#geiger 2: Developing Guidelines for Radiation Measurements Sharing on Social Media

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ABSTRACT

Radiation measurements are key information in post-nuclear accident situations. Automated Twitter accounts have been used to share the readings, but often in an incomplete way from the perspective of data sharing and risk communication between citizen and radiation experts. In this paper, we investigate the requirements for radiation measurements completeness, by analyzing the perceived usefulness of several metadata items that may go along the measurement itself. We carried out a benchmark of existing uses, and conducted a survey with both experts and lay citizens. We thus produced a set of guidelines regarding the metadata that should be used, and the way to publish it.

Keywords

Twitter, nuclear post-accident, radiation, robots, syntax

INTRODUCTION

To understand and manage the consequences of a nuclear disaster, affected people need to know radiation levels. Indeed, as radiation cannot be perceived by the human senses, measurement is the only way to reveal the radioactive contamination of the environment. Further, radiation readings differ depending on natural environmental conditions. Producing and sharing radiation measurement readings are thus critical processes to assess the risk, and to decide which protective actions are required.

Since the Fukushima Daiichi nuclear disaster, social media have been used to publish radiation measurements online. These communication platforms can propagate appropriate risk communication between citizens and experts by swiftly providing multiple-points and real-time radiation measurements The completeness and the reliability of the shared measurements could be key factors of the resilience process in the contaminated areas. In this paper, we aim to provide a set of guidelines to support measurement completeness on Twitter.

RELATED WORKS

In the aftermath of the Fukushima Daiichi nuclear disaster, March 2011, citizens lacked valid information regarding the radiation measurements and the health risk (Plantin, 2011). The scarcity of official data triggered a loss of confidence in the Japanese government's management of the disaster (Li, Vishwanath, & Rao, 2014). Since then, Japanese citizens been using social media, especially Twitter and Facebook, to discuss with scientists and experts worldwide, and to share alternative information sources (Friedman, 2011). Several citizen projects have scraped and aggregated the rare existing data, but also produced original measurements through radiation sensors managed by citizens, leading to the creation of maps showing the environmental contamination (Plantin, 2011).

A nuclear accident is usually divided in two phases. During the first one, the emergency phase, the accident occurs, radioactive substances are released into the environment and responders act to stop these leakages. Then, after a few weeks or months, the post-nuclear-accident (PAN) phase begins, and may last for decades. During the PAN phase, people deal with all the difficulties of the long-term contamination (CODIRPA, 2012). The authorities expect people living in contaminated areas to be more and more involved in the management of their everyday exposure, in collecting information about the environment, foodstuff and body contamination (SAGE Project, 2005).

For this reason, Japanese citizens regularly use radiation measurement devices and some measurement groups have been created since the aftermath of the Fukushima Daiichi accident. For example, the Pokega community gathers the users of the Pocket Geiger. This is a small radiation detector created by scholars of the Tokyo University of Electro-Communication in the months following the accident, through a participatory design approach. Since then, users have been sharing and commenting measurements on the dedicated Facebook pages (Ishigaki, Matsumoto, Matsuno, & Tanaka, 2015).

As we pointed out in a previous work (Segault, Tajariol, & Roxin, 2015), there is another type of communication devices to get information about radiation. Automated programs, called robots or bots, regularly share on Twitter the measurements performed by connected radiation sensors. Outcomes have shown that most of these bots do not give complete details about the measurement setup, the type and the location of the measurement device. The lack of this “data about measurement data”, or metadata, hinders the possibility of measurements' reuse, such as maps showing aggregated data.

Furthermore, while the completeness of radiation measurements has been a main issue during all the most severe nuclear accidents (Three Mile Island, Chernobyl, Fukushima) (Friedman, 2011), only one set of guidelines has been proposed (Rubin, 1979) to fill the metadata gap : amount and unit, rate, time and duration, location, nature and type of radioactive materials, type of exposure, and X-Ray analogy. Nevertheless, this metadata is too technical to be used by non-expert citizens, and do not fit Twitter's traditional 140-characters limit.

OBJECTIVES OF THE STUDY

In this paper, we aim to provide a set of guidelines specifically targeting the completeness of the measurements shared through Twitter. We will particularly focus on which metadata items should be included to share useful and reusable information about radiation levels. We will also provide recommendations on how this information could be presented.

Most previous works on tweet syntax aimed to support the automated data extraction. For example, in the Tweak the Tweet syntax, a set of hashtags is provided to annotate citizens' tweet during a crisis in order to make it more easily parsable (Starbird & Stamberger, 2010). Micro Formats, relying on Semantic Web technologies, were also proposed as a way to improve tweets searchability (Shinavier, 2010).

In our proposal, the tweet syntax is not intended to improve machine readability, but to promote the completeness of information on radiation levels. We thus rely on a previous work combining a benchmark of existing systems, interviews with social media users and an online survey, to select the most suitable format for the messages of a bot (Comunello, Mulargia, Polidoro, Casarotti, & Lauciani, 2015).

METHODOLOGY

We have identified a set of active bots (N=44) following a method previously used (Segault et al., 2015), and we have firstly studied the metadata they provide.

Figure 1: Screenshot of the profile of one of the identified bots

We have compiled a list of 15 metadata (Table 1) by analyzing both the user profile and the tweets of each bot. We have counted the number of bots providing each of these metadata items. We have also indicated, for some of these metadata items, whether it was displayed in the tweets or in the profile.

Metadata	Tweet text	Description field	Location field
Date	40		
Location in full text	34	16	20
GPS coordinates	13	1	1
Description of the site	2	4	
Name of the measurement device	4	19	
Precision	15		
Maximum / minimum values during the measurement	5		
Duration of the measurement	29		
Qualitative assessment	1		
Frequency of the measurements		12	
Warning		6	
Other sensors	18		
Several location	3		
Geographical hashtags	3		
Non geographical hashtags	23		

Table 1. The metadata items found in the bots profiles and tweets

We have presented this list to a panel of radiation safety experts[1]. Thanks to their feedback, we have added a few new metadata types that the experts have considered useful, and we have also split the "date/time" metadata into two separated items. We have finally obtained a list of 18 metadata (Table 2).

1 Contre d'étude pour l'Évaluation de la Protection Nucléaire : http://www.cepn.asso.fr/

Date of the measurement	Comparison value (e.g. backgound level, readings before the accident)
Time of the measurement	Qualitative assessment (e.g. normal, high, below the average)
Name of the location of the measurement (e.g. city name, street name)	Measurement frequency (e.g. every two hours)
GPS coordinates of the location of the measurement	Warning (regarding the non-professional origin of the measurements)
Type of measurement (indoor or outdoor)	Other sensors (e.g. wind, temperature)
Description of the measurement site (e.g. second floor, behind a window, wooden walls)	Measurements at several locations (communicated at the same time)
Name of the measurement device	Place related hashtags (e.g. #geiger, #yokohama)
Precision of the measurement (e.g. +/- 2µSv/h)	Topical hashtags (e.g. #geiger, #genpatsu)
Duration of the measurement (e.g. mean over one hour)	
Min / max / peak value (during the measurement duration)	

Table 2. The final list used in the metadata evaluation

We have then evaluated the usefulness of identified metadata, through two online surveys.

First Survey

We have evaluated the perceived usefulness of the metadata by a panel of radiation safety experts (from CEPN, IRSN[2] and KIT[3]). The respondents could evaluate the usefulness of each metadata on a 5-point Likert-item scale, from “useless” to “indispensable”, and propose other metadata items. We have also asked the experts to evaluate their profile in terms of radiation safety expertise and social media usage.

The French version of the survey was answered by 15 experts, while the English version have only received one answer. Most respondents have been working in the radiation safety field for more than 10 years (75%). They do not widely use social media : Facebook is “frequently” used by 13% and “occasionally” by 44% of them; Twitter is “frequently” used by 6% and “occasionally” by 25% of this panel.

Second Survey

The aim of the second survey was to assess the preferences of the non-expert citizens interested in sharing radiation measurements online. The survey was issued to the members of the previously mentioned Pokega community, by publishing a small message and a link to the online survey on the English and Japanese websites and Facebook pages. We have asked the respondents to evaluate the usefulness of the same metadata and to suggest new metadata items. Then, we have also asked them whether 8 of the 18 metadata should be displayed in each tweet or only once in the bot profile. Finally, we have evaluated the respondent's previous knowledge and experiences regarding radiation measurements and social media.

The Japanese survey was filled by 40 persons and the English one by 4 persons. The respondents are mostly men (82%, *vs.* 7% women, 11% unknown), with an average age of 52 years (range from 37 to 69), mostly living in Japan but outside of the Fukushima Prefecture (89%). Their use of social media is quite important : 59% use Facebook several times a day (14% never use it), 39% use Twitter several times a day (27% never use it). They are also familiar with radiation measurements, as 93% own a measurement device (2% don't, 5% unknown). They use social media to look for radiation measurements (50% have already done it on Facebook, 39% on Twitter) and to publish measurements (27% on Facebook, 25% on Twitter).

RESULTS

We will now detail the outcomes of the two surveys, regarding both the usefulness of the metadata and the way it should be presented.

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2 Institut de Radioprotection et de Sûreté Nucléaire : http://www.irsn.fr/

3 Karlsruher Institut für Technologie : http://www.kit.edu/

Usefulness

We have assigned a score to the respondents' answers, from 0 (for useless) to 4 (indispensable). As the collected data are respondents' preferences, we have considered these self-reported data as continuous (Agresti & Finlay, 1997; Blunch, 2008; Sharma, 1995) and we have calculated average and standard deviation values for both experts' and citizens' perceived usefulness (Figure 2).

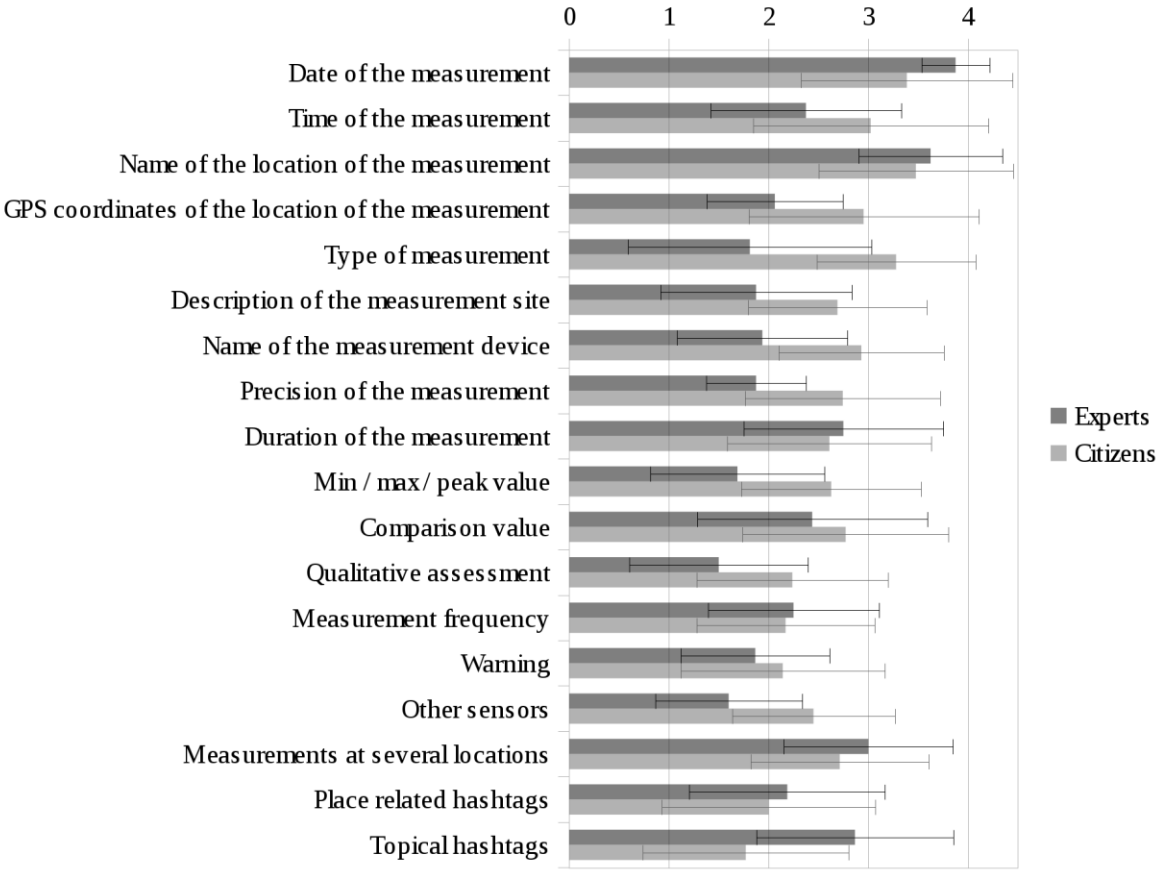

Figure 2. Perceived usefulness of metadata types

Two metadata items ("Date of the measurement" and "Name of the location of the measurement") have been perceived as highly useful by both experts and citizens, whereas the result is less obvious for the other ones.

We have plotted the comparison between the two groups' perceived usefulness (Figure 3). Through this graph, we have identified a set of metadata types having a high score in one group and an average score in the other group : "Time of the measurement", "GPS coordinates of the location of the measurement", "Type of measurement", "Name of the measurement device", "Duration of the measurement", "Comparison value" and "Measurements at several locations".

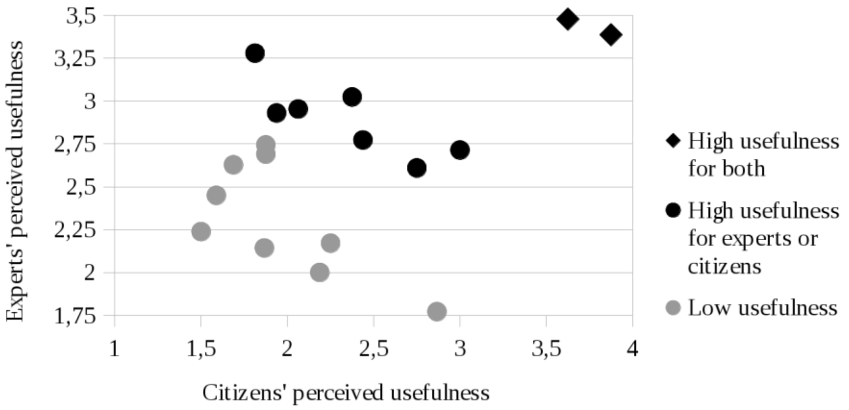

Figure 3. Comparison of perceived usefulness

Format

We will then focus on the format preferences reported by the respondent of the second survey, to determine whether 8 metadata items should be repeated in each tweet or simply displayed once, in the user profile (Figure 4).

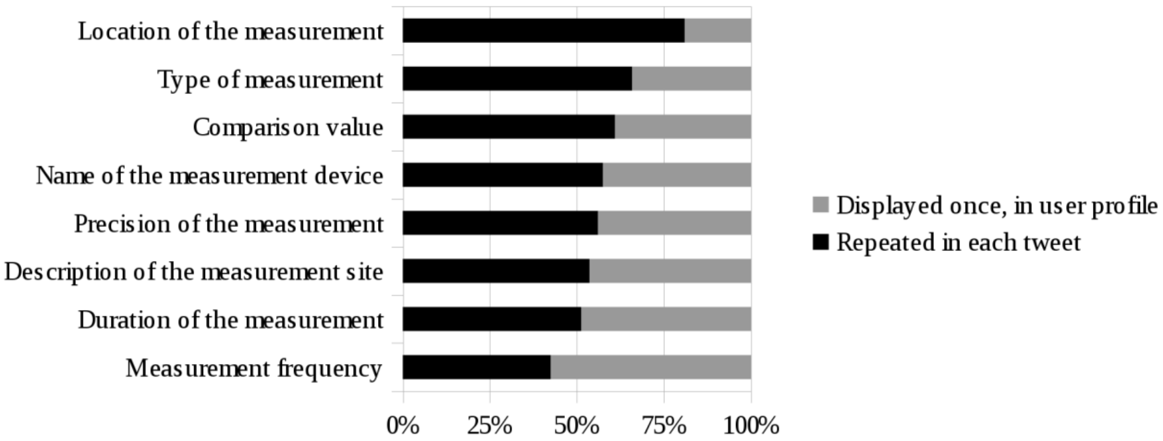

Figure 4: Format preferences by citizens

Outcomes show that there is strong consensus for the “Location of the measurement” metadata item to be repeated in each tweet. Concerning the other items, the result is more balanced and it cannot be taken as a strong preference.

GUIDELINES

On the basis of these results, we propose the following guidelines regarding the publication of radiation measurements on Twitter :

- two metadata items should be included: “Date of the measurement” and “Name of the location of the measurement”
- seven are highly recommended: “Time of the measurement”, “GPS coordinates of the location of the measurement”, “Type of measurement”, “Name of the measurement device”, “Duration of the measurement”, “Comparison value” and “Measurements at several locations”
- “Location of the measurements” should be repeated in each tweet, whereas the other metadata can either be repeated or displayed once in the user profile

We consider that the other metadata we have identified in this study can also be used. More completeness is always advisable, as long as it isn't at the expense of the most useful metadata items.

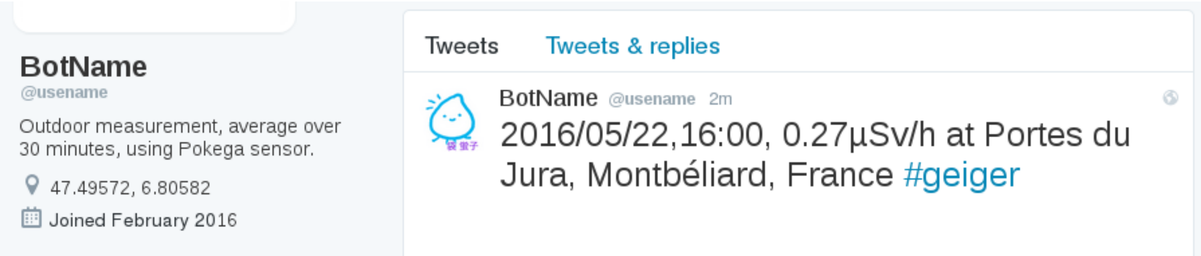

Figure 5: Mock-up of a bots tweeting according to these guidelines

In Figure 5, we show a profile and a tweet formatted according to the proposed guidelines. It features the two compulsory metadata items, “Date of the measurement” and “Name of the location of the measurement”, both in the tweet itself. It also includes five out of the seven recommended metadata items : “Time of the measurement” in the tweet, “Type of measurement”, “Duration of the measurement” and “Name of the measurement device” in the profile description, and “GPS coordinates of the location of the measurement” in the location field of the profile.

DISCUSSION

This study aimed to support the completeness of the radiation measurements shared through social media. We identified a set of robots spreading this kind of data on Twitter and analysed the associated metadata. We then collected both lay citizens' and radiation safety experts' opinions on the usefulness of each kind of metadata and their format. We consequently proposed guidelines regarding the required metadata, and a format to present this information.

These guidelines were designed to support the creation of new bots, publishing more complete radiation measurements. To achieve this goal, we need to raise awareness by communicating the guidelines to the bots creators. An interesting strategy would be to target the developers of measurement sharing tools, which are ready-to-use program that facilitate the creation of bots (Segault et al., 2015). Indeed, if one of these sharing tools followed our guidelines, it would improve the completeness of all the bots subsequently created with this tool (and perhaps, in some case, of those already using this tool).

These guidelines should not be considered as a strict framework, but rather as suggestions that can be adapted depending on the context : available data, expected public, national rules. Our outcomes must also be considered in regards of the low number of respondents. A larger test panel would also allow a more detailed analysis of the changes of perceived usefulness that may arise between different publics (in terms of age, technical knowledge, proximity to the disaster area).

Future work directions include the analysis of radiation measurements sharing on other social media platforms. We also plan to implement the resulting guidelines of this study in a demonstration program dedicated to the Pokega radiation sensor.

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