Using GIS and Handheld Technology to enhance Fieldwork

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Getting out of the classroom and doing fieldwork is probably one of the most enjoyable parts of geography. The “real world” is an exciting place, but for many students fieldwork has become limited by time, money and bureaucracy, and the experience is all too often seen as being boring and irrelevant. Engaging students in field tasks is essential for all good data collection, but more importantly by employing exciting and innovative methodologies it can enhance learning, increase interest and understanding of the study topic, and ultimately lead to greater participation in the subject.

Most teachers are aware of the advantages of modern technology to enhance post fieldwork data analysis and presentation, however what many fail to recognise is the advantages it offers to increase the efficiency and speed of data collection, to be able to analyse the field data immediately and minimize the data processing back in school. This link with mobile learning is usually not made, consequently, students are often used as ‘dumb’ data collectors and teachers miss the opportunity of having an engaged and motivated class undertaking a relevant and exciting learning experience.

Using GIS (geographical information systems) as part of fieldwork is one such method and combined with modern mobile technologies provides the platform for a range of engaging learning experiences. Students are bringing their mobile phones, iPods, handheld PDAs, PSPs and Nintendos to school and all too often schools respond by forbidding their use or threaten confiscation. However, these are the tools of the new generation and as educators we must change and consider how to utilize and embrace these new learning tools.

Coupled with these technologies are the wide variety of software packages and online utilities which embrace GIS. From Google Earth at one end of the spectrum to ESRI’s ArcView 9, a top end industrial strength software suite, there are a wide variety of options available to schools. The key to successfully implementing GIS into fieldwork is the teacher.

The first step for the teacher wanting to use GIS in their lessons is to get to grips with the software in order to be able to use it to teach with. This is not the same as learning to use the software. Many GIS packages have extensive capabilities, only a limited range of which are needed to get started. How many of us “played on” Google Earth in front of the class before realising it had GIS capabilities? The key is to regard GIS in schools as a teaching tool to promote better learning, not as a software package that needs to be mastered. Very effective lessons are possible using just a few basic functions, provided that the focus remains on the ideas or understanding the pupils should take away from the activity.

The easiest way to embrace the technology is to work directly with the students. Explain your objectives and allow the students to apply their expertise! You will be amazed by their intuitive skills and their willingness to engage with the study topic.

Background on GIS

What is GIS and what it does? (follow the link)
http://www.gis.rgs.org/whatisgis.html

CASE STUDIES

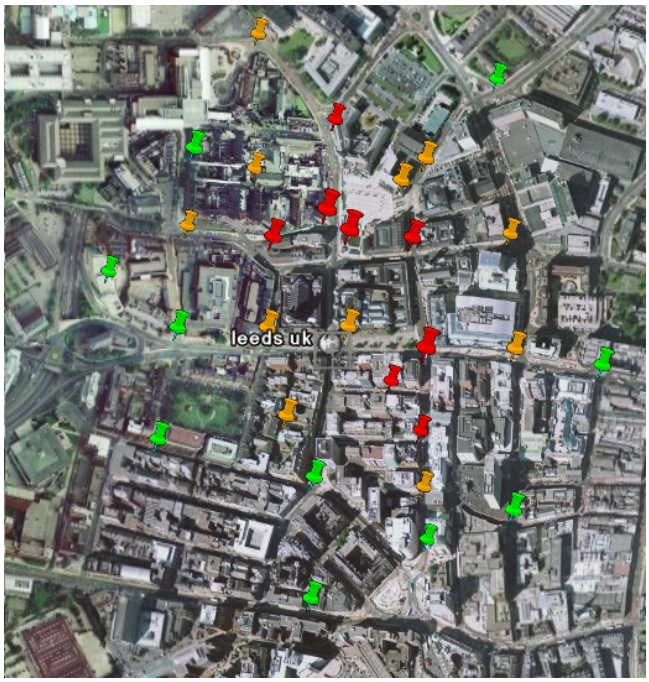
The following examples illustrate ways in which fieldwork can be enhanced using GIS and handheld technology.

1. Pedestrian Flow using a Mobile Phone and Google Earth

When using relatively in-experienced fieldworkers it is important to guarantee uniform data collection and input. Simple methodologies can be created which enable students working in the field to gather data effectively and process the information efficiently.

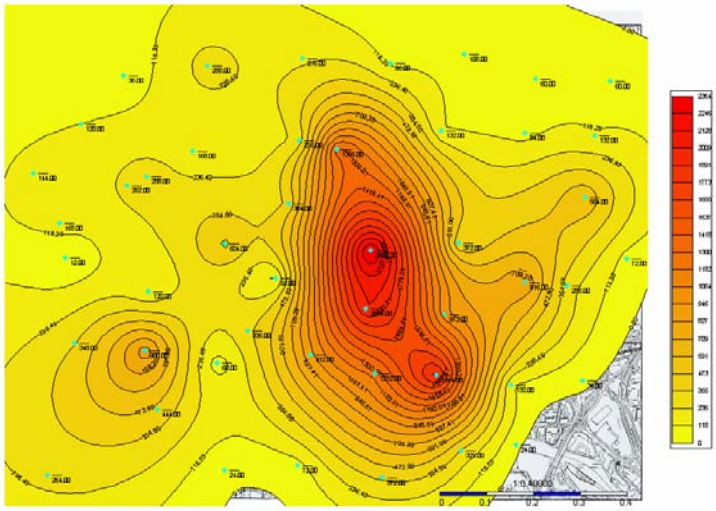
For example, students working in small groups can gather primary field data on pedestrian flow across a large urban area using mobile phone SMS to log data at pre-selected locations. The raw data once collected along with a grid reference for the location is forwarded to a central mobile number (teacher's phone). This data is then collated and copied to an Excel spreadsheet. (Students with a smartphone or a PDA can log their data directly into a spreadsheet). Students can then plot the points onto an online image or map such as those available on Google Earth/Google Maps and present their data using the available editing tools. Differentiation can be measured by the individuals' ability to utilise the software to present the raw data.

At a basic level coloured pins can be used to represent Pedestrian flow.

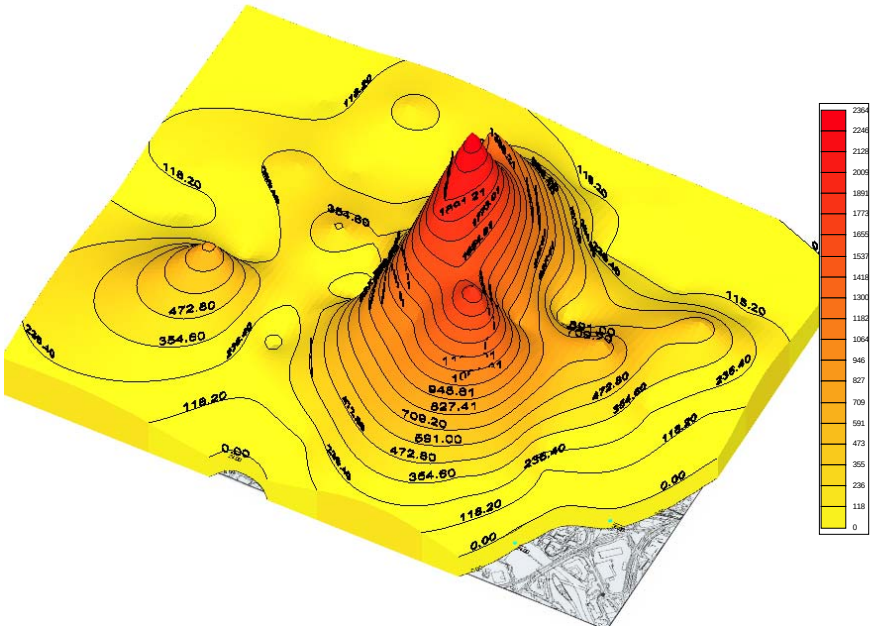


With simple GIS software the same data can be plotted, analysed and presented in a different way. Using online freeware and shareware software such as 3D Field students can produce a variety of exciting and innovative diagrams from their raw data.

3D Field is available from http://field.hypermart.net/



Isopleths of Pedestrian Flow in Leeds CBD



Students can then export their isopleth diagrams to a word processing or publishing package where they can add photos (taken from the field) or text.

2. Land Use Analysis using a PDA

With more and more affordable handheld technologies penetrating the school market a wide variety of innovative fieldwork activities are possible. This case study demonstrates how Year 8 students gather land use data in a honey pot site in the Yorkshire Dales National Park using handheld PDA and ArcPad mobile GIS software.

Grassington is a large village on the southern edge of the National Park and attracts visitors from all over the UK and overseas, as well as servicing a large local community in Upper Wharfedale. Following school based preparation students are tasked to classify land use and building function using a simple key created in class.

Category	Description
A	**Low order goods** (e.g. sandwich shop, newsagents, butchers)
B	**Low order services** (e.g. café, hairdresser, pub)
C	**High order goods** (e.g. designer clothing, electricals, department stores, "high street" chain stores)
D	**High order services** (e.g. travel agent, hotel, opticians, solicitors, estate agents)
E	**Financial services** (e.g. banks, building societies, accountants)

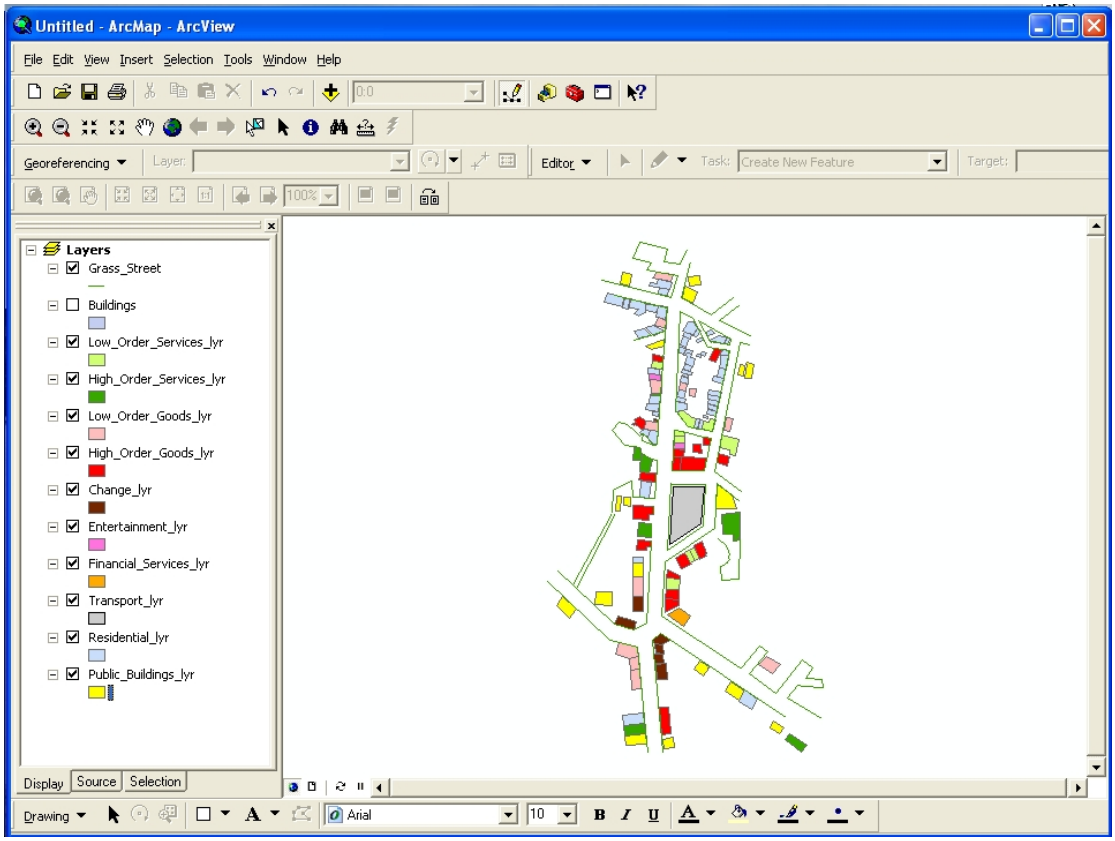
F	**Entertainment** (e.g. cinema, theatre, leisure facilities, restaurants)
G	**Public Buildings** (e.g. library, hospital, school, church, Town Hall, Police Station)
H	**Transport and Industry** (e.g. car parks, rail/bus stations, warehouses, brewery)
I	**Residential** (e.g. houses, apartments, flats)
J	**Change** (e.g. vacant premises, derelict)
K	**Construction** (e.g. new build, renovation)

This table is embedded into a digitised sketch map using the ArcPad software.

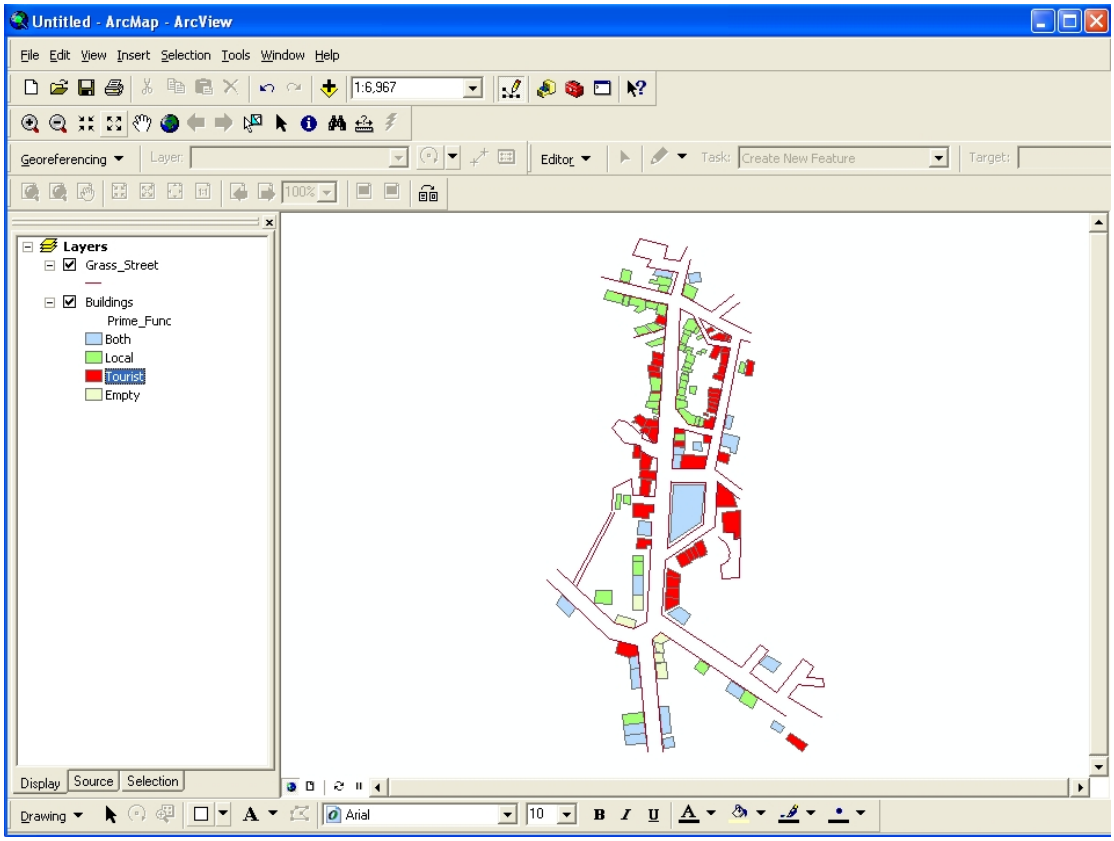
Working in small groups, students undertake a survey of the core of the village recording their observations directly into the software.

On returning to school the data and map is then imported into a desktop GIS (ArcMap) for further analysis and publishing.

Gathering data in the field using a Loox N520 with ArcPad software



Land Use Map using ArcMap with imported ArcPad data



Primary Building Use Map using ArcMap with imported ArcPad data

These maps provide students with the basis on which to undertake analysis of simple spatial relationships within the village. Using photos obtained in the field on their mobile phones students can further enhance their final pieces of work with annotated maps.

Using technologies in this way enables students to develop more awareness and get better informed of the study areas in which they have been working. As a result the student can link this information to their existing class work and show a greater understanding of the study topic. In addition, this approach increases the learning possibilities and active commitment of the students particularly through changing roles whilst collecting and inputting data and the development of computer and GIS skills.

The skills acquired at this level can then be utilised by students undertaking GCSE coursework. All GCSE Geography students at Leeds Grammar School, for example, use GIS for their geography coursework in Y10 where they can put their skills to good use to the extent that they wish.

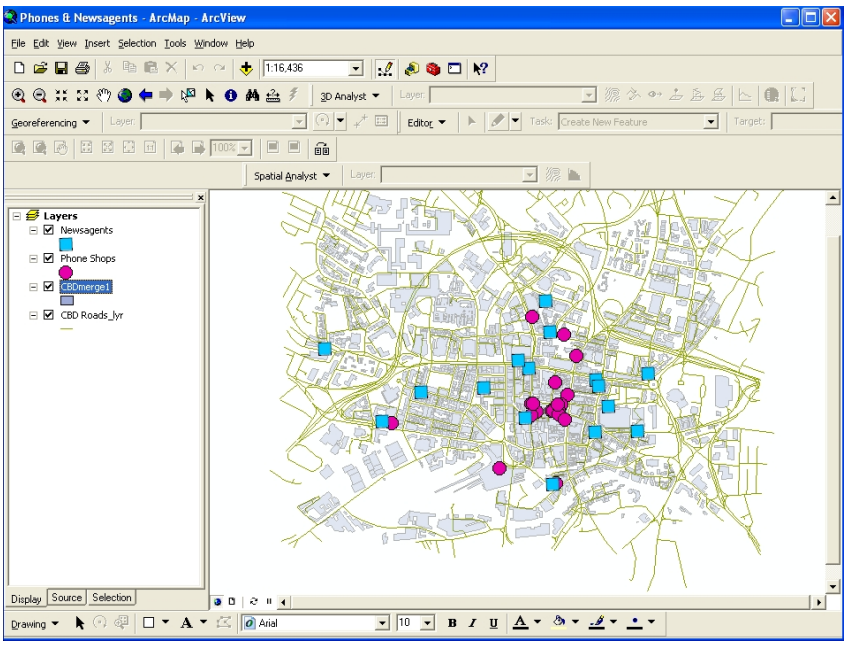
Y10 pupils collect data in Leeds for use in their GIS based GCSE coursework

Like other software applications such as Word or Excel, GIS provides students with opportunities to use a variety of skills and enhance their competency in areas such as literacy, numeracy and working with one another. It can involve high level (and highly motivating) ICT skills. It is ideal for developing all of the key skills of Application of Number, Communication, use of ICT, Improving own learning, Problem Solving and Working with others.

Some exemplars of GCSE coursework based on primary field data using ArcGIS9

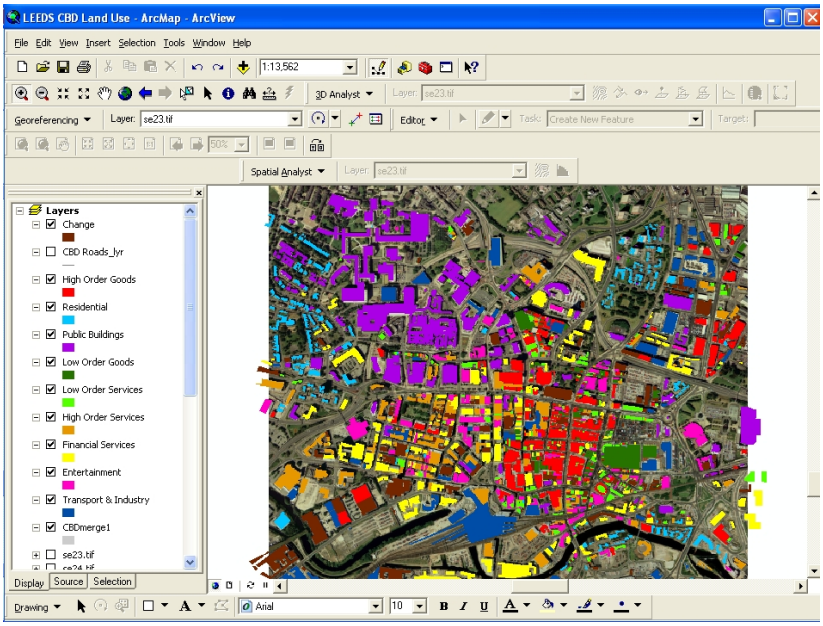
a) Functional Clustering in Leeds CBD

GIS Map based on field research. Using the Statistical Analysis tools Nearest Neighbour Index can then be calculated and Mean Centre plotted on another CBD Map.



b) Land Use Analysis and Aerial Photography in Leeds CBD

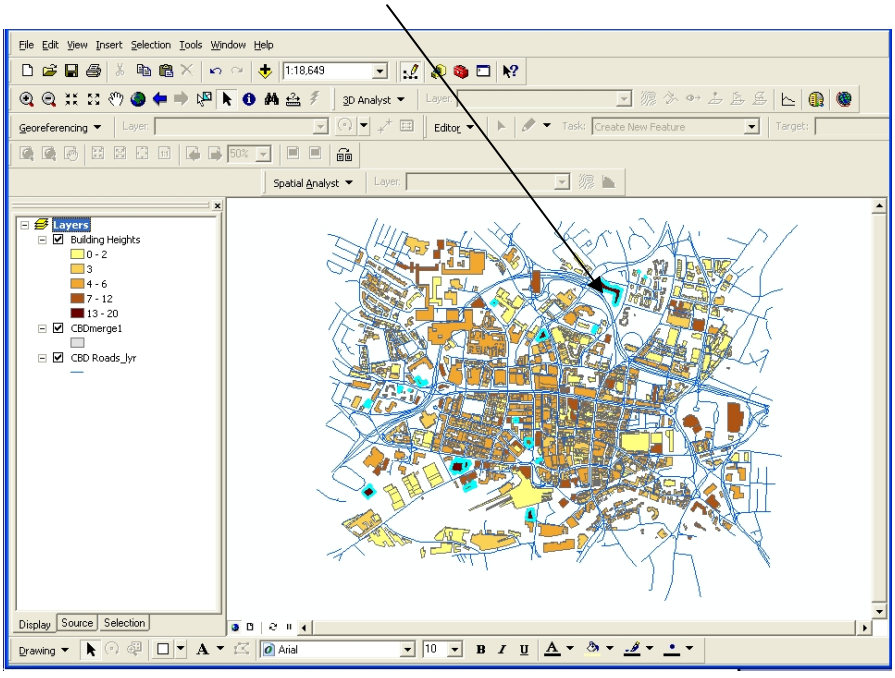
Map based on Primary Group Data gathered in the field and merged to produce a Land Use Map. Data is the projected over an aerial photo of the CBD. Further GIS analysis enables student to identify Core, Frame, Zone of Degradation and Zone of Assimilation within CBD.



c) Building height Analysis

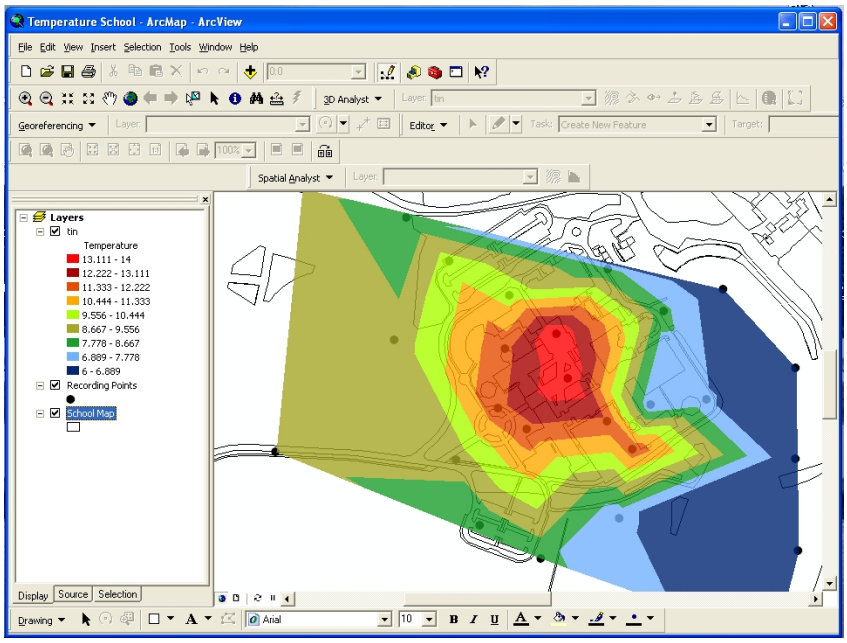
Map based on Primary Group Data gathered in the field and used to produce a Building height choropleth map. Using GIS analysis all buildings over 12 floors can be highlighted to test the hypotheses that the tallest buildings should be in the centre of the CBD.

Highlighted building



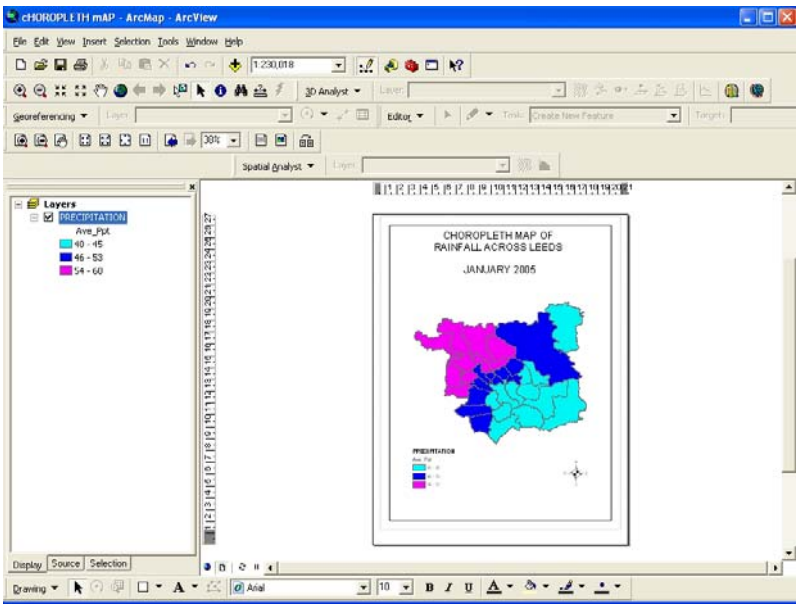
3. GIS & Data Logging the School Microclimate

Using digital thermometers, dataloggers, GPS and GIS software students can produce a “surface analysis” map to show temperature across the school site. Working in small groups students can be given the task of finding a location on the site and recording key weather data at that point. One example is to use a GPS “treasure hunt” to identify a location and record temperature using a digital thermometer. The data can be saved directly (*if using Arcpad on a PDA*) or collated and added to a spreadsheet which can then be linked to the map using GIS (***shapefile data table)*** on return to the classroom. Students can then produce a digital surface map showing temperature across the school site.



4. Plotting Home Made Rain Gauge Data

Year 8 students were given the task of constructing a rain gauge from a plastic bottle and then recording rainfall over a 14 day period. The data was collated in school and added to a database linked to the political wards of Leeds. Using ArcMap students were able to construct a simple choropleth map to show rainfall across the city. Analysis of the results enabled students to understand the link with relief rainfall and prevailing wind.



Other applications in the field

Scree slope location and analysis using GPS and Anquet software on a PDA in the Yorkshire Dales.

Slope analysis and data recording using video on a mobile phone

Slope data being Bluetooth transferred to another group mobile. Data also forwarded to School using SMS for analysis in class.

Students using GPS tracking and Anquet Maps to record slope profiles.