



Supplement of

Climate risks, digital media, and big data: following communication trails to investigate urban communities' resilience

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Supplement S1: Details on how Gargantext V2 works and step-by-step implementation.

With Gargantext it is possible to extract, automatically as well as manually, a list of key terms from a corpus of digital texts. A first list of terms is automatically extracted by Gargantext algorithms on the basis of their occurrence, compared to other occurrences that characterise all Gargantext database corpora, as well as on the basis of the co-occurrences that characterise the specific corpus. This list can be manually modified: enriched with other terms extracted from the corpus, reduced, some terms can be merged in sub-lists. Gargantext is unique in terms of ergonomics. Indeed, it is possible to analyse texts at different levels: a micro level (the manual selection of key terms in a single document), a meso level (the manual selection of key terms and creation of groups of terms in a table of terms extracted by Gargantext), a macro level (the manual selection of key terms in the graph representation).

The graph representations presented in this research are computed on the basis of the semantic proximity measure between pairs of key terms (from the list) that is called 'conditional distance'. Co-occurrence graphs based on conditional distance illustrate which terms co-occur in the same meaning unit (e.g. a press article) and with what probability. As it is specified in Gargantext documentation for advanced users (iscpif.fr/gargantext/mesures-utilisees-dans-gargantext/, last access: 18 March 2019), 'the conditional measure P_c between the term i and the term j (...) is the maximum of the two conditional probabilities between i and j . If n_i (n_j respectively) is the number of occurrences of i (j respectively) in the corpus of articles and n_{ij} is the number of co-occurrences, we will have the following formula':

$$P_c = \max\left(\frac{n_{ij}}{n_i}, \frac{n_{ij}}{n_j}\right)$$

Gargantext computes non-directed graph representations, i.e. these graph have no directed edges. The graph representations remain stable even when few documents are deleted from the corpus or few nodes are removed from the graph. Gargantext graphs are weighted a "weight" from zero to one is assigned to each edge of the graph and it indicates the probability that two terms co-occur. The degree of each node (i.e. the number of edges connected to the node) can be displayed through Gargantext graph visualisation engine.

The nodes are assembled in cohesive subsets through a clustering algorithm, more specifically through the Louvain modularity. The Louvain method for community detection is used to maximise the graph modularity. A graph with high modularity has dense edges between the nodes within modules and sparse edges between nodes belonging to different modules. The modularity maximisation involves two stages: first, the small clusters are detected, then the nodes that belong to the same cluster are aggregated and a new graph is produced whose nodes are the clusters. These operations are repeated until a maximum of modularity is reached and a cluster hierarchy is built.

All other publicly available information on how Gargantext works is presented in Gargantext documentation (iscpif.fr/gargantext/, last access: 18 March 2019).

This research was supported by Gargantext, but it required the following manual interventions that were carried out by the authors:

- 1) We selected and downloaded the two corpora of press articles (articles covering the 2016 Seine river flood and the articles covering the 2015 Alpes-Maritimes flood) from *Europresse* in HTML format;
- 2) We uploaded the file on Gargantext;
- 3) We selected, among the terms automatically extracted by Gargantext from the two corpora, the most relevant terms and we merged synonyms, declensions of terms and equivalent forms;
- 4) We kept only those terms that occur at least five times in one of the corpora;
- 5) We verified the daily distribution of terms referring to the resilience solutions (through Gargantext Analytics view) and we recorded the daily incidence values in an Excel file in order to generate a histogram (Fig. 1s);
- 6) We added to the key term list the terms referring to actors and affected infrastructure (with at least five occurrences) in order to represent in the graph the stakeholders involved in flood risk management and the context where the resilience solutions were implemented;

- 7) We launched on Gargantext the graph representation based on conditional distance between pairs of terms from the term list;
- 8) We launched, through the graph visualisation engine, the Louvain algorithm in order to position the strongly related nodes close to each other;
- 9) We selected the Gargantext option that displays the terms corresponding to each node and the node degrees;
- 10) We zoomed in the graph to observe all the nodes (even those with a small degree) and we captured a photo of the two graphs;
- 11) We extracted the graph in. gexf format in order to analyse it with Gephi software;
- 12) We imported the. gexf file in Gephi and we converted it in two Excel tables with the node degrees and the edge weights;
- 13) We generated through Excel the figures presented in the Supplements.

Table S2.1: Key terms related to flood resilient solutions (in French). The terms were extracted from the articles on the 2016 Seine River flood and the 2015 Alpes-Maritimes flood. The list was automatically created by Gargantext algorithms, then it was manually refined on the basis of the relevance of the terms.

Adaptation, adapter, adapté, adaptations, adaptées, alerte, alertes, alerte générale crue, alerte orange, alertes orange, vigilance orange, alerter, alerte rouge, anticiper, assurance, assuré, assurée, assurés, assurances, barrages, barrage, barrer, barrer l'accès, barrières, barrières étanches, barrière, barrières en inox, aquabarrières, aquabarrière, aqua-barrière, aqua-barrières, barrières anti-crue, bassin de rétention, bassins de rétention, bassins d'orage, casier, expérimental, casiers, réservoir, casier, réservoirs, réservoir, casier-pilote, batardeaux, batardeau, bulletin, bulletins, capteurs, stations de mesures, courantomètres hydroacoustiques, équipements de mesure, courantomètres hydro-acoustiques, station hydrométrique, capteur, cellule de crise, centrale de crise, constat, constats, coupés, coupez, coupées, coupée, barrées, coupé, culture du risqué, débat public, dépanneuses, dépanneuse, désimperméabilisation, désimperméabilisations, végétalisation, diagnostics, diagnostic, digues, digue, données, dons, écluse, écluses, école fermée, écoles fermées, entretien des cours d'eau, espaces verts, espace vert, estimations, estimation, état de catastrophe naturelle, cat nat, plan d'aide, solidarité financière, dispositifs de soutien, classement en catastrophe naturelle, fonds d'indemnisation des catastrophes naturelles, garantie de catastrophe naturelle, procédure de catastrophe naturelle, système de solidarité, fonds de solidarité, étude, études, évacuation, évacuations, évacuées, évacuer, évacuation préventive, évacuations préventives, évaluent, évaluation, évalue, évaluations, fonds exceptionnel de soutien, former, gestion des milieux aquatiques et prévention des inondations, hébergement, hébergées, centre d'hébergement d'urgence, centre d'accueil, centres d'hébergement d'urgence, refuge, héberger, relogées, relogés, relogée, relogé, structures d'accueil, héberge, hébergements, relogement, information, informés, renseignements, informée, informer, informations, informé, interdiction, interdite, interdictions, interdit, interrompu, suspension totale, arrêtés, interrompue, arête, interrompus, arrêté, la bassée, bassée, lacs réservoirs, lacs-réservoirs, lacs de rétention, lacs de stockage, lac-réservoir, retenues des grands lacs, lacréservoir, lacs de retenue, lac réservoir, lacs artificiels, quatre grands lacs, lacs-réservoir, lidar, mémoire, mémoires, mesure de sécurité, consignes de sécurité, règles générales de sécurité, mesures préventives, mesure préventive, mettre en sécurité, mis en sécurité, mise en sécurité, modélisation, modèles, modéliser, murer, obturer, muret, murettes, murets, nouvelles zones endiguées, nouvel ouvrage, oeuvres stockées, parpaings, plan communal, plan communal de sauvegarde, pcs, plans communaux, plans communaux de sauvegarde, plan crue, plans de prévention, plans de prévention des risques, plan de prévention, dispositifs de prévention, plans de préventions des risques naturels, plans de préventions du risque d'inondations, ppr, ppri, stratégies de prévention, programmes d'actions de prévention des inondations, plans de prévention du risque inondation, ppri, plans de protection, plan de protection, plaques, pompes, pompes de relevage, pompage, pompe, pompant, possibles évacuations, précaution, précautions, première zone pilote, préparation, préparer, préparatifs, préparés, prévenir, prévention, préventive, préventives, titre préventif, prévisions, prévoit, prévision, prévoir, prise de conscience, prendre conscience, conscientiser, conscientisation, protection, protections, recherche, recherches, reconstruction, régulation, régulateur, relevés, relevé, relevés automatiques, mesures de débit, renforcer, renforcé, renfort, renforts, réparations, reconstruire, réhabilitation, réparation, repères, repère, restrictions, restriction, retour d'expérience, sauvetage, sauvetages, scénario, secouru, secourue, sécuriser, sensibilisation, réveillé les consciences, sensibilisations, conscience du risque, sensibilisant, service de prévention vigicrues, simulation, simulateur, simulations, site vigicrues, solidarité, solidaires, solidarités, solution technique, soutien financier, financer, aides financières, fonds, rembourser, indemnisés, indemniser, fonds d'urgence, subventions, dédommagements, remboursements, indemnisations, moyens financiers, fond, financement, indemnisation, remboursement, dédommager, indemnisé, crédit, aide financière, subvention, financements, finances, indemnisées, stocker, stockages, stockage, stockant, suivi, surveillance, surveillances, surveiller, surveillance, surveillée, vanne, vannes, vigicrues, vigicrue, vigiecrues, vigilance jaune, vigilance rouge, volets en acier

Table S2.2: English translation of the key terms related to flood resilient solutions presented in Tab. S2.

Adaptation, adapt, adapted, adaptations, adapted, alert, alerts, general flood alert, orange alert, orange alerts, orange vigilance, to alert, red alert, anticipate, insurance, insured, insurance, dams, dam, to bar, to block the access, gates, barriers, barrier, waterproof barriers, water barrier, water barriers, water barrier, water barriers, stainless steel barriers, flood prevention barriers, storm-water basin, storm water basins, locker, experimental, basins, retention reservoir, basin, retention reservoirs, pilot basin, cofferdams, cofferdam, bulletin, bulletins, sensors, measuring stations, hydroacoustics current meters, measuring equipment, hydro-acoustics current meters, hydrometric station, sensor, crisis cell, crisis centre, report, findings, cut, barred, risk culture, public debate, recovering trucks, recovering truck, increase permeable surfaces, revegetation, diagnoses, diagnosis, dikes, dyke, data, donations, lock, locks, closed school, closed schools, maintenance of streams, green spaces, green space, estimates, estimate, state of natural disaster, cat nat, aid plan, financial solidarity, support systems, natural disaster classification, natural disaster compensation fund, natural catastrophe guarantee, natural disaster procedure, solidarity system, solidarity fund, study, studies, evacuation, evacuations, preventive evacuation, assess, evaluation, assesses, evaluations, exceptional support fund, to train, management of aquatic environments and flood prevention, accommodation, shelter, emergency shelter, emergency shelters, shelter, relocated, to relocate, hosted, sheltering structures, hosts, accommodation, relocation, information, informed, to inform, prohibition, prohibited, prohibitions, forbidden, interrupted, total suspension, stopped, interrupted, ridge, interrupted, arrested, Bassée, reservoir lakes, reservoir lakes, retention lakes, artificial lakes, four large lakes, lidar, memory, memories, safety measure, safety instructions, general safety rules, preventive measures, preventive measure, safety, to secure, secured, modelling, models, modelling, to wall up, to obstruct, low wall, low walls, new dyked areas, new construction, stored art pieces, concrete blocks, municipality plan, municipality plan of safeguard, municipality plans, municipality plans of safeguard, flood plan, prevention plans, risk prevention plans, prevention plan, preventive measures, natural risk prevention plans, flood risk prevention plans, prevention strategies, flood prevention action programmes, flood risk prevention plans, protection plans, protection plan, plates, pumps, recovery pumps, to pump, pump, pumping, possible evacuation, precaution, precautions, first pilot area, preparation, prepare, prepared, prevent, prevention, preventive, preventives, precautionary, forecasts, forecast, predict, awareness, protection, protections, research, reconstruction, regulation, regulator, survey, automatic surveys, flow measurements, reinforce, reinforced, reinforcement, reinforcements, reparations, rebuild, rehabilitation, reparation, landmarks, landmark, restrictions, restriction, feedback, rescue, rescues, scenario, rescued, secure, awareness raising, awakened consciences, awareness of risk, Vigiecrues prevention service, simulation, simulator, simulations, Vigiecrues site, solidarity, solidarities, technical solution, financial support, finance, financial aid, funds, repay, indemnified, compensate, emergency funds, grants, compensation payments, reimbursements, indemnifications, financial means, funds, financing, reimbursement, compensation, credit, financial assistance, grant, financing, finances, indemnified, storage, stocking, monitoring, surveillance, monitor, monitors, monitored, valve, valves, yellow vigilance, red vigilance red, steel shutters.

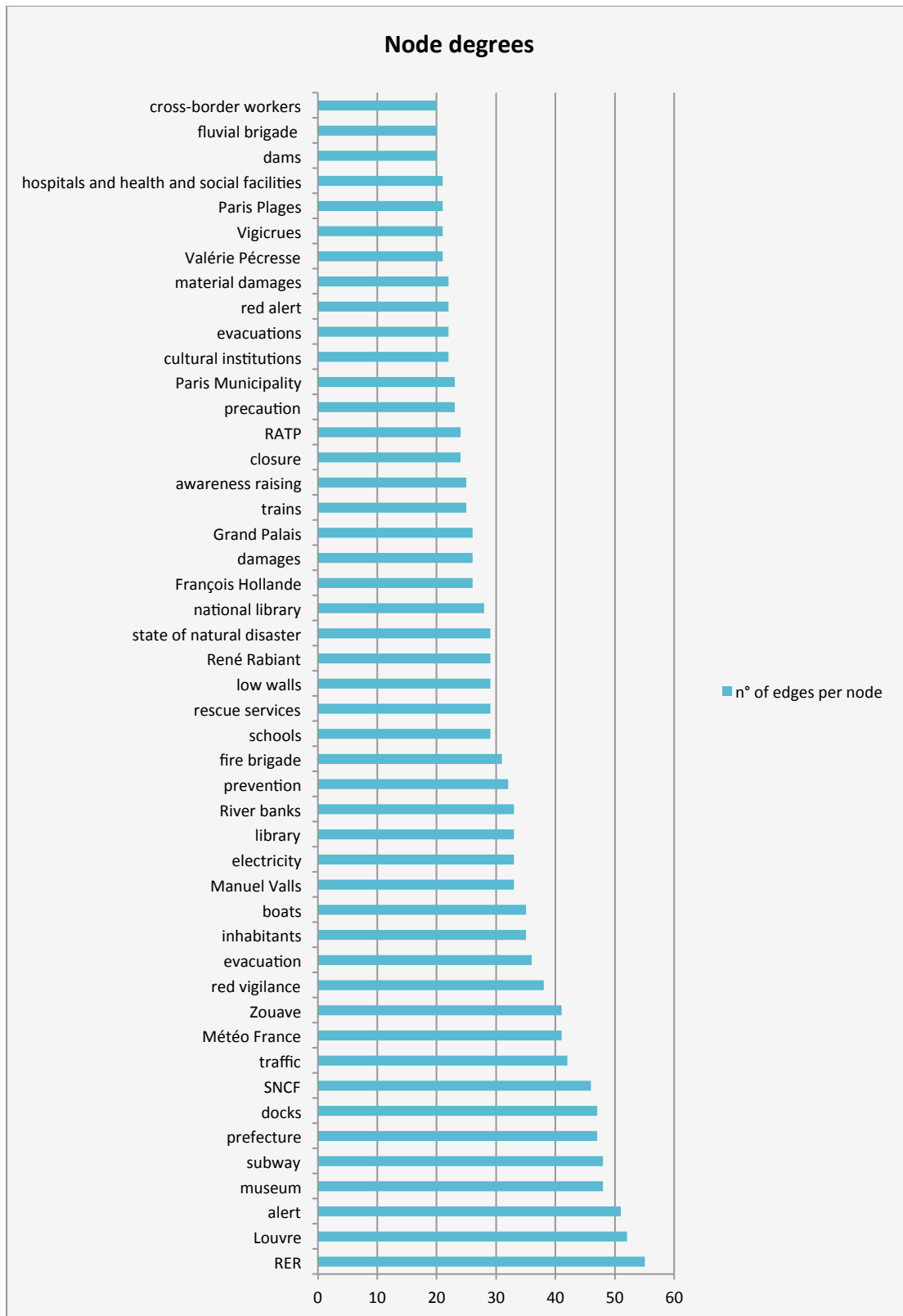


Figure S3.1: The key terms corresponding to the nodes with the highest degree in the graph. The graph representation was computed on the basis of the measure of conditional proximity between pairs of key terms in the corpus of press articles on the Seine River flood.

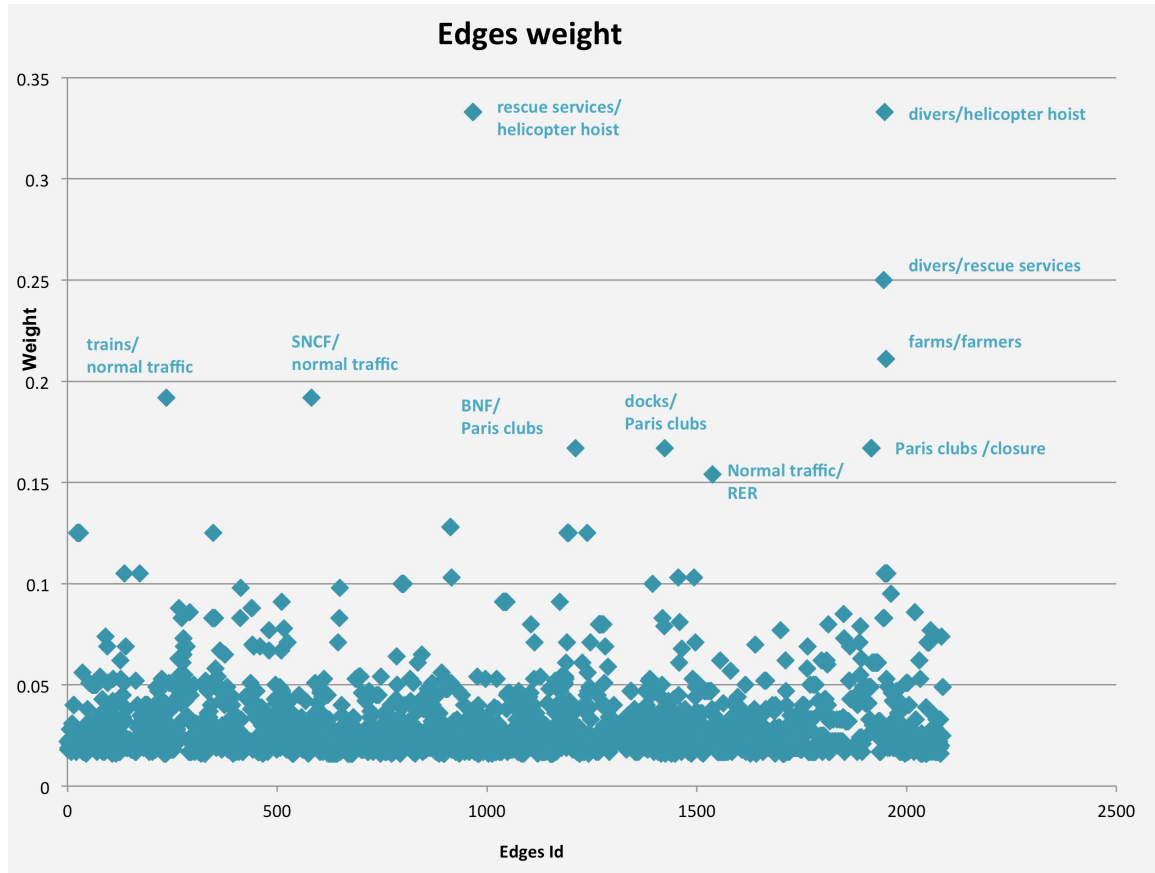


Figure S3.2: The most probable term co-occurrences corresponding to the edges with the highest weight in the graph. The graph representation was computed on the basis of the measure of conditional proximity between pairs of key terms in the corpus of press articles on the Seine River flood.

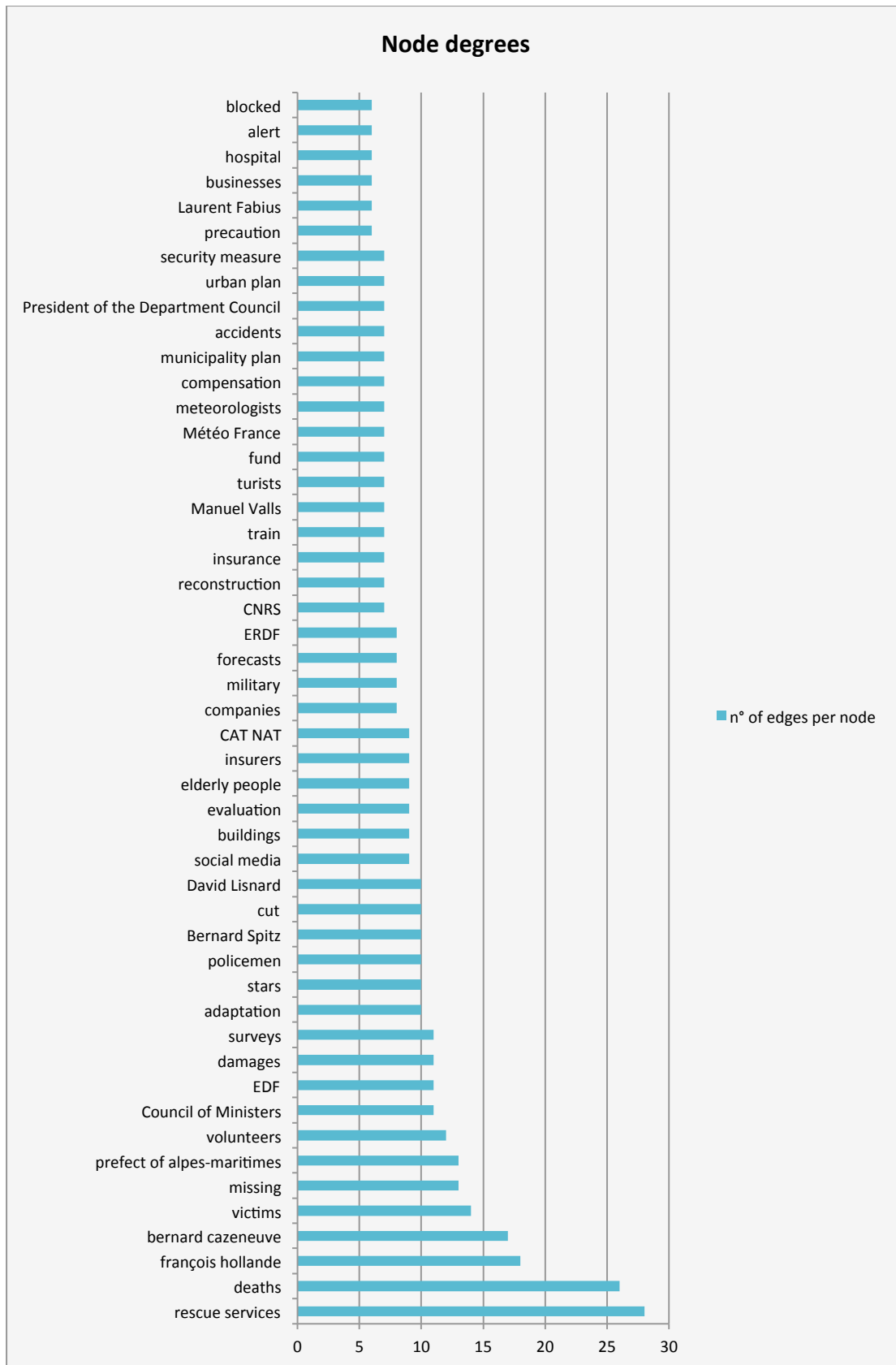


Fig. S4.1: The key terms corresponding to the nodes with the highest degrees in the graph. The graph representation is based on a corpus of press articles on the 2015 Alpes-Maritimes flood: it was computed on the basis of the measure of conditional proximity between pairs of key terms in the corpus of articles.

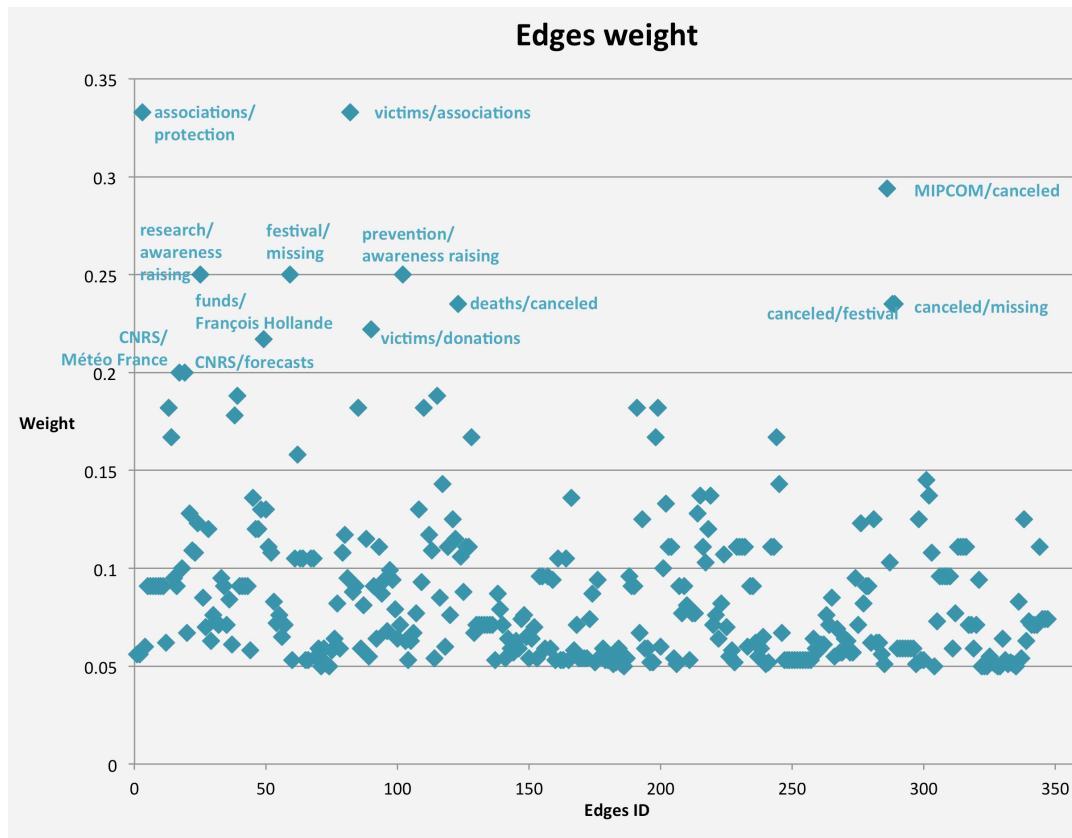


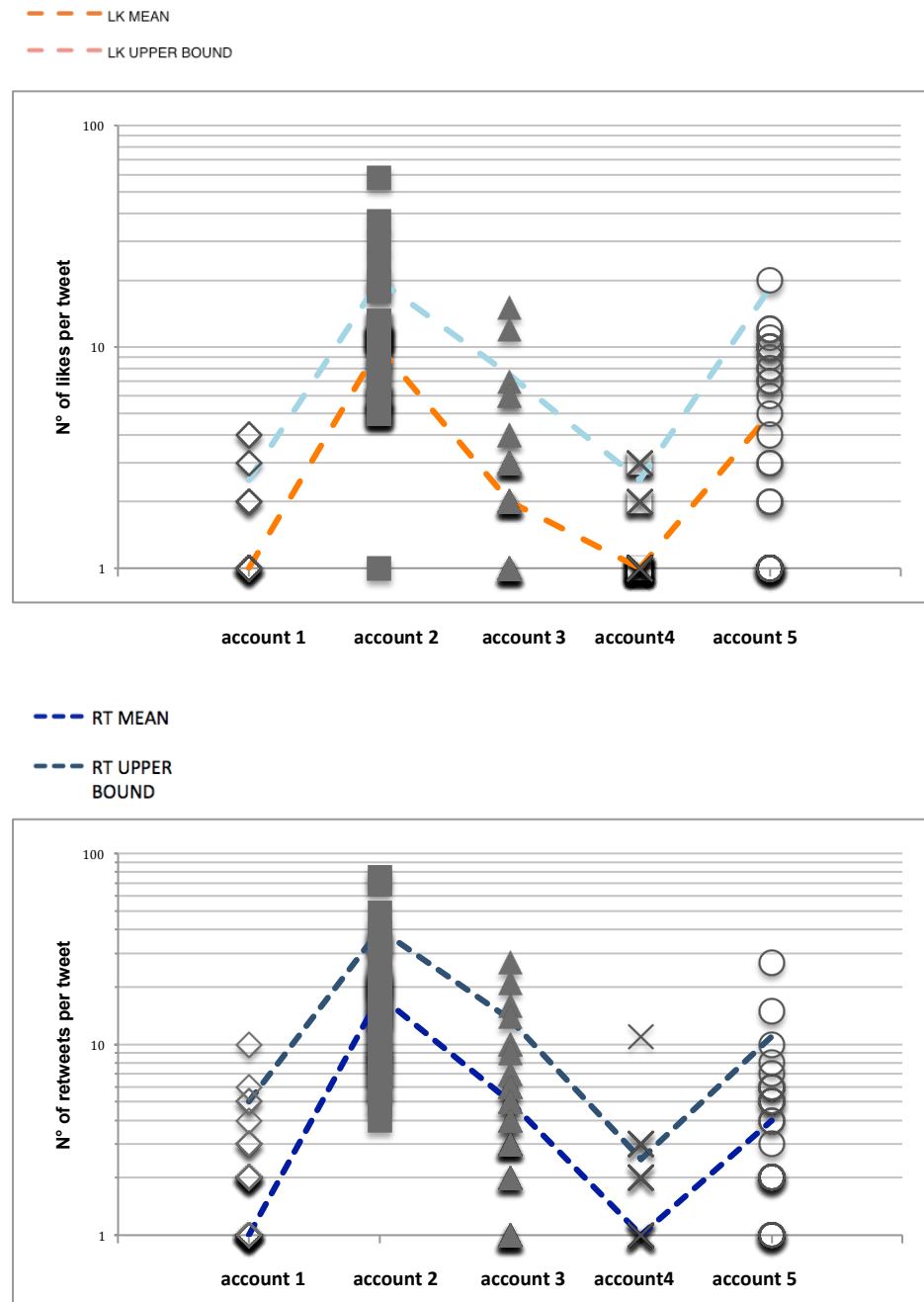
Fig. S4.2: The most probable term key term co-occurrences corresponding with the highest weight in the graph. The graph representation is based on a corpus of press articles on the 2015 Alpes-Maritimes flood: it was computed on the basis of the measure of conditional proximity between pairs of key terms in the corpus of articles.

Table S5.1: Thematic groups of key terms extracted from the corpus of tweets on the 2016 Seine River flood (in French).

<i>Thematic group (or category)</i>	<i>Key terms extracted from the corpus of tweets</i>
FLOOD RESILIENCE SOLUTIONS	agents, opération, mobilisés, exercices, nous intervenons, urgent, une aide, soutien, barrage, catastrophesnaturelle, cellules de crise, assurances, vigilances, vigilance orange, vigicrue, alert, aides, vigilance rouge, pompiers, vigilance jaune, fonds, police, prévention, sécurité, alerte rouge, secours, surveillance, appel aux dons, évacuation, sont mobilisées, alerte orange, vigilance orange, plouf, urgent, simulation, nous intervenons, catnat, précaution, bénévoles, sauvetage, mobilisation, gemapi, réparations, bétons, pcsorsay, catastrophesnaturelles, reconnaissance, travaux, mission, watergate, culture, aloa
MEDIA CONTENT (PHOTO, VIDEO...) SOURCE	photos, periscope, info, photography, images, direct sur, vidéos, photographe, pic, view, news, artwork, streetphotography, cartes, journal, pictures, photooftheday, nofilter, picoftheday, faitsdivers, longexposure @ paris, photography https, latergram, une image, infographie, actu, communiqué, msgu, video, blog, dessin, qag, rediff, hashtag, www.youtube.com/watch, sky, flickr, afp, nouvellerepublique, bfmtv, france2, septahuit, facebook
TIME/LOCATION	matin, cet après-midi, week, hier soir, lundi, yesterday, tomorrow, Sunday, spring, départements, nemours, communes, essonne, city, alma, juvisy, yvelines, idf, bercy, europe, montargis, marne, melun, ville, poissy, régions, chatou, austerlitz, puteaux, valdemarne, pontneuf, boulognebillancourt, seine-et-marne, longjumeau, hautsdeSeine, pont mirabeau, bièvre, courbevoie, pont alexandre iii, issy, cité, jatte, neuilly, eiffel, bastille, iles, concorde, village, palaisdejustice, sites, paname, quaideseine, yverres, bougival, ile saint louis, iledejacote, grigny, campagne, louvre, pontdelalma, suresnes, georges pompidou, reuil, pontmirabeau, alfortville, asnieres, notredame, cathedral, notre-dame, notre dame, paris plage, orsay, tunnel, château, park, lyon, statueofliberty, sur berges, arts
THREAT	risque, zone inondable, crue centennale, danger, crue historique, crise est hautement probable, menace, threat, soyez prudent, soyez vigilant
IMPACT	touché, catastrophe, cause, boue, stations, millions d'euros, milliards d'euros, inondée, charges, crise, streets, ports, patrimoine, cars, bateaux, sculptures, difficulté, navigation, débordé, débordements, bilan, sécher, rouvertes, impacts, laseinedeborde, major flood, coupé, bloqué, bridge, sinistrées, circulation, museum, banks, dégâts, tourisme, boats, cultures, victims, rerc, fermées, pollutions, œuvre, trains, maison, mort, agriculture, rue, archives, voitures, stations, transports, collection, bouchons, expo, facture, cars, metro, sinistres, gare, vache, inondés, pib, concert, assainissement, batobus, immobilier, moustique, restaurant
CAUSES	climatechange, climate, chgt climatique, sous-estimée, sous-estimé, développement urbain
WEATHER EVENTS	decru, highest level, météo, rain, meteo, record, mesure, hauteurs, unfetter, water levels, level, monte, seine baisse, metres, decru, feet, seine level, weather, stabilisation, landmarks, comparaison, meters, ça monte, grêle, averses, déluge, normal levels, niveau, précipitations, zouave, nasa, evolution, cumul
OTHER NEWS	loitravail, greve, grevesnfc, nonddl, grèves, attentats, brexit, manif, migrants, cgt, nuitdebout
EMOTIONAL CONTENT/ HUMOUR	parisjetaime, thankful, love, courage, impressionnant, fluctuatnecmergitur, hope, parisweloveyou, parismaville, merci à, une pensée, bottes, humour, swim, uber, insolite, pigeon, venise,
STAKEHOLDERS	hidalgo, particuliers, habitants, conseil, masson delmotte, personnes, mairie, maires, populations, people, particuliers, collectivités, communes concernées, maire, vlacroute, slefol, grandparis, seveso, conseil des ministres, comité de bassin, snfc, parisiens, holland, valls, enfants, ratp, entreprises, fraeco, ccr, courtier, clients, tourist, experts, tpe, AFA, IPRG, pme, agriculteurs, segolene

Table S5.2: Thematic groups of key terms extracted from the corpus of tweets on the 2016 Seine River flood (English translation).

Thematic group (or category)	Key terms extracted from the corpus of tweets
FLOOD RESILIENCE SOLUTIONS	agents, operation, mobilised, exercises, we intervene, urgent, help, support, dam, naturaldisaster, crisis cells, insurance, vigilance, orange vigilance, Vigicrue, alert, red vigilance, firefighters, yellow vigilance, funds, police, prevention, security, red alert, rescue services, surveillance, call for donations, evacuation, are mobilised, orange alert, orange vigilance, PLOUF, urgent, simulation, CATNAT, precaution, volunteers, rescue, mobilisation, GEMAPI, reparations, concrete, PCSOrsay, recognition, works, mission, watergate, culture, aloa
MEDIA CONTENT (PHOTO, VIDEO...) / SOURCE	photos, periscope, information, photography, images, direct, videos, photographer, pic, view, news, artwork, streetphotography, maps, newspaper, pictures, photooftheday, nofilter, picroftheday, longexposure @ paris, photography https, latergram, image, infographic, news, press release, social media in emergency management, video, blog, drawing, qag, rediff, hashtag, www.youtube.com/watch, sky, Flickr, AFP, NouvelleRepublique, BFMTV, FRANCE2, SEPTAHUIT, Facebook
TIME/LOCATION	morning, this afternoon, last night, Monday, yesterday, tomorrow, Sunday, spring, departments, Nemours, municipalities, Essonne, city, Alma, Juvisy, Yvelines, Ile-de-France, Bercy, Europe, Montargis, Marne, Melun, city, Poissy, regions, Chatou, Austerlitz, Puteaux, ValdeMarne, Pontneuf, BoulogneBillancourt, Seine-et-Marne, Longjumeau, HautsdeSeine, Mirabeau bridge, Bièvre, Courbevoie, Alexandre III bridge, Issy, Cité, Jatte, Neuilly, Eiffel, Bastille, islands, Concorde, village, courthouse, sites, Paname, SeineRiverbnks, Yerres, Bougival, Saint Louis Island, lledelaCité, Grigny, countryside, Louvre, Almabridge, Suresnes, Georges Pompidou, Reuil, Mirabeau bridge, Alfortville, Asnieres, NotreDame, cathedral, Notre-Dame, Notre Dame, Paris Plage, Orsay, tunnel, castle, park, Lyon, statueofliberty, on the banks, arts
THREAT	risk, flood-prone area, one-hundred-year flood, danger, historic flood, highly probable crisis, threat, be prudent, be careful
IMPACT	hit, disaster, cause, mud, stations, million euros, billion euros, flooded, charges, crisis, streets, ports, heritage, cars, boats, sculptures, difficulty, navigation, overflowed, overflows, evaluation of losses, dry, reopened, impacts, theSeineRiveroverflows, major flood, cut, blocked, bridge, disaster-stricken population, traffic, museum, banks, damage, tourism, cultures, victims, RERC, closed, pollution, artwork, trains, house, death, agriculture, street, archive, cars, stations, transports, collection, traffic jam, expo, bill, cars, subway, accidents, station, cow, flooded, GDP, concert, waste water system, batobus, real estate, mosquito, restaurant
CAUSES	climatechange, climate, underestimated, urban development
WEATHER EVENTS	decrease of water levels, highest level, weather, rain, weather, record, measure, heights, unfetter, water levels, level, rise, seine decreases, meters, decreases, feet, seine level, weather, stabilisation, landmarks, comparison, meters, it goes up, hail, showers, deluge, normal levels, level, precipitations, Zouave, NASA, evolution, cumulation
OTHER NEWS	labourlaw, strike, SNCFstrike, notoDDL, strikes, terrorist attacks, Brexit, protests, migrants, CGT, nuitdebout
EMOTIONAL CONTENT/HUMOUR	parisloveyou, thankful, love, braveness, impressive, fluctuatnecmergitur, hope, parisweloveyou, parismycity, thanks to, a thought for, boots, humour, swim, uber, unusual, pigeon, Venice,
STAKEHOLDERS	Hidalgo, individuals, inhabitants, council, Masson Delmotte, persons, City Hall, municipalities, populations, people, local authorities, affected municipalities, mayor, VLacroute, SleFoll, GrandParis, Seveso, Council of Ministers, Basin Comity, SNCF, Parisians, Hollande, Valls, children, RATP, companies, FRAECO, CCR, Courtier, clients, tourist, experts, TPE, AFA, IPRG, SMEs, farmers, Segolene



Figures S6: The users' behaviour: number of likes and number of retweets received by the five most active users for each of their tweets. These data were extracted from the sample of tweets on the 2016 Seine River flood.