Introduction of Geographic Information Systems (GIS)
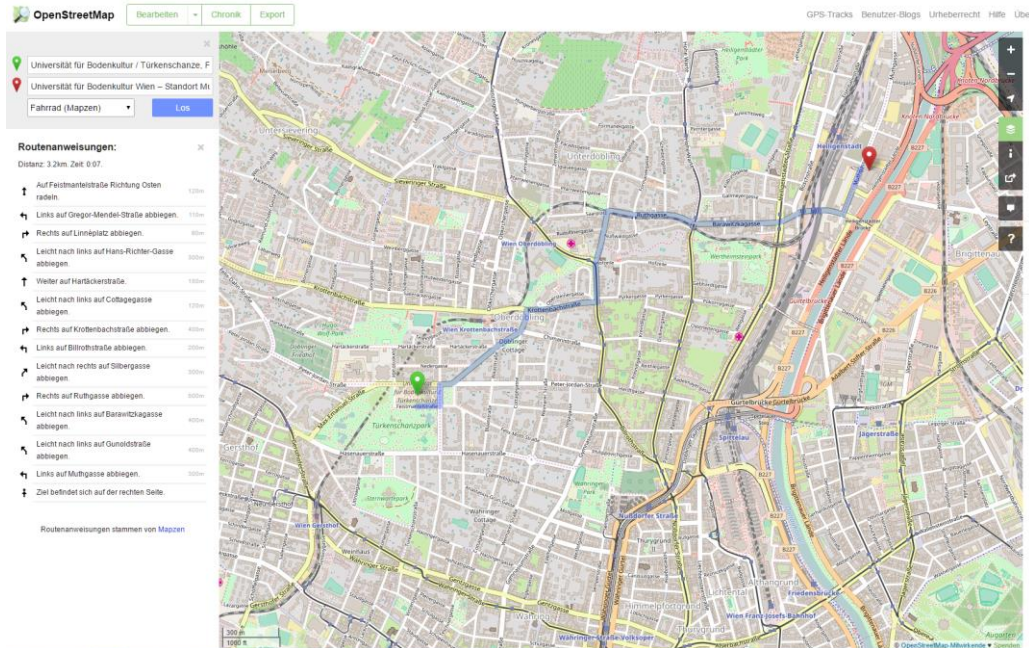
Thomas BAUER

Senior Lecturer

Institute of Geomatics
University of Natural Resources and Life Sciences, Vienna
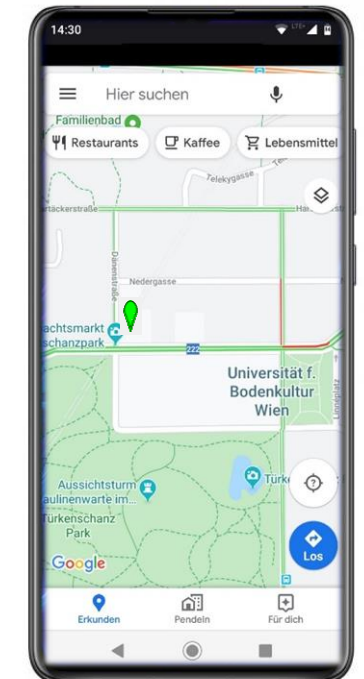
Quotations from the world of geoinformation

"Approximately 90% of our daily decisions are based on spatial information."

✓ Where is the car, bus station, ...?
✓ What is the shortest path to the office?
✓ Where is the closest restaurant?
✓ Etc., etc., etc., ...

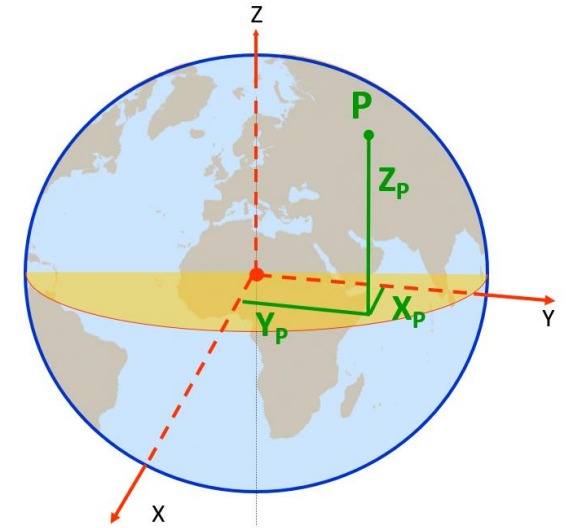"80-90% of all information has a spatial reference and is therefore geodata."

Definitions

■ **Geodata:** data with a spatial reference

→ **Spatial data**

→ **Refer to a position in the geographical space** („georeferenced")

■ **Geographic Information System (GIS):** a computer-based system consisting of hardware, software and data with which spatial problems can be modeled and processed in various application examples.

R. Bill (2010)

Geographic information system

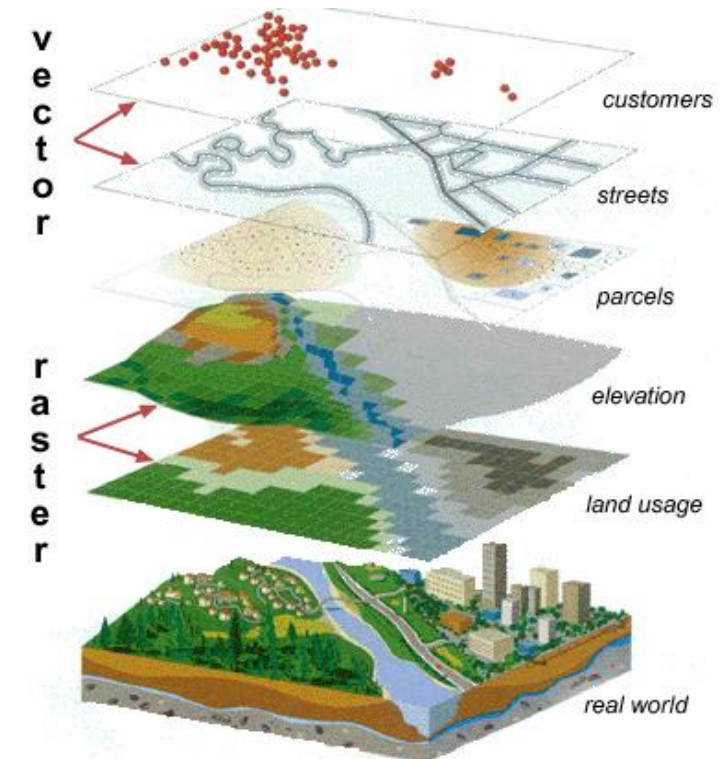A geographic (spatial) information system is used for the

Acquisition

Storage and management

Processing (analysis)

Visualisation

of geodata/geoinformation.

Source: National Coastal Data Development Centre (NCDDC), National Oceanic
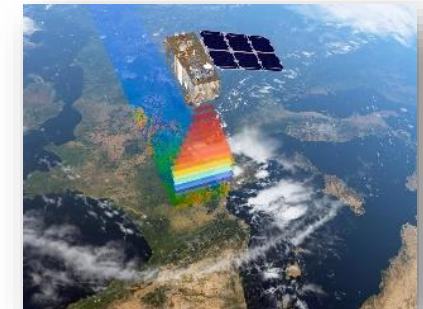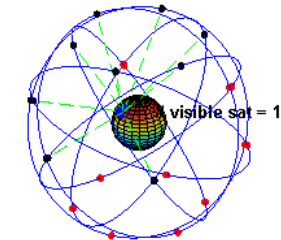and Atmospheric Administration (NOAA), USA

Data acquisition

- **In the field:** measurements
  - → Monitoring stations, surveying, GNSS (e.g., GPS, Galileo), ...

Source: https://www.wien.gv.at/umwelt/luft/messstellen/akh.html

Source: https://leica-geosystems.com/de-ch/products/total-stations/manual-total-stations

- **Remote sensing**: UAVs, airplanes, satellites
  - → Aerial photographs, satellite data, airborne laser scanning, radar, ...

visible sat = 12

Credit: ESA/ATG medialab

- **Integration of existing data sets:** provided by governments, regional authorities, municipalities, ...

https://inspire-geoportal.ec.europa.eu/
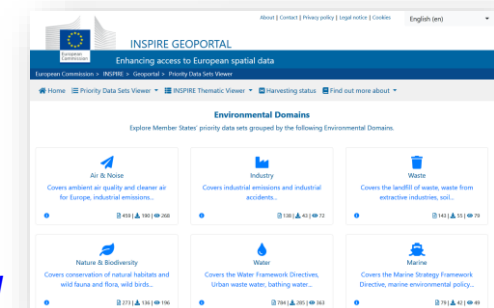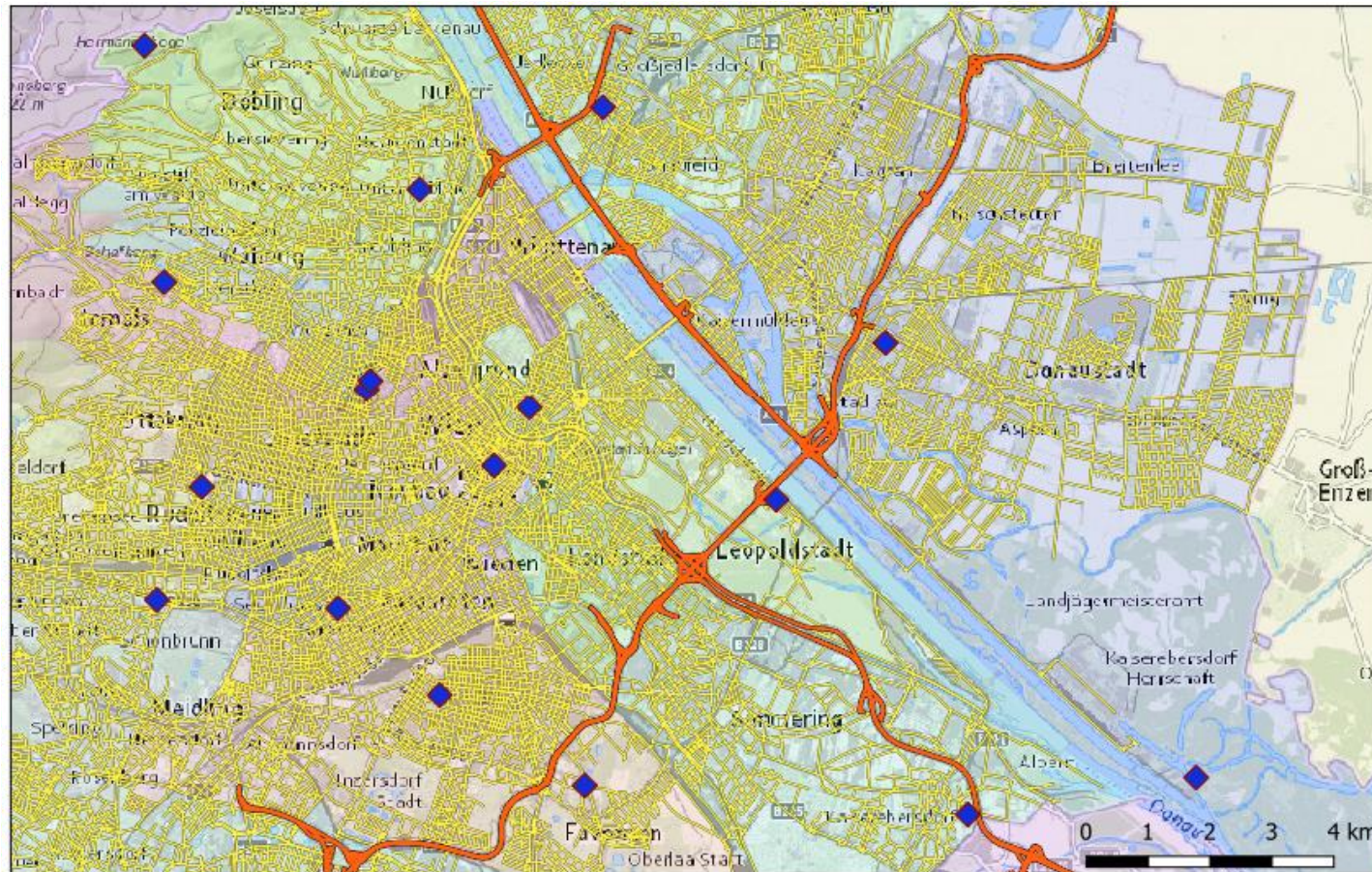
Data acquisition

- GIS: integration of different kind of geodata

Monitoring stations

Administrative boundaries

Road network

Digital elevation model

Land use

Satellite image

Basemap
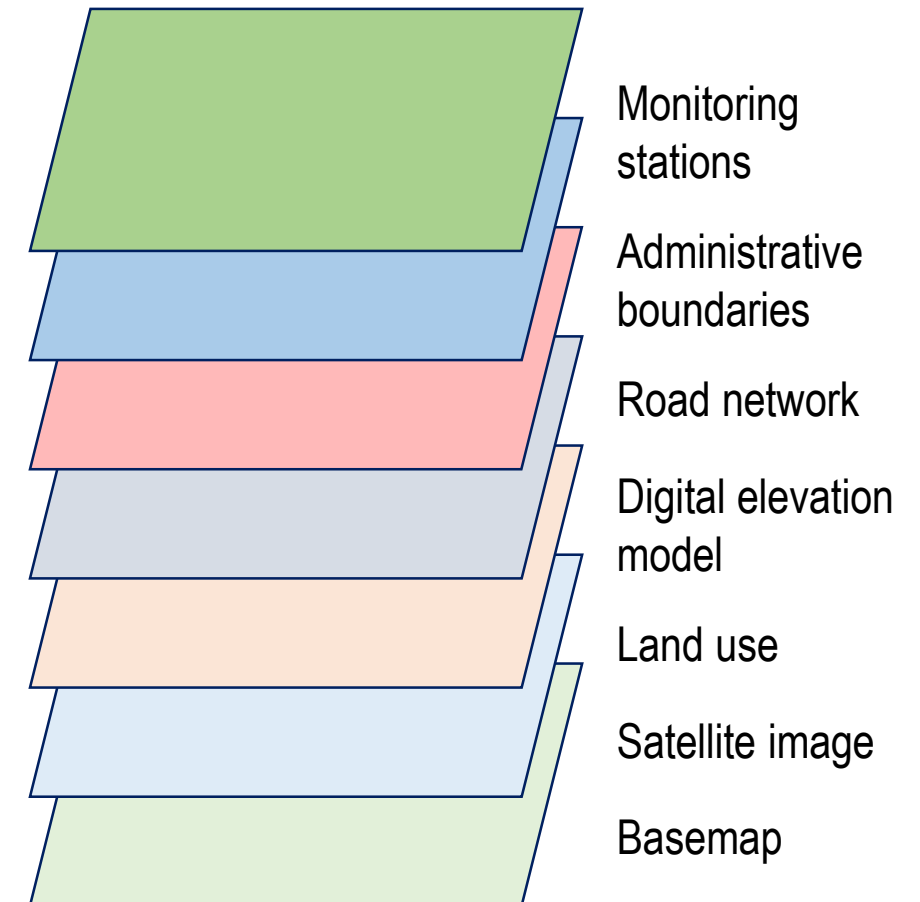
Data storage and management

- Geographic database: storing <u>geometry of objects + attributes</u>

Polygon
- ✓ Parcel # 123
- Owner XX
- Community # 45324

Line
- ✓ Drinking water supply
- Diameter 5 cm,
- Constructed in1995,
- Manufacturer XY

Point
- ✓ Oak, protected
- Age: 250 years

Source: https://www.gao.gov
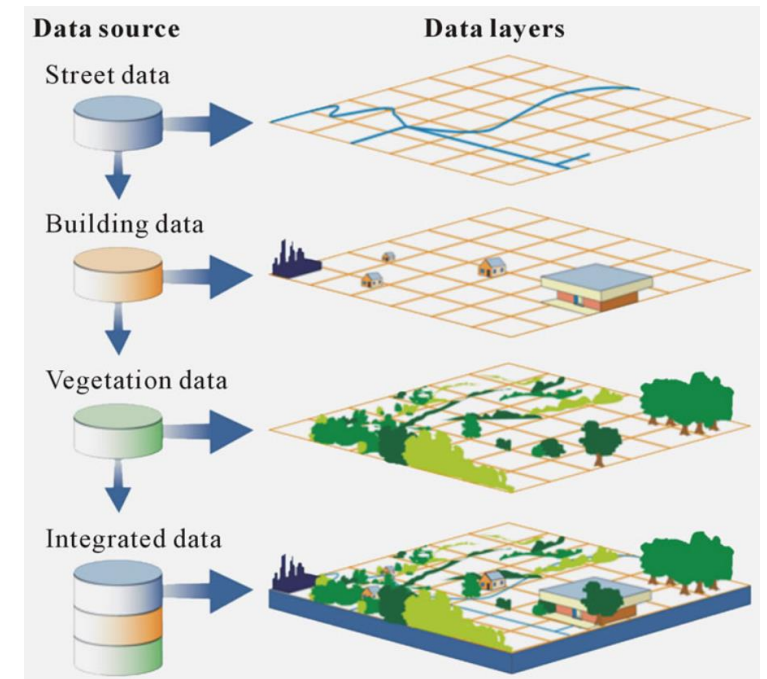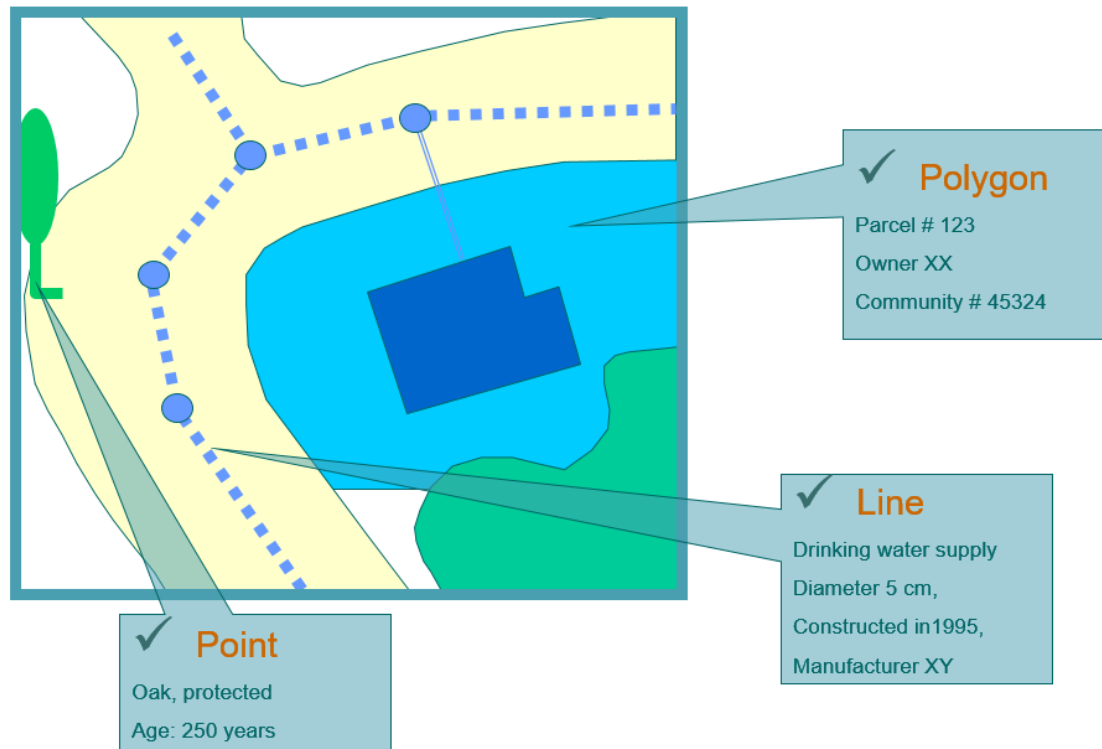
Data processing and analysis

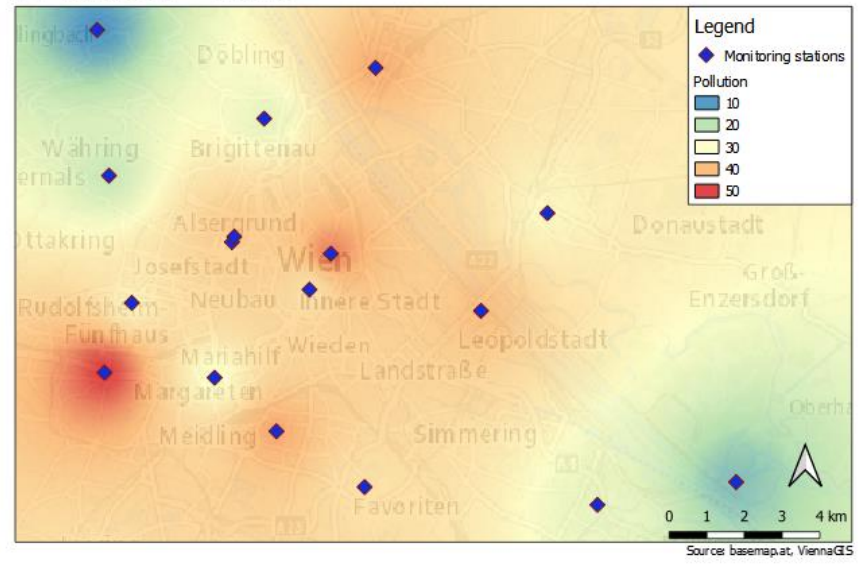- Overlay operators, interpolation algorithms, tools for modelling and simulation, ...

Monitoring stations

Administrative boundaries

Road network

Digital elevation model

Land use

Satellite image

Basemap

Resulting layer
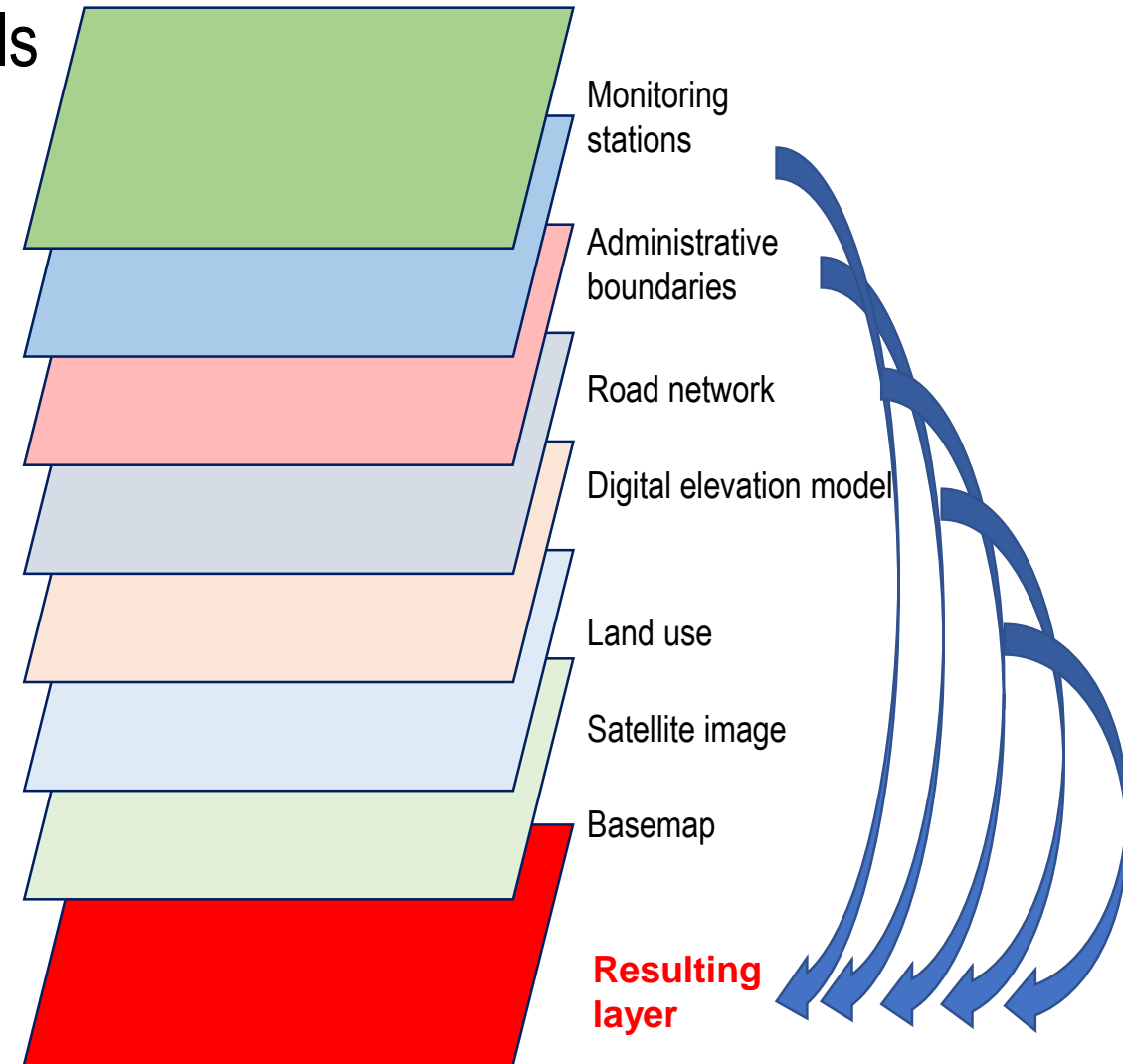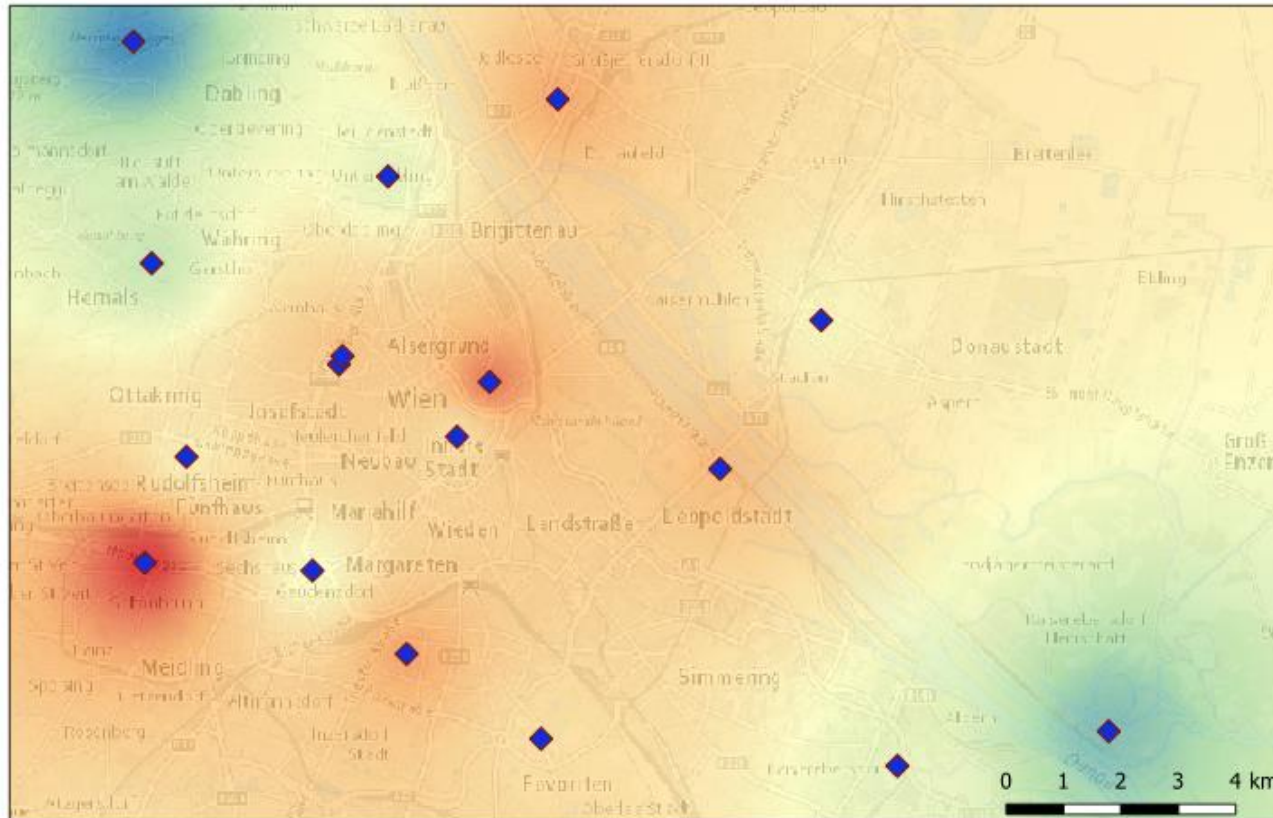
Data visualisation

- Maps, 3D-Views, WebGIS, ...

Air Pollution - Vienna

Source: basemap.at, ViennaGIS

Source: wien.gv.at

Fields of application

→ **Where maps are used for planning, documentation and decision-making, and where data can be linked by a common spatial reference.**

- Urban, regional and landscape planning, environmental impact assessments
- Surveying and cadastre, cartography
- Topographic analysis for various purposes (analysis of slope, exposure, solar radiation, run-off calculation, ...)
- Civil engineering (mass calculation, traffic planning and road construction)
- Energy supply (electricity, gas), as well as supply and disposal of water and waste water
- Environmental studies and monitoring, natural resource mapping and analysis
- ...

Benefits of a GIS

- Integrated information processing is possible (connection of geo-graphical data with thematic data).

- Themes (layers) can be combined with each other in any way (links, intersections)

- Short time for update of data

- Model calculations and simulations can be performed quickly

- Comprehensible decisions can be made

- Requests by decision makers can be responded in a short time

University of Natural Resources and Life Sciences, Vienna

Department of Spatial, Landscape and Infrastructure Sciences
Institute of Geomatics

Dr. Thomas BAUER

Peter-Jordan-Strasse 82, A-1190 Vienna
Tel.: +43 1 47654-85713

E-mail: t.bauer@boku.ac.at

https://boku.ac.at/geomatics.html