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1 **Quantitative analysis of actors' mention in press coverage of a** 2 **seismo-volcanic activity in the French overseas**

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9 **Abstract**

10 Media, especially the press, play a crucial role in shaping public understanding and representations during risk and crisis
11 management, acting as intermediaries between various actors and the public. However, their framing of sources can
12 introduce biases into representations. Limited analysis exists regarding how press coverage portrays relationships
13 between crisis and risk management actors. Using Social Network Analysis, we map quotation networks in press
14 coverage of a seismo-volcanic crisis in Mayotte, a French overseas department allowing us to: i) have an overview of the
15 relationships between actors; ii) highlight unique aspects related to the context and media portrayal; iii) display
16 underlying representations and levels of trust among interviewed actors and iv) visualises networks' dynamics over time.
17 Analysis revealed variations in narrative approaches among newspapers, with some focusing on specific aspects. General
18 results show that national authorities received more attention than local elected representatives, and scientific figures
19 dominated reported speeches, while the population's perspective remained relatively passive despite their centrality to the
20 quotation network. Identified individuals held significant positions, emphasising the importance of personal connection in
21 communication and revealing a potential distrust toward political and scientific institutions. This underscores the need for
22 proximity between sources and the community.

23 **1. Introduction**

24 Risk communication is a key component of disaster risk reduction (UNISDR, 2015). Implementing an efficient risk
25 communication strategy is however not a trivial matter (e.g. Drabek, 1986; Mileti and Sorensen, 1990; Tierney, Lindell
26 and Perry, 2001). There are many pitfalls: in the communication process between actors in charge of risk monitoring and
27 management as well as in the process of public information sharing. It is particularly difficult when uncertainties are
28 large, which is the case in crises related to volcanic hazards for instance (e.g. Barclay et al., 2008; Solana et al., 2017;
29 Andreastuti et al., 2019). Mass media (newspapers, television, radio) play an important role with regards to public
30 information (see Perry and Lindell 1989 p. 47-62 or Scanlon, 2007 for an overview). In crisis situations, they are
31 identified as the main source of information for the public while searching for hazard-related information (Nazari et al.,
32 2011; Poudel et al., 2015 ; Van Belle, 2015). It is especially the case for local and national media (Burkhart, 1991; Allan
33 et al., 2000 ; Scanlon, 2007) and their participation is thus crucial for effective warning (Lindell et al., 2006). News
34 reports are also closely followed by crisis management teams influencing official communication strategies (e.g.,



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35 Lagadec, 1991; Lindell et al., 2006). They affect risk perception in the long term, notably by contributing to the
36 circulation of “erroneous representations” about how individuals, groups or organisations behave during disasters
37 (Coleman, 1993; Quarantelli, 2002; Wachinger et al., 2013; Van Belle, 2015).

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39 As compared to other sources, newspapers, especially the daily press, are commonly seen as a more credible source of
40 information because of their ability to provide in-depth analytic coverage (Quarantelli 2002, cited by Steelman et al.
41 2015). They are also widely relayed in other media or on social networks. The local press occupies a specific position to
42 this respect, as local journalists are both interested parties and commentators of ongoing crises. The resulting coverage
43 tends to be more regular and more detailed and it often provides the raw material for press agencies and, through them,
44 for the other media (e.g. Nielsen, 2015 on how local newspapers act as a “keystone media” despite having few readers
45 and Cagé, Hervé and Viard, 2017). Studies have also demonstrated the pivotal role played by local journalists as
46 intermediaries between risk management authorities and populations while disseminating warning messages, conveying
47 the community’s concerns and providing updates on the situation at the grassroots level (Scanlon, 2007). Newspapers’
48 coverage constitutes therefore an important issue for disaster research (see Harris et al. 2012; Camilleri et al., 2020;
49 Calabrò et al., 2020; Le Texier et al., 2016 and Devès et al., 2019 for application to seismic crises and Devès et al.,
50 2022b for applications to volcanic crises).

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52 However, the daily press, and the media in general, cannot be considered as simple vehicles for providing information. As
53 recalled by Aylesworth-Spink (2017), they act as “a complex mediator with specific interests and motivations”. The way
54 the media depict an event is neither exhaustive nor neutral. There are many factors influencing the final coverage:
55 selection of topics (Pavelka, 2014), layout and design choices (e.g. Moirand, 2006; Schindler and Krämer, 2017; Billard
56 and Moran, 2023), political ideology and editorial policy of the newspaper (e.g. Wang et al., 1992; Shoemaker and Reese,
57 1996), access to sources and their respective social status (Ploughman, 1997), choices of contextualization (Llasat et al.,
58 2009; Cavaca et al., 2016; Carter et al. (2018) in the context of Christchurch 2010 and 2011 and Kaikōura 2016
59 earthquakes). Day-to-day journalistic practices also play a role (e.g. Boykoff and Boykoff (2004) about quoting sources
60 on an equal footing on the example of global warming). The way journalists tend to cross the speeches of heterogeneous
61 sources, whether important for depicting the variety of viewpoints, has been shown to “blur” messages (e.g. Lejeune,
62 2005, L’église and Garric, 2012, and Devès et al., 2022a). These various factors can lead to conveying representations to
63 the public that are sometimes very different from how authorities and scientists see the situation (Ploughman, 1995).
64 They may also implicitly replicate common misconceptions (see Quarantelli, 1996) or reproduce asymmetrical power
65 relationships between actors without really questioning them (local vs national authorities, experts vs lay public, etc., see
66 Valencio and Valencio (2018) on the under-representation of at-risk communities’ vision about recovery solutions for
67 their lives or Devès et al. (2023) on reproduction of asymmetrical power relationships in the media discourses in the
68 context of a French oversea seismo-volcanic crisis).

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70 Examining press coverage provides insights into the pivotal moments and key actors perceived by journalists covering the
71 event, who often serve as primary observers on the scene. The use of content and thematic analyses allows for the
72 reconstruction of the sequence of events, mapping of actors’ networks (Hijmans, 1996), and identification of
73 representations conveyed by the press toward at-risk communities. This is exemplified by studies like those conducted by
74 Thistlethwaite & Henstra (2019) or Calabro et al. (2020). However, there is a limited number of studies analysing how

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75 relationships between actors are portrayed in the press. Do these networks of interrelations, commonly connecting crisis
76 management actors, experts, and populations, align with the envisaged distribution of roles during crisis management
77 planning? If disparities exist, what insights do they provide?

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79 Examining such interrelations can be accomplished by creating maps of quotation networks, representing how the actors
80 themselves cite or reference each other in the press text (McLaren and Bruner, 2022). This method falls within Social
81 Network Analysis (SNA), a widely employed approach in social and information sciences (Otte and Rousseau, 2002;
82 Sapountzi et al., 2018). SNA utilises tools from network analysis and graph theory to investigate social structure and
83 information circulation within networks of actors. Past studies utilising SNA or its derivatives in the realm of disaster risk
84 research have shown interest in examining misinformation and the structuring of information networks in social media
85 (e.g., Pourebrahim et al., 2015; Kim et al., 2018), or conducting a functional analysis of crisis management organisations
86 (e.g., refer to Trias et al., 2019, for governance, and Flecha et al., 2023, for humanitarian aid). To our knowledge, there is
87 a lack of studies utilising SNA on press data within the context of risk or crisis management. Yet, this is an important area
88 of research, as this approach enables: i) gaining insights into the actual organisation of actors by providing a
89 comprehensive view of all cited actors and their interactions, allowing the detection of communities (e.g. Park et al., 2015
90 and Williams et al., 2015); ii) identifying actors who are prominently featured, whether due to their perceived reliability,
91 relevance in transmitting information on a subject, specific social role or accessibility to journalists, iii) examining the
92 involvement of various actors and the evolution of this network over time (including the appearance and disappearance of
93 actors and its effect on the structure of the network) and, iv) accessing a particular representation of actors, whether active
94 or passive in media coverage. Here, we apply this method on a press coverage of a seismo-volcanic crisis in a French
95 oversea department, Mayotte.

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97 Before presenting our corpus (Section 3.1) and methods (Section 3.2), we briefly describe Mayotte geological and
98 sociological contexts and explain why it is an interesting case study (Section 2). We then expose our findings (Section 4).
99 Section 4.1 concentrates on the actors' mention frequency and form in varying newspapers (depending on publication
100 rate). Section 4.2 focusses on whether actors' statements are displayed directly or through a third party, depending on the
101 newspaper. Section 4.3 explores the positions of the actors mentioned in the chain of quotation. Section 4.4 is a
102 comparison of the actor network structures during several specific "moments" of this media coverage. In sections 5.1 and
103 5.2, we discuss differences between the press representation of the actors network and the official organisation of risk
104 and crisis management in France and its overseas territories. Eventually, we conclude on the interest and caveat of our
105 approach and on future avenues of research.

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107 2. Case study description

108 Devès et al. (2022a) provide a detailed description of Mayotte's geological context and the so-called "seismo-volcanic
109 crisis" that began in Mayotte in May 2018. We settle here for reminding the main events and reviewing the latest
110 scientific updates since knowledge evolves quite rapidly in the area due to ongoing significant research efforts.

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112 The seismo-volcanic crisis began on the 10th of May 2018 with an unusual seismic activity (tens of felt earthquakes in the
113 first month alone, with magnitude up to M_w 5.9, see BSCF 2018). This seismic crisis turned out to be linked to a volcanic



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114 eruptive activity at sea and a newly born volcanic edifice, named Fani Maore, was discovered one year later, in May
115 2019, at about 50 km off the eastern coast of Mayotte islands. From a scientific perspective, uncertainties were really
116 high, especially in the first months of the seismic crisis due to scarce knowledge of the geodynamical context in the area
117 and a poor instrumental network (Saurel et al., 2021; Bertil et al., 2021; Feuillet et al., 2021). This made public
118 communication particularly difficult and led to the development of a “technicalist bias” with frequent, but technicalist and
119 minimalist communication from institutions that did little to help the population to appraise the situation (Devès et al.,
120 2022a). Indeed, there was an overall feeling of “lack of information” (Fallou et al., 2020) which led to the spread of
121 numerous rumours to explain this phenomenon and to regular complaints from inhabitants and their representatives (see
122 for instance the questions addressed to the government by a Member of Parliament for Mayotte Ali in 2018, as well as the
123 opened letter sent to the authorities and scientists by a group of citizens in February 2019, Picard, 2019). At the time of
124 writing, the eruption of the new submarine volcano Fani Maore has ceased and seismic activity is divided in two main
125 clusters active since the end of June 2018 (according to Lemoine et al., 2020) at respectively 5 to 15 km and 30 to 40 km
126 from coast (Feuillet et al., 2021; Saurel et al., 2021; Lavayssière et al., 2021). Most of them are volcano-tectonic seisms.
127 Another sign of activity is the detection at 10 to 15 km from the coast of acoustic plumes associated with geochemical
128 anomalies (22 sites observed in July 2022, MAYOBS 23) and possibly linked to the gas emissions monitored onland on
129 Petite Terre island since prior to 2018. Hence, magmatic processes related to these observables are still pretty close to the
130 island. As their uncertain evolution presents a significant hazard, it is currently being monitored by REVOSIMA
131 (Mayotte Volcanological and Seismological Monitoring Network).

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133 In addition to scientific uncertainties and the already mentioned ensuing difficulties in public information, other factors
134 could also have undermined the relationship between actors. For instance, there is both a geographical and a cultural gap
135 between scientists involved and the local populations since most of the former ones are based either in mainland France
136 or in La Réunion island and do not have lots of occasions to exchange with Mayotte inhabitants. As detailed in Devès et
137 al. (2022a), Mayotte is a multicultural archipelago with a dominant oral culture where about 37% of the population do not
138 speak French (INSEE, 2017), which complicates risk prevention communication from scientific institutions and
139 authorities in charge. It is also a particularly vulnerable territory marked by poverty and important social inequality
140 (Roinsard, 2014; INSEE, 2021). Since its recent departmentalization in 2011, it has been regularly shaken by social crisis,
141 one ending just as the seismic swarm began (Roinsard, 2019; Mori, 2021). Finally, there seemed to be no living memory
142 of seismic and volcanic phenomena in Mayotte implanted in the population. The last important earthquake was a
143 magnitude M_L 5.3 in 1993 (Bertil et al., 2021). This added to the underwater nature of this activity brought people to
144 confusion, some of them going so far as to doubt the scientific explanations and the very existence of a volcano, even
145 today (see testimonials in Devès et al., 2023). In this context, which brings together strong scientific uncertainties, social
146 tensions and a multitude of players, we are seeking to identify in greater detail the obstacles and mechanisms that have
147 hampered the information at each link of the communication chain.

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149 To sum up, Mayotte’s seismo-volcanic activity is an interesting case for this study because: i) although the seismic-
150 volcanic phenomenon itself has been associated with moderate impacts, in the first years of activity, it triggered a social
151 crisis that the risks managers themselves qualified as a “communication crisis” (see questions to the government, Ali
152 (2018) where the deputy Ramlati Ali expresses in national assembly a need for information and an open letter sent by a
153 citizens' group (Picard, 2019) and I which state services, elected officials and scientists were taken to task on this subject.

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154 More details are exposed in Devès et al. 2022a and b, Fallou et al. 2020, Mori 2021 and 2022); ii) despite a large quantity
155 of public information documents issued by scientists and the authorities (Devès et al., 2022a), the significant feeling of
156 “lack of information” within the exposed population documented by Fallou et al., 2020 raises questions about the
157 transmission chain of this information to the public; iii) risks are perceived mostly indirectly by at-risk populations, which
158 poses specific challenges for public information (Skotnes, Hansen and Krovel, 2021); iv) there are large uncertainties,
159 some of them still ongoing as we write; and eventually v) the activity is long-lasting allowing to study the evolution of a
160 large coverage over time.

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162 3. Method

163 3.1 Corpus

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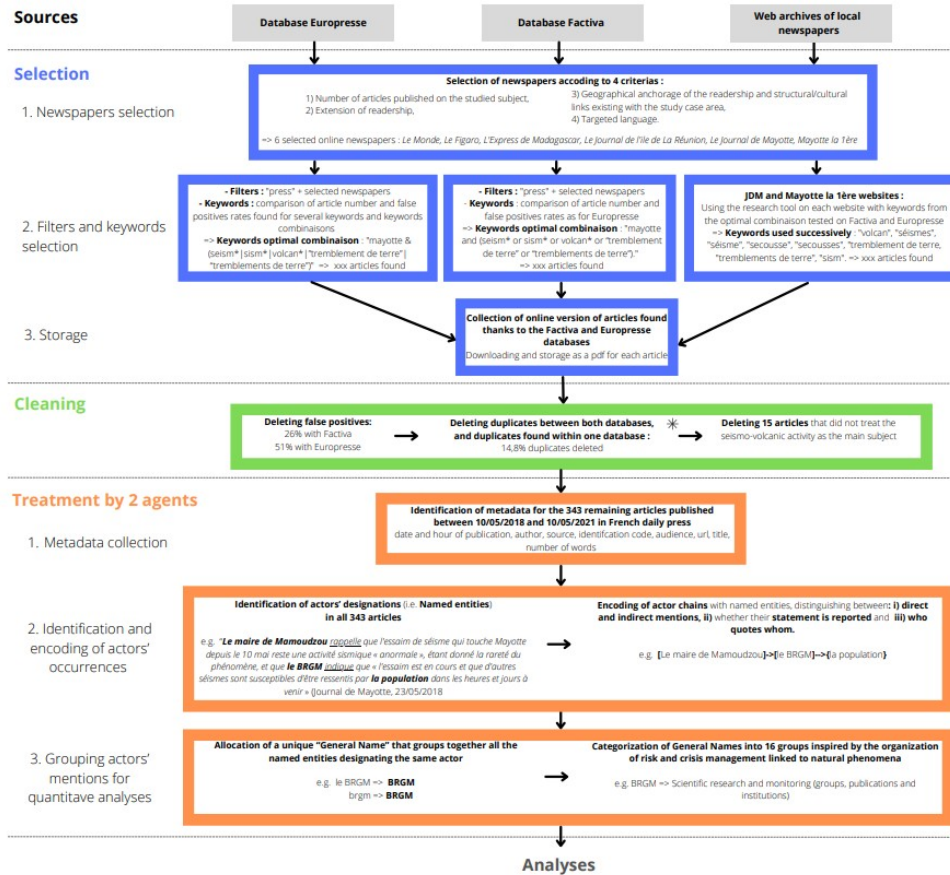
165 We build on from two previous studies (Devès et al., 2022a which focuses on public information processes and showed
166 caveats in both scientific and state institutions communication and Devès et al., 2023 which illustrate how newspapers
167 implicitly reproduce asymmetrical power relationships between actors without really questioning them (local vs national
168 authorities, experts vs lay public, etc)) to identify and compare occurrences of actors according to their role in the risk
169 reduction network, the geographical scope of newspapers (local vs regional vs national) and whether there are significant
170 differences between newspapers. We use the same corpus as Devès et al. (2022b) and Devès et al. (2023) that contain
171 articles from six French-written daily newspapers published between the 10th of May 2018 and the 10th of May 2021.
172 The methodology for creating this corpus is inspired by Le Texier et al. (2016) and Devès et al. (2019). We selected
173 newspapers based on four criterias: 1) number of articles published on our case study, 2) broadness of readership, 3)
174 spatial distribution of the readership along with the structural and cultural links existing between this zone and the study
175 case area and 4) a targeted language (French in this study). Six French language daily newspapers were selected among
176 56 sources mentioning these events, addressing national (*Le Monde*, *Le Figaro*), regional (*L'Express de Madagascar*, *Le*
177 *Journal de l'île de La Réunion*) and local readerships (*Le Journal de Mayotte and Mayotte la 1ère*); see Figure 1 and Part
178 1 in Supplementary Information. Articles were then collected with two types of sources : 1) Factiva and Europresse, two
179 full-text press databases offering a selection of general and specialised of both paywalled or freely accessible newspapers
180 with regional, national and international readerships, and 2) web archives, especially for local press articles which can not
181 be found in those two databases. Factiva and Europresse databases are often used by scholars to study media coverage
182 (Severo et al., 2015, Reboul-Touré 2021, Bernier et al. 2013).

183 The resulting database is composed of 358 articles published between May 10th 2018 and May 10st 202 thus covering the
184 first three years of Mayotte's seismic-volcanic crisis. We chose to limit this database to May 2021, after the pictures
185 taken underwater and graphical representations of the phenomenon began to be regularly broadcasted by these media thus
186 involving possible changes in the perception of the phenomenon by the readership. It is also when articles in the local
187 press become less frequent. Within this database, 15 articles were excluded (see Supplementary Information) in this
188 particular study as we wanted to work only on news items whose main subject is the seismo-volcanic activity. Therefore,
189 the final database includes 343 articles and covers the first three years of the recent seismo-volcanic unrest near the
190 archipelago of Mayotte.

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* Analysis on a representative sample of articles (74,2% of the articles in our database)

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200 3.2 Indicators

201 3.2.1 Actors and categories of actors

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We use a broad definition of the term “actor” which encompasses both individual and legal entities, groups of individuals sharing a common character or purpose such as a scientific mission or being impacted in the same way by the crisis, but also media agencies who play an active role in communicating about the event (Agence France Presse, Twitter, scientific journals, etc.). Places or buildings (mobile like a boat or immobile like a school) may be described in the media as actors when they are named as synonymous for the individuals they host and are then also selected.



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207 To study the press coverage of different categories of “actors” in our corpus, we first followed a double-reading method
 208 by human operators enabling us to select and identify each actor or group of actors mentioned in articles, even when they
 209 were identified by professional status, by nicknames, etc. This qualitative analysis of the texts in the corpus made it
 210 possible to disambiguate the majority of references to actors in the texts. For example, the terminology "experts" can be
 211 used to refer to scientists specialising in the hazard as well as to technicians from the Bureau Veritas in charge of
 212 assessing the damage and some actors have different affiliations depending the articles due to errors or evolutions in
 213 his/her career (e.g. Nathalie Feuillet, a researcher, has been wrongly affiliated to IFREMER in some articles like for
 214 instance 20190507_JDM_001). A careful reading of the articles is thus needed and generally allows the actors to be
 215 categorised. Remaining actors are labelled as “unidentified” in the category Divers/Unidentified (see Part 2 in the
 216 Supplementary Information). When an actor is identified in the press article, we note its exact denomination(s) (i.e.
 217 named entities) and we build two correspondence tables allowing to : i) identify the different ways of naming the same
 218 actor and grouping them under a chosen “general name” (TABLE NamedEntitiesToGeneralName in TABLE SA) and ii)
 219 group these actors in categories (see TABLE GeneralNamesToCategories in TABLE SB for a correspondence table
 220 between “general names” and “categories”) in order to build a structural analysis.
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222 **TABLE 1: Denominations and definitions of categories used to group actors identified by two human operators in a database of**
 223 **343 daily press articles published between 10/05/2018 and 10/05/2021 covering the first three years of the recent seismo-**
 224 **volcanic unrest in Mayotte archipelago. Categories are determined according to the organisation of risks and crisis**
 225 **management in France (see Fearnley et al. (2018) and Section 2 in Part 2 of the Supplementary Information).**

Level 1 of categorization:	Usual categories considered in risks and crisis management studies
Name of categories	Definition of categories
Scientific research and monitoring (groups, publications and institutions)	Scientific groups, publications, institutions and all groups of people involved in monitoring and research on the sismo-volcanic activity in Mayotte.
Scientific research and monitoring (named individuals)	Namely identified scientists involved in monitoring and research on the sismo-volcanic activity in Mayotte.
Risks and crisis management actors	Administrative authorities involved in risk and crisis management activities
French political institutions	French political institutions involving members of the government, the French Parliament and the Senate
Public and para-public services to the population (institutions and members)	French public or parapublic services to the population
Elected local officials	Locally elected executive representatives
Mass media and associated journalists	Includes TV, radio, magazines, newspapers and associated journalists
Social media/Internet	Social media or websites
Civil society, private sector and NGOs	Civil society, private sector and NGOs



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Local identified personalities	Influential figures in Mayotte
At-risk populations in Mayotte	Populations living in Mayotte and exposed to natural hazards
Educational staff and institutions	Educational staff and institutions in Mayotte and mainland France
Students and schoolers in Mayotte	Children living in Mayotte when mentioned in school contexts
Other populations	Populations living outside of Mayotte
Foreign states, communities and personalities	Foreign state actors, personalities or communities that are not involved in scientific or risk and crisis management activities
Divers/Unidentified	All actors that could not be categorised in the previous categories because unidentified, or belonging to more than one category

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227 **3.2.2 Direct vs indirect mentions and reported speech vs simple mention**

228 A direct mention is when an actor is cited in the text body by the author of the article without being introduced by another
 229 actor. Indirect mention corresponds to the case when an actor is mentioned through a third party in the article. For
 230 example, in the sentence “An earthquake with a magnitude of 4.0 was recorded by the Bureau of Geological and Mining
 231 Research (BRGM) informs the prefecture”, the citation of the prefecture is declared as direct and that from the BRGM as
 232 indirect. This distinction allows us to measure the interactions between categories of actors in the press, and in particular
 233 the most frequent citation links, the direction of these relationships (and therefore their potential asymmetry) and finally
 234 the more or less central position of actors and categories of actors within the citation network.

235 We also draw a distinction between reported speech and simple mentions of actors (see TABLE 2). Reported speech can
 236 be direct or indirect. What we identify as reported speech includes everything that the journalist presents as being the
 237 word or opinion of this actor, whether it appears to be reported directly (with the use of quotation marks for example) or
 238 indirectly, or even distorted. For e.g. in the sentence : “In May 2018, when the swarm of earthquakes began to shake
 239 Mayotte, the first scientists rushing to the island did not believe in volcanic activity”, we consider that a voice is given to
 240 the scientists since the news item is supposed to convey their beliefs. On the contrary, in the sentence “End of mission:
 241 French prefect Dominique Sorain leaves Mayotte”, we consider that Dominique Sorain is “simply mentioned”.

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253 **TABLE 2 : Illustration of the distinctions direct mention vs indirect mention and reported speech vs simple mention using the**
 254 **actor “prefecture”.**

	Direct mention	Indirect mention
Reported speech	<p>“The prefecture <i>confirms</i> that no fewer than 13 tremors were recorded.”</p> <p>Journal de Mayotte, 05/12/2018</p>	<p>“On Tuesday evening, they [prefecture] had to <i>deny</i> on Twitter a rumor indicating that a strong magnitude earthquake could occur soon ‘<i>This rumor is totally unfounded</i>’.”</p> <p>Le Figaro, 05/16/2018</p>
Simple mention	<p>“The Mayotte prefecture activated its crisis unit this morning.”</p> <p>Le Figaro, 05/16/2018</p>	<p>“They [STTM members] criticized the prefecture’s poor communication.”</p> <p>Mayotte la 1ère, 08/08/2019</p>

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256 **3.2.3 Actor network analysis**

257 We describe the system of actors in the Mayotte seismo-volcanic activity reported in the press using two global network
 258 analysis indicators and further detect the presence of small communities using the Louvain clustering method. We study
 259 the system of actors depicted by the network of citations in order to better understand the relationships between people
 260 and categories of actors and their evolutions using network centrality indices and network diagrams plotting citation links
 261 with arrows and weighting the size of the nodes and of the fonts of the generic names by their number of connections
 262 (degree). Unidentified actors are removed from the graph plot to avoid false co-citation relationship structures.

263 In order to study the position of the actors in the citation networks (source and destination of a citation) derived from the
 264 corpus, we use two indicators from network analysis at the node level: degree centrality and betweenness centrality.
 265 Degree centrality measures the number of links held by a node. It captures the amplitude of the network with which an
 266 actor is connected in the media, through the citation process. We distinguish in- and out-degree centrality, i.e. the number
 267 of actors by which an actor has been mentioned and the number of actors that he/she has mentioned. The actors with the
 268 highest out-degree index values are those with the strongest activity in transmitting and communicating the experiences,
 269 opinions, speeches and actions of other stakeholders (including Mayotte’s population). On the contrary, a high in-degree
 270 index demonstrates a central position in the network linked to strong interest from third parties. The study of the ratio
 271 between in and out-degree centrality makes it possible to study the level of reciprocity of these two states. Betweenness
 272 centrality measures the number of times a node lies on the shortest path between two other nodes. The values are
 273 normalised by the number of node pairs in the graph (direction of citations are not accounted for). A high betweenness
 274 index indicates that an actor plays an important role in connecting the network of actors depicted in the media, and in
 275 particular the subgroups that the citation relationships update, either because he/she positions himself/herself at the centre
 276 of the network, or because he/she is positioned on the periphery of several clusters. Actors with high betweenness are key
 277 bridges between different parts of a network.

278 Here, we provide 8 different graphs matching the 8 major periods subdivision of the seismo-volcanic activity press
 279 coverage proposed by Devès et al. (2022b). This allows us to examine the evolution of the network at different periods,
 280 each characterised by the occurrence of a new external disturbance (first earthquakes, first discussions regarding the
 281 hypothesis of a volcanic origin, discovery of the volcano, public conference, etc).



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283 **4. Results**

284 **4.1 Actors' mentions in the corpus**

285 TABLE 3 presents a set of descriptive statistics on the frequency and form of actors' mentions in our corpus. The
 286 newspapers under study have not all published with the same frequency on the events: the national daily *Le Monde*
 287 devoted 10 articles to the subject, while 190 articles were published by the local daily *Journal de Mayotte*. Differing
 288 publication rates result in differing actors' mentions rates depending on newspapers: *Le Monde* names 310 actors (often
 289 repeatedly), while this number peaks at 2,541 for the *Journal de Mayotte*. Beyond this rate effect, we also find differences
 290 in the diversity of the actors that are mentioned: *Le Monde*, the national daily *Le Figaro* and the regional daily *Le Journal*
 291 *de l'Île de la Réunion* respectively mentioned on average 31, 20 and 20 actors per news item, while this mean value only
 292 reached 13 for *Le Journal de Mayotte*, 12 for the local daily *Mayotte la lère* and fell to 10 for the regional daily
 293 *L'Express de Madagascar*. An inverse relationship emerges between publication rates and the average number of actors'
 294 mentions per article. Ultimately, the position of actors in the citation network will be driven by the most prolific media,
 295 which we control by building our analyses on relative indicators.

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297 Another source of variability in the media coverage of the actors lies in the space left by each newspaper to the direct or
 298 indirect mention of actors, and the reported speech of these actors versus their simple mention. If the trend is +/-80% for
 299 direct mentions per article (compared to +/-20% for indirect mentions), this proportion drops to 66.7% for the national
 300 daily *Le Figaro*. However, this newspaper is distinguished by the highest frequency of reported speech (68.6%) as
 301 opposed to simple mentions, whether they appear directly (70.2% of reported speech) or indirectly (65.3% of reported
 302 speech). The regional daily *L'Express de Madagascar* also has high proportions of reported speech (66.8%, as compared
 303 to simple mention), but this is mainly the case for the actors mentioned directly (74% of reported speech) and does not
 304 concern as much those mentioned indirectly (40% of reported speech). The local daily *Mayotte la lère* has the lowest
 305 rates of reported speech, with 33.6% on average, followed by the regional daily *Journal de l'Île de la Réunion* (42.7%)
 306 and the national daily *Le Monde* (45.5%). Again, the proportion of reported speech is invariably lower among actors
 307 indirectly mentioned by a third party than for actors appearing directly.

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309 **TABLE 3: Reported speech vs simple mention in each of the 6 newspapers selected. In a database of 343 press articles**
 310 **published from 10/05/2018 to 10/05/2021, we identified actors that played a part in the information chain regarding the seismo-**
 311 **volcanic activity off the coast of Mayotte. Indirect mention refers to when an actor is introduced in the press discourse by a**
 312 **third party as opposed to direct mention. A distinction is drawn between actors whose speech or opinion is reported, when**
 313 **anything presented as their word or opinion is reported, even distorted, and actors that are simply mentioned.**

	Number of news items	Number of actors mentioned	Average number of actors mentioned per news item	Direct mention			Indirect mention			Share of direct mentions in total	Share of reported speeches in total
				Reported speech	Simple mention	Total	Reported speech	Simple mention	Total		
Journal de	190	2541	13	1112	825	1937	185 (30.6%)	419	604	76.2%	51.0%

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Mayotte				(57.4%)	(42.6%)			(69.4%)			
Mayotte la lère	82	999	12	292 (36.4%)	511 (63.6%)	803	44 (22.4%)	152 (77.6%)	196	80.4%	33.6%
L'Express de Madagascar	25	259	10	151 (74.0%)	53 26.0%	204	22 (40.0%)	33 (60.0%)	55	78.8%	66.8%
Journal de l'Île de la Réunion	21	422	20	160 (44.9%)	196 (55.1%)	356	20 (30.3%)	46 (69.7%)	66	84.4%	42.7%
Le Figaro	15	296	20	139 (70.2%)	59 (29.8%)	198	64 (65.3%)	34 (34.7%)	98	66.9%	68.6%
Le Monde	10	310	31	132 (51.8%)	123 (48.2%)	255	9 (16.4%)	46 (83.6%)	55	82.3%	45.5%

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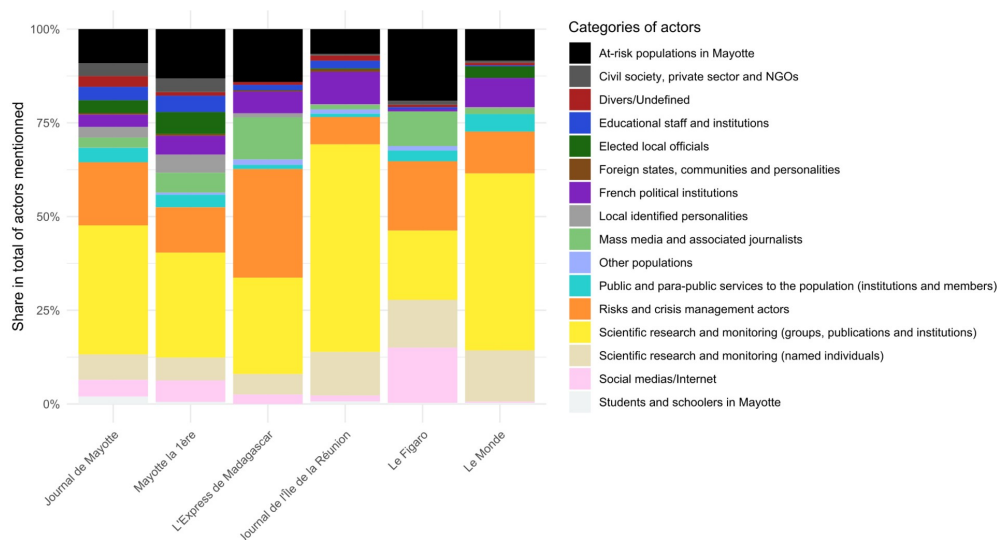
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Beyond these structural characteristics, the media are distinguished by the place given to different categories of actors (Fig. 2), revealing specialisations in the event narration. If the actors linked to scientific research and monitoring (groups, publications and institutions) are the most present in all the newspapers, this proportion varies from one media to another: they are prevalent within the regional daily *Journal de l'Île de la Réunion*, and, to a lesser extent, within *Le Monde*, while they only represents less than a quarter of the actors mentioned by the national daily *Le Figaro*. This trend is reinforced if we add up the scientific and monitoring actors whose names are explicitly mentioned. The second category of actors most represented in the different media is that of risk and crisis management actors. Again, this proportion varies from one media to another (the highest rates are observed in the regional daily *L'Express de Madagascar* and in the national daily *Le Figaro*). Interestingly, the populations at risk in Mayotte do not exceed the quarter (or even the tenth in certain newspapers such as the local daily *Journal de Mayotte*, the regional daily *Journal de l'Île de la Réunion* or *Le Monde*) of the shares of actors mentioned in the media. The relative presence of other groups of actors is more variable from one media to another: for example, citations of social networks are more common in *Le Figaro* than in other newspapers, and we observe a smaller frequency of actors from the French political institutions category in local newspapers than in national and regional newspapers (with the clear exception of *Le Figaro*).



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Figure 2: Variations in relative share of crisis actor categories in all publications by media. Categories were inspired from the organisation of risks and crisis management in France (see Fearnley et al., 2018 and Section 2 in Part 2).

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333 4.2 Direct speech opportunity vs framing of speech / reported speech

334

335 TABLE 4 reports the volume and share of direct or indirect mentions, and of reported speech or simple mentions, by
 336 category of actors in the entire corpus. Each category stands out as being mainly named in the news without an
 337 intermediary (i.e. through a direct mention), but for certain groups, their mentions in an article consecutive to a third party
 338 (i.e. indirect mention) are more common than for others. This is particularly the case for Mayotte’s populations, which, in
 339 more than 4 cases out of 10, are indirectly mentioned in the articles. The share of direct mentions is also relatively lower
 340 (to a lesser extent) for public and para-public services to the population (institutions and members) and for the students
 341 and schoolers in Mayotte (more than 3 cases out of 10) than for other groups. Named scientific and monitoring actors and
 342 local identified personalities groups are the ones that are the most frequently directly mentioned in the corpus.

343 There are large variations between categories of actors in terms of relative importance of reported speech compared to
 344 simple mentions. The analysis shows that scientific, media and institutional actors benefit from more frequent reported
 345 speech than lay people. For instance, the total proportion of reported speech for students and schoolers in Mayotte is only
 346 10.8% and 32.4% for the at-risk populations in Mayotte, while it reaches 62.9% for local personalities, 77.2% for
 347 scientific research and monitoring named individuals, 78.8 % for mass media and associated journalists and 83.3% for
 348 the social media/Internet. Among the categories identified, only named scientific actors and foreign states, communities and
 349 personalities have a higher share of reported speech when mentioned indirectly by a third party than by a direct mention
 350 in the article, which seems to illustrate the importance of these external points of view on the perception of the crisis by
 351 the various local actors.

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354 **TABLE 4: Key figures on the mentions of categories of actors in all the news items of the corpus. In a database of 343 press**
 355 **articles published from 10/05/2018 to 10/05/2021, we identified categories of actors that could play a part in the information**
 356 **chain regarding the seismo-volcanic activity off the coast of Mayotte. Indirect mention refers to when an actor is introduced in**
 357 **the press discourse by a third party as opposed to direct mention. A distinction is drawn between actors whose speech or**
 358 **opinion is reported (anything presented as their word or opinion, even distorted) and actors that are simply mentioned.**

	Number of mentions	Direct mention			Indirect mention			Share of direct mentions in total	Share of reported speeches in total
		Reported speech	Simple mention	Total	Reported speech	Simple mention	Total		
Scientific research and monitoring (groups, publications and institutions)	1762	633 (43.7%)	815 (56.3%)	1448	100 (31.8%)	214 (68.2%)	314	82.2%	41.6%
Risks and crisis management actors	683	334 (63.9%)	189 (36.1%)	523	58 (36.3%)	102 (63.7%)	160	76.6%	57.4%
At-risk populations in Mayotte	549	122 (37.7%)	202 (62.3%)	324	56 (24.9%)	169 (75.1%)	225	59.0%	32.4%
Scientific research and monitoring (named individuals)	355	237 (76.0%)	75 (24%)	312	37 (86.0%)	6 (14.0%)	43	87.9%	77.2%
French political institutions	208	85 (53.1%)	75 (46.9%)	160	11 (22.9%)	37 (77.1%)	48	76.9%	46.2%
Social media/Internet	186	134 (90.5%)	14 (9.5%)	148	21 (55.3%)	17 (44.7%)	38	79.6%	83.3%
Mass media and associated journalists	179	120 (81.6%)	27 (18.4%)	147	21 (65.6%)	11 (34.4%)	32	82.1%	78.8%
Public and para-public services to the population (institutions and members)	148	31 (34.1%)	60 (65.9%)	91	7 (12.3%)	50 (87.7%)	57	61.5%	25.7%
Educational staff and institutions	135	29 (31.5%)	63 (68.5%)	92	11 (25.6%)	32 (74.4%)	43	68.1%	29.6%
Civil society, private sector and NGOs	129	39 (39.8%)	59 (60.2%)	98	4 (12.9%)	27 (87.1%)	31	76.0%	33.3%
Local identified personalities	116	66 (66.0%)	34 (34.0%)	100	7 (43.7%)	9 (56.3%)	16	86.2%	62.9%
Elected local officials	111	47	38	85	5 (19.2%)	21	26	76.6%	46.8%

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	Number of mentions	Direct mention			Indirect mention			Share of direct mentions in total	Share of reported speeches in total
		Reported speech	Simple mention	Total	Reported speech	Simple mention	Total		
		(55.3%)	(44.7%)			(80.8%)			
Students and schoolers in Mayotte	65	6 (13.3%)	39 (86.7%)	45	1 (5.0%)	19 (95.0%)	20	69.2%	10.8%
Divers/Unidentified	64	56 (98.2%)	1 (1.8%)	57	1 (14.3%)	6 (85.7%)	7	89.1%	89.1%
Other populations	20	7 (63.6%)	4 (36.4%)	11	1 (11.1%)	8 (88.9%)	9	55.0%	40.0%
Foreign states, communities and personalities	20	5 (33.3%)	10 (66.7%)	15	3 (60.0%)	2 (40.0%)	5	75.0%	40.0%

359

360 **4.3 Position of actors in the citation network**

361 The cross-analysis of the identification frequencies of actors as source or recipient of a quotation in the corpus (Figure 3)
 362 indicates that the role played by the prefecture of Mayotte and its main representatives in communicating about the event
 363 is central, since their appearances in the media largely lead to the mention of other actors. Many mentions of actors in the
 364 event also come from the Twitter network, which appears to be an essential primary source in the media story. A few
 365 local personalities also emerge as central nodes of the network, and make it possible to relay information concerning a
 366 large number of actors. This is the case of: i) Saïd Saïd Hachim, a Mahorese geographer working at the Departmental
 367 Council of Mayotte also achieving a PhD in geography at Paul Valéry Montpellier 3 University in mainland France; ii)
 368 Lieutenant-Colonel Philippe Blanc, a member of the Directorate-General for Civil Protection and Crisis Management
 369 (part of the Bureau for Exercise Planning, Feedback and Coordination of the Beauvau Crisis Centre in the Directorate-
 370 General for Civil Protection and Crisis Management.) who exercises at a national level and was sent in Mayotte in June
 371 2018 as a member of an interministerial delegation for civil protection in the context of the seismic crisis; iii) Eric
 372 Humler, scientific director of REVOSIMA (volcanological and seismological monitoring network in Mayotte) from 2019
 373 to 2022 and in charge of the coordination of the TelluS-*Mayotte* mission, and iv) Frédéric Tronel, the regional director of
 374 BRGM (French geological survey BRGM) in Mayotte from 2017 to 2020. The UDAF (Departmental Union of Family
 375 Associations) interestingly emerges as a key player in the chains of citation of the actors within the corpus. This can be
 376 explained by the meeting they organised on the 5th of June 2018 to relay people’s experiences and promote dialogue
 377 between local actors (among them, state institutions, public and para-public services to the population, local elected
 378 representatives, ect) regarding the measures to be taken at the start of the seismic crisis (*Le Monde*, 14/06/2018 and
 379 *Journal de Mayotte*, 01/06/2018) and which was relayed by both local and national press. On the contrary, the Mahorese
 380 population and, to a lesser extent, the schoolchildren, highly cited but not often at the origin of the citation of a third
 381 actor, indicate a relatively passive position within the citation network extracted from the corpus. This is also the case for

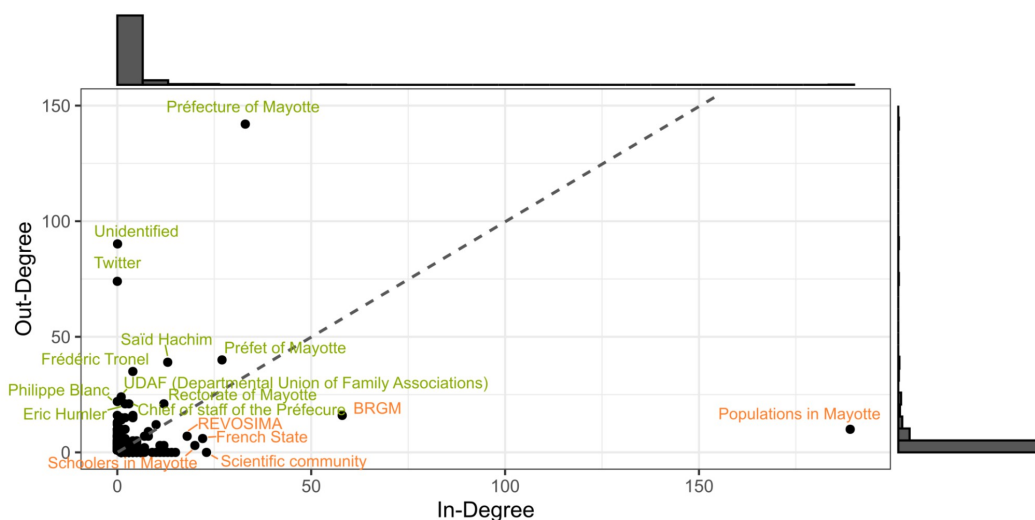


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382 the French geological survey BRGM, the REVOSIMA (Volcanological and seismological monitoring network in
 383 Mayotte) and the scientific community (in general), which are regularly used as a source of information by third party
 384 actors whose words are reported (directly or indirectly) in the articles.

385

386 Figure 4 shows an exponential relationship between the normalised values of the betweenness indices and the ranks,
 387 indicating a hierarchical structure of the network through the concentration of citation interactions by a small proportion
 388 of actors. The Mahorese population emerges as the key connection element of the network of actors constructed from
 389 citation links in the media, a role also highly played by the local expert Saïd Saïd Hachim. The central role of the prefect
 390 and the prefecture, representing the French State in the department, is also depicted. The scientific community as a whole,
 391 the French geological survey (BRGM) and the REVOSIMA also appear to be essential elements in the structuring of the
 392 network, so is the online social media Twitter allowing media visibility for individuals and institutions, and promoting
 393 citation chains via re-tweets and identifications. Expectedly, individuals with many connections also have high degrees of
 394 betweenness: Philippe Blanc, Eric Humler, Frédéric Tronel mentioned above as well as Nathalie Feuillet, observatory
 395 physicist at IPGP (Institut de physique du globe in Paris) and mission leader of the first oceanographic campaigns
 396 (MayObs 1 and 2), who, despite lower in-degree and out-degree values, contributes to concentrating a relatively large
 397 number of shortest paths in the network.



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399 **Figure 3: In- and out-degree distributions per category of actors in all the news items of the corpus.**

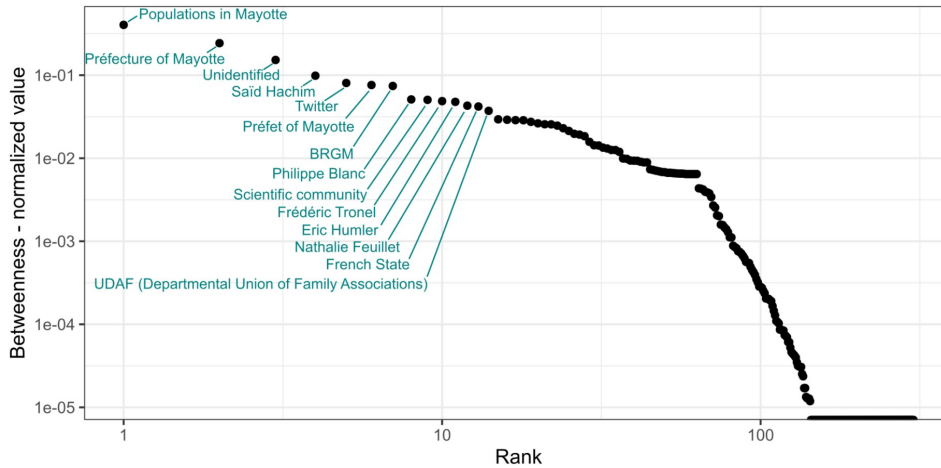
400 Scatterplot of the number of times an actor is mentioned at the start of a quoting chain (out-degree) over the number of times
 401 he or she is mentioned as a recipient of a quoting chain (in-degree). The actors who are most often the source of the quote (and
 402 who are more often the source than the one cited) are presented in green, while the actors who are most often the subject of the
 403 quote (and who are more often the one cited than the source of a quote) are presented in orange.

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Figure 4: Rank size distribution of betweenness centrality values. The plot shows the relationship between betweenness normalized values of actors and ranks (in logarithmic scales).

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4.4 Actor network structure

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The 126 articles published during the first months of the crisis (period 1, from 05/10/18 to 07/26/18) reflect a network of highly interconnected actors structured around actors polarising a certain number of citations (Figure 5): these are the Mayotte population as a whole, the prefecture of Mayotte and the prefect, the Departmental union of family affairs, actors of the educational system (rectorate, teachers), but also mayors (association of mayors, mayor of Mamoudzou-the capital city, mayor of Chirongui, or other municipalities) and the social network Twitter. The municipality of Chirongui stands out here, probably because its hosting of the Groupe d'Intervention Macrosismique served as an entry point for the presentation of the group in the local press, what's more, the mayor at the time remained in office from 2008 to 2020 and her team seems to have been particularly active and well integrated into the local community. The citation network is extensive, and all categories of actors are present with the exception of local personalities (although many groups made up of members from civil society, associations and businesses appear in the network). Interestingly, if the citation chains from the entire corpus show paths between actors belonging to the same category, the network itself presents a certain heterogeneity. The prefecture of Mayotte relayed information from local and other national risks and crisis management actors, but also from scientific research and monitoring institutions, groups and publication, and was cited by and communicated through a variety of mass media and social media. The articles in the corpus also make it possible to link the prefecture of Mayotte to the Mahorese population, as well as to various public and parapublic services such as hospitals. Thus the prefecture emerges as the central actor in the management of this first period of the seismo-volcanic activity, which is in accordance with the missions of security of people and property and representation of the State which are conferred. It is interesting to note that the prefect's interventions and mentions in the press do not link him to the same actors as the institution he represents. His communications aimed at the civilian population and representatives of civil society and associations, stakeholders in the educational world, and mayors. Actors from the delegation of specialists in civil security and natural risks like Mendy Bengoubou appear as intermediate nodes between the prefecture and the

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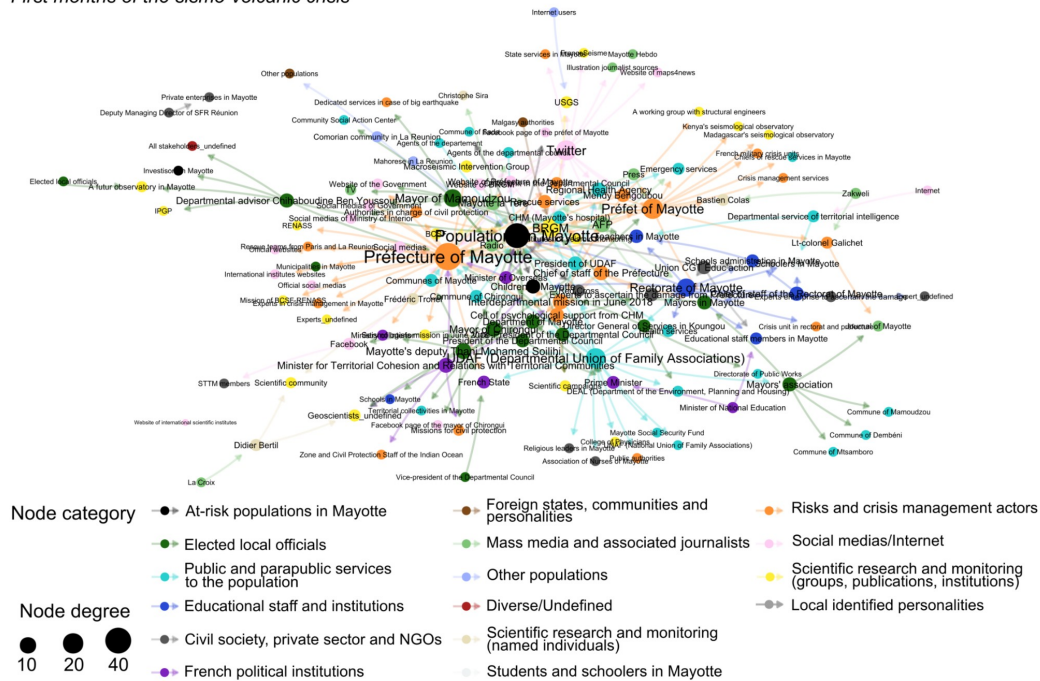
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433 prefect, with whom they share a large number of co-cited actors. Conversely, in these first months of the crisis, the
434 citation networks between scientific actors appear fragmented and local elected officials relatively peripheral.
435

Period 1: 05-10-2018 to 07-26-2018
First months of the sismo-volcanic crisis



436

437

Figure 5: The citations network of actors in the press during the first months of the sismo-volcanic crisis

439

440 The network of citations (Figure 6) for the second period (selection of 29 articles mentioning and discussing the volcanic
441 hypothesis and the first subsidence data between October 05th, 2018 and July, 26th 2018). Just as for the first period of
442 the crisis, the population (cited by numerous actors, but never at the origin of a single quote) finds itself at the centre of
443 the network. The prefecture and the prefect (and to a lesser extent the chief of staff of the prefect) still emerge as central
444 nodes of the network, as the origin of numerous citations. Only the prefecture, as an institution, receives a significant
445 number of quotes in return, from various categories of actors. Once again, the institution is separated from its two key
446 figures (prefect and chief of staff) within the citation network, with the exception of common citations to the population
447 and the BRGM. The BRGM is also the destination of numerous citations from scientific actors, which it allows to
448 partially aggregate within the network. Two scientific personalities stand out for the plurality of co-citation links they
449 create: Laure Fallou and Frédéric Tronel. The first is a sociologist research officer at EMSC (Euro-Mediterranean
450 Seismological Centre) who wrote an academic paper calling attention to the emergence of a mistrusting atmosphere and
451 circulation of misinformation due to a lack of scientific information linked with the scarcity of seismic data. Fallou et al.
452 (2020) was published in 2020, but it has also been the subject of a public communication at the General Assembly of the
453 European Geosciences Union in April 2019. The second was the regional director of BRGM in Mayotte between 2017 to

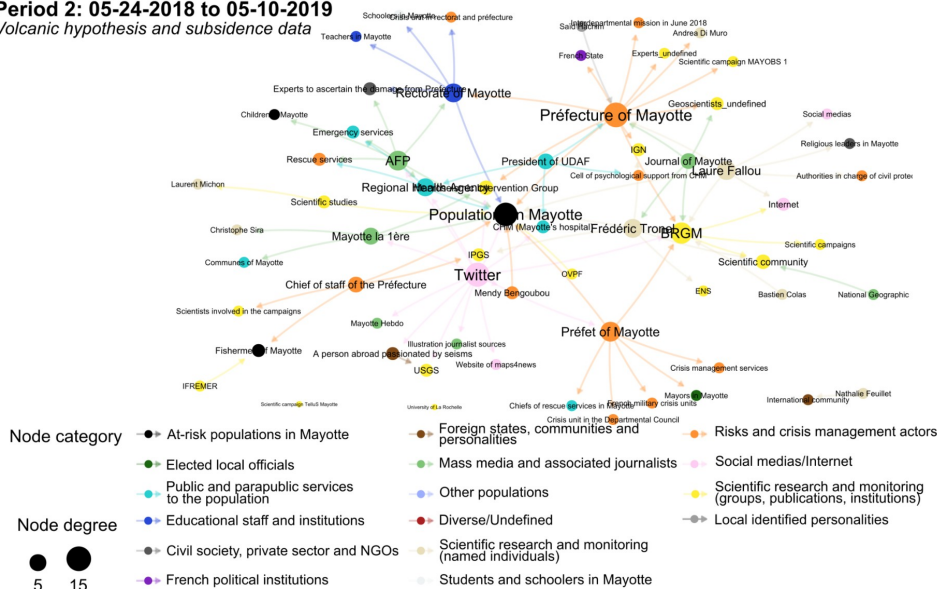
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454 2020. In contrast, Nathalie Feuillet as an observatory physicist, the University of La Rochelle in mainland France and
 455 Tellus Mayotte oceanographic mission from IPGP are isolated. Christophe Sira, a macroseismic surveyor member of the
 456 Macro seismic Intervention Group, and Laurent Michon, a research professor at University on La Réunion island, are also
 457 separated from other scientific actors. Likewise, Bastien Colas and Mendy Bengoubou, 2 out of the 3 members of the
 458 delegation of specialists in civil security and natural risks dispatched by two ministries (Ministry of Ecology and Ministry
 459 of the Interior) to assess the seismo-volcanic activity on site in June 2018, are cited separately (and are separated from
 460 mentions of the interdepartmental mission they belonged to), while the third expert, Lieutenant-Colonel Olivier Galichet
 461 is not mentioned in the selected articles. Once again, the actors in the medico-social world, at the origin of citations to
 462 various actors, have intermediate positions in the network, while the actors in the educational world find themselves more
 463 isolated than during the previous period. Another important distinctive element is the introduction of a first identified
 464 local personality, Saïd Saïd Hachim, in the network, which only cites the prefecture in this sub-corpus of the article as he
 465 relayed and detailed a note from the prefecture mentioning the volcanic origin hypothesis derived from the latest GPS
 466 data. Local fishermen also appear in the network of actors via citations from IFREMER and the chief of staff of the
 467 prefecture, following the discovery of deep-sea dead fishes about 50 km eastward from coast.
 468

Period 2: 05-24-2018 to 05-10-2019
Volcanic hypothesis and subsidence data



469

470

471 **Figure 6: The citations network of actors in the press after the emergence of the volcanic origin hypothesis and the first**
 472 **subsidence data.**

473

474 The third period studied corresponds to the discovery of the underwater volcano and concerns 36 articles published from
 475 May 16th, 2019 to August, 30th 2019. Figure 7 depicts its actor co-citation network. As compared to the previous
 476 periods, the catalytic role of the population is diminishing, while the position of local actors acting either as relays for
 477 residents' voices such as the Facebook group Signalement Tremblement de Terre Mayotte (S.T.T.M, for “earthquake

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478 reports in Mayotte” which was created after the first earthquakes of 2018) or as relays for scientific voices such as Saïd
479 Saïd Hachim is strengthened. Philippe Blanc, as a member of a Civil Security mission on volcano-related risks, also
480 appears as an important source of citations in the network, mainly for other risks and crisis management actors, without
481 benefiting from any quote from a third party in return. This is also the case of Jean-Michel Audibert, who was part of the
482 same mission for civil security, without the two actors sharing any other common citation than that of the Mahorese
483 population. The various ministries involved in crisis management and the French state are only indirectly connected to
484 each other, reflecting segmented cooperation networks even within the framework of inter-ministerial actions. The
485 Ministry of Overseas Territories introduces numerous actors into the citation network, including REVOSIMA (Mayotte’s
486 volcanological and seismological monitoring network) which was just created on the 18th of June 2019 and a hypothetical
487 future observatory in Mayotte which is still in the planning stage at the time of writing. The network of scientific actors is
488 more structured and includes more numerous, diverse and international actors than in the previous periods. Indeed, the
489 recording of the waves of a VLP earthquake all over the world on 11/11/2018 has attracted the attention of international
490 institutions and media in addition to that of scientific and political authorities at national level (Hossein and Sadaomi,
491 2021). It is however interesting to note that the scientific actors named by Eric Humler or via the Twitter network differ
492 from those named by Saïd Saïd Hachim, which mainly relays the names of scientists with whom he had published an
493 atlas of natural risks and vulnerabilities of Mayotte in 2014 and discusses MayObs’ campaigns. Several social networks,
494 the Facebook group S.T.T.M and two local newspapers appear as important nodes of the citation network, mainly citing
495 other media, the Mahorese population, scientists (despite for the STTM Facebook group), public institutions, and the
496 actors of the MayObs oceanographic campaigns carried out from the Ifremer ship Marion Dufresne. Interestingly, the
497 member of the MayObs oceanographic campaigns are not cited by the same actors, reflecting a sequencing of the actors
498 mentioned in the media as the oceanographic campaigns progress (the Prefecture, the Préfet and Twitter for the 1st
499 campaign, the Ministry of Overseas and Saïd Saïd Hachim for the 4th, while interministerial communiqués do not
500 distinguish between the different missions).
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Period 3: 05-16-2019 to 08-30-2019
Discovery of the volcano

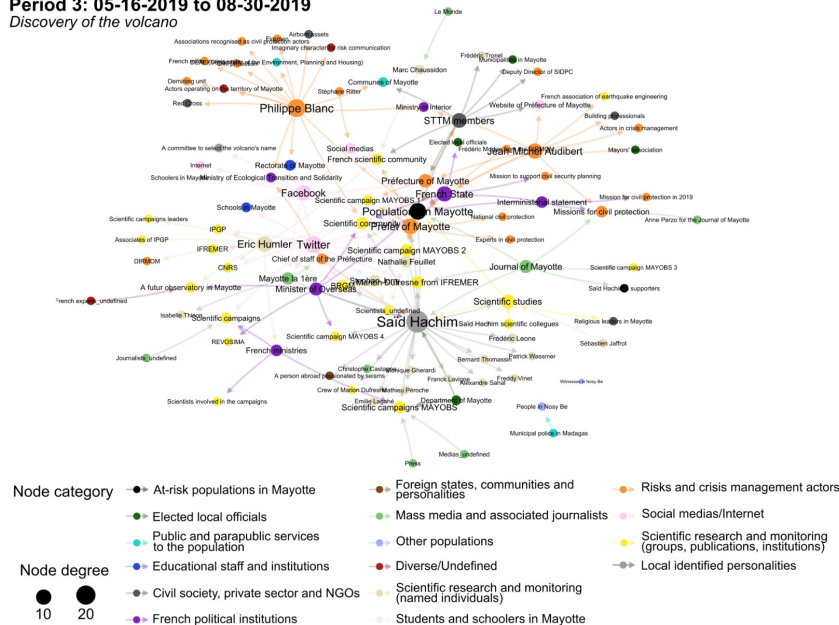


Figure 7 : Citations network of actors in the press after the discovery of the volcano.

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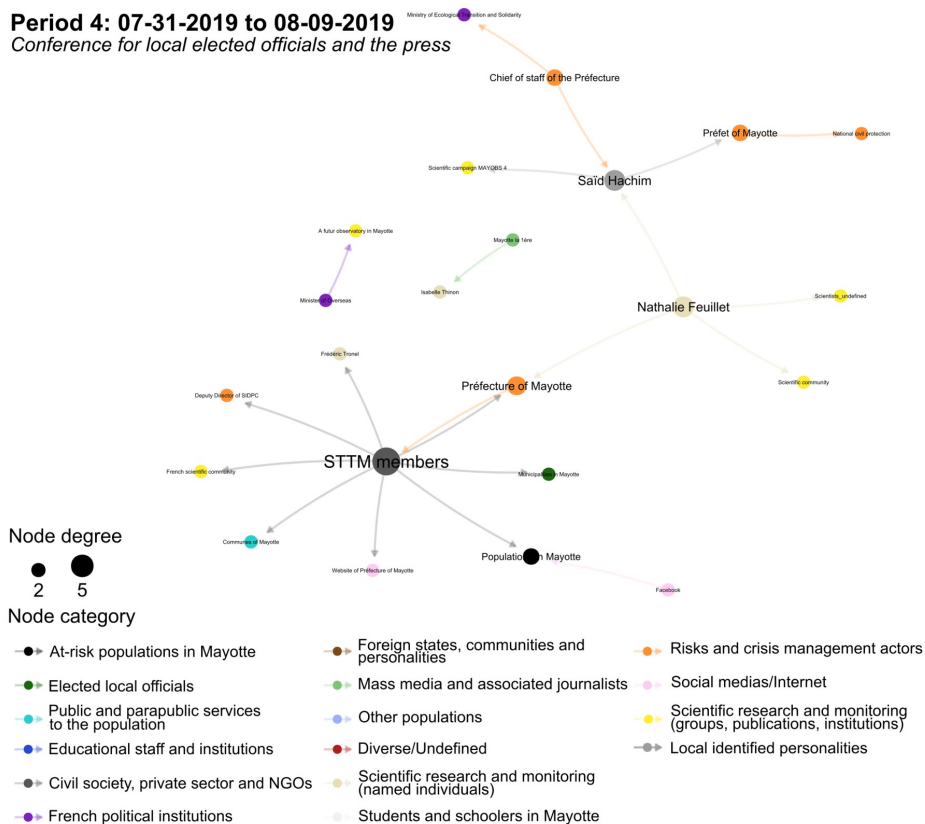
Period 4 focuses on a particular moment intersecting period 3: the organisation of a conference for local elected officials and the press organised by the prefecture and led by scientists who participated in the discovery of the volcano. It includes 6 articles published between July 31, 2019 and August 9, 2019. As shown in the network of actors represented in Figure 8, Nathalie Feuillet plays the role of intermediary between, on the one hand, the part of the network structured around Saïd Saïd Hachim and that structured around the STTM Facebook group with which she is indirectly linked via his quote of the prefecture. Without this, the network of actors appears fragmented, even between actors at the heart of the event: the scientists, the representation of the French State via the prefecture, the prefect and his chief of staff, but also via the Interministerial Defense and Civil Protection Service (SIDPC), just like the Ministry of Overseas Territories and the Ministry of Ecological and Inclusive Transition. Frédéric Tronel and Isabelle Thion are the only scientists named by a third party, the STTM Facebook group for the first and the local news broadcast Mayotte la 1ère for the second. Added to this low presence of named scientific actors is the absence of a mention of specific scientific institutions, in favour of abstract mentions of the community.



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Period 4: 07-31-2019 to 08-09-2019

Conference for local elected officials and the press



Node degree



Node category

- At-risk populations in Mayotte
- Foreign states, communities and personalities
- Risks and crisis management actors
- Elected local officials
- Mass media and associated journalists
- Social medias/Internet
- Public and parapublic services to the population
- Other populations
- Scientific research and monitoring (groups, publications, institutions)
- Educational staff and institutions
- Diverse/Undefined
- Local identified personalities
- Civil society, private sector and NGOs
- Scientific research and monitoring (named individuals)
- Students and schoolers in Mayotte
- French political institutions

518

519 **Figure 8: Citations network of actors in the press following the conference for local elected officials and the press organised by**
 520 **the prefecture.**

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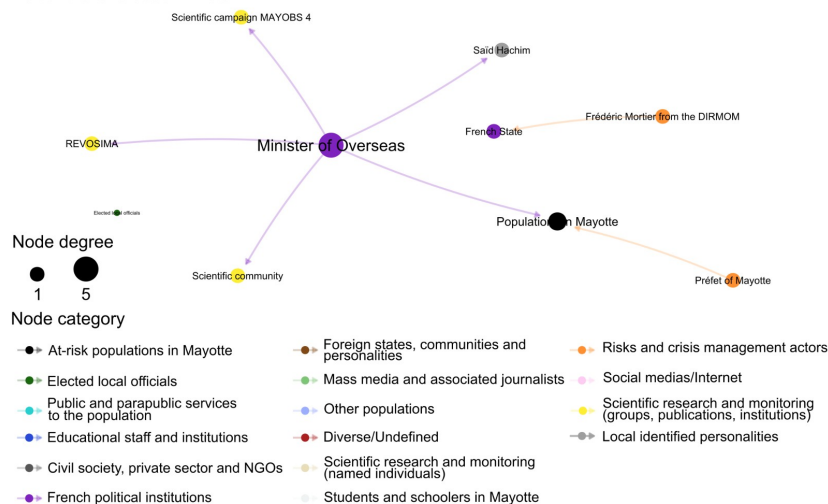
522 Period 5 focuses on a second particular moment intersecting period 3: the visit of the Overseas minister in Mayotte. It
 523 includes 3 articles published between August 27, 2019 and August 30, 2019. As depicted in Figure 9, the number of cited
 524 actors is low. The Minister of Overseas occupies a central place in the network since it mentions 5 other actors: the
 525 scientific actors in charge of studying the phenomenon (REVOSIMA and the observation campaign underwater MayObs
 526 4), and the scientific community more generally, as well as the local expert Saïd Saïd Hachim and the Mahorese
 527 population, also cited by the prefect. We also note the isolated mention of the French State by Frédéric Mortier (from the
 528 interministerial delegation for major overseas risks - DIRMOM) and the unrelated mention of local elected officials.

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Period 5: 08-27-2019 to 08-30-2019
 Visit of the Overseas Minister



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Figure 9: Citations network of actors in the press following the visit of the Overseas Minister in Mayotte.

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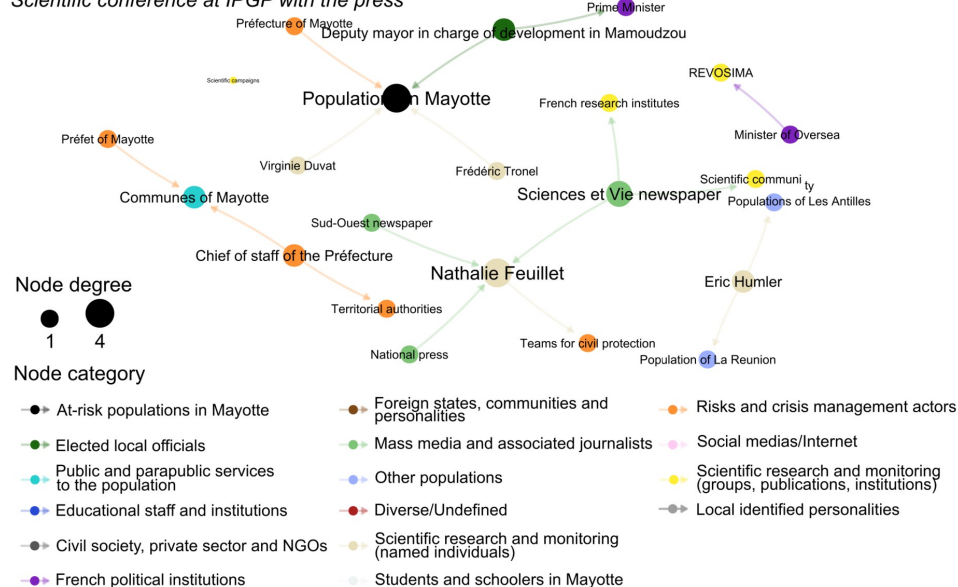
533 8 articles in the corpus cover the period from September 4, 2019 to October 26, 2019, during which a scientific
 534 conference is held at IPGP headquarters in Paris and immediately followed by a public conference operated by scientists
 535 and ministerial officials. Interestingly, REVOSIMA (once again solely cited by the Ministry of Overseas Territories) is
 536 isolated from the rest of the citation network (Figure 10), even though it brings together the actors in charge of
 537 volcanological and seismological monitoring of Mayotte. It is nevertheless the only scientific institute explicitly named,
 538 the citation network giving a more central place to individual scientists than to institutions. The network of actors is more
 539 fragmented than previously, and its subparts are respectively organised around Nathalie Feuillet (who received citations
 540 from various media), Eric Humler (quoting populations from other French overseas departments), the chief of staff of the
 541 Préfecture (citing the communes of Mayotte and territorial authorities in general), and the journal *Sciences et vie* (citing
 542 Nathalie Feuillet and encompassing the scientific community and French research institutes). Several isolated citations
 543 point again to the Mahorese populations (from scientists Virginie Duvat and Frédéric Tronel, but also from the Préfecture
 544 of Mayotte and from a local elected official from the capital city Mamoudzou). Once again, the prefecture of Mayotte is
 545 separated from the prefect and his chief of staff within the citation network. For the first time, the Prime Minister is cited
 546 by an actor, namely the deputy in charge of development in Mamoudzou, regarding a letter the latter sent to the Prime
 547 Minister to point out the effects of subsidence on urban development.



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Period 6: 09-04-2019 to 10-26-2019

Scientific conference at IPGP with the press



548

549 **Figure 10: Citations network of actors in the press following the scientific conference at IPGP followed by a public conference**
 550 **by scientists and ministerial officials and attended by journalists.**

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552

553 Period 7, which extends from May 4, 2020 to September 28, 2020 and covers the missions MayObs 13-1 and MayObs
 554 13-2, includes 7 articles from the corpus. Its citation network is shown in Figure 12. For the first time, REIVOSIMA
 555 appears as a central node of the network, although the number of nodes and links is moderated by the small number of
 556 articles. The REIVOSIMA is cited by local expert Saïd Saïd Hachim and by the Prime Minister, but also by the BRGM,
 557 one of its membering institutions. The Prime Minister also cites the IPGP separately from REIVOSIMA, even though the
 558 institute is in charge of it. The network of scientific actors appears generally fragmented during these two missions. It
 559 should also be noted that the documentary "Birth of a volcano" produced by *Crestar Productions* and *L'éolienne* and
 560 broadcasted on *Mayotte la 1ère* is not relayed by any actor other than the channel.

561

562 The last period extends from October 28, 2020 to November 3, 2020 and deals with two events recounted in 6 articles:
 563 the "Volcano week" and the first siren alerts in the municipality of Dembéné. The network of actors (Figure 12) is
 564 structured around two parts. The first is organised around Mahorese schoolchildren, and includes quotes from the chief of
 565 staff of the Rectorat of Mayotte, from the chief of staff of the Préfecture and from the Préfecture itself. The teachers in
 566 Mayotte are part of the citation chain, as they are also quoted by the chief of staff of the Préfecture. Interestingly, schools
 567 in Mayotte (mentioned as actors) belong to the second citation subnetwork, of which they form the periphery thanks to a
 568 citation by Charlotte Mucig, herself cited by the TV and radio show *Zakweli* broadcasted by *Mayotte la 1ère*. The show
 569 *Zakweli* also makes the link with Eric Humler and Frédéric Mortier, both citing the Mahorese population. The latter is
 570 also cited by Mahorese associations not identified in the articles, as well as by scientists visiting Mahoran schools during

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23

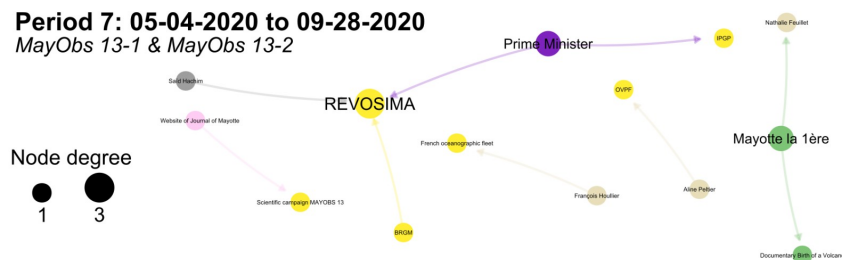


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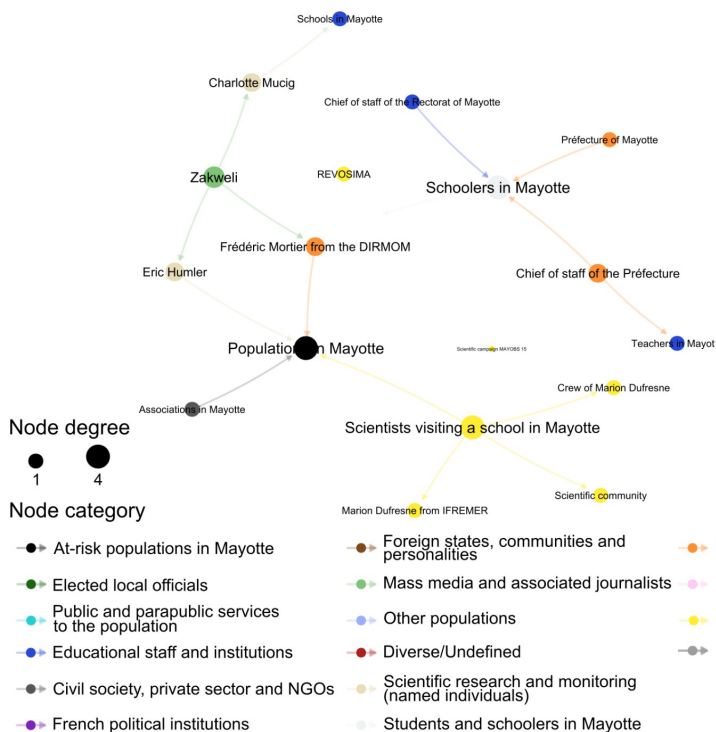
571 the volcano week, who will also mention the MayObs missions on the ship Marion Dufresne more or less explicitly.
 572 Finally, REVOSIMA appears fully isolated from the other actors.
 573

Period 7: 05-04-2020 to 09-28-2020

MayObs 13-1 & MayObs 13-2



Period 8: 10-28-2020 to 11-03-2020
"Volcano week" and first warning siren in Dembèni



574
 575 **Figure 11: Citation networks of actors during two press-covered events : In Period 7, the focus lies on the organisation and**
 576 **execution of two complementary campaigns at sea, MayObs 13-1 and MayObs 13-2. In Period 8, attention shifts to two**
 577 **communication initiatives from the Mayotte prefecture, namely the “Volcano week” a serie of conferences and activities**
 578 **related to the discovery of a new volcano designed for schoolers, and the installation of a first siren alert on the territory,**
 579 **widely relayed by the media.**
 580



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581 5. Discussion

582 Mass media play a key role in risk and crisis communication, serving as the main information source for millions of
583 people regarding natural, political and social events (e.g. Gamson and Modigliani, 1989; Allan et al., 2000; Dixon et al.,
584 2008 ; Aday, 2010). They influence people's perceptions of various actors involved in understanding, monitoring hazards,
585 and managing their effects, as well as their performance during events (Harris et al., 2012). Despite several limitations in
586 our study, such as the focus on newspaper representations rather than those among populations, and the use of articles
587 from six non-specialist French-language newspapers, it provides a comprehensive insight into media narratives during the
588 seismic-volcanic "crisis" in Mayotte from spring 2018 to spring 2021. The inclusion of additional local, regional, and
589 national daily papers in different languages and other media forms could enhance the depth of the dataset. However, the
590 chosen corpus, primarily non-specialist daily press (including *Mayotte la lère*, which displays a TV, radio, a written
591 website, and produces content in both French and Shimaore thus widely followed by inhabitants in Mayotte), remains a
592 strong candidate for studying representations conveyed by the media as a whole (Cagé et al., 2017), especially
593 considering the dynamics and complementarity of quantitative and qualitative analyses facilitated by written press data.

594

595 When examining the results, it is crucial to acknowledge the influence of journalistic writing. Newspapers, acting as
596 mediators in the broadest sense, have their own practices and priorities in collecting and disseminating information. Daily
597 newspaper journalists, often generalists with diverse profiles and working methods (Ruellan, 1992), are commonly bound
598 by the shared constraint of tight deadlines. This limitation may affect their ability to access multiple sources or delve
599 deeply into the context. Consequently, they tend to prioritise information that is deemed reliable, easily accessible, and of
600 interest to their readership (van Belle, 2015). Geographic proximity to events influences coverage (e.g. Cavacas et al.,
601 2016), with local journalists having easier access to the field and local actors. This is evident in the composition of the
602 selected articles, with a predominant 78% (and 54% in *Journal de Mayotte* alone) being published in local newspapers.
603 These local articles typically take the form of concise press releases offering updates on the latest developments.
604 Contrastingly, national newspapers, faced with the challenge of engaging a readership distant from about 8, 700 km and
605 not directly impacted by events, tend to favour less frequent but more extensive publications providing summaries or in-
606 depth analyses (see section 4.1: an average of 20-31 actors are mentioned per article in national newspapers, compared to
607 around ten in local newspapers). This also influences the selection of quoted sources, with local journalists relying more
608 on local actors and national journalists adopting alternative strategies like using social networks (here Twitter and
609 Facebook for the national dailies *Le Figaro* and *Le Monde*) or relying on news agencies like AFP (France-press Agency)
610 or their local counterparts (Lecheler and Kruike-meier, 2016). This is illustrated here by *Le Figaro* and *Le Monde* which
611 can present a comprehensive view of the involved actors, albeit with less ease in reporting their statements. Given their
612 limited time constraints, journalists typically favour sources they consider legitimate and relatively easy to access. The
613 choice of sources may vary based on editorial stance (Wang et al., 1992; Shoemaker and Reese, 1996). For example, in
614 this context, local newspapers, which are seemingly inclined to emphasise the local context in comparison to national and
615 regional newspapers exhibit a lower rate of reported speech from French political institutions. As observed in our findings
616 and reinforced by Ploughman (1997), journalists tend to have more accessible and regular contact with certain types of
617 sources, including public institutions, officials, or high-profile personalities, which are more echoed in the news.

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619 Having acknowledged the influence of journalistic writing, we show that using this method to scrutinise press coverage
620 also allows the identification of actor groups typically present in a crisis context related to a natural phenomenon (e.g.

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621 Fearnley et al., 2018; Trias et al., 2019, using network analysis on disaster risk reduction ecosystem in the Asia Pacific
622 region; Gonzalez, 2022, using assemblage theory and mapping relationships following the 1985 San Antonio
623 Earthquake). First of all, the main trio in crisis management emerges as the most mentioned and quoted actors in this
624 network: scientists overseeing monitoring, authorities responsible for civil protection, and at-risk populations (Fearnley et
625 al., 2018; Devès et al., 2023). Other categories, such as mass media, social networks, civil society, public and para-public
626 services, and even humanitarian aid associations (e.g. the Red Cross), are also well-represented. However, the latter are
627 less prevalent than in other crises, likely due to relatively minimal material and human damage (only three lightly injured
628 and cracked buildings in Mayotte). Notably, international actors, including personalities, newspapers, communities and
629 states, are also present, which is highlighted in previous studies as indicative of a growing interconnection between actors
630 in disaster risk reduction context on an international scale (e.g. Trias et al., 2019). In the case of this very local, small-
631 scale crisis, the mere presence of international reactions becomes an event worth reporting by others. The actors involved
632 in crisis management, organised by the ORSEC (Civil Security Response organisation) in France, are also represented.
633 As a reminder, according to ORSEC framework, mayors coordinate emergency services and public facility management
634 (hospitals, schools, etc.) if the event is local. If damages extend department-wide and surpass the capacity of town halls,
635 the prefecture assumes control. Ultimately, the crisis is managed by the regional headquarters (EMZCOI for Mayotte),
636 then by the French government if the lower levels are overwhelmed. However, here despite the limited physical impact of
637 this crisis, it is mainly the prefecture and national civil protection services (under the responsibility of ministries) that are
638 mentioned and whose speech is reported. Local elected representatives, including mayors, are surprisingly less present
639 than other actors who theoretically play a lesser role (such as civil society, local personalities, and public and semi-public
640 services, including education staff), while the regional headquarters is rarely mentioned. These asymmetries in
641 representation partly reflect Mayotte's unique situation as a French overseas department, with part of its administration,
642 including the regional headquarters, based more than 1,400 km away in Reunion Island. This region, while distant from
643 the mainland, poses specific challenges requiring a substantial response from the national authorities responsible for crisis
644 management (Cottureau, 2021; Roinsard, 2022; Duchesne, 2023). Another specific feature also observed in several
645 overseas departments is a lesser degree of cooperation between local elected representatives and national representatives
646 located in these departments (Lemercier et al., 2014; Gillet et al., 2023). Additionally, our results highlight the emergence
647 of different actors or groups of actors within the population, a facet not treated in the press as homogenous, as seen in
648 official/legal texts. Particularly, several local personalities are identifiable, as observed in other cases (e.g. Devès et al.,
649 2019). Overall, we obtain an overview of the diverse actors involved in this crisis management and communication,
650 aligning with findings from other studies using similar (e.g. Rajput et al., 2020) or different methodologies (e.g. Villodre
651 and Criado, 2020; Calabro et al., 2020).

652

653 Upon examining who can express themselves through media coverage, several observations emerge. Firstly, primary
654 sources of information (often introduced or relayed by other actors quoted in the article), do not necessarily align with
655 journalists' sources. This discrepancy may arise due to limited access to primary source, as elaborated earlier, either due
656 to geographical distance, time constraints, ect, or the preference for another source deemed as more legitimate, more
657 accessible or because of implicit or explicit issues of representation (see Carlson, 2009 and Grassau et al. (2021) for an
658 analysis of journalists' sources in an emergency situation). This opens a window into the newspaper's networks, the
659 hierarchy of its trust, and the perceived legitimacy of interviewed sources. As identified in a qualitative analysis (Devès,
660 Moirand and Le Vagueresse, 2023), scientific actors notably dominate reported speeches, both from the article authors

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661 and third-party actors. Consequently, they are considered the most reliable or, at the very least, the most legitimate to
662 express themselves, even surpassing the authorities responsible for crisis management and civil protection. While other
663 studies have recognized scientists as "bridges" and "focal points" among various actors (Trias et al., 2019), the notable
664 overrepresentation of scientific figures and institutions is noteworthy here. This could be attributed to journalists focusing
665 on short-term issues like hazard descriptions, impacts, and emergency operations (Devès et al., 2019) or the complexities
666 arising from scientific uncertainties requiring focused attention (Valencio and Valencio, 2018). Scientific actors, being
667 perceived as those with the knowledge, are considered closest to understanding the phenomenon and thus are positioned
668 to make recommendations (Oreskes, 2019). Apart from scientific personalities and institutions, the analysis indicates that
669 media and institutional actors also benefit from greater media reach for their statements compared to actors from civil
670 society. This proximity of journalists to institutions, as highlighted in other case studies (e.g. Ploughman, 1997;
671 Winterlin, 2020), and their reliance on the publications of their counterparts when direct sources are unavailable
672 (Coddington and Molyneux, 2023) are usual practices. On another other hand, social media sources exceed other mass
673 media in reported speech share, reflecting the increasing use of social media as information sources due to their detailed
674 coverage of current events (e.g. Lindsay, 2011; Lecheler and Kruikeimer, 2016), potentially facilitating two-way
675 communication between institutions and the public (Feldman et al., 2016; Kim and Hastak, 2018b). However,
676 Pourebrahim et al. (2019) argue that this potential is largely underused, showing that Twitter is dominated by authorities
677 primarily engaged in one-way communication rather than interacting with their audiences (see also Watters and Williams,
678 2011). A more focused analysis would be needed to explore this in the present case. Throughout the coverage,
679 populations in Mayotte and, to a lesser extent, schoolchildren are frequently cited, but as discussed in our qualitative
680 analysis, they are not often the origin of citations, indicating a relatively passive position within the citation network
681 extracted from this dataset. Despite this, the population is central to the network and is cited by numerous actors. In the
682 general imagination, its protection is the reason for the organisation of this network, but its opinion is seldom expressed,
683 even in local media which tend to apply pre-constructed news templates (Jemphrey and Berrington, 2000). This
684 perpetuates an asymmetrical and hierarchical representation favouring those perceived to hold knowledge (scientists,
685 institutions in charge of civil protection) at the expense of the inhabitants' perspective, who find themselves in the
686 position of undergoing and being protected (Valencio and Valencio, 2018; Gonzalez et al., 2022). Journalists' common
687 practices make it challenging for them to distance themselves from this representation (Cavaca et al., 2016). This result is
688 explored and assessed for this case study by Devès et al. (2023), who also demonstrate that these representations are
689 integrated by various actors in crisis management, particularly within at-risk populations.

690
691 That being said, it is worth underscoring that identified individuals hold a significant position in this network. Despite the
692 context where crisis and risk management, as well as communication, are organised and framed by established
693 institutions (ministries, prefectures, town halls, scientific institutions responsible for monitoring), individual sources with
694 clear identities tend to contribute more in reported speeches compared to institutions. Specifically, named scientists take
695 the lead over their institutions when we examine whose speeches these articles mostly report. Moreover, local
696 personalities are mainly quoted when directly mentioned, while the reverse is true when they are indirectly mentioned.
697 Even in the case of crisis managers, individuals such as the prefect, cabinet director or ministries envoys clearly stand out
698 from their respective institutions within the network (see section 4.4.). Admittedly, these personalities are often
699 associated with an institution. Oreskes (2019) highlights this aspect in her essay "Why trust science?", using scientists as
700 an example. She contends that trust in an individual is primarily conferred as a member of a professional community with

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701 a shared body of knowledge. Butts et al. (2007) also found that coordinating roles, which include information flow, are
702 influenced by the formal institutional status or position within an organisation. Added to this is the journalistic practice of
703 conducting interviews, which involves collecting an institution's stance through the discourse of one of its
704 representatives. Individuals act as entry points to information for journalists, relaying the messages of their institutions,
705 colleagues, or, in all cases, a community. Hence, they play the role of hubs, or "guardian nodes" as mentioned by Flecha
706 et al. (2023). However, this interpretation needs qualification based on interviews with inhabitants, analysed in Devès et
707 al. (2023). On one hand, these interviews highlight the importance, according to Mayotte's inhabitants, of embodying
708 information or words with a name or a face. On the other hand, they reveal a significant distrust towards political and
709 even scientific institutions. In this study, we observed that featuring the director of the local BRGM branch over the
710 national director was prioritised, and even the prefect over representatives of the ministries, although the latter have
711 visited the area. Also, the local geographer, Saïd Hachim, is given prominence over members of the scientific monitoring
712 network, even in situations where they are present during campaigns at sea or interventions with schoolchildren. Similar
713 observations were made in two other independent studies (Cripps and Souffrin, 2020, which emphasises a general distrust
714 towards official discourse, and Bedessem et al., 2023, which found confidence in scientists without being able to
715 determine if this extends to trust in their institutions). In such circumstances, one might question whether there exists a
716 gap between the representation of journalists and that of local populations, accentuated by a journalistic bias towards
717 institutions identified as reliable and easily accessible by journalists. In any case, there is a clear need for proximity -
718 geographical, if not cultural - between sources, given the evident dominance of cited personalities when they are on-site.
719 With regard to local personalities in particular, their emergence in press coverage occurs later than for others, perhaps
720 attributable to a search for new sources to compensate for the perceived lack of information on the spot (Fallou et al.,
721 2019). In any case, the over-representation of individuals compared to institutions raises questions and warrants further
722 investigation.

723

724 This approach offers: i) an overview of the interrelationships between all actors involved in managing this crisis, ii)
725 highlights specificities linked to the context and media coverage; iii) reflects implicit representations and bonds of trust
726 between actors, and iv) visualises the network's dynamics over time and how it is disrupted and reorganised after the
727 occurrence of new events. It aligns with a theoretical background discussed in recent studies, proving relevant for
728 studying risk and crisis management and governance: Post-ANT (Actor-Network Theory) (e.g. Beck and Kropp, 2011;
729 Neisser et al., 2014; Bielenia-Grajewska, 2020) and Assemblage Theory (McGowran and Donovan, 2021). This study
730 aligns with this theoretical background in several ways. First, it involves an empirical examination of interrelations and
731 associations among actors operating in a simultaneously complex, uncertain, and ambiguous context. Our perspective on
732 these actors is both relationalist and functionalist: it is the flow of discourse, itself structured by the roles these actors play
733 in relation to one another, which creates and shapes this network. Moreover, these various actors are networks themselves
734 and we consider them on an equal footing, including the media used to constitute the dataset. We also manage to depict
735 the dynamic nature of this network and how it can be affected by the emergence of new actors, relationships,
736 arrangements, or any other disruptive element, including non-human factors (see section 4.4). Finally this study illustrates
737 and enhances our understanding of the patterns of ordering. Its originality lies in the fact that we apply this method not
738 only to study the network of actors in the context of crisis management or governance but also to explore the
739 representation that certain actors (the media) have of information circulation in this crisis management context. The use
740 of Actor-Network Theory (ANT) and Assemblage Theory is relevant in this approach, considering their application to

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741 discuss the role of mobilisation in communication (Bielenia-Grajewska, 2020) and the compatibility of ANT with media
742 theory (Couldry, 2008, and Belliger and Krieger, 2015).
743

744 **6. Conclusion et perspectives**

745 This study proposes mapping citation and reference networks of actors identified in 6 daily newspapers as involved in
746 information circulation during a seismo-volcanic crisis management on Mayotte island from 2018 to 2021. In addition to
747 providing an overview of the interrelationships between these actors, it offers a dynamic representation of how these
748 networks evolve over time and how they can be disrupted and reorganised after the occurrence of new events. It also
749 allows us to identify the common organisation of crisis management as well as some specificities linked to the particular
750 context of Mayotte or its treatment in the media. This method also reveals implicit representations and trust bonds among
751 these actors and aligns with results from more detailed analyses. Key findings include an overrepresentation of scientific
752 actors, both among actors cited in the articles and among actors introduced by a third party, which emphasise the
753 centrality of scientific discourse in a context where the manifestations of the hazard are mainly visible through their
754 instruments. It also calls for further research to explain the feeling of “information vacuum” highlighted by Fallou et al.
755 (2019) among inhabitants despite the abundant communication from scientists and authorities exposed by Devès et al.
756 (2022a) and their overrepresentation in the mediatic discourse evidenced here. Another important result is the central
757 representation of individuals, beyond institutions, which suggests varying trust placed in individual versus institutional
758 discourse. The tension between national and local is evident as also observed in similar contexts in other overseas
759 departments. From an operational point of view, these results provide keys to identify profiles that have proved decisive
760 to the flow of information. The fact that these networks are not always interconnected, especially around REVOSIMA
761 (Mayotte volcanological and seismological monitoring network) which is sometimes completely isolated, also
762 emphasises the need for diversified information channels to make its circulation more efficient.

763
764 Here, we use this method to study both networks of actors in a crisis management context and media
765 representations of the information circulation. However, this method can have numerous other applications, such as
766 comparing representations between different groups of actors by applying it to several different text corpuses (scientific
767 or official press releases, media articles, experience reports, etc.) or studying the morphogenesis and the evolution of a
768 specific actor, by focusing on a particular actor and/or a given period (for instance, to study the scientific cooperations
769 from the point of view of the media). It is also a first step towards other explorations. For example, it could be refined to
770 identify the actors cited in support of or in opposition to a given statement. Ultimately, it could also generate datasets for
771 Artificial Intelligence training to automate the mapping of actors’ organisation and information circulation according to a
772 heterogenous corpus of texts. Finally, this reproducible method can be used for other case studies around the world. It can
773 also be analysed in other ways to study how scientific information flows from where it is produced to media, explore
774 tensions between information and entertainment in mediatic discourses and compare mediatic covers of the same events
775 at different geographical scales (national, regional, local).



59

776 **Author contributions**

777 MHD and MLT were responsible for the conceptualization of the study and project administration. MHD and MLT
778 provided a methodology for data collection. MHD conducted the keywords selection and analysis. LLV was responsible
779 for data collection, stockage and investigation. MLT and LLV designed the method used for actors' citation chains
780 identification and encoding. MLT was responsible for the figures and produced the scripts for the analyses reported.
781 MLT, MHD and LLV conducted all analyses. LLV and MLT wrote the original draft of the paper, MD undertook the
782 revision and editing of the final paper. All authors discussed the results and the method.

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788 **Data availability**

789 As we can not disseminate articles' content because of copyright, an attribute table is made available online on the IPGP
790 dataverse platform (<https://dataverse.ipgp.fr/privateurl.xhtml?token=7269cab5-784a-4e85-9653-64b2784f9f48>) with : 1)
791 a link to articles' URLs on newspaper websites, 2) key features such as newspaper name, publication date, authorship,
792 readership and title (see Supplementary Information available on the same IPGP platform for further details). Feel free to
793 contact the authors for more information or access to the whole database. The code used and all appendices are accessible
794 on the same dataverse platform and a valid DOI will be provided for the publication of this article.

795

796 **Competing interests**

797 The authors declare that they have no conflict of interest.

798

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