

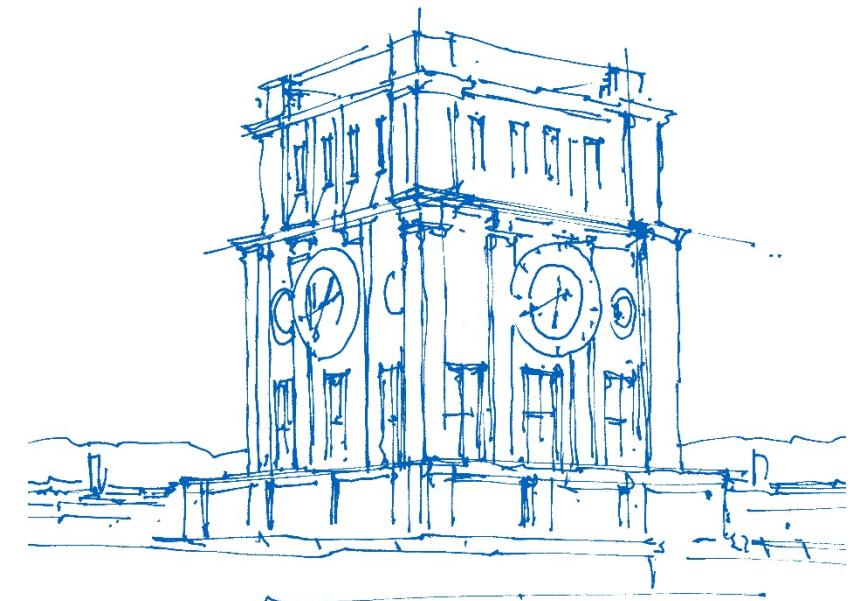
# Geographische Informationssysteme

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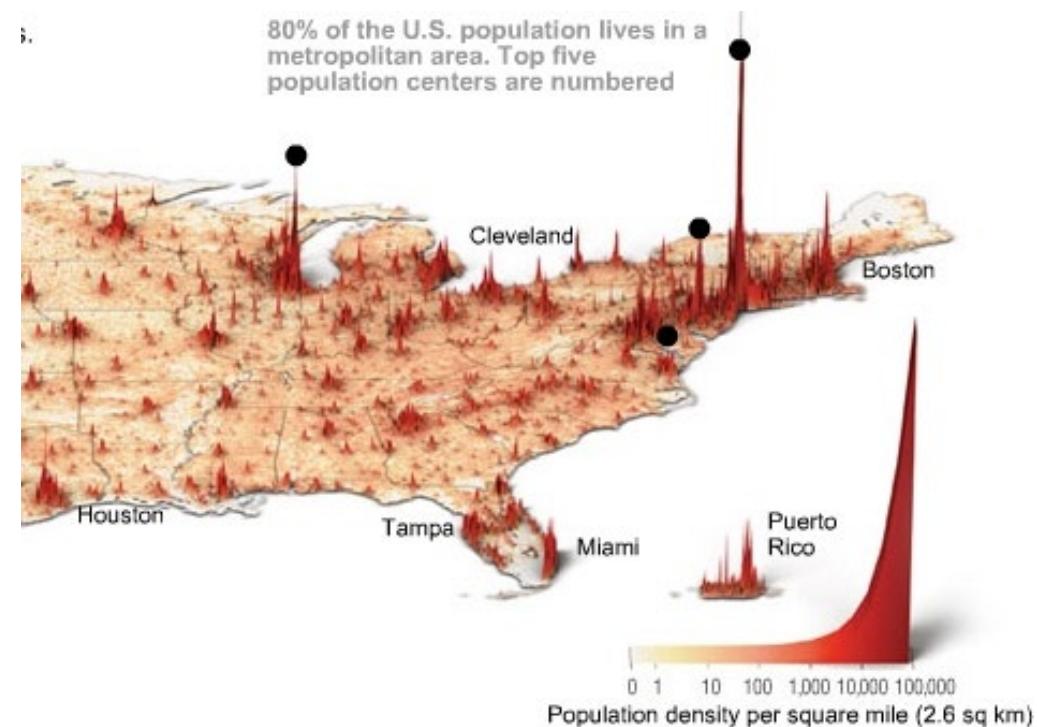


Uhrenturm der TUM

# What is GIS

Geographical information system handles data with geographical referenced information:

- Location of cities etc.
- Areas of states/countries
- Attributes and spatial relationships



# Geographical Visualizations

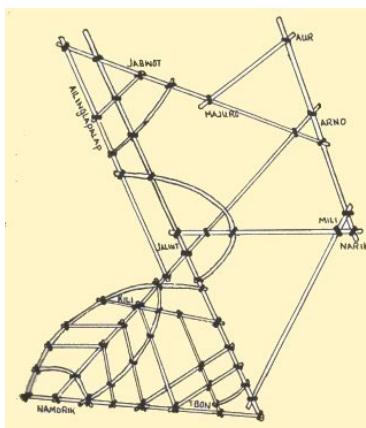
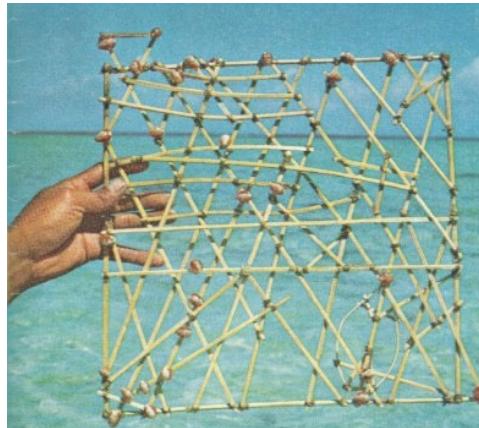
Ancient Stick Charts

Used in Micronesia, Polynesia

Constructed by palm ribs bound by coconut fiber

Shells used to represent the islands

“Rebbilib” stick chart of the Marshall Islands:



# Vector Data

Shape files (!)

Database for geographical data

Set of points, lines, and  
polygons

Described with coordinates

Used for clearly defined objects

More than one file:

- .shp: geometry of vector features
- .dbf: attributes of vector features



# Raster Data

Grid of cells

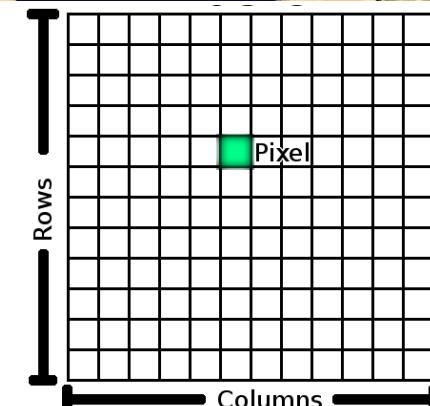
Representing areas on the ground

- Type of Land
- Elevation
- Temperature

Satellite images

Pictures

Continuous characteristics



# Vector and Raster Data

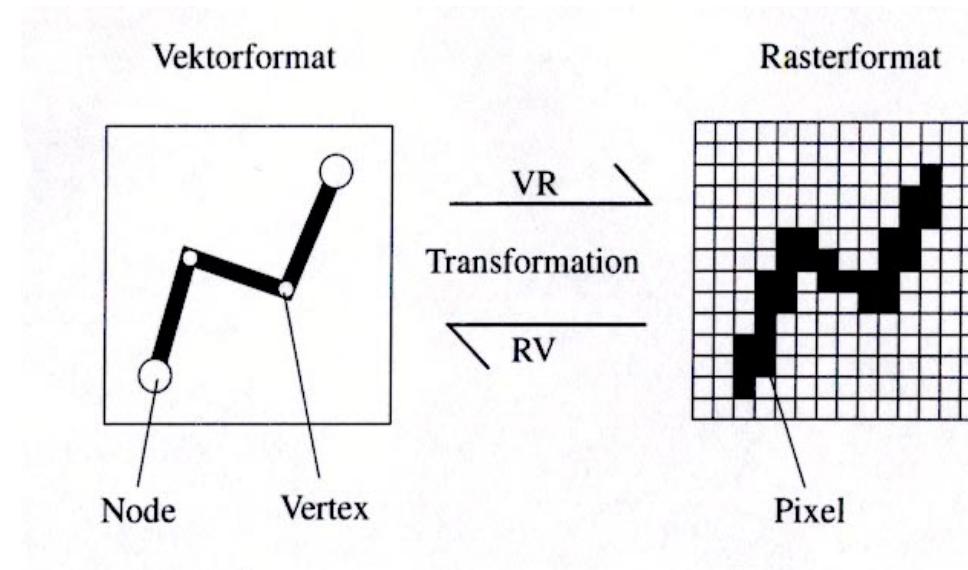
Shapes

Small storage space – endless resolution

Hard to collect

Format: .shp

Graphic  
Large storage space  
Quick to collect  
Format: tiff, jpg, esri grid

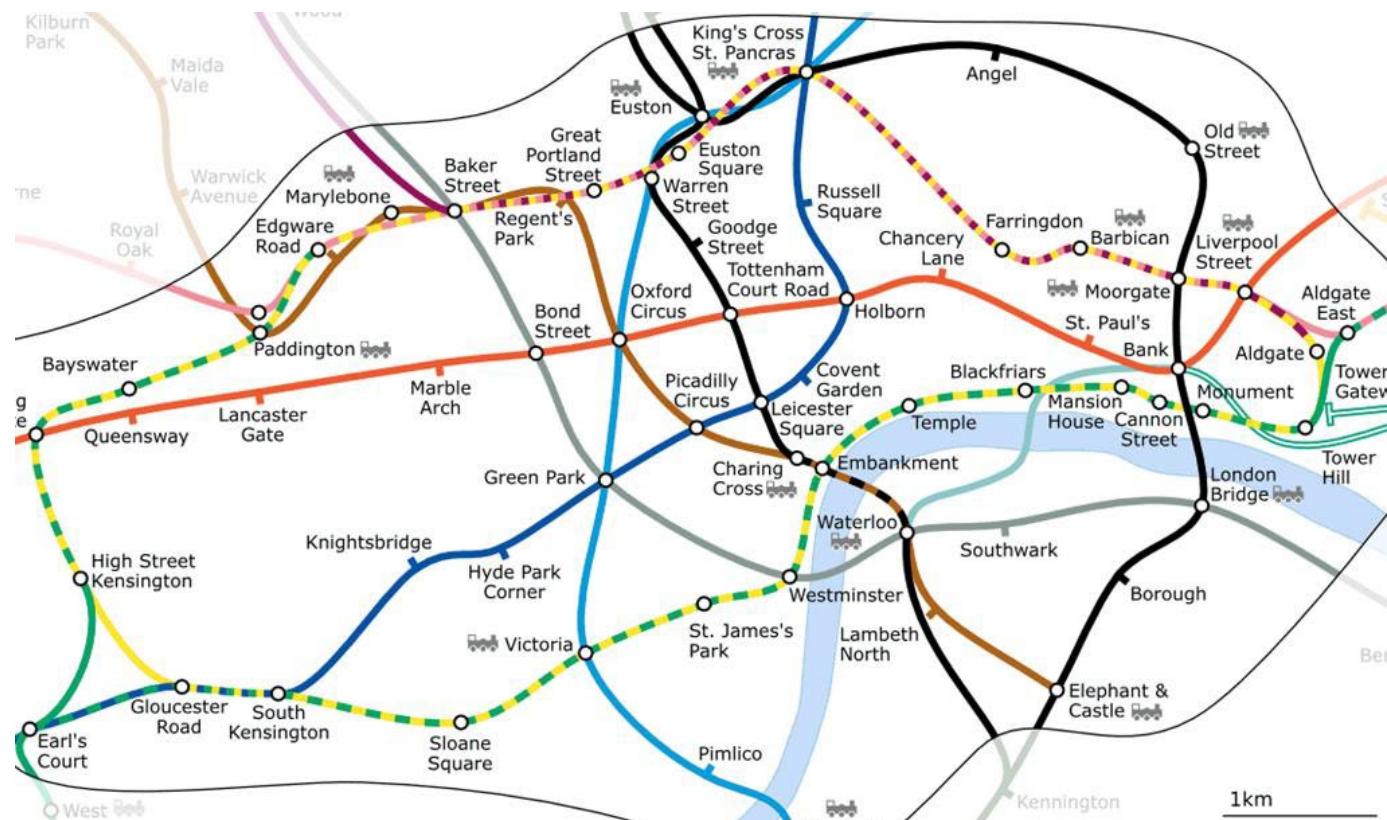


# Multiple Layers



# Topology

Topology = the spatial relationships between vector features (points, polylines and polygons)



# Geographic Coordinate System

Network of lines

## Longitude

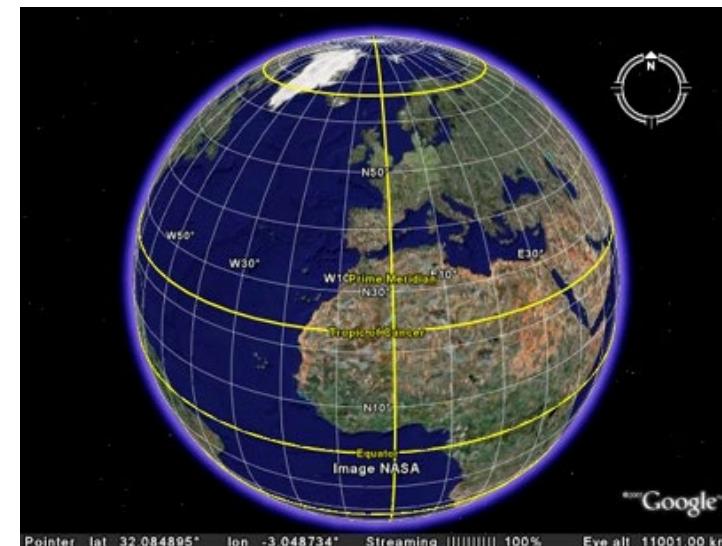
- 0-line: Prime meridian
- East + west = $\pm$  180° (great circles)
- Starting point: Greenwich, GB

## Latitude

- north-south position:  $\pm$  90°
- Circles parallel to the equator
- Different length

## Global positioning system (GPS)

- space-based system



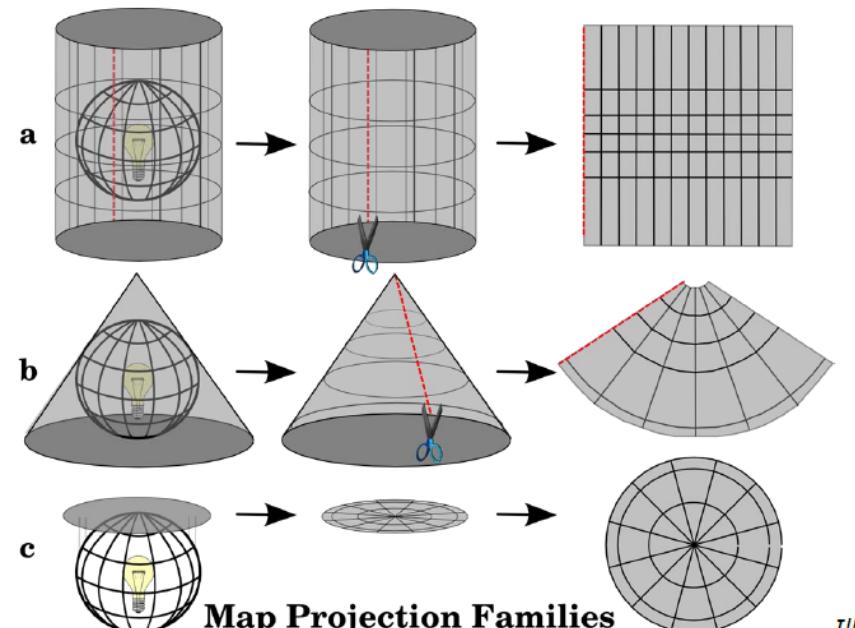
# Projection Problem

Earth is round

Maps are flat

Projections

- Cylindrical
- Conical
- Planar



62: The three families of map projections. They can be represented by a) cylindrical projections, b) conical projections or c) planar projections.

Illustration

# Projection to a Coordinate System

Global projections

WGS 84 (geoid): Standard for air traffic

Mercator projection (Australia vs. Greenland?)

- Australia is more than three and a half times larger than Greenland

Goal of projection: Representative 2D-positions in coordinate system

→ Local projections



# Projection to a Coordinate System

Projections by preservation of a metric property (ellipsoid)

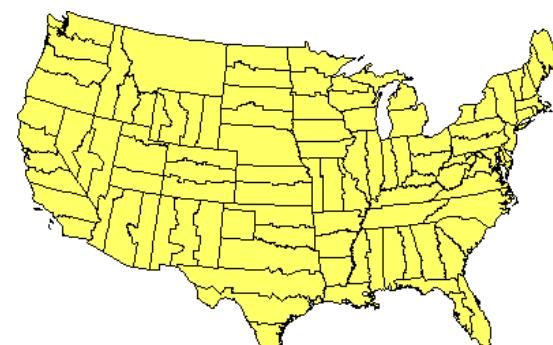
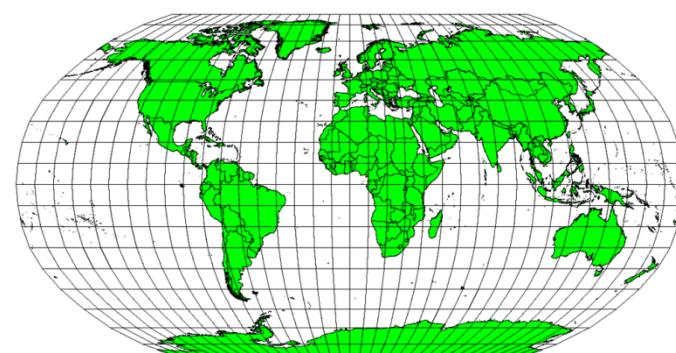
Universal Transverse Mercator Universal Transverse Mercator (UTM)

Lambert (LCC) – Europe

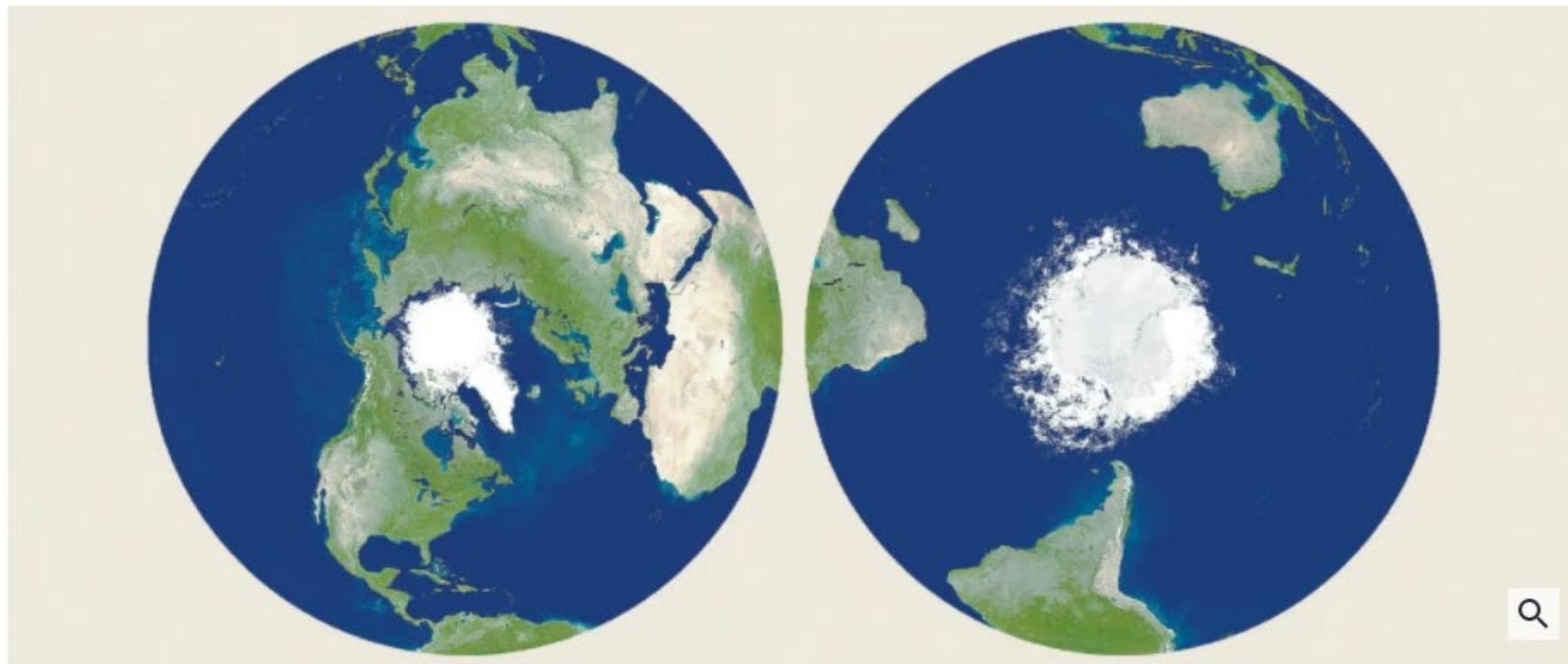
Robinson, Albers, Gauss-Krüger, Equidistant, etc.

State plane coordinates 1983 – 124 geographic zones

**(!): Every GIS dataset has its coordinate system**



## Schöne neue Scheibenwelt



Neue doppelseitige Karte der Erde, mit den Polen im Zentrum. Die Erfinder empfehlen, die beiden Scheiben auszuschneiden und an den Rückseiten aneinanderzukleben. (Foto: J. Richard Gott, David Goldberg.)

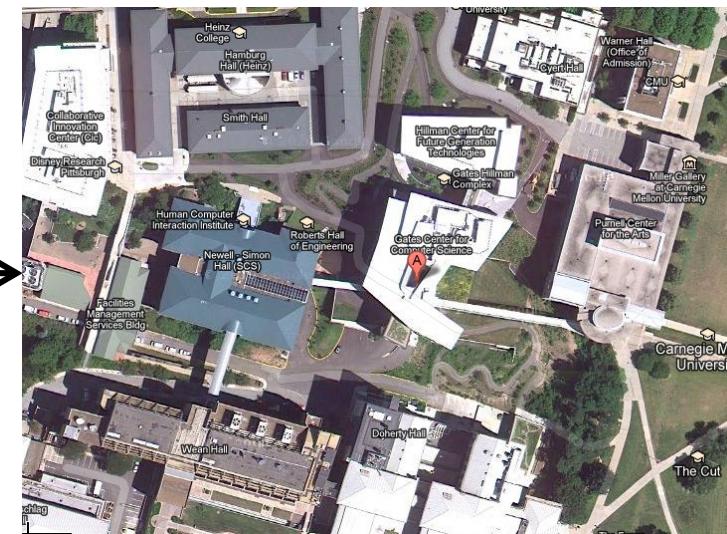
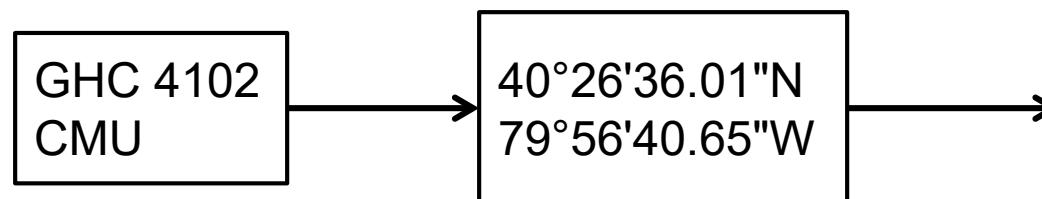
**Klassische Atlanten zeigen Länder häufig viel zu groß oder klein.  
Princeton-Forscher haben nun eine radikal neue, scheibenförmige  
Karte der Erde entwickelt, die mit den bisher geringsten Verzerrungen  
auskommt.**

# Geo-Reference

Object to coordinates

Points = addresses

Shapes = areas, countries



# Attributes

## Non-spatial information

- Related to GIS objects
- Population
- Address
- Labels
- Size/length

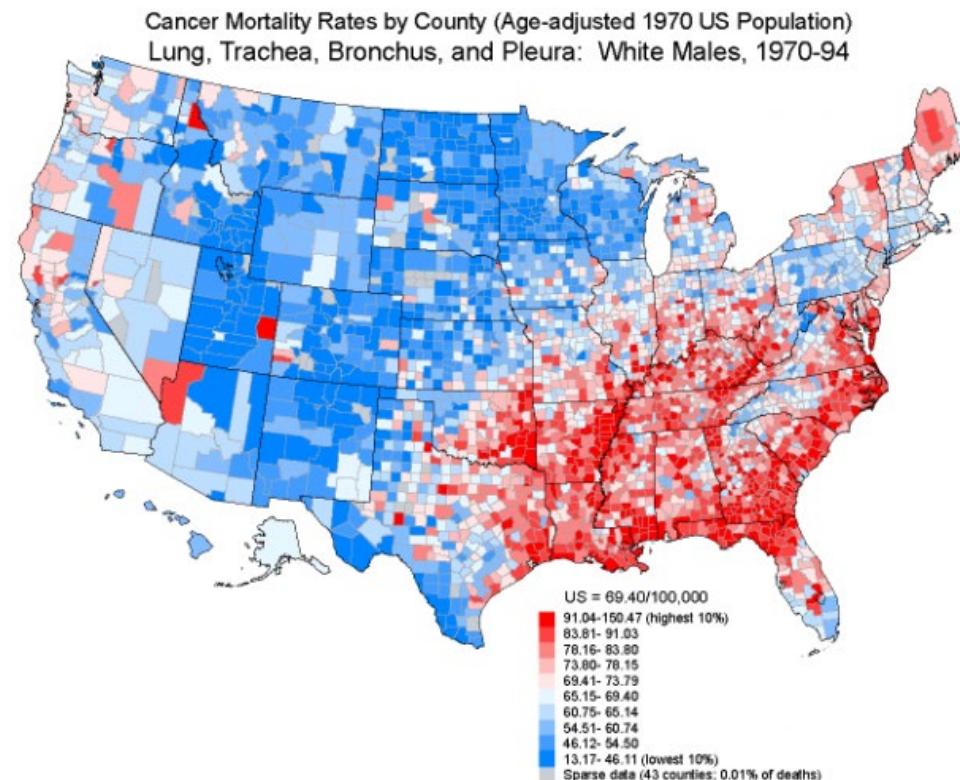
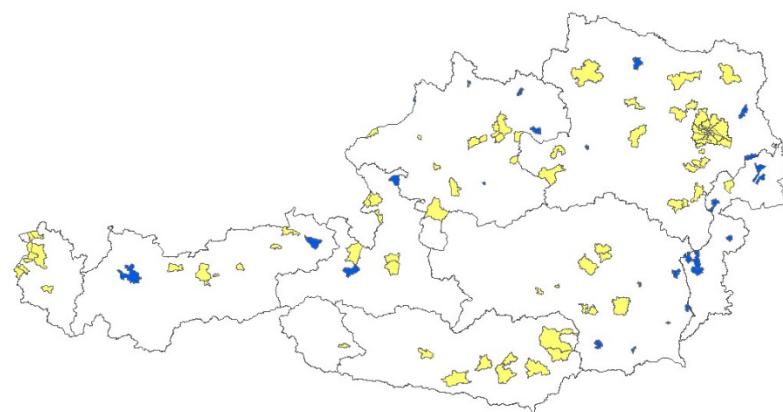
Stored in tables

GIS as database of geo-spatial data



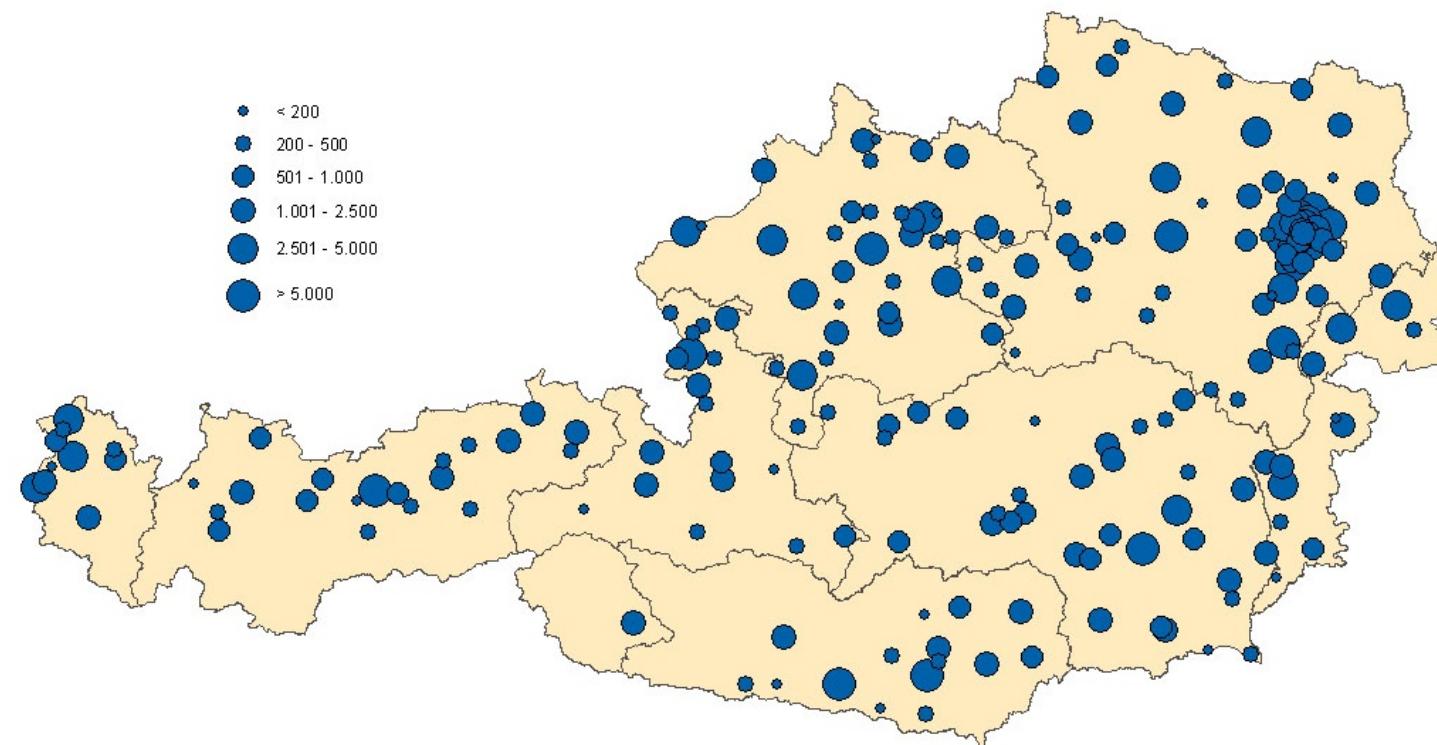
# Information Visualization

## Color shapes



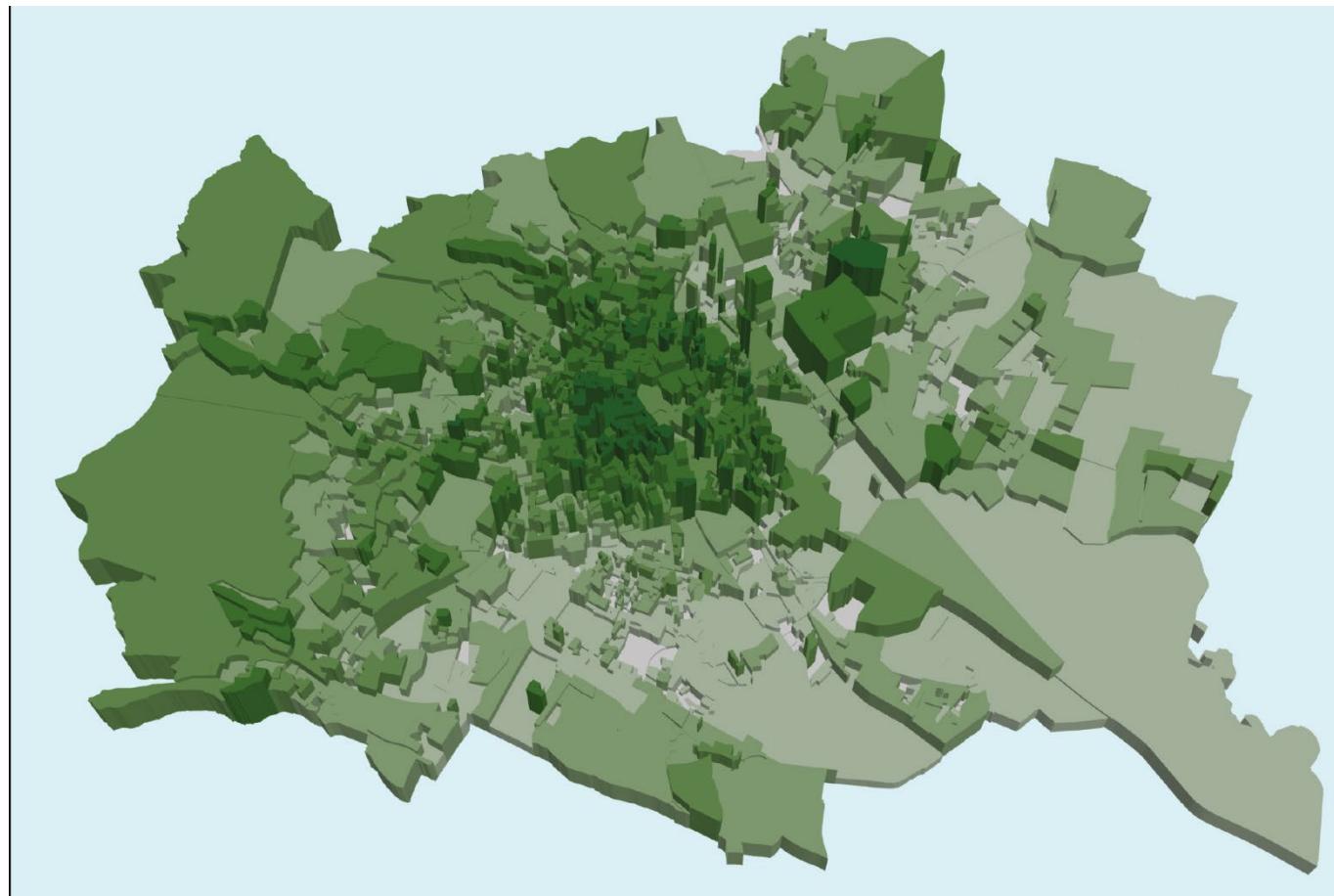
# Information Visualization

Size of points (e.g. cities)



# Information Visualization

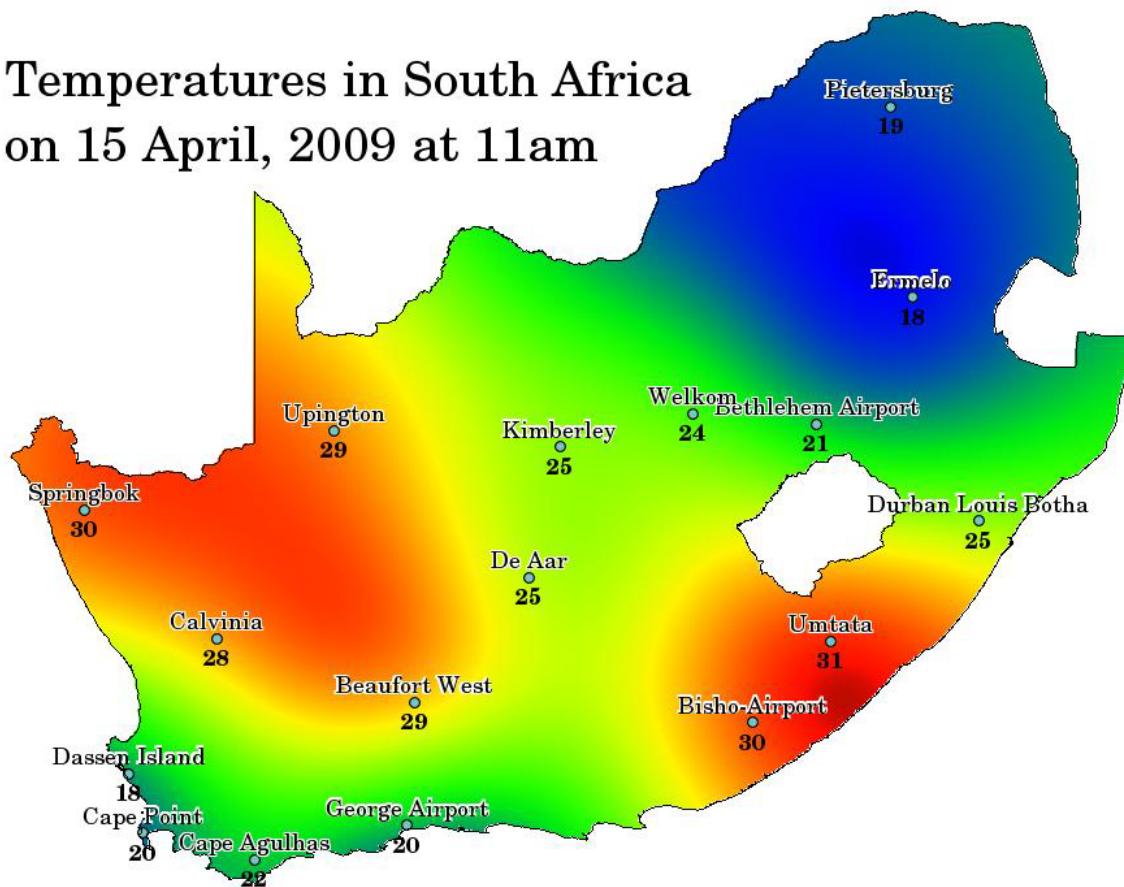
Height for attributes



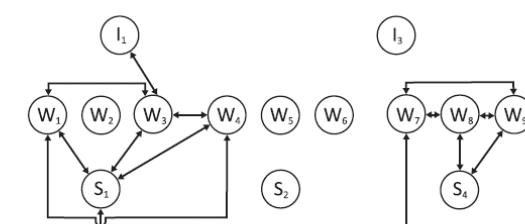
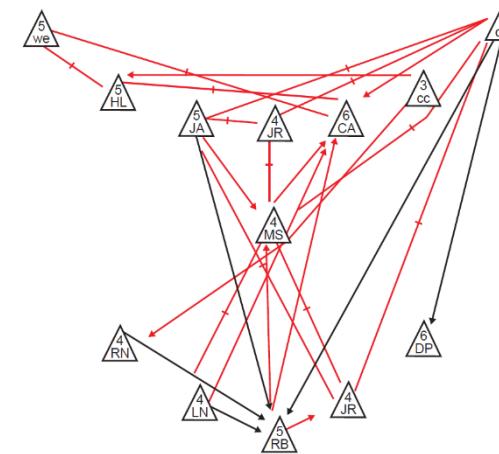
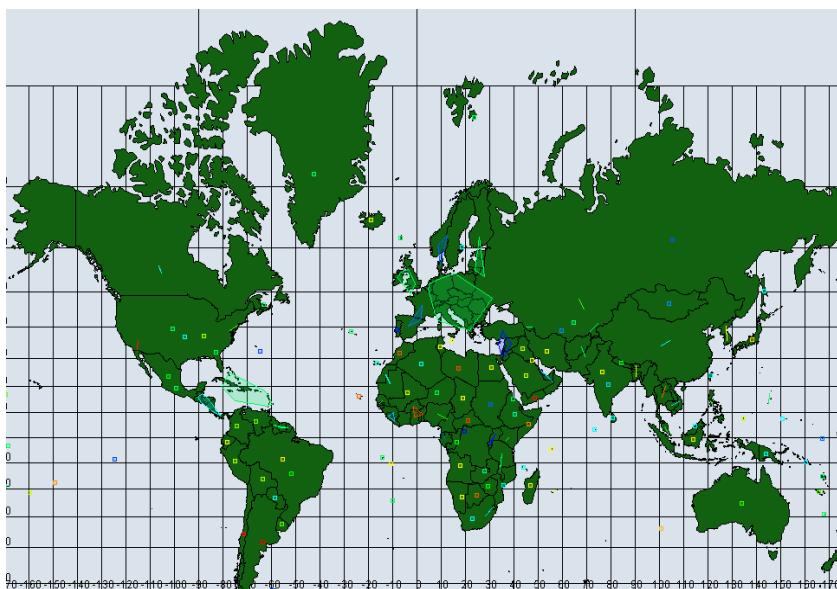
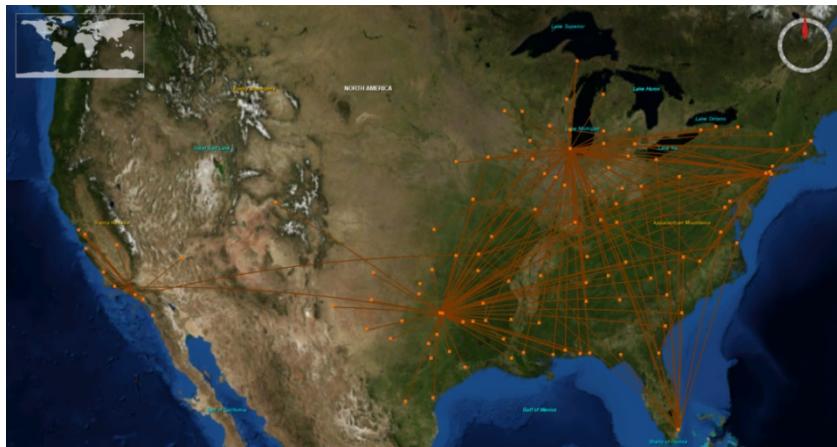
# Information Visualization

## Interpolation from point information

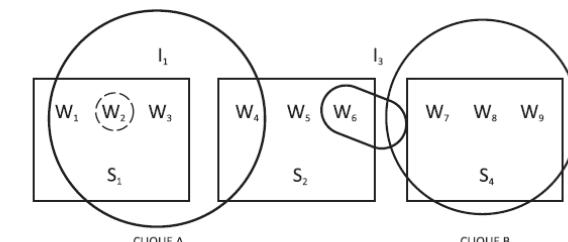
Temperatures in South Africa  
on 15 April, 2009 at 11am



# Networks and Space



FRIENDSHIPS



THE INTERNAL ORGANIZATION OF THE GROUP

# Web 2.0 GIS

## Mapping disasters

### Volunteered Geographic Information

- CrisisCamp Haiti
- OpenStreetMap
- Ushahidi
- GeoCommons

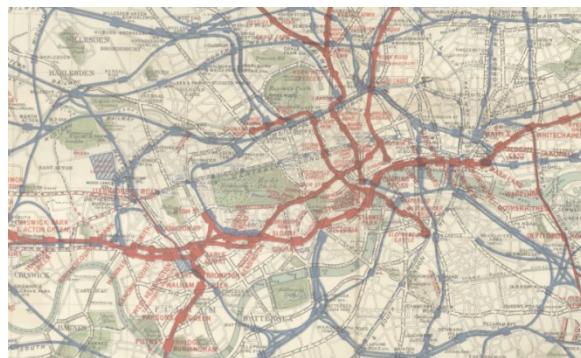


# Space and Abstraction

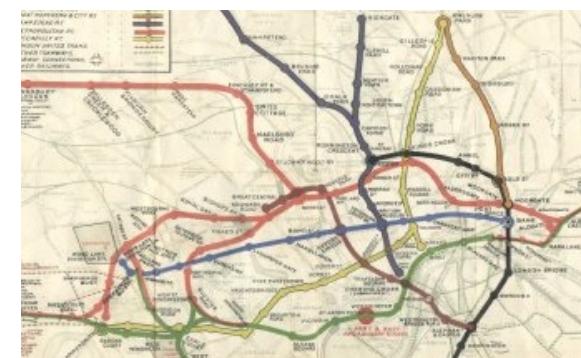
## London Underground

From geographical visualization to data visualization

1905



1908



1921



1933



# Data

You need shape files!

Data: Global Administrative Areas <https://gadm.org/maps/DEU.html>

GADM Maps Data About

World / Germany / sub-divisions

Germany has 16 first level subdivisions

Map ID Name

Map ID	Name
1	Schleswig-Holstein
2	Mecklenburg-Vorpommern
3	Hamburg
4	Bremen
5	Niedersachsen
6	Berlin
7	Brandenburg
8	Sachsen-Anhalt
9	Nordrhein-Westfalen
10	Sachsen
11	Thüringen
12	Hessen
13	Rheinland-Pfalz
14	Saarland
15	Bayern
16	Baden-Württemberg

0 90 km

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World / Germany / Bayern / sub-divisions

Bayern is a Freistaat () of Germany

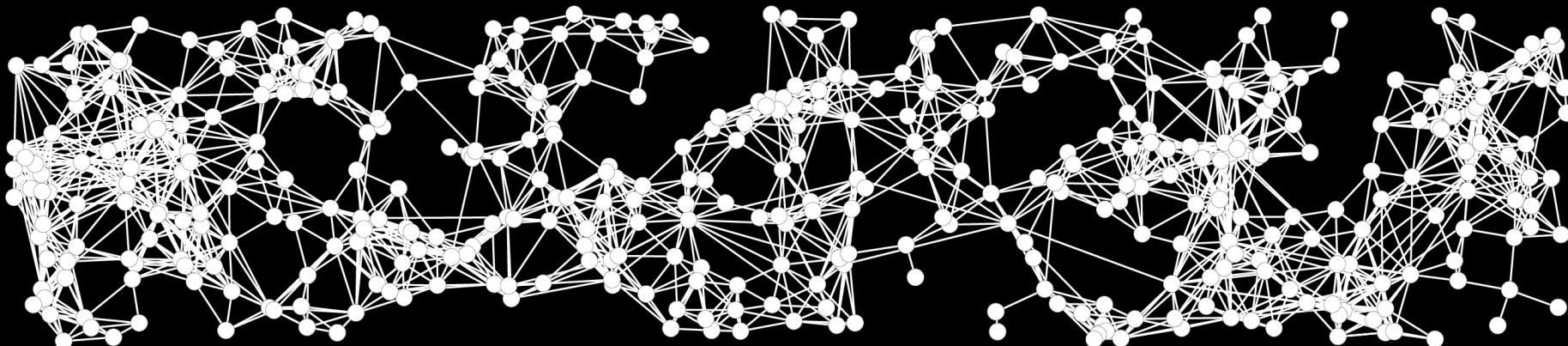
Outline

Show sub-divisions

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*“Our mission is to go forward, and it has only just begun.  
There's still much to do, still so much to learn. Engage!”*

Jean-Luc Picard, Star Trek TNG, Season 1 Episode 26



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