Chapter 4

The Need for Geospatial Data

4.1 Two worlds of mapping

Present-day users of web-based mapping products such as Google Maps are presented with an extremely rich cartographic landscape when they view maps of first-world urban centers such as New York and San Francisco. Real-time traffic data may be overlaid in lines of shifting red and green, and many buildings appear in orthographic '3D'. Well-known restaurants are interspersed with subway stops whose schedules may be called up with a few clicks. Routing algorithms offer turn-by-turn directions, optimized for pedestrians, bicyclists, and motorists.

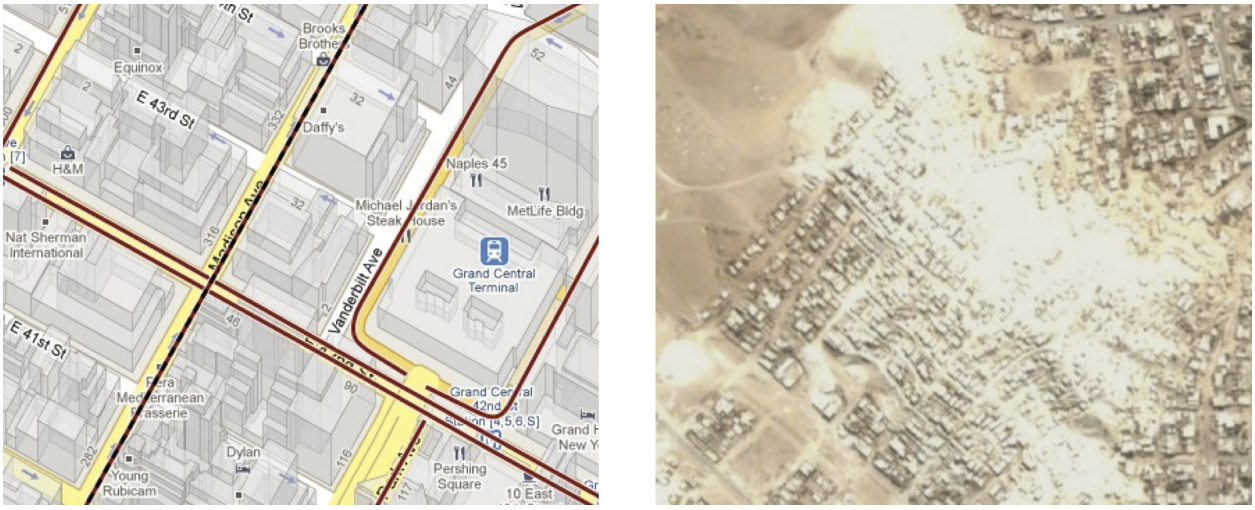

Figure 4.1: Views of Manhattan, left, and a settlement in Lima, Peru, right, as seen in Google Maps http://maps.google.com

Many are surprised when they use Google Maps to 'visit' places such as Lima, Peru, a metropolis of 11 million people, only to find that not far from the city center are vast areas of indistinct and unlabelled buildings. While some of these are recognized and official parts of the Municipality of Lima, many are informal settlements, whose inhabitants lack title to their lots of land, and whose streets and buildings do not appear on any city map. Many of these settlements, or 'invasions' as

they are known to Peruvians, are governed by leaders who are either elected by the several hundred inhabitants, or who maintain control through intimidation — employing thugs to collect taxes and enforce rules.

This state of extralegal urban sprawl exists in many parts of the world; according to UN-HABITAT, more than a sixth of the world's population lives in urban slums, and that number is likely to double by 2030. [77] A legal process may exist to establish official land ownership in these settlements, and to issue deeds to their inhabitants (as it does in Peru), but in many cases the state lacks the resources to quantify or map these areas. UN-HABITAT data indicate that 'many local governments do not have mechanisms to monitor urban growth in a systematic manner, even less to monitor informal urban growth' and that '80 cities out of 120 recognize that they do not possess monitoring systems to track changes in the spatial dimension of the city' [78]

While accessible and participatory mapmaking is by no means a solution to this problem, many of the negotiations occurring in such areas are taking place in the language of cartography — whether intentional or not, cartographic invisibility is often the first step to settlements' exclusion from planning processes:

> ...slums — all variety of precarious settlements — represent the 'invisible' city, often omitted from official maps and documents and frequently physically hidden by local authorities by colorful walls and fences. — UN-HABITAT [76]

4.2 Mapping for social change

Activists have used maps to defend vulnerable areas for decades; Jai Sen's work defending Calcutta slums, discussed in Section 3.4, is a good example. More recent efforts by Rio de Janiero-based Rede Jovem seek to promote the culture of the city's favelas using maps, in part to protect them from the imminent relocation due to the upcoming 2016 Olympics. At the Maps for Making Change project by Bangalore-based Center for Internet and Society and Tactical Technology Collective, participants advocate mapping the 'greyed-out zones' and using 'geographical mapping techniques to support struggles for social justice in India'. [72]

PGIS researchers have also established a strong case for the diverse needs which participatory mapping can address. Robert Chambers lists several, ranging from benefits to outside aid organizations to direct benefits to the local community:

> - 'Social mapping, identifying people 5, livestock, children who do and do not go to school, people in different livelihood and other social categories, wealth and wellbeing groups...
> - 'Health mapping, for people with health problems, disabilities, special knowledge etc in communities. In the UK participatory mapping by women has shown the location and concentrations of breast cancer (Lynn et al n.d.)
> - 'Farm mapping, combined with mapping of nutrient flows within the farm and over the farm boundaries (as undertaken by many organic farmers in Karatina, Nyeri District, Kenya in 1996)'
>
> [15]

4.3 Environmental assessment

As Chambers notes, beyond issues of land rights and ownership, there are many other potential uses for inexpensive map data; the ability to produce photographic, or raster maps of sensitive environmental sites may empower small organizations which are unable to acquire timely or high resoultion satellite images of sites of interest. Aerial imaging is a form of mapmaking particularly suited to environmental monitoring due to its ability to not only delineate regions of social and political interest, but raster data which can be used to compare plant growth, erosion, and even animal life. One case study we will examine is that of a group of environmental activists known as Coal River Mountain Watch. The West Virginia-based group have sought to gather meaningful and quantitative evidence of the environmental damage and health hazards of mountaintop removal mining across the Appalachia region of the United States. Besides the prohibitive cost of traditional satellite imagery and high level of expertise required by traditional GIS tools, they and other environmental activists strive for data which will make a visceral and emotional impact on policymakers and regulators, as well as the general public.

Currently, activists in Appalachia make widespread use of water conductivity tests to determine the degree of contamination in waterways due to runoff and blackwater releases. Conductivity is a secondary measure, and, though highly standardized, cannot convey the same sense of urgency as photography of, for example, a blackwater release, or the devastation that persists even in supposedly replanted reclamation sites. Aerial imaging, or specifically mapping, is an ideal blend of direct measurement and visual impact, and its main detractor is its price; overflights cost hundreds or thousands of dollars each and image processing is labor- and skills-intensive. A collaborative project examining the applicability of Grassroots Mapping tools to this problem was performed in May 2010 and is discussed in Section 10.1.

4.3.1 Asset allocation mapping

A subset of environmental monitoring is asset allocation mapping. Asserting a voice in the management of natural resources is dependent on quantitative information on the extent and valuation of the land, which is often carried out using GIS, a language of power from which local communities are often completely excluded. Peter Poole's article 'Is there Life after Tenure Mapping?' and report 'Information: the First Conservation Asset' examine in detail a number of case studies where participatory mapping was used by indigenous communities to support the 'stewardship of biodiversity' [64]. Citing examples of his and others' work from Venezuela, Suriname, Belize, and elsewhere, Poole shows how cartographic techniques helped not only to monitor the activities of industrial development and extraction industries, but in some cases to take legal action against such initiatives.

Poole distinguishes between asset-based strategies and rights-based strategies, where the former uses GIS tools to assert local control over territory in specific actions against asset extraction industries, rather than the rights-based approach of seeking broad legal recognition of territorial claims at the state level. [63] While some of the examples he cites make use of GPS track collection or sketch mapping, the emphasis on environmental assets often necessitates raster imagery instead of coordinate data, and as such, Poole's project in Belize has made use of light aircraft photography, as well as kite and balloon photography, in collecting and presenting evidence to support claims. [64] The successes of this strategy present an exciting opportunity for such dramatically lower cost

aerial photography techniques as offered by the Grassroots Mapping project, and I am excited by the prospect for future collaboration.

4.4 Open geodata and crisis mapping

4.4.1 Crisis mapping and Ushahidi

The ability of participatory mapping to provide accurate on-demand maps of changing situations has obvious applications in disaster response and management. A variety of different crowdsourced or grassroots mapping strategies have evolved in recent years with the intent to respond to, document, analyze, and report on the real-time occurrence of disasters and crises. From environmental crises such as the April 2010 BP Oil Spill in the Gulf of Mexico to the humanitarian crisis in the aftermath of the January 2010 Haitian earthquake, a clear need has evolved for low-cost, decentralized situational awareness and documentation tools with geospatial features. Here I discuss some of the challenges of fulfilling such diverse needs under unpredictable conditions.

Ushahidi

The Ushahidi platform has emerged as a common and easy-to-install system for crowdsourced crisis reporting. Developed in collaboration with Kenyan programmers to help voters report election violence in Kenya in 2008, it allows citizens with mobile phones to send 140-character text messages to a publicized telephone number. [56] These messages are read by a group of editors, who attempt to identify where the messages were sent from, and are published on a web site as red markers at their best-guess location. That users self-report their locations, and may do so inaccurately, is tolerated because it may represent a means of privacy for some users, though Patrick Meier also suggests that in the aggregate it is quite difficult to 'fake' an event. [49] In many cases no verification of reports is possible, yet in emergency response situations this has proven not to impede the use of Ushahidi data by agencies such as (in the Haitian earthquake of January 2010) the Coast Guard, the US Marine Corps, and FEMA. [47][46]

Ushahidi works in many cases because it is superficially simple to understand: visitors to an Ushahidi web site see a series of dots with messages such as 'I'm stuck under rubble' and imagine a person sending such a message from their cell phone. It makes use of existing communications infrastructure — namely that most people have cell phones — and relies on both on the ability to send text messages and a willingness to send reports to a site which is not immediately viewable. However, Ushahidi is not a means to 'make' a map per se, but rather to collect data on events occurring at specific times, and correlating them with an existing map.

Ushahidi has been successfully used to gather and publish extremely up-to-date information about unfolding crises, for example in the instance created by the New Orleans-based environmental group Louisiana Bucket Brigade (LABB) in response to the BP oil spill in April 2010. The kind of information it provides, however, is difficult to verify or to quantify, and is more useful in the context of emergency response than in evidence-gathering. [48] Locations must often be approximated to the nearest town or city, and most reports are often just a few words with no name or photographic evidence. While geotagged photographs can be uploaded to Ushahidi, EXIF data can be falsified, and in many cases there is an additional need for quantitative data. Map imagery provides more

comprehensive information in that every pixel of a map has a corresponding location in the real world, allowing it to be correlated against other maps.

A combined strategy involving the use of an Ushahidi-like platform with aerial imaging can result in clusters of crowdsourced reports providing target sites for followup mapmaking sessions. This process was employed in the BP oil spill in the Gulf of Mexico between the LABB Ushahidi instance and LABB-led Grassroots Mapping trips.[1] Maps of oil-affected areas were then posted back to the Ushahidi site as TMS layers.

Satellite imagery

Public access to up-to-date imagery of crisis areas has become somewhat of a hot-button issue in crisis mapping circles, as those companies and agencies in control of the imagery do not always elect to release it, or to license it freely for any use. Whether due to an unwillingness to offer expensive imagery for unrestricted use, or due to the administrative burden of actually publishing such data for download under a permissive license, access to satellite imagery has become a frequent bottleneck for aid organizations.

Specifically in the bottom-up response to the Haitian earthquake and subsequent humanitarian crisis of January 2010, access became more difficult within weeks of the crisis. While GeoEye and other vendors generously offered open access to satellite imagery in the initial weeks of the crisis, most did not elect to do so on an ongoing basis, or for subsequent crises such as the February 2010 earthquake in Chile. This has caused a great deal of frustration for those outside the largest and wealthiest organizations. Specifically, Google and GeoEye's decision to revert to their standard license (severely limiting reuse) for new satellite imagery of Port au Prince after January 2010 elicited questions from the broader crisis response community, as voiced by Mikel Maron on the Crisis Mappers mailing list in late April 2010:

> Maybe you can explain why Google has not continued the extremely helpful position it had in January? Is the community of CrisisMappers doomed to lose that culture of sharing? Can't we do better?

In the February 2010 earthquake in Chile, a similar plea for imagery was sent to the same list, prompting a reply from a UN-SPIDER representative. UN-SPIDER or the United Nations Platform for Space-based Information for Disaster Management and Emergency Response, is an organization whose self-described aim is in 'providing universal access to all types of space-based information and services relevant to disaster management' which it fulfills by 'serving as a bridge to connect the disaster management and space communities...' [79]. However, the organization has been slow to adopt truly open data sharing policies, and to date makes relatively few data sets available to the public; most are reserved for so-called *Authorized Users* — typically government agencies and large disaster response organizations. [74]

Ultimately, citizen-led mapping efforts present an opportunity to bypass this bottleneck by providing high-resolution, timely aerial imagery at low cost. Such an effort occurred during and after the 2010 BP oil spill in the Gulf of Mexico and is discussed at length in Chapter 8.

[1] See Chapter 8