



# Cartography and Map-communication

Introduction to GIS

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## Agenda

### What is Cartography

- Representation of space
- Map communication

### Measuring the World

- Why are we mapping?
- How are we mapping?

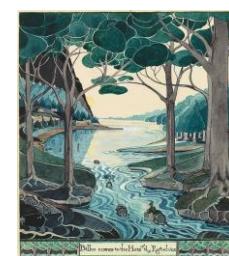
### Representation of space

- Coordinate systems
- Units
- Projections (in short)
- Handling projections in ArcGIS



### Map communication

- Generalisation
- Symbology
- 'A good map'



## What is cartography?

**Cartography is the practise of**

- representing *the world as it is* and
- ... *map production* (for map reading)

**It's about how to**

- *Transform and store information about the (3D) Globe and*
- *... how to design, produce and comprehend geographic information*

**Cartography is dealing with**

- the way the spherical Earth is projected onto whatever media is present (of the in 2D) and
- ... who's saying what to whom... and hereby what *means, technology and media* that is used



## Measuring the World

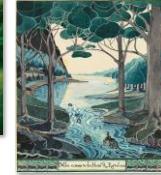
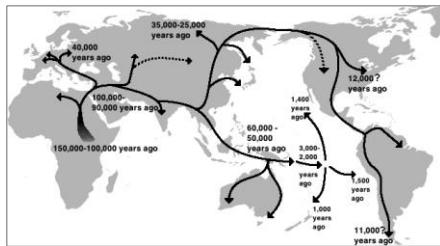


## Why are we mapping?

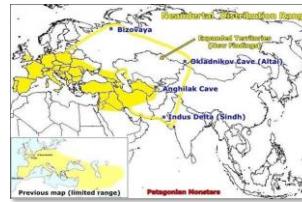
It is part of human nature  
 - to wander  
 ..... and to map



*Home Sapiens migration*  
150.000 BC - present



*Home neanderthalensis migration*  
800.000-350.000 BC – 40.000 BC



## Representation of space



## Coordinate systems

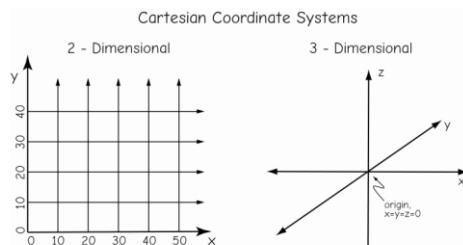


Figure 2-5: Two dimensional (left) and three dimensional (right) Cartesian coordinate systems.

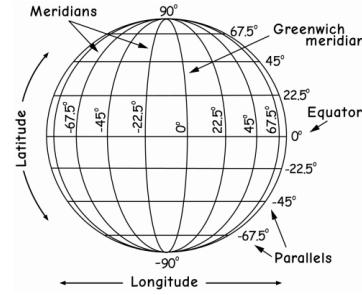


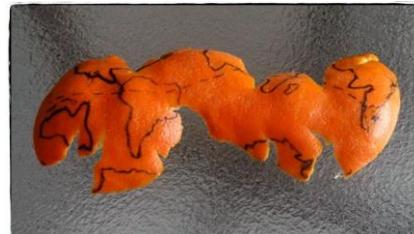
Figure 2-7: Nomenclature of geographic latitudes and longitudes.



## Projections

Why bother?

- Because the earth is not flat – and a (paper-) map is....
- A map-projection is a systematic way to transfer positions from the surface of the earth to the plane of a paper.
- Putting it another way it's about transforming 3D to 2D.
- Since the earth is spherical or double-bended and the paper is flat there is no perfect projections – only approximation working more or less well for smaller or larger areas.
- Especially when importing data from sources that are exterior to your system you will be in trouble without proper knowledge about projection etc.



## Map communication



## GIS as a media in society

**Sui and Goodchild, 2001, p. 387:**

*... the complex relationship between GIS and society can be better understood if one conceives of GIS as new media*

**Skov-Petersen :-)..., 2003, p. 272:**

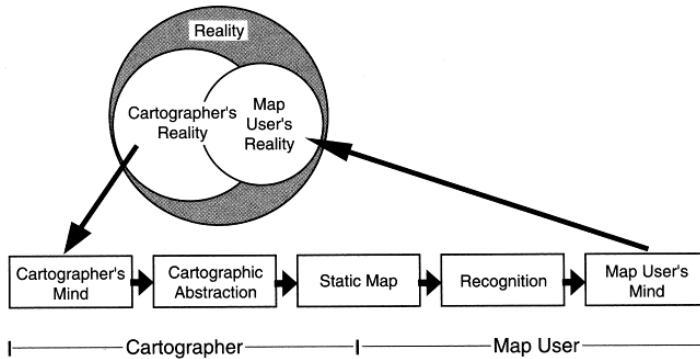
*GIS is a mass-media centred on handling and communicating geographic information*



## Cartography as communication

Like any other form of communication it is about

- The message
- The messenger
- The media
- The receiver or target



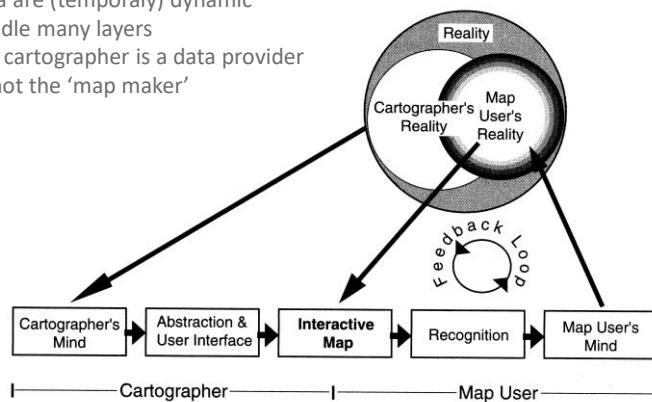
Source: Peterson, M. P. (1995). Interactive and animated cartography. Prentice Hall.



## What's special about digital cartography?

Digital cartography is special (among others) because

- The user can manipulate the system when using it
- Digital maps are user-centric, analog maps are producer-centric
- The user can change visualisation/symbolisation/scale/LOD
- Data are (temporally) dynamic
- Handle many layers
- The cartographer is a data provider
- .... not the 'map maker'



Source: Peterson, 1995



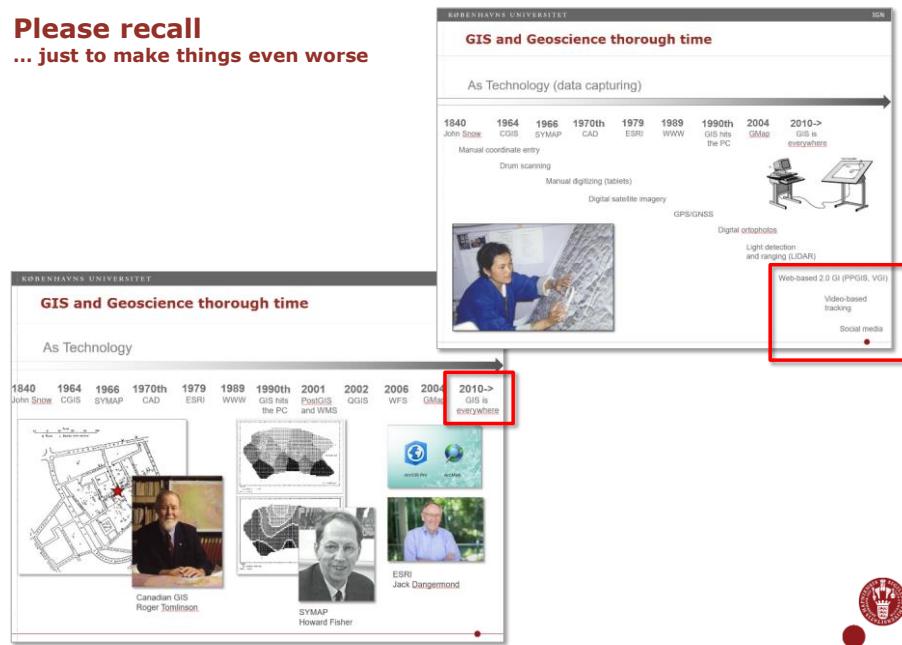
## And so what (revisited)?

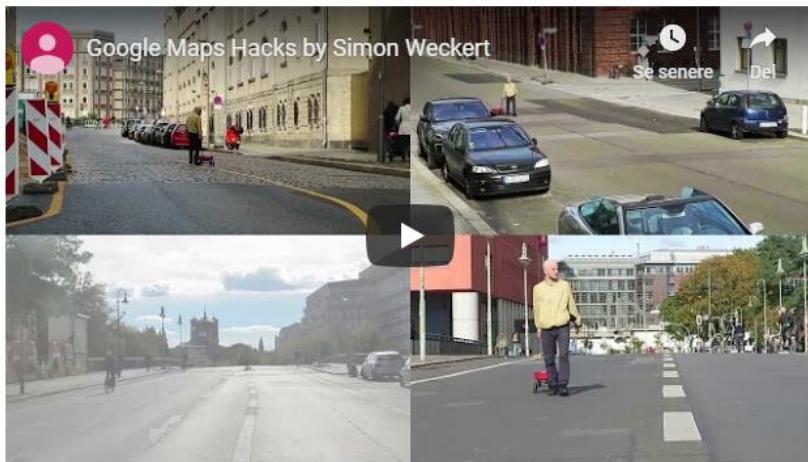
We are at point in time where...

- Data production is hidden to its end-users
- Analytical techniques are well developed (and not a prime concern of most GIS-users)
- Storage and distribution of (massive amounts) of data is becoming increasingly important
- Dynamic – and often real-time – data are becoming more prominent
- Data and spatial analysis are used more and more in the (mass-) media
- ... and accordingly, we don't know who we are talking to



## Please recall ... just to make things even worse





Google Maps Hacks by Simon Weckert.



[https://youtu.be/k5eL\\_al\\_m7Q](https://youtu.be/k5eL_al_m7Q)



**Assignment 1:**  
**What is a good map?**  
**What is good map communication?**



### Generalisation (1) – as per Bolstad p. 154

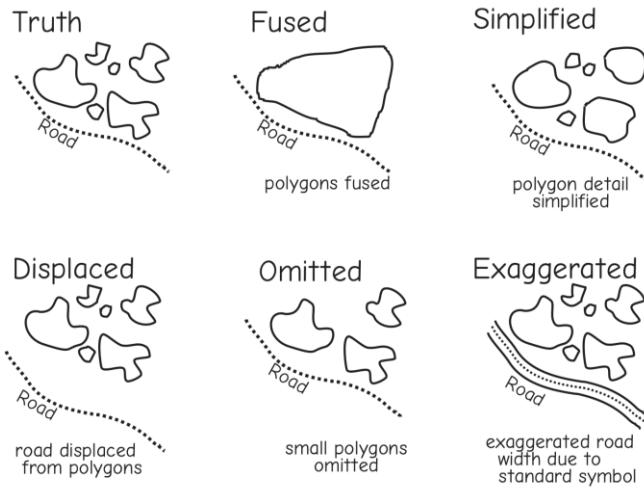
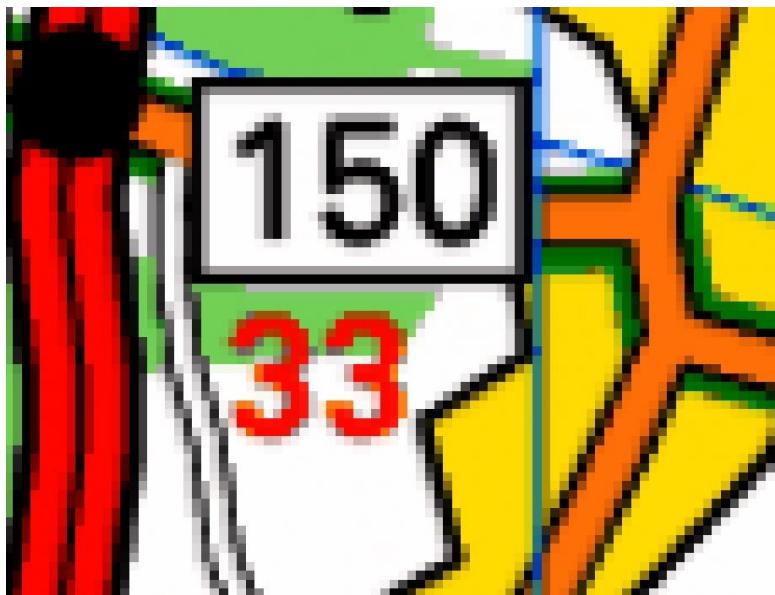


Figure 4-9: Generalizations common in maps and data layers.

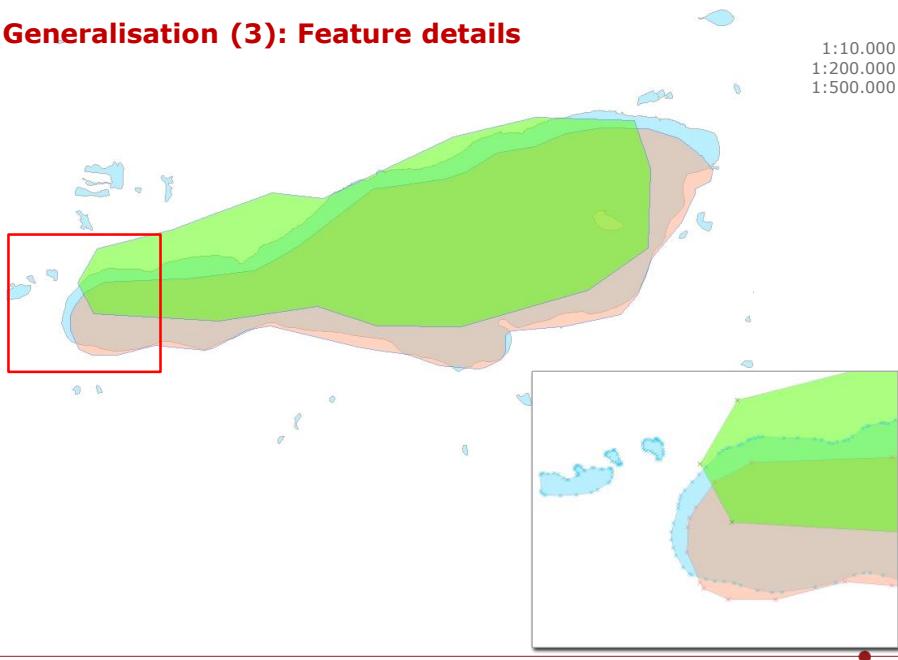


### Generalisation (2): Topographic maps

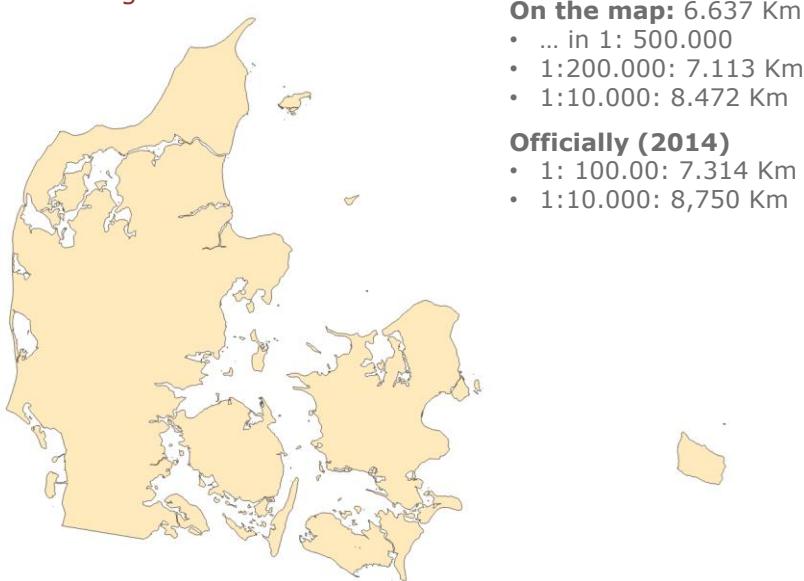


### Generalisation (3): Feature details

1:10.000  
1:200.000  
1:500.000



### The Danish coastline ... how long is it?



## Generalisation (4): Feature primitives



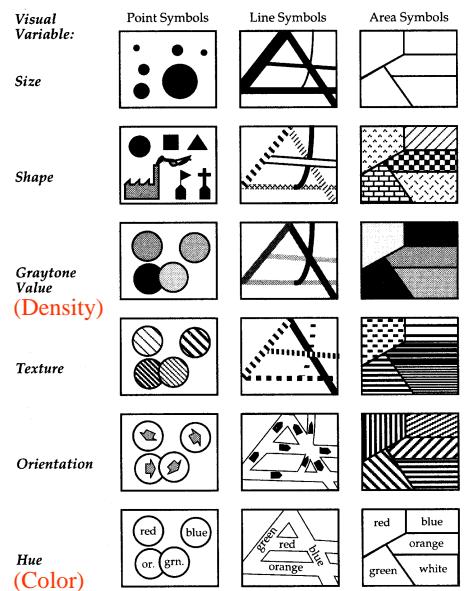
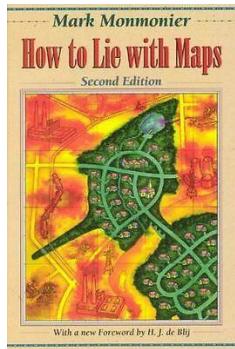
## Pause



## Visualisation of thematic information

### Symbolic handles to turn.

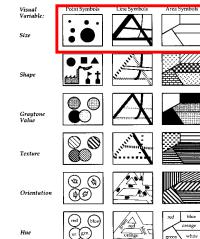
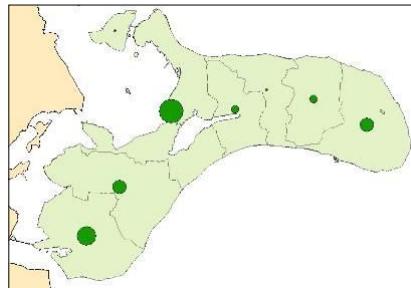
- Size
- Shape
- Graytone (density)
- Texture
- Orientation
- Hue (color)



Source: Monmonier, 1996

## Symbol Size

### Size, points



### Size (thickness), lines

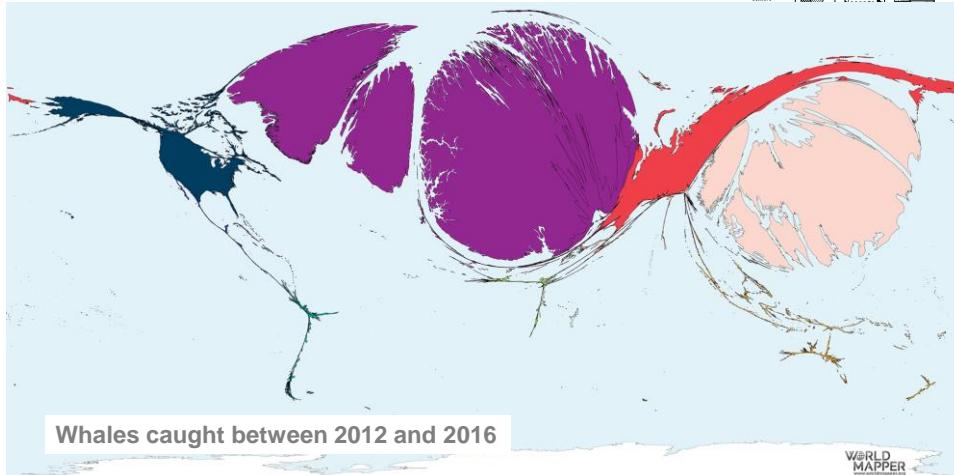
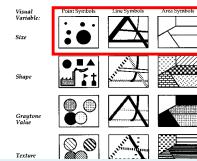


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## Symbol Size (and shape)

Size, areas (Cartograms):

Source: <http://www.worldmapper.org>



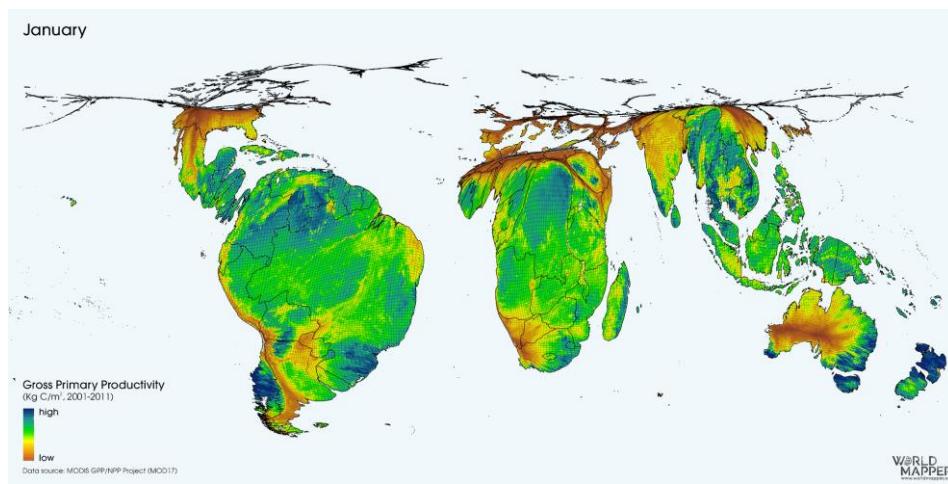
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## Symbol Size (and shape)... adding time

Nature's Heartbeat

Source: <http://www.worldmapper.org>

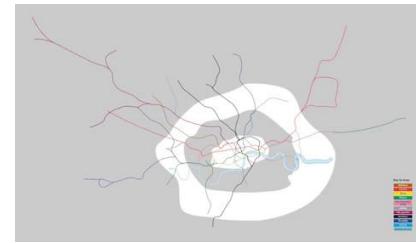
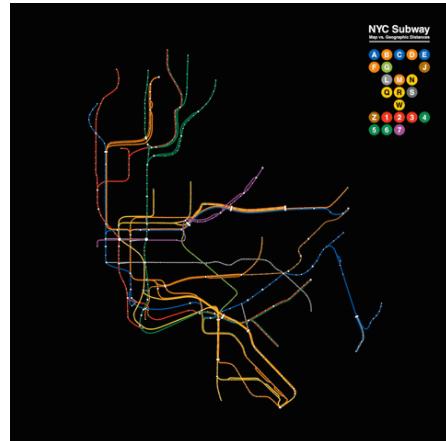


## More shapes.

### Topological maps: Famous Tubeline maps of the world

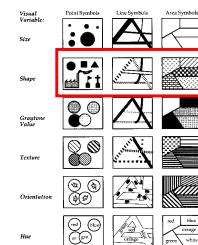
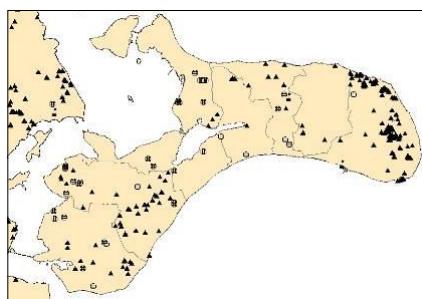
Source: [https://mymodernmet.com/animated-subway-maps/?fbclid=IwAR2G41LH6Ip8FR0NA31wb8QzSw0mQX77SFhcXe5hS2LG0w1agf\\_VI\\_79RXA](https://mymodernmet.com/animated-subway-maps/?fbclid=IwAR2G41LH6Ip8FR0NA31wb8QzSw0mQX77SFhcXe5hS2LG0w1agf_VI_79RXA)

... or Google 'Subway Maps and Their Actual Geography'

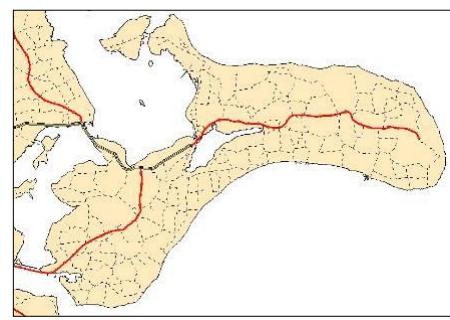


## Symbol Shape

### Shape, point



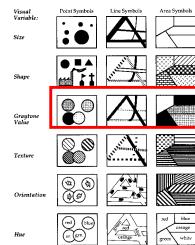
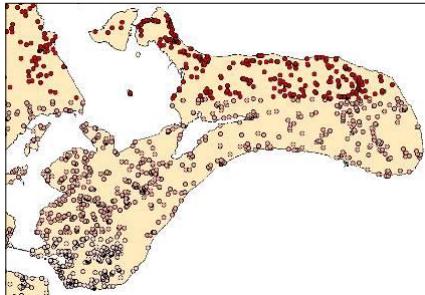
### Shape, lines



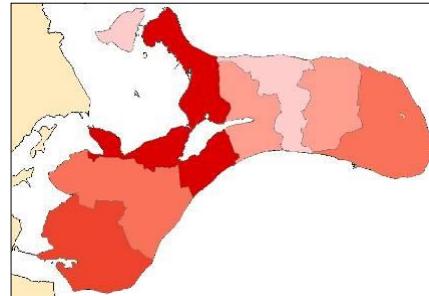
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## Colour Graytone

### Graytone, points



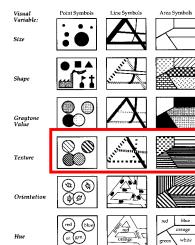
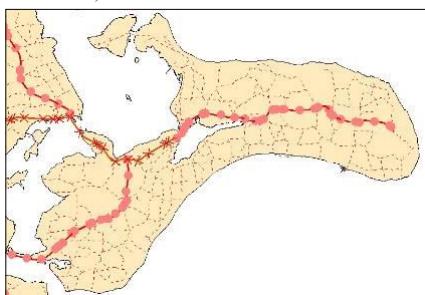
### Graytone, polygons



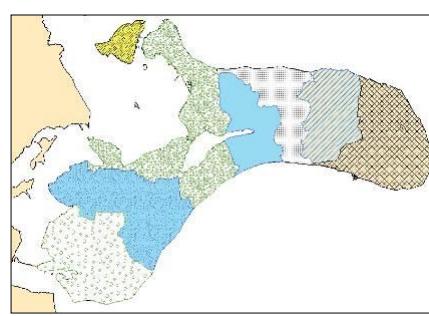
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## Texture

### Texture, lines



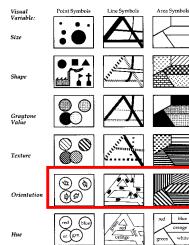
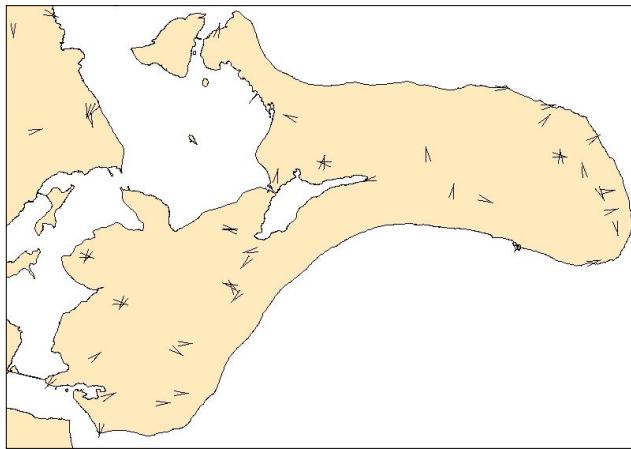
### Texture, polygons



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## Symbol angle

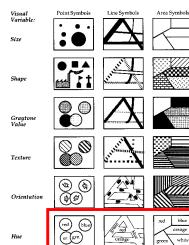
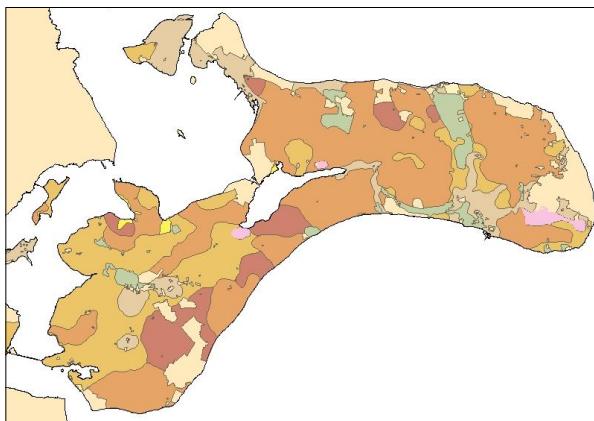
Orientation, polygons



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## Colour Hue

Colour Hue, Polygons



## A word on thematic information (attributes)

### Data types

#### Qualitative

Nominal (not ordered): 'Agriculture', 'Urban', 'Ocean' etc

Ordinal (ordered, only in relative terms): 'Good', 'Medio' and 'Bad'

#### Quantitative

Interval (continuous, defined point of origin): Distance, weight

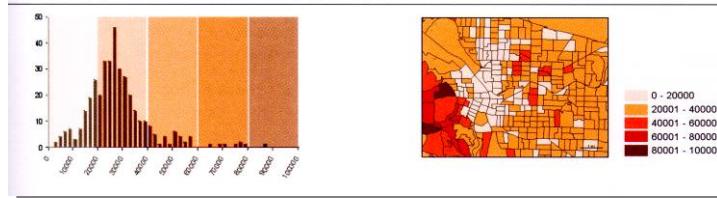
Ratio (continuous, arbitrary point of departure): Temperature c



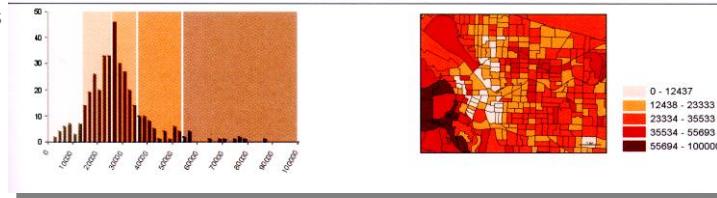
## Splitting into Categories (I)

Classification into categories as a means of visualisation

Even intervals



Natural breaks (Jenks)

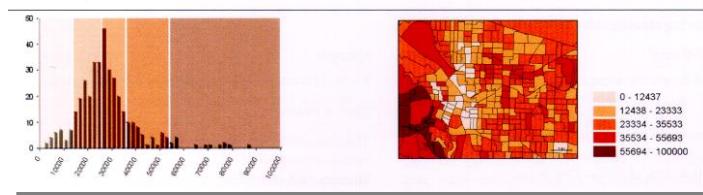


Source: Mitchell, 1999

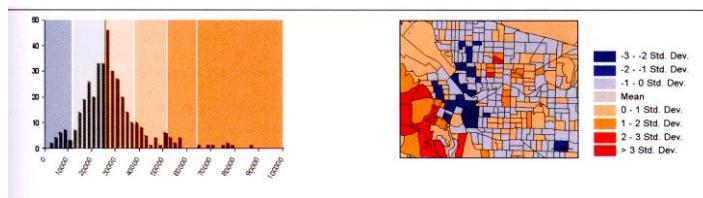
## Splitting into Categories (II)

Classification into categories as a means of visualisation

Quantiles  
(same  
number in  
each class)



Standard  
deviation



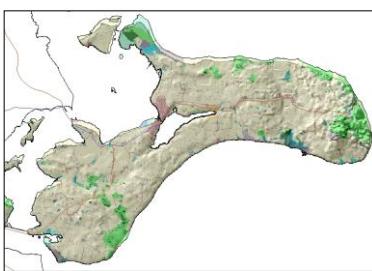
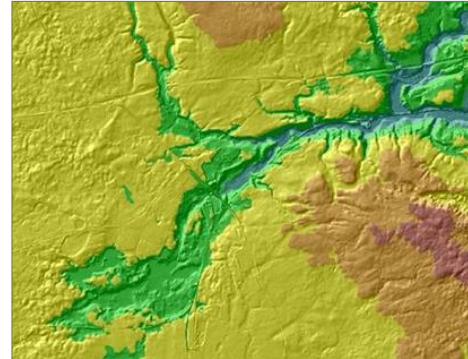
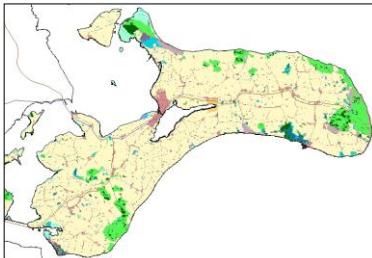
Source: Mitchell, 1999

### Assignment 5: What is wrong with this map?



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## Transparency



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## Transparency vs blending

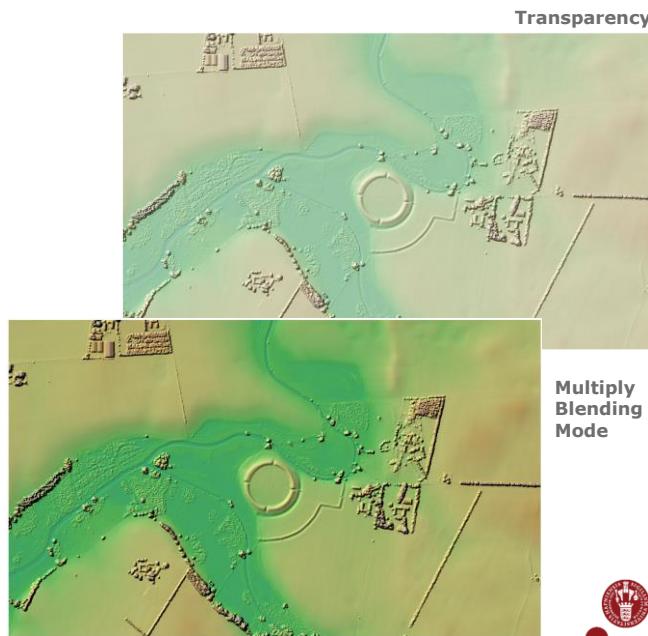
Lighten  
Screen  
Dodge  
Addition

Darken  
Multiply  
Burn

Overlay  
Soft Light  
Hard Light

Difference  
Subtract

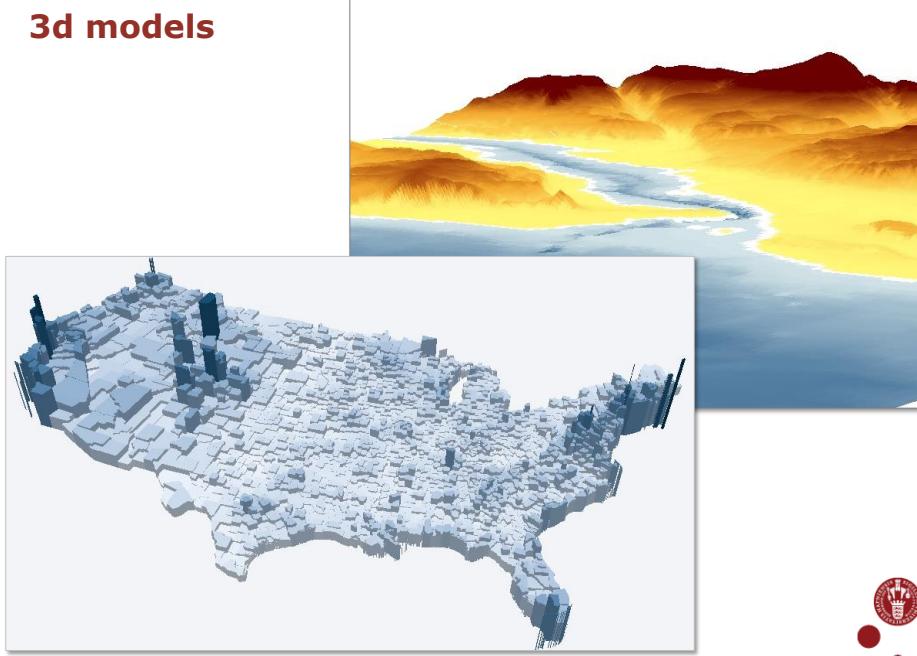
Thanks to  
Kurt Menke  
and QGIS



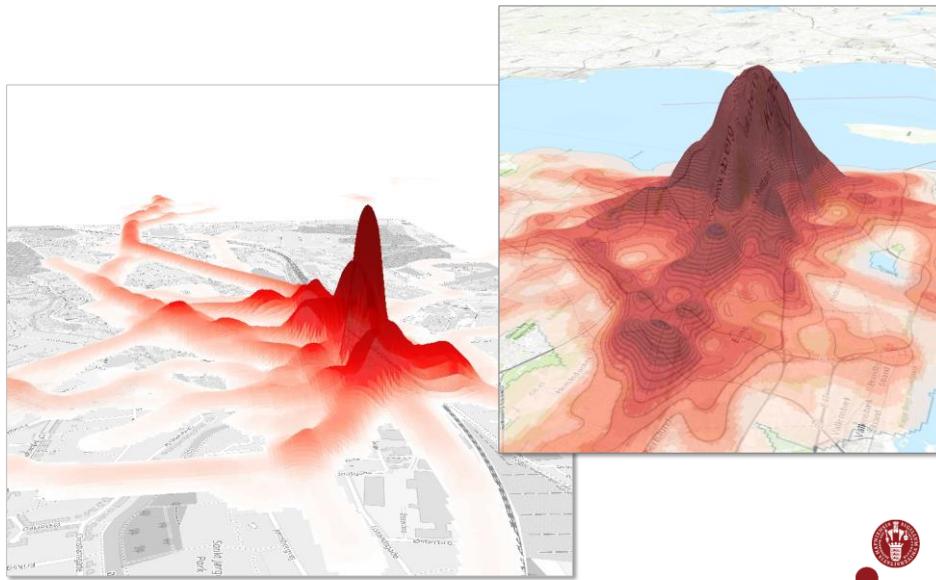
## Business graphics: Pie charts



## 3d models



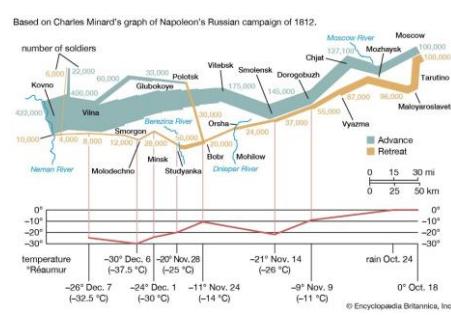
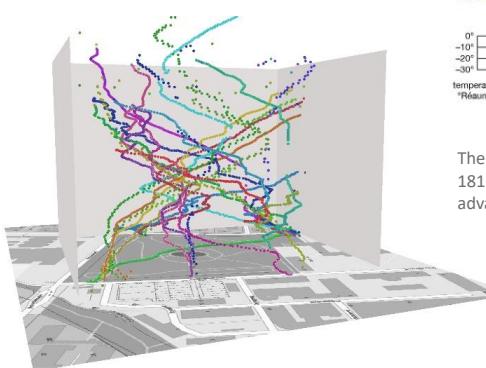
## Visualisation of movement in 3D



## Temporal cartography

There are (at least) three ways to make temporal cartography

- Classic symbols (colours, sizes, symbols etc.)
- Space/time cubes
- Animations



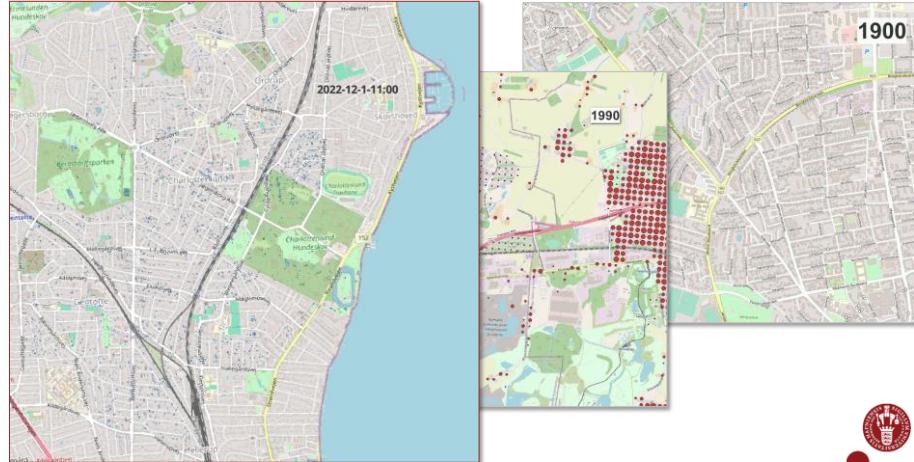
The size of Napoleon's army during the Russian campaign of 1812 is shown by the dwindling width of the lines of advance and retreat



## Animations

Three animations as examples of time stored as

- Single attributes as single attributes of single features
- Series' of attributes on individual features
- A single attribute of individual objects, re-appearing several times



## Map components

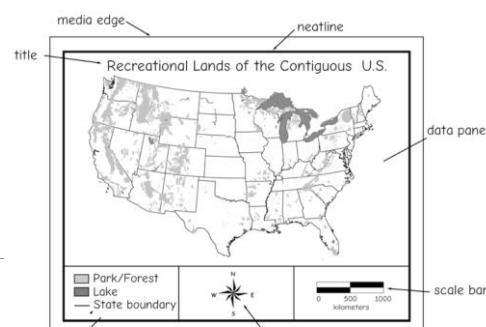
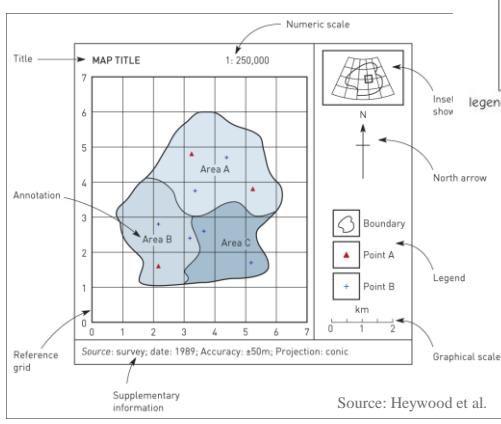


Figure 4-3: An example of a map and its components.



## Goals of good map design

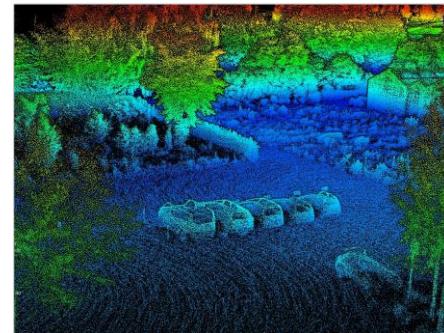
Source: [http://maps.unomaha.edu/Peterson/CartaDesign/Good\\_Map\\_Design.html](http://maps.unomaha.edu/Peterson/CartaDesign/Good_Map_Design.html)

Six elements comprise what makes good map design

- 1. Clarity** - Clarity is the ability of the map to convey its message
- 2. Order** - Order is the logic of the map; the path that the eye follows when viewing a map
- 3. Balance** - refers to visual balance
- 4. Contrast** - Contrast refers to the use of line weights, font characteristics, and colors
- 5. Unity** - Unity is the interrelationship between backgrounds, shading, font characteristics, and colors on a map
- 6. Harmony** - is the interrelationship between elements on a map. A good map has harmony between the elements.

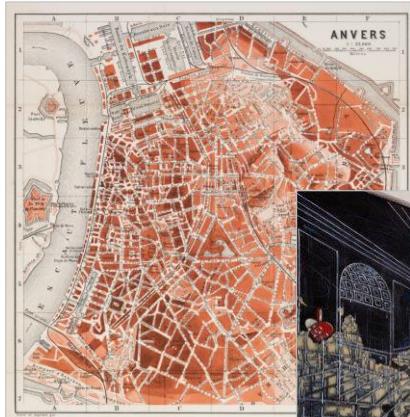


## Art in Cartography



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## Cartography in Art



© Fairburn

© Videnskabernes selskabs kort



© Jesper Christiansen

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## Introduction to GIS

That's it for now...

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