

# Bridging Local and Global – Exploring the Use of Social Media in Climate Change Reporting among Local News Outlets

Kanni Huang

Shanghai JiaoTong University ~ kannihuang@sjtu.edu.cn

Dave Poulson

The Knight Center for Environmental Journalism, Michigan State University ~ poulson@msu.edu

## Abstract

In a democratic society, news media should deliberately cover diverse ideas and opinions from different people. However, scholars have found that local, environmental reporters favor citing government and industry sources over environmental activists and local residents. This dominance of official sources is observed in climate change news reporting. Today, social media has been adopted in newsrooms as a reporting tool. Some argue that the hierarchy of sources is replicated in the adoption of social media. Others claim that social media seems to turn the hierarchy of sources upside down, giving more control to everyday citizens than to official sources.

This paper identifies local journalists who use social media. Local reporters in the Great Lakes Region were invited to participate in a survey research in 2011. The survey results show that frequent climate change reporters and those who value the public's interests (the mobilizers) are more likely to source social media. Based on the survey results, a content analysis was conducted to collect climate change stories from 2011 to 2012 through RSS feeds. The pilot survey and content analysis provide a comprehensive view that local climate change reporters may use social media in news discovery stage, but do not directly cite them in the news. The use of social media may encourage local reporting on distant and global events, but the increases of source diversity have not been found through sourcing social media.

## Introduction

Climate change is a human-caused global phenomenon that has been recognized among the majority of atmospheric scientists as early as the 1970s (Agrawala, 1998a, 1998b). More recently, the Intergovernmental Panel on Climate Change (IPCC) concluded that "most of the observed increase in globally averaged temperatures since the mid-20<sup>th</sup> century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations" (Change, 2007, p. 8).

In the light of the anthropogenic climate change and its considerable impacts on the planet, human actions to mitigate or adapt to climate change are important. News media can facilitate public awareness and provide communication channels for diverse voices, and using non-elites as sources can help achieve these goals. In a recent study, Boukes and his colleagues (Boukes, Boomgaarden, Moorman, & de Vreese, 2014) demonstrated that people's attitudes towards a public policy are more likely to be swayed by a human touch of the issue in the news. For local concerns about the impacts of potential climate change, news media can be served as a public space for citizens and advocacy groups to deliver their concerns. As Shudson (1982) suggests, news media should provide a forum for dialogue among citizens, and is thus an ideal arena for citizen engagement in public affairs.

Although non-elite sources have the potential to facilitate public awareness and contribute to deliberations about climate change policies, news media have been found to favor elite sources over non-elite ones. The majority of previous research suggests that elite sources, including government representatives, politicians and experts, dominate climate change news (Dotson, Jacobson, Kaid, & Carlton, 2012; Kuban, , 2007; Lacy & Coulson, 2000; Takahashi, Huang, Fico, & Poulson, 2014). The predominance of elite sources in climate change reporting is consistent with the elite theory, which predicts that social elites are more likely to be presented in news stories than non-elite sources (Berkowitz & Beach, 1993; Brown, BybeeT, Wearden, & Straughan, 1987; Sigal, 1973).

With the emergence of user-generated content contributed by the technologies of Web 2.0, social media are expected to expand the range of news sources (Hermida, Lewis, & Zamith, 2014). Twitter, for example, has been adopted in newsrooms as a reporting tool (Broersma & Graham, 2012). Previous studies showed how social media can be used to increase the use of non-elite sources. Some argue that the hierarchy of sources is replicated in the adoption of social media (Knight,

2011, September, 2012; Van Leuven, Deprez, & Raeymaeckers, 2014b). Others claim that social media seems to turn the hierarchy of sources upside down, giving more control to everyday citizens than to elite sources (Broersma & Graham, 2012; Hermida et al., 2014; Paulussen & Harder, 2014).

This study aims at exploring whether or not social media have been adopted by newsrooms for climate change reporting, what factors predicting the changes of source use, and what changes can be observed by adopting social media as source. To answer the above questions, a self-report survey research was conducted to explain why some local climate change reporters are more likely to adopt social media as source than others. Following the survey study, a content analysis was done on climate change stories published in the same region in order to examine the extent to which social media were actually cited in the news and how they were cited regarding the use of grassroots voice as source. The findings suggest both promising and pessimistic views of using social media to facilitate public engagement. For promising aspect, social media are not shun by local reporters, and they are used to follow distant source for the global issue. On the pessimistic view, social media are hardly cited in climate change stories. If they are used, they are usually the results of journalists' imitation behavior that leads to monitor other journalists' work. The use of social media does not increase non-elites' chance to have public conversation in the news.

## Literature Review

### Source Diversity

Sources quoted in news stories should represent a wide range of ideas and opinions. The requirement of source diversity is based on the fundamental democratic assumption that popular wisdom is derived from a great variety of ideas and opinions that can be accessed freely by informed citizens (Donohue & Glasser, 1978). In a democratic society, mass media, especially news media, should carry diverse ideas and opinions from different types of people for deliberative purposes. Voakes and his colleagues define source diversity as "a dispersion of affiliations and status positions of sources used to create a news product" (Voakes, Kapfer, Kurpius, & Chern, 1996, pp. 583-584). The more evenly the dispersion of different types of sources in a news medium, the greater the diversity (Voakes et al., 1996).

The official sources, including the government, politicians, businesses, interest groups, other organizations and public figures, dominate in news stories as the primary sources (Kwenda, 2013; Lacy & Matustik, 1984). These official sources, who represent a narrow range of American society, dominate at least one-half to three-quarters of stories (Han, Shoemaker, Jong Hyuk, Xiuli, & Di, 2010; Sigal, 1973). These official sources are usually the top executives in the organizations, so the voice of lower level employees are excluded as sources (Berkowitz & Beach, 1993; Brown et al., 1987). This pattern was found across different types of news organizations (Brown et al., 1987), different news contexts<sup>1</sup> (Han et al., 2010; Jha, 2007), across different countries (Han et al., 2010), and even when journalists cited oppositional views, they were quoted from official sources (Hansen, 1991).

Several factors have been attributed to the prevalence of official sources in news stories. First, Journalists' daily routine acquires immediate and well-produced material to be published, and official sources guarantee acceptable ideas (Bennett, 1990; Lacy & Matustik, 1984). Only if journalists have experience or are able to spend more time on a certain topics do they seek more unofficial sources (Lacy & Matustik, 1984). Second, the gatekeeping theory claims reporters' power over news content (Shoemaker & Vos, 1996). Journalists or editors are empowered to select sources by seeking the fit to their desired frames (Ericson, Baranek, & Chan, 1989).

### **Source Diversity in Climate Change News**

Climate change stories can be framed in several different ways, such as the debate between scientific consensus and skeptics, consequences of climate change and policies to mitigate or adapt to climate change (Brossard, Shanahan, & McComas, 2004; Dirikx & Gelders, 2010; Gordon, Deines, & Havice, 2010; Nerlich, Forsyth, & Clarke, 2012; Zamith, Pinto, & Villar, 2013). An important public issue is able to "evolve" in the media through a long period of time. Trumbo (1996) studied news attention cycle and found that when news coverage about the issue shifted away from causes and consequences of climate change, scientists became less common sources. Similarly, Takahashi (2011) found that when the solutions of climate change became the most common frame in news coverage, government sources were cited more frequently in Peruvian media.

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<sup>1</sup> The crisis news, such as news coverage of the Virginia Tech shootings, was found to use more non-official than official news sources (Fontenot & Wigley, 2009).

This paper suggests that when climate change issue matures, the social elites, advocacy groups and citizens should be equal sources to speak in mass media. However, previous research has not found source diversity among national news media. Government sources are dominant in climate change stories (Dotson et al., 2012; Trumbo, 1996; Wilkins, 1993). Kuban (2007) found that among all non-scientific sources, the most frequently cited sources were political or governmental figures.

Even though climate change is an international-level phenomenon in nature, local media coverage on climate change plays an important role to promote public engagement. Public engagement with climate change relies on a strong sense of local environment and actions undertaken in a local context (Leiserowitz, 2005; Lorenzoni & Pidgeon, 2006; Segnit & Ereaut, 2007).

Different from the results of national news outlets, climate change news among local media has been found to adopt more scientific sources. In a study on local coverage of climate change in the Houston Chronicle, Liu and his colleagues (2008) found that climate change was frequently linked to climate science and scientific uncertainty problems. Academic sources were the most frequently cited sources in local stories (Liu et al., 2008). Takahashi and his colleagues (2014) also found that nearly one-third of stories published in the Great Lakes region cited scientists in climate change reporting.

In short, source diversity was rarely observed in climate change stories. The results are consistent with elite theory, which predicts social elites are more likely to be quoted in news media than non-elite sources.

### **Network Journalism**

Conventional media is usually controlled by owners, editors or journalistic gatekeepers who tend to reinforce existing power structures and the status quo by adopting more elite sources (Gavin, 2010). On the contrary, the Internet is a platform to equalize and democratize issues for disadvantaged and under-represented groups that challenge the hegemonic politics (Gavin, 2010).

With the emergence of user-generated content, the term, network journalism, is created to refer to a transformation of journalism that opens up journalist-source relationship from a more closed social circle into a more diverse and decentralized social network (Heinrich, 2012; Van Leuven, Deprez, & Raeymaeckers, 2014a). Using social media as sources has potential to create a more

diverse source network. In other words, the audience's contribution enlarges the range of sources available to journalists (Shoemaker & Vos, 2009).

Scholars found that journalists have adopted social media as a tool for newsgathering (Broersma & Graham, 2012; Paulussen & Harder, 2014). The use of social media as news sources has turned the social media as a beat (Broersma & Graham, 2012). Eyewitness accounts, photos, videos, weblogs and tweets have become sources used by journalists for breaking news events, political coverage or sensational news (Broersma & Graham, 2013; Hermida et al., 2014; Messner & DiStaso, 2008). In the climate change issue, bloggers are more active in climate change reporting than traditional media are (Pew Research Center [Pew], 2011). In a week when the long-term skeptic of climate change science, Richard Muller, stated his support on the scientific consensus, Muller's testimony "received virtually no coverage from the traditional press..., but...the subject has ranked among the top five" among bloggers (Pew, 2011).

Local climate change stories are in need of incorporating more non-elite voice, and the use of social media seems to give a hope for inviting more diverse source. However, there has been little examination of using social media in climate change context. Therefore, a research question is raised:

*RQ1: How often do local and frequent climate change reporters use social media as sources?*

### **Journalistic Values and Social Media Source**

User interaction and contribution on news websites challenged journalists' values of their traditional roles. Traditionally, journalists serve themselves as gatekeepers whose role is to control the quality of news products by verifying information and its sources (Singer, 2010; Zelizer, 1993). The selection or omission of a source is a gate in news-making processes (Shoemaker, Eichholz, Kim, & Wrigley, 2001). The traditional gatekeepers tend to rely on elite sources to shape the news (Shoemaker et al., 2001). Even though the emergence of new technologies encourages passive readers to turn into active participants as news producers, research found that journalists keep playing as gatekeepers in information gathering, selection and verification (Singer et al., 2011).

Local journalists have been aware of the needs and pressure to open their products to more voices from the crowd (Lowrey, 2006; Robinson, 2007). However, they have been found to struggle in finding adequacies of citing user-generated sources because they keep their commitments to

traditional news values (Singer, 2010). Quoting tweets without contacting the source to verify the information is considered as “sloppy journalism” (Broersma, 2013; Hermida, 2012). Reporters should investigate and question sources rather than copy and paste sources’ quotes from social media (Broersma & Graham, 2013). Research found that reporters working for quality newspapers are more reluctant to adopt social media as sources because they value traditional norms of gatekeeping to maintain their authority (Lasorsa, 2012).

Journalists working for online news sites have different norms. They are under the pressure from economic demands that require faster, closer to the public and more audience-driven newsroom values (Møller Hartley, 2013). The “new” journalistic values of online journalism are contradicted from the more traditional news values, which emphasize in-depth, investigative and time-consuming news production processes (Møller Hartley, 2013). Instead of being authoritarian gatekeepers, digitally native newsrooms are more willing to invite the readers to participate news-making processes and experiment with new technologies (De Keyser & Raeymaeckers, 2012; Nee, 2013). Empirical research showed that newspapers with a longer history of online content are more likely to adopt user-generated content (Nah, Yamamoto, Chung, & Zuercher, 2015). At the individual level, editors who have more online experience tend to value public participation in news-making processes and thus use more user-generated news stories (Nah et al., 2015).

According to literature review, local journalists who value public engagement and have been working for online newsrooms are more likely to use social media as source. Therefore, this study proposes two hypotheses:

*H1: Local journalists who value their role as serving the public’s interests are more likely to use social media as source in climate change reporting.*

*H2: Regional journalists who work for online news are more likely to use social media as news source in climate change reporting.*

## Study 1: The Pilot Study

To explore the potential of using social media as source in climate change reporting, 295 journalists in the Great Lakes region<sup>2</sup> were invited to participate in the pilot study. A web survey was completed by 117 journalists.

### Sample

From April to May 2011, we administered a web-based survey to people working closely with the environmental news industry, including reporters, writers, editors, directors, hosts, meteorologists, producers, students, and teachers/professors in the Great Lakes region. Since there is no master list of environmental news workers in the Great Lakes region, we used multiple steps to create the sampling frame. First, we requested a list of current members from Society of Environmental Journalists (SEJ), and selected participants who resided in the Great Lakes region ( $n=198$ ). Second, we recruited reporters ( $n=72$ ) who had reported on environmental related topics. Respondents were invited if their news stories were posted by three online environmental news aggregators in the Great Lakes region during January to February 2011: *Great Lakes Echo*, *Midwest Energy News*, and *The Great Lakes Information Network*. Third, we gathered a list of reporters ( $n=26$ ) who reported on Agricultural topics in magazines in the Great Lakes region. Finally, to recruit as many environmental reporters as possible, we also asked respondents to recommend people they knew who had reported on environmental topics in the Great Lakes region. The snowball method found seven additional reporters. Overall, the number of our survey sample with valid email addresses was 295. Of the 295 people, 94 completed the survey – a response rate of 31.86 percent.

The link to the survey was also announced to all Society of Environmental Journalists members, subscribers to the *Knightline* online listserv based in a Midwestern University, and news readers on *Great Lakes Echo*, an online environmental news service that reports on the Great Lakes region. The open announcement of the survey link produced another 23 responses who recognized

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<sup>2</sup>Among all geographical regions in the North America, the Great Lakes region contains eight states in the U.S. (Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin) and two provinces (Ontario and Quebec) in Canada, and about one-third of the North America population live in this region. The Great Lakes region is also highly associated with the global climate change. The water circulation, water temperatures, and ice cover in Great Lakes region would be associated and inter-dependent with global climate change (Ohio Sea Grant, 2009).

themselves as journalists in the Great Lakes region. The total number of participants in the survey is 117.

## Measurement

**Experiences in climate change reporting.** All respondents were asked whether they had reported on climate change or related topics. For those who answered "Yes" ( $N = 96$ ), they were further asked how many years they have reported on climate change ( $M = 7.48$ ,  $SD = 7.06$ )

**Frequency of climate change reporting.** Respondents were asked how often they reported on climate change (1=Less than once a year; 2=1-3 times a year; 3=4-6 times a year; 4=7-11 times a year; 5>About once a month; 6=1-3 times a month; 7=3 times a month or more). Responses were recoded into a dichotomous variable by setting "1-3 times a year" as the cut point. Reporters who reported on climate change three times or less were less frequent reporters (54.7%), while those who reported four times or more a year were more frequent reporters (45.3%).

**Using social media as source.** Respondents were asked to indicate how much they used social media as source for climate change information on a 5-point scale (1 = never; 5 = always;  $M = 2.17$ ;  $SD = 1.11$ ). Responses were recoded into a dichotomous variable (0= Less frequent or non-users; 1= Frequent social media users).

**Journalistic value of public interests.** The measurement of journalistic value adopted Weaver and Wilhoit's (1993) scale measuring perceived roles of professional and citizen journalists. Respondents were asked to rate on a 7-point scale from 1= not important at all to 7= very important for a total of 11 items. For this study's purpose, the "mobilizer" role was used to measure the extent to which journalists value the public interests ( $M = 4.34$ ;  $SD = 1.15$ ;  $\alpha = .60$ ).

**Online news experience.** Respondents were asked with which medium (media) they work. They were asked to select one or more options among newspaper, television, radio, online news site, news blog, magazine and other media. Answers were recoded into a categorical variable (0=Not working for online news; 1=Working for both online and offline platforms; 2=Working only for online platform).

**Demographics.** Several demographic variables were included in study 1. Age was measured by asking respondents to provide their age on 2011 ( $M = 44.43$ ,  $SD = 13.83$ ). Gender was a single

item, asking respondents whether they were male or female (1=female, 0=male). The number of female respondents (49.0%) was nearly equaled to the number of male respondents (51%). Finally, they were asked to identify their racial category. About 88.5% of the respondents were Caucasians, 6.3% were Asians, and 2.1% were Black.

## Results

### Climate change reporting and social media as source.

RQ1 asked whether or not frequent climate change reporters ever used social media as source. The cross table (Table 1) showed a tendency of using more social media among frequent reporters in the Great Lakes region. About one-fourth of frequent reporters often or always use social media as their source for climate change issue. However, there was no statistically significant difference between the two groups of reporters ( $\chi^2=.207$ ,  $df=4$ ).

**Table 1. Frequency of using social media as climate change source. (%)**

	Frequency of social media use				
	Never	Rarely	Sometimes	Often	Always
Less frequent reporters ( $n=52$ )	34.6	32.7	23.1	9.6	0.0
More frequent reporters ( $n=44$ )	36.4	27.3	11.4	22.7	2.3

### Hypotheses test.

To further explore what types of climate change reporters are more likely to use social media as source, a two-predictor logistic model was fitted to the data. An improvement over the null model was examined by using the likelihood ratio test. The test yielded the conclusion that journalists' mobilizer scores and their experience working for online platforms were jointly more effective than the null model ( $\chi^2 = 141.360$ ,  $p < .05$ ). The non-significant chi-square test indicated the fit of data with the predicted linear model ( $\chi^2 = 6.081$ ,  $p = .638$ ).

The statistical significance of individual regression coefficients was tested using the Wald chi-square statistic. Table 2 shows that journalists' mobilize role and online experience were significant predictors of using social media as source. When journalists' mobilizer scores increased by 1 unit, the predicted odds of using social media increased by 1.52 times, holding consistently other variables. The odds of online-only reporters using social media in climate change stories were 4.13 times greater than those had no experience working for online platforms. The overall correction prediction was 62.2%. Hypotheses 1a and 1b were supported.

**Table 2. Logistic regression analysis of 96 climate change reporters' use of social media**

Predictor	$\beta$	$SE\beta$	Wald's $\chi^2$	$df$	$p$	$e^{\beta}$ (odds ratio)
Constant	-1.831	.849	4.647	1	.031	.160
Mobilizer	.418	.185	5.086	1	.024	1.519
Reporter Type (1 = Online & Offline)	.373	.425	.768	1	.381	1.452
(2 = Online only)	1.417	.686	4.271	1	.039	4.125
Test			$\chi^2$	$df$	$p$	
Overall model evaluation						
Likelihood ratio test			141.360	3	.015	
Hosmer & Lemeshow			6.081	8	.638	

*Note.* Cox & Snell  $R^2 = .090$ . Nagelkerke  $R^2 = .121$ . All statistics reported herein use 3 decimal places.

## Study 2

The pilot study suggested that frequent climate change reporters did use social media as source, and those who were lean to audience-drive news values and worked only for online news sites were more likely to adopt social media in climate change reporting. Still, it is unclear the extent to

which social media are quoted in the news and if the new technology has ever changed source diversity in climate change reporting. Therefore, study 2 aims at discovering the popularity of social media in local reporting, who use them, and how they change source diversity in climate change news.

### **Non-elite Source by Using Social Media**

The promising view on network journalism expects a greater variety of news sources, such as activists and citizens, being incorporated into the news production processes via social media (Broersma & Graham, 2013; Van Leuven et al., 2014a). These more diverse sources are normally not easy to find without the online tool for social networking (Broersma & Graham, 2012). Twitter, for example, can be used as a tool for journalists to crowdsource users who are able to provide information that fit into a news story (Broersma & Graham, 2012). Social media has been used as an important tool when journalists are in need of immediate information for breaking news, but they are restricted to access to the on-the-ground sources (Lotan, Graeff, Ananny, Gaffney, & Pearce, 2011). A content analysis research on Belgian news coverage of "Arab Spring" showed a sign of network journalism in quality newspaper and the public broadcast news, in which ordinary citizens were quoted prominently through social media (Van Leuven et al., 2014a). Similarly, another research on Belgian newspapers also indicated that the use of social media as news sources increased the diversity of voices by incorporating more ordinary citizens in the news (Paulussen & Harder, 2014).

A neutral view on network journalism suggests a more balanced use of sources from both social elites and from ordinary citizens through social media (Broersma & Graham, 2012, 2013). Journalists maintain their beats on social media with celebrities or politicians and report on their opinions or thoughts posted on Twitter when they are not available for interviews (Broersma & Graham, 2012). Also, journalists may quote posts by ordinary people who are not easy-to-access without the platforms of social media (Broersma & Graham, 2013).

The pessimistic view on network journalism suggests that politicians are those who actually benefit from the use of social media as news sources (Broersma & Graham, 2012). When journalists monitor their sources through their computer screens, they are passively receiving the one-way messages from politicians and selecting news by following other journalists' choices (Broersma & Graham, 2012). Scholars argue that politicians have more control of their own images through the

posts on social media. They know how to make their tweets newsworthy so as to set the news agenda, and use their tweets as definite answers to respond to journalists' inquiries. When selected, the same sources tend to be quoted repeatedly among different news outlets because journalists also monitor other journalists' sources and "recycle" them into different media (Messner & DiStaso, 2008). As a result, source diversity does not increase through the adoption of social media (Boczkowski, 2010)(Boczkowski, 2010).

Moreover, journalists were found to be reluctant to use quotes of ordinary people through social media, and it can be attributed to the gatekeeping process. (Haas, 2005; Van Leuven et al., 2014b). Compared to their news gathering routines which ensure credibility and reliability of sources (Gans, 1979; Shoemaker & Vos, 1996), journalists have confronted difficulties to verify the information gathered through social media (Hermida, 2010; Lariscy, Avery, Sweetser, & Howes, 2009; Paulussen & Ugille, 2008). Another barrier that hinders the use of social media for non-elite source is the information overload (Lariscy et al., 2009; Paulussen & Ugille, 2008). Following ordinary citizens on Twitter is time-consuming (Hermida, 2010). As a result, journalists tend to cite more social elites than non-elites through social media (Dylko, Beam, Landreville, & Geidner, 2012). A content analysis on ABC and Yahoo News showed that about two thirds of the cited tweets were from social elites (Landreville, White, & Allen, 2015). Similar findings were found in Belgian newspapers, in which Belgian journalists did not increase their use of ordinary citizens as sources when adopting social media in foreign news (Van Leuven et al., 2014b).

### **Non-Elite Source and Proximity**

The proximity of news outlets to the event location can determine types of news sources used in a news story (Berkowitz & Beach, 1993; Voakes et al., 1996). If news events occur farther away from the local media, the use of official sources will minimize the risks of information errors when journalists have little knowledge about the events. For those happened closer to the local media, journalists are able to cite more unaffiliated sources to incorporate community angles. Martin (1988) compared the variety of sources used among *New Albany Tribune*, *Courier-Journal* and *The Times*, and she found that *New Albany Tribune* carried a wider range of news sources than the other two media because the former outlet located closest to the event community.

The emergence of new technologies may help journalists to identify distant non-elite sources. A case study of a news story about a serial sexual offenses occurred in the UK and Australia revealed

that new technologies helped the investigative journalist identify victims across different countries (Gearing, 2014). Using ordinary citizens who reside in a foreign country in the crime coverage is impossible without the use of new technologies and network journalism (Gearing, 2014). This case study confirms that online social networks, which can be practiced by social media platforms, facilitate the coverage of long-distance story and expand the range of voices cited. Even though media outlets might not have correspondents in a remote area, they are able to access to information provided by non-elite sources through the use of social media (Broersma & Graham, 2013; Lotan et al., 2011). In another content analysis research on three mainstream news sites, Bruno (2011) found that the mainstream media relied on social media to report on a natural disaster when their teams had not been sent to the area.

According to the results of Study 1, reporters working for online news platforms were more likely to use social media in climate change stories. Thus hypothesis 2 is proposed to examine the relationship between types of platforms and the use of social media as source:

*H2: Climate change stories published in online-only news sties tend to use more social media as sources than daily newspaper sites do.*

By reviewing literature, there are unsettled debates about public participation in mass media due to the adoption of online user-generated content. A research question is raised to find out if non-elite source increases due to the use of social media:

*RQ2: When social media are used as source, are they more likely to be non-elite sources than elite sources?*

The literature review indicated the potential of using distant non-elite source by adopting social media. Research question 3 is thus asked to explore how social media may facilitate the use of non-elite sources even if they are farther away from the local media:

*RQ3: How are social media sources used in climate change reporting when they are distant from the local media? Are they more likely to be elite or non-elite sources?*

## Method

### Sample

Data of Study 2 were collected from the same Great Lakes region as those in Study 1. Online daily newspaper websites in the Great Lakes region and two online news aggregators, *Google News* and *Yahoo News*, were used to collect data during August 1<sup>st</sup>, 2011 to July 31<sup>st</sup>, 2012.

**Sampling daily newspaper sites.** First, a list of daily newspapers ( $N=501$ ) was made based on *Editor and Publisher International Yearbook 2010*. All daily newspapers published in eight Great Lakes states in the U.S. and two provinces in Canada are listed. Second, Geographic Information System (GIS) was applied to select dailies that are within the 150-mile border of the Great Lakes basin. A total of 404 dailies were identified. Third, one of the authors visited online websites of the selected 404 dailies, and subscribed to the RSS feeds on the websites. A total of 285 dailies (70.54%) provide RSS feeds services on the sites.

**Sampling online-only news sites.** *Google News* and *Yahoo News* were used to collect stories published in Great Lakes region. The geographical preferences were set up when we subscribed to their RSS feeds.

When all the subscriptions of RSS feeds were done, an online tool – Yahoo Pipes – was used to manage the 285 daily newspaper and the two news aggregator RSS feeds. On Yahoo Pipes, several keywords were set to find climate change stories: climate change, global warming, climate warming, warming climate, warming planet, climate records, carbon dioxide, CO<sub>2</sub> and greenhouse gas. Climate change stories collected from the two news aggregators were scanned to find those published by online-only news sites. The total number of stories incorporated in the dataset was 887 from daily newspaper sites and 150 from online-only sites<sup>3</sup>. Due to the unbalanced number of stories, 170 stories were randomly selected from the daily newspaper sites. The total number of stories in the sample were 320 stories.

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<sup>3</sup> The subscription of RSS feeds from the two online news aggregators generated many stories from daily newspapers, magazines, television network and radio stations. After excluding these stories from our sample, online-only news stories were mainly from five online-only sites: MinnPost, Great Lake Echo, Progress Illinois, enews Park Forest and RealClearPolitics.

## Measurement

**News Source.** At the operational level, a source is defined as a person cited as an information provider in stories. Documents, such as an article, report or a book, are not considered as sources in this study because they are not social actors that have more or less resources to be identified as elites or non-elites. However, if a source is an organization without offering any further information about a person, we treated it as a source by contacting with public relation professionals or the spokesperson, unless the story clearly indicates reasons for not providing a person's name. Therefore, when coders identify a source, a source should be mentioned with words that indicate a direct communication with reporters, such as "said," "affirmed," "told," or "according to."

When doing coding, coders identified each source in a story, and then immediately categorized each source into one of the twelve main groups and their subgroups. Table 3 shows types of sources in this paper.

**Table 3. Categories of news sources**

	Group Types	Subgroups
Elite	Think-Tanks	
	Scientific sources	
	Corporations and business	Managers or higher level News releases or PR representatives Trade Associations
	Media	
	Public officials or regulators	Elected Non-elected executives PR representatives
	Politicians	Former public officials or regulators Candidates of public elections
	Celebrities	
	International Units	Officials in the United Nations Officials in the World Bank Group Officials from other international political units
Non-elite	Individual	Citizens Protestors Small businesses (local retailers, farmers...)
	Environmental groups	
	Corporations and business	Staff Labor unions
	Non-environmental groups	
	Public officials and regulators	Non-elected staff
	Others	

**Elite and Non-elite Sources.** After the coding is done, each source was assigned to the dichotomous variable (1 = Elite; 0 = Non-elite) based on the classification presented in Table 3. Elite sources (77.7% in the sample) include experts, media, politicians, celebrities and people who have more power or resources in a private or public institution. Non-elite sources (22.3%) refer to lay people, advocacy groups, and staff in a private or public institution.

**Social media as source.** Sources that were quoted from social media, including Facebook, Twitter, YouTube, weblogs and any other social networking sites, were coded as a social media source (0=Not a social media source; 1=A social media source).

**Proximity.** The distance of the source was coded by identifying the location of where the source works for and where the story published. If the source located at the same state with the media outlet, it was coded as an in-state source (22.7%). If they were located at different states, the source was identified as an out-of-state source (58.1%). If they were in different countries, the source was coded as a foreign source (21.2%).

**Types of news media.** Sources were coded based on where they were published (0= Daily newspaper sites; 1= Online-only news sites). The daily newspaper sites contained 542 sources (55.8%), and the online-only sites had 430 sources (44.2%).

## Reliability and Analysis

An inter-coder reliability test was performed with three coders, using a 5 percent random sample selected from both daily newspaper and online-only sites. Following recommendations in Riffe, Lacy and Fico (2005), all study variables met the .8 Krippendorff's alpha criterion.

## Results

H2 tested if the use of social media as source depended on the types of media outlets. By counting all sources from selected stories, only 13 out of 950 sources were cited from social media. The result showed a low percentage (1.37%) of social media use in regional climate change reporting. To further observe who use social media, the data showed that both dailies and online-only sites cited social media as source (Table 4). When they were cited, almost all of them were distant and elite sources (Table 4). Among those elite sources, the majority of them were journalists' blogs. The only non-elite source cited through social media was the blog of an environmental group. Crowdsourcing through social media was not observed in climate change reporting.

The observed results did not suggest a promising view of using social media for distant non-elite sources, neither did they showed that the online-only sites would made a difference through social media.

**Table 4. The use of social media for types of source, media and source distance (N=950).**

	Social media		Not a social media		Total
	Elite	Non-elite	Elite	Non-elite	
Dailies	5	0	397	128	530
Online-only	7	1	329	83	420
In-state	1	0	142	54	197
National	9	0	422	121	552
Foreign	2	1	162	36	201
	12	1	726	211	Total

## Discussion

A host of studies has documented that elite source dominates climate change reporting, which may distance citizens from related issues and alienate them from taking immediate actions to minimize the impacts of the global phenomenon. Although the pilot study shows the potential that frequent climate change reporters may use social media as source, the content analysis indicates that very few stories actually cite social media in the news. Among those using social media as source, elite source is still the main source at journalists' best interests. Crowdsourcing is not found in climate change reporting through the use of social media.

Even so, data show some promising use of social media. First, the results indicate that those who value public interests or work for online news platforms tend to use more social media as source. This finding suggests the practice of network journalism is more likely to occur among those who are facing new challenges of faster and closer to the public newsroom values. Consistent with Nah and his colleagues' finding (2015), reporters working for digital platforms tend to value public participation in the production. The lack of social media source in the content analysis implies that reporters may be more likely to use social media in the news discovery stage rather than having them cited in stories. Future research should adopt a two-stage model of news formation to further examine if social media are used as news discovery tool or news gathering source. In fact, if social media are used as news discovery tool, they are more likely to lead journalists to a specific story frame.

Another promising view of using social media for climate change reporting is that social media can be used to incorporate distant source into local reporting. Among all staff-written stories, almost all but one social media sources are located in distant regions. In other words, local journalists tend to cite social media sources who are located farther away from their local outlets. When journalists cannot reach distant sources directly, they may use social media to follow their opinions. Although source diversity is not increased from distant social media source, it implies that regional journalists are more likely than ever to closely follow the global source and incorporate them in stories with local angles.

In spite of the promising findings, the results are consistent with the pessimistic view on network journalism suggesting that social elites are the real winners adopting social media. The results show more than half of the social media source come from other journalists' blog posts. As argued by Boczkowski (2010) that journalists tend to monitor other journalists through social media, and the imitation behavior leads them to use the same sets of elite sources and ultimately decreases source diversity. By citing other journalists' blog posts, the same sources are recycled among different local media. The elites' voices are doubled and amplified through following other journalists' tweets or blogs.

However, this study is not without limitations. Data collection through the RSS feeds limit the generalization of the results to newspapers or online-only news sites providing this service. For example, through subscribing the RSS feeds from *Google News* and *Yahoo News*, we only collected stories from five online-only sties. In fact, there are a lot of small-scale online-only sites in the Great Lakes regions. As for online daily sites, we also observed that how each news outlet select content in their RSS feeds is varied from providing headline news to the entire news sites. Therefore, for those who only provided partial news coverage in their RSS feeds, the number of climate change stories that were collected in our sample was very limited. In spite of the limitation, the results represent what news a reader is able to consume through RSS feeds subscription among various local news sites. Without using the RSS feeds, collecting data from such various local media will be almost impossible to achieve. Local newspapers incorporated in our sample have the circulation as small as of 2,393 (*Port Hope Evening Guide*) to as large as of 465,892 (*Chicago Tribune*), which can be hardly achieved by conventional sampling strategies, such as the Lexis-Nexis database.

To our knowledge, this study is the very first one to provide an overview of climate change journalists' use of social media through the lens of public engagement and deliberations. The findings add to existing literature to identify who use social media and how they are used in the context of climate change reporting. With the unsettled conclusions of how new technologies change the use of news sources, this study provides evidence that using social media in newsrooms may only occur in the early stage of news discovery, and conditioned by those who value public interests and have experience in online news sites. When social media are cited in climate change stories, they are distant and elite sources. It indicates that source diversity may stay the same with the use of social media, but local journalists have an alternative way to follow distant source through social media. A future research should focus on obstacles that prevent local journalists from citing distant and non-elite sources in climate change reporting. The ultimate goal is to facilitate mass media as a public sphere for more diverse voices to join the climate change conversation.

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