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"We only have 12 years": YouTube and the IPCC report on global warming of 1.5°C

by Liliana Bounegru, Kari De Pryck, Tommaso Venturini, and Michele Mauri

Abstract

This article contributes to the study of climate debates online by examining how the *IPCC Special Report on Global Warming of 1.5°C* (*SR15*) played out on YouTube following its release in October 2018. We examined features of 40 videos that ranked the highest in YouTube's search engine over the course of four weeks after the publication of the report. Additionally, this study examines the shifting visibility of the videos, the nature of the channels that published them and the way in which they articulated the issue of climate change. We found that media activity around *SR15* was animated by a mix of professional and user-led channels, with the former enjoying higher and more stable visibility in YouTube ranking. We identified four main recurrent themes: disaster and impacts, policy options and solutions, political and ideological struggles around climate change and contested science. The discussion of policy options and solutions was particularly prominent. Critiques of the *SR15* report took different forms: as well as denialist videos which downplayed the severity of climate change, there were also several clips which criticized the report for underestimating the extent of warming or overestimating the feasibility of proposed policies.

Contents

Introduction

While print and broadcast media are classic objects of study in environmental research (see Downs, 1972; Boyce and Lewis, 2009; Boykoff, 2011; Painter, 2013), in the last few years Web sites and online platforms have come to occupy an increasingly important role in environmental, and particularly climate communication (for reviews of the large body of work on these topics see, *e.g.*, Pearce, *et al.*, 2018; Schäfer, 2012; Schäfer and Schlichting, 2014). If media represent "important arenas and important agents in the production, reproduction, and transformation of the meanings" of environmental issues [1], social media offer both new channels to communicate about climate change (Pearce, *et al.*, 2015) and new sites for social research (Marres, 2017; Rogers, 2013; Ruppert, *et al.*, 2013; Spartz, *et al.*, 2017).

Studies of climate communication on social media, however, have so far focused almost exclusively on Twitter (because of the ease to obtain and analyze its records) and neglected other popular platforms (Pearce, *et al.*, 2018). YouTube in particular appears as an understudied platform despite not only its popularity [2] but also the fact that even the platform itself has recently expressed concerns about the increasing activities of climate deniers (Hirji, 2018; see also Oreskes and Conway, 2010; Uscinski, *et al.*, 2017).

The handful of studies that have examined climate debates on YouTube have focused on the politicization of climate science especially around controversial issues, such as Climategate (Shapiro and Park, 2015; Porter and Hellsten, 2014) or in association with conspiracy theories such as those related to "Chemtrails" (Allgaier, 2016) and "Flat Earth" (Paolillo, 2018). These studies have generally focused on the most viewed videos and their comments (Porter and Hellsten, 2014; Shapiro and Park, 2018) as well as on search results (Allgaier, 2016). Previous work found that YouTube was useful in informing the public about climate change, but also cautioned against the tendency of the platform to increase polarization. As noted by Allgaier [3], "people and groups who oppose mainstream scientific positions already gained a strong

foothold on such channels and know very well how to use them to their advantage". These articles called for further research into how climate change is represented in YouTube's videos but also into the ways the platform shapes the issue through its technical affordances (Davis and Chouinard, 2016), including its search engine (Porter and Hellsten, 2014).

In this article, we investigate the articulation of climate change on YouTube focusing on the activity spurred by the publication of the *IPCC Special Report on Global Warming of 1.5°C* (*SR15*) [4]. The Intergovernmental Panel on Climate Change (IPCC) is a key actor in climate debates and an authoritative voice on climate science. Its publications represent major "focusing events" in the climate debate (Newman, 2017) and *SR15* was a keenly awaited report. Requested in 2015 in the Paris Agreement and strongly advocated by small island states for whom climate change poses an existential threat (Ourbak and Magnan, 2018), the report was issued on 8 October 2018, following a two-year writing process. For the first time, this process involved all three IPCC Working Groups (WG I on the physical basis; WG II on impacts, adaptation and vulnerability; and WG III on mitigation). *SR15* was meant to reopen the discussion about the 2°C target, by discussing the effects that could be avoided by preventing a warming beyond 1.5°C.

In line with the tendencies observed above, research on the IPCC and social media has so far mainly focused on Twitter, examining the users, media sources and frames that have animated discussions about IPCC reports, and in particular its Fifth Assessment Report (AR5) released in 2014 (O'Neill, *et al.*, 2015; Newman, 2017; Pearce, *et al.*, 2014; Holmberg and Hellsten, 2016). O'Neill, *et al.* (2015) for instance, found that WG I findings were more prominently discussed on Twitter than those from the two other WGs (a tendency also found in print and broadcast media by Kunelius and Yagodin, 2017). Newman (2017) showed that both elite (mainstream media sources) and non-elite actors (independent bloggers, concerned citizens and activists) were particularly active following the release of the WG I report. He also noted that the most frequently discussed sources came from mainstream media, thus challenging the common assumption that the advent of social media platforms has limited the influence of traditional media. Finally, Yagodin, *et al.* (2017) highlighted the communication tactics increasingly used by the IPCC to attract and shape media attention (*e.g.*, press releases and tweets). Their findings called for attention to an increasing media presence of scientific institutions (see Lewenstein, 1995; Peters, *et al.*, 2008).

In this article, we approached the study of climate change on YouTube with the following questions in mind: How did the release of *SR15* play out on YouTube? How was the debate influenced by the communication practices of the IPCC? Which actors and themes were most salient in this space? And finally, were positions that challenge the report prominently featured at the top of the search result rankings?

In this article we pursued a quali-quantitative approach (Latour, *et al.*, 2012; Venturini, *et al.*, 2015), in contrast to previous studies, which focused either on statistical analysis of metadata and textual features of large datasets (of tweets in particular) or on a dissection of a sample of online content. Through a combination of digital methods (Rogers, 2013) and close and distant readings (Moretti, 2013) of 40 videos that occupied the highest positions in YouTube's search ranking over more than four weeks, we sought insights on the state of the climate debate on a relatively understudied platform.

After presenting our overall approach and the research protocol we used in this study, we describe the communication strategy of the IPCC in general and in the specific context of the launch of its *SR15*. The core of the article is dedicated to the analysis of the highest ranked videos in YouTube's search engine, both in terms of their individual features and of their relative visibility. Finally, we explore the thematic framings present in our corpus and describe in detail the four most prevalent ones.

Research approach and method

Rather than focusing on a specific aspect of the *SR15* online discussion, our aim was to provide a broader account of the activities that the report prompted on YouTube. Instead of focusing exclusively on the content made available by the platform, its attention cycles, the actors intervening in the conversation or the capacity of the IPCC to shape online discussions, we tried to consider all of these aspects together in order to provide a more holistic picture of how climate change was articulated through YouTube's platform or device culture (Pearce, *et al.*, 2018; Weltevrede and Borra, 2016). We applied digital methods that allowed us to attend to how issues were shaped by the technical and economic features of online platforms as well as by the practices and cultures of those communities that populated them (Langlois and Elmer, 2013; Marres, 2017, 2015; Marres and Moats, 2015; Pearce, *et al.*, 2018).

In this article, we approached YouTube starting with its search engine (Rieder, *et al.*, 2018). While much research exists on YouTube's recommendation algorithm (*e.g.*, Matamoros-Fernández, 2017; Burgess and Matamoros-Fernández, 2016; Airoldi, *et al.*, 2016), less attention has been dedicated to its search algorithm, which is generally used simply as a tool to sample videos on a given topic (*e.g.*, Ache and Wallace, 2008; Basch, *et al.*, 2015; Keelan, *et al.*, 2007; Murugiah, *et al.*, 2011). In this article, besides using YouTube's search engine to identify top-ranked videos about *SR15*, we also explored the hierarchy of visibility produced by this ranking and we investigated its temporal fluctuations through exploratory visual techniques (Moats and Borra, 2018; Mauri and Ciuccarelli, 2016; Niederer, 2018).

In what follows, we focused in particular on the top results returned by the query [IPCC report 2018] with YouTube's default settings. The choice of research query was crucial, as in any digital methods project (Rogers, 2017). Since social actors often use different words in order to demarcate their position in public debates, choosing one keyword instead of another can privilege one position over others. In our case, a query using the full report title and even its short version (*i.e.*, [Special Report on Global Warming of 1.5°C]) returned highly specialized clips and favored certain professionalized and institutional expert cultures over broader societal engagement with the report. The report acronym, *SR15*, on the other hand,

was underspecified and prompted results about the SR15 rifle series. We thus agreed on the query [IPCC report 2018], which offered a convenient middle ground and was often suggested by Google Web Search as a "related" query for a number of terms associated with the report (thus suggesting its frequent use).

As we were less interested in tracing the immediate reactions generated by the report than in providing an overview of media activities after it reached relative stability, we started our data collection 10 days after the release of the report and continued it for four consecutive weeks, from 18 October to 18 November 2018 [5]. To examine fluctuations in ranking of videos over time, we collected the daily ranking of each video as well as various metadata (publication date, views count, number of comments, associated channels, etc.). Where available, transcripts of the videos were also collected.

Data was harvested through the "Search: list" endpoint of the YouTube API which "returns a collection of search results that match the query parameters specified in the API request" [6]. More specifically, we used the "Video List" module from a set of scripts that queried YouTube's API using its default settings, with the region code set to "US" and the results ranked by relevance (Rieder, 2015). By avoiding the personalisation and localisation encountered in the user interface, this approach offered a baseline appraisal of video ranking (Rieder, *et al.*, 2018). While we captured the first 100 results for each day, in this article we limited our analysis to a subset of the top 20 daily search results over the study period, resulting in a corpus of 40 unique videos.

YouTube is often presented as a space where professional video producers sit alongside amateur video creators, such as home video makers and vloggers. In reality boundaries between professional and amateur practices are blurred as video contributors span "a range of professional, semi-professional, amateur, and pro-amateur participants" [7]. With this challenge in mind, we attempted to understand the types of actors that performed best in the ranking and thus were more influential in articulating the issue of climate change on YouTube. Following Burgess and Green (2009), we examined whether a channel appeared to be institutional (*i.e.*, associated with established or emerging actors of the media industry, or with institutions and companies from other domains) or whether it appeared to be user-led (*i.e.*, associated with individual content producers that span the whole professional-amateur spectrum, including, semi-professional, pro-amateur, such as citizen journalists, lay experts, journalists and scientists). We also treated as user-led those channels that offered no explicit description but appeared to be set up by non-professional users, in the sense that they did not present an institutional affiliation or markers of professional content production.

Besides the level of professionalization, we also identified 13 clips containing some criticism of the report. Most of these videos did not reject the whole report, but rather challenged some of its conclusions (*e.g.*, the underestimation of climate-related risks or the proposed solutions). Only four videos in our corpus take overtly denialist positions refusing the existence of climate change or its anthropogenic causes.

Finally, we examined how climate change was thematically articulated on YouTube by considering titles, content and transcripts [8] to identify their most salient framings, *i.e.*, storylines "communicating why an issue might be a problem, who or what might be responsible for it, and what should be done about it" [9]. Because we worked with videos (and not just with textual documents encountered when studying public discussions on Twitter or in the blogosphere), we incorporated multimodal analysis (Jewitt, 2009; Kress and van Leeuwen, 2001). In accordance with this approach, we considered YouTube videos as layered multimodal constructions combining written and spoken language, static and moving images, diagrams and other resources.

We identified our thematic framings inductively through an examination of videos in our corpus but also took guidance from a list of frames developed by O'Neill, *et al.* (2015) in a study of the IPCC *Fifth Assessment Report*, as well as from the IPCC's own communication strategy (see the next section). Given their different genres, lengths and degrees of narrative complexity, videos elicited one or multiple thematic readings. We focused our analysis on the most recurring framings: Disaster and impacts (DI), Policy options and solutions (POS), Political and ideological struggle (PIS) and Contested science (CS) (Table 1).

	Disaster and impacts (DI)	Policy options and solutions (POS)	Political and ideological struggle (PIS)	Contested science (CS)
Framing	Unprecedented rise in global average surface temperature; potential impacts are multiple and dire, posing a threat to all aspects of human and non-human life. Humanity is not well prepared to	Discussion of policy options and solutions available to tackle climate change.	Focus on the political context in which IPCC reports are produced and released, highlighting conflicts over strategies to address climate change. Climate debate is presented as	This frame has two manifestations: 1) claims that there is not enough scientific evidence on climate change; and 2) critiques of the IPCC for underestimating the degree of warming, or uncertainties about CDR techniques.

Table 1: Main features of the four most salient thematic framings in our corpus, building on O'Neill, *et al.* (2015).

	respond and worsening impacts could become a threat to human security.		a battle for power within nations, and between nations, communities and individuals.	
Typical sources	*SR15* report, conference and press release, IPCC Bureau, scientists (*e.g.*, K. Anderson).	*SR15*, IPCC Bureau, report authors and other scientists, journalists and campaigners.	Theme often not explicitly sourced or referenced. Political figures, *e.g.*, J. Bolsonaro (Brazil), D. Trump (US) or S. Morrison (Australia).	1) Sceptical blogs (*e.g.*, whatsupwiththat), news articles and tweets (*e.g.*, by Lorrie Goldstein); deniers such as J. McLean, D. Peña and A. Watts; 2) Scientists such as M. Mann, G. McPherson and P. Wadhams on anomalies in temperature rise or M. Watson and H. Hunt on the feasibility of CDR.
Typical stories	Lists and images of severe impacts (sea level rise, ice melting, coral reef deterioration; extreme weather; migration; threat to energy, water and food security). Particular focus on discussion of differences in impacts between a rise of 1.5 or 2 degrees.	Discussion of solutions available and global percentage of emission reduction required (*e.g.*, 45 percent by 2030) as well as of individual and collective actions (*e.g.*, mitigation options, renewables, CDR, solar radiation management, adaptation, voting, behavioral changes, plant-based diets, sustainable transport).	Discussion of specific policies and disagreements over them (*e.g.*, carbon tax). Reference to ideological disputes (imperialism, deep state). Questioning the motives or funding of opponents; Reference to recent events, *e.g.*, D. Trump pulling out of the Paris accord and the election of J. Bolsonaro in Brazil.	1) Climate change has always happened (reference to medieval warm period and little ice age). 'Climategate' (showing "sloppy record keeping"; use of erroneous data by IPCC). The IPCC (and the UN) support "climate porn". 2) The IPCC is a conservative institution, it underestimates the level of warming already occurred ("even closer to climate disaster than IPCC predicts") and its scenarios rely on uncertain technologies (*e.g.*, CDR).
Visual imagery	Images of extreme weather events (*e.g.*, hurricanes), melting glaciers, forest fires, poor and vulnerable populations, floods, climate refugees, vulnerable plants and animals and refugee camps. Images of scientists and graphs of impacts, particularly showing the	Images of renewable energy fields, automobile traffic, techniques of CDR, dikes and graphs from the report.	Images of politicians making speeches. Images of climate protests.	Graphs of temperature rise and fall. Images of IPCC meetings. Images of Web sites, blog posts and reports that contest climate science. Images of news articles that are being questioned.

differences in impacts between 1.5 and 2 degrees.			

The IPCC communication strategy and *SR15*

The IPCC is an authoritative voice on climate change. It was established in 1988 under the auspice of the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) to provide assessment reports on the current state of knowledge on climate change and its potential environmental and socio-economic impacts. It is composed of three Working Groups which work under the supervision of the IPCC Bureau. The WGs conduct their activities thanks to the input of thousands of volunteer experts. The IPCC, as an intergovernmental organization, is open to governments that are members of the United Nations (U.N.) or WMO.

IPCC assessment reports feed into the negotiations under the United Nations Framework Convention on Climate Change (UNFCCC). *SR15* was intended as a key scientific input to the 24th Conference of the Parties (COP24) organized in December 2018 in Katowice, Poland. It was expected to provide inputs to the Talanoa Dialogue, a platform launched in 2018 to evaluate countries' steps towards avoiding dangerous climate change.

While originally a small and rather informal organization, the IPCC has progressively become more and more institutionalized and has increasingly adapted to an age of online communication and social media (Hickman, 2015). Outreach activities took center stage during the Third Assessment Report (AR3) in 2001 but remained confined to the maintenance of the official Web site, the organization of workshops and the attendance of UNFCCC meetings. At the time, the IPCC preferred to avoid responding to online and off-line criticism and misinformation campaigns (De Pryck, 2018). The IPCC communication strategy has been thoroughly revised after the 2009 controversies (Climategate and the errors found in AR4) as a response to the poor management of these disputes (InterAcademy Council (IAC), 2010; Beck, 2012). It has since pursued a careful management of the information that was displayed about its work, seeking to project an image of scientific objectivity and maintain (at least formally) a strict separation between science and politics (De Pryck, 2018). Since 2009, the organization has established a closer relationship with the media, in particular through the hiring of Jonathan Lynn, the IPCC's senior communication specialist (and former Reuters reporter). The organization has thus sought to gain greater influence on the coverage of its activities by media and has also become active on all major online platforms. Its YouTube channel was created in February 2011.

The IPCC is most visible around the release of its reports. To benefit from such visibility, it carefully orchestrates the launch of its reports. Regarding the release of *SR15*, the Secretariat issued a press release and organized a press conference. The communication focused on the dissemination of the main findings of the report and remained discreet about the negotiations that led to them. The press release of *SR15* ("Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C approved by governments") is a four-page document, which brings together excerpts from the "approved" language contained in the Summary for Policymakers (SPM — Intergovernmental Panel on Climate Change (IPCC), 2018a) of the report and statements by IPCC Bureau officials. The document opens by stating that "limiting global warming to 1.5°C would require rapid, far-reaching and unprecedented changes in all aspects of society. [...] With clear benefits to people and natural ecosystems, limiting global warming to 1.5°C compared to 2°C could go hand in hand with ensuring a more sustainable and equitable society [...]" [10]. It then describes the context through which the report was produced and offers a few key figures: the report has been written by 91 authors and contains 6,000 scientific references. The document acknowledges that the planet is already seeing the consequences of 1°C warming. It then underlines a number of effects that could be avoided by limiting global warming to 1.5°C (regarding sea level rise, ice cover in the Arctic Ocean and coral reefs). A key statement [11] is that "global net human-caused emissions of carbon dioxide (CO_2) would need to fall by about 45 percent from 2010 levels by 2030, reaching 'net zero' around 2050". Overall, the report remains positive about limiting warming to 1.5°C, which "is possible within the laws of chemistry and physics but doing so would require unprecedented changes".

The press conference was live-streamed on YouTube on 8 October 2018 from the IPCC's official channel (video number 24). The IPCC chair, Hoesung Lee, introduced the report by stating that "this is one of the most important reports ever produced by the IPCC and surely the most keenly awaited". Key findings from the report (mainly from the SPM) were presented by the co-chairs, following a narrative similar to the one from the press release (from the state of warming to impacts and policies): WG I co-chair Panmao Zhai noted that "at the current rate, global temperature is likely to reach 1.5°C between 2030 and 2052"; WG II co-chair Hans-Otto Pörtner presented the benefits of remaining below 1.5°C (fewer floods, heat, rainfall, etc.), noting that "every bit of extra warming makes a difference"; finally, WG III co-chair James Skea discussed the emission reduction technologies (including CDR), investments and behavioral changes needed to remain below 1.5°C.

Statements from the press release and press conferences were widely cited and discussed on YouTube and in other media, illustrating the influence of IPCC's communication in framing media coverage. For instance, the statement that the IPCC reviewed more than 6,000 scientific references was often used to highlight the rigor of the report's conclusions. The major impacts on sea level rise, coral reefs and the prospect of an Arctic Ocean free of sea ice in summer were also widely discussed. Only few videos (mostly

by amateur channels) went beyond the official press materials to discuss statements from the report itself.

Yet, as the next sections illustrate, the IPCC press release and press conferences were not the only reference materials used in YouTube videos. A widely cited phrase (possibly the most widely shared) was linked to an article published by the *Guardian* following the release of *SR15* (Watts, 2018), claiming that humanity had only 12 years to act on climate change. This headline was linked to two statements on the probability of reaching 1.5°C between 2030 and 2052 and on the need to reduce emissions by 45 percent by 2030.

Features of top ranking videos

In this section we begin to examine the 40 videos that featured in the top 20 results for the query [IPCC report 2018] describing their location, category, duration, format and authorship.

Location. All but three of the 40 videos are in English and more than a third of them have been published by channels based in the United States (U.S) (16 videos), not surprisingly given our English language query and that location is set by default to this region. Other countries that appear in our listing are: United Kingdom (U.K.) (5), India (4), Canada (3), Australia (1), Greenland (2), Sweden (1) and Qatar (1). Seven videos were issued by channels that do not specify their location.

Category. The majority of the videos (33 out of 40) were dedicated specifically to the *SR15* report, seeking to engage viewers in a debate about its implications for the climate debate. The seven remaining clips did not primarily address this report, but rather were focused on the IPCC or climate change more generally. According to YouTube's classification, more than half of the videos (23 out of 40) belonged to the category "news and politics". Other prominent categories were "science and technology" (6), but also "people & blogs" (5) and "education" (4). The top result in the first days of our study period (number 4 in Figure 1 below), for instance, was an education clip about the IPCC and its reports from an Indian Web site providing preparation for civil service exams.

Duration. Among the top results, we found productions of different lengths and nature. Contributions ranged from short clips of less than five minutes (12 videos) to videos lasting more than half an hour (six videos). While traditional media seemed to prefer short or medium durations, amateur and digital native videos were often more extensive — the longest video in our list was a 54-minute report from the alt-right climate skeptical channel Red Ice TV, taken down by YouTube on 17 October 2019 [12] (number 9), followed by another Indian educational video (number 40 — 51 minutes) and a long amateur interview of a former environmental scientist and known catastrophist, Guy R. McPherson (number 37 — 48 minutes).

Format. As for the video format, little less than half of the contributions (18) accorded with the classic television format of an anchor in discussion with one or more reporters or interviewees, while the other half (19) were simpler videos with a single narrative voice (the remaining clips are the IPCC press conference and two collages of existing video footage). The distinction between these two formats overlaps largely with that between channel types, featuring an even distribution of professionalized channels (associated with media industry, scientific institutions, popular science producers or advocacy organizations) and less professionalized or amateur content creators (from scientists, to "preppers," to video creators). Not surprisingly, professional news productions tended to rely on the anchor-based format, while most user-generated contributions were single-voice videos. The separation between the two types of videos however, was far from clear cut, as amateur channels often employed content from professional news in their production and sometimes simply re-posted professional news content.

Authorship. Having a closer look at professional news producers, the channels in our list spanned from established news brands associated with traditional media organizations (such as CNN and the BBC), to small and medium sized news producers such as digitally native news brands (*e.g.*, *The Young Turks*), independent producers and nonprofits (*e.g.*, *Democracy Now*), and alternative news producers (*e.g.*, *Red Ice TV*). The variation was even larger amongst user-led channels, which ranged from semi-professional initiatives, which published videos regularly, featured a good quality of sound and video recording, employed post-production editing and displayed a consistent format (*e.g.*, *ClimateAdam*) to less curated clips featuring a mere voice recorded over a static image (*e.g.*, *Going South*).

Visibility of top ranking videos

Shifting from the features of single videos to the dynamic ranking produced by the platform's search engine, Figure 1 provides an overview of the 'video space' generated on YouTube by the publication of *SR15*. In Figure 1, each line corresponds to one of the 40 videos in our listing, rising or falling according to the rank of the video in each of the 29 days of our study.
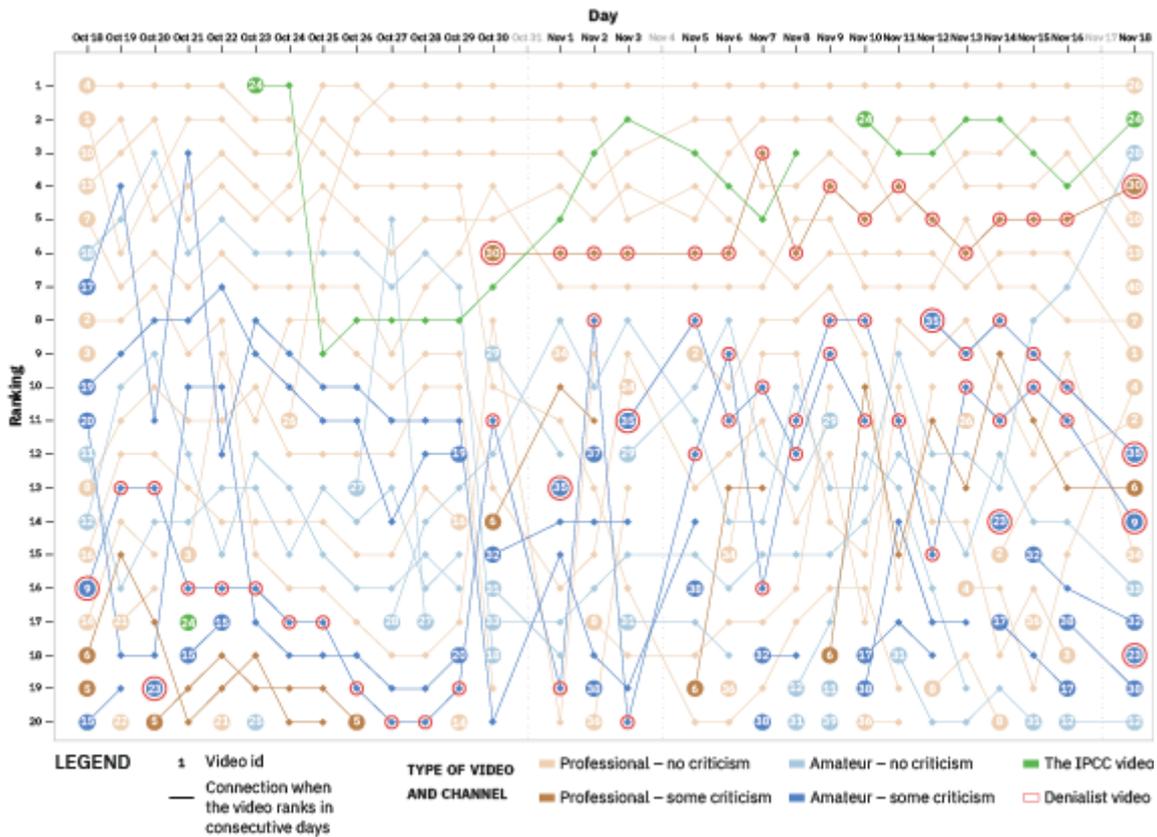
Figure 1: Rank flow visualisation of fluctuations in the top 20 results day by day. Video titles are given in table below.

Note: Larger version of Figure 1 available here.

1	Why we're heading for a 'climate catastrophe' — BBC Newsnight	21	Watch the US stall on climate change for 12 years
2	What Earth Will Look Like In 2040	22	#IPCC Report about #ClimateChange on BBC Breakfast, 8 October 2018
3	Why a Half Degree Rise in Global Temperature Would Be Catastrophic	23	Mark Steyn — IPCC Official Admits Global Warming Is A Lie To Redistribute Wealth
4	IPCC Report on Climate Change 2018 — Current Affairs 2018	24	IPCC *SR15* Press Conference Live 8 October 2018
5	Climate Scientist: As U.N. Warns of Global Catastrophe, We Need a Marshall Plan for {...}	25	1.5 Degree Climate Limit: Small Number; Huge Consequences
6	Michael Mann: We Are Even Closer To Climate Disaster Than IPCC Predicts	26	Why the IPCC Report is so Scary
7	IPCC climate change report	27	26 October 2018 — *Hindu* Editorial News Paper Analysis — IPCC Report [...]
8	UN global warming report issues dire warning	28	IPCC Special Report 2018
9	New IPCC Report:	29	UN Report:

	Catastrophic Global Warming, We Only Have 12 Years (Again!)		Catastrophic Climate Change By 2030, Unless ...
10	IPCC's New Climate Report: We Could See Irreparable Damage by 2040	30	Many question IPCC climate change report
11	What is IPCC? | IPCC report on climate change Detail Study in Hindi [...]	31	Lets talk the IPCC Global Warming of 1.5°C Report!
12	We Have 12 Years to Act on Climate Change, IPCC Report Finds	32	IPCC's 2018 1.5°C Report: Deep State vs Deep Ecology
13	IPCC Released Its New Report on Climate Change & other topics [...]	33	Lets Talk IPCC Global Climate of 1.5C Report
14	Author of New IPCC Report Says She Still Has Hope	34	Landmark UN climate report warns time quickly running out | *Al Jazeera* English
15	EXCLUSIVE! Dr. Peter Wadhams on IPCC SR 1.5 Report (short version)	35	Climate Change, IPCC, Rigged Data sets — But we TOTALLY need a Carbon Tax?
16	Key points from the UN's Intergovernmental Panel on Climate Change report| ITV News	36	New climate change report issues stark warning
17	IPCC's 2018 1.5_C Report: An Insanely Deceptive Climate Report	37	Guy McPherson Discusses UN Climate Change Report & Trump Admin [...]
18	UN: Earth has 12 years to avert climate change catastrophe	38	Survivable IPCC projections based on science fiction — reality is far worse
19	Scott Morrison dismisses the 2018 IPCC report	39	Climate Change IPCC report Marr on Sunday
20	Initial Thoughts on IPCC Report — September 2018	40	Current Affairs: IPCC Special Report, 2018

Considering the overall pattern produced by the videos' shifting visibility, most of line crossings occur in the left and in the bottom of the chart. This pattern confirms Rieder, *et al.'s* (2018) suggestion that YouTube's visibility cycle is characterized by higher levels of variation in times of increased attention (in our case, around the release of the report). A couple of weeks after the release of *SR15*, the upper half of the ranking seemed to become relatively stable and in the final two weeks of the study only two new videos entered the rankings.

There are asymmetries between actor types and opinions when it comes to their position in the search results. Considering the color of lines in Figure 1, the top of the ranking appears to be dominated by professional and supportive sources (*i.e.*, the light brown lines representing scientific institutions, news channels, digital media producers and online education channels which endorse the report), with few user-led channels (*i.e.*, the blue lines) and few videos expressing critical views (*i.e.*, the darker lines) making it to the top positions. The only video containing skeptical views (number 30) that featured stably in the top 10 of our corpus was an interview with the director of *Power the Future*, a fossil fuel advocacy organization, produced by the American right-wing television channel *One America News Network* [13].

Videos from professional channels enjoyed more views, with an average number of views seven times higher than amateur channels (167,435 against 1,169,449, see also Figure 5 below). For example, one of the videos that enjoyed the highest stability in the top positions (stably occupying the first position from

27 October on) was a video released by a YouTube popular science channel called *Second Thought* (with around 100,000 views when it entered the ranking and over 270,000 at the end of the study period). The 10-minute-long video (number 26) started with ascertaining the authority of the IPCC ("when the IPCC issues a report, the world knows that it is the real deal") and then moved to explaining the findings of the report in greater detail drawing on the press release and the SPM.

In our case study, professional channels such as those of media and scientific institutions seemed to benefit from higher visibility (especially if one considers that less professionalized video production relied on these sources as well). Exceptions were videos number 17 and 18 (by the channels *Going South* and *Kristie Lu Stout*), which reached the third position in the first week of our study and video number 28 by Dave Borlace of the channel *Just Have a Think* that reached the same position at the end of our period. These three videos were very different, the first (number 17) was a video by a user from Greenland who criticizes the IPCC for underestimating climate risks, the second was a mere republishing of a CNN program, while the last discussed various graphs contained in the SPM, but then moved to challenge its optimistic conclusions ("the reality is that the IPCC aspiration [...] is extremely unlikely to be achieved").

The IPCC Press Conference (green line in Figure 1, number 24) was live-streamed on YouTube on 8 October and its position in the search results ranking varies over our study period from position 17 on 21 October, to the first place on 23 October. By the end of our study period the video had accumulated 12,170 views, becoming the 17th most viewed video in our corpus.

As YouTube itself indicates, top ranked videos are not necessarily the most viewed ones. A video with less than 100 views made it to the top 20 results (number 20). The video (by the Climate Deception Network, featuring Paul Beckworth) provided a preliminary analysis of some possible problems in SR15 and accused the IPCC of underestimating global warming by taking as a baseline for comparison the average temperature of the second half of the nineteenth century (and not of the eighteenth century as previously done). The video with the highest view count in our corpus (close to half a million) never made it over the sixteenth position in the ranking. A possible explanation for this discrepancy is that the video was not specifically dedicated to the subject of our query. The clip by the news and opinion Web site Vox (number 21) was a presentation of the U.S. position in climate change negotiations and it did not mention the IPCC report specifically in its title or description. *SR15* appeared only briefly towards the end of the clip.

Salient themes in top ranked videos

The videos varied in their length and complexity, from news reports that typically followed a three-frame narrative format (presenting the current state of warming, climate impacts and solutions) and were based mainly on IPCC material, to more complex commentaries which covered multiple themes and drew from multiple sources.
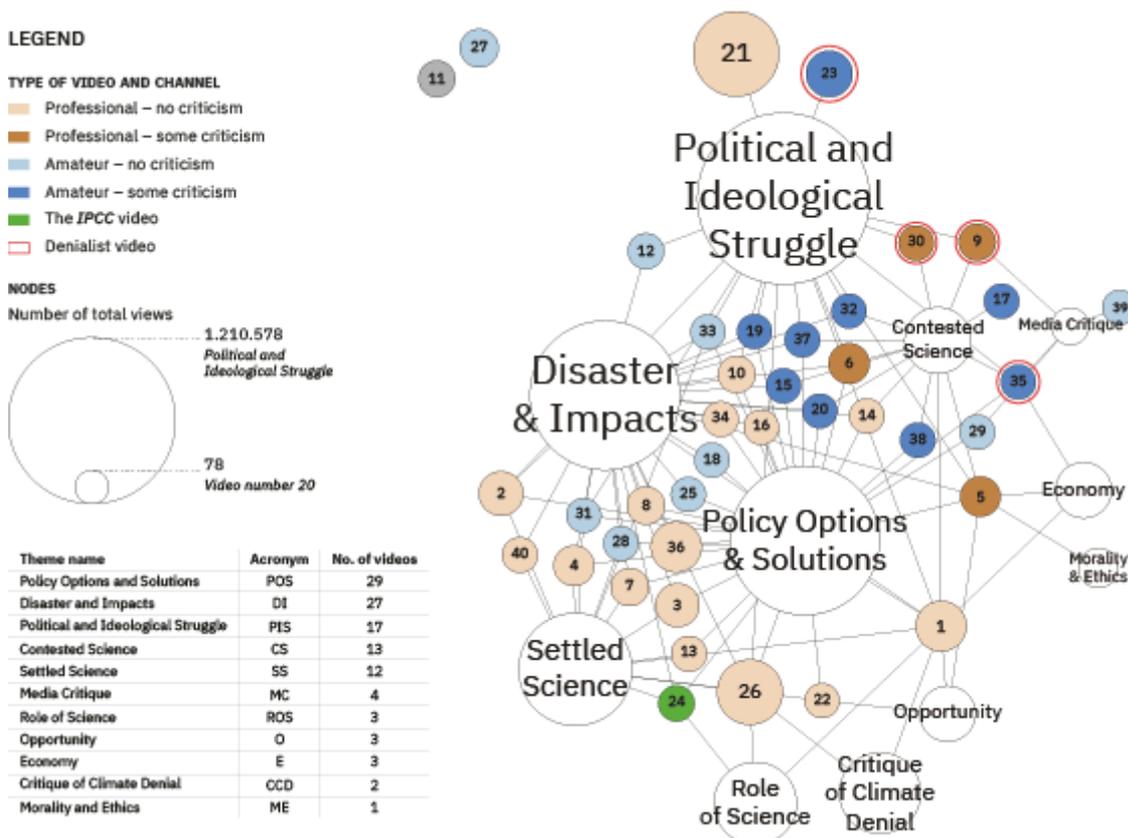

Figure 2: Network representation of relations between themes and videos. Themes are sized by the sum of views collected by the videos that feature them in our corpus and videos by the number of

views they obtain during our study period.

Note: Larger version of Figure 2 available here.

In Figure 2, we display a bipartite network of the 40 videos of our corpus in connection to the themes that feature in their narratives. Nodes representing the videos are colored according to whether they are issued by a professional (brown) or an amateur (blue) channel and their color is darker if they express critical views towards the report either because they find it either too or not sufficiently alarmist (denialist videos are marked with a red border). The size of the circles representing the videos is proportional to the number of views they collected during the period of this study. The size of the circles representing the themes is proportional to the sum of views collected by the videos that feature each theme. The number of videos that feature each theme is indicated in the table under the caption. The network is spatialized using a force directed algorithm that brings closer the nodes that are more directly or indirectly connected (Jacomy, *et al.*, 2014).

Overall, climate change was presented in videos through a catastrophic lens (Disaster and Impact — 27 videos) requiring urgent and unprecedented actions (Policy Options and Solutions — 29 videos). The contestation of scientific evidence (Contested Science — 13 videos) and the politicization of debates (Political and Ideological Struggle — 17 videos) were also often discussed. The theme Settled Science (SS — 12 videos), which underlined the scientific consensus about climate change, was also very present in our corpus. It was presented in the section dedicated to the IPCC communication strategy.

Figure 2 also reveals that, not surprisingly, "Political and Ideological Struggles" and "Contested Science" featured more prominently in videos featuring critical views and particularly in those by amateur channels (hence the proximity of the relative nodes in the network). Examining the figure, it is also possible to see that not all the videos marked as critical (darker nodes) were connected to the Contested Science theme. Two videos in particular criticize the IPCC report for political reasons: number 23 claimed that climate policies were in fact an excuse for global wealth redistribution and number 32 denounced the human-centric vision of the climate debate (as opposed to a deep ecology approach).

Disaster and Impacts (DI)

Disaster and Impacts (DI) appeared in 27 videos of our corpus and seemed to be particularly popular in professional videos (16 out of 21) as compared to half of amateur clips (11 out of 19). The conclusions of *SR15* are presented as a dire warning with impacts of climate change leading to potentially disastrous consequences on people and ecosystems. A distinctive storyline emerged concerning the effects that could be avoided by remaining within a 1.5°C of warming, in particular those impacts highlighted in the IPCC press release (on sea level rise, Arctic ice cover and coral reefs), but also increased droughts, floods and hurricanes. Some of the most prominent images included images of melting ice, floods and forest fires. When humans were involved, vulnerable communities and migrations were depicted.

Figure 3 is a montage of images extracted from the videos of the Disaster and Impacts (DI) theme. Images have then been cropped using as borders a Voronoi diagram built on top of the network of videos and themes. Examining the pictures, clusters emerged and have been annotated to better illustrate different typologies of images.

Figure 3: Montage of images related to disaster and impacts (DI) grouped by theme. The position of image clusters is based on co-occurrence in our corpus of videos.

Note: Larger version of Figure 3 available here.

To substantiate this theme a wide range of sources were mobilized, including IPCC press materials, but also the report and its Summary for Policymakers (SPM). Commentaries by influential media sources were also discussed, from the *Guardian* ("We have 12 years to limit climate change catastrophe, warns UN") and the *New York Times* ("Major Climate Report Describes a Strong Risk of Crisis as Early as 2040"). A recurrent translation of the conclusions of the report was that humanity has only 12 years to avoid catastrophic climate change, referring to the aforementioned story published in the *Guardian* (Watts, 2018).

This theme was especially prominent in the titles of the videos, which lured viewers' attention drawing on a sense of alarm (*e.g.*, "New climate change report issues stark warning", "Why we're heading for a 'climate catastrophe' — BBC Newsnight", "Why a Half Degree Rise in Global Temperature Would Be Catastrophic") and impending emergency ("UN: Earth has 12 years to avert climate change catastrophe", "Michael Mann: We Are Even Closer To Climate Disaster Than IPCC Predicts", "Landmark UN climate report warns time quickly running out | Al Jazeera English") [14]. The language was affective and alarmist: the report offered "a dire warning" (video number 36), delivering "more bad news" (number 36), and describing the potential "irreversible damage to the planet" (number 36), as "truly biblical" (number 26) and as "very scary stuff" (number 26). Apocalyptic statements were also recurrent: "the date of

complete destruction appears to be getting closer and closer" (number 2), "the inevitable collapse of human civilization" (number 32).

Fear-inducing representations of climate change such as the ones gathered under this theme are common in climate change communication, yet scholars have questioned their capability to engage the public (O'Neill and Nicholson-Cole, 2009) and encouraged a shift towards more positive conceptions of action (Marshall, 2014; Nordhaus and Schellenberger, 2007).

Policy Options and Solutions (POS)

While impacts have always been a common theme in the climate debate, mitigation and adaptation options have been less prominently discussed in both traditional and new media. The closest frame identified in previous studies revolved around the economic opportunities created by climate change (see Nisbet, 2009; O'Neill, *et al.*, 2015; Shapiro and Park, 2015). The prevalence of discussions of Policy Options and Solutions (POS) in our corpus was thus a novelty. Present in 29 videos, it was the most frequent among the themes we surveyed in all types of media production but particularly in professional videos, where it appeared in 17 clips out of 20.

Following the completion of the Paris Agreement in 2015, this shift saw discussions of solutions increasingly replacing debates about the reality and severity of climate change (De Pryck and Wanneau, 2017). The fact that *SR15* brought together for the first time the three IPCC Working Groups, allowing the discussion, in a single document, of both the physical and political dimensions of climate change, may have facilitated the prominence of this theme.
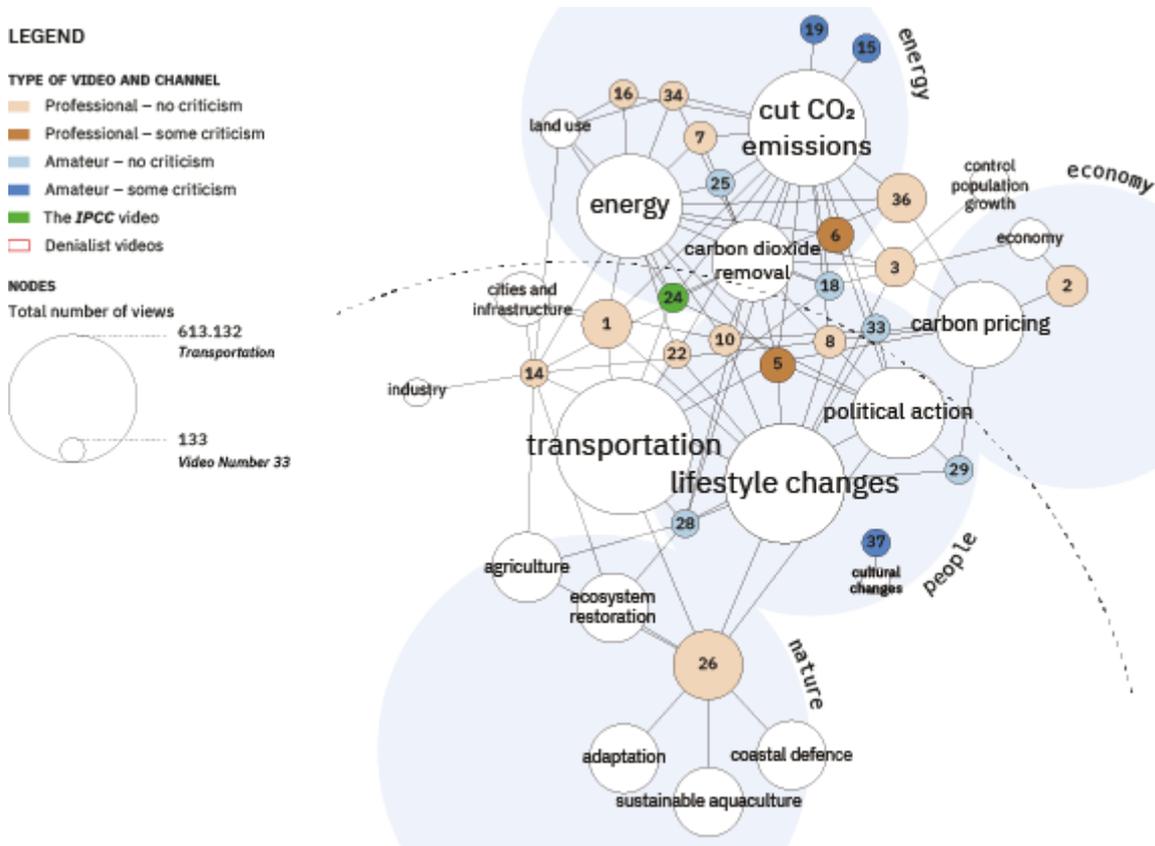

Figure 4: Bipartite network graph of videos and mentioned actions and solutions. Solutions are sized by the number of videos that mention them and videos by their view count.

Note: Larger version of Figure 4 available here.

Figure 4 above represents a network of the most salient terms connected to policy options and solutions employed in our corpus. Mitigation measures feature more prominently than adaptation ones and were widely discussed both from the perspective of energy transition and of life-style changes. A highly cited statement from *SR15* [15] is that emissions need to fall by about 45 percent from 2010 by 2030 reaching net zero by 2050. Policy options to achieve such goal include a variety of mechanisms for cutting carbon emissions, such as carbon pricing, the shift to renewable energy and techniques of carbon dioxide removal (CDR), such as carbon capture and storage and afforestation. While most videos followed the language of the report closely, the recourse to certain measures was also challenged (particularly carbon dioxide removal and carbon pricing). For instance, the user-led channel *CanadaPoli* (number 35) used the release of the report as an occasion to challenge the introduction of a carbon tax in Canada and to question the scientific evidence underpinning the reality of climate change (by references to denialist sources).

The construction of this theme most commonly relied on the report, its authors and other communication materials (*e.g.*, press release, statements and graphs, clips of IPCC officials making statements in the

press conference). Other sources included news articles, interviews with experts, advocacy organizations and campaigners, politicians, and tweets from various sources. Many videos went beyond IPCC press material to discuss individual and collective changes, including reduction in water consumption, adoption of plant-based diets and use of public transportation and electric vehicles. In user-led content productions, calls for action in the face of a perceived indifference by policymakers were particularly salient. Suggested actions included activism, voting for candidates that favor climate action and putting pressure on governments to adopt more climate-friendly policies. As noted by David Doel (number 29), "smart politics and activism is how we can actually collectively address the climate crisis".

Political and Ideological Struggle (PIS)

Present in 17 videos in both professionalized and user-led content, this theme may co-occur with the framing of climate change as contested (see next section). Political or ideological debates over climate change were discussed in reference to particular national contexts. For example, the video that was by far the most viewed in our corpus (number 21) was a clip by *Vox* reviewing the ambivalent position of the U.S. on climate change over the past 12 years, ending with the U.S. withdrawal from the Paris Agreement. Several videos discussed this decision, President Trump's position on climate change and the role of the fossil fuel industry in sustaining climate denial. Other recent political events that signaled possible internal struggles over climate policy included the election of Jair Bolsonaro in Brazil as well as political interference in Australia and Saudi Arabia in favor of CO_2 intensive industries. This theme generally followed presentations of the report's findings, as a discussion of political challenges to tackling climate change and the limits of individual action. For instance, the educational channel *Second Thought* (number 26) argued that "that truth of the matter is that we are largely at the mercy of world governments. [...] Even if every single individual did their part, it is still a tiny step in the right direction".

Another way in which this theme materialized in our corpus was through conspiratorial narratives, staging a conflict between the ideals of democracy and individual freedom, and the U.N. (including the IPCC). The latter were depicted as totalitarian, socialist or communist organizations plotting against democratic ideals. In a video with a substantial number of views and conspiratorial tones (number 23), Mark Steyn portrayed climate policies as a threat to democracy and exposed the supposed ideological motives behind the IPCC (and in particular WG III former co-chair, Ottmar Edenhofer), namely the global redistribution of wealth. A similar narrative was developed in an alt-right channel video (number 9) which stages U.N. environmental work as a threat to individual freedom and a pretext to controlling society. Finally, the video by the pro-Trump channel *One America News Network* (number 30) was centered around a conflict opposing U.S. energy industry to its competitors abroad as well as to the "collectivist worldview" incarnated by the U.N. and the IPCC.

On the other side of the spectrum, another conspiratorial narrative in our corpus presented the IPCC report as a manifestation of human-centrism: an effort to save the human world in its current industrialized form as opposed to saving the biosphere, in reference to the "deep ecology movement and philosophy" (number 32). The latter was positioned in response to what is termed "shallow ecology" and called for climate policy to be guided by "principles of diversity, complexity, autonomy, decentralization, symbiosis, egalitarianism, and classlessness" [16].

This theme was often not explicitly sourced or referenced, and it cannot easily be traced back to specific sources. Rather, sources mentioned in the two previous themes were generally challenged in this theme.

Contested Science (CS)

Finally, the theme Contested Science (CS) was present in 13 videos (seven by amateur channels and six by professional channels). Climate expertise was discussed from a variety of perspectives, including climate denialists denouncing alleged manipulations in data but also scientists criticizing the report for underestimating climatic impacts and the consequences of particular policies.

Contestation in this framing rarely addressed the anthropogenic nature of global warming or its threats. Only three videos assumed this minority position (videos number 9, 30 and 35). The narrating voices in these videos relied on well-known arguments portraying climate science as fraudulent or erroneous (in reference to Climategate, the Hockey Stick controversy and ClimateGate 2.0). In their view, climate science should not be trusted and should not serve as a basis to justify increased climate action. In the context of the release of SR15, they emphasized that scientists have been predicting disastrous impacts for many years (as suggested by the title of video number 9: "New IPCC Report: Catastrophic Global Warming, We Only Have 12 Years (Again!)"). To construct this narrative the videos relied on a number of different sources, from representatives of pro-energy groups, to videos featuring known climate deniers such as Anthony Watts and Richard Lindzen as well as posts from climate skeptical blogs such as wattsupwiththat.com and joannenova.com.au.

All other videos featuring this theme presented subtler or more interesting critiques. For example, several interviewees challenged the report for underestimating the amount of warming that the planet has already experienced (videos number 6, 14 and 20) by, *e.g.*, omitting some climate feedback mechanisms and the role of methane (videos number 15 and 38). As the debate about solutions took center stage, many commentators also questioned the feasibility of the transition that awaits society ("when it comes to what we have to do about it, [...] [the IPCC] runs scared of being really honest", video number 15) and, in particular, of the desirability and feasibility of carbon dioxide removal (CDR) as one of the most prominent technologies discussed in the report ("Research into developing it has been riddled with controversy, [...]. The bottom line is that we are basing our collective future safety on this planet on pure science fiction", video number 38).
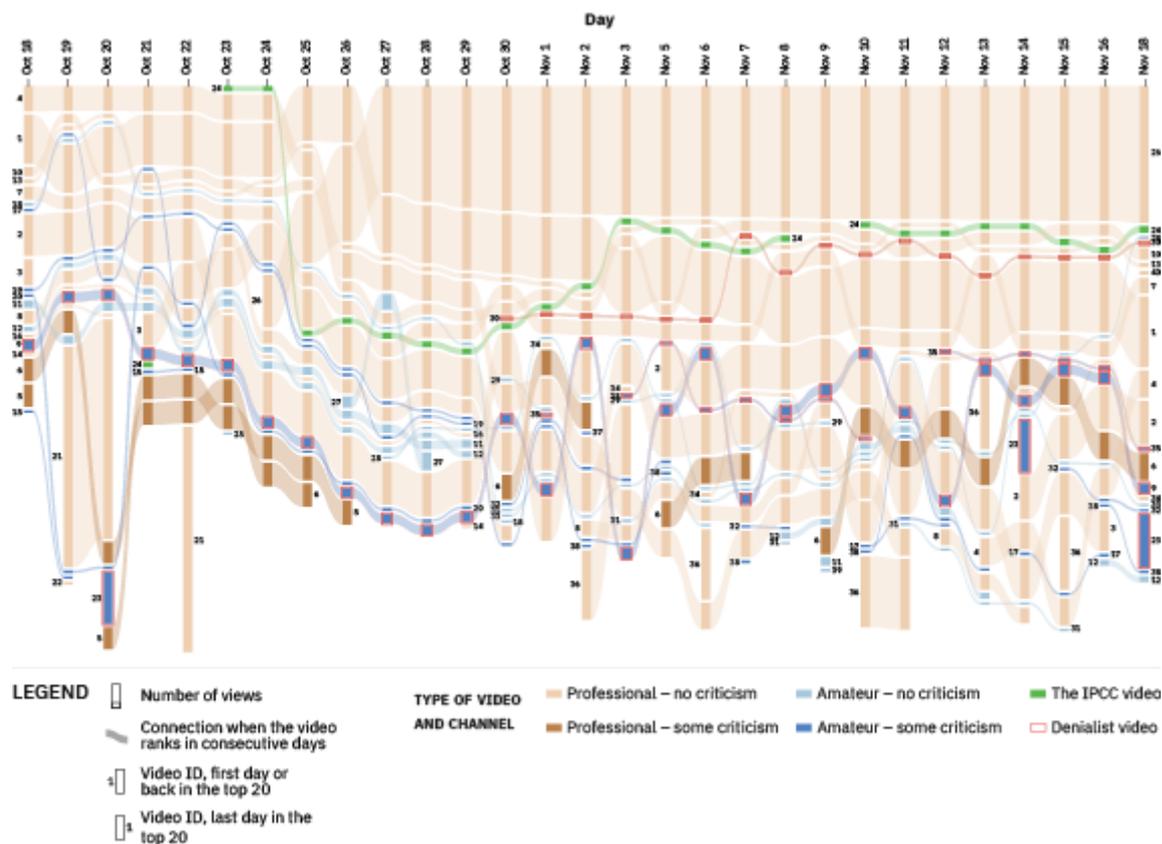
Figure 5: Rank flow chart of top 20 daily results over the studied period. The size of the flows is proportional to the number of views collected by each video during the period of our study. Clips that challenge the IPCC or its report are highlighted with darker colors (dark brown for professional video and dark blue for amateur videos).

Note: Larger version of Figure 5 available here.

The number of videos expressing perspectives that question or challenge aspects of the report remained stable over the period of this study, ranging between four and six days. Few videos made it to the top of the ranking and did not trigger high numbers of views. A notable exception in terms of ranking was the video produced by *One America News Network* (number 30), released on 19 October, which challenged the validity of the report and the financial interests of the IPCC. It entered the ranking on 30 October and maintained a stable presence at the top of the list until the end of our study period, although its view count remained low (2.602 on 18 November 2018). The video challenging the scientific evidence of the report with the highest number of views in our corpus (more than 19.000) was the video by alt-right channel *Red Ice TV* (number 9).

Conclusion

This article contributes to the understanding of the role of social media in the climate debate by examining how the IPCC Special Report on Global Warming of 1.5°C (*SR15*) was covered in YouTube videos. Our article makes a number of contributions.

First, while research into climate change and social media has so far been biased towards Twitter and limited to textual content, in this study we employed multimodal analysis, visual and quali-quantitative methods to examine media activity associated with the *SR15* report on YouTube. Secondly, analysis of the content of the videos was complemented with an analysis of the channels that populate the top of the ranking and their fluctuating visibility in YouTube's search engine rankings. Thirdly, we provided a detailed description of the communication strategy of the IPCC and explored how it is reverberated (or challenged) in our corpus.

In agreement with previous research on climate debate and social media, our investigation of YouTube's most visible videos revealed an extremely heterogeneous landscape composed of clips which differ widely in format, length and quality, ranging from well-curated collages of video footage and expert interviews by professional content producers, to videos shot with simple webcams or phone cameras. The producers of these videos were equally diverse, ranging from traditional media companies (such as CNN and BCC) and scientific institutions (such as IPCC and the Australian Academy of Science), to digitally native producers (such as *Seeker* and *Second Thought*) and amateur vloggers (such as *Jamarl Thomas* and *Just Have a Think*).

This does not mean a complete parity between professional and amateur channels. Professional channels were more stable and present in the highest positions in search ranking (especially after the media activity prompted by the *SR15* release had cooled down and search ranking stabilized) and tended to attract more views. They were also referenced as authoritative sources by less professionalized content producers. The IPCC itself, thanks to a carefully orchestrated communication strategy, succeeded in gaining high visibility on YouTube (both in terms of ranking and number of views) and in setting the tone for discussion. On the other hand, the most original and in-depth engagements with the report were often found in productions on amateur channels, which took more time to develop an analysis of *SR15*, often departing significantly from the official line established by the IPCC. Interestingly, we did not find any clips by established environmental NGOs in the top positions of YouTube's search ranking (unlike debates prompted by previous IPCC reports on Twitter, where they featured prominently).

Alongside the usual framing of climate change as a disastrous phenomenon, our analysis of the 2018 IPCC Special Report pointed to the emergence of a lively discussion about political and technical solutions as well as about ideological struggles, to a much larger extent than observed in previous studies. In spite of YouTube's efforts to curb misinformation, a few denialist videos still appeared. Interestingly, however, they were less visible than the opinions of experts who criticized the report for underestimating climate effects and for overestimating the efficacy of some proposed solutions (CDR in particular).

Future investigations could extend the thematic analysis and the question of visibility (in terms of views and search ranking) to investigate other features through which the platform organizes content, such as video and channel recommendations, as well as the way in which YouTube videos circulate and are embedded in other online spaces.

Finally and perhaps most importantly, the particular prominence of climate solutions and actions detected in our corpus demands further study. While the solutionist discourse observed in our corpus is still closely dependent on scientific notions conveyed by the IPCC report, following Jasanoff's (2010) sensibility towards "embedded experience", we encourage exploration of the role of social platforms in mediating the articulation of more participatory responses and possible solutions, as well as being mindful of the algorithmic mediation and economic logics of these platforms and devices. **FM**

About the authors

Liliana Bounegru is Lecturer in Digital Methods at King's College London. Previously she was a postdoctoral research fellow at the Oxford Internet Institute (University of Oxford). She is also a researcher at the Digital Methods Initiative (University of Amsterdam), research associate at the Sciences Po Paris médialab and founding member of the Public Data Lab.
Web: http://lilianabounegru.org/
E-mail: liliana [dot] bounegru [at] kcl [dot] ac [dot] uk

Kari De Pryck is a teaching assistant in political science at the Global Studies Institute at the University of Geneva. She completed her Ph.D. at the University of Geneva and Sciences Po Paris (Centre for International Studies).
E-mail: Kari [dot] DePryck [at] sciencespo [dot] fr

Tommaso Venturini is a researcher at Centre Internet et Société of CNRS. He is also associate researcher of the mdialab of Sciences Po Paris and founding member of the Public Data Lab.
E-mail: tomm [dot] venturini [at] gmail [dot] com

Michelle Mauri is a research fellow at Politecnico di Milano. He is one of the authors of RAWGraphs, an open source platform for data visualisation.
E-mail: michele [dot] mauri [at] mail [dot] polimi [dot] it

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Notes

1. Carvalho, 2010, p. 172.

2. As of January 2019, YouTube was the second largest social media platform by number of active users globally, according to statista.com.

3. Allgaier, 2016, p. 4.

4. The report's full official title is "IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty".

5. Data missing for 31 October and 4 and 17 November 2018. The three missing dates, however, should not have a great impact on our findings because of the relative stability of the rankings and the reduced scale of video production that enters the top of ranking over the studied period.

6. See https://developers.google.com/youtube/v3/docs/search/list.

7. Burgess and Green, 2009, p. 55.

8. We excluded from this analysis three videos that were not in English.

9. Nisbet, 2009, p. 15.

10. IPCC, 2018b, p. 1.

11. IPCC, 2018b, p. 2.

12. For more details see Media Bias/Fact Check's description of *Red Ice TV*: https://mediabiasfactcheck.com/red-ice-tv/. On YouTube removal of the channel see: https://www.mediamatters.org/white-nationalism/how-white-nationalist-red-ice-tv-working-around-its-youtube-ban.

13. For more details see Media Bias/Fact Check's description of *One America News Network*: https://mediabiasfactcheck.com/one-america-news-network/.

14. From the point of view of search engine optimisation, video titles are an important piece of content and metadata that shape matching of videos with user queries in search. When crafting video titles content creators are encouraged to align them with user interest and preferences by using services such as Google Trends and Google Ads Keyword Planner to identify popular keywords and queries related to their content. YouTube video titles thus may be seen as co-produced with search engine users. See https://creatoracademy.youtube.com/page/lesson/descriptions#strategies-zippy-link-6.

15. IPCC, 2018a, p. 14.

16. Naess, 1973, p. 95.

References

K.A. Ache and L.S. Wallace, 2008. "Human papillomavirus vaccination coverage on YouTube," *American Journal of Preventive Medicine*, volume 35, number 4, pp. 389–392.
doi: https://doi.org/10.1016/j.amepre.2008.06.029, accessed 20 October 2019.

M. Airoldi, D. Beraldo and A. Gandini, 2016. "Follow the algorithm: An exploratory investigation of music on YouTube," *Poetics*, volume 57, pp. 1–13.
doi: https://doi.org/10.1016/j.poetic.2016.05.001, accessed 20 October 2019.

J. Allgaier, 2016. "Science on YouTube: What users find when they search for climate science and climate manipulation," *ArXiv* (18 April), at http://arxiv.org/abs/1602.02692, accessed 1 April 2019.

C.H. Basch, C.E. Basch, K.V. Ruggles and R. Hammond, 2015. "Coverage of the Ebola virus disease epidemic on YouTube," *Disaster Medicine and Public Health Preparedness*, volume 9, number 5, pp. 531–535.
doi: https://doi.org/10.1017/dmp.2015.77, accessed 20 October 2019.

S. Beck, 2012. "Between tribalism and trust: The IPCC under the 'public microscope'," *Nature and Culture*, volume 7, number 2, pp. 151–173.
doi: https://doi.org/10.3167/nc.2012.070203, accessed 20 October 2019.

T. Boyce and J. Lewis (editors), 2009. *Climate change and the media*. New York: Peter Lang.

M.T. Boykoff, 2011. *Who speaks for the climate? Making sense of media reporting on climate change*. Cambridge: Cambridge University Press.

J. Burgess and A. Matamoros-Fernández, 2016. "Mapping sociocultural controversies across digital media platforms: one week of #gamergate on Twitter, YouTube, and Tumblr," *Communication Research and Practice*, volume 2, number 1, pp. 79–96.
doi: https://doi.org/10.1080/22041451.2016.1155338, accessed 20 October 2019.

J. Burgess and J. Green, 2009. "The entrepreneurial vlogger: Participatory culture beyond the professional-amateur divide," In: P. Snickars and P. Vonderau (editors). *The YouTube reader*. Stockholm: National Library of Sweden, pp. 89–107, and at http://www.kb.se/dokument/aktuellt/audiovisuellt/youtubereader/youtube_reader_052009_endversion.pdf, accessed 20 October 2019.

A. Carvalho, 2010. "Media(ted) discourses and climate change: A focus on political subjectivity and (dis)engagement," *Wiley Interdisciplinary Reviews: Climate Change*, volume 1, number 2, pp. 172–179.
doi: https://doi.org/10.1002/wcc.13, accessed 20 October 2019.

J.L. Davis and J.B. Chouinard, 2016. "Theorizing affordances: From request to refuse," *Bulletin of Science, Technology & Society*, volume 36, number 4, pp. 241–248.
doi: https://doi.org/10.1177/0270467617714944, accessed 20 October 2019.

K. De Pryck, 2018. "Expertise under controversy: The case of the Intergovernmental Panel on Climate Change (IPCC)," Ph.D. dissertation, Sciences Po — Institut d'études politiques de Paris, at https://medialab.sciencespo.fr/en/productions/2018-12-expertise-under-controversy-the-case-of-the-intergovernmental-panel-on-climate-change-ipcc, accessed 20 October 2019.

K. De Pryck and K. Wanneau, 2017. "(Anti)-boundary work in global environmental change research and assessment," *Environmental Science & Policy*, volume 77, pp. 203–210.
doi: https://doi.org/10.1016/j.envsci.2017.03.012, accessed 20 October 2019.

A. Downs, 1972. "Up and down with ecology — The 'issue-attention cycle'," *Public Interest*, volume 28, pp. 38–50, and at https://www.nationalaffairs.com/public_interest/detail/up-and-down-with-ecologythe-issue-attention-cycle, accessed 20 October 2019.

L. Hickman, 2015. "The IPCC in an age of social media," *Nature Climate Change*, volume 5, pp. 284–286.
doi: https://doi.org/10.1038/nclimate2528, accessed 20 October 2019.

Z. Hirji, 2018. "YouTube is fighting back against climate misinformation," BuzzFeed News (7 August), at https://www.buzzfeednews.com/article/zahrahirji/youtube-climate-change-denial, accessed 1 April 2019.

K. Holmberg and I. Hellsten, 2016. "Integrating and differentiating meanings in tweeting about the fifth Intergovernmental Panel on Climate Change (IPCC) report," *First Monday*, volume 21, number 9, at https://firstmonday.org/article/view/6603/5621, accessed 20 October 2019.
doi: https://doi.org/10.5210/fm.v21i9.6603, accessed 20 October 2019.

InterAcademy Council (IAC), 2010. "Climate change assessments: Review of the processes and procedures of the IPCC," at https://archive.ipcc.ch/pdf/IAC_report/IAC%20Report.pdf, accessed 19 April 2019.

Intergovernmental Panel on Climate Change (IPCC), 2018a. "Global warming of 1.5°C: Summary for policymakers," at https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf, accessed 1 April 2019.

Intergovernmental Panel on Climate Change (IPCC), 2018b. "IPCC Press Release. Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C approved by governments" (8 October), at https://www.ipcc.ch/site/assets/uploads/2018/11/pr_181008_P48_spm_en.pdf, accessed 1 April 2019.

M. Jacomy, T. Venturini, S. Heymann and M. Bastian, 2014. "ForceAtlas2, a continuous graph layout algorithm for handy network visualization designed for the Gephi software," *PLoS ONE*, volume 9, number 6, e98679.
doi: https://doi.org/10.1371/journal.pone.0098679, accessed 20 October 2019.

S. Jasanoff, 2010. "A new climate for society," *Theory, Culture & Society*, volume 27, numbers 2–3, pp. 233–253.
doi: https://doi.org/10.1177/0263276409361497, accessed 20 October 2019.

C. Jewitt (editor), 2009. *Routledge handbook of multimodal analysis*. London: Routledge.

J. Keelan, V. Pavri-Garcia, G. Tomlinson and K. Wilson, 2007. "YouTube as a source of information on immunization: A content analysis," *Journal of the American Medical Association*, volume 298, number 21 (5 December), pp. 2,482–2,484.
doi: https://doi.org/10.1001/jama.298.21.2482, accessed 20 October 2019.

G. Kress and T. van Leeuwen, 2001. *Multimodal discourse: The modes and media of contemporary communication*. London: Arnold.

R. Kunelius and D. Yagodin, 2017. "Attention, access and the global space of interpretation: Media dynamics of the IPCC AR5 launch year," In: R. Kunelius, E. Eide, M. Tegelberg and D. Yagodin (editors). *Media and global climate knowledge: Journalism and the IPCC*. New York: Palgrave Macmillan, pp. 59–80.
doi: https://doi.org/10.1057/978-1-137-52321-1_3, accessed 20 October 2019.

G. Langlois and G. Elmer, 2013. "The research politics of social media platforms," *Culture Machine*, volume 14, pp. 1–17, and at https://culturemachine.net/wp-content/uploads/2019/05/505-1170-1-PB.pdf, accessed 20 October 2019.

B. Latour, P. Jensen, T. Venturini, S. Grauwin and D. Boullier, 2012. "'The whole is always smaller than its parts' — A digital test of Gabriel Tardes' monads," *British Journal of Sociology*, volume 63, number 4, pp. 590–615.
doi: https://doi.org/10.1111/j.1468-4446.2012.01428.x, accessed 20 October 2019.

B.V. Lewenstein, 1995. "From fax to facts: Communication in the cold fusion saga," *Social Studies of Science*, volume 25, number 3, pp. 403–436.
doi: https://doi.org/10.1177/030631295025003001, accessed 20 October 2019.

N. Marres, 2017. *Digital sociology: The reinvention of social research*. Cambridge: Polity Press.

N. Marres, 2015. "Why map issues? On controversy analysis as a digital method," *Science, Technology, & Human Values*, volume 40, number 5, pp. 655–686.
doi: https://doi.org/10.1177/0162243915574602, accessed 20 October 2019.

N. Marres and D. Moats, 2015. "Mapping controversies with social media: The case for symmetry," *Social Media + Society* (30 September).
doi: https://doi.org/10.1177/2056305115604176, accessed 20 October 2019.

G. Marshall, 2014. *Don't even think about it: Why our brains are wired to ignore climate change*. New York: Bloomsbury.

A. Matamoros-Fernández, 2017. "Platformed racism: The mediation and circulation of an Australian race-based controversy on Twitter, Facebook and YouTube," *Information, Communication & Society*, volume 20, number 6, pp. 930–946.
doi: https://doi.org/10.1080/1369118X.2017.1293130, accessed 20 October 2019.

M. Mauri and P. Ciuccarelli, 2016. "Designing diagrams for social issues," *Proceedings of DRS 2016, Design Research Society 50th Anniversary Conference*, at http://www.drs2016.org/185, accessed 20 October 2019.

D. Moats and E. Borra, 2018. "Quali-quantitative methods beyond networks: Studying information diffusion on Twitter with the Modulation Sequencer," *Big Data & Society* (19 June).
doi: https://doi.org/10.1177/2053951718772137, accessed 20 October 2019.

F. Moretti, 2013. *Distant reading*. London: Verso.

K. Murugiah, A. Vallakati, K. Rajput, A. Sood and N.R. Challa, 2011. "YouTube as a source of information on cardiopulmonary resuscitation," *Resuscitation*, volume 82, number 3, pp. 332–334.
doi: https://doi.org/10.1016/j.resuscitation.2010.11.015, accessed 20 October 2019.

A. Naess, 1973. "The shallow and the deep, longrange ecology movement. A summary," *Inquiry*, volume 16, numbers 1–4, pp. 95–100.
doi: https://doi.org/10.1080/00201747308601682, accessed 20 October 2019.

T.P. Newman, 2017. "Tracking the release of IPCC AR5 on Twitter: Users, comments, and sources following the release of the Working Group I Summary for Policymakers," *Public Understanding of Science*, volume 26, number 7, pp. 815–825.
doi: https://doi.org/10.1177/0963662516628477, accessed 20 October 2019.

S. Niederer, 2018. *Networked images: Visual methodologies for the digital age*. Amsterdam: Hogeschool van Amsterdam, and at https://pure.hva.nl/ws/files/4959407/networked_images_1_.pdf, accessed 20 October 2019.

M.C. Nisbet, 2009. "Communicating climate change: Why frames matter for public engagement," *Environment: Science and Policy for Sustainable Development*, volume 51, number 2, pp. 12–23.
doi: https://doi.org/10.3200/ENVT.51.2.12-23, accessed 20 October 2019.

T. Nordhaus and M. Schellenberger, 2007. *Break through: From the death of environmentalism to the politics of possibility*. Boston: Houghton Mifflin.

S. O'Neill and S. Nicholson-Cole, 2009. "'Fear won't do it': Promoting positive engagement with climate change through visual and iconic representations," *Science Communication*, volume 30, number 3, pp. 355–379.
doi: https://doi.org/10.1177/1075547008329201, accessed 20 October 2019.

S. O'Neill, H.T.P. Williams, T. Kurz, B. Wiersma and M. Boykoff, 2015. "Dominant frames in legacy and social media coverage of the IPCC Fifth Assessment Report," *Nature Climate Change*, volume 5, number 4, pp. 380–385.
doi: https://doi.org/10.1038/nclimate2535, accessed 20 October 2019.

N. Oreskes and E.M. Conway, 2010. *Merchants of doubt: How a handful of scientists obscured the truth on issues from tobacco smoke to global warming*. New York: Bloomsbury Press.

T. Ourbak and A.K. Magnan, 2018. "The Paris Agreement and climate change negotiations: Small islands, big players," *Regional Environmental Change*, volume 18, number 8, pp. 2,201–2,207.
doi: https://doi.org/10.1007/s10113-017-1247-9, accessed 20 October 2019.

J. Painter, 2013. *Climate change in the media: Reporting risk and uncertainty*. London: I.B. Tauris.

J.C. Paolillo, 2018. "The Flat Earth phenomenon on YouTube," *First Monday*, volume 23, number 12, at https://firstmonday.org/article/view/8251/7693, accessed 20 October 2019.
doi: http://dx.doi.org/10.5210/fm.v23i12.8251, accessed 20 October 2019.

W. Pearce, S. Niederer, S.M. Özkula and N.S. Querubn, 2018. "The social media life of climate change: Platforms, publics, and future imaginaries," *Wiley Interdisciplinary Reviews: Climate Change*, volume 10, number 2, e569.
doi: https://doi.org/10.1002/wcc.569, accessed 20 October 2019.

W. Pearce, B. Brown, B. Nerlich and N. Koteyko, 2015. "Communicating climate change: Conduits, content, and consensus," *Wiley Interdisciplinary Reviews: Climate Change*, volume 6, number 6, pp. 613–626.
doi: https://doi.org/10.1002/wcc.366, accessed 20 October 2019.

W. Pearce, K. Holmberg, I. Hellsten and B. Nerlich, 2014. "Climate change on Twitter: Topics, communities and conversations about the 2013 IPCC Working Group 1 report," *PLoS ONE*, volume 9, number 4, e94785.
doi: https://doi.org/10.1371/journal.pone.0094785, accessed 20 October 2019.

H.P. Peters, D. Brossard, S. de Cheveigné, S. Dunwoody, M. Kallfass, S. Miller and S. Tsuchida, 2008. "Science-media interface: It's time to reconsider," *Science Communication*, volume 30, number 2, pp.

266–276.
doi: https://doi.org/10.1177/1075547008324809, accessed 20 October 2019.

A.J. Porter and I. Hellsten, 2014. "Investigating participatory dynamics through social media using a multideterminant 'frame' approach: The case of Climategate on YouTube," *Journal of Computer-Mediated Communication*, volume 19, number 4, pp. 1,024–1,041.
doi: https://doi.org/10.1111/jcc4.12065, accessed 20 October 2019.

B. Rieder, 2015. "YouTube data tools," at https://tools.digitalmethods.net/netvizz/youtube/, accessed 20 October 2019.

B. Rieder, A. Matamoros-Fernández and Ò. Coromina, 2018. "From ranking algorithms to 'ranking cultures': Investigating the modulation of visibility in YouTube search results," *Convergence*, volume 24, number 1, pp. 50–68.
doi: https://doi.org/10.1177/1354856517736982, accessed 20 October 2019.

R. Rogers, 2017. "Foundations of digital methods: Query design," In: M.T. Schäfer (editor). *The datafied society: Studying culture through data*. Amsterdam: Amsterdam University Press, pp. 75–94.
doi: http://dx.doi.org/10.25969/mediarep/12536, accessed 20 October 2019.

R. Rogers, 2013. *Digital methods*. Cambridge, Mass.: MIT Press.

E. Ruppert, J. Law and M. Savage, 2013. "Reassembling social science methods: The challenge of digital devices," *Theory, Culture & Society*, volume 30, number 4, pp. 22–46.
doi: https://doi.org/10.1177/0263276413484941, accessed 20 October 2019.

M.S. Schäfer and I. Schlichting, 2014. "Media representations of climate change: A meta-analysis of the research field," *Environmental Communication*, volume 8, number 2, pp. 142–160.
doi: https://doi.org/10.1080/17524032.2014.914050, accessed 20 October 2019.

M.A. Shapiro and H.W. Park, 2018. "Climate change and YouTube: Deliberation potential in post-video discussions," *Environmental Communication*, volume 12, number 1, pp. 115–131.
doi: https://doi.org/10.1080/17524032.2017.1289108, accessed 20 October 2019.

M.A. Shapiro and H.W. Park, 2015. "More than entertainment: YouTube and public responses to the science of global warming and climate change," *Social Science Information*, volume 54, number 1, pp. 115–145.
doi: https://doi.org/10.1177/0539018414554730, accessed 20 October 2019.

J.T. Spartz, L. Yi-Fan Su, R. Griffin, D. Brossard and S. Dunwoody, 2017. "YouTube, social norms and perceived salience of climate change in the American mind," *Environmental Communication*, volume 11, number 1, pp. 1–16.
doi: https://doi.org/10.1080/17524032.2015.1047887, accessed 20 October 2019.

J.E. Uscinski, K. Douglas and S. Lewandowsky, 2017. "Climate change conspiracy theories," In: H. Von Storch (editor-in-chief). *Oxford research encyclopedia of climate science*. Oxford: Oxford University Press.
doi: https://doi.org/10.1093/acrefore/9780190228620.013.328, accessed 20 October 2019.

T. Venturini, D. Cardon and J.P. Cointet 2015. "Méthodes digitales: Approches Quali/Quanti des données numériques — Curation and presentation of the special issue," *Réseaux*, number 188, pp. 9–21.
doi: https://doi.org/10.3917/res.188.0009, accessed 20 October 2019.

J. Watts, 2018. "We have 12 years to limit climate change catastrophe, warns UN," *Guardian* (8 October), at https://www.theguardian.com/environment/2018/oct/08/global-warming-must-not-exceed-15c-warns-landmark-un-report, accessed 19 April 2019.

E. Weltevrede and E. Borra, 2016. "Platform affordances and data practices: The value of dispute on Wikipedia," *Big Data & Society* (1 June).
doi: https://doi.org/10.1177/2053951716653418, accessed 20 October 2019.

D. Yagodin, M. Tegelberg, D. Medeiros and A. Russell, 2017. "Following the tweets: What happened to the IPCC AR5 synthesis report on Twitter?" In: R. Kunelius, E. Eide, M. Tegelberg and D. Yagodin (editors). *Media and global climate knowledge: Journalism and the IPCC*. New York: Palgrave Macmillan, pp. pp. 193–211.
doi: https://doi.org/10.1057/978-1-137-52321-1_9, accessed 20 October 2019.

Appendix

Note: Larger version available [here](#).

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