Seismic Risk: The Biases of Earthquake Media Coverage

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Abstract

The capacity of individuals to cope with threatening situations depends directly on their capacity to anticipate what will come next. The media should play a key role in that respect, but an extensive analysis of earthquake media coverage by the international news reveals systematic biases. Exploring a corpus of 320 888 news articles published by 32 worldwide newspapers in 2015 in English, Spanish or French, we found that the press covers a very small number of events: 71% of the news about seismic events was dedicated to only 3 earthquakes (among the 1559 of magnitude 5+). A combination of frequency and content analysis reveals a typical framing of the 'earthquake news'. Except for the 'Nepal quake', the duration of the coverage is usually very short. The news thus tends to focus on short-term issues: the event magnitude, tsunami alerts, human losses, material damage, and rescue operations. Longer-term issues linked to the recovery, restoration, reconstruction, mitigation and prevention are barely addressed. Preventive safety measures are almost never mentioned. The news on impacts show a peculiar appetency for death counts, material damage estimates and sensationalism. News on the response tends to emphasize the role played by the international community in helping the 'poor and vulnerable'. The scientific content of the coverage is often restricted to mentions of the magnitude, with the concept of the seismic intensity being largely ignored. The notion of the 'seismic crisis' also seems unclear, with aftershocks sometimes being treated as isolated events. Secondary hazards are barely mentioned, except in the case of tsunami alerts. Together, these biases contribute to fatalistic judgments that damage cannot be prevented. If scientific messages are to be communicated, they should be broadcast a few hours after an event. Why not taking that opportunity to familiarize people with the real timeline of seismic disasters?

Keywords

earthquake, media coverage, seismic risk, risk perception, international news flow theory

Key Points

- Analysis of earthquake media coverage by the international news reveals systematic biases in the coverage of seismic crises
- News focuses on a small number of events: in 2015, 3 earthquakes attracted 71% of the news (among 1559 earthquakes of magnitude over 5)
- The duration of the coverage is very short with respect to the issues at stake: from a few hours to a few days, rarely more
- The 2015 Nepal quake was exceptionally well covered both in terms of duration and number of news items
- There is a typical framing of 'earthquake news' in the international news
- News content focuses on short-term issues: the event magnitude, tsunami alerts, human losses, material damage, and rescue operations
- Longer-term issues linked to recovery, restoration, reconstruction, mitigation and prevention measures are barely addressed
- To reach the public, scientific messages should be released within hours of big events. Why not taking that opportunity to familiarize people with the real timeline of seismic disasters?

1 Introduction

1.1 Newspapers play a key role in times of disaster

Despite the increasing influence of social media, newspapers remain major gatekeepers in the process of selection and dissemination of the news proposed by press agencies to national and local audiences (Harcup & O'Neill, 2017). For risk managers, they remain an important tool for reaching a wide range of people (Cottle, 2014). To this respect, one can expect the press not only to inform, but also to provide the public with the knowledge to reduce disaster risks (see for instance the Media kit created by the Asian Disaster Preparedness Center and the Department of Disaster Management and Climate Change of the Ministry of Natural Resources and Environment of Lao PDR, Thanthathep et al., 2016).

Numerous studies have explored the ability of the news media to influence public perception. According to McClure et al. (2001) and Mc Clure and Velluppillai (2013), public education programs and news reports often describe disasters "in ways that accentuate the extent and severity of damage", thus contributing to "fatalistic attributions and judgments that the damage cannot be prevented". Improper attribution can hinder peoples' preparedness: "When people attribute damage to an earthquake's magnitude, they invoke an uncontrollable cause, but when they attribute damage to human design, they invoke a relatively controllable cause". For authors such as Gaddy & Tanjong (1987) or Hiroi, Mikami, & Miyata (1985), understanding how the media report on disaster situations has direct implications as it shows "how [the] agencies [involved in disaster risk reduction] could reduce fatalism and facilitate preventive action by the way they present information about earthquakes and other disasters."

It is not uncommon to hear scientists criticizing the press for conveying distorted messages (e.g. Smith, 1996; Cocco et al., 2015; Harris, 2015a and b). Journalists have even been accused of playing the role of "crisis catalyst" (Boin et al., 2008). Comparing the news treatment of a real earthquake with that of a false quake prediction, Smith (1996) concludes that "the interest in drama at the expense of public affairs interferes with good scientific reporting." In general, scientists denounce the tendency of the press to search for "culprits" and "accountability" and for "stirring up old rivalry and exaggerating conflicts" (Harris, 2015a and b). Harris (2015a) shows how the placement of the information in the frame of the pages, selection of stories, use of sources, selection of data, exaggeration, omissions and preferences for certain sources or pieces of information contribute to the oversimplification of scientifically complex arguments and an orientation toward information interpretations forcing inclination or prejudice for, or against, an argument, person or group, putting a particular emphasis on some aspects of the situation. Harris (2015b) concludes that, what he calls the 'media filter', can influence the public understanding of scientific uncertainties and argues that a careful study of the media coverage would help scientists to communicate in a manner that reduces the chance of misunderstanding.

1.2 Earthquake media coverage and international news flow theory

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From the social science and humanities perspectives, media do not just introduce biases into the perception of 'real' events, they also construct part of the reality (Searle & Willis, 1995). Media are primarily seen as being a cultural tool helping people to make sense of what happen to them, collectively. Among the few psychological studies focusing on the impacts of media coverage in a post-disaster context, Yoshida et al. (2016) suggest that watching the news may even help people to recover from their traumatic experiences, as it provides a good opportunity for deliberate rumination over disaster-related memories. Studying two Canadian rural communities following a forest fire in 2003, Cox et al. (2008) show that the newspaper coverage acts as "a local as well as a broader cultural resource for affected individuals and communities in determining the 'correct' way of responding to and recovering from the disaster". Their analysis emphasizes the power of media "to convey and normalize dominant cultural assumptions" and influence social attitudes and health-related behavior (Gaddy & Tanjong, 1987). It points out the effect of the neoliberal discursive framing of recovery, emphasizing the economical-material aspects of the process and a reliance on experts. Cox and Perry (2011) shows that the dominant discursive constructions of disasters have drawn on and reinforced a hierarchy of credibility in which local voices are marginalized in favor of experts.

This study, led by a pluri-disciplinary team of researchers coming from geophysics, psychology and geography, builds on previous results (Devès, 2015; Grasland et al., 2016; Le Texier & al., 2016) to address the following question: *in a globalized world, can we find systematic trends in how the international news published by daily newspapers covers earthquake events?*

By 'international news', we mean news published by daily newspapers about foreign countries or, in practical terms, news published by newspapers through specific RSS flows entitled "international" or "world". Many hypotheses about the rules governing the international news flow were formulated more than 50 years ago (Galtung & Ruge, 1965; Östgaard, 1965) and verified by empirical studies concerning the unequal salience of countries in the media and the effects of size, proximity and the preference for elite countries or negative news (Peterson, 1981; Kim & Barnett, 1996; Wu, 2000). The development of new forms of electronic communication has not modified the rules previously observed, and recent works confirmed that the circulation of international news is still very influenced by cultural factors such as language and physical factors such as the distance between the location of the media and the location of events (Segev, 2016; Grasland et al., 2016). However, the salience of countries is generally manifested over a mixture of heterogeneous events, and some authors have focused on subsets of events that are either mentioned or ignored by the media. The event-oriented approach is based on a selection of foreign news related to a specific topic for which it is possible to define a finite and possibly objective list of events occurring in the "real" world. One of the most interesting areas of research from this perspective is the study of the media coverage of earthquakes, for which objective measures of the magnitude or victims are regularly published. It is thus possible to analyze the level of newsworthiness according to the general laws postulated by Galtung and its followers (Galtung & Ruge, 1965; Harcup & O'Neill, 2001, 2017; Wu, 2000) and their specific application to earthquake media coverage (Koopmans & Vliegenthart, 2010). Examining the news media coverage of more than 900 earthquakes, Le Texier et al. (2016) showed that the event severity (reported in the press as a moment magnitude) affected the volume of media coverage following a power law. Studying the dynamics of public interest in major earthquakes using Google Trends, Tan & Maharjan (2018) find that the duration and search peak vary with the death toll and damage but not with the earthquake magnitude. Earle et al. (2010) found the same pattern for the 2009 Mw 4.3 Morgan Hill (California) earthquake using Twitter data, in a period of only a dozen minutes.

This paper goes further in questioning the existence of systematic trends in how earthquakes are covered by international news. More specifically, we look into the temporal dynamics of the coverage (duration, trends) and into the potential existence of a typical framing of 'earthquake news' (i.e. by comparing news content between events and between newspapers from various countries and languages). Section 2 presents the datasets we use and the main steps we follow for data analysis. First, we analyze the intensity, time distribution and content of a large corpus of approximately 320 888 news items published by 32 international news media RSS feeds in 2015. Second, we associate a statistical analysis of the news frequency with a textual analysis of the content of the news. Section 3 describes the main results. Those are discussed in Section 4. Section 5 concludes.

2 Materials and methods

2.1 Presentation of the datasets

The datasets run from January 1, 2015 at 00:00:01 to December 31, 2015 at 23:59:59. 2015 is particularly interesting as it is the year of the Nepal quake, a major event well covered by the international news published by daily newspapers. The *geophysical dataset* is built from the online seismic catalogue provided by the United States Geological Survey (USGS). For each earthquake, we collect the following parameters: hypocenter, magnitude and label. The *media dataset* is built from the ANR corpus GEOMEDIA, which contains information published by more than 330 news RSS feeds from 180 media, localized in 61 countries and written in 10 languages over three years (ANR-12-CORP-0009, Grasland et al., 2012-2015). We selected international news media RSS feeds based on several criteria: national or international status of newspapers (broadsheet newspapers), RSS feed regularity, media localization, and the volume of transmitted information (see the supplementary information of Grasland, 2019). The final corpus consists of 32 RSS feeds related to international news in three languages (English, French and Spanish) that are equitably geographically distributed, according to the possibilities offered by the initial database (Figure 1). Analysis have been completed using the software R, and notably the package tm for text mining.

(insert Figure 1 – currently located at the end of the document)

2.2 Data cleaning and selection through tagging

Before starting the data analysis, three processing steps were required (Figure 2). First, some of the selected RSS news items were not worth analyzing because they were totally devoid of information, simply advertising or summarizing a heterogeneous set of news of the day. These items were deleted from the corpus. Second, the initial database continuously collects RSS items on newspaper websites, and a similar item can be published several times without changes. Therefore, we had to delete all the duplicate items (items with the same title and text). During these two processing steps, more than 60 000 news items were deleted. After the cleaning, the dataset contains 320 888 news items. To build the joint corpus (called EQ-MEDIA in the following), we then enriched the news media dataset with a tagging process in two steps: 1) the geographical tagging of all mentioned countries using word dictionaries and 2) the thematic tagging of all news mentioning a seismic event using an 'earthquake dictionary'. The first dictionary was tested and validated in previous research (Grasland et al., 2016). The latter has been tested manually on 1% of the total number of news items to determine the number of false positives (i.e., items containing metaphoric references to earthquakes such as a 'political earthquake'). We found a reasonable error rate of approximately 4%. The rate of false negatives (i.e., missed items) was even smaller (approximately 2 to 3%). The final number of news items dedicated to earthquakes over the year 2015 is 4411, which represents 1.37% of the total number of news items published during that time period by all the RSS feeds of the corpus.
(insert Figure 2)

2.2 Two levels of analysis: the year 2015 and 3 major events

An analysis of the intensity and duration of coverage is undertaken on the whole EQMEDIA corpus. The analysis of the news content, which requires coupled qualitative and quantitative approaches, is undertaken on a selection of earthquakes. As shown in Figure 3, the 'earthquake news' is not evenly distributed over time. Three earthquakes garnered the most attention:

- *the Gorkha earthquake:* Nepal and neighboring countries witnessed a 7.8 magnitude earthquake on the 25th of April 2015. It was followed by many aftershocks, among which one on May 12th had a magnitude of 7.3. These earthquakes killed more than 9,000 people and affected at least 8 million, affecting the main economic and political center of the country (Katmandu) and causing massive economic losses (half of the GDP of the country) (CRED, 2017). The first quake (April 25th) was the most devastating. It also triggered landslides and avalanches in the mountains, killing hundreds of people, among whom were foreign tourists whose fates most interested the news media. The magnitude of the main shock was similar to that of the 1934 earthquake.
- *the Ilapel earthquake*: An earthquake of magnitude 8.3 hit the area of Ilapel, Chile, on September 9th, 2015, killing at least 15 persons and affecting thousands. Chilean authorities ordered the immediate evacuation of the coast due to a tsunami threat. Pacific-wide tsunami warnings were issued, and the evacuation affected approximately 1 million people.
- *the Hindu Kush earthquake*: An earthquake of magnitude 7.5 hit the Hindu Kush region between Afghanistan and Pakistan on October 26th, 2015. The earthquake and its aftershocks killed approximately 400 people and affected thousands in Afghanistan, Pakistan and the neighboring countries (including India and Tajikistan).

(insert Figure 3)

2.3 Analyzing the news content

To more closely examine our dataset, we adopted a method inspired by Cox et al. (2008) who analyzed the print-news media coverage of the recovery process following a forest fire. The first step is to conduct a careful analysis of the content of the news itself to identify thematic patterns but also possible "textual silences", defined by Huckin (2002) as "the omission of some piece of information that is pertinent to the topic at hand". As we are dealing with thousands of news items, this qualitative approach is complemented by a quantitative analysis based on keywords.

Supprimé: toward critical discourse analysis

It was possible but ultimately not relevant to proceed to a classification of the content of our thousands of news items with inductive exploratory methods such as cluster analysis (Wilks, 2011) or latent Dirichlet allocation (Blei & al., 2003). Thus, we chose a deductive approach where we tried to extract from the news media coverage the categories or concepts defined by experts on disasters. Following Hass, Kates and Bowden (1977) and Kates et al. (2006), we define six *expected categories of content*: hazards, impacts, response, restoration, reconstruction and preparedness. The category of *hazards* refers to the seismic phenomenon itself or to any hazardous event it can trigger such as tsunamis or landslides. The category of *impacts* refers to the immediate effects of these hazards: human loss, injuries, and damage to buildings and infrastructures. The category of *emergency response* refers to the actions taken

during or immediately after the earthquake to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected. The category of *rehabilitation* includes recovery and restoration, i.e., actions taken to restore basic services and facilities and improve the livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of the earthquake-affected community. By *reconstruction*, we mean the medium- and long-term rebuilding and restoration of the critical infrastructures, services, housing, facilities and livelihoods. *Preparedness* refers to actions carried out to build the capacities needed to efficiently manage future emergencies. News may refer to one or several of these categories of content.

We classify the most frequently used words of the 'earthquake news' into one of these categories of content and build two keyword dictionaries: a *discourse content dictionary* corresponding to the above categories (table 1) and an *identity matrix* dedicated to actors (table 2). For this work to be manageable in a reasonable time, we adopt a threshold of a minimum of 4 occurrences in French and Spanish and 8 in English (there are, respectively, 619 and 478 news items in Spanish and French, so the threshold remains very low, as it corresponds to words occurring in at least 0.36% of the news items. There are 2097 items in English, and thus the threshold remains sensibly the same: it corresponds to words occurring in at least 0.38% of the news items). Conjunctions and adverbs are not considered, and words with common roots are treated together. We use words that are representative of one and only one of our categories of discourse (principle of exclusivity) and that do not introduce too many false positives. Tagging the database using these two keyword dictionaries allows us to quantify the presence/absence and evolution of each theme/subtheme/topic. There are limitations to this keyword approach (the meaning of isolated words is often ambiguous and related to the context and the position before or after other words, e.g. Church & Hanks, 1990) but the independent classification of the news items by the coauthors indicates a good consistency in the coding of themes and subthemes and the identification of topics (we reach a maximum of 12% of differences for the emergency response category).

(insert table 1 and table 2)

3 Results

3.1. 'Earthquake news' analysis of temporality

News concentrates on a very small number of earthquakes. 71.4% of the news items about seismic events were dedicated to only three earthquakes (Figure 3). The 'Nepal Quake' was exceptionally well-covered, representing 59.7% of the news, and the earthquakes in Chile (Ilapel) and Afghanistan (Hindu Kush) collected, respectively, 6.1% and 5.8% of the news. The other events of the year (some of which are visible as small peaks in the brown curve of Figure 3) share the remaining 28.6% of the coverage.

The curves of coverage intensity exhibit a similar trend for all earthquakes: the initial peak is followed by an exponential decrease. This signature has been proved as typical of the media

coverage of dramatic events, characterized by an initial shock to public opinion (Boomgaarden, H. G. & de Vreese, 2007). The amplitude of the initial peak is higher in the case of the 'Nepal Quake' than in the other cases. The duration of the coverage is also much longer with a second peak, corresponding to the aftershock of May 12th, triggering a new round of coverage. This may be explained by various factors, including a death toll an order of magnitude higher and that it affected the economic and political center of a touristic country (Koopmans & Vliegenthart, 2010). However, despite these differences in intensity and duration, the overall signature of the 'Nepal quake' is similar to the signature of the Hindu Kush earthquake, likely because both events occurred in similar geodynamical settings (i.e., intracontinental faulting) and both caused massive impacts (i.e., huge death tolls and vast material damage). The real question is why the Chilean earthquake, which only caused moderate impacts, was so well covered. Occurring in a different geodynamical setting (i.e., subduction faulting), the earthquake triggered tsunami waves threatening many countries on the ocean rim. The release of the tsunami alert explains the level of the international coverage in remote countries. All together, these observations support earlier works showing that the death toll in itself is not sufficient to predict the volume of media coverage, as other factors – such as the physical, political, or economic distance to the place of publication – also influence the newsworthiness of disasters (i.e., Adams (1986), Simon (1997), and Van Bell (2000), among others).

Eventually, the main peaks of intensity are not significantly different among the English, Spanish and French newspapers. Only small differences are observed, essentially on the extent of the main peaks or on the secondary peaks. The similarity of the results obtained in the three different languages confirms the robustness of our methodology. It also suggests the existence of a typical *and global* framing of the 'earthquake news', inviting us to dive deeper into the analysis of content.

3.2. 'Earthquake news' analysis of content

3.2.1 News reproduces the categories of content expected from Disaster Risk Management (DRM) models

The 'earthquake news' content broadly reproduces the sequence expected from DRM models but with an important bias: the duration of coverage is too short (hours to days) for mid- to long-term issues (weeks to months or years) to be well-covered (Figure 4). The themes of *Hazards, Impacts* and *Emergency Response* are overrepresented compared with those of *Recovery, Restoration, Reconstruction* and *Preparedness* (Figure 5).

- 77% of the news items contain a general description of the *Impacts* of the event, either simply to outline its level of destructivity or to count fatalities.
- 46% of the news items refer to the *Hazards*, often to communicate the magnitude of the earthquake but sometimes to inform about secondary hazards such as tsunamis, aftershocks and, more rarely, avalanches, mud slides or floods.
- 45% of the news items refer to *Emergency response* describing either aid, search and rescue operations (in the case of the Nepal and Hindu Kush earthquakes) or the release and lifting of tsunami warnings (in the case of the Ilapel earthquake).
- Only 5.6% of the news items refer unambiguously to *Recovery, Restoration and Reconstruction*, and none refer directly to issues of *Preparedness*. These low

percentages are partially due to the small numbers of keywords identified for each of these themes, but it is the low frequency of these themes in the database that prevented us from identifying more keywords.

It is interesting to note that the big aftershock of May 12th in Nepal triggered a new cycle of information. Although characterized by a peak of smaller intensity, the news content followed a similar sequence to the one triggered by the main shock.

Figure 6 shows the temporal distributions of these themes. The Nepali and the Afghani earthquakes have similar signatures: content on hazards comes first, very soon followed by content on impacts; content on response comes next, and content on recovery, rehabilitation and reconstruction comes later on – when it comes. The Chilean earthquake has a significantly different signature, which is due to its tsunamigenic character. The news focuses first on the hazards including tsunamis, which makes the content on the response (tsunami warnings) appear much earlier.

(insert Figures 4, 5 and 6)

3.2.2 The typical 'earthquake news'

To give a sense of the framing of 'earthquake news', in the following, we build an (artificial but well-informed) example of the evolution of the news content over time after an event. Of course, there are to be variations due to elements of context, but our guess is that the main trends would remain comparable.

Imagine that an important earthquake occurs…

- Within a few hours

The news focuses on the description of the seismic hazard and, when relevant, passes on information about tsunami warnings. The news first reports that an earthquake has been felt, providing an approximate location of the impacted area (often a country, sometimes a region or a city). Many recall the magnitude of the event.

e.g., 'USGS: Magnitude 7.5 earthquake strikes Afghanistan' (USA today, October 26th, item 10366718), 'Un terremoto de 7,9 grados sacude el centro de Nepal' (Faro de Vigo, April 25th, item 6369528), 'Un séisme de magnitude 7,5 a secoué lundi le massif de l'Hindu Kush' (Le Monde, October 26th, item 10368842)

It quickly becomes clear that the event is worth mentioning because it had noticeable impacts.

e.g., 'La ONU advierte dramático impacto tras nuevo temblor en Nepal' (El informador, May 13th, item 6774985), 'Scores of people were killed when a 7.5-magnitude earthquake centered in Afghanistan rocked neighboring Pakistan and rattled buildings as far away as India.' (USA Today, October 26th, item 10371195)

The combination of the location and magnitude is often use to 'label' the event and distinguish it from other ones. After a few days, 'big' events are known by their 'nicknames', and the magnitude is less often mentioned. A few hours after the main shock, journalists named the earthquake the 'Nepal earthquake', and it soon became the 'Nepal Quake'.

e.g., '5 things to know about the Nepal earthquake' (The Star, April 25th, item 6376436) 'Nepal quake: 7.9 magnitude tremor hits near Kathmandu' (The Guardian, April 25th, item 6370804)

However, only a few earthquakes become famous enough to be called by nicknames; the Chilean and Afghani earthquakes of 2015 did not, and the news settled for recalling the country and magnitude of the main shocks.

Interestingly, that initial phase of coverage is also the phase with most scientific content. The extensive use of the notion of magnitude, although often made at the expense of the notion of seismic intensity, testifies to the successful transfer of a geophysical notion to the lay public. We should also outline here that aftershocks are sometimes treated as singular events by the press, with the notion of a seismic crisis remaining unclear to many. Among the most cited expert bodies, the USGS is the most visible internationally, as it provides immediate information about the earthquakes. Regionally important centers such as national meteorological agencies and emergency operations centers, etc. can also be cited.

Secondary hazards are barely mentioned in the news, except for tsunamis. In Chile, the news passed on very well the information about tsunami warnings, mentioning at the same time the primary and the secondary hazards and the authorities' response to it:

e.g. 'Tsunami warnings in Chile and Peru as 8.3 quake hits' (Daily Telegraph, September 17th, item 9501990), 'The tsunami warning from New Zealand's Ministry of Civil Defence & Emergency Management after a big quake off Chile will affect a night surfing event.' (The Age, September 17th, item 9504366).

- Few hours to few days after the event

The peak of coverage is reached within a few hours to a day after the event, with many updates of the same news including more and more precision or detail. Earthquake events become 'breaking news' or 'top stories' and are disseminated simultaneously on different RSS feeds. Most news talk about impacts, especially human losses. The description of the impacts is the theme that attracts the most coverage. 76.7% of the news of our corpus focuses on the description of the impacts (81% for the three considered earthquakes). 34.3% focus on human losses, and only 17.3% on material damage. Messages about human impacts adopt a factual tone and evolve following a rather systematic pattern.

For illustration, we provide an example of the treatment by *The Guardian* of the 'Nepal Quake'. The news starts by mentioning the occurrence of an event with fatalities:

e.g., 'Fatalities as earthquake hits Nepal' (The Daily Telegraph, April 25th, 09:19, item 6371294)

Within a few hours, the regular update of the human losses starts:

e.g., 'Nepal earthquake: more than a hundred people dead' (The Guardian, April 25th, 12:04, item 6371816), 'Nepal earthquake: nearly 700 people dead' (The Guardian, April 25th, 13:42, item 6373501), 'Nepal quake: more than 1,000 people dead after tremor near Kathmandu' (The Guardian, April 25th, 17:44, item 6381853)

As the hours go by and the numbers continue to rise, concurrent topics start emerging. Stories become more personalized and the news starts referring to distinct categories of victims (famous people, nationals, vulnerable ones, etc.):

e.g., 'Nepal quake kills more than 1,000 and spreads terror on Everest' (The Guardian, April 26th, 00:23, item 6382569), 'Google executive Dan Fredinburg filmed at Everest base camp before

death' (The Guardian, April 26th, 16:49, item 6396313)), 'Népal: le bilan des victimes françaises pourrait s'alourdir' (Le Parisien, May 3rd, item 6542461)

Aid and rescue operations and life conditions start attracting interest:

e.g., 'Nepal earthquake: rescue continues as death toll exceeds 2,500' (The Guardian, April 26th, 18:18, item 6397229), 'Nepal earthquake: thousands seek shelter as death toll exceeds 2,500' (The Guardian, April 27th, 2:04, item 6402976)

As the days go by, the death toll appears less frequently, with the news reporting official numbers only when those are updated:

e.g., 'Nepal earthquake death toll exceeds 4,000 with many still missing. More than 4,000 are confirmed dead and 6,500 injured…' (The Guardian, April 28th, item 6430398)

Proportionally, there is a lack of interest in injuries and general health issues (with psychological issues even more ignored).

During the phase of coverage dedicated to impacts, we observe a tendency to sensationalism. Almost half of the news items use superlatives such as 'devastating', 'powerful', 'catastrophic', 'enormous', 'dramatic', 'monster', or 'violent', etc., emphasizing the extent of the devastation. Surprisingly, terms referring directly to emotions (such as 'fear', 'desperation', 'panic', 'courage', etc.) remain rare.

e.g., 'Nepal's second monster quake' (The Australian, May 12th, item 6749166), 'As rescue efforts were hampered by bad weather, dramatic details emerged about the devastation at the base camp in the wake of an avalanche' (The New York Times, April 28th, item 6423784), 'Nepalíes cavaron con sus manos para sacar a sobrevivientes de montañas de escombros. Pánico. Lágrimas. Miedo. Todos estos sentimientos se conjugaron ayer como parte de la jornada trágica que vivieron los miles de nepalíes que habitan Katmandú, y es que tras el fuerte terremoto de 7.8 grados en la escala de Richter que dejó en el país al menos mil 475 muertos […] los sitios históricos están completamente devastados' (La chronica de hoy, April 26th, item 6387254), 'vías de comunicación completamente sepultadas por corrimientos de tierra y rocas' (La chronica de hoy, October 27th, item 10394058), 'En el barrio de Gongabu, completamente arrasado, fallecieron 500 de las 8.000 víctimas del terremoto' (El Pais, May 13th, item 6779435), 'Reportage dans des villages coupés du monde, dévastés par la catastrophe, où les secours peinent à arriver comme l'aide des autorités.' (Le Monde, April 28th, item 6434796)

- Within a few days after the event

The focus slides from impacts to response operations. 45.2% of the news of our corpus refer to that category (Figure 5). In the case of a tsunami alert, the theme of response operations appears earlier in the coverage, as the news passes on information about warnings and, if relevant, mass evacuations. In the absence of a tsunami threat, the news focuses on aid, search and rescue operations. In that case, evacuation and displacement are generally undercovered.

e.g. 'Rescue teams dig for Nepal quake survivors' (USA Today, April 27th, 6401498); 'Rescuers were struggling to reach quake-stricken regions in Pakistan and Afghanistan on Tuesday as officials said the combined death toll from the previous day's earthquake rose to 339.' (The Times of India, October 27th, item 10393016), 'FRANTIC rescue efforts to save people trapped under rubble are taking place after a 7.9 magnitude earthquake hit near Nepal's capital, Kathmandu.' (Daily Telegraph, April 25th, item 6372184)

First, the messages adopt a general tone, becoming more specific when the international community starts sending help:

e.g., 'China's rescue team pulls first survivor out of debris after Nepal quake ' (China Daily, April 27th, item 6409965), 'The burly Californian and fellow members of a disaster response team deployed by the U.S. Agency for International Development were looking, against all odds, for

collapsed buildings' (The Los Angeles Time, May 1st, item 6499637), 'Turkish rescue workers in Kathmandu, Nepal pulled a man alive from the rubble of a destroyed building on Monday.' (USA Today, April 27th, item 6414192).

We note a tendency of the international news to glorify the contribution of the international community to help the 'poor and vulnerable'.

e.g. 'As world leaders and global charities tried to grasp the scope of an earthquake that devastated Nepal, they offered condolences for the nearly 1,400 people killed and readied emergency aid for the survivors. Mountaineering groups struggled to check on climbers, and Nepalese abroad did their best to reach families in the stricken area.' (The Times of India, April 26th, item 6382872), 'With the help of Los Angeles firefighters, rescuers Thursday pulled a teenage boy from the wreckage of a nine-story Katmandu hotel that collapsed around him five days ago when an enormous earthquake shook Nepal.' (The Los Angeles Times, April 30th, item 6494627)

Rescue operations are also an occasion for relating personal stories, if not miraculous ones.

e.g., 'Google executive Dan Fredinburg filmed at Everest base camp before death' (The Guardian, April 26th, item 6396313), 'Boy found alive 5 days after Nepal quake' (The Age, April 30th, item 6481498)

Such stories can take different forms depending on context. In Nepal, one finds several stories about 'children saved from the rubble' (The Guardian, April 30th, item 6480552). In Afghanistan, stories focus on 'twelve girls caught in a stampede while trying to escape from their school' (Daily Telegraph, October 26th, item 10367166).

At that stage, the duration of coverage plays an important role in the richness of the content of the news. The coverage of the 'Nepal Quake' is longer and richer: the living conditions, internal displacement, epidemic risk, and mass cremation are all issues that are not at all addressed in the coverage of the other earthquakes.

- Few days to few months after the event

The coverage intensity has faded out, impeding the proper coverage of long-term issues (Figure 4). Few news items refer to *recovery*, which tends to cover distinct temporalities, from a few days to several months (Figure 5).

e.g., 'Nepalese villagers clean up four days after a monster earthquake killed more than 5,000 people in the Himalayan nation' (USA today, April 29th, item 6462063), 'The International Federation of Red Cross and Red Crescent Societies warned on Friday that longer-term support is needed to help shattered communities recover six months after a magnitude 7.8 earthquake struck Nepal.' (China Daily, October 10th, item 10361489)

The theme of *reconstruction* is dedicated to more permanent repairs and rebuilding. There are enough news items referring to that theme for us to identify a few keywords, but the coverage remains poor (Figure 5). There are again different temporalities. In the short term, the news reports that people are rebuilding their homes. In the longer term, the news reports the reopening of public infrastructures such as schools, hospitals and historical buildings as a sign of returning to normal life.

e.g., 'Survivors in quake-hit Pakistan seek help to rebuild homes' (Times of Malta, October 28th, item 10408082), 'Hundreds of thousands of Nepalese children have returned to school in Nepal

for the first time since two earthquakes last month killed more than 8,700 people and injured 23,000…' (The Guardian, May 31st, item 7161853)

- A window of communication for scientists

According to Haas et al. (1977), the second and longer phase of reconstruction corresponds to the continuing assessment of hazards and risks and structural and nonstructural improvements to reduce the impact of future events (i.e., mitigation and adaptation measures, prevention). This phase lasts many years, during which attempts are made not only to recover but to improve the state of living, and society devotes some attention to the construction of memorials or the institutionalization of a narrative memory of the event. We could not find enough news items referring to mitigation, adaptation and prevention to identify keywords. There are, however, a few items referring to a narrative dimension: the ones that place the event in a country's history.

e.g., 'El terremoto fue el sexto mayor movimiento telúrico en la *historia* de Chile y el de mayor intensidad en el mundo durante 2015.' (El Universal, September 17th, item 9516610)

A few news items also mention the lessons learned (or not learned) from past events.

e.g., 'Nepal earthquake: learn lessons or more will die in future disasters, warns expert' (The Guardian, April 29th, item 6460947), 'How Nepal can avoid the mistakes of Haiti' (The Guardian, May 12th, item 6745299)

By doing so, the press contributes to maintaining a form of knowledge about existing risks. That contribution to the collective memory often happen just after the main shock (or after large aftershocks). It is also a time when the press listens to experts, and so it might be a good window for communication. People are looking for elements to make sense of what has just been going on. This time window could be used to reinforce preparedness in the general population, as news about a disastrous earthquake – even located far away – may momentarily alter the feeling of safety among readers (Wood et al. 2012).

3.2.3 The figures of 'earthquake news'

The identity matrix allows the identification of the categories of actors that are the most present in the news. 44.2% of the news mentions the people affected by the earthquake. The exact terminology varies with time. 'Those affected' start as 'victims' to become 'rescued', 'survivors' and then 'locals' or 'villagers'. 6% of the news refers explicitly to vulnerable persons.

27.7% of the news mentions state representatives who are responsible for organizing the public response, but regional and local public services are absent (Figure 5). Surprisingly, only 8% of the news refers to civil and military security services and 7.7% to rescuers in general. 3.8% of the news mentions UN agencies, and 2.5% international aid. Only 5.4% of the news refers to experts, specialists or scientists, mostly during the initial phase of coverage after the main shock and after the big aftershock in the case of the Nepal Quake. The private sector is rarely mentioned, except Google and Facebook for their people finder tools. Other figures emerging from the 'earthquake news' are 'famous unknowns' whose stories serve to exemplify the experience of the affected people. The news sometimes refers to famous personalities, either because they are among the victims or because of their generous donations. It is interesting to observe that local communities and their representatives are almost absent from the news. That

confirms one classical rule of newsworthiness about preference for elite people and celebrities (Galtung and Rudge, 1965; Harcup and O'Neill, 2001 and 2017).

4 Discussion

Studying earthquake coverage at the global scale, we reach different conclusions from authors such as Rovai and Christine (1998). Among the 7 136 earthquakes of magnitude 4.5+ occurring in 2015, we indeed observe significant differences in coverage: most events are not reported by the news media, except a few that are particularly well-covered. However, once events are covered, we observe an astonishing homogeneity in the news content. There are, of course, variations in the way journalists treat the information - editorial choices and cultural proximity with the impacted countries are both parameters influencing the duration and content of the coverage - but these variations remain small. Our results suggest that there is a typical framing of earthquake in the international news.

This framing seems to introduce major biases in the representation of the seismic risk. A first bias is linked to the short duration of the coverage. Analyzing Googling trends, Tan et al. (2018) confirm our empirical observation that the peak of public interest after destructive earthquakes follows an exponential temporal decay. The same tendency was observed for smaller events by Earle et al., 2010. Our results complement these findings in showing that the international online journals follow the same tendency. However, we go further than previous studies in exploring the consequences of that exponential decay on the news content. It focuses the information on short-term issues such as the description of the hazard and of its impacts and emergency operations. The mid-term and long-term issues of recovery, restoration, reconstruction, adaptation, mitigation and preparedness are largely undercovered.

This finding outlines the necessity for scientists to communicate, whenever possible, within a few hours after the occurrence of an earthquake, especially the big ones that are the most capable of catching a large audience. Of course, the need for reactive communication should not result in unpreparedness. Having a knowledge of the content and the evolution of typical earthquake news can help design typical communication tools that could be quickly adapted on a case by case basis once the event has occurred. Designing scientific messages, one should pay particular attention to counterbalance the known biases.

Communicating about the hazards, for instance, it would be important not to insist on including information about the magnitude but to find simple words to pass on the notions of seismic intensity and seismic crisis. As discussed in a previous paper (Le Texier et al., 2016), the term of magnitude is commonly used as a synonym of intensity by the news media. But the notion of intensity is the only one allowing to introduce the notion of differential damages, which is required to understanding the importance of mitigation and preparedness (earthquake-resistant construction, site effects, etc.). Another topic that is absent of news media narratives is that of the location of the next event. Coulomb stress triggering theory can help answering that question, at least probabilistically speaking. It could thus be interesting to communicate on the dynamics of the seismic phenomenon, notably to help designing adequate prevention measures (it might shake elsewhere the next time! it might shake again several times after the main shock!). About impacts, our analysis supports the statement of McClure et al. (2001): the representation of the seismic risk that is built by the press emphasizes the immediateness and hyperdestructivity of the event, occulting the real timing of such disasters: a time to anticipate

and get prepared, a time to protect and a time to recover and reconstruct. We agree with authors such Lamontagne et al. (2016) and Wood et al. (2009): scientific messages should encourage people to take preparedness actions and get them prepared for potential losses, describe to them the timeline of the disaster cycle and teach them ways to diminish losses.

Although unprecedented, we are aware that our study also has some caveats. The use of keywords to quantify themes and topics provides robust conclusions but is not completely satisfactory. We tried to get around its limitations by preselecting words from a list of the most frequently used terms. A further step is to engage with more complete techniques of text analysis combining inductive and deductive approaches. We could, for example, use machine learning methods such as word2vec (Le & Mikolov, 2014) for the simplification of the collection of keywords and the quantification of the different steps of the news coverage. However, this tool would complement but not replace the qualitative analysis of the content we undertook in this study.

One of our working hypotheses was to demonstrate the existence of a global framing of earthquake news and, to reach that goal, we chose to work on the international news, but it would be important to undertake a similar analysis on the national and regional press as well as social media. A recent work by Jamieson and Van Belle (2019) suggests for instance that the level of development of the disaster-stricken community influences the nature of news coverage in other at-risk communities : "if an earthquake occurs in a community with a high level of development, the news coverage is much more likely to draw lessons for their community, and less likely to emphasize differences that prevent policy learning".

Another interesting lead to explore would be to study the evolution of the public state of mind as they read the news. This could allow choosing more carefully which information to provide and at which time (see Wein et al., 2016, for an example).

5 Conclusion

"Most people do not experience disasters first-hand, but rely on mediated depictions of distant events." (Jamieson and Van Belle, 2019). This is why it is of utmost importance to study the narratives built by the news media in reporting about distant disasters. In this paper, we explore the news media coverage of seismic events in the international news during the year 2015, analyzing 320 888 news items published in English, Spanish or French by 32 RSS feeds distributed worldwide. Among the 7 136 earthquakes of magnitude 4.5+ occurring that year, three were predominantly covered: the sadly famous 'Nepal quake' that hit the valley of Kathmandu in April, an earthquake in Chile that shook the area of Ilapel in September, and an earthquake in Afghanistan that struck the Hindu Kush in October. We compare the duration and content of the news media coverage of these three major earthquakes with classical models of Disaster Risk Management.

Doing so, we demonstrate that: 1) there is a typical framing of the news about earthquakes in the international news, 2) this framing introduces major biases in representation, impeding the proper appropriation of the seismic risk by the public. The news content faithfully follows the succession of phases predicted by the DRM scheme, describing the hazard before reporting on its effects and the response of the impacted communities. However, an important bias is introduced by the very short duration of coverage: only the first phases of the DRM scheme are

covered, while the issues of recovery, restoration, reconstruction, adaptation, mitigation and preparedness remain largely ignored. We also observed the following biases: i) The news tends to concentrate on the description of impacts and, among them, more specifically on human losses. That focus is associated with the pervasive use of sensationalistic terms describing a landscape of devastation, which may contribute to fatalistic judgments that the damage cannot be prevented. ii) The second theme of interest – the second in terms of coverage intensity but the first one in terms of timing - is that of hazards. The communication is centered on the notion of magnitude, with the concept of seismic intensity being ignored. Aftershocks can be occasionally treated as isolated events, testifying to a lack of understanding of the concept of the seismic crisis and, except for tsunamis, secondary hazards are barely mentioned. iii) The third theme of interest is that of the emergency response. The focus is made on alert and evacuations in case of tsunami warnings and on aid, search and rescue otherwise. Other issues such as safety measures, temporary housing, water or electricity cuts, etc., and longer-term issues are barely mentioned.

On the basis of that analysis, we discussed leads to improve the scientific communication on earthquakes. Taking the opportunity of the short window of interest that follows big earthquakes, scientists should familiarize people with the real timeline of a seismic disaster cycle… which tends to last longer than the interest of the news media.

Data and Resources

This paper has benefited from the database GEOMEDIA produced and maintained by the International College of Territorial Science (http://www.gis-cist.fr). Earthquake parameters were obtained from the USGS Comprehensive Earthquake Catalog (ComCat), which was searched using https://earthquake.usgs.gov/earthquakes/search/ (last accessed on November, 1th 2019).

Authors contribution

Conceptualization, project administration, methodology, writing – original draft: M. Devès; Writing – review & editing: all authors; Data curation and investigation: M. Devès, M. Le Texier. H. Pécout; Formal analysis: M. Le Texier, H. Pécout; Validation; M. Le Texier, M. Devès; Visualization: H. Pécout, M. Devès ; Resources: C. Grasland.

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References

Adams W.C. Whose lives count? TV coverage of natural disasters. Journal of Communication, 36, 113-122, 1986

Bauer, M. W., Howard, S., Ramos, R., Jessica, Y., Massarani, L., & Amorim, L. ,Global science journalism report: working conditions & practices, professional ethos and future expectations. Science and Development Network, 2013.

Blei, D. M., Ng, A. Y., and Jordan, M. I. Latent dirichlet allocation. Journal of machine Learning research, 3Jan, 993-1022, 2003

Boin, A., McConnell, A., and Hart, P. T. (Eds.). Governing after crisis: The politics of investigation, accountability and learning. Cambridge University Press. 2008

Boomgaarden, H. G., and de Vreese, C. H. Dramatic real-world events and public opinion dynamics: Media coverage and its impact on public reactions to an assassination. International Journal of Public Opinion Research, 19(3), 354-366, 2007

Church, K. W., & Hanks, P. Word association norms, mutual information, and lexicography. Computational linguistics, 16(1), 22-29, 1990.

Cocco, M., Cultrera, G., Amato, A., Braun, T., Cerase, A., Margheriti, L., ... and Meletti, C. The L'Aquila trial. Geological Society, London, Special Publications, 419(1), 43-55, 2015.

Cottle, S. Rethinking media and disasters in a global age: What's changed and why it matters. Media, War & Conflict, vol. 7, no 1, p. 3-22, 2014

Cox, R. S., Long, B. C., Jones, M. I., and Handler, R. J. Sequestering of suffering: Critical discourse analysis of natural disaster media coverage. Journal of health psychology, 13(4), 469-480, 2008

Cox, R. S., and Perry, K. M. E. Like a fish out of water: Reconsidering disaster recovery and the role of place and social capital in community disaster resilience. American journal of community psychology, 48(3-4), 395-411, 2011

CRED. The International Disaster Database. Centre for Research on the Epidemiology of Disasters, Brussels, Belgium (Accessed 17/4/17, http://www.emdat. be/), 2017

Devès, M. La question du réel: de la science à la catastrophe. Recherches en psychanalyse, 20, 107-116, 2015

Earle, P., Guy, M., Buckmaster, R., Ostrum, C., Horvath, S. and Vaughan, A. OMG earthquake! Can Twitter improve earthquake response? Seismological Research Letters, 81(2), 246-251, 2010

Foucault, M. The archaeology of knowledge, trans. AM Sheridan Smith (New York: Pantheon, 1972), 24, 1972

Gaddy, G. D., and Tanjong, E. Earthquake coverage by the Western press. Journal of Communication, 36, 105–112, 1987

Galtung, J., and Ruge, M. H. The structure of foreign news the presentation of the Congo, Cuba and Cyprus Crises in four Norwegian newspapers. Journal of Peace Research, 2(1), 64–90, 1965

Grasland, C. International news flow theory revisited through a space–time interaction model: Application to a sample of 320,000 international news stories published through RSS flows by 31 daily newspapers in 2015. International Communication Gazette, 2019 (https://doi.org/10.1177/1748048518825091)

Grasland, C., Lamarche-Perrin, R., Loveluck, B., and Pecout, H. International Agenda-setting, the Media and Geography: A multi-dimensional Analysis of News Flows. L'Espace Géographique, 45(1), 25–43, 2016

Haas, J. E., Kates, R. W., & Bowden, M. J. Reconstruction following disaster. In Reconstruction following disaster. US The Massachusetts Institute of Technology, 1977

Harcup, T., and O'Neill.,D. What is news? Galtung and Ruge revisited. Journalism studies 2(2), 261-280, 2001

Harcup, T., and O'Neill., D. "What is news? News values revisited (again)." Journalism studies, 18(12), 1470-1488, 2017

Harris, A. J. Forecast communication through the newspaper part 1: framing the forecaster. Bulletin of Volcanology, 77(4), 29, 2015a

Harris, A. J. Forecast communication through the newspaper Part 2: perceptions of uncertainty. Bulletin of Volcanology, 77(4), 1, 2015b

Hiori, O., Mikami, S., and Miyata, K. A study of mass media reporting in emergencies. International journal of mass emergencies and disasters, 3(1), 21-49, 1985

Jamieson, Thomas, and Douglas A. Van Belle. How Development Affects News Media Coverage of Earthquakes: Implications for Disaster Risk Reduction in Observing Communities. Sustainability, 11 (1970), 2019

Kates, R. W., Colten, C. E., Laska, S., and Leatherman, S. P. Reconstruction of New Orleans after Hurricane Katrina: a research perspective. Proceedings of the national Academy of Sciences, 103(40), 14653-14660, 2006

Kim, K., and Barnett, G. A. The determinants of international news flow: A network analysis. Communication Research, 23(3), 323–352, 1996

Koopmans, R., and Vliegenthart, R. Media attention as the outcome of a diffusion process—A theoretical framework and cross-national evidence on earthquake coverage. European Sociological Review, 27(5), 636–653, 2010

Lamontagne, M., Flynn, B. and Goulet, C. Facing the communication challenges during an earthquake swarm period. Seismological Research Letters, 87(6), 1-5, 2016

Le, Q., and Mikolov, T. Distributed representations of sentences and documents. In International Conference on Machine Learning, 1188-1196, 2014

Le Texier, M., Devès, M. H., Grasland, C., and De Chabalier, J. B. Earthquakes media coverage in the digital age. L'Espace géographique, 45(1), 5-24, 2016

Lupton, D. Discourse analysis: A new methodology for understanding the ideologies of health and illness. Australian Journal of Public Health, 16(2), 145-150, 1992

McClure, J., Allen, M. W., and Walkey, F. Countering fatalism: Causal information in news reports affects judgments about earthquake damage. Basic and Applied Social Psychology, 23(2), 109-121, 2001

McClure, J., and Velluppillai, J. The effects of news media reports on earthquake attributions and preventability judgments: Mixed messages about the Canterbury earthquake. Australasian Journal of Disaster and Trauma Studies, 2013(1), 27-36, 2013

Östgaard, E. Factors influencing the flow of news. Journal of Peace Research, 2(1), 39–63, 1965

Peterson, S. International news selection by the elite press: A case study. Public Opinion Quarterly, 45(2), 143–163, 1981

Uchida, Y., Kanagawa, C., Takenishi, A., Harada, A., Okawa, K., & Yabuno, H. How did the media report on the great east Japan earthquake? Objectivity and emotionality seeking in Japanese media coverage. PloS one, 10(5), e0125966, 2015

Van Belle D.A. « New York Times and Network TV news coverage of foreign disasters: the significance of the insignificant variables ». Journalism & Mass Communication Quarterly, t. 77, n° 1, p. 50-70, 2000

Searle, J. R., & Willis, S. The construction of social reality. Simon and Schuster, 1995

Segev, E. International news flow online: Global views with local perspectives. Peter Lang, 2016

Simon A.F. « Television news and international earthquake relief ». Journal of Communication, 47, 3, 82-93, 1997

Smith, C. Reporters, news sources, and scientific intervention: the New Madrid earthquake prediction. Public Understanding of Science, 5, 205-216, 1996

Tan Y.J and Maharjan R. What googling trends tell us about public interest in earthquakes. Seismological Research Letters, 89(2A), 653-657, 2018

Thanthathep, K. et al. Disaster Risk Reduction: Information Kit for Media, scaling-up community-based disaster risk reduction in Lao PDR (Department of Disaster Management and Climate Change, Ministry of Natural Resources and Environment of Lao PDR & Asian Disaster Preparedness Center), 2016

Wein, A., Potter, S., Johal, S., Doyle, E., Becker, J. Communicating with the public during an earthquake sequence: improving communication of geoscience by coordinating roles. Seismological Research Letters, 87(1), 112-118, 2016

Wilks, D. S. Cluster analysis. In International geophysics, Academic press, 100, 603-616, 2011

Wood, M.M., Kano, M., Mileti, D.S., and Bourque, L.B., Reconceptualizing household disaster readiness: The "Get Ready" pyramid. Journal of Emergency Management, 7(1), 25-37, 2009

Wood, M.M., Mileti, D.S., Kano, M., Kelley, M.M., Regan, R., and Bourque, L. B., Communicating Actionable Risk for Terrorism and Other Hazards. Risk Analysis, 32, 601-615, 2012

Wu, H. D. Systemic determinants of international news coverage: A comparison of 38 countries. Journal of Communication, 50(2), 110–130, 2000

Yoshida, H., Kobayashi, N., Honda, N., Matsuoka, H., Yamaguchi, T., Homma, H., and Tomita, H. Post-traumatic growth of children affected by the Great East Japan Earthquake and their attitudes to memorial services and media coverage. Psychiatry and clinical neurosciences, 70(5), 193-201, 2016

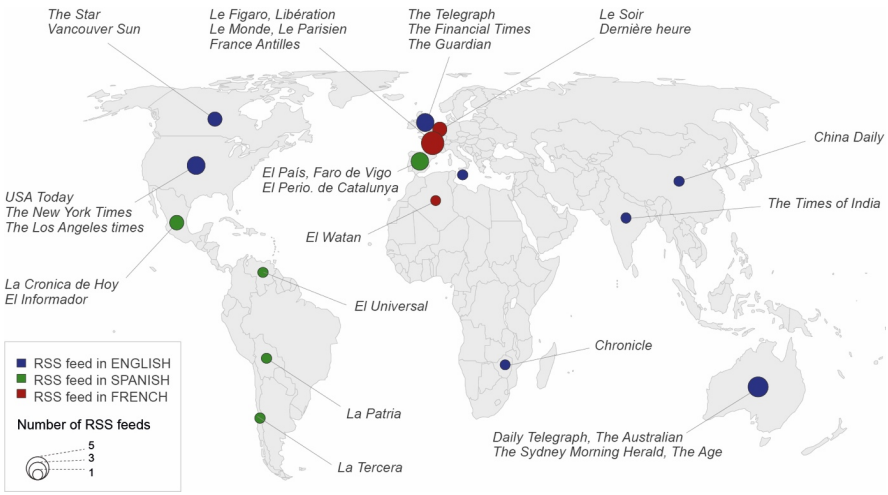

Figure 1. Corpus of news RSS feeds used, by origin and language

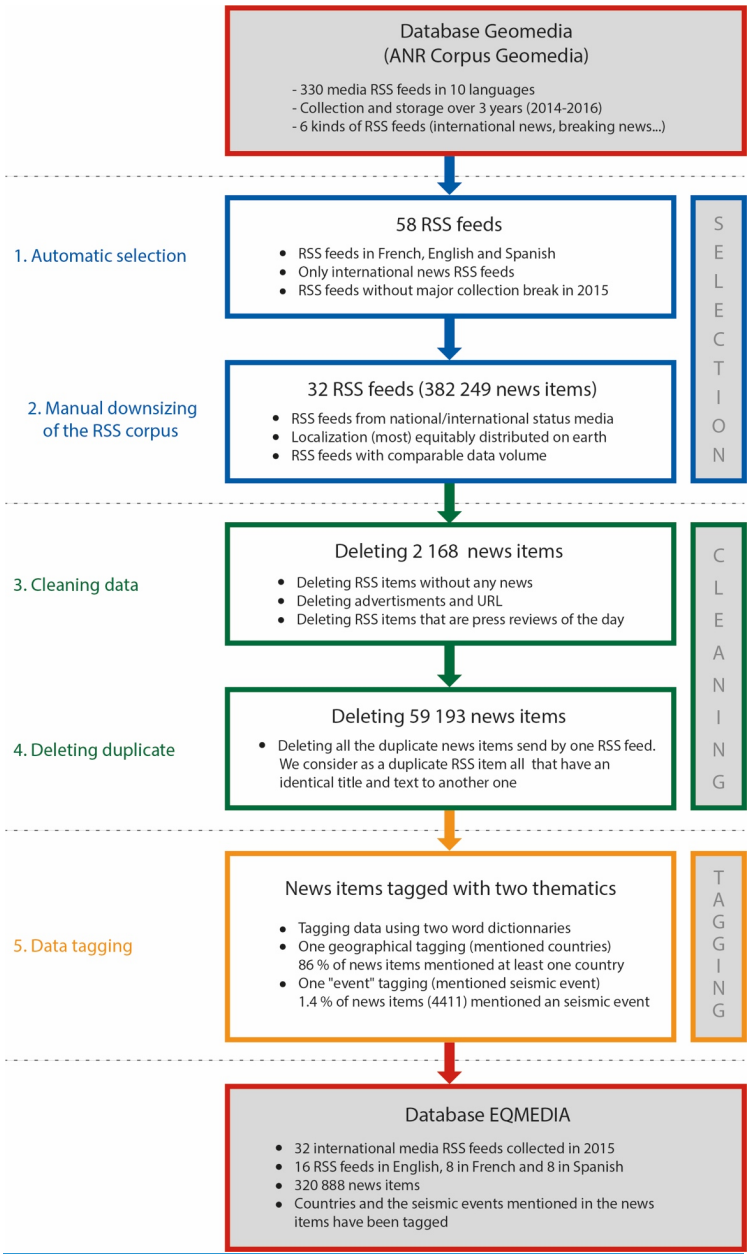

Figure 2. Building the EQMEDIA database

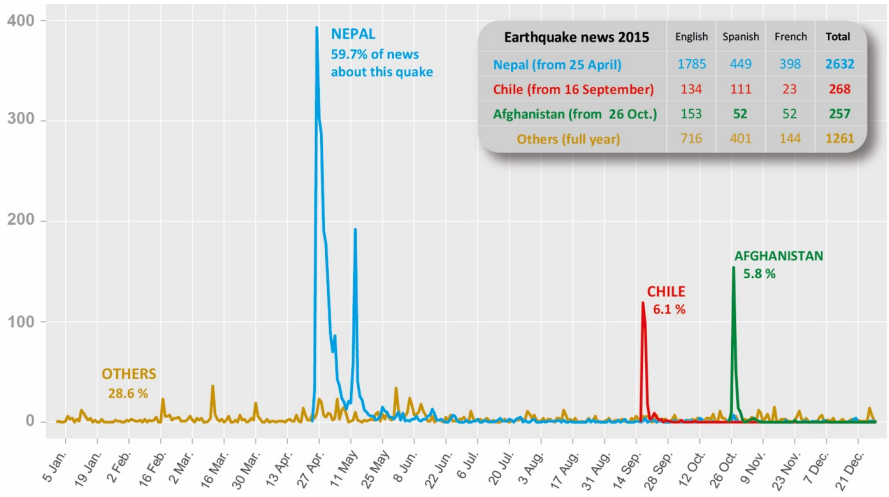

Figure 3. The media coverage intensity (number of news items published per day) of the year 2015 is dominated by three events: the Nepal Quake, an earthquake in the area of Ilapel, Chile and an earthquake in the Hindu Kush, Afghanistan.

Supprimé: articles

Table 1 (next page). Discourse content dictionary. Contains the keywords used to classify news items into categories of discourse corresponding to the main phases and topics of disaster risk management. Keywords were identified from a list of most frequent words using different thresholds for English, Spanish and French to balance differences in the RSS feed numbers.

CONTENT CATEGORIES	KEYWORDS BY THEMES AND TOPICS
HAZARDS	**Magnitude** EN: magnitude, Richter SP: grados, Richter, magnitud(es) FR: magnitude, Richter **Tsunami** EN: tsunami(s) SP: tsunami(s), maremoto(s), olas FR: tsunami(s) **Aftershocks** EN: aftershock(s) SP: aftershock(s), réplica(s) FR: aftershock(s), réplique(s) **Other secondary hazards** EN: avalanche(s), landslide(s), flood(s)/flooding SP: avalancha(s), deslizamiento(s), alud, inundacion(es) FR: glissement(s) de terrain, avalanche(s)
IMPACTS	**Impacts – general** EN: hit(s), struck, felt, shook, shak(e)(ing)(en), rocked, jolt(s)(ed), rattled, shattered, sway(ed), battered, suffered, toppling, crushed, strike, stricken, impact SP: impacto, estimacion(es), afectación, sacud(e)(ido)(ida)(idas)(ieron), golp(e)(eó)(ea), golpead(o)(os)(a)(as), azotó, azotado, sentido, se sintió, afectó, sufrieron, arrasó, temblar, asoló, castigad(o)(a) FR: frappé(e), touché(s), ressenti(e), ébranlé, secoué **Human impact** *Human impact – general* EN: fatalities, casualt(y)(ies), victim(s), affected, stranded SP: balance, víctima(s), afectados, damnificados, recuento(s), saldo, contabilizado FR: bilan, victime(s), sinistrés *Human impact – death toll* EN: death(s), kill(s)(ed)(ing), dead, bodies, died, deadly, claimed SP: muerto(s), muerte(s), mueren, murieron, mortal(es), fallecido(s), fallecieron, cuerpos, cadavers, decesos, mató FR: mort(s), tué(e)(s), corps, meurtrier *Human impact – injured* EN: injured, wounded SP: heridos FR: blesses **Material damage** *Material damage – general* EN: rubble, damage(d), collaps(e)(es)(ed) (ing), devastat(ed)(ion), destroy(ed)(ing), destruction, wreckage, debris, ravaged, ruins/ruined SP: daños, escombros, dañad(os)(as), destruid(o)(os)(as), perdidas, destrucción, ruinas, caíd(o)(a), destruyó, destrozadas, colapso, devastó, devastadas, derrumb(e)(es)(aron)(ado) FR: dévast(é)(ée), décombres, dégâts, détruit/détruits, effondr(ée)(ées), destructions, gravats

	Material damage - on buildings EN: homes, building(s), houses, structure(s), property SP: edificio(s), vivienda(s), edificaciones FR: maisons, bâtiments *Material damage - on infrastructures* EN, FR: no recurrent keywords were found SP: eléctricas, infraestructuras
EMERGENCY RESPONSE	**Tsunami warning** EN: tsunami warning(s), alert(s) SP: alerta de tsunami, alarma FR: alerte **Evacuation** EN: evacuat(e)(ed)(ion)(ions), evacuees SP: evacuad(os)(as), evacuar, evacuación FR: evacu(ees)(er)(ation) **Aid, Search & Rescue** *General* EN: effort(s), response, respond, operation(s), deployed, aid, rescu(e)(es)(ed)(ing), relief, help(ed)(ing), assist(ance), helicopter(s), chopper, aircraft, support, send(s)(ing), save(d), distribut(ing)(ion), airlifted, dig(ging), dug, missing, search(ing), alive, pulled, trapped, recovered + table 2/rescuers SP: operación/operaciones, gestión, respuesta, solidaridad, crisis, apoy(o)(ar), ordenó, responder, envoi, enviado(s), reacción, ayuda, ayudar, ayudas, ayudando, rescate, rescatar, rescatan, rescatado, helicóptero(s), asistencia, socorro, attender, ofrece, aeronave, búsqued(a)(as) + table 2/rescuers FR: operation(s), répondre, secours, aide, sauver, assistance, disparu, chiens, recherchés, sans nouvelles + table 2/rescuers *Vital needs and supplies* EN: food, hungry, sanitation, water, drink(ing), fuel, blankets, gasoline, suppl(y)(ies), resources, basic, vital, lack of, goods, need, needed, material, equipment SP: agua, alimentos, alimentaria, necesidad(es), comida, suministro(s) FR: de materiel, besoins **Medical care** EN: hospital(s), medical, medicine(s), disease(s), health, outbreak, epidemic(s), treatment, patients SP: hospital(es), médico(s), salud, medicinas, sanitarios FR: no recurrent keywords were found **Displacement & Temporary shelter** EN: shelter(s), outdoors, sleep, sleeping, homeless, refuge, fled SP: noche al raso, albergues, tiendas de campaña, desplazados, refugio(s) FR: camps, fuir, dehors **Cremation** EN, FR: no recurrent keywords were found SP: funerarias
RECOVERY REHABILITATION RECONSTRUCTION	**Recovery/Reconstruction** EN: recover(y)(ing), return to, returned, reconstruction, rebuild(ing), reopen(s)(ed), normal

(PREPAREDNESS)	SP: desescombro, reconstrucción, reconstruir, normalidad FR: reconstruction *No recurrent keywords were found that unambiguously refer to Risk assessment, development and land use planning / Adaptation and mitigation measures / Education and information / Preparedness, contingency planning, consolidate preparations for next disasters*

869
870
871 **Table 2.** Identity matrix. Contains the keywords used to quantify the presence/absence of
872 different categories of stakeholders. Keywords were identified from a list of most frequent
873 words using different thresholds for English, Spanish and French to balance differences in the
874 RSS feed numbers.
875

CONTENT CATEGORIES	KEYWORDS BY THEMES AND TOPICS
STATES	EN: nation, state(s), government(s), authorities, minister(s), ministry, foreign secretary, foreign office, president, parliament, royal rulers, embassy, European Union SP: país, nación, gobierno, autoridades, ministerio, ministro, president(a)(e), exteriores, funcionarios, gabinete, ispr, fata, europea FR: pays, gouvernement, affaires etrangeres, autorités, ministère, ministre, Quai d'orsay
UN AGENCIES	EN: United Nations, UNICEF, UNESCO, World Food Programme SP: onu, naciones unidas, Programa Mundial de Alimentos, unesco, unicef FR: nations unies, onu
INTERNATIONAL AID	EN: international aid, international agencies, aid agencies, humanitarian aid SP: ayuda internacional, comunidad internacional, organización no gubernamental, ong, cruz roja FR: aide internationale, croix rouge, humanitaire(s)
CIVIL SECURITY & DEFENSE	EN: police, army, military, marine(s), air force, soldiers, troops, firefighters, Gurkhas SP: ejército, policía, militares, armada, marina, soldados, Oficina Nacional de Emergencia
RESCUERS	EN: rescuers, rescue team(s), aid workers, rescue workers, relief workers, volunteer(s), personnel SP: equipo de rescate, equipos de rescate, servicios de emergencia, rescatistas, socorristas FR: équipe, secouristes, sauveteurs
AFFECTED PEOPLE	**Directly affected ones** EN: people, rescued, survivor(s), victims, those affected SP: persona(s), víctima(s), los afectados, damnificados, desaparecid(o)(a)(os)(as), supervivientes, sobrevivient(e)(es), rescatad(o)(os) FR: victimes, survivant(s), sinistrés, rescapes, personnes **Locals**

	EN: residents, locals, villagers, sherpa(s), guides, Famous locals: Ang Tshering, Bajracharya SP: población, habitantes, guías FR: habitants, villageois, population **Vulnerable ones** EN: children, child, boy, girl(s), wo(man)(men), famil(y)(ies), teenag(e)(er), teen, bab(y)(ies) SP: niños, famili(a)(as), muj(er)(eres), jóven, bebe, anciano FR: familles, adolescent, enfants, orphelins
'EXPERTS'	EN: expert(s), US Geological Survey, specialists, scientists SP: usgs, Centro Sismológico Nacional, especialistas, Servicio Hidrográfico y Oceanográfico de la Armada FR: usgs, institute américain de géophysique
PRIVATE COMPANIES	EN: Google, Facebook, compan(y)(ies) SP: google, Facebook FR: no recurrent keywords were found

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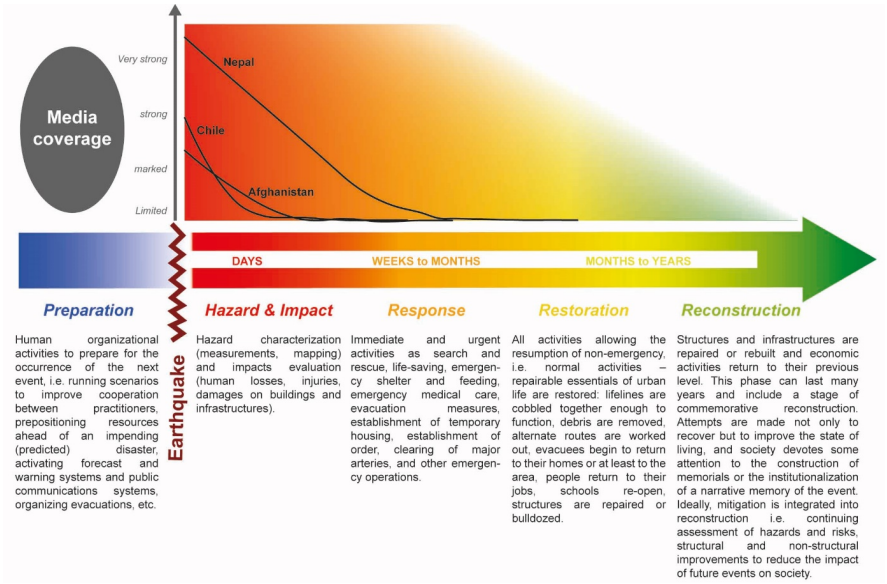

Figure 4. Temporal distribution of the media coverage for the three well-covered earthquakes of the year 2015. The color scale allows comparing the duration of the media coverage with the expected duration of the different phases of disaster risk management models.

	Themes	% of earthquake news	Number of items	Subthemes	%	Number of items	Topics	%	Number of items
Discourse content	Hazard	45,8	2020	Tsunami	8,9	391			
				Aftershocks	5,8	254			
				Secondary hazards	7,8	343			
				Magnitude estimation	23,5	1033			
	Impacts	76,7	3384	General impact	40,9	1802			
				Human impact	49,6	2189	General	17,1	756
							Death toll	40,7	1797
							Injured	8,9	393
				Material damage	30,8	1358	General	26,1	1150
							Buildings	13,3	585
	Response	45,3	1996		4,3	191			
				Evacuation	2,1	93			
				Aid Search Rescue	34,0	1501	General	29,6	1306
							vital needs	4,4	196
				Medical care	2,2	95			
				Temporary shelter	2,7	117			
	Reconstruction	5,6	249						
Identity Matrix	States	27,7	1220						
	Un agencies	3,8	168						
	International Aid	2,5	111						
	Civil Security Defence	8,0	353						
	Rescuers	7,7	341						
	Affected People	44,2	1951	Directly affected ones	33,4	1475			
				Locals	4,8	211			
				Vulnerables	6,0	265			
	Expert	5,4	239						
	Private Companies	1,6	72						

Corpus = 320 888 news items, including 4 411 news items about earthquake (1,37%)

Figure 5. Percentage of news items mentioning a theme or topic. NB: One news item can include several themes and topics.

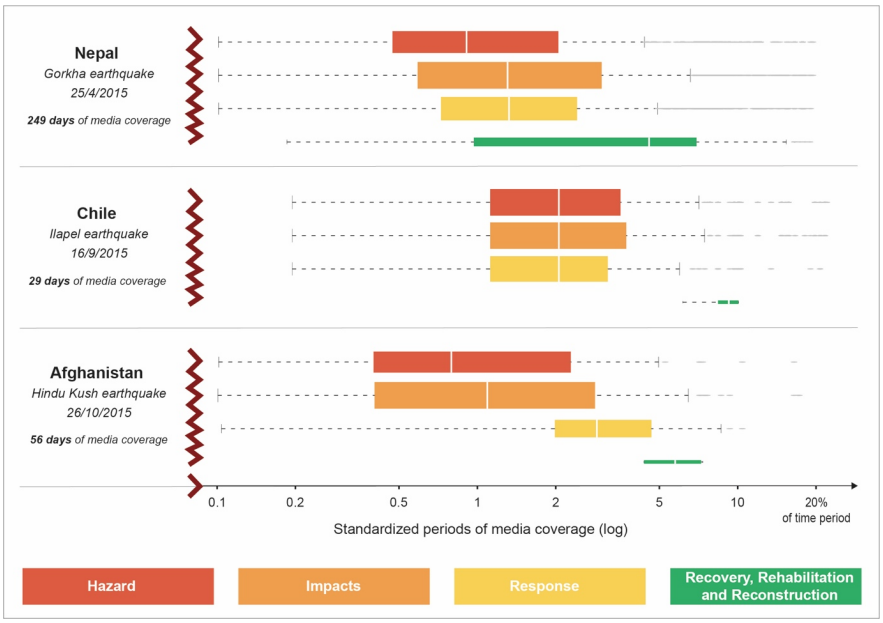

Figure 6. Temporal distribution of the DRM categories in the media coverage of three main earthquakes in 2015. The height of the boxes is proportional to the number of news items (for each earthquake). Box starts and ends corresponds to the first and third quartiles. The white line inside corresponds to the median.