

TWEET-SOURCING CARACAS

Using E-Participation for Urban Planning In Global South Cities

Alexandra Guadalupe Paty Diaz
M.S. Urban Planning

A Thesis Presented to the Faculty of Architecture and Planning
COLUMBIA UNIVERSITY

In Partial Fulfillment
Of the Requirements for the Degree
Master of Science in Urban Planning

Thesis Committee

Thesis Advisor:

Nadia Mian
Visiting Assistant Professor, GSAPP

Reader:

Juan Francisco Saldarriaga Chaux
Reseracher Scholar, Center for Spatial Research GSAPP

May 2016

TWEET-SOURCING CARACAS

Using E-Participation for Urban Planning In Global South Cities

By Alexandra Guadalupe Paty Diaz
M.S. Urban Planning

Thesis Advisor:

Nadia Mian
Visiting Assistant Professor, GSAPP

Reader:

Juan Francisco Saldarriaga Chaux
Reseracher Scholar, Center for Spatial Research GSAPP

ABSTRACT

The purpose of this study is to explore how social media can be used as a data source and to engage citizens in urban planning and governance process. Given the rise of mobile technologies and the extensive use of social media networks in cities in the global south, electronic participation (e-participation) has become a mechanism for constant interaction between residents and government officials and is a method to collect unique information from the public. However, it is still not clear how reliable and accurate social media data can be for urban planning. Through a case study analysis of Sucre Municipality in Caracas, the capital city of Venezuela, this research used a social media platform, Twitter, to examine the content collected through the exchange between the public and the Mayor of Sucre over three months.

The tweets were examined regarding time, location, theme and content and comparisons were made with official documents and news articles to evaluate accuracy and relevance of the data. People engage more with the Mayor than the institution and the amount of tweets regarding the city overpass political or personal ones. Slum areas use social media as an advocacy platform to rise their concerns regarding water shortage and waste management irregularities. Urban and formal areas use tweets as primary mechanism to communicate crimes and irregularities in the physical state of streets. Two tweet-sourced interactive maps were developed in web mapping platform to visualize the content of the tweets. Recommendations were made to help municipalities and planners to incorporate efficiently and critically social media as a new participatory tool for planning and governance.

*Caracas,
aun en sus momentos más profundos de tristeza y oscuridad,
tiene un pueblo resiliente, inspirador y esperanzador.*

Nunca está tan oscuro como cuando va amanecer.

Acknowledgements

XXXXX

*Para Jonathan Alexander y Leonardo Andrés,
por quienes trabajo todos los días de mi vida,
por su futuro en ciudades venezolanas ,
llenas de oportunidades e innovación,
la vida sea respetada
y todos los derechos sean para todas las personas*

TWEET-SOURCING CARACAS

Using E-Participation for Urban Planning In Global South Cities

Alexandra Guadalupe Paty Diaz
M.S. Urban Planning

Table of Content

ABSTRACT	03
ACKNOWLEDGEMENTS	05
TABLE OF CONTENT	11
INTRODUCTION	13
THE CONTEXT	16
BACKGROUND	19
Big Data, Smart Cities and Data-Smart Governance	19
The Possibilities of E-Participation For Urban Planning	20
LITERATURE REVIEW	24
The Importance of Community Participation in Urban Planning	24
E-Participation	24
Mobile Technologies and Social Media	25
METHODOLOGY	31
Sucre's Municipality as Case Study	33
Twitter as e-participation platform	36
Data Collection	38
Strategy	39
Evaluating the Data	40
Limitations	42
FINDINGS	45
Topic, Format, Location, Theme	47
Water Crisis, the role of the Municipality and the Distortions in Social Media	52
The public in constant vigilance of streets and public health	54
The citizens of the most violent city in the world denouncing through social media	58
CONCLUSIONS	65
BIBLIOGRAPHY	69

Introduction

When my parents obtained an identity card for my younger brothers in Venezuela, for some unknown reason, the main database of the civil registry services SAIME (acronym for Servicio Administrativo de Identificación, Migración y Extranjería) did not keep any record. Without being in the database, my brothers could not make an appointment to process a passport application. My father went multiple times to SAIME's headquarters and nobody responded to the problem.

My father was advised to write through Twitter to @chavezcandanga, the account of President of National Government Hugo Chavez, and to @dantetivas, the account of the President of Saime, Dante Rivas. Skeptical, he opened a Twitter account and wrote two tweets. Within weeks, my brothers were in the system and could obtain their passport.

This is an example of the undeniable power of social media in Venezuela.

From the start, social media has been a popular mode of interaction among youth in Venezuela. Two events helped raise the number of users of social media accounts in the country. First, the high level of censorship and bias the traditional media faced due to extreme government controls. Second, the President of the National Government, Hugo Chavez, launched his own Twitter account @chavezcandanga to communicate directly with the citizens of Venezuela. This helped make social media in Venezuela, especially Twitter, a primary source of information, communication and social interaction.

However, the political, economic and social crisis that the country encounters nowadays has deeply impacted deeply a citizen's daily life. In 2015, Venezuela surpassed its own record of violent deaths, reaching 27.875 murders (ONV, 2016). It also recorded citizen's feeling of insecurity over 47.6% (third highest of Latin America) and a record inflation rate over 159% (Statista, 2016). The country is also rationing water, electricity and food.

According to CONATEL (2014), over 15 million Venezuelans have access to the internet, representing 60.33% of total population, and 30,528,002 active mobile phone lines. With this context, the troubles and shortages pushed people to begin using social media for everyday necessities, such as informing when a product was available in supermarkets, which places in the city are dangerous, or just reading the news from direct sources.

According to Mashup Interactive Agency (2015), one of the lead digital media agency in the country with strong presence in Latin America, most of the global users of social media are the young population between 18 and 34 years old. Also, Facebook and Twitter are the social media platforms with the most even demographic distribution of users: 40% of users are between 18 and 34 years old and 60% of the users are over 35 years old. Venezuela represents 6% of the digital audience in Latin America, 65% of the users are between 15 and 34 years old and 35% have over 35 years old. Above all, the main interest of Venezu-

elans are technology, politics and health.

In that sense, municipalities and elected officials are using social media platforms as a main form of communication with citizens. The authorities and institutions of Caracas, the capital of Venezuela, are actively communicating their activities via social media, specifically Twitter, and gaining more audience every year. Consequently, political sites experienced a growth of 117% in 2015 (Mashup Interactive Agency, 2015).

Caracas is the central area of the Greater Caracas, and it is also the capital of Venezuela. The Metropolitan Area of Caracas (MAC) is comprised of five municipalities: Libertador, Chacao, El Hatillo, Baruta and Sucre. The case of study selected is the Municipality of Sucre, the second largest of the MAC and the first largest district of Miranda State. Since 2008, the Mayor of Sucre's Municipality is Carlos Ocariz, who got reelected on 2014 for a second term and recently won as best Mayor of Latin America and fourth Best Mayor of the world by the organization, World Mayor. Sucre has become

an example of resiliency and best urban practices within the city, actively the public with a strong team of community leaders, community assemblies and participatory process including being the most active audience in social media. Thus, making the city a strong candidate for study.





THE CONTEXT

Background

Engaging the communities in planning and policy-making process has never been an easy task. Planners are educated to be the advocates of the communities they serve and to use public participation as a mechanism to validate policies. Therefore, new, creative and innovative ways to involve the public in city issues and include a good representation of total population is a challenge.

In today's day and age, walking on the streets, entering a class, having lunch with friends or sitting on a park bench, we have the unique possibility to connect with people that are not next to us and share information with either a mobile or a computer. We are able to capture a moment with our camera and immediately send the picture to friends through Instagram, Facebook or Twitter. We use smartphones to see predictions of traffic or consult public transit schedules, even using it as guide by enabling GPS location, with apps such as Google Maps or Waze. We are living a unique moment of time when technology is right in our hands and information is more accessible and democratic than

ever. That being the case, how can planners in developing countries plan cities by using digital social networks?

BIG DATA, SMART CITIES AND DATA-SMART GOVERNANCE

With the advance of technology and the understanding of the complexity of the city's processes, big technology enterprises Cisco, IBM and Siemens provide software and technological infrastructures to local governments to improve data processing and maximize urban problem-solving actions, such as police procedures, vigilance and transportation. The main concept is to make data easily available and manageable for city officials to predict and solve, almost instantly, the city's complex problems. However, this approach has been criticized because it is too profit-driven (Greenfield, 2013); it is a top-down approach without community-based input (Townsend, 2013) and invades citizen's privacy by over observation and collection of data.

A different approach to the smart cities concept originated from local governments, citizens and

academia. In the developed world, cities started making changes about how to integrate technology to governance to facilitate and make city management and planning more transparent. For example, Citizens Connect was developed in Boston as an app to allow citizens to report problems or issues they saw on the streets and to propose solutions. It quickly became an efficient tool for the Department of Public Works to collect data and inform citizens about the resolution of reported problems. Michael Bloomberg, founder and owner of a global financial data and media company, believes that in order to be able to manage a city you need to be able to see the data. When he took office as Mayor of New York City in 2012, one of the main goals of his administration was to digitalize city data and build an open data platform (Goldsmith and Crawford, 2014). Another example is the development of 'Mobile Landscapes' app in Milan (Italy) to collect data and analyze the intensity of urban activities (Ratti, Frenchman, Pulselli and Williams, 2006).

All these cases exemplify how government initia-

tives in technological tools to manage large data bases and how public participation can improve planning and governance. Still, such initiatives need budget, political support, technical knowledge and expertise to be developed, making it difficult to achieve in developing cities where city budgets are highly scrutinized and limited. Therefore, which other technological tools to engage communities in governance and planning are available for the city?

THE POSSIBILITIES OF E-PARTICIPATION FOR URBAN PLANNING

The use of technological platforms by city officials to foster public participation is understood as e-participation (Ann Macintosh and Angus Whyte, 2006). Mobile technologies and social media have been used primarily for data collecting and connecting families and friends, while evolving as tools for marketing and targeting publicity for both businesses and non-profit organizations. For example, Twitter is a micro-blogging platform that allows users to share short messages (140 characters) called tweets; Facebook allows users to connect with

friends and share content; Instagram allows users to share multimedia content; Foursquare allows one to check in places and keep track of social actions. The success of these free-service platforms relies on their user-friendly interfaces; freedom of speech; how can they be used for both personal or professional purposes; and how direct the interaction can be between users. Indeed, city officials and institutions are relying more on these social networks to spread their message, share information and connect directly with city dwellers. However, what are the opportunities that social media brings to e-participation?

The utility of social media platforms for planning and governance can be summarized into two possibilities. First, social media serves as a direct communication bridge between city officials and communities sharing information and interacting without the traditional bureaucracy or having to wait for an occasional community assembly (Bizkaj, 2012). Second, the ability to georeference the data and its content enriches and supports traditional

official datasets (Campagna, 2014). Even more, data analysis on the location of mobile devices could potentially become one of the most exciting new sources of information for urban analysis (Ratti, Frenchman, Pulselli and Williams, 2006). Planners and those in local governments could facilitate public access to information in earlier stages of urban planning. Furthermore, these social networks allow the public to have access to information 24 hours a day and not only on day of formal public hearings. On the other hand, the effectiveness of e-participation depends on the proportion of public able to use computers and mobile technologies (Bizjak, 2012). Therefore, how can planners make use of data collection through interaction in social networks and strengthen the planning process?

The purpose of this paper is to explore how urban planners can use social media either as a source of demographic data or as an e-participation mechanism to engage citizens in the planning process of the city. By no means does technology substitute traditional face-to-face interactions. However,

e-participation is an opportunity for constant interaction and collects unique information from communities. First, an examination of public participation and its technological approach as e-participation will be presented. Next, an analysis of tweets collected from the interaction between official accounts of the Municipality of Sucre (Caracas, Venezuela) and the public will be presented. Tweets will be examined in terms of time, location, frequency and subjects of discussion to study how citizens are engaging with city processes, specifically the ones related to urban planning. Then, a comparison will be conducted to compare it to official budgets and programs of the district to evaluate accuracy and relevance of the social media information. Lastly, findings and conclusions will serve to summarize recommendations for planners to foster existing social media as participation tools for urban planning in developing countries.

Literature Review

This chapter draws on three bodies of literature in order to determine the main concepts and the academic frame of the study. First, I will review the definition of public participation, the levels of engagement and why are they important for planners. Second, I will introduce the concept of e-participation as the practice of public participation with digital tools and how the raise of mobile technologies has contributed to the raise of this practice. Third, an overview of how the use of social media platforms as e-participation tools, how users can be defined according to how they contributed or interact and what recent academic studies have focus in analyze regarding their usefulness in urban planning and governance.

THE IMPORTANCE OF COMMUNITY PARTICIPATION IN URBAN PLANNING

Planners are in constant search for more creative, efficient and effective ways to involve citizens in the planning process. We look to the community as a main source of information and knowledge. Planners understand a neighborhood better with the

stories and experiences described by their neighbors. Transportation problems are better understood by looking at the data and interpret it with the experience of the commuters.

Public participation is a main instrument to do more accurate and efficient urban planning and policy-making. As Bizkaj (2012) stated, public participation can be formal or informal. Formal participation is a public act for the authorities to implement, for example public assemblies, elections, surveys, referendums and public initiatives. In the other hand, informal participation is initiated by the public, with optional binding for the authorities and greater power of decision for the public, for example consultations, protests, signing petitions and making demands. Nevertheless, public participation is not possible if either planners or those that commission the plans are unwilling to listen, accept and integrate opinions and ideas that are not necessarily made by experts. Therefore, participation in urban planning must be understood as a democratic process in the city where political and administrative

decisions are taken daily affecting the built environment that shapes our cities.

But how much public participation is good participation? Arnstein (1969) defined a very accurate ladder of participation. There are three main levels of participation: non participation where power holders educate or instruct participants (manipulation, therapy); tokenism that allows some level of voice (informing, consultation and placation); and citizen power as an increase of the power of citizens in decision-making (delegated power and citizen control). It seems that in the planning process different levels of participation are usually mutually exclusive of each other.

What if planners have access to a digital platform for more interaction and discussions? How can planners capture complaints when they are not asking for them? How can we assess and contextualize database and official statistics for better understanding and interpretation for planners?

E-PARTICIPATION

Definition

According to Ann Macintosh and Angus Whyte (2006), electronic participation (e-participation) is a connection between elected representatives of authority and various public groups through information technology tools. It is about getting initiatives and suggestions from the public toward elected representatives of authority. Simon Delakorda (2003) explains e-public participation as “a computer application (websites and web portals) for methodically standardized, public, expert and political participation of citizens in policy making, adopting programs and plans about matters of public interest”. As Bizjak(2012) redefines E-participation is a commonly accepted term that incorporates participation in various phases of the democratic political process, supported by technology.

As commonly understood, e-participation allows a spontaneous and direct interaction between citizens and officials, thereby evading bureaucratic and tedious procedures. It also allows participants

of many sites to form their own virtual community for exchanging information. Turton and Macgill (2005) have identified two types of e-participation in urban planning according to how participants interact: synchronous participation, where all participants interact using the same data available in one server; asynchronous participation where the interaction is not simultaneously but remains present online to later reviewing, evaluation or response.

Mobile technologies and Social Media

Kleinhans (2015) defines mobile participation as the use of mobile devices to broaden the participation of citizens and other stakeholders by enabling them to connect with each other, generate and share information, comment and vote (Hoffken & Streich, 2013: 206). One of the unique advantage of mobile technologies is that it is expected to attract a much wider interest group than conventional participation tools, in particular youths and young adults who are difficult to engage in public affairs or participation schemes (Clark et al., 2013). Activities can be mapped to the location where it happens,

data can account for people's movements and the intensity of communication activity at different times and the very high penetration of cell phones in most developed countries make them an ideal technology to collect amounts of statistically significant data (Ratti, Frenchman, Pulselli and Williams, 2006).

Social media can be defined as a social interaction using web-based and mobile technologies, to turn scalable communication into interactive dialog (Sui and Goodchild, 2011). Social network platforms can be used for different purposes due to their flexible technology and user-friendly interfaces. However, the integration of geographical information to interactive social platforms has introduced opportunities to share data that was not previously available. As an example, Google Maps, Open Street Maps and CartoDb allows people to build their own maps by collecting geographical information of their activities; in Flickr or Instagram users share geo-tagged multimedia content; Facebook, Twitter and others not only allows users to share geo-tagged content but allows interactions between

users thanks to the flexibility of their platforms. All these cases have been proven extremely useful for emergency response, environmental issues, special events and urban planning. However, the lack of efficient and advanced technical tools to analyze and present data accumulated by e-participation is a challenge. The data provided by e-participation is usually unstructured, there is too much information, much of it is useless, and a lot of time is lost arranging it (Sui and Goodchild, 2011). However, the information that can be collected can provide tremendous value and insight into situations which traditionally, approaches to gaining information about are very costly for local governments and planners (Ratti, Frenchman, Pulselli and Williams, 2006).

SOCIAL MEDIA AND URBAN PLANNING

As Manovich (2011) defined there are three categories for people and organizations in big data: those who create data, those who have the means to collect it and those who have the expertise to analyze it. Every citizen can create data, even without

realizing they are, and it does not excludes those who do not use mobile technologies and social networks.

A major advance in big data is the integration of geographical information to the data produced. It can be classified by how the data is produced, as follows: (1) Authoritative Geographic Information (A-GI) data produced by experts, professionals, organizations and mapping agencies for a mission under institutional or legal frameworks (Ball 2010; Goodchild and Glennon 2010). (2) Volunteered Geographic Information (VGI) according to Goodchild (2007) it refers to the user-generated content with a geospatial component created by citizens acting as volunteer sensors. Particularly, this data has been useful to online mapping where citizens can express their opinions on world events and broadcasting their findings to the world directly in a map. One example is how through the mapping community in Arcgis.com participants have uploaded their own maps of diverse topics (location of bin Laden's death, assistance in earthquake relief ac-

tions, etc). (3) Social Media Geographic Information (SMGI) data produced in a social media platform with geocoded information.

With the smart cities movement, those who have the means to collect data and those who have the expertise to analyze it collide when the big software companies provided software and tech-infrastructure to city governments in order to maximize police procedures, vigilance, transportation and other process, but also for profit. In one way or another, companies owned the data and tech-infrastructure and municipalities had to buy their services. Alternatively, the second group can also be represented by companies such as Google, Amazon or Microsoft, that have the computing infrastructure to host large data sets and various free services, holding and collecting massive amounts of data.

Social media has increased its location-based feature. This allows users to know and see on a map where their friends are physically located at a particular time. It also allows to share opinions and perceptions to share information of different

stakeholders and even gather visual ideas with the multimedia content. Social media with geographical information also allows one to conduct spatial and thematic analyses by time, media type, as well as analyzing the user's personal information. The quality and credibility of social media data for scientific research and decision-making still needs further investigation. That is why protocols and procedures can be developed to link asserted, crowd-sourced information (Sui and Goodchild, 2011).

The geocoded social media data and web-tools with geographic information have made GIS a powerful media for the general public to construct dialogs and interactions about social issues (Sui and Goodchild, 2011) . They also allow shifting the role of GIS from being an arcane technology used by trained professionals to a popular social medium for the general public to report problems and built community. Similarly, this virtual interaction through social media and mapping communities has resulted in independent meetings in person and activities in real places (Sui and Goodchild, 2011). Further-

more, as official data is more available to the public and communication between communities, planners and city officials becomes more direct and spontaneous, how can planners process efficiently social media data?

The analyzes that have been found so far about the applicability of social media information in urban planning and governance are concentrated in case studies of a specific event, area or topic. For example, Williams and Currid-Halkett (2014) studied the discrete activities of designers within the Garment District in New York City (USA) using Four-square data, to understand the economic dynamics of an industrial agglomeration. Shelton, Poorthuis and Zook (2015) used Twitter to study processes of segregation and mobility in Louisville (USA). Ratti, Frenchman, Pulselli and Williams (2006) developed 'Mobile Landscapes' app in Milan (Italy) to collect data and analyze the intensity of urban activities within the city. Campagna, Floris, Massa, Girsheva and Ivanov (2015) used social media geographic information to study tourism planning in Cagliari

(Italy).

Previous analyses in the subject has taken as epicenter the geographical information of the social media data. However, there is no further analysis of why users could choose to disable their geospatial/geographic function in their profiles. This could also be an important source of information itself: why do users feel the necessity to deactivate location. Is it a sign of safety problems in dangerous cities? There is also little analysis regarding textual analysis and even so, geo-localization of the content itself. Do planners care more about the location where the data was produced or is it more important the content communicated?

Nonetheless, there is not enough literature about how social media can be useful for daily urban planning process that hold a city together.





METHODOLOGY

The purpose of this study is to explore how urban planners can use social media to engage citizens in urban planning processes. Given the lack of studies related to this specific topic, it is necessary to select a real case to analyze



Sucre's Municipality as Case Study

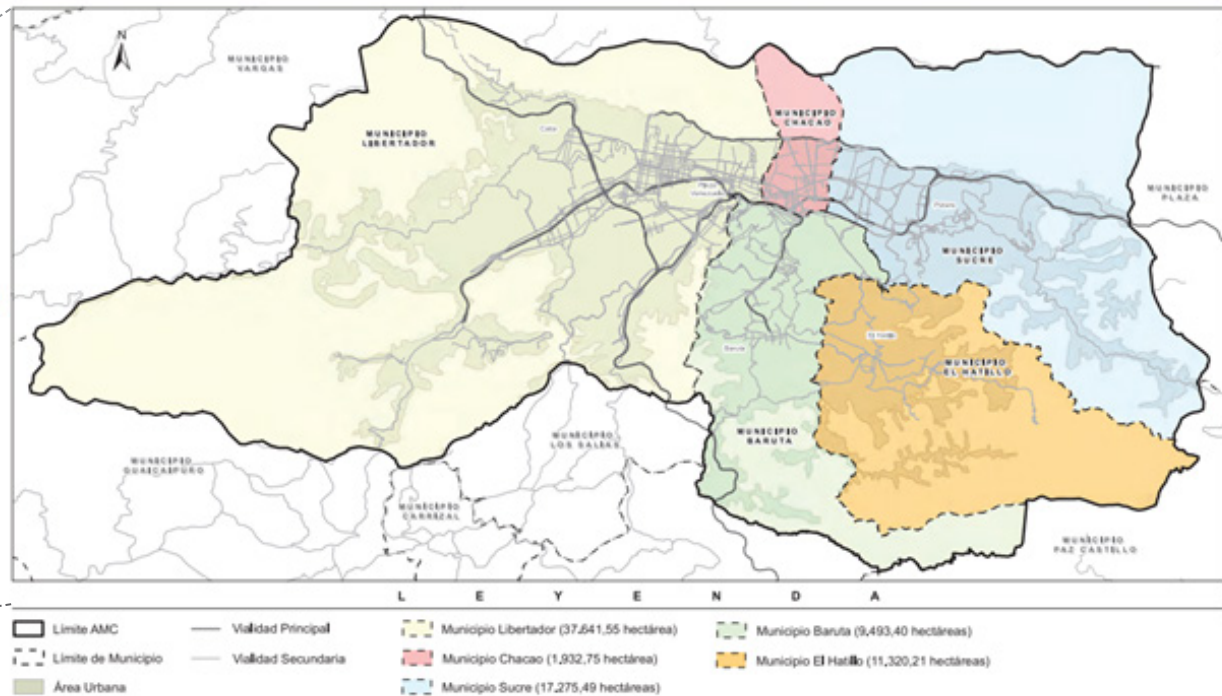


Figure 1 | Metropolitan Area of Caracas. Source: Plan Caracas 2020, IMUTC

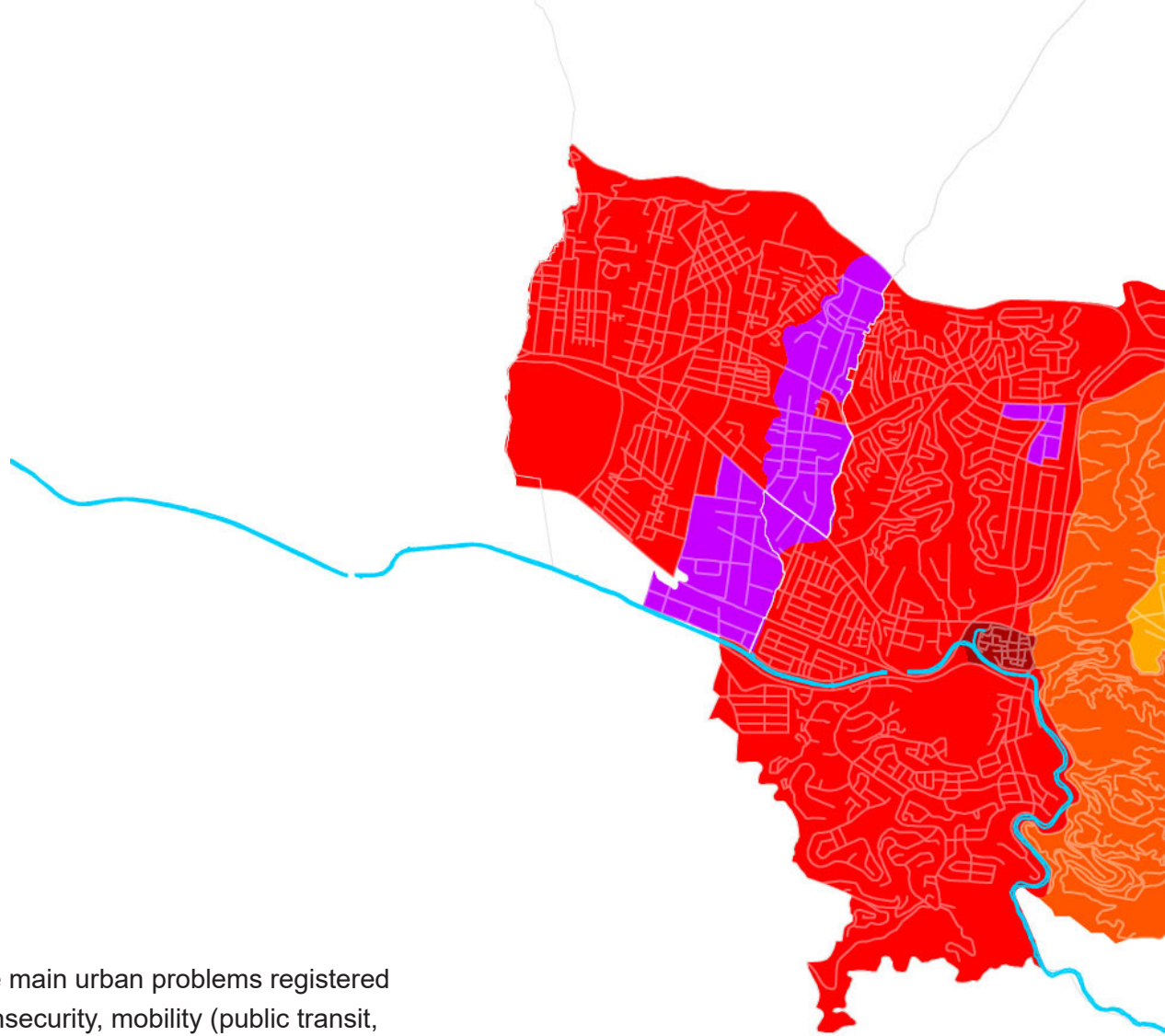
The case study selected is located in Caracas, the capital of Venezuela, because of the knowledge and familiarity of the author with the city and its local governments. In addition, the popularity of smart phones and social media in Venezuelan society makes it an ideal context to study this issue. The ongoing blackout of information from traditional media as a consequence of government restrictions drove demand for information from social networks, and Venezuelans continue to demand mobile devices and access to the internet so as to be informed about important news (Euromonitor International, 2015).

Caracas is the central area of Greater Caracas, and it is also the capital of Venezuela. The Metropolitan Area of Caracas (MAC) is comprised of five municipalities: Libertador, Chacao, El Hatillo, Baruta and Sucre (Figure 1). The first, Libertador, is also the Capital District and the four remaining are also part of Miranda State. Each district has an independent local government, each with an executive and legislative power. They also share a Metro-

politan government with independent executive and legislative power. The case study for this thesis will be the Municipality of Sucre.

MUNICIPALITY OF SUCRE

Sucre is one of the five municipalities of the MAC and one of the 21 districts of Miranda State. According to the National Institute of Statistics of Venezuela (2015), the municipality has a population of 600,351 inhabitants, constituting 22.4% of Miranda's population, which makes it the most populated district of the state. With an area of 164 km², most of the population is located in the informal settlements Petare, La Dolorita and Caucaguita. There are also some dense areas in the formal neighborhoods. Sucre's conjunction of formal and informal settlements correspond to the diversity of household income of its population. This characteristic makes it an ideal case through which to study public participation in a diverse population. Affluent socioeconomic sectors are located on the flat area of the city and the poorest social sectors in the informal settlements are located on the hills. According to



ARePA (2014), the main urban problems registered in the district are insecurity, mobility (public transit, infrastructure, access to diverse modes of transportation) and waste management.

Since 2008, when Carlos Ocariz was elected Mayor of Sucre’s Municipality, one of the main pillars of the municipality has been to involve the community in the policy-making process to the greatest extent possible. Consequently, a special team of community leaders was created at the Mayor’s Office to serve as a direct nexus with the communities. By creating institutional accounts in diverse social media platforms –Facebook, Twitter and Instagram- to enhance communication and participation with the public, the municipality made communication between the institutions and the public accessible, consistent and direct.

This study was framed before and after the legislative national election on December 6th, 2015, because during campaign times both local governments and citizens communicate more through the political campaign, and discuss city issues. These

discussions occur mainly in social media due to the strong censorship local leaders face in traditional mass media. Therefore, this study collected data produced from November 2015 to January 2016.

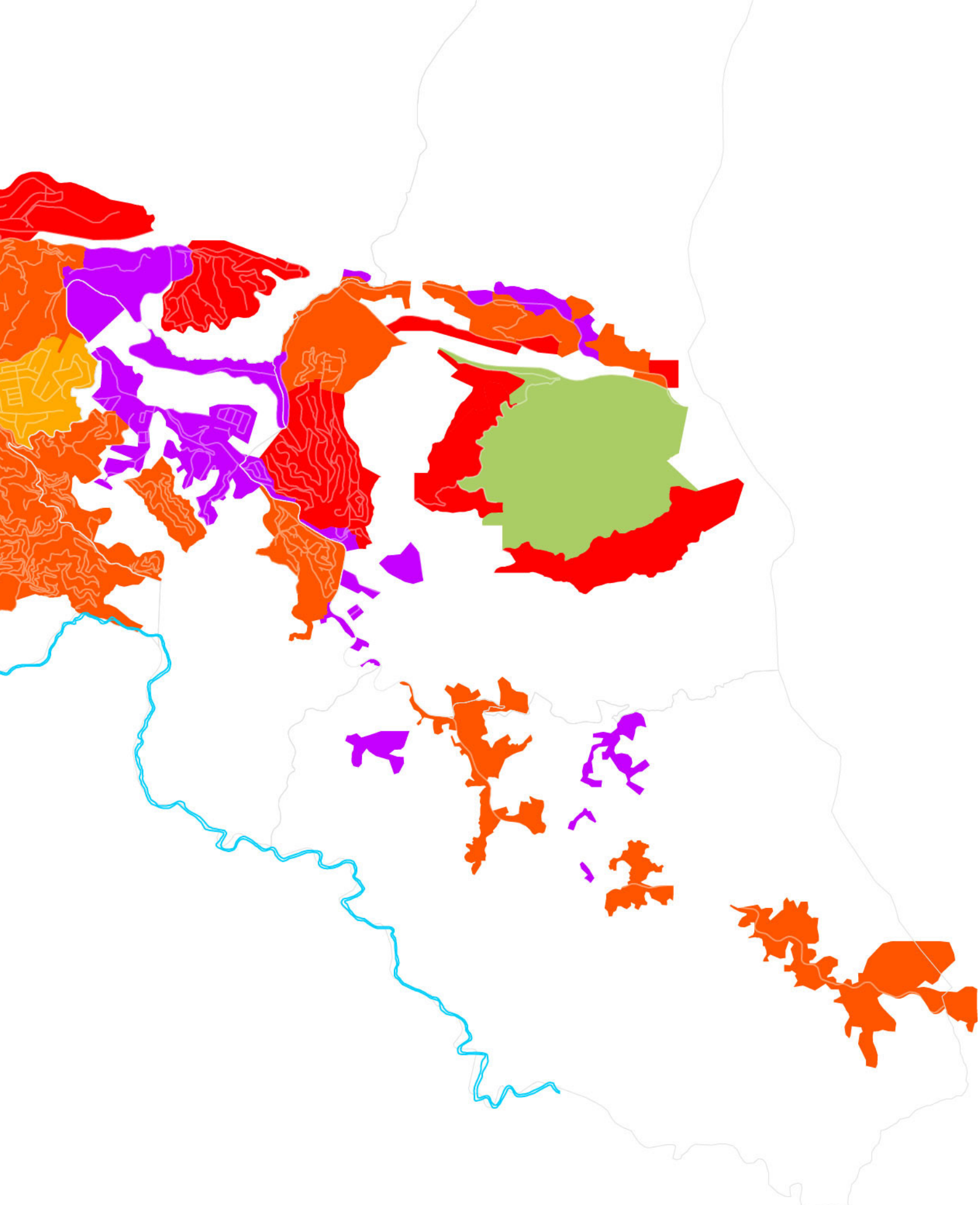
Sucre's Urban Form Classification

Map data provided by the Special Plan Office of Sucre’s Municipality

- Slums
- Historic Center
- Formal City
- Industrial Polygon
- Residential Polygon
- Rural

0 1Miles

Figure 2 | Sucre’s Urban Form Classification



Twitter as e-participation platform

Sucre’s Office of Digital Communications manages the social media accounts of both the Mayor and the Municipality. The rest of the departments manage their social media accounts independently. When evaluating which of the platforms reaches the largest audience in order to conduct the study, the Twitter account of the Mayor stood out dramatically as the one with highest amount of followers, as shown in Table 1. Furthermore, the @CarlosOcariz account on Twitter makes him the most followed Mayor of the five districts of Caracas, and the second one –after the Mayor of the Metropolitan Area of Caracas @alcaldeledezma- of the Metropolitan Area of Caracas.

Twitter is a digital social networking platform where participants can send short messages called tweets. Each user has a username that starts with the “@” sign. The username is used to mention someone in a tweet. Also, each user can follow (subscribe to receive the information of another user), and can be followed by ‘followers’ (other users subscribe to receive their information). Any-

one can follow or stop following anyone else at any time. A user can send a message, public by default, of a maximum of 140 characters and it can be liked, retweeted or replied to: to like a tweet indicates you appreciate it; to retweet a tweet means to forward a tweet from another user to your followers, usually used to pass along news and other valuable information; and a reply consists in responding to another user’s tweet beginning with the @username. This is possible by clicking the reply button that can be found next to each tweet (Twitter Glossary, 2016).

Social Media	Username	Followers	Likes
Twitter	@CarlosOcariz	1,197,443	10,972
Facebook	Carlos Ocariz	n/a	190,439
Instagram	@CarlosOcarizAlcalde	131,014	n/a

Social Media	Username	Followers	Likes
Twitter	@CarlosOcariz	98,607	3,305
Facebook	Alcaldia de Sucre	n/a	17,906
Instagram	@AlcaldiadeSucre	31,380	n/a

Table 1 | Carlos Ocariz and Sucre’s Municipality Social Media Accounts



Figure 3 | Anatomy of a Tweet

Data Collection

This study analyzes the Twitter account that belongs to the Mayor of Sucre's Municipality Carlos Ocariz, @CarlosOcariz. The tweets extracted for this study can be divided in two groups: (1) the tweets produced by the Mayor, and the responses ('replies') connected to those tweets; and (2) the tweets that mention the Mayor.

The data was collected manually using Twitter's Advanced Search Engine, where you can specify the user, the time frame and the type of tweets you want to see. For this study, we indicated we wanted (1) all the tweets mentioning @CarlosOcariz, that (2) were produced between November 1st 2015 until January 31st 2016, (3) the retweets were excluded as well as (4) any filter regarding the tone of the tweets (positive or negative). The information collected for each tweet was: (1) date, (2) hour, (3) username, (4) tweet, (5) number of retweets, (6) number of likes, and (7) if the tweet contained any multimedia content such as photo or video. In total, 6,733 tweets were collected (Table 2)

In addition to the tweets, official documents

were requested from the Municipality, such as a special report of growth and behavior in social media and a detailed report of Twitter accounts' growth, to understand how the accounts were growing and being managed before this study. This was submitted by the Office of Digital Communications with strategies that explained how they are managing the accounts. In order to contextualize the content of the tweets and examine how Twitter can be a participation tool to improve the Municipality's activities, the researcher requested a database of crimes geocoded for the study time period, as well as the community outreach assemblies schedule, the program of asphaltting of streets, garbage collection and urban interventions. Although the Police Department PoliSucre has a database with all homicides geocoded since 2009, it does not have the same for major felonies. Furthermore, there is no significant programming of community assemblies, or a detailed schedule for asphaltting. In fact, the Department of Public Works has an annual budget for this matter that executes organically through the year.

Strategy

MONTH	TWEETS
November 2015	2,611
December 2015	2,070
January 2016	2,052
Total	6,733

Table 2 | Quantity of tweets collected for the study

The data was collected manually using Twitter's Advanced Search Engine and stored in an Excel document using columns to classify the information. Each row represented one tweet (see Figure 2). The columns used to classify the information while extracting the tweets were: (1) month; (2) date; (3) format: 1A Mayor's tweet, 1B reply, 2A mention; (4) number of tweets; (5) hour; (6) username; (7) tweet; (8) if the tweet contained multimedia info such as photo or video; (9) number of retweets; (10) number of likes. Once the data was collected, the researcher proceeded to cate-

gorize the content of the tweets, using the filters and search tool in Microsoft Excel. Therefore, new columns were added to the database: (1) subject, if the tweet referred to topics regarding the municipality, political, personal or others; for those classified as 'municipality' a detailed categorization was done in a column called (2) 'urban themes'; (3) neighborhood, (4) type of sector and (5) parish was added to identify of what part of the municipality people were commenting about.

Once the data was collected, it was examined using pivot tables and basic statistical tools of the program. Further, the main trends were compared to the official documents of the municipality but also with news report for an in-depth analysis of the urban themes.

Evaluating the Data

A	C	D	F	H	I	J	K	L	M	
1	id	date	Format	Hour	Subject	Urban Theme	Neighborhood	Type of Sector	Parish	Tweet
2	1	11/1/2015	1A	10:11:00	Municipality	unclassified				Trabajando por y para ustedes! https://twitter.com/andres_ale23/status/655562524545392640 ...
3	2	11/1/2015	1B	12:34:00	Municipality	Crime	EL MARQUES	FORMAL SETTLE	PETARE	@CarlosOcariz @andres_ale23 @atencionsucre POR FAVOR QUE PON POLICIAS SANZ . ROMULO Y MI
4	3	11/1/2015	1B	00:31:00	Municipality	Garbage	MACARACUAY	FORMAL SETTLE	PETARE	@CarlosOcariz Macaracuay + de 16 días no recogen basura, ancianos y niños mayoría. Cobro más alto en
5	4	11/1/2015	1B	10:31:00	Municipality	Noise Complai	PARQUE CAIZA	FORMAL SETTLE	CAUCAGUI	@CarlosOcariz @atencionsucre es imposible descansar.
6	5	11/1/2015	1B	10:30:00	Municipality	Noise Complai	PARQUE CAIZA	FORMAL SETTLE	CAUCAGUI	@CarlosOcariz @atencionsucre todos los viernes y sábado hasta el amanecer. Uno llama a la policía y nad
7	6	11/1/2015	1B	10:29:00	Municipality	Noise Complai	PARQUE CAIZA	FORMAL SETTLE	CAUCAGUI	@CarlosOcariz @atencionsucre necesitamos de tu ayuda en parque caiza. 1 caballeriza en la pata de gallin
8	7	11/1/2015	1A	13:14:00	Municipality	Culture	CASCO COLONIAL	HISTORIC CENTER	PETARE	#AlMomento Domingo alternativo en nuestro Casco Histórico de Petare --> vía @Fundalamas
9	8	11/1/2015	1B	13:28:00	Personal					@CarlosOcariz @Fundalamas bello mi Angel Dios te bendiga
10	9	11/1/2015	2A	00:10:00	Political					@CarlosOcariz @MaracaiboTrafic Gobierno Comunal, esclavitud del siglo XXI https://youtu.be/jzz8K2QnoI4
11	10	11/1/2015	2A	01:44:00	Municipality	Transportation	PALO VERDE	FORMAL SETTLE	PETARE	1Nov 1:44am Aun sigue cerrada la Av. Ppal Palo Verde @CarlosOcariz @ulisesferrerg
12	11	11/1/2015	2A	02:14:00	Municipality	Crime	PALO VERDE	FORMAL SETTLE	PETARE	@LomasDelAvila @CarlosOcariz Hoy se presentó un tiroteo en palo verde y un procedimiento irregular. Porq
13	12	11/1/2015	2A	05:30:00	Political					@CarlosOcariz Derecha venezolana es PROLÍFICA: tienen descuartizadores, drogas y AHORA -> #Yorman
14	13	11/1/2015	2A	07:47:00	Political					@ismaelprogreso @JulioBorges @CarlosOcariz Aldo Cedeño perdió la ética y su seriedad política con esta
15	14	11/1/2015	2A	07:51:00	Political					Es con usted alcalde @CarlosOcariz ! Haga que sigamos confiando en ustedes!
16	15	11/1/2015	2A	07:55:00	Municipality	Crime	BOLEITA	FORMAL SETTLE	LEONCIO M	El Boleita Center y alrededores, eran Osais los fines de semana, pero ya ni 15 y ultimo se puede andar por a
17	16	11/1/2015	2A	09:20:00	Municipality	Police Presence	LOS DOS CAMIN	FORMAL SETTLE	LEONCIO M	@AlcaldiaDeSucre presencia de alcabala policial a diario en el club hebraica. Regimen exclusivo de @Carlos
18	17	11/1/2015	2A	09:34:00	Municipality	Water				¿Tengo que vivir sin lavarme el papo @CarlosOcariz ?
19	18	11/1/2015	2A	09:57:00	Political					Bro ya basta contigo @CarlosOcariz
20	19	11/1/2015	2A	10:02:00	Political					@geniuslawyer Da pena decirlo pero @CarlosOcariz @AlcaldiaDeSucre y @hcapriles son la peor pesadilla c
21	20	11/1/2015	2A	10:09:00	Municipality	Transportation				@CarlosOcariz @GerardoBlyde @dsmlansky por favor asuman esta aérea en equipo y solucionen tránsito
22	21	11/1/2015	2A	10:11:00	Municipality	Police Presence				Q buen trabajo d esmero y sobre todo valentia está haciendo Policía del Mun Sucre. Mi reconocimiento para
23	22	11/1/2015	2A	02:24:00	Municipality	Crime	PALO VERDE	FORMAL SETTLE	PETARE	@RedPaloVerde @CarlosOcariz cuando matan un vecino no llegan tanto efectivos del cicpc y GNB
24	23	11/1/2015	2A	11:44:00	Municipality	Streets	LA CALIFORNIA N	FORMAL SETTLE	PETARE	@CarlosOcariz por favor un cariño a la zona de California Norte y Sur anarquía el el unicentro no hay segurid
25	24	11/1/2015	2A	12:55:00	Municipality	Water	PALO VERDE	FORMAL SETTLE	PETARE	Aló mejor alcalde del mundo? @CarlosOcariz será posible que haga algo por la falta de agua de más de 5 di
26	25	11/1/2015	2A	13:22:00	Municipality	Streets	EL LLANITO	FORMAL SETTLE	PETARE	@CarlosOcariz , las calles de el llanito un desastre, puente baloa rompieron y no repararon, hueco a la altur
27	26	11/1/2015	2A	23:50:00	Municipality	unclassified	LA CALIFORNIA	FORMAL SETTLE	PETARE	A la hora @paramedicostmtt labora en búsqueda y rescate de canino en el guaire, la california. @Tuviarapida
28	27	11/1/2015	2A	15:36:00	Municipality	Garbage	LA URBINA	FORMAL SETTLE	PETARE	LIMPIEN LA URBINA LA BASURA NOS AHOGA @CarlosOcariz
29	28	11/1/2015	2A	15:53:00	Municipality	unclassified	LA CALIFORNIA	FORMAL SETTLE	PETARE	Parrita Rescatada del Guaire @paramedicostmtt @FDMisionNevado @polisucre_pms @AlcaldiaDeSucre @C
30	29	11/1/2015	2A	16:27:00	Political		PETARE	SLUMS	petare	@StefanyPao @LomasDelAvila @paloverde_lomas Que caro estamos pagando aqui haber votado otra vez x
31	30	11/1/2015	2A	00:08:00	Municipality	Water				Hay denuncias de que algunos vecinos pagan a los operadores del IMAS para que les pongan en el agua
32	31	11/1/2015	2A	17:25:00	Municipality	Public Spaces				@lmvhSucre @CarlosOcariz gracias x darles este espacio para nuestras mascotas esperemos q abran má:
33	32	11/1/2015	2A	17:55:00	Municipality	Streets	SEBUCAN	FORMAL SETTLE	LEONCIO M	@CarlosOcariz Buenas tardes alcalde favor pavimentar urgentemente la Ppal de sebucan esta destruida con
34	33	11/1/2015	2A	09:44:00	Municipality	Garbage	LOS DOS CAMIN	FORMAL SETTLE	LEONCIO M	@hcapriles regalo de @CarlosOcariz en los dos caminos hasta cuando la basura en municipio sucre?
35	34	11/1/2015	2A	19:32:00	Municipality	Streets				"Para acabar la anarquía" @CarlosOcariz inaugura separador vial en la Av. Fco. de Miranda #Sucre @juanca
36	35	11/1/2015	2A	19:38:00	Municipality	Transportation				@CarlosOcariz payasos en los semáforos, parque para mascotas... Para cuando la seguridad sin polisuc
37	36	11/1/2015	2A	12:00:00	Municipality	Water	PALO VERDE	FORMAL SETTLE	PETARE	5 días sin agua en la calle 16 de Palo Verde. El Imas de la alcaldía de Sucre tiene suspendido el servicio sin

The data was examined as follows: the description of the data extracted, the average and count numbers of the basic information of the tweets; and the categorization of the data. Each tweet was classified in four main categories: format, topic, theme and location.

The tweets extracted for this study were divided into three groups according to their format: (1) the tweets produced by the Mayor, mentioning information about any activity, program or event of the municipality; (2) the responses ('replies') connected to those tweets and (3) the tweets where the Mayor is mentioned, but which are not connected to a conversation that started with a tweet by him. Further, the categorization per topic was made according to whether the content related to (1) municipal issues; or (2) political issues (regarding the social and political crisis of the country); if the message was (3) personal or if it was (4) none of the above. The ones classified with the topic 'municipality' were then sub-categorized by their 'urban theme', meaning the main subject of the message. The urban themes

used in this study are: crime, culture, economic development, education, emergency, garbage, homelessness, housing, invasions, light, noise complaints, PAR (Project of Rapid Response by its acronym in Spanish), planning, police presence, public health, public lighting, public spaces, public vendors, social, sports, streets, transportation, tributes, unclassified, environment, water, water/par, water/streets. Additionally, although the majority of the tweets did not contain geo-information, the content expressed in them indicated places, neighborhoods and addresses relevant to this study. Therefore, three categories were created to classify this data: (1) parish given by the official geo-political division of the municipality, (2) macro-neighborhood given by the municipality and (3) type of sector, i.e. if the neighborhoods are located in the urban area, informal settlements or in the rural areas of the territory.

After the data was categorized, the researcher proceeded to evaluate how many tweets produced by the public could be categorized under each for-

1	A	B	C	D	E	F	G	H	I	J	K	L	M
1	tweet	Month	tweet date	Form	tweet num	Hour	U	Subject	Urban Theme	Neighborhood	Type	Parti	Tweet
3580	3578	Dec-15	12/13/2015	2A	10	16:26:00	@EC	Municipality	Public Spaces				Alcalde @CarlosOcariz Inauguración de dos canchas y áreas comunes en #TerrazaDeAvila @UrbTerMinforma
3581	3579	Dec-15	12/13/2015	2A	11	15:14:00	@eli	Personal					@CarlosOcariz Venezuela unida en una misma oración por la salud de tu hijo
3582	3580	Dec-15	12/13/2015	2A	12	14:59:00	@gr	Municipality	Police Presence	SEBUCAN	FORMAL LEONIC		FORMAL LEONIC @polsucre_pms Estimados Sres Policía Sucre, todos los días hay secuestros y robos en Sebuacán, por favor ayuden a para esto @CarlosOcariz
3583	3581	Dec-15	12/13/2015	2A	13	13:54:00	@pt	Municipality	Water	PARQUE CAIZA	FORMAL CAUCAG		Gracias a @IMASucre @AlcaldiaSucre y @CarlosOcariz por otro domingo sin agua en @CPCaiza
3584	3582	Dec-15	12/13/2015	2A	14	13:37:00	@Ar	Municipality	Garbage	LOMAS DEL AVI	FORMAL PETARE		Danza d Zamiros q veo dsd mi ventana #LomasDeAvila refleja acumulación d basura q pronto pudrirá nuestro aire @CarlosOcariz totaly pasó 6D
3585	3583	Dec-15	12/13/2015	2A	15	12:41:00	@IM	Municipality	Water	LA DOLORITA	SLUMS LA DOLO		@CarlosOcariz Agua, Agua, Agua para la Lira en la Dolorita a pesar de que sea zona popular tiene derecho al suministro del liquido
3586	3584	Dec-15	12/13/2015	2A	16	12:29:00	@da	Municipality	Water				@IMASucre @CarlosOcariz Alcalde para cuando la reparación de las tuberías bajando por el ELAM Pen el IMAS
3587	3585	Dec-15	12/13/2015	2A	17	12:02:00	@ok	Municipality	Transportation	LA URBINA	FORMAL PETARE		@CarlosOcariz alcalde semáforo ppal urbina esquina abadia malo hace tiempo
3588	3586	Dec-15	12/13/2015	2A	18	11:56:00	@ns	Municipality	Water				@CarlosOcariz no se olvide para que incluya en sus obras es urgente es agua negras en la avenida y un canal destruido. Vea lo usted vaya
3589	3587	Dec-15	12/13/2015	2A	19	11:54:00	@ns	Municipality	Transportation	BARRIO LA VEG SLUMS	PETARI		@CarlosOcariz alcalde atienda la av ppal las vegas de petare esa zona está horrible en ese botado basura aguas negras no se puede caminar
3590	3588	Dec-15	12/13/2015	2A	20	11:50:00	@ns	Municipality	Garbage	BARRIO LA VEG SLUMS	PETARI		@CarlosOcariz alcalde atienda la av ppal las vegas de petare esa zona está horrible en ese botado basura aguas negras no se puede caminar
3591	3589	Dec-15	12/13/2015	2A	21	11:47:00	@nc	Municipality	Noise Complian				Se les ha dicho personalmente sobre este problema una y otra vez, pero no les importa. @CarlosOcariz #noalruido #noenzonasresidenciales
3592	3590	Dec-15	12/13/2015	2A	22	11:45:00	@nc	Municipality	Economic Development				Es una falta de respeto con estos mercados. A las 6am y justo ahora tirando los tubos. No se descansa @CarlosOcariz @cecaraballo
3593	3591	Dec-15	12/13/2015	2A	23	11:44:00	@at	Personal					@CarlosOcariz feliz navidad saludos a todos y espero q la hija este bien ien
3594	3592	Dec-15	12/13/2015	2A	24	11:18:00	@Jo	Political					¡ OJO PELAÑO DIPUTADOS! LOS ZORROS VIEJOS ALGO TRAMAN http://gatobriceno.blogspot.com/2015/12/ojo-pelao-diputados-los-zorros-viejos.htm
3595	3593	Dec-15	12/13/2015	2A	25	10:26:00	@jal	Municipality	Water				@IMASucre @hcapriles @CarlosOcariz Ese ingeniero del imas. Encargado no resuelve el otro que estaba resolvia algo de verdad senedad agua
3596	3594	Dec-15	12/13/2015	2A	26	10:22:00	@mi	Municipality	Public Vendors	PALO VERDE	FORMAL PETARE		@CarlosOcariz hasta cuando tanto butoneros, delincuentes, y bachaquero en petare, palo verde y nadie les dice nada compran en bicentenario
3597	3595	Dec-15	12/13/2015	2A	27	10:21:00	@jal	Municipality	Water	BARRIO LA BOW SLUMS	PETARI		@hcapriles @IMASucre @CarlosOcariz o busquen nuevas idea para poner agua en la bombilla sector la barraca No puedo estar en esto Marté sábad
3598	3596	Dec-15	12/13/2015	2A	28	10:20:00	@jal	Municipality	Water	BARRIO LA BOW SLUMS	PETARI		@hcapriles @IMASucre @CarlosOcariz ayuda activen sistema bombeo terrazo o otro que tenga para la bombilla sector la barras así no se vive
3599	3597	Dec-15	12/13/2015	2A	29	9:47:00	@UR	Municipality	Public Spaces	TERRAZAS DEL FORMAL PETARE	HOY23D Tzas del Avila a las 11:00AM inauguración cancha C3 Los Esperamos!!! -) @AlcaldiaSucre @BrianFincheltub @Urb_Sucre @CarlosOcariz		
3600	3598	Dec-15	12/13/2015	2A	30	9:39:00	@M	Municipality	Sports	BARRIO LOS RE SLUMS	LEONIC		Inauguración de Cancha Deportiva por el Alcalde @CarlosOcariz, sector Los Reyes, Sebuacan @URB_LeoniciOM @Urb_Sucre
3601	3599	Dec-15	12/13/2015	2A	31	9:08:00	@ju	Political					@TamaraAdrian @CarlosOcariz @hramosalup los 112 deben ser UNO sólo, una sola Voz. Cero divisiones. Sino nos jodemos...
3602	3600	Dec-15	12/13/2015	2A	32	9:00:00	@VE	Municipality	Transportation	PARQUE CAIZA	FORMAL CAUCAG		El mejor regalo de navidad que pueden dar a vecinos de @ParqueCaiza es un #TransporteDignoParaParqueCaiza @TransporteSucre @CarlosOcariz
3603	3601	Dec-15	12/13/2015	2A	33	8:34:00	@Be	Political					#LecturasDelDomingo @CarlosOcariz Año a año, con elecciones, sin elecciones, con cargo, sin cargo siempre lo haremos!
3604	3602	Dec-15	12/13/2015	2A	34	8:07:00	@ca	Municipality	Water	LOMAS DEL AVI	FORMAL PETARE		@IMASucre hasta cuando su incompetencia con el servicio de agua en @paloverde_lomas @LomasDeAvila @AlcaldiaSucre @CarlosOcariz
3605	3603	Dec-15	12/13/2015	2A	35	7:31:00	@ce	Municipality	Sports	LOS RUICES	FORMAL LEONIC		@CarlosOcariz fuera los maratones de los ruices el único día de descanso y te despiertan a las 7 de la mañana con música full volumen
3606	3604	Dec-15	12/13/2015	2A	36	7:29:00	@ce	Municipality	Sports				@CarlosOcariz Cdm con los maratones a las 7 am no dejan dormir a la comunidad en su día de descanso gritos y música con alto volumen
3607	3605	Dec-15	12/13/2015	2A	37	7:28:00	@so	Municipality	Tributos				@CarlosOcariz Un tema de enorme impacto para los trabajadores: subir la Unidad Tributaria. Así recuperan su sueldo. Los apoyarán todos.
3608	3606	Dec-15	12/13/2015	2A	38	0:28:00	@cs	Municipality	Garbage	BARRIO LEBRUR SLUMS	PETARI		@polsucre_pms @CarlosOcariz restos de moto de imprudente que se estrello en lebrun @danielgcolina @jenyoro1
3610	3607	Dec-15	12/13/2015	2A	39	0:24:00	@ok	Municipality	Transportation	LA URBINA	FORMAL PETARE		@CarlosOcariz semáforo principal la urbina esquina abadia malo PELIIIIGRO
3612	3609	Dec-15	12/14/2015	1B	1	varios	varic	Personal					Apoyo por el hijo (3 reply)
3613	3611	Dec-15	12/14/2015	1B	2	varios	varic	Personal					Apoyo por el hijo (3 reply)
3614	3612	Dec-15	12/14/2015	2A	1	4:08:00	@mi	Political					El Pueblo de Petare le metera revocatorio a @CarlosOcariz de la @AlcaldiaSucre en el 2016
3615	3613	Dec-15	12/14/2015	2A	2	5:43:00	@so	Municipality	Police Presence				#14D Amigos @polsucre_pms y @CarlosOcariz Se requiere URGENTE atención ocupación módulo frente P. San Francisco, en la noche. No hay policia
3616	3614	Dec-15	12/14/2015	2A	3	5:47:00	@co	Municipality	Police Presence	LA URBINA	FORMAL PETARE		X eso es q le he insistido a @AlcaldiaSucre y a @CarlosOcariz implementar el vigilante d parques en @BUEN_VECINO
3617	3615	Dec-15	12/14/2015	2A	4	6:20:00	@tib	Municipality	Water	BARRIO BRISAS SLUMS CAUCA	@ArbaToty		28 dias sin agua en Calle Los Palos de Turumo @IMASucre @la_patilla @CarlosOcariz Ese es el pan nuestro de cada día.
3618	3616	Dec-15	12/14/2015	2A	5	6:40:00	@jct	Municipality	Transportation	PARQUE CAIZA	FORMAL CAUCAG		Los Habitantes de Parque Caiza MERECEMOS un TRANSPORTE DIGNO!!! @ParqueCaiza @AlcaldiaSucre @CarlosOcariz
3619	3617	Dec-15	12/14/2015	2A	6	6:52:00	@nc	Political					@AlcaldiaSucre @CarlosOcariz copien de ellos, nosotros necesitamos acciones en contra del ruido
3620	3618	Dec-15	12/14/2015	2A	7	7:26:00	@jal	Municipality	Water	BARRIO LA BOW SLUMS	PETARI		@CarlosOcariz @IMASucre @hcapriles saludos buenos días estoy en el imas mariche está full de reclamo que pasa. La bombilla barraca sin agua
3621	3619	Dec-15	12/14/2015	2A	8	7:42:00	@hc	Municipality	Crime	SEBUCAN	FORMAL LEONIC		@polsucre_pms bandas armadas azotan sin piedad Sta Eduvigis y Sebuacán. Los delincuentes en el Este. @giselaromeroat @CarlosOcariz
3622	3620	Dec-15	12/14/2015	2A	9	7:47:00	@ha	Municipality	Crime	SEBUCAN	FORMAL LEONIC		@CarlosOcariz @polsucre_pms bandas armadas azotan sin piedad Sta Eduvigis y Sebuacán. @anselmoarand @serman @CarlosOcariz

Figure 4 | Screenshots from the dataset

mat and whether users created a tweet to complain, propose or report something to the municipality, or if they were reactive, meaning users created the tweet to respond to information given by the municipality. Also, the relation between the tweet's format and topic of discussion was examined by looking at the correlation between how the Mayor handles his account and how people respond to this, particularly which format per topic was more used in the time-frame studied. A location analysis was conducted by looking at which formats of tweets were used more commonly by type of sector and how many tweets could not be related to a specific location. I also studied which neighborhood had the largest number of tweets and which urban theme was mentioned most frequently.

Finally, the urban themes users mentioned were analyzed by month and a deeper examination was conducted into the ones that were mentioned most frequently. The deeper examination consisted of contextualizing the data, finding out through official documents and news reports why these themes

were mentioned so often, which ones are the responsibilities of the municipality and how it reacted to those issues. Finally, conclusions are presented regarding whether social media data reflects general concerns of the neighborhoods and if the data allows municipalities to better understand the communities by helping technicians to contextualize official statistics like census data using the social media feed. Recommendations are proposed to the municipality and to planners regarding how to analyze information collected through social media and how to use it for urban planning and governance.

Limitations

Sucre's Municipality was selected because of, among many reasons, the diverse socioeconomic composition of its population and the diversity of the built environment. However, there is no comprehensive census data that could help illustrate this condition, because Venezuela does not conduct a comprehensive census of the population.

There is a bias related to analyzing social media information. Social media platforms are commonly related to younger generations and millennials. The use of these platforms is also more common among people of medium and high income. A verification of the authenticity of the users was not conducted because this study focuses on the content rather than who it originates from. However, this is an important analysis that future studies should undertake to have a deeper comprehension of users' characteristics.

Another improvement to the study would involve including all the municipalities of Caracas as case studies, to cover the whole metropolitan area and to make a comparison between the Mayor's ac-

count and the official account of each Municipality.

In terms of the sample size, this study look at a compilation of tweets related to @CarlosOcariz's account in the time period selected. However, a larger time frame or a comprehensive study of all the accounts of the municipality could improve the study. For example, adding the institutional account of the municipality @AlcaldiadeSucre and those of the departments related to the urban themes studied, such as PoliSucre, IMAS (Municipal Institute of Water and Aqueducts of Sucre), the Department of Engineering and Urban Planning, IMAPSAS (Municipal Autonomous Institute of Environmental protection and Sanitation of Sucre) and the Department of Public Works, would strengthen the study.

The data was collected manually. A code to extract the tweets could have saved time and collected the location for geocoded tweets, but there were not enough geocoded tweets to conduct an analysis regarding the location of the tweets.



An aerial photograph of a city, likely Bogotá, Colombia, showing a dense urban area with many buildings and green spaces. In the background, there are large, forested mountains under a blue sky with scattered white clouds. The city is built on a hillside, and the mountains are partially shrouded in mist or low clouds.

FINDINGS + DISCUSSION

In this section I provide a brief description of the data collected by analyzing how many tweets were produced by the Mayor and the public, which format was more commonly utilized and the topics mentioned most frequently, followed by a description of which areas of the city and which urban themes were mentioned most frequently by the public. Then, I selected three urban themes through which to discuss important issues such as accuracy, relevance and utility of the information provided by the citizens

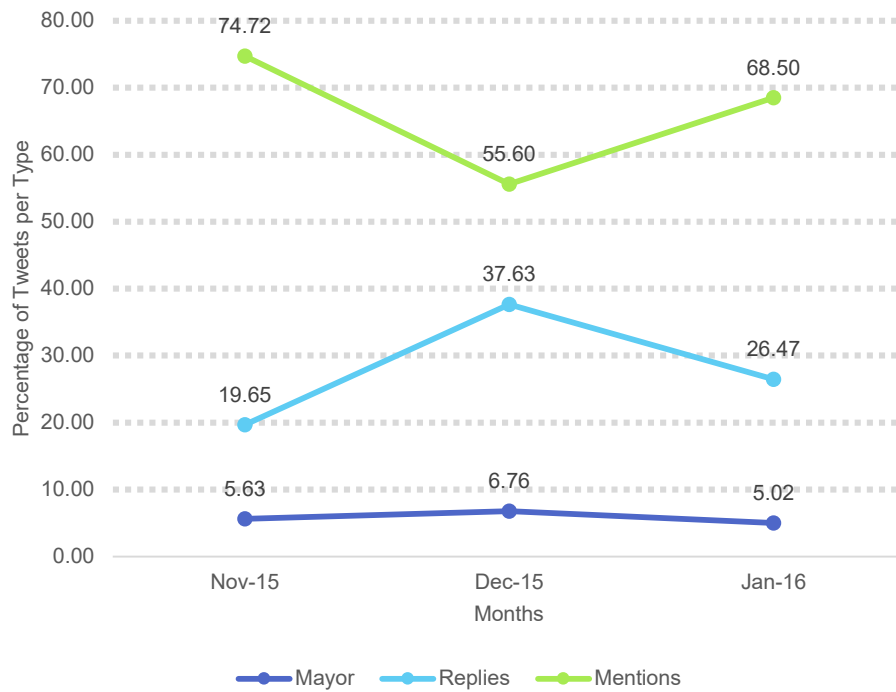


Figure 5 | Percentage of Type of Tweet by Month

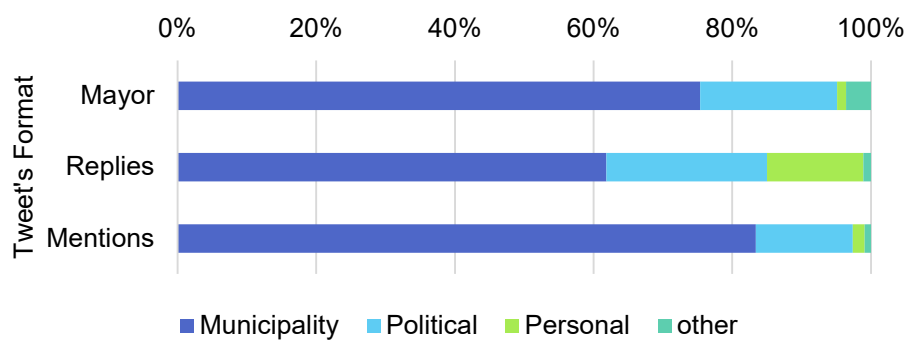


Figure 6 | Percentage of Tweet's Subject by Tweet's Format

Findings

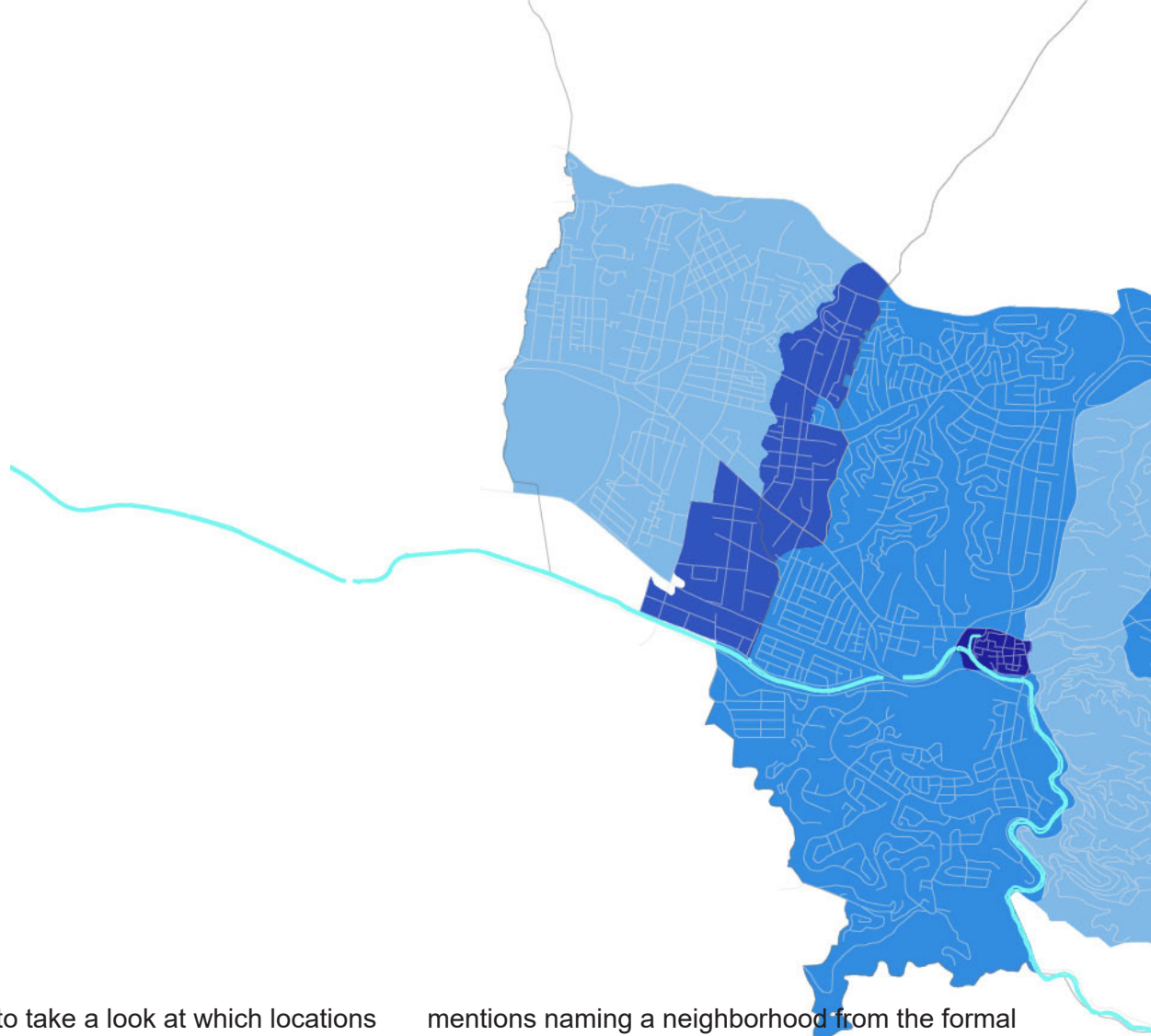
FORMAT

In the time period studied, tweets produced by the Mayor represented approximately 5.79% of total tweets, the replies he received were 26.62% and he was mentioned 66.71% of the time, as shown in Figure 5. Although the trend reflects a large proportion of tweets mentioning the Mayor rather than responding to his tweets, during December the replies increased reaching 37% of the tweets of the month in comparison with 55% of the mentions, reducing the difference from 55.07% to 17.97%. This shift happened again in January. The change can be explained by the impact of the national political event, the legislative elections taking place on December 6th, it increased momentarily the engagement of the public with the Mayor. Overall, the total 'reactive tweets', meaning the ones responding to official information, represent 27.26% and the 'spontaneous tweets', meaning the ones produced by the public proactively represented 66.95%. Therefore, the public is more proactive when communicating with the Mayor than responding to official information.

TOPIC

In the time period studied, the topic 'Municipality' -in average- represented 76.85% of total tweets, the topic 'Political' 16.71%, the topic 'Personal' tweets 5.29% and 'Others' 1.15%. 'Municipality' remained the most popular topic of the tweets and this is correlated to how the Mayor managed his communication in the social media platform. This becomes evident when analyzing the relation between topics and format: the Mayor uses the social media platform to communicate matter of the Municipality more than for political propaganda, as shown in Figure 6.

A change can be seen in December when the political tweets of the Mayor increase and the municipality ones decrease but not enough to change the overall trend. This event also impacted how many tweets per topic were produced by the public but just enough to reflect the behavior of the Mayor and not to change dramatically how the municipality is the main topic of discussion of the community in this social media platform.



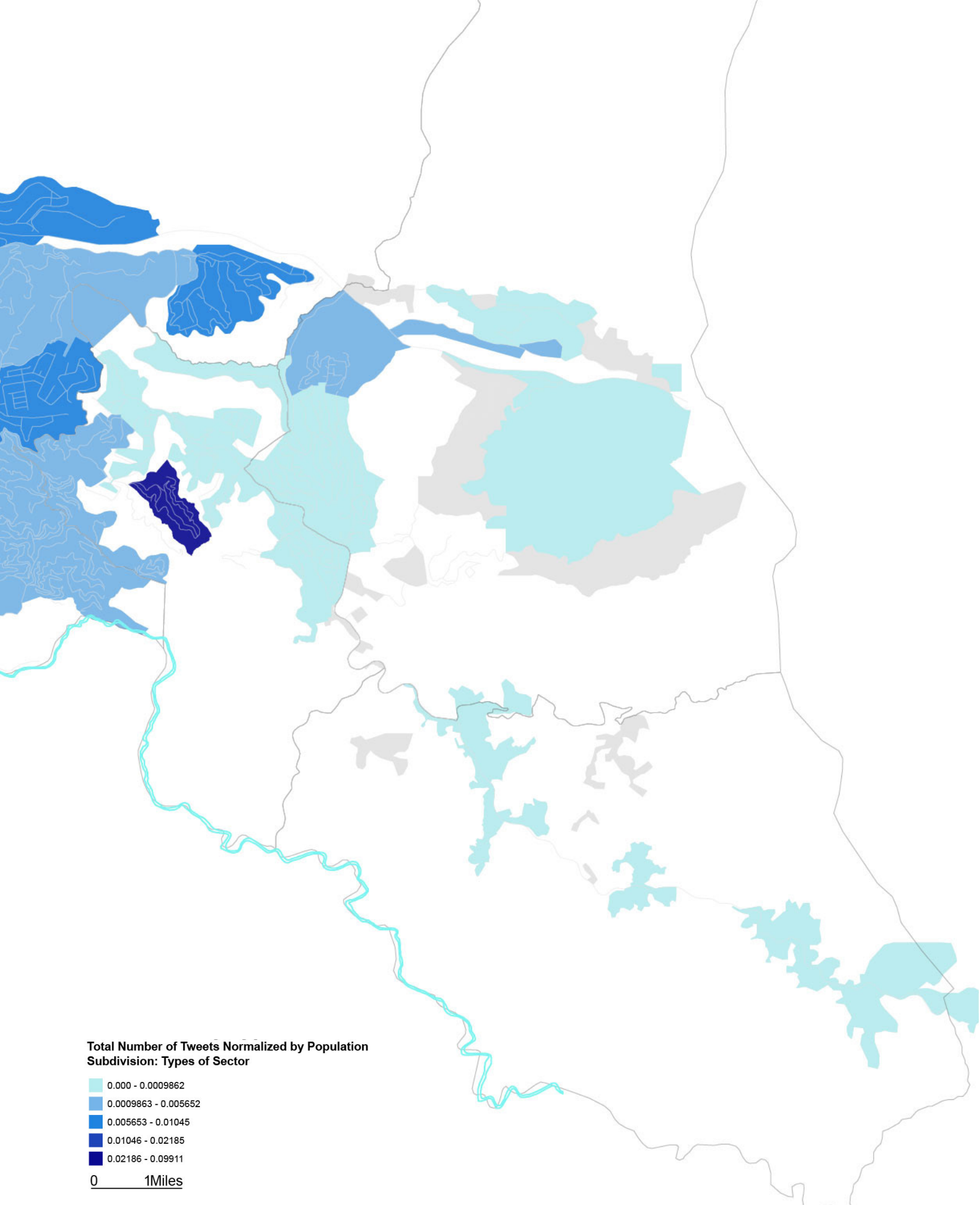
LOCATION

It is important to take a look at which locations are most commented over the time period studied. An important fact is that the majority of the tweets did not present geocoded location information. Some reasons can be attributed to this: concerns about privacy, ignorance about the ability to allow localization or just consciousness about security. That being the case, an analysis of which sectors and neighborhoods that were named in the tweets came to be an important subject of analysis. Overall, 51.47% of the tweets did not name a specific neighborhood but when analyzing in detail the tweets from the public (replies and mentions) come with more localizable data than the ones from the Mayor.

By no means must it be interpreted as the tweets without a distinguishable neighborhood were expressing random issues without a location related to it. Moreover, this can also indicate that they are city issues rather than a specific sector of the city. For the tweets that named a neighborhood in the tweet, 14.99% were replies and 27.91% were

mentions naming a neighborhood from the formal city; 2.78% were replies and 2.78% were mentions naming the historic center; 0.54% were replies and 2.46% were mentions naming areas from the industrial polygons; 6.32% were replies and 6.92% were mentions naming the residential polygons; 0.05% replies and 0.22% mentions named the rural areas and 11.28% replies and 16.31% of mentions named the slums. One criticism that is commonly made to the use of social media is that users are not from poor and informal areas of the city. Although the majority of the tweets are related to formal areas of the city, almost 20% of them are expressing issues within the informal areas. Furthermore, a recent investigation conducted by the Municipality showed that they are reaching more the slums by the platform Facebook and that the formal areas are reached better with Twitter.

Figure 7 | Tweet Rate by Type of Sector



**Total Number of Tweets Normalized by Population
Subdivision: Types of Sector**

- 0.000 - 0.0009862
- 0.0009863 - 0.005652
- 0.005653 - 0.01045
- 0.01046 - 0.02185
- 0.02186 - 0.09911

0 1Miles

THEME

In other to understand which are the main issues discussed, it is important to analyze the urban themes with location. Overall, from the urban themes of the replies and mentions received by the Mayor, the top ten urban themes most commented upon were: water, garbage, streets, crime, transportation, police presence, public vendors, public spaces and housing (Figure 8). However, when taking a look at the detail of urban themes by type of sector in Table 3, we can see that almost all the sectors share the same concerns: water, garbage, streets and crime.

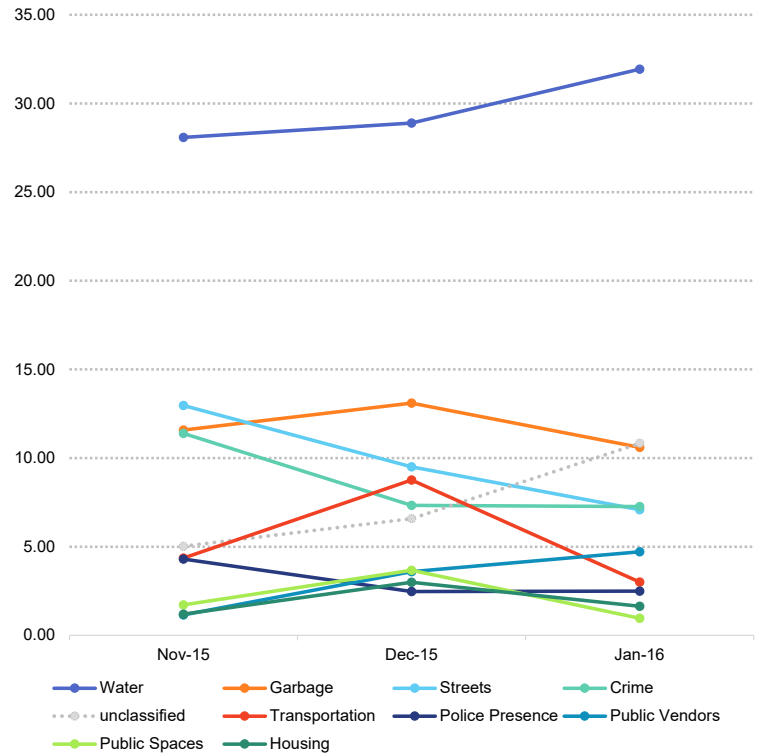


Figure 8 | Percentage of Tweets by Top 10 Urban Themes

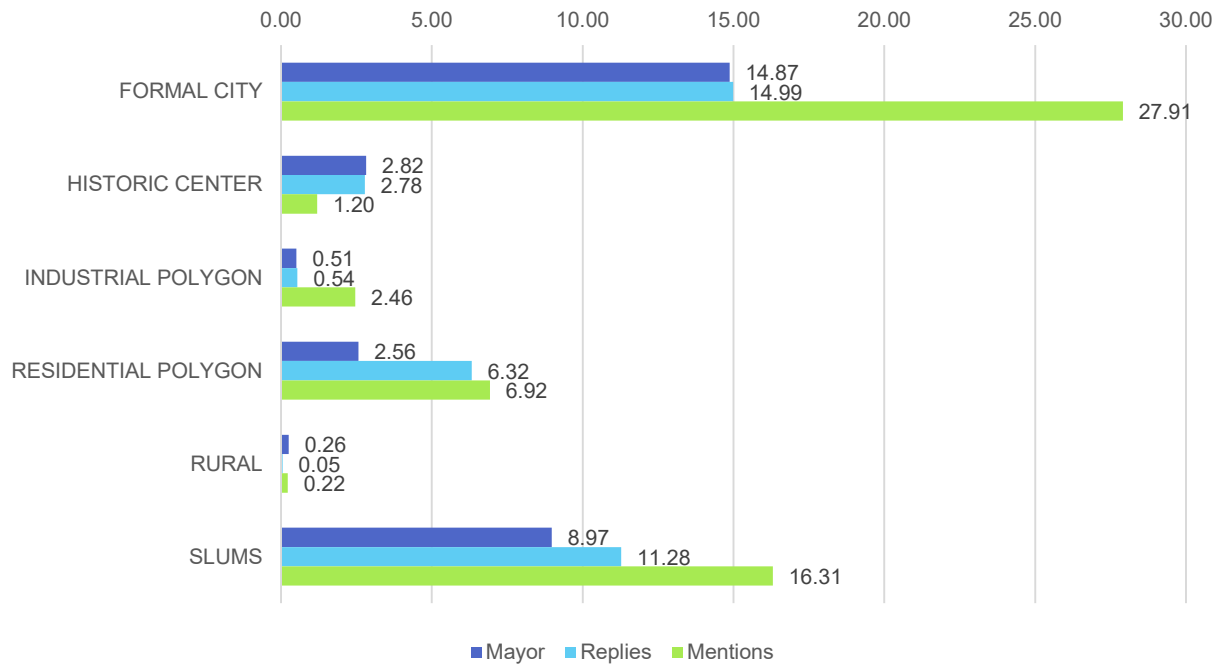


Figure 9 | Percentage of Sector by Type of Tweet

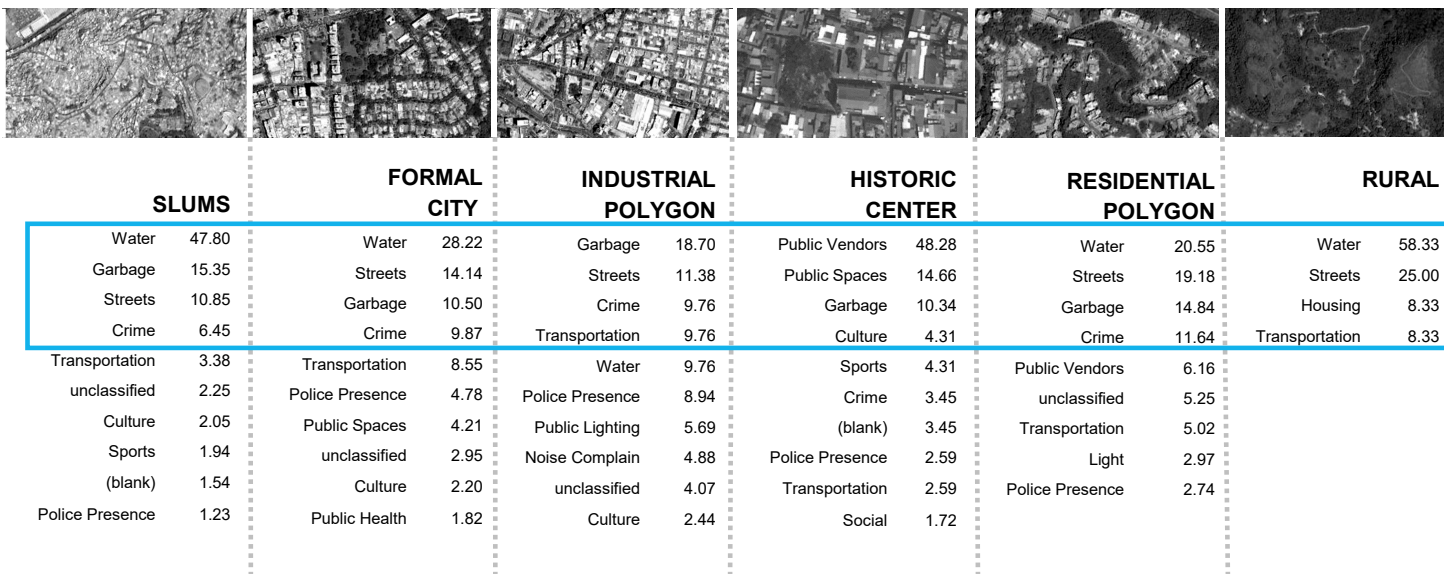


Figure 10 | Percentage of Urban Themes Tweets by Type of Sector

WATER CRISIS, the role of the Municipality and the distortions in Social Media

Twitter has become a platform for public interaction, and the findings show that the public corresponds directly with the Mayor on issues that are more municipal related than personal or political, especially during election season. For example, the public is most interested in discussing issues like water, crime, streets and garbage. Therefore, when analyzing tweets, it is important not to analyze them in isolation. Without making connections with others sources of information one cannot accurately explain the changes and the relevance of this information. This is something that planners also do with official statistics. Therefore, a deeper analysis of the main topics will help to evaluate if social media can be used to engage citizens for urban planning and management.

Water Crisis, the role of the Municipality and the Distortions in Social Media

Water was a subject with a remarkably growth over the months, making it the lead subject of discussion. However, water supply as a public service is not a responsibility of the Municipality. The Munic-

ipality has an 'Institute of Water' whose main objective is the management of some water pumps that supply water to the informal settlements of Petare. These water pumps can only function and are completely dependent on the water sent by Hidrocapital, the service operator for the MAC managed by the national government. During the last year, the country has been suffering from drought and bad maintenance of its water supply system, resulting in supply schedules and shortages.

The tweets directed to the municipality have two main purposes: to report if the schedules –set by Hidrocapital- are being respected, and to complain about the lack of water or request that the Municipality take more action. The amounts of tweets towards the municipality could also be interpreted as a popular claim to decentralize the services and to help the public regardless of the direct lack of responsibility. However this opinion should be studied in depth incorporating Hidrocapital.

When examining the location cited in the tweets regarding water, there is disruption of the

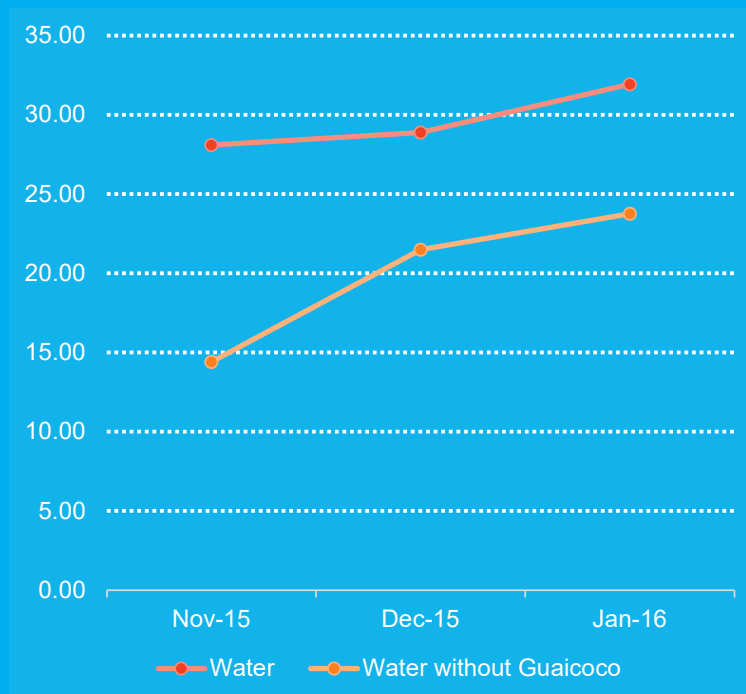


Figure 11 | Influence of Barrio Guaicoco/La Fenix's Water Tweets in Water Total

trend that indicates a spatial bias. Although of all the water tweets 28.22% named a location in the formal settlements, 47.80% came from the slums. Until now this seems accurate with the problematic explained before. But, when looking in detail at the characteristics of these tweets we discovered that 73% of tweets were concentrated in only two areas: Barrio Guaicoco and Barrio La Fenix (Figure 11). The residents of these two neighboring communities are driving a campaign with the hashtag #2bombasparalafenix (#twowaterpumpsforLaFenix) asking the municipality to provide two water pumps to this area. Overall, these tweets represent 50.91% of all water tweets.

The fact that citizens from slum areas took over, for several month, the social media platform, to pressure the Mayor to intervene in the water system is fascinating. It demonstrates that, locally, the use of social media platforms is not exclusive to the wealthy areas of the city. Instead of taking part in radical demonstrations, the community applied pressure through the digital platforms while advo-

cating on other fronts.

Their efforts were fruitful. On February 13th, the Municipality inaugurated the pipe connection between the La Fenix Pump Station with the main La Dolorita Feeder South, providing benefits for more than 70.000 residents. Although there was no public indication that the social media campaign was a decisive factor in this issue, when the researcher brought this matter to the knowledge of the Office of Digital Communications while requesting material for this study, they were absolutely aware of the situation and how this community had a dominant presence in the digital feedbacks received at the Municipality.

WASTE MANAGEMENT AND STREETS TWEETS

The public in constant vigilance of streets and public health



Figure 12 | Waste accumulated at Redoma de Petare



Figure 13 | Mayor Ocariz outside Federal Supreme Court introducing social media data as appendix for the waste management's court case

The only public service that is the competence of municipal governments in Venezuela is waste management. Due to the political tensions and how politicized institutions are in the country, the Municipality faced a crisis after the elections in 2014 when Mayor Carlos Ocariz was reelected. At the beginning of his second term, the Municipality realized the main problem, after the high levels of crime and violence, was waste collection. The workers of the company hired for the service were sabotaging the service and leaders from the national party pressured the Supreme Court to asset the critical sanitation level reached by Sucre's Municipality. After strategizing the collection routes, buying more collection vehicles and working hand in hand with the workers, the political struggle continued. Therefore, the Municipality started a social media campaign asking the public to help supervise the waste collection schedules and digitally report irregularities in the service. It was so successful that when fighting in court, the Municipality submitted a report with 37,500 annexes composed of all the digital submissions the public made through Facebook,

Twitter and Instagram.

The impact of this campaign can still be seen in the tweets extracted for this study. The public is still reporting, though with less frequency, the performance of the waste collection service. As seen in Figure 8, formal settlements are leading the report and complaints about the service with an average of 35% of the tweets in this matter. The neighborhood La Urbina presents 10% of overall tweets, follow by Lomas Del Avila with 7.1% and Palo Verde with 3.39%. Interesting enough, it can be seen again that the community of the slums with the strongest presence in social media Barrio Guaicoco is present again with 4.03% of the tweets. Either way, residents of formal settlements are more engaged in complaining and reporting sanitation issues than slums or rural areas.

This behavior also replicates when analyzing the street's tweets. The main reason is that the urbanized areas are the ones with more asphalt streets regardless of the municipality's effort to urbanize the slums and rural areas. Leading this

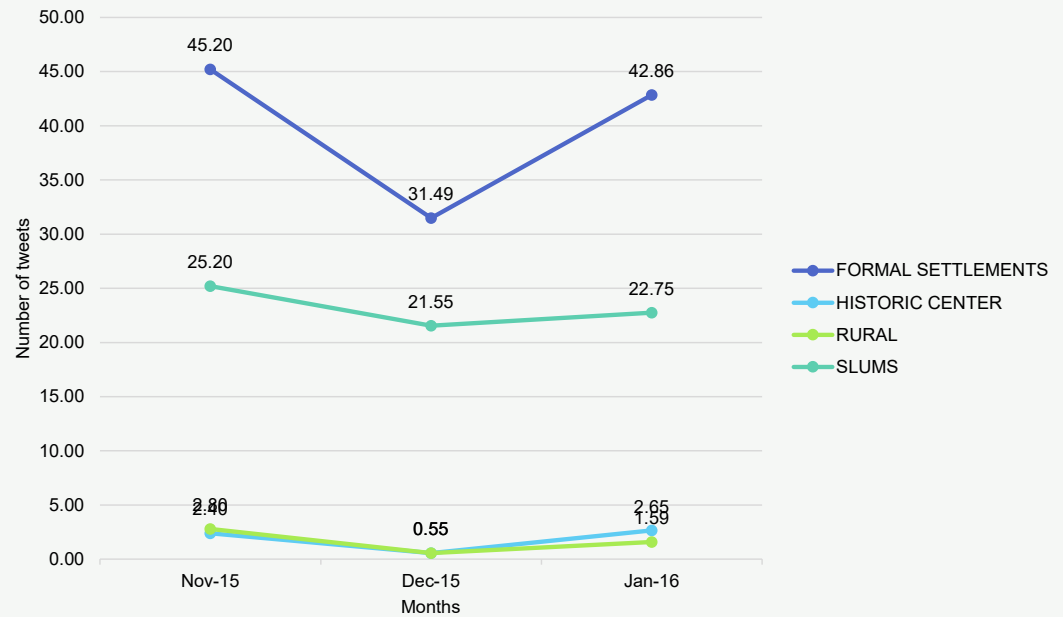


Figure 14 | Sanitation's Tweets by Type of Sector

discussion are the most transited areas of the municipalities, the formal neighborhoods that connect the informal areas with the rest of the city. The most active neighborhoods in the formal areas are Palo Verde with 10.8%, La Urbina with 6.41%, Sebucan 6.22% and el Llanito with 5.86%. Their tweets focus on reporting potholes and damage on the streets and asking for more maintenance.

The Municipality lacks a map or any kind of visualization as an inventory of the state of the streets. Therefore a map was developed by the researcher, using the streets tweets and the web-mapping site CartoDB (Figure 15) to show all the reports and denounces regarding the streets and asphaltting of Sucre's Municipality, made through mentions and replies for @CarlosOcariz between November 2015 and January 2016. The interactive map allows the viewer to navigate through the city and examine the sample tweets mentioning each street and discover the most reported avenues and streets of the Municipality.

It can be observed in the Streets Tweet Map

that streets from multiple urban territories (residential and industrial polygons, formal city and slums, rural) were subjects of complaint. The majority of the streets tweets were related to streets that play an arterial function within the road network. Among these, the most mentioned were the ones that connect the formal city with the rest of the urban forms: Av. Ppal de La Urbina, Av. Ppal Palo Verde, Av. Ppal. Macaracuay and Petare-Santa Lucia Highway.

The interactive map creates the possibility of visualizing, through the crows feed, the state of the streets through the lens of the people who pass the streets daily with almost immediate information. This could be a mechanism for the Municipality not only to have an inventory but for the institution and citizens to supervise the progression of the repairs and the response of the Municipality, sharing the responsibility of solving problems between elected officials and citizens.

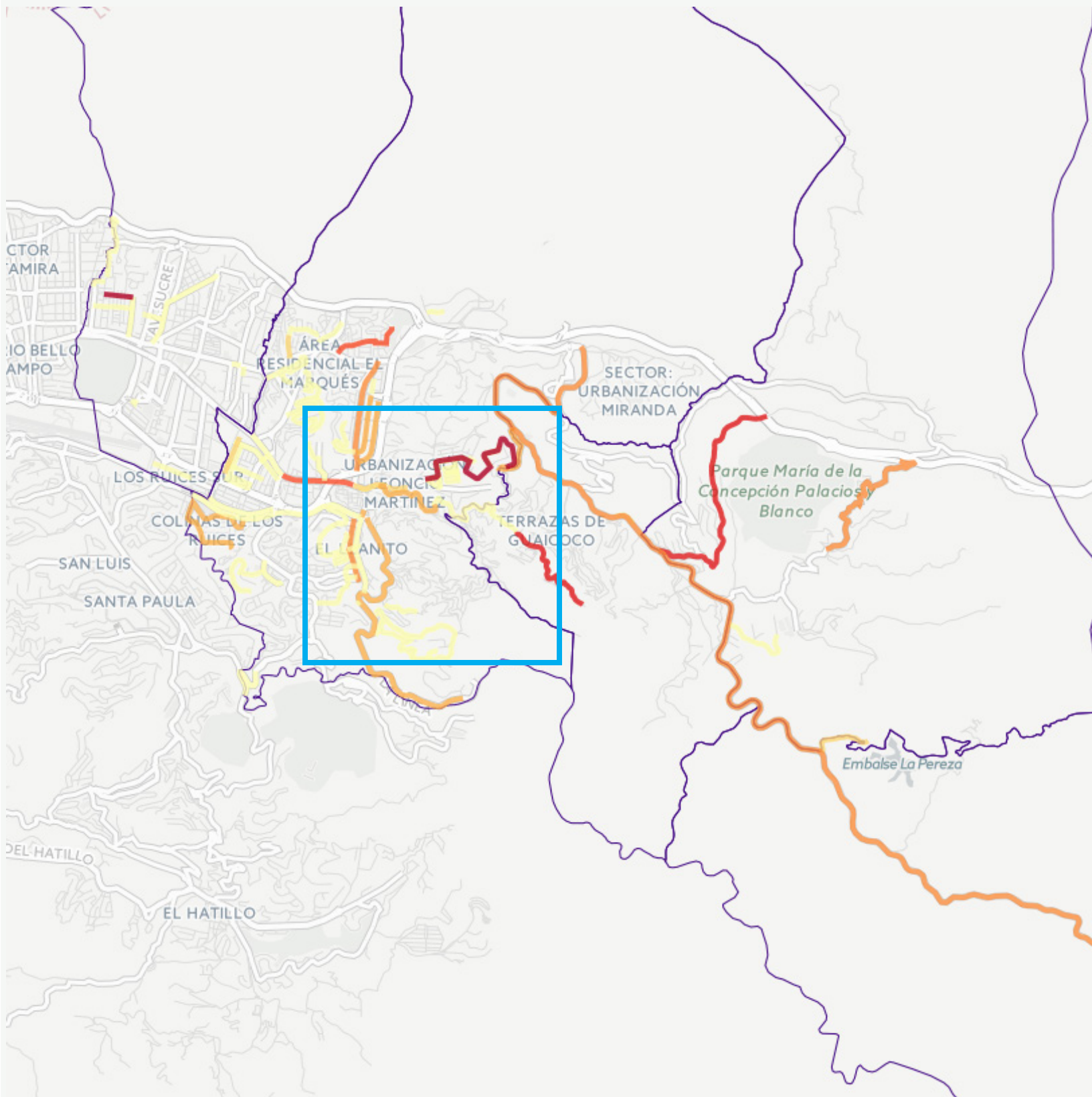
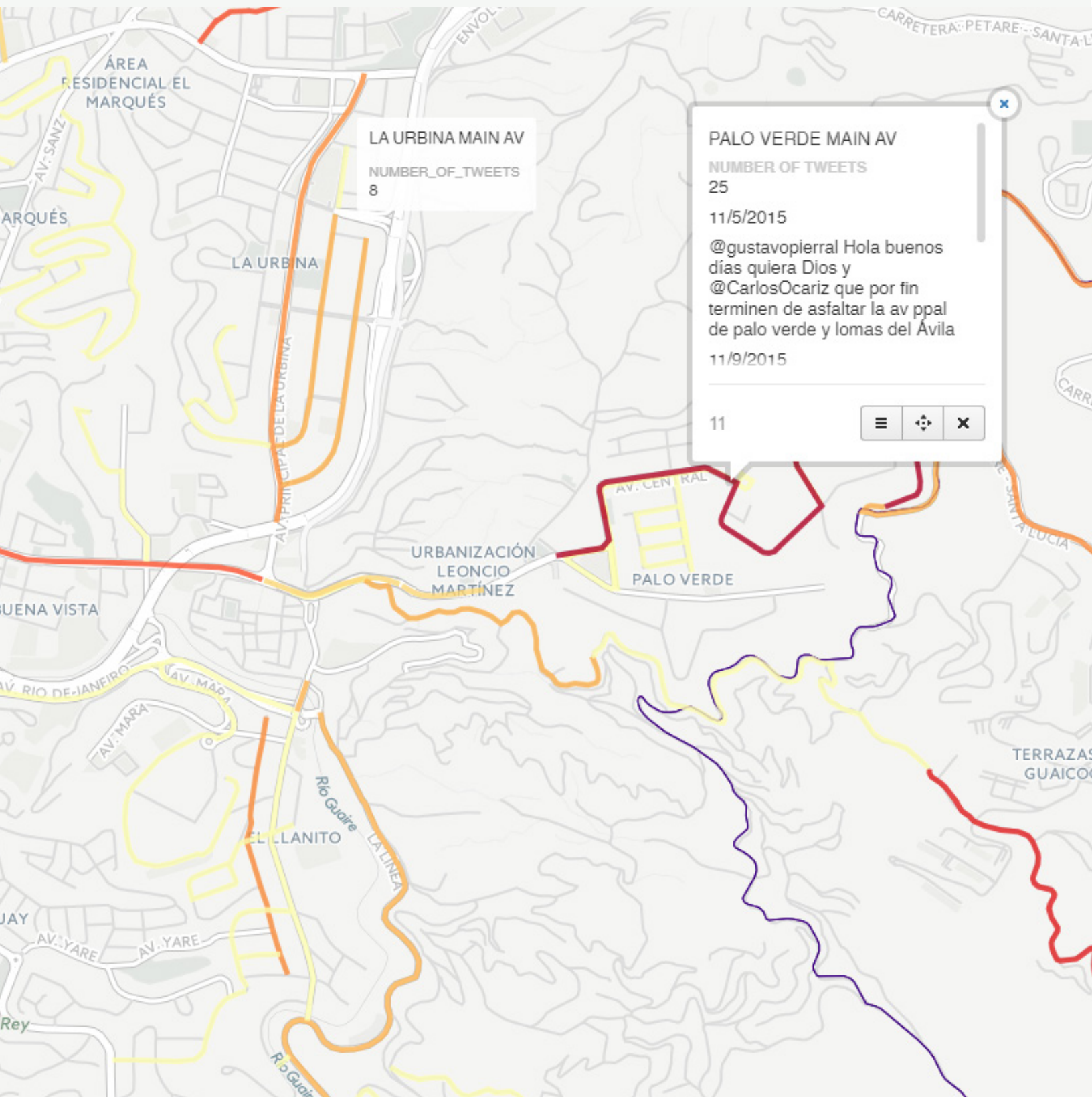


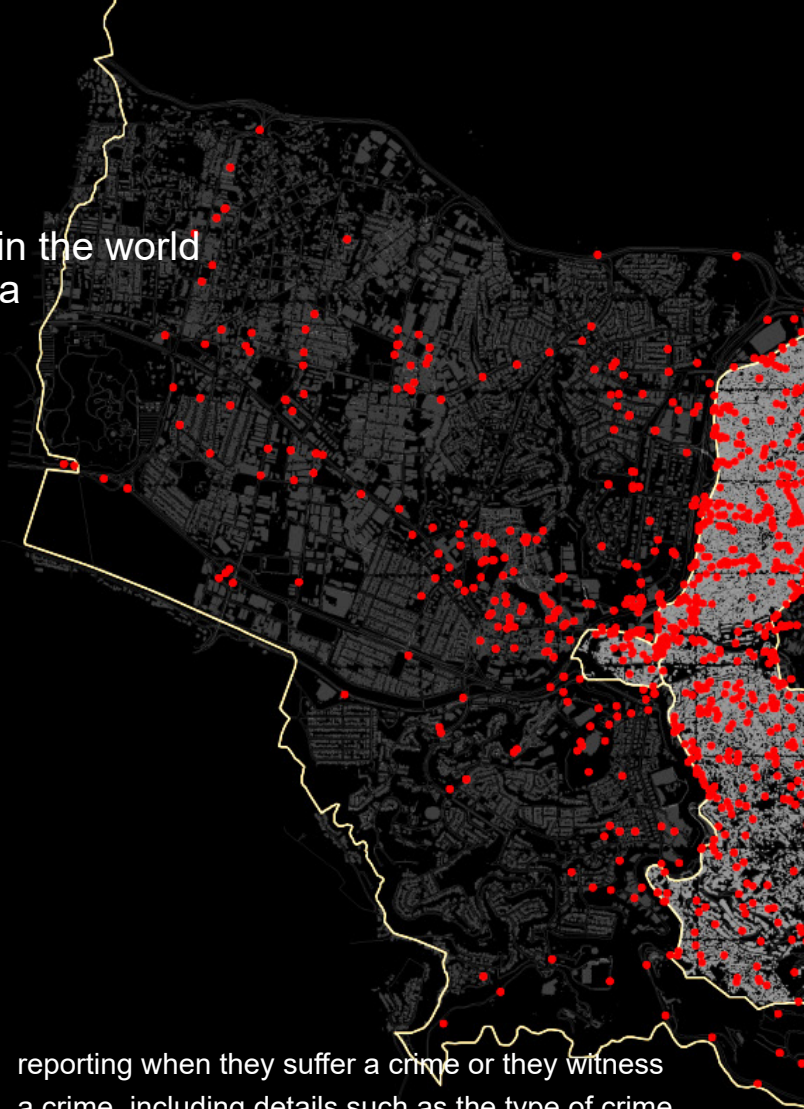
Figure 15 | Screenshots of the Streets and Asphalting Interactive Tweet-Sourced Map

Map Available at https://columbialibraries.cartodb.com/u/alepaty2138/viz/1b0d4eb6-eb5a-11e5-b0c5-0ecd1babdde5/public_map



CRIME TWEETS

The citizens of the most violent city in the world are denouncing through social media



Caracas is one of the most dangerous and deadliest cities in the world. The crime rate is getting higher every year. Sucre concentrated almost 60% of homicides for the MAC for many years. However, since the implementation of the plan 'Puntos Calientes' (HotSpots Plan) with CAF (Latin American Development Bank), they have achieved a reduction in the homicides rates. This plan consists of targeting the hotspots where crime commonly occurred. With the study, they identified that 80% of crimes were happening in 6% of the territory. Although homicide rates have been decreasing since the implementation of the plan, other types of crimes, such as robbery, assaults and felonies, haven't decreased as much. One of the many reasons is that people do not report such crimes often. Consequently, the Municipality does not have a database with the crimes, their characteristics and location for further study. However, social media presents an opportunity to change this situation.

When examining the content of the tweets related to the urban theme crime, citizens are

reporting when they suffer a crime or they witness a crime, including details such as the type of crime, location and modus operandi. A deeper sociological study could explain why people feel confident using social media instead of the Municipality or the Police Emergency Number to report crimes. The assumption for this study is that many factors can contribute to this result: 'anonymity' of the platform, meaning there is no personal information one is obligated to declare when reporting a crime (in contrast to the official call), in conjunction with a discontent public releasing stress and frustration, alerting their own community at the same time as informing the municipality. This makes social media a useful platform to collect initial data. By no means is the proposition to build an entire dataset just from this data. But as an initial point, with a proper communications strategy and complementing it with official data, the municipality could engage the public in informing them where crimes are occurring to tailor public policies to lower the rates.

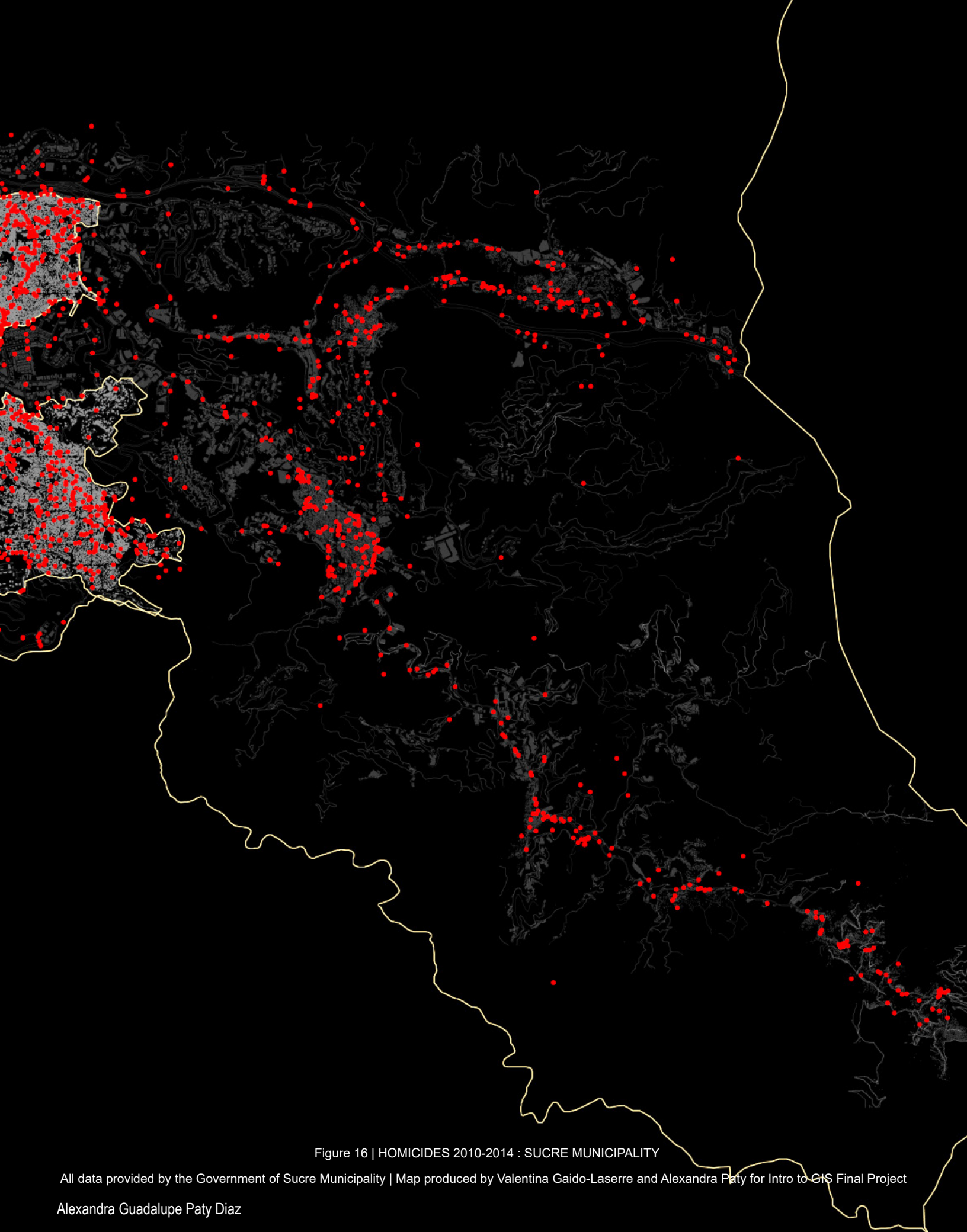


Figure 16 | HOMICIDES 2010-2014 : SUCRE MUNICIPALITY

All data provided by the Government of Sucre Municipality | Map produced by Valentina Gaido-Laserre and Alexandra Paty for Intro to GIS Final Project

Alexandra Guadalupe Paty Díaz

As can be seen in the Figure 17, 83 crime tweets were mapped from 277 tweets in total. These tweets named a specific location, either a place or a street. The rest of the tweets indicated whole neighborhoods as insecure areas or demanded more police presence in areas frequented by criminals. This crime map by tweets shows that there is a concentration of crime in areas that are not reflected in the Puntos Calientes Maps. Also, when examining the tweets, you can see a trend of where crimes are occurring: around educational facilities, traffic jams and arterial streets. A deeper analysis should be conducted to examine how much the crime tweets can contribute to the overall police strategy. However, this information can be use by planners and designers when building the framework of an area to study or planning urban interventions while the municipality does not have a more comprehensive dataset of all crimes occurring in their territory.

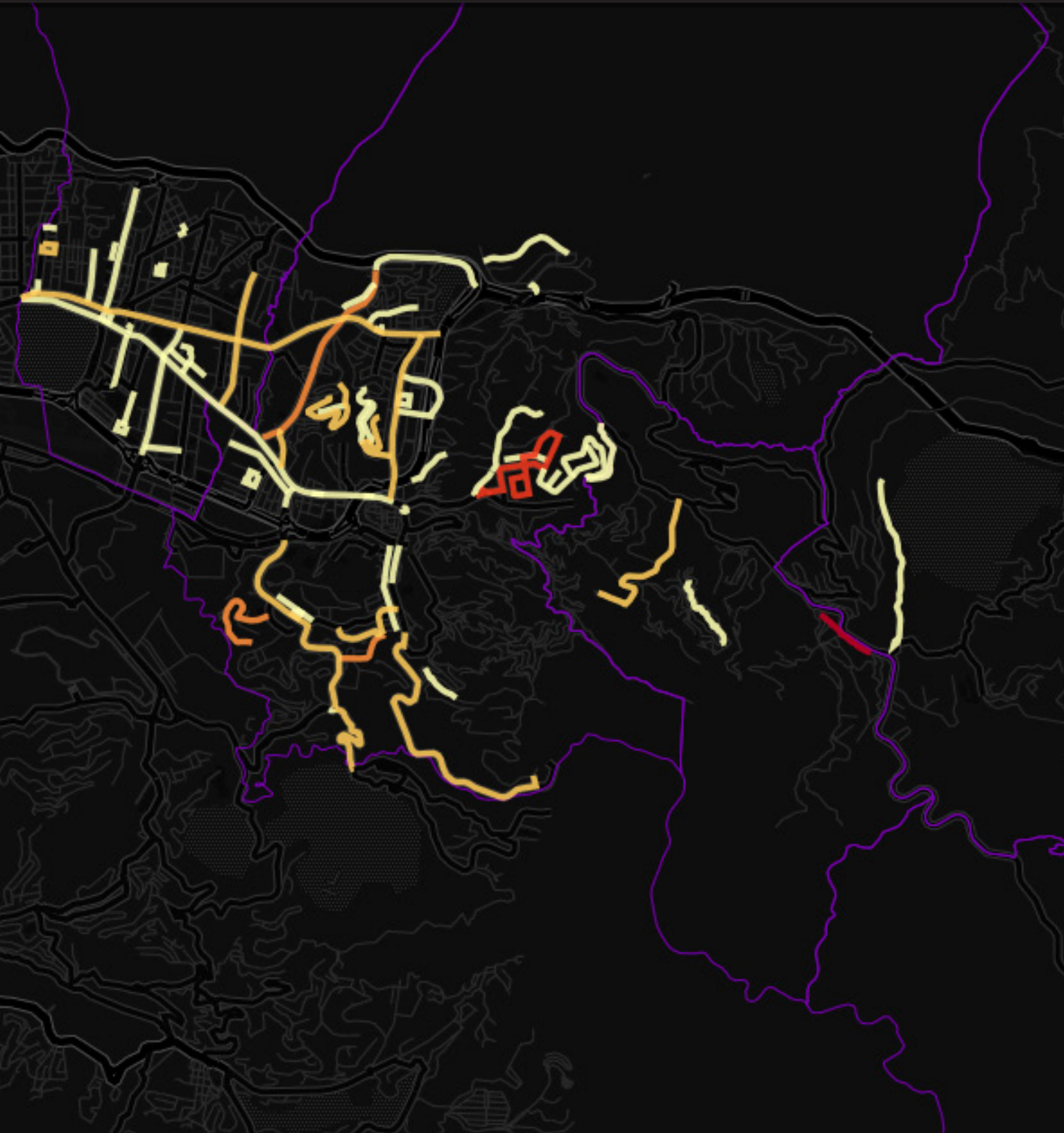


Figure 17 | Screenshots of the Streets and Asphaltting Crime Interactive Tweet-Sourced Map

Map Available at https://columbialibraries.cartodb.com/u/alepaty2138/viz/2152e566-f775-11e5-8f9d-0e3a376473ab/public_map



An aerial night photograph of a city, likely Bogotá, Colombia, showing a dense urban landscape with numerous lights from buildings and streets. A large, dark hillside dominates the foreground, and a mountain range is visible in the background under a cloudy sky. The text 'CONCLUSIONS AND RECOMMENDATIONS' is overlaid in white, bold, uppercase letters on the right side of the image.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS AND RECOMMENDATIONS

Although this topic merits further examination, some conclusions from this study can be stated. First, social media can be used as a source of data for planning. However, its effectiveness depends on how planners, policy makers and designers decide to use it strategically, from the moment they start communicating through the Mayor, the Municipality or institutions, to building a relationship with the public. And as with any other participation tool, the effectiveness depends on the authorities that invite the public to participate and how much they integrate the ideas into their practice. For example, the Municipality stimulated the public, in a specific period of time, to report the waste collection service and hold it accountable, even receiving an overload of information, but was not efficient enough to incorporate the comments systematically as a policy. This example also helps to illustrate the utility of social media platforms in punctual and urgent events. that social media can be used to get feedback quickly on time-sensitive events.

Second, previous academic studies, by ex-

tracting geocoded tweets, discarding the ones without geographical information, and disregarding the content of the tweets, mainly concentrated their analysis on where tweets were produced and how that related to demographic data. However, this study demonstrate that the content produced by the public, if studied critically, can be used for planning and governance regardless of knowing where the person was standing while writing the tweet.

Third, the public communicates more with leaders rather than institutions. One possible reason is that social media creates a direct bridge of communication between the elected official and the elector. Therefore, from the moment of the election a bond is created and it is the responsibility of the Mayor to take advantage of that relationship. Although Carlos Ocariz posts at least five tweets per day, he hardly replies to any of the comments and some of them are answered by the departments. On the other hand, the public is using the platforms, specifically Twitter, as a mechanism to report things that they could report through the official 0-800 SU-

CRE line, but they choose not to. Then, the opportunity is to systematize the contributions regarding crime, streets and waste management, as well as to foster the public to make these contributions. Subsequently, social media can be used as participatory tool for the planning process, such as special plans and participatory projects. It can be used not only to invite people to community assemblies but also to analyze the comments regarding the sector to be planned and by gathering ideas and using multimedia tools to test the proposals or actions. Furthermore, this study demonstrated the high level of engagement crowds have with the Mayor but not with the Municipality as an institution. The Municipality needs to craft its communication strategy to incentivize the identification of departments and agencies rather than a person whose time in office is limited.

Fourth, the global crisis Twitter is facing has hardly affected the growth of followers of the Mayor and of other institutions. This is when the particular political situation in Venezuela comes into focus.

Because of the control and censorship the national government imposes on many subjects - among them, opposition leaders like Carlos Ocariz -Mayors and Municipalities have rallied more and more on social media to spread their actions and connect with citizens directly. In addition, citizens are relying more on social media to access information and connect with their local authorities. Therefore, the challenge for Municipalities is to take advantage of this digital connection, which is occurring already and without any cost.

Fifth, one of the common criticisms of social media is the bias regarding who is using these digital platforms and who has access to them. However, this is something that also happens in other types of public participation. The use of social media for governance is also an opportunity to incorporate sectors of the population that commonly do not get involved in governance issues. Furthermore, Venezuelan society can be considered atypical for the level of commitment in social media it exercises, but this is also an opportunity for politicians in other

contexts to update traditional mechanisms for new ones that can facilitate, motivate and engage the public in planning and governance.

This research has shown how the social media platform Twitter can be used to study the public participation process in urban planning. However governments and officials, as well as planners, architects and urban designers, need to keep up to date with the latest trends of technology, big data and mobile apps. In this case the social network was Twitter and nowadays the most popular ones are Facebook, Twitter and Instagram. But it is a matter of time that in the future new apps and technological advances will come and it is the responsibility of elected officials and institutions to learn how to take advantage and adapt the communication and participatory strategies to them.

Social media presents an opportunity to incorporate citizens in the problem-solving processes of the city. As mentioned before, the reliability of the social media data, as any other participatory mechanism, depends deeply in how the authorities de-

cide to truly incorporate the public and their opinion in planning and governance.

BIBLIOGRAPHY

ARePA: Arquitectura, Ecología y Paisaje (2014). *Informe Asesoría Integral Urbana – Redoma de Petare [In English: Integral Urban Consulting Report – Redoma de Petare]*. Report Client: Municipality of Sucre, Caracas. Available Online: <http://www.arepa.info/proyectos/oficina-del-plan-del-municipio-sucre-odp-s/#.VmhGiLgrKUK>

Arnstein, S (1969). *A Ladder of Citizen Participation*. The City Reader. Eds. Richard T. LeGates and Frederic Stout. New York, NY: Routledge, 1996. Pages: 238-250.

Bizjak, I (2012). *Improving Public Participation in Spatial Planning with Web 2.0 Tools*. *Urbani Izziv* 23, no. 1 : 112–24.

Campagna, M. *The Geographic Turn in Social Media: Opportunities for Spatial Planning and Geodesign*. University of Cagliari, Cagliari, Italy campagna@unica.it

Ciuccarelli, P, Lupi, G and Simeone, L. *Visualizing the Data City : Social Media as a Source of Knowledge for Urban Planning and Management* . PoliMI SpringerBriefs, DOI: 10.1007/978-3-31119-02195-9_1, 2014

Conatel (2014). *Cifras del Sector Telecomunicaciones: Presentación Anual al 2014 [In English: Telecommunications Sector figures: Annual Presentation 2014]*. Available Online: <http://www.conatel.gob.ve/resumen-del-sector-telecomunicaciones-2014/>

Crawford, K, Miltner, k, & Gray, M. *Critiquing Big Data: Politics, Ethics, and Epistemology*. *International Journal of Communication* (19328036) 8 (January 2014): 1663–72.

Euromonitor International (2015). *Mobile Phones in Venezuela*. [online]. Available from: <http://www.euromonitor.com/mobile-phones-in-venezuela/report>

Geertman, S, Ferreira, J, Goodspeed, R and Stillwell, J (2015). *Planning support systems and smart cities. Lectures Notes in Geoinformation and Cartography*. Springer International Publishing Switzerland 2015. DOI: 10.11007/987-3-319-18368-8_1

Glaeser, E. (2011). *Triumph of the city: How our greatest invention makes us richer, smarter, greener, healthier, and happier*. New York: Penguin Press.

Goodchild, M and Sui, D (2001). *The convergence of GIS and social media: challenges for GIScience*. International Journal of Geographical Information Science, 25:11, 1737-1748, DOI: 10.1080/13658816.2011.604636

Goodspeed, R (2015). *Smart Cities: Moving beyond Urban Cybernetics to Tackle Wicked Problems*. Cambridge Journal of Regions, Economy and Society 8, no. 1 (March 1, 2015): 79–92. doi:10.1093/cjres/rsu013.

Grubmüller, V, Götsch, K & Krieger, B (2013). *Social Media Analytics for Future Oriented Policy Making*. European Journal of Futures Research 1, no. 1 (September 2013): 1–9. doi:http://dx.doi.org.ezproxy.cul.columbia.edu/10.1007/s40309-013-0020-7.

Shirky, C . *Here comes everybody: The power of organizing without organizations*. New York; Penguin Press.

Kleinhans, R, Maarten Van Ham, and Evans-Cowley, J. *Using Social Media and Mobile Technologies to Foster Engagement and Self-Organization in Participatory Urban Planning and Neighbourhood Governance*. Planning Practice & Research 30, no. 3 (May 27, 2015): 237–47. doi:10.1080/02697459.2015.1051320.

Manovich, I. (2011). *Trending: the promises and the challenges of big social data* [online]. Available from: http://www.manovich.net/DOCS/Manovich_trending_paper.pdf

Ratti, C, Frenchman, D, Pulselli, R and Williams, S (2006). *Mobile Landscapes: Using Location Data from Cell Phones for Urban Analysis*. Environment and Planning B: Planning and Design 33, no. 5 (October 1, 2006): 727–48. doi:10.1068/b32047.

Shelton, T, Ate Poorthuis, and Zook, M. *Social Media and the City: Rethinking Urban Socio-Spatial Inequality Using User-Generated Geographic Information*. Landscape and Urban Planning, Special Issue: Critical Approaches to Landscape Visualization, 142 (October 2015): 198–211. doi:10.1016/j.landurbplan.2015.02.020.

Townsend, Anthony (2013). *Smart cities: big data, civic hackers, and the quest for a new utopia*. W.W. Norton & Company, Inc.

