

Far Far Away in *Far Rockaway*: Responses to Risks and Impacts during Hurricane Sandy through First-Person Social Media Narratives

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ABSTRACT

When Hurricane Sandy swept over the US eastern seaboard in October 2012, it was the most tweeted about event at the time. However, some of the most affected areas were underrepresented in the social media conversation about Sandy. Here, we examine the hurricane-related experiences and behaviors shared on Twitter by residents of Far Rockaway, a New York City neighborhood that is geographically and socioeconomically vulnerable to disasters, which was significantly affected by the storm. By carefully filtering the vast Twitter data, we focus on 41 Far Rockaway residents who offer rich personal accounts of their experience with Sandy. Analyzing their first-person narratives, we see risk perception and protective decision-making behavior in their data. We also find themes of invisibility and neglect when residents expressed feeling abandoned by the media, the city government, and the overall relief efforts in the aftermath of Sandy.

Keywords

Crisis Informatics, Hurricane Sandy, Protective Decision Making, Risk Perception, Social Media, Twitter

INTRODUCTION

When a natural hazard like a hurricane approaches and arrives, people respond to the threat and its impacts in a variety of ways. Some may not perceive significant risk even in the presence of formal risk warnings (Morss and Hayden, 2010; Lazrus, Morrow, Morss, and Lazo, 2012; Demuth, Morss, Morrow, and Lazo, 2012) and rely on the actions of others and their own observations to assess risks and decide how to respond. Others may be fearful or worried based on forecasts and warnings, but still must decide whether and how to prepare and protect themselves and their families. Studies of protective decision-making (Lindell and Perry, 2012; Morss, Demuth, Lazo, Dickinson, Lazrus, and Morrow, 2015) help debunk assumptions about why people act how they do when a hazard threatens. Rather than “fail to evacuate” or “disobey evacuation orders,” for example, people may instead face challenges that make evacuation impossible or riskier than sheltering-in place.

In addition, some geographically vulnerable areas are home to marginalized populations who also experience other forms of vulnerability, including social, political, and economic. In such areas, vulnerabilities can further complicate decisions leading up to and during a disaster. Far Rockaway, a neighborhood in Queens, New York City, was one such location during 2012’s Hurricane Sandy. Our analysis of geotagged tweets in the Sandy keyword Twitter data set suggest that people in Far Rockaway were underrepresented on Twitter compared to many other neighborhoods in the New York City area. This underrepresentation means that residents’ voices may not have been so readily heard even by those who attend to social media, as often happens with less central and less affluent neighborhoods (Shelton, Poorthius, Graham, and Zook, 2014). However, our study reveals that despite the lower frequency of social media authorship, some Far Rockaway residents who did engage with social media during Sandy offered rich, situated, first-person accounts of their experiences, responses, and behaviors in the face of the hurricane.

In this paper, we bring analytical attention to social media reports by Far Rockaway residents through close examination of their first-person narratives to illuminate what it means to be at-risk to natural hazards. We examine their tweets to explore discussions of their decisions about protective actions, the information they sought and shared during Sandy, and the associated sentiments. We then investigate two users in greater depth in conjunction with the larger data set to elucidate key themes. This paper is part of a larger research project that investigates how people respond to forecast and warning information about coastal hazards.

Background

The 2012 Hurricane Sandy Event

Hurricane Sandy made landfall in the US on the evening of October 29, 2012 near Atlantic City, New Jersey, after having caused extensive damage throughout the Caribbean (FEMA, 2013). Sandy’s most devastating US impacts were in New Jersey, New York, and Connecticut; this region is the focus of our study.

In the US, 162 deaths were directly attributed to Sandy (FEMA, 2013). It was the second costliest hurricane to hit the US with damage estimated to be US \$6 billion (Blake, Kimberlain, Berg, Cangialosi, and Beven, 2013). Approximately 776,000 people were displaced (Yonetani and Morris, 2013) and 650,000 homes were damaged or destroyed. 8.5 million people lost power as a result of the storm (Blake et al., 2013), and many were without power for weeks.

Far Rockaway Neighborhood

The Far Rockaway neighborhood is located on the Rockaway Peninsula in the New York City borough of Queens. What used to be a summer getaway for New Yorkers in the first half of the 20th century has become a mixed income, remote residential New York neighborhood with a large concentration of public housing. Formerly populated by Eastern European Jewish and Irish immigrants, it is now a racially and ethnically diverse community with a large percentage of African Americans (50%). The median income in Far Rockaway in 2010 was \$27,820, which is significantly less than U.S. median household income of \$49,445 (U.S. Census, 2010).

The geographic location of the peninsula and the socio-economic characteristics of Far Rockaway make this community especially vulnerable to the effects of hurricanes and tropical storms. Hurricane Sandy caused extensive damage in Far Rockaway due to storm surge and coastal flooding. The livelihoods of local residents were disrupted by physical damage to their homes and the environment, loss of power, and a long—in many places still ongoing—post-storm recovery.

Long Paper – Social Media Studies

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Three factors—major flooding during Hurricane Sandy, high social vulnerability of local residents (de Sherbinin and Bardy, in press), and sparse social media activity among the Far Rockaway residents—contributed to the selection of this community as a case study within our larger research effort.

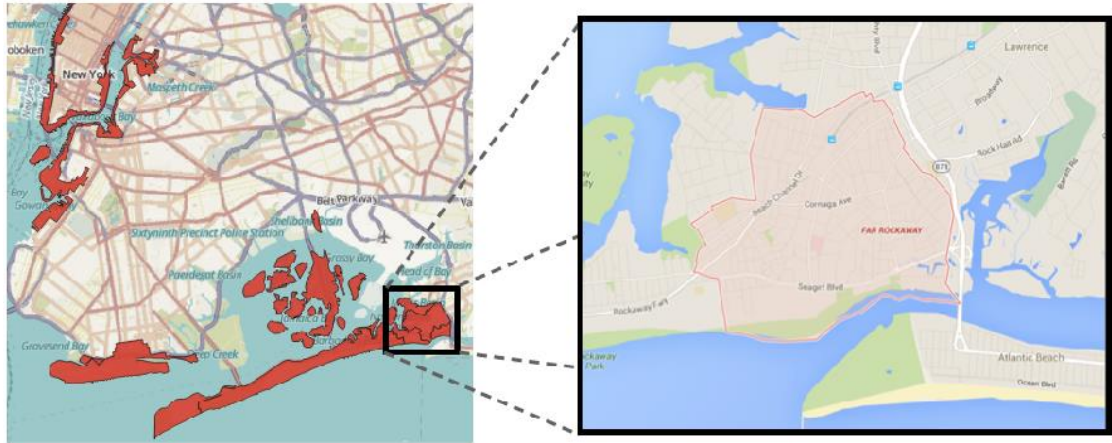


Figure 1: New York City with Evacuation Zone A (red) with Far Rockaway inset
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METHODS

During the Sandy event, we collected tweets based on a keyword search for terms related to Hurricane Sandy using Twitter's Streaming API, generating a data set of 15.9 million tweets from Oct. 24-Nov. 16, 2012 (for details of this data collection, see Kogan, Palen, and Anderson, 2015). In addition to this dataset, we made use of a historical search service (referred to here as the GNIP API) on Twitter's full database of tweets made available to us via a data partnership established between Twitter and the University of Colorado Boulder.

Our goal is to identify various themes in the Twitter data relevant to Far Rockaway. As there were relatively few geo-tagged tweets in the Far Rockaway area, we searched our keyword dataset for the following terms in either the text of the tweet or in the user's description: *farrockaway*, *far rockaway*, *farrock*. This search yielded 368 users of interest. We then used the GNIP API to pull every tweet generated by these users. (This would not have been possible using Twitter's REST API since that service only retrieves the most recent 3,200 tweets from a user; for many users, that number is too few to include the tweets created in October 2012.) This resulted in a total of 143,816 tweets and retweets generated by 307 of the 368 Twitter users of interest during the study period (Oct. 24-Nov. 7). The remaining 61 users have either since made their tweets private or deleted their accounts, eliminating them from the study.

After identifying the 307 Twitterers, a team of three researchers (the first three authors) read the entire tweet histories for the study period. The researchers read Twitter biographies and traversed links that subjects shared in their tweets and bios to determine their geographical location at the time of the study and to examine other media they might have posted. Ultimately, we found 112 users with a connection to Far Rockaway during the study period. The team then sorted these 112 Twitterers according to the quality of their first-person accounts of how they were affected before, during, and after the storm. Twitterers with less than three mentions of content pertaining to Far Rockaway were not included in the final set, even if they were from the area. Similarly, people who had detailed social media content but were from elsewhere (although the tweets mentioned Far Rockaway) were also not included.

At the end of this iterative team coding process, we identified 41 users who were in Far Rockaway before and/or during the storm who provided understandable narratives of their experiences. In sum, these users created 6,957 tweets during the study period. Table 1 describes the distribution of tweets per user, which is long-tailed as is common in social media activity (Kogan et al, 2015).

<i>User Set</i>	<i>Mean Num. of Tweets/User</i>	<i>St. Dev. of Tweets/User</i>	<i>Median Tweets/User</i>
307 Users mentioning “Far Rockaway”	468.46	876.43	144
41 Far Rockaway residents	169.68	211.00	97

Table 1. Distribution characteristics for tweets per user in our study.

The same team then together analyzed these data by coding tweets into the thematic categories described below and by inductively analyzing the tweet streams for key themes emerging from the narratives (thus eliminating the need for inter-rater reliability measures). We found that some Twitter users narrated their thoughts and action through multiple consecutive tweets. Some of these narratives yield a particularly rich dataset that offers more nuanced insight into how people prepared for the storm. We characterize these narratives as ‘rich’ because they provide vibrant real-time first-person accounts of what it was like to experience the storm, allowing for *thick description* (Geertz, 1973), where we created detailed narratives for each of these users by interpreting their tweets and reported experiences within the context of their position in the community, professional affiliation, and family circumstances.

DATA ANALYSIS AND RESULTS

In research leading up to this study, our team—which is comprised of information, atmospheric, and social scientists with expertise in hazard vulnerability, warning and response—integrated knowledge from the literature on protective decision making during natural hazards (Lindell and Perry, 2012) to develop thematic categories related to hazard information and decision-making processes. The three main themes on which we focus in this analysis are: *Preparation*, *Passing on and seeking information*, and *Reporting on one’s personal and local environment*.

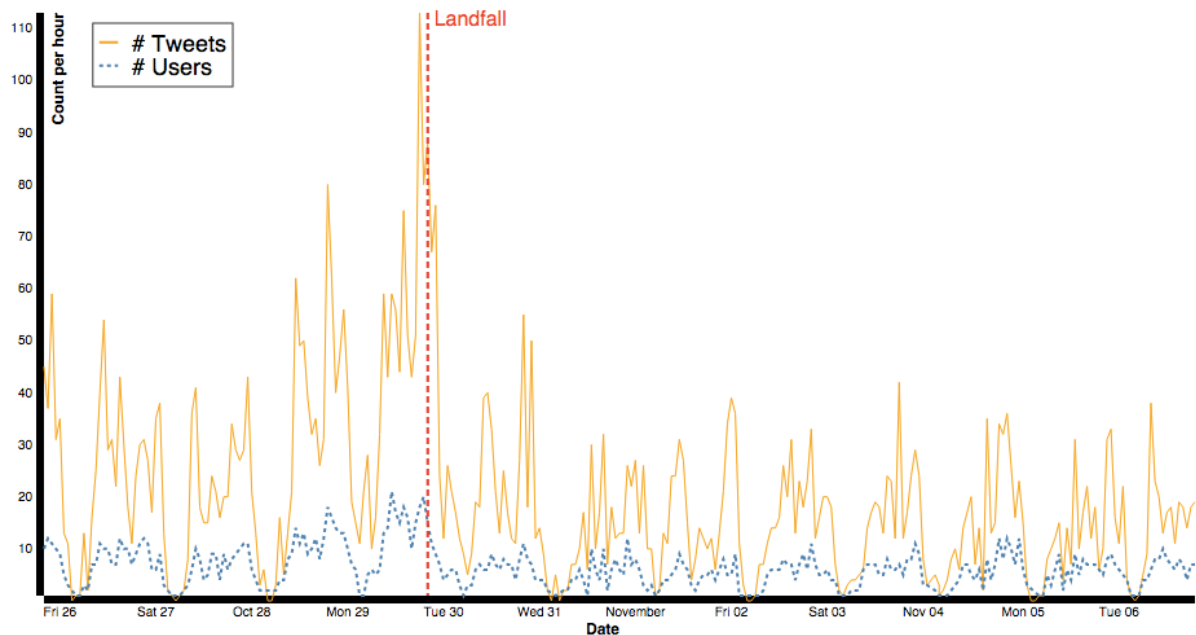


Figure 2: Dataset of 41 Twitterers and their total tweets per hour

Preparation

Preparatory activity involves preparing physical property, its residents, and/or a means of transportation for evacuation or sheltering-in-place. Examples include boarding up windows, stocking up on food and drink, filling cars with gas, or checking for changes to bus and train schedules.

As Hurricane Sandy's landfall approaches, Twitter-active residents of Far Rockaway talk about their preparatory actions (Table 2). Before landfall, residents document stocking up on food and water, together with other emergency supplies. As shown in Table 2, the author of tweet P1 seems to feel prepared for the storm and comfortably settled at home.¹ As the landfall draws closer, we see multiple Twitterers announce that they expect to lose power, heat, and water, and prepare by filling up bathtubs and charging their devices, especially those necessary for communication (P2, P3). As the storm makes landfall and infrastructure begins to fail, the mobile network provides a communication network, but one that must be used in balance with battery power conservation (P4). Finally, as residents take stock of the damage after the hurricane passes through, we see some of them retroactively reflecting on their storm preparation, as well as the information that was helpful in that process (P5). The latter tweet also illustrates some of the positive coping (discussed later) we see emerging for some Twitterers as they reflect on the decisions they made to prepare for the storm.

Movement as Preparation: To Evacuate or Shelter-in-Place?

Deciding whether to evacuate or to shelter-in-place is one crucial aspect of preparation. As shown in Figure 1, Far Rockaway was under official mandatory evacuation orders ("Zone A") (NYC Government, 2012). In our study population, we see that 22 people discussed their choices to stay or evacuate.

For example, two friends share their worries about their families sheltering-in-place in Far Rockaway in a back-and-forth Twitter conversation (M1, M2). Tweet M2 also suggests prior experience with an earlier storm, which can affect risk perception in a subsequent hazard (Lindell and Perry, 2012).

Other Twitterers share their decision on whether to evacuate in the hours after the mandatory evacuation was announced on the 28th (M3, M4). However, we also see people discussing their decisions to evacuate themselves and/or their families in the days after the hurricane, as the power outages and dropping temperatures from a Nor'easter worsened the conditions in Far Rockaway (M5).

Negative affect (worry, fear, etc.) is a common sentiment in the movement-related tweets (M2), as these emotions are often an integral part of people's risk perceptions and decision-making (Slovic, 2010). On the other hand, some Far Rockaway residents turned to humor when discussing their complicated situations. This can be seen in tweet M4 where the author declares he is staying and then anthropomorphizes Sandy, implying a romantic candle-lit evening. Such humor and sarcasm are common sentiments expressed by some users as they prepared for Sandy.

Underestimating Sandy Based on Experience with 2011's Hurricane Irene

Prior experience with Hurricane Irene—which threatened the same region a year before—affected people's preparation as it colored many residents' perception of Sandy's danger, including the need to evacuate before the storm landfall (U1, U2). Because Hurricane Irene did not end up having severe impacts in New York City, some New Yorkers felt that the media frenzy and the city government's messages were largely an overreaction during Irene, and thus took pre-landfall information about the severity of Sandy less seriously.

On the other hand, as the storm gets closer and the risks it poses for New York become more apparent, some Twitterers explicitly call out this prior experience bias and warn about the real danger (U3). As the danger of Sandy becomes clear, both during and after landfall, some users admit having underestimated Sandy (U4) and resolve to be more vigilant in the future (U5).

¹ Tweets are identified by a reference number of the form <theme><#>, like this first *preparation* tweet, "P1."

Ref. No.	Tweet Details
P1	infinitewords14 (Oct 28 11:57): House is stocked up, got the 1st aid kits, bottled water. Now, we wait. Hunkered down for Sandy.
P2	chansonthegreat (Oct 29 09:00): Let me go take this shower before I don't have hot water for two weeks #sandy
P3	PersiaNYC (Oct 28 19:11): @Dashing_divaG lemme charge my phone a lil before Sandy shows up and kills the lights LOL
P4	chansonthegreat (Oct 29 18:30): Welp, my power's out. Time to conserve this phone battery.
P5	MattMinerXVX (Nov 03 14:57): @SWCTweather thanks for your work. Your warnings got us to board up and move things - saved some of our furniture when our house flooded
M1	BlissfullILO (Oct 28 13:10): My family is staying here in the rockaway's #wishusluck
M2	Maria_Batres (Oct 28 13:16): Mines too,not gonna lie im scared. Sandy looks tougher
M3	mattgunn (Oct 28 14:19): And with that, I evacuate my home for higher ground. See you on the other side, Rockaway. #sandy http://t.co/felB7Ivq
M4	KasheemDaniels (Oct 28 21:37): They labeled us Zone A but I stayed... hope she likes candles. #HurricaneSandy #FarRockaway #NY http://t.co/fltilRZA
M5	Saint_TueCynn (Nov 04 10:53): @beyond_beauty25 i had to send my pregnant wifey and my son to brooklyn to be safe and warm... #RockawayNeedsHelp
U1	chansonthegreat (Oct 28 13:29): @lfrsh @kokupuff @tynie626 last time it wasn't as bad as they said. If I stayed I could have pumped out the water and prevented damage.
U2	RedBottomsVixen (Oct 28 18:43): I live in zone A but im not gunna evacuate because I did last time and regretted that choice.
U3	Drenyce311 (Oct 29 14:33): everyones not making a big deal about this because of IRENE. Come on people. Now thats its getting bad everyone wants to leave. Stay safe people and god be with you all.
U4	Gritz718 (Oct 29 15:33): I'm not too proud to admit it... I'm starting to think I might've underestimated this storm. Fuck. #Sandy #NYC
U5	TherealBigFred (Oct 30 02:40): Next time they say evacuate I'm out 🌊🌊🌊 everyone be safe http://t.co/Th44vvK2

Table 2. Preparation (Preparation, Movement, Underestimation of Sandy) tweets

Passing On / Seeking Information

One of the most frequent social media behaviors we observed among Far Rockaway Twitterers as Sandy approached and arrived was passing on and seeking information about the situation. In our data set of 41 local Twitterers, 33 propagated or sought information related to Sandy on Twitter.

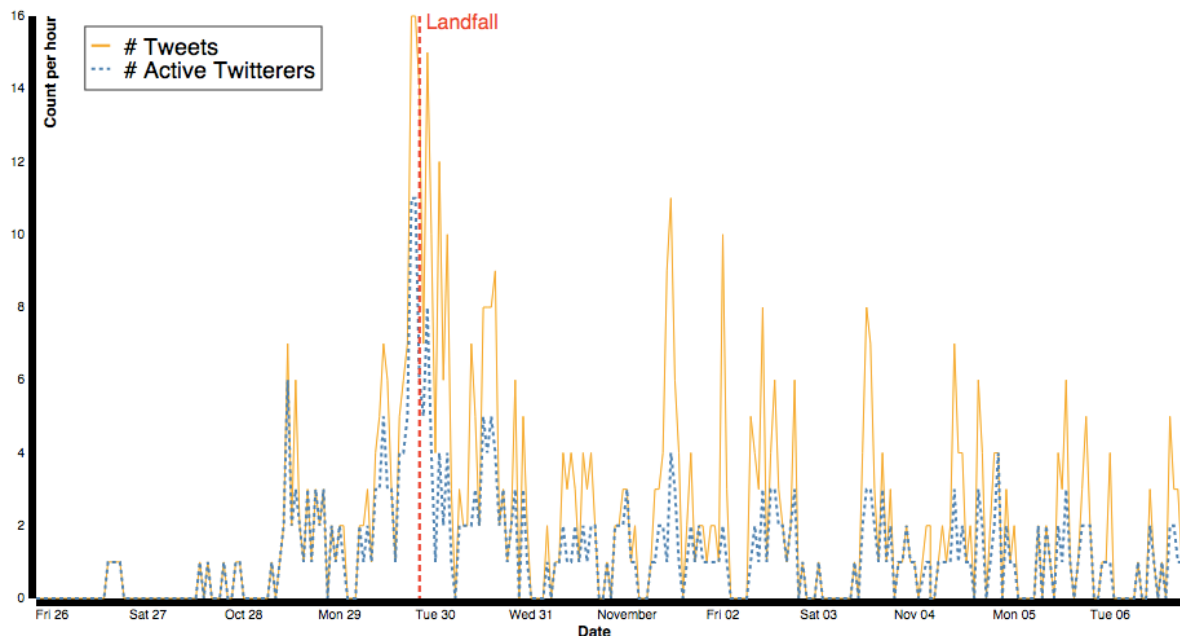


Figure 3: Twitterers and tweet counts for passing on/seeking Sandy-related information per hour.

The number of tweets related to sharing and seeking Sandy-related information spiked sharply on the evening of Oct. 29th, the night of Sandy's landfall (Figure 3). Also interesting are the subsequent spikes in these information behaviors in the days following landfall when people are assessing impacts (damage, outages, etc.), connecting with others, and watching relief efforts get underway.

Twitterers share information on a variety of topics with a large number of tweets offering concrete and actionable local information, as shown in Table 3. Many early tweets pertain to Sandy-related transportation closures across New York City (I1), with a subset highlighting the specific limitations that Far Rockaway residents face for moving around (I2). In tweet I2, "878" refers to a highway that connects Far Rockaway to other city arteries like the Belt Parkway. Other pre-landfall tweets pass on information about the evacuation status of NYC neighborhoods and shelter locations (I3). As the storm approaches, Twitterers focus on spreading the information about the inclement weather and its impact on the physical infrastructure (I4).

In the hours leading up to landfall, we also see some instances of information-seeking behavior among Twitterers, especially relating to the timing of the event and its impacts (I5). As the storm passes, many evacuated residents seek information about their neighborhood, their friends and family, the condition of the built environment, and the general sense of safety in Far Rockaway (I6).

After residents took stock of the damage and spread the word about the devastation (see Reporting, below), tweet content shifted to the controversy over possibly cancelling the NYC marathon (I7) and issues of gas shortages and power outages. Specifically, Twitterers shared which gas stations still had gas, as the shortage was a widespread problem that impeded movement (I8). As time progressed, the information being shared shifted to issues of long-term recovery and rebuilding (I9, I10).

Ref No.	Tweet Details
11	Drenyce311 (Oct 28 10:16): All rail buses and subway will stop running at 7pm tonite. #hurricanesandy #sandy #nyc #newyork
12	Dearstephaniexo (Oct 28 20:57): 878 has been close down. People from rockaway can leave but are not allowed to come back. ☐
13	Dearstephaniexo (Oct 28 11:49): Mandated evacuation for all of the Rockaways ☐
14	BlissfullILO (Oct 29 18:10): #Therockaways are already experiencing power outages #hurricanesandy #prayforus
15	FarRocksReese (Oct 28 20:56): When exactly is Sandy suppose to get here?
16	CHDADONNRF (Oct 31 21:13): @DanielSquadron @NYCHA @chriscquinn @rosiemendez #sandy what's going on with NYCHA in far rockaway. Are they safe from looting?
17	bonjoursalope (Nov 02 15:42) RT @H_Combs: My stepfather has run the NYC marathon for 20 some odd years. Real New Yorkers know this no time to run. Help the people...
18	Drenyce311 (Nov 05 13:25): #HESS cypress ave & cooper has almost 9000 gallons. #bkgas #brooklyngas #queensgas #nycgas #gasrelief http://t.co/Izgg4uK0
19	precious2005143 (Nov 04 15:49): RT @RobinHoodNYC: Please share: Sites in Coney Island, Rockaways, & Staten Island where residents can apply for FEMA loans #SandyRelief
110	Dearstephaniexo (Nov 06 13:47): So I hear far rockaway A trains won't be working for a couple of months #thestruggle #helloLIRR

Table 3. Information Seeking and Sharing

Reporting

Leading up to and during Sandy, Far Rockaway Twitterers frequently report on the situation around them: 37 of the 41 users authored reporting tweets. Reporting tweets peak on the day and night of landfall, with smaller peaks for several days after landfall as people assessed and communicated about the post-landfall situation (Figure 4).

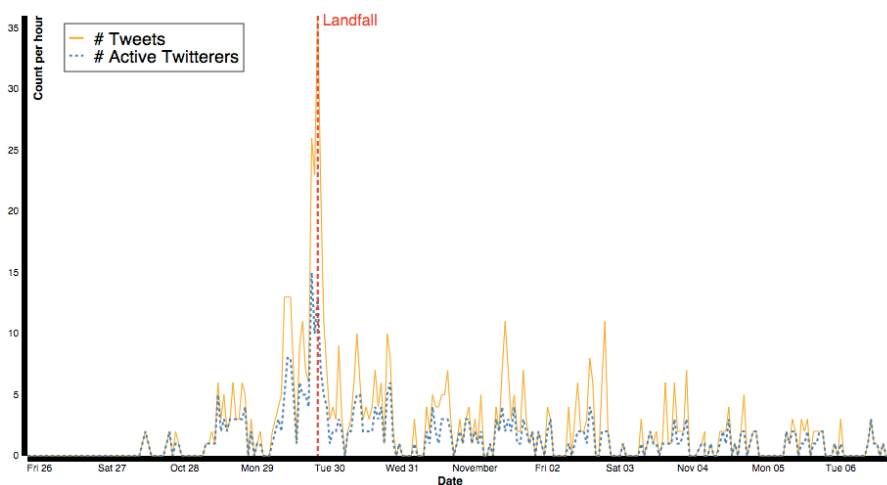


Figure 4: Twitterers and tweet counts per hour for reporting

We can broadly separate these tweets into three themes: *environmental reporting*, *personal reporting*, and *social cue reporting*. These themes are discussed below, and example tweets are shown in Table 4.

Environmental reporting includes reports about the severity of the weather, other natural environmental conditions such as flooding, and the damage they subsequently caused to the built environment (R1, R2). Many of these tweets include images that show damage.

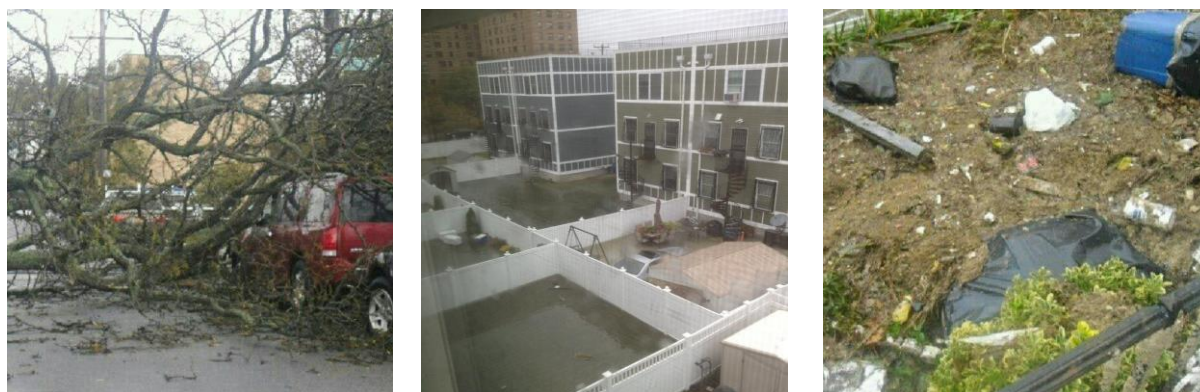


Figure 5: Pictures from Environmental and Personal Reporting Tweets: Links from R1, R2, R3, Respectively.

Personal reporting documents the conditions of people's immediate surroundings, such as flooded and littered yards (R3), as seen in the linked photographs (Figure 5). Wind damage is also often documented (R4), but most frequently reported in these tweets is the availability of electricity (R5, R6). Environmental and personal reporting both spike sharply at landfall.

Social cue reporting involves talking about the behavior of others. Reporting on social cues is not as frequent as environmental or personal reporting, but Twitterers who comment on the behavior of others seem to assign a lot of importance to these cues. Interestingly, in our dataset, many examples of such reporting focus on the behavior of neighborhood food and retail spaces (R7, R8, R9, Figure 6).



Figure 6: Image Illustrating Social Cue Reporting (link from Tweet R9)

Ref. No.	Tweet Details	Scope of Reporting
R1	DJ2020 (Nov 01 02:56): Big Tree down on Car in Far Rockaway, NY B 30th @ Mr. Deli & Mini Market http://t.co/0CGl2uLr	environment
R2	swaglegendary (Oct 29 12:43): this was like an hour ago. OKAY #Sandy http://t.co/DtXRPkyz	environment
R3	DJ2020 (Nov 01 02:49): My yard after Sandy in Far Rockaway, NY (420 B 29th) @ Mr. Deli & Mini Market http://t.co/f3j0QqJD	personal
R4	bonjoursalope (Oct 29 18:02): Oh God the tree down the street is about to fall D: #sandy	personal
R5	Saint_TueCynn (Oct 29 20:21): Power just went out!!!!!!! Omfg I thought I was gonna be all good....	personal
R6	Tani_____ (Nov 03 22:05): @ItsJoeyBiitch nah we chilling actually. We have the generator during the day n when that goes off we go to bed lol	personal
R7	dstdonna88 (Oct 29 19:27): You know Rockaway's in trouble when Pickles and Pies is closed. The bay meets the ocean on 116th. Wow. Hoping everyone is safe and business don't suffer too much damage. http://t.co/JNAX4HGs	social cue
R8	PersiaNYC (Oct 28 23:32): Ok Im a lil scared now....the arab store stayed open during Irene, that mufukka is closed (-_-)	social cue
R9	TherealBigFred (Oct 29 10:10): When you ever saw them not open up shop.....not even on a holiday http://t.co/djeqtG7P	social cue

Table 4: Reporting

A DEEPER DIVE INTO FIRST-PERSON NARRATIVES

We next examine in greater depth two Twitterers who were active throughout the event, and although they are not necessarily representative of the population of Far Rockaway, their narratives better illustrate the situations and decisions that multiple residents discussed over Twitter. (Their Twitter activity is being reported here with their permission).

Donna's Story

Donna is an Emmy-winning TV producer and co-owner of a performing arts school, according to her Twitter profile. From October 27th to November 6th, she tweeted 71 times with most posts relevant to Hurricane Sandy. Many of her tweets below are cross-posted (and publicly available) from Facebook (noted as *FB*), which lifts the limit of 140 characters off her communications and allows us to observe the rich, comment-based interaction within her social network. Her first storm-related tweet discusses frustration at the lack of official information being shared to prepare for Sandy, especially in contrast to Irene (here *FIOS* refers to her fiber optic internet access):

FB: dstdonna88 (Oct 28 11:00): I felt so prepared for Irene. For Sandy, I have no info or plan. Every network is focused on the election. That's cool. But can someone tell me if I have to evacuate??? Love my FIOS, but where is NY1 when I need them.

Within a half hour, she receives seven comments from five people sharing television stations, websites, and personal information telling her that, yes, she is supposed to evacuate and pointing her to more information. She responds:

dstdonna88 (Oct 28 11:04): Finally! Ask and you shall receive. Press Conference coming on

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now.

Next in a series of tweets abbreviated here, she begrudgingly accepts the news to evacuate, books a hotel room, and prepares to leave:

FB: dstdonna88 (Oct 28 11:29): Dammit!! Mandatory evacuation of Zone A. Hazards of living on the beach. Been there, done that. But this time we have to pack up a baby. UGGGGHHH!

Throughout this part of her narrative during October 28-29, Donna maintains a positive attitude, chatting with friends and finding television shows to pass the time. After landfall, she turns her focus to news reports in search of information about Far Rockaway.

dstdonna88 (Oct 30, 01:22): The news reports make Rockaway sound like a disaster zone. Wondering when we will be able to go back to check on our homes. Sad and anxious. But safe

As reports come in from Far Rockaway that cause worry, she reaches out to her network, even in the middle of the night, to get more information.

dstdonna88 (Oct 30 01:47): @BrattyTart @dstdonna88 So sad. Hope ur safe. Are u there? I want to come home.

dstdonna88 (Oct 30 01:51): Any news from #rockaway? Worried about my neighbors and home on B74. Hope everyone is safe.

A friend responds, and the exchange shows that Donna is being vigilant about checking on her home community through Twitter:

robyac (Oct 30 02:01): @dstdonna88 apparently there is a big fire out there

dstdonna88 (Oct 30 02:07): @robyac I know. Many. Following tweets. So worried. I want to go home.

Next she tweets directly to a reporter about coverage that she is providing via Twitter—news that cannot be found in mainstream media:

dstdonna88 (Oct 30 02:38): @katie_honan Just want to thank you for your updates. Folks from Rockaway not getting enough info from the news.

At this point, we learn that @katie_honan has a personal commitment to reporting on Far Rockaway and is trying to get the information out in any manner she can.

katie_honan (Oct 30, 03:07): @dstdonna88, if i can defend the news for a moment, everyone working off of different info and easier for me to tweet than news to put on tv

dstdonna88 (Oct 30 03:18): @katie_honan not knocking the news. just praising your supplements

katie_honan (Oct 30 03:19): @dstdonna88, ha. thank you. i feel like i report on many different things but this was so personal to me. can't sleep. need to get info out.

The matter of poor news coverage is a topic that loomed large in these Far Rockaway first-person narratives. Though Donna shares positive interactions with @katie_honan as she continues to report on Twitter and Facebook in an effort to help, other users express frustration with the media coverage (Table 5).

Matt's Story

Matt is a Far Rockaway resident. He is a self-described comic book writer, dog lover and rescuer. He is a prolific Twitterer who extensively documented his Sandy experience with nearly 500 Hurricane Sandy related tweets during our study period. Like many of our found Twitterers, Matt reported a great deal about his personal/local environment and passed on copious amounts of information during Sandy—he even live-tweeted and video-streamed his experience. However, two of the themes that stand out the most in his activity are his family's preparatory activities and his frustration with the government's handling of Sandy's impact in Far Rockaway.

Matt's Twitter discussions of Sandy begin with many humorous tweets, which are mostly dark and sarcastic:

MattMinerXVX (Oct 26 10:50): Off "aware" and on "alert" for #Sandy. I'll be live-tweeting photos and video if this #frankenstorm hits us. Watch me drown in real time!

Though he continues with jokes, only 1.5 hours later he candidly admits to being quite nervous about the storm:

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MattMinerXVX (Oct 26 12:32): I know I'm making a lot of jokes about Sandy, but I'm actually pretty nervous. We're right on the shore now.

He begins to prepare:

MattMinerXVX (Oct 26 20:10): Gonna try and stock up on bottled water tonight before the rush. Shit is gonna be crazy. As long as the animals & my wife are OK I'm happy

MattMinerXVX (Oct 27 10:46): Stop n Shop in the Rockaways is a madhouse. Everyone's stocking up on water & canned food. #Sandy #ZoneA

His experience at the store serves as a social cue of how serious Sandy is expected to be. Another social cue is provided by his neighbors' preparatory actions:

MattMinerXVX (Oct 27 11:34): From my office I hear the "tap tap tapping" of people boarding up their windows. #ZoneA #Sandy

Eventually, Matt and his family are confronted by one of the most important aspects of preparation—the decision of whether to evacuate or shelter-in-place, as their home is in the mandatory evacuation zone:

MattMinerXVX (Oct 28 11:29): Mandatory evac of #ZoneA for hurricane #Sandy. About time, @MikeBloomberg - why'd you wait so damn long?

Matt expresses his frustration with Mayor Bloomberg for issuing the evacuation order so late. Ultimately, the family decides to stay and weather the storm, a decision that he explains:

MattMinerXVX (Oct 29 20:41): Why we didnt leave: 6 animals, one with special needs, could not take to shelter. Was told specifically we would be robbed if we left.

Having pets is a common reason why some people do not evacuate even when mandated (Irvine, 2009; White and Palen, 2015). For Matt, the decision seems to be further tied to the late evacuation order:

MattMinerXVX (Oct 28 19:41): phon70 yeah, well mayor Bloomberg only gave the evac order 7 hours ago and called that "plenty of time".

After his house gets flooded and loses power, his frustration with the government's handling of Sandy's impact in Far Rockaway steadily grows.

MattMinerXVX (Oct 31 12:22): Have heard that FEMA forgot this part of the Rockaways and that we need to call. I can't call - no service. (1/2)

MattMinerXVX (Nov 03 11:40): .@LIPAnews what's the power ETA for Rockaway? Are we last priority because we're poor? #SANDY

Moreover, Matt explicitly suggests that delays in the response in Far Rockaway are largely due to the economically and politically marginalized status of the neighborhood.

ANGER AND FRUSTRATION AT BEING FORGOTTEN

Ref. No.	Tweet Details
F1	swaglegendary (Oct 29 21:44): @NYMag there's about 6 feet of water in front of my house though lets talk about that
F2	TheAcecapade (Oct 30 13:29): #sandyabc7 why isn't anyone covering the Rockaway Peninsula? My neighborhood and hometown is in ruins.
F3	Nakia_ (Oct 30 22:21): @andersoncooper @CNN when will you guys venture to Far Rockaway and show the damage? We have homes and loved ones we can't check on
F4	DariusWears (Nov 04 22:15): @STARANDBUCWILD please a few words on your show. People are suffering in far rockaway. The media has refuse to speak on it. No power, lootin

Table 5: Tweets that reflect feelings of being forgotten by the media

Donna's distribution of reports that were not covered by mainstream media and Matt's sense of Far Rockaway being neglected by local government speak to feelings of being forgotten that were shared by 18 other local Twitterers (Figure 7, Tables 5, 6):

MattMinerXVX (Nov 03 18:40): Angry groups of people walking by our house yelling because no power, no sign of @LIPAnews in Far Rockaway.

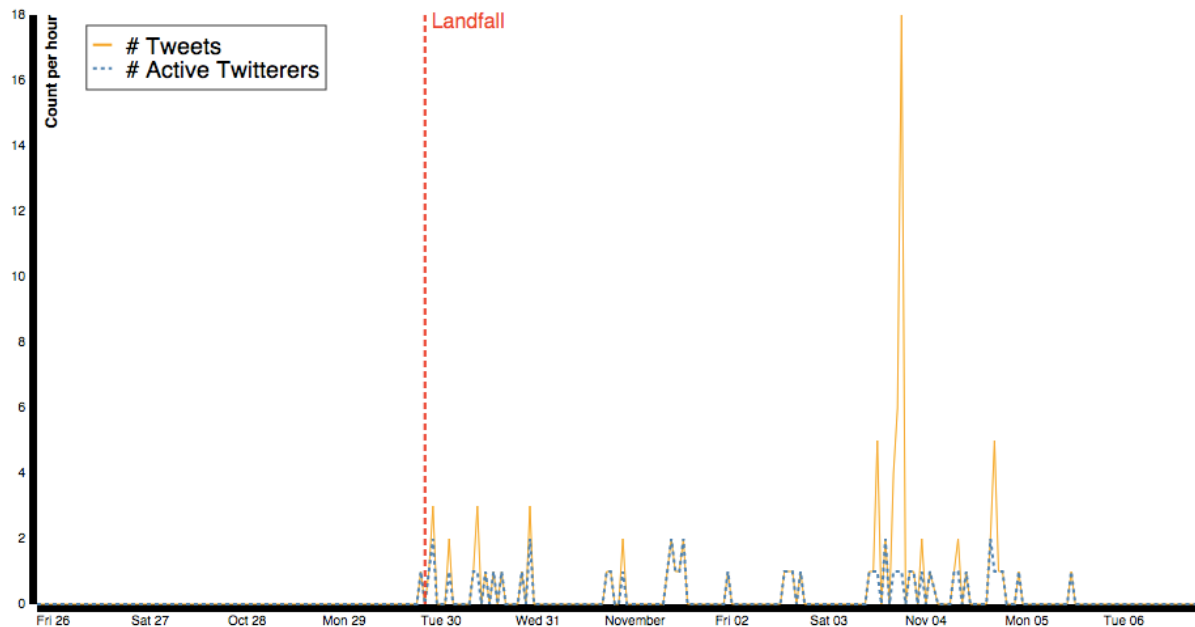


Figure 7: Twitterers and counts per hour for tweets expressing this sentiment of frustration, feeling forgotten, and seeking media and government attention in the week after Sandy's landfall.

Ref. No.	Tweet Details
F6	BrattyTart (Oct 29 22:05): It kills me that the mayor and the news people care more about updating about subway than truly flooded area . Pple need help assholes
F7	youadore_Leesh (Nov 01 09:47): RT @T2flyy2btouched: Nah they really doing FarRock dirty. The national guard is all up & down Howard Beach. No aid in the Rockaways. ...
F8	WildsByBirth (Nov 04 16:21): Bloomberg for all your banter about LIPA not doing they're job getting power back to The Rockaways... Your not doing any good by isolating

Table 6: Tweets that reflect feelings of frustration and being forgotten by the media, city & relief efforts

In this context of feeling ignored by the city, Far Rockaway residents on Twitter chose to address the mayor, the President, and other politicians on Twitter directly to plead for help. Reflecting these feelings, a local government representative, Assemblyman Phil Goldfeder, repeatedly tweeted that the Far Rockaway response was poorly handled and residents could not rely on the city for much-needed help:

YPGoldfeder (Nov 01 11:25): RT @alexaaltman: .@YPGoldfeder says lack of city & state resources sent to Queens neighborhoods affected by #Sandy is "downright shocking." @queenscourier

YPGoldfeder (Nov 02 18:22): @claretrap it's amazing what we have done with only volunteers and donations...if we would have waited for the city we would be starving!

YPGoldfeder (Nov 04 15:55): First sighting of a @RedCross truck in Rockaway about 3pm...6 days in to disaster! #relief #finally

Long Paper – Social Media Studies

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Tapia, Antunes, Bañuls, Moore and Porto de Albuquerque, eds.

POSITIVE COPING

Despite feelings of frustration and abandonment by official channels, one of the most prominent emotions we observe in this population is *positive coping*, in the form of expressions of gratitude, concerns for others, prayers, and “shout outs.” Many residents pray for friends and neighbors, offer blessings, and check on each other’s status:

dstdonna88 (Nov 01 10:01): *Checking on my Rockaway peeps! Y'all surviving? Sending you strength and love. We WILL bounce back.*

youadore_Leesh (Nov 01 12:33): *@hiiimchowder_SB ☐condolences . Prayers go out to you*

Many instances of positive coping reflect people’s gratitude, especially towards their family and friends:

FB: DJ2020 (Nov 03 12:55): *Family is beautiful, I appreciate my new found family right now, right now my new sis Annette Castillo has everybody here over 20 PPL including mine and that makes me say God Is Great...*

TheAcecapade (Nov 05 18:02): *Sooooooooo, these friends I have are too much. First day back, and I'm speechless.*

Twitterers also expressed gratitude towards first responders, government agencies, and volunteers, although less frequently (probably due to what they perceived as the insufficient nature of the response):

narontillmanSPC (Nov 03 18:28): *#God bless @carllentzNYC @JohnTermini and @hillsongNYC for coming to meet me in my hood #farrockaway to help my people who have nothing*

precious2005143 (Nov 04 20:54): *@fema Thank you for bring me an my family supplies we really appreciate it still have no power #FarRockaway*

Another example of positive coping is that many of the residents who evacuated discussed staying with family and friends and relying on extensive family networks:

Saint_TueCynn (Nov 02 13:57): *at mah Aunt Tue-Sweet house.... deff puttin dhat good ol' Frankenstorm Updates up as i make'em but i gotta catch... <http://t.co/ptuplUQt>*

Reliance on extended family and other existing social networks often reflects the neighborly attitude among these Twitterers. They talk about their neighborhood as the place where people know each other and care for one another, beyond immediate family:

BrattyTart (Oct 30 08:51): *@ItsEasyforMe great news! I knew they were ok, Rockaway takes care of their own. #rockstrong*

infinitewords14 (Nov 02 10:26): *Proud to be part of a neighborhood that is helping each other & has made inroads to help folks back a'yard in Jamaica & Haiti. #Sandy*

This is also reflected in the residents’ willingness to help each other and volunteer for their neighborhood:

mattgunn (Nov 02 12:52): *Planning to go back home to Rockaway Beach tomorrow with food, water, blankets and whatever we can give to our affected neighbors.*

TheAcecapade (Oct 31 17:05): *@_gerardine It's my home. I've already been helping my neighbors out, cooking and stuff. I wouldn't mind if I didn't have class.*

This community orientation generates pride among the residents. For example, several Twitterers wanted to document their community experience of overcoming the difficulties of Sandy by creating music, documentaries, and even a comic book:

IamSoFarRock (Oct 28 14:14): *Imma shoot a movie bout Wat happen to far rock*

The pride that the residents feel about their neighborhood is often linked with a sense of resilience of the neighborhood and hopeful attitude towards the future:

KanarPaparazi (Nov 03 13:03): *#farrockaway were we survive the struggle, legend are born & dreams are made. #proud to wear this. <link to instagram picture showing "Far Rockaway" tattooed on the author's back>*

FB: dstdonna88 (Oct 31 22:30): *Despite the devastation, the people of Rockaway remain hopeful as the recovery begins.*

CONCLUSION

Previous studies show that Twitter can contribute to situational awareness in disaster (Vieweg, Hughes, Starbird, and Palen, 2010). Here we further explored what types of information Twitterers seek and share during a far-reaching disaster that affected many publics, with a focus on themes related to larger protective decision-making literature.

In this paper we have used tweets from people connected with Far Rockaway, specifically those identified as local residents, to reveal the nature of experiences, attitudes, and actions taken before, during, and after a hurricane in a neighborhood that is vulnerable to such hazards and not always well-represented in the public sphere. We explored reasons it can be difficult to evacuate and ways in which prior experience can influence risk perceptions and protective decision-making.

In these data, we find feelings of frustration and anger are directed at those who have a responsibility to represent and provide services for a region. We also observe that positive sentiments of gratitude and desire to help the neighborhood are prevalent in the study population. These positive emotions are often associated with the values of community and resilience (Goldstein, 2012). To this point, we observe that the Far Rockaway community is supported by grassroots organizations, such as Rockaway Wildfire (rockawaywildfire.org) and the Far Rockaway Youth Task Force (<http://rytf.org/>), which emerged in the months after the storm to foster discussion around rebuilding and development.

Environmental risk is unevenly distributed, and already economically disadvantaged groups often bear the brunt of hazards, geographically and socially (Lee, 2002; Cutter, 2012). Social media representation, when it can be found, palpably draws attention to the risks people face through *in situ* accounts of their experiences. Our work provides insight into these issues so that additional development of social computing solutions can give voice to all those affected by future events.

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REFERENCES

1. Blake, E. S., Kimberlain, T. B., Berg, R. J., Cangialosi, J. P., and Beven II, J. L. (2013) Tropical Cyclone Report: Hurricane Sandy, National Hurricane Center, 12.
2. Cutter, S. L. (2012) Hazards vulnerability and environmental justice, Routledge.
3. de Sherbinin, A., and Bardy, G. (in press) Social vulnerability to floods in two coastal megacities: New York City and Mumbai, Vienna Demographic Yearbook.
4. Demuth, J.L., Morss, R.E., Morrow, B.H., and Lazo, J.K. (2012) Creation and Communication of Hurricane Risk Information, Bulletin of the American Meteorology Society, 93, 1133–1145.
5. FEMA (July 1, 2013) Hurricane Sandy FEMA After Action Report, http://www.fema.gov/media-library-data/20130726-1923-25045-7442/sandy_fema_aar.pdf
6. Geertz, C. (1973) Thick Description: Toward an Interpretive Theory of Culture, In *The Interpretation of Cultures: Selected Essays*, New York: Basic Books, 3-30.
7. Goldstein, B. E. (Ed.) (2012) Collaborative Resilience: Moving through Crisis to Opportunity, MIT Press.
8. Kogan, M., Palen, L., and Anderson, K. M. (2015) Think Local, Retweet Global: Retweeting by the Geographically-Vulnerable during Hurricane Sandy, Proceedings of CSCW '15, 981-993.
9. Lazrus, H., Morrow, B.H., Morss, R.E., Lazo, J.K. (2012) Vulnerability beyond Stereotypes: Context and Agency in Hurricane Risk Communication. *Weather, Climate, and Society*, 4, 103–109.
10. Lee, C. (2002) Environmental justice: building a unified vision of health and the environment, *Environmental Health Perspectives* 110(2), 141–144.

11. Lindell, M. K. and Perry, R. W. (2012) The protective action decision model: theoretical modifications and additional evidence, *Risk Analysis*, 32(4), 616-32.
12. Morss, R. E., Demuth, J. L., Lazo, J. K., Dickinson, K., Lazrus, H., and Morrow, B. H. (2015) Understanding public hurricane evacuation decisions and responses to forecast and warning messages, submitted to *Weather and Forecasting*.
13. Morss, R.E. and Hayden M.H. (2010) Storm surge and “certain death”: interviews with Texas coastal residents following Hurricane Ike, *Weather, Climate, and Society*, 2(3), 174–189.
14. New York City Government. (2012) Mayor Bloomberg Issues Order for Mandatory Evacuation of Low-Lying Areas as Hurricane Sandy Approaches, *News from the Blue Room: Press Release 377-12*.
15. Irvine, L. (2009) *Filling the ark: Animal welfare in disasters (Animals and Ethics)*, Temple University Press: Philadelphia, PA, USA.
16. Shelton, T., Poorthuis, A., Graham, M., and Zook, M. (2014) Mapping the data shadows of Hurricane Sandy: Uncovering the sociospatial dimensions of ‘big data’. *Geoforum* 52: 167-179.
17. Slovic, P. (2010) *The feeling of risk: New perspectives on risk perception*, Routledge.
18. Vieweg, S., Hughes, A.L., Starbird, K., and Palen, K. (2010) Microblogging During Two Natural Hazards Events : What Twitter May Contribute to Situational Awareness, *Proceedings of CHI '10*, 1079-1088.
19. White, J., Palen, L. (2015) Expertise in the Wired Wild West, *Proceedings of CSCW '15*, 662-675.
20. U.S. Census (2010) U.S. Census Bureau 2010, <http://www.census.gov/2010census/>
21. Yonetani, M. and Morris, T. (2013) *Global Estimates 2012: people displaced by disasters*, IDMC.