissions.

Modelling sustainability

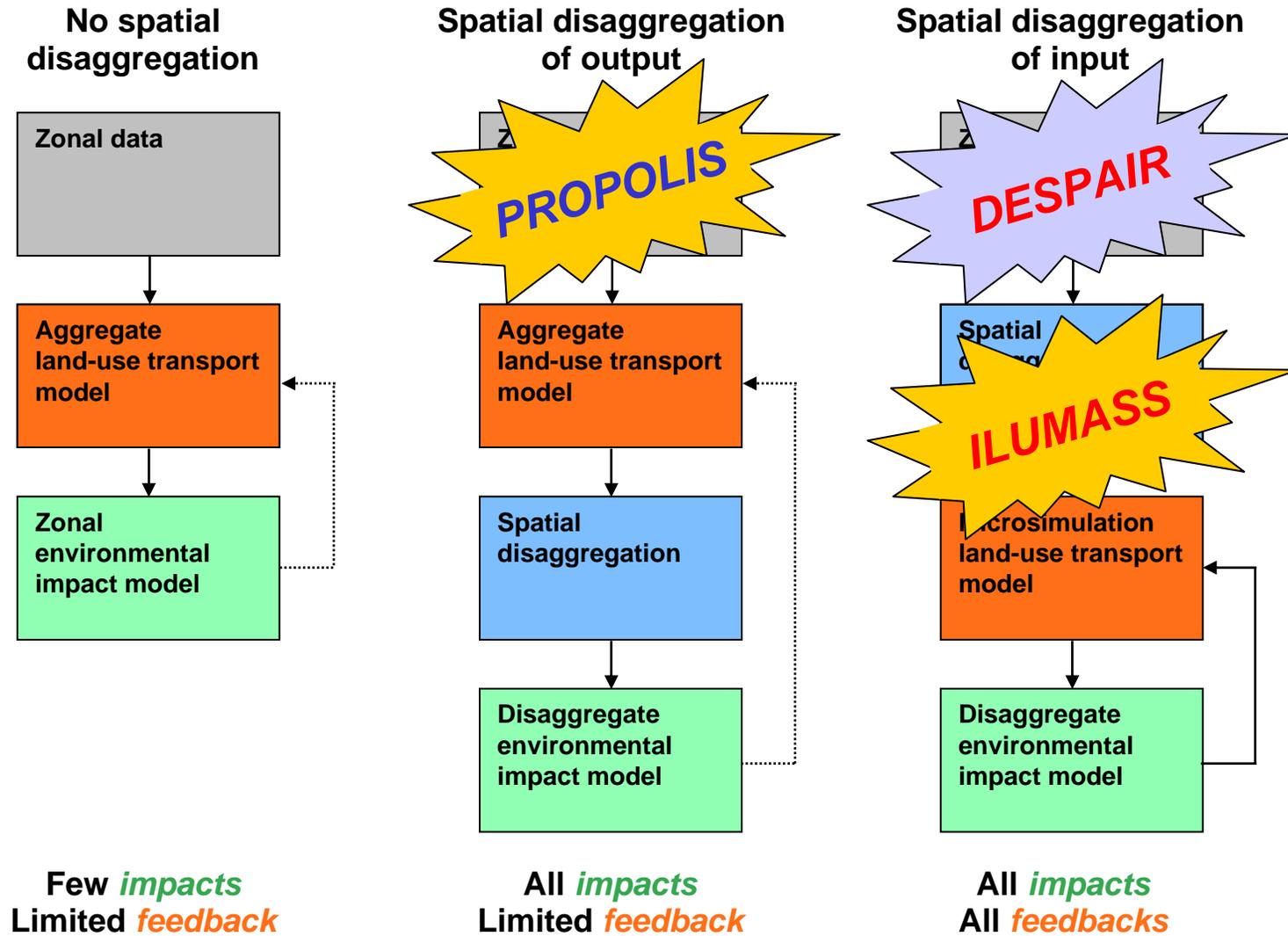*Environmental models (examples)*:

Air distribution models

- model the two- or threedimensional distribution of pollutants from emission sources with or without photochemical reaction.

- require raster data of emission sources and topographical features such as elevation and surface characteristics such as green space, built-up area and high-rise buildings.

Noise propagation models

- model the propagation of noise from emission sources with or without single or multiple reflection.

- require spatially disaggregate data on emission sources, topography, land cover and sound barriers such as dams, walls or buildings.

Existing land-use transport models lack the *spatial resolution* required by environmental models.

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Modelling sustainability

No spatial disaggregation	Spatial disaggregation of output	Spatial disaggregation of input
Zonal data	Zonal data — **PROPOLIS**	Zonal data — **DESPAIR**
Aggregate land-use transport model	Aggregate land-use transport model	Spatial data — **ILUMASS**
Zonal environmental impact model	Spatial disaggregation	Microsimulation land-use transport model
	Disaggregate environmental impact model	Disaggregate environmental impact model
Few *impacts* **Limited** *feedback*	**All** *impacts* **Limited** *feedback*	**All** *impacts* **All** *feedbacks*

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PROPOLIS

*Planning and Research of Policies for Land Use
and Transport for Increasing Urban Sustainability*

Objectives

- to research, develop and test **integrated land use and transport policy assessment tools** and methodologies to define **sustainable urban strategies** and to demonstrate their long-term effects,

Partners

- **LT Consultants Ltd.**, Helsinki (Coordinator)
- **Institute of Spatial Planning**, University of Dortmund
- **Spiekermann and Wegener (S&W)**, Dortmund
- **University College London**, London
- **Marcial Echenique & Partners Ltd.**, Cambridge
- **Trasporti e Territorio srl**, Milan
- **Marcial Echenique y Compañia SA**, Bilbao
- **STRATEC S.A.**, Brussels.

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PROPOLIS

Case study
cities/models
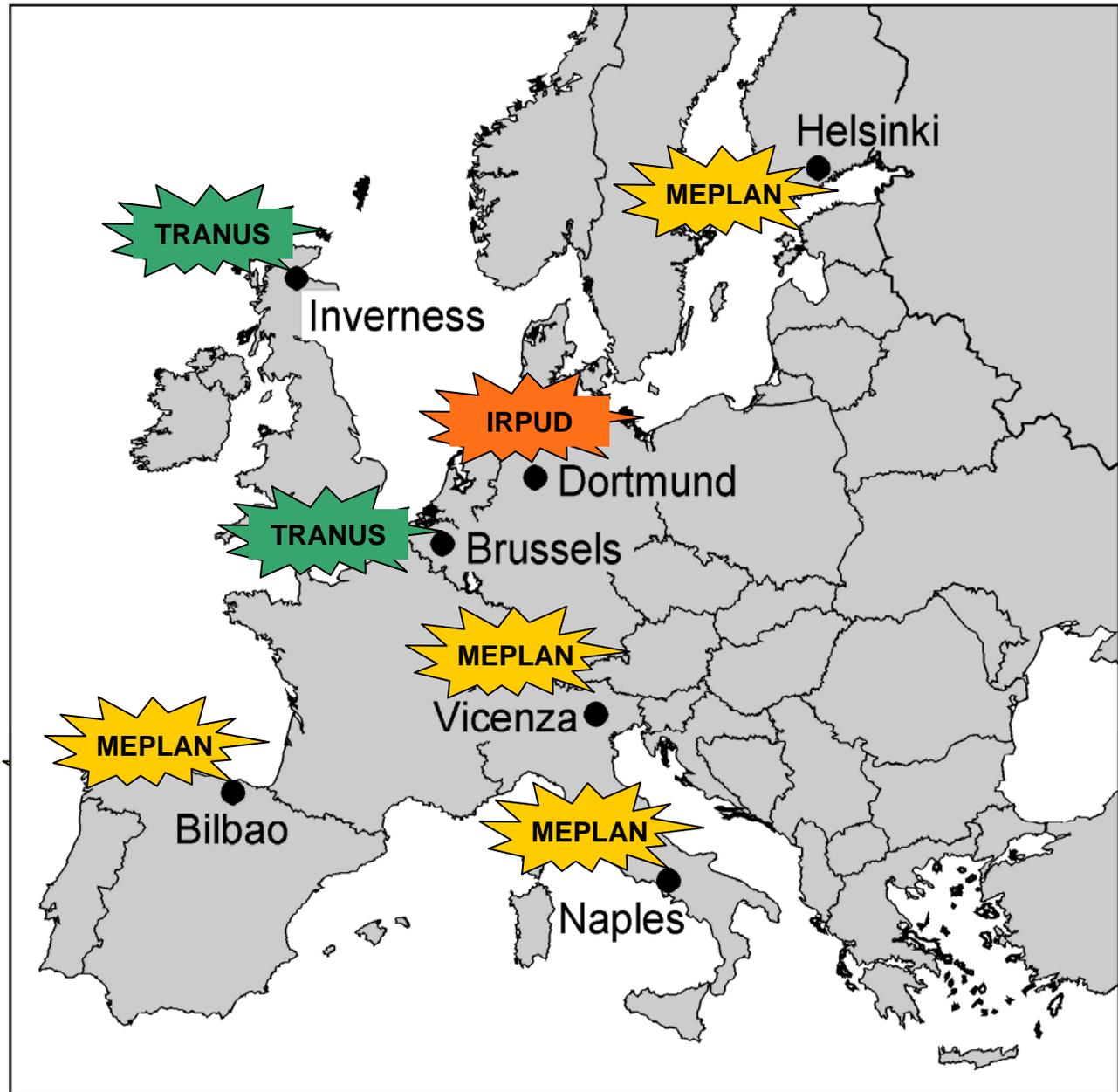
PROPOLIS Dortmund Model
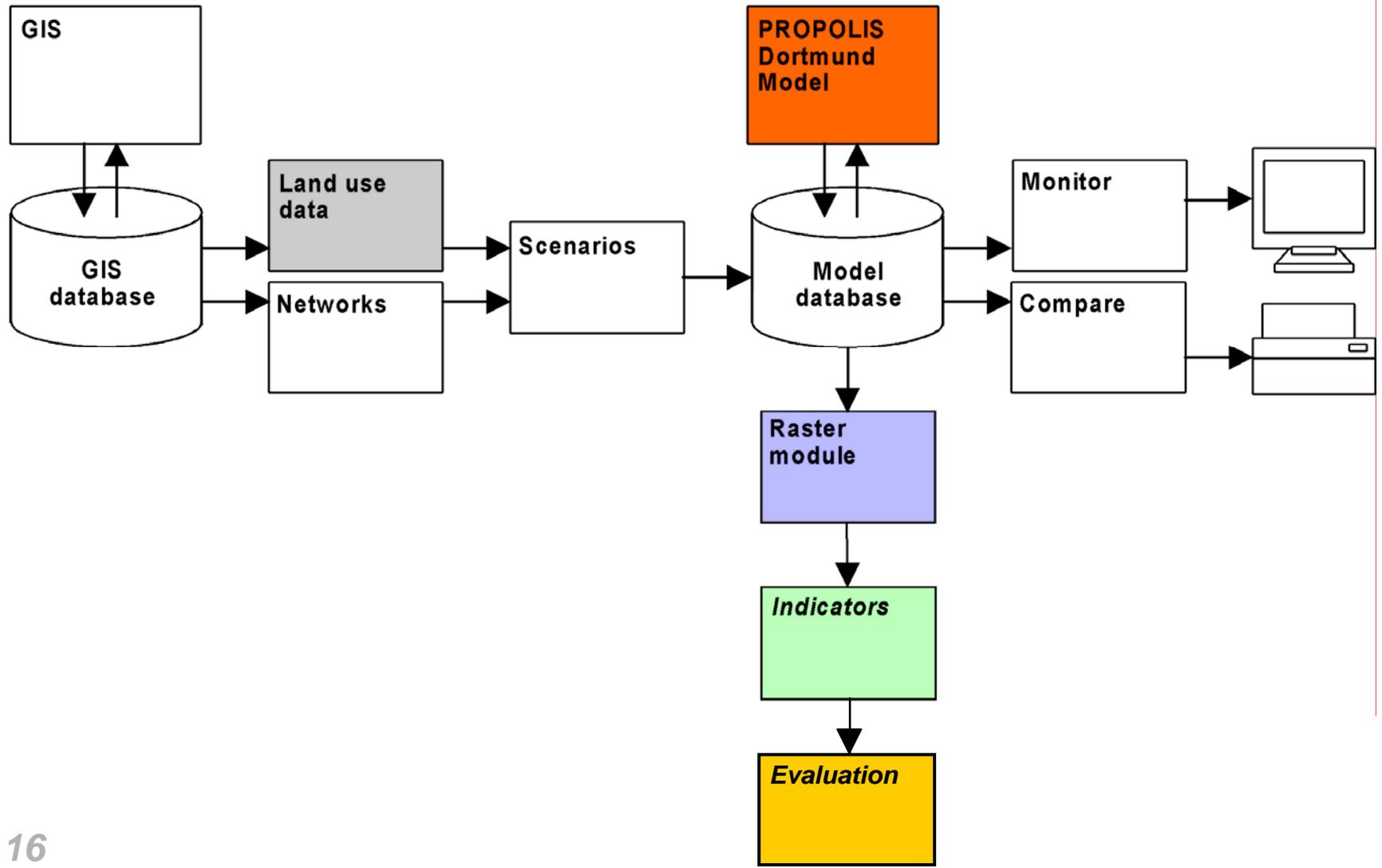
PROPOLIS Dortmund Model

Conversion of zonal data to raster data

Land-use categories

■ Residential high-density

■ Residential low density

■ Industrial

■ Open space

100
50 persons
10

1,487 persons

PROPOLIS Dortmund Model

Conversion of network data to raster data
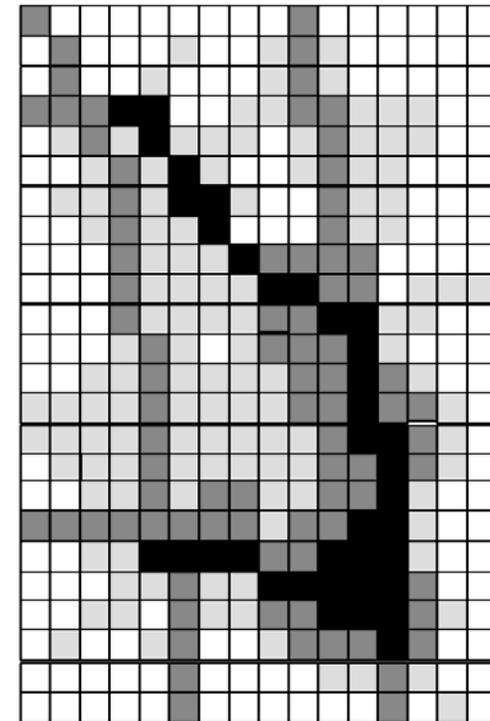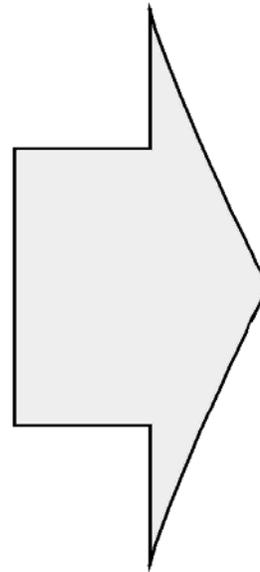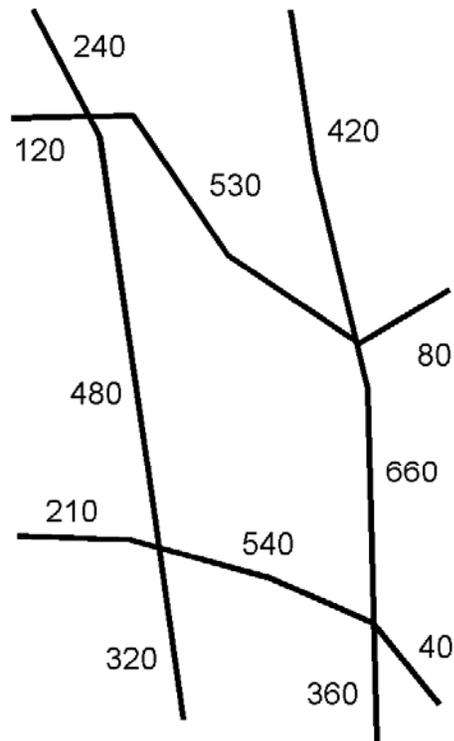
plus car traffic on functional links:
670 car access trips from zone to network
410 car trips from network to zone parking
340 intrazonal car trips

no car traffic
1 - 100 cars
101 - 500 cars
501 - ... cars

PROPOLIS

Sustainability
indiactors

Environmenl	*Climate change*	Greenhouse gases from transport	
	Air pollution	**Acidifying gases from transport**	
		Volatile organic compounds from transport	
	Natural resources	Consumption of mineral oil products	
		Land coverage	
		Need for additional new construction	
	Environmental quality	**Fragmentation of open space**	
		Quality of open space	
Social	*Health*	Exposure to PM from transport at housing	
		Exposure to NO$_2$ at housing	
		Exposure to traffic noise	
		Traffic fatalities	
		Traffic injuries	
	Equity	Justice of distribution of economic benefits	
		Justice of exposure to PM	
		Justice of exposure to NO$_2$	
		Justice of exposure to noise	
		Segregation	
	Opportunities	Housing standard	
		Vitality of city centre	
		Vitality of surrounding region	
		Productivity gain from land use	
	Accessibility and traffic	Total time spent in traffic	
		LOS of public transport and slow modes	
		Accessibility to city centre	
		Accessibility to services	
		Accessibility to open space	
Economic	*Benefit*	Economic benefit	

Population
2021

S&W

**Employment
2021**

21

S&W

Population
2021

22

S&W

S&W

Land use
2021

24

S&W
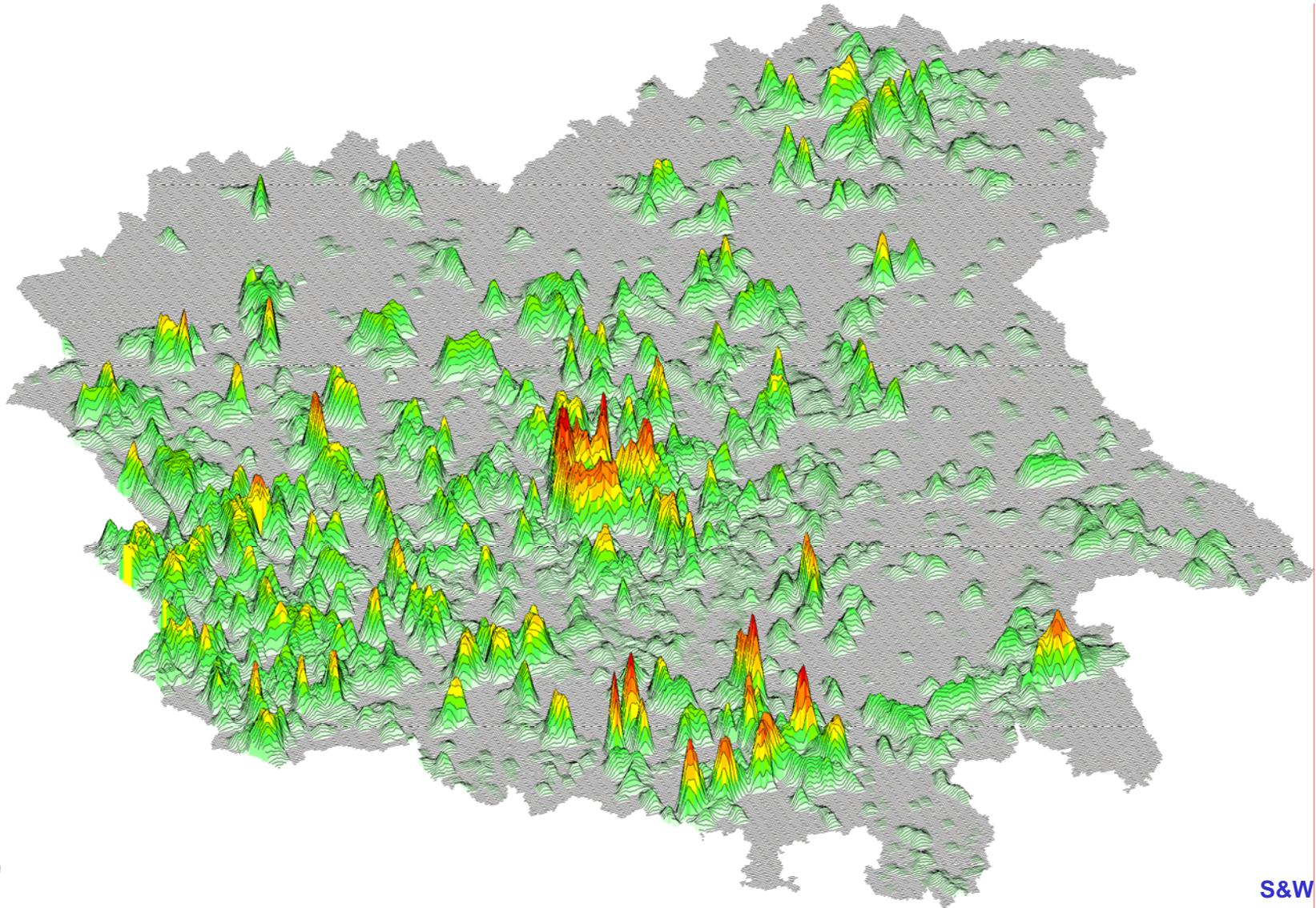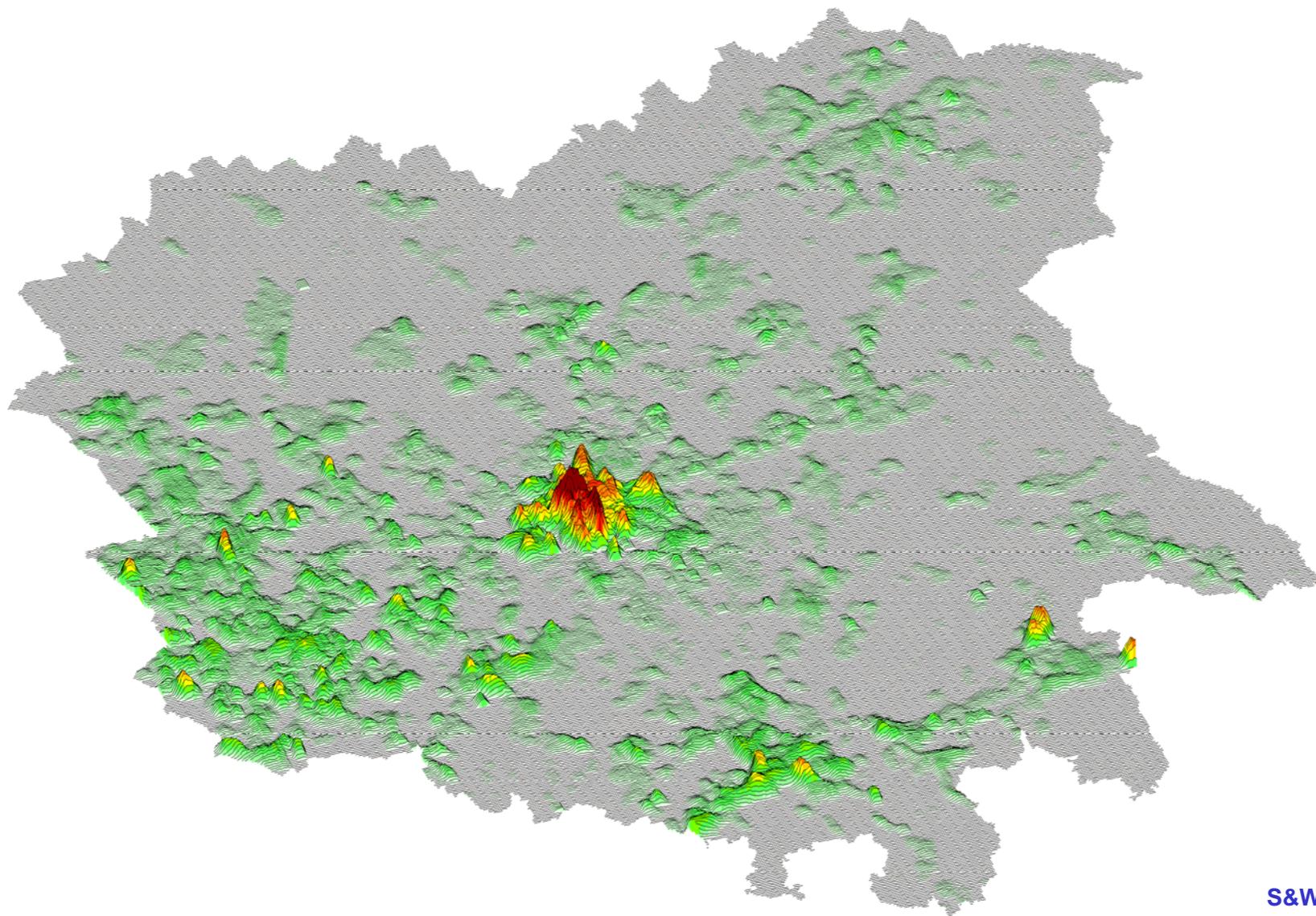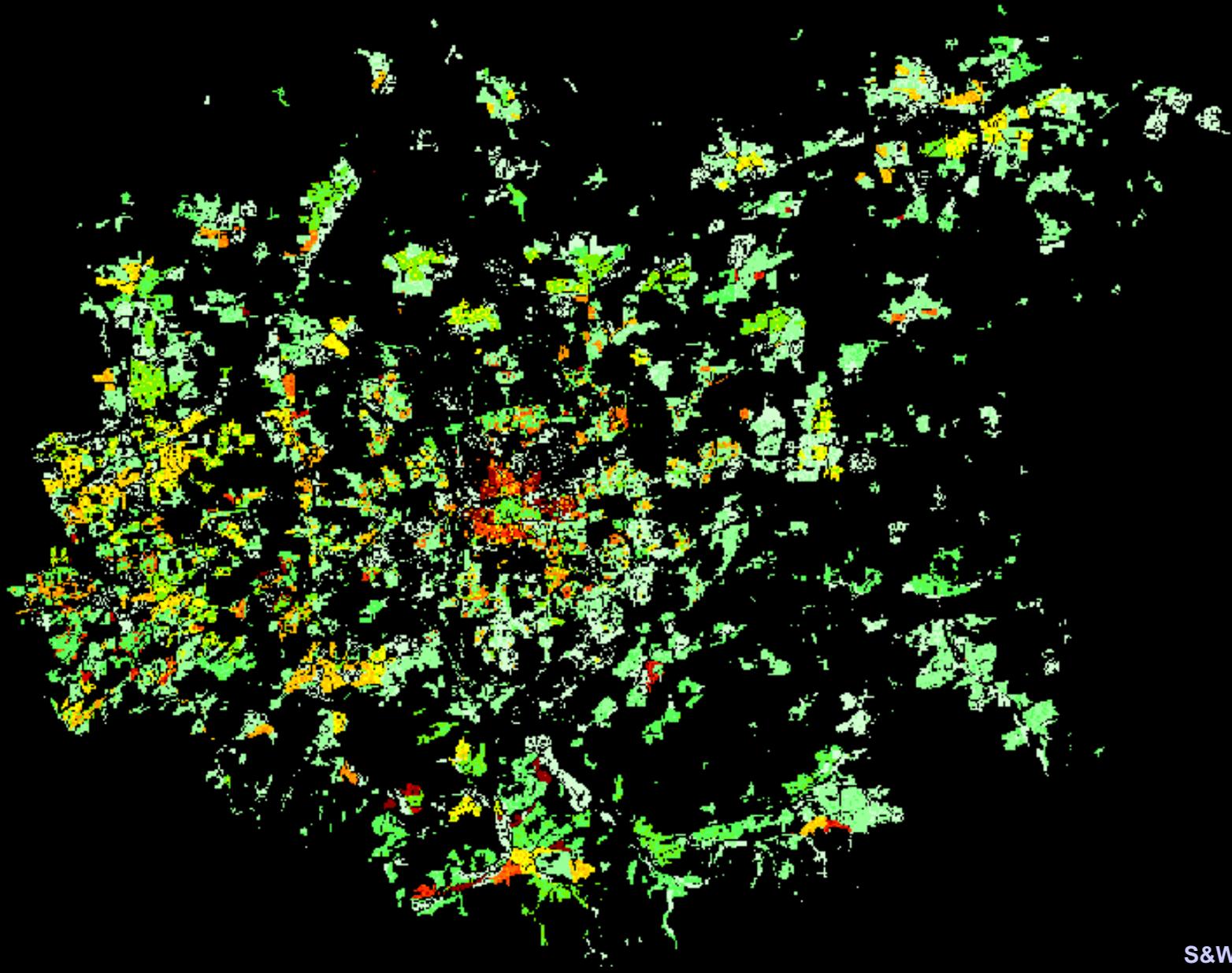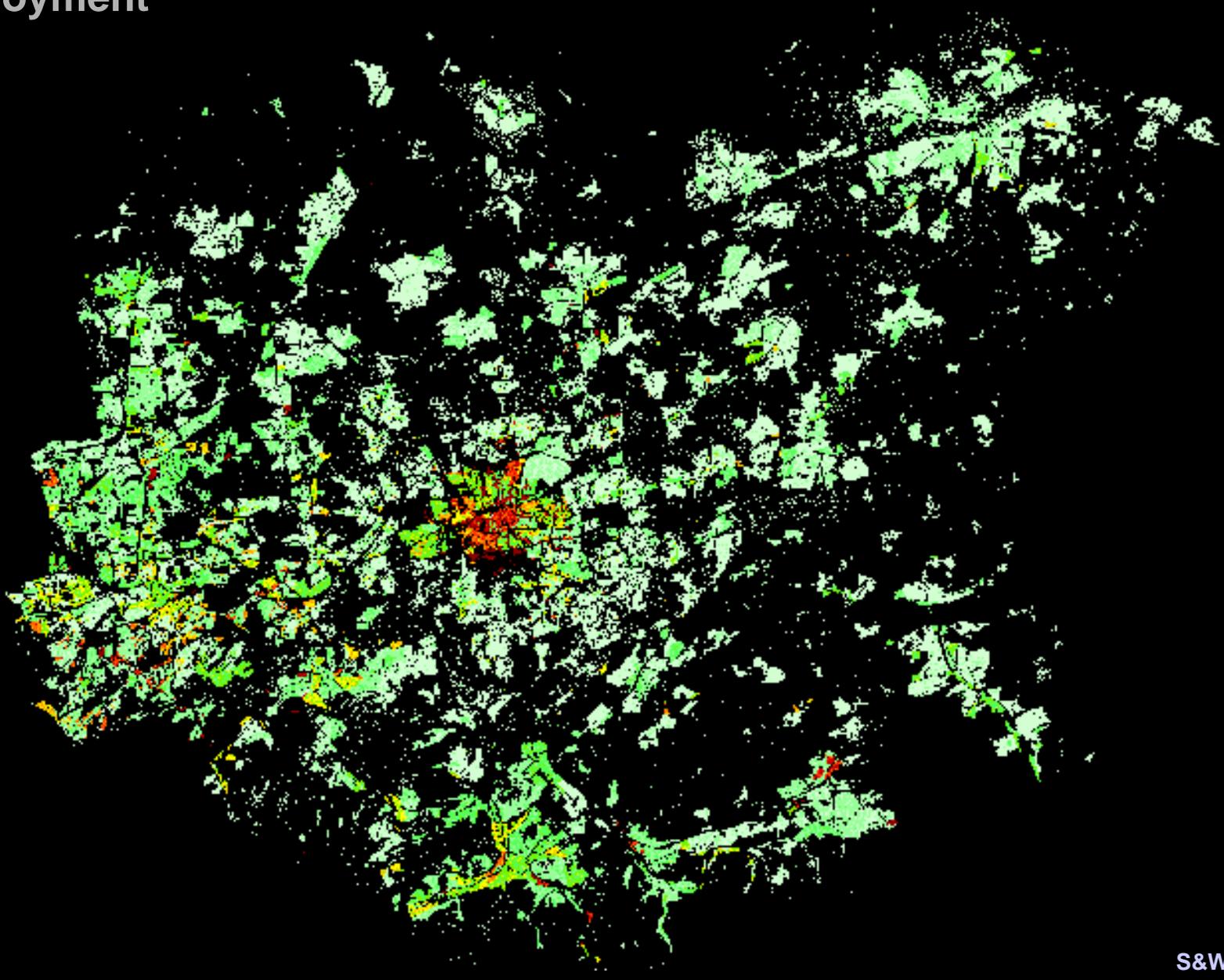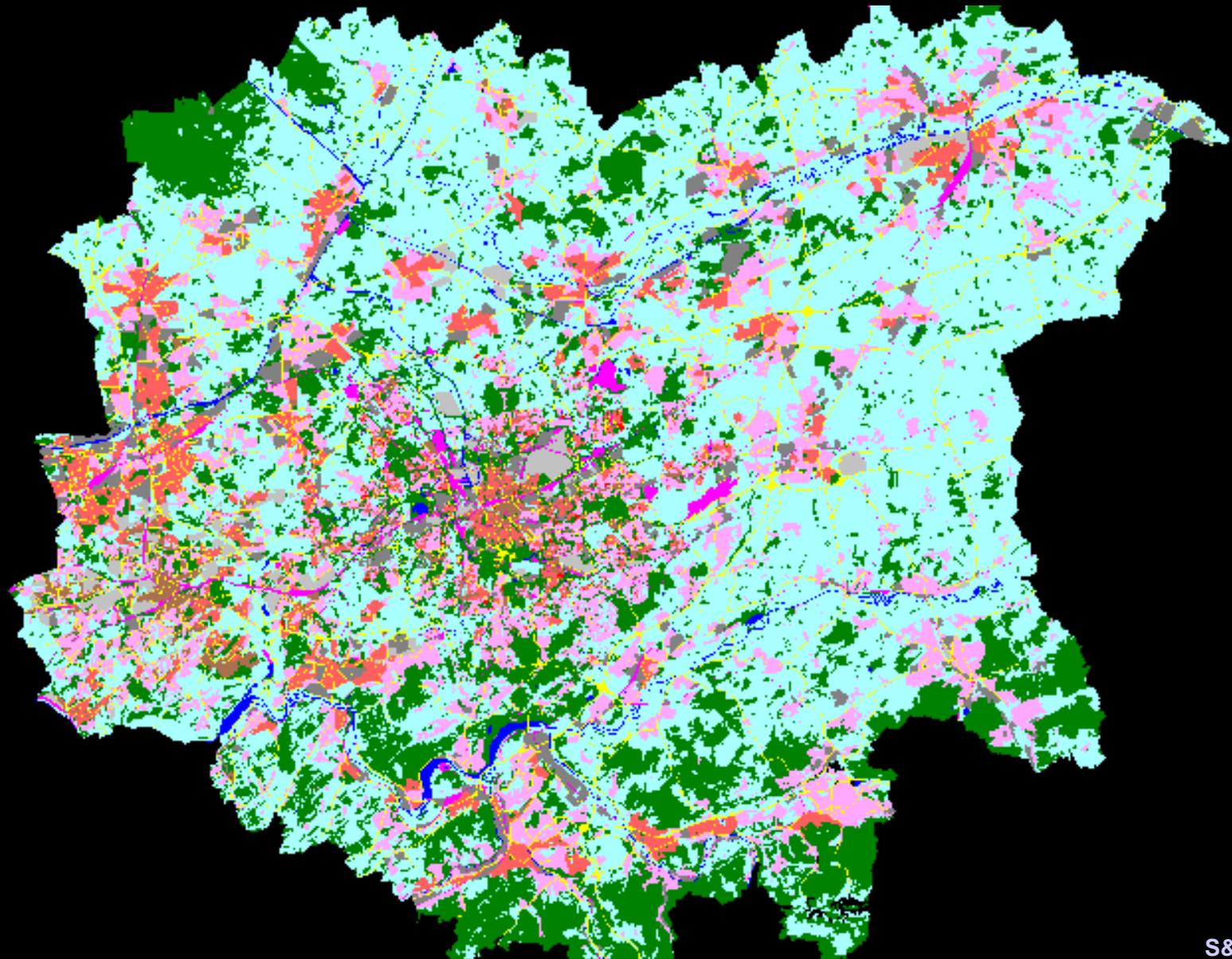
Land coverage
2021

25

S&W

**Link loads
2021**

26

S&W

27
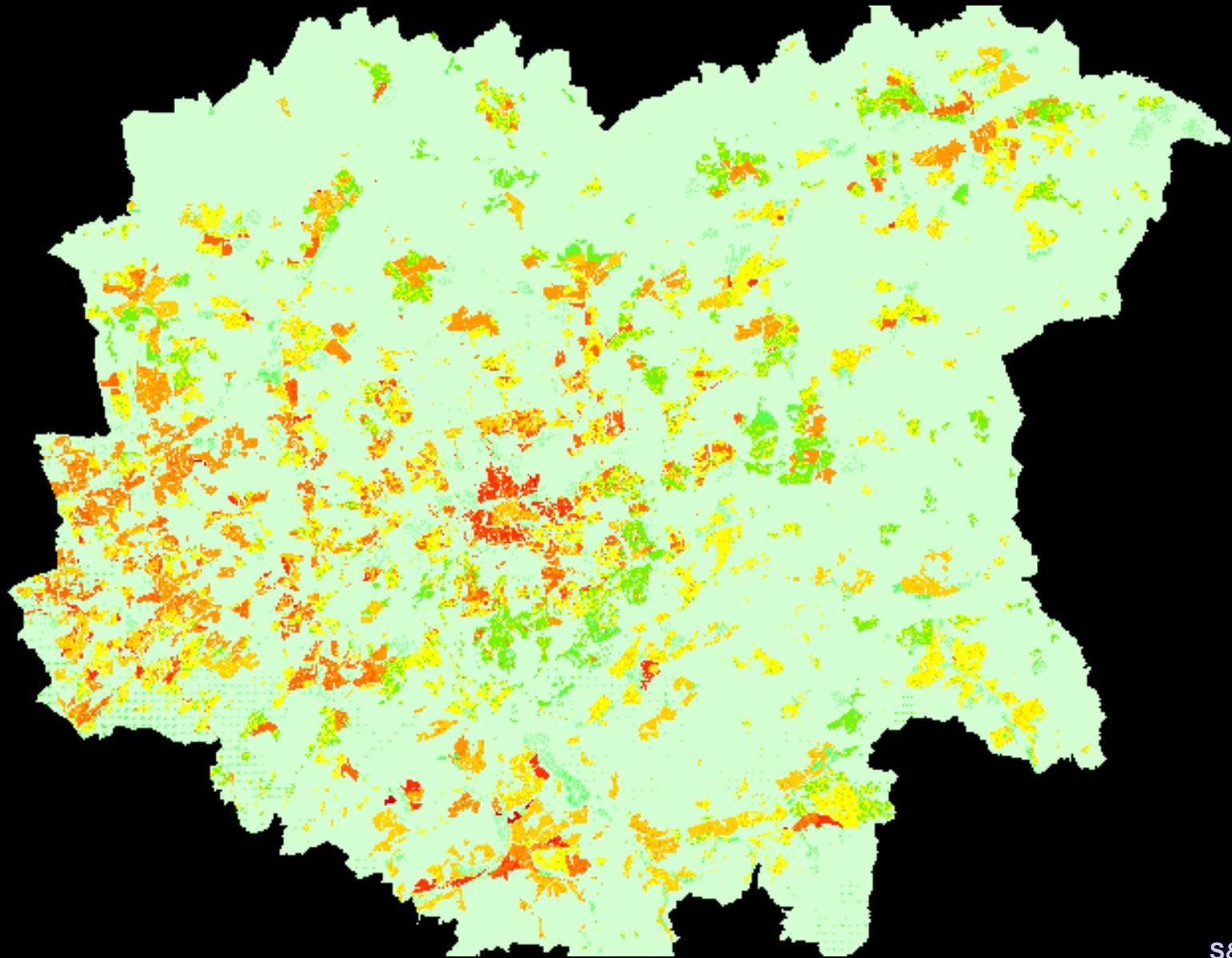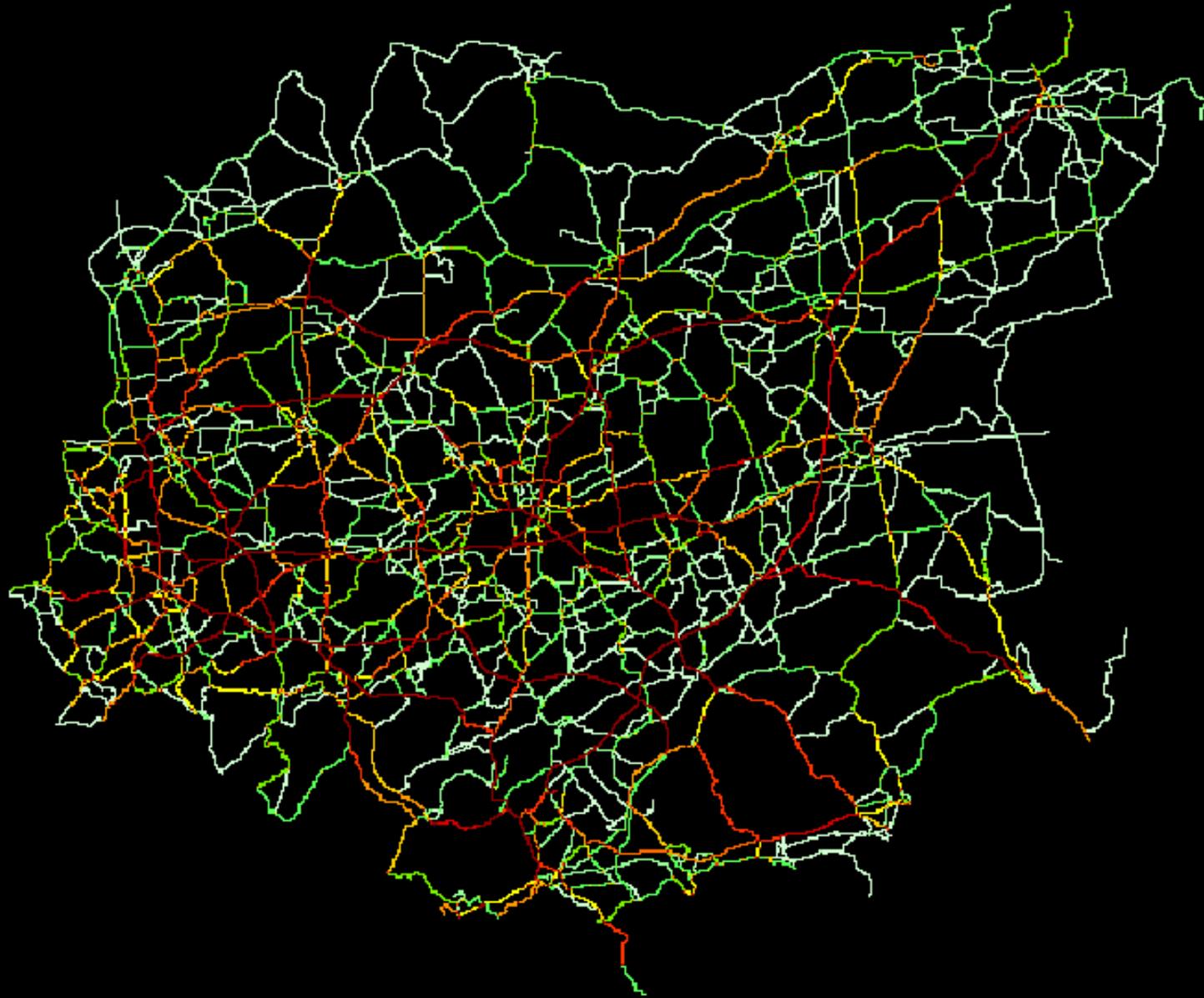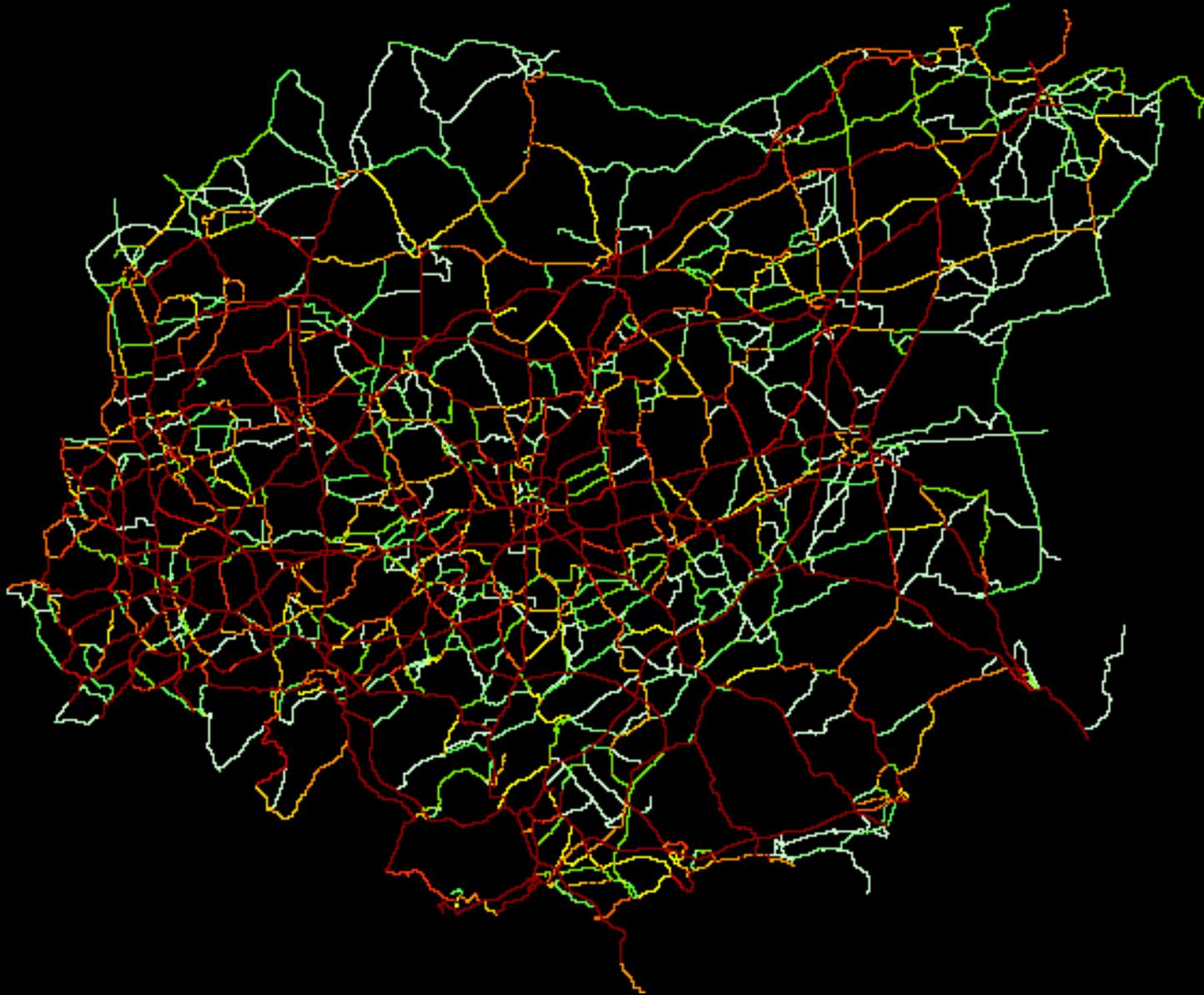
Air quality (NO₂)
2021

28

S&W
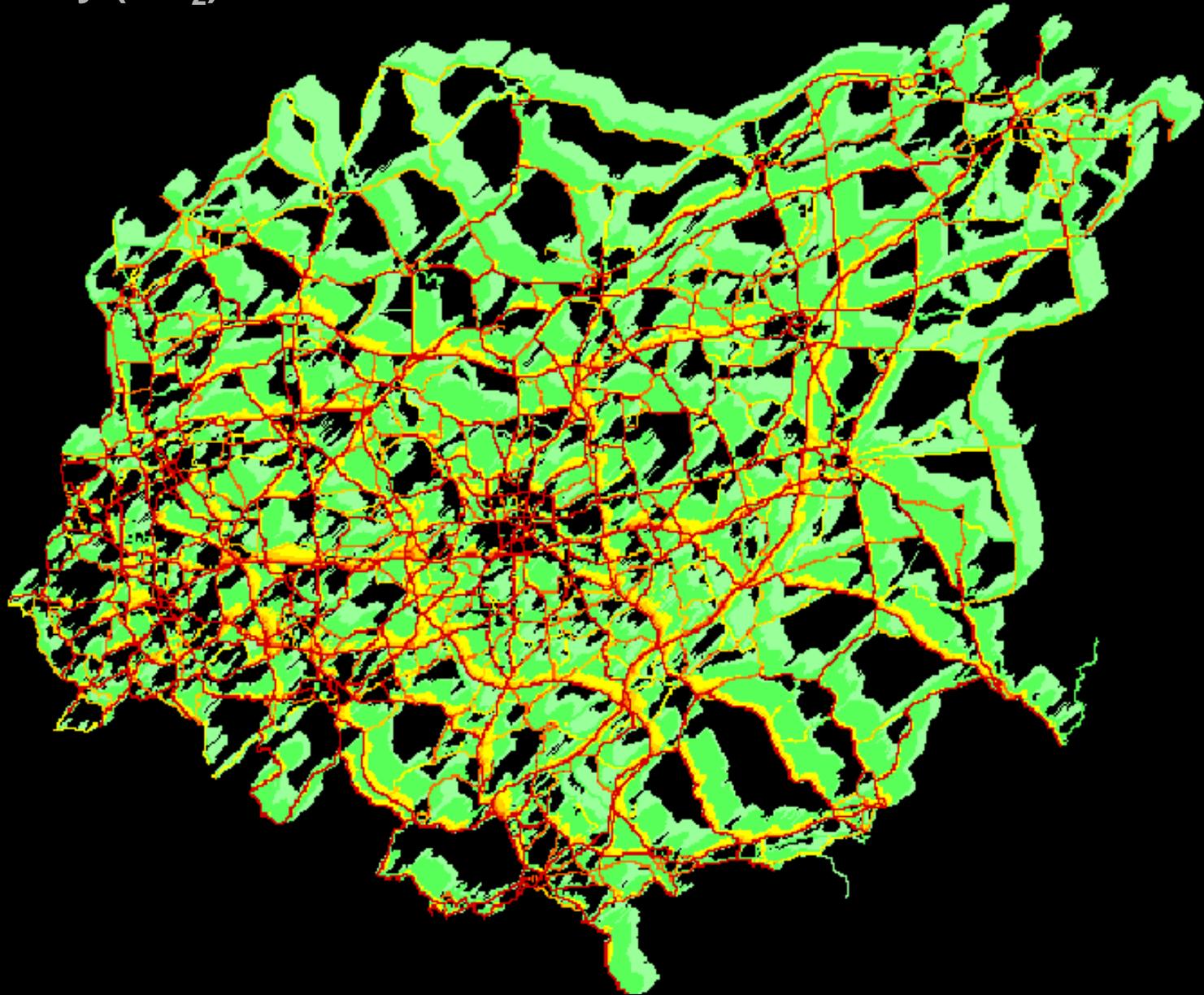
Traffic noise
2021

29

S&W

**Open space
2021**

30

S&W
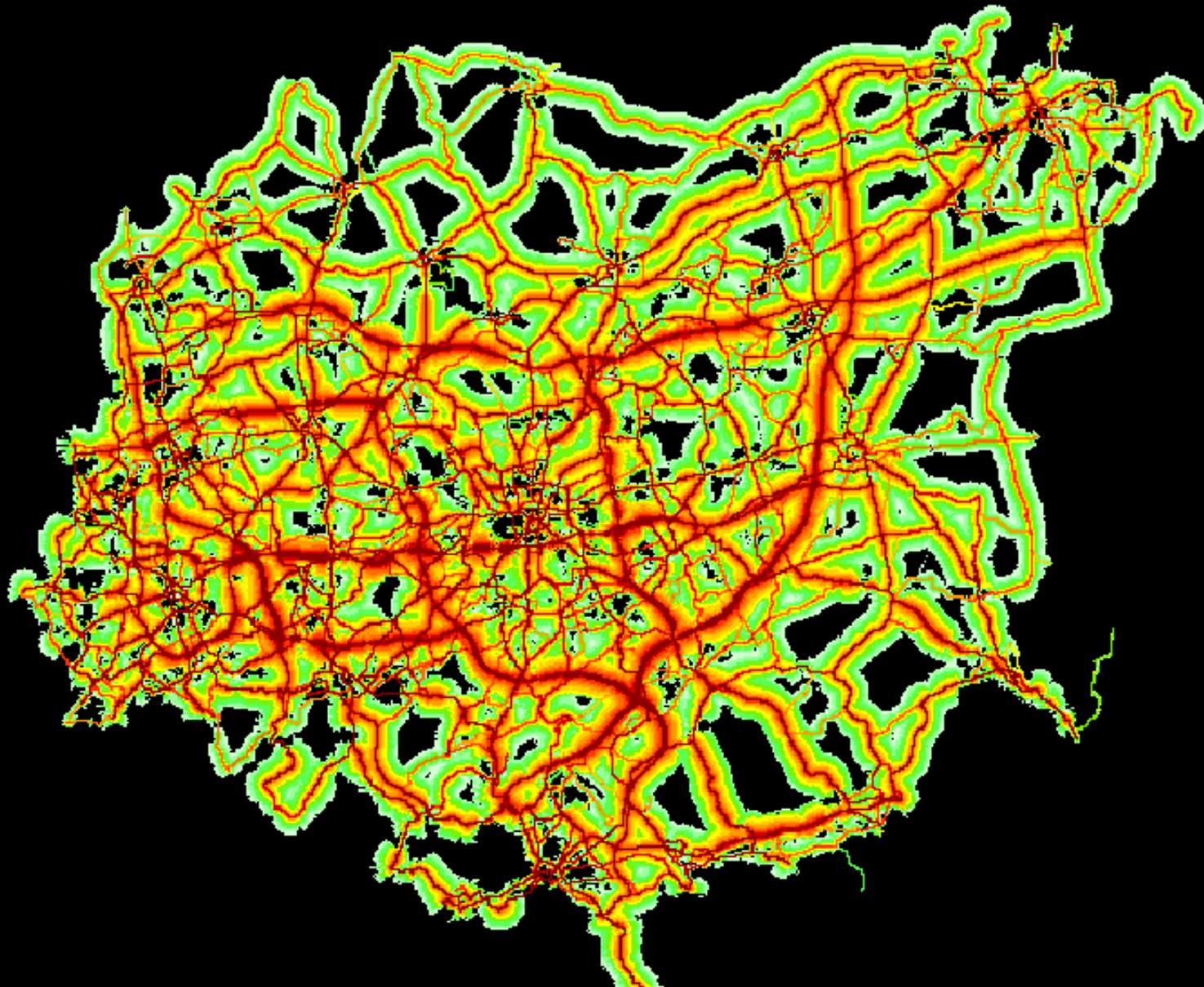
Fragmentation of open space
2021

31

S&W
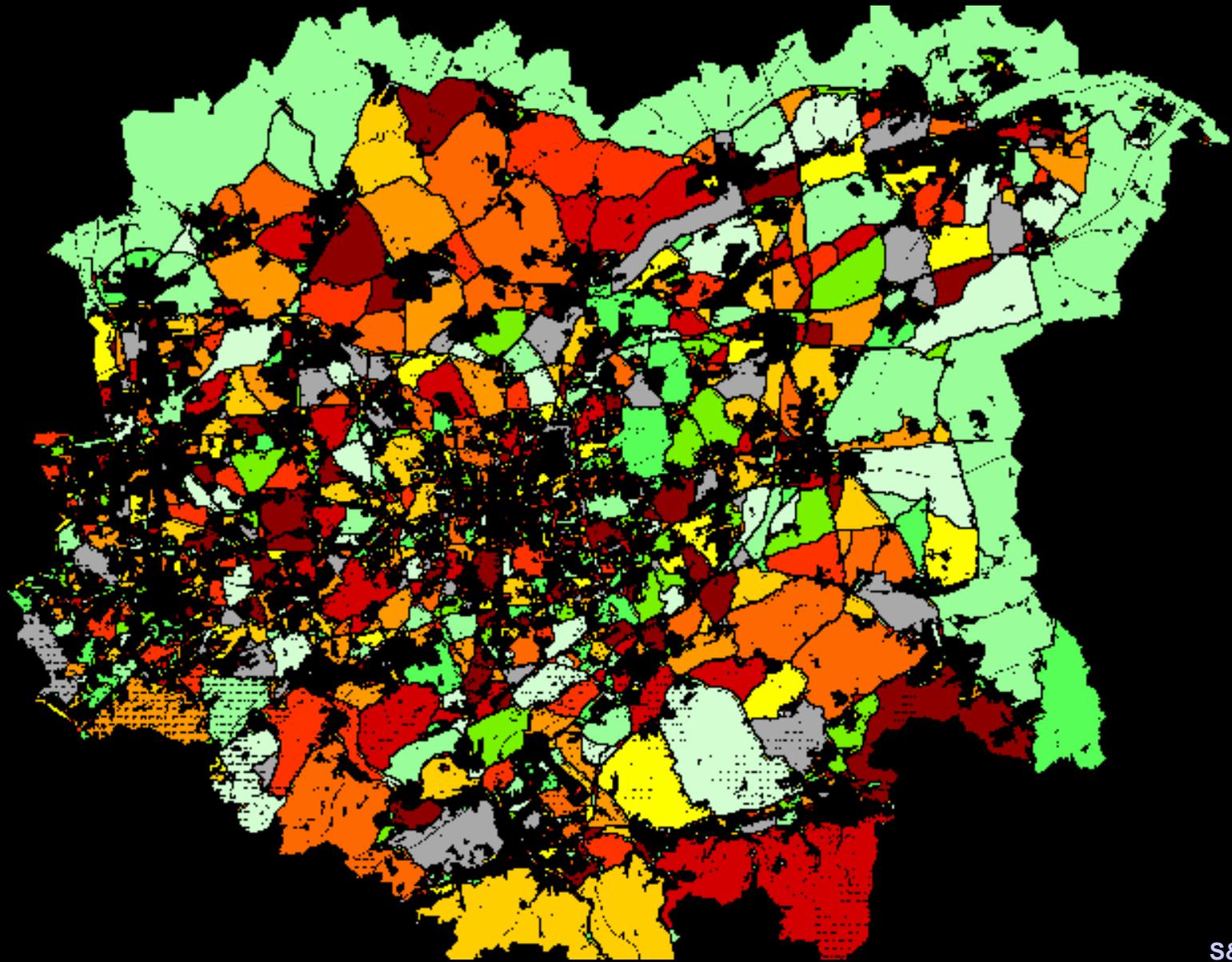
**Traffic noise and open space
2021**

32

S&W

S&W

34

S&W
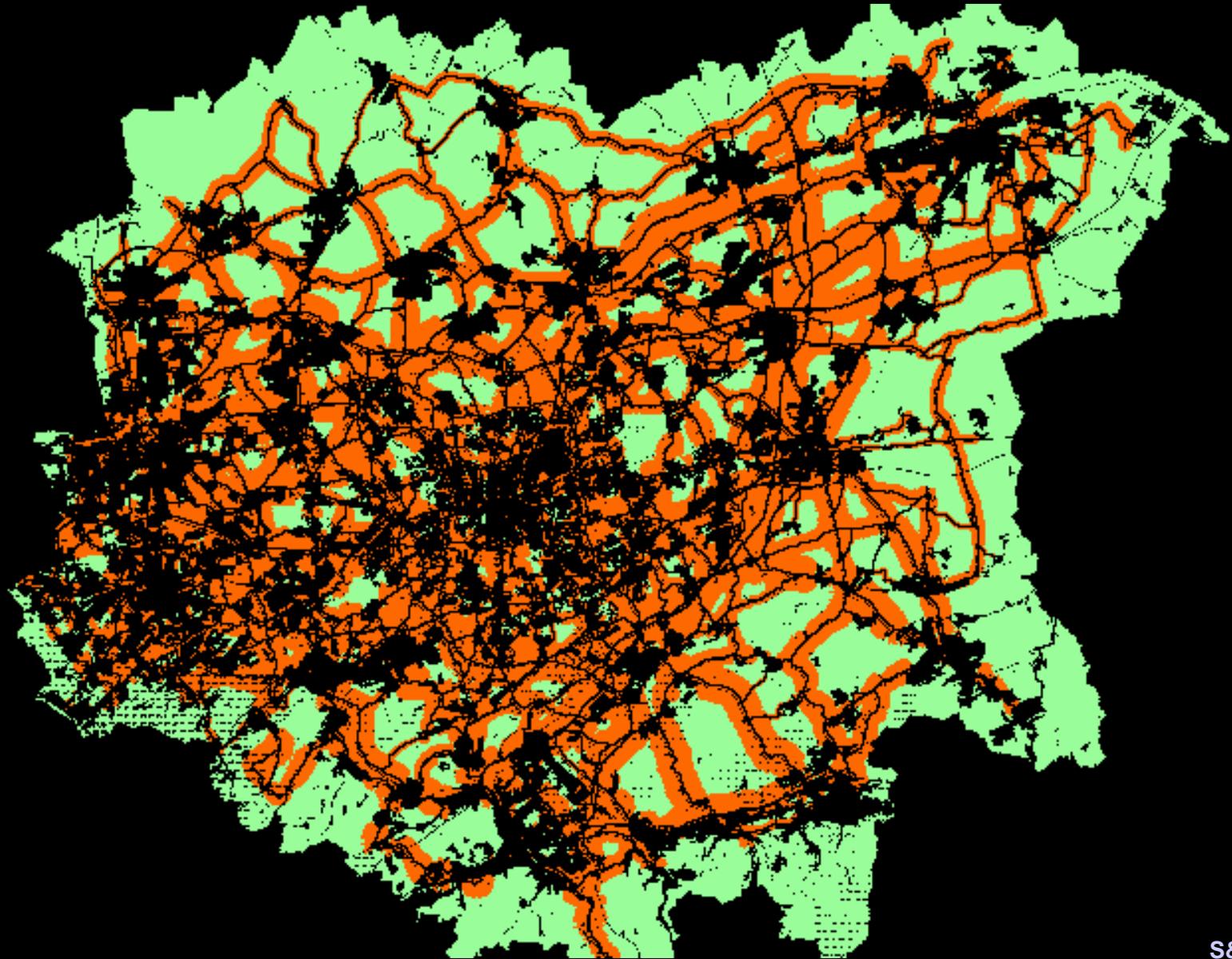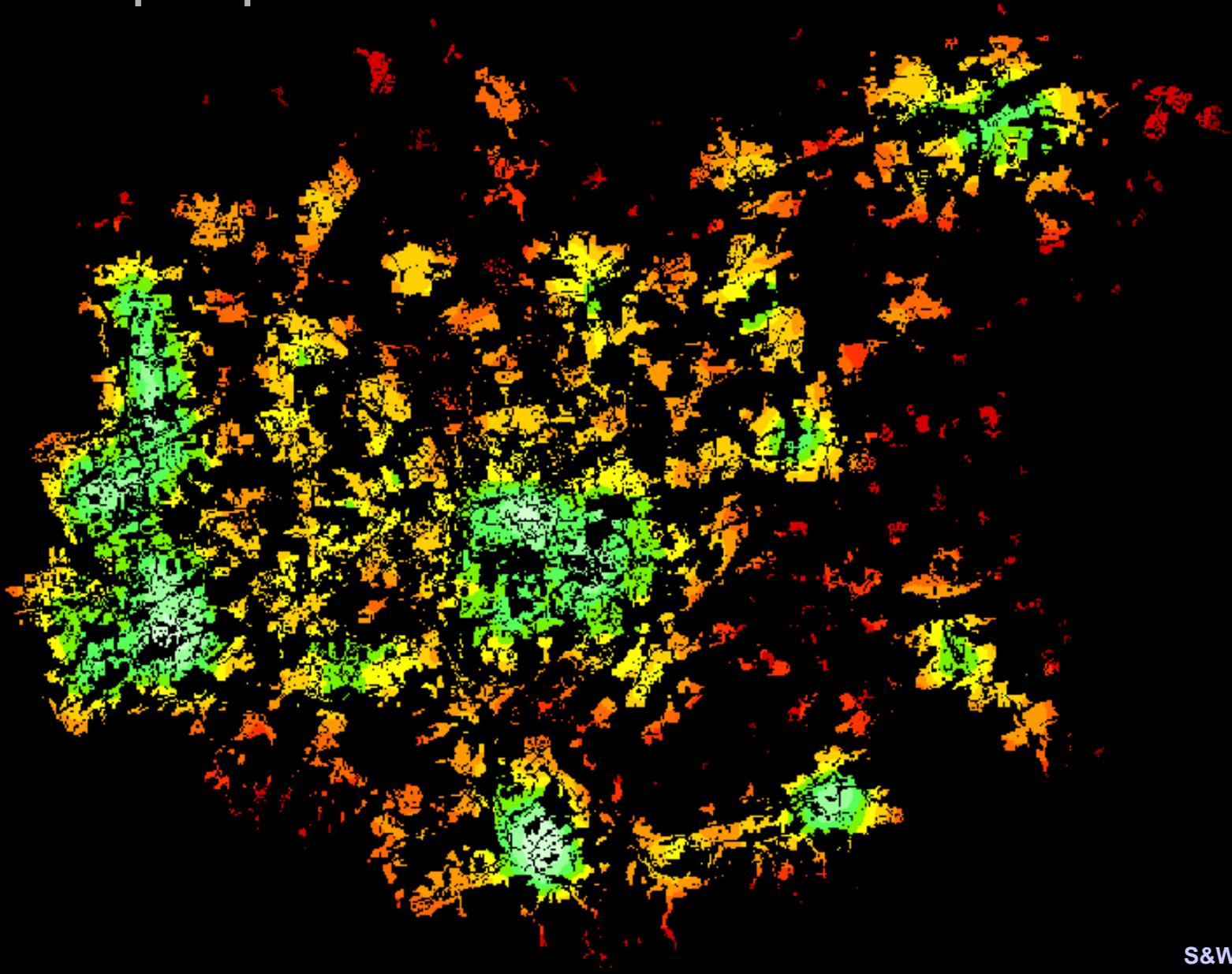
Conclusions

The integration of environmental models in land-use transport models requires the modelling of environmental *impacts* and environmnetal *feedback*.

Existing land-use transport models lack the **spatial resolution** required by environmental models.

Spatial disaggregation of the *output* of land-use transport models permits the modelling of environmental *impacts* but only limited modelling of environmental *feedback*.

Only spatially disaggregate microsimulation land-use transport models permit the modelling of both environmental *impacts* and environmental *feedback*.

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More information

PROPOLIS

http://www.ltcon.fi/propolis

PROPOLIS Dortmund model

http://irpud.raumplanung.uni-dortmund.de/irpud/pro/...
... mod/mod_e.htm
... co2/co2_e.htm