Out of the Flames

Mapping Online Engagement and Public Narratives Around the 2019 Amazon Rainforest Fires

Authored and edited by Liliana Bounegru, Jonathan Gray, Gabriele Colombo, Rina Tsubaki and Yitagesu Tekle Tegegne for the New Ways for Forest Governance project by the European Forest Institute

NewGo!
New Ways for Forest Governance

Authors and Contributors

This report was developed for [New Ways for Forest Governance (*NewGo!*)](#), a start-up project of the EFI's newly established Governance Programme, funded by the German Federal Ministry of Food and Agriculture (BMEL), and has been prepared and coordinated by a core team comprising:

We would like to thank King's College London MA students from the 2019-2020 digital methods class for joining us in exploratory work on this topic ahead of the start of this project.

About New Ways for Forest Governance (NEWGO!)

With support from

Federal Ministry
of Food
and Agriculture

by decision of the
German Bundestag

Table of Contents

1. Introduction

Digital technologies are transforming many aspects of collective life, including **science-society relations and communications**. The way people express their voices, gather information and construct knowledge is changing; people share opinions, interests and concerns using different digital objects such as hashtags, images and URLs on digital platforms. Whenever a forest-related event makes the news headline, social media platforms become flooded with messages, media and calls for action. Digital media can also shape and enable different kinds of engagements with forest issues, the roles and function of forests in collective life, and questions around forest futures, including how and by whom they should be managed and maintained.

Out of the Flames explores **online engagement and public narratives around forest-related issues**, driven by a case study on **the 2019 Amazon rainforest fires**. It examines how online platform users engage with issues relevant to forest governance and presents a range of digital methods and approaches that can be used to support learning about public engagement with forest-related issues.

This series of analyses have been carried out by the European Forest Institute and the Public Data Lab as part of the [New Ways for Forest Governance (*NewGo!*)](#), a project funded by the German Federal Ministry of Food and Agriculture (BMEL), undertaken as part of the EFI's newly established Governance Programme. This report provides an overview of the project's analytical approaches and the results from two exploratory analyses: **Twitter analysis** and **cross-platform image analysis**.

2. What is Out of the Flames?

Out of the Flames examines **how online publics engage with key global events associated with forests, forest issues and forest governance** and **how social media activities are involved in articulating different ways of relating to, experiencing and knowing about forests in society**.

It does so by taking the 2019 Amazon rainforest fires, one of the most globally mediatised forest fires of the recent past, as a case study. By analysing data from digital platforms including Twitter, Facebook, Google, Instagram and YouTube, it seeks to understand public narratives and forms of engagement, participation and

experience that emerge around this event at the peak of its international coverage in the second half of August and the first half of September 2019.

To demonstrate possible avenues for future research, two additional experimental media analyses, namely news source analysis and media discourse analysis, have been carried out using a corpus of news articles collected from the Twitter dataset. The former analysis focused on uncovering 'where science sits' in the media articles that have circulated on Twitter with the misleading claim, "*20% of the world's oxygen is produced in the Amazon*". The latter analysis explored the main narratives and discursive strategies employed in the most shared media articles on Twitter using the Discursive Agency Approach (Leipold & Winkel, 2016)[1]. These additional analyses will be made accessible on the *Out of the Flames* website (URL: http://amazonfires.publicdatalab.org/).

By exploring online public engagement, *Out of the Flames* aims to offer new insights about emerging online cultures and practices associated with forest-related issues. The analysis results have been used as prompts for further discussion and debate with researchers, journalists, policymakers and other experts to facilitate dialogue about the social lives of forests and complement expert knowledge with everyday perspectives on forests in society.

The following four analyses have been carried out under *Out of the Flames:*

1. **Twitter analysis,** using the English language data collected via the open-source Digital Methods Initiative Twitter Capture and Analysis Toolset (TCAT)[2]
2. **Cross-platform image analysis,** using image data from Twitter, Facebook, Google, Instagram, and YouTube
3. **News source analysis,** based on a corpus of articles compiled through a combination of social media engagement metrics and topical focus on a misleading statement (using "20%" "oxygen" as the query to collect data from TCAT)
4. **Media discourse analysis,** based on a corpus of media articles compiled through the social media analysis (top journalistic articles from the most shared URLs via the Twitter analysis)

---

[1] Leipold, S. and Winkel, G. (2017) Discursive Agency: (Re-)Conceptualizing Actors and Practices in the Analysis of Discursive Policymaking. Policy Stud J, 45: 510-534. https://doi.org/10.1111/psj.12172
[2] See E. Borra and B. Rieder (2014) "Programmed method: developing a toolset for capturing and analyzing tweets," Aslib Journal of Information Management, Vol. 66 Iss: 3, pp.262 - 278. http://dx.doi.org/10.1108/AJIM-09-2013-0094 and https://github.com/digitalmethodsinitiative/dmi-tcat

This report provides an overview of analyses outcomes and additional interpretations and insights from expert consultations for the **Twitter analysis** and **cross-platform image analysis**. From a series of analyses, we identified three distinct areas relevant to our main inquiry and summarised the key insights as Issue Stories, which can be accessed on the project website via the following links:

1. **Issue Story 1**: Emerging forest governance issues through hashtags (link)
2. **Issue Story 2**: Exploring the role of science online beneath the surface (link)
3. **Issue Story 3**: Tracing online recycling practices (link)

3. The 2019 Amazon rainforest fires

During the months of August and September 2019, the Amazon rainforest fires captured global attention. Celebrities, politicians and other public figures spoke up and shared their voices and concerns with hashtags on social media. While the Amazon rainforest fires became an international issue in 2019, far fewer debates and news stories have emerged in 2020 despite the situation becoming worse, surpassing the previous years. In 2020, not only did the number of fires show a 61% rise in September compared to the same month in the previous year, but the Pantanal wetlands in Brazil also faced a record-high number of fires. The fires in the Amazon are reported to have a strong link with deforestation driven by the global agricultural commodity trade. As the forest loss has significant impacts on soil moisture, the dry land is amplifying the severity of the fires every year. Therefore, the Amazon rainforest fires are not just a single event that happened in the past. They continue to exist as an issue that needs to be addressed globally and locally.

Despite these caveats, the 2019 Amazon rainforest fires make an interesting case study for many reasons. Firstly, the issue had been picked up quickly by the media and online once the smoke had plunged into Sao Paulo on 19 August 2019. To obtain different perspectives on the situation, we conducted interviews with 17 Brazilian and international journalists who followed the event. Interestingly, **all interviewees have pointed out that the smoke in Sao Paulo was one of the key events they recalled**. Due to the distance between the Amazon and urban areas, one of the journalists referred to this as the 'turning point' for media to rush to the affected areas for coverage. Yet, there were a number of other events in the lead up to it. Following the annual deforestation data release by INPE, the National Institute for Space Research in Brazil, the Bolsonaro government dismissed Ricardo Magnus

Osório Galvão as the INPE's director on 3 August 2019. The event was followed by the Day of Fire' (Dia do Fogo) on 10-11 August 2019 which many referred to as an event confidentially planned and illegally organised by the local ranchers and landowners for 'slash-and-burn' of the publicly owned forests in the state of Para. Secondly, the 2019 Amazon rainforest fires were surrounded by **political controversies**. For instance, Bolsonaro has widely supported agricultural businesses and industries such as cattle ranching, soybean farming and gold mining, accelerating deforestation in the Amazon. There was growing criticism towards the government within Brazil before the fires made it to the international media. *Panelaç*o, a form of protest where people bang pots and pans on their balconies, have been organised across different cities in Brazil, and hashtags such as #panelaco and #forabolsonaro have emerged on social networks in our analysis. There was also a tension between Bolsonaro and other heads of state both offline and on social networks. For example, Macron among other politicians responded on social media calling for a discussion of international aid at the G7 meeting. A series of criticisms between Macron and Bolsonaro followed which led to a 'war of words', as the [Guardian reported](#). Thirdly, the event has been widely picked up by celebrities including Leonardo DiCaprio and Cristiano Ronaldo. **Social media became an echo chamber** as these public figures shared messages. Fourthly, while many heads of state and celebrities gathered public attention, they also promoted **recycled images which could be construed as misleading**. This has led the news media to respond with fact-checking and debunking stories on the photos from past/unrelated events and the claim, "[20% of Earth's oxygen is produced in the Amazon](#)".

According to a number of Brazil-based journalists consulted in this project, environmental issues have not been a popular subject in the Brazilian media. Therefore, the 2019 event was the first time that the Amazon rainforest fires were widely reported nationwide. Many who were involved in reporting pointed out that the political climate has positively influenced them to focus on Amazon issues. Yet, those who have been following the deforestation issues closely and others following political matters indicated the growing difficulties in carrying out their journalistic work in Brazil, due to the limited access and the abundance of false and unverified information provided by the government. According to the consulted journalists, international media also widely reported the event, sending reporters to Brazil and the affected area. While the international media sparked national interests on the issue even further, some were conducting 'parachute journalism' without the background, context or local contacts. It is also noteworthy that various debunking efforts have been carried out by the international media, verifying the photos, videos and claims that have circulated on social media.

4. Social media analysis

4.1 Objectives, analytical approach and surfacing perspectives on #AmazonFires

The objectives of the social media analysis are two-fold. Firstly, we seek to understand the **actors, narratives, issues and practices that emerged around key Amazon rainforest fires hashtags on Twitter**, one of the key platforms where debates around the fires unfolded. The interest is in understanding why, how and for whom the Amazon forests matter according to activity around Amazon rainforest fires hashtags. Secondly, prompted by widely mediatised concerns about the circulation and impact of "misleading images" of the fires online, we seek to understand **the role that images play in narratives, practices and engagement around the Amazon fires across multiple social media platforms**.

To address these objectives, we employed "quanti-qualitative" social media analysis, specifically **Twitter image and text analysis** with **digital methods** (Rogers, 2013[3], 2019[4]; Caliandro & Gandini, 2016[5]) and **cross-platform image analysis** with **visual methods** (Colombo, 2019[6]; Rose, 2016[7]; Rogers, 2017[8], Niederer, 2018[9], 2019; Niederer & Colombo, 2019[10]).

The analyses are informed by **issue and controversy mapping approaches** developed in recent work in new media studies, digital science and technology studies (STS) and digital sociology (Marres, 2015[11], Venturini, 2010[12], Rogers, 2013, Marres & Moats, 2015[13]). Such approaches help address the question of what we can learn about an issue from its unfolding in online settings by using "digital techniques for the detection, analysis and visualisation of topical affairs" (Issue Mapping Online). It is an **empiricist style of inquiry** that seeks to suspend pre-existing assumptions about who and what constitutes the issue being investigated and instead follows how

---

[3] Rogers, R. (2013) Digital Methods. Cambridge: The MIT Press.

[4] Rogers, R. (2019) Doing Digital Methods. London: Sage Publications.

[5] Caliandro, A., & Gandini, A. (2016). Qualitative Research in Digital Environments: A Research Toolkit (1st ed.). London: Routledge.

[6] Colombo, G. (2019) Studying digital images in groups: the folder of images. In Rampino, L and Mariani, I. (Eds.) Advancements in Design Research. pp.185-196. Milano: Franco Angeli s.r.l. ISBN 9788891786197.

[7] Rose, G. (2016). Visual Methodologies. Fourth Edition. London: Sage Publications.

[8] Rogers, R. (2017). Digital methods for cross-platform analysis. In J. BurgessA. Marwick, & T. Poell (Eds.) The sage handbook of social media. pp.91-108. London: SAGE Publications

[9] Niederer, S. (2018). Networked Images: Visual methodologies for the digital age. Amsterdam: Amsterdam University of Applied SciencesISBN: 9789463012010

[10] Niederer, S., & Colombo, G. (2019). Visual Methodologies for Networked Images: Designing Visualizations for Collaborative Research, Cross-platform Analysis, and Public Participation. Diseña, (14), pp/40–67. https://doi.org/10.7764/disena.14.40-67

[11] Marres, N. (2015). Why Map Issues? On Controversy Analysis as a Digital Method. Science, Technology, & Human Values, 40(5), pp.655–686. https://doi.org/10.1177/0162243915574602

[12] Venturini, T. (2010). Diving in magma: how to explore controversies with actor-network theory. Public Understanding of Science, 19(3), pp.258–273. https://doi.org/10.1177/0963662509102694

[13] Marres, N., & Moats, D. (2015). Mapping Controversies with Social Media: The Case for Symmetry. Social Media + Society. https://doi.org/10.1177/2056305115604176

the issue is articulated and the role of digital media in producing (partial) accounts of the issue (Marres & Moats, 2015).

It is also a **participatory style of inquiry** which sees maps, visualisations and research outcomes as starting points for public debates about the issue at stake. To obtain contextual and background information about the event, semi-structured interviews with 17 issue experts consisting of Brazilian and international journalists, researchers and representatives from NGOs and fact-checking organisations have been conducted to collect key events including controversial/contentious issues.

The research framework for social media analysis has been developed by the Public Data Lab. It began with exploratory research undertaken with MA students in the "Digital Methods for Internet Studies: Concepts, Devices and Data" module at the Department of Digital Humanities, King's College London, as part of a pilot on "engaged research-led teaching". Based on the insights gained from the initial students' inquiries, the analytical approach has been iterated and defined through a series of data sprints. As part of a participatory approach to inquiry, subject matter insights and interpretations have been collected and incorporated by the European Forest Institute through a series of internal and external consultations. These engagement practices will be continued with a broader community of researchers, policymakers, journalists, and other forest governance experts to elicit different perspectives and insights.

The following set of inquiries has been conducted under the social media analysis:

- **Mapping voices, narratives and practices around Amazon fires hashtags on Twitter**
    - What are the most prominent hashtags per day associated with Amazon fires on Twitter?
    - How do hashtags associated with Amazon fires on Twitter relate to each other?
    - What kinds of voices are most active around #Amazonfires hashtags?
    - What types of actors are retweeted and @mentioned in relation to the Amazon fires?
    - What are the top retweets per day associated with Amazon fires on Twitter?
    - What are the most shared URLs per day associated with Amazon fires on Twitter?
    - What are the most shared domains per day associated with Amazon fires on Twitter?
    - What kinds of concerns are present in images associated with Amazon fires on Twitter?

- **Mapping prominent Amazon fires images across platforms (Twitter, Instagram, Facebook, YouTube and Google Images)**
    - What are the most shared images per platform? (Image grids)
    - What are the most shared images per platform? (Image stacks)
    - How are images and hashtags connected in tweets associated with misinformation?
    - How are images thematised and modified through the act of tweeting and retweeting?

Our exploratory research indicates how the Amazon fires have **surfaced many different relations between forests and various societal actors, issues, practices, politics, cultures and processes** – from bots to boycotts, agriculture to eco-activism, scientists to pop stars, indigenous communities to international concern.

The following section summarises the key results from the social media analysis, incorporating and layering into the interpretation gained through a series of consultations with 14 researchers, media, NGOs and forest practitioners with knowledge and expertise about the subject matter.

4.2 TWITTER ANALYSIS: Mapping voices, narratives and practices around Amazon fires hashtags on Twitter

4.2.1 Hashtags as devices for organising public engagement with forest fires

Many different claims have been made in the media about the role of hashtags in organising public engagement around the 2019 Amazon fires, such as the following news headlines:

- "the world's attention has been belatedly sparked with the hashtag #AmazonFires trending globally" – The Independent
- "The most viral photos of the #AmazonFires are fake" – Mother Jones
- "The hashtag #PrayForAmazonia went viral" – Common Dreams
- "Social media users concerned over the long-term environmental consequences of deforestation and fires in the Amazon region began the online campaign #prayforamazonia to bring awareness to the issue." – NBC News

Given this media interest, we took Twitter hashtags as a starting point for our investigation. We started with a

collection of 311,483 tweets containing one of the following hashtags: #ActForTheAmazon, #amazonfires, #AmazonRainforest, #PrayforAmazonia, #SaveTheAmazon, #SOSAmazonia, and covering the period of 24th August to 2nd September 2019 (10 days).

This period was chosen because it corresponds to a window of higher engagement on Twitter and other platforms, spanning from when we began capturing data to when activity drops off significantly, as indicated in the following graph. We then carried out 12 further lines of inquiry to understand the actors, narratives, issues and practices that emerged around key Amazon rainforest fires hashtags on Twitter.
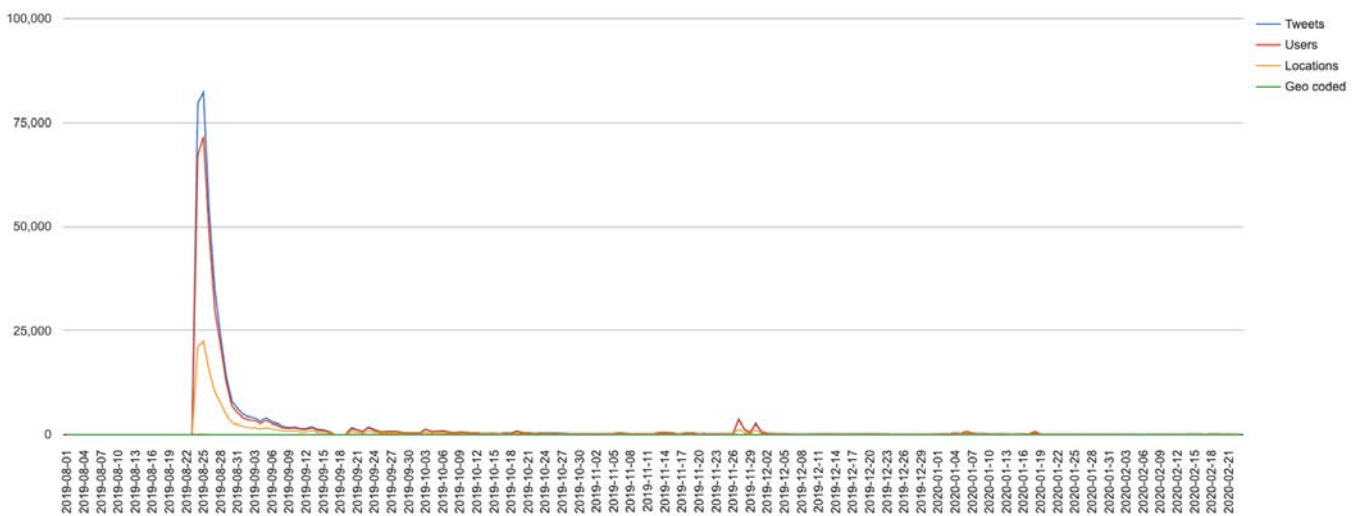
4.2.2 Tools

The data was collected with the Digital Methods Initiative Twitter Capture and Analysis Toolset (DMI-TCAT) and analysed with a number of software tools, including:

- Google Spreadsheets
- the data cleaning tool OpenRefine
- the data visualisation suite RAW Graphs
- the network analysis and visualisation tool Gephi

These have been chosen as they are readily available and accessible. We follow an approach to digital methods research based on breaking things down into documented, replicable steps, resulting in packages of material and recipes which other researchers, students and practitioners may use and build on in future projects.

4.2.3 What are the most prominent hashtags per day associated with Amazon fires on Twitter?

What we are looking at

Hashtags may serve as indicators of issues, concerns and formats of public involvement. This analysis assessed how different issues were brought together with the Amazon fires over the 10-day period when the event caught international attention. The method for this analysis can be found in Annex 1.

Findings

There are different (sometimes competing) ways of articulating the Amazon fires issue on Twitter with different affective dimensions and invitations to action (e.g. "pray" vs "save" vs "act"). For example, the most popular hashtag is initially #prayforamazonia (days 1-2), then #savetheamazon (day 3), before moving onto the more general framings of #amazonfires (days 4-8, 10) and #amazonrainforest (day 9).

There is a substantive drop-off in public attention over the course of the 10-day period. For example, there is a twenty-fold drop in the frequency of most engaged with the hashtag #prayforamazonia (34,216) on 25th August to most engaged with the hashtag #amazonrainforest (1,662) on 1st September. This gives a sense of the rhythm and temporality of online engagement around the hashtags.

The hashtags indicate **how the Amazon fires come to matter for different actors in different settings** and the materials and relations through which attention is invited and organised.

One can observe a wide variety of associated issues, including Amazon rainforest fires as:

- **Climate movement** (e.g. #climateaction, #climatecrisis, #climateemergency, #extinctionrebellion, #malizia)
- **Science** (e.g. #sciencematters, #sentinel2, #unitedbehindthescience, #nasa)
- **Environment** (e.g. #nature, #biodiversity, #deforestation)
- **Countries in the Amazonia** (e.g. #brazil, #bolivia, #sosbolivia)
- **Brazilian politics** (e.g. #bolsonaro, #bolsonaroensueur, #brazil, #illegitimatepresident, #forabol卐onaro)
- **US politics** (e.g. #trump, #yanggang, #fauxcahontas, #elizabethwarren2020)
- **Political tension between Macron and Bolsonaro** (e.g #Macron, #macronlies, #desculpabrigitte)
- **Intergovernmental event** (e.g. #G7, #g7summit, #g7biarritz, #cop24)
- **Trade bloc** (e.g. #mercosur)
- **Policy** (e.g. #greennewdeal)
- **Meat consumption** (e.g. #beef, #vegan, #govegan, #meatfreelaborday)
- **Money and financing** (#blackstone, #financing, #billionaires)
- **Unrelated disasters** (e.g. #africafires, #hurricanedorian)
- **Celebrity** (e.g. #armyhelptheplanet, #army, #방탄소년단, #boywithluv, #bts, #leonardodicaprio, #armypurpleearth, #yoshiki, #kamalhassan)
- **Religious figure** (e.g. #popefrancis)
- **Indigenous people** (#indigenous)
- **Media** (e.g. #msnbc, #rt, #afp)
- **Fact-checking/misinformation** (e.g. #fakenews)

Overall, there is a **strong association between the Amazon rainforest fires and national issues pertaining to Brazil, much more than other countries in the Amazon**. While the top 10 hashtags were mostly English, the top 100 show different language hashtags, mostly in Portuguese. They were mainly associated with **national politics,** representing **hashtags that criticise the Bolsonaro government** (i.e. #forabolsonaro, #forasalles, #panelaco, #calabocabolsonaro). A few other places in the Amazon (i.e. #bolvia, #sosbolivia, #soschiquitania) have also emerged but are less visible.

In addition, top hashtags corresponded to news events. G7-related hashtags (i.e. #g7, #g7summit, #g7biarritz, #g7france) started to appear in the top hashtag lists on 26 August 2019, precisely at the same time when 20 million USD emergency funding was announced at the G7 meeting.

Various heads of state participating in the meeting have appeared in the top hashtag lists. The most visible is the

French president **Macron,** who announced the [need to address the Amazon rainforest fires at the G7 meeting](#) via Twitter on 22 August. During that period, his wife Brigitte was [mocked by Bolsonaro](#) on a Facebook post, triggering a feud between Macron and Bolsonaro. This series of events has also been reflected on Twitter through hashtags like #desculpabrigitte, which means 'sorry, Brigitte' in Portuguese.

Public opinion towards national politics outside of Brazil has also emerged, particularly criticism towards the heads of state. The former US president **Trump** made it on top hashtag lists receiving criticism for [not agreeing to the G7 aid package](#) through hashtags such as #illegitimatePresident and #NotMyPresident. The Canadian prime minister **Trudeau** appeared on the top list with #trudeauworstpm and #TrudeauMustGo as he announced a [15 million USD package](#) to help the Amazon fires.

Celebrities from all around the world have been brought together with the Amazon fire-related issues (e.g. #messi, #BTS, #leonardodicaprio) and **religious figures** (e.g. #pope). These public figures have either voiced their opinions, announced donations, or were promoted by their fanbase online. For instance, Leonardo Dicaprio has announced the [Earth Alliance's Amazon Forest Fund](#) on 26 August 2019. BTS fans, a popular Korean boy band, launched a [hashtag campaign](#), resulting in many other BTS-related hashtags. The Pope also commented, "*That forest lung is vital for our planet*" on 25 August, 2019.

Interestingly, Lionel Messi has been [promoted by his fans](#), who claimed that he had sent four jets to help combat the fires. The accuracy, however, appears questionable as there is no news reporting about it, the screenshot shows an uncapitalised account name of @Sports_En, and no original tweet has been found.

Social media influencers also play a significant role in bringing the issue to public attention. Two hashtags, #bolsonaroensueur, #clash, used by a French social media influencer in [this video](#), were among the most engaged hashtags.

Some issues concerning forest governance have been observed on the top hashtag list. For instance, a number of hashtags have indicated the **link between the rainforest fires, deforestation and meat consumption** (i.e. #beef, #govegan, #meatfreelabourday).

In addition, #mercosur appeared on the top list during the period. When looking at the tweets, many top tweets using #mercosur were from **Germany-related accounts**.

20% of these referred to this tweet by Irina von Wiese, a former British Liberal Democrat MEP originally from Germany, calling for Brazil's immediate action on the fires in the Amazon. The tweet included a link to a news article which claims that Finland is considering banning beef import from Brazil.
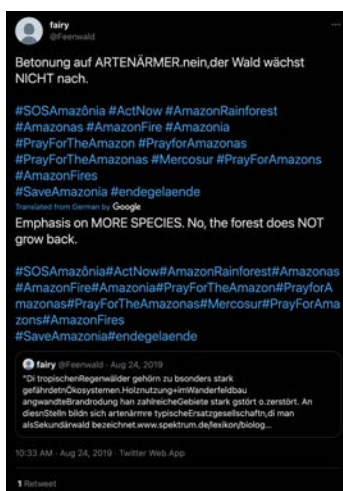
13% of these were from an account (@Feenwald), seemingly a (semi-)automated account according to Botometer, tweeting a series of hashtags in relation to the Amazon. The account tweets in German and has been tweeting about biodiversity-related issues referring to German media articles.

13% was a tweet from @greenpeace in Germany, which called for the Mercosur agreement to include binding guidelines for climate and species protection. This tweet also tagged German government accounts such as @JuliaKloeckner and @cducsubt and included a hashtag, #Merkel.

Only a handful science-related hashtags (e.g. #sciencematters, #sentinel2, #nasa, #unitebehindthescience) emerged in the top hashtags. These science-related hashtags were supporting the role of science and/or referring to the Earth observation programme.

#sciencematters

98% of tweets with this hashtag promoted a tweet by @DrGJackBrown, a physician and a body language & emotional intelligence expert who frequently appeared on CNN.
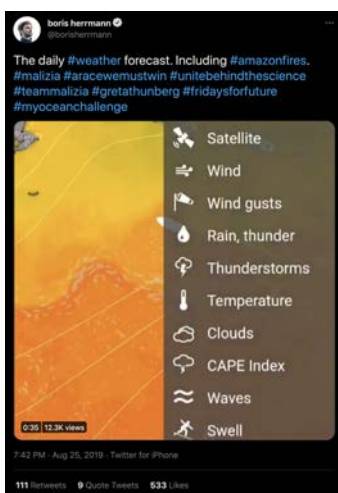
#unitebehindthescience

73% tweets quoted the tweet by @borisherrmann, a German offshore sailor and skipper of Team Malizia (a zero-carbon boat on which Greta Thunberg was sailing to New York at the time). He tweeted a GIF of a live map with the hashtag #amazonfires. The hashtag #malizia also appeared on the top hashtag list.

Science-related hashtags also included the **Earth observation programmes** (#sentinel2, #nasa), sharing a planetary-scale perspective on the issue and portraying the fires in the context of earth viewed from space.
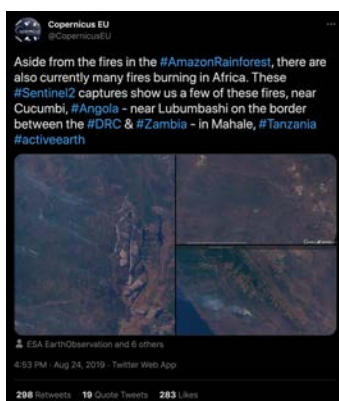
#sentinel2

97% of tweets referred to this tweet by @CopernicusEU, the EU Earth Observation Programme. It called for more attention to the fires in Africa, which were happening simultaneously. Notably, #africafires emerged in the top hashtags in the peak period of the Amazon rainforest fires.
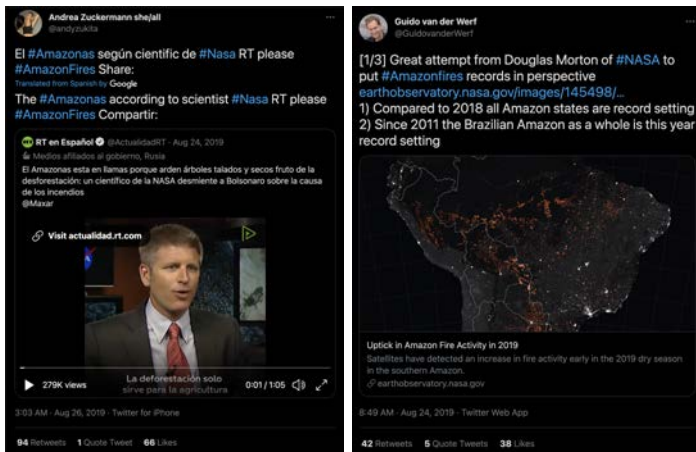
#nasa

Top tweets with this hashtag referred to NASA's scientist Douglas Morton with his interview on Russia Today in Spanish. Another tweet was an endorsement for Douglas Morton by another academic.

4.2.4 How do hashtags associated with Amazon fires on Twitter relate to each other?

What we are looking at

This analysis looked at how different issues have been brought together through hashtags on Twitter. The closer the hashtags are, the more they share associations, for instance, they have been tweeted together more frequently. The method for this analysis can be found in Annex 2.
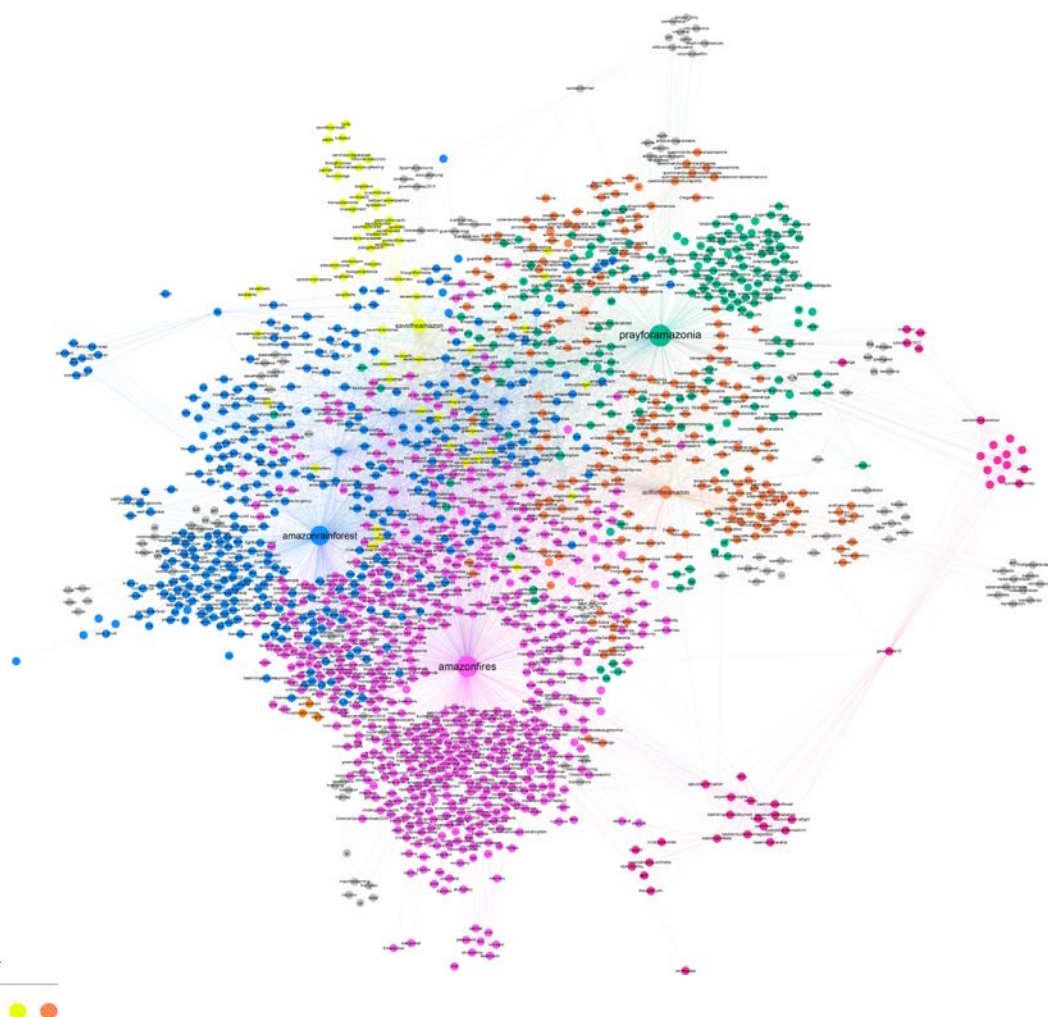
Findings

Following on from the top 100 hashtags per day visualisation, with the above network, one can observe how different (sometimes competing) ways of articulating the Amazon fires issue on Twitter are **related to each other** through the co-occurrence of hashtags.

Different clusters contain **different ways of figuring the relations between Twitter users and the fires and different invitations to action** - including to mobilise, to click, to sign, to purchase, to boycott, to defund, to save, to pray, to vote, to watch, to check, to defend, to join and to change.

The significance of the Amazon fires is **articulated with reference to many different kinds of entities,** including celebrities, international political fora, industries, products, conflicts, political struggles, regions and countries, communities, media organisations, hacker groups and climatic changes.

Various types of clusters could be recognised in relation to the issues either directly or indirectly linked to **forest governance**. Forest governance deals with a wide range of issues and concerns from deforestation to global trade, from land use to sustainable financing. Looking at how the hashtags associated with Amazon fires on Twitter relate to each other, one can observe different voices, concerns and positioning around a wide variety of forest governance issues, involving international and national political, business and other public figures.

One of the most visible clusters was associated with the **Brazilian President Bolsonaro and the series of events and exchanges between him and the French President Macron**, referred to as the 'war of words' by The Guardian.

When the Amazon rainforest fires became international news, Macron tweeted the need to address the Amazon rainforest fires at the G7 meeting on 22 August 2019, receiving support from the Canadian Prime Minister Trudeau. Bolsonaro then criticised Macron for using the Brazilian issue for personal political gain, saying that suggesting a discussion of the issue without Brazil's involvement showed a colonial mentality in the 21st century. At the same time, Bolsonaro supposedly mocked the French first lady in a Facebook post, to which Macron responded that this was "disrespectful" during the G7 press conference. Brazil then rejected $20 million in aid offered by G7 countries, followed by Twitter exchanges between the former US President Trump and Bolsonaro showing support for each other.

When looking at the network below, the hashtags denouncing Bolsonaro or showing support for Macron are more visible than the hashtags that are either supporting Bolsonaro or criticising Macron. Brazilian perspectives

against Bolsonaro were prominent including many hashtags in Portuguese, indicating that Brazilian perspectives criticising Bolsonaro have surfaced more prominently in the English language Twitter space. While the hashtags critical towards Macron and showing support to Bolsonaro were scattered across the networks, not forming any clusters of their own, the hashtags against Bolsonaro were positioned closely with other hashtags criticising Bolsonaro.
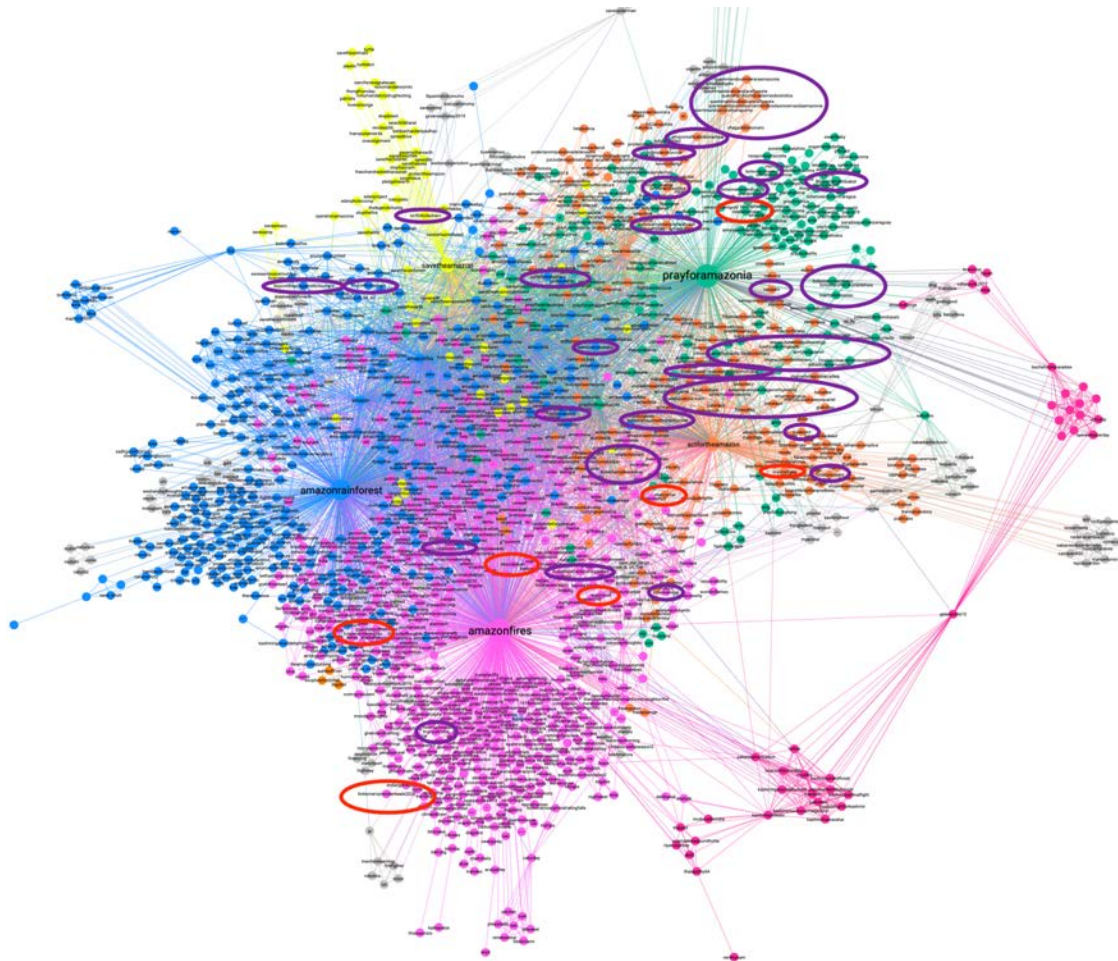
When zooming into #forabolsonaro, one of the most popular hashtags against Bolsonaro with over 2300 tweets, the top tweet was a tweet by Dilma Bolada, a fictional character who became a social media influencer during the terms of Dilma Rousseff, the former Brazilian president. With 1.1 million followers, the account called for protests in various cities in Brazil.

Another tweet posted a video claiming to show the fires reaching a residential street in the state of Para, one of the Brazilian states with an increasing deforestation rate. There was also a tweet with a video of protests at the Brazilian embassy in Peru, using hashtags that criticise Bolsonaro and Ricardo Salles, the former Brazilian Environment Minister.

Dilma Bolada's account was also visible when looking into the hashtags #panelaco and #panelaço. Panelaco is a form of protest which was originally used against the former Dilma government and was later taken over by the protestors against Bolsonaro. The social media influencer's account tweeted calling for a balcony protest by banging pots and pans at their window using a photo of the former president Dilma holding a pan and sharing a video of panelaço in Rio de Janeiro.

One of these tweets was also [shared by the Brazilian Labour Party Senator Humberto Costa](#) and the former Health Minister.

While not as prominent as those against him, voices supporting Bolsonaro were also present. When zooming into pro-Bolsonaro hashtags, it is possible to identify tweets from pro-Bolsonaro accounts, many of which are suspended on Twitter. For instance, #MacronLiar was used to criticise the NGOs presence in the Amazon. The narrative corresponds to Bolsonaro's statement on 21 August 2019 accusing them of setting the fires.

Another pro-Bolsonaro hashtag, #vivabolsonaro, was used in a tweet by a columnist of Breitbart, an American alt-right news site.

The tweet included a link to Breitbart's article "Delingpole: Amazon Fires – A Big, Fat Nothingburger of a #FakeNews Scare Story". The article criticised the news from the mainstream media as "fake news" and twisted the narrative to portray alternative ways to interpret scientific insights. Interestingly, to do so, the article used a mix of references ranging from tweets from suspended accounts to those from scientists.

Some people who tweeted with trending Amazon fires-related hashtags made the **connection between deforestation and consumer responsibilities**. As shown below, a number of deforestation drivers have been brought up in close proximity to hashtags associated with deforestation, most of which were linked with meat or beef (i.e. #govegan, #beefindustry, #boycottbrazilianbeef), followed by #soybeans, #mining, and #palmoil. These hashtags were brought up in close proximity to the deforestation hashtags including #stopdeforestation, #amazondeforestation, #defunddeforestation. A number of hashtags also referred to consumer practices around meat or beef, such as #gowithoutbeef, #govegan, and #stopeatingmeat.

There were also **business, investment, economy and trade-related hashtags** forming different clusters. Specific company names such as #Minervafoods, one of the biggest meat processing companies in the world, and #Blackrock, the leading investment firm criticised for investing in deforestation also emerged. Some referred to tradewars (i.e. #tradewars) and Mercosur (i.e. #eumercosur, #stopmercosur), while others brought up the CEO's name. A few CEOs name appeared (#stephenschwarzman, #jeffbezos). There is also a cluster on the top left where #taxpayer, #bank and #cocoa sit close to

#trumpaskidsincage and #liarinchief. At the centre bottom, one can also identify a cluster where #financing, #highway, appear next to #responsible. These hashtags were brought together with #farmers, indicating the link with agricultural activities. #responsible was also brought together with #mercosur, a trade bloc.

These findings indicate that the Twitter publics were making a global link addressing 1) the consumption of deforestation drivers such as beef and soy, 2) trade issues such as Mercosur and 3) political issues such as Bolsonaro and the feud between him and Macron.

Several **contested agricultural practices** can also be witnessed in the network. When looking at #gmo, #glyphosate, and #glifosato, all of them have been brought together with #climatechange, #bolsonaro and #brazil. In the case of #gmo, the following hashtags have been tweeted together: #deforestation, #plantatree, #forestfires, #bees, #agribusiness, #soybeans, #reforestation, and #protest. In addition, a company name,

#monsanto and #boycott were brought together with #gmo and #glyphosate. These hashtags were positioned closely with #crimeagainsthumanity and #stopdeforestation. For instance, #crimeagainsthumanity was brought together with #ecocide, #GOP (the US Republican party), #environment and hashtags against Bolsonaro and Ricardo Salles, the Brazilian Agriculture and Environment Minister.

There was also a cluster referring to **crime, misconduct and conflict**, including hashtags such as #warcrime, #corruption, #pollution, #tradewar, #landgrabbing, sitting closely with #leather, #europe, #sdgs and #cop24.

Rights-related issues have also been brought up, namely #animalrights, #landrightsnow, #indigenousirghts, #humanrights and #defendindigenousrights.

In addition, **wildfires taking place elsewhere in the world** have also appeared, including the fires in Sub-Saharan Africa, Siberia, Turkey and Alaska. While the Amazon rainforest fires were mainly associated with the Brazilian Amazon in the English language Twitter space, Bolivia appeared through the hashtag #bolviafires.
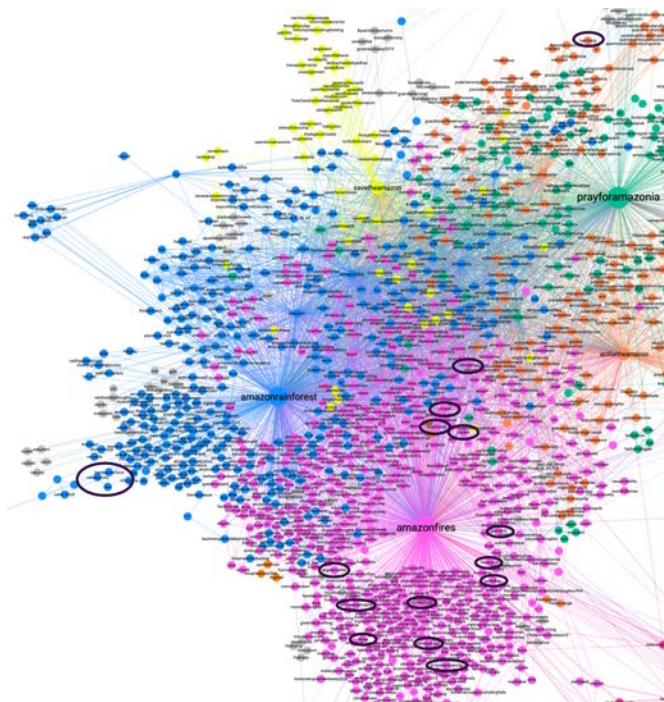
Hashtags referring to a specific country/language also appeared across the networks. The left image portrays the issues that were associated with **Germany or in the German language**. For instance, a left cluster refers to Hambacherforst and RWE, closely positioned to "naturschutz" (conservation). The hashtag #hamburg appeared on the right top was near #xr, the hashtag of Extinction Rebellion. A number of hashtags also referred to climate-related topics in German (i.e. #klimakatastrophe, #klimashutz, #klimawandel).

A notable mention is **BTS-related hashtags**. BTS is a popular Korean boy band whose official fandom is called ARMY. A number of them have appeared around the #prayforamazonia hashtag.

@oneInAnARMY, a charity account founded by BTS fans, has tweeted the tweet on the right on 22 August 2019, receiving 13.6K retweets. Their site indicates that the BTS fanbase actively raised awareness and funds online for social and environmental issues such as #BlackLivesMatter.

4.2.5 What kinds of voices are most active around #AmazonFires hashtags? What domains do they share?

What we are looking at

Which types of users were most active in sharing their voices on Twitter? This analysis focused on the type of users who tweeted the most and how influential they were. Their influence can be measured by the number of mentions from other users. In many cases, their tweets were either being retweeted or received responses. To understand the information they have shared through their tweets, we also looked at the domain-level links in their tweets. The method for this analysis is outlined in Annex 3.

ACCOUNT TYPE		TWEETS	MENTIONS
politics		382	28
personal		262	38
personal		254	4
entrepreneur		225	207
personal		197	195
research		165	1324
politics		159	17
personal		156	163
policy		128	736
suspended account		123	0
music		121	2
personal		107	0
personal		97	0
botlike		96	0
music		86	0
personal		83	5
sports		82	3
personal		81	0
personal		79	0
personal		75	3

number of tweets

number of mentions

Findings

With few exceptions, the users who tweeted the most using hashtags related to Amazon rainforest fires in our dataset, are accounts that present themselves as **personal accounts**, tweeting in different languages, including English, Portuguese, German and French.

One of the most active users was @profstrachan who presents themselves as a **professional researcher** at a university in energy policy and environmental management in their Twitter bio. This user is also the most "influential" user in this set, receiving the highest number of @mentions more than any other of the top accounts. Another active user who received a considerable number of @mentions presents themselves as a **policy expert**, a German policy expert who is specialised in foreign, climate and environmental policies, and have worked at the European institution and German Bundestag.

Hence, while most of the active accounts present themselves as personal accounts, it is notable that the most "influential" of the active accounts in terms of the number of @mentions are those few active accounts that present themselves as **experts**.

Also noteworthy amongst the most active users in our collection is a **suspended account**, an **account with botlike behaviour**, as well as the active presence of an **entrepreneur** who seeks to promote and sell "Save the Amazon" t-shirts on Etsy. More activity does not always translate into more engagement.

As far as the domains shared by the most active users are concerned, **YouTube** emerges as the top source, being shared close to 200 times and suggesting a further investigation into its role as an information source around this issue. The **link destination on YouTube was diverse**: news reports by Democracy Now and Ruptly; a Zoom meeting organised by Latin Voices; protest videos, an interview with a Brazilian senator, a Youtube influencer channel with 3.3M followers, an interview with Andrew Yang, a US Democratic presidential candidate, and a music video of David Bowie.

In the bipartite network visualisation, many shared domains by the top 20 users are **news media**. The most 'influential' account that belongs to a researcher tweeted news articles as the sources such as the Guardian, BBC, OpenDemocracy and New Yorker.

The science-related domains that the top 20 active users shared included **NASA**, an independent agency of the U.S. government, **Carbon Brief**, a UK-based non-profit website covering climate science and policy, and **IFLS (I Fucking Love Science)**, an influential science blog founded by Elise Andrew, a British science communicator.

One-fourth of the users have rarely or never shared links in their tweets. For instance, the bot-like account has not shared any links. The second most 'influential' account belonging to a German policy expert had only one tweet with a link referring to its own tweet.

A tweet from the top 20 most active users included a link to this tweet by **Heiko Maas**, the German foreign minister.

4.2.6 What types of actors are retweeted and @mentioned in relation to Amazon fires related hashtags?

What we are looking at

Tweets can mention another user account (in the form of @username) as a 'referral'. For example, in her tweet, Ellen DeGeneres (@TheEllenShow) included Leonardo DiCaprio's username (@LeoDiCaprio), as shown on the right. The more people retweeted and replied to this tweet, the more visibility and attention it received on Twitter. This analysis focused on understanding the relations among the most mentioned and retweeted accounts associated with the Amazon fires hashtags. In particular, we are interested to see if the communities that emerge on Twitter come in contact with each other. The method for this analysis can be found in Annex 4.
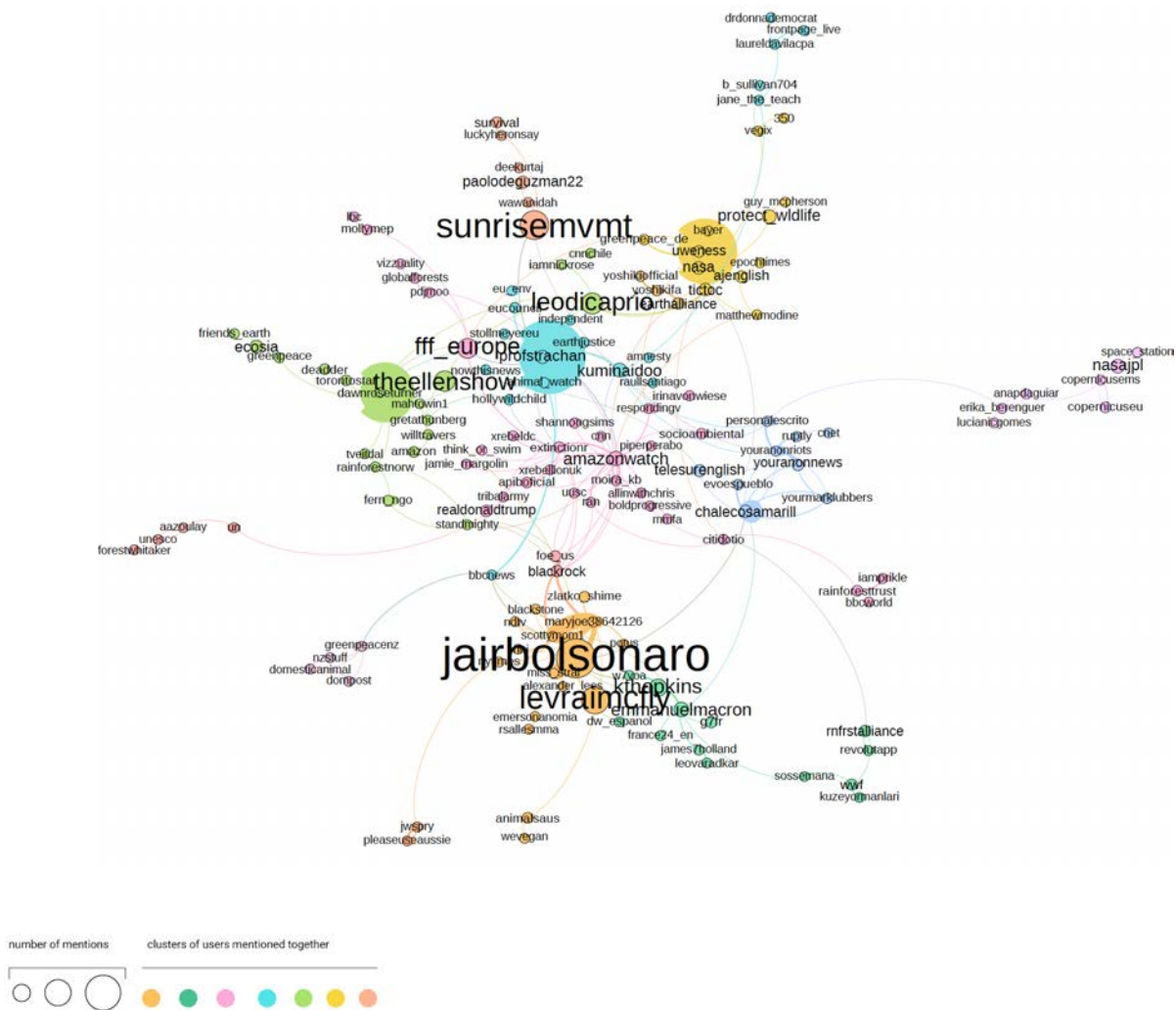
Findings

The top 10 most mentioned users are mostly **public figures** ranging from political figures (heads of state) to celebrities (actors and talk show hosts) to YouTube celebrities and representatives from activist networks. Among these users, there were also **suspended accounts**.

A look at the most prominent figures in each cluster suggests that **Twitter activity does not necessarily succeed in bringing different kinds of actors** (e.g. activist networks, political institutions, etc.) **into sustained new engagements with each other**. Instead, exchanges often appear to occur within particular clusters. Notable is the political domain of national politics and particularly the political figures Jair Bolsonaro and Emmanuel Macron situated in proximity to each other, alongside YouTube celebrities and accounts that have been suspended. At the opposite pole of the graph is the US activist network The Sunrise Movement, in close proximity to a cluster

prominently featuring celebrities. Occupying a central position in the network is a cluster of activist organisations which link all conversation clusters. The account of Articulação dos Povos Indígenas do Brasil (@ApibOficial), an association of NGOs focusing on indigenous issues in Brazil, has also been spotted at the centre, next to Extinction Rebellion accounts.

When zooming in, a political cluster around Bolsonaro's account can be identified. There is @POTUS, an official US president's account, closely situated to Bolsonaro's account. @kthopkins, a banned account by Katie Hopkins, a "far-right" political commentator in the UK, is also visible between Bosonaro's and Macron's accounts. Around Macron, there is also an official G7 account (@g7fr).

It is also notable that @foe_us (Friends of the Earth) is mentioned together with @blackrock, one of the investment management firms accused of driving deforestation in Amazon (an association that arises from the former's campaign's around the latter). Bolsonaro's account is also positioned near @maryjoe38642126, an animal rights account, along with @blackstone, and further in the middle, @blackrock. A number of celebrity accounts are closely positioned to @sunrisemvmt. Notable mentions are @theellenshow, who tweeted this tweet mentioning @LeoDiCaprio on 27 August 2019.

Furthermore, @raullsantiago, an influential Brazilian activist, was found next to the @kuminaidoo, formerly with Greenpeace and Amnesty International. Finally, in close proximity, the most 'influential' users in the previous analysis can also be observed (@profstrachan and @uweness).

Another interesting cluster is the one in blue where several Anonymous-related accounts are found, including @ChalecosAmarill, @youranonews, @YourAnonRiots. In addition, @evoespueblo, the official account of the Bolivian president, appears near @telesurenglish, a Latin American broadcaster and @ruptley, a Russian broadcaster.

Scientific accounts were often peripheral in Twitter activity associated with the Amazon fires. In particular, scientists and researchers were not only the least visible, but also not engaged with other clusters of actors.

While most scientific actors did not come into contact with other most mentioned accounts, @profstrachan, an account representing an academic specialised in energy policy and environmental management, who also appeared to be the most active and influential user in our earlier analysis was frequently mentioned in our corpus. Far from the centre, there are a few scientist names that can be observed, namely @Erika_Berenguer, a tropical forest ecologist at the University of Oxford, and @AnaPDAguiar, a researcher at the Stockholm Resilience Centre specialised in land-use models and scenarios. Further to the right, @nasajpl (NASA Jet Propulsion Laboratory), @Space_Station (the International Space Station), @copernicuseu and @copernicusems (the EU Earth Observation Programme) can be observed.
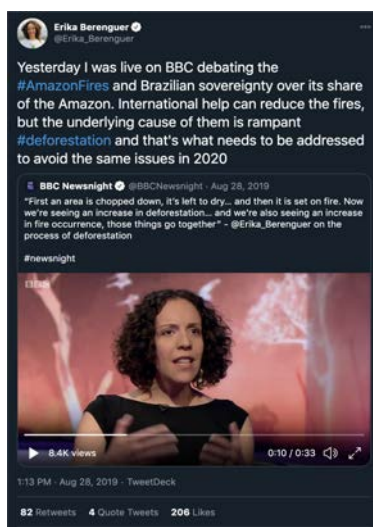
As an example of how a specific user gathered mentions, @erika_berenguer, one of the few scientists to surface in our data collections, is very active on Twitter, voicing her perspectives on the Amazon forests. She was also involved in the paper from which several researchers pulled out due to the fear of political pressure. The top tweet (52%) mentioning @erika_berenguer directed to a tweet with a video of a BBC Newsnight interview.

@AnaPDAguiar, a researcher closely positioned to @Erika_Berenguer, tweeted with scientific insights on the increase in the number of fires in the Amazon. It stated that the increase of fires in 2019 has taken place in the period after the deforestation control actions have been put in place. It points out a simple comparison without context can lead to a wrong conclusion.

4.2.7 What are the top retweets per day associated with Amazon fires related hashtags on Twitter?

What we are looking at

By looking at the number of retweets, this analysis explored which issue gathered the most attention on Twitter over the 10-day period. Retweets increase the tweet's visibility and exposure; hence, the more retweets a tweet receives, the more likely the tweet gets exposed to different users. The method for this analysis can be found in Annex 5.

Findings

Similar to the 100 top hashtags per day, one can observe a variety of issue-articulations, including Amazon Fires as:

- Something to pray for = blue
- Call for action (tree planting, eco-friendly products, plastic ban, donation, petition)= violet
- Indigenous tribes issue = green
- Celebrity cause = purple
- Misinformation issue = yellow
- Cattle ranching and meat consumption= orange
- The link between deforestation and investment = black
- Foreign aid= red
- Whataboutism for other forest issues = grey
- Science/scientists = pink
- Criticism/mockery against Bolsonaro =orange
- Support for Bolsonaro = lime

Whereas in the first days, "pray" tweets are more prominent, different call-to-actions appear in the second part of the 10-day period (e.g. using the browser Ecosia; financial donations; planting trees; going vegan). In addition, the top retweets per day are in **different languages**: English, Italian, Korean, French, Portuguese, Tamil, Thai and Japanese.

The most retweeted tweet (14340 retweets) in the 10-day period had an implication of '**whataboutism**', pointing out the deforestation in Thailand, following the Thai prime minister indicating his concerns around the Amazon fires. This tweet included a photo claiming to show the deforestation issues in Thailand. When running a TinEye reverse image search, one can see that this photo has also appeared in a news article published on 19 May 2018 by Thairath, which reported about the housing project in Chiang Mai province claiming to affect the forest ecosystems in the area.

The [second most retweeted tweet](#) used the photo of a Brazilian soldier holding a jaguar. More about this image will be discussed under *4.2.10 What kinds of concerns are present in images associated with Amazon fires related hashtags on Twitter?*.

NGOs got some visibility by actively promoting their publications after the spike ceased. A number of NGOs' calls for actions (@wwf_uk) and Blackrock report (@AmazonWatch, @foe_us) emerged after the drop-off on 30 August 2019.

Again, a **single social media influencer has acted as a big promoter of the issue**. The French social media influencer who appeared in earlier analyses showed up as it received the highest retweets on 28-29 August 2019.

Scientific voices gathered visibility only after the spike when the number of tweets started to decrease in the peak period. As shown below, a few science-related tweets appeared at the top as the overall number of retweets slowed down. These tweets were from the users claiming to have a scientific or research background, namely @astro_luca (astronaut), @BiologistDan (biologist), and @ProfStrachan (energy policy).

A [tweet](#) by Luca Parmitano (@astro_luca), an Italian astronaut of the European Space Agency, emerged on the top retweet list on 29-30 August 2019, receiving more than 850 retweets. His tweet included aerial images of the Amazon fires.

A tweet by @ProfStrachan, the most active and influential account based on the number of tweets and mentions over the 10-day period, appeared at the top once the peak started to cease. One of his tweets referred to a Guardian article featuring the executive secretary of the UN convention on biological diversity.

Another tweet from a science-related account that appeared after the peak period was from @BiologistDan, an account claiming to be a biologist. The tweet points out the link between cattle farming and the fires.

One of the most popular tweets that received a high volume of retweets in the peak period was from Sunrise Movement. Their tweet gathered more than 131K retweets and 157K likes and generated discussion on Twitter. The tweet included a referral video where a Pataxo indigenous woman is calling for the media's attention on their burning land. While it was filmed in a place closer to the Amazon, it did not actually come from the affected area. The tweet included a source link to a user, @kimtaehgukk, who tweeted this video on 21 August 2019. However, this video was later debunked by the Associated Press as content not linked with the Amazon rainforest fires, was instead filmed in the Brazilian state of Minas Gerais. Originally from Brumadinho, the Pataxo-Hahahae tribe was directly affected by the dam collapse in early 2019.

What we are looking at

Just like hashtags, URLs in the tweets can provide a better understanding of what type of issues, actors and sources were surfacing in relation to the event. This analysis explored the most popular URLs that appeared within the Twitter data collection we gathered. The method for this analysis can be found in Annex 6.
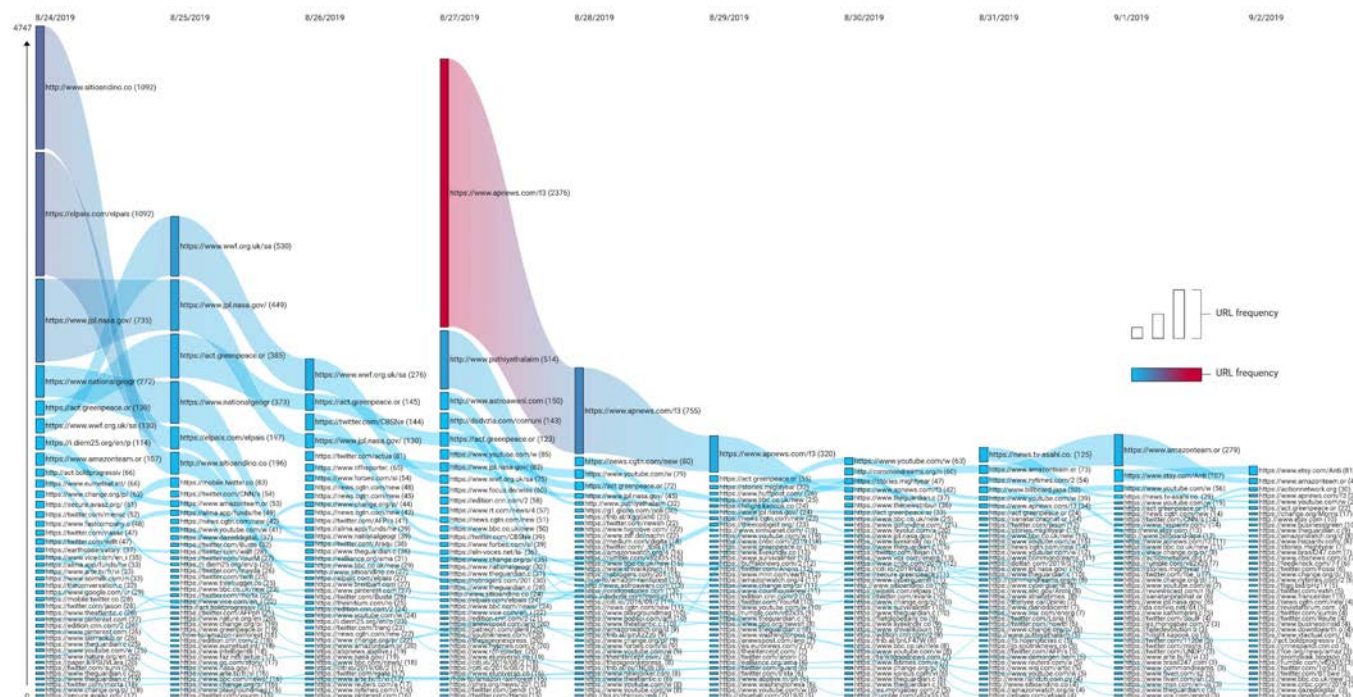
Findings

The two peaks of most shared URLs during the 10-day period are **news media content** on **24th and 27th August**, with the high frequency marked in purple and red. There is also a **prominent presence of petitions** amongst top shared URLs and NGOs active around the fires. For instance, The WWF UK's page and Greepeace's petition page were among the top URLs in the first few days. There is also a presence of scientific pages about **satellite imagery** from fires, such as this page on NASA. Another webpage from NASA summarised the significance of the 2019 Amazon rainforest fires, stating "*the most active fire year in that region since 2010*."

On days 9 and 10, we see the rise of **promotional content for merchandise** (Etsy), including the possibility of programmed/queued regular posts. While most pages are no longer available, one of the URLs suggests that the page sold Save the Amazon short sleeve shirts.

There is also a strong presence of **links to social media, including Twitter and YouTube**, ranging from a CBS News' tweet referring to DiCaprio's $5M pledge to a YouTube livestream on Hurricane Dorian. A more detailed analysis of the content of these URLs suggests **different narratives, entities and concerns**.

While news media contents were among the most shared, these links were directed to El Pais, The New York Times and other international media. In contrast, while Brazilian press appeared in the top URLs such as Brasil247, Folha de S.Paulo, and Globo, they were much less visible when compared to the international media.

The most shared URL (3563 times) in the 10-day period was a news article by the Associated Press with the headline "*Fund backed by DiCaprio pledges $5M to Amazon amid fires*". This link remained the most shared on 27-29 August 2019. A few months later, Bolsonaro accused DiCaprio *"of giving money to set the Amazon on fire"*.

Some of the top URLs were not directly associated with the Amazon rainforest fires. For example, on 24 August 2019, two URLs were among the most shared URLs, shared 1092 times.

The first one was a Spanish-language media article by El Pais published in 2006, which was not related to the Amazon rainforest fires but about the fires in Galicia, Spain.

The second one was from an online newspaper called Sitio Andino in Argentina. The article was published in January 2018 and reported about the fires in General Alvear in Mendoza.
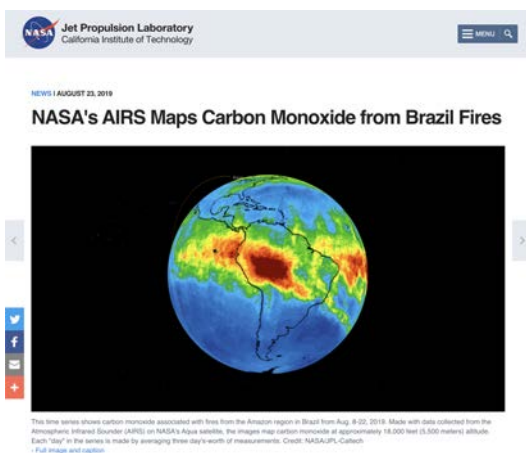
The only scientific source that has prevailed in the top 10 URLs was NASA. The second most-shared URL over the 10-day period was a page on NASA which showed a map of carbon monoxide from the fires in the Amazon.

4.2.9 What are the most shared domains associated with Amazon fires related hashtags on Twitter?

What we are looking at

This analysis explored the most popular domains per day across the 10 days to compare with the most shared URLs. The method for this analysis can be found in Annex 6.
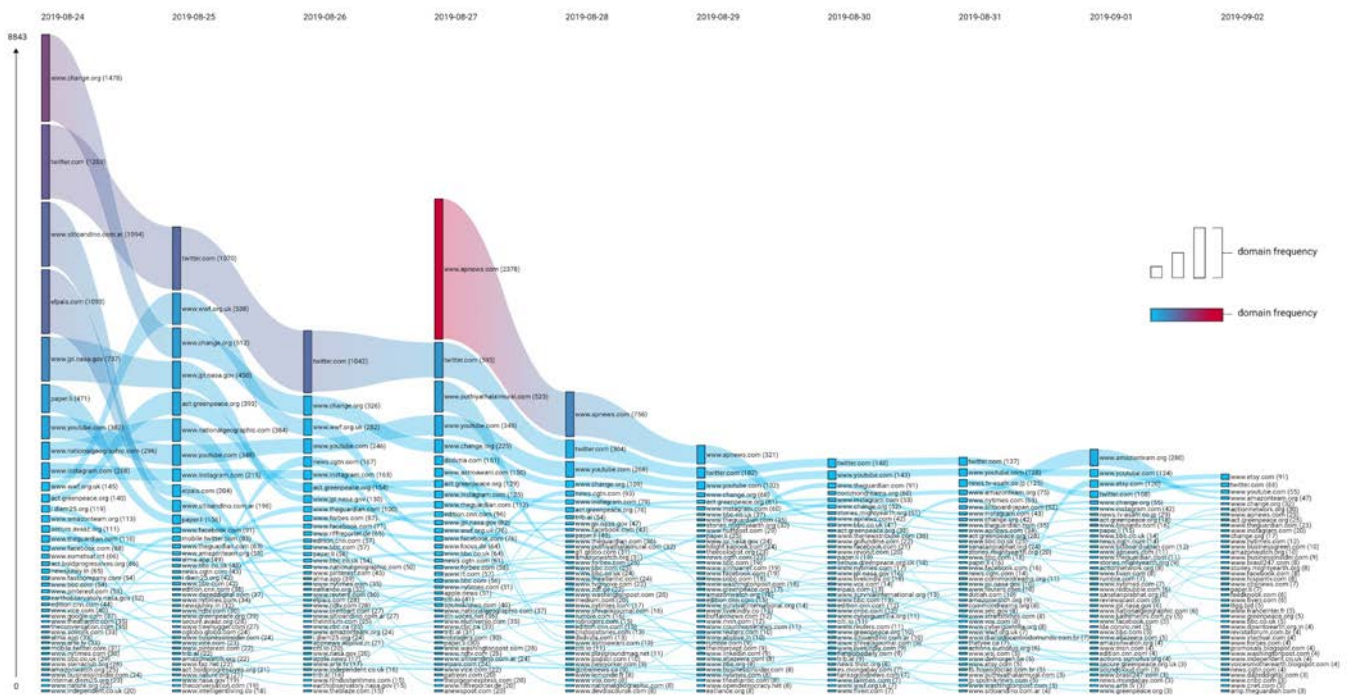
Findings

The two peaks are the same as the most shared URLs - but with the difference that the **most shared domains on the first day are change.org and Twitter**.

While the strong presence of **news media** was prevalent in most engaged with URLs, when looking at the top domains, one sees **social media platforms** (Twitter, Instagram, YouTube) and **petition websites and platforms** (change.org, change.org, act.greenpeace.org) instead.

Other top engaged with domains include **news media** (Sitio Andino, El Pais, National Geographic, CGTN, Common Dreams, Guardian, Forbes, Astro Awani, Huffington Post, APA, BBC, TV Asahi), **NGOs** (Greenpeace, WWF, Mighty Earth, Amazon Team, DSDVZLA) and **scientific institutions** (NASA).

Two Brazilian domains also appeared in the top domains.

Diário do Centro do Mundo: They (re)publish content from Brazilian and foreign newspapers and original stories.

Revista Fórum: The magazine's primary focus is disseminating the most recent events of social movements in Brazil. It is an independent and digital-only media that publishes a weekly edition of an online magazine.

4.2.10 What kinds of concerns are present in images associated with Amazon fires related hashtags on Twitter?

What we are looking at

What do the images tell us about the way Twitter publics felt and perceived about the Amazon fires? This analysis looked at the most engaged images on Twitter per day. The method for this analysis can be found in Annex 7.

	3021		8914		1054		417		4264		2216		250		102		82		69
	2969		4269		832		184		321		745		224		82		44		69
	2969		4269		723		155		284		745		160		73		44		54
	2969		4269		631		85		161		745		109		72		40		29
	2599		1453		631		85		83		745		109		69		36		22
	2075		1279		631		80		80		208		109		59		21		22
	1400		1162		558		80		75		180		109		50		14		18
	918		736		558		69		47		97		103		29		14		18
	918		736		558		67		47		54		92		25		14		17
	918		736		314		65		45		33		72		20		14		11

Content Warning

The following section contains images of burning/burnt animals and may not be suitable for some viewers.

Findings

In the first few days of the 10-day period, one of the most engaged images depicts **animal rescue**.

There is a notable **presence of satellite and "earth from space" type images**, emphasising the international and planetary context of Amazon Fires - including dystopian "2000" and "2050" comparison images.

Another widely shared image shows a group of **Xingu indigenous people** in the video published by Instituto Socioambiental.

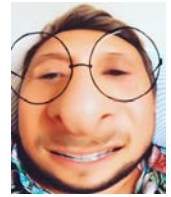One widely shared image is a video preview from a **French influencer's video clip** which appeared several times in the earlier analyses.

There is also a notable **presence of screenshots from Twitter and other platforms** - including advertising the Ecosia, a Germany-based search engine that [donates 80% of its profits](link) to the organisations focusing on reforestation.
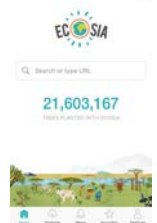
When looking at these images, many of them portray **remote perspectives from people far away** concerned about the Amazon fires.

Different emotions and perspectives are also visible in the images. Some images may have been intended to capture public attention as they **humanise** the Amazon rainforests. For instance, the following images portrayed the forests as the **planet's lungs**.
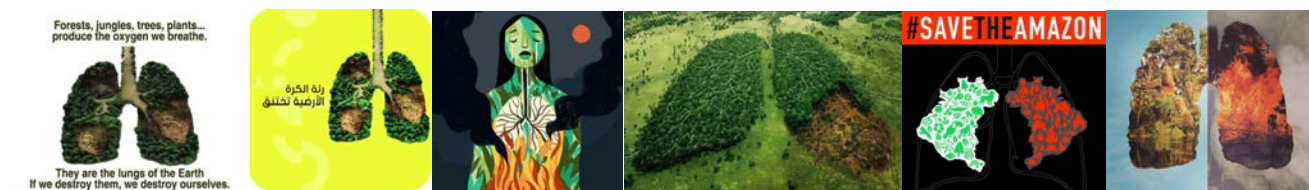
In 2019, the Amazon rainforest fires became a major centre of attention on social media as political actors, celebrities, and athletes including the French President Macron, Leonardo DiCaprio and Cristiano Ronaldo shared their voices, positions and concerns. While these actors raised public awareness, they also promoted **photos and videos from other, sometimes unrelated, past events**. While the news media and science communities have contested and debunked these unrelated images and videos online, the contents can be repurposed in different contexts and can continue to circulate widely online.

As media and communications researchers have highlighted, we encounter a wide variety of "**generic images**" in media we consume every day. In our analysis, various types of images have been collected showing fires and animals affected from Australia, Africa and Asia.

In many cases, animal photos have been mobilised to share concerns around the Amazon rainforest fires. Among the most visible images in our analyses, there were a number of animal photos portraying species which are endemic to the Amazon.

One of the iconic photos was an image of a jaguar rescued by the Brazilian army. Originally taken in 2016 for a conservation project, this photo portrays Jiquitaia, an adopted jaguar held by the army officer that adopted him. Later in the same year, this photo appeared on social media when Juma, a captive jaguar who became an iconic star during the Rio de Janeiro Olympics, was shot by an army officer at the torch event in Manaus. In 2019, the same photo re-emerged online when the Amazon fires became an international issue.

There were other images from unrelated events elsewhere in the world including those showing a monkey, elephant, orangutan, bear and koala.
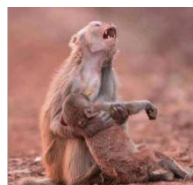
Among these animal photos, we identified that the image of monkeys had a similar history to the jaguar image. When running a reverse image search on TinEye, it is possible to determine that the original image was published on Shutterstock in 2017. In the same year, the Independent published the photo stating that the picture was from Jabalpur, India.

During the 2019 Amazon rainforest fires, this image of the monkeys has been **memefied** to form an Internet meme, where the flames have been added in the background.
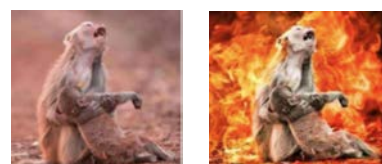
In the peak period of the Amazon fires, this image has also appeared on the printed edition of the Arab News article. The article also treated the misleading claim of the Amazon producing 20% oxygen as a confirmed fact, while it was highly contested by scientists and journalists.

Other animal photos included burnt animals, many of which were from different past events, including the fires in Cajamarca, Peru (2016), at the Kutai National Park in the Borneo Island, Malaysia (2016), and in California, USA (2018). The latter two have also emerged on Twitter during the fires at the Bandipur national park in India.

Apart from the animal pictures, other most engaged images on Twitter included those from the **BTS fanbase**, the Korean boy band that appeared in several analyses.
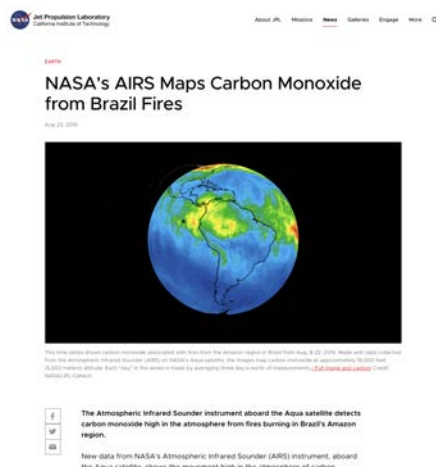
The image from **NASA**, which appeared in other analyses, could also be spotted in the top 10 images on Twitter.
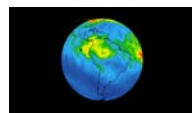
The discussion about the role of images on social media will continue in the following section on cross-platform image analysis.

4.3 CROSS-PLATFORM IMAGE ANALYSIS: Mapping prominent Amazon fires images across platforms (Twitter, Instagram, Facebook, YouTube and Google Images)

4.3.1 From single platform to visual cross-platform analysis

The first part of our social media analysis of the Amazon rainforest fires focused on the social media platform Twitter. However, as our Twitter analysis showed, debates about the Amazon rainforest fires spill over onto multiple platforms, including YouTube, Instagram, and Facebook. The Twitter analysis has also demonstrated that widely circulated content about the rainforest fires takes shape not only of text but also of visuals and

multimodal productions: images, videos, GIFs, emojis, etc. In relation to the latter, journalists and investigators have drawn attention to recycled visual content about this event which could be construed as misleading.

For these reasons, in this second part of our analysis, we follow **visual content about the fires shared across platforms**, focusing on Twitter, Instagram, Facebook, YouTube and Google Images. The aim is to trace how different conceptions of forests in society are articulated visually, their presence or absence and prominence or marginality.

Datasets

For this analysis, we collected the most engaged images on five platforms (Twitter, Instagram, Facebook, YouTube and Google Images), covering 24th August to 2nd September 2019 (10 days). This period corresponds to a period of higher social media activity around the Amazon rainforest fires. Similar queries were used for data extraction to enable cross-platform comparison.

Platform	Data collection tool	Data extraction query
Twitter	Twitter Capture and Analysis Toolset (TCAT)	[ActForTheAmazon, amazonfires, AmazonRainforest, PrayforAmazonia, SaveTheAmazon, SOSAmazonia]
Instagram	CrowdTangle	[ActForTheAmazon, amazonfires, AmazonRainforest, PrayforAmazonia, SaveTheAmazon, SOSAmazonia, "amazon fires"]
Facebook	CrowdTangle	[ActForTheAmazon, amazonfires, AmazonRainforest, PrayforAmazonia, SaveTheAmazon, SOSAmazonia, "amazon fires"]
YouTube	YouTube Data Tools	["amazon fires" OR amazonfires OR AmazonRainforest OR PrayforAmazonia OR SaveTheAmazon OR SOSAmazonia OR ActForTheAmazon]
Google Images	Google Image Scraper	[ActForTheAmazon OR amazonfires OR AmazonRainforest OR PrayforAmazonia OR SaveTheAmazon OR SOSAmazonia OR "amazon fires"]

Tools

In addition to the data collection tools, data analysis and visualisation were also supported by:

- Google Spreadsheets
- the data cleaning tool OpenRefine
- the data visualisation suite RAW Graphs
- the network analysis and visualisation tool Gephi

4.3.2 What are the most shared images per platform? (Image grids)

What we are looking at

This analysis compared the top shared images on five different social media platforms to identify the issues associated with the Amazon rainforest fires across platforms. The method for this analysis can be found in Annex 8.

Findings

Iconic images of the fires, including recycled media labelled as "misleading" (and have been flagged as such on Facebook), **are prominent** in the most shared images across platforms.

Twitter screenshots are amongst the top 10 on Twitter, Instagram and Facebook. **Google has mainly professional stock and newsy photography**, rather than screenshots or user-generated content. **YouTube images nearly all display branding** and/or **promotional logos mostly from news media**.

Indigenous peoples also gained visibility on YouTube and Twitter in the top 10 images; on other platforms, human actors such as responders, commentators, protestors and rescuers are visible - but not forest residents.

Recycled images shared by the public figures have appeared several times on the Top 10 image list, particularly on Facebook and Instagram. For instance, an old image of burning forests tweeted by Macron has appeared multiple times on Facebook and Instagram. This image was shot by a photographer who passed away in 2003. The photo posted by Cristiano Ronaldo was from 2013 and taken in southern Brazil. Leonardo DiCaprio also acknowledged that the picture on his Instagram was from 2017.

When looking at how the image shared by Macron is treated on Facebook, one can observe that **not all versions of the same image are treated equally**. For example, one widely circulating version of an image on Facebook has a warning from fact-checking organisations, whereas the same image posted by Macron contains no such warning.
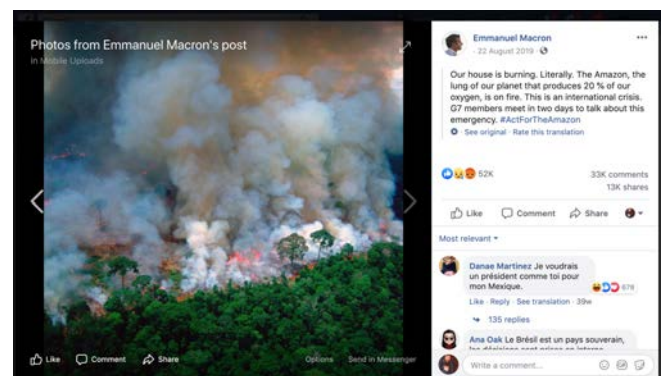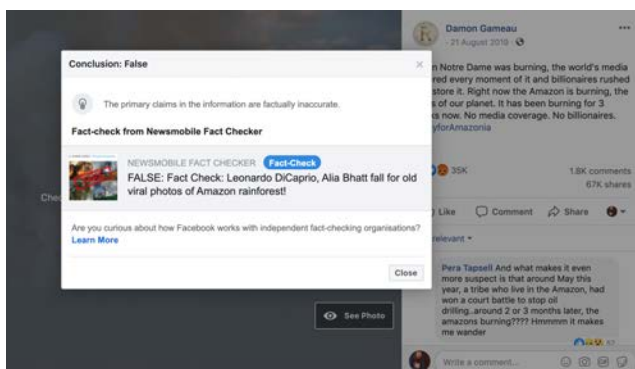
This example indicates that a "potentially misleading image" can have a longer life despite verification labelling and fact-checking practices on digital platforms. Their policies and algorithms can therefore prolong the lifespan of "potentially misleading" content online.

4.3.3 What are the most shared images per platform? (Image stacks)

What we are looking at

The above analysis results have been visualised in a stack format to create another way to look at the most shared images per platform. The method for this analysis can be found in Annex 9.

FACEBOOK   GOOGLE   INSTAGRAM   YOUTUBE   TWITTER

Findings

Generally, one can see **recurring iconic images of the fires** present in most of the stacks.

On **Facebook and Instagram,** there are Twitter screenshots and images reposted on Instagram, mixed with iconic images of fires.

The **YouTube** stack contains mainly imagery with **overlaid logos of news outlets**, portraying **humans rather than fires**.

The Google Images stack displays more visually **homogeneous imagery** composed of iconic images of fires.

The **Twitter** stack shows the most **diverse set of visual formats** (beyond conventional photographs of forest fires), from a French influencer's video thumbnail to the recycled jaguar image, but **no presence of fires**.

Images of people are only visible on **YouTube and Twitter.**

4.3.4 How are images and hashtags connected in tweets associated with misinformation?

What we are looking at

This analysis visualised the relationships between the images and hashtags associated with misinformation (e.g. #fakenews) to see whether specific types of images circulated with the misinformation hashtags. The method for this analysis can be found in Annex 10.

Findings

The relationship between images and hashtags offers an overview of how different image formats animate different debates regarding misinformation on the Amazon Fires:

○ **Screenshot debunking**: with the hashtags #FakeNews and #misinformation: screenshots of other tweets or news articles debunking misinformation around the Amazon rainforest fires, in particular about the sharing of recycled images which could mislead.

○ **Amazon fires as a "hoax from the left"**: a group of images (memes, screenshots of news articles, photos of TV news programs, charts and diagrams) misleadingly suggests that the Amazon rainforest fires are a leftist hoax to attack Bolsonaro.

○ **Mocking of misinformation practices through memes**: scattered around the network, a few memes mock recycled and potentially misleading images shared about the Amazon rainforest fires. These are explicitly "fake" images of animals (e.g. dolphins and dinosaurs) in danger because of the fires. It is a sort of commentary, performed through memes, of the Amazon fires as a misinformation issue.

○ **Commercial veganism as an approach to Amazon fires "without fakes"**: the hashtag #AmazoniaSemFake pulls into the network the Amazon fires as a food issue and veganism as a solution. It is a slightly commercial space, with the advertising of the meatless "beyond burger".

4.3.5 How are images thematised and modified through the act of tweeting and retweeting?

What we are looking at

This case study explored how a recycled image shared by Macron, who also spread the misleading claim "*the lung which produces 20% of our planet's oxygen*" has transformed on Twitter. As pointed out earlier, the image was an old photo taken by a photographer who passed away some time ago.

On social networks, images can be modified by different users to **add new and different meanings**. This analysis focused on identifying image variations by grouping them by similarities. The method for this analysis can be found in Annex 11.

A = Copies of original image with minor modifications
B = Screenshots of tagged image circulated on other platforms
C = Memefied image

A	B	C
#prayforAmazonia	this went in my insta story, but i think twitter needs it too #AmazonRainforest #AmazonFire	#SaveTheAmazon
#PrayforAmazonia	#AmazonFires #Amazonia #media #planet #Billionaires	Sorry that this is not a meme but this is very important. #prayforamazonia
#PrayforAmazonia our earth is dying	#PrayforAmazonia เอาแล้วไง 😭 🙏 🙏 บันเทิงวะ 😭 😭 😭 (ของจริง อยู่ เม้น ล่าง 👇)	Sorry that this is not a funny but this is very important. #prayforamazonia
We are out of time! Please, save the earth! #PrayForAmazonia #ARMYHelpThePlanet	this went in my insta story, but i think twitter needs it too #AmazonRainforest #AmazonFire	
I have no words to express the sadness inside me 💔 #AmazonFires #حرائق_الأمازون		
เห้ยย เค้าบอกว่าไหม้แบบนี้มา 3 สัปดาห์แล้ว เกิดไรขึ้นกับปอดของโลก😭😭 #PrayforAmazonia	Triste réalité #PrayforAmazonia	
Images from the Amazon Forest. We don't deserve this world. #savetheamazon	Come on, humanity! Do better. 😡 🌍 💔 #AmazonForest #AmazonFires #AmazonIsBurning	
NATURE DOESN'T NEED PEOPLE. PEOPLE NEED NATURE. #ARMYHelpThePlanet #PrayforAmazonia #saveAmazonia	#AmazonFires #Amazonia #media #planet #Billionaires	
EARTH IS NOT ONLY FOR HUMANS. 🚫 #SaveTheAmazon		
Ho ça va, L'Amazonie qui brûle, c'est... pas........ ... #PrayforAmazonia		
#PrayforAmazonia قبل ويعد غابات الامازون 💔		
12 years to save the Earth? i don't think so anymore :((#PrayforAmazonia		
EARTH IS NOT ONLY FOR HUMANS. 🚫 #SaveTheAmazon		
As a nature lover I can't see this 🥺 this breaks my heart 💔 #PrayforAmazonia #PrayForTheAmazon		
Um desabafo #PrayforAmazonia 💚		
Amazon fire!! #PrayforAmazonia		
We are out of time! Please, save the earth! #PrayforAmazonia #ARMYHelpThePlanet		
#prayforAmazonia		
I have no words to express the sadness inside me 💔 #AmazonFires #حرائق_الأمازون		
Amazon fire!! #PrayforAmazonia		
#prayforAmazonia		
#prayforAmazonia		

Based on the above visualisation, three main modifications of the same image can be identified as follows:

- Group A: **copies of the original image with minor modifications** (cropped or stretched)
- Group B: **screenshots of the image posted in other online spaces** (Instagram stories and posts, tweets) with additional textual elements
- Group C: **memefied image**, e.g. image with other visual elements overlaid or juxtaposed (mainly satirical content)

All three types of image modifications are similarly framed through the text of the tweets in which they are embedded. The tweets are mostly brief, with a dominant affective register realised through words, emojis and hashtags.

Satirical and memes-sharing profiles reappropriate the image by overlaying/juxtaposing other visual elements (image type C).

Research indicates that images "do well" on social media. The professionalised use of stock images in social media posts and news coverage is widespread amongst journalists and media organisations, especially where visuals accompany breaking news stories.

Our analysis indicates the **prominent role that stock and "generic" images play not just in news coverage but also more widely in online mobilisations around environmental issues**. While images can be "fact-checked" and it can often be assumed that an image is being presented as a literal representation of events, the re-purposing of such images is not in itself inherently problematic. Image reuse is not only part of professional image editorial, but also **digital culture** and **social media user practices** (e.g. making memes from common images and stock photography).

The politics of recycled media, stock photography and generic images in relation to environmental issues deserve careful attention and interpretation. Our research suggests **the value of more differential analyses about what such images do and more situated accounts of the meanings with which they are invested, rather than being assumed to default to a more literal, representational mode**.

4.4 Summary of the takeaways

The key takeaways from each analysis described above can be found in the following (with corresponding section number):

4.2.3 What are the most prominent hashtags per day associated with Amazon fires on Twitter?

- **Hashtags can act as an indicator of the issues and concerns of different publics and social media users**. It can also help policymakers, researchers, and journalists understand how different issues are associated with the main event and which actors engage with those issues.
- **Hashtags can have a short lifespan**. They may correspond to **events and news media cycles**. For example, one can observe the rise and fall of G7 related hashtags around the time of the summit.
- While there were a number of countries being affected by the Amazon rainforest fires, the **Brazilian context was most visible** in the top English hashtags – including those engaging with the fires in the context of Bolsonaro's government and domestic political concerns.
- While the event took place in the Amazon, **other unrelated events and national issues** were addressed with the hashtags. For example, a number of heads of state have been praised or criticised for their political (in-)actions.
- **Famous public figures and influencers** can promote the issue, perspective and narratives. For instance, the Amazon as the 'planet's lungs' has been repeated by a wide range of celebrities.

- A news event like the Amazon rainforest fires can **bring up the issues that directly fall within the scope of forest governance**. For instance, online publics have established links between the Amazon rainforest fires and beef consumption (e.g. #beef, #govegan). It also brought up trade issues such as the Mercosur trade agreement (#mercosur).
- A few science-related hashtags on the top hashtag list indicate the **support for the role of science** but are on the whole **less prominent than other hashtags** associated with the issue (e.g. those relating to world leaders and international politics).

4.2.4 How do hashtags associated with Amazon fires on Twitter relate to each other?

- Looking at how hashtags are associated with each other, **different ways of articulating the Amazon rainforest fires** have been identified, including the issues directly or indirectly dealt with by forest governance.
- Just as the top hashtags, there were a number of **Brazilian political perspectives, opinions and concerns in relation to and critical of Bolsonaro**, forming different clusters.
- While #beef and #mercosur have surfaced in the top hashtag list, a more **diverse range of forest governance issues** have been identified in the hashtag network, ranging from **other deforestation drivers** (#soy, #mining), **companies** (#minervafoods, #monsanto), **investors** (#blackrock, #bank), **pesticides** (#glyphosate), **rights** (#landrightsnow, #indigenousirghts), **crime** (#landgrabbing) and **infrastructure** (#highway), indicating that Twitter publics surfaced and thematised **global relations**.
- **Other forest-related issues happening elsewhere in the world** have also been articulated together with the Amazon fires, including wildfires in Africa and Hambacherforst in Germany.
- The **fanbase of BTS**, a popular Korean boy band, has also seemingly made significant contributions to online mobilisations around the Amazon rainforest fires.

4.2.5 What kinds of voices are most active around #AmazonFires hashtags? What domains do they share?

- Most active users during the peak of the event presented themselves as **personal accounts**.
- The most active account belonged to a **professional researcher**. This user was also the most influential, receiving a high number of references from other users.
- Those who present themselves as **experts** received more retweets and mentions by other users.
- Among the most active users, there was a **suspended account**, an **account with botlike behaviour**, and a **PR/marketing account**.

- These most active users have tended to share **YouTube** and **news media** links in their tweets. A **few scientific domains** such as NASA and Carbon Brief have also been identified.
- Around a **quarter of the users have never shared any links** in their tweets.

4.2.6 What types of actors are retweeted and @mentioned in relation to Amazon fires related hashtags?

- While different communities have emerged around the Amazon rainforest fires on Twitter, the **conversation and exchanges took place within specific clusters** and not across a wide variety of actor networks.
- For instance, an **international political cluster** included the accounts of Bolsonaro, Trump (@POTUS), Macron, Katie Hopkins, and G7-related accounts. These accounts were **not brought together with**, for instance, **celebrities** such as Leonardo DiCaprio and Ellen DeGeneres. They were brought up in conversation with **activist accounts** such as Sunrise Movement and Fridays for Future.
- The **most active and influential accounts** during the 10-day period were also positioned closely with the celebrities, activists and NGOs.
- The **scientific cluster was on the margins of mention networks**, indicating that they were less frequently mentioned in exchanges with celebrities, politicians, activists and NGOs, except one user who was the most active and influential in our earlier analysis.
- At the centre of the network, there are a number of **activist and NGO accounts** such as Amazon Watch, Extinction Rebellion, and Articulação dos Povos Indígenas do Brasil (Articulation of Indigenous Peoples of Brazil), indicating that they were the **link across different exchanges** involving the users in the network.

4.2.7 What are the top retweets per day associated with Amazon fires related hashtags on Twitter?

- The top retweets included **different language contents**, varying from English to Thai, from Korean to Italian.
- The most-tweeted retweet during the 10-day period implied '**whataboutism**', with reference to deforestation in Chiang Mai, Thailand.
- **As the peak started to subside, NGOs contents emerged on the top retweets lists**, particularly Friends of the Earth's report on Blackrock. This was also the case for **scientists** who started to rise to greater prominence towards the end of the period.
- **An influencer** has once again appeared on the top retweet lists, indicating their potential role in promoting specific issues and narratives.

- Some top retweets used **contents which were repurposed from other contexts**. Many of them are photos and videos used out of context. For instance, Sunrise Movement included a video of indigenous people who are not residents of the Amazon rainforests.

4.2.8 What are the most shared URLs associated with Amazon fires related hashtags on Twitter?

- **News media articles** received the most shares, indicating the prominent role they play across different kinds of engagements with the fires on Twitter.
- **Petitions pages** were also popular and appeared on the top URL list, suggesting how social media users were invited to take different kinds of actions in relation to the fires.
- The only **scientific web page** on the top URLs showed NASA's carbon monoxide satellite image.
- Some links are directed to **commercial pages** on Etsy.
- When zooming into news media articles, the top articles were not about the Amazon rainforest fires but the **past fires in different parts of the world**.

4.2.9 What are the most shared domains associated with Amazon fires related hashtags on Twitter?

- Compared to the top URLs where news media pages were most present, a **petition site** (change.org) and **Twitter** were the most shared at the domain level.
- **News media platforms from various countries** emerged on the top domains, including Sitio Andino, El Pais, National Geographic, CGTN, The Guardian, and Forbes.

4.2.10 What kinds of concerns are present in images associated with Amazon fires related hashtags on Twitter?

- The most engaged images portray **remote perspectives** about the Amazon rainforest fires.
- Images played an **affective role** - such as sharing animals of animals affected by the fires, and human-animal care relations.
- Other images served to **anthropomorphise the fires,** for example by portraying the Amazon as the planet's lungs.
- There was a **strong presence of recycled media and "generic images"**. For example, there was a tendency for these images to show **animals** and were originally taken during the **fires in different parts of the world**, from Peru to India.
- **NASA's AIRS map** has also shown up, which also appeared on the top URL and domains.

- Images associated with **BTS**, the Korean boy band, have also emerged on the top images.
- **International political figures** were also prominent, including Bolsonaro, Evo Morales, Macron, and Trump.

4.3.2 What are the most shared images per platform? (Image grids)

- **Images of fires** are most visible across all platforms (Twitter, Instagram, Facebook, YouTube and Google.
- The **recycled media shared by celebrities, athletes and politicians** have appeared multiple times on Instagram, Facebook and Google.
- **Twitter screenshots** were prominent on **Twitter, Instagram and Facebook**, while **professional and news photographs do well on Google Search**.
- The top images on **YouTube** were mainly from **news media**.
- **Facebook** treats the **same recycled photo differently on the platform**, labelling the image with a warning on one Facebook post while not indicating such alert on another post by Macron.

4.3.3 What are the most shared images per platform? (Image stacks)

- Across **all platforms** except Twitter, one can see **recurring iconic images of the fires**. In particular, the strong presence of fire images can be observed for Google.
- The **recycled image shared by Cristiano Ronaldo** can be witnessed on **Facebook and Instagram**.
- Unlike other platforms, **Twitter** shows a wide range of issues, but **fire imagery is less prominent**.
- **YouTube** also highlights many images of **humans rather than fires**.

4.3.4 How are images and hashtags connected in tweets associated with misinformation?

- When looking at the images that have circulated with misinformation-related hashtags, there were at least **four types of usage of images and hashtags**.
- Firstly, **screenshot debunking** where the images of news articles and tweets debunking misinformation have been used together with the hashtags like #FakeNews and #misinformation.
- Secondly, some images misleadingly present the **Amazon fires as a "hoax from the left".**
- Thirdly, a number of images **mocked misinformation practices through memes**.
- Finally, a network of images **promotes veganism as a solution** to the Amazon fires with the hashtag #AmazoniaSemFake.

4.3.5 How are images thematised and modified through the act of tweeting and retweeting?

- The recycled photo shared by Macron has not only circulated on social media but has been modified. There were at least three categorisations of modification on Twitter, namely a) **copies of the original image with minor modification**, b) **screenshots of the image posted in other online spaces**, and c) **memefied images**.
- Our analysis shows the **prominent role that stock and "generic" images** not just in news coverage but also more widely in online mobilisations around environmental issues.
- The re-purposing of such images is not in itself inherently problematic. Image reuse is not only part of professional image editorial, but also **digital culture and social media user practices**.

Annex

Annex 1: The analysis method for 4.2.3 "What are the most prominent hashtags per day associated with Amazon fires on Twitter?"

1. Export "hashtag frequency" data from TCAT (2019-08-01 to 2020-03-08).
2. Re-organise data into columns of top hashtags per day for a 10-day period.
3. Harmonise cases of hashtags using OpenRefine.
4. Create a subset of the top 100 hashtags for a 10-day period.
5. Create exploratory visualisation using the RankFlow tool (w: 2000, h: 1000).

Annex 2: The method for 4.2.4 "How do hashtags associated with Amazon fires on Twitter relate to each other?"

1. Export co-hashtag network data from TCAT (2019-08-01 to 2020-03-08)
2. Open using the Gephi network analysis tool.
3. Filter by word frequency > 10.
4. Filter by edges weight > 10.
5. Size nodes by hashtag frequency (using the logarithmic curve to see small differences in smaller words).
6. Colour nodes by modularity class.
7. Spatialise with force atlas 2.
8. Export network and clean in illustrator.
9. Created network walkthrough using Teselle.

Annex 3: The method for 4.2.5 "What kinds of voices are most active around #AmazonFires hashtags? What domains do they share?"

1. Export user mention and visibility data from TCAT for the 10-day period.
2. Identify and analyse the top 20 most active users in terms of the volume of tweets.
3. Export the URLs and domains shared by each of the top 20 most active users.
4. Create a bipartite network of users and domains that they share to understand the most tweet sources across the set of most active users.

Annex 4: The method for 4.2.6 "What types of actors are retweeted and @mentioned in relation to Amazon fires related hashtags?"

1. Export network file of mentions between top 500 users from TCAT.
2. Import, analyse and visualise network file with network visualisation software Gephi.
3. Interpret the network following the principles of Visual Network Analysis (VNA).

Annex 5: The method for 4.2.7 "What are the top retweets per day associated with Amazon fires related hashtags on Twitter?"

1. Export retweet data per day from TCAT (2019-08-01 to 2020-03-08)
2. Re-organise data into columns of top retweets per day for 10-day period
3. Create a subset of top 10 retweets for 10-day period
4. Colour code tweets according to their main topic

Annex 5: The method for 4.2.8 "What are the most shared URLs associated with Amazon fires related hashtags on Twitter?"

1. Export URL frequency data from TCAT (2019-08-24 to 2019-09-02)
2. Reconcile URLs with different query strings (bit after "?" in URL) by filtering by day, alphabetising URLs, and manually combining near-identical ones
3. Organise into columns of up to 100 URLs per day
4. Selected 40 URLs per day (maximum multiple of ten shared by all days) plus 10 URLs per day (to have a closer look at most engaged with)
5. Create exploratory visualisations using RankFlow tool (w: 2000, h: 1000)

Annex 6: The method for 4.2.9 "What are the most shared domains associated with Amazon fires related hashtags on Twitter?"

1. Export URL frequency data from TCAT (2019-08-24 to 2019-09-02).
2. Opened in OpenRefine to look for duplicates (none found using various clustering mechanisms).
3. Organise into columns of up to 200 URLs per day using Google Sheets macro.

4. Selected 40 URLs per day (maximum multiple of ten shared by all days) plus 10 URLs per day (to have a closer look at most engaged with).

5. Create exploratory visualisations using the RankFlow tool (w: 2000, h: 1000).

Annex 7: The method for 4.2.10 "What kinds of concerns are present in images associated with Amazon fires related hashtags on Twitter?"

1. Exported list of most shared images from TCAT.
2. Used pivot tables to get data for most engaged with images overall and per day
3. Used image preview function to generate image grids for 100 most engaged with images.
4. Used Flourish bar race chart tool to generate animation showing the top 10 most engaged with images per day.
5. Used image tagging tool and Gephi to create an image-theme network.

Annex 8: The method for 4.3.2 "What are the most shared images per platform? (Image grids)"

1. Obtain data for the cross-platform image dataset
2. Twitter: TCAT export for "most shared media" filtered by 10-day period;
3. Instagram: CrowdTangle export for 10 posts with most interactions filtered by 10-day period
4. Facebook: CrowdTangle export for 10 posts with most interactions filtered by 10-day period
5. YouTube: YouTube data tools export for 10 highest ranked videos (by relevance) filtered by 10-day period. Obtained thumbnails for each video.
6. Google Image Search: DMI Google Images Scraper export for 10 highest ranked images on 20th of August 2020.
7. Organise top 10 images per platform into Google Sheets.
8. Use the "=IMAGE()" function to preview images in a spreadsheet.
9. Hide URL columns and format/colour headers.
10. Export as PDF.

Annex 9: The method for 4.3.3 "What are the most shared images per platform? (Image stacks)"

1. Get top 10 images per platform
2. Download top ten images per platform
3. Import images in vectr.com

4. Set images opacity to 10%

5. Stack 10 images per platform, from less shared (bottom) to most shared (top)

6. Export one stack per platform

Annex 10: The method for 4.3.4 "How are images and hashtags connected in tweets associated with misinformation?"

1. Export full dataset from TCAT.

2. Create a subset of tweets based on a list of hashtags concerning misinformation

3. Extract image URLs from the dataset

4. Download images with DownThemAll!

5. Prepare network dataset (images and hashtags)

6. Visualise network with Gephi

Annex 11: The method for 4.3.5 "How are images thematised and modified through the act of tweeting and retweeting?"

1. Create a colour similarity grid of all images in the dataset.

2. Identify similar images.

3. Cluster images into types based on similarity.

4. Extract tweets associated with each image type.