Better Mapping Seminar, London
8th November 2011

Programme

Entitled 'Better Mapping', these one day seminars, featuring a number of expert presenters, introduce a range of topics and easy methods that will demonstrate how good cartographic practice can greatly improve the quality, accuracy and effectiveness of your digital and hard copy maps.

The use of geographic information, digital mapping software and GIS is ever increasing. Never before has the importance of understanding the fundamentals of good map design been more important. A poorly designed map can at least diminish effective communication of information to users and at worst mislead, perhaps seriously.

"Without good design and careful consideration of the fundamental elements of cartography, maps simply are not worth the paper on which they are printed," said Mary Spence, who was awarded an MBE for her contribution to map design and map-making, and is Past-President of the British Cartographic Society.
"As a nation we have a rich history of map making that has a deserved worldwide reputation for quality, it is therefore essential that modern GI professionals have the knowledge and skills to continue to produce great maps."

The Association for Geographic Information (AGI) and The British Cartographic Society (BCS) hold joint events around the UK, and believe these Better Mapping events are of tremendous interest to all individuals involved in creating and outputting maps.

We have compiled this document to make it easier for you to find the examples we mentioned on the day and so you have a handy reference available to you. We hope you find it useful.

Better Mapping Seminars
Promoting good practice throughout the UK

Programme:

1. Good Maps and Bad Maps, Recap on map design principles - *Mary Spence MBE, Global Mapping*
2. In the Beginning - *Giles Darkes, Cartographic Consultant*
3. Sourcing Good Data - *Clare Seldon, Steer Davies Gleave*
4. Communication and Map Design - *Giles Darkes, Cartographic Consultant*
5. Designing for Multiple Output - *Clare Seldon, Steer Davies Gleave*
6. Designing for the Web - *Warren Vic*
7. Statistical Mapping - *Giles Darkes, Cartographic Consultant*
8. New Directions in Cartography - *Dr Alex Kent, Canterbury Christ Church University*

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Good Maps and Bad Maps – Recap on map design principles

Mary Spence MBE, Global Mapping

Maps are everywhere – in print, on computers, mobile phones, SatNavs, PDAs and TV, in newspapers, magazines and books. Maps can be created by anyone with access to a computer with appropriate software. But what is this doing to the quality of the map?

Unfortunately, some maps do not communicate their message at all well but through the application of a few basic design principles the end result can be much improved.

What is a map?

A map is a symbolised image of geographic reality. A map cannot show everything that is on the ground, so there has to be compromise – selection, generalization, etc.

The content of a map is determined by who the map is for, what the map is for, what its message is, the conditions under which it will be viewed and its medium of delivery. Only then does the design of the map detail itself come to the fore.

Forward Planning

Before we can begin the process of making a map we must ascertain just what is required, find the appropriate information, check and verify source data ensuring that it is accurate, current and complete, select only the information that is needed and then design according to purpose, user, etc.

Map Design

Apart from the design of the map detail itself, the presentation of support information (insets, legends, photographs, tables, graphs, etc) and the layout of the various elements are equally important.

Map Design Principles

A good map communicates its message in a clear, efficient and effective manner. A few simple principles aid that process:

Clarity and legibility – each element should be seen clearly, distinct from one another

Contrast – emphasis should be added to the main feature to make it stand out

Figure-ground – important features should sit in the foreground

Visual hierarchy – structure should be added to aid interpretation

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Good Maps and Bad Maps

Good maps are accurate, are up-to-date, show only relevant information, use appropriate symbolisation, are clear and legible, communicate their message well and designed for the purpose required.

But, beware – a map can have all of these properties yet still be a bad map if the quality of the data is poor. Inaccurate, incomplete, inconsistent and out-of-date data can be camouflaged with good design. Accurate, complete, consistent and current information can be lost in bad design.

Conclusion

Poor mapping = poor communication
Poor communication = poor decision making
Poor decision making = ☹🗲😐↯☹!!! 💣

Poor decision making leads to goodness knows what - it may not matter but if it does it may do so in a spectacular fashion.

What is the secret ingredient that saves us from this uncertainty?

It is CARTOGRAPHY.

Full stop.

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In the Beginning - Giles Darkes, Cartographic Consultant

Promoting the Art and Science of Map Making

Map projections

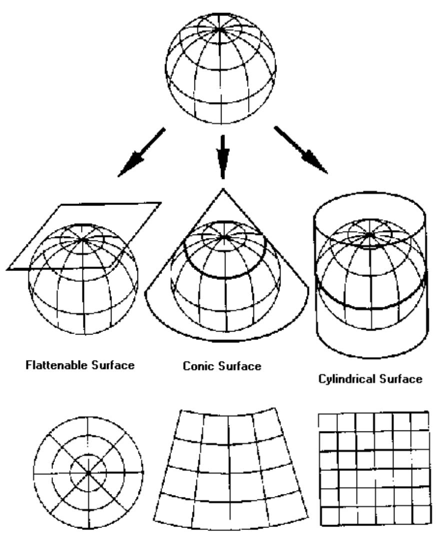
In transforming the 3-D earth to flat paper or a flat screen, it's impossible to avoid introducing distortions to the shape of the earth. For a map to have integrity, the transformation of the round earth into a flat surface has to be done consistently, and the process is that of *map projection*.

There are many ways to project a map, but most projections come into one of three categories: cylindrical, conical or azimuthal. The names derives from imagining a point source of light at the centre of a model globe, and seeing the pattern of lines and land shapes projected onto sheets of paper wrapped either as cylinders, cones or as sheets touching tangentially at points on the earth. In all three main classes, there are subdivisions according to whether the maps keep angles (conformal), areas (equal area) or distances (equidistant) correct; no projection can keep more than one of those properties correct.

Cylindrical projections produce maps of the earth which are rectangular in shape. They include the familiar Mercator projection. Conical projections are useful for depicting landmasses greater in east–west extent than north–south (e.g. Europe). Azimuthal projections are often used for polar maps, or for distances from a point.

The choice of projection is critical for maps of extensive areas (continent or world maps), but for small areas it is less important. Distribution maps should use equal area projections.

A useful gallery of map projections can be found at:
www.csiss.org/map-projections/index.html

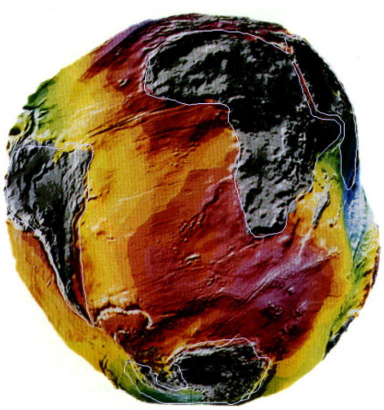


Map Datums

In order to describe the location of a point on the earth, it's necessary to have a defined system of co-ordinates which can give an unambiguous reference. If the earth were a perfect sphere, it would be easy, but it is flattened at the poles relative to the equator, and in any case is irregular in shape.

The actual shape of the earth is the *geoid* (= an earth-shaped object) which is defined as the 'gravitational equipotential surface' which runs through the earth. It's a surface on which gravitational pull is the same everywhere, and gravity is everywhere perpendicular to the surface. It's essentially mean sea level, as extended underneath continental land masses, but it varies from a smooth surface because of local gravitational changes. Heights are measured above the geoid.

For locational information, it's convenient to model the earth as a regular spheroid (an oblate or squashed sphere) where the degree of squashing at any point is represented mathematically. Locations can then be given as degrees north or south of the equator and east or west of an arbitrary meridian (Greenwich), taking the oblation into account. There are many different models of the earth, known as *reference spheroids* or *reference ellipsoids*, and different reference ellipsoids have been used historically for different parts of the world according to the best fit in a location (e.g. the OSGB ellipsoid for the British Grid). These reference ellipsoids provide horizontal datums.



The World Geodetic System in its 1984 guise (WGS84) is a single reference system which combines a standard world-wide reference ellipsoid with a standard co-ordinate reference system and a defined gravitational equipotential surface (geoid) in a single system. It's the reference ellipsoid used by the GPS satellites. Note that the same location given as degrees, minutes and seconds using different reference ellipsoids denote places several hundred metres apart on the earth. Many maps (and charts) are now standardising on WGS84 as their reference ellipsoid.

The difference in height between the WGS84 ellipsoid and the geoid used for terrestrial surveying can give height readings which vary considerably. This is known as the geoid-ellipsoid separation, and varies from -107 to +85 m.

Terrestrial surveying uses heights above mean seal level (MSL) as a vertical datum, which was determined originally by long-term measurements from tide gauges (e.g. Newlyn, Malin Head). Nowadays, GPS is used for height measurement, as well as terrestrial positional surveying.

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Sourcing Good Data - Clare Seldon, Steer Davies Gleave

RESOURCE LINKS

Ordnance Survey Mastermap
    http://www.ordnancesurvey.co.uk/oswebsite/products/osmastermap/
    http://www.cartography.org.uk/downloads/bm2011.pdf

UKMap data	http://www.theukmap.co.uk/
Collins/Bartholomew data	http://www.bartholomewmaps.com/
Navteq	http://www.navteq.com/
TeleAtlas	http://www.teleatlas.com/index.htm

FREE RESOURCE LINKS

OS OpenData	http://www.ordnancesurvey.co.uk/oswebsite/opendata/

Examples
    http://www.mapsinternational.co.uk/blog/index.php/2010/06/25/mapping-out-theelephants-in-the-elephant-parade/
    http://www.EssexWalks.com

OpenStreetMap	http://wiki.openstreetmap.org/wiki/Downloading_data
OpenStreetMap, 3rd party downloads	http://downloads.cloudmade.com/
	http://www.geofabrik.de/data/download.html
Examples	http://resultmap.neis-one.org/japan.html
	http://www.movingyouforward.org/
Downloadable UK base map	http://www.systemed.net/carto/ukbasemap.html
Natural Earth	http://www.naturalearthdata.com/

CREATE YOUR OWN MAP DATA

	http://www.systemed.net/gpx/
OS New Popular Edition	http://www.npemap.org.uk/
OS 1” 7th Series	http://steve8.dev.openstreetmap.org/os7.htm
Map warper	http://warper.geothings.net/
Warp-gbos	http://wiki.openstreetmap.org/wiki/Warp-gbos

then share...

Potlatch	https://www.openstreetmap.org/ then click on edit
Walking papers	http://walking-papers.org/

NON MAP DATA

USGS geological patterns	http://structure.harvard.edu/~andreas/map%20patterns/

MaPublisher (UK)
    http://www.xyzmaps.com/mapping-software/avenza-mappublisher.asp

SVG icons	http://www.sjjb.co.uk/mapicons/introduction

ArcGIS resources
    http://mappingcenter.esri.com/index.cfm?fa=arcgisResources.gateway

Colours	http://colorbrewer2.org/

Better Mapping Seminar, London
8th November 2011

Communication and Map Design - Giles Darkes, Cartographic Consultant

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Good communication

Some maps — perhaps many maps — fail to do their job properly because they don't communicate with their audience, or they send the wrong message. This is usually done unwittingly, but consideration of your audience and through checking of your data will help to eliminate the problem.

Good geography

Ultimately, all maps show some aspect of geography. It's therefore essential to check that you have the geography of an area correct when you make a map of it. Amongst the pitfalls for cartographers are:

- Giving the wrong labels (e.g. wrong country or province)
- Using out of date information (place-name & boundary changes, transport changes such as road numbers)
- Giving the wrong titles

Most errors come about because you're mapping something that's unfamiliar, in which case checking is even more important.

Maps that mislead

Most maps that mislead usually do so out of ignorance, not malice. Perhaps the most frequent cause of misleading is the inappropriate use of a map projection. As the examples in the presentation show, many newspapers will use a cylindrical projection for a world map (because it's familiar), but if the subject relates to distances from a point or a world distribution map, then it's likely to be wrong.

Use:

- For **world maps**, use an equal-area projection (e.g. cylindrical equal area, Mollweide's, Hammer-Aitoff), or a projection that is not strictly equal area but is nearly so and keeps the shapes familiar (e.g. Robinson, Winkel Triple — as used by National Geographic).
- For **regional maps**, use a projection that keeps areas or distances correct. For example, for a map Europe, use an Albers conical projection.
- For maps showing **distances from a point**, especially on a world map, use an azimuthal equidistant projection.

Maps where communication is poor by design

Maps need to be designed to communicate effectively. To that end, all information must be clear and legible — this sounds obvious but some maps fail because you can't read the contents.

- Ensure that labels (text) and symbols don't clash
- On thematic maps, the background map gives context to the theme mapped, but enough of the background needs to be visible to make sense of the theme.
- If the map is too stylised, then it may lose its message.

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Designing for multiple outputs - Clare Seldon, Steer Davies Gleave

The British Cartographic Society

Promoting the Art and Science of Map Making

Changes in paper and media products:
More about paper and media product requirements at:
http://www.sustainablecommunication.org/downloads/whitepapers/printvsdigital_falsedilemmas-and-forced-choices.pdf

Evolving media world:
Social Network map http://www.vincos.it/world-map-of-social-networks/
Google Stats http://www.bgr.com/2011/03/13/google-vp-marissa-mayer-dishes-googlemobile-stats-150m-mobile-users/

Why consider designing for all?
Time v Money v Quality

Design considerations
- SIZE
- COLOUR
- CONDITIONS

The processes

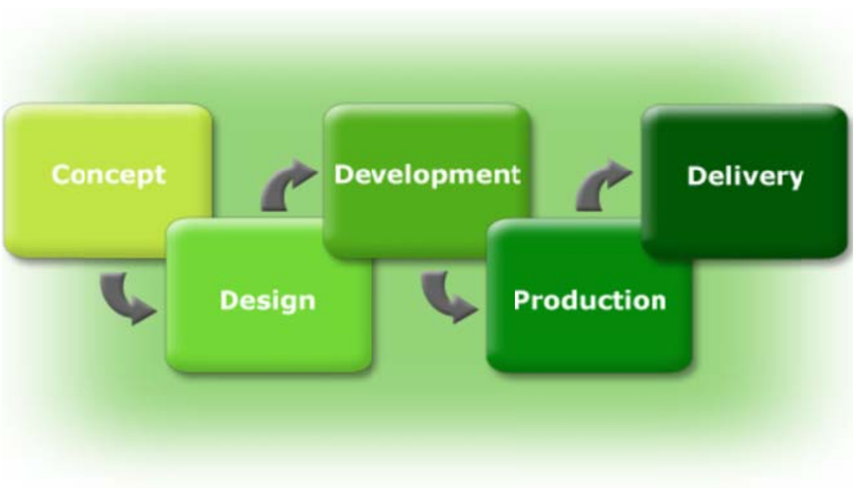
1. Web Testing –
   a. Browser info: http://www.w3schools.com
   b. More Stats http://gs.statcounter.com

2. Printing

3. User Groups

4. Design processes
   a. Symbols
   b. Linework
   c. Text

Summary
Work on a strategy for your user, design ideology and software =



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Statistical Mapping - Giles Darkes, Cartographic Consultant

Statistical maps

The vast majority of information and data is related to geography — that's to say that location is an important element in it. Accordingly, it's often the case that the graphic presentation of a set of data in the form of a map can be a very effective way of showing that data, far more so than just a table of information.

There are many established ways of mapping statistical data, including choropleth maps, proportional point symbol maps (where a symbol such as a circle is varied in size to represent the data), dot mapping and several other methods.

Data classification

Note that the way in which the data are classified is critical. Classification is the amalgamation of data into groups or classes, and the way that it is done can radically affect the appearance (and hence the message) of the map. Classification can be done according to rigorous mathematical methods (e.g. dividing the data according to quartiles or quintiles based on the median value, or by using standard deviations around the mean as dividing points between classes). There is no single fool-proof method of data classification and it's incumbent on the cartographer to use a method that as honestly as possible reflects the message within the data. In practice, many cartographers use a 'suck it and see' approach which *may* produce a good map, but may not. Equal class intervals rarely reveal much of the truth.

Choropleth maps should use no more than six classes of data (preferably five or fewer) to avoid confusion between classes. Choropleth maps should almost always show *ratio* data, (e.g. the death rate) as opposed to absolute numbers (numbers of deaths), since most phenomena relate to population density. So, the number of deaths per thousand people is far more revealing than the absolute number of people in an area — there will be more deaths where there are more people living. Data are classified and each areal unit of data-gathering (such as a county or electoral division) is assigned to the correct class. The areas are then coloured in in increasing values (saturation) of a single tone, or a series of tones. A useful guide to colour series can be found at www.colorbrewer.org where a range of colour series has been worked out with values in CMYK and RGB. The legends of choropleth maps should have *adjacent* (contiguous) colour boxes, to convey hierarchy. Note that maps for qualitative data (e.g. land use, natural regions) should have legend boxes which are *separated*.

Proportional point symbols use circles, squares or pictorial symbols which are varied in size to represent the data values for areas or points on a map. In theory the symbols can be scaled absolutely, where the symbol size exactly reflects the data value, but in practice readers find it very difficult to distinguish two or three similar sized symbols. As a result, it's often necessary to classify your data into groups and then use a smaller range of symbol sizes (again five or six at most) to depict the data. The size of the symbol is critical — you need to be able to see enough of the base map to know where the symbol relates to, but on the best maps the symbols begin to coalesce in the most crowded areas.

Dot mapping relies on the use of dots to represent a phenomenon. In qualitative mapping, a dot is placed in the right place on the map to denote something, but with quantitative mapping the dots are usually *indicative* of location, not specific. However, the dots should still be placed in reasonable locations. This can be done by reference to real-world geography, and a feel for the actual distribution of a phenomenon. For example, population density is relatively easy to determine in an area, and the dot fill can be spaced accordingly. In the case of many natural phenomena, it may be possible with research to find out the likely location of whatever it is you are mapping, to avoid putting alligators in deserts!

The modifiable areal unit problem

The way in which statistics are gathered is of critical importance to the patterns that emerge. For the most part, the data you have to work with will have been gathered using artificial, arbitrary boundaries, be they countries, states, or census enumeration districts. However, they can produce statistical maps that poorly represent actual distributions of phenomena, or indeed completely misrepresent them. The arbitrary boundaries of statistical units, when rearranged, can show total different patterns.

This is called the modifiable areal unit problem and is a substantial problem in statistical geography. As a cartographer, you can often do little to avoid the problem, but if you have a raw set of data to be mapped, it may be possible to choose a way of assigning areal units that avoid the worst of the problem.

Legends

Any map which shows statistics should have a legend.

Legends should show samples or all of the actual symbols used, at the size they appear on the map.

- Decide of the highest or lowest data value will go at the top
- Label each entry with its range (e.g. 201–300) or mark the point of change between classes.
- If you are using proportional symbols on your map (e.g. scaled circles or squares) then your legend should show at least three examples of the symbol, including (if practicable) the smallest and largest symbols.
- Sate the units used, especially for ratios (e.g. percentages, density per km^2)
- Often statistics show change across time, in which case the time interval must be shown (e.g. 'Percentage change 2001–2011').

Put an explanatory note onto the map which gives information on the areal units that are shown (e.g. 'by census ward'), source of information, and date of information.

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New Directions in Cartography - Dr Alex Kent, Canterbury Christ Church University

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Innovative and Inspirational Maps

Throughout history, cartographers have made us think about the world in new ways. Maps have the power to bring the faraway close and the past to life. We might glance at one map to see where to go, or hang another up at home to admire.

Some maps are particularly innovative and inspirational – they make us see things afresh and challenge our assumptions. They can be emotive and suggest a particular attitude towards a subject or place, or be more pragmatic and help us to make decisions more efficiently.

Harry Beck's design for the London Underground was a radical departure not warmly accepted by management at the time (1933), yet it met with immediate public approval. Its elegant solution to the problem of navigating the Tube and strikingly simple design has led to its utilisation in metro systems all over the world.

In 1973, Arno Peters presented a world map which used a very different map projection system than others. Although it was welcomed by the UN and a host of charities, people were divided as to whether the map was actually trustworthy or not. Nevertheless, its radical representation of the continents challenged the way in which the world was viewed.

Danny Dorling's maps use a mathematical algorithm which distorts the shapes of continents according to statistics such as population density, birth rates, and cases of disease. By freeing the map from its topographical constraints, the message is stronger and more immediate. The continents are like familiar faces, so their distortion grabs our attention.

How can our maps be more innovative or inspirational?

Cartography tends to be conservative and its representations are often very conventional. Moreover, organisations have a set way of doing things and change is not easy. But this should not prevent experimentation and creativity. The most innovative and inspiring cartographic solutions come from tacking the problem from a different angle – often by stepping into the shoes of the user and imagining their needs. As a starting point, try approaching your next map with these questions in mind:

How are people currently using your maps to make their decisions?

What key types of information are they basing their decision-making upon?

Is it possible to create a solution that enhances the elements associated with this information while suppressing others?

There is a way to do it better – find it! Thomas Edison