

Maps in the Computer Age part II

Thanks to Peter Woodsford of Cambridge U3A

*Most of the material in this presentation is taken from a U3AC
course presented by Peter Woodsford in Cambridge in 2015*

3D

The world is not flat

3D data – the current focus



- Terrain models can be made from contour maps
- Nowadays very detailed models of the shape of the ground can be made by laser-scanning

Why 3D data?

- Navigation
 - Z-critical situations
 - Air traffic control
 - Shipping
 - Greater realism, service differentiation
- Games, movies, cyber-environments,...
- Planning, environmental, tourism,.....
- Flooding
- Mobile comms planning
- Military

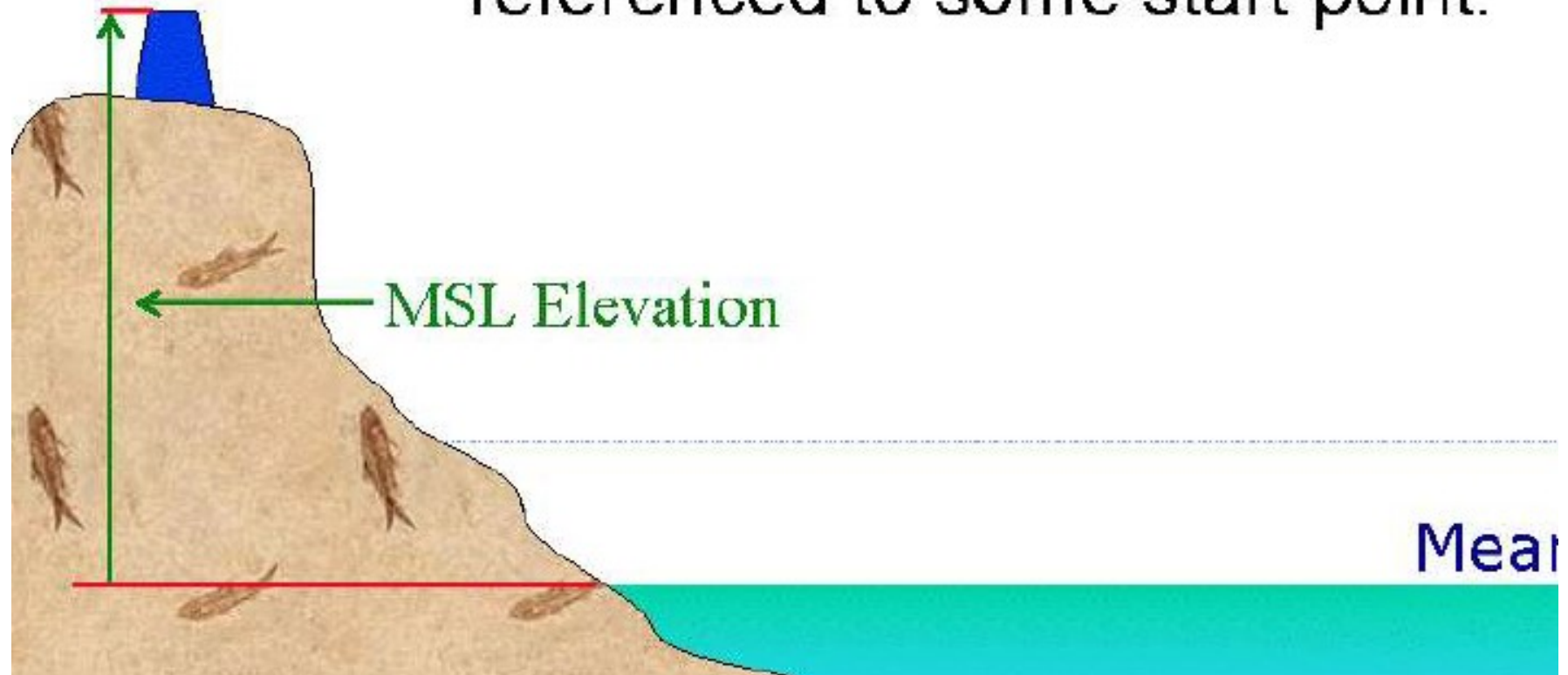
What's special about 3D?

- 3D data costs more to collect/create than 2D
 - But it is more realistic
- It is not so obvious where to measure height (Z) from
 - The 'vertical datum' is an issue, especially for precision applications
- 'inside' and 'outside' issues are more complex
- A lot of research is going on in this area



Vertical Datums

Like horizontal measurements, elevation only has meaning when referenced to some start point.



Taming Vertical Datums

- Historically, there have been many (local) Vertical Datums
- Harder to rationalise than Horizontal Datums
 - Many, conflicting, versions of coastlines
 - But recently problem is getting solved
- Some applications, eg Flood control, require very precise height models, maybe across datums
- Some sensor systems can 'see through water' and measure depth in shallow areas.

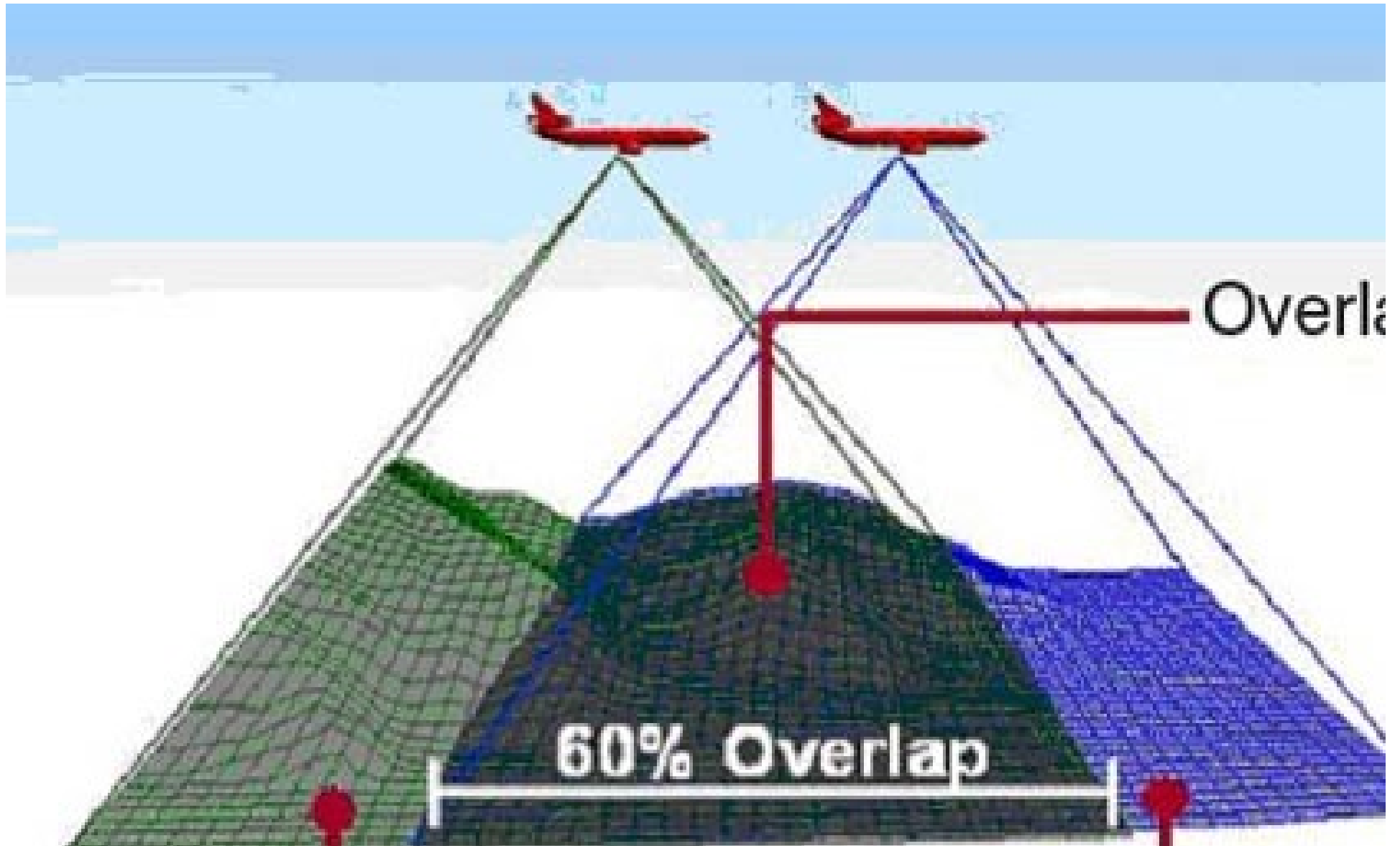
Remote Sensing – Air Photos

- More and better imagery means we don't have to survey everything on foot.
- Air Photography
 - Very rapid advances post WW2
 - Overlapping photos used ('stereo pairs') to get 3D information
- Photogrammetry is the science of taking measurements from imagery. It handles
 - Compensation for camera effects, distortions
 - Registration, using control points on the ground
 - Measurements and editing

Stereoscopy

- Technique for creating the illusion of depth in an image for binocular vision
- Most stereoscopic methods present two offset images separately to the left and right eye of the viewer.
- This technique is not the same as 3D displays that display an image in three full dimensions, allowing the observer to increase information about the 3-dimensional objects being displayed by head and eye movements.

Capturing Stereo Pairs

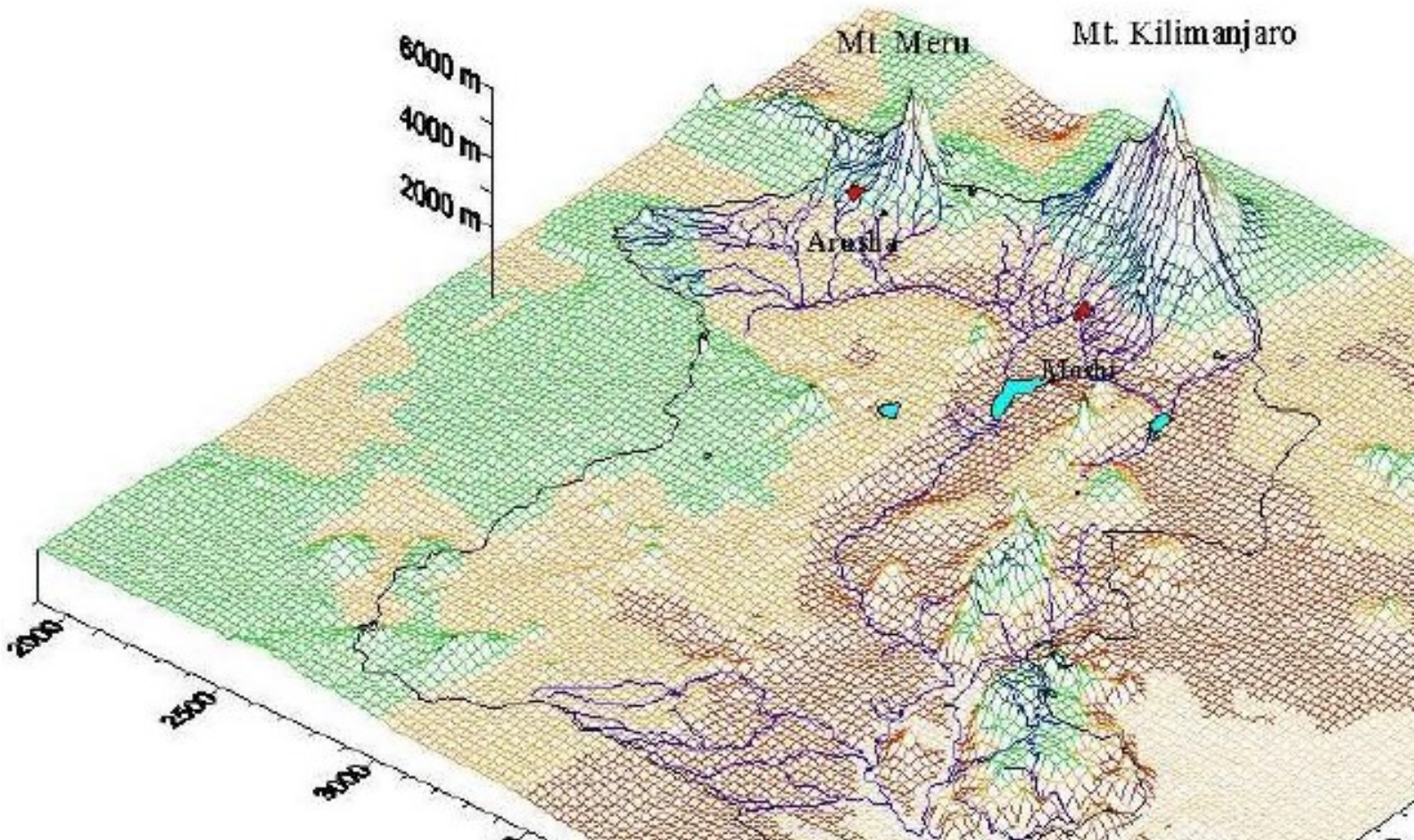




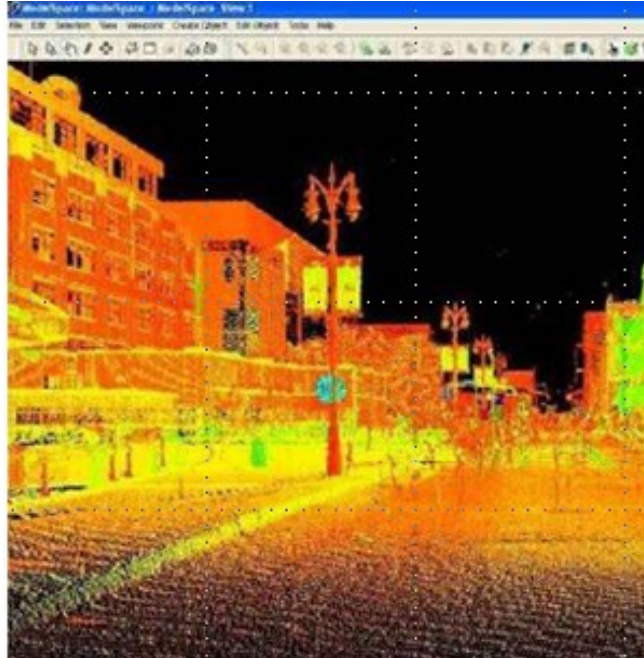
Digital Terrain Model

- A digital terrain model is a topographic model of the bare earth that can be manipulated by computer programs.
- The data files contain the spatial elevation data of the terrain in a digital format which is usually presented as a rectangular grid.

Digital Terrain Model of the Pangani Basin in Tanzania



3D data from Laser Scanning



- Can be from the air or the ground
- Huge amounts of (x,y,z) data
- Nowadays it is cheap and quick
- *(look at Songa Mnara)*

3D Street Views in Google Maps and Google Earth

- 360-degree, street-level imagery
- Collected by GPS-enabled vans with video cameras
- Example in Emsworth
- <https://www.google.co.uk/maps/@50.8462761,-0.9365174,17z?hl=en>
- Privacy Issues
 - <http://www.mirror.co.uk/news/weird-news/google-street-view-couple-caught-1592233>
- Google have had to develop face recognition/blurring software, and also to respond very fast to complaints

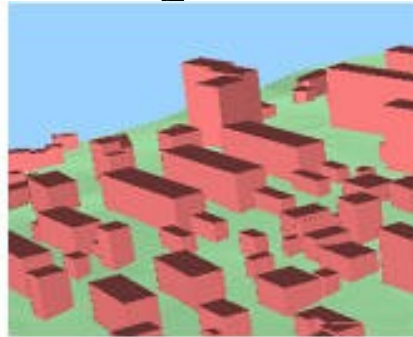
3D City Modelling

- Urban areas are complex, changing fast and difficult to manage
- A major current focus is on 3D City Modelling
 - For visualisation
 - For navigation
 - For analysis and planning

3D City Models



LoD0



LoD1



LoD2



LoD3



LoD4

- Created from map base + height data + texture
- Different Levels of Detail
- Available in many European cities esp. in Germany

3D City Models in Google



City of Heidelberg Example

- See:
 - <http://www.heidelberg-3d.de/>
 - Download 'videos'

Google Building Maker for all

In 2011 Google launched **Google Building Maker**, a 3D modelling tool for creating buildings for Google Earth. It's fun to use, and an easy way to get on the 3D map. Basically, you pick a building and construct a model of it using aerial photos and simple 3D shapes – both of which Google provides. When you're done, Google take a look at your model. If it looks right, and if a better model doesn't already exist, they add it to the 3D Buildings layer in Google Earth. You can make a whole building in a few minutes.

Building Maker is in 50 cities and available in 14 languages. Try Building Maker–

<http://sketchup.google.com/3dwh/buildingmaker.html>

4D

Time – Mapping changes over
time

Temporal – the 4th Dimension

- Why is Temporal information important?
 - Recording the past
 - Recording significant change
 - Traceability, liability
 - Providing accurate and timely information
 - On the day when a change comes into effect
 - Modelling change over time
 - Prediction
 - Planning

Modelling Temporal Change

- Prediction
 - Weather-forecasting
 - Climate Change
 - Spread of pollution
 - Elections
 - Biodiversity
 - The economy!!??

Recording Change in the Database

- Features (or objects) have defined validity:
 - Valid from
 - Current
 - Valid until
- Life Cycle recorded
 - Created
 - Modified
 - Deleted
- Ability to recover past versions

Recording the Past - Maps

- Traditionally, maps only updated infrequently and each new version was archived.
 - Glass Plate
 - Film
 - Granite slabs
- Nowadays these archives are scanned and stored digitally. For example
 - www.oldmaps.co.uk

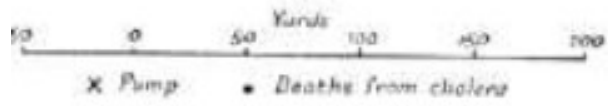
Archiving Today

- A much bigger problem – the rate of recorded change are too much
- – 5,000 changes a day to the OSGB database
- – No long term ‘standard version’
- Have to archive a base-line and then the changes to it
- How ‘survivable’ are current archival media?

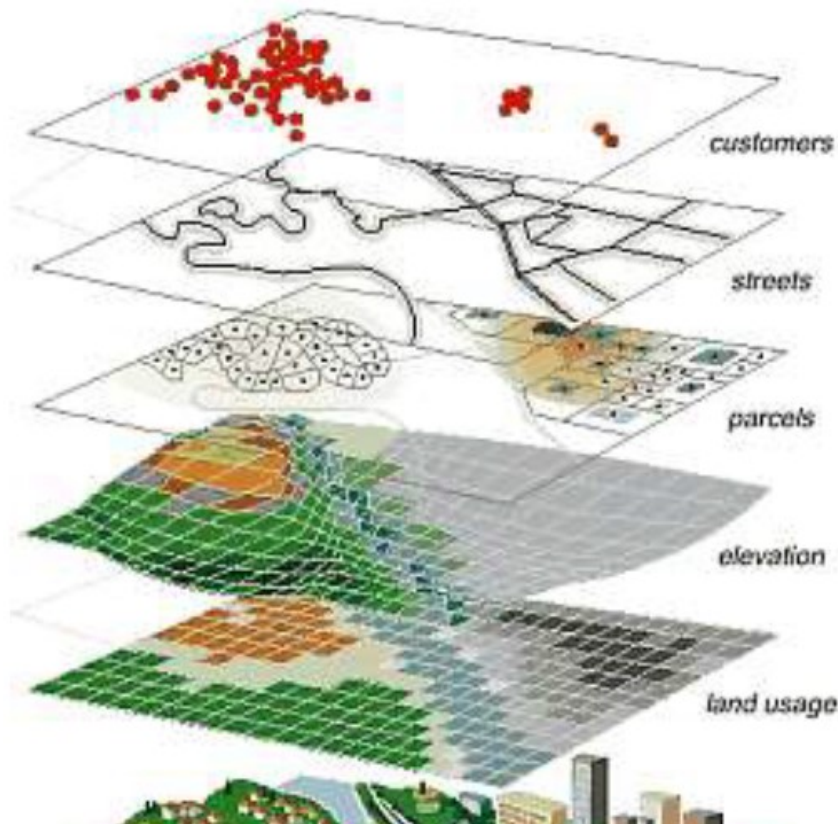
Graphical Information Systems

GIS

- What is a Geographical Information System?
 - A system to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data.
- In 1854 John Snow determined the source of a cholera outbreak in London by marking points on a map depicting where the cholera victims lived, and connecting the cluster that he found with a nearby water source.
 - Until then, it was thought that diseases such as cholera were caused by ‘miasmas’
 - Snow concluded that the cause was water from the Broad Street pump
 - He locked up the pump, and the outbreak stopped
- This was the first use of cartographic methods not only to depict but also to analyse clusters of geographically dependent phenomena



Thinking in 'Layers'



- Snow used
 - the map as a layer
 - Cholera death as a 'phenomenon'
- Nowadays we use multiple
 - Vector
 - Raster
 - Image

Some Simple Applications

- Flood Risk
- Emergency Services
- Estate Agents
- Nature Conservation
- Retail
- Environmental Impact Assessment
- Noise Pollution

....

Growth of GIS

- GIS is now huge and the market is growing world-wide
- **Location based services (LBS)** are services offered through a mobile phone and take into account the device's geographical location. LBS typically provide information or entertainment.

Major GIS Companies

- Several mainstream IT players now have significant GI activities
 - Google Earth
 - Microsoft Virtual Earth
 - Oracle and Oracle Spatial
 - ESRI, Intergraph, Autodesk,.....
- UK_Based
 - 1Spatial (LaserScan)
 - Snowflake
- Location Based Services
 - ‘Nokteq’ (Nokia acquisition of Navteq)
 - TomTom acquisition of TeleAtlas
 - Garmin, Magellan

Some Interesting Websites

- Archaeological Research
 - <http://www.songomnara.rice.edu/images.htm>
- National Trust Surname Profiler
 - <http://gbnames.publicprofiler.org/>
- National Land Information Systems (NLIS)
 - <http://www.nlis.org.uk/home/>
- Police and Crime Maps
 - <http://www.police.uk/>
- The Geography of Prejudice
 - <http://www.behance.net/gallery/Mapping-Stereotypes/355732>