



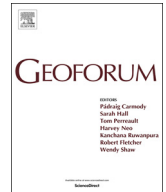
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Cartographers of North Korea: Who are they and what are the technical, political, and social issues involved in mapping North Korea

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ABSTRACT

Volunteered Geographic Information (VGI) has made possible the expansion the mapping to previously unmapped areas, thanks to technological advancements such as Web 2.0 and satellite imagery. However, more than a technical feature, VGI has brought to light the political aspects of cartography, when multiple stakeholders have access to mapping tools. This is the case of the collaborative mapping strategies used to map North Korea, one of the most, if not the most, closed countries in the world in terms of diplomatic relations, tourism and its economy. OpenStreetMap (OSM) enables “armchair mappers” to map opaque territories in which local governments control citizens’ access to the internet. In this paper, we discuss the following questions: Who is mapping North Korea in OSM? Which tools and methods do contributors use to gain access to information about the country and to represent it? What are the motivations behind this mapping endeavor? We analyze technical aspects of OSM data for North Korea and structured correspondence exchanged with 889 contributors. We argue that crowdsourced efforts can make good the dearth of knowledge resulting from the physical, cultural and political barriers associated with uncharted territories and that, although the motivations for such efforts vary greatly, they all have their origin in a sense of empathy and the power technology has to penetrate geopolitical barriers.

1. Introduction

Mapping is, and has been since its inception, a combination of technical, political, and social capabilities and intentions. By technical capabilities, we mean instruments for seeing, measuring and representing spatial features, as well as the scientific knowledge of the period, which is usually translated into cartographic standards. Political aspects cover the intentionalities underlying the creation and use of maps, while social aspects include the ways cartographers and people living in mapped areas see space, sometimes eliding or pushing the boundaries of established cartographic standards.

These technical, political, and social characteristics influence each other. Examples include a series of highly detailed maps of the United States produced by the Soviet Union during the Cold War (Miller, 2015); the long search for a precise method for measuring longitude in the sixteenth century, which involved fierce disputes among scientific societies and important geopolitical and economic interests (Sobel, 2010); and the incorporation of urban ethnography in mapmaking in the 1950s and 1960s, which played a crucial role in the battle against the technocratic planning that predominated at the time (Lynch, 1984).

In recent years, fast internet connections and domestic computers with high computational capabilities have resulted in powerful cartographic tools becoming widely available. These include free satellite imagery and user-friendly mapping applications, which have prompted new forms of cartographies and digital geographies that, rather than merely using digital tools, involves the production of novel geographic knowledge and epistemologies (Ash et al., 2018).

The focus of this paper is the contributors who map territories that are often uncharted. Satellite imagery, until recently available only to a small community of specialists, has become a staple of freely available web-based services, from Google Earth to Microsoft Bing, both of which offer street-level photographs of hundreds of cities worldwide (Allen, n.d.). These and other services also provide high-resolution maps of cities at the parcel level. Most of these maps and mapping tools are provided by large corporations, but a well-known exception is OpenStreetMap (OSM), an open-source mapping platform created by Steve Coast. The goal of the platform is to collect freely available geographic data from the bottom-up, and the data can be used for non-profit organizations, amateur mappers and activists. This bottom-up process of geographical data collection is the most unique aspect, compared with

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government or industry-driven top-down ownership of the data (Barron et al., 2014; Budhathoki and Haythornthwaite, 2013). Launched in 2004, OSM had 505,000 users, and 38% of the registered users have contributed at least once as of 2011 (Neis and Zipf, 2012). OSM is considered one of the most successful Volunteered Geographic Information (VGI) projects (Goodchild, 2007; Neis and Zipf, 2012). OSM has been used in what has been known as VGI, geoweb (Scharl and Tochtermann, 2007), or collaborative mapping—in a nutshell, a network of volunteers that collaborate in collecting data, building digital maps, and disseminating cartographic information.

Despite the abundance of online satellite images and detailed maps covering virtually the entire world, including thousands of cities, and the fact that OSM has been used to map more than 95% of the road network in 42% of countries around the world (Barrington-Leigh and Millard-Ball, 2017), coverage of some regions remains incomplete. To address such mapping inequality, digital humanitarian organizations like the Humanitarian OpenStreetMap Team (HOT) have organized mapping task groups to map vulnerable areas, mostly in developing countries where there is a lack of human and technical resources (Palen et al., 2015). HOT has responded to tragic events like flooding and earthquakes and mapped such area by providing human and technical resources remotely (Humanitarian OSM Team). Moreover, there are also efforts to quantify those under-mapped areas, compared with population size (Johnson, 2019). One thing to note is that these inequalities are often caused by political oppression or conflicts: for instance, the institutional mapping regulations in China (Lin, 2018), or non-mapping strategies of Palestine mappers (Bittner, 2017).

The Democratic People's Republic of Korea (the focus of this paper, and hereafter referred to as North Korea) is one of these examples: in an era when mapping tools scrutinize every corner of our cities, North Korean cities remain largely opaque because of the extreme control. The country's very limited diplomatic relations with other nations, its repeated refusal to accept international committees (mainly from the International Atomic Energy Agency), the closely monitored access to the country, which is visited by very few tourists and journalists, and the country's almost complete disconnection from the Internet make North Korea, in particular its cities, terra incognita. Even large technology companies like Google and Microsoft are unable to gain full access to the territory because of US law. For example, to map North Korea and Pyongyang, Google resorted to a civic group that used Google Map Maker and satellite imagery rather than first-hand data collected on the ground (Ramstad, 2013).

As a case study, we focus on the collaborative mapping strategies used by open-source mapping contributors and describe a case study based on North Korea. We address the following questions: Who is mapping North Korea in OSM? Which tools and methods do contributors use to gain access to information about such a closed country and to represent it? What are the motivations behind this mapping endeavor? We argue that crowdsourced efforts can make good the dearth of knowledge resulting from the physical, cultural and political barriers associated with uncharted territories and that, although the motivations for such efforts vary greatly, they all have their origin in a sense of empathy and the power technology has to penetrate geopolitical barriers. More than the technical aspects made possible by the availability of satellite imagery, GPS devices, and web-based tools, collaborative mapping has an important political component: who is mapping matters to what is mapped, and how geographic space is mapped. Map-making as a political instance is the underlying theoretical discussion in this paper.

We come to these conclusions in the following sections. First, before we go into the case of North Korea, we review the previous literature on how VGI is associated with the social and political aspects of GIS research and discuss the motivation of individuals and the role of VGI platforms in contested territories. Second, we give a brief overview of the history of mapping North Korea and subsequently examine their open-source oriented software development and internet governance.

Then, we analyze the contributions to the OSM dataset for North Korea made by 889 individuals and structured correspondence exchanged with 222 of these contributors. Subsequently, we describe the efforts that have been made to map North Korea and unveil ordinary daily urban life after the country became closed to the outside world. This is followed by a discussion of contemporary mapping tools, particularly OSM, a description of the methodology used to collect and analyze the study data and a discussion on how the use of open-source mapping tools in a particularly isolated territory involves technical, political, and social issues inherent to mapping.

2. The politics of VGI in contested territories, the motivation of individuals and the role of VGI platforms

GIS researchers have studied VGI and relevant technologies to examine not just its technological importance, but its association with their social and political aspects. For instance, Elwood (2008) examines how VGI potentially have societal and political research agenda in the lens of “GIS and Society”—especially critical GIS, Participatory GIS (PGIS), and Feminist GIS (Elwood, 2008). The availability of tools to gather geographic data, the methods and scientific standards to collect and organize such data, the availability of the infrastructure to share the results of the mapping activity, and even the languages used by the technical and scientific communities influence map-making and VGI (Sheppard, 2005). Within this context, the use of open-source tools risks the bias the discussion of the political aspects of technology, as if “open” would inevitably imply accessible to all. As David Serwadda et al. (2018) discuss in the case of the open data movement when the broader scientific, economic, and technical frameworks remain the same, open data might repeat the pitfalls of colonial science.

Some scholars situate VGI into the political economy context, especially the interaction between a state, market, and private citizens. Leszczynski (2012) situates VGI in the neoliberal context where a state attempt to “roll back” the publicity of the cartographic project whereas markets are “rolling out” the publicity. With regard to the neoliberal logic, researchers have been focusing on the use of online and collaborative cartographies of such political economy context to shed light on the politics of VGI (Lin, 2018; Carraro and Wissink, 2018; Bittner, 2017). While using OSM goes against mapping regulations in China, with strident control by the government, it is accepted that the government is not willing or do not have the capacity to persecute every mapper; and while there is a discourse of community empowerment among some OSM groups, there is a significant amount of commercial interests driving the small group of OSM mappers in China (Lin, 2018). Bittner (2017) compares Israeli and Palestinian OSM maps and shows how the social and political imbalances between the two countries are represented in the dataset. Focusing on the same region, Valentia Carraro and Bart Wissink (2018) further discuss the work of the Jerusalem-based NGO Grassroots Jerusalem (GJ), an online crowdsourced mapping project that uses OpenStreetMap (Bégin et al., 2017). Although online crowdsourced tools have been allowing the emergence of new cartography to counter to Israeli-dominated cartography of Palestine, technical and linguistic barriers still make difficult a larger non-Israeli representation—for example, using Arabic is more complicated than Hebrew, which is the default for the region. A long history of Israeli dominance also make GJ members suspicious of collaborating with Israeli peers; so they downloaded the OSM map and created a parallel map, rather than modifying the main OSM map of the region.

The politics of VGI can be accentuated in regions with highly authoritarian and closed countries, such as North Korea—and such contexts give a unique opportunity to discuss the politics of VGI. The individuals in a VGI platform can collaborate inside and outside of the local community, thereby partially contributing local spatial knowledge (Caquard, 2014): what happens when the VGI community encounters a highly closed country like North Korea? By combining knowledge from satellite imagery and the internet, VGI contributors' sympathetic

response to the country, and the mapping activity as a response do not necessarily relate to the local residents' situation where they generally do not have access to the information. Rather, on the one hand, the North Korea OSM map may emphasize exclusion which socially and politically volunteering the geographical information could possibly produce (Elwood, 2008). On the other hand, the volunteered mapping activities which are prohibited or highly regulated by the state could include the local residents in which they could utilize such information in different (even illegal) routes.

Thus, we believe that the motivation of individual contributors in VGI is worth exploring. In a seminal paper by Budhathoki and Haythornthwaite (2013), they examine the motivation of contributions to the OSM by applying the model of lightweight and heavyweight contributors. They propose to discuss what the core value of the contributors are, and reveal how the motivations of the casual mappers and the serious mappers are different. Casual mappers are more oriented to more general values, such as the value of open-source projects, whereas serious mappers are more oriented to the OSM community, or some special attention in developing their career—although both share similar general values. One thing to note is that both mappers are motivated by the contribution of local geography, and this tendency is amplified more by serious mappers (Budhathoki and Haythornthwaite, 2013). However, because of the extreme control by the North Korean government, it seems that contributors could lose a meaningful portion of the motivation to the country: obtaining local knowledge; and it appears to be questionable that the information is either verifiable and valuable.

Hence, in this paper, we discuss whether contributors' motivation from the first-world and bird-eye view can be legitimized in such contested territories. Moreover, if a VGI platform cannot reflect on epistemologies and data settings which could “compass the experiences, knowledge claims, and identities of their representations of some social groups or places,” (Elwood, 2008, p.178) its function may be inherently limited. In that sense, we aim to discuss that VGI platforms need to think about how they expose the level of engagement of contributors, as well as their motivation, like the series of visualizations for exposing “data settings” done by Loukissas (2019). Underlying this research is the question of how VGI platforms can better shape social and political contexts, thereby better informing the contributors when they take the endeavor of mapping uncharted territories.

3. A brief history of the mapping of North Korea

Historically, maps have been drawn for internal and external purposes: a ruler may map territory as a form of control, while outsiders may seek to understand unexplored lands. In the case of Korea, during the Joseon period (1392–1910) all maps were state property. Civilians were not allowed to possess maps, and access to government maps was extremely restricted (Short, 2012). Because the country had a long history of foreign invasions, periods of relative openness to external cartographers and cartographic techniques alternated with periods of isolation from the outside world, a characteristic which, as Short (2012) points out, is still present today and can be observed by comparing North and South Korea.

However, contemporary cartography based on satellite imagery is not constrained by geopolitical limits. Researchers have taken advantage of data produced by multiple satellites to map changes in land cover in North Korea using areas in China and South Korea as ground-truth data (Kim et al., 2007); to detect forest fires and associated smoke plumes, possibly due to agricultural activities and the mishandling of fires (Chung and Kim, 2008); to assess deforestation (Jin et al., 2016), particularly across large expanses and in the 1990s following the economic crisis and severe energy shortages (Engler et al., 2014); and to develop a crop-simulation model integrated with satellite imagery to enable crop productivity to be monitored (Yeom et al., 2018).

Although most of these mapping efforts tend to be purely technical,

they are, as Kim et al. (2007) note, important because they allow reliable datasets to be assembled and a solid foundation for cartography to be laid in preparation for the eventual reunification of North and South Korea. These efforts in themselves, therefore, represent a strong political stance. As David Shim (2014) shows, even satellite imagery can be used to reinforce the image of North Korea as a remote, isolated country, with analysts using satellite images of the peninsula by night to highlight the absence of night lights as a sign of isolation and scarcity, rather than discussing the negative environmental impacts of excessive artificial night lights.

OSM contributors, like anyone interested in North Korea, are subjected to a stream of very selective imagery coming out of North Korea. The scientific cartography discussed above is not immune to political interpretation (to see the peninsula as a single spatial entity is a political view, as is the opposite), and both the official North Korean and Western media release selective depictions of the country that are intended to separate 'them' from 'us' (Shim and Nabers, 2013). Images of military parades released by the official North Korean media reinforce the Western cartography of the country as a nuclear threat used in the mainstream media (Vujakovic, 2002) and at the same time coexist with images of orphaned children, poor working conditions and overcrowded hospitals (Sudworth, 2010).

Bombarded by contradictory images of an isolated country, OSM contributors mostly use satellite imagery to collect data points. As North Koreans do not have access to the Internet and, consequently, OSM, the majority of these contributors are foreigners who usually do not have first-hand access to the mapped areas. Why these contributors choose to map North Korea and how they do so are questions that lie at the core of this paper, in which we discuss how the use of open-source mapping tools reveals a critical mapping culture that does not blindly accept mainstream cartography.

Open mapping tools have been used to unveil North Korea's isolated territory to the world and have revealed its forests and rural areas as well as cities. By the end of 2018, OSM contained 324,415 data points for North Korea, 30 cities in the country had been mapped, and 889 contributors had provided information (Neis, 2018). However, since the country is closed to the Internet, North Koreans themselves do not directly benefit from OSM.

4. The unusual open-source culture of the North Korean regime

North Korea has, somewhat surprisingly, been successfully adapting open-source software for security and regulatory reasons and now has its own versions of Linux, which includes a modified Firefox, and Android. The story when a researcher in Kim Il Sung University posted an article to propose a new character set to Firefox (ko-KP) exemplifies that effort (Channy, 2004; Williams, 2011). Red Star OS was first developed in 1998 by the Korea Computer Center; it is based on Fedora Linux, and the user interface is based on KDE 3. As it is derived from the Linux kernel, Red Star OS is found in a wide variety of systems, from personal desktops to web servers, and is used in the Air Koryo website. One possible reason why North Korea has been investing in open-source projects is that most operating systems and web browsers cannot, under US law, be distributed in North Korea (Bureau of Industry and Security, 2016). Moreover, the North Korean government would be exposing itself to a significant potential vulnerability if it used US software and would need to read all the code to make sure there was no backdoor.

Another important technological factor is that the population of North Korea only has extremely limited internet access. While a select group of people can access the internet for research purposes, everybody else can only access a countrywide intranet called Kwangmyong. A full-bandwidth internet was installed in 2010 by Star, a joint venture between North Korea and Thailand-based Loxley Pacific, but is only available to foreigners. In 2013, internet access was expanded to mobile networks, which are maintained by Koryolink, a national cellular operator launched in 2008 with Egypt's Orascom Telecom (Williams,

2016). A foreign lecturer at Kim Il Sung University noted that “[the internet connectivity] is real, (...) the grad students have [access], but the undergrad don’t” (Williams, 2014).

Since these open-source software programs are heavily customized for government purposes, studying North Korean software would appear to provide a means of acquiring a reasonable understanding of how North Korea controls information in the closed internet and its own intranet. For instance, according to a study (Hansen, 2015) of Naenara, a North Korean customized version of Firefox, the browser automatically makes a request to an IP address for internal purposes (<http://10.76.1.11>) when it is first run, showing that the default communication is through the intranet. What is even more interesting is that the mothership server (10.76.1.11) seems to act as a large proxy server for the internet and may filter access according to who/what is allowed to connect.

It is particularly interesting to note that citizens cannot benefit from any of this open-source software. While the open-source community normally benefits from developing and contributing code, in North Korea, the government uses the code obtained in this way to allow it to track all citizens but not be tracked itself.

5. Open mapping in North Korea: who benefits?

The fact that North Korea is essentially disconnected from the internet gives rise to the question “who benefits from OSM data?” For a country that is closed to the internet, the quality of OSM data in North Korea is extraordinary: 324,415 data points drawn by 889 contributors since 2007. Even more interesting is that contributors have not only drawn highways and buildings, which can be done remotely based on satellite imagery, but also provided street-level information about specific places. That these specific places have been included in OSM suggests that, in the absence of services similar to Google Street View, contributors have some sort of first-hand access to the mapped areas. However, since North Koreans do not have access to OSM through the country’s intranet system, this begs the following questions:

- Who contributes such detailed, high-resolution information? Are they residents of North Korea who somehow gain access to the internet, or do they live in other countries?
- Is there any relationship between the state-driven open-source culture and the open-mapping culture?
- Who eventually benefits from the map of North Korea and North Korean geospatial data in OSM?

Specific locations in the OSM of North Korea have details that imply a local knowledge of the terrain. While there is an abundance of ordinary images available on the internet for virtually any city in the world, whether on social media or large corporate sites, this is not the case for North Korea, for which the available imagery, provided by the few tourists or the official media, often reinforces the uniqueness of the country, highlighting the separation between ‘them’ and ‘us’ (Shim and Nabers, 2013).

6. Methodology

The approach used in this study consists of two main elements: descriptive statistics of the contributors and interviews with them. The OSM data for North Korea was downloaded in October 2018 using Geofabrik’s OpenStreetMap Data Extracts (<http://download.geofabrik.de/>), a service that breaks down OSM planet data to country level and updates it daily.

For the descriptive statistics of the contributors, we identified the number of contributions made by each contributor, the average number of contributions per contributor, and the country of origin of the contributor. We then analyzed data to identify the types of data points contributed, such as street-level points of interest (restaurants, statues,

parks) and controversial data points (such as nuclear test sites). Finally, we analyzed each contributor’s changeset (see Figs. 1 and 2).

For the interviews, we sent a letter via the OSM messaging system to all 889 contributors and held follow-up interviews with 222 contributors who replied to the initial letter. The questions in the interviews concerned but were not limited to, contributors’ motivation and nationality and their opinions on North Korea and mapping strategies.¹

7. Analysis

7.1. Descriptive statistics of the contributors: who are they and how did they contribute?

Since 2008, a total of 324,415 data points have been contributed to the OSM of North Korea by 889 contributors.² Fig. 3 shows that the top 10 contributors drew 61 percent of the map. This result is in line with the analysis of OSM contributors by Neis and Zipf (2012), which notes that only 5% of the registered users created more than 1,000 nodes in the OSM database. It is also in line with the 1% rule which is commonly seen in community-based web projects (Nielsen, 2006). Besides, that 62 of the contributors (including the top five) labeled map objects in Korean.

Contributors’ activity can also be estimated by means of OSM changesets, which are a history of each user’s past contributions. Using these changesets, one can see which regions other than North Korea contributors have also worked on. For instance, the top 20 contributors who used Korean to label map objects also contributed to the OSM dataset for China, Germany, India, the United States, and South Korea; for the top five contributors, this list changes slightly: India, Germany, Ukraine, Russia, and Japan.

It is particularly interesting to note that there are a number of street-level points of interest, including the graves of Kim Hyeong-jik and Kang Ban-seok, Kim Il Sung’s memorial statue, and restaurants serving particular types of food (Italian, Chinese and rice-cake soup). Typically, this kind of local information can only be gleaned by local residents. There are also a number of attempts to reveal secrets of the North Korean regime, including nuclear test sites, military sites, and the location of individual fighter planes (see Figs. 4 and 5).

8. Interviews

In the first round of interviews, we addressed three areas: the contributor’s motivation for mapping North Korea; what his or her particular interest in North Korea was; and the mapping strategies used (Fig. 6). In particular, two of the top 10 contributors responded to the interview request. The motivation for mapping North Korea varies from mapping as a private hobby to a political act and is illustrated by the following excerpts. Each excerpt is followed by a participant ID and an indication of the number of contributions the participant made (high: 1,000 to 80,000; medium: 100 to 999; low: 1 to 99). Quotations by those who said mapping was a private hobby included:

“Like others doing Sodoku or Mandala I draw rivers and roads from a satellite image” (P768, High); “[...] just for fun at places I find in the news...” (P709, High); or “North Korean is a mystical place due to its regime, so that is what brought me there” (P587, Mid). “I’ll continue to make more building when I have the time.” (P220, Low)

This category also includes participants who contributed out of cartographic curiosity: “There are huge white areas [unmapped] on the map.” (P588, Mid); “the OSM is uncensored, unlike Google, Naver and

¹ The English in this quotation and in the comments of contributors quoted elsewhere in this article has not been edited for correctness.

² The visualization, quantitative information, and correspondence with the cartographers of North Korea can be viewed at <https://cartographers-nk.wonyoung.so>.

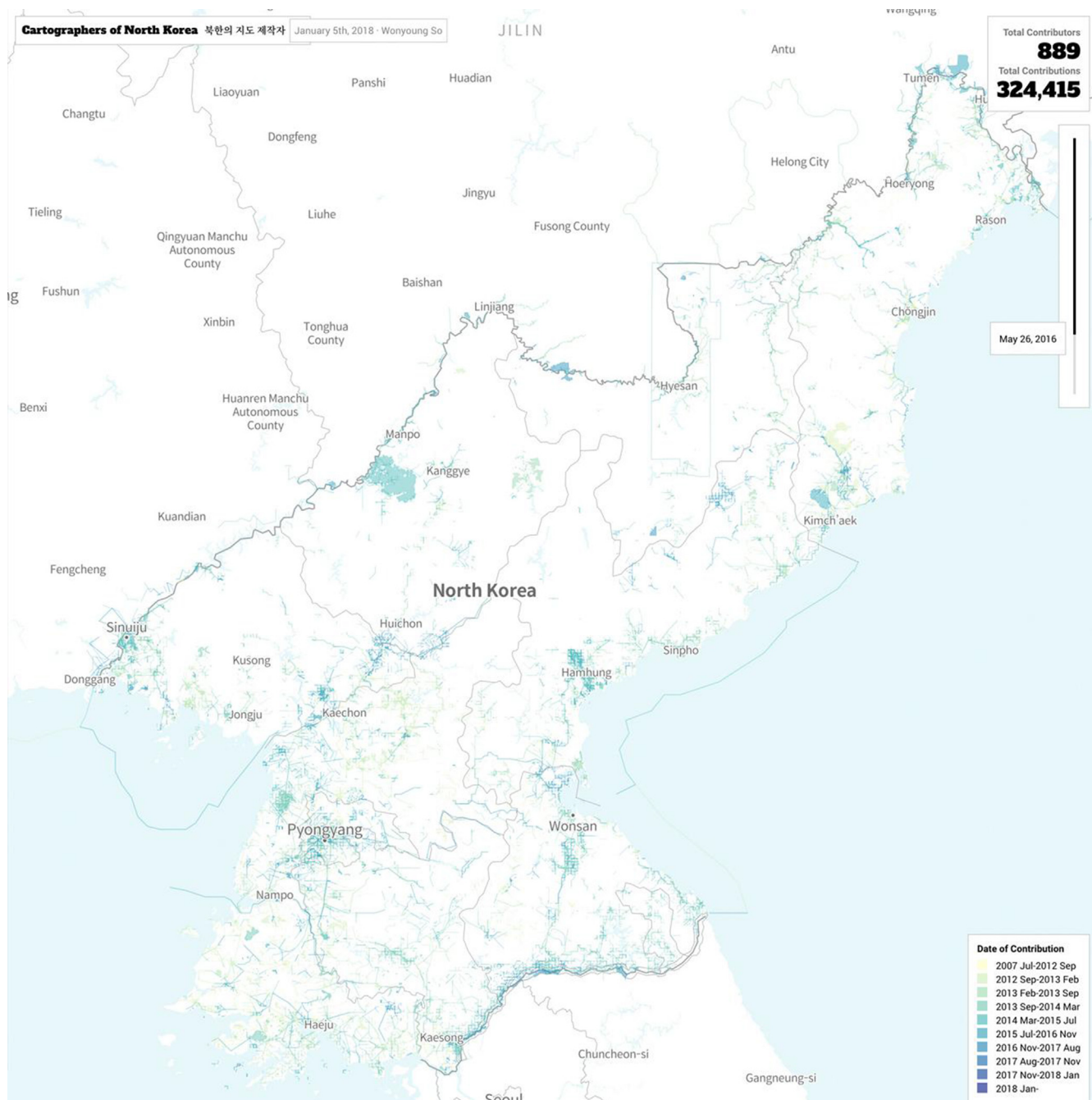


Fig. 1. OSM data for North Korea in May 2016: contributions were initially near urban areas and the border between the two Koreas.

Daum, the latter two are Korean companies" (P886, Mid); *"almost all of Europe is basically complete (...) I decide to find a new blank canvas and North Korea is basically just that"* (P881, High); or *"... it is important that there is good map material even for remote areas, such as North Korea"* (P586, Mid).

Interestingly, North Korea's exposure in the media was an important factor motivating some of the contributors, who mapped because the news stimulated their curiosity. Responses by these contributors included:

"I am mapping mostly just for fun at places I find in the news, or about places I have been [to] or I would like to go." (P709, High)

Many contributors suggested that mapping was to a greater or lesser extent a political act and hoped that mapping would have a positive impact on North Koreans from a humanitarian point of view. In particular, many of the contributors who identified themselves as Germans

showed a sympathetic response to the division between South Korea and North Korea, probably because of Germany's own experience of being divided between East and West during the Cold War. Some relevant quotations include:

It is *"a small act of expressing my desire for a better future for the people of North Korea"* (P880, High); *"... to help North Koreans"* (P791, Mid); *"I want geographical data and maps to be free"* (P581, Mid); or *"[...] a future where the North Koreans can access the internet. Then it would be nice to have open and non-commercial knowledge available."* (P883, Mid). *"[...] Today, 30 years later and after 30 years of a united Germany [...] So, I['] am politically [interested] in North- and South Korea[...]"*(P588, Mid)

As expected, a contributor's particular interest in North Korea often goes hand in hand with a desire to map the country. Although the reasons for contributing to the OSM database may vary from political interest to visits to the country or some other personal involvement,

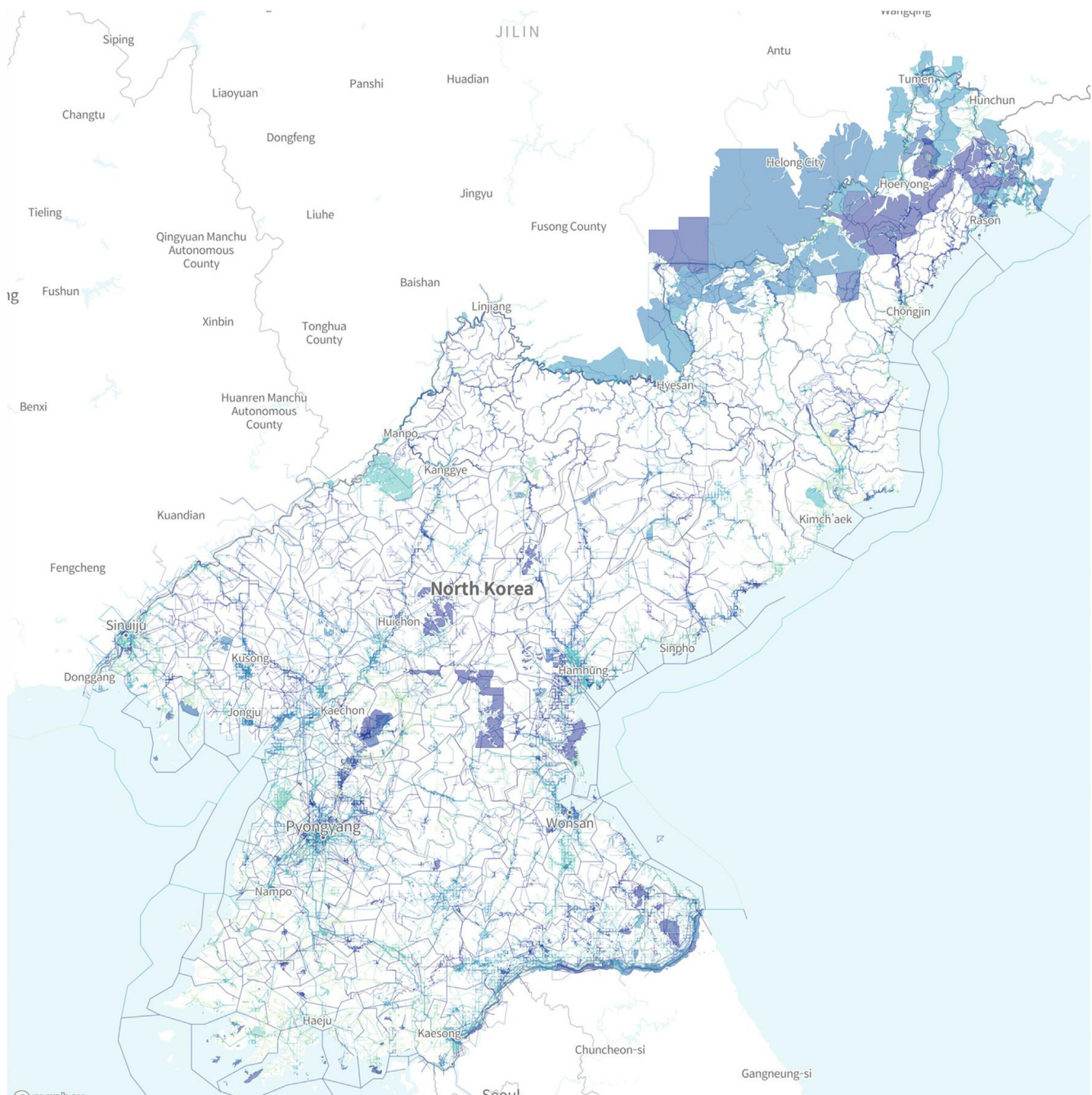


Fig. 2. OSM data for North Korea in October 2018.

most contributors do not have the first-hand experience of the country. Noteworthy comments include:

“When mapping other parts of the world, I do not usually trace buildings or fences, but near the Korean border I do, because these features are dangerous for people who are trying to cross the border. [...] DVD players and mobile phones have been imported from China. Smartphones will be imported, and OpenStreetMap can be hidden in a smartphone” (P791, Mid); *“editing the map in NK allows me to form some kind of understanding on the geography, where people live, how densely it’s settled”* (P858, Mid); or *“the government there tries to be as secretive as possible, and mapping too much in detail might lead to important information about military/government sites to get leaked out”* (P868, Low).

Other contributors, though, map as a way of keeping their first-hand knowledge of the country up-to-date, as reflected in the following comments:

“I frequently travel to North Korea, I use OSM offline while I am in the country. [...] I have sometimes shown the map to North Koreans, and they are extremely surprised that foreigners have access to such a detailed map.” (P780, Low); *“I live not far away from the former border [between East and West Germany]. I have old maps here from Cold War time with missing, wrong and falsified data. We don’t need wrong maps if want to live together in peace”* (P768, High); or *“My father brought back North Korea mortar fragments in his body and lived with the health impacts from them until the fragments eventually killed him”* (P880, High).

Since access to North Korea is extremely limited and it is difficult for even the local population to move within the country, mappers need to use multiple sources, from reports, maps, and images available in media outlets to posts on social media and descriptions provided by visitors. These strategies are similar to those used by amateur cartographers and forensic experts to map Daesh, which involved combining data from

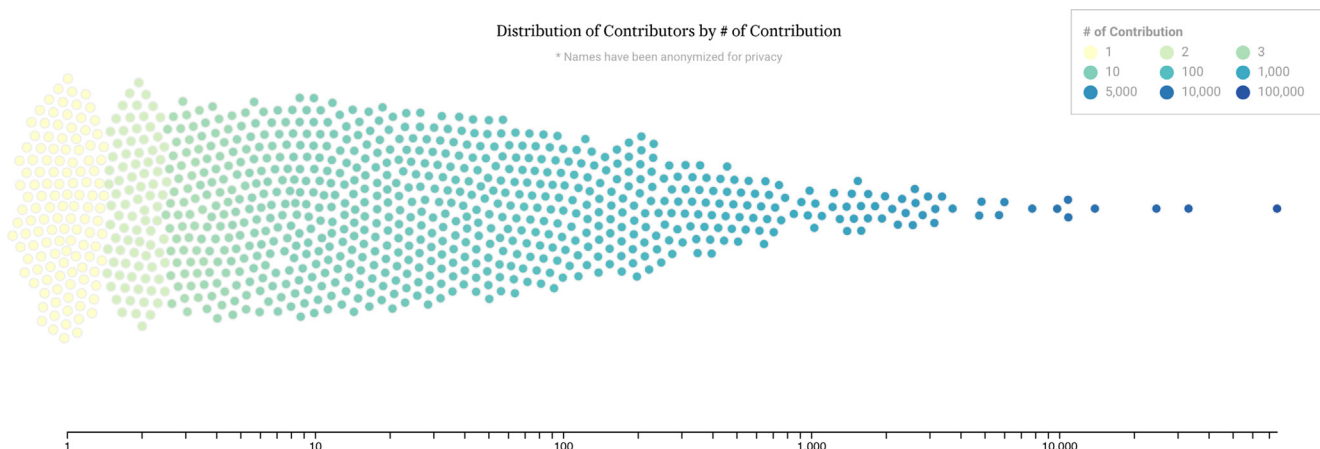


Fig. 3. Distribution of contributors by the number of contributions. The top 10 contributors drew 61 percent of the map.

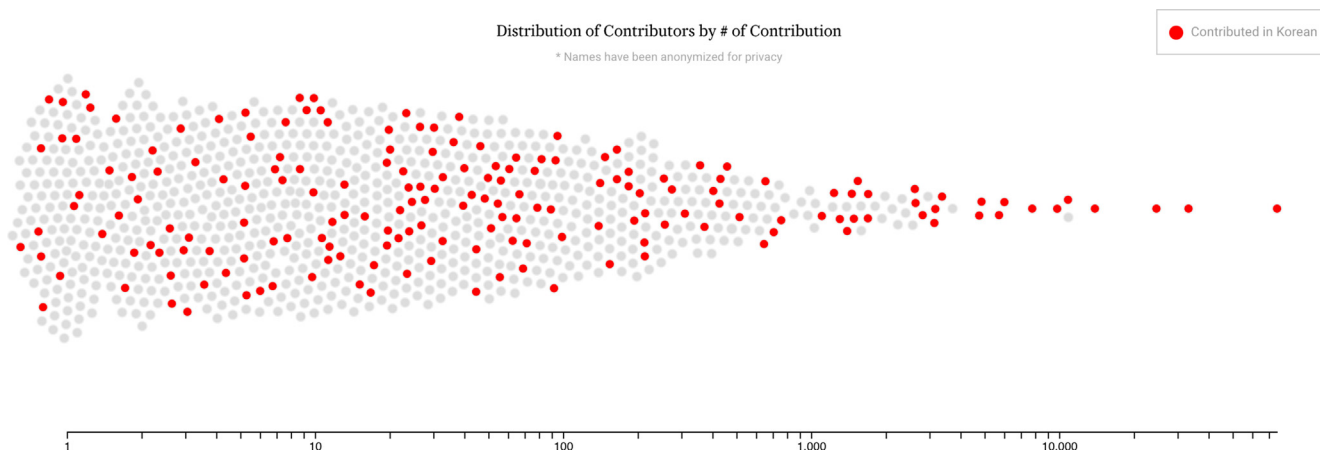


Fig. 4. Distribution of contributors by the number of contributions. Contributors who labeled data in Korean are shown in red. These contributors accounted for 62 percent of the contributions. All of the top 5 contributors labeled data in Korean.

different sources such as social media, drone footage, and georeferenced tweets to map the contested territory (Offenhuber, 2018). Quotations about mapping strategies used by OSM contributors include:

“[...] photos available on the internet or published in the magazines *Korea Today*, *Korea* and *Kumsugansan*. I took most of the internal toponymy and POIs from *Wikimapia*, which was most likely made by tourists from *China* and *Russia*, and perhaps even by foreign students from *Kim Il Sung University*” (P860, High, translated from Russian); “[...] mostly from free-to-trace aerial imagery link *Bing/DigitalGlobe*” (P720, High); or “mostly, my contributions are based on being there on the ground, but for inaccessible places, such as railway lines, I also used aerial images” (P581, Mid).

9. Discussion

The technical, political, and social aspects of mapping can be linked to three core spatial concepts: space, territory, and place, respectively (Duarte, 2017). Space is the arrangement of and interrelations between objects and actions. In this regard, technical advances (both in terms of tools and scientific knowledge) foster research into the meaning and representation of space. Territory is a portion of space in which the arrangement of objects and actions is intended to control those who belong to this territory, as well as to establish how other territories should see and deal with this portion of space—national boundaries are a prime example of a territorial artifact. Place is also a portion of space in which the arrangement of objects and actions is impregnated with subjective values; the difference between place and territory is that in

the former these values are not imposed and may be ignored—or, indeed, go unnoticed—by others. In places, whatever meaning a certain arrangement of objects and actions has only matters to those who share such values and the same portion of space.

The case discussed in this paper demonstrates that place-level knowledge can be accumulated remotely. Although OSM enables local spatial knowledge to be accumulated using satellite imagery, street-level information is usually considered impossible to acquire remotely. However, a number of active armchair mappers have combined information from different sources, such as Instagram photos, blog posts, and Russian and Chinese wikis, some of which was posted several years ago, to accumulate street-level knowledge. A similar example is Thomas van Linge, a 19-year-old Dutchman who produced one of the most accurate maps of the Islamic State conflict by gathering data available online (Kuntz, 2015). Offenhuber (2018) also noted that amateur cartographers’ efforts could “fill the void” that most media agencies fail to fill. Thanks to the indirect sources available on the internet, individuals can contribute highly detailed information gleaned from multiple sources. This kind of mapping provides a reasonable degree of accuracy and can be backed up with information collected on the ground by visitors or tourists.

Information about uncharted territories is generally considered hard to obtain not just because of the physical distances involved, but also because of cultural differences and language barriers. However, in the case discussed here, some contributors’ knowledge of languages enabled them to find relevant information in Russian or Chinese, whose countries are friendly to North Korea, and so contribute place-level

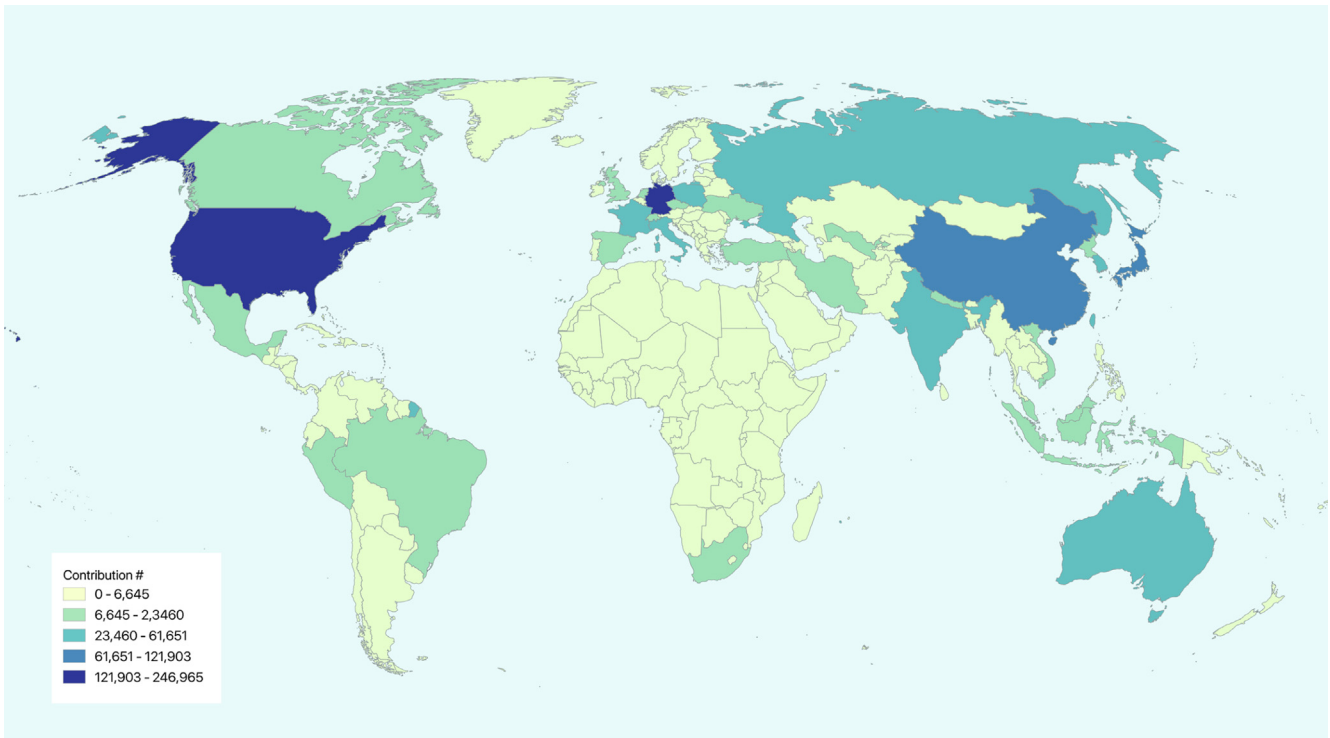


Fig. 5. Spatial distribution of contributors' OSMap changeset: The map shows which areas, other than North Korea, contributors have shown interest and contributed data.

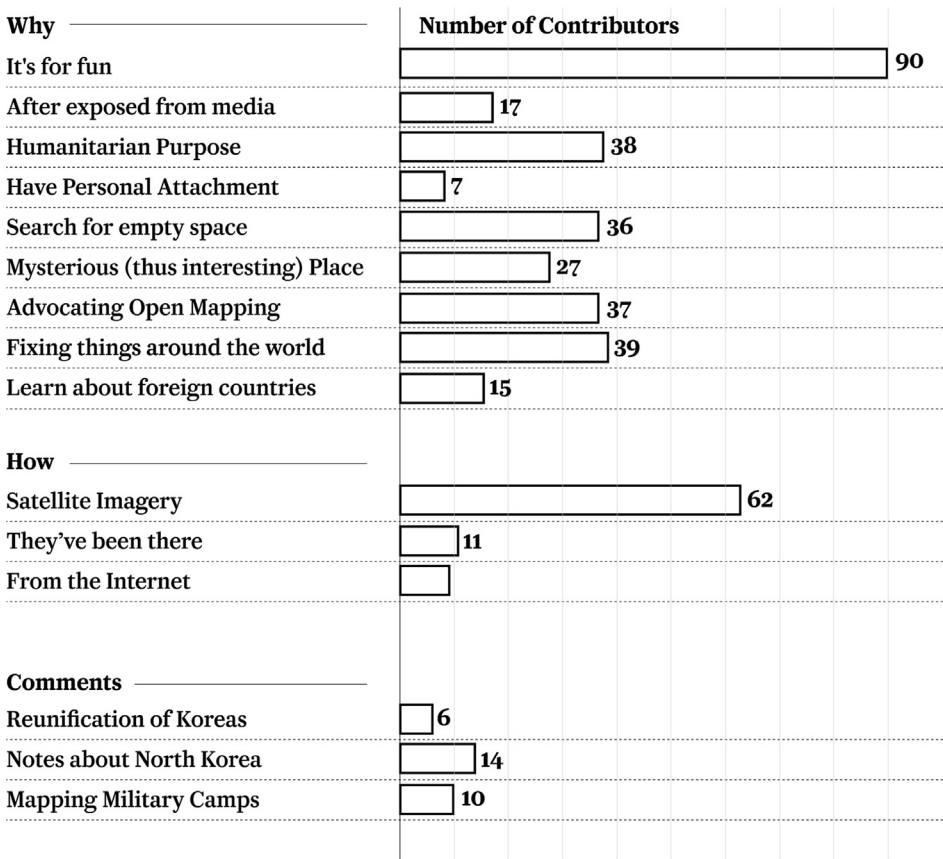


Fig. 6. Visualization of individual responses. All of the responses were split into sentences and assigned to one of thirteen different categories. Nine possible reasons for contributing ("Why?") were considered: It's for fun, After exposed from media, Humanitarian Purpose, Have Personal Attachment, Search for empty space, Mysterious (thus interesting) Place, Advocating Open Mapping, Fixing things around the world, and Learn about foreign countries. Three different ways of contributing ("How?") were considered: Satellite Imagery, They've been there, From the Internet. The comments categories consisted of the Reunification of Koreas, Notes about North Korea, and Mapping Military Camps. Most contributors stated that they contributed because it's for fun, but some had specific, altruistic reasons.

knowledge of North Korea. This kind of contribution to local data can reasonably be compared to investigative journalism, and one can imagine a new data cosmopolitanism whose advocates are deeply

committed to global issues and act remotely, armed only with digital tools. According to many of the contributors interviewed for this paper, empathy with people facing problems far removed from those they

experience in their own daily lives acts as the trigger for their contributions as they started to map North Korea after seeing news articles about the country's isolation. As Zuckerman notes (Metz, 2018), this kind of engagement in the digital realm can be both trivial and meaningful and thus changes the norms of mapping. A potential next step could, therefore, be to investigate ways of generating this kind of reaction over a distance and encouraging active engagement in crowdsourced projects.

However, it is debatable whether the motivation driving contributors identified here can be generalized to other crowd-sourced data projects. While contributors were motivated by a variety of factors, most of them said they contributed for fun, and the driving force behind the mapping effort was essentially a few highly motivated individuals who were responsible for 60% of the contributions. Besides, remotely contributed data is not only inherently unreliable and potentially biased as it has not been verified but can even be unstructured; for instance, eight MiG-19 jet fighters were mapped, which would appear not to make sense as these are mobile objects. As Elwood (2008) noted, if we considered the contributed data as valuable ones just because they are 'volunteered,' we would lose the critical perspective. (Elwood, 2008). Flanagan and Metzger (2008) noted some strategies of how users in crowd-sourced projects collectively obtain credibility, such as referring other users' reviews or votes or viewing edit histories (Flanagan and Metzger, 2008). However, in North Korea's case, it is limited in the sense that there are no local residents to verify the places that users contributed. This limitation, in line with the fact that the contributed data is represented as a map, results in further strengthening the belief that the contributed information is seemingly objective. Lastly, since almost all of the contributors relied on satellite imagery to create the base map, whose resolution is determined by OSM, there is a problem of dependence on citizen cartographers' interpretation of low-resolution satellite photos and on the satellite imagery provided by first-world internet companies' "corporate lenses", such as Google Maps or Microsoft Bing Maps (Barney, 2019). As OSM data for North Korea is mostly mapped by "a small group of technologically savvy individuals" using the satellite imagery owned by "high-tech private companies," it is worth pondering whether this effort is "reworking [...] existing power structures, rather than truly resisting them" (Caquard, 2014, p.146).

Just how valuable these contributions remain the subject of controversy. The question "who benefits?" seems not to have been answered yet. "[P]eople in a place" who can inform and validate such local knowledge is missing (Leszczynski, 2012), thereby leaving the question unanswered. Since most North Koreans cannot access the internet and armchair mappers do not necessarily know the local residents' situation, it is possible that only the North Korean government will benefit from all of these contributions. Despite the OSM mappers' good intentions, their initiative may, in fact, be based on a naïve first-world perspective. In the end, it is the North Korean government that can use the OSM maps, perhaps to confuse outsiders by, for instance, exposing multiple fake nuclear sites while hiding real ones. In that case, should we still encourage OSM mapping of North Korea while the country's citizens do not have access to this mapping tool?

10. Conclusion

We have presented a brief history of the mapping of North Korea and discussed how the North Korean government has adapted the open-source culture and maintained very closely controlled connectivity to the internet. We have examined OSM data for North Korea, surveyed the 899 contributors who contributed to the OSM dataset for the country since 2007 and interviewed over 200 of these individuals to identify what motivated them to contribute and what concerns they had about mapping the country.

Although most cartographers of North Korea do not live in the country, they are motivated by issues there. Like data analysts and

investigative journalists, they combine information obtained from different sources by a variety of methods to produce place-level knowledge remotely. However, because of the inherent limitations of remotely contributed data, it is questionable whether these strategies can be applied to other crowdsourced projects. We should also consider who ultimately benefits from the OSM process. As mapping is a combination of technical, political, and social capabilities and intentions and open data can be accessed not only by citizens but also by institutions, unexpected outcomes are frequently observed.

The overall attempt of North Korea's control to access to the internet, and adoption of the open-source environment depicts their eagerness to exert power and control, thus remaining invisible to the world. This kind of intention has been well witnessed in the context of an authoritative governmental body (Lin, 2013) or contested territories (Bittner, 2017). Yet the endeavor of the contributors creates a meaningful tension between not to be seen versus to be seen (Elwood and Leszczynski, 2013; Burns, 2014). The contributors draw the attention to make North Korea visible, and the accumulated knowledge reflects not just spatial understanding but power structures: for instance, the praising label of the monument of Kim Il Sung. However, as Burns (2014) noted, the VGI platform also could exert the power of deciding what is encouraged to collect and what is not desirable. Indeed, some of them are not desirable in OSM, like the case of mapping jet fighters, and it is not encouraged to add potentially inaccurate information, such as the location of nuclear test sites. This matter of controlling the terms of visibility (Elwood and Leszczynski, 2013) inside and outside of the VGI platform ultimately causes mapping coverage inequalities in the platform. In that regard, it is a question of how the VGI platform could incorporate information which is inherently inaccurate but opens other avenues of political aspects of mapping.

Drawing on the case of North Korea in OSM, we imagine political aspects of the VGI platforms beyond the limitations of contributing data points on a map (Radil and Anderson, 2019). The contributors' efforts to make knowledge visible, such as their intention of mapping fences between China and North Korea, are potentially strong political acts, because they tried to subvert the relationship of geographical visibility and the residents in the country (Elwood and Leszczynski, 2013; Burns, 2014). Therefore, it would be imperative for the VGI platforms to expose more information about data points and stories, as that information could potentially stimulate other mappers' interest and politicize the issue of inequalities of mapping coverage and the situation of the country as well. We argue that these kinds of mapping practices might be a counter action of what North Korea has done to its residents.

CRedit authorship contribution statement

Wonyoung So: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Visualization, Writing-original draft, Writing-review & editing. Fábio Duarte: Supervision, Writing-original draft, Writing-review & editing.

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