

# **BASE MAPS FOR VISUALIZING NEOGEOGRAPHY DATA**

ANDREAS ILYO AMUKWAYA

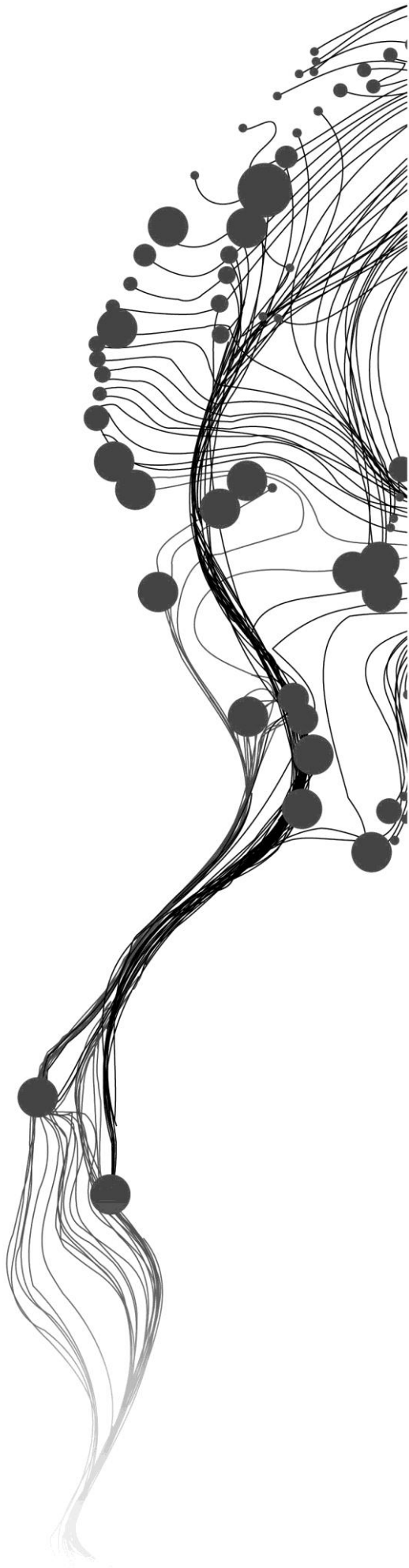
February, 2013

SUPERVISORS:

Dr. C.P.J.M. van Elzaker

Prof. Dr. M.J. Kraak

Mr. T. Das (Advisor)



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**ANDREAS ILYO AMUKWAYA**

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**SUPERVISORS:**

Dr. C.P.J.M. van Elzakker

Prof.Dr. M.J. Kraak

Mr. T. Das (Advisor)

**THESIS ASSESSMENT BOARD:**

Dr. A.A. Voinov (Chair)

Ms Dr. K. Ooms (External Examiner, Ghent University)

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## ABSTRACT

Online base maps are readily and freely available for users to overlay their own neogeography data and create or produce neogeography maps. However, these online base maps were not created specifically for the purpose of neogeography mapping. For a good base map to be created some criteria need to be taken into consideration, such as, the base map should be as simple as possible, should contain only basic layers that help users to localize and that emphasize the overlaid neogeography data, and base map should present a clear visual hierarchy between base layers and the overlaid neogeography theme. Since these base maps were not produced with those criteria in mind, they usually suffer from design (lack of visual hierarchy), content (too much information than needed) and generalization problems. A created inventory for some of the available neogeography maps led to the discovery that Google Maps is the most used base map for neogeography maps. Therefore, an investigation was carried out to find the possibility of adjusting Google Maps and fit it to the purposes of neogeography maps and in accordance with the mentioned criteria. Some tools or solutions such as Google Maps Styled Maps Wizard and Google Maps Colorizr were discovered and used in the adjustment to try and minimize the said problems. A usability test was conducted on the original and adjusted Google Maps to compare their effectiveness, efficiency and usability. The results from the usability test show that most users find it easier to answer posed questions with adjusted Google Maps base maps than with non-adjusted Google Maps base maps.

**Keywords:** Base map, online base map, Google Maps, neogeography map.

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# 1. INTRODUCTION

## 1.1. Background

Maps are abstractions of the reality or simple graphic representations of the earth surface (Dent, 1999). From this definition of a map we can then say that base maps are maps that depict or present the base layers or elements/features of the earth surface. These base features can be roads, buildings, rivers, administrative boundaries as well as relief or elevation of the terrain, just to mention a few. Maps in general have different roles and functions, for example, Kraak & Ormeling (2011) listed orientation and/or navigation, town planning, forecasting, management/storing or monitoring, education and codification as various functions of maps. Depending on their functions, maps are then categorized accordingly. Among these maps there are those that can be used as base maps where other data or thematic information can be overlaid to produce new map products, referred to as thematic maps.

Base maps are very important and useful tools that can be used as backdrops for displaying different sorts of spatial data. Base maps can be defined as maps that are designed to provide geographic context and reference for other layers of thematic information that are overlaid on them, and help to orient the map users as well as "to explain the geographic distribution of the thematic information" (Van Elzakker & Van De Berg, 2010). Topographic maps have long been used as base maps for thematic maps (Van Elzakker & Van De Berg, 2010) and ortho-rectified imageries can also be used as base maps on which thematic information can be overlaid. Of recent, there are online base maps (comparable to the topographic maps of the past) that can be used to create so-called "neogeography maps". Thematic maps have increasingly been produced over the past century and a new boost to thematic mapping has recently been given by neogeography. Google Maps ([URL1-1](#)), OpenStreetMaps (OSM) ([URL1-2](#)), Bing Maps ([URL1-3](#)) and Yahoo! Maps ([URL1-4](#)) are just some of the freely available base maps with which users can mash-up their thematic layers (Figure 1-1, 1-2 and 1-3).

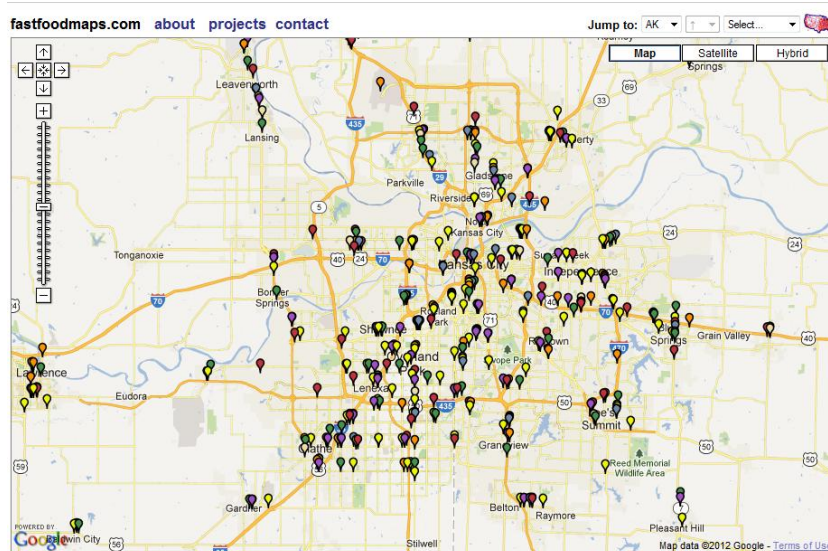


Figure 1-1: Fast-food map on Google Maps ([URL1-5](#))

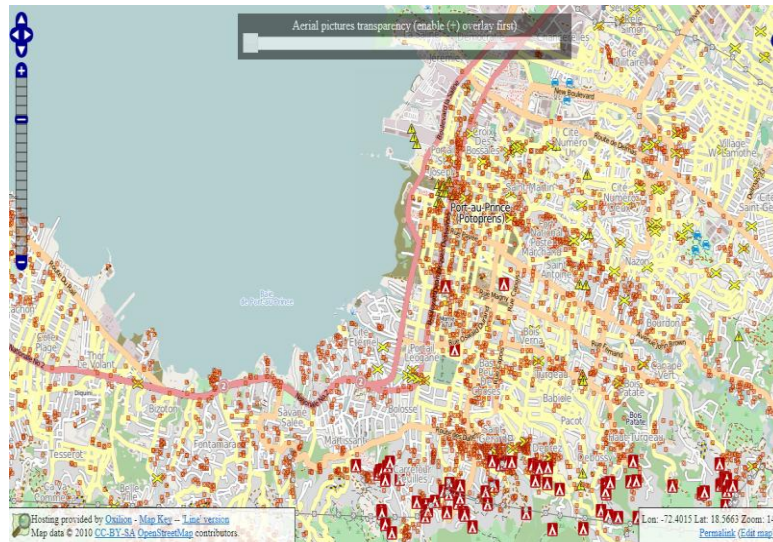


Figure 1-2: Haiti crisis map on OSM (URL1-6)

The term neogeography as defined by Turner (2006) refers to the way people are collecting and using their own data and creating their own maps, without cartographic guidelines and by combining elements of an existing toolset. Das & Kraak (2011) referred to neogeography as “a domain where users make use of geographic information using web 2.0 applications.”

Maps produced according to the above definition are then referred to as neogeography maps (Das & Kraak, 2011), while persons who produce them are being referred to as neogeographers. Neogeography maps are often created through mash-ups (Huang & Gartner, 2012), where user generated geo-content (UGGC) (Das, 2010) is overlaid onto online base maps.

It has been noted that in many thematic maps there is a lack of proper generalization of both the base map layers and thematic layers (Van Elzakker & Van De Berg, 2010). Although, traditionally, the creation of thematic maps was usually a task performed by professional cartographers and/or national mapping agencies, often problems of imbalance between the generalization of the base map and thematic layers are experienced. These problems can be attributed to the fact that the base maps were actually produced for a general purpose and, therefore, they were characterized by a rich and, for thematic mapping, a partly redundant amount of information content. Therefore, overlaying a specific theme could result in cartographic conflicts between the base layer and the primary layer (overlaid theme). The problems are usually observed depending on the level of details of the map (generalization) as well as between base and primary layer symbols, colours and texts. These problems are even more so with neogeography maps that are commonly used nowadays, as neogeography maps are not produced by professional cartographers. Some of the neogeography maps have not much differentiation in symbols, colours and texts of the thematic layer and those of the base layer: this means there is a lack of visual hierarchy as the thematic information should be visually emphasized (Toomanian et al., 2011).

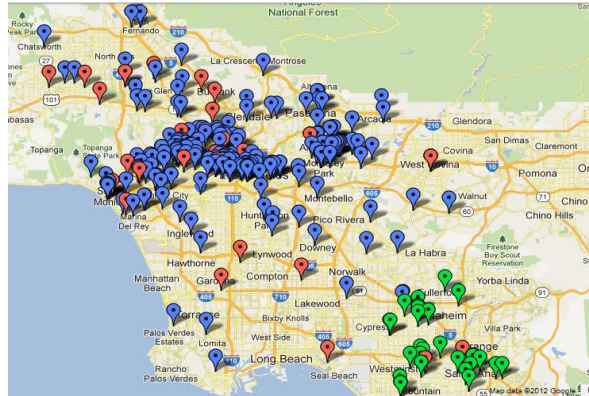


Figure 1-3: Good food restaurant map on Google Maps (URL1-7)

Base maps that are used to create neogeography maps were not specifically made for this application. This means that they also contain a lot of information that may not necessarily be needed (lack of generalization) when displaying neogeography data. Due to the fact that neogeography data are being visualized by non-experts, even more problems in the cartographic design may be experienced than before because of the overlaid thematic information.

The zooming function that is usually present in neogeography maps may also lead to problems of generalization. For example: the step-wise generalization in relation with step-wise zooming in existing online base maps may not be in proper correspondence with the generalization of the thematic information layer. So, designing a base map according to or with a view in mind of the nature of information to be overlaid on it as well as the purpose of the map (Field, 2008; Foerster et al., 2011; Van Elzakker & Van De Berg, 2010) is very crucial for the effectiveness of the neogeography map.

Over the past years, it was not possible or easy to adjust / improve the base map layer(s). However, this trend is changing because there are now tools available that allows users / developers to change / edit map styles. CloudMade Style Editor ([URL1-8](#)), for OSM is one example among the available tools.

In view of the above, it is imperative to look at all those problems and come up with a set of recommendations by which existing base maps can be better utilized for visualizing neogeography data depending on the thematic map purpose and user requirements. It is equally important to look at the possibilities of adjusting or improving existing base map solutions and look at what needs to be improved on the base maps.

Very few other researchers dealt with this or related problems. Van Elzakker & Van De Berg (2010) looked at or investigated the use of topographic base maps for physical planning maps, and suggested that “through a proper generalization and suitable map design, base maps can be adjusted to the purpose and scale of the thematic layers”. Furthermore, Foerster et al. (2011) looked at the technological environment that generates on-demand base maps and developed a user profile which can be applied to generate on-demand base maps (for physical plans), “... but might be tested for multi-source web-based maps”. Cartwright (2008) investigated whether online base maps such as Google Maps can be appropriate and good designs practice to be accepted as base maps. Nowadays, tools are available to deal with the adjustment of base maps styles although they may not be well documented in literatures yet.

A well designed base map should include only the amount of information that will help in communicating the message of the overlaid theme (Dent et al., 2009). So, knowledge of cartographic visualization techniques and the cartographic grammar (Dodge et al., 2008; Kraak & Ormeling, 2009) that can be applied to the base layer is vital for a well designed base map. All design efforts are made to try to improve the effective communication of neogeography maps, as Das & Kraak (2011) put it that “the effectiveness of the map depends on its cartographic design.”

## **1.2. Research problem**

A number of online base maps are available for individual users (neogeographers) and institutions to display or overlay their self-generated spatial information or what is now called neogeography data. However, as such, these base maps are not immediately suitable for an effective and efficient communication of neogeography data, as most of these maps were not specifically designed in view of a neogeography base map purpose.

Displaying thematic information on a general-purpose base map often leads to illegibility of the neogeography map as a whole, as there is too much information (lack of generalization) on the background and the cartographic design does not lead to an appropriate visual hierarchy between the thematic layer and the base map which may hinder the communication of geographic information. Symbol design is another problem where some features on the base map will be obscured by thematic layers (Figure 1-3) and in some cases the colour of symbols (thematic layer) may be too close to colours used on the base map as in the case of the Haiti crisis map (Figure 1-2). This study is therefore to come up with recommendations to users, on how existing base maps can be adjusted in order to function better for neogeography mapping.

## **1.3. Research objective**

The objective of this research is to identify the problems associated with base maps for neogeography maps, suggest possible solutions and make recommendations for the improvement or adjustment of existing base map solutions.

### **1.3.1. Specific research objectives and research questions**

In order to realize the above-mentioned objective, the following specific objectives have to be met by answering their respective questions as indicated in the next sub-section.

- a) To identify the currently available base maps for neogeography mapping.
- b) To determine problems with base maps for neogeography maps.
- c) To determine the suitability of the available base maps to fulfil the purpose of neogeography mapping.
- d) To investigate whether the existing base maps can be improved/adjusted to suit visualization of neogeography data.

**1.3.2. Specific research objectives and their respective research questions**

Specific research objective	Research questions
To identify the currently available base maps for neogeography mapping	a) What base maps are currently available for neogeography mapping?
	b) What are their characteristics?
	c) What are the purposes of neogeography maps?
	d) Are the users satisfied with the current available base map solutions?
To determine problems with base maps for neogeography maps	a) What are the main categories of problems with base maps for neogeography maps?
	b) Are there currently solutions available for those problems?
	c) How can those problems be minimized, improved or eliminated?
To determine the suitability of the available base maps to fulfil the purpose of neogeography mapping	a) What are the criteria to determine the suitability of these maps?
	b) What is the suitability of the available base maps to fulfil the purpose of neogeography mapping?
To investigate whether the existing base maps can be improved/adjusted to suit visualization of neogeography data	a) Can existing base maps be improved or adjusted to suit the visualization of neogeography data?
	b) What could be improved or adjusted?
	c) Are there tools available for improving/adjusting these existing base maps?

Table 1-1: Specific objectives and their corresponding questions

**1.4. Research design**

For the researcher to meet the above-mentioned objective(s) and answer research questions as listed in table 1-1, the following procedures have to be carried out:

- a) Review of related literatures: For the researcher to get acquainted with the previously encountered problems with base maps for thematic maps and neogeography maps, and determine if there are currently available solutions to those problems, literatures related to the topic were reviewed.
- b) Review different existing neogeography maps and existing online base maps: This review was done in order to detect problems with these maps as well as look for possible available solutions. This could also help in discovering which online base maps are currently available for use as base maps for neogeography maps as well as if there are tools that can be used in adjusting existing online base maps to fit the purposes of neogeography maps.
- c) Case study: A case study is done to illustrate or demonstrate problems with existing online base maps and how those problems can be minimized or solved by adjusting the online base map using available tools for base map adjustments.
- d) Usability research: This research is carried out to evaluate the case study results. Neogeography maps with original online base map and another with an adjusted online base map are put to user test to evaluate the maps' effectiveness, efficiency and usability.

### **1.5. Thesis overview**

This thesis is made up of seven chapters that are structured and organized as indicated below:

The first chapter introduces the research topic where its background is given leading into the definition of the research problem. It is also here where the research objectives and questions are given as well as how the research is carried out. Chapter two is the literature review where the researcher looked at maps that are used as base maps for thematic and neogeography mapping and the role they play in that regard. The criteria for a good base map are also discussed here as well as problems and possible solutions as identified and suggested by other researchers. In chapter three an inventory of available neogeography maps and the online base maps they are using was created before going through some of those neogeography maps to identify problems and come up with possible solutions. Chapter four is about the tools and approaches used in the adjustment of online base maps (Google Maps in particular), and then implement some of the suggested solutions with a case study in chapter five. The thesis concludes by evaluating the results of the case study and online survey as well as by presenting sets of recommendations to neogeographers on base map adjustments in chapter six and final recommendations and conclusions in chapter seven.

## 2. OVERVIEW OF BASE MAPS AND NEOGEOGRAPHY

### 2.1. Introduction

One of the map functions as listed by Kraak & Ormeling (2011) is that maps can be used as references to which other data can be related. This is where thematic maps come in. Once thematic information is overlaid to any (topographic) map, then that map can be called a base map. However, for those maps to function and communicate effectively and remain legible after thematic information overlay, some generalization and other adjustment needs to be carried out so as to reduce an amount of information that is not needed from the base map, as well as some design adjustment to enhance visual hierarchy.

Therefore, in this chapter, maps that can be used as base maps for thematic mapping will be the subject of discussion in the next section (section 2.2) where the role of base maps in thematic and neogeography mapping will be highlighted. Before getting to the problems experienced with base maps when thematic information is overlaid on them (section 2.5), we will look at the domain, neogeography, in which neogeography data are being collected and neogeography maps created (section 2.3). The criteria for a good base map are also given to guide in problem finding. The effects that overlaid themes have on base maps and possible ways of rectifying these effects or problems will also be elaborated on as well as looking at how different researchers attempted to come up with solutions to those problems.

### 2.2. Base maps for thematic maps

Base maps for thematic maps, usually topographic maps, have been used long before the introduction of computers and internets. Although one can produce a base map specifically for thematic mapping, most of the base maps used were usually produced for other purposes such as topographic mapping. The production of these maps was a task executed only by professionally trained cartographers. After these new developments (computers and internets), maps are still used for similar purposes but are now available online. The free availability of online maps brought about the ‘freedom of mapping’ where map users started to use those maps to overlay their data or use tags to produce their own maps. Apart from being used as backdrops for thematic information, base maps also have an important role of disseminating geospatial data (Kraak & Brown, 2001). For these reasons, it is important to produce a well designed map taking into considerations cartographic rules (Kraak & Ormeling, 2011). Most of the maps (base maps) were created for a general purpose, which means they can be used for many other purposes like navigation, planning as well as being used as base for thematic maps. According to Dent et al. (2009), the purpose of general purpose maps is to show the heterogeneity of the earth’s features with emphasis placed on location. In Figure 2-1, different maps that can be used as base maps are shown. The two maps below (a & b) can serve as general purpose maps although the topographic map (b) has extra layers such as contour lines and emphasizes some layers/features over the others. For map (a) no layer/feature is emphasized; they all show the same or equal importance.



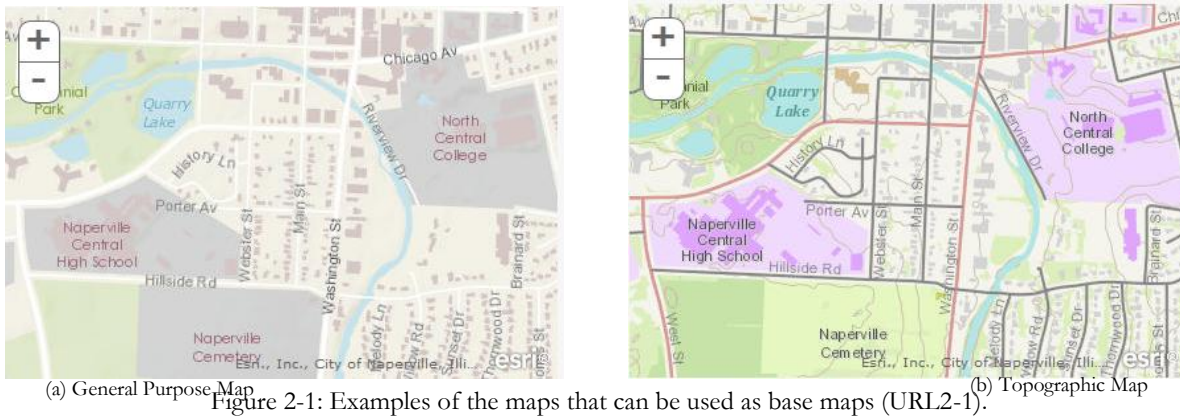


Figure 2-1: Examples of the maps that can be used as base maps (URL2-1).

In thematic mapping, it is crucial to have a base map as a backdrop to provide the following functions (Van Elzakker & Van De Berg, 2010):

- ✓ they allow the map user and map producer to localize the thematic information;
- ✓ they help to explain the geographic distribution of the thematic information.

Reference information in base maps can be used by users/producers who, for example, place points on base maps manually rather than entering coordinates, for they may place symbols (e.g. “markers”) in reference to existing features on base maps. Similarly, with a base maps in the background one can see how far an event or a particular theme is from a specific location, or what the areal coverage is of that theme, as illustrated by Hurricane Sandy’s path (Oct. 2012) in figure 2-2. Depending on the scale of the map or zoom level (level of details), some generalization may need to be done to the base map to fit it to the purpose and scale of the overlaid theme (Van Elzakker & Van De Berg, 2010). In the same vein, the purpose of the map should dictate the visual hierarchy of the layers (Dent, 1999). This will help map users to have more understanding of information being communicated to them by the map. As it can be seen from the map in Figure 2-2, thematic information (as indicated in the legend at the bottom right corner of the figure) is overlaid on top of other features that are part of the base layer. Some of these base map features could have been removed by generalization (if not needed in the map). The map shows a lack of generalization and not much distinction exist between base map features such as water and land. Although the map design is not that good due to similar colours applied to the different thematic layers and nuclear reactor symbols seem to be too big and are covering or overlapping some details of the base layer, it is not that extreme. As a result, the predicted path and the spatial extent of the possible path are still visible and one can see the direction the hurricane may head to and how far it is from the nuclear reactors, which is the purpose of this map.

In a neogeography environment, people are making use of free available online base maps from the web. Most of these online maps are general purpose maps and they can only be called online base maps when thematic information is overlaid on them. Common online maps are maps like Google Maps (URL1-1), OpenStreetMaps (OSM) (URL1-2) and Microsoft Bing Maps (URL1-3), just to mention a few. Unlike the traditional thematic maps that were produced only by professional cartographers and mapping organizations, with online maps it is easy for any individual to mash-up different maps and data from different sources to produce what are known as neogeography maps (Goodchild, 2007).

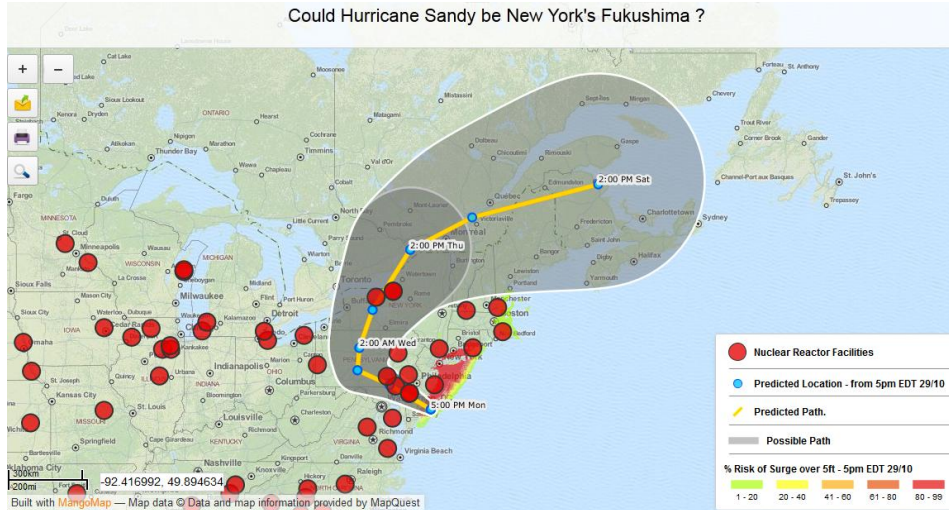


Figure 2-2: Hurricane Sandy's path, October 2012, in US (URL2-2).

### 2.3. Neogeography

Neogeography is a term given to a domain where people are using the freely available online maps, tools and techniques to overlay data themselves, visualize, disseminate and produce their own maps without necessarily following cartographic rules and principles (Hudson-Smith et al., 2009; Turner, 2006). Data used in this domain can be sourced from the cloud, known as crowdsourced data (Heipke, 2010), or collected by users themselves. Different terms like volunteered geographic information (VGI) (Goodchild, 2007), user generated geo-content (UGGC) (Das, 2010) and web mapping 2.0 (Haklay et al., 2008) exist that have also been used to refer to individual user mapping. This type of mapping was made possible after the technological development of web 2.0 (Hudson-Smith et al., 2009; Mlay, 2010). Due to this evolution every user becomes an expert in producing his/her own maps, or simply put, users are now both beneficiary and contributor of geographic information (GI) (Habib et al., 2011). It was noted that web 2.0 is an effective means of information dissemination (Haklay et al., 2008). Therefore, users are taking advantage of this development to publish their information on the web as neogeography maps, geo-tags and/or blogs as shown, for example, in Figure 2-3 where geo-tagged videos on the Gaza conflict are mapped on Google Maps. The background (Google Map) which consists of water, land, roads and some geographic names made up a base map and thematic information (television icons) can be seen at location where videos were geo-tagged. More of the maps produced in neogeography environment can be found in chapter 3.

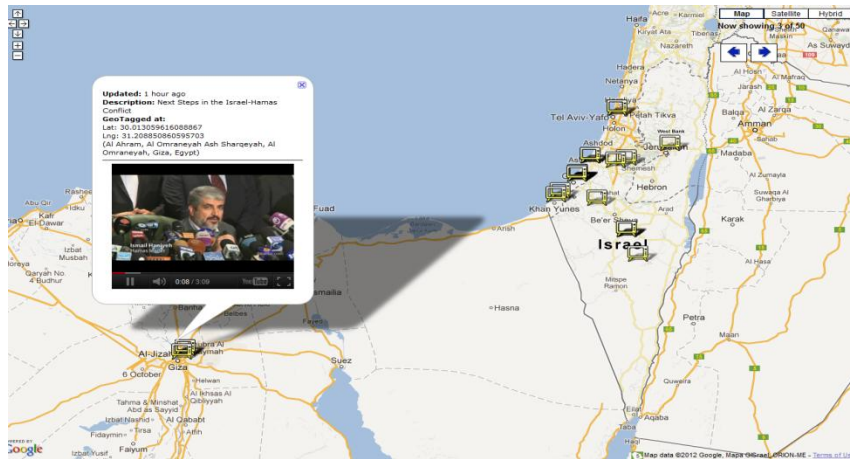


Figure 2-3: Geo-Tagged Videos on Gaza Conflict (URL2-3).

## 2.4. Criteria for base maps for neogeography maps

In the sections above, reference was made to the importance of having a good base map on which neogeography data can be overlaid. A clear distinction must be made between the use of a base map by a producer / contributor who places thematic symbols (like “markers”) on it and the functioning of a base map in a neogeography map that is meant for communicating geographic information to an end-user. Here, we are focusing on the latter role of base maps. In doing so, we may state that not all available online base maps are good base maps for neogeography mapping, although users and producers are making use of them in the absence of better base maps. What are the criteria for a good base map for neogeography map communication? In their research Van Elzakker & Van De Berg (2010), concluded that base map produced for other purposes can be adjusted to the scale and purpose of the thematic layer ‘through a proper generalization and suitable map design’. This conclusion may be translated into the following criteria:

1. A base map should be as simple as possible, i.e. it must not be overcrowded with unnecessary information.
2. A base map should contain (only) basic layers that allow the neogeography map users to localize and explain (Van Elzakker & Van De Berg, 2010) the overlaid neogeography data.
3. A base map should have a level of generalization that is suitable for the overlaid neogeography data. For instance, there should not be big differences between the level of generalization of the base map and the thematic map layer. Otherwise, the end-users may draw conclusions about the neogeography map information.
4. The base map design should be such that a clear visual hierarchy is created between the base map and the overlaid neogeography data layer (Kraak & Ormeling, 2011).

The question now is whether current online base maps can be redesigned or adjusted to fit neogeography mapping purposes and taking into account the above criteria.

## 2.5. Map Redesign

It was mentioned earlier, that base maps were not produced necessarily for the purpose of thematic or neogeography mapping. Therefore, there is always likely to be a problem or conflict (Das et al., 2012) when neogeography data are overlaid, due to information redundancy in the base map. Although original

base maps (on their own without any thematic or neogeography data overlaid on them) do not show much concern, this can change in a blink of an eye the moment a theme is overlaid. Of concern in the neogeography maps is that the scale or level of details of the base map may not be appropriate for the overlaid theme. Hence, there may be a need for a redesign of the base maps. According to (Das et al., 2012), redesigning can be either layer generalization or adjustment in colour and symbology. The lack of difference in colours and symbols (between base and topic layers) will evaporate the visual hierarchy in the neogeography map which leads to failure in communicating information to users and is “visually confusing” (Dent, 1999).

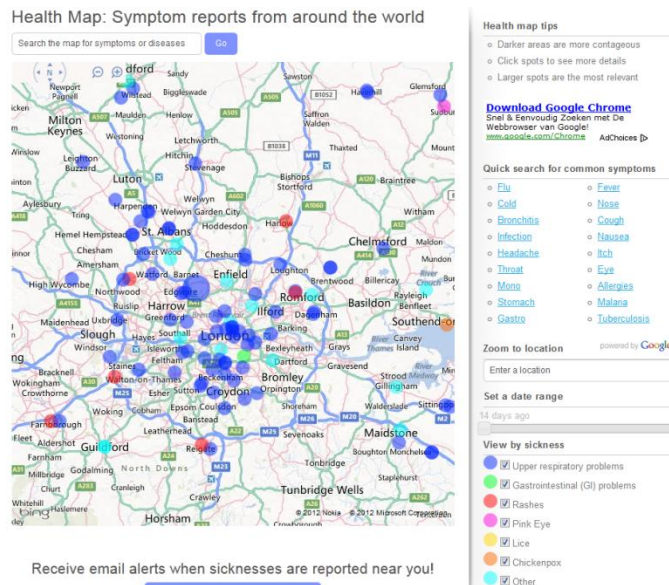


Figure 2-4: Tweet locations about symptom of diseases (URL2-4).

From the map in Figure 2-4 above one can see why there may be a need to redesign the base map. This map is really visually confusing due to the lack of graphical distinctions between the different layers (e.g. both tweet points and roads represented in blue) as well as texts. There is no clear visual hierarchy between base map and thematic information. The texts belong to the base layer and could have been de-emphasized if not removed completely and the colour of roads (they could also be generalized more) should also take second class to the points of the topic layer that need to be emphasized.

### 2.5.1. Generalization

Although most of online base maps have in-built automatic generalization, it may not be a suitable generalization for the purpose of (base map for) neogeography maps. Therefore, further generalization which is dictated by the purpose of the map being created should be applied. This has to be done in order to reduce the amount of original information on base maps that may not be necessarily needed at the scale of that neogeography map. Leaving too much information (than needed) on base maps “will interfere with the communication of the map theme and obscures its message” (Tyner, 1992) and as a result, rendering the map illegible and ineffective. Scale of the map is another issue which necessitates generalization, especially when a map has to be created at reduced scale or viewed at lower zoom level, and scale should also be controlled by the map purpose. Generalization can be applied to both base map layers and topic layer(s) in conjunction.

Generalization is a process of reducing the amount of information or details in a map and it involves different operations such as selection, simplification, enlargement, classification as well as symbolization (Dent, 1999; Kraak & Ormeling, 2011). In general, all maps are generalized from the reality (earth surface) by selecting features that fit the map purpose and can be represented at reduced scale (Tyner, 1992). According to Kraak & Ormeling (2011), cartographic generalization can be done in two ways, being:

- ✓ graphic generalization – which involves simplification, enlargement, merging and selection, and it is done on the geometry of map data;
- ✓ conceptual generalization – involves merging and selection as well as symbolization and enhancement, and this is done to the attribute data (affects the legend)

While both methods reduce complexity of the maps, they keep the spatial properties and attributes of the data (or theme) respectively. During the selection process, one has to select and retain only features that enhance the purpose or message of the map. On the other hand simplification involves smoothing feature(s) or removing excess details while maintaining the original shape of the feature(s). Figure 2-5 shows two maps: (a) the original OpenStreetMap and in (b) a generalization and enhancement as well as symbolization of the original OSM to fit a specific purpose. Of note in map (b) is the pale colour of the general map where most of the landcovers (except forest and parks, in green) are merged by given same colour using the merging operator which can be used to combine or aggregate features that can be represented as one or with similar colour. Roads, especially highways, can also be seen emphasized in map (b). Here, the difference in the amount of information is evident between the two maps and the colours of most layers in map (b) have been de-emphasized.

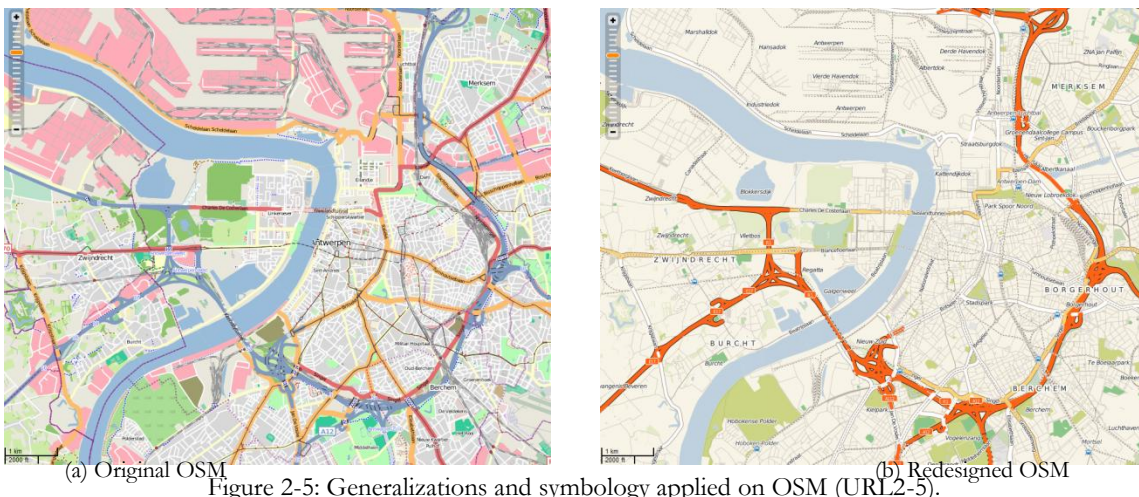


Figure 2-5: Generalizations and symbology applied on OSM (URL 2-5).

### 2.5.2. Colour and symbology adjustment

Most of the base maps have been created with consideration given to the cartographic principles and guidelines. However, when neogeography data/thematic information are overlaid on base maps, there may be an insufficient graphical distinction between the base layers and thematic information (Van Elzakker & Van De Berg, 2010). Therefore, a good contrast should be applied to create a visual hierarchy in the map where thematic information has to stand out followed by base layers that enhance the message of the theme. It can be experienced in Figure 2-6 that (at this level of details) apart from a lack of generalization, the map is also difficult to read and lacks graphical distinctions. It is evident that from the generalization point of view or lack of it thereof, the base map has a lot of streets that may not be needed and the street

names are overlapping with the thematic symbols. One can also witness health facility symbols in the base map which are not only too big, but some of them are even on top of the roads, and their colours are brighter and look more emphasized than those of the thematic symbols. Thematic layer (crisis information) symbols are also big, cluttered and in need of colours that will make them stand out from the base layer. For this particular map however, a case study was done by Das et al. (2012) where they suggest and implement a new design as can be seen in Figure 2-7. From the Das et al. (2012) map, most streets are left out or removed from the base layer, base map was given a few colours that are not dominant only, and thematic information symbols were redesigned (made small and given colours that are making them stand out from the base map).

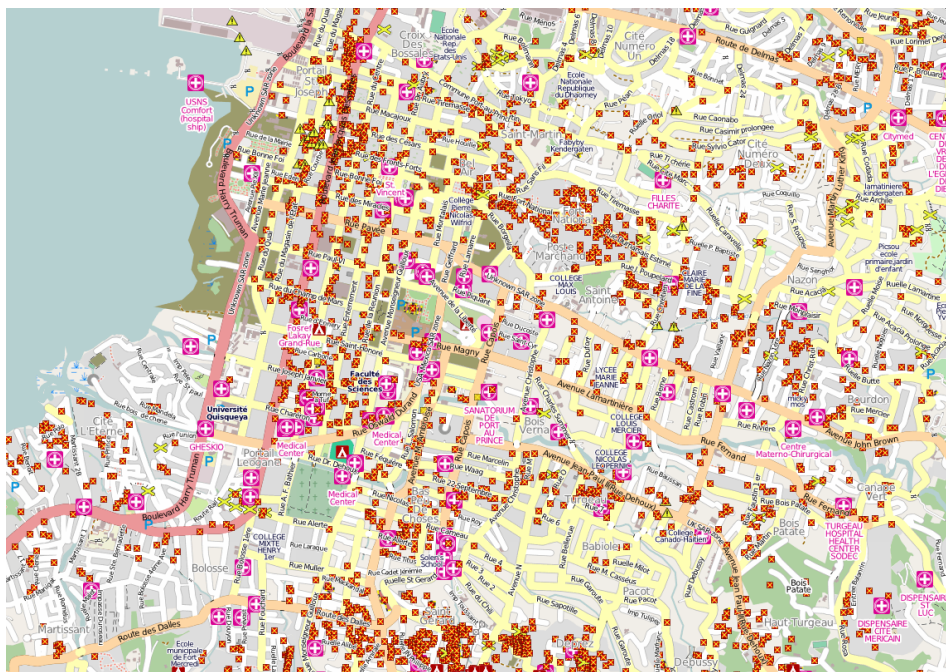


Figure 2-6: A portion of Haiti Crisis Map (URL1-6).

It is expected that when neogeography data are overlaid onto a base map, that neogeography map will still be able to clearly communicate the message in line with the “How do I say what to whom, and is it effective?” concept (Kraak & Ormeling, 2011). However, if no generalization or redesign is made to the base map, it compromises the effectiveness of communication between the map and the map user. For the map to be effective it must have a good cartographic design (Das & Kraak, 2011). Therefore, efforts should be made to improve the effectiveness of neogeography maps.

## 2.6. Suggested solutions

A number of researchers have been trying to solve problems related to the visualization of neogeography data in order for the neogeography maps to be legible and effective in communicating information contained therein. Huang & Gartner (2012) investigated ways of reducing the cluttering of icons of the primary layer. In their research they focus on filtering of irrelevant place of interests (POIs), and icon placement and aggression, so that they can tackle the problem of cluttering of icons. They suggested an integration of techniques and solutions from both cartography and computer science in order to come up with good looking mash-up maps. The other alternative is the use of summarization of neogeography data

by clustering them using clustering algorithms (k-means and DBSCAN) as indicated by Mlay (2010). However this method or technique will have to be visualized well as it creates polygons that may overlap some other information in the base map unless visualized with outlines instead of filled polygons (Mlay, 2010).

On the other hand, in this project the focus is on the base maps and other researchers looked at how improvements can be made to the base layer so that it can be adjusted to be in line with the purpose of the primary layer. In this regard, Van Elzakker & Van De Berg (2010) suggested that using a proper generalization and a suitable map design, base layers can be adjusted to the purpose and scale of the primary layer. They mention that nowadays technology has made it possible for an automatic generation and generalization of base maps which can be done from existing geographic databases, as long as it is done with the purpose of the map use in mind. Further, Foerster et al. (2011) looked at developing a solution for automatic generalization of web base maps, based on the concept of user profiles. Although this was done for base maps for physical planning maps, they suggested that the concept can be tested for other themes that make use of web-based maps.

Last but not least, Das et al. (2012) illustrated conflicts found between base map layers and topic layers as well as between different features of the topic layers. They mention that conflicts can be grouped in three categories being;

- ✓ generalization conflicts – ‘due to a lack of cartographic generalization of neogeography data’
- ✓ design conflicts – ‘due to poor cartographic design’
- ✓ functional conflicts – ‘due to limited functional properties of base maps and topic layers as well as tools in the interface’

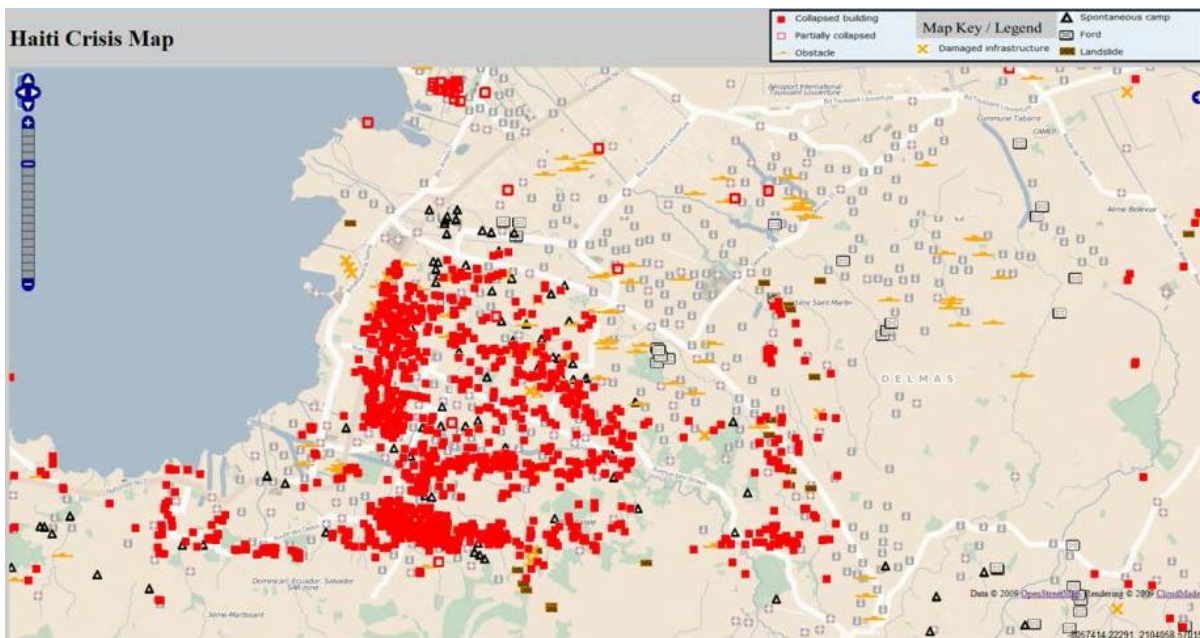


Figure 2-7: Implementation of solution and redesign of Haiti Crisis Map (Das et al., 2012).

For the above mentioned conflicts Das et al. (2012) proposed solutions like guidelines for generalizations, colour coding for the design and adding additional functionalities (e.g. layers on/off switch) to the interface. They (Das et al., 2012) did however mention that “whether these conflicts within neogeography maps are problems depends on the use of such particular neogeography maps”.

## 2.7. Conclusion

In this chapter a brief discussion of base maps in general and online base maps is given. The researcher also looked at neogeography maps as well as at the role of base maps in information dissemination through neogeography maps. Some problems related to the use of base maps that were not produced for purposes they are being used for were talked about. Furthermore, the chapter went through methods that were attempted to solve those problems. A common language in this chapter is that there is a need for generalization of base map layers to match the purpose of the primary layer at a certain scale and/or level of details, and a need for redesign and design of symbology and colours of both base and primary layer to emphasize the visual hierarchy between the layers.

This research will make use of one or a combination of the above methods or solutions to illustrate how they can be used for adjusting online base maps or base layers in order to improve communication and the effectiveness of neogeography maps. A detailed description of how this will be done is not part of this chapter but it is given in chapter four.

It was indicated earlier that a number of neogeography maps that were produced for various purposes are in existence and available online. These neogeography maps are making use of different available base maps as backdrops, and this will be elaborated in the next chapter.





## 3. ONLINE BASE MAPS AND NEOGEOGRAPHY MAPS

### 3.1. Introduction

The evolution of the internet or World Wide Web (WWW) has brought along some easiness to map users and producers alike. Nowadays, maps can be accessed on the web not only for viewing but also for editing, thanks to the development of Web 2.0 as indicated in the previous chapter. A lot of different users are making use of those freely available online base maps and overlay them with their own data to create their neogeography maps that they in turn publish back online whether for their own use or for other people to look at and/or utilise as well.

In this chapter, we will briefly describe online base maps in general and some of the available online base maps that are commonly used in neogeography mapping. We will then look at the characteristics of online base maps (section 3.3) since not all maps can be used as base maps. In section 3.4 we look at the definition of what neogeography maps are and how they were (or how they can be) created. By browsing the internet, it was evident that there are good numbers of available neogeography maps. Therefore, an inventory was created of some of those maps I came across. A brief description of each of these neogeography maps is given as well as the base map used to create each map, plus links (URL's) to where each map can be retrieved. Each neogeography map was created with a purpose, which differs from one map to another. This will be a topic of discussion in section 3.5. Last but not least, the chapter will discuss the problems that are identified in base maps with regard to or in relation to the overlaid neogeography data and in consideration with the criteria for a good base map as set out in the previous chapter.

### 3.2. Online base maps

Online maps referred to in this research are those maps that are found on the web and can be used as base layers where other data can be overlaid to create neogeography maps. Usually, as such these base maps are produced for general purposes and are mainly meant to show the heterogeneity of the earth's features with emphasis placed on locations (Dent et al., 2009). Some of these online base maps come with a switchable base layers option from which users can choose which layer to use as a background. The available layers are usually map(s) (street or topographic) layers, imagery (satellite) layers and hybrid layers (combination of imagery and map data) (Cartwright, 2008). A visualized example of these options can be seen in Figure 3-1 where a map is shown on the left followed by imagery (centre) and then a hybrid to the right.

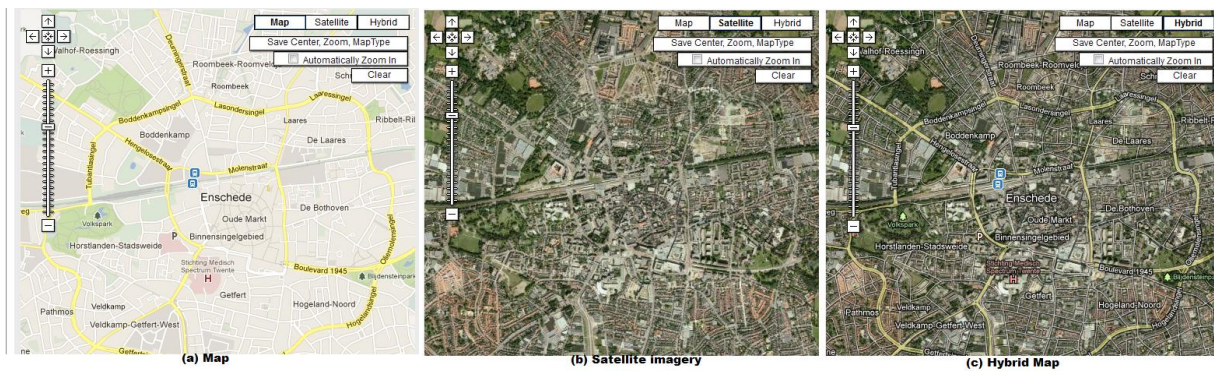


Figure 3-1: Map options available in Google Maps (URL3-1).

Basically, online base maps are created using different methods whereby some are created by extracting features of interest from aerial or satellite imageries, while some are created with data acquired from national mapping agencies (NMAs) and private mapping companies as well as by way of individual contribution. Individual users are contributing by updating or editing places they know and then the contribution can be approved by moderators (like in OSM and Google Map Maker). These base maps are created using different stylesheets and design and this is evident in their appearance or look. In Figure 3-2, the same road is presented with different colours in four different maps from four different “providers”. The same goes for the blue colours given to water that has different tones of blue although they represent the same features in different maps.

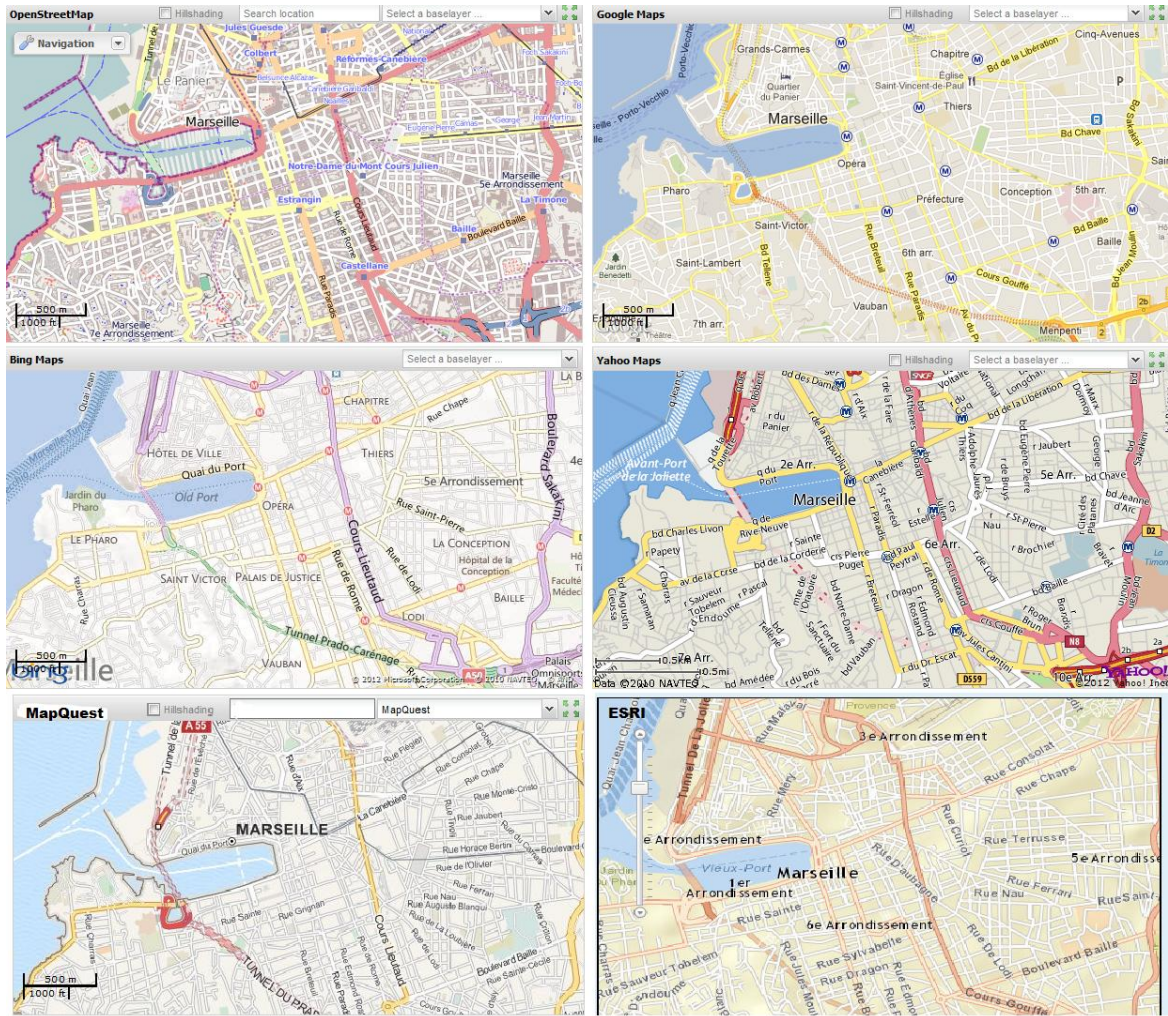


Figure 3-2: Different designs of different online base maps from different providers (URL3-2).

Following below are brief descriptions of some of the available online maps that were discovered during an internet search for neogeography maps. These maps are Bing Maps, Google Maps, OpenStreetMap, Yahoo! Maps, MapQuest and ESRI Maps. The listed maps, apart from being commonly used, all have world coverage of data although the coverage differs from one map to the other as well as from one area to the other. This means, for example, that Bing Maps can have more data coverage in Namibia than Google Maps (see Figure 3-3 and Figure 3-4) but it could be the other way around in other parts of the world. If one look at Figure 3-3 (Bing Maps) one could see two neighbouring towns Oshakati (to the left) and Ongwediva (to the right). The two towns are shown up to street level of details in Figure 3-3 but only the town on the left (Oshakati) is having details up to street level in Google Maps (Figure 3-4).

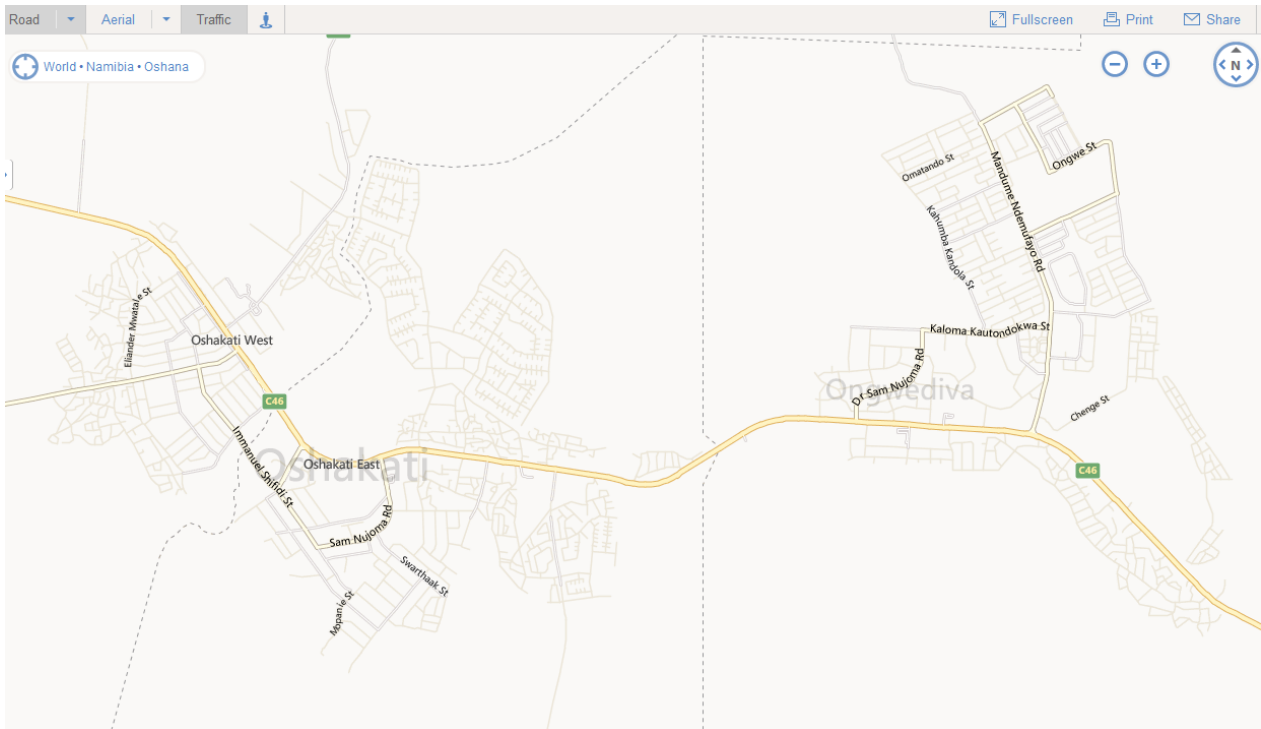


Figure 3-3: Oshakati and Ongwediva towns as shown in Bing Maps (URL1-3).



Figure 3-4: Oshakati and Ongwediva towns as shown in Google Maps (URL1-1).

### 3.2.1. Bing Maps

Bing Maps is an “online mapping service provided by Microsoft, which enables users to search, discover, explore, plan, and share information about specific locations” (URL3-64). Map options available on Bing Maps are street (roads) and aerial imagery that can be viewed at different levels of detail or zoom levels ranging from 0 to 19. An inbuilt automatic generalization makes sure fewer details are displayed at lower zoom level and the level of details changes as zoom level increases. The background of the map is designed with a single colour (white) with only a few landscape features, like water and parks/forest emphasized in blue and green respectively (see middle left map fragment in Figure 3-2). Roads are visualized in a hierarchical way using colour to differentiate them (purple for highway and arterial roads, yellow to pale yellow for major roads and the rest are represented by dark outline to dotted lines). Map data for Bing Maps are provided by Nokia (URL3-68).

### 3.2.2. Google Maps

Google Maps is an online mapping service by Google, which offers “powerful, user-friendly mapping technology and local business information -- including business locations, contact information, and driving directions” (URL3-66). Like most of the other online base maps, Google Maps has an option to switch between street map and satellite imagery. Google Maps also has an inbuilt generalization which regulates the amount of information to be displayed at each zoom level from 0 to 17 although the zoom level can be up to 18, 20 or even 23 depending on the area and data availability (URL3-66). This means at locations where detailed data are available, the higher zoom level you apply the more details will be displayed. Unlike Bing Maps for example, Google Maps has more classified features in its background, giving the map different colours that represent those features and more information in the process (see top right map fragment in Figure 3-2). Although they are getting their data from different national and private mapping companies (URL3-66), individuals can also contribute through Google Map Maker (URL3-69) where users can edit and update the areas they know.

### 3.2.3. OpenStreetMap (OSM)

OSM is a collaborative mapping service that offers users not only the ability to search, discover, explore, plan, and share information about specific locations but also free access and download the data that make up the base map (URL3-70). In fact, one could argue that OSM is also a neogeography map as its data are contributed by volunteers unlike other maps that source their data from national mapping agencies and private mapping companies. With OSM, users can update and edit places they know as well as download the data for other uses. The map has more information content that includes even building outlines, among other features (see top left map fragment in Figure 3-2). This is basically due to the contribution from individual users who update their own places. Although there is a lot of information in the map, the inbuilt automatic generalization makes sure that fewer and detailed information is displayed at lower and higher zoom levels respectively. Available zoom levels are from 0 to 18.

### 3.2.4. Yahoo! Maps

“Yahoo! Maps is a free online mapping portal provided by Yahoo!” (URL3-63). Yahoo! Maps offers also street maps, driving directions as well as search for places of interests (POI). With Yahoo! Maps, users have an option to view a street map, satellite or hybrid map. Since Yahoo! Maps also gets their map data from Nokia (Navteq), Tele Atlas, and public domain sources (URL3-63), the design and style is almost similar to that of Bing Maps (see middle right map fragment in Figure 3-2) but Bing Maps colours are

lighter and it has less texts than Yahoo! Maps. Users can view details with zoom levels ranging from 0 to 19 and the amount of details displayed at each zoom level is regulated by inbuilt automatic generalization.

**3.2.5. MapQuest**

MapQuest (URL3-4) is a free online web mapping service by AOL. It allows users to search locations as well as driving directions and route planning (URL3-3). Like in Bing Maps and Yahoo! Maps, maps in MapQuest are rendered by Nokia (NAVTEQ). Therefore, the design and presentation is merely similar with a difference in colours given to parks areas (see bottom left map fragment in Figure 3-2). MapQuest has also an option for users to contribute by updating and edit in MapQuest Open (URL3-71). Level of details can be viewed by zooming in from levels 0 to 16.

**3.2.6. ESRI Maps**

These are online base maps and reference map services as well as map layers provided by ESRI through ArcGIS online. With ArcGIS one can access the ESRI database and create a new base map from the available layers in the database. Available are base maps such as topographic maps, satellite imagery as well as street maps (see Figure 3-5 and bottom right map fragment in Figure 3-2). Unlike other base maps, as described above, ESRI Maps are not entirely freely available. To be able to use most of their maps and tools, users need to have a licence for one or more of their (ESRI) products such as ArcGIS for Desktop, ArcGIS Explorer and/or Web GIS Applications (URL3-72) to mention just a few. However, this is gradually changing and some data and maps can be freely accessed especially by using ArcGIS Explorer. With this tool (ArcGIS Explorer) users can access ESRI base maps and some data as well as overlaying their own data such as KML files, shape files, GPS files and even geo-tagged photographs. Apart from the possibility of overlaying neogeography data, ArcGIS Explorer is also offering some tools for basic data analysis.

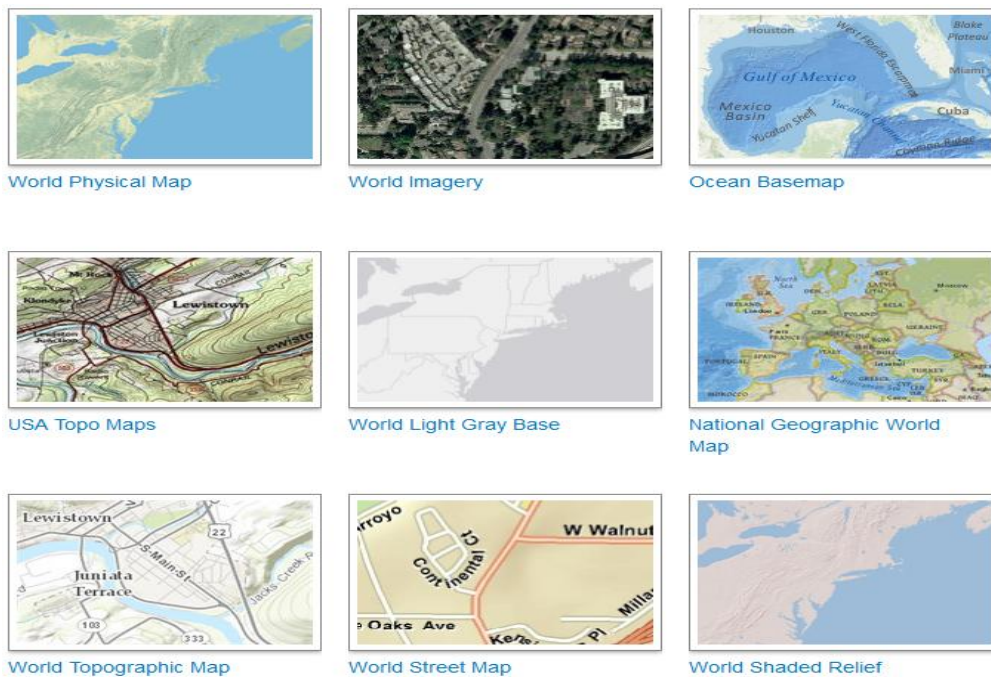


Figure 3-5: Online base maps available from ESRI Maps (URL3-73).

### 3.3. Characteristics of online base maps

All the above mentioned online base maps can be embedded into the users or developers' own web pages who overlay their neogeography data through mashups. There are different application programming interfaces (API's), for each of the mentioned maps, that is making it possible for the base maps to be embedded into different web pages. Examples of these APIs are Bing APIs, Google Maps APIs, Yahoo! Maps APIs as well as the ArcGIS API for JavaScript.

This research did not look deep into data coverage and accuracy of each resource but an overview look gave us the impression that it varies from one map to another depending on the locations (see Figures 3-3 and 3-4 above). Coverage and accuracy of the data aside, the general presentation of the online base maps' design are not the same as each map producer is using their preferred colours in the absence of an established system of colour coding (Das et al., 2012). As indicated in the above sub-sections, these online maps have different zoom levels from one map to another. The levels of details at each zoom level are also different as some maps have more data availability than others depending on the locations. The zoom levels of these maps are not necessarily comparable. This means that, if you display these maps at zoom level 16 for example, you will not get the same amount of information in those maps. Therefore, the choice of which base map to use may be determined by its ease of access and/or easy usage of the API used to embed the map into one's own website as well as coverage.

Those and all online base maps are characterized by (but not limited to) the following characteristics:

- ✓ Online base maps show the basic layers (such as buildings, road networks, rivers as well as administrative boundaries) that are frequently used for location references.
- ✓ Online base maps are not created for a specific purpose, i.e. they serve as general purpose maps.
- ✓ A base map can help to create a geographic meaning for the overlaid theme or neogeography data.
- ✓ Since they are general purpose, online base maps can be used as base map for visualization of different themes / neogeography data.

In other words, the map should also show the geographic names of locations. Furthermore, the base map should be able to help in communicating the overlaid information effectively.

### 3.4. Neogeography maps

We have learnt from the previous chapters that neogeography refers to a domain where people are collecting and using their own GI to create their own maps, on their own terms using web 2.0 applications (Das & Kraak, 2011; Turner, 2006). The maps created by users in a neogeography environment are then referred to as neogeography maps (Das & Kraak, 2011) inheriting the name from the environment they were created in. In Figure 3-5, the words trending on twitter around the world are mapped and visualized in real-time, i.e. once the twit is posted the number of counts of that particular twit are updated in the map. To come up with a neogeography map one needs to have access to online base maps (as described in section 3.2) and make use of available web 2.0 technology. Neogeography maps can be created in different ways, depending on the data and purpose of the map a user is creating. Other examples of neogeography maps are shown in Figure 3-6, where accidents that occurred as a result of television are mapped, as well as in Figure 3-7, with the locations of gas stations in and around New York. Like traditional thematic maps, neogeography maps can show both qualitative and quantitative data as long as there are X, Y or



latitude, longitude attributes associated to them. Neogeography maps are often created as mashups where a user/producer can overlay data of his/her places of interest onto a base map of choice, for example on OSM or Google Maps (Huang & Gartner, 2012). Features of interest are placed on a base map with the help of existing base map features such as roads and buildings or by directly indentifying objects from imagery (in case an aerial photographs or satellite image is used as a background).

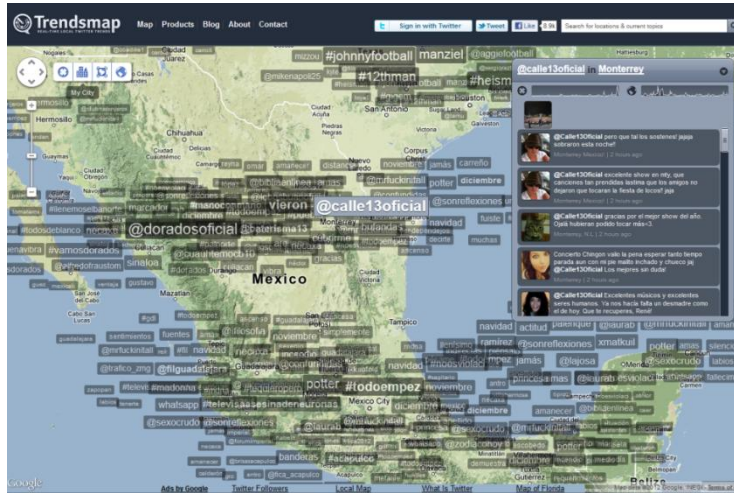


Figure 3-6: Real-time mapping of Twitter trends (URL3-59).

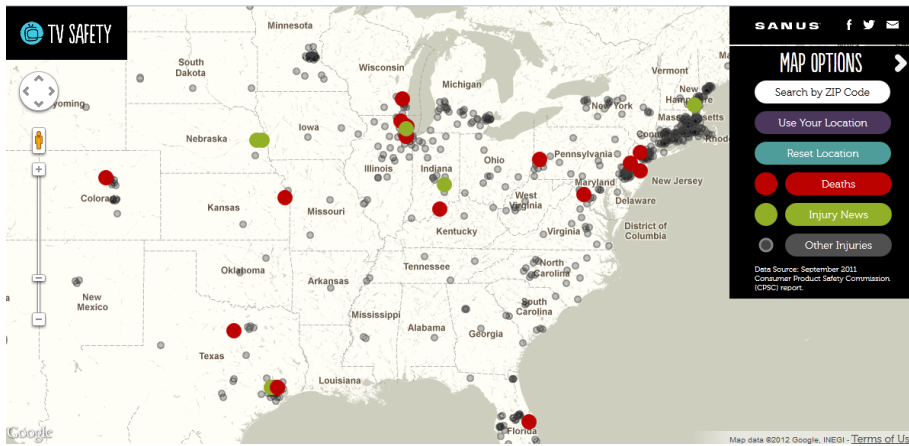


Figure 3-7: Accidents (deaths and injuries) caused by television (URL3-60).



Figure 3-8: Locations of Gas Stations around New York (URL3-61).

Usually, each map is created with or for a particular purpose. The purpose of a neogeography map will also guide the user/producer to choose a base map which is appropriate for the desired map. This will be discussed in the next section, but before discussing the purpose of different maps we will look at some of neogeography maps available from the web as well as the base maps used as background for each map. The following inventory is an adjustment of the one created by Moseme (2012). Added on this list is the column which has the type of online base maps used in created each given neogeography map. Furthermore, neogeography maps with non-functioning URL's (at the time of this research) were removed and new ones were also added. These neogeography maps can be found on the internet and there are especially two sites that documents neogeography maps. Google Maps Mania (URL3-67) is one site where most neogeography maps that uses Google Maps as a base are published and archived. The available maps dated back from 2005 up to the week (if not the day) one is visiting the site (in this case 15/12/2012). Another site is "programmable web" (URL3-62) which, unlike Google Maps Mania, is a host to neogeography maps that uses different online base maps. It is therefore, from the two above mentioned sites that most of the maps in this inventory were taken. The inventory is shown in the table below.

<b>Neogeography Map Name</b>	<b>Use description</b>	<b>Base map</b>	<b>URL</b>
ACTRES Preserve Map	Find areas to hike and explore in NE Indiana	Bing Map	<a href="#">URL3-5</a>
GermTrax	Tracking the spread of sickness and disease via real-time symptom reports from around the world.	Bing Map	<a href="#">URL3-6</a>
Help a Classroom in Need	Shows classrooms that need contributions by the location of the school.	Bing Map	<a href="#">URL3-7</a>
Pakistan Flooding	Crisis map for Pakistan flooding	ESRI + OSM	<a href="#">URL3-8</a>
360 Cities	Sharing photo around the world	Google Map	<a href="#">URL3-9</a>
AmigoMapper	Sharing location live with friends	Google Map	<a href="#">URL3-10</a>
Bambuser	Visualization of most played videos on Bambuser	Google Map	<a href="#">URL3-11</a>
BlueMapia	Sharing sailing tips, videos, photos and comments	Google Map	<a href="#">URL3-12</a>
Buddyway	Sharing GPS tracks and location using cell phones	Google Map	<a href="#">URL3-13</a>
CitySearch Map	Lookup locations of places of interest in USA	Google Map	<a href="#">URL3-14</a>
CliptooMap	Sharing local information with tourists	Google Map	<a href="#">URL3-15</a>
CodexMap	Mapping books	Google Map	<a href="#">URL3-16</a>
Coloci	Sharing trip information on places one plans to visit	Google Map	<a href="#">URL3-17</a>
Did you feel it?	Earthquake reporting in USGS	Google Map	<a href="#">URL3-18</a>
eBird	Collecting and sharing information on the birds to conserve and restore natural ecosystems	Google Map	<a href="#">URL3-19</a>
EvolutionMegaLab	Collection and sharing data on snails	Google Map	<a href="#">URL3-20</a>
F1 Grand Prix Circuit	Visualizing the locations of formula one grand prix circuits worldwide.	Google Map	<a href="#">URL3-21</a>
Fast food maps	Visualizing fast food restaurants in US	Google Map	<a href="#">URL1-5</a>
Fietsrouteplanner	Sharing of bicycle routes in Europe	Google Map	<a href="#">URL3-22</a>
Geo-Wiki	Global land cover validation on Geo-wiki	Google Map	<a href="#">URL3-23</a>
Google Latitude	Sharing current locations with friends on Google Maps	Google Map	<a href="#">URL3-24</a>
Hurricane Katrina	Crisis map of Hurricane Katrina	Google Map	<a href="#">URL3-25</a>
Kathmandu Valley Earthquake	Crisis map of the Kathmandu Valley earthquake	Google Map	<a href="#">URL3-26</a>
London Profiler	Visualizing and sharing of geospatial data in London	Google Map	<a href="#">URL3-27</a>
Louisville Crime Map	Visualizing 90 days crime data for Louisville county	Google Map	<a href="#">URL3-28</a>
Map My Tracks	Mapping routes for running, walking and cycling	Google Map	<a href="#">URL3-29</a>
MapMyRIDE	Sharing of bicycle routes.	Google Map	<a href="#">URL3-30</a>

Mibazaar	Sharing videos for Gaza conflict	Google Map	<a href="#">ULR2-3</a>
Mologogo	Sharing location live with friends	Google Map	<a href="#">ULR3-31</a>
Nature Find	For finding parks, trails and other nature sites.	Google Map	<a href="#">ULR3-32</a>
Nearbyfeed	Sharing information about places nearby restaurants, events	Google Map	<a href="#">ULR3-33</a>
Open Algeria	Sharing with world the political situation in Algeria.	Google Map	<a href="#">ULR3-34</a>
Polska Monitor	Monitoring Poland 2011	Google Map	<a href="#">ULR3-35</a>
Postcode Map -UK	Providing free online postcode maps (as general reference tool), in UK	Google Map	<a href="#">ULR3-36</a>
Syria Tracker	Reporting on the situation in Syria	Google Map	<a href="#">ULR3-37</a>
Tweet Heat map	Create and share heat maps using geospatial data	Google Map	<a href="#">ULR3-38</a>
Washington Voting Map	Reporting problems in Washington voting	Google Map	<a href="#">ULR3-39</a>
WikiMapia	Collection and sharing of geospatial data on WikiMapia	Google Map	<a href="#">ULR3-40</a>
Winery Guide Map	Showing winery locations and information on winery events	Google Map	<a href="#">ULR3-41</a>
WMATA problems	Reporting problems in Washington metro service	Google Map	<a href="#">ULR3-42</a>
Hurricane Sandy Map	Visualizing the predicted path of Hurricane Sandy	MapQuest	<a href="#">ULR2-2</a>
Mapquest Open	Driving route planning and locate nearby place of interest and share with others	MapQuest	<a href="#">ULR3-43</a>
Politicians Salaries	Visualizing politicians salaries worldwide using GDP to salary ratio	MapQuest	<a href="#">ULR3-44</a>
The Flickr World Map	Geotagged photos on Flickr	Yahoo! Map	<a href="#">ULR3-45</a>
1940s New York map	New york neighbourhood in 1940s	OSM	<a href="#">ULR3-46</a>
Cycle Map	Show global cycle routes and information useful to cyclists	OSM	<a href="#">ULR3-47</a>
foursquare	Sharing locations and places of interest.	OSM	<a href="#">ULR3-48</a>
Haiti Crisis Map	Crisis Map for Haiti earthquake	OSM	<a href="#">ULR1-6</a>
Journey Planner	Route planning for cyclists in UK	OSM	<a href="#">ULR3-49</a>
Map Kibera	Visualizing reports in the city of Kibera Nairobi	OSM	<a href="#">ULR3-50</a>
OpenRouteService	Sharing routes (walking, cyclist, motor...)	OSM	<a href="#">ULR3-51</a>
Sudan's Conflicts	Crisis map for Sudan's conflicts	OSM	<a href="#">ULR3-52</a>
Thai Election Results 2011	Visualizing Thailand 2011 election results	OSM	<a href="#">ULR3-53</a>
Sinsai	Crisis map for Japan earthquake	OSM + Bing + Google Map	<a href="#">ULR3-54</a>
Waze	Sharing of traffic information and routes	WAZE Map	<a href="#">ULR3-55</a>
Graigslist Apartment map	Craigslist apartment listings plotted on a map, with answers to real-estate and apartment-related questions for your city.	Yahoo! Map	<a href="#">ULR3-56</a>
RentCompass	Finding apartments for rent in major Canadian cities like Toronto, Ottawa, Edmonton or Vancouver.	Google Map	<a href="#">ULR3-57</a>
Tesco Store locator	Finding Tesco store locations on a Virtual Earth map of the UK.	Bing Map	<a href="#">ULR3-58</a>

Table 3-1: An inventory of neogeography maps and respective base maps (partly based on Moseme (2012)).

### 3.4.1. Most used base map

During the compilation of the inventory (Table 3-1), we have come to realize that there is an imbalanced use of available base maps. Even though we could not list all neogeography maps available on the Internet, the results we have show that Google Maps is being used as a base map for neogeography mapping more than all other base maps. Off the fifty nine (59) maps on the list, thirty six (36) of them used Google Maps while the rest used either one of Bing Maps, Yahoo! Maps, MapQuest, OSM, ESRI

Maps or a combination of different base maps. Perhaps this may not be a surprise in view of the fact that Google Maps Mania (URL3-67) was used as a source for the inventory, but the high number was also backed up by figures for each base map from the “programmable web” website (URL3-62) where Google Maps also proves to be dominant for maps submitted to the site (as of Nov. 2012). In table 3-2 below are the base maps and the number of mashup maps created over respective base maps.

Base Map	Number of Mashup Maps
Google Maps	2420
Bing Maps	175
Yahoo! Maps	135
OSM	15
ESRI Maps	10
MapQuest	10

Table 3-2: Number of mashup maps against respective base maps on the programmable web website (URL3-62).

### 3.4.2. Why Google Maps?

Although Google Maps is used most often as a neogeography base map, there has been no much scientific research (as far as I know) into the reasons why. However, Google Maps “made mapping more visible and made access to base maps more immediate” Cartwright (2008), and this could be one of the reasons. Further, Hsu et al. (2012) mentioned the highly extensibility of the Google Maps API and the way it allows for integration with other databases and servers as reasons to use Google Maps. Other reasons why Google Maps maybe used more often than other base maps for neogeography maps may be:

- ✓ Google Maps was the first to come up with an API that allowed users to embed it into their own web pages.
- ✓ It was well publicized and became popular.
- ✓ It is easy to use the Google Maps API and people became familiar with it.
- ✓ The search engine of Google Maps is user friendly.

According to Field (2008), some people perceived Google Maps as the only available source maps, so, as a result they will recommend to their colleagues (if asked) to make use of the same map.

### 3.5. Purpose of neogeography maps

In general, each map producer has an initial purpose for which s/he wants to create a map and neogeography maps are no exception. Neogeography map purposes differ from one neogeographer to the other, depending on the individual information needs. The different purposes can clearly be experienced when going through the inventory in table 3-1 in the previous section, where one finds maps created for purposes such as information sharing, route planning as well as crisis mapping to mention but a few. According to Moseme (2012), neogeography maps can be categorized according to the purpose they were created for. Following are the purposes as identified by Moseme (2012):

- ✓ Navigation – These maps are created to help users plan their journey in advance from one point to the other. The planned route will be highlighted from point of departure up to the destination point. Real-time traffic flows and cycle routes sharing maps are also falling under this category. WAZE (ULR3-55) is a good example of a real time traffic flow map.

- ✓ Data collection and storage – These maps are created for users to contribute geospatial data, e.g. Google Map Maker (URL3-63).
- ✓ Validation – These are maps that are created for users to contribute by editing and/or updating geographic features that are then validated before being published for the public to use. In this category one can find a map like GeoWiki (URL3-23).
- ✓ Tourism – These maps are created to show mainly places that are of interest to tourists. Tourists themselves can also create these types of maps showing places they have visited, restaurants they have dined in and hotels they have slept in. Example: Fast Food Map (URL1-5).
- ✓ Crises management – During crises maps are created not only for management but also for information sharing, for example where people need relief assistance or showing damaged infrastructures. Among examples of these maps are Sinsai (URL3-54) and Hurricane Sandy (URL2-2).
- ✓ Repository for geographic information – These are the maps that can help users to answer their geographic questions e.g. “Show me all café’s in/near Enschede” or “Where can I find public parks in Hengelo?”
- ✓ Social map – These are maps that are used in social media circles. Users use these maps to share their current locations (e.g. Google Latitude, URL3-24) with friends in their connections or share geotagged photos and videos (e.g. Flickr, URL3-45).

With different map purposes, users and producers should be able to avoid “one size fits all base maps” and use base maps that meet their purpose and the criteria as mentioned above and in section 2.4 respectively. In this way a map with problems, as those discussed in the next section, can be avoided or adjusted accordingly. As an example, Figure 3-9 shows a physical planning map with a topographic map as a base map overlaid with planning information. In this map the base layer is able to compliment the purpose of the map, enabling users to see what features available at a specific planned area (Van Elzakker & Van De Berg, 2010).



Figure 3-9: Example of physical planning map (Van Elzakker & Van De Berg, 2010).

### 3.6. Problems with base maps for neogeography mapping

Looking back at section 2.4, we have learnt that for a particular map to be considered as a base map, it has to meet some criteria. That means, the maps should be as simple as possible, should contain only basic

layers that help to localize and / or explain the thematic layer, and the final map design must present a clear visual hierarchy. It is also important for the base map to have a level of generalization that is suitable to the overlaid theme. A map produced without these criteria will be likely to experience problems when thematic information is overlaid.

It was also indicated that base maps produced without consideration of these criteria are likely to have problems that appear as soon as neogeography data are overlaid on them. This may be due to the fact that the information contained in base maps might be too much since the maps were created for other purposes than neogeography mapping. The following problems (Table 3-3) were encountered by other researchers (Das et al., 2012; Foerster et al., 2011; Van Elzakker & Van De Berg, 2010) and we also experienced them when looking at the neogeography maps for the inventory we have created in table 3-1. Figure 3-10 is showing the locations and distribution of playgrounds in and around Amsterdam. Some problems with this map are that there are too many details (e.g. small roads) that are not necessary at this scale and the purpose of the map which is to show just the distribution. Thus, a lack of generalization can be observed in this map. Another concern are the colours of the roads in yellow and playground symbols (also in yellow) that need to be changed to a different colour which is not conflicting with the other layer. There is no clear visual hierarchy between the base layer and the topic layer.

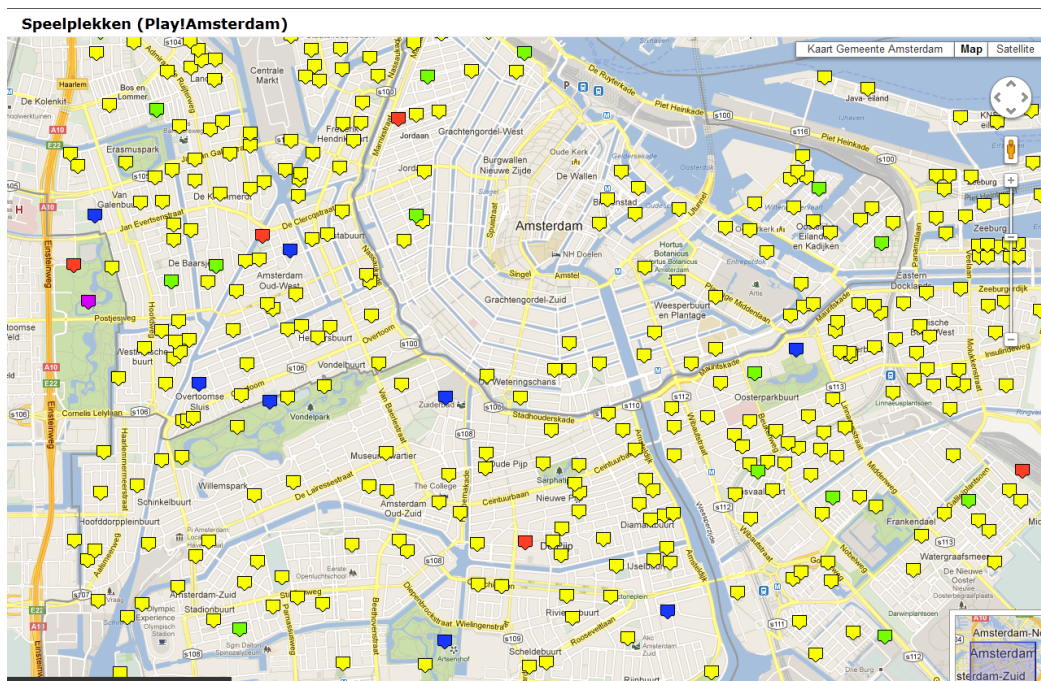


Figure 3-10: Location of Playgrounds around Amsterdam (URL3-65).

The following maps (Figure 3-11 and 3-12) are showing the locations where snails were found. The colour(s) of the pie chart represent different species of snails that are found at that particular location. It is not really possible at the scale or level of details to see what is where as the symbols are too big and covering the content of the base map, e.g. roads and texts (Figure 3-11). Although this is not really a base map problem, but that of the topic layer, the symbols could have scaled so that they are not becoming relatively larger when the map is zoomed out. At this scale, there is no need of having a lot of information in the base map, except for the country boundary to show and help identify which pie falls in which country. The size of the symbols remain the same from the lowest zoom level until at zoom level 11, the

beyond that the size and design changes where the size becomes smaller. In this case, at the current zoom level (Figure 3-11) the symbols are aggregated and as one zoom in or increase the scale of the map, the symbols will be scattered or disaggregated while more information on the base map becomes visible. This occurs due to the inbuilt automatic generalization of base maps where more details appear with the increase in scale or the level of zooming in. For the purpose of showing an overview at the displayed zoom level, Figure 3-11 needs some generalization to remove some of the information in the base layer in addition to better scaling of symbols of the topic layer.

In Figure 3-12 detailed locations of different species of snails are shown. At this scale or zoom level a design problem is evident as there is a lack of visual hierarchy between the roads in yellow and the symbols of the theme. The roads in yellow not only need to be de-emphasized but also to be given a different colour to that of the topic layer. In fact, looking back at the criteria of a good base map in the previous chapter, this base map should have few colours so that the topic layer can be highlighted. For example, the general landscape can be given one colour, parks and forests can remain but with lighter green then water in blue and all roads given grey colour.

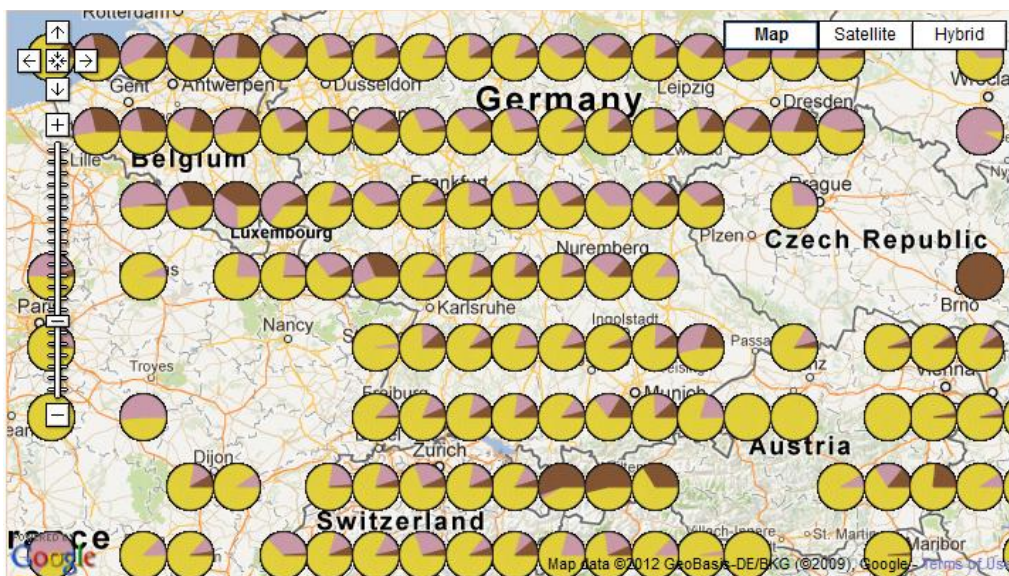


Figure 3-11: An overview of locations of different species of snails (ULR3-20).

In some maps symbols remain fixed in sizes whether the map is zoomed at lower or higher as can be seen in Figure 3-13 (lower zoom level). The map in this figure shows the locations of schools posting requests for help in different needs in United States of America (USA). Again for an overview map, the base map should have contained only state boundaries and remove other layers for legibility of the map.

In Figure 3-14, the icons are overlapping or obscuring texts, roads and road/route numbers although the scale is large. Therefore, redesign is needed to create visual hierarchy between base layer and thematic information, as well as generalization to eliminate some of the text, small roads and other features that are not useful for the map purpose.



Figure 3-12: Detailed locations of different species of snails (ULR3-20).

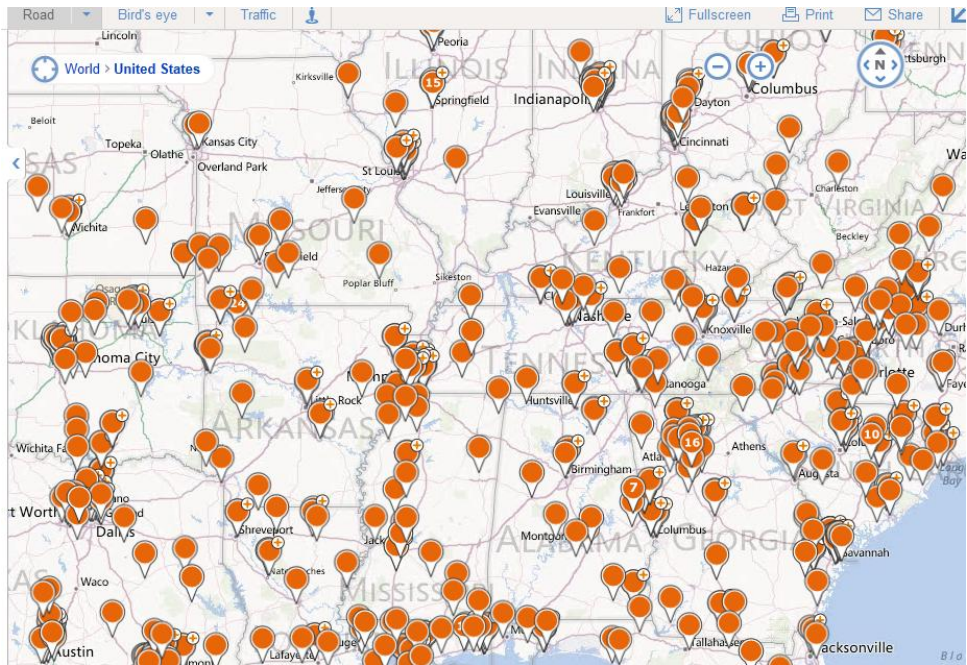


Figure 3-13: Overview of schools at zoom level = 5 (URL3-7).



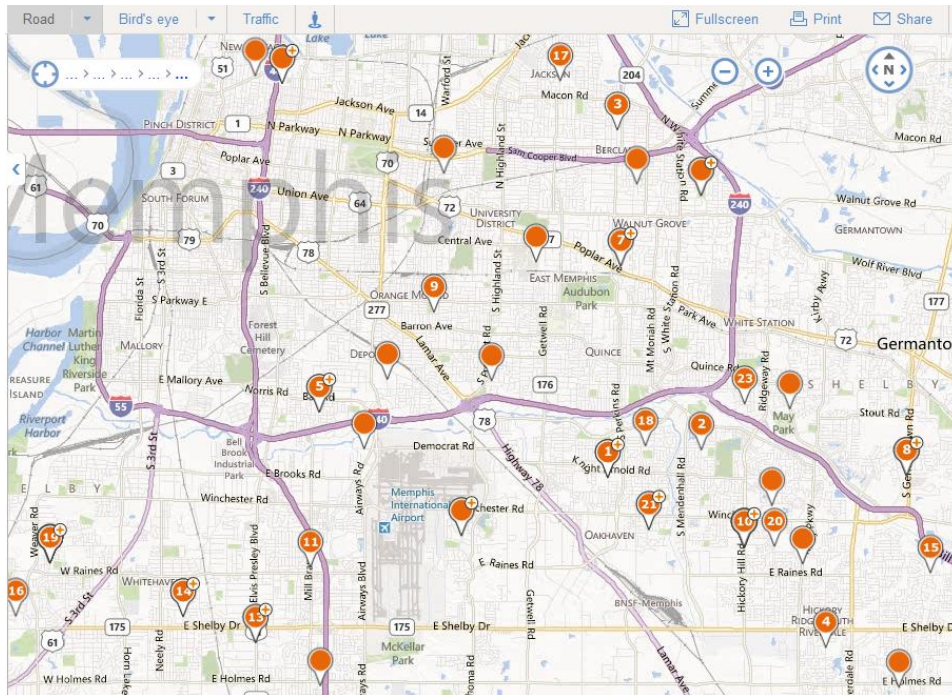


Figure 3-14: A more detailed view of schools at zoom level = 12 (URL3-7).

Basically, three main problems have been identified and an attempt will be made to explore the possibility of adjusting base maps in order to minimise these problems. Problems that were identified from online base maps are tabulated below and proposed or suggested solutions will be discussed in the next chapter (together with the possibility of adjusting base map to minimize them).

Problem	Description
<b>Design</b>	This problem involves the symbolization and colours of map features. Too big symbols and lack of difference in graphics creates a design problem and can lead to visual hierarchy problems where users can get confused as they may not know which feature belongs to the base or topic layer.
<b>Content</b>	If the map has too much information content, then that map will likely not effectively communicate the message of the neogeography map. This is also against the criterion which states that a base map should be as simple as possible, and must contain only information that enhances the purpose of the (base) map.
<b>Generalization</b>	Due to more information than needed in the base map, one will need to remove some of the information. In so doing, over or under generalization must be avoided in order to keep the balance between the base map and the topic layer (s) in accordance with purpose and scale of the map to be created.

Table 3-3: Base map problems and their descriptions.

### **3.7. Conclusion**

This chapter discussed online base maps, highlighting the commonly used ones such as Google Maps, OSM, Yahoo! Maps, Bing Maps as well as ESRI maps and MapQuest. Pointed out also are the characteristics of online base maps, and then turning to neogeography maps. A search of neogeography maps led us to the creation of an inventory of some of the neogeography maps and the base maps they are using. It is indicated in this chapter that Google Maps is the most used as base maps for neogeography maps as indicated by the number of mashup maps submitted on the programmable web site. Highlighted here are also the purposes of neogeography maps as well as problems experienced in base maps when neogeography data are overlaid, and some of the suggested solutions to minimize or eliminate those problems.



## 4. APPROACHES FOR BASE MAPS ADJUSTMENT

### 4.1. Introduction

Google Maps has proved to be the most used base map for neogeography maps, as indicated in the previous chapter. Although it is most used, Google Maps, like other online maps that are normally used as base maps, is not free of problems that are associated with most base maps that are not produced for a purpose of neogeography base maps, overlaid with thematic information. Therefore, based on the criteria for a good base map, we are to find out if Google Maps can be adjusted, so as to minimize the said problems and fit the base map to the purpose of neogeography mapping.

In this chapter, we look at the possibility of adjusting the original Google Maps in order to make them suitable as base maps for neogeography maps and whether there are tools available to make those adjustments. We will also look at what solutions other researchers have suggested for tackling online base map problems. Moreover, we will present the approach that we will use to try and implement solutions to the base maps problems taking into consideration the base map criteria and the purposes of neogeography maps.

### 4.2. Suggested Solutions

Problems with online base maps are not unique to this research as other researchers (Das et al., 2012; Foerster et al., 2011; Van Elzakker & Van De Berg, 2010) identified them in their works before. Suggestions have been given for reducing these problems, for example, to adjust the base map to fit the purpose of the topic layer (Van Elzakker & Van De Berg, 2010) as well as redesigning symbology and colours of the base layer (Das et al., 2012). The table below highlights the type of problem found on most online maps and their respective solutions as suggested by other researchers (Table 4-1).

<b>Problem</b>	<b>Suggested Solution(s)</b>
<b>Design</b>	A use of deemphasized colours for base layers is encouraged and text size should be reduced in accordance with its importance (Das et al., 2012). To improve visual hierarchy, fewer and less strong colours should be assigned to base layers and they should not be similar to those representing the overlaid theme (Das et al., 2012).
<b>Content</b>	Features that are needed at a preferred scale / zoom level and that are not enhancing the topic layer can be eliminated. Some features can also be merged, for example giving a same colour to all landcovers (Das et al., 2012).
<b>Generalization</b>	Base maps can be generalized to fit the purpose of the primary layer and user requirements (Foerster et al., 2011; Van Elzakker & Van De Berg, 2010). Create a base map from existing geographic databases using or choosing layers that enhance the purpose of the neogeography map (Van Elzakker & Van De Berg, 2010).

	Automated generalization on web based topographic databases that can be used for the creation of base maps (Foerster et al., 2011).
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Table 4-1: Identified base map problems against suggested solutions.

### 4.3. Available tools for adjusting online base maps

In search for the solutions to the problems associated with existing base maps for neogeography maps, researchers and/or developers have come up with some tools and APIs that can help users to adjust and change the style of the original map in line with criteria for a good base map and fit them to the purpose of neogeography maps. A brief description for the available tools we came across from the Internet will be given in the next sub-sections. These are tools such as Style Editor, Google Maps API Styled Maps Wizard (Google Maps Style Editor), as well as Google Maps Colorizr.

#### 4.3.1. Style Editor

Style Editor is an online tool which can be used by users and developers to change or customize the styles of the OSM online base maps. Developed by CloudMade (URL4-1), Style Editor can be used to minimize or solve generalization, design and content problems, as the tool lets the user choose which feature should be displayed on the map and how it should appear at different zoom levels (URL1-8). This is a tool that enables users to create their own styles that suit the purpose and scale of their thematic layer(s). However, this tool can only work with OpenStreetMap and/or OpenStreetMap data (URL4-2). Figure 4-1 below shows different styles created by different users and the same area at the same scale. It can be clearly seen that images have different styles where different generalization of the content is applied and emphasis given to different features in different maps. The original map is the original OpenStreetMap design.



Figure 4-1: Different styles applied to OpenStreetMap using Cloudmade Style Editor (URL4-3).

This tool gives more freedom to users when it comes to styling the map in comparison to Google Styled Maps and Colorizr, for example (see sections 4.3.2 and 4.3.3 below). This is in addition to the inbuilt automatic generalization of the base maps. One stand out option for this Style Editor is the ability to set how much data should be visualized at each zoom level. However, its limitation is that it cannot be used for all online base maps but only for OSM. During the implementation of their proposed solutions for

adjusting the ‘Haiti Crisis Map’, Das et al. (2012) used CloudMade Style Editor to adjust the OSM base layer. Since the base map of Haiti Crisis Map was overcrowded with information that was not needed for the purpose of the map and/or at the preferred scale, some features were generalized either by elimination or by merging. The design was improved by assigning fewer and lighter colours to the landscape features and water bodies. These adjustments can be seen in Figure 4-2 where the top map is the original Haiti Crisis Map and the bottom one is the same map as adjusted by Das et al. (2012). It should be noted that in this map the symbology of the thematic layer was adjusted as well. However, in this research we will not be able to use this tool due to the limitation that it can only be used for OSM, but instead, we will look at tools that can be used to adjust Google Maps.

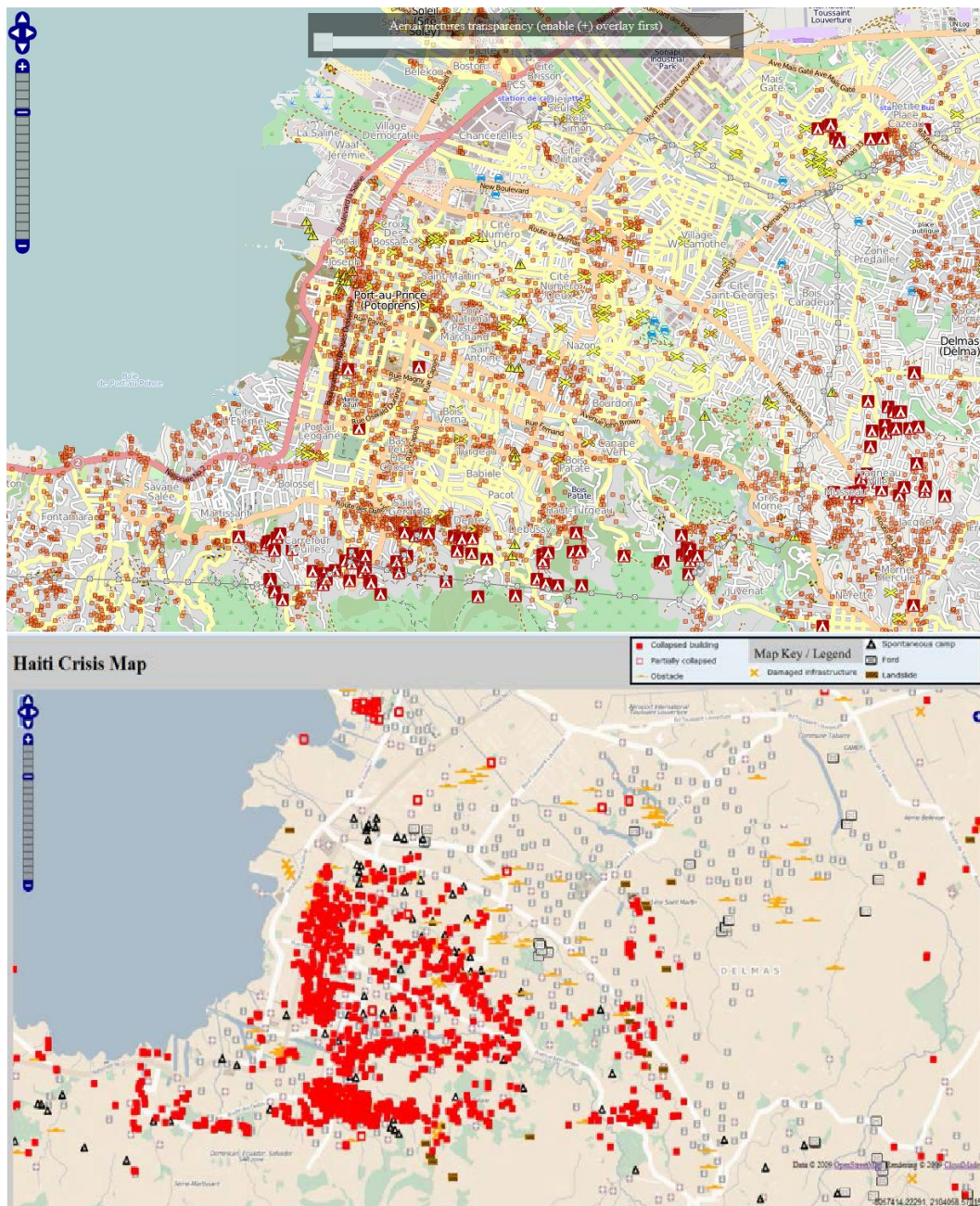


Figure 4-2: Original Haiti Crisis map (top) – (URL1-6) and adjusted Haiti Crisis map (bottom) – (Das et al., 2012).

### 4.3.2. Google Maps API Styled Map Wizard

The Google Maps API Styled Map Wizard (URL1-9) is a tool which can be used by users and developers to change or customize the style of Google Maps to another style that fits the purpose of the neogeography map being created. With this tool, elements in Google Maps can be simplified, switched off/on and assigned colours according to how users want their final map to look like. Two menus can be found on either side of the interface (left and right), and a map overview covering the whole background. The settings can be done on three elements being, feature type (e.g. roads), element type (e.g. road geometry/labels or all) and styles (where one can set the visibility, colours, hue, etc). Visibility has three options to choose from being: on, off as well as simplified. Simplification is a generalization operator which in this tool is used to reduce the width of line features such as roads. These options are found on the “selector” menu on the left side of the interface. The other menu, named “Map Style” is where the code is generated (Figure 4-3).

With this tool one can apply the style to features outline choosing to style only the stroke or the interior fill or both. Figure 4-3 below shows an overview of the wizard interface. Although not all options can be seen from the figure below, a detailed table with all available options is given in table 4-2. This tool compared to Colorizr, has some features that contain sub-categories and sub-subcategories, e.g. category landscape contain man-made and natural, and the natural contain landcover and terrain. Available in Styled Map Wizard’ Stylers and not in Colorizr are options such as “Invert lightness, Weight, Hue, Saturation, Lightness, and Gamma”. Invert lightness if selected will invert the colour of the selected feature (dark to light or vice a versa), Hue indicates the basic colour usually hex codes, Lightness indicates the amount of change in brightness of the colour of the selected element/feature, and Saturation is responsible for the intensity of the colour of the selected element/feature (URL4-8). Available from this tool options also are the fill and stroke of both geometry and labels. The fill applies to the inside colour of the feature or text while stroke apply to the stroke or outline colour of the feature or text (Figure 4-6).

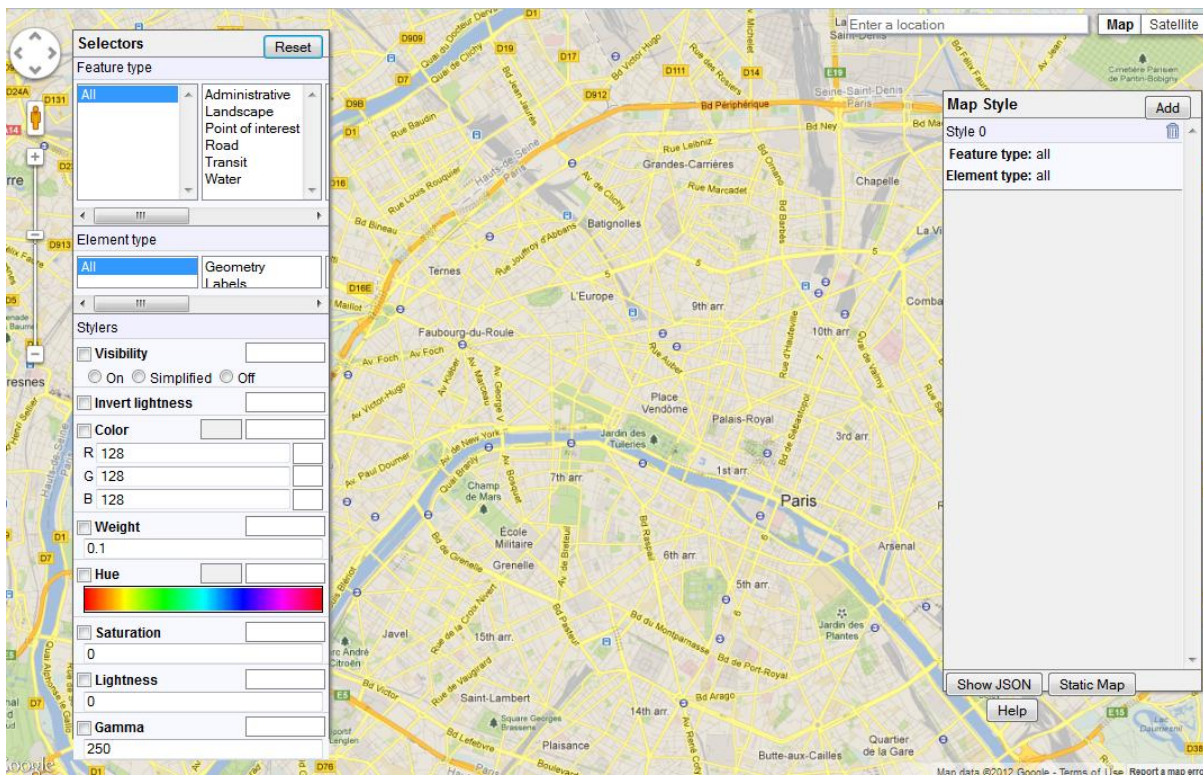


Figure 4-3: Overview of the Google Maps API Styled Map Wizard (URL1-9).

### 4.3.3. Google Maps Colorizr

This is a web based tool which users and developers can make use of to change or set the styles and appearance of features in Google Maps. According to Zainab (2011), Google Maps Colorizr (URL4-4) allows users to easily convert their HEX RGB colours to the HSL (Hue, Saturation and Lightness) that are used by Google Maps. HEX (short for hexadecimal) colours are six (3 pairs) digit codes made up of a combination of numbers from 0 to 9 and letters from A to F (00 to FF) with 00 being the lowest and FF the highest. These colours are usually used HTML and CSS to instruct browsers what colours to display. For example a HEX code for black colour is #000000 (same as 0, 0, 0, in RGB colour) and for white colour is #FFFFFF. Any other colour can be derived from the combination of these digits, e.g. brown colour is #A52A2A. For users to get the collect colours code to use, there are colour charts available online to refer to, e.g. w3schools (URL4-6) or Colour-Hex (URL4-7).

Clarke (URL5-1) stated that to some users, HSL colours may be confusing while it is easier for them to work with RGB colours. However, unlike Styled Maps Wizard, Colorizr has no option for users to enter HSL colour codes. The tool's interface has side bars on either side (left and right) from which users can select the feature they want to change the appearance of and display the generated code respectively as well as the map display in the middle (Figure 4-4). Changes applied to elements will be instantly viewed on the map. Four options are available from the customization menu on the left, being:

- 1) Feature: this is where a selection of feature is made for change in representation. Feature type found here are water, landscape (man-made & natural), road (highway, arterial & local), POI (park, business, attraction, medical, school, government & place of worship), administrative (country, land parcel, locality, neighbourhood & province) and transit (see also Figure 4-5a).
- 2) Element: here, selection is made to whether to apply adjustment to the presentation of the feature's geometry or labels or both geometry and labels (all, geometry, labels) as can be seen in Figure 4-5b.
- 3) Visibility: there are options to switch features on, off or simplified. With this tool, generalization can be done by selecting which feature(s) will be visible or not as well as by simplification. Applying the simplified visibility to a line feature (e.g. roads) will remove the outline if you select "all" or "geometry" element and remove labels if element labels is chosen, while for area features and points it can only affects their labels (disappear).
- 4) Colour: this where users can enter the colour they want to be applied to specific feature(s). Design problems can be taken care here of as users can assign their preferred colours that fit their map purpose and enhance the overlaid theme.

Furthermore, as settings are applied on the left menu (as discussed above) and visualized on the map, a code is also generated in another panel on the right hand side of the wizard (Figure 4-5c). It is this code that can be integrated into your site code. It must be noted that Google Maps, like many other online base maps, has inbuilt automatic generalization. Therefore, when applying adjustment, they should be done at targeted zoom level(s) because adjustment may not look effective when you zoom out to lower zoom levels, and when the map zoomed in to higher zoom level, may look too generalized. However, all these depend also on the purpose of the map. In the next section, sub-section 4.4.2 style setting examples are given from the two wizards and results visualised.



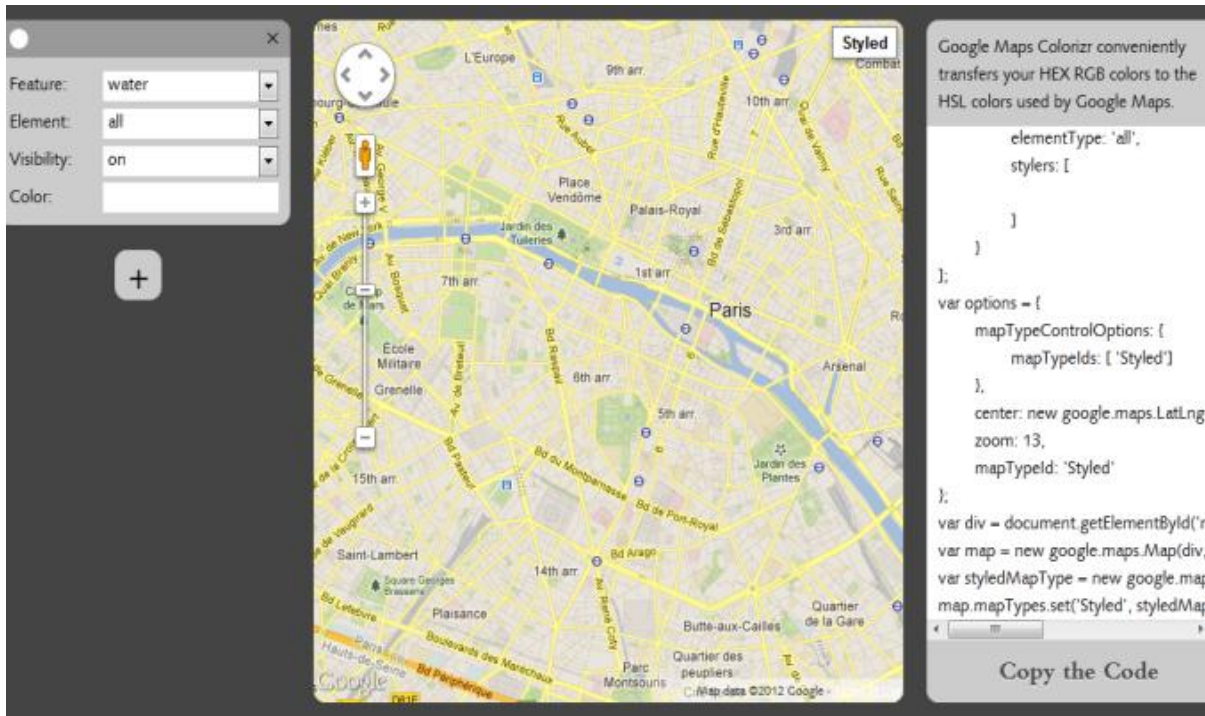


Figure 4-4: Overview of Google Maps Colorizr (URL4-4).

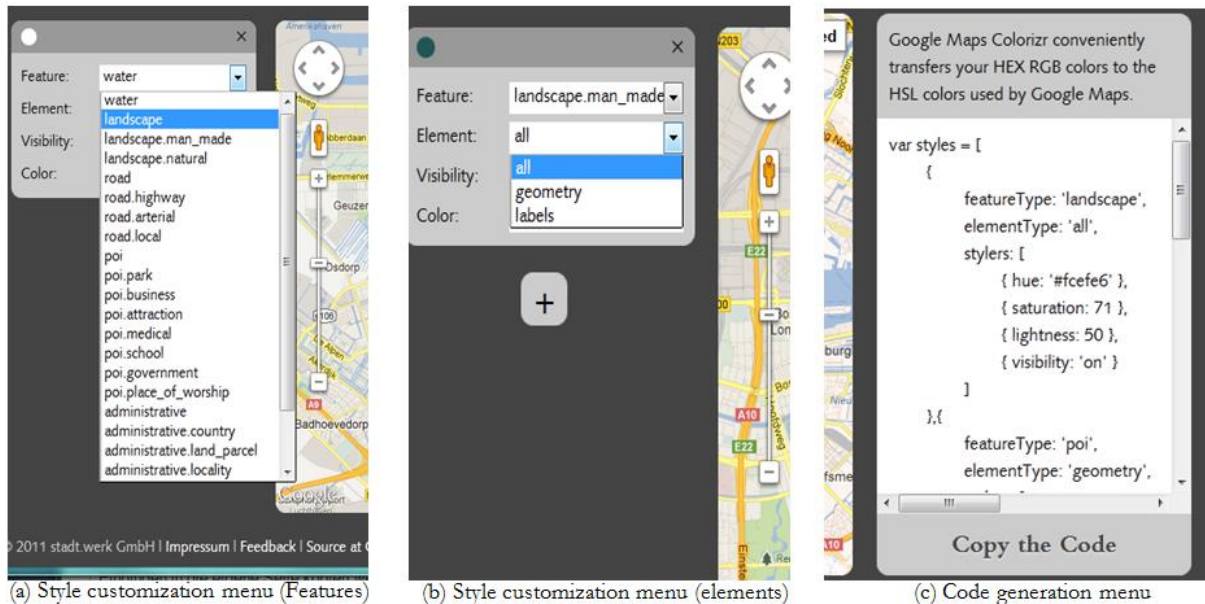


Figure 4-5: Google Maps Colorizr menus (URL4-4).

## 4.4. Approach to Google Maps

### 4.4.1. Overview

The last two tools are developed specifically for Google Maps which is the most used base map for neogeography maps, and as a result we will find out how we can make use of them to customize Google Maps to our desired style and appearance.

There are three main problems with online base maps as indicated earlier, and in this research we are going to investigate how we can solve or minimize these problems on Google Maps. We will investigate the possibility of the above described tools in solving or minimising those problems, as indicated in table 4.1, using the generalization operators such as selection, merging and simplification. However, there is no high level generalization in both tools as some of the (generalization) operators such as enlargement and displacement are not available. Selection is needed to remove features that are not enhancing the purpose of the map or less important and reduce information content. Merging can be applied in the design where different features can be assigned a similar colour, and simplification is applied to line features such as roads in order to narrow their width.

#### 4.4.2. Choice of tool

From table 4-2, it can be seen that with Styled Wizard one can set the style with more options, e.g. road - highway - controlled access then geometry - fill/stroke. On the other hand Colorizr, for example, has no option of styling fill or stroke individually but apply style to geometry as a whole. Figure 4-6 show an example of the settings applied to road geometry and labels in Google Styled Map Wizard. Notice red stroke (outline) of the roads and road labels (text), black fills with white stroke (outline).

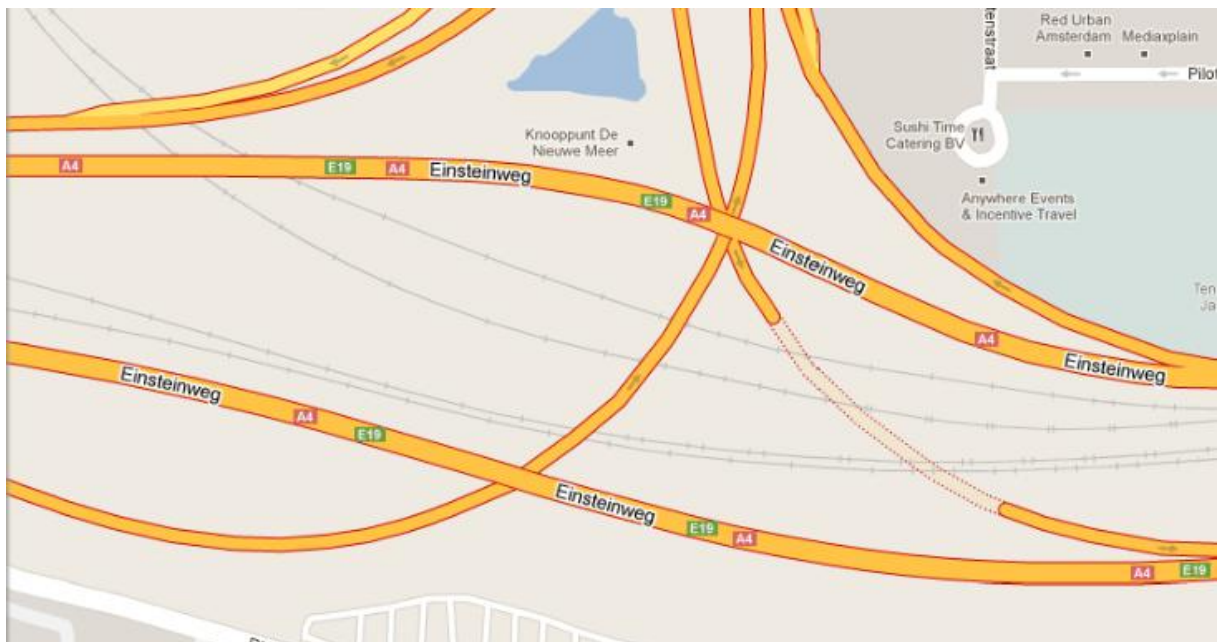


Figure 4-6: Example of fill and stroke settings roads and text.



Google Maps Styled Wizard		Google Maps Colorizr		
Feature type	Administrative	Country	Country	
		Province	Province	
		Locality	Locality	
		Neighborhood	Neighborhood	
		Land parcel	Land parcel	
	Landscape	Man made	Man made	
		natural	natural	
		Attraction	Attraction	
	Place of Interest (POI)	Business	Business	
		Government	Government	
		Medical	Medical	
		Park	Park	
		Place of worship	Place of worship	
		School	School	
		Sport complex		
	Road	Highway	Highway	
		Arterial	Arterial	
		Local	Local	
	Transit	Station	Airport	
			Bus	
Rail				
Line				
Water				

Element type	Geometry		Fill	
	Geometry	Stroke	Fill	Stroke
Labels	Labels		Fill	Stroke
			Stroke	
Stylers	Visibility	On	on	On
		Off	Simplified off	Simplified Off
	Invert lightness	On		
		Off		
Color	Color	On	R (value)	(enter HEX code)
		Off	G (value)	
			B (value)	
Weight	On	(enter value)		
	Off			
Hue	On	(enter value)		
	Off			
Saturation	On	(enter value)		
	Off			
Lightness	On	(enter value)		
	Off			
Gamma	On	(enter value)		
	Off			

Table 4-2: Different style setting options available in Google Maps Styled Wizard and Google Maps Colorizr.

Two tools (Google Maps API Styled Map Wizard and Google Maps Colorizr) available for adjusting Google Maps were discussed in the previous section above. In this sub-section we will compare them (see Table 4-2) to find out which one can give better results: i.e. the tool that can reduce the information content and change the design of Google Maps in accordance with the criteria given in chapter 2, with easy and in a reasonable time. The tool which gives better output will then be used in the implementation of the case study in the next chapter. The overview of the two wizards Styled Maps Wizard and Google Maps Colorizr can be seen above in Figure 4-3 and Figure 4-4 respectively and the detailed available options in table 4-2. It is from those wizards that different styles can be set and applied to the background Google Maps. Once a user is satisfied with the style settings, the code can be generated, copied and integrated into a html code (in our case) which displays the original Google Maps in the standard browser.

Efforts were made to enter similar style settings in both wizards and the results of that can be seen in Figure 4-5 and Figure 4-6, for Styled Maps and Colorizr respectively. In each wizard there are different features and each feature has a feature type made up of geometry and labels. In the settings, a light cream colour (#ede7d7) is assigned to all landscape features and to the POI geometry and a light grey (#c8c8c8) to highways and major roads. The local roads, load labels and place of interest labels are switched off. Water is assigned a light blue colour (#cfd7fd).

Both wizards responded well to the settings. That means that some features have been generalized by switching the visibility off and there are fewer colours on the map as most features are given equal emphasis preparing them for a correct or proper visual hierarchy when neogeography data are overlaid. The two codes can then be copied and integrated into one's mapping or website codes. The settings applied here were not used in relation to a specific neogeography map purpose but just to investigate how the tools respond to the applied settings. The settings for real problems will be applied during the case study implementation in the next chapter.

Looking at the map overview in the two wizards in Figure 4-5 and Figure 4-6 respectively, one could clearly see that the two are in agreement in terms of the visualized colours. That means the wizards have responded well to the settings that were applied and that they are both able to be used for Google Maps adjustment. However, the Google Maps Styled Wizard, as can be seen in the table in table 4-2, has more options and as a result it will take longer to apply the settings than in Colorizr. In this case during our testing, we got the same results from both tools but it was faster to get the results with Colorizr because of less options compared to Styled Map Wizard. Therefore, in this research we will use Google Maps Colorizr in our case study implementation as we found it to give the result we hoped for in less time and it is also straight forward and easy to use compared to Styled Map Wizard. It is worth noting that a common limitation with both tools is that, one cannot do further generalization of the data apart from what is being done by the tool. In other words, one can only make use of options that are available from the tool, no elimination, displacement and no merging the features geometry (e.g. small polygon into one big polygon).

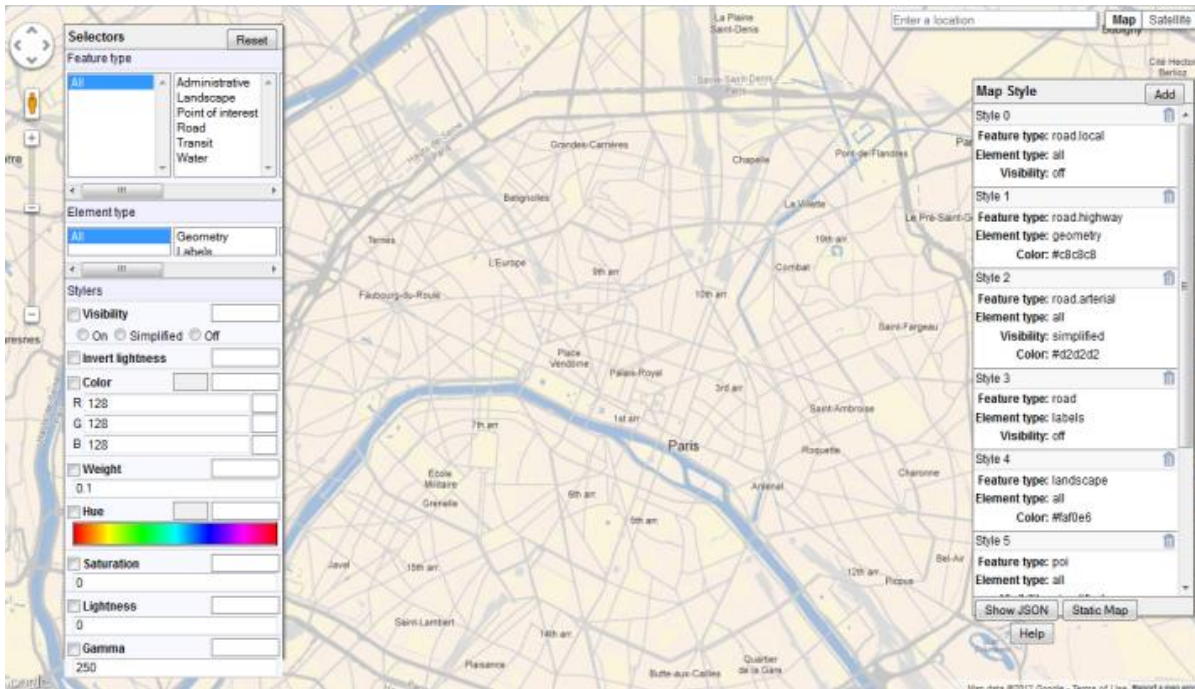


Figure 4-7: Style settings and a code generated in the Google Maps API Styled Maps Wizard (URL1-9).

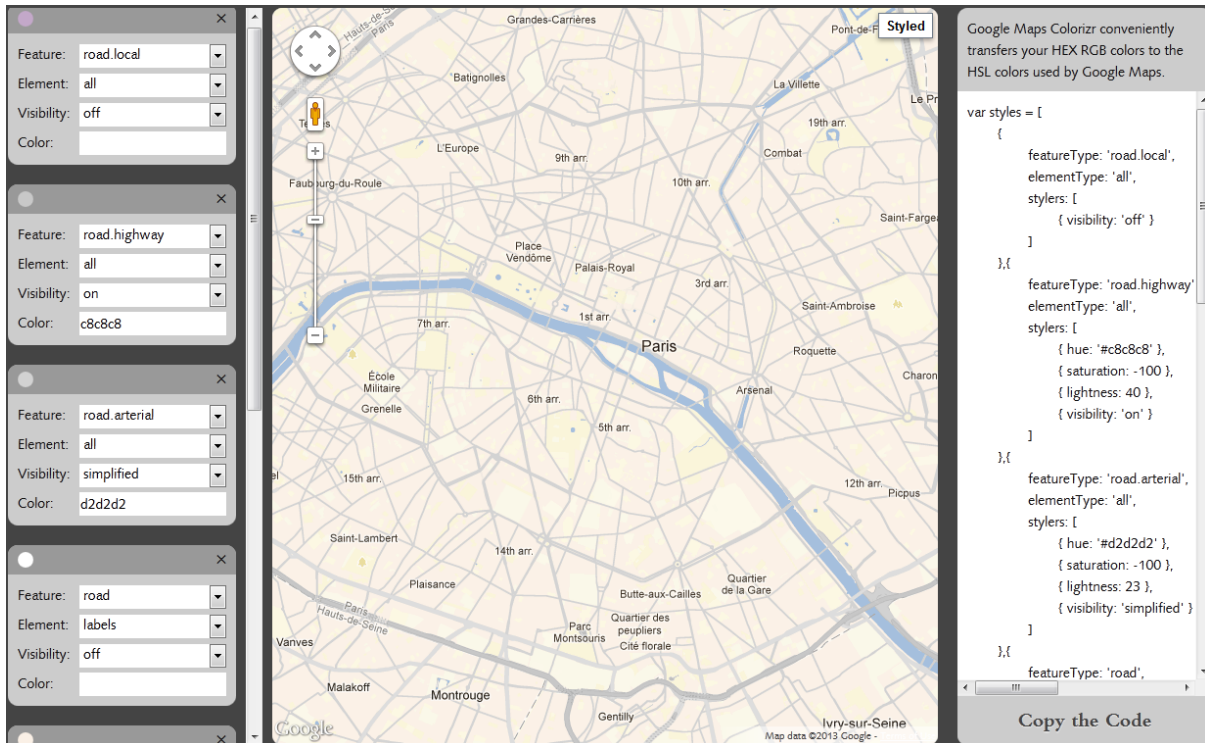


Figure 4-8: Style settings and code generated in the Google Maps Colorizr Wizard (URL4-4).

#### **4.5. Conclusion**

It is now known that there are problems with online base maps, as described in this chapter, and there are suggested solutions that users can apply to the maps to minimize or remove those problems. Discussed here also are tools that can be used to adjust base maps and specifically Google Maps API Styled Wizard and Google Maps Colorizr that can be used for Google Maps, which is a focal point of this research. Other tools that work with other online maps do exist as well, such as CloudMade Style Editor which has been used to adjust an OpenStreetMap base map. In the next chapter, further usage of Google Maps Colorizr in adjusting Google Maps will be explained and demonstrated in the case study.





## 5. CASE STUDY AND USER SURVEY

### 5.1. Introduction

The use of online base maps for neogeography maps has witnessed an increase of usage in recent years as witnessed by the number of neogeography maps posted on the Web. However, users are just making use of what is available to them and those base maps do not necessarily meet the criteria of good base maps in terms of information content and design. As previously mentioned in the earlier chapter, some researchers (Das et al., 2012; Foerster et al., 2011; Van Elzakker & Van De Berg, 2010) have tried to see how base maps can be adjusted to fit individual purposes of different neogeography maps.

This chapter will try to demonstrate the possibility of adjusting Google Maps and try to fit it to the purpose of neogeography map(s) to be created based on the method described in section 4.4. Two map alternatives will not only be produced but will also be presented to potential users: a neogeography map with an original Google Maps base map (not adjusted) and the same neogeography map with an adjusted Google Maps base map, so as to find out which map has a better visualization in relation with the map purpose. But before that, a summary of research methods used up to this point will be given and, thereafter, a brief talk about the case selection and the user research technique applied.

### 5.2. Methodology

To arrive at this research stage, we have already applied few methods. On the first part, a literature review was done so as to find out the type of problems with online base maps that have been encountered by previous researcher(s) and if they have solved (some of) those problems or given suggestions on how they can be solved. We have also done a study or a review of available neogeography maps and the online base maps they are using. This was done in order to detect problems with base maps and to possibly discover whether there are tools or solutions available that can help in mitigating those problems. This review has culminated into the creation of an inventory of some of the available neogeography maps and online base map used in each case.

Problems that we detected and those found by other researchers were analysed for possible solutions which led us to discovering some tools that we investigated on how best they can be used for online base map adjustments. So, in this chapter, we present a case study where an original Google Maps base map will be adjusted using one of the discovered tools (Colorizr) and put to a test with potential users. How the case study and usability test was done is discussed in the next sections. Later on in the next chapter(s), we will then draw our recommendations from the results of the case study and usability test, on whether the base map can effectively be adjusted (or not) to fit the purpose of neogeography maps in line with the criteria for a good base map and which tool to use.

### 5.3. Case study

#### 5.3.1. Case selection

During the compilation of an inventory in Chapter 3, the observation was made that most neogeography maps found on the Internet are using Google Maps as a base map. Therefore, Google Maps was selected for this case to investigate if it can be adjusted to the users' preferred design. For the adjustment

demonstration or implementation, an area was chosen where we found some good points to use as neogeography data (different kinds of restaurants) and overlay them on two different maps to visualize the difference between the two base maps. An area in Amsterdam was chosen and maps were set to centre at this city with a default loading at zoom level 13, to give an overview of all visualized restaurants (Figure 5-1). Below this zoom level, some information of the base map that was left visible during the adjustment start to disappear due to inbuilt automatic generalization, and the restaurants symbols starts to clutter hiding base map information in the process. Again, zooming beyond zoom level 15 for example, will not only reduce the spatial extent of the visible restaurants but the map also looks too generalized for the purpose it was created for. Therefore, the ideal zoom level to visualize this map with all restaurants visible is at zoom level 13. Although the maps are centred at Amsterdam, once the style is applied it takes effect to the whole map but we limit our case to an overview of Amsterdam and the surroundings only.

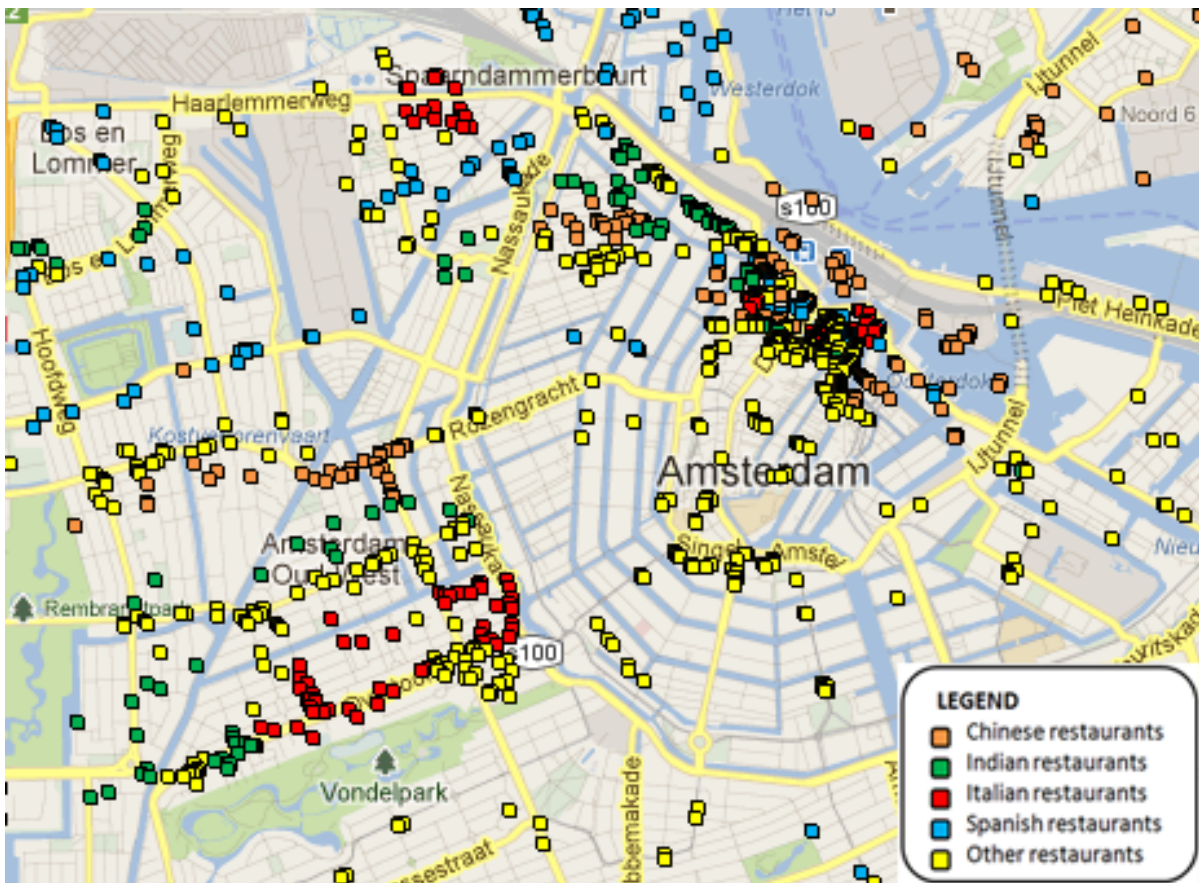


Figure 5-1: Google Maps with an overlaid theme (restaurants)

In this case study, the purpose of the maps is to visualize the spatial distribution of different kinds of restaurants in and around Amsterdam. For this purpose we hypothesize that the maps are to be used by municipal officials who would like to see the spatial distribution of restaurants in Amsterdam so that they can regulate their (restaurants) establishments. The maps are supposed to help them to identify areas that are congested with restaurants and those with few restaurants only so that, for instance, areas with many restaurants will be exempted from opening new ones (or for the implementation of alternative policies) (Figure 5-1). This purpose does not include how to navigate to the individual restaurants but solely to give an overview of which areas have more or fewer restaurants.

Looking at this purpose of the map and the criteria for a good base map to reach this purpose, Google Maps as it is, contains too much information that is not needed in this regard and it lacks visual hierarchy between the base map layers and the topic layer (restaurants). This is especially more evident between the roads in yellow and restaurant points with a similar colour (yellow). Therefore, the design of the map is to be adjusted and generalization applied to improve visual hierarchy and reduce the information content of the base map respectively in accordance with the purpose and criteria of good base maps. A brief description of the base map and accessibility of the underlying data is given in the next subsection 5.3.2, while the topic layer and how it was obtained is described in subsection 5.3.3.

### 5.3.2. Google Maps

Google Maps was described earlier (in chapter 3) as a free online web mapping service provided by Google. Although Google Maps is free for use, accessing the underlying data is not possible as is the case with other online maps. This is partly so due to the fact that Google Maps' data are visualized under licence agreement between Google and national mapping agencies and private mapping companies around the globe (URL3-66). Some of the data is also contributed by individual users through Google Map Maker (URL3-69) where users edit and update places or areas that they know well especially their neighbourhoods and the surrounding environments. However, even the very same data a user contributed, it is not possible to get access to those data unless with an agreement with Google.

Google Maps however, like all other online maps, allows contributors / users to overlay their data. These data can be of any form, which means, polygons, polylines or points. With Google Maps APIs, users are also able to embed Google Maps into their own web sites. Another option with Google Maps is the creation of one's own map on the Google's main interface under "My places". With this you can copy / extract data from a Google search and store them under your own map. An interactive tutorial to create a new map is available to help users on how to go about creating and sharing their maps (Figure 5-2). Although it is a good idea to create one's own map on Google, a limitation still exists as users have no choice to change the base map to fit the purpose of their neogeography maps. Change or adjustment of Google Maps is needed because the map may have too much information than needed or the design (colours and symbology) may be conflicting with the topic layer(s).

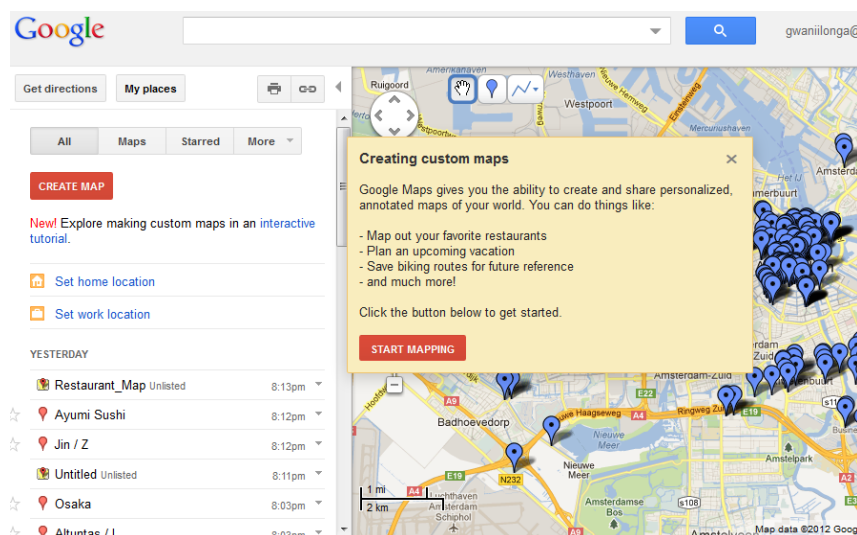


Figure 5-2: An interactive tutorial for creating a new (own) map on Google Maps (URL1-1).

Since access to the underlying data is (was) not possible although Google Maps is the most used base map for neogeography maps, the option available now is to embed Google Maps into one's own site and apply adjustment with the help of available tools. Some tools have been developed to overcome this challenge and this research is to demonstrate the possibility of adjusting Google Maps using one of the available tools as indicated in chapter 4 and sub-section 5.2.2.

### **5.3.3. Topic theme**

For the sake of this research and to get a clear difference between the original and adjusted Google Maps base maps, a typical neogeography map was simulated: neogeography data restaurants in and around Amsterdam, which could typically also have been collected by volunteers, were extracted by the researcher from the main Google Maps (using the search option) and saved in a new map created under Google's 'My places'. Those points were then saved or exported as KML to enable them to be used with other maps. The extraction and saving to KML of points was necessitated by the fact that it is not possible to carry out an adjustment to the original Google Maps on the Google site.

### **5.3.4. Implementation**

In this sub-section a flow chart is given (Figure 5-3) to illustrate the process of adjusting Google Maps using Google Maps Colorizr. At the end of the adjustment, the two maps will then be compared and put forward to test persons in a user test to see and find out which one is a better visualization in accordance with the criteria for a good base map and purpose of the topic layer.

The idea was to visualise the two maps in a simple browser. So, we took an HTML code for visualizing Google Maps. Using Google Maps Colorizr, style settings were done and a style code generated which was then integrated into the HTML for the adjusted map (Figure 5-4).

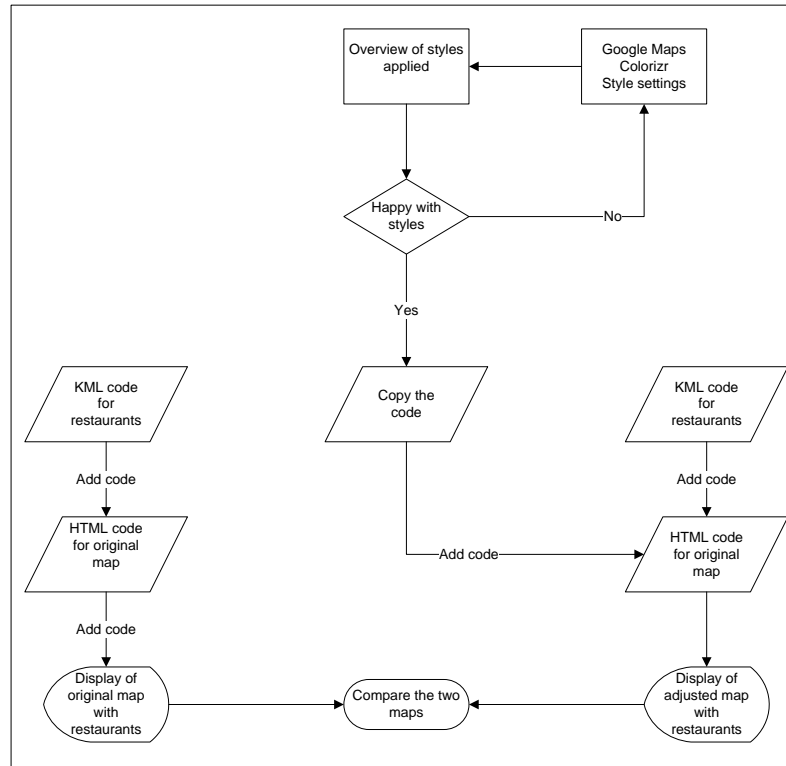


Figure 5-3: Processes taken to create the two case study maps: one with the original Google Maps as base map and one with an adjusted Google Maps base map.

Illustrated in the flow chart is Google Maps Colorizr, as described above, where style settings are applied, changes are visualized in the overview map and a code generated. In the settings, some of the roads (local roads), road labels (for all roads), transit and places of interest (POI) labels were turned off to reduce the amount of information content of the base map (see Table 5-1). The visible or remaining roads on the map were generalized by simplifying their geometry (reduce their width to minimize overlapping with topic layer). Some features such as landscape (natural and man-made) and POIs were given a light cream colour (#cfdefd) and the roads a light grey colour (#c8c8c8) to make sure that there is a visual hierarchy when the theme is overlaid (see Table 5-1). This process can be done repeatedly until the user is happy with the results in the map before copying the code and integrating it into a HTML code. Thereafter, a KML that was generated as described in sub-section 5.3.1.2 is added to the HTML code and the resulting map can be seen in Figure 5-5. For the original map, only the same KML (no style code from Colorizr) was added to the HTML (Figure 5-1) since we wanted only to overlay the restaurants on the non-adjusted / original map. The two (adjusted and non adjusted) maps with overlaid restaurants (see Figure 5-1 and Figure 5-5) were then compared to each other through a usability test as described in the next section.

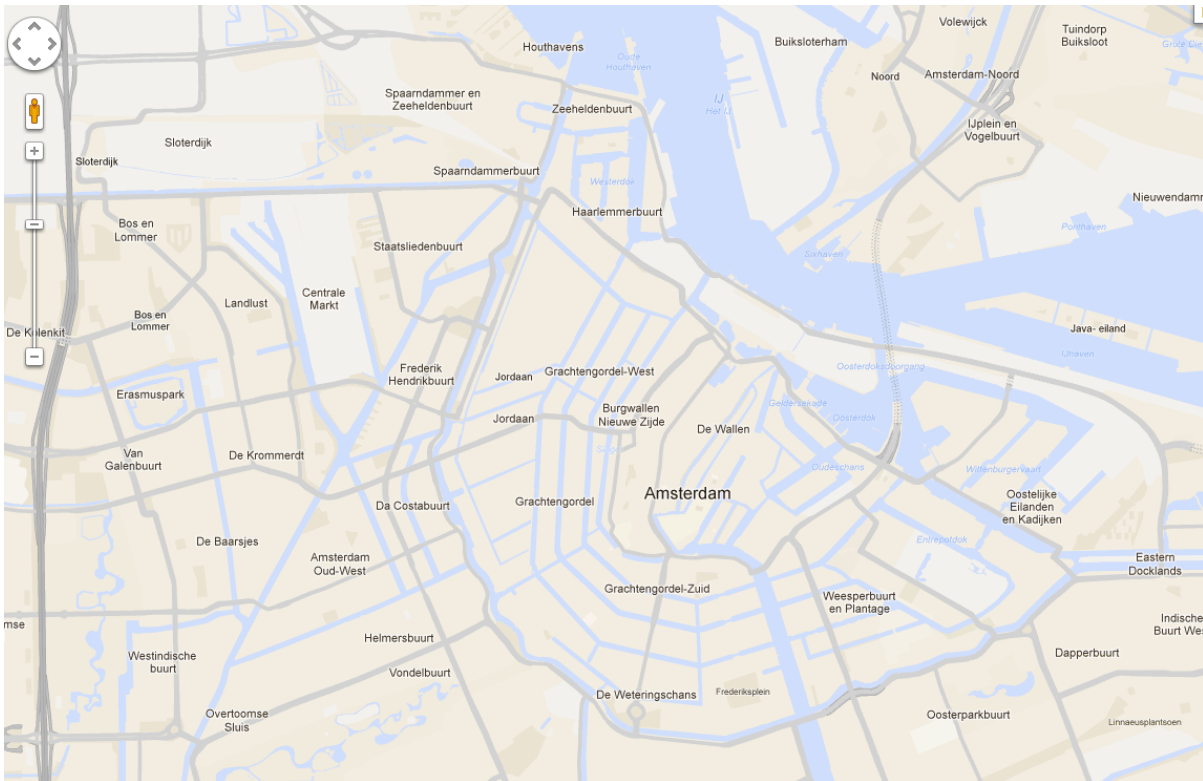


Figure 5-4: Adjusted Google Maps base map of Amsterdam.

Feature Type	Visibility	Colour Assigned	Reason
Landscape (man-made & natural)	on	Light cream (#cfdefd)	To have a de-emphasized colour which contrasts with other features in the base map as well as with the topic layer(s) for a good visual hierarchy.
Place of interest (labels)	off	N/A	To reduce information content in the base map in accordance with criteria for a good base map.
Place of interest (geometry)	on	Light cream (#cfdefd)	To have fewer colours in the map and merge these features (by colour) with the landscape.
Road (highway & arterial geometry)	simplified	Light grey (#c8c8c8)	Simplification is applied to narrow the width of the roads and colour is given to contrast with the background of the map and thematic information.
Road (labels)	off	N/A	To reduce information content in the base map in accordance with criteria for a good base map.
Road (local)	off	N/A	To reduce information content in the base map in accordance with criteria for a good base map.
Transit	off	N/A	To reduce information content in the base map in accordance with criteria for a good base map.
Water	on	Light blue (#cfdefd)	Mapping convention: – water is conventionally blue colour, and in this case to contrast with land.

Table 5-1: Redesigned features and colour coding used in the adjusted Google Maps using Colorizr.

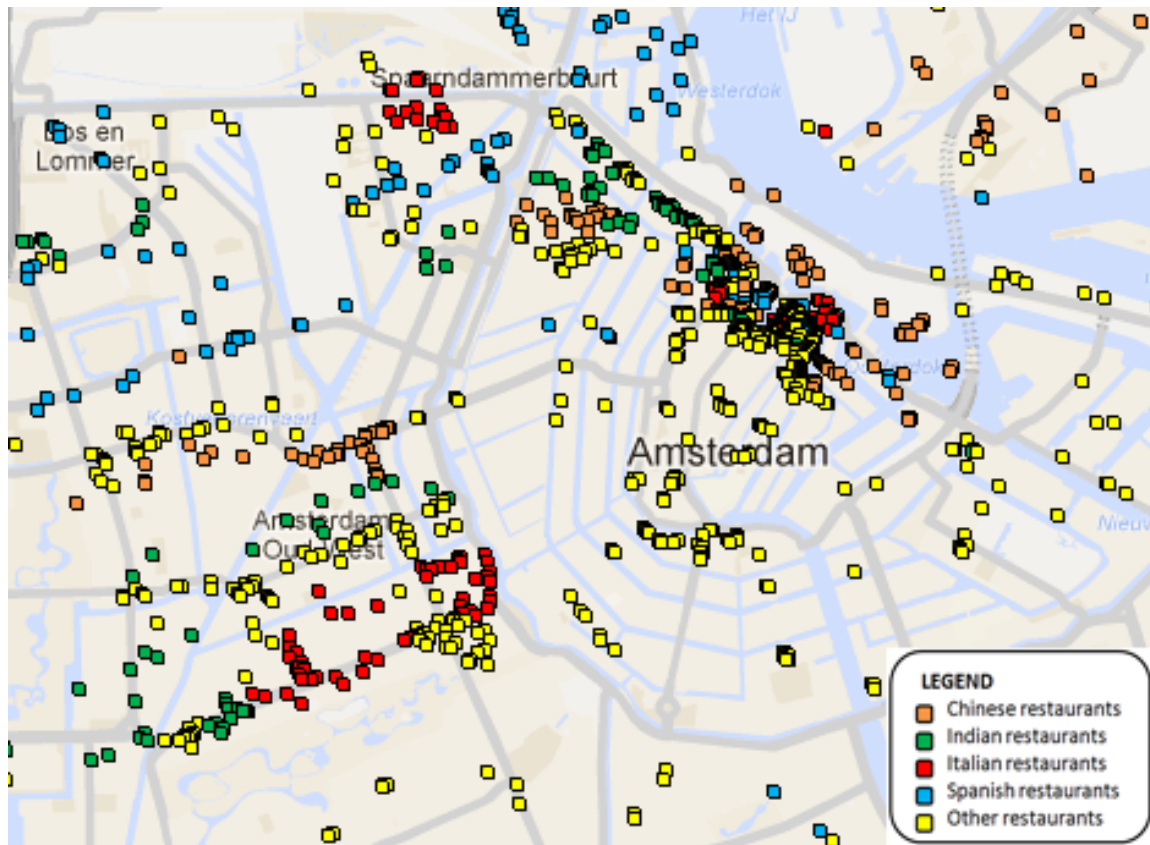


Figure 5-5: Adjusted Google Maps base map with an overlaid theme (restaurants).

#### 5.4. User research methods

For us to have a clear idea that the adjustments we made to the map are good and that the adjusted map is more effective in communicating the overlaid information, a usability test has to be arranged with representatives of potential end users. For this purpose, the two maps were made available to subjects where points for restaurant are visualised on the original Google Maps and the adjusted Google Maps base map.

There are different methods that can be used to carry out such a user test. The usability test can be done by using one or a combination of techniques such as surveys, interviews, focus groups, observations, questionnaires, think aloud, eye tracking, screen logging as well as contextual inquiries (Nivala et al., 2007; Van Elzakker & Van De Berg, 2010), just to mention a few. On which method or technique to be used has to be decided taking into consideration the purpose of the test as well as other constraints like time and cost. For the use case in this research, the (online) survey method was selected and conducted in the form of a questionnaire which test persons have to fill in while looking at the presented maps.

##### 5.4.1. Online Survey

Online survey is one of the methods and techniques that can be used to test or evaluate new products on their usability by the general users. Techopedia (URL5-1) defined an online survey as a digital questionnaire that can be sent, completed and returned online through the Internet. The advantages of the questionnaire are that it is usually fast and cost effective (URL5-2). One can reach a lot of audience by



using an online survey compared to other methods. According to Dumas & Redish (1999), it is good to have written questionnaires so that each participant can have exactly the same questions and that there is no risk of forgetting to ask a question. A combination of these advantages and limited time on our side led us to choose this method. Furthermore, this online survey will help us find out if the end users (and producers) of neogeography maps are satisfied with their use of Google Maps as base map for neogeography maps, and if they have experienced problems while using Google maps as a base map. Last but not least, by comparing the two maps we will find out the effectiveness, efficiency and usability of each map (original and adjusted Google Maps).

#### **5.4.2. Test execution**

An online survey questionnaire was designed using “SurveyMonkey” (URL5-3). This tool can be used to design the questionnaire, collect the responses and analyze the results. A number of questions was designed, ranging from personal ones to find out the background of the test persons to questions that relate to the products that have to be compared or evaluated. The questionnaire is made up of both open-ended questions where test persons may have to write down answers, give comments and/or suggestions, and closed-ended questions where test persons are just choosing an answer from multiple options. Map images visualizing the products of the case study were also included in the survey and questions related to the maps were asked (Appendix). The first pair of the maps named “Map A” and “Map B” (in the questionnaire) are visualizing the overview of the spatial distribution of the restaurants, and are shown in Figure 5-1 and Figure 5-5 above. Two surveys were created with the same questions but different ordering of the maps (adjusted and non-adjusted ones), which were preceding questions such as; “In which area of the map are the most restaurants?”, “In which area of the map do you find the most Chinese restaurants?” and “At first sight of the maps, which map did you use to answer these questions (Q19&20)?”. This was done to avoid bias answers that can possibly arise due to how respondents view the first map (they may think the first map is always the best or vice a versa).

The links to surveys were then sent to the targeted participants’ email addresses. In this case one link was sent to University of Twente, Faculty ITC Geoinformatics (GFM) MSc students (2012) and staffs (professors and lecturers) from the GeoInformation Processing Department (GIP), and another link sent to other contacts outside ITC (mailing list of the commission on Use and User Issues of the International Cartographic Association (ICA)).

#### **5.5. Conclusion**

A brief description of the methods undertaken in this research, from literature review, review of base and neogeography maps, problem analysis up to the investigation of the availability of tools for adjusting online base maps, is given. A case study was done in this chapter where Google Maps is adjusted to fit the purpose of serving as a base map in visualizing the spatial distribution of restaurants in Amsterdam and in accordance with the criteria of good base maps as described in chapter two. The resulting maps of the case study were subjected to a usability test through an online survey in order to get the users’ perspective on the two maps. The results of the online survey will be analyzed and discussed in the next chapter.

## 6. RESULTS EVALUATION AND RECOMMENDATIONS

### 6.1. Introduction

From the last three chapters 3, 4 & 5, we have learnt about online base map problems, available tools for adjusting existing online base maps in order to minimize or eliminate the discovered problems, and we have seen how one of those tools can be used in adjusting Google Maps which was then put to a user test through an online survey. In this chapter we evaluate the results from that usability research and thereafter recommendations will be on how to deal with base maps for neogeography maps making use of existing online base map sources.

### 6.2. Evaluation

The two maps as produced in the chapter 5 case study were evaluated through an online survey. Three pairs of map fragments (an overview and a zoomed area at two zoom levels) were attached to the survey and questions on the maps' effectiveness, efficiency and usability were posed to the respondents to answer while looking at the maps. The maps were designed to show an overview at zoom level 13, as at this zoom level all restaurant are visible (as can be seen in Figure 5-1 and 5-5, Chapter 5 as well as in Appendix). These maps were then named "Map A" for original (non-adjusted) and "Map B" for adjusted map so that respondents compare the effectiveness and usability of the two maps for the purpose they were created for. Two more pairs of map fragments were also presented at two different zoom levels (zoom level 14 and zoom level 15). This was done to further probe respondents on the design, generalization and information content of the maps as well as to what happen when maps are visualized at zoom level. The zoomed in map fragments are shown in Figure 6-1 to 6-4 below and named "Map C", "D", "E" and "F". The following sections describe the results of the online survey. It should be noted that Map A, C and E represent the maps with original Google Maps base maps and Map B, D and F represent maps with adjusted Google Maps base maps. However, the order was of these map fragments was changed in one copy of an online survey in order to minimize the influence of the results from the way maps are ordered. This means Map A, C and E became adjusted Google maps in the second of the survey. This arrangement was for the survey only, and in the analysis in this chapter Maps A, C and E represent original (non-adjusted) while Maps B, D and F represents adjusted Google Maps base maps.

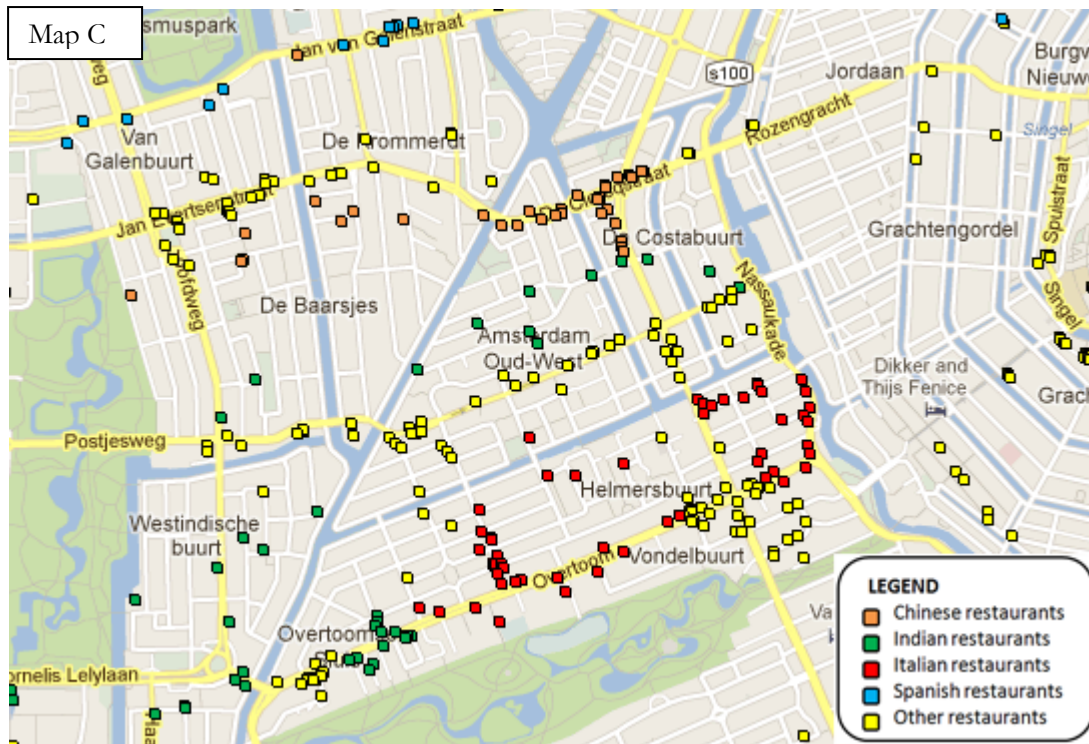


Figure 6-1: A zoomed-in area with restaurants on original Google Maps base map (zoom level 14).

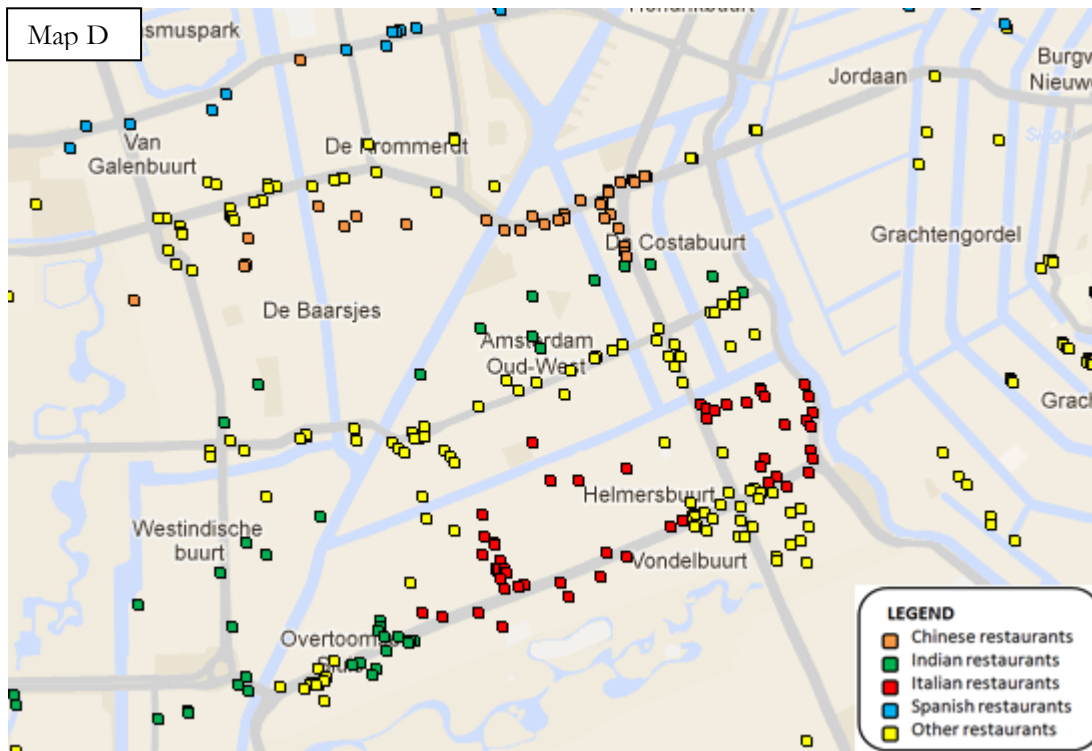


Figure 6-2: A zoomed-in area with restaurants on adjusted Google Maps base map (zoom level 14).

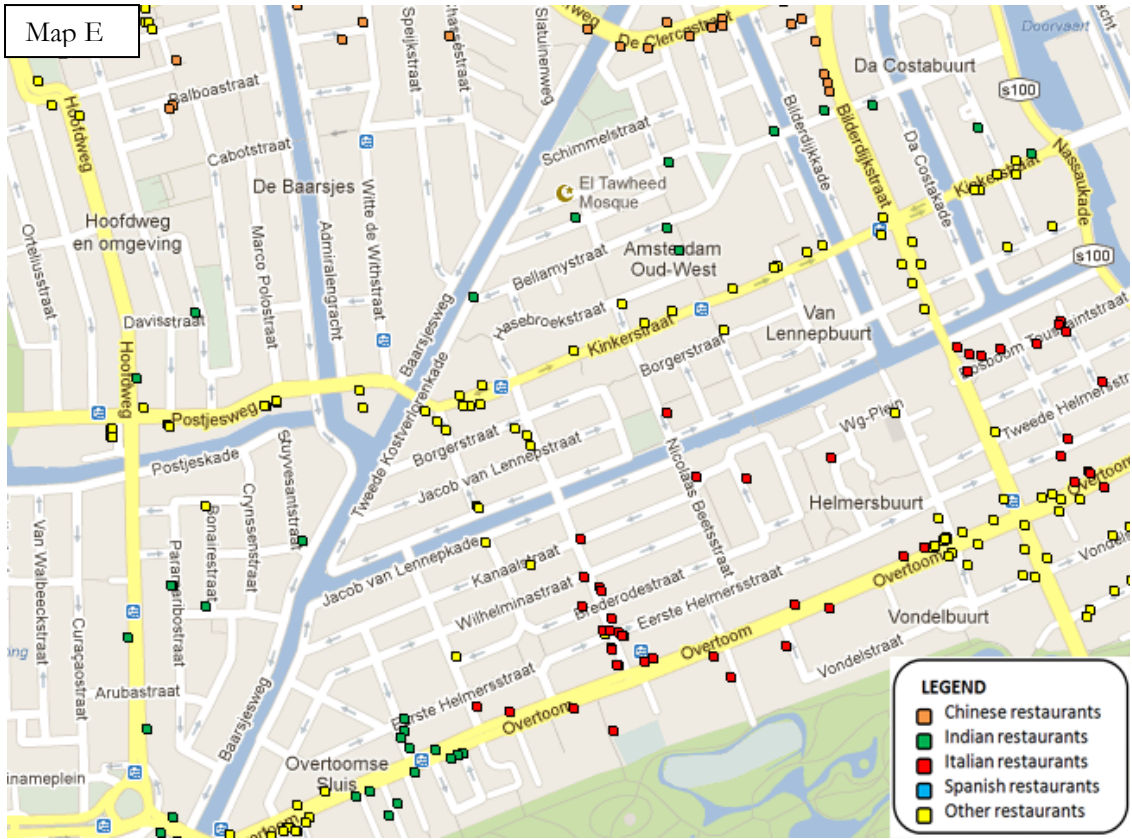


Figure 6-3: A zoomed-in area with restaurants on original Google Maps base map (zoom level 15).

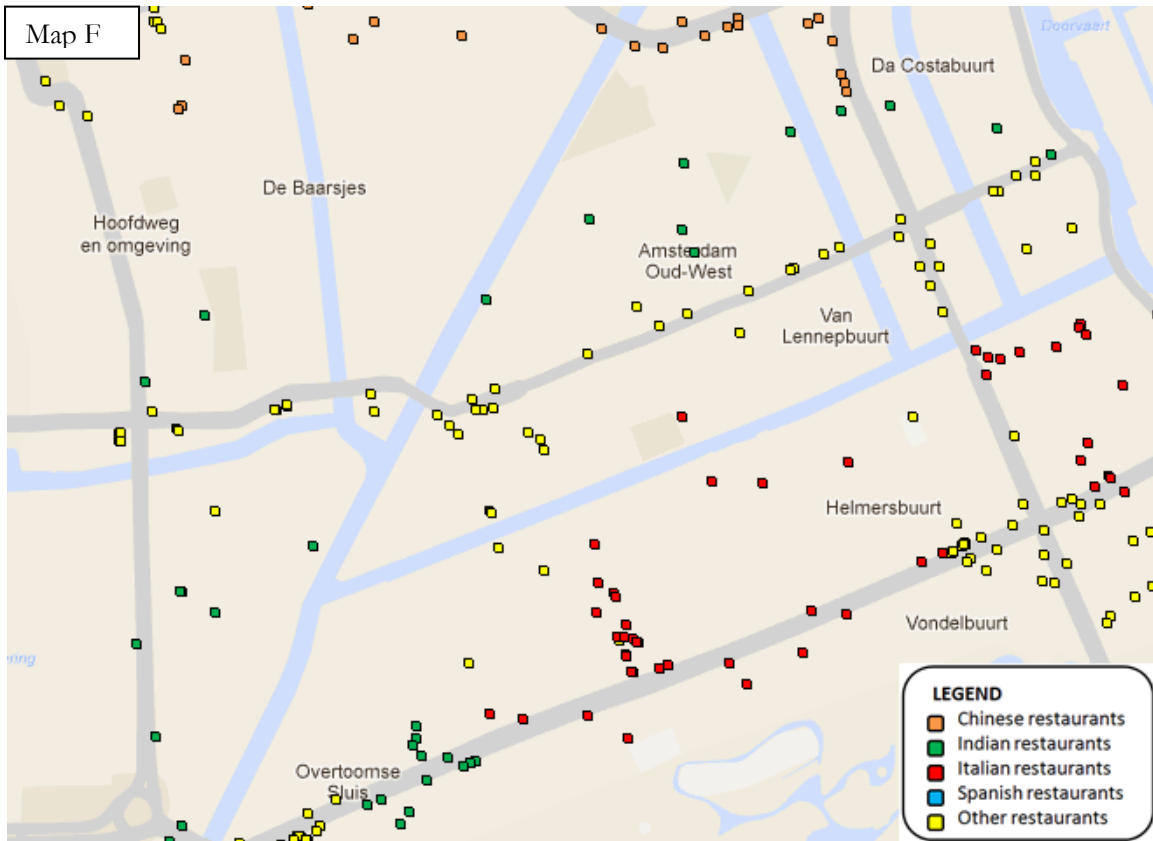


Figure 6-4: A zoomed-in area with restaurants on adjusted Google Maps base map (zoom level 15).

### 6.2.1. Knowing respondents and their use of online base maps

In total, forty four (44) responses were received from respondents with a variety of professional backgrounds. The majority of the respondents are male with 65.9% while 34.1% are female. Most of the responses came from the age group 21 to 40 (61.4%) followed by 41 to 60 (36.4%) and the remaining percentage are for the age group 60 or older, nothing from age group 20 or young. Among the respondents are MSc and PhD students, GIS specialists, lecturers and developers, and this could probably explain why there was no response from the young age group (who may still be doing their undergraduate or so). Table 6-1 shows the number of respondents against their professional background. Six (6) of the respondents did not indicate their professional background.

<b>Profession (Occupation)</b>	<b>Number of respondent</b>
MSc Student	4
PhD student	6
Teacher / Lecturer / Professor	9
Researcher	7
Cartographer	2
Developer / Designer	2
GIS consultant (Consultant)	4
GIS Specialist / Analyst	2
Scientist	1
Geographer	1

Table 6-1: Number of respondents and their professional background.

Out of 44 respondents, 31 have completed the survey while 13 did not complete the survey. From the 13 incomplete 9 answered only the first page (5 answered only the first six questions) and 4 answered up to the second page but did not continue to the third (last) page of the questionnaire.

Looking at the table above it is evident that the survey covers a range of different professional background. Eighty one percent (81.8%) of the respondents has indicated that they created thematic maps before for different purposes. The results of the survey have also indicated that more respondents (77.3%) have used online maps and more than half of the respondents (52.3%) have used online maps as base maps for thematic maps. As the majority of the respondents are from age group 21 – 40, they also have a lion share (50%) of those who are using online maps while 27.3% are from 41 – 60 age group. Our finding in chapter 3 about which online base map is mostly used was also backed up by the results of this online survey. Most respondents have used Google Maps to create their thematic /neogeography maps, as can be seen in the graph below (Figure 6-5). Among the “other” maps that were used are ArcGIS Online (ESRI Maps) and MapQuest.

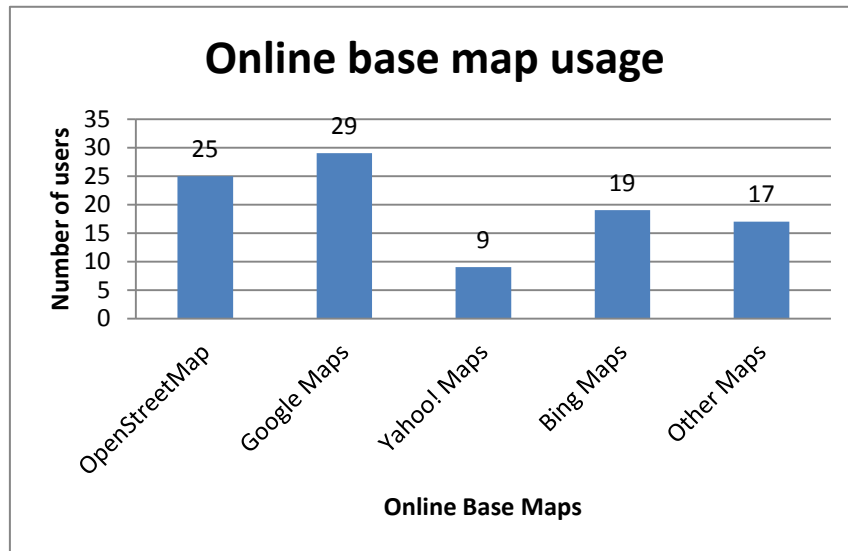


Figure 6-5: Different online base map and number of users per map.

It must be noted here that most of the respondents (59.1%) have indicated that they have used more than one online base map. Out of the 23 respondents who used online base maps for thematic maps, 52.3% of them have used those maps a couple of times a year while 21.7% are using those maps on a daily basis. Meanwhile 65.2% and 21.7% of those (23) who have used online base maps have been doing so for 'more than two years' and for 'one to two years' respectively for thematic mapping purpose. Most of the respondents (78.3%) who have used online base map for thematic maps have experienced problems with the base maps they have used and below is a summary of the problems:

- ✓ Lack of generalization between the base map and thematic layer which leads to obscure, overlap and/or cluttering in the map.
- ✓ Lack of styling options.
- ✓ Lack of visual hierarchy between base map layer(s) and thematic layer(s).
- ✓ Too much information on base maps.

Out of 24 responses (to the question if there is need for online base map adjustment), 62.5% feels that there is a need to adjust the existing base maps where there is a need for colour adjustment in the design, the reduction of information content (depending on the purpose of the theme) and more generalization options in addition to available switch on/off options.

### 6.2.2. Effectiveness of original and adjusted Google Maps

The three pairs of the maps as shown in Figures 6-1 to 6-4 were used in the survey to answer questions about their effectiveness, efficiency and usability. In this survey, effectiveness was assessed by asking respondents to identify areas (in Amsterdam) that have more restaurants in general and areas with more restaurants belonging to specific categories (e.g. Italian, Chinese restaurants, etc.). Apart from those that skipped the questions (27.3%), most of the participants have answered the questions (Qn19, 20, 24 & 25) correct.

To find out about the efficiency of the maps, rating scale questions were asked where respondents had to choose how easy or difficult it was to answer the questions using the map alternatives. Maps A & B and C & D were used to answer questions 19 & 20 and 24 & 25 respectively. Asked which map they can use to

answer questions 19 and 20 at first sight, 62.9% of 35 responses to this question used Map A and 37.1% used Map B. Three options were provided (“Easy”, “Not easy nor difficult” and “Difficult”) to measure efficiency of the map alternatives. In the graphs below (Figure 6-6) the numbers of respondents are shown next to the choice made to each of the given questions using the preferred map. Respondents were also asked to give reasons to why they choose a specific option.

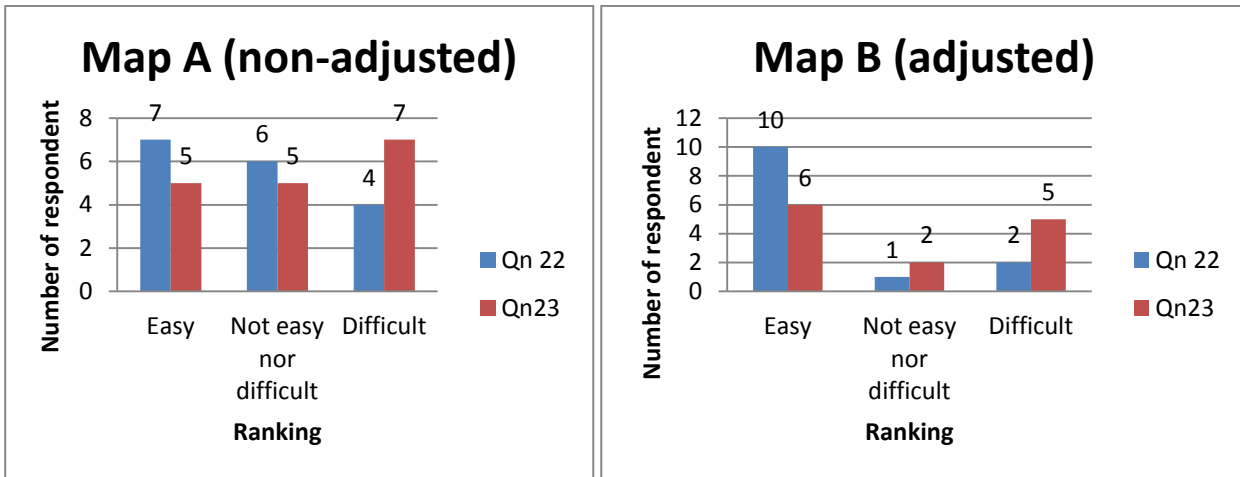


Figure 6-6: Comparison of map preference in answering questions (Map A and Map B).

Comparing the two graphs above, it can be seen that respondents who chose Map B found it easy to answer both two questions (19 & 20) while less respondents also found it difficult using Map B then Map A. The same comparison was made between the zoomed in maps (Map C and D) and respondents asked which map they use at first sight and how difficult /easy to answer given questions with their preferred map. In this case, out of 28 responses to these questions (24 to 26), half of them used Map C and the other half used Map D. Like in the previous questions, those who chose to use the adjusted map (Map D in this case) found it easier to answer the questions as illustrated in Figure 6-7.

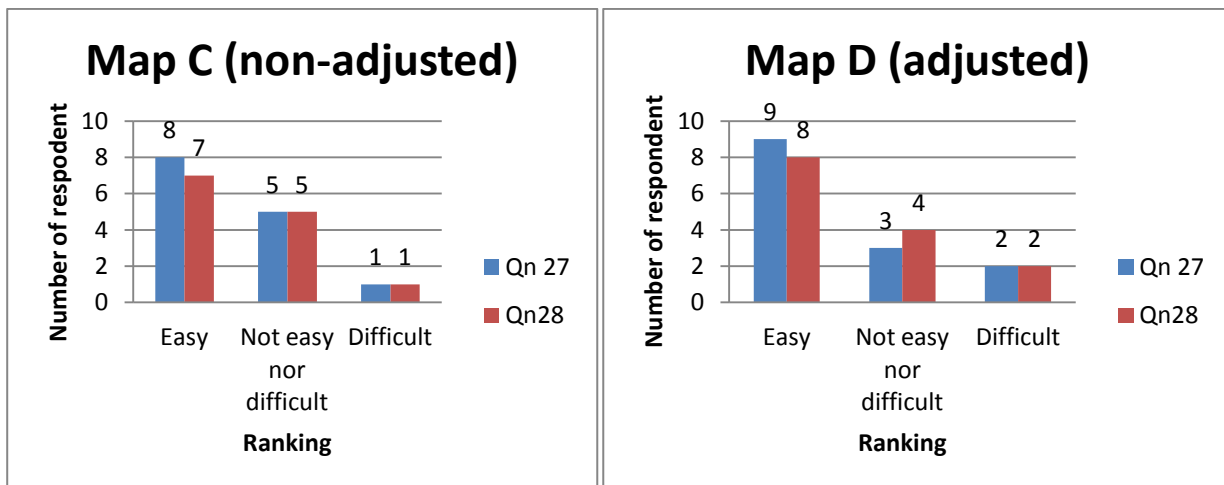


Figure 6-7: Comparison of map preference in answering questions (Map C and Map D).

Reasons given for finding areas with more restaurants in general with ease is that the maps contain only one thematic layer and clusters are very clear on both maps. However, some respondents found it difficult to identify restaurants belonging to specific categories due to cluttering points that are overlapping and

only their outlines are dominant. From Map E and Map F, respondents were asked to find restaurants in the category “Other” and give their ranking on how easy/difficult they found them. Again, more respondents find it easy to find the answer using the adjusted map (Map F) as indicated in Figure 6-8 below.

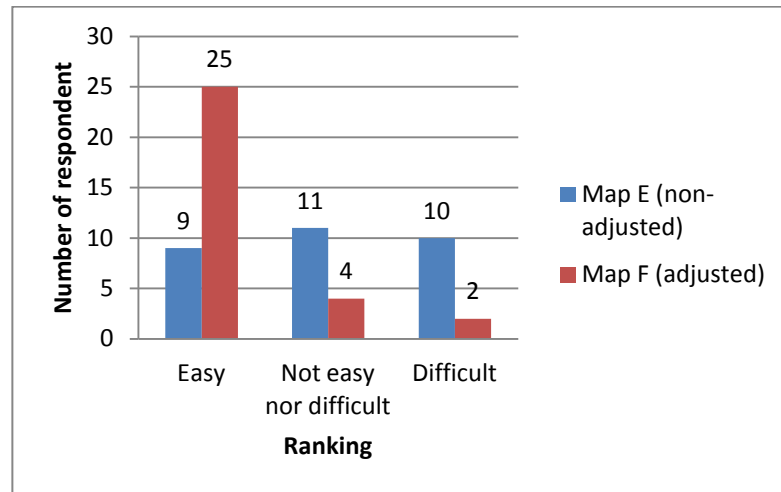


Figure 6-8: Comparison of map preference in answering questions (Map E and Map F).

Since the survey were served in two version with re-arranged maps to avoid bias, we did analyze the results for that and found out that using the overview maps (Map A & B) on one survey with non-adjusted put first the bias chance is ruled out as there were 50% response for each map. For the other survey with adjusted map put first, out of 27 responses 70.3% chose Map B which is closer to the questions and one cannot rule out bias in this case. Indeed, 3 of the respondents stated it clear that they chose Map B because it is close to the questions.

It must also be noted that there are different preference between Map A & B and Map C & D when respondents answering which map they used at first sight. For Maps C & D, 14 responses were counted and 71.4% indicated the same map preference (Map A – non-adjusted) while 28.6% choose a different map to their previous choice (first preferred Map A - non-adjusted, and change to Map D – adjusted). Those who changed cite reasons such as less destructive information as well as better colour contrast in Map D. On the other hand, 8 out of 14 changed from their first map choice of Map B (adjusted) to Map C (non-adjusted) with reasons such that Map C has more reference information (e.g. street names) than Map D as well as biasness.

Looking at the responses as presented in graphics above, it is shown that the adjusted maps are more functional than non-adjusted ones in this case. This is the case because although a good number of percentages as indicate above prefer to use no-adjusted map, they found it difficult to answer the given questions using that non-adjusted map.

**6.2.3. Comparing the usability of the map alternatives**

Map A (original) and Map B (adjusted), which show the overview of all restaurants in Amsterdam were used to compare their design, generalization and information content with regard to their function as base maps for visualizing the spatial distribution of restaurants. In this regard, 59.3% of the 27 respondents who answered this question that “which map do you think is usable for the municipal officer to get the



right answers in a quickest way?” felt that Map B is more usable in answering question in a quickest way. A common reason given for this is that there is less information in the background making the map less distracting and it is easier to identify the restaurants.

		Very good	Good	Ok	Bad	Very bad	Total
Design	Map A	6 (22.2%)	3 (11.1%)	8 (29.6%)	9 (33.3%)	1 (3.7%)	27
	Map B	4 (14.3%)	12 (42.9%)	8 (28.6%)	4 (14.3%)	0 (0%)	28
Generalization	Map A	3 (11.5%)	3 (11.5%)	12 (46.2%)	8 (30.8%)	0 (0%)	26
	Map B	7 (25.9%)	5 (18.5%)	13 (48.1%)	2 (7.4%)	0 (0%)	27

Table 6-2: Original (Map A) and adjusted Google Maps (Map B) comparison based on generalization and design.

As can be seen in table 6-2 above, more respondents felt that the design of map A is bad while that of map B is good. However, for the generalization they felt it is ok for both maps although a bit more respondents (48.1%) prefer map B. They also felt that information content is ok in both maps (61.5% and 55.6%), with 44.4% thinking that map B has too little information content (Table 6-3). This was also picked up throughout the questionnaire and the researcher agrees that some information such as street names could have been left in the map.

		Too much	Ok	Too little	Total
Content	Map A	8 (30.8%)	16 (61.5%)	2 (7.7%)	26
	Map B	0 (0%)	15 (55.6%)	12 (44.4%)	27

Table 6-3: Original (Map A) and adjusted Google Maps (Map B) comparison based on content.

#### 6.2.4. Summary

The results of the online survey have indicated that the existing online base maps do have some problems when neogeography data or thematic information is overlaid. From the 44 responses received, 24 of them answered the question if there is a need to adjust existing online base maps to serve as base map for thematic maps, and 20 skipped the question. Out of those 24 responses, only 3 felt that there is no need for adjustment of the existing online base maps to serve as base maps for thematic maps. Although the survey results are not disappointing, the researcher is of the opinion that they might be different if the test was done with interactive maps, which due to time could not happen. Furthermore, there is a general from the respondents that more could be done on the adjusted map to make it more preferable.

### 6.3. Recommendation for using online base maps

As neogeography maps are produced by non-professional map makers / users themselves, using existing tools which are available online, there is no way one can advice them to seize using existing online base maps as base maps for neogeography maps as it seems there is no better freely available alternatives. After investigating the existing online base maps, this research recommends users to continue using those maps in the absence of better alternative as indicated earlier. However, online base maps should be adjusted and brought in line with thematic information to be mapped and criteria for a good base map as discussed in chapter 2. This research discovered that there are tools for adjusting these maps as discussed in chapter 4 and 5, and an experiment was done with adjusting Google Maps using Google Maps Colorizr. Basically,

three areas have been noticed where adjustments are needed in online base maps and these are: the design of the base map, reducing information content and base layers generalization. Colorizr can handle some of the problems of these base maps but still need to be improved to include more options especially with regard to generalization operators. The recommendations here are based on Google Maps (but could be same for other online base maps) and Google Maps Colorizr.

### **6.3.1. Recommendation to the developers of Google Maps Colorizr**

Our recommendation to the developers is that the following improvements should be added to the existing tool Google Maps Colorizr (or comparable tools like the Google Maps Styled Map Wizard):

- a) An option to choose and set what feature(s) should be visible at what zoom level (similar to what is available in CloudMade).
- b) To include more options for generalization operators e.g. displacement and merging. Currently only selection (through switch on/off) and simplification (only thinning of linear features) are available in Colorizr; more is needed to enable graphical generalization and a simplification that can for example smooth lines by removing some nodes/vertices.
- c) Increase the number of feature type categories so that more control on the features' visibility can be achieved.
- d) To include a save option so that users can save their settings that they can retrieve at a later stage when changes or adjustments are needed.
- e) To provide more and clear documentation about the tool especially on how the feature types were classified or categorized from the original Google Maps.

### **6.3.2. Recommendations to neogeographers**

It was mentioned earlier in the previous chapter that it is okay to use online base maps as base map for neogeography maps as long as they can be adjusted to fit the purpose. Therefore, before neogeographers embark on overlaying the neogeography data onto online base maps, it is recommended that they consider the following:

- ✓ Carefully look at the data and think of the purpose of your map.
- ✓ Think of the online base map you are going to use.
- ✓ Look at the base map and decide on the layer(s) that need to be included (that enhances your neogeography layer)
- ✓ Decide on how to present those (remaining) layer(s) / feature(s), in terms of colour and symbology.
- ✓ Think and decide on the ideal scale (zoom level) at which to visualize data depending on the purpose of the map.

Depending on the purpose of the neogeography map, the following can be applied to the base map to put it in line with the criteria as discussed in section 2.4. Google Maps Colorizr can handle these.

- ✓ The background (landscape features) of the map should contain as few colours as possible (could even be two only, representing land and water. Water can be given a blue colour that will differentiate it from land features).
- ✓ If roads are not enhancing the purpose of the map, they must be removed or reduced in quantity by leaving only the major ones, but these have to be de-emphasized.
- ✓ All less important features and texts should be removed by switching their visibility off.

- ✓ All features that are left visible on the base map should be de-emphasized to give a clear visual hierarchy when the neogeography theme is overlaid.
- ✓ Work with a targeted zoom level(s) and generalization should be for that specific zoom level, as details may change with change in zoom level due to automatic generalization.

#### **6.4. Conclusion**

This chapter discussed the results of an online survey which looked at the effectiveness, efficiency and usability of the two maps produced from the case study in chapter 5. Map fragments from the originals were present in the survey, questions related to the maps were asked and responses received from the respondents. The results shows that although there are some users / producers that feel that they are ok with the original Google Maps, most of the respondents feel that there is a need to adjust existing online base maps to fit the purposes of base map for thematic maps. Finally, some recommendations on the adjustment of Google Maps and/or online base maps in general were also given in this chapter.

## 7. CONCLUSIONS AND RECOMMENDATIONS

### 7.1. Conclusion

The number of neogeography maps available on the Internet is increasing every single day. Researchers have tried to solve the problem of cluttering icons for overlaid neogeography data while little has been done on looking at problems of online base maps that are being used as base maps for neogeography maps, although they were created for other purposes than that. Due to this, a need was felt to adjust existing online base maps and align them to a purpose of neogeography map and in line with criteria for a good base map.

In this research, an inventory of neogeography maps and the online base maps they are using was created. Google Maps as the most used base map for neogeography maps was used in the case study where it was investigated if it can be adjusted and fitted to the purpose of the map and the criteria of a good base map. For this, two tools for adjusting Google Maps namely: Google Maps API Styled Map Wizard and Google Maps Colorizr, were found and evaluated. Google Maps Colorizr was chosen for the case study implementation due to its straight forwardness and ease of use. Two maps showing the spatial distribution of points (restaurants) were produced and put to a user test through an online survey.

The main objective of this research was to identify problems associated with base maps for neogeography maps, suggest possible solutions and recommendations for improvement or adjustment of existing base map solutions. This is achieved by answering the research questions presented in Chapter 1 throughout the research:

- 1) What base maps are currently available for neogeography mapping? What are their characteristics?

In order to come up with an answer to these questions, a review of neogeography maps accessed through the Internet was done and culminated into an inventory of available neogeography maps and the base maps they are using. The commonly used online base maps they were found are: Google Maps, Yahoo! Maps, Bing Maps, OpenStreetMap, MapQuest as well as ESRI Maps (ArcGIS Online). Their characteristics are such that online base maps can help to create a geographic meaning for neogeography data, and online base maps show the basic layers that are frequently used for location references, just to mention a few. The review and the characteristics of online base maps are listed and described in chapter three.

- 2) What are the purposes of neogeography maps?

Each map available, whether it is thematic or topographic, has been created to serve a certain purpose. Neogeography maps are no exception and different neogeography map purposes are provided and discussed in chapter 3, section 3.5. Among the purposes are navigation, planning, tourism and information sharing to mention just a few.

- 3) Are the users satisfied with the current available base map solutions?

Without looking at the outcome of the usability test, one could already conclude that not all users are satisfied with the available online base maps. This conclusion was triggered by the fact that there are tools

developed to adjust available base maps (as discussed in section 4.3) to the liking of their users and to fit the purpose of the maps they are producing. The results of the usability research as presented in chapter 6 indicate that most users are not satisfied with the existing online base maps and they prefer to adjust those maps to fit their neogeography map purposes. However, some users indicated the difficulties in adjusting the base maps to their purposes, but I hope this research will point them to the right tools to use especially for Google Maps.

4) What are the main categories of problems with base maps for neogeography maps?

As the available online base maps were not produced specifically for the purpose of serving as base maps for neogeography maps, problems are likely to be experienced when neogeography data are overlaid. These problems are mentioned in chapter 2, investigated and discussed in chapter 3, section 3.6. The three main areas are: the base map design where lack of visual hierarchy usually experienced due to symbolization and colours of map features; information content which means that too much information than needed in the map will render it illegible and ineffective in communicating the message of the overlaid neogeography data; and generalization of base map layer(s) where a balance is needed between the base layers and topic layer and in accordance with the purpose scale of the map.

5) Are there currently solutions available for those problems?

In chapter 2, it was found out that there are suggested solutions on how to mitigate problems in base maps for neogeography maps, and these are elaborated on in section 4.2. Adjusting or improving the design of the base map, reducing information content and generalization of the base map are some of the suggested solutions. These adjustments can be done using available tools such as Google Maps Colorizr.

6) How can those problems be minimized, improved or eliminated?

In chapter 4, it is indicated how base maps problems can be minimized, improved or eliminated by adjusting the available online base maps. Suggestions are given specifically on how to approach those problems in Google Maps using the tools available. Design problems can be minimized by opting for fewer and de-emphasized colours assigned to base layers; features that are not needed or not enhancing the purpose of the map can be removed from the map to reduce the information content, and base map features can be generalized to fit the purpose of topic layer and user requirements.

7) What are the criteria to determine the suitability of these maps? What is the suitability of the available base maps to fulfill the purpose of neogeography mapping?

For any base map to be considered as suitable to be used as a base map for neogeography maps, it must meet some criteria for a good base map. For example, a base map should be as simple as possible, and a base map should contain (only) basic layers that help to localize the overlaid neogeography data. These criteria are given in section 2.4 of the literature review chapter. Respondents to the online survey indicated that the existing online base maps are just suitable in the absence of other freely available alternatives and mainly pointed out too much information content as the problem.

8) Can existing base maps be improved or adjusted to suit the visualization of neogeography data? What could be improved or adjusted? Are there tools available for improving/adjusting these existing base maps?

The availability of tools for adjusting online base maps are discussed in chapter 4 and demonstrated with a case study in chapter 5 where Google Maps is adjusted to meet a specific neogeography map purpose and in accordance with criteria for a good base map. Adjusting colours in the base map will help improve the visual hierarchy between base map layer(s) and overlaid neogeography topic, less important features can be removed and some other features can be generalized. Some tools are available for online base map adjustments such as CloudMade Style Editor which can be used to adjust OpenStreetMap, and Google Maps Styled Map Wizard and Google Maps Colorizr that can be used in adjusting Google Maps.

The usability research result shows that or gives an indication of the need for base map adjustment tools as some respondents expressed frustration for unable to adjust and style base maps to visualize the neogeography data in the way they want to see the in the map. Indication given is that too much information in base map than needed is one of the main problem and lack of visual hierarchy or conflicting colours that usually occur between base layers and topic layer(s) as another. It was also demonstrated from the survey responses as users felt the adjusted map function better due to its less and de-emphasized colours and less information than non-adjusted map which some users said it is distracting. However, for the case used some users also felt that it was too generalized for the given purpose as some text (e.g. road/street labels) supposed to be left in the map.

Last but not least, it must be noted that base map adjustment alone cannot completely make neogeography maps legible and effective in communicating geospatial information to end users. Therefore, it is recommended that base map adjustment should be done in combination with other design and generalization solutions for topic layers.

## **7.2. Limitations**

Although the case study produced interactive maps, it was not possible to invite users to a usability test with interactive maps due to time constraints. Maybe, some questions could have been answered differently with an interactive map rather than static images.

Another limitation is that this research could not implement and test different designs for different map purposes and at different areas. Therefore, more tests are required for other map purposes and other areas.

## **7.3. Recommendations for further research**

There are couple of things that cropped up during this research that we could not do (mainly not part of this research's objectives but linked somehow) and it may be recommended for other researchers to look at and investigate.

- ✓ There is more research needed as to the formulation of criteria for a good base map in relation to different types of map purposes so that perhaps that process can be made automatic. For example, Google Maps offering a service whereby one can just download the data he/she needs for his/her map purpose.
- ✓ Further, more research is needed to formulate base map requirements for different neogeography map purposes (e.g. planning, tourism etc.).
- ✓ To synchronize the map generalization options of the adjustment tools with the inbuilt automatic generalization of the base map(s).

- ✓ To combine base map adjustments with solutions of topic layers such as icon declustering.
- ✓ To work on existing adjustment tools or come up with new ones that allow users/producers to save their settings as well as to allow further generalization in addition to the predefined options/settings.
- ✓ Look at solutions for adjusting other base maps other than Google Maps and OSM or how the existing ones can be extended to cater for other base maps.

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## LIST OF URLS

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URL1-1	<a href="https://maps.google.com/">https://maps.google.com/</a>
URL1-2	<a href="http://www.openstreetmap.org/">http://www.openstreetmap.org/</a>
URL1-3	<a href="http://www.bing.com/maps/">http://www.bing.com/maps/</a>
URL1-4	<a href="http://maps.yahoo.com/">http://maps.yahoo.com/</a>
URL1-5	<a href="http://www.fastfoodmaps.com/">http://www.fastfoodmaps.com/</a>
URL1-6	<a href="http://haiti.openstreetmap.nl/">http://haiti.openstreetmap.nl/</a>
URL1-7	<a href="https://maps.google.com/maps/ms?ie=UTF8&amp;oe=UTF8&amp;msa=0&amp;msid=100846698290636585833.00046c2ced151dda240fa">https://maps.google.com/maps/ms?ie=UTF8&amp;oe=UTF8&amp;msa=0&amp;msid=100846698290636585833.00046c2ced151dda240fa</a>
URL1-8	<a href="http://cloudmade.com/products/style-editor">http://cloudmade.com/products/style-editor</a>
URL1-9	<a href="http://gmaps-samples-v3.googlecode.com/svn/trunk/styledmaps/wizard/index.html">http://gmaps-samples-v3.googlecode.com/svn/trunk/styledmaps/wizard/index.html</a>
URL2-1	<a href="http://resources.arcgis.com/content/local-government/basemaps">http://resources.arcgis.com/content/local-government/basemaps</a>
URL2-2	<a href="http://www.mangomap.com/maps/user/3180#">http://www.mangomap.com/maps/user/3180#</a>
URL2-3	<a href="http://www.mibazaar.com/gazaconflict.html">http://www.mibazaar.com/gazaconflict.html</a>
URL2-4	<a href="http://www.germtrax.com/Map.aspx">http://www.germtrax.com/Map.aspx</a>
URL2-5	<a href="http://cloudmade.com/products/style-editor/gallery">http://cloudmade.com/products/style-editor/gallery</a>
URL3-1	<a href="http://www.mapbuilder.net/">http://www.mapbuilder.net/</a>
URL3-2	<a href="http://geotribu.net/applications/baselayers/index.php">http://geotribu.net/applications/baselayers/index.php</a>
URL3-3	<a href="http://en.wikipedia.org/wiki/MapQuest">http://en.wikipedia.org/wiki/MapQuest</a>
URL3-4	<a href="http://www.mapquest.com/">http://www.mapquest.com/</a>
URL3-5	<a href="http://www.acreslandtrust.org/clientimages/44551/FullScreenMap.htm">http://www.acreslandtrust.org/clientimages/44551/FullScreenMap.htm</a>
URL3-6	<a href="http://www.germtrax.com/Map.aspx">http://www.germtrax.com/Map.aspx</a>
URL3-7	<a href="http://www.bing.com/maps/?form=MPSRCH&amp;style=u&amp;app=60108~sortBy~0">http://www.bing.com/maps/?form=MPSRCH&amp;style=u&amp;app=60108~sortBy~0</a>
URL3-8	<a href="http://mapapps.esri.com/disasters/social-media-pakistan/index.html">http://mapapps.esri.com/disasters/social-media-pakistan/index.html</a>
URL3-9	<a href="http://www.360cities.net/map#lat=45&amp;lng=19&amp;zoom=3">http://www.360cities.net/map#lat=45&amp;lng=19&amp;zoom=3</a>
URL3-10	<a href="http://www.amigomapper.com/">http://www.amigomapper.com/</a>
URL3-11	<a href="http://bambuser.com/broadcasts?broadcasts-tabs=map">http://bambuser.com/broadcasts?broadcasts-tabs=map</a>
URL3-12	<a href="http://www.bluemapia.com/">http://www.bluemapia.com/</a>
URL3-13	<a href="http://www.buddyway.com/">http://www.buddyway.com/</a>
URL3-14	<a href="http://www.mapmash.in/citysearch.htm">http://www.mapmash.in/citysearch.htm</a>
URL3-15	<a href="http://cliptoo.nl/site/">http://cliptoo.nl/site/</a>
URL3-16	<a href="http://www.codexmap.com/book.php?isbn=%200273722794">http://www.codexmap.com/book.php?isbn=%200273722794</a>
URL3-17	<a href="http://www.coloci.com/Default.aspx">http://www.coloci.com/Default.aspx</a>
URL3-18	<a href="http://earthquake.usgs.gov/earthquakes/dyfi/">http://earthquake.usgs.gov/earthquakes/dyfi/</a>
URL3-19	<a href="http://ebird.org/ebird/map">http://ebird.org/ebird/map</a>
URL3-20	<a href="http://www.evolutionmegalab.org/en_GB/maps">http://www.evolutionmegalab.org/en_GB/maps</a>
URL3-21	<a href="http://www.mapmash.in/f12010.html">http://www.mapmash.in/f12010.html</a>
URL3-22	<a href="http://www.fietsvakantie.eu/">http://www.fietsvakantie.eu/</a>
URL3-23	<a href="http://www.geo-wiki.org/login.php?ReturnUrl=/index.php">http://www.geo-wiki.org/login.php?ReturnUrl=/index.php</a>
URL3-24	<a href="https://latitude.google.com/latitude/b/0/">https://latitude.google.com/latitude/b/0/</a>
URL3-25	<a href="http://gregstoll.dyndns.org/scipionus/katrina.html">http://gregstoll.dyndns.org/scipionus/katrina.html</a>
URL3-26	<a href="https://ktmeq.crowdmap.com/">https://ktmeq.crowdmap.com/</a>
URL3-27	<a href="http://www.londonprofiler.org/">http://www.londonprofiler.org/</a>
URL3-28	<a href="http://www.louisvilleky.gov/MetroPolice/CrimeMaps">http://www.louisvilleky.gov/MetroPolice/CrimeMaps</a>

URL3-29 <http://www.mapmytracks.com/>  
 URL3-30 <http://www.mapmyride.com/routes/>  
 URL3-31 <http://www.mologogo.com/>  
 URL3-32 <http://www.nwf.org/404-error-page.aspx>  
 URL3-33 <http://www.nearbyfeed.com/>  
 URL3-34 <https://openalgeria.crowdmap.com/main>  
 URL3-35 <https://polskamonitor2011.crowdmap.com/main>  
 URL3-36 <http://www.free-postcode-maps.co.uk/>  
 URL3-37 <https://syriatracker.crowdmap.com/main>  
 URL3-38 <http://www.myheatmap.com/maps/ncaa>  
 URL3-39 <https://dcelection.crowdmap.com/>  
 URL3-40 <http://www.wikimapia.org/#lat=51.8&lon=4.6667&z=10&l=0&m=b>  
 URL3-41 <http://www.americanwineryguide.com/>  
 URL3-42 <https://tbddc.crowdmap.com/>  
 URL3-43 <http://open.mapquest.com/>  
 URL3-44 <http://www.mangomap.com/maps/user/2908/Politicians%20Salaries#>  
 URL3-45 <http://www.flickr.com/map>  
 URL3-46 <http://www.1940snewyork.com/>  
 URL3-47 <http://www.opencyclemap.org/>  
 URL3-48 <https://foursquare.com/explore?near=Enschede%2C%20NL&q=Clothing%20Store>  
 URL3-49 <http://www.cyclestreets.net/>  
 URL3-50 <http://voiceofkibera.org/main>  
 URL3-51 <http://openrouteservice.org/>  
 URL3-52 <https://jan30sudan.crowdmap.com/>  
 URL3-53 <http://www.mangomap.com/maps/user/2223#>  
 URL3-54 [http://www.sinsai.info/?l=en\\_US](http://www.sinsai.info/?l=en_US)  
 URL3-55 <http://www.waze.com/livemap/>  
 URL3-56 <http://www.rentcompass.com/>  
 URL3-57 <http://www.rentcompass.com/>  
 URL3-58 <http://www.tesco.com/storelocator/>  
 URL3-59 <http://trendsmap.com/>  
 URL3-60 <http://www.tvsafety.org/map>  
 URL3-61 <http://mappler.net/gasstation/#nyc>  
 URL3-62 <http://www.programmableweb.com/tag/mapping>  
 URL3-63 [http://en.wikipedia.org/wiki/Yahoo!\\_Maps](http://en.wikipedia.org/wiki/Yahoo!_Maps)  
 URL3-64 <http://msdn.microsoft.com/en-us/library/dd877180.aspx>  
 URL3-65 [http://maps.amsterdam.nl/play\\_amsterdam/](http://maps.amsterdam.nl/play_amsterdam/)  
 URL3-66 [http://en.wikipedia.org/wiki/Google\\_Maps](http://en.wikipedia.org/wiki/Google_Maps)  
 URL3-67 <http://googlemapsmania.blogspot.nl/>  
 URL3-68 <http://www.bing.com/maps/#>  
 URL3-69 <http://www.google.com/mapmaker>  
 URL3-70 <http://wiki.openstreetmap.org/wiki/About>  
 URL3-71 <http://open.mapquest.com/>  
 URL3-72 <http://resources.arcgis.com/en/home/>  
 URL3-73 <http://resources.arcgis.com/en/communities/arcgis-content/029700000044000000.htm#s=0&n=30&d=1&md=acomt-online:10000>  
 URL4-1 <http://cloudmade.com/>  
 URL4-2 <http://support.cloudmade.com/answers/style-editor>

URL4-3 <http://maps.cloudmade.com/editor#>  
URL4-4 <http://googlemapscolorizr.stadtwerk.org/#>  
URL4-5 <http://googlemapsmania.blogspot.nl/2011/04/new-styled-map-wizard-for-google-maps.html>  
URL4-6 [http://www.w3schools.com/html/html\\_colors.asp](http://www.w3schools.com/html/html_colors.asp)  
URL4-7 <http://www.color-hex.com/>  
URL4-8 <https://developers.google.com/maps/documentation/javascript/styling>  
URL5-1 <http://www.techopedia.com/definition/27866/online-survey>  
URL5-2 <http://www.ucc.ie/hfrg/resources/qfaq1.html#whatisaquestionnaire>  
URL5-3 <http://www.surveymonkey.com/>

# APPENDIX

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Online base maps' online survey questionnaire.

### Participant Details

**1. What is your gender?**

Female

Male

**2. Which category below includes your age?**

20 or younger

21-40

41-60

61 or older

**3. What is your occupation (e.g. surveyor, lecturer, etc)?**

**4. Did you ever create (a) thematic map(s) yourself?**

YES, continue to Q5

NO, go to Q19 (click the "Next" button at the bottom of this page)

**5. Which online maps have you ever used (more than one answer possible)?**

OpenStreetMap

Google Maps

Yahoo! Maps

Bing Maps

Other (please specify)

**6. Have you used online maps (like Google Maps, Bing Maps, OpenStreetMap, etc) as a base map for thematic maps?**

YES, continue to Q7

NO, go to Q19 (click the button "Next" at the bottom of this page)

**7. What kind of thematic map did you produce with online base map?**

**8. Why did you use that/those particular online base map(s) and not the others?**

**9. How often did you use the online base map(s) you have mentioned above, for the function of base map for thematic maps?**

- Daily
- Weekly
- Monthly
- A couple of times a year
- Only once or twice

**10. How often do you use the online base map(s) you have mentioned above, for other function(s) than that of base map for thematic maps?**

- Daily
- Weekly
- Monthly
- A couple of times a year
- Only once or twice

Please specify the use.

**11. How long have you been working with online base maps for the function of base map for thematic maps?**

- Less than 6 months
- 6 months to 1 year
- 1 to 2 years
- More than 2 years

**12. How long have you been working with online base maps for other function(s) than that of base map for thematic maps?**

- Less than 6 months
- 6 months to 1 year
- 1 to 2 years
- More than 2 years

**13. Do you think the online base map(s) you have used is / are suitable as base map for thematic maps?**

- YES
- NO

Please explain your answer

**14. Have you experienced any problem (e.g. with respect to design, content, etc) in your use of online base maps for thematic maps?**

- YES, continue to Q15  
 NO, go to Q16

**15. What kind of problem(s) did you experience with using online base maps for thematic maps?**

**16. Do you think there is a need to adjust the existing online base maps to serve as base map for thematic maps?**

- YES, continue to Q17  
 NO, go to Q18

**17. What should be changed or adjusted with respect to the following aspects (in view of functioning as base map for thematic maps)?**

- A. Design (of map symbols, including colours)
- B. Content
- C. Generalization

**18. Would you be prepared to adjust the base map to fit the purpose of your thematic neogeography map if that would be possible?**

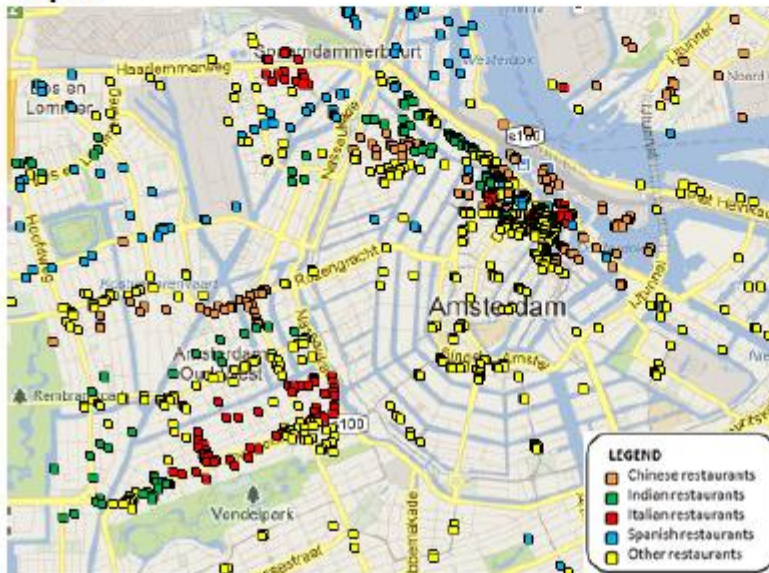
- YES  
 NO

Please explain your answer

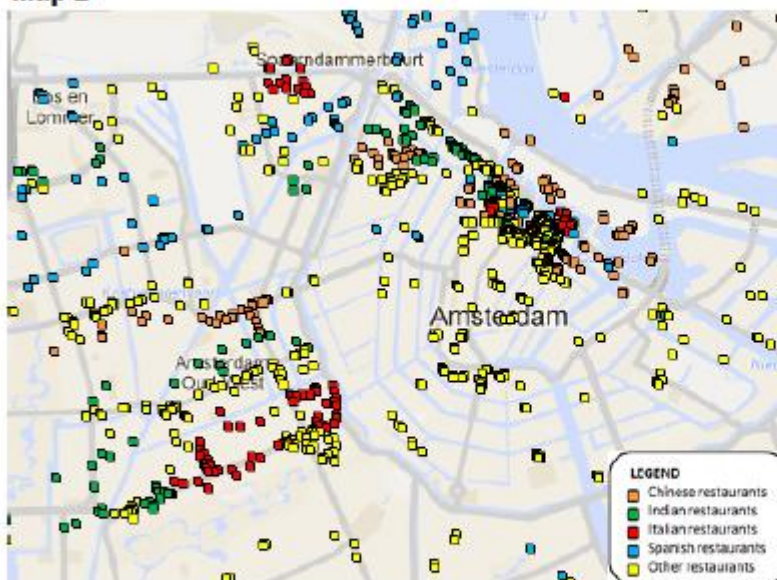
## Map Effectiveness

The following maps were created for the purpose of visualizing restaurants in the city of Amsterdam. For this survey you have to imagine that you are a municipal official responsible for giving permissions to open new restaurants in certain parts of Amsterdam. The purpose of the map does not include looking at how to navigate to those restaurants but solely to give an overview of which areas have more or fewer restaurants. The maps below (Map A to Map F) should guide you to answer subsequent questions.

**Map A**



**Map B**





**19. In which area of the map are the most restaurants? (That will be the area in which no more new restaurants may be opened).**

**20. In which area of the map do you find the most Chinese restaurants? (That will be the area in which no more new Chinese restaurants may be opened.)**

**21. At first sight of the maps, which map did you use to answer these questions (Q19 & Q20)?**

- Map A  
 Map B

Please give reason for your choice.

**22. How difficult or easy was it to find the answer to question 19?**

Easy	Not easy nor difficult	Difficult
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please give reason for your choice.

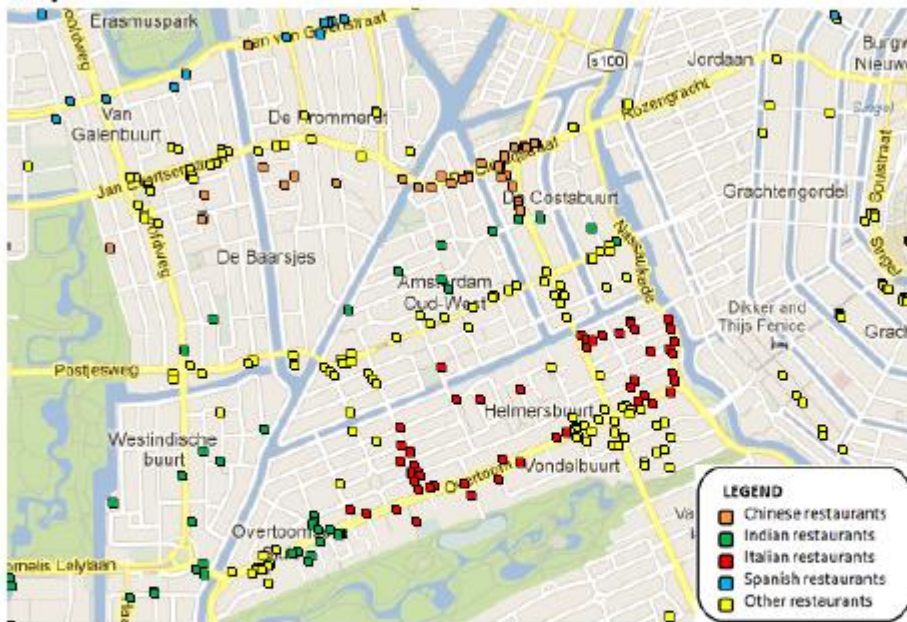
**23. How difficult or easy was it to find the answer to question 20?**

Easy	Not easy nor difficult	Difficult
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

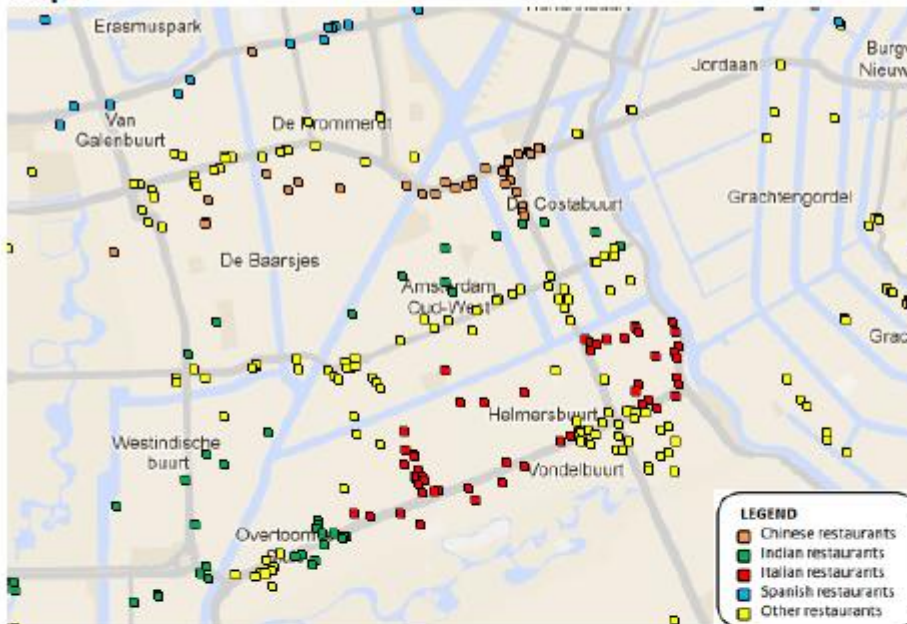
Please give reason for your choice.

The following maps shows the zoomed areas of the same maps as above (Map A & B respectively).

**Map C**



**Map D**



**24. In which area of the map are the most restaurants? (That will be the area in which no more new restaurants may be opened.)**

**25. In which area of the map do you find the most Italian restaurants? (That will be the area in which no more new Italian restaurants may be opened.)**

**26. At first sight of the maps, which map did you use to answer these questions (Q24& Q25)?**

- Map C  
 Map D

Please give reason for your choice.

**27. How difficult or easy was it to find the answer to question 24?**

- Easy                                      Not easy nor difficult                                      Difficult
- 

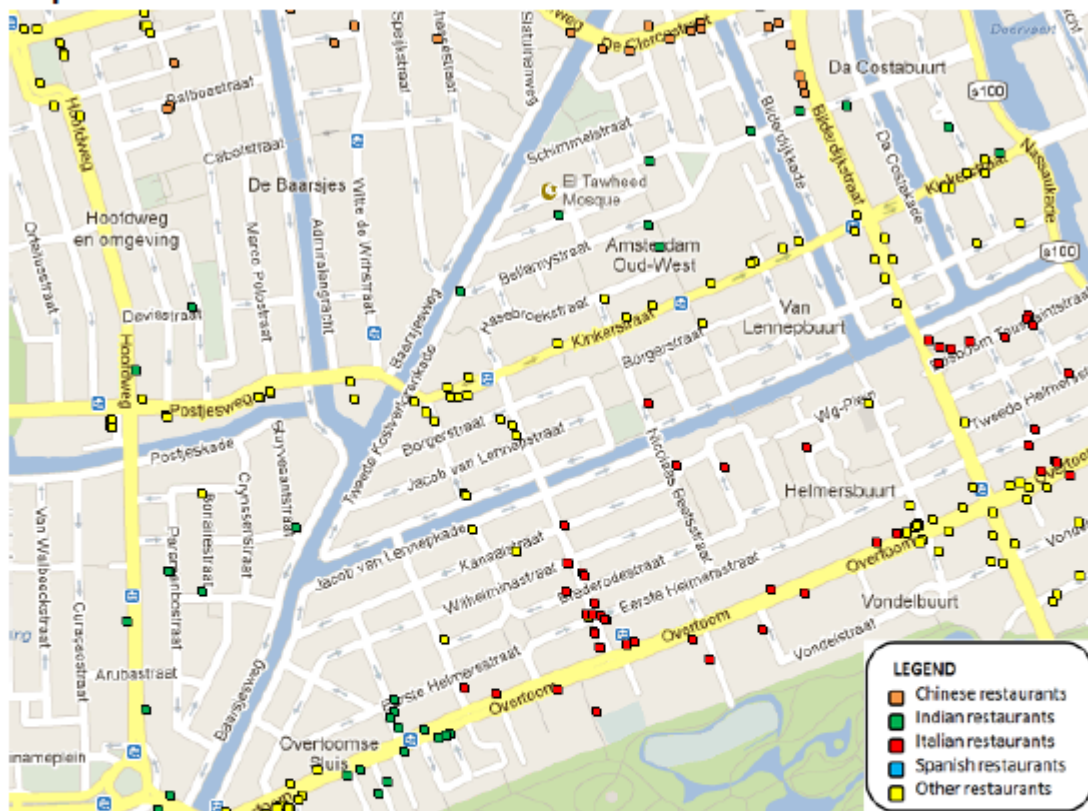
Please give reason for your choice.

**28. How difficult or easy was it to find the answer to question 25?**

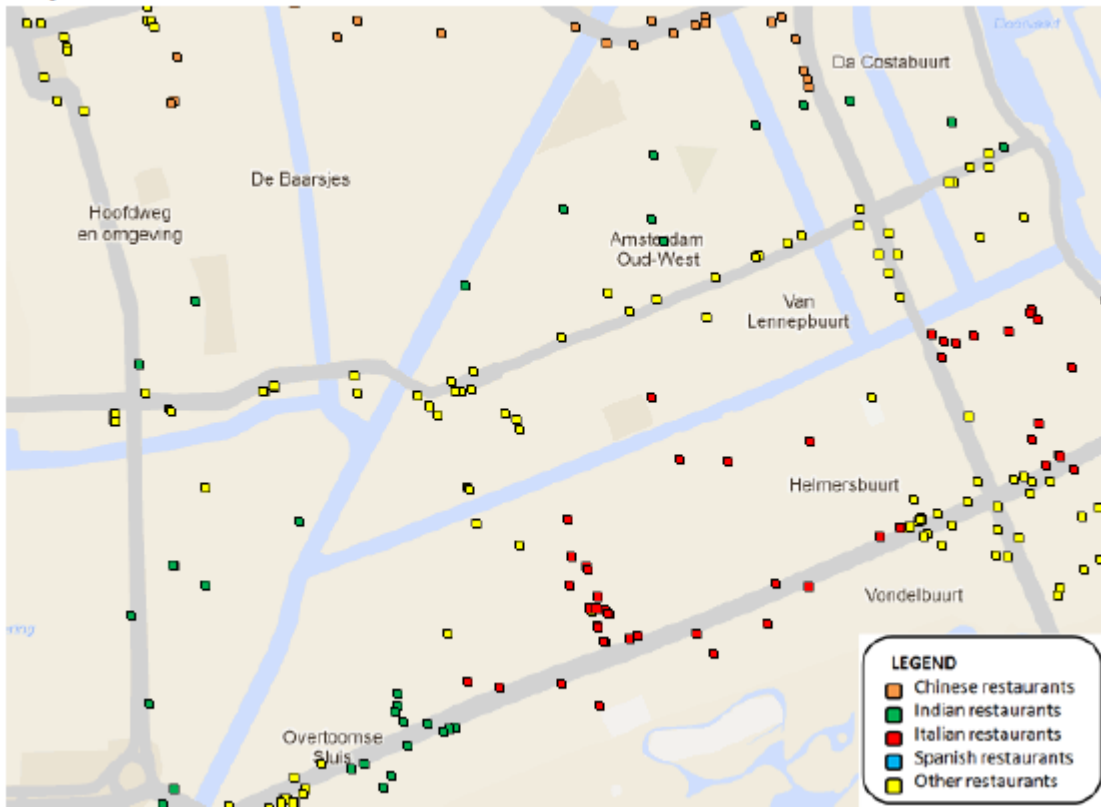
- Easy                                      Not easy nor difficult                                      Difficult
- 

Please give reason for your choice.

**Map E**



**Map F**



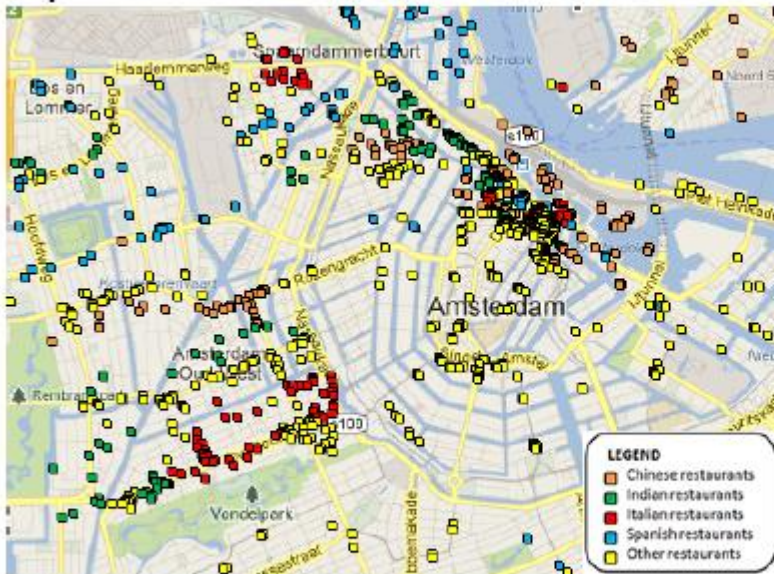
**29. Can you identify the restaurants belonging to category "other" (represented in yellow) in these maps? How difficult or easy was it to find those other restaurants?**

	Easy	Not easy nor difficult	Difficult
Map E	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Map F	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

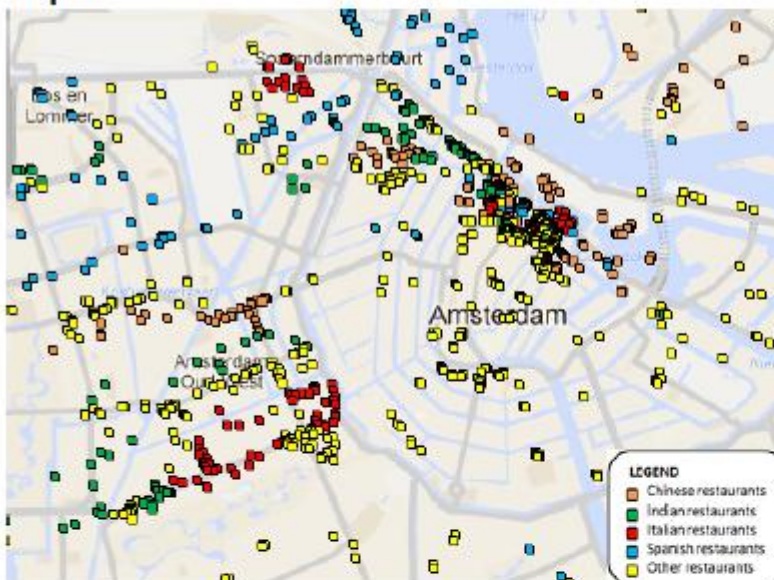
Please explain your answer

## Maps comparison

**Map A**



**Map B**



**30. Comparing Map A and Map B, which one do you think is more usable for the municipal officer for obtaining the right answers to the questions posed in the quickest way?**

- Map A  
 Map B

Please explain your answer

**31. Which base map has a better design in view of its function as base map for this particular thematic map?**

	very good	good	ok	bad	very bad
Map A	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Map B	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please explain your answer

**32. Which base map has a better content in view of its function as base map for this particular thematic map?**

	too much	ok	too little
Map A	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Map B	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please explain your answer

**33. Which base map has a better generalization in view of its function as base map for this particular thematic map?**

	very good	good	ok	bad	very bad
Map A	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Map B	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please explain your answer

**34. Will your answer to questions 25 to 28 be the same if we use Map C vs Map D or Map E vs Map F, instead of Map A vs Map B?**

- YES  
 NO

Please explain your answer

**35. Please give any other comments or suggestions you may have about the two maps.**

**36. Statistics show that Google Maps is being used as a base map more often than all other online base maps combined. Do you have any idea why Google Maps is the most used online base map in this regard?**