

High Resolution Land Use Information by combined Analysis of Digital Landscape Models and Statistical Data Sets

Tobias Krüger
Gotthard Meinel



Leibniz Institute of
Ecological Urban and
Regional Development

EUROPEAN FORUM
FOR GEOSTATISTICS 2012
Prague Conference

24-26 October 2012
Prague, Czech Republic



Agenda

- Monitoring approach
- Input Data
- Data Processing
- Output Data and Presentation
- Conclusion



Land Use Monitoring Conception

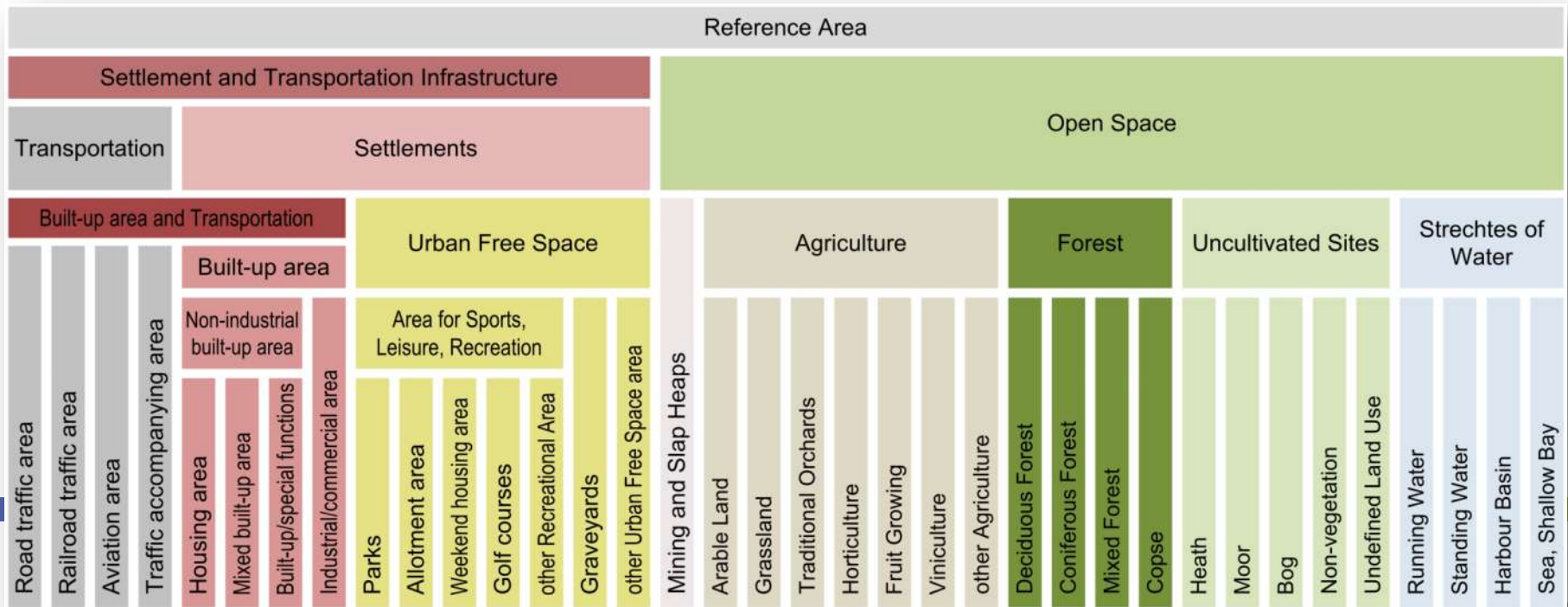
- Description of state and development of **land use** and its **structure**
 - Indicator-based and quantitative
 - Description of real situation (no planning data)
 - Nation-wide administrative/non-administrative
- Satisfy information demands
 - Discover **spatial patterns**
 - Provide spatial high resolution information
 - **Spatial and temporal comparability**
- Base information for further scientific research
 - Interactive online visualisation (www.ioer-monitor.de)
 - Maps, tables, indicator sheets (descriptions)
 - Combination with population, transportation, economical, environmental data
 - Information provided free of charge



IÖR-Monitor

- Land use scheme
 - Based on official land use classification catalogue
 - Hierarcal concept
 - Non-overlapping (unambiguous assignment of areas)
 - LU classes sum up to 100% reference area

→ Full redundancy-free land use classification



Input data needs

Requirements

- **Availability:** Nation-wide
- **Topicality:** regular updating cycles with small intervals
- **Scale:** low degree of generalisation, suitable for local spatial analysis
- **Content:** adequate land use information content
- **Data processing:** automation, scripting-enabled

→ **ATKIS**

Authorative Topographic-Cartographic Information System



ATKIS(R)

Authorative Topographic-Cartographic Information System

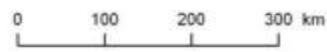
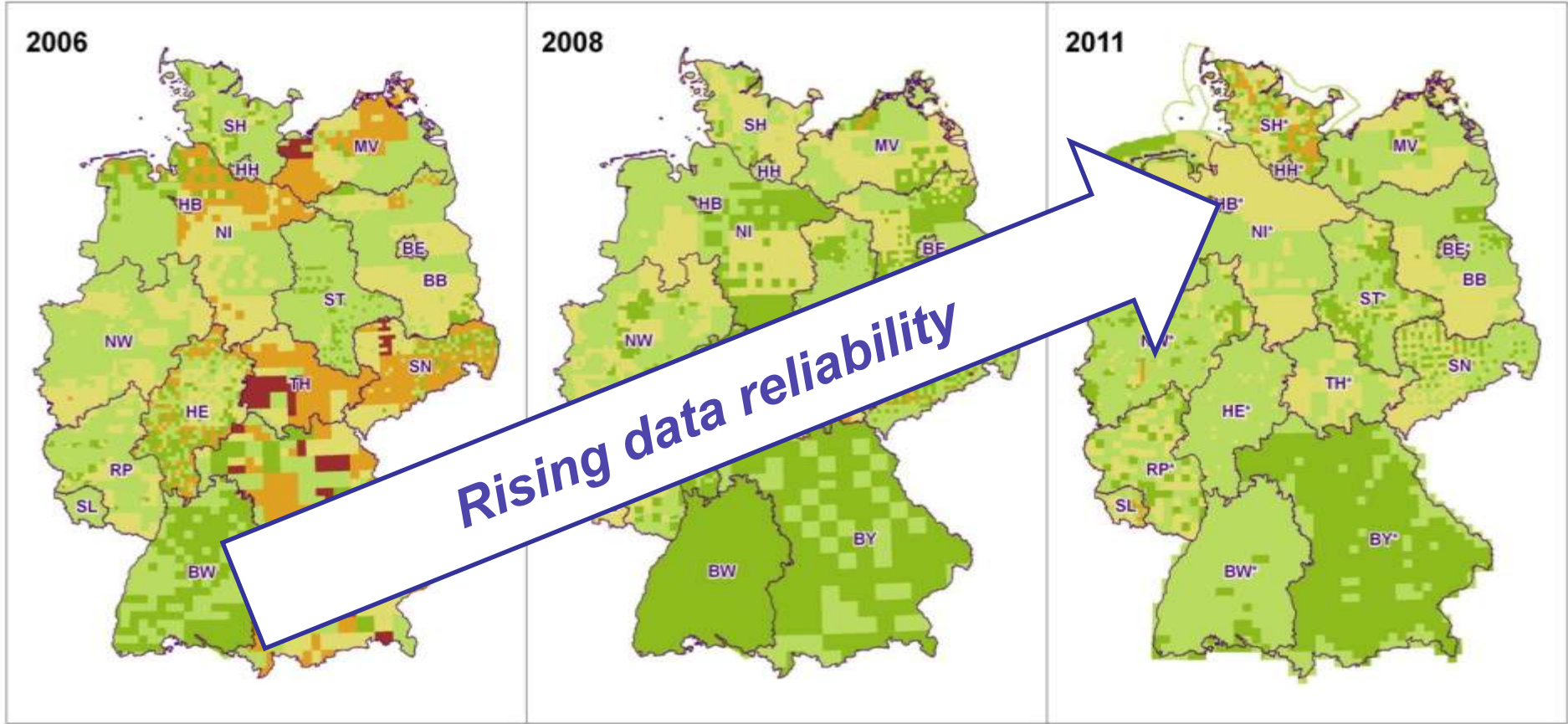
- **Authorative** → defined by the Working Committee of the Surveying Authorities of the States of the Federal Republic of Germany
- **Topographic** → comprehensive description of the earth surface (DLM, DTM, DOP)
- **Cartographic** → Basis for official topographic map series 1:10'000 – 1:1'000'000
- **Information System** → object based spatial information system
- **Digital Basis Landscape Model (Basic DLM)**
 - **Digital Terrain Model (DTM)**
 - **Digital Surface Model (DSM)**
 - **Digital Orthophotos (DOP)**
 - **Digital Topographical Maps (DTK)**



Basic DLM

- Object type catalogue
 - >100 object types
 - Geometrical domain: Polygons, Polylines, Points
 - Semantical description: >60 Attributes
- Extensive semantic differentiation of objects
- Target mapping scale: 1:10000/1:25000
- Most precise geo-topographical dataset in with nation wide availability in Germany
- Authoritative dataset
 - Regular updating (3 years)
 - Basis for topographic map series





 Leibniz-Institut für ökologische Raumentwicklung

Anmerkungen:
Die Kartenwerke und Blattschnitte für die Aktualisierung differieren je nach Bundesland.

Mit * bezeichnete Bundesländer liefern die ATKIS-Daten 2011 im neuen AAA-Modell 6.0.

Geoinformationen:
© Bundesamt für Kartographie und Geodäsie 2007/2009/2012 (www.bkg.bund.de)

Bearbeitung: Tobias Krüger und Ulrich Schumacher 2012



Land use information from ATKIS

Base Layer Objects (Object Class Factual Use)

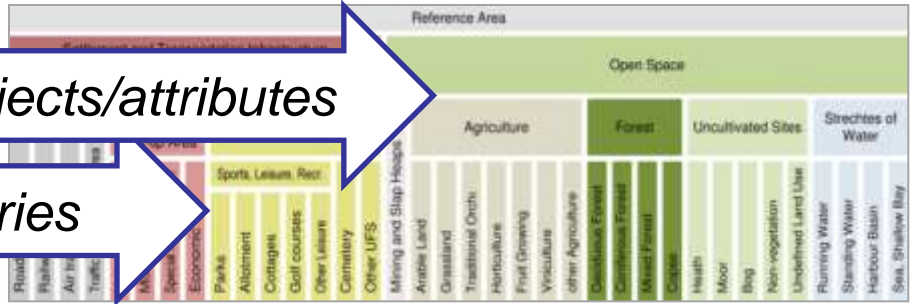
Water	running/standing inland water, channels, sea, shallow bays
Settlement	built-up areas, mining, slag heaps, recreation and sports
Vegetation	agriculture, forest, swamp, non-vegetated
Transportation	roads, railroads, aviation

Overlaying objects

Special vegetation characteristics

Selection and Priorisation of objects/attributes

Assignment to land use categories



Object Assignments to Land Use

Land use category	Land use sub-category	ATKIS objects	
Settlement	Housing area	41001	Built-up area with housing function
	Industrial and commercial area	41002	Industrial and commercial area
		41004	Mining industry
		42016	Shipping
Park, Green space	41008	Sports/Leisure/Recreational Site FKT=4400/4420	
Allotments	41008	Sports/Leisure/Recreational Site FKT=4440	
Free Space	Arable	43001	Agriculture VEG=1010
	Greenland	43001	Agriculture VEG=1020
	Wine yards	43001	Agriculture VEG=1040
...			

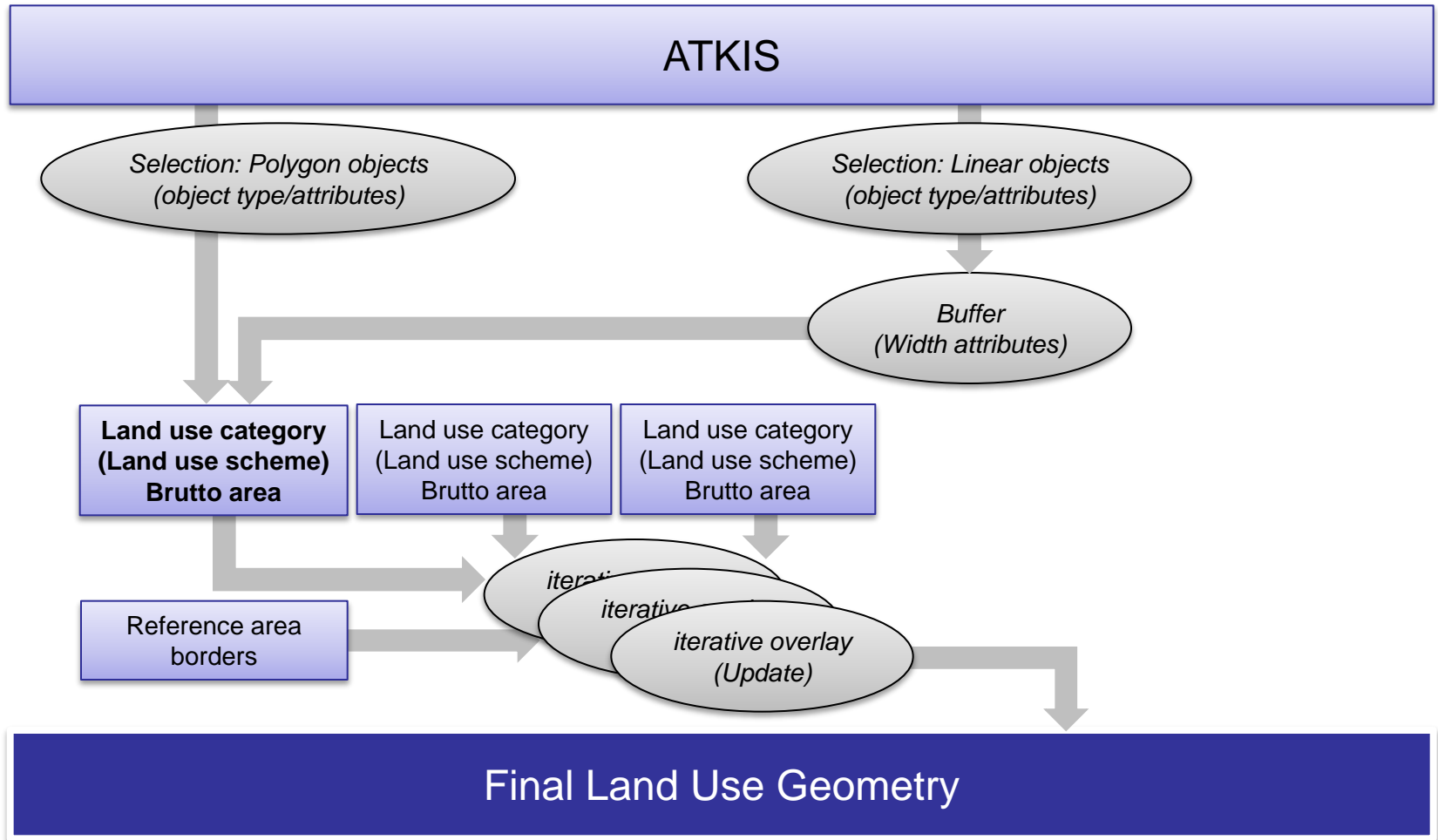
One object type per land use category

Several object types per land use category

Assignment of one object type to several land use categories based on attribute values

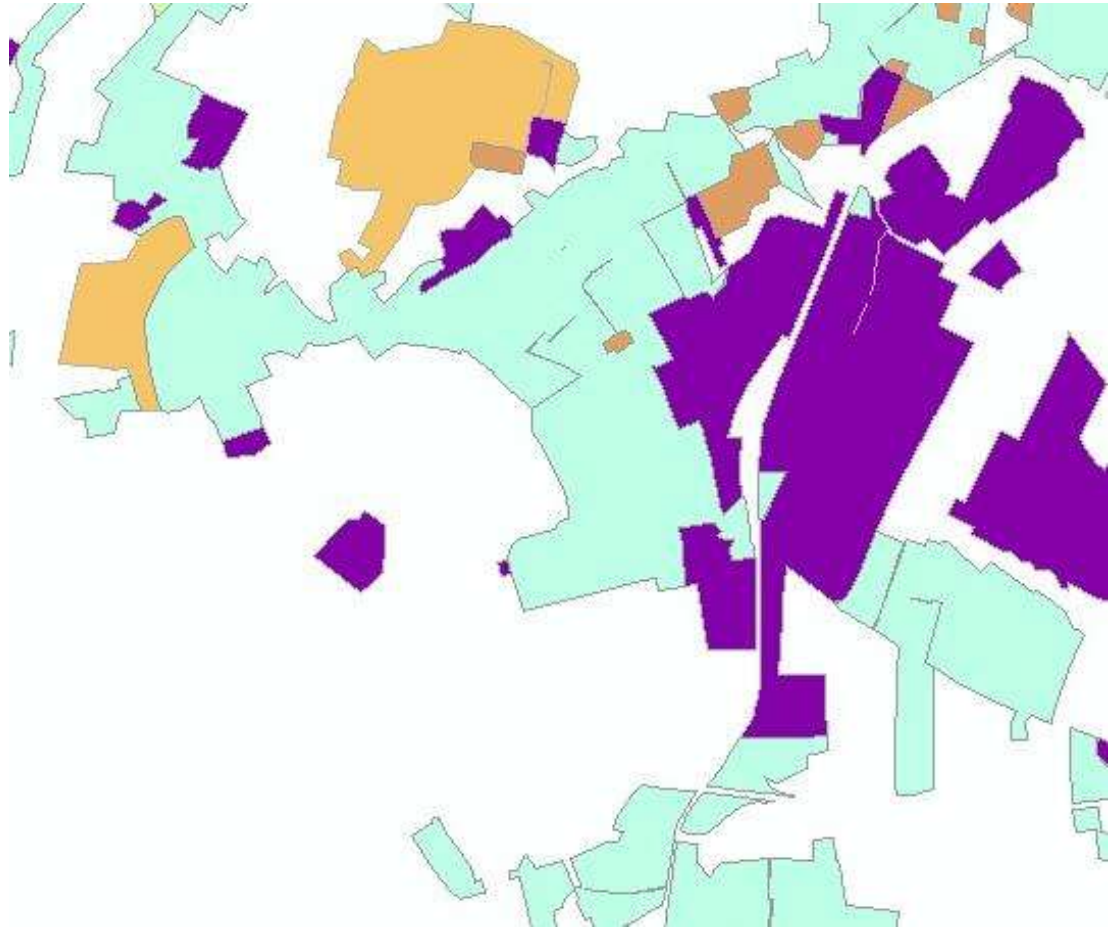


Modelling chain (simplified)



Polygon objects

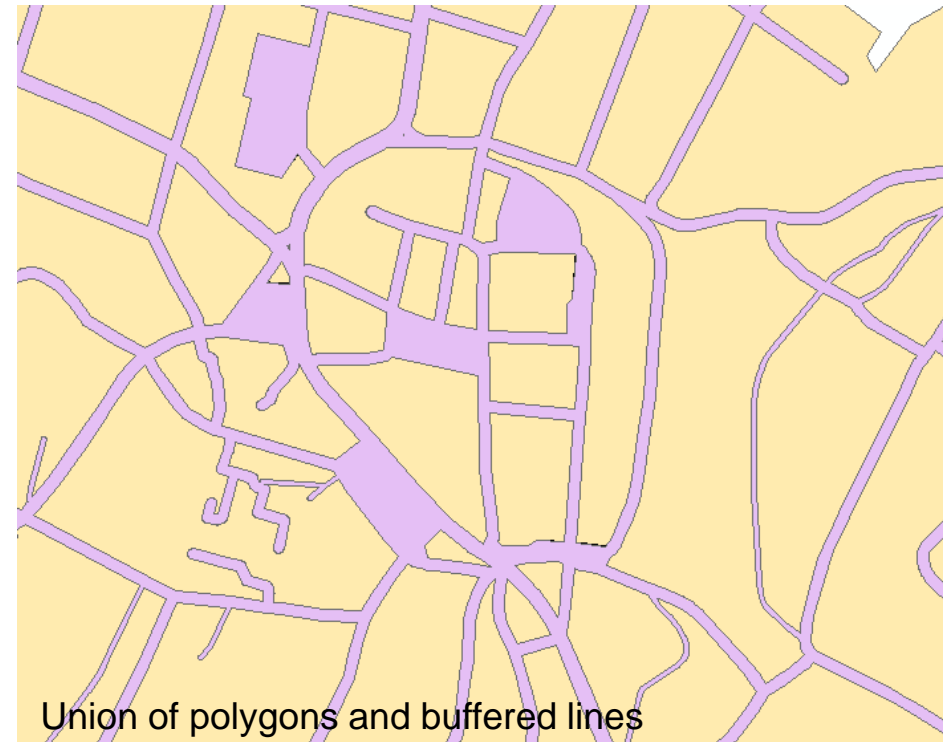
- Explicit area information
 - Select/merge relevant objects
- ➔ Geoprocessing (Select, Union)



Linear objects

- No explicit areal information
- Width attributes
- ➔ Geoprocessing
(Select>**Buffer**>Union)

Transportation	Water (< 12 m width)
Roads, streets, pathways	Running water
Railroads	Channels
Runways	



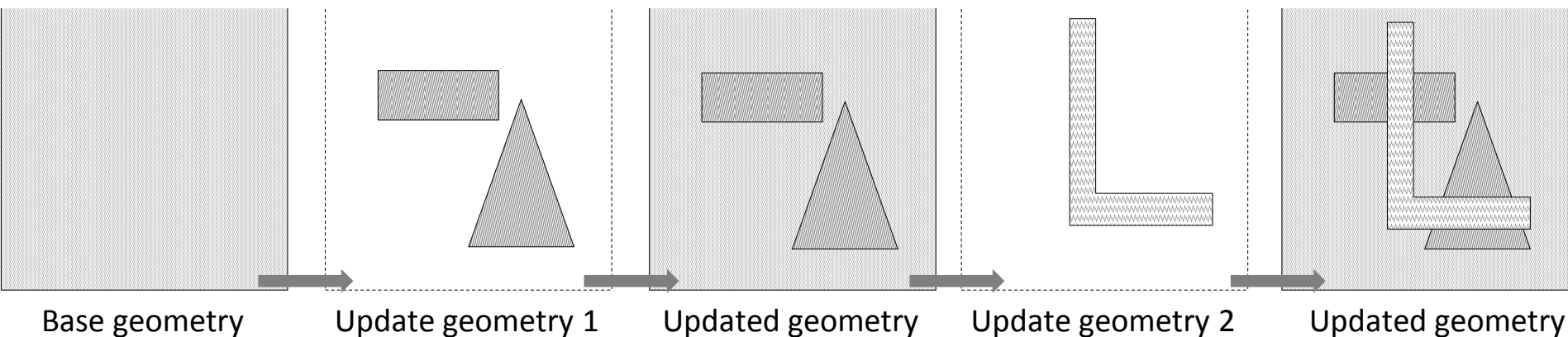
Union of polygons and buffered lines

Example: Road traffic



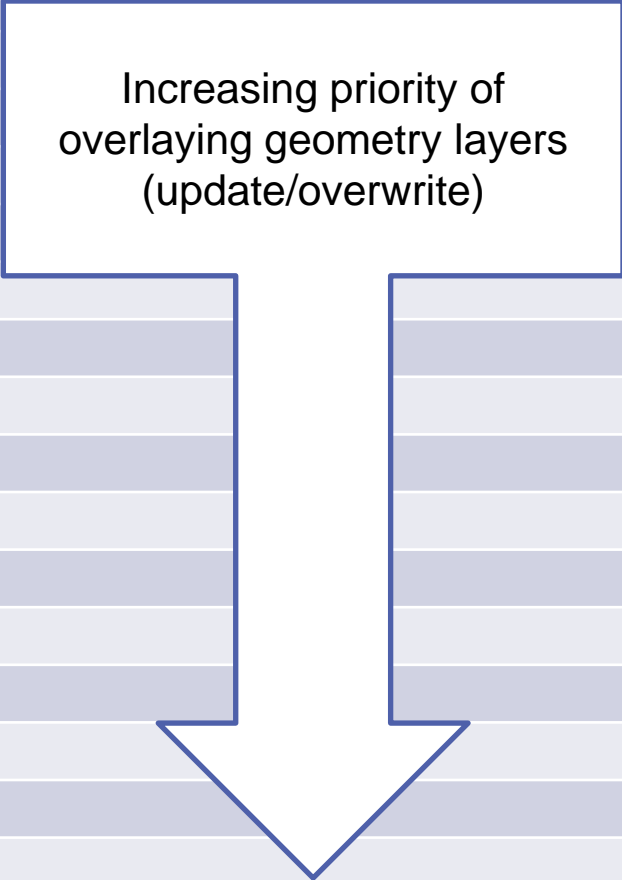
Geoprocessing

- ATKIS Input Geometries:
 - Polygons → explicite area information
→ direct use
 - Polylines → implicite area information
→ Buffering
- Resolve overlaps
 - updating by sequential overlaying



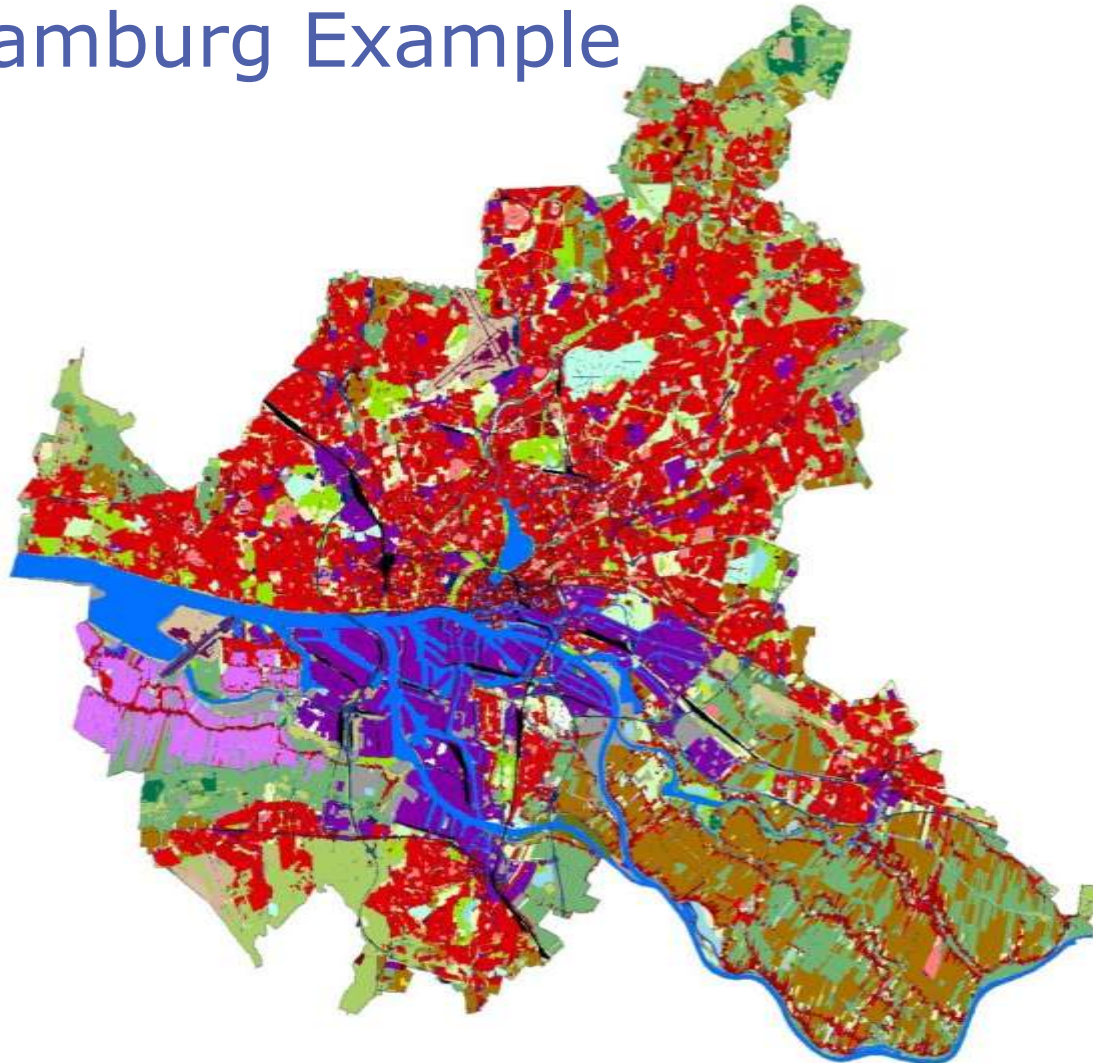
Sequential updating of land use geometry

Layer	Land use category
0	Currently undefined area
1	Vegetation-free
2	Bog
...	
10	Arable land
11	Greenland
...	
17	Area of special functional purposes
18	Cemetery
...	
23	Park
24	Economic area
...	
28	Running water
...	
37	Roads



Increasing priority of overlaying geometry layers (update/overwrite)

Hamburg Example



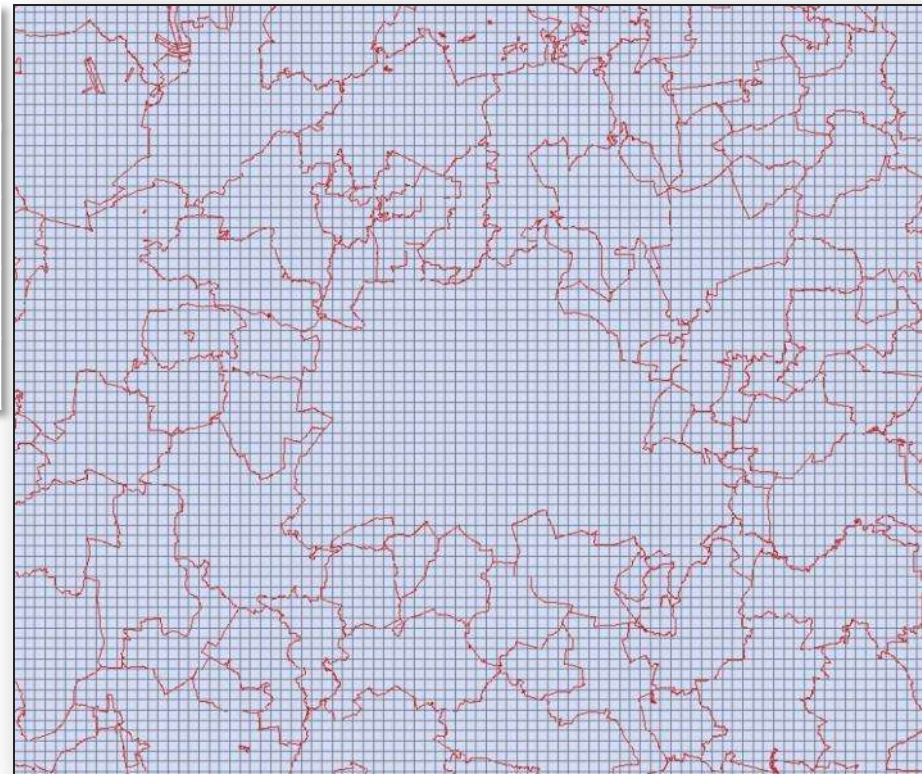
<ul style="list-style-type: none"> ■ Straßenverkehr ■ Bahnverkehr ■ Flugverkehr ■ Verkehrsbegleitfläche Straße ■ Verkehrsbegleitfläche Bahn ■ Verkehrsbegleitfläche Flug 	Transportation
<ul style="list-style-type: none"> ■ Hafenbecken ■ Stehendes Gewässer ■ Meer, Bodden ■ Fließgewässer 	Stretches of water
<ul style="list-style-type: none"> ■ Wohnbau ■ Mischnutzung ■ sonst. Siedlungsfreiflächen ■ Industrie-, Gewerbefläche 	Built-up area
<ul style="list-style-type: none"> ■ Park- Grünanlage ■ Wochenend-, Ferienhaus ■ Kleingarten ■ Golfplatz ■ sonst. Sport-, Freizeit-, Erhol. ■ Friedhof ■ Bes. fkt. Prägung 	Urban free space
<ul style="list-style-type: none"> ■ Abbau-, Haldenfläche ■ Gehölz ■ Mischholz ■ Laubholz ■ Nadelholz 	Forest, Mining areas
<ul style="list-style-type: none"> ■ Grünland ■ Ackerland ■ Gartenland ■ Obstbau ■ Weinbau ■ Streuobst ■ sonst. Landwirtschaft 	Agricultural land use
<ul style="list-style-type: none"> ■ Heide ■ Moor ■ Sumpf ■ Vegetationslose Fläche ■ Derzeit unbestimmte Fläche 	other



Land use – Reference areas

Administrative level	Number 2006	Number 2010
Federal states	16	16
Planning regions	97	96
Districts	439	412
Municipalities	12556	11669

Grid size [m]	Cells
10000	3866
5000	14984
1000	361689
100	36 millions

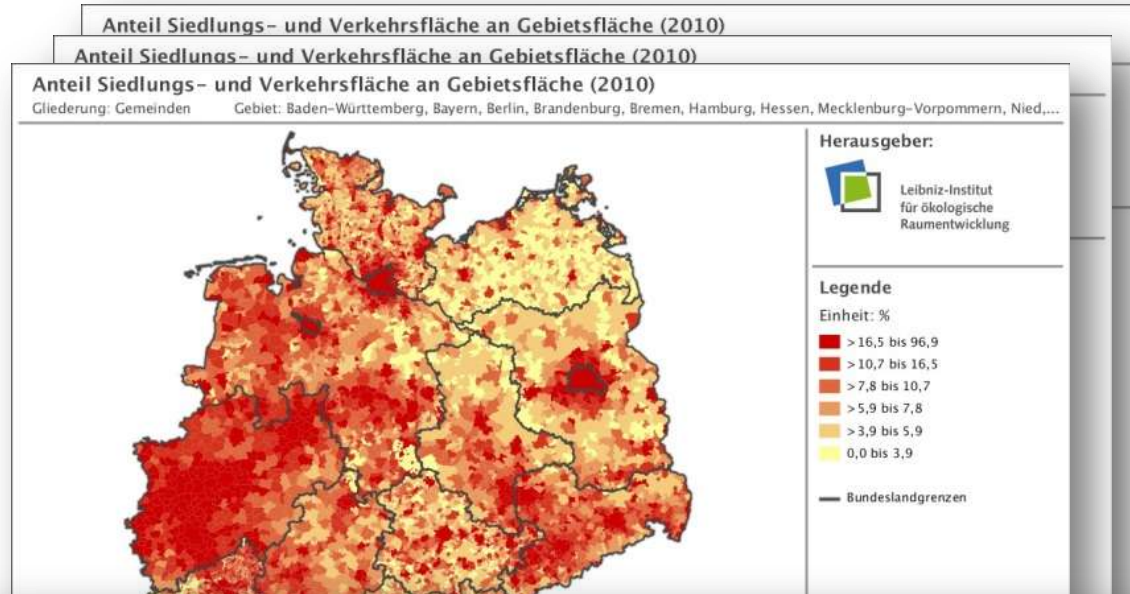


Results

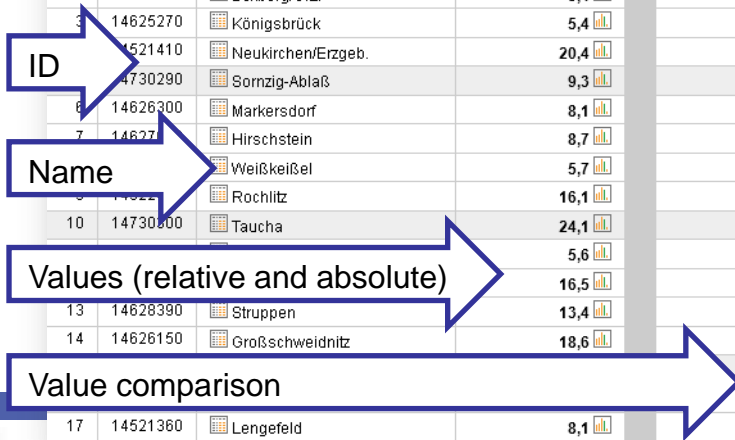
- Administrative maps
 - Länder
 - Districts
 - Municipalities
- Tables
- Export



Example:
Share of Settlement and Transportation Area



Anteil Siedlungs- und Verkehrsfläche an Gebietsfläche (2010)				Zum Vergleich (2008)		
lfd. Nr.	AGS	Name	Gemeindevwert	Gemeindevwert	Entwicklung von 2008 bis 2010	Veränderung von 2008 bis 2010 pro Jahr
1	14523350	Reuth	5,4	5,3	0,02	Grundaktualität unverändert
2	14626060	Boxberg/O.L.	5,4	4,9	0,52	0,17
3	14625270	Königsbrück	5,4	5,5	-0,04	-0,04
4	14521410	Neukirchen/Erzgeb.	20,4	20,6	-0,23	-0,03
5	14730290	Sornzig-Ablass	9,3	9,6	-0,35	-0,35
6	14626300	Markersdorf	8,1	8,3	-0,20	-0,10
7	14627	Hirschstein	8,7	8,7	-0,05	Grundaktualität unverändert
8	14627	Weißkeißel	5,7	5,1	0,58	0,29
9	14627	Rochlitz	16,1	15,8	0,27	0,04
10	14730200	Taucha	24,1	24,1	-0,08	Grundaktualität unverändert
11	14627	Witzsch	5,6	5,5	0,10	0,10
12	14628390	Struppen	16,5	16,5	0,07	Grundaktualität unverändert
13	14628390	Struppen	13,4	12,7	0,65	0,08
14	14626150	Großschweidnitz	18,6	18,6	0,06	Grundaktualität unverändert
15	14627	Witzsch	7,9	7,9	0,37	0,18
16	14627	Witzsch	12,6	12,6	-0,47	-0,16
17	14521360	Lengefeld	8,1	8,3	-0,20	-0,10



Results

- Grid maps
 - 10 km
 - 5 km
 - 1 km

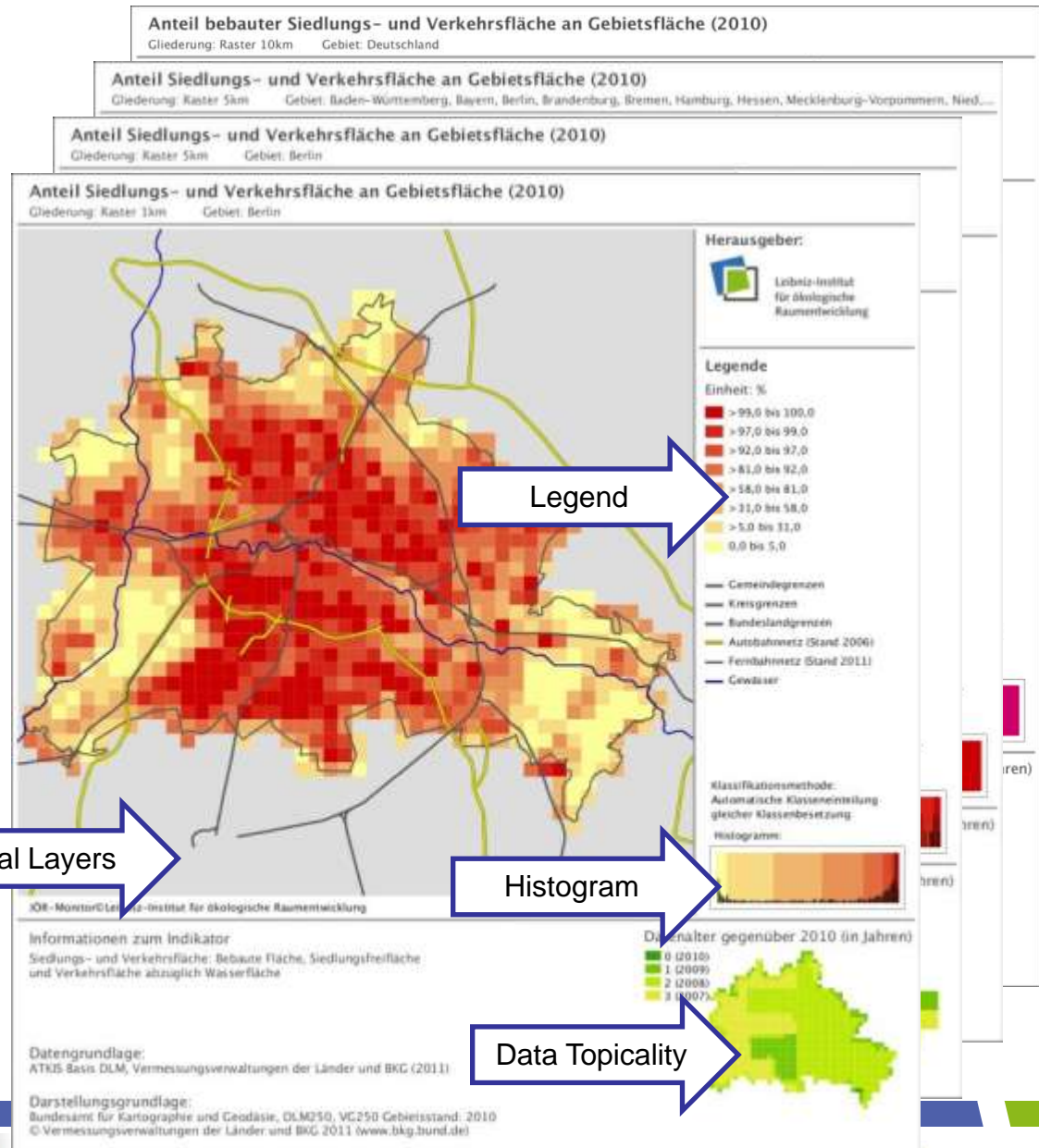
Example: Share of Settlement and Transportation Area

Additional Layers

Legend

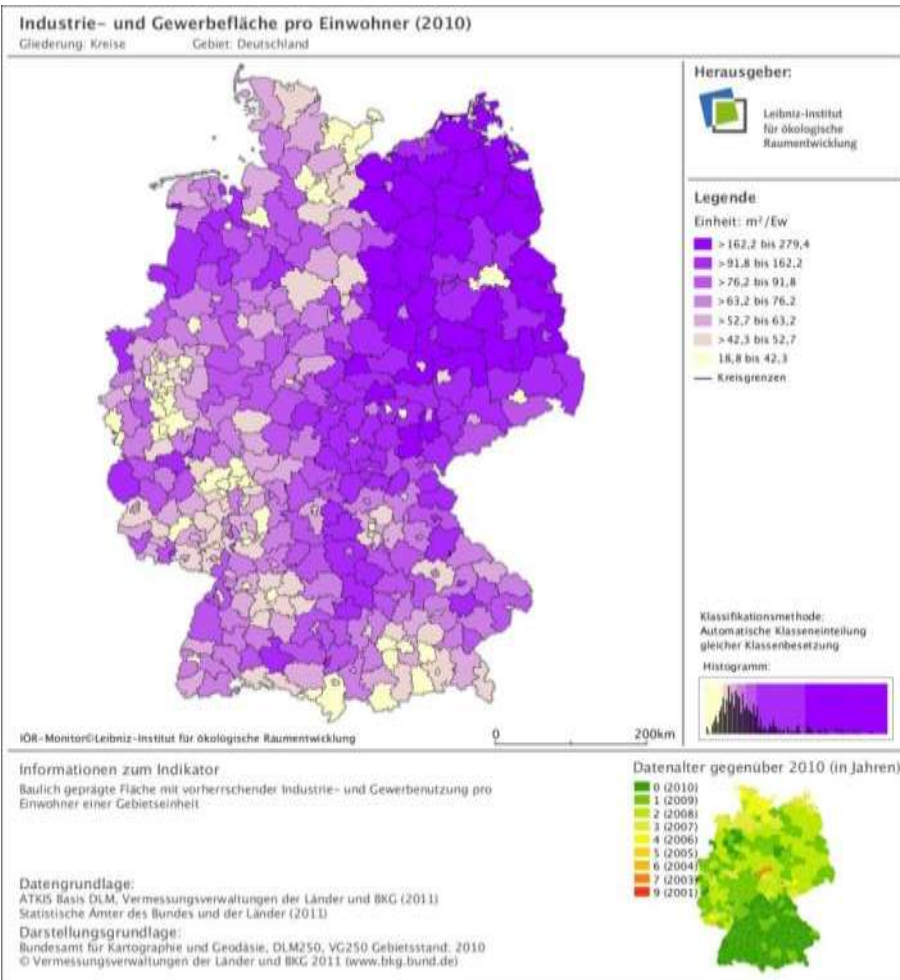
Histogram

Data Topicality

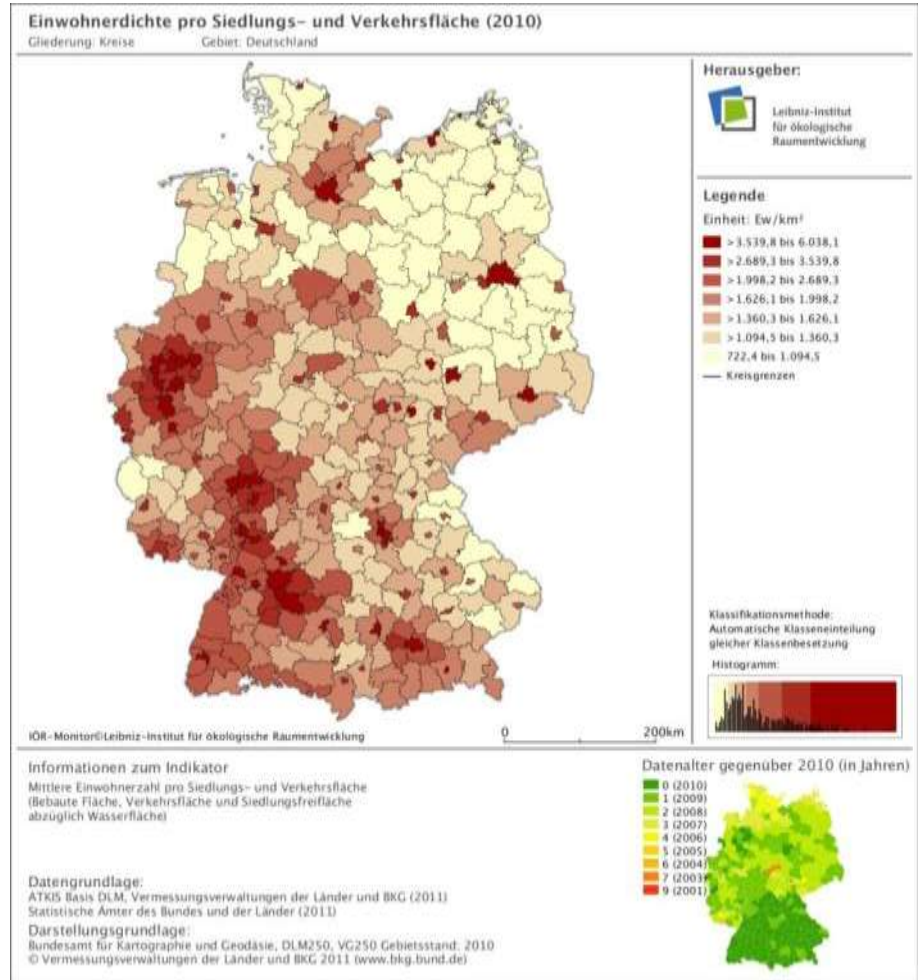


Results

Industrial and commercial area per inhabitant



Inhabitants per settlement and traffic area



Conclusion

ATKIS data (Topographical base data)

- Nation-wide availability
→ *Homogeneous data for all federal states*
- Semantically differentiated
→ *rich area-covering information*
- Target scale $\sim 1:10.000$, i.e. few generalisation
→ *geometrical correctness*
- Object based digital data model
→ *High degree of automation possible*

Problems

- Slightly different modelling practice in federal states
→ *in some cases limited spatial comparability*
- currently change in ATKIS model definition
→ *limited temporal comparability*
- Updating cycles up to federal states
→ *Varying regional/local topicality*
→ *Object changes due to in-situ-changes or data corrections?*
- Large dataset (Base DLM: ~ 20 GB)
→ *Scripting limitations/sequential data processing*



Conclusion

IOER Monitor

- Defined land use scheme
 - ➔ Transparent definitions of object assignments
- Using authoritative nation-wide available datasets
 - ➔ guaranteed data continuity
- Online platform
 - ➔ Accessibility
- International visibility
 - ➔ GEOSS component

GEOSS Component Details

Component Basic Information

Component Id:	urn:geoss:csr:component:urn:uuid:0dfb6ff7-e7e2-4119-b49a-e849e6b26341
Name:	Monitor of Settlement and Open Space Development (IOER-Monitor)
Abbreviation:	IOER-Monitor
Description:	Internet based Information System to land use and land cover state and development for whole a Germany on base of indicators and in high resolution
GEO Member or Participating Organisation :	ISPRS : International Society for Photogrammetry and Remote Sensing UNEP : United Nations Environment Programme UNU-EHS : United Nations University Institute for Environment and Human Security EEA : European Environmental Agency Germany
Responsible Organisation:	Leibniz Institute of Ecological Urban and Regional Development (IOER)
URL to Component Information:	www.ioer-monitor.de

Component Contact Information

Contact Name:	Dr. Gotthard Meinel
Contact Email:	monitor@ioer.de

Component Category

websitesDocuments

Societal Benefit Areas

Agriculture
Biodiversity
Ecosystems
Energy



Outlook

- Densification of time series (→ annual)
- Further indicators
 - Protected areas (already in use)
 - Landscape fragmentation (in progress)
 - Ecological landscape quality (hemeroby indicators; defined but not yet implemented)
 - Building based indicators (in progress)
- Better visualisation
 - Enhanced data viewer
 - Web Mapping Services



- Contact
Tobias Krüger



Leibniz Institute of
Ecological Urban and
Regional Development

Weberplatz 1
01217 Dresden
E-Mail: t.krueger@ioer.de

