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Tracing online flood conversations across borders: a watershed-level analysis of geo-social media topics during the 2021 European flood

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Supplementary material

Table S1. Complete list of relevant terms per each topic identified in the topic modelling.

Topic Abbreviation	Relevant Terms	Number of Tweets
Topic 1	climate, change, crisis, climatecrisis, catastrophe, protection, energy, extreme, heat, climateactionnow	231
Topic 2	limburg, water, maas, high, flooding, venlo, valkenburg, maastricht, watersnood, south	719
Topic 3	cologne, intensity, precipitation, area, koelle	46
Topic 4	towards, direction, closed, near, blocked, bastogne, li, flooding, charleroi, travel	301
Topic 5	people, affected, flood, disaster, many, victims, floods, solidarity, help, thanks	594
Topic 6	country, poland, italy, uk, people, hunger, strike, schoenstatt, schoenstattorg, srebrenica	300
Topic 7	pastoral, care, emergency, koblenz, mayen, mission, landkreismayenkoblenz, deployment, districtmayenkoblenz, operation	10
Topic 8	mh, mystery, solved, youtube, check, video, judge, answers, research, questions	16
Topic 9	ahrweiler, flood, help, germany, donations, bonn, district, ahr, fire, people	445
Topic 10	electricity, power, warning, diesel, disaster, siren, areas, lives, without, outage	139
Topic 11	br, veghel, bob, upscaling, alarm, veldenweg, drunen, new, middle, large	17
Topic 12	vaccinated, vaccination, covid, corona, infections, pandemic, people, via, incidence, cases	347
Topic 13	belgium, floods, liege, li, namur, meuse, dinant, water, flooding, city	389

Topic 14	khuzestan, tigray, justice, people, defundaredes, liberenalos, freedom, kurdistan, iran, crime	225
Topic 15	samson, gesves, closed, towards, flooding	8
Topic 16	hotton, tohogne, ardenne, roche, travel, direction, blocked, towards, flooding, accident	10
Topic 17	hertogenbosch, cooperation, found, injury, missing, police, transport, bbn, burgernet, accident	116
Topic 18	bless, god, amen, living, dead, lord, condolences, relatives, flees, crawls	207
Topic 19	cuba, soscuba, venezuela, cuban, freedom, cubans, cubaesunadictadura, cambiodesistema, free, cubadecide	121
Topic 20	ring, inner, accident, near, lane, outer, blocked, zellik, left, tervuren	63
Topic 21	belgium, national, day, victims, mourning, solidarity, floods, silence, minute, netherlands	358
Topic 22	laschet, germany, merkel, chancellor, cdu, german, catastrophe, people, climate, nrw	190
Topic 23	donations, help, donate, aid, flood, donation, thank, money, volunteers, distance	245
Topic 24	neufch, teau, sunday, valjoly, sweets, wiese, nebach, mutt, saure, monday	20
Topic 25	germany, flood, rhine, rain, heavy, water, erftstadt, nrw, cologne, wuppertal	460
Topic 26	water, basement, high, see, damage, flooded, dry, photo, house, cellar	301
Topic 27	fire, leverkusen, explosion, brigade, bait, dog, poison, waste, operation, friesenhagen	201
Topic 28	flood, rain, floods, water, weather, flooding, storm, heavy, flooded, like	540
Topic 29	direction, near, lummen, blocked, accident, lane, brussels, closed, ranst, stop	235
Topic 30	good, strength, thank, family, luck, everyone, keep, people, fingers, thanks	369

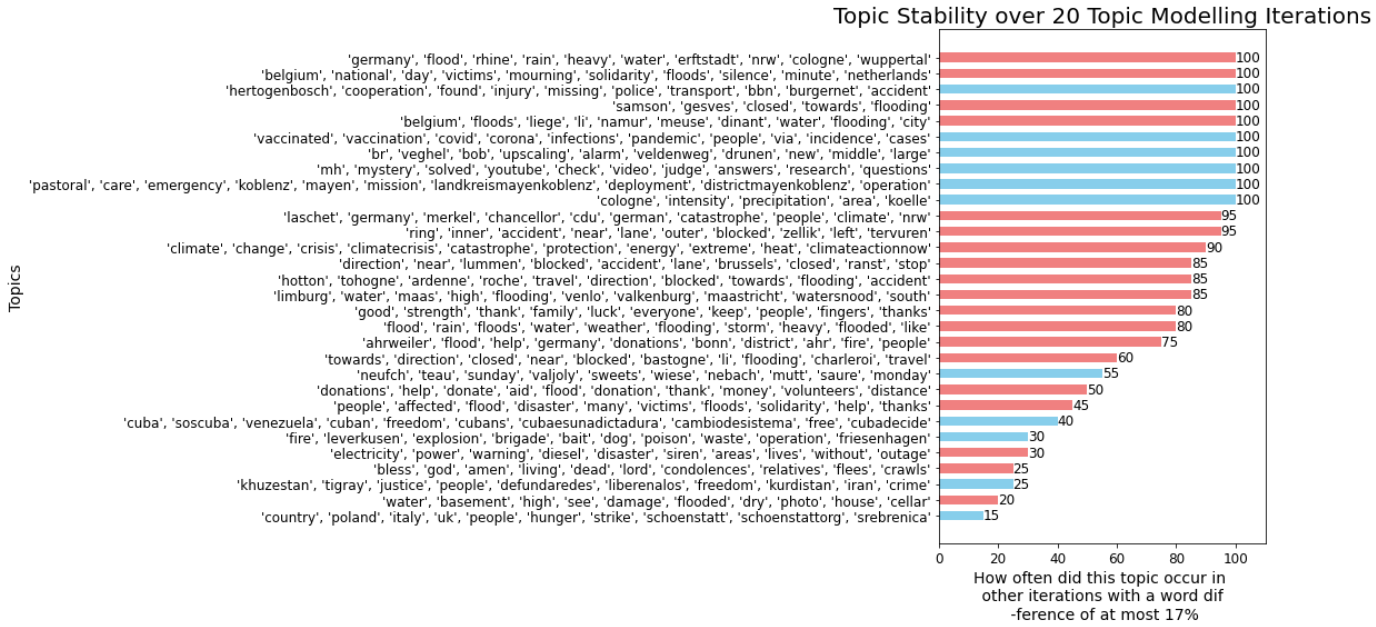


Figure S1. Topic stability in percent of all iteration, for the topics in the iteration with the most stable topics. The percentages indicate across how many iterations this topic emerged with a maximum difference of 17%. The red bars depict the topics selected for further analysis.

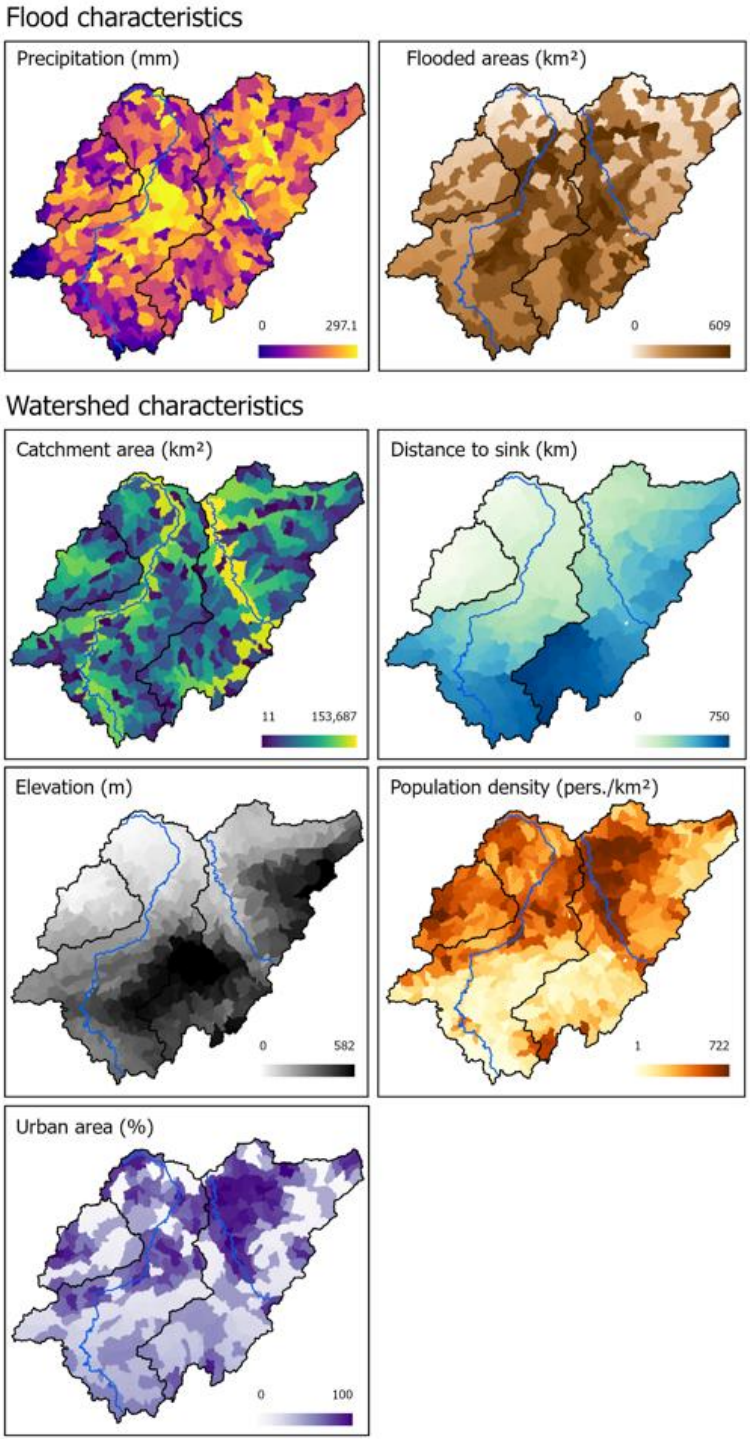
Topic occurrence frequency	All (N)	Dominant (N)	Discarded (%)
1	2523	996	61
2	555	319	43
3	158	101	36
4	99	65	34
5	48	33	31
6	26	14	46
7	25	22	12
8	10	8	20
9	8	6	25
10	4	3	25
11	3	3	0
12	5	5	0
13	1	1	0
14	5	5	0

15	2	2	0
17	2	2	0
18	1	1	0
19	1	1	0
21	1	1	0
22	2	2	0
23	2	2	0
35	1	1	0

Table S2. Summary table showing the distribution of daily topics per watershed based on their value of occurrence frequency. 'All' represents the total number of topics detected for a given occurrence frequency, while 'Dominant' refers to the number of topics retained after filtering. 'Discarded' indicates the proportion of topics at each frequency that were excluded from the analysis. Figures represent summary values for the entire study period and area. Topics that were less frequently discussed were primarily affected by the filtering process (e.g., 61% of topics mentioned only once on a given day and watershed were discarded). In contrast, the most frequently discussed topics (i.e. those occurring between 11 and 35 times) were retained in the analysis.

	Escaut		Meuse		Rhine		Study area		
	All	Dominant	All	Dominant	All	Dominant	All	Dominant	Discarded (%)
Heavy Rain	74	26	163	58	156	61	393	145	63.1
Roads Blocked	95	61	209	168	18	13	322	242	24.8
Meuse Flood	93	39	338	232	49	15	480	286	40.4
Rhine Flood	20	1	95	33	358	208	473	242	48.8
Damages	37	12	115	38	146	53	298	103	65.4
Help to Victims	76	30	155	50	180	59	411	139	66.2
Volunteering	29	5	62	21	89	26	180	52	71.1
Compassion	55	16	157	71	181	81	393	168	57.3
National Victim's Day	85	40	114	59	18	4	217	103	52.5
German Politics	12	3	30	5	96	36	138	44	68.1
Climate Crisis	33	8	59	28	85	33	177	69	61.0

Table S3. Total number of Tweet occurrences for each topic category per main river basin (Escaut, Meuse, Rhine) and across the study area before and after the selection of dominant topics. The initial number of occurrences is detailed in the first column ('All'), while the number of dominant topics retained after filtering is provided in the second column ('Dominant'). 'Discarded (%)' indicates the proportion of topics excluded from the analysis after selecting dominant topics. At the river basin level, the number of dominant topics is sometimes low, with less than 10 daily occurrences per watershed. However, at the study area level, all topics are well represented, with occurrences ranging from 44 (for German Politics) to 286 (for Meuse Flood). The filtering process impacted topics to a relatively similar degree, with the proportion of discarded topics ranging from 40% to 70%, except for Roads Blocked, for which only 24.8% of occurrences were filtered out.



25 **Figure S2. Map of variables analysed to describe the flood and watershed characteristics across three main river basins (Escaut, Meuse, and Rhine). Variables are classified using a quantile method (100 classes).**

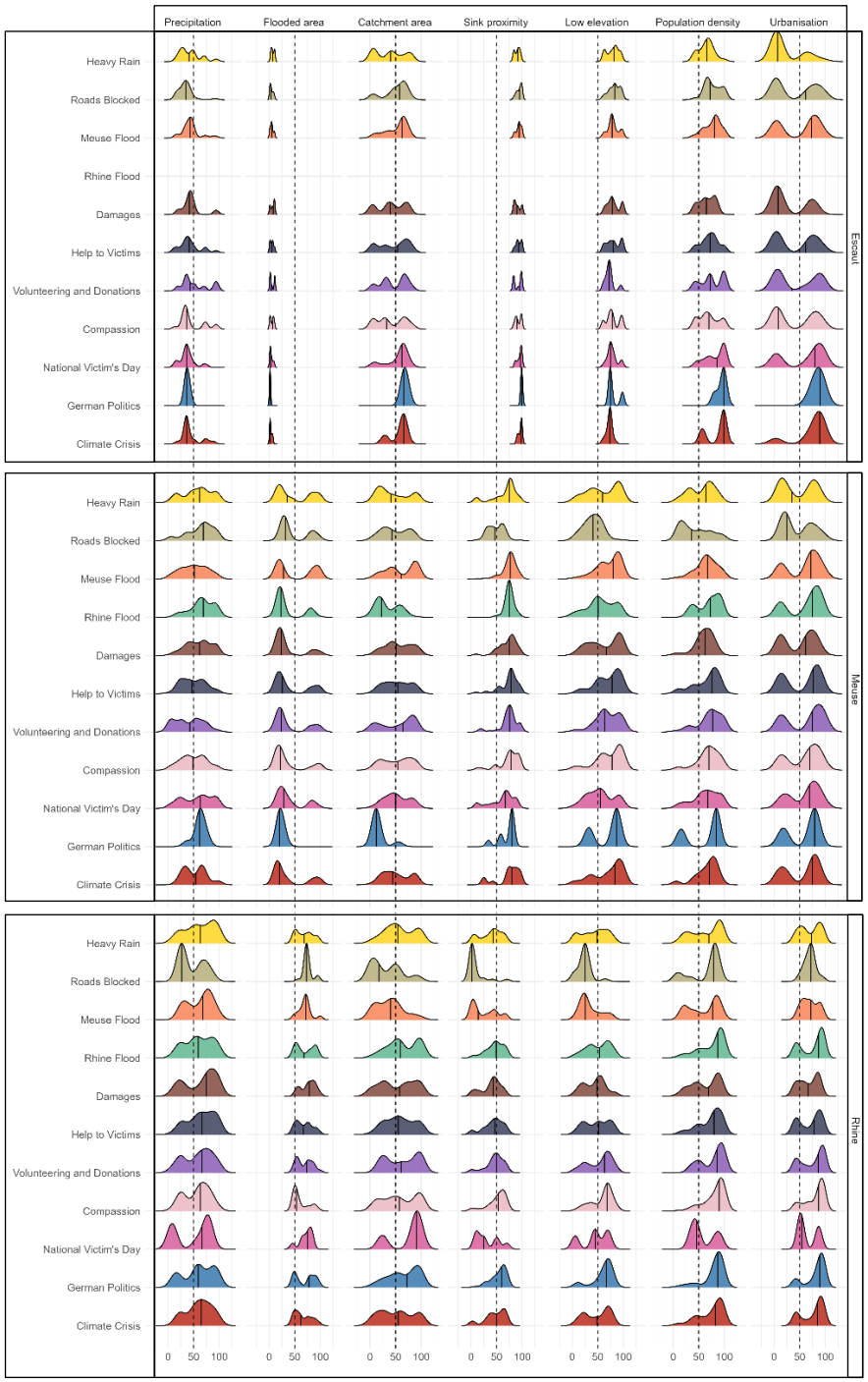


Figure S3. Distribution plots of dominant topic occurrences per main river basin based on flood and watershed characteristics. Topics from the Escaut river basin, as well as the *German Politics* of the Meuse river basin and *National Victim's Day* of the Rhine river basin, should be interpreted with caution due to their limited frequency (fewer than 10 occurrences – See Table S2).