Bundesamt für Kartographie und Geodäsie

Leibniz Institute of Ecological Urban and Regional Development

BKG Wir geben Orientierung.

Automated Detection of Landscape Features in Historical Maps to Support Climate Protection and Modelling

1st EuroSDR Workshop on Historical and Time Stamped Data for SDGs - 23./24.04.2024, Zagreb

Hendrik Herold | IÖR, Leibniz Institute of Ecological Urban and Regional Development, Dresden

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Eszter Kiss | BKG, Federal Agency for Cartography and Geodesy, Frankfurt am Main

Idea of the project

- **Italy** - University of Brescia, Hydrology and human geography (Roberto Ranzi)
- **Hungary**
  - University Eötvös Loránd, Budapest · Department of Geophysics and Space Sciences Cartography (Gábor Timár
  - Arcanum, SME from Hungary which produced the MAPIRE GIS (Biszack) https://mapire.eu/de/
- **Poland** - University of Warsaw, Department of Cartography (Tomasz Panecki)
- **Greece** - Aristotle University of Thessaloniki, Digital Approaches to cartographic heritage (Evangelos Livieratos, Petros Patrias)
- **Germany** - Federal Agency for Cartography and Geodesy (Eszter Kiss)

Idea of the project

1. Project
   - Federal Agency for Cartography and Geodesy
   - Leibniz Institute of Ecological Urban and Regional Development

2. Project: Gauss Center
   - Federal Agency for Cartography and Geodesy
   - Leibniz University of Hannover
   - Jade University of Applied Sciences

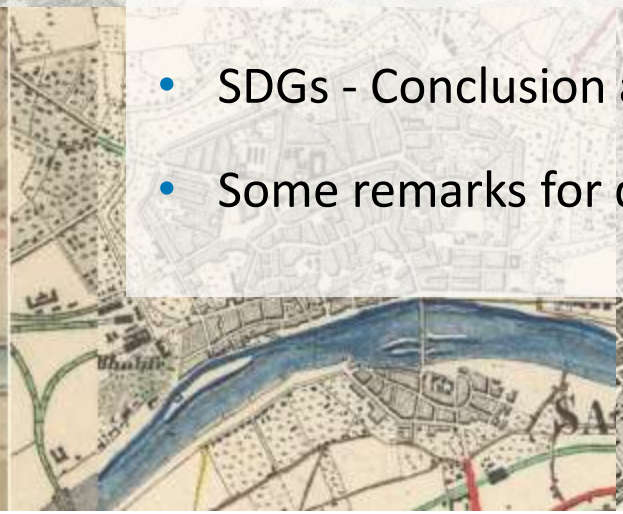
MAPIRE Portal: https://maps.arcanum.com/, https://mapire.eu/de/

Agenda

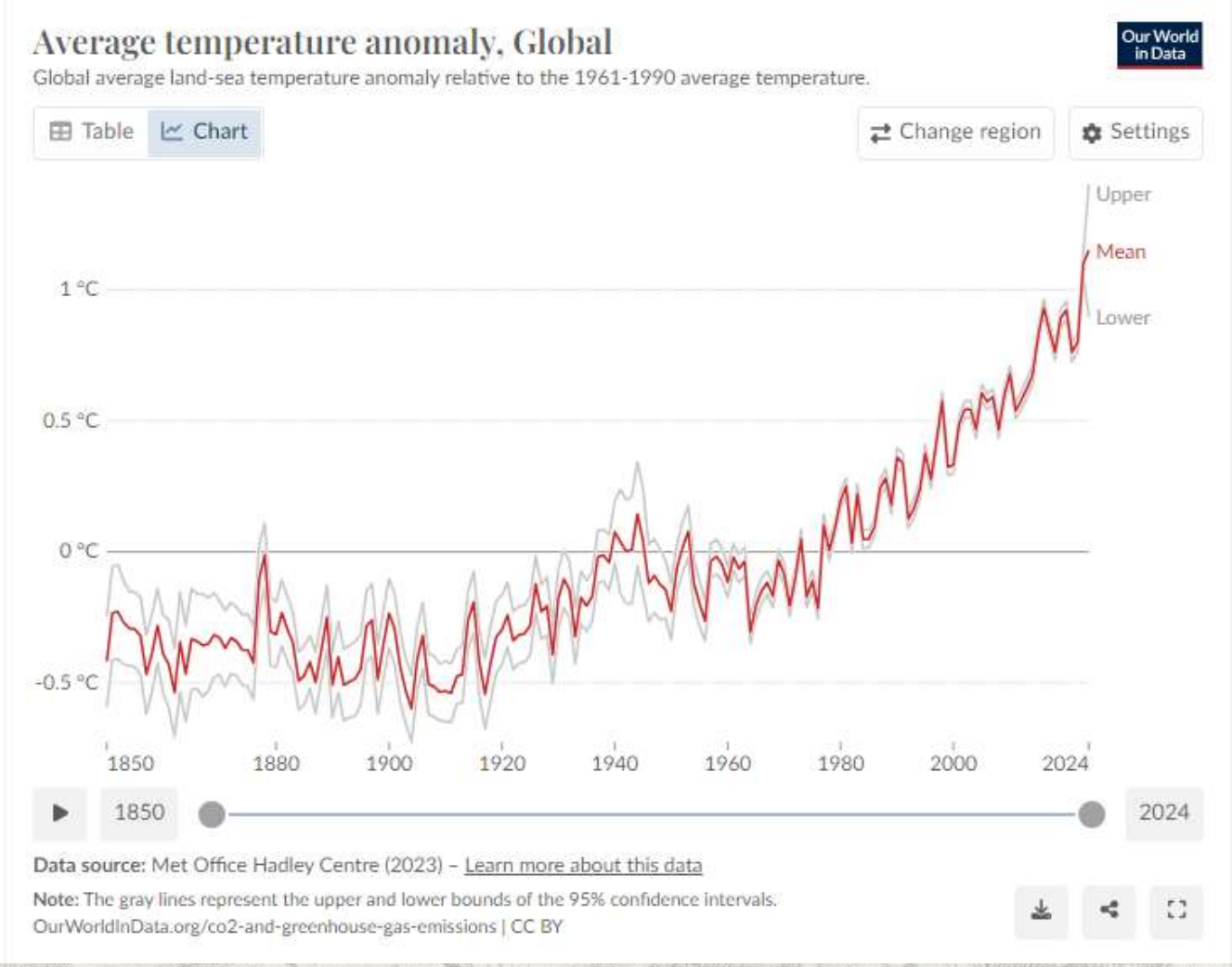
The longer you can look back, the farther you can look forward.

Winston Churchill (1874-1965)

- Background, timing, financing
- Aim of the project
- Land change monitoring - IOER Monitor
- Challenges and concept
- Methods and results
- SDGs - Conclusion and outlook
- Some remarks for discussion

Background Information: Earth System Science

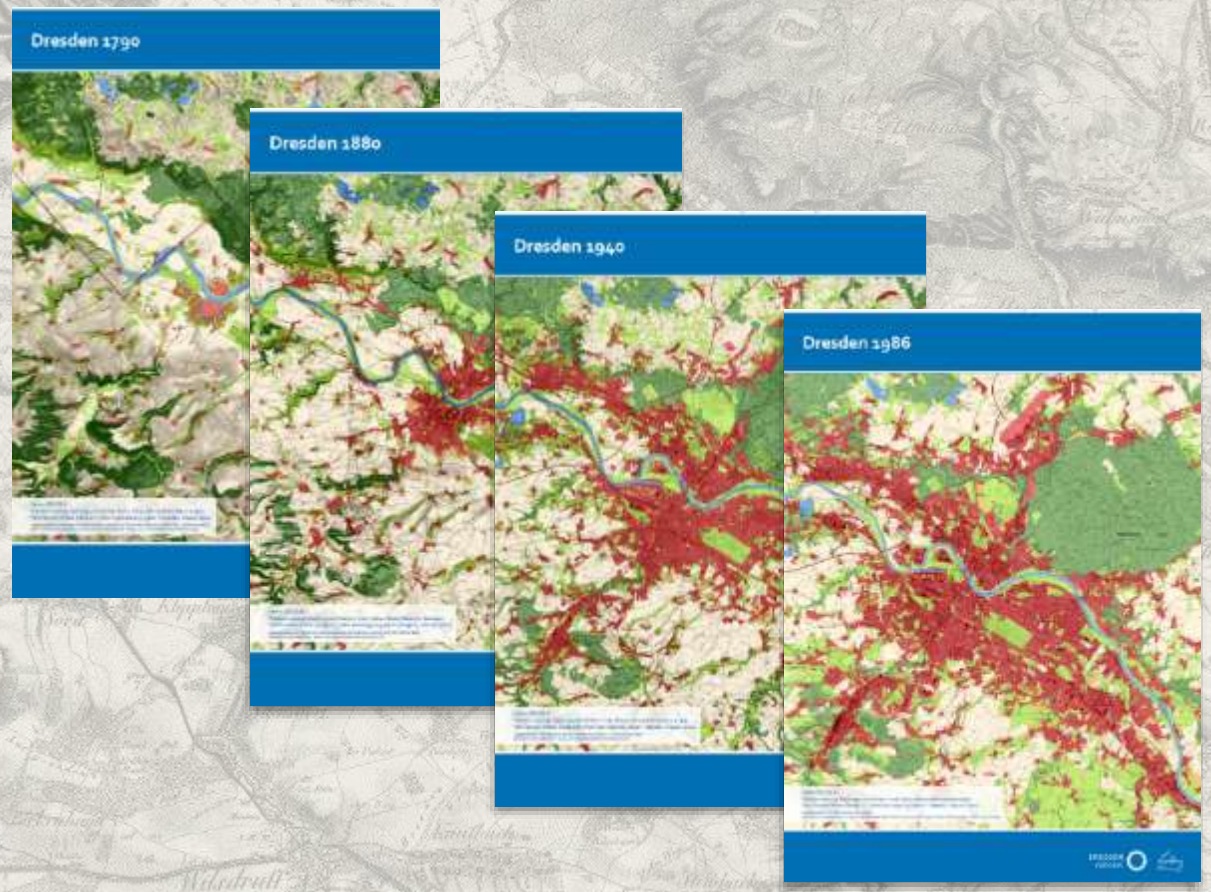


Earth system research: long time series

→ Land cover change especially since the beginning of the industrial revolution

→ Analysis → Climate change and much more

Background Information – Project Timing and Financing

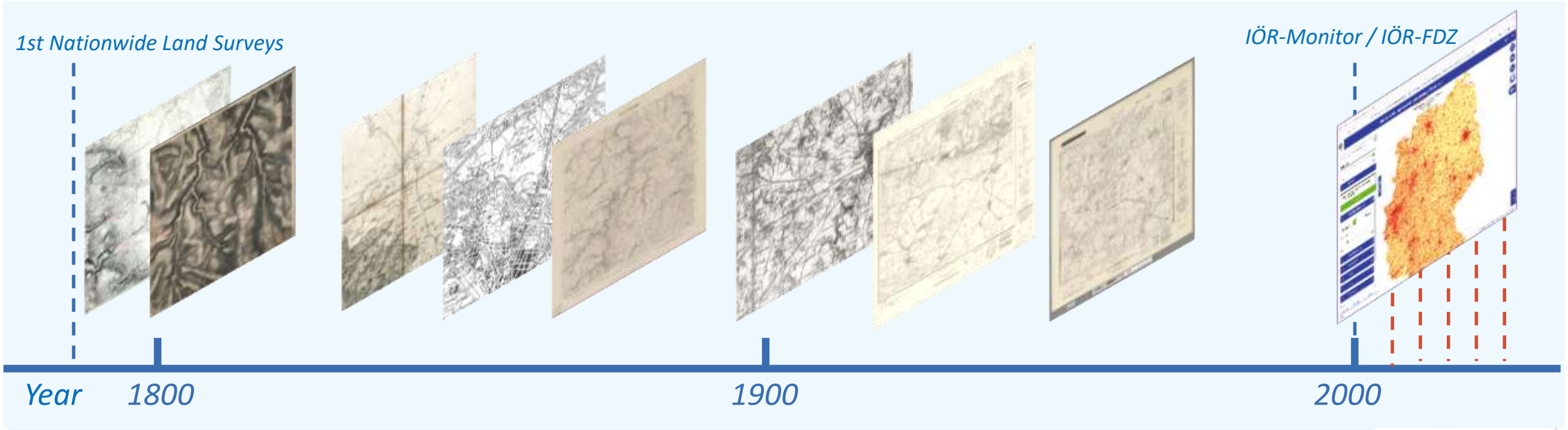


Time series over long periods and, as far as possible, covering whole Germany, especially since the beginning of the industrial revolution

- Climate research and especially active climate protection
- Renaturalisation of wetlands and protection of old-growth forests
- Open Data, Open Source

- Annual funding
- Duration: - Feasibility study: 08/2022 - 07/2024
  - Project: 2024-2027

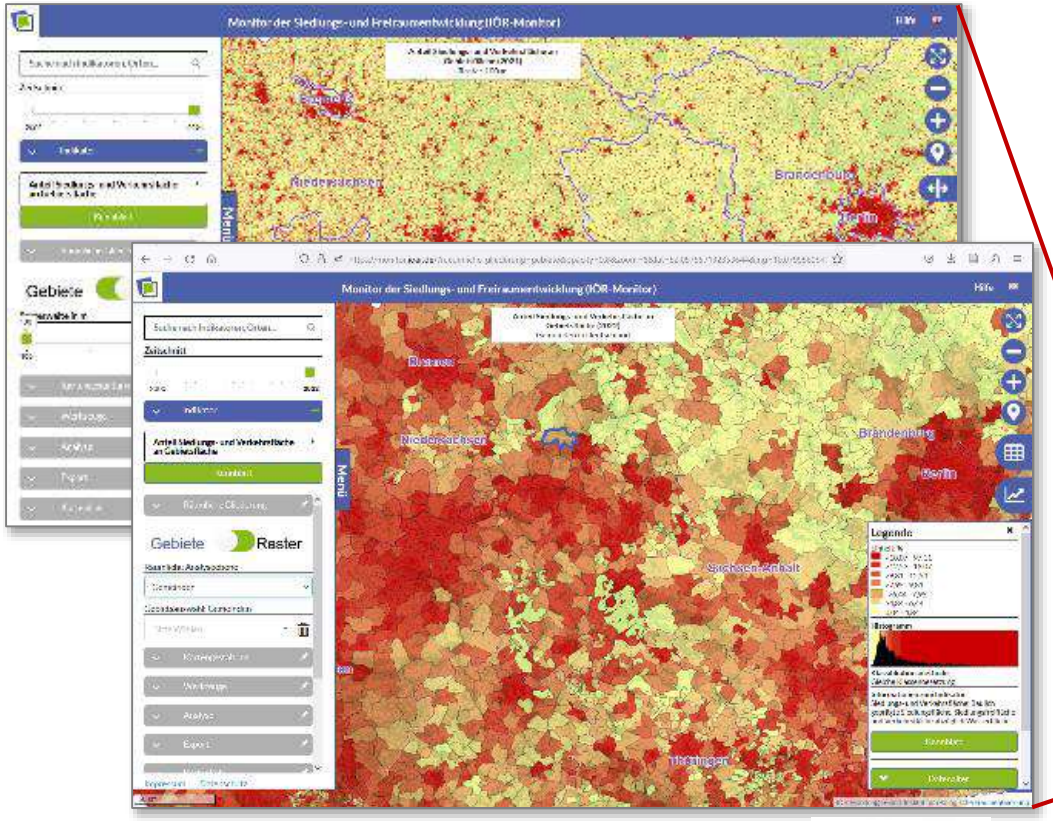
Aim of the project



Automated Detection of Landscape Features in Historical Maps

Backward Extension

Land change monitoring – IOER Monitor



https://www.ioer-monitor.de/

https://ioer-fdz.de/

FDZ IOER Research Data Centre

Information Systems and Databases

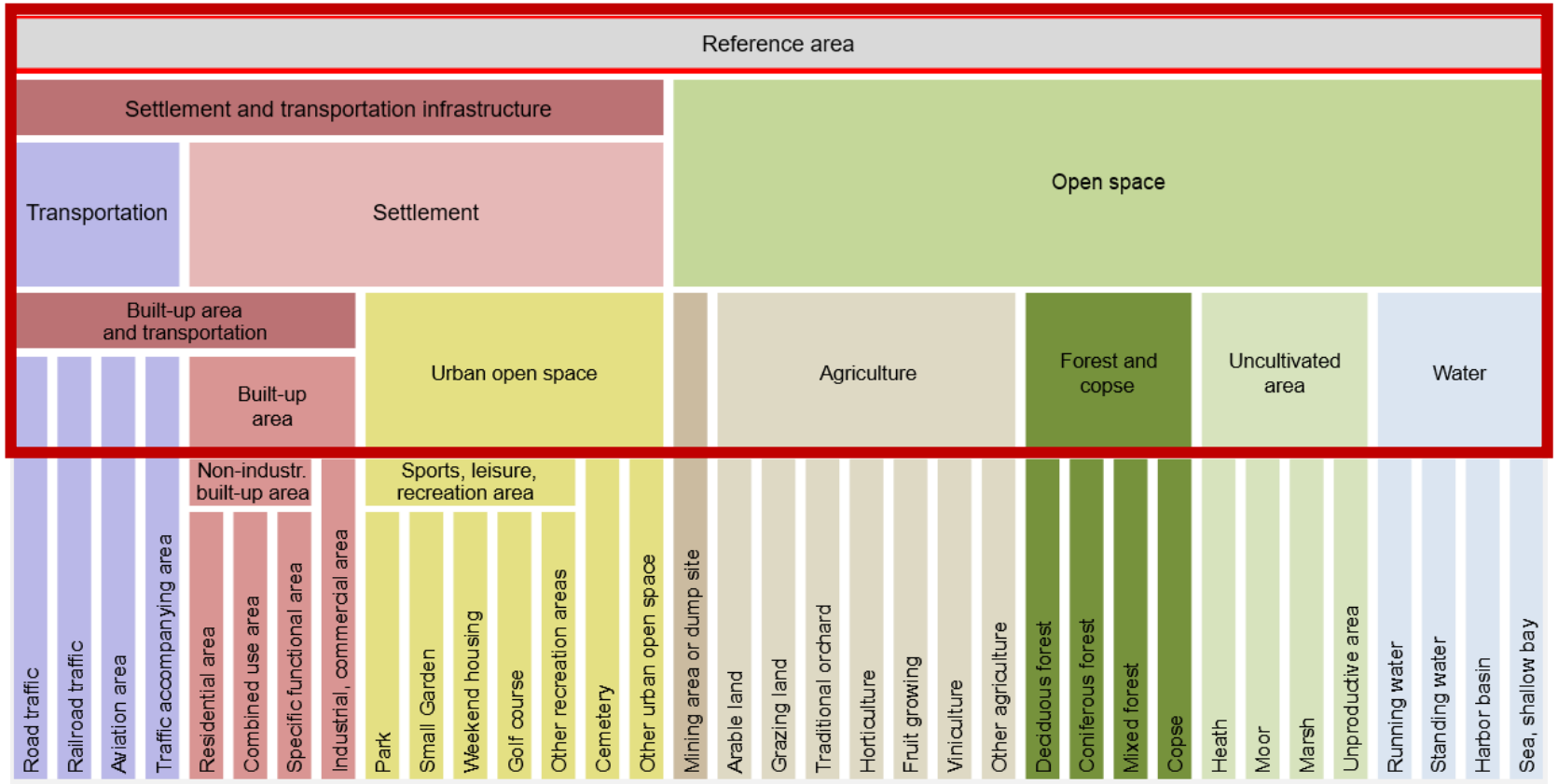
- IOER Monitor of Settlement and Open Space Development
- IOER Information System Built Environment
- Information System on Germany's Ecosystems
- Geodata on Urban Trees

Land change monitoring – IOER Monitor

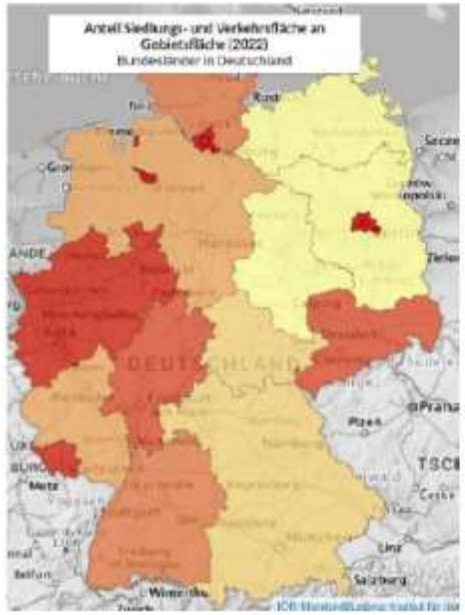
Basic Data Source for the IOER monitor

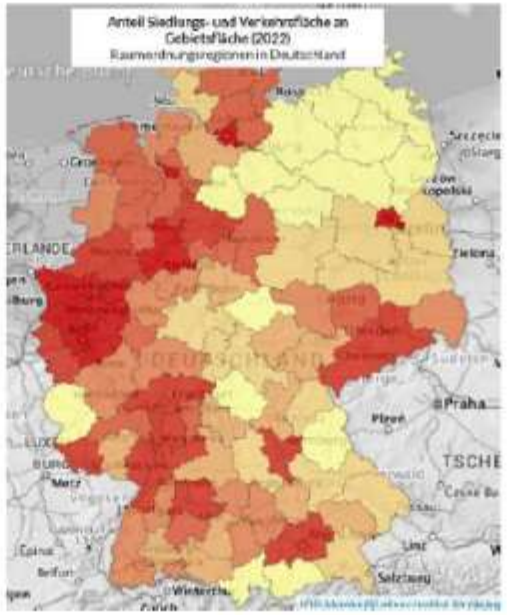
- **ATKIS (National Authorative Topographic-Cartographic Information System)**

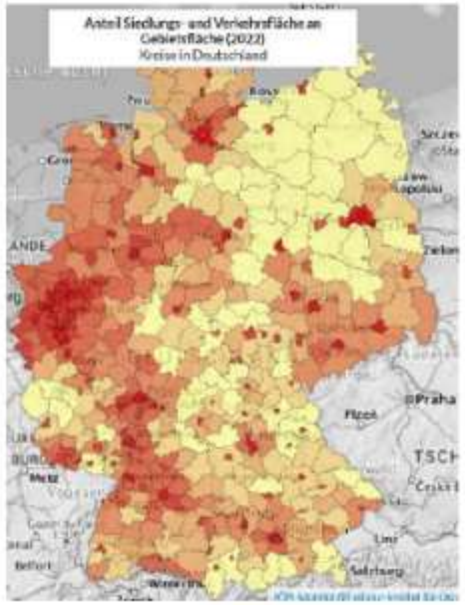
Land change monitoring – IOER Monitor

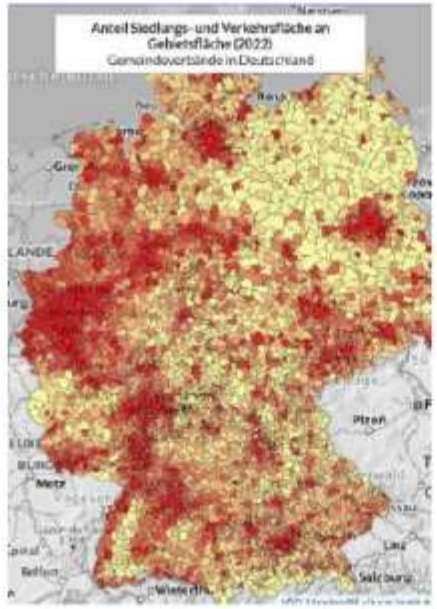


Land change monitoring – IOER Monitor

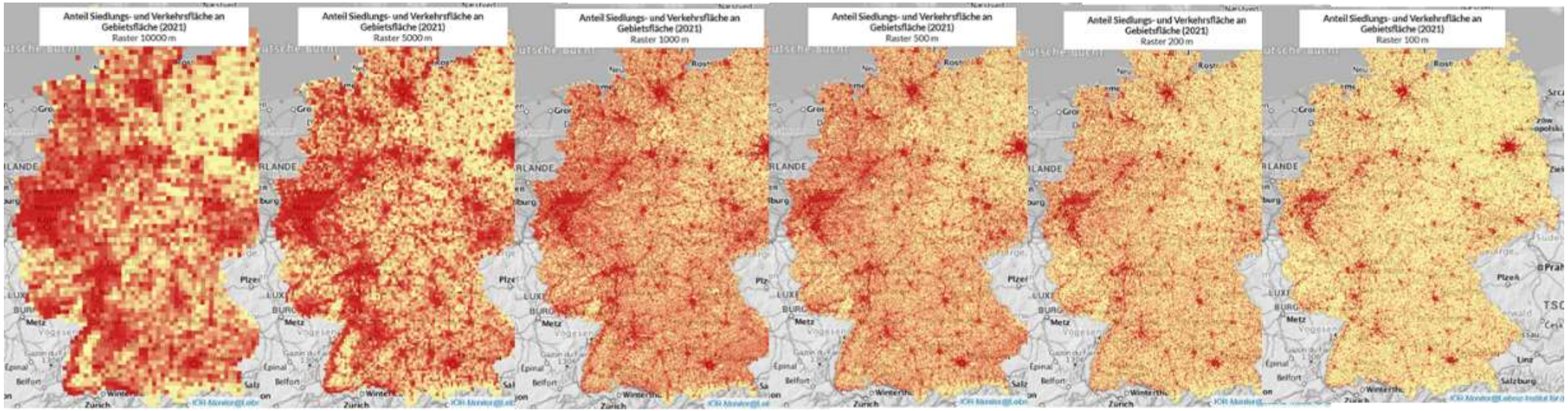








Land change monitoring – IOER Monitor

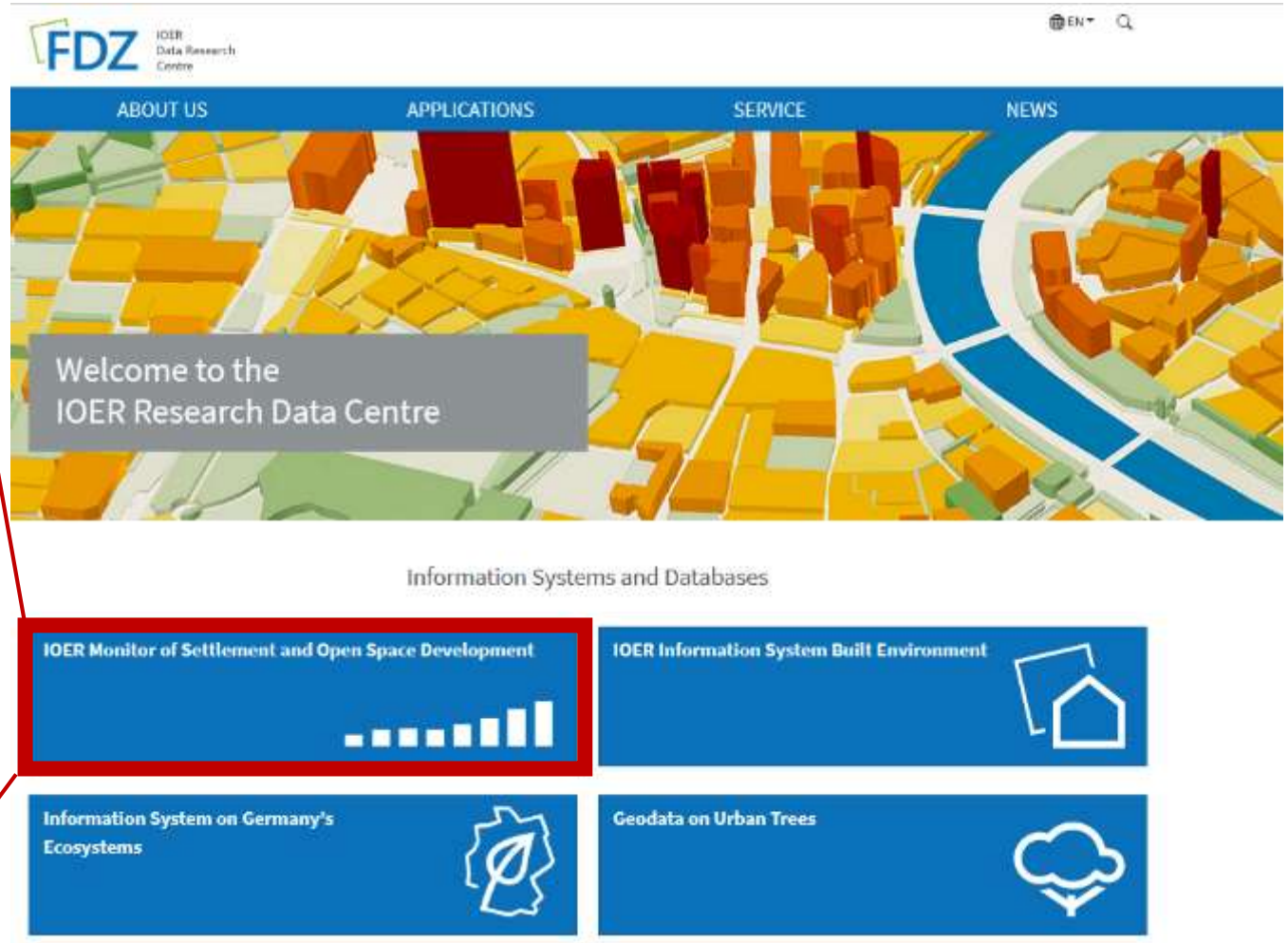


10.000 5.000 1.000 500 200 100

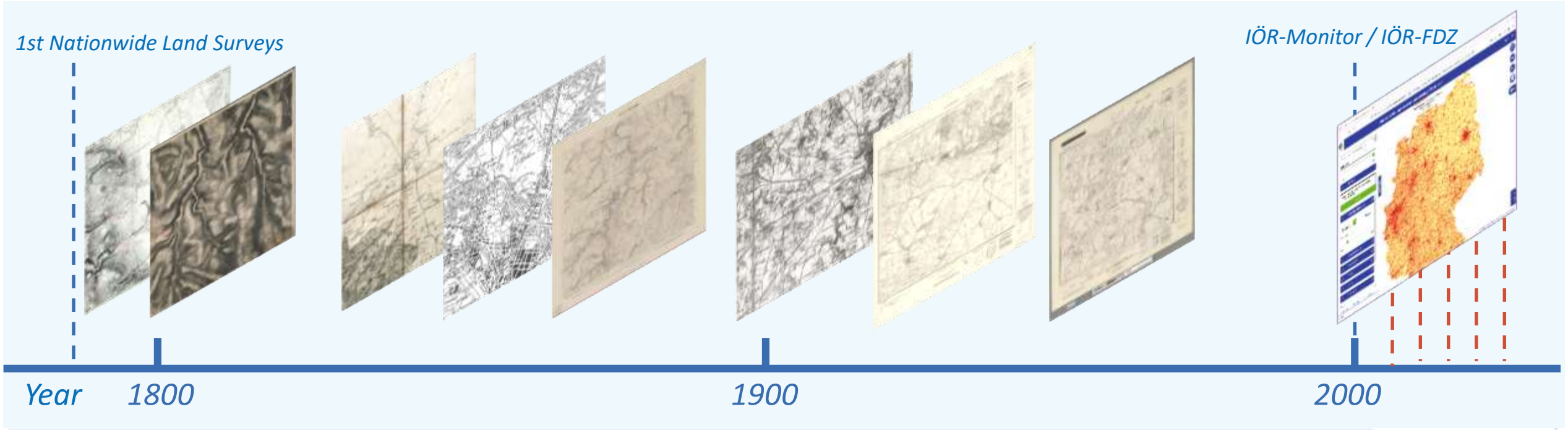
Land change monitoring – IOER Monitor / Research Data Center

Monitoring is the basis for:

- - Sustainability strategy
- - Biodiversity strategy
- - Climate protection program



Aim of the project



Automated Detection of Landscape Features in Historical Maps

Backward Extension

Our previous work on historical maps

Approaches to automated map analysis

- Settlement structure (German TM 1:25k)
- Urban block reconstruction (German TM 1:25k)
- European topographic map comparison
- Semantic map segmentation and uncertainty
- Settlement areas 1875-1943
- Automated georeferencing and metadata generation

Challenges

Very diverse data sources: different map series

Digital Geodata

Date of origin

Coordinate reference system

Georeferencing method

Cartographic representation

Data formats

Metadata

Scale

Findability & accessibility of the maps

Metric quality

Various map makers & construction methods: not standardised

Semantics

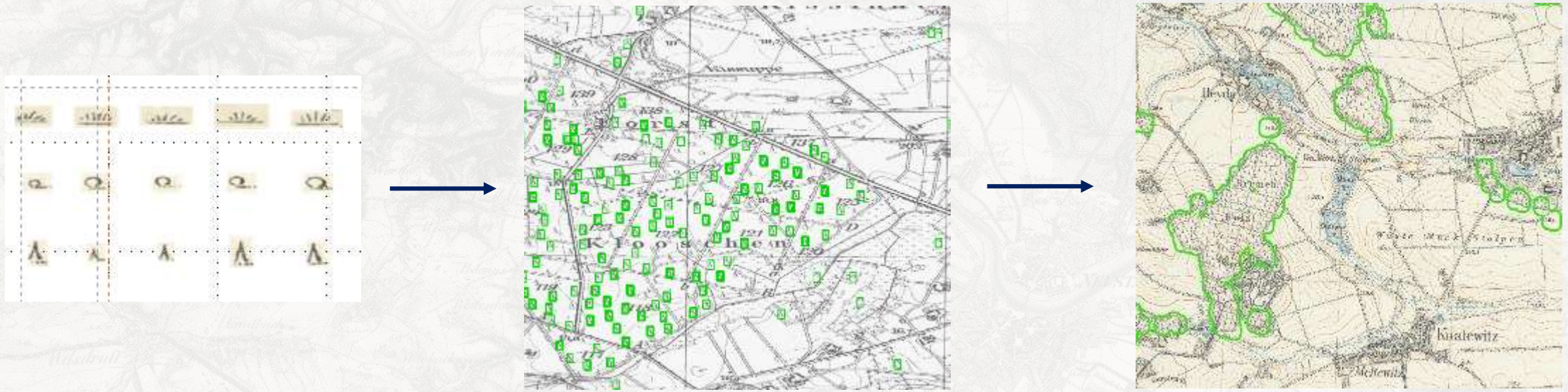
Processing level

Methodological Research

Workflow:

1. Template "catalog"is created interactively (any image processing program)
2. Each template is tested against map image
3. Entirety of the find positions is displayed as a binary mask
4. Conversion into vector data and semantic extension

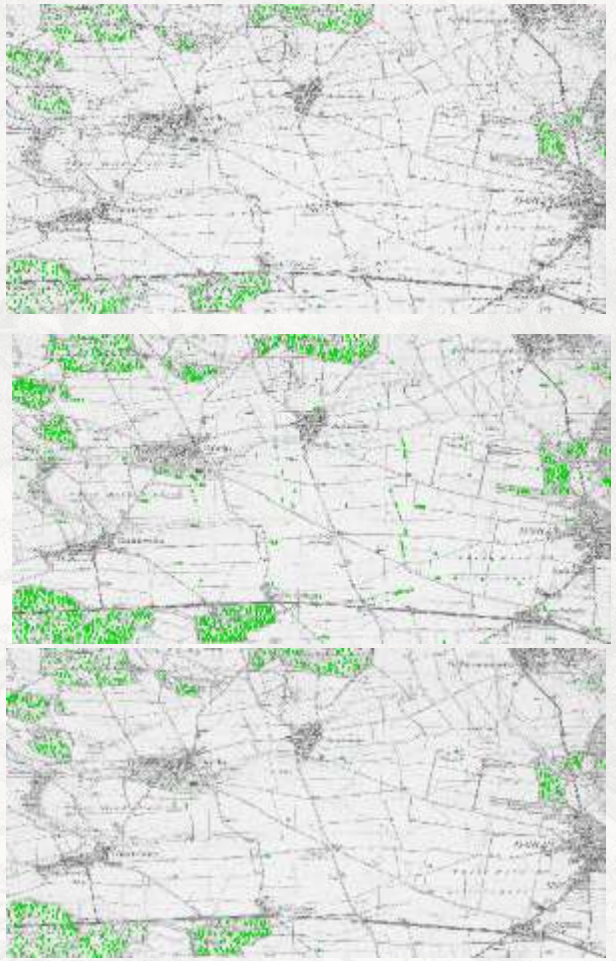
Forest area detection in survey table sheets (Meßtischblätter, 1875-1943), IÖR



Methodological Research

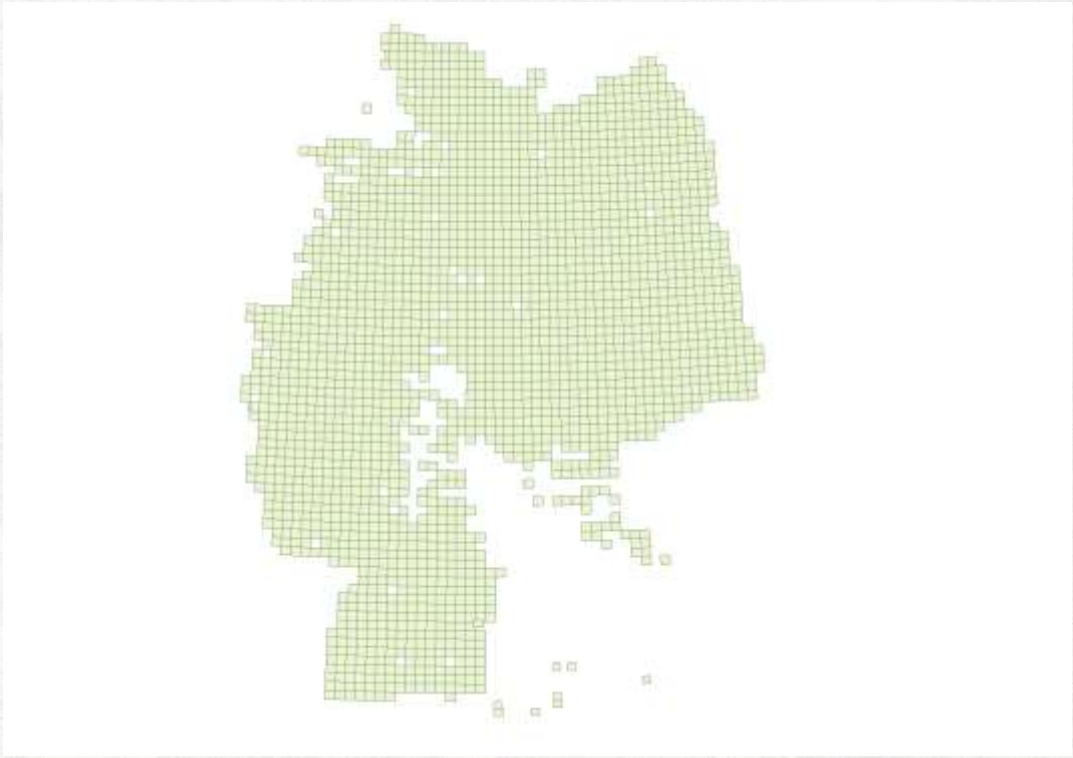
Tabelle 1: Graphische Details in Messtischblättern bei veränderter Bildgröße. Die Auflösung beträgt je 96dpi.

Messtischblatt		Original	75%	50%
	MTB 1725	7849 x 4710	5886 x 3532	3924 x 2355
	MTB 2343	7972 x 4784	5981 x 3588	3987 x 2392
	MTB 4643	8315 x 4990	6236 x 3743	4158 x 2495
	MTB 4902	8379 x 5028	6284 x 3771	4771 x 2514

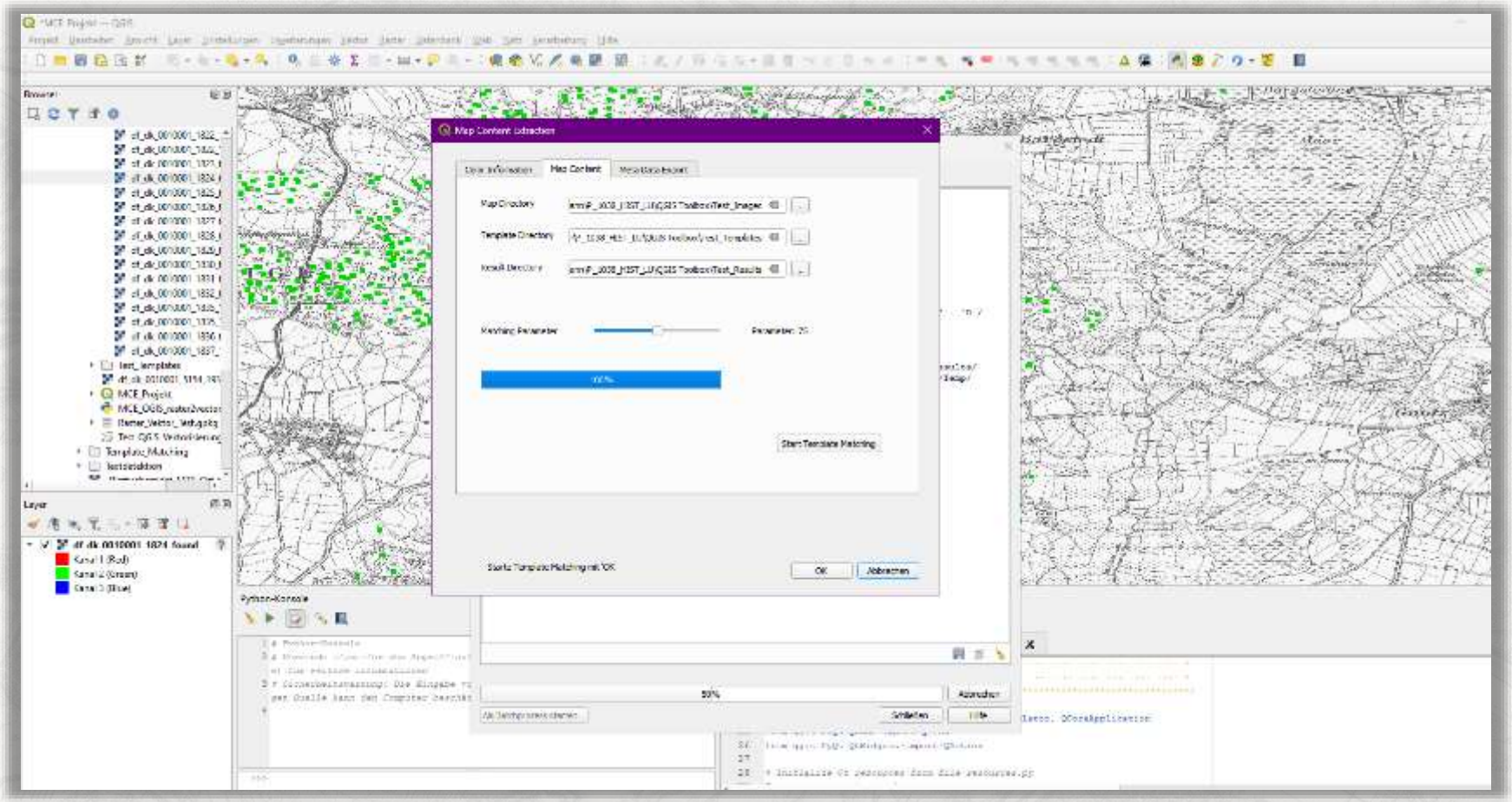


Methodological Research

- Corpus: „Messtischblätter“
- ca. 4.000 Map sheets
- ca. 400 GB Raster data
- Python / OpenCV
- **Calculation time per class: approx. 29h (workstation)**



Methodological Research QGIS Toolbox

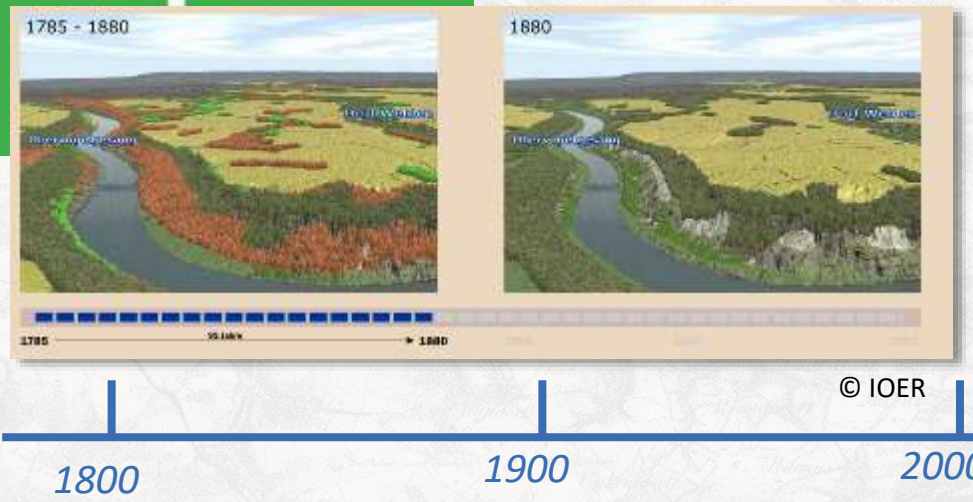


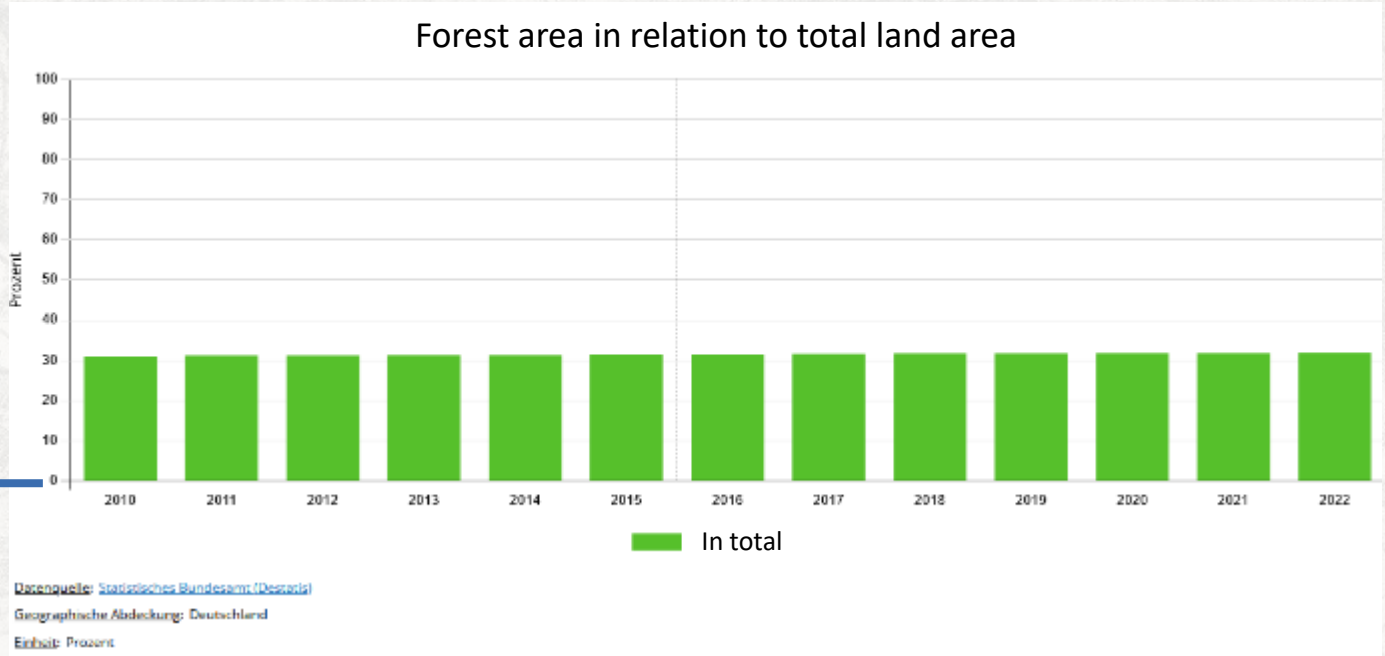
SDGs - Conclusion and Outlook

- **Increasing demand for historical geodata**
- Complex task → multiple approaches
- Evaluation → Reference data (!)
- Further classes and methods DL/ML
- Georeferencing? → Libraries / Citizen Science
- Consistent time series? > e.g. 30 years
- **Exchange with research and target groups**

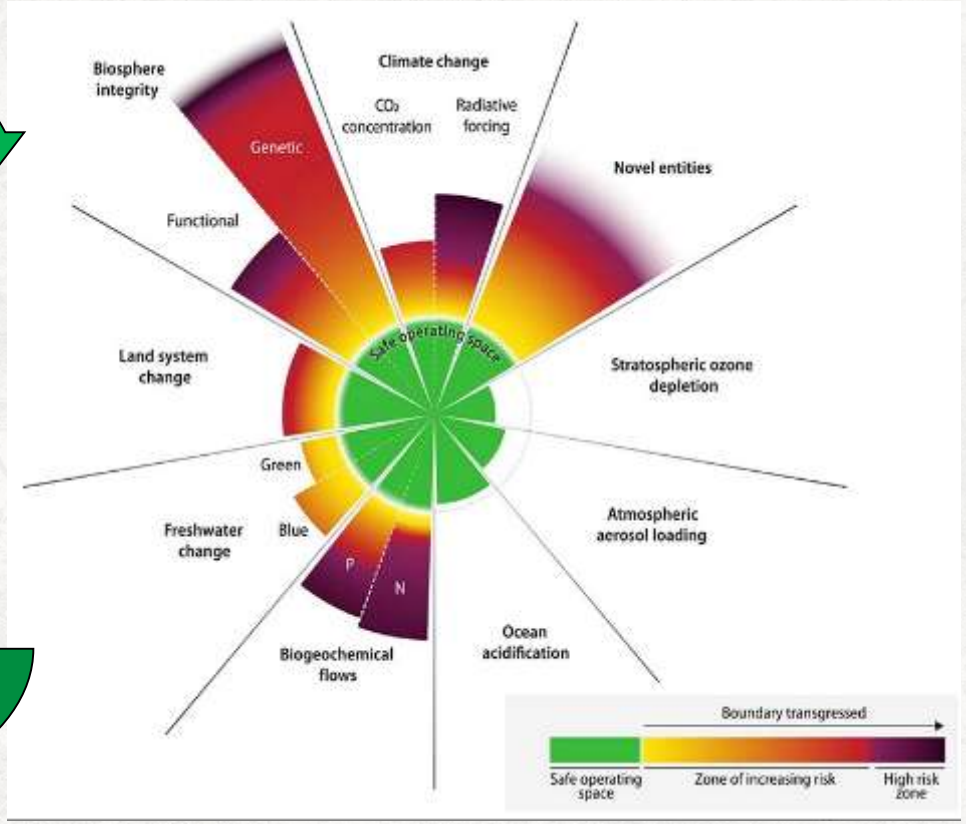
SDGs - Conclusion and outlook

Monitoring forest cover change: Indicator 15.1.1 - Forest area in relation to total land area





Some remarks for discussion



Current condition of the nine earth systems. © Richardson et al/ Science Advances, CC-by-nc 4.0

Outlook - Combine efforts of all

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Thank you for your kind attention!

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