TWEETING UP A STORM

THE PROMISE AND PERILS OF CRISIS MAPPING

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INTRODUCTION

In 1998, Slonecker *et al.* published an article in *Photogrammetric Engineering & Remote Sensing* titled, "Emerging Legal and Ethical Issues in Advanced Remote Sensing Technology." They described the development of a new generation of sensors and capabilities, and the rise of a global information infrastructure facilitated by the expansion of the Internet. The authors observed the economic restructuring of the remote sensing community that expanded the control and distribution of remotely-sensed imagery and other products from the U.S. government to foreign governments and multi-national corporations. They posited that the combination of these fundamental changes would have significant legal and ethical consequences, including privacy and constitutional guarantees against unreasonable search.

Fifteen years later the geospatial and remote sensing fields are experiencing another wave of significant technological, institutional, and social change. We continue to see innovations in mapping technologies (e.g., wireless sensor networks, lidar, intelligent 3-D multisensory detectors, interior mapping) and another restructuring of the U.S. commercial remote sensing industry with the merger of Digital Globe and GeoEye (Walsh 2013). The most disruptive change has come from the expanding role of the public in generating and using geographic and geo-referenced information.

This involvement can be seen in efforts of academic institutions and government agencies to foster broad public participation in scientific research, from classifying galaxies and collecting environmental data to collectively solving the structure of an AIDS-related enzyme through a protein-folding game (http://www.zooniverse.org.). It is also present in the aftermath of recent disasters, where people use cellphone cameras and social networking tools to help authorities find missing people, connect survivors with needed supplies, map affected areas, and alert those on the ground to changing conditions (Crowley and Chan 2011, Wardell and Yu 2011). This paradigm shift towards crowdsourcing, location-based social networking, and collaborative mapping is blurring our conception of "expert" and "amateur" (Elwood *et al.* 2012, Goodchild 2009, Rana and Joliveau 2009). It is also shifting information production and distribution from governments to individuals.

New technologies and approaches come with new risks and responsibilities. As government agencies and other organizations attempt to innovatively incorporate crowd-generated data into their traditional workflows, they will face many challenges surrounding trust and credibility, privacy, security, intellectual property, accessibility, and liability. All will need to be addressed before agencies can take full advantage of these new tools.

These issues are further complicated when crowd-generated data is used in the context of vulnerable populations during a crisis, as evident in the emerging field of *crisis mapping* (related terms: community remote sensing, crowdsourced mapping, crowd mapping). Crisis mapping is an inter-disciplinary field that aggregates crowd-generated input data, such as social media feeds and photographs, with geographic data, to provide real-time, interactive information in support of disaster management and humanitarian relief (Meier 2011a). This article provides a brief overview of the emerging legal and ethical issues within crisis mapping. It does not provide any legal advice.

A CHANGING LANDSCAPE

The role of the public in generating and publishing geo-referenced information has gradually expanded. It has been fueled by the development of web-based mapping platforms, a growth in mobile technology usage, the phenomenal popularity of social networking sites, and the recognition that crowds can tackle large and complex problems (Goodchild 2007, 2010; Shilton *et al.* 2009). Different roles and relations of the public to technology, and the government to data production, have also accelerated this development, but this paper focuses mostly on the technological shifts and their legal and ethical implications. Some of the key shifts include:

Web-based Mapping Platforms. The 2005 launch of Google Maps and Google Earth, freely available, user friendly online platforms, dramatically increased awareness and use of geospatial data by the general public. The evolution of web-based mapping and web Application Programming Interfaces (APIs) allowed users to combine multiple web services into new applications often called "mashups." Web scripting libraries such as Asynchronous JavaScript and XML (AJAX), popularized in the mid-2000s, allowed dynamic page interactivity, a central technological component to many web mapping sites. Open mapping platforms like OpenStreetMap, Ushahidi, and MapStory enable individuals and virtual communities to remotely share, co-create, and curate knowledge spatially and in near-real time.

Mobile Technologies. According to the International Telecommunications Union (ITU), the world has nearly as many cell phone subscriptions as inhabitants: more than 6 billion (ITU 2011) smartphones are GPS and Internet enabled. The next generation of mobile telephones is equipped with altimeter sensors to detect elevation or location in a building, bio-sensors to monitor health, and air quality and other sensors to monitor pollution. In response to the 2011 Fukushima nuclear disaster in Japan, SoftBank's Pantone 5 107SH mobile phone now comes with a built-in radiation detector (Byford 2013). These capabilities, quite different than ten years ago, have streamlined producing and sharing geo-tagged information.

Social Media. Social networking services, such as Twitter, Facebook, Flickr, and YouTube, are connecting millions of people across the globe and changing how people share information. The development of location-based social media over the last few years, as Sui and Goodchild (2011) note, has created stronger links between physical location and cyberspace. It is providing new spaces for individuals to connect with each other across geography and interests, for groups to mobilize grassroots action, and for data scientists to track crowd behavior and forecast emergent crises. This trend is expected to continue. Facebook has more than 1 billion monthly active users and 680 million mobile users, Twitter has 500 million users (Smith 2013), and other services like Qzone, Pinterest, Tumblr, and Instagram are growing rapidly.

The Capable Crowd. The convergence of technology with crowdsourcing, citizen science, and participatory mapping has placed the power of mass collaboration and collective intelligence into the hands of citizens and organizations (Craiglia *et al.* 2012, Goodchild 2007). The neologism *crowdsourcing*, coined by Howe in 2006, has been defined as a method of outsourcing tasks to a large group of distributed individuals. However, it is now being applied to a broad range of crowd-related activities, including data production, data processing, problem solving, and providing access to personal computing resources (Goodchild and Li 2012, Burns and Shanley providing access to personal computing resources (Goodchild and Li 2012, Burns and Shanley 2013). Crowdsourcing also includes gathering crowd-generated information from social media that may not have been intended for these purposes. This passive role of the crowd in data production has nevertheless been deemed useful for many diverse applications (Harvey 2013).

A new form of "digital volunteerism" has emerged. Grassroots volunteer and technical communities are engaging people around the world to tackle problems of common interest using these new tools and approaches (Capelo *et al.* 2012, Jones *et al.* 2012). The potential of these efforts has received growing attention in disaster management and humanitarian aid (Wardell and Yu 2011, Liu and Palen 2010, Goodchild and Glennon 2010). The International Network of Crisis Mappers has blossomed from a small community of interest to a global network of more than 5,000 members, representing response organizations, government, academia, the private sector,

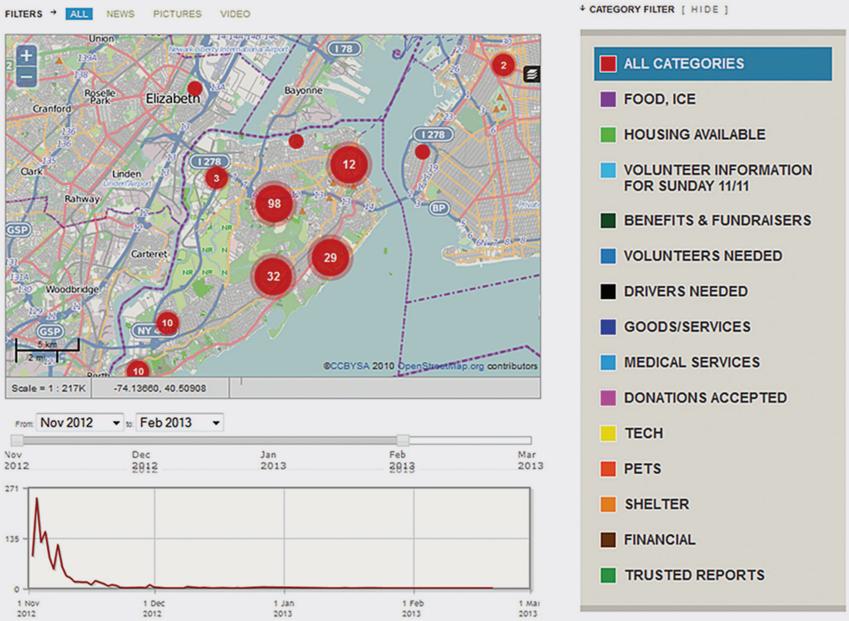

FIGURE 1. HURRICANE SANDY CRISIS MAP.

Crisis map of filtered and aggregated social media posts developed in support of the Hurricane Sandy relief and recovery efforts for Staten Island using the Ushahidi platform. © 2012, Mo Krochmal. Used with permission. Available at: https://statenisland.crowdmap.com/main

Non-Governmental Organizations (NGOs), grassroots volunteer groups, and the public (Zeimke 2012). Crisis mappers "leverage mobile and web-based applications, aerial and satellite imagery, geospatial platforms, advanced visualization, live simulation, and computational and statistical models, along with participatory and crowdsourcing approaches, to support early warning, situational awareness, and data synthesis for rapid response to natural disasters and complex humanitarian emergencies" (for example, Figure 1).

This volunteerism also can be found in the resurgence of interest in citizen science. These efforts include "citizen seismology" projects like the U.S. Geological Survey's Did You Feel It? (Young *et al.* 2013), providing a rapid and cost-effective way of generating earthquake intensity maps based on citizen reports submitted online. They also include individuals keeping logs on their health, aiding researchers and hospitals in tracking the spread of influenza and other diseases (Marcus 2011).

Do-It-Yourself grassroots groups are building and deploying inexpensive kites, balloons, and unmanned aerial vehicles (UAV) equipped with cameras and other sensors to assess the severity and extent of damage after disasters (Barnes 2012, see also OpenInfrared (http://openir.media.mit.edu/main) and Public Laboratory (http://publiclaboratory.org/tool/kit-balloon-hybrid). Similarly, the U.S. Federal Emergency Management Agency (FEMA) enlisted the help of Civil Air Patrol volunteers to collect 24,000 aerial images in the aftermath of Hurricane Sandy. In collaboration with this pilot effort, the Humanitarian OpenStreetMap MapMill project utilized 3,000 volunteers to process these images in less than a week for rapid assessment of storm and flood damage (Chan 2013).

Remote sensing and satellite imagery communities are connecting to the crisis mapping community through the efforts of the United Nations Office for Outer Space Affairs (UNOOSA). UNOOSA initiated the Platform for Space-based Information for Disaster Management and Emergency Response, which supports capacity building to process and analyze satellite data, facilitates access to imagery, and hosts an annual "Expert Meeting on Crowdsource Mapping for Disaster Risk Management and Emergency Response" (UNSPIDER 2013). Efforts like Amnesty International's Eyes on Darfur (http://www.eyesondarfur.org) and the Satellite Sentinel Project (http://hhi.harvard.edu/programs-and-research/crisis-mapping-and-early-warning/satellite-sentinel-project) are monitoring and analyzing satellite imagery during humanitarian crises and posting action alerts to Twitter. Thus, these communities use new technologies and approaches to provide a human rights and human security early warning system.

EMERGING LEGAL AND POLICY CHALLENGES

By harnessing the collective power of "the crowd" and engaging communities in their own response and recovery efforts, this convergence of GIS with social media has the potential to transform crisis management and create new capacity for community resiliency and self-reliance. But new tools and approaches come with strings attached, such as privacy, liability, and intellectual property (Pomfret 2010, Scassa 2012, Shoenmaker 2011). Legal and policy frameworks need to be adjusted, clarified, or built anew.

NEEDLE IN THE HAYSTACK

Data flowing from the public can be messy. It is often loaded with non-essential information—unrelated opinions, jokes, and off-topic conversation. The variety, complexity, inter-connectedness, and speed of information can be overwhelming for crisis managers. Hurricane Sandy sparked more than 20 million "tweets" on Twitter alone (Shih 2012). Response organizations typically do not have the resources to sift through these massive data streams to extract actionable information.

What can be done to realize the promise of crowd-generated information for disaster response? The urgency of crisis response and the higher temporal resolution of these new information streams will require faster and continuous processing and analysis. New techniques and tools are needed to automate data extraction and integration. Two areas of research show promise. The first is computational and information science research in socially distributed knowledge representation, machine learning, and reasoning (Palen *et al.* 2010, CRICIS 2012, Starbird *et al.* 2012). One example of this research is TweetTracker, developed at Arizona State University (Barbier *et al.* 2012). TweetTracker is an open system that allows groups to collaboratively track, filter, analyze, visualize, and map social media feeds in real time. A grand challenge is the development of intelligent systems for crowdsourcing "in which computer agents learn about tasks and about the competencies of [individuals] contributing to solving the tasks, and make effective decisions for guiding and fusing multiple contributions" (Kamar *et al.* 2012, 1).

How do we integrate crowd-generated data of uncertain origin and precision (e.g., photos, text, audio, documents, blog posts, and tweets) with traditional sources, such as satellite imagery, geospatial data, scientific data and models? How do we identify patterns, and synthesize and make sense of the near-endless flow of information? This brings us to the second area of research, *spatial dynamics,* which emphasizes spatiotemporal integration of humans, societies, economics, and the environment; models dynamic complexity and aggregates across socio-spatial scales; and works toward socio-economic sustainability (Yuan *et al.* 2012, Sui and Goodchild 2011, Wright and Wang 2011, Goodchild 2010). Each disaster presents a unique set of factors. But in the cases where they translate to other disasters, responders may be able to predict how the disaster may unfold. Social media increases the number of factors and contexts to consider, but spatial dynamics may help make sense of this larger set of variables. This research may be limited. Human, social, and economic systems behave in ways not easily captured by the quantitative modeling approach favored by spatial dynamics research.

TRUST AND CREDIBILITY

Peoples' lives are at stake in crisis situations, so trust and credibility play a critical role in what data are used and why. Crowd-generated data does not usually come with metadata or assurances of its quality. Instances of exaggerated, inaccurate, or outright false information may be an inherent problem, as evidenced by the hoax photos and rumors circulating on Twitter during Hurricane Sandy (Madrigal 2012). On the other hand, crowd-generated data is relatively inexpensive to collect and often timely (Goodchild and Li 2012).

Response organizations work to avoid risk. They are understandably reluctant to use unverified information from unknown individuals. Crowd-generated data can be evaluated with traditional fit-for-use criteria. Verification methods are also in development, some of which Goodchild and Li (2012) categorized into crowdsourcing, social, and geographic approaches (See also Haklay 2010). The crowdsourcing approach refers to allowing error detection and correction by other volunteers—"self policing." The social approach would rely on a small group of trusted individuals and groups to act as gatekeepers and vet the data before it becomes accepted into the general dataset. The geographic approach would use rules about how things exist in the world to automatically detect potential errors. For instance, if a volunteer maps a coffee shop in the middle of a lake, this is likely an error. A fourth method found by Mummidi and Krumm (2008) involves aggregating multiple reports of a single phenomenon and deriving the "average" location of these reports in high-volume data production areas. Combining traditional data representation frameworks, such as relational databases, with modern probabilistic graphical models, to cipher user intention, trust, and relevance is another line of promising research.

Regardless of how trust is ascertained, it is important for emergency responders to recognize and account for the uneven nature of crowdsourced data: significantly higher amounts of credible data are produced in dense urban environments. This is not to imply that data are less accurate in non-urban areas, but that fewer numbers of contributions and error-correctors make authoritative datasets more complete and reliable (Haklay 2010). In other words, there is a spatial discrepancy between well-mapped and not-so-well mapped areas (Haklay 2013). In the heat of a crisis, the currency of the information and credibility of the source may be more important than achieving extremely high accuracy and completeness (Goodchild and Glennon 2010). Methods for assessing credibility include seeking independent confirmation of the information (Coleman *et al.* 2010), using trust and relationship models (Bashir and Janowicz 2010), and factoring in the proximity of the source to the situation. For example, do they have in-depth local knowledge or are they contributing remotely (Latonero and Shklovski 2010)? Within the context of social media, new research by Castello *et al.* (2012) reveals a surprising "correlation between how information propagates and the credibility that is given by the social network to it," allowing them to develop an automated way of identifying credible information on Twitter.

To gain the trust of the formal response community, digital volunteer groups will need to build a reputation for being reliable and consistent. GISCorps, for example, carefully vets all incoming volunteers, provides guidance on workflow, and solicits feedback from agencies and volunteers upon completion to ensure the quality of their efforts (GISCorps 2013). The Virtual Operations Support Team (VOST) concept, developed by emergency manager Jeff Phillips, integrates "trusted agents"—a mix of professional emergency managers and vetted volunteers—into local emergency operations to support social media and communications with the public (St. Denis *et al.* 2012). Internationally, the United Nations Office of Coordination of Humanitarian Affairs launched the Digital Humanitarian Network in 2012 to coordinate the efforts of self-organized volunteer groups, like GISCorps, Humanitarian OpenStreetMap team, and the Standby Task Force, with the work of the formal international response community (http://digitalhumanitarians.com).

PRIVACY

A few contentious, high-profile cases have propelled location privacy issues to the foreground of the national dialogue. In the 2012 case *United States v. Jones*, the U.S. Supreme Court ruled that GPS tracking by the government constitutes a "search" under the fourth amendment (Bloomberg Law 2012). Domestic unmanned aerial vehicle (UAV) use by law enforcement has expanded and resulted in backlash in some communities (ACLU 2013). Other concerns have arisen around Facebook's changing privacy policies and Google StreetView's privacy and trespassing breaches, (EPIC 2012, PC World 2012). Privacy concerns over mobile phone applications prompted the Federal Trade Commission to issue recommendations (de Montjoye *et al.* 2013, FTC 2013).

Using social media and collaborative web-based mapping inevitably raises privacy concerns (Acquisti and Gross 2009, Boyd 2011, Boyd and Crawford 2012, Obermeyer 2007). Digital volunteers and responders sometimes aggregate many disparate datasets. While a single dataset may not erode privacy, combining several may create greater risk (Elwood and Leszczynski 2011). Because data continue to live on the Internet long after a disaster and might be used for other purposes (colloquially called "function creep"), privacy and ethical issues persist. How do we protect the privacy and safety of individuals, and especially of vulnerable populations, both during and after a crisis?

There are factors that distinguish privacy concerns in these new data production technologies from older-generation technologies like GIS. First, geographic information is now attached to new forms of data. Social networking, crowdsourcing, citizen science, and collaborative mapping have introduced many new kinds of data to which geographic location information are being attached. Flickr adds geographic referencing information to many images submitted to its site, and social networking sites like Facebook automatically register and publish the location from which someone posts information. For citizen science, geotagging is central to individuals' ability to contribute photographs, environmental records, and monitoring. Information about a person's location also has been recorded without their knowledge or for purposes other than its original intent, using the GPS tracking functionality of smartphones (Bilton 2012, Chen 2011). Many people post information to public social media sites without considering that it may be monitored and mined by others. Concerns for privacy naturally stem from different cultural, generational, and gender perceptions of what constitutes an intrusion, yet within disasters these concerns may have more severe implications. Further, whereas geo-referenced information was represented primarily in map form in the last generation of geospatial technologies, it now pervades many aspects of social activity, such as updating a social media "status," or giving a natural language descriptor in a crisis map or environmental monitoring report.

Second, privacy is often balanced with competing interests, including operational needs, transparency, and national security, but how people weigh the benefits of privacy or the impediments it generates may shift considerably depending on the contexts and the culture in which it is situated. More research is needed to determine the degree of privacy individuals and social groups are willing to surrender in different situations. Some may be more willing to have government agencies monitor individual social media accounts or collect geotagged photographs in disaster situations than they would be on a day-to-day basis. To address these concerns, the U.S. Department of Homeland Security instituted limitations on its monitoring activities, restricting any tracking of individuals via social media (Lindsay 2011). The willingness to give up some degree of privacy may also vary across different social groups. It has been shown that people who feel vulnerable on social media often expect, or need, a greater degree of privacy than others, often requiring anonymity (Boyd 2011). Victims of domestic violence, foreign workers, political dissidents, and refugees fall within these highly vulnerable groups.

Privacy is especially a concern when it comes to locating, documenting, and connecting missing persons through crowdsourced online registries in the aftermath of disasters. A recent report sponsored by the Woodrow Wilson International Center for Scholars found that while legal frameworks for protecting missing persons data in Europe is quite strong, privacy frameworks in the United States primarily restrict federal agency and private sector data usage (Gellman *et al.* 2013). The United States lacks a central privacy coordinating agency, and only two federal laws have been enacted to protect privacy (Gellman *et al.* 2013, 58). The first, the Health Insurance Portability and Accountability Act (HIPAA) of 1996, pertains to medical information privacy. The second, the Privacy Act of 1974, restricts federal agencies' collection, use, and distribution of personally-identifiable information. Further, the courts are still debating the legality of government access to and use of information obtained from mobile technologies and social media accounts.

As Schoenmaker (2011, p. 4) emphasizes, "in most countries, national legislation mostly protects against violations of privacy in public authorities, but no mention is made of private or commercial intrusions;" but in the context of remote sensing imagery, "even public authorities' use of satellite imagery is not even clearly regulated yet, let alone commercial or private use." Even so, there is a wide variety of remotely sensed imagery, not all of which needs to be regulated. Landsat imagery, for example, will not reveal the personal identities of individuals, although it may reveal how much property is owned. What, if anything, is protected? What should be protected? Within our local communities and as professionals, we should re-evaluate these questions of governance as technology advances.

Response organizations and digital volunteers must work to find an appropriate balance between protecting privacy and facilitating critical information sharing about affected populations and missing persons during and after disasters. The U.S. government needs to clarify federal agency authority to access, use, and share personal information in emergency situations through executive or legislative actions (Gellman *et al.* 2013), such as the U.S. Department of Health and Human Services regulations guiding the use of medical information for treatment in an emergency (NRC 2012). The crisis mapping and missing persons communities also should establish and self-regulate their own privacy standards and codes of conduct. By proactively creating and coordinating best practices, these communities could address ethical problems and provide common sense guidelines to future participants. This could also provide an educational framework for lawmakers in the event that relevant legislation is later created. U.S. organizations and groups must also take care when participating in efforts with international elements—although U.S. law may not restrict their activities, the impact of organizational behavior abroad may create liability.

SECURITY

Social networking tools and crowdsourcing approaches can be used by response organizations and digital volunteers for the public good, but also by bad actors to manipulate the public, foment strife and undermine stability, as seen during violent incidents in the Assam state of northeast India in July 2012 (Goolsby 2013) and in Egypt and Libya in September 2012 (Eijndhoven 2012). Oppressive governments also are using these tools (Puig Larrauri 2013, Madrigal 2011). In Sudan, the government stood up mock protest pages to trap the opposition (Meier 2011; see also Madrigal 2011). In Egypt, the government used Facebook to track down protesters' names and arrest them (Gallagher 2011). In 2013, the Egyptian government began crowdsourcing censorship by asking its citizens to report blasphemous websites (Ungerleider 2013). Crisis mappers may become victims too, as evidenced by the retaliatory murders of Mexican citizens who came together through social media to track the activity of drug cartels (Chamales 2013).

The greater degree of openness of these technologies potentially exposes disaster response organizations and the public to inappropriate content, malware threats, and breaches of confidential information. Chamales and Baker (2011) identified five potential vulnerabilities in crisis mapping situations: 1) identification of reporters and vulnerable groups; 2) control of communications networks; 3) programming flaws in crisis mapping platforms; 4) identification and infiltration of the digital volunteers; and 5) use of unverified reports. Cybersecurity efforts must take into account these vulnerabilities and the growing potential for cyber-attack using social media, where hoax messages are incorporated into a stream of otherwise legitimate messages. Mobile apps and text services can quickly disseminate false information. Crisis response organizations and digital volunteers must develop a healthy skepticism about information derived from these systems and take precautionary steps. They must also be cognizant that different countries will have different standards, legal and otherwise. New technologies for mitigating vulnerabilities, such as improved reverse search engines and new techniques for discovering scams, hoaxes, and exploitations, also are needed (Chamales 2013, Goolsby 2013).

INTELLECTUAL PROPERTY

Crowdsourced data production raises several important questions regarding intellectual property. These issues relate to ownership, usage rights, and interoperability. Conflict can frequently stem from differing priorities of owners and users of platforms (e.g., Puschmann and Burgess 2013). Control and monetization, central to proprietary companies' business models, may be at odds with what is most beneficial for end-users and those affected by spatial data. Copyright and terms of use are used to protect data as well as derivative products, such as maps and commercial activity. The recent uproar that emerged when Instagram announced changes to their terms of service demonstrated that the business plans of social media platforms and the expectations of their users may be in opposition (Chang 2013, Sloane 2013). In that particular case, the public pressure was enough for Instagram to reconsider the scope of their intellectual property policies (Systrom 2013). Users would do well to be wary and anticipate that no platform is truly free. All include a cost, which may encompass giving the platform rights to their intellectual property.

On April 1, 2012, OpenStreetMap switched from their Creative Common license to a new Open Database License, which allowed sharing as long as credit is given where due and enhancements are also shared (Chapman 2012, OpenStreetMap Foundation 2012). Creative Commons was developed for creative works. It allows a creator to select from a range of options, beginning with an extremely permissive license allowing any derivative use, to a restrictive one allowing sharing but no alterations (Creative Commons 2013). The Open Database License is exclusive to databases and is thus more apt for OpenStreetMap's structure (Open Data Commons 2013). In contrast, Google's analogous product MapMaker operates under a copyright license that does not allow an individual to own the data they or others contribute, nor to download that raw data. Thus, while some platforms may be popular, they may involve compromises that are inappropriate for crisis mapping.

Lastly, "derived work" and copyright interoperability has raised some concern, since some disaster response work necessitates aggregation of large heterogeneously-sourced data that may contain copyright incompatibilities. For example, Ushahidi deployments often gather and display Twitter data on top of OpenStreetMap base maps. Simple data procurement can lead to complex copyright licensing situations, even with open data projects (Saunders and Scassa 2012, Schonmaker 2011, Onsrud 2010, Onsrud *et al.* 2010). Proposed laws, such as one drafted by the German Bundestag , may extend copyright and require free online news aggregators, like Google News, as well as the crisis mapping efforts, to pay for access to news articles curated from newspapers, TV, and radio. This may increase costs and limit accessibility of critical information, in turn impeding crisis mappers' ability to identify, monitor, and rapidly map emergent threats, like infectious disease and unfolding humanitarian crises (Scales and Brownstein 2012). An overarching scheme for copyright and data distribution is needed, streamlining data usage for disaster response and humanitarian relief. How can crisis mapping communities, policymakers, and on-the-ground responders coalesce around a legal and policy framework? What collaboration must occur before such policies are put in place? One of the best opportunities for monetization can be licensing map data for profit. This demonstrates how differing priorities can create tension between the owner of a platform and its users.

DATA ACCESS AND DISTRIBUTION

National security concerns, restrictive commercial licenses or terms of use, and cost may impede crisis mappers' ability to access satellite imagery and data to support their response efforts (Schoenmaker 2011, Pomfret 2010). The Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters (Disasters Charter) provides for the voluntary sharing of satellite imagery in the event of major disasters. However, because the Charter is an agreement primarily among satellite operators who have to pay for Charter activities from their own budgets, it does not guarantee access to digital volunteer groups, nor does it provide for imagery sharing for disaster preparedness, reconstruction, or reduction efforts (Gabrinowicz 2012, Williamson and Antoniou 2012). Harris (2013, p. 1214), however, notes that there may be an ethical duty "to relieve the suffering of others at times of disasters and so provide data free of charge as soon as possible" to all users, not just those authorized under the Charter.

To address this gap, the Humanitarian Information Unit of the U.S. Department of State and the U.S. Agency for International Development are piloting a process for the temporary release of high-resolution commercial satellite imagery under a government license so that digital volunteers, like the Humanitarian OpenStreetMap team, can support mapping efforts in collaboration with formal response organizations (Braunstein 2012; see Figure 2. The Horn of Africa Mapping Experiment, U.S. Department of State Humanitarian Information Unit Brief https://hiu.state.gov/ittc/HIU_HoA_ImageryToTheCrowd_2Apr2013.pdf and Imagery to the Crowd website http://hiu.state.gov/ittc). The Committee on Earth Observation Satellites (CEOS) Data Democracy initiative and Group On Earth Observations GEOSS (Global Earth Observation System of Systems) Data Sharing Principles also encourage satellite data accessibility and capacity building (CEOS 2013).

In addition, over the last few years, numerous countries have implemented "open government" and "open data" initiatives, including the United States, the United Kingdom, Canada, Kenya, Indonesia, Philippines, and Brazil. This culminated in 2011 with the formation of the Open Government Partnership, in which more than 55 countries now participate. Global humanitarian and development assistance organizations like the United Nations and the World Bank have opened their data vaults to encourage innovation and improve effectiveness (Badiee 2012). Significantly, as Stauffacher *et al.* (2012) note, the United Nations not only has provided open access to its datasets, but also has opened up its analysis and decision-making frameworks. As Williamson and Antoniou (2012, p.

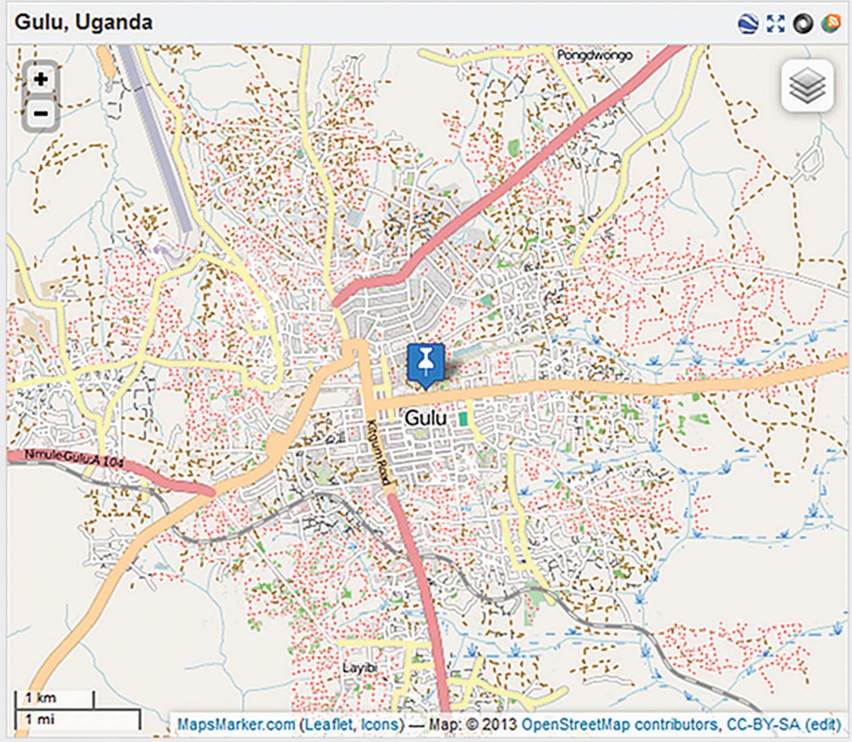

FIGURE 2. CROWDSOURCED MAP OF GULU, UGANDA.

This map was traced from high-resolution satellite imagery donated by the U.S. Department of State's Humanitarian Information Unit and hosted on the Humanitarian OpenStreetMap Team's tasking server. This data was generated by OpenStreetMap contributors for an American Red Cross and Ugandan Red Cross disaster risk reduction project. © 2012, OpenStreetMap Contributors. Used with permission. Available at: https://hiu.state.gov/ittc/ittc.aspx

6) emphasize, "[t]he availability of these data sets encourages the development of innovative ways to use the data because users can focus their resources on applications, rather than purchasing data sets." It is critical that cost does not become a prohibitive factor, discouraging interested parties from taking part in crisis mapping activities.

LIABILITY

Providing or acting on crowd-generated information about disaster conditions carries potential legal liability. Crisis mapping creates the potential for liability arising from: 1) violation of privacy laws; 2) negligent responses or selection of volunteers; and 3) violation of licensing agreements for the use of proprietary imagery or software. This section focuses on the potential tort liability for digital volunteers within the context of U.S. law and potential mitigation strategies, based on the research conducted by Robson (2012a,b; see also Chandler and Levitt, 2011, Rak *et al.* 2012 and Scassa 2012).

Crisis mapping, if conducted from or directed to the United States, can subject digital volunteers to tort liability under U.S. law. Digital volunteers are at risk if they fail to use reasonable care in making their responses. This could include disseminating false information, sloppy software development, failing to act in a manner commensurate with similarly situated individuals, or failing to properly vet and supervise volunteers. Digital volunteers also may be subject to liability if they fail to act when they have a duty to do so. Such a "duty to rescue" can arise if a digital volunteer creates a hazardous condition, begins to render assistance or forms a special relationship with survivors. In certain states, there are statutes that may mandate a response.

Still, statutory protections are available for certain digital volunteers. Individual states provide varying degrees of immunity for digital volunteers who have followed the requirements of such statutes. Since many digital volunteers make interstate responses and it can be unclear as to which state's law applies, the utility of state immunity laws may be limited.

A federal statute, the Volunteer Protection Act of 1997, offers more predicable protection to a broader range of digital volunteers. The "VPA" requires that digital volunteers adopt particular organizational structures to come within its protections and imposes limits on volunteer compensation that can be inadvertently exceeded.

Contrary to the belief of many digital volunteers, so-called "good Samaritan laws" offer little, if any, protection. These statutes typically require that the volunteer rescuer be responding in person to a medical emergency that he or she came upon by happenstance. The digital volunteer model does not satisfy these requirements.

There are several other strategies digital volunteers can use to mitigate their risk. Groups should engage in a high-level risk assessment to identify where they are most at risk for liability and install appropriate protections. The development and enforcement of operational policies can help to mandate reasonable behavior and create an industry practice across groups. Digital volunteers could organize non-profit corporations to avail themselves of statutory protections and to reduce vicarious liability among individual volunteers. Groups also can utilize disclaimers and form contracts to discourage reliance or limit liability, and should seek to obtain indemnification from the governmental agency or non-profit requesting the services of the digital volunteers. Importantly, groups should seek professional legal counsel (Robson 2012a, b).

Finally, digital volunteers should consider the possibility that they may be subject to foreign law and/or to the jurisdiction of courts in other countries. U.S. courts may apply foreign law pursuant to choice-of-law doctrines. Even more worrisome, digital volunteers may be at risk for prosecution by foreign governments, including prosecution for espionage. China, for example, has fined and arrested foreigners caught mapping within its borders, which it considers illegal and a "threat to national defense and economic security" (Wei 2012). Oppressive governments could attempt to extradite digital volunteers who build crisis maps remotely from another country (Hanchard 2013).

The potential for liability can make traditional responders reluctant to incorporate crowd-generated information into their data sets. Sicker *et al.* (2010) offer a brief overview of the potential liabilities for formal response organization using social media within the United States, which may include a failure to respond to a request for help via social media.

ETHICAL CONSIDERATIONS

In the absence of legal and policy constraints, the remote sensing community (ASPRS 2013, Slonecker *et al.* 1998), geospatial community (Urban and Regional Information Systems Association 2003, Verrax 2011), and participatory mapping community (Rambaldi *et al.* 2006) developed ethical guidelines and codes of professional conduct. The disaster management, humanitarian, and digital volunteer communities are currently deliberating these issues in the context of location-based social networking, crowdsourcing, and live mapping (Letouze et al 2013, Searle and Wynn-Pope 2011. See also "Ethical Issues and Crisis Mapping: Links to Resources": http://geodatapolicy.wordpress.com/2012/02/14/ethical-issues-and-mapping). In the context of natural disasters and humanitarian crises, the security and safety of individuals and vulnerable populations may be especially impacted by data collection and mapping efforts. Issues raised include informed consent, data verification and quality, privacy, risk mitigation and security, ownership and control of data, impartiality and bias, and ethical best practices (Harris 2013, Meier 2013, Raymond *et al.* 2012, and Gellman *et al.* 2013).

Questions about how to apply or adapt the humanitarian principles of "Do No Harm" and impartiality and neutrality, the *Principles for Good International Engagement in Fragile States and Situations* (OECD 2013), as well as the International Committee of the Red Cross Data Privacy and Protection Protocols, are central to these discussions (Letouze *et al.*2013). Raymond *et al.* (2012, 1) pose three questions: What new risks do these new technologies and approaches present to vulnerable populations and humanitarian responders? Can these risks be mitigated? Are these risks worth mitigating? For example, what are the potential consequences of re-purposing data harvested from open social media channels? Some organizations believe that resolving these issues is necessary before expending further efforts in contentious circumstances. The Standby Task Force, a volunteer group of over 900 individuals, has suspended crisis mapping activities in situations of armed conflict until professional standards can be developed (Meier 2012b).

As Slonecker *et al.* (1998, p.594) put it, we as remote sensing and geospatial professionals or digital volunteers:

> "…cannot let existing and future technologies simply take [us] down certain paths of behavior merely because these activities are technologically feasible and/or economically profitable. Indeed, it is consistent conformance to a common set of moral principles and values about what is right and wrong, coupled with common technical standards, that defines what a profession is and does. The challenge ahead is to continually define and appropriately modify these professional ideas, both individually and collectively, because law and public policy will likely never 'catch up' to the issues surrounding this rapidly changing technology."

THE CHALLENGES AHEAD

The convergence of remote sensing and spatial technologies, with social networking and crowdsourcing approaches, offers tremendous opportunity. In order to harness the full potential, many challenges will need to be addressed. Formal response organizations must determine how to effectively leverage these platforms, processes, and people to augment existing information and improve decision-making. New tools are needed to filter, synthesize, and make sense of the near-endless flow of crowd-generated information. But the greatest barrier to widespread adoption will not be technical: It will be legal and institutional resistance. How do we build trust? How can government agencies like FEMA successfully navigate administrative hurdles, such as privacy and procurement or the Paperwork Reduction Act (PRA)? How do they integrate crowd-generated data with official data? What are the potential implications of using fused data sets for operational decision-making (Burns and Shanley 2013)?

Government agencies in the United States are bound by the Paper Work Reduction Act (PRA), 44 USC 3501, which limits the information agencies can collect and sets a required process that must take place before new collections begin. It is important to consider those parameters when asking whether government response organizations can leverage the work of digital volunteers. If an activity is considered information collection, the agency must overcome a series of hurdles. Form 83-1 must be submitted, where the applicant describes the information, why it is needed, and the burden on citizens who provide it. The approval process takes a minimum of 120 days, requiring publication in the *Federal Register* and an opportunity for public comment. The PRA forces agencies to go through a cost-benefit analysis. Any information collection involves an administrative burden, so agencies must carefully select their activities.

However, the Office of Management and Budget (OMB) has issued a series of guidelines designed to encourage agencies to engage the public, all publicly available on the White House web portal. (OMB 2013). They have published several memorandums offering clarifications of OMB policy, exempting many activities from the PRA approval process, and creating a streamlined procedure when an agency repeatedly conducts similar collections of information. The latter might be the best opportunity for agencies to utilize crowd-generated data, but the issue is heretofore untested.

This uncertainty means that agencies interested in working with digital volunteers should collaborate with their internal counsel and create a plan tailored to their unique mission and responsibilities. There is a risk that undergoing this review means that the agency will conclude that approaches such as crowdsourcing and collaborative mapping are inappropriate. But deliberately undergoing this analysis is essential. If it fails to take place, both the agency and the public could dedicate time and effort to information that an agency cannot use. This speaks to whether it would be legal for organizations to collect such information. Incorporating it into an agency workflow is a completely separate and equally vital challenge.

Government agencies will need to transform ad hoc methods and processes for engaging the public and digital volunteers into durable, official workflows. To this end, the Woodrow Wilson International Center for Scholars is conducting research that begins to explore some of these issues (Crowley 2013, see also Roberts *et al.* 2012). Questions being considered include:

- "How should agencies establish workflows with volunteers that create no expectation of payment and do not overlap with duties already performed by Federal personnel as part of their usual duties (Anti-Deficiency Act)?
- How should these processes control for personally identifiable information (Privacy Act) and prevent the disclosure of confidential and proprietary information (Nondisclosure provisions)?
- How should agencies ensure that data integrated from outside sources adhere to criteria for quality, objectivity, utility and integrity that citizens expect from government's authoritative data sets (Information Quality Act)?"

Overall, many of these laws and regulations will need to be clarified or updated to facilitate broader public engagement and operational use of crowd-generated information by formal response organizations. This will require flexibility as well as systems that provide reliable, actionable information without compromising privacy or security.

And it will require ongoing evaluation to assess the actual impact and provide feedback for improvements over time (Burns and Shanley 2013, Chan 2012). But, what forms of monitoring and evaluation might be effective? How do we develop an iterative research and implementation design process with a positive output and measurable impact? How do we define success?

As the digital volunteer community expands it will need training to better integrate its efforts with those of the formal response organizations. The American Red Cross' Digital Volunteer Program, the Digital Humanitarian Network's collaboration with UN OCHA, and the emerging VOST model offer useful models for trusted collaborations between informal volunteers and contributors, and the formal response community.

In summation, the emphasis has shifted from information collection to collaboration and two-way feedback loops with organically created, self-organized communities. The best use of these emerging tools and approaches may be in building social capital and resilient communities that will reduce the impact of disasters and speed recovery time. After all, that is when we really need our friends.

ACKNOWLEDGEMENTS

The authors would like to thank the following individuals for their constructive comments and suggestions: Aaron Lovell, editor for the Science and Technology Innovation Program, Woodrow Wilson International Center for Scholars; Dr. Leysia Palen, Department of Computer Science, University of Colorado-Boulder; Prof. Teresa Scassa, Canada Research Chair in Information Law, University of Ottawa; and Prof. Joanne Gabrynowicz, Director, National Center for Remote Sensing, Air and Space Law and Research Professor of Law, University of Mississippi School of Law. These reviewers, however, were not asked to endorse the material presented, nor did they see the final draft of the article before its release. Responsibility for the final content rests entirely with the authors.

This research was funded by the Alfred P. Sloan Foundation through a grant to Commons Lab of the Science and Technology Innovation Program of the Woodrow Wilson International Center for Scholars in Washington, D.C.

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