



Open Research Online

The Open University's repository of research publications and other research outputs

Analysing engagement towards the 2014 Earth Hour Campaign in Twitter

Conference or Workshop Item

How to cite:

Fernández, Miriam; Burel, Gregoire; Alani, Harith; Piccolo, Lara Schibelsky Godoy; Meili, Christoph and Hess, Raphael (2015). Analysing engagement towards the 2014 Earth Hour Campaign in Twitter. In: EnviroInfo & ICT4S 2015: Building the Knowledge Base for Environmental Action and Sustainability, 7-9 Sep 2015, Copenhagen, Denmark (Forthcoming).

For guidance on citations see [FAQs](#).

© 2015 The Authors

Version: Accepted Manuscript

Link(s) to article on publisher's website:
<http://enviroinfo2015.org/>

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online's data [policy](#) on reuse of materials please consult the policies page.

oro.open.ac.uk

Analysing engagement towards the 2014 Earth Hour Campaign in Twitter

Miriam Fernandez, Gregoire Burel, Harith Alani, Lara Schibelsky Godoy Piccolo
The Open University
UK
{m.fernandez, g.burel, h.alani, lara.piccolo}@open.ac.uk

Christoph Meili, Raphael Hess
World Wide Fund For Nature (WWF) Schweiz
Switzerland
{Christoph.Meili, Raphael.Hess}@wwf.ch

Abstract—*Earth Hour (EH) is a large-scale campaign launched by the World Wide Fund For Nature (WWF) every year to raise awareness about environmental issues. Although the EH campaign is active on social media, there is currently no systematic way of assessing its impact on public engagement and the topics they post about. In this paper we study engagement towards the 2014 EH campaign on Twitter. By analysing more than 35K tweets around the campaign we observed that longer posts, easier to read and with positive sentiment generated higher attention levels. Conversations were driven by the main themes of the campaign (super hero, the panda, etc.), but engagement towards these themes did not always translate in engagement towards environmental issues. Users decreased their engagement towards the topics of the campaign after it finished, but these topics still remained in their conversations one month later.*

Keywords—*Earth Hour, Social Media, Engagement Analysis*

I. INTRODUCTION

Social media is now commonly used to help communicate messages to the general public. Many organisations have staff dedicated to this task and to improve the connection of the key messages with the wider public through social media. The World Wide Fund For Nature (WWF), as an organisation, disseminates messages to the public, on climate change, energy consumption, impact of fossil fuel extraction, conservation of endangered species, and other relevant topics that aim to help stopping the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.¹

Every year since 2007, WWF organises the Earth Hour (EH)² campaign, a campaign that challenges the citizens to switch off all lights for one hour. This event has grown from a one-city initiative to a mass global event involving more than 162 countries and 7,000 cities and towns. Its goal is not mainly to reduce carbon emissions, but to increase awareness about environmental issues.

To engage users in this event, WWF also uses social media channels, and specifically Twitter. With over 288 million monthly active users and 500 million messages per day,³

Twitter has become a rich resource for organisations to communicate their messages and to engage with the public. The work of this paper aims to understand the type and level of engagement generated by the EH campaign via Twitter. Signs of engagement include tweeting, retweeting, and replying to tweets about EH.

Engagement dynamics, i.e., understanding how and why users engage with certain pieces of social media content and not others have been recently studied in the literature [2][6][7][4][8][9][12]. However, little research has been performed on systematically assessing the effect that social media campaigns have on public engagement. In the case of EH, several works in the literature have studied the characteristics of the campaign by analysing the messages from the official Twitter accounts [1], its symbolism [5] and the effect of the campaign on reduction of electrical usage [13]. But, to the best of our knowledge, no studies have attempted to assess the impact of the campaign on public engagement.

In this work our focus is to assess how the messages and themes around the EH campaign influence the public. For this purpose, we study how users respond to and spread the word, and how they engage with the core themes of the campaign, during and after the campaign. In performing this study we make the following contributions:

- We discover some of the key characteristics of the Twitter messages that gathered high attention levels during the EH14 campaign.
- We identify the key themes that emerged during the EH14 campaign and analyse the user adaptability of those themes on Twitter.
- We show that the durability of the impact of EH topics on Twitter content is short-lived for the majority of users.

The rest of the paper is structured as follows: Section II provides a summary of the related work. Section III explains the data collection process and the dataset gathered to conduct our analyses. Section IV and V and VI explain the performed engagement analysis. Sections VII and VIII discuss and conclude the paper.

¹ http://wwf.panda.org/wwf_quick_facts.cfm

² <http://www.earthhour.org/about-us>

³ <https://about.twitter.com/company>

II. STATE OF THE ART

Recent years have seen a large body of research on measuring and predicting engagement across social media platforms. Engagement has been measured in different forms (e.g., retweets, replies to comments, popularity of posts and answers) in search for a better understanding of engagement dynamics and the features that influence engagement. For retweets, which is the main indicator of engagement used in this paper, it was found that content features were more influential than social features for determining whether a tweet will be retweeted or not [2][6][7][12]. For example, the presence of URLs and hashtags in the tweets were often found to be good indicators of retweetability [8][12]. Some social features, such as number of followers, followees and account age were also found to have some impact, although less than content features [12].

The role of topics in attention generation has also been investigated. It has been found that people are less likely to retweet on topics that they themselves tweet about [7], and that tweets on topics of general interest are more likely to be retweeted [8].

While these works have focused on understanding the different factors that influence engagement dynamics in different social networking platforms, little research has focused on understanding engagement towards the campaigns launched by social movement organisations, and specifically those around climate change and sustainability issues.

In [1] Campbell provides a comparative study of three climate change campaigns' Twitter accounts. This study observes that EH builds anticipation and momentum for the annual culmination of the campaign and engage followers by sharing user-generated content such as photos. Kazakoza [5] also studies the EH campaign construction and its symbolism. In this study she highlights the different modes of communication used within the campaign including – persuasion, rhetoric, images, advertising, news stories and other modes of symbolic action. While these studies analyse the characteristics of the EH campaign and the mechanisms used to engage with the public, these works do not assess the effect of those mechanisms and their impact on public engagement.

In the household context, the following works studied engagement towards the EH campaign in terms of reduction levels in energy consumption [11][13]. While electricity reduction is a countable metric, it only helps assessing engagement towards the campaign in a short period of time. It is also difficult to assess whether the actual reduction in energy is produced as a consequence of the campaign or because of other external factors.

This study aims to complement the previous works by assessing the impact of the EH14 campaign in public engagement. With this purpose, we investigate the different factors that trigger or influence engagement actions towards the messages and topics of the campaign in Twitter and we assess the persistence of this engagement up to a month after the event.

III. SOCIAL MEDIA DATA COLLECTION

This section presents a brief overview of the data that has been collected around EH14 in Twitter and the architectural solution developed to collect this data. The collection process consists of two steps:

- Step 1: collect tweets on EH. This was done using the official Twitter data collection services (i.e., Twitter Streaming API). This data will be analysed to study direct online engagement with EH campaign.
- Step 2: To study the level and longevity of the infiltration of EH topics into users' messages on Twitter, we need to analyse their messages beyond EH. Hence in step 2 we collect all previous tweets posted by each user found in Step 1 (up to a the max of 3,200 tweets set by Twitter). Analysing this data will help us to better understand the evolution of topics for the users who were engaged with EH.

The architectural diagram of our data collection solution is shown in Figure 1. As we can see the collector extracts data for four main units of information and stores them in a database. These units include: posts, replies/retweets, tags and users.

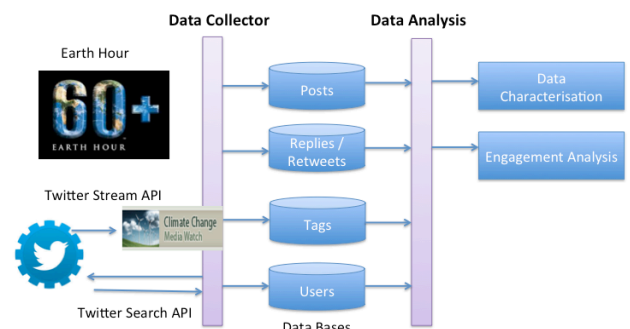


Figure 1: System Architecture

- Posts: information regarding the posts, including its own identifier, its author, its text, and the date it was created.
- Replies/Retweets: information about the messages that have been retweeted or replied. A message with a high number of replies and retweets indicates that the message is popular and is therefore engaging users in the conversation. These engagement indicators, in particular retweets, will be used later for the analysis presented in section IV.
- Tags: information about the set of hashtags mentioned in the tweets. Hashtags provide an indication of the topics that have been posted around the EH campaign.
- Users: information of those users who participated in the 2014 EH campaign in Twitter, including their geographical location, their profile description, the time since they joined the platform, etc.

The collected dataset contains more than 14 million posts produced by 6,195 users. Note that these posts contain data

around the 2014 EH campaign, as well as other topics of interests posted by the users over time. Within these posts we have 35,354 posts about the 2014 EH campaign which contain the keywords “earth hour” or “earthhour” or the hashtag “#earthhour”. Note that, for the analysis performed in sections IV and V we make use of the subset of 35K posts around EH, while we use the complete dataset for the analysis performed in section VI.

IV. ENGAGEMENT ANALYSIS

Once the data has been collected our goal is, first to characterise engagement towards the EH campaign in Twitter, and second, to study which factors influence engagement.

A. Indicators of Engagement

In the Twitter platform, retweeting, replying and favouring are actions that require an explicit interaction from a user towards another user. These actions have been repeatedly considered in the literature on social media [7][9][12] as engagement indicators. Note that, when retweeting, as opposed to when favouring or replying, users are spreading the word to their followers, which constitutes a stronger involvement and engagement with the issues posted around the EH campaign. In total, the posts generated around the EH campaign received 261,487 retweets. For an overview, the following table shows the top 5 retweeted posts.

Table 1: Top 5 retweeted posts around Earth Hour

Post	Retweets
RT @ArianaGrande: Joining the movement by going dark for #EarthHour on March 29 from 8:30-9:30 pm /hR0mUi5JT4 @World_Wildlife yo...	4901
RT @earthhour: Join the world for #EarthHour at 8:30PM local time wherever you are in the world. Use #YourPower at /HxefGDqjDL	2721
RT @earthhour: #EarthHour 2014 shows our world is full of Superheroes for the Planet. Join the movement at /HxefGDqjDL http://t...	2316
RT @earthhour: #EarthHour 2014, inspiring a new generation of Superheroes for the Planet. You can mobilise the Power of Youth at http://t.c...	1874
RT @Ennui_Raver: Gucci mane turn off youre blackberry torch. It earth hour. You piece of shit. Yuo fuckin piece of shit turn off your black...	1831

B. Characterising Users and Content

In this section we propose different features to characterise the EH14 messages (how they are written, when they are published, etc.) as well as the users who posted or engaged with those messages. Our goal, by using these features, is to identify the main characteristics of those users and posts generating higher levels of attention during the EH campaign in Twitter.

A large-body of literature already exists that have studied engagement dynamics in different platforms, proposing for this

purpose the use of different features [2][6][7][4][8][9][12]. In this work we have selected those features that are common across social media platforms [9]. These features are listed in Table 2.

Table 2: User and Content Features

User Features	
<i>In-degree</i>	Number of incoming connections to the user
<i>Out-degree</i>	Number of outgoing connections from the user
<i>Post Count</i>	Number of posts that the user has made over her account life in Twitter
<i>User Age</i>	Length of time that the user has been a member of Twitter
<i>Post Rate</i>	Number of posts made by the user per day
Content Features	
<i>Post length</i>	Number of terms in the post
<i>Complexity</i>	Concentration of language and its dispersion across different terms. This feature aims to study whether posts receiving high attention levels contain many terms which are not repeated often or rather repeat terms from a limited vocabulary. Specific details of this metric can be found in [9].
<i>Readability</i>	This feature gauges how hard the post is to parse by humans. To measure readability we use the Gunning Fox Index ⁴
<i>Referral Count</i>	Number of hyperlinks (URLs) present in the posts
<i>Mentions</i>	Number of mentions to other users within the posts
<i>Informativeness</i>	The novelty of the post’s terms with respect to the other posts. We derive this measure using the Term Frequency-Inverse Document Frequency (TF-IDF) measure. Specific details of this metric can be found in [9].
<i>Polarity</i>	Average polarity (sentiment) of the post. We are computing sentiment by using SentiStrength, ⁵ a state of the art method for analysing sentiment in social media data. For specific details of how sentiment is computed for each particular tweet, the author is referred to the list of scientific publications behind this library. ⁶
<i>Time of the day</i>	Time when the tweet was posted (e.g., 20:00)

C. Mining Engagement Dynamics

To identify the key characteristics of the posts and users that attracted higher attention levels during the EH14 campaign we perform two different analyses:

- First, we identify the characteristics of those tweets that are followed by an engagement action (retweet). We call these tweets the seed posts. As we can see in Table 3, 22,623 posts (64% of the posts in our dataset) received at least one retweet.
- In a second step we identify the characteristics of those posts that were followed by a higher number of engagement actions (i.e., received a higher number of retweets)

⁴ http://en.wikipedia.org/wiki/Gunning_fog_index

⁵ <http://sentistrength.wlv.ac.uk/>

⁶ <http://sentistrength.wlv.ac.uk/#About>

Table 3: Seeds vs. non seeds posts in Earth Hour Dataset

Dataset	Posts	Seed	Non seed
Earth Hour	35,354	22,623 (64%)	12,731 (36%)

Characterising Tweets Receiving an Engagement Action

To perform the first task, we train three different Machine Learning (ML) classifiers (Naïve Bayes, J48 and Support Vector Machines) using historical data, and select the one that provides the most accurate classification of seed posts from non-seed posts. This classifier automatically assesses the probability of a tweet to generate attention and engagement, depending on the features of the tweet. To generate the different classifiers we use a balanced dataset of randomly selected 12K seeds vs. non-seed posts and use 10-fold cross validation to test their performance.

Once the optimal classifier is identified (in this case the J48 decision tree), we remove one feature at a time from the classifier, and measure the drop in performance. Those features that generate a higher performance drop are the most discriminative ones, i.e., they are the ones that better distinguish the seed posts (those generating engagement) from the non-seed posts (those that are less likely to be retweeted).

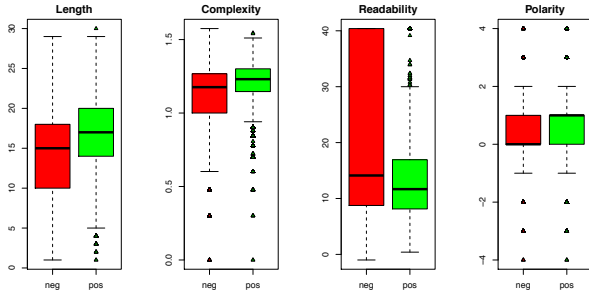
**Figure 2: Features with higher influence on engagement levels**

Figure 2 shows the result of this analysis. More particularly, the top 4 discriminative features that help distinguishing seed from non-seed posts are: readability, post length, complexity and polarity. Posts generating attention (i.e., being retweeted) are slightly longer, easier to read, have positive sentiment and tend to repeat terms existing in other posts. Note that readability is measured using the Gunning Fox Index. This index estimates the years of formal education needed to understand the text on a first reading (i.e., the lower the index level, the easier is for a text to be read).

It is important to highlight that the key discriminative features to identify retweets do not include any social features, meaning that, in terms of generating engagement towards the EH campaign, the content of the tweet is more relevant than the reputation of the user.

Characterising Tweets Receiving High Engagement

For our second analysis the goal is to determine which are the characteristics of those seed posts generating higher attention levels (i.e., receiving a higher number of retweets). To obtain this information, we induce a linear regression model, where the different attributes or features listed above are used

to approximate the number of engagement interactions (i.e., the number of retweets) that a tweet is receiving.

Table 4 presents the results of this analysis. By inspecting the coefficients of the regression model we can observe how the change in each feature is associated with the likelihood of engagement (i.e., how the change in each feature would impact the likelihood of the post being retweeted).

The more significant features are readability, informativeness, polarity, mentions, and out-degree. This means that posts followed by a higher number of engagement actions are easy to read, repeat keywords and themes present in other posts have positive sentiment and mention other users.

Table 4: Regression Coefficients. Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**

Feature	Regression Coefficient	Significance
length	8.93E-01	
complexity	1.10E+02	**
readability	-1.49E+00	***
referral count	4.81E+00	*
informativeness	-2.25E+00	***
polarity	1.17E+01	***
mentions	2.72E+01	***
timeDay	-8.71E-01	
indegree	1.69E-05	
outdegree	-1.20E-03	**
postcount	1.59E-04	
age	8.48E-04	
postrate	4.57E-01	

V. TOPIC ANALYSIS

The following section aims to investigate the key themes that emerged during the EH14 campaign. To extract these themes we have followed two main steps:

- The first step aims to analyse the hashtags contained within the tweets. Hashtags are keywords preceded by the # symbol that users include in the tweets to express their main themes.
- The second step uses automated semantic annotators to process the text of the tweet and to identify the key entities (places / products / companies, etc.) that appear in the tweets under analysis.

A. Hashtag Topic Analysis

The tag cloud displayed in Figure 4 shows the main hashtags appearing in the EH dataset. The size of the hashtag is an indication of its frequency within the dataset. The colours are for better visualisation but do not convey any meaning. Note that we have removed the main hashtag (#earthhour) for a better visualisation, since its frequency (13,898 occurrences) is significantly higher than the one of the other hashtags. The

second most frequent tag is iniaksiku with 2,080 occurrences. The main hashtags of interest during the campaign are listed in the following table:

Table 5: Top EH hashtags

Hashtag	Meaning
iniaksiku	Term used during the campaign in Indonesia. It means 'ini aksiku, mana aksimu' (this is my action, what is yours). It is the Indonesian version of IWIYW (I will if you will)
Earthhourza	Domain name of South Africa. Tweets with these Hashtag aimed to identify content regarding the EH South African campaign
earthhour2014	is the identifier of the year 2014 EH camping
yourpower	Represents the campaign slogan “use your power to make change a reality” ⁷
passthepanda ⁸	Campaign action in which several teddy panda bears were given to people so that they keep passing them to raise awareness.
Turnofftoturnon, durexsexplorers, getclosergofurther ⁹	These hashtags are part of the Durex promotion of the EH campaign. Their goal is to reconnect couples when the lights are switched off
spiderman ¹⁰	In the 2014 year’s campaign, Spiderman was selected as ambassador
bebrilliant	This hashtag represents a message of the original campaign “Be a part of Earth Hour - the world’s biggest celebration for our brilliant planet ¹¹ !”
welshwish ¹²	Campaign that the Wales rugby stars launched to promote EH
momentofdarknes	Moment when the lights are switched off
Earthhouruae	Campaign of the United Arab Emirates
tahiti ¹³	Campaign conducted in the French Polynesia, and more particularly, the concert taking place in Tahiti

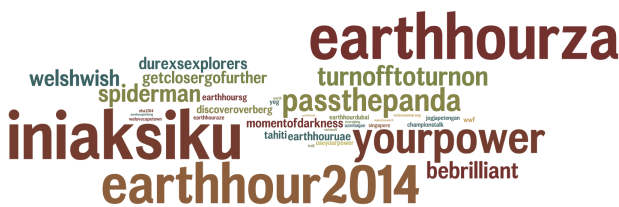


Figure 3: Top hastags within the EH dataset

This analysis reveals that the top themes found in the tweets are the ones promoted by the EH campaign.

B. Semantic Topic Analysis

Additionally to the analysis of hashtags (which are keywords explicitly expressed by the users) we have processed

⁷ <http://www.earthhour.org/>

⁸ <http://earthhour.wwf.org.uk/get-involved/pass-the-panda>

⁹ <http://www.thedrum.com/news/2014/03/18/durex-promotes-earth-hour-turnofftoturnon-campaign-spanning-56-markets-worldwide>

¹⁰ <http://www.earthhour.org/superhero3>

¹¹ <https://www.facebook.com/EarthHourUK>

¹² http://wales.wwf.org.uk/wwf_articles.cfm?unewsid=7039

¹³ <http://www.earthhour.org/french-polynesia>

the posts with a semantic annotator, in this case TexRazor,¹⁴ with the purpose of identifying the key entities and concepts within the EH dataset. TextRazor offers a text analysis infrastructure. It combines state-of-the-art natural language processing techniques with semantic knowledge bases to extract the key entities and concepts from documents.

As we can see in Table 6 the top 15 identified entities include: Planet, World_Wide_Fund_for_Nature, Superhero, Durex, Cape_Town, Twitter, Singapore, Indonesia, climate_change, Wales, Andrew_Garfield, Reef, and Energy. The entity names are similar to the hashtags identified by our previous analysis or refer to similar topics (e.g., Wales refers to the campaign that the Wales rugby stars lunched to promote EH, Andrew Garfield is the actor of Spiderman, the super hero selected for 2014 EH campaign, etc.). The main addition provided by the semantic analysis is that we are now able to identify concrete concepts: locations, organisations, persons, etc., appearing within our dataset.

Table 6: Top Entities

Entity	Frequency
http://en.wikipedia.org/wiki/Earth_Hour	12566
http://en.wikipedia.org/wiki/Earth	1803
http://en.wikipedia.org/wiki/Planet	915
http://en.wikipedia.org/wiki/Hour	798
http://en.wikipedia.org/wiki/World_Wide_Fund_for_Nature	672
http://en.wikipedia.org/wiki/Superhero	424
http://en.wikipedia.org/wiki/Durex	376
http://en.wikipedia.org/wiki/Cape_Town	367
http://en.wikipedia.org/wiki/Twitter	334
http://en.wikipedia.org/wiki/Singapore	328
http://en.wikipedia.org/wiki/Indonesia	227
http://en.wikipedia.org/wiki/Climate_change	226
http://en.wikipedia.org/wiki/Wales	220
http://en.wikipedia.org/wiki/Andrew_Garfield	220
http://en.wikipedia.org/wiki/Reef	203
http://en.wikipedia.org/wiki/Energy	201
http://en.wikipedia.org/wiki/Candle	201

For example, among the top organisations driving engagement towards the campaign we can highlight some of the main organisers and contributors, such as the World Wide Fund for Nature, Durex or Twitter; media and entertainment organisations, such as Instagram, THX, YouTube, WWE, Facebook and Verizon Communications; and international organisations dedicated to the research and development of sustainability, such as ICLEI, York_University, National_Institutes_of_Health, etc.

Key persons/celebrities that help to raise awareness about the campaign in social media include: Andrew_Garfield, Emma_Stone, Jamie_Foxx, Gucci_Mane, Marc_Webb and Sophie_Ellis-Bextor. Andrew Garfield, Emma Stone, Jamie Foxx and Marc Weeb are actors of the Spiderman film (the EH 2014 super hero). Gucci mane is an American rapper, target of the popular tweet “Gucci mane turn off your blackberry torch. It earth hour. You piece of shit. Yuo fuckin piece of shit turn off your blackberry”. Sophie Ellies Bextor was one of the celebrities performing for the EH campaign in London. Among the politicians we can highlight Crhstiana Figueres, Executive

¹⁴ <https://www.textrazor.com/>

Secretary of the UN Framework Convention on Climate Change and David Miller, Canadian former politician and president of WWF-Canada.

The previous analyses reflect the topics/entities that were more popular among users during the EH campaign. To investigate whether the topics and elements used to promote the campaign (the Super hero, Durex, the participation of the Wales rugby stars) stimulate awareness towards topics such as climate change, energy, sustainability, etc., we have performed a correlation analysis between the top 10 most frequent entities within our dataset. Correlation is measured considering the distribution of entities per user.

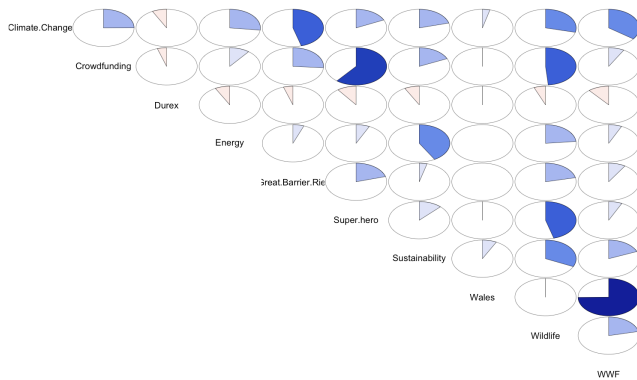


Figure 4: Frequencies of co-appearances among the most frequent entities

The results of the performed analysis are displayed in Figure 4. Red means, negative correlation, blue positive correlation. Colour intensity indicates intensity of the correlation. As we can see in this image, there is a low or negative correlation between Durex and any other entity, meaning that users tweeting about Durex during the EH campaign did not show any particular interest about climate change, sustainability, or any other entity.

Users talking about climate change also mentioned themes around the Great Barrier Reef, wildlife, or WWF. Energy is strongly correlated with sustainability, and sustainability is correlated with wildlife. However, these entities have low-medium correlations with the main elements of the campaign, such as Crowd funding, Durex, the Super Hero or the Wales rugby stars. This indicates that, while the main activities and themes of the campaign did drive most of the social media conversations, the fact that the users engaged in these themes did not necessarily mean that they also engaged with climate change and sustainability issues.

VI. TOPIC PERSISTENCE

In this section our main purpose is investigating the persistence of engagement towards the EH topics among the users who participated in the campaign. For this purpose we consider not only the 35K tweets about the campaign (which were the ones used for our previous analyses) but also the additional tweets posted by the 6K users who generated those tweets (see Section III for more details about the data

collection process). We restricted this analysis to one month before and one month after the campaign.

We extracted the key topics of discussion during these two months by applying the Latent Dirichlet Allocation (LDA) algorithm [1] with a number of 50 topics. LDA looks at the distribution of words in different documents (in our case tweets) and generates different topics (groups of words). By performing LDA we derive the latent topics discussed within the two-month period surrounding EH. Examples of these topics are displayed in Table 7:

Table 7: Examples of Topics

Topic	Percentage
photo facebook posted	2%
news south singapore	2%
day good morning	3%
energy climate change	3%
weather rain high	2%
missing malaysia flight	2%
people work women	3%
earth hour earthhour	2%

In order to better understand how users' discussions are centred around EH, we compare topic distributions at different points in time against the EH reference distribution.

We generate the EH reference distribution by considering all the tweets about EH during the day of the campaign. We perform the same process to obtain a topic distribution for each day before and after the campaign and compare each topic distribution against the EH reference distribution by using the Jensen-Shannon divergence (JSD) between the topic distributions.

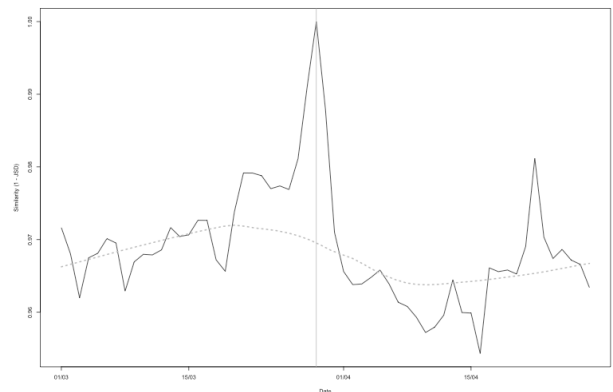


Figure 5: Topic Similarity of topic distributions of different points in time against the EH reference distribution

As it can be observed in Figure 5, topic distributions get similar to the EH topic distribution as we get closer to the day of the campaign. Then, topic distributions start fading, as the users go back to their usual conversations. Nevertheless, it appears that topics of discussion maintain some similarity to the topics of EH, meaning that, after the campaign is finished,

users maintain some level of engagement towards the topics of the campaign.

VII. DISCUSSIONS

One of the most fascinating dimensions of social media is the way in which it allows individuals and organisations to engage with large audiences, helping them spreading relevant ideas and messages. In this paper we have focused on assessing how the 2014 EH Twitter campaign influenced public engagement.

Our observations indicate that, in terms of generating engagement, the content of the tweet is more relevant than the reputation of the Twitter user who posted it. This was also observed by previous studies focused on analysing engagement dynamics in different social media platforms [2][6][7][12]. Posts generating higher attention levels are slightly longer, easier to read and have positive sentiment. These “recipes” for writing posts are now being used as recommendations for future EH campaigns. Posts will be shaped using longer text, expressing simple and positive messages, in order to increase engagement.

Our selection of user and content features was inspired by the literature [9], and consisted of features that were found relevant, in one aspect or another one, to identify engagement. However, we acknowledge the fact that there could be other features that might better characterise engagement in the context of this particular campaign.

By analysing the topics of these tweets we observed that, while the main activities and themes of the campaign (the 2014 EH super hero, the panda, etc.) did drive most of the social media conversations, the fact that the users engaged in the campaign, did not necessary mean that they also engaged with climate change and sustainability issues. This is an important lesson learned, since the goal of EH is to raise awareness about climate change. Future editions of the campaign should therefore work on emphasising more the relevant messages that WWF as organisation aims to transmit to the public.

By studying the temporal evolution of these topics we also observed that, while users decrease their engagement towards the topics of the campaign after it finished, these topics still remained, with less intensity, in their conversations one month later. This positive result indicates that the campaign not only triggered short-term engagement, but that some of the key messages did persist in the Twitter conversations during at least a month after the campaign. However, more extensive research needs to be done to assess the long-term effect of the campaign in terms of engagement. This action requires the collection and analysis of data for at least one year, to cover the period between events, which is part of our future work.

Further experiments are also needed to shed more light on the actions or strategies that get users to get engaged. Note that, for the purpose of this study we collected information from users who were participating in the 2014 EH campaign. However, we don't know which of those users were already aware about the campaign and were already engaged with climate change and sustainability issues and which ones got engaged because of the strategies and interventions conducted

during the campaign. Further research is therefore needed to assess the effect of these interventions by using a control group (i.e., users who were never involved with EH).

It is also relevant to mention that, while for this study we considered all tweets around EH, some of those tweets were not produced by citizens, but by Twitter accounts belonging to WWF and other relevant organisations. Our aim for analysing the next EH campaign is to profile and filter these social media accounts and to differentiate citizen engagement vs. engagement actions produced by organisations associated to the campaign.

In summary, while there is still extensive room for future work, or experiments and results highlight some of the effects of the 2014 EH campaign in public engagement. We hope that the presented study will serve as a basis for future work within the community and enable further research into the systematic assessment of engagement produced by climate change campaigns and actions.

VIII. CONCLUSIONS

Although much research has been done on identifying the factors that influence engagement in social media, very little attention has been giving to measuring the impact that climate change campaigns and actions have on public engagement.

This paper aimed to study the impact of the 2014 EH Twitter campaign. For this purpose we collected 35K tweets around the EH campaign in Twitter. By analysing these tweets we observed that, in terms of generating engagement, the content of the tweet is more relevant than the reputation of the user. Posts generating higher attention levels are slightly longer, easier to read, have positive sentiment, mention other users and tend to repeat terms existing in other posts.

By analysing the topics of these tweets we observed that, while the main activities and themes of the campaign (super hero, the panda, etc.) did drive most of the social media conversations, the fact that the users engaged in the campaign, did not necessary mean that they also engaged with climate change and sustainability issues. Studying the temporal evolution of these topics we also observed that, while users decrease their engagement towards the topic of the campaign after it finished, these topics still remained in their conversations one month later.

REFERENCES

- [1] Campbell, A. (2010). *How cavemen did social media* (Doctoral dissertation, The University of Sydney).
- [2] Cha, M., Haddadi, H., Benevenuto, F., & Gummadi, P. K. (2010). Measuring User Influence in Twitter: The Million Follower Fallacy. *ICWSM*, 10(10-17), 30.
- [3] Cheong, M., & Lee, V. (2010). Twittering for earth: A study on the impact of microblogging activism on Earth Hour 2009 in Australia. In *Intelligent Information and Database Systems* (pp. 114-123). Springer.
- [4] Hodas, N. O., & Lerman, K. (2012, September). How visibility and divided attention constrain social contagion. In *Privacy, Security, Risk and Trust (PASSAT), 2012 International Conference on and 2012 International Conference on Social Computing (SocialCom)* (pp. 249-257). IEEE.

- [5] Kazakova, E. (2009). Environmental campaign construction and symbolism: in the case of WWF's campaign "Earth Hour". *Master's thesis*.
- [6] Kwak, H., Lee, C., Park, H., & Moon, S. (2010, April). What is Twitter, a social network or a news media?. In *Proceedings of the 19th international conference on World wide web* (pp. 591-600). ACM.
- [7] Macskassy, S. A., & Michelson, M. (2011, July). Why do people retweet? anti-homophily wins the day!. In *ICWSM*.
- [8] Naveed, N., Gottron, T., Kunegis, J., & Alhadi, A. C. (2011, June). Bad news travel fast: A content-based analysis of interestingness on twitter. In *Proceedings of the 3rd International Web Science Conference* (p. 8). ACM.
- [9] Rowe, M., & Alani, H. (2014, June). Mining and comparing engagement dynamics across multiple social media platforms. In *Proceedings of the 2014 ACM conference on Web science* (pp. 229-238). ACM.
- [10] Segerberg, A., & Bennett, W. L. (2011). Social media and the organization of collective action: Using Twitter to explore the ecologies of two climate change protests. *The Communication Review*, 14(3), 197-215.
- [11] Solomon, D. (2008). How effective are individual lifestyle changes in reducing electricity consumption?-measuring the impact of earth hour. Tech. rep., University of Chicago, Graduate School of Business.
- [12] Suh, B., Hong, L., Pirolli, P., & Chi, E. H. (2010, August). Want to be retweeted? large scale analytics on factors impacting retweet in twitter network. In *Social computing (socialcom), 2010 IEEE second international conference on* (pp. 177-184). IEEE.
- [13] Tan, Y. (2009). Persuasive technology in motivating household energy conservation. In *Business aspects of the internet of things seminar of advanced topics*. FS (pp. 52-58).