

NeoGeography and Web 2.0: concepts, tools and applications

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In this article, we explore the concepts and applications of Web 2.0 through the new media of NeoGeography and its impact on how we collect, interact and search for spatial information. We argue that location and space are becoming increasingly important in the information technology revolution. To this end, we present a series of software tools which we have designed to facilitate the non-expert user to develop online visualisations which are essentially map-based. These are based on Google Map Creator, which can produce any number of thematic maps which can be overlaid on Google Maps. We then introduce MapTube, a technology to generate an archive of shared maps, before introducing Google Earth Creator, Image Cutter and PhotoOverlay Creator. All these tools allow users to display and share information over the web. Finally, we present how Second Life has the potential to combine all aspects of Web 2.0, visualisation and NeoGeography in a single multi-user three-dimensional collaborative environment.

Keywords: GIS; NeoGeography; Web 2.0; Second Life; Google

1. Introduction

The world of geographic information and analysis is undergoing a transformation. Mapping services, hacks and task-specific software have emerged that are changing the way we share, communicate and distribute data. These changes are to such deep extent that we stand on the edge of a new geography based on a digitally connected world at whose core lies citizen-created data organised at an increasingly fine geographic scale.

Central to these changes and the explosion in available data organised by its geography is the concept of Web 2.0, a term adapted by O'Reilly Media in 2004 to summarise the rise of services from web-based communities focusing on technologies of social networking, social booking marking, blogging, Wikis and RSS/XML feeds (Graham 2007). In the past five years, we have witnessed the emergence of user created web content in the spirit of Web 2.0, as evidenced by the growing popularity of sites such as MySpace, Facebook, Flickr, YouTube, etc. This growth relies on our ability to communicate and share data and information through simple, freely available tools. These can be learnt quickly and effectively without immersion in professional activities (Hudson-Smith *et al.* 2007) with some describing this as the cult of the amateur (Keen 2007). As such, these tools and the way they can be used

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are redefining the very disciplines that traditionally have made sense of such phenomena – sociology and geography – in the same way that economics is being redefined in Web 2.0 as Wikinomics (Tapscott and Williams 2006).

At the heart of this growth is the desire to tag data to specific locations. We would argue that location and space now represent a third force in information technology besides computers and communications. Tagging not only the type of data but also where such data is produced, who uses it and at what time, is becoming one of the core applications of web-based services.

This re-emergence of the importance of geography within Web 2.0 technologies is becoming known as 'NeoGeography'. Whereby people use Web 2.0 techniques to create and overlay their own locational and related data on and into systems that mirror the real world. The term is derived from Eisnor (2006) one of the founders of www.platial.com where she defines it (NeoGeography) as: '...a diverse set of practices that operate outside, or alongside, or in the manner of, the practices of professional geographers. Rather than making claims on scientific standards, methodologies of NeoGeography tend towards the intuitive, expressive, personal, absurd and/or artistic, but may just be idiosyncratic applications of 'real' geographic techniques. This is not to say that these practices are of no use to the cartographic/geographic sciences, but that they just usually do not conform to the protocols of professional practice'.

One of the characteristics of NeoGeography and Web 2.0 is the term mashup, originally used to describe the mixing together of musical tracts on DJ Danger Mouse's *The Grey Album*; the term now refers to websites that weave data from different sources into a new integrated single user service (Hoff 2005). This has been made possible through companies granting access to their platforms through application programming interfaces (APIs) with the use of such mashups becoming increasingly popular for plotting data on maps. For example, the release of the Google Maps API enables users to mix Google stream-based data with other spatially referenced material. These data can then be served as bespoke applications through the Google Map interface. A number of different terms have been used to describe these applications, including 'map mashups' (Purvis *et al.* 2006), 'map hacks' (Erle *et al.* 2005) and 'Mapplets' (Google 2008). The mixing of various data sources through common and open standards is central to Google Maps' position within the concept of Web 2.0. NeoGeography could therefore be argued as being about people using and creating their own maps, on their own terms and by combining elements of an existing toolset (Turner 2006). In time, some believe that mashups could change science if researchers could be persuaded to share their data (Butler 2006a) despite the reluctance of many research labs and agencies to consider doing science in this fashion.

In many ways, NeoGeography and mashups go hand in hand (Hudson-Smith *et al.* 2007). One of the most important innovations in the development of NeoGeography and the mashups that accompany it is the concept of the Digital Earth. A term popularised by former US Vice President Al Gore for describing a virtual representation of the Earth on the Internet, that is spatially referenced and interconnected with digital knowledge archives from around the world. Google Earth and to an increasing extent Microsoft's Virtual Earth and NASA's World Wind (collectively known as geobrowsers) have produced 3D worlds at a speed and resolution that was unimaginable only a few years ago.

Until Google Earth and other geobrowsers, geographical information systems (GIS) remained largely the preserve of specialists. Google Earth has increased awareness of GIS potential and encourages researchers to explore more powerful techniques (Butler 2006b). 'Just as the PC democratised computing, so systems like Google Earth will democratise GIS.' (Goodchild quoted in Butler 2006b). The Google Earth phenomena has opened up some of the more straight forward capabilities of GIS to the general public, making it easy to deploy GI across computer platforms through a standard, easy to navigate graphic user interface. They provide a base layer on which to overlay data whereby users can pan (by dragging the mouse) and zoom (by using the mouse wheel) onto mapping data almost anywhere in the world. It has opened GI to the masses and is leading the way to NeoGeography, Crowdsourcing (Howe 2006), Volunteered Geographic Information (VGI) (Goodchild 2007) and Collective Intelligence. Creating and visualising data is now a central part of the web experience. Indeed, geography is important again and the rapid diffusion of geobrowsers are simply in the vanguard of a whole series of software systems providing a geographically enabled Web 2.0 service that promise to bring geo-location to the fore and of course to everyone (Hudson-Smith 2008).

There has been an explosion in the amount of GI available and just as Web 2.0 relies on user generated content, NeoGeography relies on user generated content that is locationally tagged (i.e. VGI). Sites such as Wikimapia and OpenStreetMap are empowering citizens often with no formal qualifications to volunteer to create a global patchwork of GI, which for a long time has been reserved for official agencies. Other virtual globes are encouraging volunteers to develop interesting applications with their own data (Goodchild 2007). With the rise in citizen level mapping has come the demand for data, issues of copyright, questions over accuracy (including metadata), issues over coverage and resolution of data and threats to individual privacy. While these are issues that have faced the more traditional GIS user for a number of years, it is new to the world of NeoGeography. Accuracy is without question changed when data is collated by the non-professional geographer, yet perhaps questions over accuracy are superseded by the sheer wealth and diversity of data emerging online. Indeed, a number of 'classic' NeoGeography websites have filters built in to ensure quality control, as sites such as OpenStreetMap are able to offer high-quality data free of charge and are starting to threaten the more established data providers. As the business model of GI is changing, the world of Wikinomics is becoming geo-coded.

As with Web 2.0 in general, the popularity of superimposing GI from sources over the web, many of which are created by amateurs, is growing rapidly. As a result, the number of available mashups has reached over the hundreds of thousands and the number of downloads of Google Earth software exceeds 100 million (Goodchild 2007). This change allows cartographers to acquire new tools and methods capable of enhancing static maps and introducing multiple layering, interactivity and multimedia (Dransch 2000). This increased use of computers has also led to a growing interest in geovisualisation (Buckley *et al.* 2004) in terms of concepts, tools and applications (Dodge *et al.* 2008) but with these new tools rarely conforming to the protocols of existing professional practice (Eisnor 2006).

The remainder of this article presents a series of software tools we have developed in our group (CASA) at University College London as part of the National Centre

for e-Social Science's node on Geographic Visualisation of Urban Environments (GeoVUE). These tools comprise a GeoVUE toolset which includes GMapCreator, MapTube, Google EarthCreator, Image Cutter and PhotoOverlay Creator. We relate how the toolset has been used and indeed become part of the NeoGeography movement allowing the non-professional user to effectively share and visually compare GI. Finally, we present how real-time collaboration in a three-dimensional environment à la Second Life has the potential to combine all aspects of Web 2.0, visualisation and NeoGeography.

2. Tools and applications

NeoGeography is about people using their own maps, on their own terms and combining the maps with elements of an existing toolset. The following section briefly outlines a number of tools that we have developed, the concepts behind them and the application domains of such tools. It should be noted that our tools are in the mindset of Web 2.0 and NeoGeography, allowing the non-professional user to integrate their data, creating and exploring GI anywhere, anyplace at anytime.

2.1. Google Map Creator

Placing your own data onto Google Maps used to mean getting your hands dirty via the Google Maps API and a request to Google for a licence key. This restricted map making to those determined to visualise data or those already at ease with basic code editing, as for example in our own shortest path Mashup entitled the University College London (UCL) Campus Route Finder (UCL, 2008).

Google allowed users' access to the Google Maps API in order to create their own map applets, or 'Mapplets' in 2005. Chicagocrime.org (now part of the EveryBlock.com) produced one of the first mashups combing Google Maps with the Chicago Police Department's Citizen ICAM web site to show incidents of crime within the Chicago region. Crimes were plotted directly upon Google Maps. In 2007, Google launched MyMaps, essentially built on the same product as Google Maps but allowing users to create their own maps via a simple point and click interface. One can draw lines and shapes, embed text photos and videos – all using a simple drag and drop interface. This is possibly one of the most important innovations in mapping since the development of GIS (Hudson-Smith 2008). While not as customisable as using the full Google Maps API, MyMaps is, in our view, the purest example of a NeoGeography and Web 2.0 application currently available, allowing citizens to add, edit and share geographical data *en masse*.

One of the first high-profile applications of MyMaps in the UK was the BBC Radio Berkshire Flood Map (2007). Created in the wake of the floods which swept across the region in July 2007, BBC Radio Berkshire put together a Google Map which showed a multitude of different information about the extent and characterisation of local flooding. These included locations of emergency centres, audio clips from news correspondents, and pictures and videos (e.g. taken from mobile phones and posted on YouTube) sent by listeners, thus providing views of information in the flood-hit area as shown in Figure 1. At the time, MyMaps were limited to single user editing, listeners stories, and locations were emailed to the BBC



Figure 1. BBC Berkshire's flood map highlighting photographic and video content.

and subsequently entered on the map accordingly. MyMaps is now collaborative allowing real-time editing ranging from invited individuals and groups up to a global user base.

However, Google Maps is not without its problems. Google is not a GI provider for it is in essence a marketing company, and thus maps are merely a means to provide geographical context to business data. As such, any data within Google Maps in their Keyhole Markup Language (KML) format is accessible, and indeed must be on a public server as part of the license agreement. Data confidentiality is therefore limited with Google Map mashups focused on the interested NeoGeographer rather than on the professional GIS user. Furthermore, building rich cartographic websites with KML files is currently limited to 1MB due to download limits.

Further to this, a commonality between many mashups is that they only display spatial point data, as thematic maps cannot be easily created within such applications. The problem is that these point objects are often misleadingly used to summarise an areal distribution (Gibin *et al.* 2008) and as such, they are instances of what Martin (2001) describes as spatial object transformations. Viewed from this perspective, many choropleth maps also entail spatial object transformations, since spatially referenced data are aggregated into artificially bounded areas.

For mashups, there are relatively few choropleth maps. This most likely arises because Google Maps API neither supplies nor supports tools to incorporate areal

aggregated data into the Google Maps interface. For this reason, we have created a free tool called Google Map (GMap)Creator¹ which enables the creation of choropleth thematic layers which can be quickly and easily integrated into Google Maps.

External data displayed by Google Maps may originate from and in a variety of sources and formats. Typically data relates to the classic GIS data objects of points, polylines and polygon vectors or rasters. However, GIS files common across desktop GIS software such as ESRI shapefiles cannot be directly mapped into Google Maps mashups. While building polygons is possible in Google Maps using the Google Maps API, building polylines and polygons is difficult, slows down the application and as we have already noted, is limited to 1MB KML files (see Gibin *et al.* 2008 for more information). Therefore, Google Maps mashups showing polygon data thematised by a particular attribute is uncommon. In order to help this situation, the freeware application, GMapCreator, enables us to simplify thematic mapping in Google Maps.

GMapCreator is the simplest solution possible to create thematic maps as it is rooted in a tile-based approach to allow it to handle large amounts of data. GMapCreator enables a user to take a map which consists of vector data (a shapefile) describing the physical configuration of objects and features that make up the map together with attributes that relate to these geometric features, and then generate a layer that can be displayed or overlaid in a Google Map. GMapCreator was developed to publish shapefiles files in a simple 'point and click' manner as we highlight in Figure 2. The software, like others in today's Google-led world, is free software with high levels of functionality but requiring relatively low levels of expertise to make it work.

Unlike the Google Maps API method for displaying points, lines and polygons, which requires arrays of vertices and coordinates to be specified in the HTML, GMapCreator reads data from the shapefile as a series of raster image tiles (256 by 256 pixels) whose frequency depends on the zoom level selected. The higher the zoom level, the greater the frequency of tiles required to cover any given geographic area. The use of this architecture has the added benefit of avoiding the infringement of many intellectual property rights. The raw data is never shared or placed online, only the data visualisation. Furthermore, it is practically impossible to recover the original vector data from the image tiles. Even if an image processing algorithm were used to extract the data from the images, the recovered data would only be a scaled approximation to the original; and thus the original dataset cannot be recovered.

Using GMapCreator, it is possible to overlay pre-rendered thematic tiles on top of street and satellite views of Google Maps, making it possible to show complex areal coverages. The client's browser only has to download and display the pre-rendered tiles rather than complex vector data consisting of multiple points, lines and polygons. For wider dissemination, one can build individual websites to show the data, and to aid this, the software also renders a basic webpage that contains the Google mapping interface. This can be built upon like the LondonProfiler or it can be used to link the data to MapTube for wider dissemination (as we describe below).

The purpose of such a tool is to publish extensive geospatial data for light browsing and exploring rather than for more formal exploratory spatial data analysis (ESDA).² It is envisaged that the main use of GMapCreator will be by data providers and local agencies using maps. GMapCreator reduces the thematic map

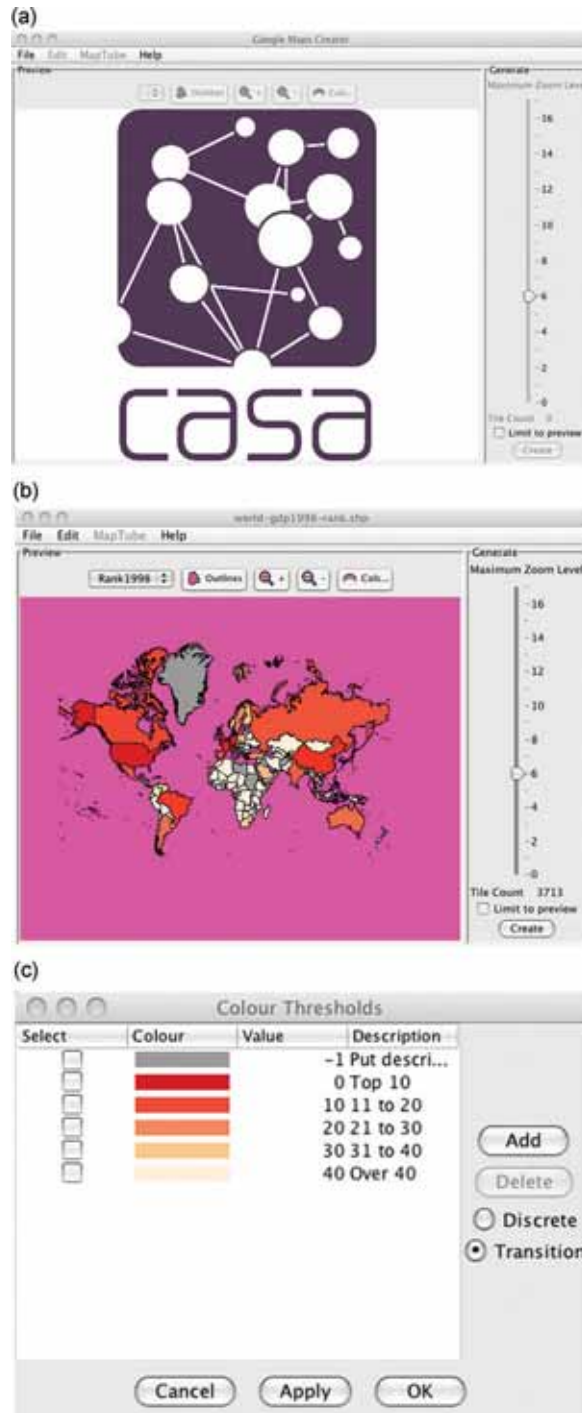


Figure 2. Google Map Creator. (a) Initial screen when GMapCreator is first opened; (b) uploading a shapefile and selection the required level of zoom; (c) selecting the scales for the thematic data.

into a dataset of files, thus making it possible for the data to be served using simple file transfer. This offers the facility to display thematic maps to those who do not have access to a programmable GIS web server. Since being released it has been downloaded over 9000 times and is continuously being developed, most recently with its integration into MapTube which we explore later.

Software packages in a Web 2.0 world have a short shelf life. GMapCreator is of its time and currently meets the needs of local councils, government organisations and interested individuals to quickly and easily publish thematic maps. Software is arguably moving towards a service in what is increasingly being called 'The Cloud' where files are saved, processed and manipulated on a remote server and yet made accessible on any machine. The premise comes from the fact that services and architecture should be on servers. We call it 'cloud computing' for it assumes that these data and services should be in a 'cloud' somewhere. And that if you have the right kind of browser or the right kind of access, it does not matter whether you have a PC or a Mac or a mobile phone or a BlackBerry or any device yet to be developed, you can still get access to the cloud (Schmidt 2006). Indeed this article was written using 'Buzzword' from Adobe, a word processor in 'The Cloud' which allows multiple users to edit and amend a file without that file ever being saved to a local hard drive. Google's MyMaps is a similar service with data added, edited and held via a remote server, a geographical service that is geography neutral in terms of computing power.

We envisage GMapCreator and similar applications morphing into a cloud-based service, holding and serving data remotely, ironically rather like traditional GIS-based web services. This points towards the future; in the present using our toolset, it is possible to build feature rich cartographic websites that may easily be used and interpreted by individuals who have limited experience of spatial data handling. This is to which we now turn, location-specific maps using GMapCreator, specifically the London Profiler.

2.1.1. Usage: London Profiler

The purpose of the London Profiler website (<http://www.londonprofiler.org/>) is to create a resource on which spatial data from a variety of public sector domain of public sector sources can be displayed against the backcloth of Google Maps, such data facilitating online exploratory cartographic visualisation in a range of areas of policy concern (Gibin *et al.* 2008). To achieve this, the site uses image tiles created with GMapCreator.

Currently the London Profiler is a beta test site and contains data sets including the Multicultural Atlas of London (Mateos *et al.* 2007), the E-Society Classification (Longley *et al.* 2006), the HEFCE POLAR Classification and Associated HE data (Corver 2005), Hospital Episode Statistics,³ the Index Multiple Deprivation (DCLG 2007), crime statistics (Metropolitan Police Service 2008) and the National Statistics Output Area Classification (Vickers and Rees 2007). Travel information from Transport for London including a Tube map, public transport accessibility and travel card zones, are also displayed.

The interface was designed to allow different stakeholders access to a variety of different information through a common visual interface. Designed to be interactive, the interface to the site shown in Figure 3 is similar to Google Maps with panning

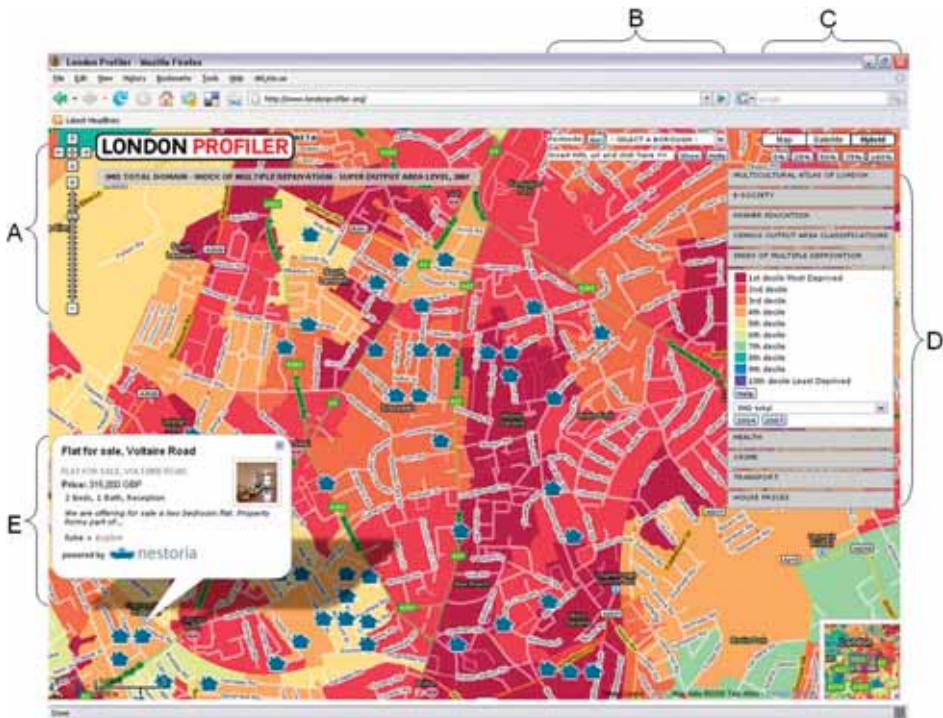


Figure 3. The London Profiler interface. Note that the features in the figure identified as A to E match details in the text.

and zooming facilities (Figure 3A). However, to refine the search capability, users can search and select from the map by borough or unit postcode (Figure 3B), and enable different views (map, satellite or hybrid maps) to act as a background for which thematic maps can be overlaid at different levels of transparency (Figure 3C). Furthermore, to display the different datasets, several tabs arranged by themes, for example health, E-Society, Crime, Transport, etc., have been added where the user can select a dataset, see a legend and access a help section which provides details on how the source data was created. This has links to Spatial Analysis Online, an independent source for geospatial reference material, also available in de Smith *et al.* (2007) which is a further example of how Google is promoting GIS with links to more detailed information as shown in Figure 3D.

Through the use of Google Maps API 2 released in 2006, this site also allows KML files to be rendered on top of the Google Maps background data. Therefore a publicly available Uniform Resource Locator (URL) can be entered into the display box and third party KML files can be displayed on top of the thematic map, thus allowing user interaction such as displaying third party boundaries and point data or the integration of disparate data feeds. One such link has been formalised as a tab, a link to the Nestoria website, a UK site that produces aggregated information of property prices and related data. For example, Figure 3E shows the 2007 Index of Multiple Deprivation for a selected part of London, overlaid on top of which are properties for sale from the Nestoria site. These properties for sale can be queried and further information about them can be highlighted as we show in Figure 3E.

The site has numerous potential policy applications. For example, an educational practitioner may be interested in widening participation and in finding the percentage of 18–19 years old cohort that participate in education. The user could enter a URL to a KML file showing the location of schools and see which schools have low participation rates, while others interested in crime can explore burglaries in an area and then see how this relates to deprivation. A member of the general public can search for a new home and use all this information in their residential decision making process.

The London Profiler is a good example of online exploratory cartographic visualisation of thematic maps. Through the use of GMapCreator a cheap and effective platform for visual communication of health and education data is provided to both internal and external users. London Profiler and indeed any maps created using GMapCreator are not meant to be classified as GIS maps or indeed as web-based GIS applications for they do not result from the usual functionality used in GIS but simply sit between Google MyMaps and more traditional web-based GIS server systems thus illustrating once again, the essential difference between the activities of a NeoGeographer compared to a geographic professional.

The London Profiler is a site written for the task of portraying information related to a specific location. To widen out the concept and add in the ability to create, mix, match and visually compare maps on a global scale a change in concept is required, and it is this to which we now turn in the form of MapTube.

2.2. MapTube: 'a place to put maps'

MapTube (www.maptube.org) combines the generic idea of YouTube where users can share information with the ability of GMapCreator to create thematic maps. MapTube provides a 'place to put maps' as we highlight on its homepage in Figure 4 which shows the most viewed maps currently on the MapTube site. MapTube acts as a portal for geographic data, data which is not stored on the site. Every map hosted on MapTube is held on an outside server, and pulled in using the XML file which is automatically created when it is first generated using GMapCreator. This allows data creators to maintain ownership of the data, an important nod back to professional GIS providers in light of today's Web 2.0 environment where there are increasingly hazy views about what constitutes copyright and legitimate data use.

As with other Web 2.0 applications, the content within MapTube relies on users submitting content. Users can submit their own maps to MapTube via a simple user interface which we demonstrate in Figure 5 where users are asked for several pieces of information: the URL of where the map is located (i.e. the XML file), the title of the map, keywords which describe the map, for example, 2001 population density London which is used when others are searching for maps, a brief description of the map along with information (metadata) about the data portrayed on the map, for example, how was the data collected and when was it collected, etc. This does raise issues about the quality of the data and as with traditional GIS metadata, it is difficult to persuade those responsible for creating geographic data to produce adequate documentation.

MapTube allows one to view and compare different datasets as a series of layers (i.e. a mashup) through the Google Map interface, as we highlight in Figure 6, which



Figure 4. The MapTube home page showing the most popular maps.



Figure 5. MapTube interface where members can add their own maps.

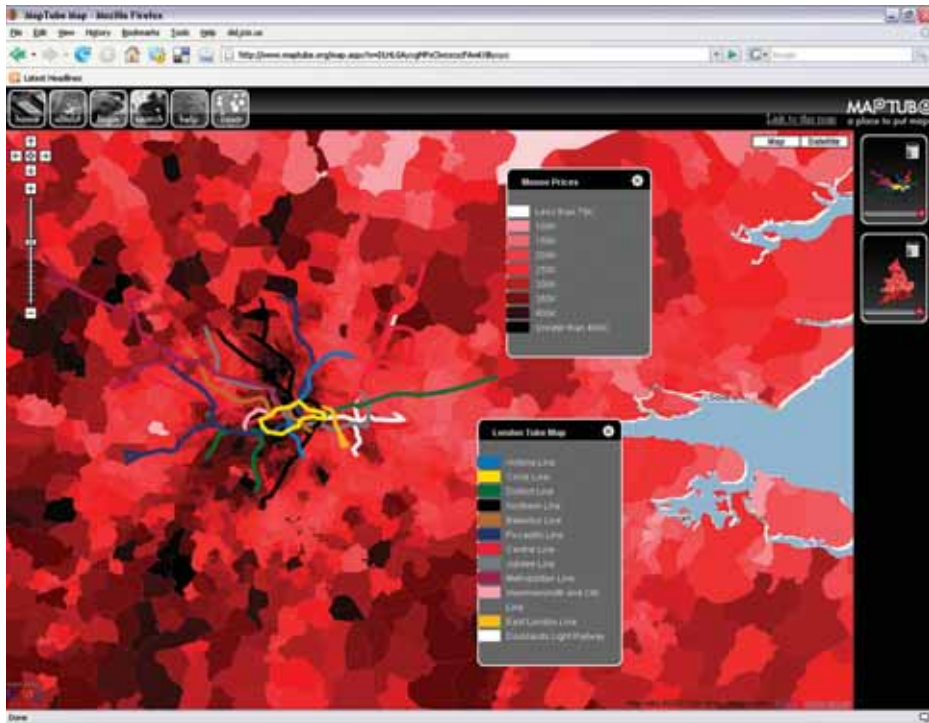


Figure 6. Viewing maps in MapTube with the London Underground (tube) lines overlaid on house prices.

shows house prices with London underground lines overlaid on top. Once the required visualisation has been created, it can be saved and shared and disseminated via a unique URL.

2.2.1. Mapping the credit crunch

Not only does MapTube allow people to share and view other peoples maps but it can also be used in more innovative ways. For example, as web surveys are often aspatial (e.g. surveymonkey.com), the ability to use GMapCreator and MapTube offers a simple solution to build spatial surveys for large areas. A pilot study was carried out as an experiment to create a mood map of the credit crunch within the UK in conjunction with BBC Radio 4 iPM show (Figure 7a).⁴ Based on what is the singly most significant factor hurting the person the most about the credit crunch, participants were asked to enter the first part of their postcode (postcode sector) so their responses could be geotagged along with one of the six options to choose from: mortgage or rent, fuel, food prices, holidays, other, or the credit crunch is not affecting me as shown in Figure 7(b).

No personal data was collected and participants were reassured that actual locations could not be identified. This was ensured through the use of postcode sector rather than the postcode unit or building address, therefore preserving data confidentiality. Each response updated the database element of the underlying



Figure 7. Mapping the Credit Crunch. (a) Link from the BBC Radio 4 iPM Show; (b) choosing the singly most important factor hurting people the most concerning the credit crunch and entering their postcode; (c) maps of the mood; (d) changes to the map of the mood as more people enter their information.

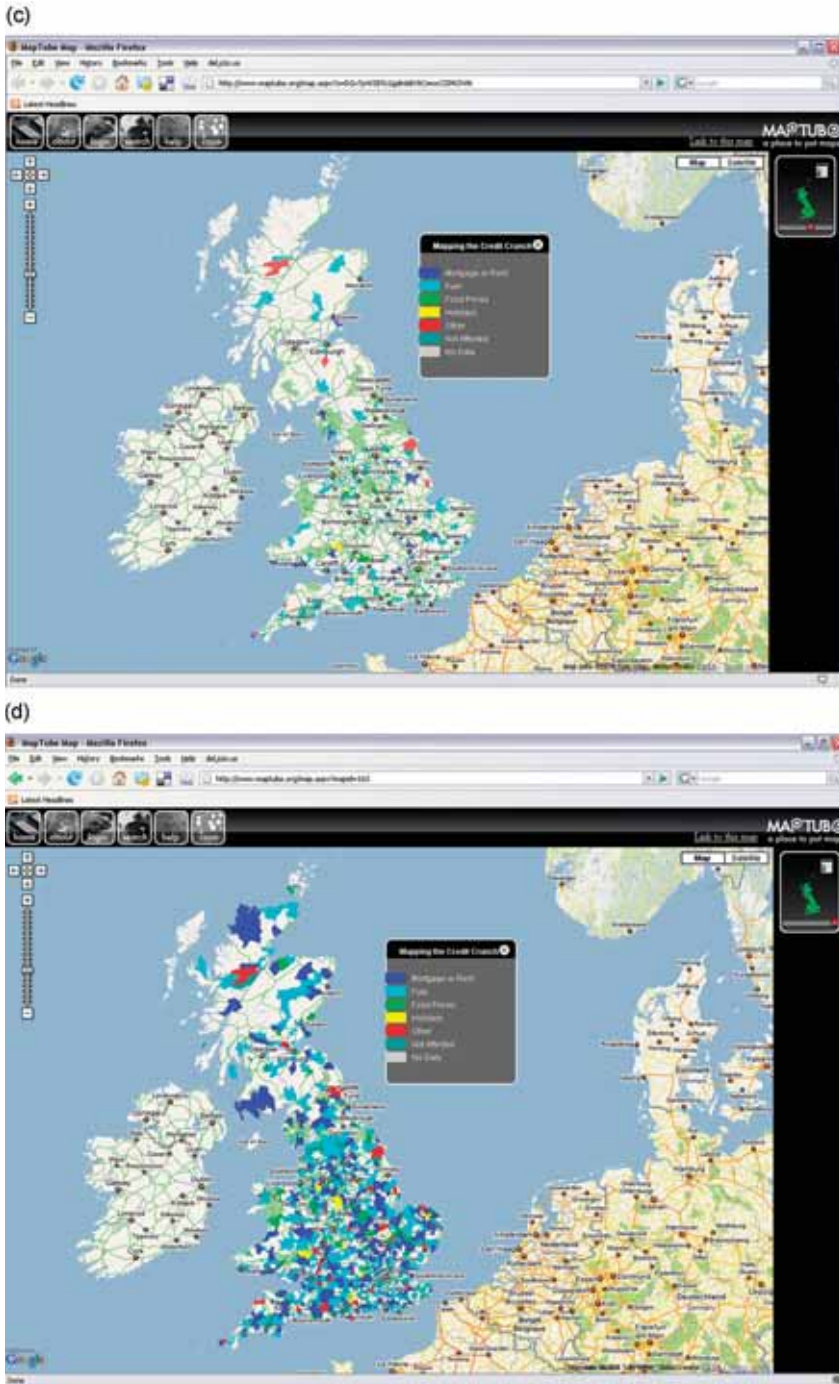


Figure 7. Continued.

shapefile with GMapCreator running in the background every 30 min to create a new map which was subsequently updated on MapTube as shown in Figure 7(c). Over time, as more participants enter data, the map went from blank to different shades depending what people are worried the most about in the postcode sector as demonstrated in Figure 7(d). Used in conjunction with MapTube, it allows participants and other users to take other information and lay the maps on top of one other. The potential of this approach for gathering spatial data is enormous, as for example, it could be easily used to gather other data such as fear of household burglary, the quality of primary school education, access to local health facilities and so on.

Mapping the Credit Crunch represents one of the first near real-time geographic surveys of a nation's mood. As such the time element is also of importance as each response includes a time stamp allowing the nations mood to be visualised in both time and space. At the time of writing the experiment is ongoing with over 22,000 submissions made over a 10-day period in May 2008. We consider this in many senses to be Web 2.0 and NeoGeography in action.

2.3. Other tools

Both GMapCreator and MapTube provide easy ways for non-expert users to create and disseminate data. However, we have also created several other tools that take advantage of multimedia and spatial location in Web 2.0 technologies and it is to these that we now turn.

2.3.1. Google Earth Creator

Google Earth was developed for non-GIS users and thus the level of functionality is compromised compared to a more traditional web-based GIS (e.g. ArcExplorer), but the ability to navigate and overlay other data sets is vastly increased. Google Earth and other geobrowsers provide a base map on which to overlay, query and zoom in and out of the geographically organised data. It allows anyone to visualise data for free unlike many professional GIS applications and has enormous potential. For example, the MODIS (2008) Active Fire Mapping Program by the US Forest Service provides near real time satellite maps of currently active fires in various map formats including KML.

As with Google Maps, displaying thematic data in Google Earth requires a certain amount of 'hacking'. Google EarthCreator, pencilled for release in the third quarter of 2009, aims to reduce this at the same time providing a more advanced visualisation of data than with Google Maps. Representing geographic data in three dimensions is a step on from GMapCreator. Google EarthCreator is currently being developed based on the same ideas of GMapCreator; it is intended to be a freely available simple toolset to import shapefiles into Google Earth through KML. As with GMapCreator, various datasets (points, lines and polygons) can be uploaded and linked to attributes, as we show in Figure 8 which represents population counts extruded by London boroughs. However as noted in Section 2.1 the use of KML allows others access to data and therefore copyrighted material cannot be freely shared, for example, 3D virtual cities. Our Virtual London model (Batty and Hudson-Smith 2005) at CASA is a case in point, created to inform the public at large

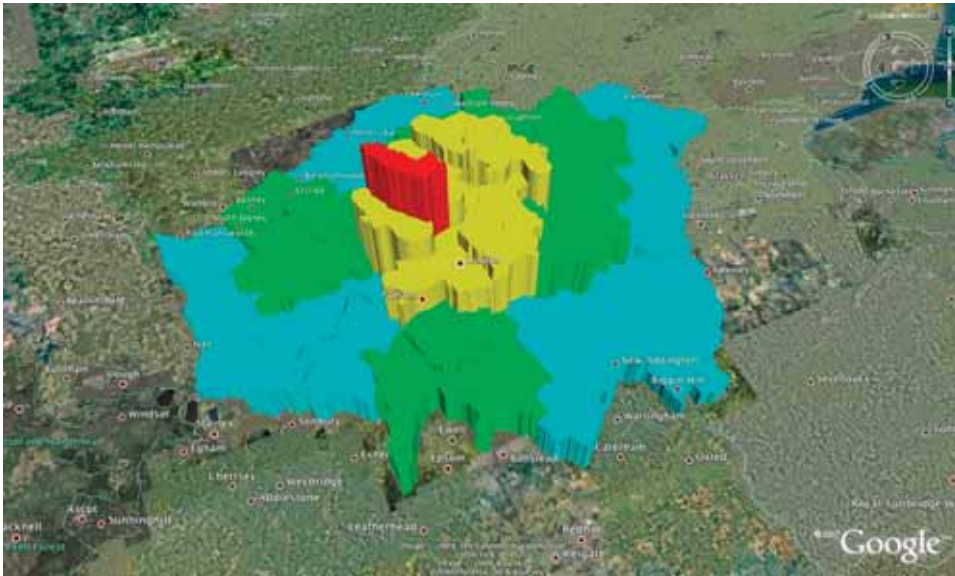


Figure 8. Visualising three-dimensional data of London via Google EarthCreator.

on issues relating to the city using a 3D model but the use of KML is problematic due to copyright issues. As such, Virtual London can be seen as limited to a Web 1.0 environment due to issues over data ownership. This is a common tale, especially when national datasets are involved, and it throws into stark relief the whole motivations for the development of Web 2.0 technologies

The publishing of geographical data from professional packages into any number of online mapping services is an emerging field. Yahoo Maps, Microsoft Live, OpenStreetMap to name but a few, all allow data to be overlaid using various software routes. One such example is a feature in LandSerf (Wood 2007) that allows the user to export a shapefile to a KML and shade the polygons by attribute values, while the Arc2Earth⁵ exports ArcGIS data to view in Google Earth, Google Maps or Virtual Earth. Indeed the professional packages are also playing catch-up by building in KML export direct, for example, the recently released product ArcGIS 9.3 by ESRI.

These packages or extensions can be seen as professional GIS compared to say GMapCreator and Google EarthCreator which are more aimed at the non-expert user or NeoGeographer. Of note in these times of fast moving software which addresses emerging needs, the low-end software often has more functional than their corporate counterparts due to the shorter development times compared with larger packages.

2.3.2. Google Map Image Cutter

While Google EarthCreator uses points, lines and polygons, our next application Google Map Image Cutter⁶ is designed to take any image or digital photo and cut it into a series of smaller tiles (256 by 256 pixels) using a similar quad tree algorithm as in GMapCreator, the tiles then being displayed on a Google Map.



Figure 9. An example of the usage of Google Map Image Cutter to display a classical greek manuscript (Harvard University 2008).

Aimed at distributing gigapixel images in a plug-in free environment, Google Map Image Cutter automatically chooses the depth of the maximum zoom level to correspond with the original size of the image. Using this software tool, large images can be published on the web in a format that allows the user to pan and zoom using the standard Google Maps interface. We illustrate this in Figure 9 where Image Cutter is used to display classical Greek Manuscripts (Harvard University 2008). Although publishing large digital photos is the most obvious application, this technique can also be used for annotated maps of an area that are not to scale, e.g. directions for how to get to the office. While an unexpected use is the visualisation of high-resolution microscope work or Google-oscopy and demonstrates how technologies and applications from different fields can be used together.

At the time of writing the application has been downloaded over 3700 times. While it was produced in essence to distribute images of the city resulting from our gigapixel image research, its use by classical scholars at Harvard and parts of the medical world to share data with one another over the web is of note. With the use of blogs and other online publication systems, our software is able to easily reach an audience much wider than its target market, in our case anyone interested in geography and cities in general. This begs the question whether there are emerging groups of other domains such as neomedical or a neohistorical group of users and so on. This of course is the promise of a Web 2.0 world.

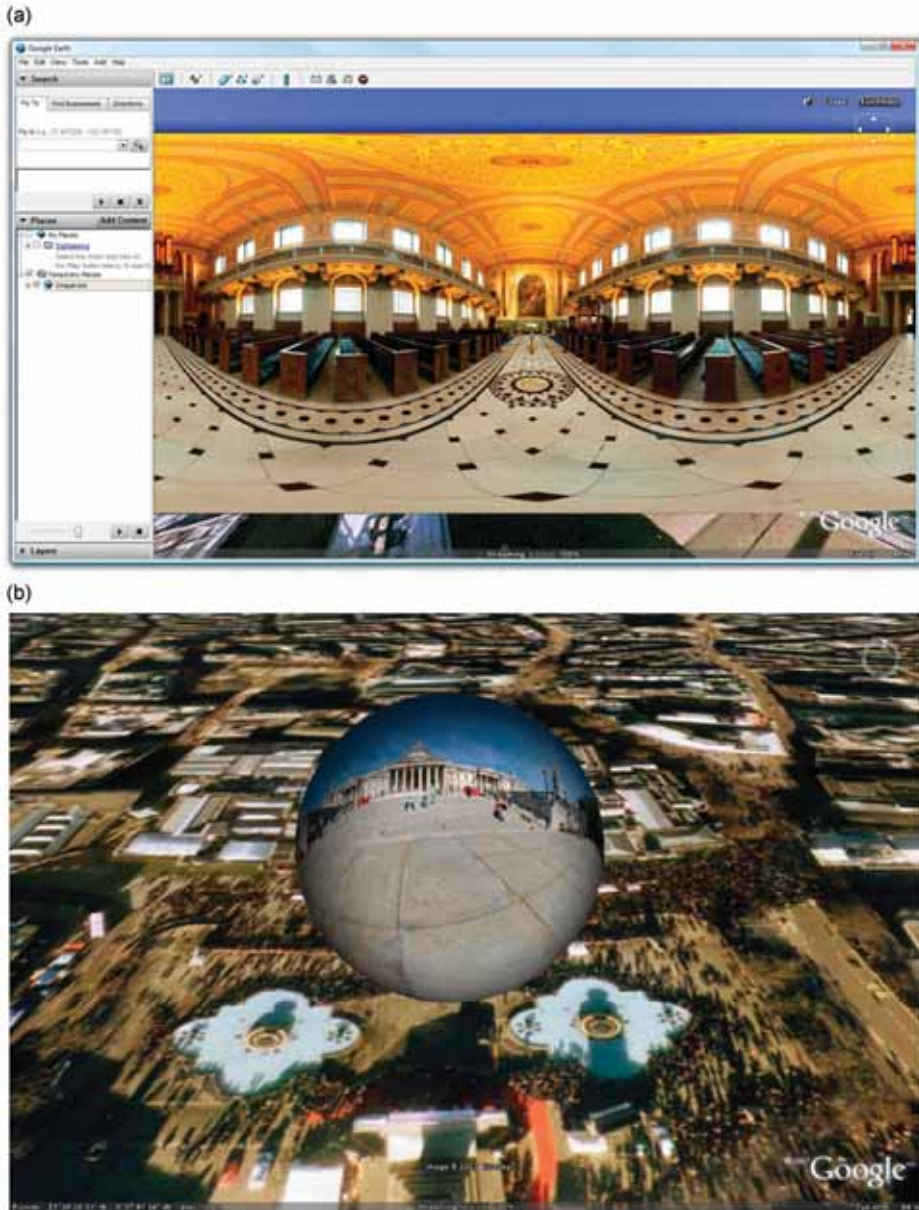


Figure 10. High resolution panorama images within Google Earth. (a) Chapel of St Peter and St Paul in Greenwich, London created using PhotoOverlay Creator; (b) Panoramic sphere of Trafalgar Square, London.

2.3.3. PhotoOverlay Creator

In a similar vein to Image Cutter, PhotoOverlay Creator⁷ has been created to allow high-resolution imagery to be imported into Google Earth, including 360×180 panoramas. Working in a similar manner to GMapCreator, the program tiles the data, in this case images, and creates a KML file ready to place on a server. KML is

simply a file based on the XML language for 3D geospatial data in Google Earth. Just as web browsers display HTML files, Digital Earth browsers such as Google Earth display KML files. PhotoOverlay Creator essentially allows one to place any imagery into Google Earth on a 3D surface and in its correct geo-location as we highlight in Figure 10(a). The ability to embed an image such as a panorama into Google Earth allows an instant sense of location and space.

Furthermore, the use of PhotoOverlay Creator allows one to create panoramic spheres where the panorama is draped onto a sphere in x - y - z three-dimensional space as shown in Figure 10(b). The images are placed on the reverse face of the sphere allowing the user to look inside, while wrapping around a user when the user enters the nodal point of the view, thus providing an exact replica of the human eye's line of sight from that location. These panoramas or 'Urban Spheres' as we call them, are open source files linking to imagery outside Google Earth on sites such as Flickr and this quickly enables us to create a sense of location and place. At the time of writing, PhotoOverlay Creator has been downloaded over 1100 times.

3. NeoLives

Our discussion of Web 2.0 and NeoGeography naturally moves towards immersive digital environments such as Second Life. Second Life and other similar virtual environments are easy to dismiss as pure distraction and entertainment. However, such worlds have a great potential for research (Bainbridge 2007). For example, Second Life has the potential to combine all the aspects of Web 2.0, visualisation and NeoGeography in a single multi-user, 3D collaborative environment where location and place are of utmost importance.

The idea behind virtual worlds like Second Life is to engage a community of users through the web which opens their use to whoever is connected (with obvious limits of membership and censorship). This ability of many to engage and interact is the key feature that defines Web 2.0 where interaction is key and where most interaction is currently achieved through graphical user interfaces (GUIs) (Hudson-Smith *et al.* 2007).

Second Life is but the tip of an iceberg. It represents a glimpse into the future of collaboration and visualisation. Overlapping with systems such as Google Earth and toying with the concept of populated space, within the next few years the predictions are for a 'Second Earth': a merger of Google Earth and Second Life (Roush 2007). Second Earth is in short, an occupied version of Digital Earth. However this will be difficult to achieve in Second Life, for while Second Life is a visual world, it does not collate to cities or places in Google Earth. And nor could it, due to technology constraints (Roush 2007), the lack of gravity, and the ability of its Avatars to fly or teleport to areas. This creates a world whose physics is considerably different to the real world.

Second Life currently represents the most successful social/visual environment on the web and differs from other more game-based systems such as the World of Warcraft, as it does not have any overriding quests or goals. Launched in 2003 with little more than a few kilometres of simulated computer space, it now covers more than 750 km² (Ondrejka 2007).⁸ Created by Linden Labs, the world of Second Life has been created almost in its entirety by its users. For example, residents spend

a total of 23,000 h a day creating things (Hoff 2006) and therefore represent an excellent example of crowd sourcing. The users have created digital geography in its purest geographic sense. The rolling fields, rivers, valleys, mountains, hamlets and towns that occupy the ever growing space have been created piece by piece by the millions of users and every part of Second Life's visual space is editable.

It is free to enter Second Life, chat and begin exploring but if one wants to start 'building' one has to register and purchase land. Many companies, organisations and academic institutions have bought land in Second Life, including IBM, Sony-Ericsson, Oxford University and Nature Publishing, to name but a few, building store fronts or head quarters where their employees' avatars can do business. Our section of land in Second Life can be found on Nature Island (Nature 2008), a plot of land set up by Nature publishing group to encourage scientific research and outreach. Our interest in Second Life is exploring this geographic space and to what extent we can use it as a urban laboratory, exploring issues of urban planning and public debate in a visually collaborative environment. To this extent we are working on three main themes within Second Life. The first is the importation of geographically tagged data including buildings, the second is real time feeds and third is the visualisation of the built environment including building facades and 'step inside' urban spheres, all of which provide a sense of place.

Second Life provides a synchronous platform with the ability to tie information, actions and rules to objects opening the possibility of a true multi-user GIS. We have been working on importing GI into Second Life such as physical terrain data allowing 'table top' models of the earth's physical geography to be viewed and discussed within a collaborative environment. Furthermore, one can import 3D data into Second Life; for example we imported our Virtual London model (Batty and Hudson-Smith 2005) which contains over three million buildings, of which pieces have been laid out onto a scrolling map at a scaled down level. Created around a simple North/South/East/West interface the city has been split up into sections with data loaded as and when required as we show in Figure 11(a). While in the background of Figure 11(a) buildings with facades are directly imported as JPEG's from graphic packages. This shows how different scales can be represented within such an environment from building blocks to 'life' size buildings. The importation of GIS data has a huge potential for the display, quarrying and discussion of data either directly from native GIS formats (e.g. shapefiles) or by creating map boards. For example, Figure 11(b) illustrates a map display for global literacy rates directly linked from MapTube. This ability opens up all sorts of possibilities for importing geographical data into an environment that is ripe for public participation and collaboration-type outreach activities.

While the visualisation and querying of GI is one avenue of research. The acquisition of real time data is also of interest. For this first we experimented with importing an RSS feed running on a text board within our section of Second Nature Island. For example linked to the BBC News feed, updating every 20 s with the latest news as we demonstrate in Figure 11(c). Second, we link near real time feeds to geographic places. For example, in Figure 11(d) we show weather data in Second Life – global maps in our space on Second Nature Island displaying temperature, rainfall, wind speed, barometric pressure and humidity round the world. The global data is updated every 15 min with the data for the UK on the local map updated every 10 s, allowing the 3D visualisation to morph between values.

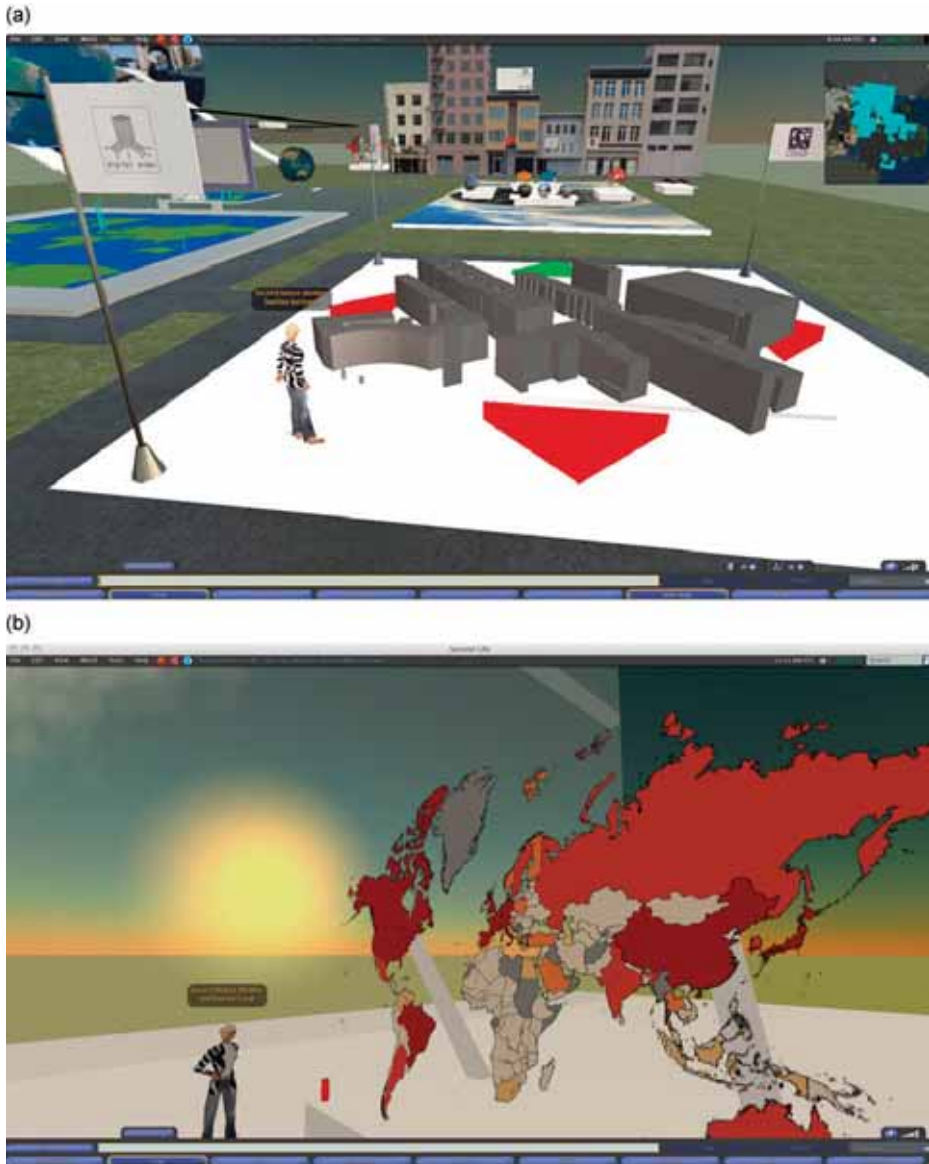


Figure 11. Visualisation of data within Second Life. (a) Importing and visualising virtual cities; (b) visualising GI data; (c) RSS feed running on a text board; (d) real-time weather feeds from around the world.

While the Second Life environment offers a whole host of possibilities, it is still experimental and there is still a major challenge in assembling information coherently and then using it collectively. Another stumbling block revolves around copyright within virtual worlds. For example, Ordnance Survey asked us to remove our London Model from Second Life (Cross 2007). We are currently working on other avenues of research within Second Life. One is to import a live global positioning system (GPS) feed of a tagged person within London onto a scaled



Figure 11. Continued.

avatar on the map with the 3D buildings in theory scrolling and building as the person walks around London in real life. We are also working on tagging information and textures to the facades, allowing perhaps for the first time a public 3D collaborative GIS to be feasible. Furthermore, rule sets can be assigned to

sub-objects allowing for agent-based models to be integrated into the system (e.g. Maher and Merrick 2005).

What we hear you ask is all this for? Second Life provides a rich environment for teaching and learning as for example, in the National Oceanic and Atmospheric Administration's (NOAA) 'Science on a Sphere' which informs the public about how weather, climate change and human disturbance affect our world (Hackathorn 2006). While one of our colleagues is building a tourist information system for Phuket in Thailand using the traditional GIS, planning and decision support which is targeted at decision-makers, planners and tourists themselves. Bringing a great diversity of material together in digital form and co-locating it in a form that resembles the geography of the area is what Second Life offers. Moreover, it provides an easy entry to space which is attractive and interactive from which users can download material and search for related items of information and perhaps this is at the core of the whole concept behind NeoGeography.

4. Discussion

The key to Web 2.0 and NeoGeography is the ability to communicate and share data through simple, freely available tools that can be learnt quickly and effectively without immersion in professional activities. For example, Google's MyMaps makes it possible to create one's own map in a matter of minutes, with points, lines and polygons and to integrate both images and video via either Google Video or YouTube. These themes are complementary to GIS as one of the traditional roles of GIS has been to provide data to support decision making, such as in public debates. In essence, this is key to the success of MapTube in its ability to mix professionally derived GIS information with the NeoGeographers at large. Tools for spatial analysis are increasingly being delivered in a manner suitable for wider consumption,

The growth in geobrowsers and tools to collect and manipulate geographic data demonstrates that a decrease in knowledge is required to create and present geographical information and hint at the potential of geospatial technology to maintain virtual communities and to revolutionise the production, distribution and consumption of media products (Scharl 2007). We are but at the starting point of a NeoGeography and the wealth of information that will come with it. The incorporation of fast network links via WI-FI, 3G and Edge-based services combined with location aware devices is moving NeoGeography away from the desktop and into the field. Indeed, the Nokia N95 mobile phone with its built in GPS, 5 megapixel camera and 3G is perhaps the first true NeoGeography tool. Where once a geographer would pack a map, compass and notepad, the NeoGeographer merely needs a mobile device to explore, navigate, document, capture and log the environment.

Mobile devices, especially mobile phones, are becoming increasingly locationally aware, potentially paving the way for augmented reality and augmented services such as Mediascape,⁹ freely available software released by Hewlett Packard which allows the development of simple location-based information applications. Defined by Sterling (2007) as 'hyperlocal', these devices point to the future of NeoGeography where geo-tagging items, people and objects will simply be common practice. It should be noted that the development of computer graphics, broadband

communication and the widespread access to the internet does provide a digital differential (Longley *et al.* 2008) and coverage tends to be better in cities.

Mashups and virtual globes facilitate in the communication of spatial information between stakeholders and government agencies and as such, mashups provide a low cost and easy to use solution to this as we have shown with the London Profiler. Combining different datasets within cities and overlaying them on aerial photos and maps gives a visual understanding of our built environment. The geographical world has changed. Google, perhaps more than any other company before it, has done more for geography than any other, and it is not even a company with geography at its core business. Geography has merely become a given and with it have risen the tools and applications we have explored.

Applications such as Google's MyMaps or Yahoo Maps allow for the visualisation of the 'where' with the 'what', but with this there is still a need for careful design when creating the maps (Tufte 1990) and it still remains an art. As Gibin *et al.* (2008) note for geovisualisation, the choice of colour scheme for the thematic overlay must avoid tones that can be confounded with the underlying Google map. Placing the thematic map data and putting on the street layer on top allows essential GI to be conveyed along with additional attribute data.

Sites such as Wikimapia or OpenStreetMap allow people to be converted from being passive users to becoming active producers of geospatial information (Sui 2007). However, this rise in personally gathered data, compared to data as we would traditionally view it in large information sets from a central repository, often government-based, raises several concerns, specifically accuracy, privacy and liability with respect to VGI especially when one comes to share such data.

While the number of tools available for the NeoGeographer as highlighted within this article is growing, analytic tools for ESDA such as those that enable brushing and highlighting across a series of maps are still missing. For example, Google Earth has no analytic functions and it is not designed to replace professional GIS software such as ArcGIS Explorer which comes equipped with a series of analytic tools (and which is free for the end-user) that allows users of ArcGIS to publish virtual globes (Butler 2006b).

Google Maps is useful for a data publishing solution, however a 'browse-tool' would be useful. For example, with GMapCreator the pre-rendered data stored makes it possible to publish geographically extensive data on the web but its tile-based architecture as described earlier makes it more suited to browsing rather than interrogating the data. Using pre-rendered tiles it is possible to dynamically overlay different thematic layers and make comparisons manually based on values contained in the raster layer similar to Map Algebra (Tomlin 1990). Boolean comparison of thematic regions from pre-rendered layers can be done as this can be reduced to a pixel operation between map tiles from different sources on the web server based on user-specified criteria. For example, a system has been tested that renders a demographic classification for areas where house prices are greater than a specified threshold. The inputs to this system are two pre-rendered thematic maps built using the GMapCreator with the output a hybrid overlay (CASA 2007). This opens up some interesting possibilities in which people can publish data that may be explored interactively by a large numbers of users.

The applications we have presented within this article lie at the centre of NeoGeography and Web 2.0. They demonstrate the importance of space, place and allow public participation in mapping endeavours. Web 2.0 and innovations like Second Life continue to point the way to a rich and multifaceted info-space with Web 2.0 changing the ways companies work, embracing the consumer, allowing social networks to build content and therefore add value to their systems. In many ways, this combination of ideas, work hours and mass collaborative efforts is like the emergence of a digital frontier, a bottom up model for an interconnected system of relatively simple elements which self organise themselves into a form of intelligent, adaptive behaviour (Johnson 2001).

In essence, we are at the beginning of what will be a revolution in social, visual and informational data plotted geographically by general users. The world of the NeoGeographer is currently mashup, freeware, mobile device and information creation led. The NeoGeographer is in essence a data-logger using the latest technologies and software to collect and share GI. The future is neoinformation, whereby the everyday person uses this collated data simply as part of everyday life. Information is becoming hyperlocal and with it so are we.

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Notes

1. Google Map Creator is available from <http://www.casa.ucl.ac.uk/software/googlemapcreator.asp>.
2. This is at the crux of what distinguishes a NeoGeographer from a GIS professional.
3. More information can be found at <http://www.hesonline.nhs.uk/>.
4. Link to the radio show http://www.bbc.co.uk/blogs/ipm/2008/04/mapping_the_credit_crunch.shtml.
5. <http://www.arc2earth.com/>
6. Google Map Image Cutter is available from <http://www.casa.ucl.ac.uk/software/googlemapimagecutter.asp>.
7. PhotoOverlay Creator is available from <http://www.casa.ucl.ac.uk/software/photooverlaycreator.asp>.
8. Further statistics about Second Life can be found at http://secondlife.com/whatis/economy_stats.php (last accessed 12th May 2008).
9. Mediascape is available at <http://www.hpl.hp.com/mediascapes/>.

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