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Science, Twitter and election campaigns: tracking #auspol in the Australian federal elections

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Abstract

Social media is increasingly being used by science communicators, journalists and government agencies to engage in discourse with a range of publics. Despite a growing body of literature on Twitter use, the communication of science via Twitter is comparatively under explored. This paper examines the prominence of scientific issues in political debate occurring on Twitter during the 2013 and 2016 Australian federal election campaigns. Hashtracking of the umbrella political hashtag auspol was used to capture tweets during the two campaign periods. The 2013 campaign was particularly relevant as a major issue for both parties was climate change mitigation, a controversial and partisan issue. Therefore, climate change discussion on Twitter during the 2013 election was used as a focal case study in this research. Subsamples of the 2013 data were used to identify public sentiment and major contributors to the online conversation, specifically seeking to see if scientific, governmental, media or 'public' sources were the more dominant instigators. We compare the prominence of issues on Twitter to mainstream media polls over the two campaign periods and argue that the potential of Twitter as an effective public engagement tool for science, and for politicised scientific issues in particular, is not being realised.

Keywords

Public engagement with science and technology; Public perception of science and technology; Science and media

Introduction

The emergence of social media has served to expand the discursive space around public policy issues by empowering media consumers to be directly involved. Traditional media sources can 'pre-interpret' issues for presentation to their audience, potentially setting the parameters — or limitations — for audience discussion and debate before they even begin [O'Neill et al., 2015]. Social media platforms, such as Twitter, allow the users to raise issues they wish to discuss and form communities of publics using hashtags for identification [Bruns and Burgess, 2012]. These groups represent an audience who have the ability to set their own parameters for discussion of issues, including controversial ones. Journalists and citizens have a role on Twitter as they are both "involved in the flow, framing and interpretation of news" [Hermida, 2013, p. 304]. An earlier study of the discussion of the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report

(AR5) report on Twitter found that users would form conversational connections with others who shared their views [Pearce et al., 2014]. Although the results indicated some polarization of the opposing 'sides' of the climate change debate, they also suggested that there is scope for continued conversations between the two sides which may create a shared understanding. This is an important, and as yet under-developed, area of research which warrants exploration. The communication of science on Twitter may have significant impact upon how the public perceive new scientific developments and understand science [Brossard and Schefeule, 2013], therefore a better understanding of science communication on Twitter is needed, particularly in regard to controversial and politicised issues, such as climate change.

As researchers and organisations increasingly engage with social media to promote scientific issues and agendas to the public, it is important to understand how these messages engage, and are received by, audiences [Adams, Lomax and Santarini, 2011; van der Meer and Verhoeven, 2013]. In Australia, tweeting about politics is prolific, averaging over 5,000 tweets per day in the first half of 2012 [Bruns and Highfield, 2013]. By observing the manifestation of political debate on Twitter it is also possible to gain a picture of the current public sentiment in order to help advance agendas and engage with the public in a more effective manner [van der Meer and Verhoeven, 2013].

The politicisation of climate change in Australia has been demonstrated through the last two federal elections in 2013 and 2016. In 2013 the two main candidates for the position of prime minister — Australia's top political position — had opposing viewpoints. This exemplifies the politicisation of the climate change issue which can create messages that divide public opinion [Buys et al., 2014]. In 2016 the two candidates had similar viewpoints, but different campaign platforms for addressing climate change. This study will examine the 2013 campaign in depth, and compare the prominence of scientific issues between the 2013 and 2016 campaigns. The results of this study will provide a clearer understanding of the role social media plays in public democratic discourse especially pertaining to complex, and sometimes controversial, scientific issues such as climate change.

Literature review

Science in social media

Only 20% of newspapers that had a dedicated science section in 1989 retain a weekly science section today [Brossard, 2013]. Research indicates that this reduction in science news coverage in traditional media could be caused by a shift towards online media sources, with increasing numbers of people now reading newspapers online [Brossard and Schefeule, 2013]. Similarly, people are increasingly relying on the Internet for news about science and to follow scientific developments [Brossard, 2013]. The Internet news media is unique in allowing interaction between users, which is an important factor in driving people online as the public are no longer passive readers [Brossard, 2013; Brossard and Schefeule, 2013]. News information is no longer broadcast by only a small circle of journalists but created by the audience itself [Goode, 2009]. People can express their point of view by commenting on articles and broadcast the news by sharing it via their own social media presence. This freedom allows the lay audience to discuss subjects that may not be covered in traditional media.

The rise of social media also allows scientists the ability to communicate directly with the public. Some studies of the communication behaviours and motivations of scientists indicate that scientists are reluctant to use social media because of a lack of time, or they do not see any benefits of using it in a professional context [Nicholas and Rowlands, 2011]. However other studies indicate that scientists believe science communication is important, and want to be able to share their scientific findings with both the lay audience and the media [Dudo and Besley, 2016; Peters, 2013]. Social media can facilitate this by increasing public accessibility to information rich events such as scientific conferences where the use of Twitter hashtags allows participation from people unable to attend [Osterrieder, 2013], which may include members of the public.

Despite the increasing use and recognised importance of Twitter for science communication, there are surprisingly few studies of how the social media platform is used to communicate science. Adams, Lomax and Santarini [2011] looked at how stem-cell science was being communicated during two discrete events that were the subject of considerable activity on Twitter. The first event was the introduction of The Stem Cell Research Advancement Act in the United States Congress. The second was the announcement of successful trachea transplantation into a terminal cancer patient in Sweden. The researchers examined the tones of the tweets, identifying them as positive, negative or neutral, finding that there were a higher percentage of messages that were positive in tone about the trachea transplant in comparison to the Stem Cell Advancement Act, perhaps highlighting the more controversial nature of stem cell science. Those tweets that were positive about the Stem Cell Advancement Act were more likely to come from organisations and practicing scientists [Adams, Lomax and Santarini, 2011]. In this instance, it appears Twitter was predominantly used as a means of supporting certain scientific developments, in particular by professionals with a vested interest in the Stem Cell Advancement Act.

Similar results were found in a second study which examined the discourse on Twitter surrounding nanotechnology in America [Runge et al., 2013]. This study, which also examined tone of tweet and its geographic origin, found that tweets were more likely to originate from states with a vested interest in the topic; in this case a federally funded National Nanotechnology Initiative centre or network.

These two papers illustrate how Twitter can provide an important mechanism for individuals to support their ideals and purposes [Hargittai and Litt, 2011; Sauter and Bruns, 2013]. However there is very little research which examines the changeable nature of science communication via social media [Runge et al., 2013]. The open discussion and presentation of differing viewpoints by experts and non-experts helps create a space for "public discussion, deconstruction and de-stigmatising of science" [Hargittai and Litt, 2011, p. 6]. It also allows members of the public to demand attention to issues that affect them, and lobby for change [Sauter and Bruns, 2013]. An in-depth study with Twitter users found that political persuasion is a key activity within the social network, giving Twitter the ability to influence media coverage [Parmelee, 2014]. Earlier studies support this claim [Sauter and Bruns, 2013], with Jericho [2012] noting that Twitter allows users to ask others, such as journalists, for analysis of issues, particularly political ones.

Political communication on Twitter

In comparison to science communication, the research on the use of Twitter for political communication is extensive, but still incompletely understood. The open system of Twitter allows users to publicly respond to others, thereby making it a vibrant forum for public discourse [Kim, 2011].

Some argue that a key plank in Barack Obama's successful presidential campaign in 2008 was his extensive use of social media, going as far as to suggest that his social media strategy won him the presidency [Cogburn and Espinoza-Vasquez, 2011]. Since Obama's success, politicians throughout the democratic world have begun to embrace such tools as a new way to connect with their constituents, shortcutting the heavily mediated connections offered by traditional media [Baxter and Marcella, 2012; Golbeck, Grimes and Rogers, 2010; Grant, Moon and Busby Grant, 2010].

Although the interaction between the public and politicians appears to be limited, it's possible that such interactions are helping to shape policy decisions. The extent of this influence is unclear. Some argue that it is having a large effect [Auer, 2011], but studies confirming the link are hard to find. Twitter has been used to rapidly mobilise protests against political decisions. For instance, in 2012 a social media campaign was launched against the Australian Government's decision to allow the super trawler Margiris to fish in Australian waters. Despite the best available scientific advice the Government, under intense pressure from the campaign, moved to ban the trawler [Miller, 2012]. This is an interesting corollary. Social media sentiment trumped scientific advice as the determinant of action. Could social media sentiment in favour of particular scientific advice influence policy decisions? This is beyond the scope of this paper, but an area worthy of further exploration.

One of the drawbacks of using Twitter for shaping political debates is the huge volume of tweets that can run into millions during a single event, such as an election [Mohammad, Kiritchenko and Martin, 2013], which makes it difficult to accurately gauge public sentiment towards policies. Lobby groups can distort public sentiment and drown out dissenting views by hijacking the debate using legitimate and nefarious methods [Verkamp and Gupta, 2013]. However it is important to recognise that all Twitter users are not representative of their entire electorate [Bruns and Highfield, 2013]. Bruns and Burgess [2012] conducted a study observing the #auspol hashtag. This hashtag is the blanket catch all for discussion of Australian domestic political issues. They conducted their study between February and December of 2011 and their results showed that the top 10% of contributors were responsible for 90% of tweets, indicating that another breakdown at levels of activity is required for analysis [Bruns and Burgess, 2012]. It has been previously observed that those who actively converse on Twitter rather than broadcast have more of an influence on the direction of discourse [Grant, Moon and Busby Grant, 2010]. In this study we will draw a random subsample of tweets from the most frequently discussed topics to identify the leading contributors to the discussion, and to examine the sentiment and tone of communications on those issues.

Science in political discourse on Twitter?

Outside of politicised scientific issues such as climate change, there has been little work examining the discussion of scientific issues as part of political discourse on Twitter. Previous studies have looked at whether Twitter was a venue for conversations about polarized issues such as climate change [Pearce et al., 2014], or if activity on Twitter can predict electoral outcomes [Murthy and Petto, 2015] or the likelihood of general political participation [Bode and Dalrymple, 2014]. The results of these studies point to some general, if not counterintuitive, trends which have greater implications for Twitter as a science communication tool.

There is cautious optimism about the potential contribution Twitter can make to democratic discourse. Despite revealing highly polarized views in tweets about climate change, Pearce and colleagues sounded a note of "cautious optimism regarding continued communication between the supportive and unsupportive. . . with a view to building greater mutual understanding" (2014:9). Ausserhofer and Maireder [2013] argue that Twitter provides the general citizenry with the opportunity to engage in the political discourse by helping link the political centre and the public. Similarly Larsson and Moe [2012] conclude that Twitter broadens the public debate and provides an opportunity for non-key players to have their say.

As a stimulant of political influence and participation, Twitter is not necessarily a 'big player', especially in comparison to traditional media sources [Bode and Dalrymple, 2014]. However, the frequency of tweets about a person or issue has not been found to correlate with traditional media coverage [Murthy and Petto, 2015]. Earlier studies show that mainstream media influence what Twitter users respond to [Vargo et al., 2014], and most people indirectly experience politics through mass media, with the most important topics as determined by mass media coverage as the ones potentially most likely to be discussed [Jungherr, Jurgens and Schoen, 2012]. However the same study also states that "conversing about politics on Twitter requires that a political topic has caught the user's interest" [p. 9]. The authors conclude by suggesting that examining topics mentioned in tweets might highlight differences between what Twitter users deem salient in comparison to what other surveys may identify as the most important political issue of the day [Jungherr, Jurgens and Schoen, 2012]. This current study will examine this proposition within two Australian federal elections, however the 2013 campaign will be examined in greatest detail.

The 2013 Australian election campaign

There were a number of key policy issues discussed in the media leading up to the 2013 election, all of which received significant media attention and were rated as important issues for voters identified in media collated 'round ups' [Australian Broadcasting Corporation, 2013] and in a national exit poll [The Climate Institute, 2013]. The exit poll, conducted by JWS Research for The Climate Institute with 1591 voters, found the most important issues were economy and jobs (31%), cost of living (15%), and healthcare and hospitals (13%). Some of the more contentious issues between the major political parties were asylum seekers and border control (7%) and action on climate change (5%). These results suggest that the majority of

Australians are quite focused on the economy and employment first and foremost, with the exception of 23% of Green party voters surveyed who identified action on climate change as their top concern [The Climate Institute, 2013].

Climate change was a significant issue during the 2007 and 2010 election campaigns [Glover, 2007; Hepburn, 2010], but was a minor part of the political debate during the 2013 campaign [Readfearn, 2013] despite the focus on climate change related policy. Much of the 2013 election campaign did not involve any science in political discussions, a scarcity noted by commentators [Grant, 2013]. Both of the major Australian political parties expressed a commitment to cutting greenhouse gas emissions in an effort to combat climate change [Clarke and Greene, 2013], yet historically both parties have poor performance in responding to climate change [Jaspal, Nerlich and van Vuuren, 2016].

Climate change has long had an "observable partisan divide with respect to perceptions of risk" [Buys et al., 2014, p. 174] in Australian politics, and a comprehensive history of the stances of the political parties is provided by Jaspal and colleagues [2016]. In 2013, the Liberal party leader, Tony Abbott, was described as a climate sceptic (by a member of his own party — see Turnbull [2009]) and the leader of the Australian Greens described his approach to climate change as 'anti-science' [Australian Associated Press, 2013]. The dominant discussions in the traditional media were largely economic. A search through the wire articles from the Australian Associated Press (the major domestic news agency) for the entire election campaign period using the search terms election AND scien* OR climate found 263 non-duplicate articles. Only two of these articles contained any actual science or questioned science related to climate change and the proposed policies from the major parties.

There is a strong consensus (97–98%) among professional climate scientists that climate change is happening [Anderegg et al., 2010; Cook et al., 2013; Doran and Zimmerman, 2009]. In comparison, of all Australians surveyed in the 2013 election exit poll, 63% of respondents believe that climate change is occurring, 20% do not think it is occurring and 18% are undecided [The Climate Institute, 2013]. Contributing to the discrepancy in opinion between the climate scientists and the public is the favourable coverage of climate scepticism in the Australian media. Bacon [2013] found that 32% of newspaper articles suggested doubt or rejected the consensus position. The proportion of articles expressing doubt regarding climate change has also grown since 2011. Bacon also criticised certain journalists for aiming to "build public support against action on climate change rather than to report on climate science" [2013, p. 96].

The Sceptical Climate report has observed that over 70% of climate change articles were published after page 8, indicating a general trend in the declining prominence of the subject amongst news editors [Bacon, 2013]. A study by Hmielowski and colleagues [2014] has suggested that trust is an important mediator in public opinion towards climate change and that audiences who subscribe to conservative media have a diminished trust in scientists and therefore greater scepticism regarding global warming [Hmielowski et al., 2014]. Discussions on social media may be a way of creating that trust, but it depends on who is driving the conversation.

Research purpose and aim

There is ongoing debate regarding science related public policy in Australia, especially related to addressing the effects of climate change. Given the polarisation observed in online communities, the sentiment of opinions expressed on Twitter during the election will be a valuable tool to observe the varied positions that exist in the politically engaged online community. Specifically, this study will examine the following research questions, using climate change as a case study for the second two:

1. What were the important science issues raised on Twitter during the 2013 election?
2. How do Twitter users perceive climate change?
3. Who were the main drivers of the climate change policy conversation on Twitter during the 2013 election?
4. How did the main issues identified by mainstream media and polls differ to those most talked about on Twitter in the 2013 and 2016 elections?

Method

Data was identified by the auspol hashtag (#auspol) and collated using hashtracking software collecting from the Twitter streaming API. The hashtracking approach to examining election communications on Twitter is appropriate in the context of this study as #auspol is well established as the main thread of discussion regarding Australian politics [Bruns and Highfield, 2013]. The content is typically representative of a breadth of political views as hashtags, like #auspol, allow political leaders and others to share their views beyond their followers [Parmelee, 2014].

For the 2013 collection tStreamingArchiver v 1.02 [Moon, 2012] was used to collect tweets with the auspol hashtag from the day the 2013 election was called on 4 August, until the day the election was held on 7 September. A second dataset was collected during the 2016 election and is used to supplement our detailed 2013 analysis. The 2016 dataset is used to show initial indications of changes in the number of tweets between the 2013 and 2016 election, and to identify if the key issues discussed differed in the two campaign periods.

The 2016 election period was longer, the election was called on 16 May through to election day on 2 July, a period of just under 7 weeks compared to just under 5 in 2013. Different software, DMI-TCAT [Borra and Rieder, 2014], was used to collect the 2016 dataset. The tStreamingArchive software was run in parallel for part of the period to allow comparison of the tweets collected to ensure that changing the collection software did not alter the tweets collected. Minor differences in the number of tweets collected by each collector were found, probably due to variation in rate limiting on each collector (discussed later under Limitations), but they were not large enough to affect the analysis.

The content of the original tweets (not retweets) was used in order to track what people actively contributing to the discussion were saying. We chose to exclude retweets as the study of original tweets has received little research attention [Veltri and Atanasova, 2015] and we are interested in examining this "first degree of

sharing" [p. 3]. The stream of data generated during this timeframe was further analysed to ascertain the nature and interest in politically relevant general and scientific topics by the public and the level of scientific discussion in the political debate [Beacco et al., 2002]. The content of tweets was searched using IPython [Perez and Granger, 2007] for keywords taken from the exit poll and media round ups, such as economy, climate, employment and health, [Australian Broadcasting Corporation, 2013; Blumer, 2016; The Climate Institute, 2013; The Climate Institute, 2016]. These themes were consistent across both election periods, with the economy, health, the environment and education prominent. There was a difference in some of the main electoral issues in the 2016 campaign. For example, immigration was much less of an issue of public concern due to a change in political party and thus immigration policy. In both datasets, commonly recurring themes were identified and grouped.

Tweets using the keyword 'science' within the 2013 #auspol dataset were extracted to determine where Twitter users were looking to incorporate science into the conversation. This created a sample of 504 original tweets that were categorised. Inter-rater agreement was assessed using Fleiss' kappa test by examining 40 tweets independently assessed by all three raters. Agreement among raters was high ($\kappa = 0.81$, 94% mean agreement). The remaining tweets were divided evenly among the three raters to categorise.

Given the focus on climate change related policy in the 2013 election, a file of climate change tweets was exported from the 2013 #auspol dataset. A random subsample (n = 1000) was created by removing all retweets and assigning uniformly distributed pseudorandom numbers to the remaining tweets. The subsample of 1000 tweets was then classified as exhibiting pro, con or neutral sentiment about climate change. Examples of collected tweets exhibiting each sentiment are as follows:

> *Pro — Climate change science is scientific fact, not a political debate #auspol*
>
> *Con — Climate change is as natural as the seasons. Ditch the tax AND the nonsense talk of action. Adapt or find a planet with another sun! #auspol*
>
> *Neutral — Will #climatechange policy be affecting your vote this September? #debate #auspol #ausvotes*

Three raters classified the same 40 tweets from the subsample to test inter-rater agreement. A Fleiss' kappa test showed agreement among raters was extremely high ($\kappa = 0.87$, 97.5% mean agreement). Each rater then classified a further 320 tweets each.

A list of all of the users and their descriptions was compiled from the climate science sub sample in order to determine who the main contributors to the Twitter climate change conversation were. Users were categorised primarily based on their volume of Twitter activity, then their Twitter descriptions and tweet content were used to identify, as much as was possible, as being representative of views of an individual, an organization (governmental or scientific), or a news site, and what their agenda may be (for or against climate action).

Results

The total number of tweets captured tracking #auspol in 2013 was 647,539. Retweets were removed from the sample to allow focus on the original content of the discussion, leaving a total sample of 369,099 from the overall dataset. There were 41,583 contributors to the original tweet dataset with the majority of the tweets (75.65%) contributed by the most active 10% of Twitter users.

RQ1: What were the important scientific issues in the 2013 election discussed on Twitter?

The original tweets were categorised using keywords (as described in the method section and shown in Figure 1) to determine the range of issues being discussed. The range of issues could be broadly categorised into immigration/asylum seekers (5,688 original tweets); economy/employment (11,358); education including universities (2,878); health (2,941); climate change (4,738); climate policy (2,554); science and research (general — 1,840) and general environmental issues including water and the Great Barrier Reef (2,353). Figure 1 compares the frequency of each issue. Economy and employment were the most prominent topics for discussion, followed by immigration and asylum seekers. Climate change and climate policy were also prominent issues, accounting for around 2% of all tweets, and if collated had greater prominence than immigration and asylum seekers; although are still noticeably lagging behind economic issues. Science issues comprised less than five percent of the total number of tweets that used the auspol hashtag, with the word 'science' itself appearing in less than 0.5 percent of all #auspol tweets in 2013.

The subsample of tweets using the keyword 'science' in 2013 yielded six main themes, with tweets characterising each as shown in Table 1.

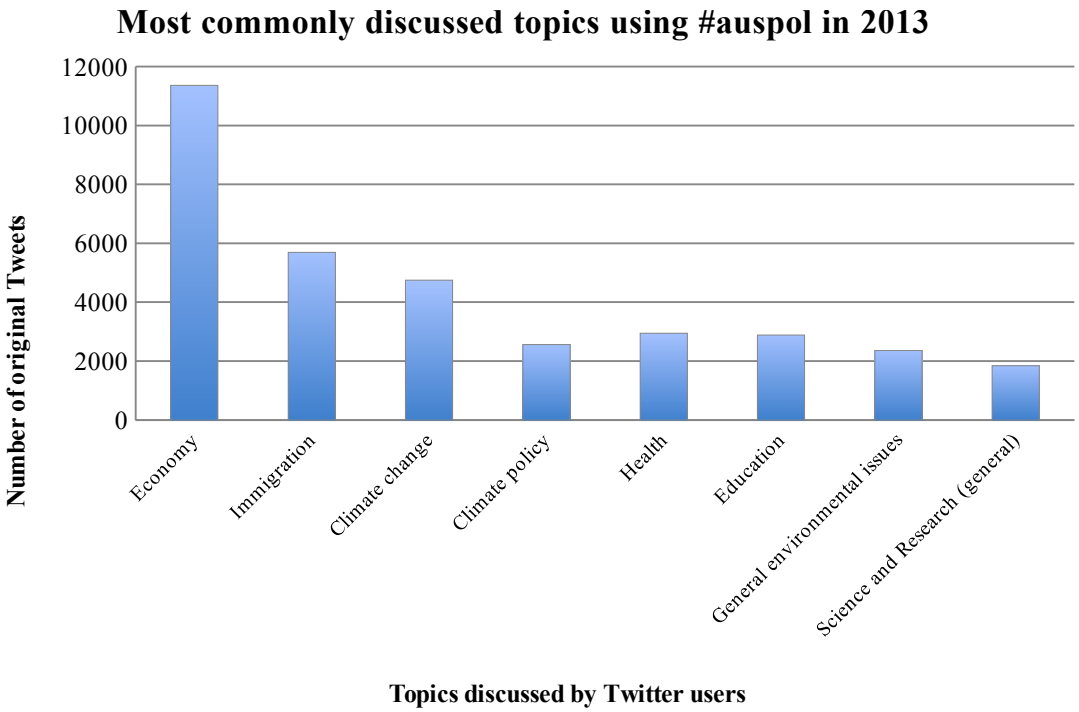

Figure 1. Most commonly discussed topics on Twitter using #auspol during the pre-election period.

Table 1. Main themes identified in subsample using the keyword 'science'. Note — #auspol hashtags were used in each and are not included in these samples, however additional hashtags are retained.

Themes	***Example***
Pro science based policy making	*This election it's not politics as usual. For the 1st time in our history both Labor & Liberals ignore science for short term profit*
Pro climate change action	*Climate change science is a scientific fact, not a political debate*
Against climate change action	*If the science is settled why do alarmists need to LIE, DECEIVE, BE DISHONEST via Watts #ClimateScam http://t.co/CXTdtzcOtX*
Noting the absence of science from the election discourse	*Science policies are nowhere to be found this election despite so many science issues #climatechange #publichealth #energy #scipol*
Pro science in general	*Does science literacy matter? Yes, and here's why http://t.co/LSTLVAwFTD#p2*
General mention using #science	*AM now streaming live from our website http://t.co/4qSUwjkq01 #ausvotes #education #Syria #science*

Support for science based policy making was the largest category in this subsample, containing over 27% of collected tweets. Tweets supporting climate science and the need to act was the next largest group with 122 tweets (24.2%). In comparison there were 63 tweets against climate action and questioning the science of climate change, representing 12.5% of the sample. About 20% of the tweets showed support of science generally, and just under eight percent of tweets were reporting some general science issue that was being discussed in the media. There was a small (8%), but notable proportion of contributors demanding more science be discussed in the election campaign. The most active 10% of users in this subsample contributed 53.5% of tweets with the most active user contributing over 15% of the tweets on their own.

RQ2: How do Twitter users perceive climate change?

As Figure 1 showed, climate change was the most prominent science based discussion captured on Twitter with 4,738 original tweets in 2013. The random subsample of 1000 tweets was categorised into those who believed climate change was real and required action (pro); those against (con) and those who were neutral. Of the 1000 tweets, 73.3% were pro climate change and action to mitigate it, 19.9% against and 6.8% of tweets did not express value judgments but simply reported news related to climate change.

Relatively few Twitter users dominated the discussion. The most active 10% of all users contributed more than half of the original tweets. Well over half of the sub sample was comprised of tweets that were 'pro' climate action. This category also had the largest number of contributors, almost 80% of the entire sample. Of those supporting climate action the top 10% of users contributed 43% of the tweets, and the most active one percent almost a quarter (24%) of the tweets in this category. The skew in the 'con' climate category was much more pronounced, with 94% of the tweets contributed by 10% of the users, and the most active one percent contributing 40% of all tweets in this category (see Table 2). The anti climate action contributors made up about 17% of the total number of contributors in this subsample.

Table 2. Comparison of proportion of tweets contributed by most active users in sub sample of climate related tweets.

Sentiment	Number of Tweets (n = 1000)	Number of contributors (n = 534)	Proportion contributed by most active 10% (n = 1000)	Proportion contributed by most active 1% (n = 1000)
Pro	73%	416	43%	24%
Neutral	7%	56	26%	40%
Against	20%	92	94%	40%
Total	100%	564[a] (534)	54%	26%

[a] Thirty contributors wrote Tweets which fell into two categories (i.e. pro and neutral) meaning that they were counted twice giving a contributor total of 564, however the number of contributors overall is 534.

RQ3: Who were the main drivers of the climate change policy conversation on Twitter during the 2013 election?

The majority of contributors in the sample of 1000 tweets about climate policy only had one or two tweets. A notional limit of five tweets was set to capture the main contributors to the discussion represented in this sample, creating a list of 18 top tweeters. The major contributors were predominantly individuals (10), and three groups without any stated political affiliations. Five users did not have enough information in their biographical details or tweet content to distinguish them as an individual or a group. None of the top tweeters identified as a scientist or science communicator or other representative of a scientific organisation.

The majority of contributions were pro climate action, with 10 separate individual and group contributors. Examples of tweets ranged from sharing news stories and information from other organisations, questioning anti-climate protagonists, and the major parties' policy decisions. Representative samples as follows:

> Economy to dominate election campaign. The economy will collapse if we don't fix the climate. #auspol http://t.co/p4kW9Bg1xP (individual Twitter user — most prevalent contributor in this sample)
>
> Kid science experiment explains difference between climate & weather. Kids get it. Deniers, Libs & NewsLtd? #auspol http://t.co/jlKXJCuoHC (Individual Twitter user)
>
> We need major parties to make decisive action in stopping dangerous climate change by making it national economic priority! #auspol #1MW (Group Twitter user)

Three contributors were harder to identify as being for or against climate action, as they shared news stories or links criticising the policies without clearly identifying their own opinion, as shown in the following examples:

> The Coalition's climate change policy: it's the public, not polluters, who pay http://t.co/b5kS4sAVfd via @guardian #auspol #AusVotes (unknown if group or individual tweeter)

> Global Temperature Vs CO2 1940–1979 What is driving the climate? #ausvotes #auspol #asktony #sydney #australia http://t.co/pIbvAmmM1D (Group Twitter users)

The second tweet example given here does not seem to give an opinion, which could render the tweet to be classified as neutral. However the user description refers to "…all sides of the man made global warming debate aired…" Further examination of their other tweets not captured in this sample show them to be more focussed on 'airing' the sides which question human influence on global temperatures. Although their tweets appear neutral, their agenda is that of climate change sceptics.

One group user was a news publication, which tweeted links to its own articles. It is possible that the articles themselves may have had an agenda, but the Tweets did not have a clearly identified agenda coming through.

> No extra money if Direct Action falls short: Abbott http://t.co/ew5cACfA4z #auspol #climate

Similarly, the user description did not reveal an agenda, describing itself as a news website aiming to bring "…fast, up-to-date coverage and analysis on the topics that matter to you". This was the sole 'news' coverage that was contributing to the conversation captured in this sample.

The remaining four users were vociferously opposed to climate change. Two were individual users and the other two were unable to be classified in to individual or group. The content produced by all four users was very similar in that they refer to climate data as being false, part of a conspiracy or some kind of fear campaign as follows:

> #auspol The New York Times' Global Warming Hysteria Ignores 17 Years Of Flat Global Temperatures http://t.co/pmWQAC17T2 (unknown if group or individual)
>
> #auspol UN Struggles with Data Suggesting No Global Warming ITS ALL A LOAD OF CLIMATE CRAP http://t.co/LNAT51FRn5 (individual Twitter user)

They also often personally attack individuals who endorse climate action and argue that it is influenced by corruption or falsified to suit individual needs and purposes as shown by the following:

> This Climate report is pure lies — I'd believe @chriskkenny ahead of 384 lying corrupt scientists #auspol http://t.co/plRrvnNeTY (individual Twitter user)
>
> @Jamiow @ABCNews24 @KRuddMP Sorry, but FALSIFIED climate models do NOT constitute "overwhelming evidence" #auspol #AusVotes2013 #ausvotes (unknown if group or individual Twitter user)

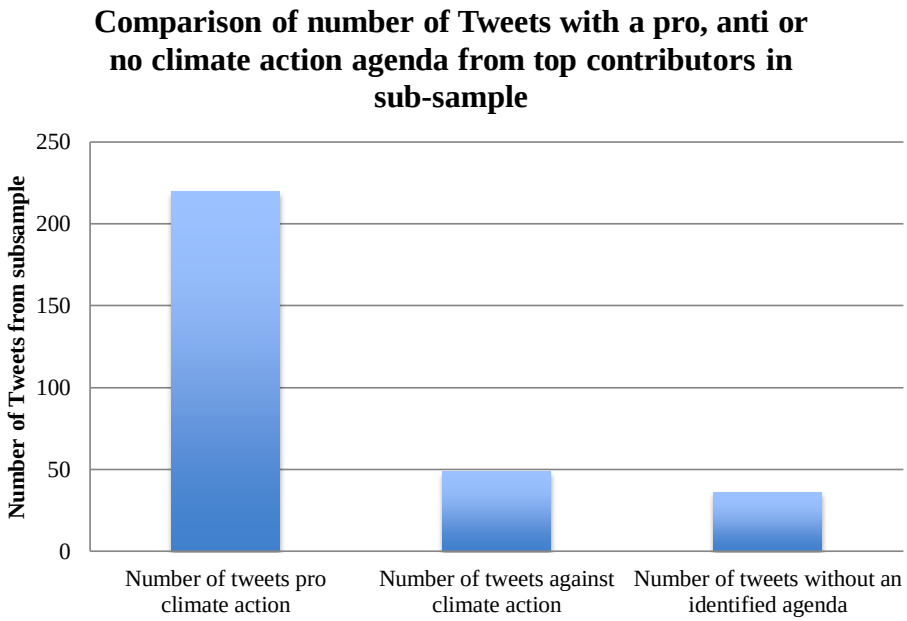

Figure 2. Comparison of contributions for, against or neutral about climate action from most active Twitter users in subsample (n = 1000).

The second example above referring to falsified models was from the most active climate sceptic in this sample, who contributed 33 tweets out of the 1000 taken — the second highest number of tweets collected. Their user description on Twitter laments the downfall of science in order to "…serve the myth of man-made global warming".

The biggest contributor to the climate related tweets collected in this sub sample was an individual who started their personal description with "I believe climate change is a real and present danger…" This individual had 140 tweets collected in this sub sample, far greater than the 33 tweets from the climate sceptic described above. Overall, the positive contributors to the climate discussion on Twitter were much more active than the negative and neutral contributors, as shown in Figure 2.

RQ4: How did the main issues identified by mainstream media and polls differ to those most talked about on Twitter in the 2013 and 2016 elections?

During the 2016 election period the total number of tweets captured tracking #auspol was 1,418,987 of which 450,550 were original tweets. Using tweets per week we can compare this to the 2013 election as shown in Table 3. Although there were nearly double the number of tweets per week in 2016, the number of original tweets per week actually decreased by 13% (9,460). This is also reflected in a reduction in the proportion of original tweets in 2016.

The same keyword search terms were used for the tweets collected during the 2016 election. Similar results were seen with the economy the most prevalent issue (18,732) discussed, followed by climate change (8,737), education (8,452), health (5,496) and immigration (4,386). A comparison of the prevalence of tweets for each category in both campaigns is shown in Figure 3. Tweets about science in general were more common in the 2016 election with 3,088 original tweets collected. This

Table 3. Comparison of numbers and types of tweets between 2013 and 2016 Australian elections.

	2013	2016
Total tweets	647,539	1,418,987
Original tweets	369,099	450,550
Proportion of original tweets	57%	32%
Total tweets/week	130,000	203,000
Original tweets/week	73,820	64,360

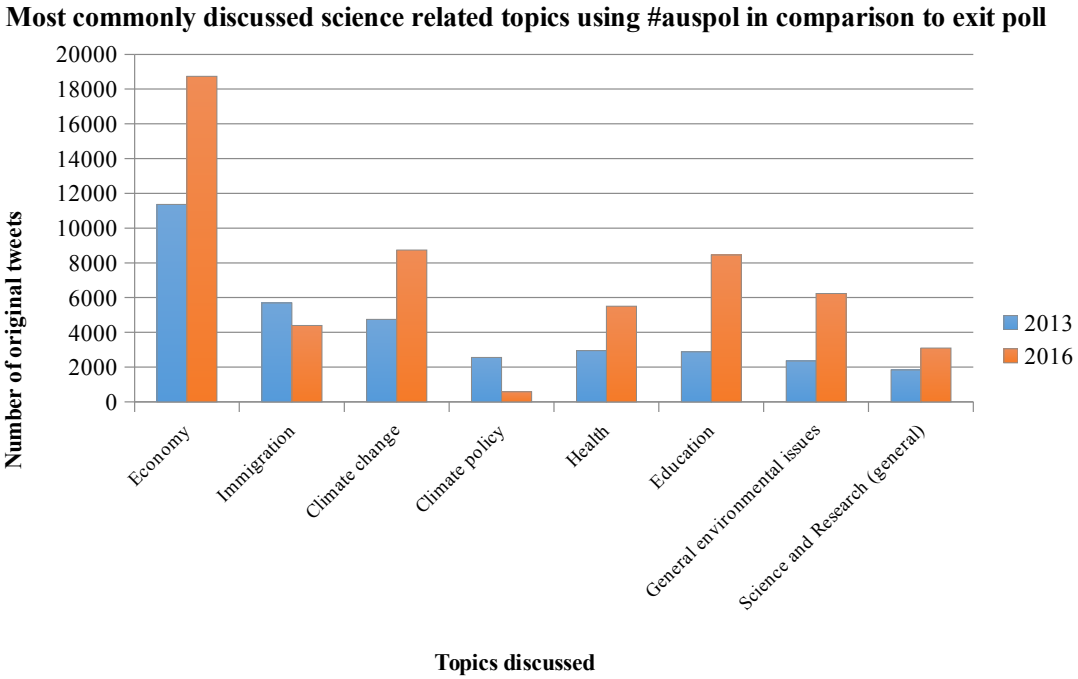

Figure 3. Most commonly discussed topics on Twitter using #auspol during the 2013 and 2016 pre-election periods.

represented just under 0.7% of the total sample. Tweets pertaining to climate change and climate policy comprised about 2% of the total 2016 collection.

Discussion

We examined the nature and interest of public discussion on Twitter regarding science issues in the 2013 and 2016 Australian Federal elections. In general, the 'popularity' of issues discussed on Twitter reflected the same trends captured in media round ups and the election exit poll with the economy dominating. Immigration was a major issue in 2013 [Australian Broadcasting Corporation, 2013; The Climate Institute, 2013], but less so in 2016 [Blumer, 2016]. Climate change and health were the most frequently tweeted about science issues, with climate change being the second most 'popular' issue on Twitter during the 2016 campaign. The topic of climate change also featured prominently in the tweets that specifically mentioned the word 'science'.

The prominence of climate change as a *science* issue in the #auspol conversation on Twitter is interesting as it did not feature prominently in traditional media coverage during the 2013 election campaign [Holmes and Farrant, 2013] beyond the economic arguments. However it is important to note that previous studies have not found a correlation between mass media coverage and Twitter [Murthy and Petto, 2015]. The Climate Institute's exit poll (2013) found that five percent of voters saw climate change as a major election issue. The same poll found that 13% of people believed health was a major issue. This was not reflected in the samples collected in this study, which showed about three times more tweets devoted to climate than health topics. This discrepancy is to be somewhat expected as previous research has shown that Twitter may not accurately reflect the political attitudes of the broader offline community [Jungherr, Jurgens and Schoen, 2012; Sang and Bos, 2012].

The tweets collected in the 2013 sample further differed from the traditional media coverage by containing more calls for science based policy and decision making, with eight percent of a subsample dedicated to commenting on the lack of science being used and discussed in the election campaign and formulation of policy. This could be an indicator of one of the potential powers of social media, to be used as "tools for citizens to speak out against public policy issues that affect them negatively, and to rally for change" [Sauter and Bruns, 2013, p. 28]. Certainly, Twitter users will discuss what they deem is salient [Jungherr, Jurgens and Schoen, 2012]. Whether or not Twitter was effective in this case is beyond the scope of this research, but the impact of social media on affecting change — either from community level to policy makers or vice versa — is an area worthy of further research.

Almost three quarters of tweets in the climate sub sample showed pro climate action sentiment, indicating that the majority of Twitter users in this conversation want action on climate change. The content of the tweets that were sceptical of climate change quite often fell into two groups: anti-science or anti-climate change science. The two groups, which comprised 20% of the sub sample, consistently discredited any messaging related to climate change being a real risk and/or requiring action. One potential explanation for this could be that the prediction of risk from climate change is simply too complex and uncertain, leading the public to dismiss the issue [Nisbet, 2009]. Or that personal evaluations of political party leaders were shaping their views of climate change as described by Tranter [2011] given both party leaders were similarly (un)popular.

This is further supported by the later study of Buys and colleagues [2014], conducted within the year leading up to the 2013 election, who describe the "disillusionment. . . [as] characteristic of the broader public mood in Australia, which led to the election of a hung parliament" [pp. 185–186]. Irrespective of the reasoning, the results are similar to those of earlier studies, which show that despite scientific and educational institutions being the most trusted sources of information, the public can remain sceptical about some of the information they provide [Bulkeley, 2000] or mitigation strategies they propose [Miller, Bell and Buys, 2007]. The apparent diminished trust in scientists exhibited here, has been reported before [Hmielowski et al., 2014]. However there did not appear to be any scientists or scientific organisations captured in this study who were attempting to communicate on Twitter, and potentially build trust, with a politically engaged and motivated public.

The main contributors to the Twitter conversation in this sample were individuals, with one contributing more than 15% of the tweets related to climate change. We found that 75% of all tweets were contributed by just 10% of the most active users. Bruns and Burgess [2012] found that the top 10% of users contributing to the auspol hashtag were responsible for 90% of the tweets. The difference in our study may be due to the fact that our sample was taken during an election campaign, which attracted many more contributions to the #auspol conversation. Bruns and Burgess [2012] gathered approximately 850,000 tweets in 11 months, while we gathered nearly 650,000 in five weeks and over 1.4 million in seven weeks respectively.

The 2016 data set showed similar levels of discussion about the key electoral issues. The higher numbers reflect the longer duration of the campaign period but the percentages of 'science' tweets increased in 2016 in comparison to 2013. This could reflect the cuts that the government had made, and would likely make again, to some of the key scientific organisations [McMah, 2016]. The 2016 survey from The Climate Institute showed an increase in public concern about climate change and its impacts, up from 53% in 2013 to 72% [The Climate Institute, 2016]. However, there was no change in the percentage of climate tweets between the years, holding steady at 2%.

There is a significant change in the way in which people are participating in the #auspol conversation, with a lot more sharing of retweets in 2016 and fewer original contributions. This may be in part due to changes in the Twitter platform, with the introduction of the new comment retweet in 2015 [Shu, 2015]. Or it may reflect the kinds of political communities identified by Pearce and colleagues [2014] where users sharing similar views tended to show greatest connectivity. We echo Pearce and colleagues' [2014] call for further research into these connections in order to determine the potential for broader conversations between networks of differing opinion as a means of building greater understanding, especially about politicised scientific issues.

This study shows that tweets about climate are typically instigated, and dominated, by individual members of the public. This reinforces the earlier findings of Larsson and Moe [2012] who advocate Twitter as a means of allowing non-key players to have their say. We argue that social media is being under utilised by those that have the most to gain from its use. Using Twitter to communicate science could impact the public's perception and understanding of science [Brossard and Schefeule, 2013]. Certainly scientists communicating their work to the public via Twitter could be a means of de-stigmatising science and opening the way for public discussion [Hargittai and Litt, 2011]. Given the politicisation of climate change and the absence of scientific discourse being used to drive policy decisions, it would appear that there is a void which scientists and science communicators should be trying to fill, particularly those with a vested interest in climate change and mitigation strategies. A science policy discussion paper from 2011 states exactly this, exhorting government to encourage scientific organisations to communicate with the wider public "to increase democratic discourse in publicly funded science" [Harris and Meyer, 2011, p. 27]. The majority of users in this study want climate action, however there does not appear to be the same impetus for political change to support vested interests as has been seen in other studies [Adams, Lomax and Santarini, 2011; Runge et al., 2013]. Despite the obvious online public

support for climate action, no-one seems to be using Twitter to gauge public sentiment to drive more effective engagement, which others have deemed not only possible but a strength of Twitter [van der Meer and Verhoeven, 2013].

Limitations

The main limitation of 'hashtracking' is that it does not capture the follow-on individual responses to specific tweets that do not include the hashtag, most commonly in reply to specific @user(s). The dataset can be used nevertheless to observe the content of leading contributions within the topic of discussion and to subsequently form baseline observations [Bruns and Burgess, 2012]. Another factor for consideration is the potential for results to be confounded by spamming. The public nature of Twitter makes it a prime target of spamming and other common methods of political manipulation including frequent re-tweets. By excluding re-tweets from our sample we have minimised some, but not all, potential confounding.

The collection of tweets from the Twitter streaming API was part of a larger sampling program that included a number of other keywords. This may have adversely affected our results as Morstatter et al. [2013] found results could be negatively influenced by increased amounts of activity matching the streaming parameters. One effect was the loss of some tweets. Although the number of tweets to the auspol hashtag was relatively small, the sampling of other keywords caused some tweets to be dropped — we have no way of knowing how many.

Conclusion

We set out to examine the prominence of scientific issues — especially climate science — on Twitter during the 2013 and 2016 federal elections. The topics discussed on Twitter reflected the major issues identified in exit polls and the mainstream media. Economic issues dominated with climate change mitigation the most prominent scientific issue, although garnering less attention. The majority of users that did tweet about climate issues however, were supportive of action to mitigate climate change impacts, a sentiment not seen in mainstream media. We propose that future studies examine the potential of Twitter to shape change at a policy level, and to influence media focus on issues.

Our results indicate that advocacy for science-based policymaking was not successful in engaging a majority of the public audience on Twitter during the 2013 and 2016 elections. Scientists and science communicators were noticeably absent from our sample, despite recognition that Twitter is prevalent in political engagement [Conover et al., 2011] and could be used to better engage with the public on scientific issues [Hargittai and Litt, 2011; van der Meer and Verhoeven, 2013]. Twitter as a tool for science communication will only be as effective as the people using it. We urge scientists and science communicators to be more proactive in this space and to explore the potential role that Twitter may have in facilitating greater public participation in politics and discussion about key scientific issues.

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References

Adams, A., Lomax, G. and Santarini, A. (2011). 'Social media & stem cell science: examining the discourse'. *Regenerative Medicine* 6 (6), pp. 121–124. DOI: 10.2217/rme.11.82.

Anderegg, W. R. L., Prall, J. W., Harold, J. and Schneider, S. H. (2010). 'Expert credibility in climate change'. *Proceedings of the National Academy of Sciences* 107 (27), pp. 12107–12109. DOI: 10.1073/pnas.1003187107. PMID: 20566872.

Auer, M. R. (2011). 'The Policy Sciences of Social Media'. *Policy Studies Journal* 39 (4), pp. 709–736. DOI: 10.1111/j.1541-0072.2011.00428.x.

Ausserhofer, J. and Maireder, A. (2013). 'National politics on twitter'. *Information, Communication & Society* 16 (3), pp. 291–314. DOI: 10.1080/1369118X.2012.756050.

Australian Associated Press (3rd September 2013). 'PM steers clear of post-poll speculation'. *Australian Associated Press General News*.

Australian Broadcasting Corporation (2013). 'Vote Compass: The most important issues to voters'. URL: http://www.abc.net.au/news/2013-08-09/vote-compass-data-results-important-issues/4872896.

Bacon, W. (2013). *Sceptical Climate Part 2: Climate science in Australian newspapers*. URL: https://www.uts.edu.au/sites/default/files/Sceptical-Climate-Part-2-Climate-Science-in-Australian-Newspapers.pdf.

Baxter, G. and Marcella, R. (2012). 'Does Scotland 'like' This? Social Media Use by Political Parties and Candidates in Scotland during the 2010 UK General Election Campaign'. *Libri* 62 (2), pp. 109–124. DOI: 10.1515/libri-2012-0008.

Beacco, J.-C., Claudel, C., Doury, M., Petit, G. and Reboul-Touré, S. (2002). 'Science in media and social discourse: new channels of communication, new linguistic forms'. *Discourse Studies* 4 (3), pp. 277–300. DOI: 10.1177/1461445602004003020 1.

Blumer, C. (2016). 'Vote Compass: Issues by state and territory'. URL: http://www.abc.net.au/news/2016-05-13/vote-compass-issues-by-state-territory/7412718.

Bode, L. and Dalrymple, K. E. (2014). 'Politics in 140 Characters or Less: Campaign Communication, Network Interaction, and Political Participation on Twitter'. *Journal of Political Marketing*. DOI: 10.1080/15377857.2014.959686.

Borra, E. and Rieder, B. (2014). 'Programmed method: developing a toolset for capturing and analyzing tweets'. *Aslib Journal of Information Management* 66 (3), pp. 262–278. DOI: 10.1108/AJIM-09-2013-0094.

Brossard, D. and Schefeule, D. A. (2013). 'Science, New Media and The Public'. *Science* 339 (6115), pp. 40–41. DOI: 10.1126/science.1232329.

Brossard, D. (2013). 'New media landscapes and the science information consumer'. *Proceedings of the National Academy of Sciences* 110 (Supplement 3), pp. 14096–14101. DOI: 10.1073/pnas.1212744110. PMID: 23940316.

Bruns, A. and Burgess, J. (2012). 'Notes towards the scientific study of public communication on Twitter'. Paper presented at the Keynote presented at the Conference on Science and the Internet, Düsseldorf.

Bruns, A. and Highfield, T. (2013). 'Political Networks on Twitter'. *Information, Communication & Society* 16 (5), pp. 667–691. DOI: 10.1080/1369118X.2013.782328.

Bulkeley, H. (2000). 'Common knowledge? Public understanding of climate change in Newcastle, Australia'. *Public Understanding of Science* 9 (3), pp. 313–333. DOI: 10.1088/0963-6625/9/3/307.

Buys, L., Aird, R., Megen, K. v., Miller, E. and Sommerfeld, J. (2014). 'Perceptions of climate change and trust in information providers in rural Australia'. *Public Understanding of Science* 23 (2), pp. 170–188. DOI: 10.1177/0963662512449948. PMID: 23825246.

Clarke, S. and Greene, A. (26th June 2013). 'Environment policy: where the parties stand'. *ABC News Online*. URL: http://www.abc.net.au/news/federal-election-2013/policy/climate-change/.

Cogburn, D. L. and Espinoza-Vasquez, F. K. (2011). 'From Networked Nominee to Networked Nation: Examining the Impact of Web 2.0 and Social Media on Political Participation and Civic Engagement in the 2008 Obama Campaign'. *Journal of Political Marketing* 10 (1), pp. 189–213. DOI: 10.1080/15377857.2011.540224.

Conover, M. D., Goncalves, B., Ratkiewicz, J., Flammini, A. and Menczer, F. (2011). 'Predicting the Political Alignment of Twitter Users'. In: *Proceedings of 2011 IEEE Third Inernational Conference on Social Computing. Boston, MA, U.S.A., 9–11 October 2011*. DOI: 10.1109/PASSAT/SocialCom.2011.34.

Cook, J., Nuccitelli, D., Green, S. A., Richardson, M., Winkler, B., Painting, R., Way, R., Jacobs, P. and Skuce, A. (2013). 'Quantifying the consensus on anthropogenic global warming in the scientific literature'. *Environmental Research Letters* 8 (2), p. 024024. DOI: 10.1088/1748-9326/8/2/024024.

Doran, P. T. and Zimmerman, M. K. (2009). 'Examining the Scientific Consensus on Climate Change'. *Eos, Transactions American Geophysical Union* 90 (3), p. 22. DOI: 10.1029/2009EO030002.

Dudo, A. and Besley, J. C. (2016). 'Scientists' Prioritization of Communication Objectives for Public Engagement'. *PLOS ONE* 11 (2), e0148867, pp. 1–18. DOI: 10.1371/journal.pone.0148867.

Glover, J. (23rd November 2007). 'The lucky country?' *The Guardian Australia*. URL: https://www.theguardian.com/environment/2007/nov/23/climatechange.australia.

Golbeck, J., Grimes, J. M. and Rogers, A. (2010). 'Twitter use by the U.S. Congress'. *Journal of the American Society for Information Science and Technology* 61 (8), pp. 1612–1621. DOI: 10.1002/asi.21344.

Goode, L. (2009). 'Social news, citizen journalism and democracy'. *New Media & Society* 11 (8), pp. 1287–1305. DOI: 10.1177/1461444809341393.

Grant, W. J. (4th September 2013). 'Australia 2013: Not a very 'sciencey' election'. *The Guardian Australia*. URL: http://www.theguardian.com/science/political-science/2013/sep/04/australia-2013-science-policies.

Grant, W. J., Moon, B. and Busby Grant, J. (2010). 'Digital Dialogue? Australian Politicians' use of the Social Network Tool Twitter'. *Australian Journal of Political Science* 45 (4), pp. 579–604. DOI: 10.1080/10361146.2010.517176.

Hargittai, E. and Litt, E. (2011). 'The tweet smell of celebrity success: Explaining variation in Twitter adoption among a diverse group of young adults'. *New Media & Society* 13 (5), pp. 824–842. DOI: 10.1177/1461444811405805.

Harris, P. and Meyer, R. (2011). *Science Policy: Beyond budgets and breakthroughs. Discussion paper on enhancing Australian Government science policy*. URL: https://coombs-forum.crawford.anu.edu.au/sites/default/files/publication/coombs_forum_crawford_anu_edu_au/2013-08/science_policy_-_discussion_paper_-_final.pdf.

Hepburn, J. (23rd August 2010). *Australia's second climate change election*. URL: https://blogs.crikey.com.au/rooted/2010/08/23/the-world%E2%80%99s-second-climate-change-election/.

Hermida, A. (2013). '#JOURNALISM: Reconfiguring journalism research about Twitter, one tweet at a time'. *Digital Journalism* 1 (3), pp. 295–313. DOI: 10.1080/21670811.2013.808456.

Hmielowski, J. D., Feldman, L., Myers, T. A., Leiserowitz, A. and Maibach, E. (2014). 'An attack on science? Media use, trust in scientists, and perceptions of global warming'. *Public Understanding of Science* 23 (7), pp. 866–883. DOI: 10.1177/0963662513480091.

Holmes, D. and Farrant, B. (14th August 2013). 'Where is the scrutiny of 'the greatest moral challenge of our time'?' *The Conversation*. URL: http://www.theconversation.com/where-is-the-scrutiny-of-the-greatest-moral-challenge-of-our-time-17048.

Jaspal, R., Nerlich, B. and van Vuuren, K. (2016). 'Embracing and resisting climate identities in the Australian press: Sceptics, scientists and politics'. *Public Understanding of Science* 25 (7), pp. 807–824. DOI: 10.1177/0963662515584287.

Jericho, G. (2012). The rise of the fifth estate: social media and blogging in Australian politics. Brunswick, Victoria, Australia: Scribe Publications Pty Ltd.

Jungherr, A., Jurgens, P. and Schoen, H. (2012). 'Why the Pirate Party Won the German Election of 2009 or The Trouble With Predictions: A Response to Tumasjan, A., Sprenger, T. O., Sander, P. G., & Welpe, I. M. "Predicting Elections With Twitter: What 140 Characters Reveal About Political Sentiment"'. *Social Science Computer Review* 30 (2), pp. 229–234. DOI: 10.1177/0894439311404119.

Kim, Y. (2011). 'The contribution of social network sites to exposure to political difference: The relationships among SNSs, online political messaging, and exposure to cross-cutting perspectives'. *Computers in Human Behavior* 27 (2), pp. 971–977. DOI: 10.1016/j.chb.2010.12.001.

Larsson, A. O. and Moe, H. (2012). 'Studying political microblogging: Twitter users in the 2010 Swedish election campaign'. *New Media & Society* 14 (5), pp. 729–747. DOI: 10.1177/1461444811422894.

McMah, L. (15th August 2016). *Job cuts, funding slashes prompt questions about future of CSIRO*. URL: http://www.news.com.au/technology/science/job-cuts-funding-slashes-prompt-questions-about-future-of-csiro/news-story/477272463cbbb519ba5118815a920dc8.

Miller, C. (2012). 'Dispatches. Twitter trumps science in trawler ban'. *Frontiers in Ecology and the Environment* 10 (9), pp. 456–460. DOI: 10.1890/1540-9295-10.9.456.

Miller, E., Bell, L. M. and Buys, L. (2007). 'Public understanding of carbon sequestration in Australia: Socio-demographic predictors of knowledge, engagement and trust'. *Australian Journal of Emerging Technologies and Society* 5 (1), pp. 15–33.

Mohammad, S. M., Kiritchenko, S. and Martin, J. (2013). 'Identifying purpose behind electoral tweets'. In: *Proceedings of the Second International Workshop on Issues of Sentiment Discovery and Opinion Mining (WISDOM-2013). Chicago, IL, U.S.A., August 2013*, pp. 1–9. DOI: 10.1145/2502069.2502070. arXiv: 1311.1194.

Moon, B. (2012). *tStreamingArchiver v. 1.02*. URL: https://github.com/brendam/tStreamingArchiver.

Morstatter, F., Pfeffer, J., Liu, H. and Carley, K. M. (2013). 'Is the sample good enough? Comparing data from Twitter's streaming API with Twitter's firehose'. In: *Proceedings of International AAAI Conference on Weblogs and Social Media (ICWSM).Boston, MA, U.S.A., July 2013*. arXiv: 1306.5204.

Murthy, D. and Petto, L. R. (2015). 'Comparing Print Coverage and Tweets in Elections: A Case Study of the 2011–2012 U.S. Republican Primaries'. *Social Science Computer Review* 33 (3), pp. 298–314. DOI: 10.1177/0894439314541925.

Nicholas, D. and Rowlands, I. (2011). 'Social media use in the research workflow'. *Information Services & Use* 31 (1–2), pp. 61–83. DOI: 10.3233/isu-2011-0623.

Nisbet, M. C. (2009). 'Communicating Climate Change: Why Frames Matter for Public Engagement'. *Environment: Science and Policy for Sustainable Development* 51 (2), pp. 12–23. DOI: 10.3200/ENVT.51.2.12-23.

O'Neill, S., Williams, H. T. P., Kurz, T., Wiersma, B. and Boykoff, M. (2015). 'Dominant frames in legacy and social media coverage of the IPCC Fifth Assessment Report'. *Nature Climate Change* 5 (4), pp. 380–385. DOI: 10.1038/nclimate2535.

Osterrieder, A. (2013). 'The value and use of social media as communication tool in the plant sciences'. *Plant Methods* 9 (1), p. 26. DOI: 10.1186/1746-4811-9-26.

Parmelee, J. H. (2014). 'The agenda-building function of political tweets'. *New Media & Society* 16 (3), pp. 434–450. DOI: 10.1177/1461444813487955.

Pearce, W., Holmberg, K., Hellsten, I. and Nerlich, B. (2014). 'Climate Change on Twitter: Topics, Communities and Conversations about the 2013 IPCC Working Group 1 Report'. *PLOS ONE* 9 (4), e94785. DOI: 10.1371/journal.pone.0094785.

Perez, F. and Granger, B. E. (2007). 'IPython: A System for Interactive Scientific Computing'. *Computing in Science & Engineering* 9 (3), pp. 21–29. DOI: 10.1109/MCSE.2007.53.

Peters, H. P. (2013). 'Gap between science and media revisited: Scientists as public communicators'. *Proceedings of the National Academy of Sciences* 110 (Supplement 3), pp. 14102–14109. DOI: 10.1073/pnas.1212745110. PMID: 23940312.

Readfearn, G. (5th September 2013). 'Australia's federal election just couldn't face up to climate change'. *The Guardian*. URL: https://www.theguardian.com/environment/planet-oz/2013/sep/05/australia-election-climate-change.

Runge, K. K., Yeo, S. K., Cacciatore, M., Scheufele, D. A., Brossard, D., Xenos, M., Anderson, A., Choi, D.-h., Kim, J., Li, N., Liang, X., Stubbings, M. and Su, L. Y.-F. (2013). 'Tweeting nano: how public discourses about nanotechnology develop in social media environments'. *Journal of Nanoparticle Research* 15 (1), pp. 1–11. DOI: 10.1007/s11051-012-1381-8.

Sang, E. T. K. and Bos, J. (23rd April 2012). 'Predicting the 2011 Dutch Senate election results with Twitter'. In: *Proceedings of the EACL Workshop on Semantic Analysis in Social Media (SASN 2012). Avignon, France, April 2012*, pp. 53–60.

Sauter, T. and Bruns, A. (2013). *Social media in the media: How Australian media perceive social media as political tools*. URL: http://www.cci.edu.au/socialmediainthemedia.pdf.

Shu, C. (6th April 2015). 'Twitter officially launches its "retweet with comment" feature'. *TechCrunch*. URL: https://techcrunch.com/2015/04/06/retweetception/.

The Climate Institute (2013). 'Election 2013: Exit polling factsheet'. URL: http://www.climateinstitute.org.au/verve/_resources/TCI_ExitPolling_Factsheet_September2013.pdf.

— (2016). 'Factsheet: Australian attitudes to climate change as captured in the lead up to the 2016 Federal election'. URL: http://www.climateinstitute.org.au/verve/_resources/TCI-Pre-Election-Polling-Factsheet.pdf.

Tranter, B. (2011). 'Political divisions over climate change and environmental issues in Australia'. *Environmental Politics* 20 (1), pp. 78–96. DOI: 10.1080/09644016.2011.538167.

Turnbull, M. (7th December 2009). 'Abbott's climate change policy is bullshit. Opinion'. *The Sydney Morning Herald*. URL: http://www.smh.com.au/federal-politics/political-opinion/abbotts-climate-change-policy-is-bullshit-20091207-kdmb.html.

van der Meer, T. G. L. A. and Verhoeven, P. (2013). 'Public framing organizational crisis situations: Social media versus news media'. *Public Relations Review* 39 (3), pp. 229–231. DOI: 10.1016/j.pubrev.2012.12.001.

Vargo, C. J., Guo, L., McCombs, M. and Shaw, D. L. (2014). 'Network Issue Agendas on Twitter During the 2012 U.S. Presidential Election: Network Issue Agendas on Twitter'. *Journal of Communication* 64 (2), pp. 296–316. DOI: 10.1111/jcom.12089.

Veltri, G. A. and Atanasova, D. (2015). 'Climate change on Twitter: Content, media ecology and information sharing behaviour'. *Public Understanding of Science*. DOI: 10.1177/0963662515613702.

Verkamp, J.-P. and Gupta, M. (2013). 'Five incidents, one theme: Twitter spam as a weapon to drown voices of protest'. In: *Proceedings of the Workshop on Free and Open Communications on the Internet (FOCI'13). Washington, D.C., U.S.A., August 2013*. URL: https://www.usenix.org/conference/foci13/five-incidents-one-theme-twitter-spam-weapon-drown-voices-protest.

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