

# Using Google Maps to collect spatial responses in a survey environment

Nick Bearman<sup>1</sup>, Katy Appleton<sup>1</sup>

<sup>1</sup>School of Environmental Sciences, University of East Anglia, Norwich, NR4 7TJ

Tel. +44 (0)1603 591346 Fax. +44(0)1603 591327

Email. n.bearman@uea.ac.uk, k.appleton@uea.ac.uk, www.nickbearman.me.uk

**ABSTRACT:** This paper examines the use of Google Maps-based tools to collect spatial responses from participants during academic research surveys conducted via the Internet. Using two recent examples from the University of East Anglia it discusses the online survey context and how Google Maps was used, issues surrounding the technical implementation of these tools, processing and use of the collected data, and concludes with considerations for future research that might employ similar methods.

**KEYWORDS:** surveys, spatial data collection, Internet mapping, Google Maps API

## 1. Introduction

Internet surveys are now a common way of gathering data for academic research and although there are caveats about their use in terms of representativeness (Peng, 2001), this paper specifically considers the collection of spatial data responses within a survey, as opposed to the general use of online surveys themselves. In standard HTML forms and third-party (e.g. SurveyMonkey) surveys, responses are usually limited to the selection or ranking of one or more pre-set options and the input of free text. Spatial information, if elicited, is commonly in the form of postcodes or named locations such as towns. Some research applications, however, require more precise spatial information for later GIS analysis. This is generally not catered for within third-party tools, but can be achieved within bespoke surveys by using an Application Programming Interface (API) for an online mapping service such as Google Maps (Google, 2010a). An API is a set of 'building blocks' - tools, data structures and functions - allowing relatively easy programmatic access to and customisation of a web service. This paper outlines two examples from recent research at the University of East Anglia where the Google Maps API (GMAPI) has been used to provide an interface for spatial data input within a survey. It discusses issues related to these two specific implementations, followed by more general considerations about the use of such tools and their implications for academic research.

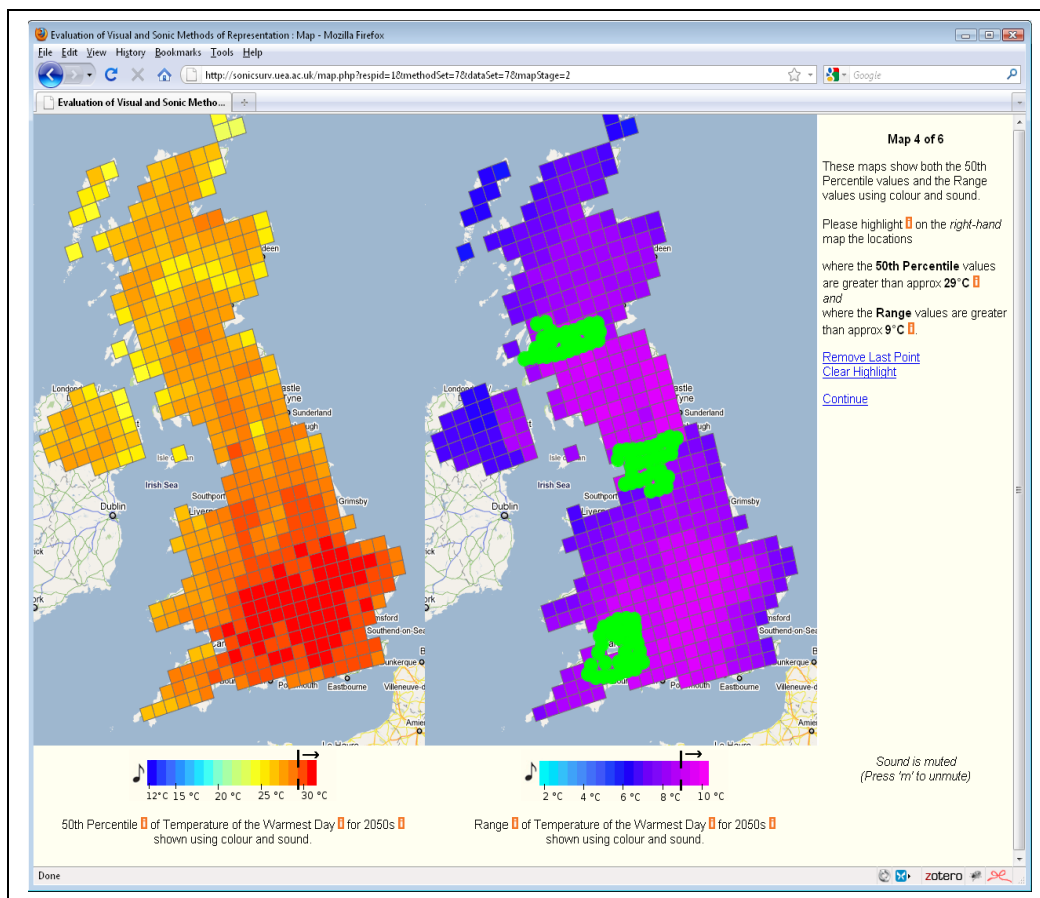
## 2. Case studies

### 2.1 Sonification of uncertainty in spatial data

This case study compared visual and sonic methods of representing uncertainty in spatial data, specifically UK Climate Projections 2009 (UKCP09) data (Jenkins et al., 2009). One way of showing uncertainty information more effectively is to use sound in combination with vision, and this has been addressed from a theoretical and practical point of view (Krygier, 1994; Fisher, 1994). Sonification can be particularly useful to show an extra layer of data, if no more could be added visually without obscuring the underlying data (for more details, see Bearman & Lovett, 2010). Respondents were shown maps overlaid with datasets from the UKCP09 series and asked to highlight areas meeting certain criteria (e.g. exceeding a stated value) using a 'paintbrush type' tool over the Google Maps interface displaying a KML (Keyhole Markup Language (OGC, 2010)) file of the UKCP09 data (Figure 1). The evaluation<sup>1</sup> also had a number of multiple choice questions. All responses were written to a MySQL database.

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<sup>1</sup> Available at: <http://sonicsurv.uea.ac.uk>



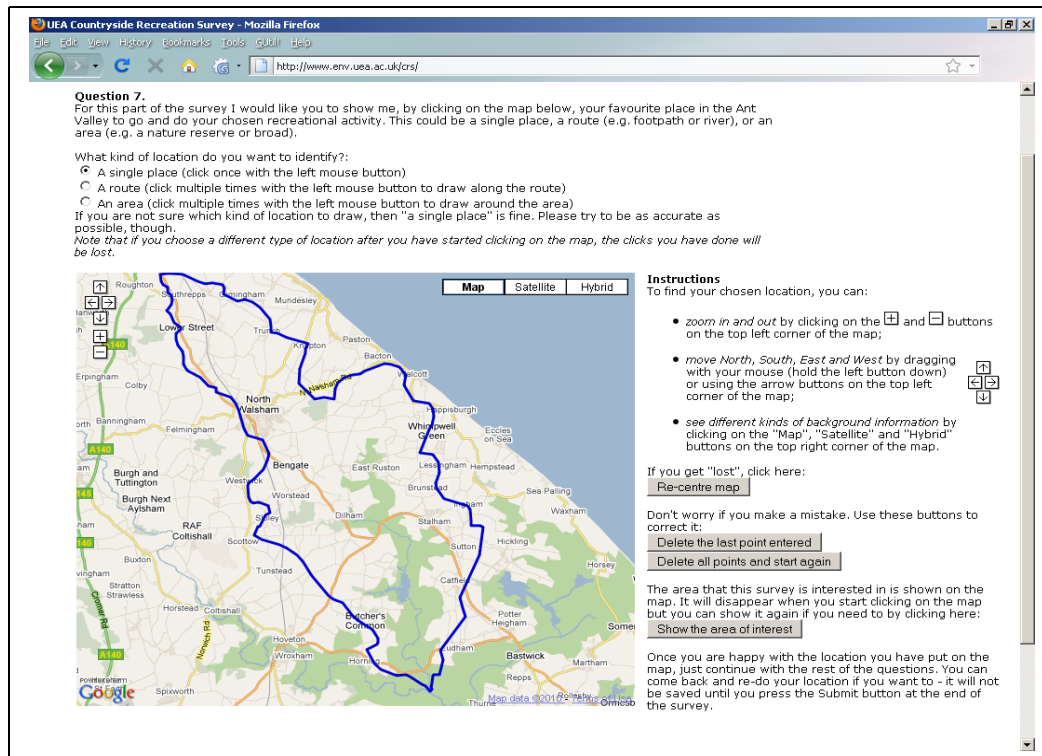
**Figure 1.** Screenshot of Google Maps interface with UKCP09 overlay and an area highlighted. The respondents were not allowed to pan or zoom the map.

An Internet-based approach was chosen due to its simpler software requirements (previous work used ArcGIS 9.2 (Bearman and Lovett, 2010)). Evaluations were mostly run in small groups (6-8 people) and were followed by a discussion session where qualitative data on participants views of the sonification and interface were gathered. Additionally, the survey could be completed remotely, which was particularly useful for users of the UKCP09 data (such as local authority policy-makers), who are geographically dispersed.

## 2.2 Countryside recreation in the Norfolk Broads

This case study investigated locations for countryside recreation in the River Ant catchment of the Norfolk Broads. Participation was invited via email contacts and relevant online forums; 71 responses were received online, plus 66 offline (which are not considered further in this paper). It used a simple form-based questionnaire<sup>2</sup> (employing HTML, PHP and JavaScript) featuring multiple-choice and free-text responses in addition to a map-based question; user responses were written directly to a MySQL database. The map-based question (Figure 2) used GMAPI to request a single point, line or area feature to show the preferred location for a chosen activity. The spatial response was requested in order to allow locations to be identified in detail and analysed alongside existing datasets to investigate the importance of landscape and other factors for user preference. GMAPI was also used on the introductory page, providing a navigable map to illustrate the area of interest. The survey only examined recreation preferences and did not ask respondents to comment on the map interface.

<sup>2</sup> Available at: <http://www.env.uea.ac.uk/crs>



**Figure 2.** Screenshot of Google Maps interface requesting input. The respondents were allowed to pan and zoom the map, and choose the base layer.

### 3. Why use an online survey?

An online survey was used for reasons similar to those discussed by Wherrett (1999). Primarily it was to access a wider population than would be possible from fieldwork alone, particularly in terms of including recreation away from obvious facilities such as visitor centres. Web links are easily distributed via contacts, online forums and social media, and an online survey can also be completed at a convenient time. Finally, the ability to write survey responses directly to a database both saves time and prevents data entry errors.

#### 3.1 Why Google Maps API?

GMAPI was chosen for these case studies largely due to the dominance of Google Maps in online mapping (Ellul et al., 2009; Hitwise, 2010a, 2010b), with the conclusion that this would give the greatest chance of existing user familiarity with the interface and base mapping style. The cartography of the base maps is clearer in many ways than alternatives Bing Maps and Yahoo! Maps (O'Beirne, 2010), both of which also offer an API (Microsoft, 2010; Yahoo!, 2010). The existence of resources to assist with development was the other main motivation for choosing GMAPI; online documentation, tutorials and user forums are more developed than for the alternatives, and experience within the department was also a consideration.

### 4. Related research examples

Google Maps and Google Earth are well-used for presenting spatial information to varied audiences, both in an official capacity (e.g Brent Council, 2010; Westminster City Council, 2010) and via more informal "mashups" (e.g. MapTube 2010; Google Maps Mania 2010). They are also used to collect spatial information for re-presentation on the same online mapping base, i.e. Volunteered Geographic Information (see Goodchild 2007; Heipke, 2010). However, a literature search has not revealed other

work that has, as part of a questionnaire, specifically requested (and used in later GIS analysis) the sort of precise spatial information gathered in the two case studies. Ellul et al. (2009) report on a community mapping website requesting and sharing user-entered spatial data; storage methods do allow future GIS analysis of that data, but such work is not the project's focus. Rosser (2010) used GMAPI within a Facebook application to gather data on vernacular areas, extending earlier work on capturing fuzzy areas (Evans & Waters, 2008) using raster data. This paper, contrastingly, focuses on the input of more definite (vector) location data.

## **5. Discussion - use of Google Maps API within the case studies**

### **5.1 Setting up the survey - design/coding**

Neither of the authors had a great deal of coding experience and extensive use was made of online resources to make the maps look and behave as desired. The recreation survey's spatial question was implemented based upon two tutorials covering the creation of a digitiser function using GMAPI v2, and interfacing GM with a MySQL database (Google, 2010b, 2010c respectively), with additional assistance from the Google Groups help forum. The sonification survey used the same examples as a starting point, moving to v3 of the GMAPI and utilising Flash to handle the sound (Ribeiro Amigo, 2006).

In general, learning to use the API for these applications was not significantly complicated, but did require additional time. Some problems were encountered, such as combining code from different versions of the API and ensuring browser compatibility (see below), but these were largely resolved through online resources. On the whole, coding a robust and user-friendly survey took longer than anticipated in both case studies; while this was not solely due to GMAPI, the additional consideration of creating a clear, map interface that would elicit the required information did add to the time taken.

### **5.2 Compatibility and reliability**

Both case studies were developed in Firefox 3.5/3.6. Wider compatibility with other browsers was important for the recreation case study, and Internet Explorer had to be forced to work in compatibility mode. The more complex coding for sonification would have required significantly more work, and since the survey design meant that Firefox was sufficient, further compatibility was not pursued. For larger surveys it would be necessary to test GMAPI implementation using alternative browsers and hardware, to ensure accessibility.

Both case studies were reliant on Google Maps performing as expected when the survey was taken. For example, map tiles may be received slowly or not at all, leaving gaps in the base map or potentially causing the survey to be abandoned – feedback on this issue was not solicited.

The use of any third-party map service is vulnerable to data updates. Visual content may be updated, but perhaps more important is spatial registration, particularly imagery (Goodchild, 2009) – low accuracy could be significant for surveys involving digitising. The GMAPI interface used to customise the interaction with the map may also change. The sonification study suddenly began to display additional, unwanted controls. As many other API users were affected, solutions were available through relevant forums, but this does highlight the issue of relying on a service that may change without notice.

In general, both of the surveys worked well and there were no known major problems with browser compatibility or Google reliability. The most significant impact was when the network connection was disrupted during some of the sonification evaluation sessions causing them to be rescheduled. However this problem can be considered a potential drawback of any online survey methodology.

### **5.3 The maps in use**

In both case studies, information was overlaid on the base map using a KML file. The KML Layer class of GMAPI is perhaps less well developed than other classes, and there were some interaction problems. In the countryside survey clicking on the map to digitise also cleared the study area boundary from the map. This may have been beneficial in removing map clutter while digitising, but for the sonification study the KML needed to remain and so the click had to be handled differently. The documentation was unclear as to whether this behaviour was intended. The sonification data occasionally required a browser refresh to load all KML tiles, but this was less problematic in a supervised survey.

The countryside survey also revealed problems digitising concave polygons: Google Maps interprets mouse clicks within the presumed area of an unfinished polygon as a click on the polygon feature itself, rather than a click on the underlying map, and is unable to retrieve latitude and longitude values. This is believed to be solvable with more complex coding, but time limitations meant that instead an explanatory message and request to click beyond the feature being drawn was implemented, possibly frustrating users.

#### **5.4 Data obtained**

The spatial data obtained from the recreation survey was written to a database table, subsequently imported to ArcGIS as a collection of points, and reconstructed as lines or polygons where necessary. This type of simple output is able to be processed using any of the increasingly available tools for GPS data.

Analysis continued by buffering the point and line features and combining them with the polygons to create a “heat map” showing how many times each area had been digitised. It is clear that there are issues with the accuracy of digitising, which will have implications for the ongoing analysis. Examination of the line data, for example, revealed examples for waterborne activities that were 400m from the river. A useful refinement for any future use of this GMAPI code would be to record which zoom level and base map settings the user chose while digitising. Asking for additional text information (e.g. "riverside walk from X to Y") could provide further support.

The sonification case study stored users' input as individual points in the MySQL database, to be processed later into a surface layer and compared with the ‘correct’ answer. Data collection is ongoing for this case study, and a full analysis will be included in the presentation. Initial analysis showed that using sound to reinforce data shown visually increased participants ability to select the correct area.

#### **5.5 Methodological issues for academic research**

Academic research should be reproducible, and in addition to a standard methodology report, it is natural to include a demonstration of any online surveys used. With any work based on computer technology it is inevitable that at some point the code or files created will no longer work; for example, each major version of GMAPI will only be supported by Google for 3 years after deprecation (Google, 2010d), and browser standards and compatibilities will also develop.

Therefore, as well as a copy of the source code (fully commented), a conceptual representation of the processes involved, such as a flow chart, should be kept, to allow the data collection methods to be replicated with tools that are available in the future. A further possible solution would be to have a video of the working application to show the user experience, including sound in the case of the sonification study.

#### **6. Conclusions**

Google Maps API offers a useful, reasonably accessible (to authors) and familiar (to respondents) way to elicit spatially-referenced responses within research surveys. There are some limitations to the information that can be obtained, and considerations to be made when designing a survey using GMAPI, that require careful thought about the intended use.

Any survey that is to be completed unsupervised needs to be carefully designed. There must be clear instructions and robust error trapping for both the non-spatial and spatial parts of the survey but this may well be more important for map-based input because respondents are likely to be less familiar with providing this type of information. Related to this, there is a need for research into the question of digitising accuracy, and whether this can be improved through on-screen instructions or map interface settings.

Technically, there are unknowns related to the persistence and consistency of the API over time that increase the importance of conceptual documentation of any use of the API within a survey, as well as a reference copy of the final code. However, if use of GMAPI for survey purposes continues to be developed and progress shared, it has the potential to become an accessible and extremely useful tool for research data collection.

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## 9. Biography

Nick Bearman is studying for a PhD at UEA in Environmental Science, researching different methods of representing uncertainty using sound in a variety of spatial data environments. As well as UKCP09 data, these include Ordnance Survey Address Layer 2 and representation of varying uncertainty of future landscape visualisation in a Virtual Reality setting.

Katy Appleton is Research Officer for the SSEVREL (Social Science for the Environment - Virtual Reality Laboratory) facility in the School of Environmental Sciences at UEA. Her

research interests include GIS-based landscape visualisation for environmental communication and decision-making, and multifunctional landscape management.