Geoinformation Systems „Quo Vadis"

a talk in the workshop „Geoinformation Systems" at CODE Jahrestagung 2019

- Studied math and computer science
- Postdoctoral Research on **Trajectory Computing**
- Jun.-Prof. for **Big Geospatial Data** in Hannover
- PI of the **Interdisciplinary Center for Applied Machine Learning** at University of Hannover
- Now Senior Scientist in the **Earth Observation Center of DLR**
- From September: **Jun.-Prof. for Big Geospatial Data**

Quo Vadis
Where do we come from?

der Bundeswehr
Universität München
www.martinwerner.de
DLR

Maps in Babylon

1,400 BC **Babylon maps** have circles for cities, rivers as lines, and hills as semicircles engraved into clay. Cardinal directions (North, South, West, East) are marked as well. Some area measures are given.

Ancient World Maps - http://ancientworldmaps.blogspot.com/
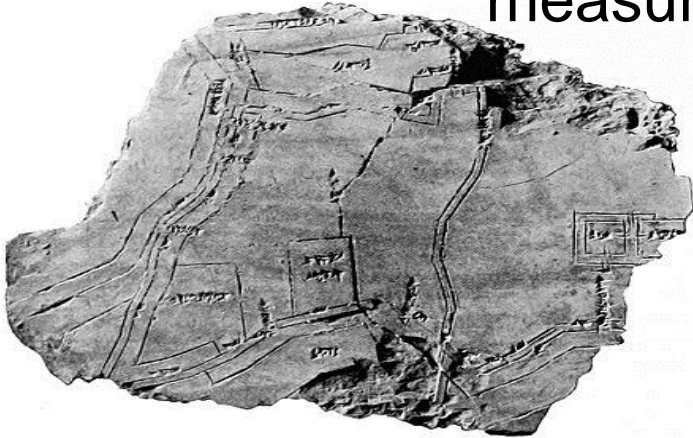
The Birth of Spatial Data Science (GIScience)

Cholera near Broadwick Street in 1854. The original map has been drawn by John Snow (1855).

He used this map to highlight the argument that the spatial distribution of the outbreak makes the theory of that Cholera is related to drinking water much more likely than the theory of that Cholera is related to particles in air.

The map shown here is a version of E. W. Gilbert (1958)
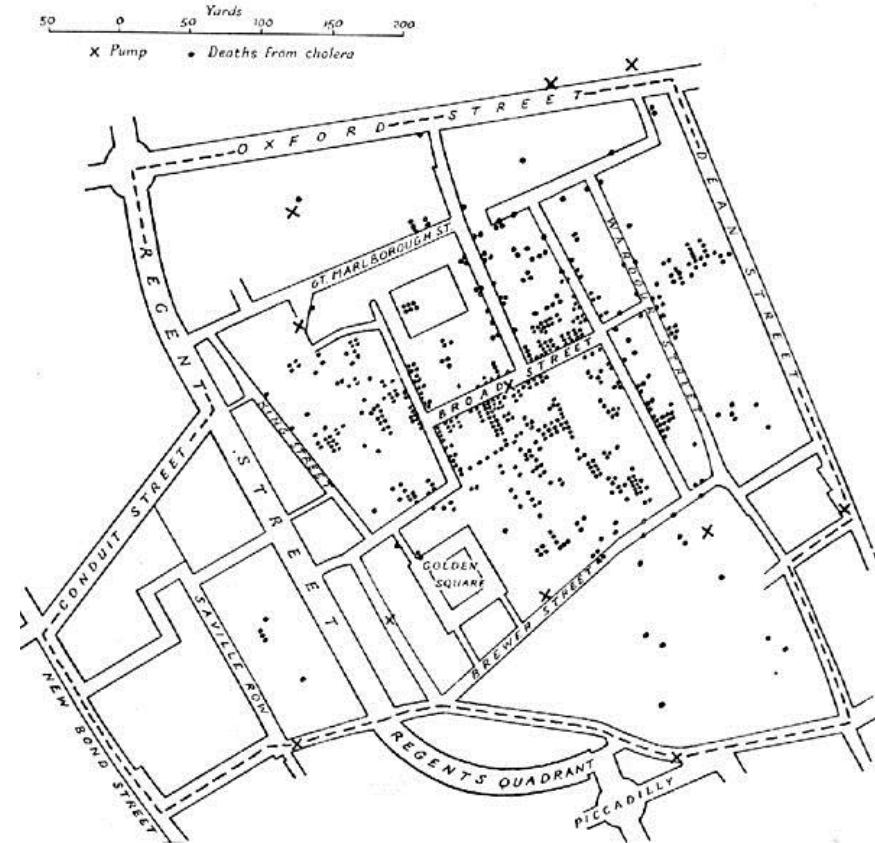
Today?

Challenge One:
Big Data (esp. from space)

Flood Mapping (near Jacksonville, 15. September 2018)

https://www.esa.int/spaceinimages/Images/2018/09/Floods_near_Jacksonville

Reykjavik im Spotlight-Mode

https://www.dlr.de/dlr/desktopdefault.aspx/tabid-10293/427_read-22816/#/gallery/27214
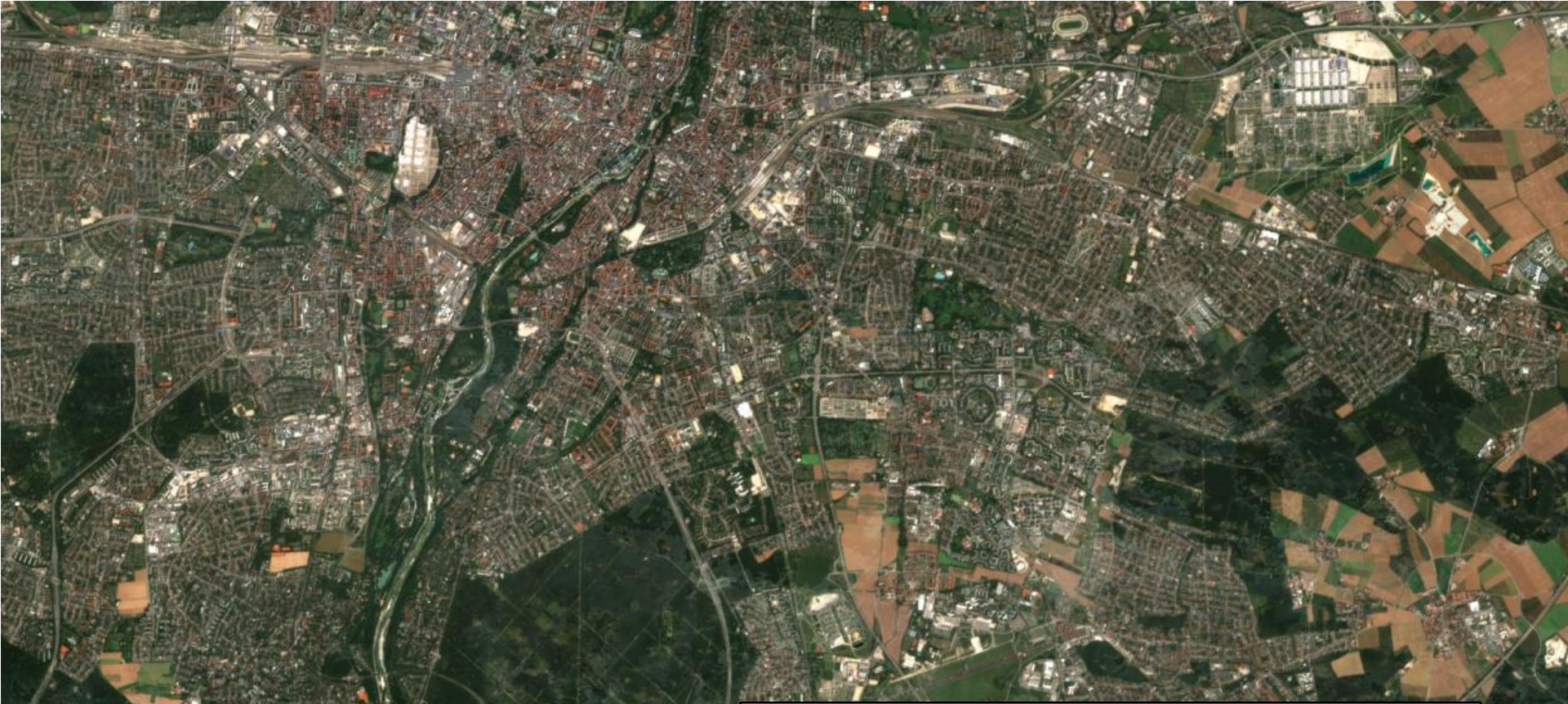
The first picture taken

https://www.dlr.de/dlr/desktopdefault.aspx/tabid-10293/427_read-22816/#/gallery/27214

It is even possible to extract accurate 3D information from multiple SAR images
(image shows building height, cf. http://www.so2sat.eu)

https://www.so2sat.eu

Sentinel 2 – Cloudfree Mosaic, August 2018 – Data © Copernicus; ESA

This is Munich ;-)

This is Munich ;-)

Landsat imagery courtesy of NASA Goddard Space Flight Center and U.S. Geological Survey

Tesla Factory
May 11, 2016

This image has been taken by a satellite of Planet Labs showing a factory in Nevada, where Tesla is building battery packs for Model 3.

CC Attribution: Planet Labs,
https://www.planet.com/gallery/tesla-gigafactory-20170808/

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Tesla Factory
Nov 10, 2016

... site is expanding ...

CC Attribution: Planet Labs,
https://www.planet.com/gallery/tesla-gigafactory-20170808/

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Tesla Factory
Aug 08, 2017

... and completed ...

- These collections are big!
  - Not the big of Hadoop and Spark (1,000 PCs)
  - The Big of HPC (Peta-Scale)
- Agreement reached:
  - DLR transmits about **40 petabyte** to LRZ (online)
  - LRZ provides technical service in exchange for data access for Bavarian research

This is
- an equivalent of 9 million DVDs!
- would weigh about 140 tonnes!

https://www.dlr.de/dlr/presse/en/desktopdefault.aspx/tabid-10172/213_read-33817/

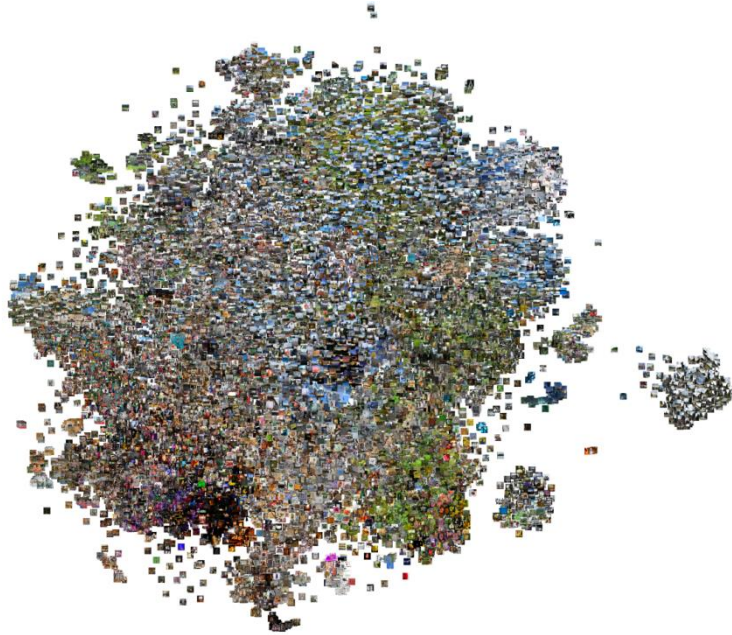# Challenge 2: Complex Data
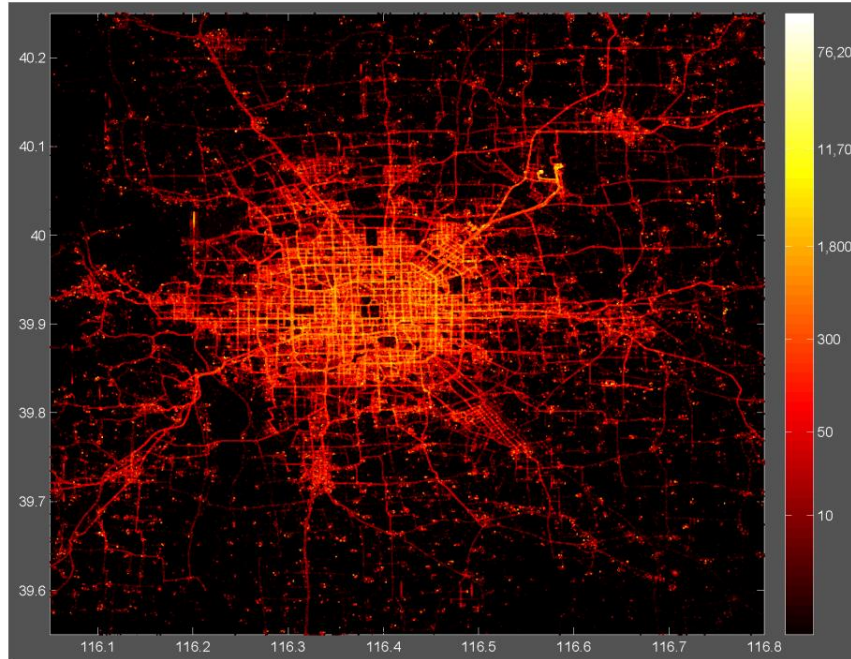
(a) Data overview in Beijing

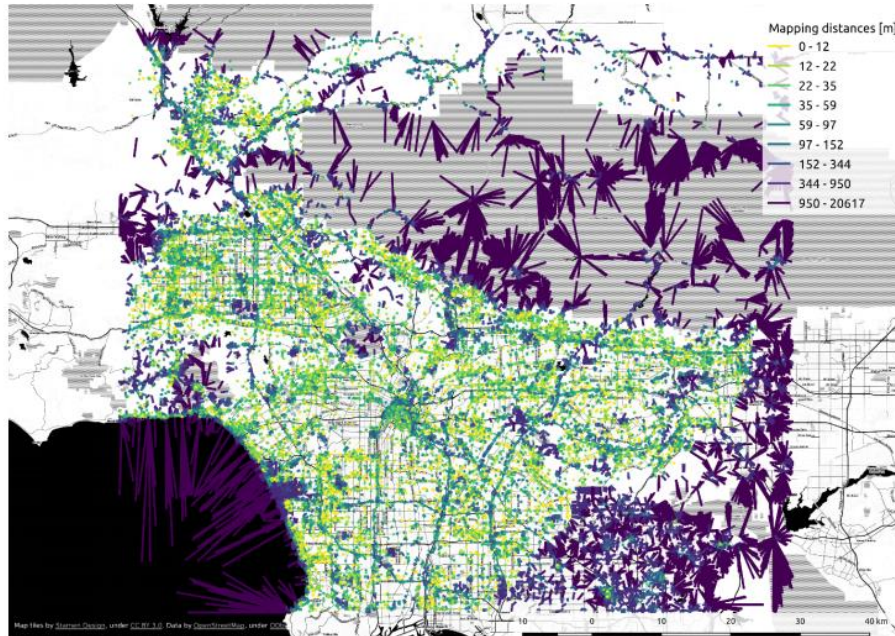(b) Within the 5th Ring Road of Beijing

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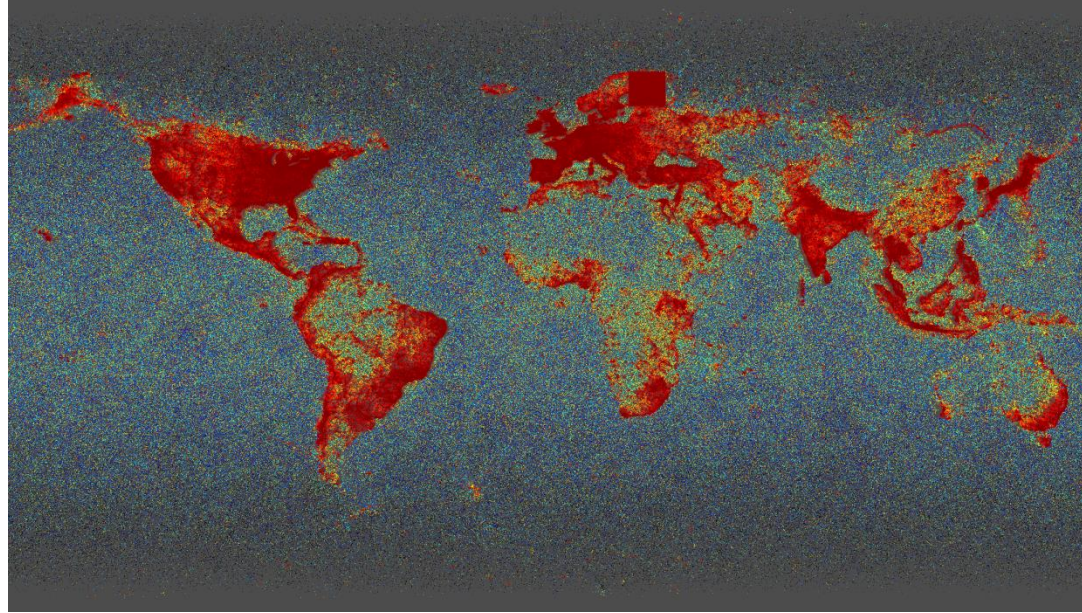
The image shows (part of) the public twitter stream for one year. (ca. 5 TB text, 201 million precisely geolocated tweets)

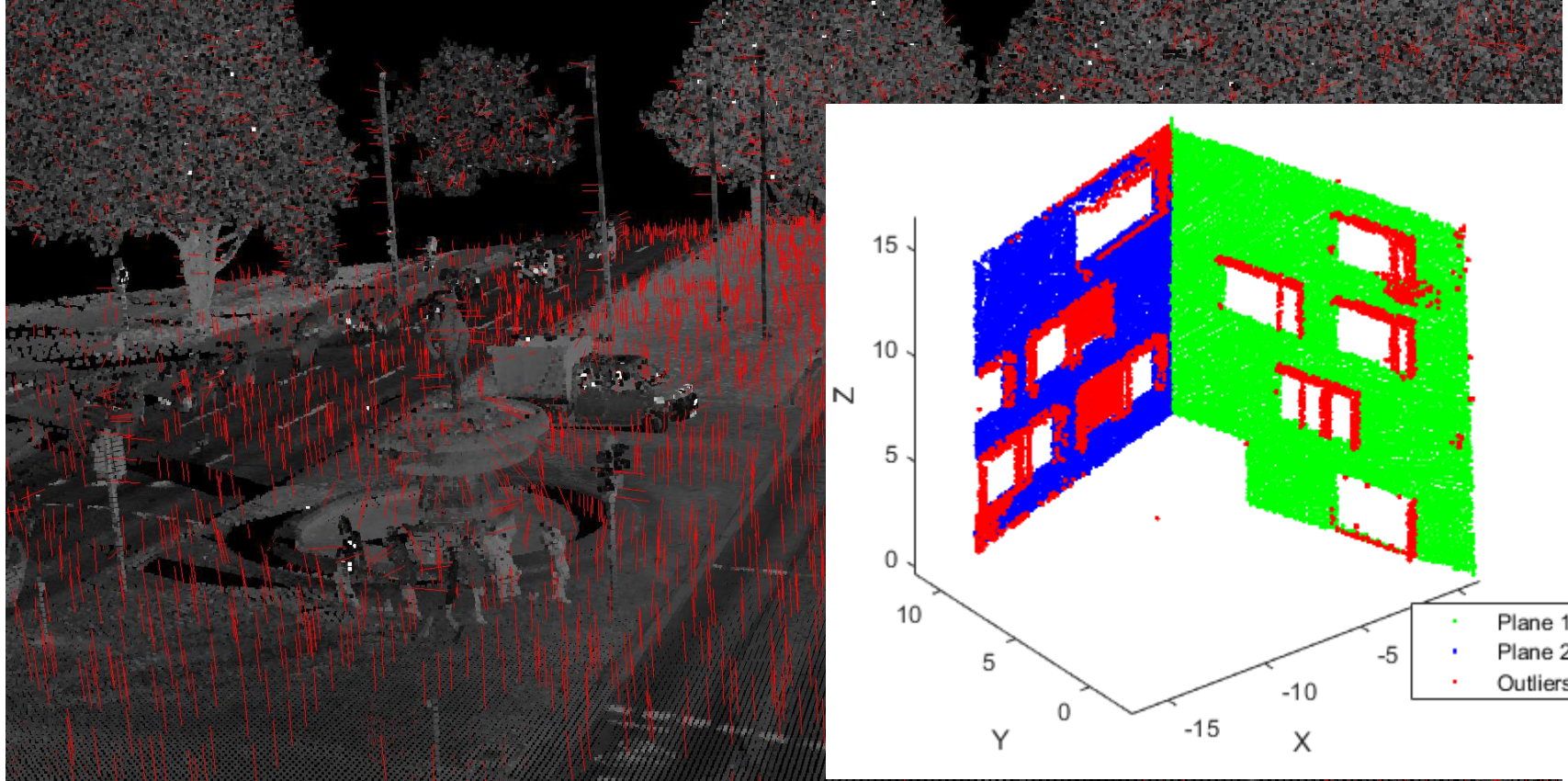Some precisely geolocated images from Black Forest (Schwarzwald)

Bild: Eike-Jens Hoffmann, TUM, für seine Dissertation

Extract and Spatially Assign Information

Class	Sample Images
a) accommodation	
b) civic	
c) commercial	
d) religious	
e) other	

Figure 2: Example images from five different usage clusters

Hoffmann, E. J., Werner, M., & Zhu, X. (2019). Building Instance Classification using Social Media Images. In *Joint Urban Remote Sensing Event (JURSE)* (pp. 1–4).

Streets from Munich

OpenStreetMap Data

https://icaml.org/canon/data/geo-data/laserscanning/ransac.html

Input

Output
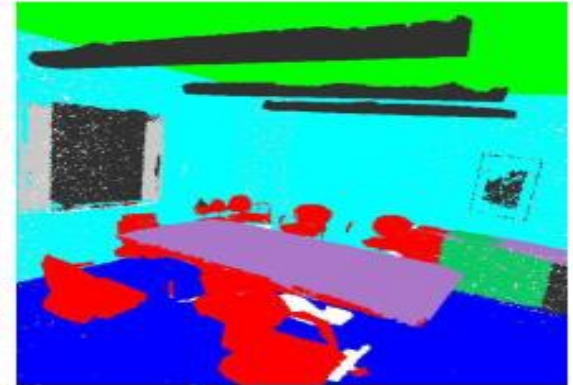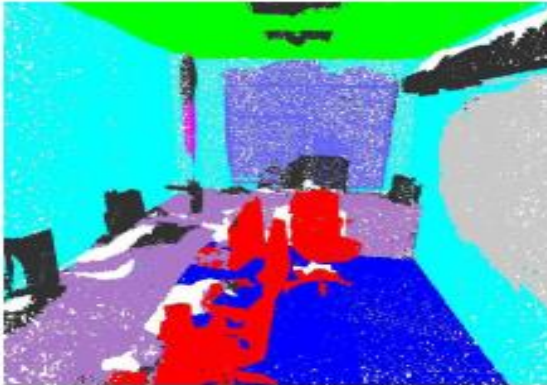
Challenge 3:
Finding, Visualizing and Using This Data

Enrichment & Value

Interoperability & Actionability

Machine Learning

Spatial Data Warehouse

Standards

AI

Spatial Data

Database

Topologie

Data Mining

Geometrie

Computational Geometry

Theory & Understanding

Computation
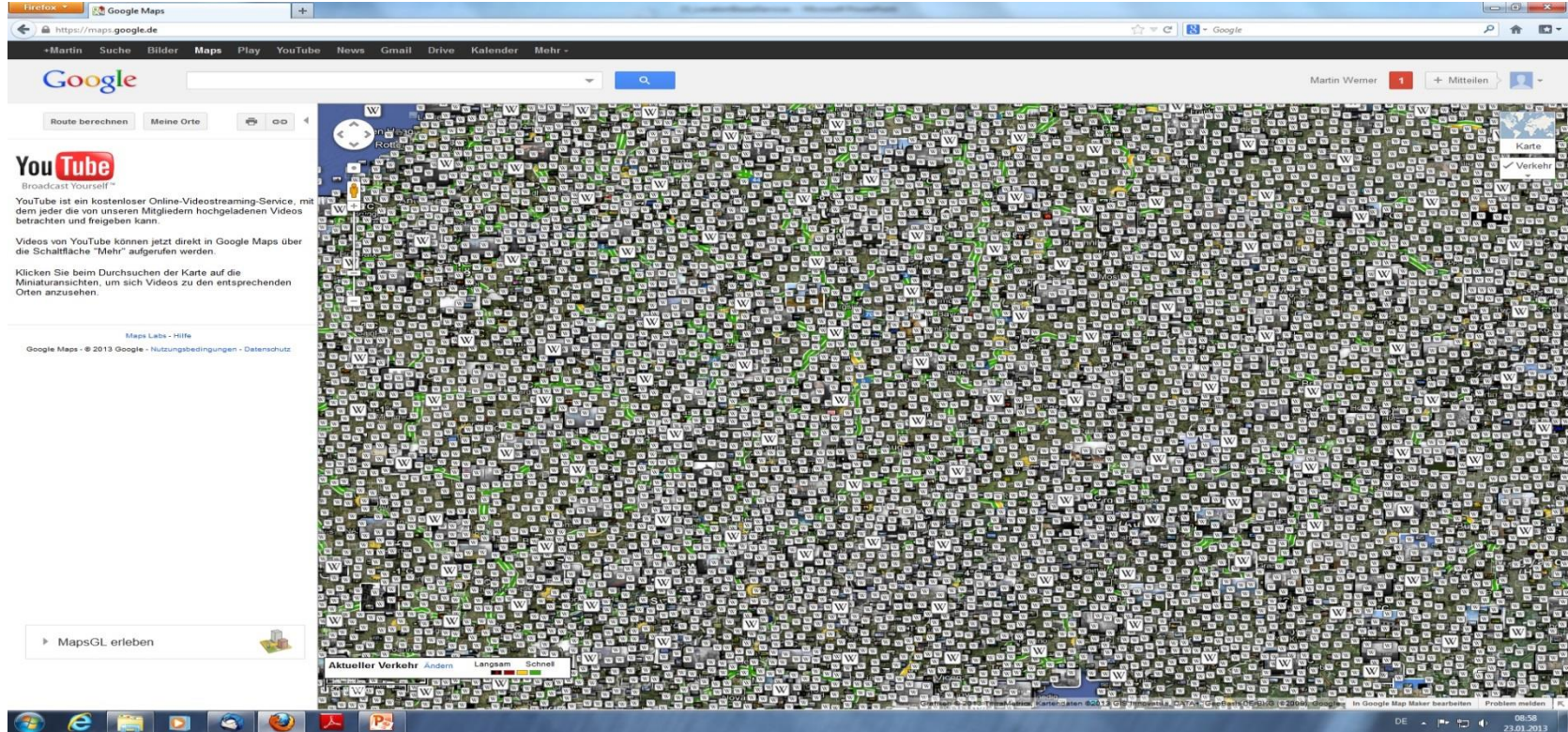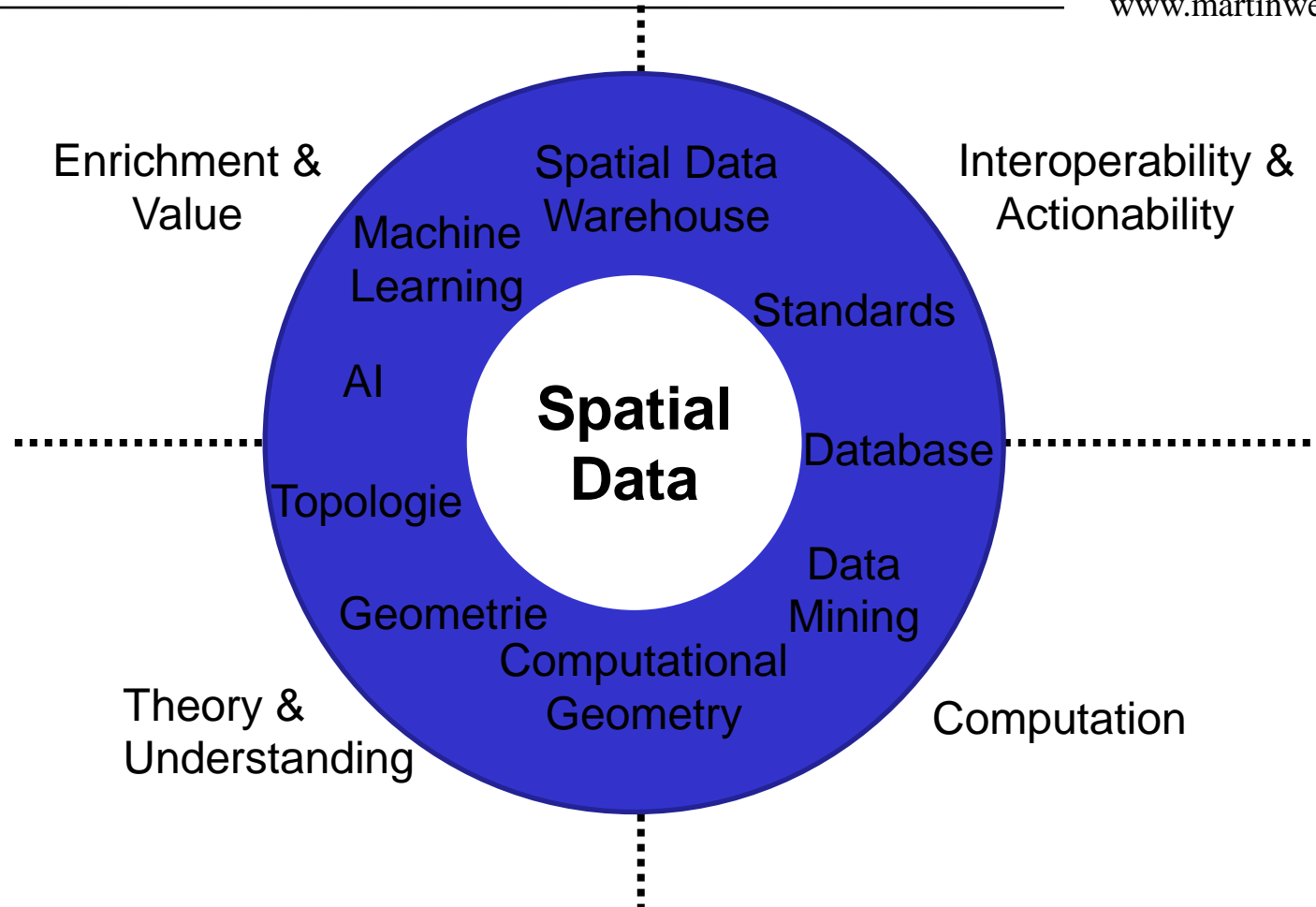
- *Technical Challenges*

Spatial Technology Quo Vadis:
We need to **simplify** technology.
We need to **educate** (more, all) people.
We need to **learn** (about the negative as well as the positive).
We need to **avoid** (the negative).
We need to **support** (the positive).

Thank you!