

1 [Please find our response to Referee 1 below, and reference to each included edit.](#)

2  
3 ***Interactive comment on “What Does Nature Have to Do***  
4 ***with It? Reconsidering Distinctions in International***  
5 ***Disaster Response Frameworks in the Danube Basin” by***  
6 ***Shanna N. McClain et al.***

7 **Anonymous Referee #1**

8  
9 Received and published: 6 January 2017

10  
11 Review of “What Does Nature Have to Do with It? Reconsidering Distinctions in  
12 International Disaster Response Frameworks in the Danube Basin”

13  
14 **Summary**

15 Using the example of the Danube basin and the Tisza sub-basin, the authors attempt to  
16 reflect on whether the policy distinctions made between natural and man-made dis-  
17 asters are a) suitable and functional, b) up to date, c) without fault. For this, the authors  
18 made a literature review and semi-structured interviews. The thematic scope of the  
19 latter remains unclear, though. They give a broad overview on the different disaster  
20 response frameworks in their study area and show that the diversity of these, combined  
21 with a lack of cooperation and ambiguity of responsibilities enhance the vulnerability  
22 of the population living in the area. However, it remains unclear in how far these  
23 problems are related to the nature vs. man-made dichotomy and why they are not  
24 simply regarded as insufficient response systems. On a more technical level, the paper  
25 lacks structure and focus and it remains unclear in how far the interviews provided  
26 considerable insight into the question of the distinction between natural vs. man-made  
27 disasters. If the authors delved more deeply on the issues of multi-hazard and trans-  
28 boundary hazards, the paper would gain focus and – so I assume – the results of the  
29 interviews could be more easily linked to the conclusions.

30  
31 **Scientific Significance:** Does the manuscript represent a substantial contribution to  
32 the understanding of natural hazards and their consequences (new concepts, ideas,  
33 methods, or data)?

34  
35 fair

36  
37 **Scientific Quality:** Are the scientific and/or technical approaches and the applied methods  
38 valid? Are the results discussed in an appropriate and balanced way (clarity of  
39 concepts and discussion, consideration of related work, including appropriate  
40 references)?

41  
42 poor

43

44 Presentation Quality: Are the scientific data, results and conclusions presented in a  
45 clear, concise, and well-structured way (number and quality of figures/tables,  
46 appropriate use of technical and English language, simplicity of the language)?  
47

48 Poor due to poor structure and lack of clarity – English and number/quality of  
49 figures/tables is good, though.  
50

51 [Following the reviewer's comments, the paper was substantially shortened and](#)  
52 [streamlined, and citations were added.](#)  
53

54 Review Questions – summary  
55

56 1. Does the paper address relevant scientific and/or technical questions within the  
57 scope of NHESS?  
58

59 Yes  
60

61 2. Does the paper present new data and/or novel concepts, ideas, tools, methods or  
62 results?  
63

64 Trying, but in its current state is failing to do so.  
65

66 3. Are these up to international standards?  
67

68 unclear  
69

70 4. Are the scientific methods and assumptions valid and outlined clearly?  
71

72 no  
73

74 5. Are the results sufficient to support the interpretations and the conclusions?  
75

76 no  
77

78 6. Does the author reach substantial conclusions?  
79

80 They could be substantial, but they are discussed too superficially.  
81

82 7. Is the description of the data used, the methods used, the experiments and  
83 calculations made, and the results obtained sufficiently complete and accurate to allow  
84 their reproduction by fellow scientists (traceability of results)?  
85

86 no  
87

88 8. Does the title clearly and unambiguously reflect the contents of the paper?  
89

90 no – the authors rather describe the general problems of transboundary disasters and  
91 those of multi-hazards. The dichotomy between nature and man-made disasters and  
92 their respective response systems is rarely touched upon, and in those parts where it is  
93 discussed needs more reflection.

94  
95 A discussion regarding the differences between hazard, vulnerability and risk was  
96 added, as well as clarification that the paper is focused solely on disaster response. A  
97 discussion on the purported differences between natural and man-made disasters was  
98 added for clarification, and since the intended focus should be on the policies for  
99 response, this was also clarified. One of the key arguments of this article is that the  
100 historic dichotomy between natural and man-made disasters is outmoded and  
101 inappropriate. Too much emphasis on the dichotomy undermines this central argument.  
102 See page 1-2 and related footnote, and page 11 and related footnote.

103  
104 9. Does the abstract provide a concise, complete and unambiguous summary of the  
105 work done and the results obtained?

106  
107 Partly. The paper does examine the policy frameworks in the Danube and Tisza region. If  
108 the authors focused on the general problems of the transboundary multi-hazard dis-  
109 aster management, this would be sufficient. The authors do not, however, discuss  
110 nature vs. man-made in detail.

111  
112 The differences are discussed on page 11, again though – since the paper is focused  
113 on the differences in response, language was clarified to make this more apparent  
114 throughout the paper.

115  
116 10. Are the title and the abstract pertinent, and easy to understand to a wide and  
117 diversified audience?

118  
119 yes

120  
121 11. Are mathematical formulae, symbols, abbreviations and units correctly defined and  
122 used? If the formulae, symbols or abbreviations are numerous, are there tables or  
123 appendixes listing them?

124  
125 /

126  
127 12. Is the size, quality and readability of each figure adequate to the type and quantity of  
128 data presented?

129  
130 yes

131  
132 13. Does the author give proper credit to previous and/or related work, and does he/she  
133 indicate clearly his/her own contribution?

134

135 From my point of view, the authors do not cite enough. I've indicated this at some  
136 points, but not always. Whenever facts, numbers, dates. . . are given, there should be a  
137 source given, just as for definitions etc. If the authors want to discuss whether the  
138 dichotomy between nature vs. man-made disasters is needed/useful, they need to cite  
139 much more literature from the social sciences, too. There (but not only there) they  
140 should find a vast body of literature dealing with nature-society-dichotomies.  
141 Furthermore, the question nature/man-made also touches considerably the issue of  
142 environ- mental determinism, an issue not discussed at all so far in this paper.

143  
144 Per standard practice, we do not cite for facts, numbers, or dates that are readily  
145 available. Citations were added to paper to support argument, see page 11.

146  
147 14. Are the number and quality of the references appropriate?

148  
149 more references advised

150  
151 References/citations were added throughout.

152  
153 15. Are the references accessible by fellow scientists?

154 yes

155  
156 16. Is the overall presentation well structured, clear and easy to understand by a wide  
157 and general audience?

158  
159 It could be helpful if the authors provided a short summary of what their main points  
160 and/or what they wanted to say within the respective chapter. So far, the authors often  
161 leave the reader to draw her/his own conclusions without indicating what they – the  
162 authors – intended to conclude. Furthermore, the whole structure of the paper needs to  
163 be revised. The introduction should frame why the question is of importance, and  
164 should also give a broad literature overview. The results of the literature research – a  
165 task common to all scientific studies – has to be moved from the (supposed) results  
166 section to a section on the differences between response systems to natural and man-  
167 made disasters, respectively. The literature review should either focus on this  
168 question, or the scope of the paper needs to be changed towards the general  
169 problems of transboundary multi-hazards in the Danube region. The method (semi-  
170 structured interviews) needs to be explained in much more detail in order to be  
171 comprehensible and reproducible. Within the results section, the outcomes of the  
172 interviews need to be much more clearly linked to the research question. Within the  
173 discussion, no new literature and results should pop up.

174  
175 We appreciate this comment from the reviewer, and agree that the paper's message  
176 could be sharpened. To do so, as noted above, we streamlined the paper. More  
177 specifically, the main point of the paper was clarified in the abstract and the introduction.  
178 The methodology section was substantially expanded and clarified. The interviews'  
179 insights were expanded. .

180

181 17. Is the length of the paper adequate, too long or too short?  
182 too long – if restructured and focused it can be much shorter

183  
184 [As noted, the paper is now about 1,800 words shorter.](#)

185  
186 18. Is there any part of the paper (title, abstract, main text, formulae, symbols, figures  
187 and their captions, tables, list of references, appendixes) that needs to be clarified,  
188 reduced, added, combined, or eliminated? see above: literature review, methods,  
189 results, discussion need clarification, restructuring and – partly – reduction.

190  
191 19. Is the technical language precise and understandable by fellow scientists?

192  
193 yes

194  
195 20. Is the English language of good quality, fluent, simple and easy to read and under-  
196 stand by a wide and diversified audience?

197  
198 yes

199  
200 21. Is the amount and quality of supplementary material (if any) appropriate?

201  
202 /

203  
204 Specific comments Major points

205  
206 Introduction: Line 41: The authors start with principal questions on the benefits and  
207 consequences of distinguishing (or not) between natural and man-made disasters.  
208 Although starting with a question is “catchy”, here some introductory sentences on the  
209 type of distinctions traditionally made is missing.

210  
211 [Clarification was provided on the distinctions among disasters. This is the same](#)  
212 [clarification as noted above in comments #8 and #9.](#)

213  
214 Lines 44-49: The line of argument needs to be sharpened: One could simply argue  
215 that we need another type of expert for this kind of disaster, i.e. an expert for cascading  
216 events. As the argument reads now (without having read any further), you seem to argue  
217 that expert knowledge in one field is not enough, but that we’ll need “interdisciplinary  
218 experts”. This is a common and popular demand, but nevertheless a tricky one and not  
219 as straightforward as it seems (e.g. you need to be an expert in a specific discipline in  
220 order to become a good “interdisciplinary expert”). I’d also argue that we need  
221 dichotomies in order to structure our knowledge (how else should we do it?), but that  
222 maybe the type of dichotomies need to be reconsidered. Hence, your argumentation  
223 seems to be plausible, but at a closer look is too shallow and short.

224  
225 [Further clarification and sharpening in regard to the need for improved holistic policies](#)  
226 [to streamline response was provided throughout the paper.](#)

227  
228 Lines 50-54: These “facts” disturb the line of argument: First, you state that  
229 dichotomies need to be eliminated (without really giving any reason for this statement),  
230 then you give some numbers of total losses, only to then switch to an example of a  
231 natech accident in your study area, and you end the latter paragraph by stating that  
232 international help was needed. Maybe my listing reveals to you, too, that you’re doing  
233 just that here: listing different facts and arguments without any coherence with regard to  
234 content. What is the problem with the fact that international support was needed?  
235 What does this have to do with your initial questions? You seem to imply that if specific  
236 experts for cascading or natech events had been in charge, then this support would not  
237 have been necessary – but you don’t say this explicitly, and most importantly: you do  
238 not argue why this would have been so. You need to exclude other factors, e.g. the lack of  
239 financial and other resources, the lack of disaster response measures – or the mere  
240 possibility that this happened because no-one ever thought something like this could  
241 happen (a core characteristic for why a disaster is a disaster. . .). In short: Discuss.

242  
243 We have addressed this comment by further discussing and making clear the point that  
244 disaster policies have traditionally divided response between natural disasters and  
245 response to man-made disasters, explain how this has created problems in practice,  
246 and how this can be improved upon via more holistic policy approaches.

247  
248 Lines 85-93: This section should reason why you structured your paper the way you  
249 did. For example, by stating “in order to understand why. . ., we first exemplify. . .” or the  
250 like. The mere structure becomes obvious by the headings.

251  
252 The discussion on how the paper is structured is provided on page 4. As the reviewer  
253 indicated, the structure is made obvious by the headings.

254  
255 Overview of the study area and methodology: Line 168: The numbering of the heading  
256 does not make sense. If you want to split section 2 in parts, you do need at least two  
257 parts. Either you skip this sub-heading, or you split section 2 in 2.1. study area and  
258 2.2. methodology.

259  
260 As noted, the methodology section has been substantially revamped, in part to address  
261 comments from reviewer #2.

262  
263 Line 168ff: the whole section remains rather superficial. It is unclear why the authors  
264 chose a semi-structured interview (and not another method), how they chose the  
265 interviewees (criteria?), and what was the framework of themes to be explored within  
266 the semi-structured interview. Has there been an interview guide, and if so, what was  
267 in there?

268  
269 The methods section has been expanded, the use of semi-structured interviews has  
270 been explained, along with detail on how individual interviewees were selected, please  
271 see methodology section.

272

273 Lines 191ff (table 1): Currently, the table does not provide much information. It could be  
274 interesting, for example, how many experts from international, national, ... have been  
275 interviewed. Plus, change the order: International, national, regional. Ah no, I only  
276 realize now that you imply a different understanding of "regional" - this is somewhat  
277 confusing. Plus, I am not quite sure why the EC is not listed within international (just as  
278 the ICPDR, which even has "International" in its name)? Maybe you should then write  
279 supranational instead of regional? Or, yet another possibility: global, international,  
280 national. Non-state actors could also be distinguished in global, international, and  
281 national  
282 (or at least it should be clarified which type of non-state actors).

283  
284 [Additional clarification has been provided regarding table 1 \(now table 3\).](#)

285  
286 Distinctions between natural disasters and man-made accidents in policy frameworks:  
287 Lines 211f: I do not understand the meaning of "traditionally" in this sentence. Does  
288 this imply that non-traditionally the approaches do not shape monitoring and response  
289 methods? Plus, some source(s) should be given for this statement.

290  
291 [The word "traditionally" was removed..](#)

292  
293 Lines 223f: I do not understand what you want to imply with this sentence. Here,  
294 again, you simply place a statement without source, and more importantly, without  
295 saying what you want to say with it. Currently, this sentence is a mere filler.

296  
297 [This sentence has been removed.](#)

298  
299 Lines 224ff: This is not the definition of disaster, but the definition of a natural event. In  
300 order to be a disaster, people have to be involved. Plus, if you give a definition, you  
301 should also cite the source for the given definition. If you give a correct (in the sense of  
302 well-accepted) definition of natural disaster, it might also become easier to discuss  
303 whether the distinction of natural vs. man-made makes sense. After all, it might also be  
304 seen as a decision of individuals or the society to take some risks – hence, is the  
305 disaster (not the event itself!) man-made or natural?

306  
307 [Citations have been added.](#)

308  
309 Line 229: "some natural events"? Why only some? And other natural events are  
310 disasters per se? Plus, you're not sticking to your initial definition of natural disaster.

311  
312 [Please see page 12, this was clarified.](#)

313  
314 Line 230ff: They only become a function of where people reside? In opposite to what?  
315 Has this ever been different, i.e. something has been a disaster without any impact on  
316 individuals or society? I do not think so.

317  
318 [Clarification has been provided, please see page 12.](#)



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Lines 238-256: The paragraph is well argued. However, the conclusion of the argumentation is still missing. As a consequence, the authors leave the reader to assume what they want to state. For example, I assume that your statement is that natural disasters become a disaster due to societal circumstances and conditions. Because of this, you might want to state, the term “natural disaster” is misleading, which could be a first hint that the distinction between man-made and natural is not useful. But as I said, this is what I assume – you keep the reader in suspense.

We followed the reviewer’s suggestion, and new language was included. Please see pages 13-15.

Line 264: How do disasters multiply or become more complex? This, again, is a mere statement without any source or argumentation given. Why should disasters be more complex nowadays than in previous times? Do they multiply, or is this a question of awareness and/or mass media and/or statistical bias? There are so many questions and uncertainties attached to this statement that it needs source and discussion, the latter especially if – as I think it is – the statement is important for your line of argumentation. Please be also aware of the difference between complex and complicated. As your focus is on dichotomies and differences, I think you should be especially clear with respect to your wording.

The definition (and further elaboration) of cascading and complex events has been provided on page 2.

Lines 273ff: So what you meant by “complex” in the previous paragraph actually means the degree of uncertainty of knowledge of cause and effect? In fact, I do not quite understand why you include this aspect here and what you want to tell the reader with it. How does it relate to what was previously said? Over wide parts you employ an “additive style of writing”, i.e. adding several arguments without clarifying how these arguments relate to each other.

Please see page 2.

Lines 221-279 (section 3.1.): I do not quite think that you give the “rationale for different treatment” of natural and man-made disasters. The rationale could be stated in two or three sentences of what you wrote and seems to center around liability. Plus, not only natural hazards but also man-made hazards are a function of where people live, but you do not discuss this. In fact, you leave the reader rather puzzled with respect to what you really want to say. What you do in this chapter is discussing different terms (e.g. moral hazard and vulnerability (although one could ask if especially the latter should be discussed in the context of man-made hazards, too?)). Honestly, I do not quite get your point, and I still do not know the “rationale” behind the distinction of



365 natural and man-made hazards – apart of the question of liability. The mentioning of  
366 climate change at the end of this section further adds to this confusion. Maybe if you  
367 change the heading of this section, so that it reflects the discussion of the difficulties in  
368 distinguishing between “natural” and “man-made” with respect to disasters, the section  
369 would gain focus.

370  
371 [We agree with the reviewer. The section has been renamed, and language has been](#)  
372 [clarified. Please see new title and new language.](#)

373  
374  
375 Lines 284-286: Before stating how the fragmented nature of disaster response has  
376 emerged, you should explain in how far the disaster response has been fragmented so  
377 far.

378  
379 [This was provided in lines 270-303, section 3.2 “Dimensions for Different Treatment”.](#)

380  
381 Lines 288: Why do you refer to chemical accident response programs only? Here,  
382 you assume that the reader knows all or sufficiently enough about response programs to  
383 man-made hazards. In order to provide the reader with the knowledge that (s)he  
384 needs for understanding your argumentation, you need to give an overview of the  
385 respective response programs. Are natech accidents included in industrial and nuclear  
386 etc. response programs?

387  
388 [Language clarified to denote absence of “natechs” in disaster response frameworks,](#)  
389 [please see page 7.](#)

390  
391 Lines 280-322: I’m afraid I’m totally lost – I do not understand what you want to state  
392 within this section. Maybe repetition and clarity would help: The principle of “First, state  
393 what you’re going to state, then state what you’re stating, and the state what you’ve just  
394 stated” might be useful here and in other parts of your paper. You need to be much  
395 more explicit about your take-home-message in every section of your paper, as well as in  
396 your paper as a whole.

397  
398 Disaster frameworks in the Danube and Tisza: Line 331: Heading should be changed to  
399 “Introduction to disaster response programmes (? If that is what is meant?) in the  
400 Danube and Tisza region/basin/ . . .”

401  
402 [Heading changed, as suggested.](#)

403  
404 Line 353ff (Table 2): It remains unclear what classifies as disaster here. Is it classified by  
405 each individual country, or is there a definition of the EC that is utilized here? Or is your  
406 above "definition" used, meaning that any event is a disaster? Sometimes, you add  
407 "natech" to an event, but it remains unclear why it is classified as such.

408  
409 [Note has been added to clarify references to natech accidents, see Table 4.](#)

410

411 Line 355: Heading 4.2. is misleading – it is a sub-section of the Danube and Tisza but  
412 the heading reads as if response frameworks in general are treated. Without having  
413 read the section so far: If you do discuss the response frameworks in general, then  
414 this section has to be moved further to the beginning of the paper, since all your  
415 argumentation is based on the differences in these frameworks. However, to this point  
416 of the paper, you have not given any information on how they do in fact differ. If you  
417 discuss the response frameworks with respect to the Danube and Tisza region, say so in  
418 the heading. However, the first sentences of the sub-chapter suggest that the first is the  
419 case, so that this section will have to be moved. Another possibility is to split this  
420 section and to move the general part to the first parts of the paper, and to keep the  
421 Danube-specific section here (with an appropriate heading). In particular, the heading  
422 should stress the differences between response frameworks for natural and man-made  
423 disasters, respectively, and not the differences of frameworks in general.  
424

425 Line 389ff: This is a little bit confusing for the reader: The focus of your paper is – or  
426 should be – the problems arising from the dichotomy of response frameworks for  
427 natural and man-made hazards, respectively. Your discussion, however, centers on  
428 general problems of disaster response frameworks such as the different treatment of  
429 sudden-onset and slow-onset disasters. This is a major issue, but minor with respect to  
430 your main question, and thus misleading for the reader who starts to lose track.  
431

432 [Please see page 14, where this has been clarified/explained.](#)  
433

434 (in the following, I left my initial comments to transport my confusion while reading. It  
435 was not at all obvious to me that I was reading the results-section) Lines 409ff: These  
436 are already results and do not belong in this section.  
437

438 Lines 470ff: see above – these are results. Lines 493ff: see above, results.  
439

440 Lines 506ff: see above, results. Lines 539ff: results?  
441

442 Lines 589ff: results? I start to realize only now that this seems to be supposed to be  
443 the result section. It seems that the authors employed an inductive way of reasoning,  
444 and this is reflected in the structure of the paper, which results in some difficulties for  
445 the reader. Deduction, however, is part of “normal science” and is thus what the reader  
446 would expect and – in fact – needs in order to follow the argumentation. Hence the  
447 authors need to rearrange the content of the paper, so that the results of the literature  
448 review – which, actually, is part of every scientific study and thus is not really a “result”  
449 but rather prerequisite for any study – need to be given first. This is then the framework in  
450 which the detailed results of the interviews can be set. Hence, your paper needs a  
451 profound restructuring.  
452

453 Questioning the distinction Line 612: Do you really believe that vulnerability can be  
454 avoided? How should this be possible?  
455

456 We agree with the reviewer. The sentence was rewritten to be clearer - vulnerability can  
457 be reduced, see page 27.

458  
459 Line 613ff: What do you mean by “proper”? Disaster is characterized by something  
460 unexpected happening – how can this be “properly” avoided? Again, this is a mere  
461 statement that would need discussion.

462  
463 The word “proper” has been removed.

464  
465 Line 616: There is ample literature on the question whether natural hazards can be  
466 considered natural hazards. Maybe this literature should be reflected, too – the  
467 discussions go much further and deeper than is currently the case in this paper.

468  
469 We thank the reviewer for this helpful comment. Please see page 12, hazard and  
470 disaster are now discussed and defined.

471  
472 Line 616ff: It still remains unclear what difference it would make to simply name natural  
473 hazards not natural, but complex hazards or maybe even man-made. The key is to  
474 consider all potential causes and triggers of disasters, regardless of them being natural  
475 or man-made. Hence, the problem is not the distinction, but the problem is the  
476 insufficient knowledge regarding causes and triggers – and maybe also: that new  
477 technologies bring with them new hazards and risks, which can often only be known in  
478 retrospective. Instead of propagating a higher level of security by avoiding the  
479 distinction between man-made vs. natural you could also come to the conclusion that  
480 “proper protection” is impossible. With your argumentation you presume that things  
481 would change for the better just because of naming it differently. This is clearly not  
482 the case. In a nutshell, so far you simply argue for taking more causes and triggers  
483 into account, in other words: for a better understanding of the hazardous processes.  
484 Everybody would agree on that – but what is the new finding? And how does this relate to  
485 the interviews you’ve made? The results you’ve mentioned so far do not at all relate to  
486 your initial question.

487  
488 We agree we could have sharpened the argument and clarified our point. Please see  
489 the reworked section 5.

490  
491 Line 631: Why “for this reason”? As you wrote before, this accounts for every type of  
492 hazard, not only natech! Highly populated areas mean higher risks (not hazards!).

493  
494 Please see clarification of language in paragraphs and in footnote on page 12.

495  
496 Line 651: Are we in the discussion section now or still within results section? Here, you  
497 suddenly bring new results (as well as new literature) – if this was supposed to be the  
498 discussion section, no new information should be given, but only previous information  
499 be discussed.

500  
501

502 Line 677: Section 6 suddenly brings up multi-hazard approaches, without them being  
503 mentioned beforehand. Actually I have more or less expected the paper to start with  
504 multi-hazard approaches, as natech would classify as such. Here, at the end and in  
505 the way you present this information, it is not included in the previous discussion, but  
506 suddenly opens up a new discussion that leaves the reader rather helpless: How does  
507 this relate to the previous sections? Why does this come up now? How does it relate to  
508 “multilevel disaster response”, yet another issue that is new and non-discussed?  
509

510 [Multi-hazard approaches are suggested in the introduction, per the reviewer’s](#)  
511 [suggestion.](#)

512  
513 Minor points - See comments within the attached pdf  
514

515 [All minor points in attached document have been corrected throughout.](#)  
516

517 Please also note the supplement to this comment:  
518 [http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2016-307/nhess-2016-307-](http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2016-307/nhess-2016-307-RC1-supplement.pdf)  
519 [RC1-supplement.pdf](http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2016-307/nhess-2016-307-RC1-supplement.pdf)  
520

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528 [Please find our response to how we incorporated Referee #2’s suggestions listed](#)  
529 [below.](#)

530 ***Interactive comment on “What Does Nature Have to Do***  
531 ***with It? Reconsidering Distinctions in International***  
532 ***Disaster Response Frameworks in the Danube Basin” by***  
533 ***Shanna N. McClain et al.***

534 **Anonymous Referee #2**  
535

536 Received and published: 19 March 2017  
537

538 Review of NHESD 2016-307 (What does nature have to do with it? – Reconsidering  
539 distinctions in international disaster response frameworks in the Danube basin) by  
540 McClain et al.  
541

542 The distinction made between natural hazards and man-made disasters is not so clear  
543 to me since the policy and therefore institutional framework needed for risk  
544 management  
545 is interrelated.  
546

547 Clarification regarding the focus of this paper -dichotomies between response to natural  
548 disasters versus response to man-made disasters, and the need for improved  
549 frameworks for response – was provided throughout the paper, but especially on page  
550 2, and in the corresponding footnote found on page 2. Since the paper is not focused on  
551 disaster/risk management, but on how organizations/institutions respond to disaster in a  
552 fragmented manner, this point was clarified as well.

553  
554 In the introduction the authors argue that the dichotomy between both disaster types  
555 – even if historically grown – is to be eliminated also because of the effects of  
556 anthropogenic  
557 climate change. I encourage the authors to not overemphasize the man-made  
558 effects on climate here since also the natural climate change together with the socio-  
559 economic development in the case study regions call for more tailored risk management  
560 options. Maybe the introduction would gain in conciseness if the argumentation  
561 string will be streamlined and some additional references (apart from these of  
562 international  
563 organizations) are consulted. Even by searching quickly Science Direct, some  
564 sources caught my eyes and with respect to the mentioned natech disasters some  
565 studies are available.

566  
567 Additional references were provided using the Kappes et al. paper suggested by the  
568 reviewer. Argument in regard to the focus of the paper – disaster response (not  
569 management), and how institutions respond to each type of disaster based on a  
570 fragmented system of legal frameworks – was clarified on page 2. Overall, the paper  
571 was streamlined to ensure the focus was clear throughout.

572  
573 In their overview on the case studies I am missing some Citations (there should be  
574 more than ICPDR available), also with respect to the historical flood risk management  
575 activities in the region, and I kindly would like to suggest to also show rivers Danube  
576 and Tisza in Figure 1.

577  
578 The map has been updated to include the rivers as requested.

579  
580 In the method section some clarification is needed in order to better follow the  
581 arguments.

582 To give an example, the authors conducted 71 interviews and an overview is  
583 given in Table 1. In Table 1, however, it remains unclear what exactly the numbers  
584 in brackets show: Either “multiple interviews conducted at each level of governance”,  
585 which should then sum up to 71, or “a reference to the interview citations in the text”, as  
586 indicated in the Table footnote. Moreover, the method section is quite short (only two  
587 paragraphs) and does neither describe the secondary data analysis nor the sources  
588 for this analysis. An additional Table could help here. Some additional information is  
589 needed on the method itself, why semi-structured interviews were chosen and which  
590 criteria were used. Finally, if there is a section 2.1 there should also be a section 2.2  
591 in the text (could be linked to section 2 so that 2.1 is the overview on the case studies  
592 and 2.2 is the method description).

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The methodology section has been considerably expanded to address this comment. See pages 8-11

In section 3.1, more citations are needed to underpin the statements made; for flood risk in Europe there are some sources available showing the historical development of risk management beyond the simple classification of disasters being seen as “acts of good” and technical approaches. Moreover, in this section the wording is a bit confusing since the authors are addressing dynamics in exposure (population and assets) but are talking about vulnerability (which even from a societal point of view is more than just exposure). There have been some articles in the targeted journal (NHES) on this topic which may serve as guidelines for re-writing this section. So I suggest to first make a clear distinction between hazard, vulnerability and risk and second between different management options for technical and natural disasters (and here I suggest to only focus on the disaster type studied and not on all types of disasters since the management of earthquake risk in Danube countries is highly different from managing flood risk. The same for moral hazard: also here we do have excellent examples published in NHES on the associated issues (insurance etc.). Of course the authors are free to choose any other sources, but this will help to streamline the chapter and to make it more concise, also with respect to the hypotheses and statements the article is at the moment missing over larger parts.

Citations from Kappes et al. were added, as well as distinctions requested regarding hazard, vulnerability and risk on page 11, and in corresponding footnote found on page 11.

With respect to section 4 (Disaster frameworks. . .) I suggest to shorten the introduction and to integrate the material in the overall introduction of the paper. This would help to increase the accessibility of the text, and to streamline the string of argumentation (which is the different treatment of natech and natural hazards in both of the catchments?).

The different treatment is, moreover, also a result from the different legal situations in the affected (EU) countries, as such it remains a bit unclear to me how the current top-down approaches are interwoven. It may be good to re-write this section in a way to mirror (a) the overall UN activities which are somehow legally binding, and (b) the regulations spanning from EU level to individual countries and below (some regions may have specific rules and also a specific institutional setting, such as e.g. the water associations in some of the Austrian federal states (see for example Thaler et al. (2016; 2016) for some in-depth discussions). I also assume that potential reasons identified for a lower level of integration in terms of flood management on river basin level as opposed to bilateral levels are connected to funds availability as well as potentially a lack of political will, while Tisza states focus on preserving their national sovereignty. Did this also result from the interviews?

The top down approach follows the chain of various laws governing response to natural and/or man-made disasters (which are often delineated by disaster type) from UN to EU



639 to basin level (via the Danube Convention of the ICPDR) – table 1 was added to reflect  
640 this. Discussion of funding constraints is provided on pages 21-23. The EU WFD  
641 stipulates management at the basin level and activities are funded through annual  
642 support from each Danube member state.

643  
644 An additional Figure with all the regulations (in terms of boxes and arrows) would also  
645 help to clarify the diversity here.

646  
647  
648 Table was added to reflect the legal mechanisms governing response to natural and  
649 man-made disasters.

650  
651  
652 Section 5 could then be better connected to section 4, and here I also would like to  
653 raise the question whether it is really a dichotomy or a “question of distinction” between  
654 natech and natural hazards (both of them of course could be cascading, see for  
655 example the discussion in Kappes et al. (2012)).

656  
657 The title of this section is “Questioning the Distinction” because the argument is not  
658 about whether natech accidents or natural disasters can be cascading – they both can  
659 be, as the review mentioned. However, the question is – do we need multiple  
660 organizations piecemealing strategies for responding based on whether the disaster is  
661 natural or technological in origin, particularly when natural disasters are often  
662 recognized as anthropogenic in nature – and when disasters are more often including a  
663 natech element to them (which requires (unnecessarily) fragmented response by  
664 numerous agencies). Please see clarified language in section 5.

665  
666 To summarise, I kindly would like to suggest to

667  
668 - Streamline the paper in terms of avoiding repetition, - To clearly discuss definitions on  
669 hazard, vulnerability and risk in the very beginning, - To clearly state the hypotheses  
670 in the introduction, - And then to smoothly develop a set of arguments why the current  
671 management is suboptimal and where you identified necessary changes. This should  
672 be clearly linked (or more prominently stated) to the interview results.

673  
674 The paper was considerably shortened and streamlined, per both reviewers’  
675 suggestions. Clarification was provided in the introduction, see page 2.

676  
677 I encourage the authors to undertake the necessary improvements and I definitely  
678 believe that then the paper becomes acceptable for publication in a journal such as  
679 NHESS.

680  
681 References relevant to the paper, and recommended by the reviewer were added to the  
682 paper.

683  
684 References mentioned in the text



685  
686 Kappes, M., Keiler, M., von Elverfeldt, K., and Glade, T.: Challenges of analyzing  
687 multihazard  
688 risk: a review, *Natural Hazards*, 64, 1925-1958, 2012.  
689 Thaler, T., and Hartmann, T.: Justice and flood risk management: reflecting on different  
690 approaches to distribute and allocate flood risk management in Europe, *Natural*  
691 *Hazards*, 83, 129-147, 2016.  
692 Thaler, T., Priest, S., and Fuchs, S.: Evolving interregional co-operation in flood risk  
693 management: distances and types of partnership approaches in Austria, *Regional*  
694 *Environmental*  
695 *Change*, 16, 841-853, 2016.  
696 Interactive comment on *Nat. Hazards Earth Syst. Sci. Discuss.*, doi:10.5194/nhess-  
697 2016-307,  
698 2016.

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702 **What Does Nature Have to Do with It?**

703 **Reconsidering Distinctions in International Disaster Response Frameworks in the Danube**  
704 **Basin**

705

706 Shanna N. McClain<sup>1</sup>, Carl Bruch<sup>2</sup>, Silvia Secchi<sup>1,3</sup>, Jonathan W.F. Remo<sup>3</sup>

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713

714 **Abstract**

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716 This article examines the policy and institutional frameworks for response to natural and man-

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718 made disasters occurring in the Danube basin and the Tisza sub-basin. Response to these types of

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720 incidents has historically been managed separately, as has the monitoring of these types of

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722 incidents. ~~Given policy distinctions in response to natural and man-made disasters, W~~ we discuss

723

724 whether the policy distinctions in response to natural and man-made disasters remain functional

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726 given recent international trends toward holistic response to both ~~natural and man-made~~ kinds of

727

728 disasters. We suggest that these distinctions are counterproductive, outdated, and ultimately

729

730 flawed, ~~a conclude by reflecting on the lessons learned and eonclude~~ by proposing an integrated

724 ~~framework for disaster response in the Danube basin and Tisza sub-basin and conclude with a~~  
725 ~~reflection of the lessons learned, and propose an integrated framework in the Danube basin and~~  
726 ~~Tisza sub-basin.~~

727  
728 **Keywords:** International Disaster Response Frameworks; Natural Disasters; Man-made  
729 Accidents; Industrial Accidents; Natech Accidents; Danube River basin; Tisza River Sub-basin  
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## 744 **1 Introduction**

745         What are the benefits of maintaining the distinction between natural and man-made  
746 disasters? What are the consequences of eliminating this distinction? When a disaster occurs,  
747 local and national capacities for disaster response can be overwhelmed, often triggering a request  
748 for external, international assistance. The actors engaged in disaster response<sup>1</sup> have historically  
749 been determined by the nature of the disaster (i.e., natural disaster, industrial accidents, nuclear  
750 accidents, marine oil spills) and legal frameworks typically divide response between natural  
751 ~~disasters and response to man-made disasters~~. However, there is ~~;~~ ~~but with~~ growing recognition  
752 that anthropogenic climate change and other human activities such as land use change are ~~is~~

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<sup>1</sup> While disaster response is considered part of the disaster management cycle, disaster management includes the application of policies and actions regarding disaster risk (i.e., prevention, preparedness and mitigation, response, and recovery). Each have their own set of policy frameworks, actors and mechanisms for implementation. This paper focuses on the disaster response phase specifically, and on the policy frameworks and actors related to requesting and receiving assistance immediately following a disaster, and the legal mechanisms by which responders are deployed.

753 driving more ~~extreme,extreme~~ and sometimes cascading events. Cascading events (e.g., refer to  
754 the phenomencases on associated with events in which a primary threat is followed by a  
755 sequence of secondary or additional hazards, (Pescaroli and Alexander, 2015), where the effects  
756 of disasters are multiplied, or where they are composite, or concurrent) that require complex and  
757 often overlapping types of response (Pescaroli and Alexander, 2015). Thus, the question of  
758 eliminating ~~this the natural/man-made~~ dichotomy is brought to the forefront. The complexity of  
759 disaster events increases with cascading events, both temporally and spatially, due to the  
760 interaction of multiple hazards, threats, and vulnerabilities — thus, creating challenges in response  
761 fragmented response frameworks since the main impact from a disaster event can be from its  
762 subsidiary events and not necessarily from the triggering event (Pescaroli and Alexander, 2015).

763 In Europe, natural and man-made disasters combined caused total losses of US\$ 13  
764 billion in 2015 of which only US\$ 6 billion were insured; the predominant losses came from  
765 flood events (Swiss Re, 2016). Flooding and pollution are considered to be the primary  
766 transboundary pressures of the Danube River basin; however, a number of other man-made  
767 accidents occurred in the region (ICPDR, 2015a).

768 Specifically, in 2000, the Baia Mare and Baia Borsa mine-tailing pond failures  
769 mobilized approximately 100,000 m<sup>3</sup> of metal-contaminated water into the Tisza River,  
770 eventually polluting the Danube River and Black Sea. Since the industrial accidents occurred  
771 originally as a result of significant rainfall and flooding, these events are an example of what are  
772 commonly referred to as natech accidents, technological accidents triggered by natural disasters.  
773 In 2010, an industrial accident occurred in the Hungarian portion of the Danube River when a  
774 dam containing alkaline red sludge collapsed, releasing 1.5 million m<sup>3</sup> of sludge into the  
775 surrounding land (approximately 4000 hectares) and waterways (including Kolontár, Torna

776 Creek, and the Danube River), killing 10 people and injuring several hundred more (ICPDR,  
777 2010). In 2014, following Cyclone Tamara, over 1,000 landslide events occurred in Serbia as  
778 well as significant flooding, resulting in damage to properties and infrastructure and the  
779 inundation of agricultural land. Due to concern over possible breaches in infrastructure to mine  
780 tailing dams in the surrounding area, and the harmful effects to human health, technical experts  
781 investigated mining sites and provided recommendations for local evacuations (NERC, 2014). In  
782 all three disasters, the need for disaster response exceeded the capacity of national actors;  
783 therefore, international response involved the United Nations, the European Commission, and  
784 various other international organizations.

785         While international humanitarian law is generally well defined, the law of international  
786 disaster response is still incomplete (Fisher, 2008). Historically, a distinction has been drawn  
787 between the scope of response to natural disasters and man-made disasters; however, this  
788 distinction is absent from the 2015 Sendai Framework for Disaster Risk Reduction, which adopts  
789 a multi-hazard risk approach providing management tools for disasters that are both natural and  
790 man-made (UNISDR, 2015). The European Union's disaster response framework is also holistic  
791 and includes natural and man-made disasters, and some multilateral sub-regional agreements are  
792 also taking similar approaches, such as those adopted by the Association of South East Asian  
793 Nations (ASEAN) and the Baltic Sea Economic Cooperation (BSEC). Adopting a multi-hazard,  
794 or all-hazards, approach to disaster response allows for recognition of all conditions, natural or  
795 man-made, that have the potential to cause injury, illness or death; damage to or loss of  
796 infrastructure and property; or social, economic and environmental functional degradation  
797 (Kappes, Keiler, von Elverfeldt and Glade, 2012).

798           With international policies starting to shift toward more holistic frameworks of response  
799 that incorporate both natural and man-made disasters, this article explores what this trend will  
800 mean for regional institutions in the Danube basin and Tisza sub-basin, whose policy  
801 frameworks for monitoring and response continue to distinguish between types of disasters, and  
802 resultantly have separate policy response options depending on the type of disaster.

803           This article begins with an overview of the study area and a description of the methodology.  
804 Next is a discussion of the distinctions between natural disasters and industrial accidents – how  
805 and why they have been treated differently and how recent developments in international law and  
806 practice are raising questions about the merits of these distinctions. It is followed by an  
807 examination of the international frameworks governing disaster response in the Danube basin  
808 and Tisza sub-basin. Subsequently, the differences in how natural disasters and industrial  
809 accidents are monitored, and how they are responded to, are explored. The article discusses the  
810 transition of international policies toward more holistic frameworks for response, and concludes  
811 with a reflection of how this might affect the Danube basin and Tisza sub-basin.

## 812 **2 Overview of study area and methodology**

813           The Danube River basin covers more than 800,000 km<sup>2</sup> – over 10 percent of continental  
814 Europe – and flows through the territories of 19 countries with nearly 80 million people residing  
815 within the basin. Today, 14 of the 19 countries, plus the EU, have committed to transboundary  
816 cooperation in protecting the Danube via the Danube River Protection Convention (DRPC), and  
817 work jointly toward the sustainable management of the Danube basin and the implementation of  
818 both the European Union’s Water Framework Directive (WFD) and Floods Directive (EU FD)  
819 (ICPDR 2015a).

820           Among the tributaries of the Danube River, the Tisza sub-basin has the largest catchment  
821 area, and covers approximately 160,000 km<sup>2</sup> (20 percent of the Danube basin's area), with  
822 approximately 14 million people (Fig. 1). There exists a distinct socio-economic contrast in the  
823 basin between western and former socialist countries, and since the end of communism in the  
824 late 1980s, the central and lower Danube has experienced a rapid shift to free market democracy  
825 within the context of increased globalization, privatization, and deregulation. This has led to  
826 rural decline as well as increased poverty, unemployment, and depopulation (WWF, 2003).

827 ~~Additionally, as a result of the continuing conflict in Syria and neighboring states, countries in~~  
828 ~~the Danube and throughout Europe are experiencing a significant increase in population from~~  
829 ~~refugees, displaced persons, and other migrants who are escaping persecution, conflict, and~~  
830 ~~poverty, and are settling in empty buildings, hotels, or refugee camps that have become ad hoc~~



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833

834 ~~The headwaters of the Danube are located in the Black Forest of Germany. After leaving~~  
835 ~~the Bla~~ **Fig. 1** Map of Danube River basin and Tisza River sub-basin. ~~Eastern Europe to~~

836 ~~the Black Sea in eastern Romania (Fig. 1; ICPDR, 2009a).~~ International measures regulating the

837 Danube were first undertaken in 1882 for flood protection and navigation. Dams were

838 constructed within the upper Danube basin for flood mitigation, hydroelectric power generation,

839 and regulation of river levels for navigation. The operation of these dams ~~for these services~~ has

840 been attributed with altering the flow regime of this segment of river and consequently varying

841 the ecological disturbance regime within the river and on the floodplain resulting is substantial



842 changes in the riverine ecosystem (ICPDR, 2009a). The flow regulation provided by the dams  
843 and the construction of levees has allowed for the conversion of floodplains and riverine  
844 wetlands into area suitable for agricultural and urban development. Today only 12 small reaches  
845 (<1 km in length) of the Upper Danube ~~relatively~~ remain relatively untransformed (Schneider,  
846 2010). In the Middle and Lower Danube, the river bed has been dredged repeatedly to maintain a  
847 navigable river channel. Along these segments of the Danube River, levees and dams mitigate or  
848 prevent inundation of over 72 percent of the floodplain. The substantial reduction ~~in~~ Danube's  
849 connection with its floodplain combined with wastewater discharge from agricultural and  
850 industrial sources, and increasing levels of pollutants along these river segments have  
851 substantially altered or damaged riverine ecosystem and reduced resiliency of urban and rural  
852 communities to large floods which exceed the protection level of their flood mitigation measures  
853 (Schneider, 2010; UNECE, 2011). The degree of industrial development and amount of pollution  
854 created by the industrial sector varies among Danube countries. In general, pulp and paper  
855 industries represent the largest contributors of pollution, followed by chemical, textile, and food  
856 industries (ICPDR 2009a).

857         The Tisza headwaters are located in the Carpathian Mountains in Ukraine. From these  
858 headwaters the Tisza River flows southwest across central portions of the great Hungarian Plain  
859 into the Danube River in Serbia (Fig. 1; ICPDR, 2008a). ~~Precipitation within the Tisza basin is~~  
860 ~~generally concentrated in the Carpathian mountains within the upper portion of the watershed.~~  
861 ~~The intense, concentrated ity of the~~ rainfall and the steep terrain coupled with deforestation and  
862 channelization of many streams ~~within this portion of the Tisza watershed,~~ results in some of the  
863 most sudden and high-energy flooding in Europe. ~~Flood levels along the upper reaches of the~~  
864 ~~Tisza can range up to 12 m deep within as little as 24-36 hours~~ (Nagy et al., 2010). The sudden

865 water level rises coupled with the high energy of the flows often threaten human lives and result  
866 in substantial damage to infrastructure and croplands (ICPDR, 2008a).

867 While industrial production has dropped drastically in the Tisza since the 1990s, there  
868 remain a variety of industries that contribute to the economy of the region, and the legacy of  
869 heavily concentrated industrial activities continues to threaten the surrounding ecosystems. The  
870 main industrial regions of the Tisza are located in Romania and Hungary, where the potential for  
871 ~~greatest~~ flood damage and losses is also greatest. Chemical and petrochemical industries  
872 (including oil refinery, storage and transport) are important for both Hungary and Ukraine, and  
873 the cellulose and paper, textile, and furniture industries are also present predominantly in the  
874 upper portion of the Tisza in Slovakia, Romania, and Ukraine (ICPDR, 2011). ~~Beyond the threat  
875 of mobilizing hazardous materials from industrial activities directly into the Danube or Tisza  
876 Rivers, the risks posed from industrial accidents to the surrounding communities, particularly  
877 with increasing urbanization, is of growing concern.~~

878 Mining activities, and the accidental spills of chemical substances, have affected the  
879 aquatic environment and water quality within the Tisza sub-basin since the 2000 Baia Mare and  
880 Baia Borsa natech accidents (JEU, 2000). Natech accidents present significant challenges, as  
881 natural events can trigger multiple and simultaneous accidents in one installation, or depending  
882 on the impact of the natural hazard, in several hazardous facilities at the same time (Krausmann  
883 and Baranzini, 2012). ~~Furthermore, natechs present additional difficulties to already fragmented  
884 disaster response activities, as they remain absent from disaster response frameworks  
885 (Krausmann, Cruz, and Salzano, 2017).~~ A 2009 assessment identified more than 92 potential  
886 sources for industrial and waste deposits; however, the list does not include abandoned mine  
887 sites and their mine tailing dams – only those from currently operational mines (ICPDR, 2015a).

888 Therefore, the potential risk of accidental pollution could be substantially higher (ICPDR,  
889 2015a).

890

## 891 **2.1 Methodology**

892 The ~~analysis-examination~~ of policy and institutional frameworks for monitoring and  
893 responding to natural disasters and man-made accidents in the Danube ~~River basin~~ and Tisza  
894 ~~River sub-basin was conducted~~~~occurred~~ through a combination of primary and secondary data  
895 collection and analysis. The primary data ~~collection and analysis~~ consisted of semi-structured  
896 interviews, while the secondary data ~~analysis~~ included analysis of the legally binding  
897 mechanisms in the region, including conventions and directives (Table 1), of bilateral  
898 agreements (Table 2), and a literature review of peer-reviewed publications and white papers,  
899 providing for -and an analysis of international laws, policies, and institutions within the Danube  
900 basin and Tisza sub-basin regarding the provision of disaster response. Semi-structured  
901 interviews were conducted over an eight-month period from January to August 2013. This  
902 format of interviews was chosen so that the pre-determined set of interview questions could be  
903 expanded through the natural course of conversation and allow for a more thorough  
904 understanding of what was initially queried – in particular, each expert interviewed was provided  
905 with the freedom to express their personal views in their own terms.

906 Table 1. List of legally binding mechanisms for Danube basin and Tisza sub-basin.

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<u>Governing Body</u>	<u>Convention</u>	<u>Type of Instrument</u>	<u>Description of Instrument</u>
<u>UN Economic Commission for Europe</u>	<u>Industrial Accidents Convention</u>	<u>Legally binding for parties to convention.</u>	<u>Determines actions of request for assistance and response for industrial accidents</u>

			<a href="#">specifically.</a>
<a href="#">European Commission</a>	<a href="#">Water Framework Directive</a>	<a href="#">Legally binding for EU member states, and though Danube Convention.</a>	<a href="#">Sets basin-level management of water quality and quantity.</a>
<a href="#">European Commission</a>	<a href="#">Floods Directive</a>	<a href="#">Legally binding for EU member states, and though Danube Convention.</a>	<a href="#">Requires action regarding flood mapping at the basin level.</a>
<a href="#">European Commission</a>	<a href="#">Seveso Directives</a>	<a href="#">Legally binding for EU member states.</a>	<a href="#">Requires corporations to list possible risk of industrial accident, and develop preparedness plans.</a>
<a href="#">European Commission</a>	<a href="#">Civil Protection Mechanism Directive</a>	<a href="#">Legally binding for EU member states,</a>	<a href="#">First EU-wide law to include multiple-hazards in disaster risk strategies.</a>
<a href="#">International Commission for the Protection of the Danube River (ICPDR)</a>	<a href="#">Danube River Protection Convention</a>	<a href="#">Legally binding for Danube member states.</a>	<a href="#">Provides integrated framework for all Danube countries to participate in basin-level management, regardless of EU affiliation.</a>

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909 **Table 2.** [List of bilateral agreements within countries in the Danube basin and Tisza sub-basin.](#)

<a href="#">Countries</a>	<a href="#">Transboundary Watercourses</a>	<a href="#">Disasters / Emergencies</a>
<a href="#">Austria – Czech Republic</a>	<a href="#">1967*</a>	<a href="#">1994 (Floods Only)</a>
<a href="#">Austria – Germany</a>	<a href="#">1987</a>	<a href="#">1991 (Floods Only)</a>
<a href="#">Austria – Hungary</a>	<a href="#">1956</a>	<a href="#">1959 (Floods Only)</a>
<a href="#">Austria – Slovakia</a>	<a href="#">1967*</a>	<a href="#">1994 (Floods Only)</a>
<a href="#">Austria – Slovenia</a>	<a href="#">1956***</a>	<a href="#">1956* (Floods Only)</a>

<u>Bosnia and Herzegovina – Croatia</u>	<u>1996</u>	<u>1996 (Natural/Manmade Disasters)</u>
<u>Bosnia and Herzegovina – Serbia and Montenegro**</u>	<u>=</u>	<u>2011 (Flood EWS)</u>
<u>Bulgaria – Romania</u>	<u>2004</u>	<u>2004 (Floods Only)</u>
<u>Bulgaria – Serbia</u>	<u>Draft</u>	<u>Draft (Floods Only)</u>
<u>Croatia – Hungary</u>	<u>1994</u>	<u>1994 (Floods Only)</u>
<u>Croatia – Serbia</u>	<u>=</u>	<u>=</u>
<u>Croatia – Slovenia</u>	<u>No Date</u>	<u>1977*** (Coastal Pollution)</u>
<u>Czech Republic – Slovakia</u>	<u>1999</u>	<u>=</u>
<u>Hungary – Romania</u>	<u>1986</u>	<u>2003 (Floods Only)</u>
<u>Hungary – Slovakia</u>	<u>1956*</u>	<u>2014 (Floods Only)</u>
<u>Hungary – Slovenia</u>	<u>1994</u>	<u>1994 (Floods Only)</u>
<u>Hungary – Ukraine</u>	<u>1997</u>	<u>1998 (Floods Only)</u>
<u>Moldova – Romania</u>	<u>2010</u>	<u>2010 (Floods Only)</u>
<u>Moldova – Ukraine</u>	<u>1994</u>	<u>=</u>
<u>Serbia and Montenegro – Hungary</u>	<u>1955**</u>	<u>1955*</u>
<u>Serbia and Montenegro – Romania</u>	<u>1955**</u>	<u>Under Discussion</u>
<u>Ukraine – Romania</u>	<u>1997</u>	<u>1952*** (Floods Only)</u>
<u>Ukraine – Slovakia</u>	<u>1995</u>	<u>2000 (Floods Only)</u>

\* Agreement formed with Czechoslovak Socialist Republic

\*\* Agreement formed with Yugoslavia

\*\*\* Agreement formed with Union of Soviet Socialist Republics

- No Information Available

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915           Seventy-one interviews were conducted in various locations throughout Europe. The  
916 interviews took place with experts working within the International Commission for the  
917 Protection of the Danube River, within the expert groups of the International Commission for the  
918 Protection of the Danube River (i.e., Tisza group, river basin management, flood protection, and  
919 accident prevention and control), with respondents working at the national ministries, water  
920 management directorates, and non-governmental organizations in the Tisza and Danube  
921 countries, as well as with experts working within in the European Commission, and the United  
922 Nations involved in the Danube basin and Tisza sub-basin. Those interviewed were chosen based

923 on their knowledge of and work within the Danube River basin and Tisza sub-basin. Given  
 924 public roles, the interviews are intentionally left anonymous to ensure candidness in the  
 925 responses ~~(Table 1)~~. Thus, only the kind of organization the experts work for is identified - the  
 926 numbers appearing in brackets in the table below refer to the interview citations in text; ~~reflect~~  
 927 multiple interviews ~~were~~ conducted ~~within~~ each level of governance indicated (Table 13). The  
 928 questions focused on how Danube basin and Tisza sub-basin policies and laws were  
 929 implemented in practice, as well as the perceptions of the experts regarding the frameworks and  
 930 implementation of disaster monitoring and response throughout the Danube basin and Tisza sub-  
 931 basin.<sup>2</sup>

932 **Table 13.** Organizations from which experts were drawn for interviews.

		933
<b>International</b>	United Nations, United Nations Economic Commission for	934
	Europe, and United Nations Environment Programme	935
	(UNEP)/UN Office for the Coordination of Humanitarian	936
<b>Regional</b>	Affairs (OCHA) Joint Environment Unit [1]	937
	European Commission [2]	938
	International Commission for the Protection of the Danube	939
	River (ICPDR) and Expert Groups (Tisza Group, River Basin	940
<b>National</b>	Management, Flood Protection, and Accident Prevention	941
	and Control) [3]	942
	National Ministries of Environment, Rural Development,	943
<b>Non-State Actors</b>	Interior, Environment Agency [4]	944
	Water Directorates [5]	945
	NGOs [6]	946
		947

948 \* Numbers in brackets refer to interview citations in text.

### 949 **3 Distinctions between natural disasters and man-made accidents in policy frameworks**

951 ~~Traditionally~~ The approaches used for describing, limiting, and categorizing disasters  
 952 fundamentally ~~shap~~es the methods for monitoring and responding to disasters. They determine  
 953

<sup>2</sup> Questions relevant to international frameworks for disaster response included: (1) What are the respective roles in multilevel governance in regard to response for natural and man-made disasters? (2) To what extent are natural and man-made disasters included in policy frameworks for response; in what context and at what level, and what is the language being used? (3) What gaps exist between policies and practice in regard to response for natural and man-made disasters? (4) What constraints or opportunities exist in including policies for response to natural and man-made disasters; which type would be most effective and at what level?

954 the solutions utilized, the resources allocated, and the governance frameworks selected by  
955 categorizing the types of disaster into that which is natural or man-made. It is therefore important  
956 to ~~understand~~recognize the etiology of disaster in order to understand why the distinctions  
957 among the various types of disasters~~s~~ still remain. These are discussed below.

958

### 959 **3.1 Rationale for different treatment between natural and man-made disasters**

960

961 ~~The manner in which disasters are framed by society has evolved over time, still the role~~  
962 ~~of human responsibility features prominently in disaster narratives.~~ Natural ~~disasters~~hazards are  
963 naturally occurring physical phenomena, which can include earthquakes, landslides, tsunamis,  
964 volcanoes, and floods. Disasters disrupt individuals and communities at various scales due to  
965 hazardous events interacting with conditions of exposure, vulnerability, and risk – leading to  
966 human, material, economic and environmental losses and impacts.<sup>3</sup> Natural disasters have  
967 historically been characterized either (1) as a direct form of punishment from God for the sins of  
968 humanity, or (2) in more recent history~~more recently~~ as an “act of God” that removed humans  
969 from culpability (Rozario, 2007). ~~The framing of natural disasters continues to shift, and some~~  
970 ~~natural events—earthquakes, hurricanes, tsunamis—only become disasters as they impact and~~  
971 ~~interact with individuals and communities.~~ The consequences of natural disasters become a  
972 function of where people reside—~~along coastlines, in floodplains, in vicinity of fault lines, and~~  
973 ~~within mountainous regions—~~ and their overall vulnerability, including aging infrastructure and a  
974 function of their ability to monitor and prepare for these events (Peel and Fisher, 2016).

975 Vulnerability within and between populations can vary, and occurs~~s~~ for multiple reasons – social

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<sup>3</sup> Exposure is understood as people, infrastructure and housing, production capacities and other human assets located in hazard-prone areas. Vulnerability is defined as a set of physical, social, economic and environmental factors or processes that increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards. Disaster risk is the potential loss of life, injury, or damaged assets occurring to an individual or community as a function of hazard, exposure and vulnerability (UNISDR, 2015).



976 inequalities, community demographics (e.g., age and poverty), lack of access to health care, and  
977 limited access to jobs or to lifelines (e.g., emergency response, goods, services) (Cutter and  
978 Emrich, 2006). While building in disaster-prone areas is not the sole responsibility of  
979 individuals, they do share responsibility for investing in the risk involved. ~~The existence of moral  
980 hazard<sup>4</sup> can increase the amount of damage from disaster and reduce the capacity of insurance to  
981 cover disaster loss; this occurs due to individuals acting irresponsibly and because of those who  
982 erroneously believe there is coverage for any loss incurred (Smith, 2013). For example, offering  
983 insurance encourages people to build and live in flood-prone areas, in spite of the known risks—  
984 if insurance were not available, the household would absorb the entirety of the risk and  
985 prospective buyers would most likely choose to reside elsewhere. Additionally, as seen with  
986 some large disasters such as Hurricane Katrina, losses suffered by policyholders can be several  
987 times larger than collected premiums, consuming insurers' capital and, if the losses are severe  
988 enough, not only jeopardize claim payments, but also cause insurance companies to declare  
989 bankruptcy before covering any—or only some—insured losses (Nekoul and Drexler, 2016). For  
990 example, while the total economic loss incurred during Hurricane Katrina is assessed at  
991 approximately US\$ 125 billion, insured losses covered an estimated US\$ 45 billion, however,  
992 only an estimated US\$ 2 million in insurance claims were paid (Munich Re, 2005). Moral  
993 hazard can also exist in disaster preparedness and response activities when actors believe they  
994 are sufficiently prepared to respond to any event or crises. During Hurricane Katrina, despite  
995 emergency preparations, preexisting social vulnerabilities and the collective failure to adequately~~

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<sup>4</sup>For purposes of this paper and described by Munich Re (2007), moral hazard is a lack of incentive by an individual to guard or protect against risk (or to enter into a situation of risk), knowing that they are protected from risk through insurance, which results in higher insurance loss claims. Examples provided are assured compensation for flood damage, leading to increased building in flood-prone areas and assured compensation for crop losses in drought-prone areas that encourage farmers to grow more compensated crops instead of planting alternative crops or adopting alternative land uses.

1996 ~~respond to the emergency made response inadequate for the type of complex emergency relief~~  
1997 ~~needed (Cutter and Emrich, 2006).~~

1998 Industrial accidents and other man-made accidents are traditionally ~~considered governed~~  
1999 ~~and responded to~~ separately from natural disasters. The role of human agency features even more  
1000 prominently in these events, due to potential moral or legal obligations to mitigate risk (e.g.,  
1001 preparedness, insurance, disaster aid). Man-made disasters suggest potential moral and legal  
1002 obligations to both aid the victims of the disaster in a response capacity in the period  
1003 immediately following the disaster, as well as to compensate those who are harmed during their  
1004 long-term recovery (Verchick, 2012). The liability is only effective if a polluter can be identified  
1005 or liability can be assigned. As disasters continue to multiply, ~~cascade become more complex,~~  
1006 and their costs mount, responsibility for the disaster also becomes more complex. For example,  
1007 in assigning liability to the 2010 red sludge spill in Hungary, early reports from the Hungarian  
1008 Prime Minister Victor Orbán indicated that the breach was likely due to human error, and that  
1009 “there was no sign the disaster was caused by natural causes, therefore it must be caused by  
1010 people” (Dunai, 2010). In ongoing efforts to determine human negligence, it was determined that  
1011 flooding and subsidence led to structural breaches in the reservoir containing the alumina, yet it  
1012 remained difficult to prove whether officials at the MAL alumina facility knew of the weakened  
1013 infrastructure (NDGDM, 2010).

1014 The degree of uncertainty related to the amount of damage and probability of occurrence  
1015 is very high with disasters, particularly those influenced by climate change (Greiving et al.,  
1016 2012; Munich Re, 2016). Liability can be more difficult to calculate and assign in these cases, in  
1017 part because disaster loss agencies (i.e., Munich Re, Swiss Re), are often accounting for specific  
1018 losses from flooding and sudden-onset disasters that are more easily quantified, whereas the

1019 impact of slow-onset, or “silent”, disasters ~~related to climate change~~ can be more difficult to  
1020 quantify ~~since they occur slowly over time~~ (IFRC, 2013). Therefore, due to numerous  
1021 anthropogenic influences on these events (including anthropogenic effects of climate  
1022 change/slow-onset events), it is misleading to continue the differentiation in terminology  
1023 between “natural” versus “man-made” disasters, and the frameworks that govern mechanisms for  
1024 disaster response.

### 1025 **3.2 Dimensions for different treatment**

1026  
1027 Increased frequency of major disasters, legal barriers to disaster response, and the  
1028 absence of unified response ~~to both natural disasters and man-made accidents~~ have led to  
1029 increased attention at a variety of levels for more integrated international frameworks ~~for disaster~~  
1030 ~~response~~ (IFRC, 2007). The fragmented nature of disaster response has emerged from the need to  
1031 address specific types of disasters, in specific regions, or response modalities. Furthermore,  
1032 while natural disasters and industrial and nuclear accidents have established frameworks for  
1033 response, natech accidents are often missing from chemical accident response programs (OECD,  
1034 2015). Natech accidents can lead to the release of toxic substances, fires, or explosions and result  
1035 in injuries and fatalities; therefore, the lack of consideration for natech response mechanisms,  
1036 planning tools or response programs can be an external risk source for chemical and nuclear  
1037 facilities (Krausmann and Baranzini, 2012). Some international instruments, such as the  
1038 Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency and the  
1039 Convention on Early Notification of a Nuclear Accident apply only to specific types of disaster.  
1040 While the Nuclear Accidents Conventions were adopted almost immediately following the  
1041 Chernobyl nuclear accident, there still remains no similar overarching global framework for  
1042 notification or assistance in response to industrial accidents, or for environmental emergencies

1043 more broadly (Bruch et al., 2016). Other disaster frameworks, like the Tampere Convention,  
1044 apply only to a single sector or area of relief (~~such e.g., as the provision of importing~~  
1045 ~~telecommunication resources following disasters caused by nature or human activity, or whether~~  
1046 ~~occurring suddenly or as the result of complex, long-term processes~~). ~~Conversely~~ However, the  
1047 ability to provide disaster response for natural disasters is quite broad and is included in a  
1048 number of international frameworks. A question of applicability of agreements arises, however,  
1049 when a complex disaster occurs and multiple institutions have a mandate for response, but it is  
1050 unclear which institution should take the lead in responding or coordinating response efforts  
1051 (Bruch et al., 2016). ~~During the Lebanon crisis in 2006, international assistance was requested in~~  
1052 ~~response to the bombing of fuel storage tanks at a power station, and over 70 countries and~~  
1053 ~~organizations responded—it was unclear who should take lead, and the need for coordination~~  
1054 ~~was reflected among response efforts (Nijenhuis, 2014).~~

1055 An additional ~~difficulty~~ challenge with fragmented disaster response frameworks lies in  
1056 the types of international actors engaged in natural disasters and man-made accident response.  
1057 Generally, there is a failure to include non-state actors, the private sector, or individuals in  
1058 response efforts to disasters (IFRC, 2007). The Tampere Convention and the sub-regional Black  
1059 Sea Economic Cooperation (BSEC) and Association of South East Asian Nations (ASEAN)  
1060 agreements are exceptions. With the Tampere Convention, for example, the decision to offer  
1061 assistance, the type of assistance provided, and the terms of assistance are up to the discretion of  
1062 the non-state actors offering assistance (Bruch et al., 2016). Given the increasing role of private  
1063 funds in disaster response and relief operations, ~~considering the inclusion of~~ these actors in  
1064 disaster frameworks can be beneficial.  ~~Oftentimes, there is the assumption that assets and~~  
1065  ~~personnel are provided as a favor to an affected state government, where when in reality they~~

1066 ~~might are normally be expected to reimburse costs and manage how assistance is carried out~~  
1067 ~~(Bruch et al., 2016). However, efforts are increasingly being made to clarify the respective roles~~  
1068 ~~of actors and institutions in regard to disaster response, and more recently laws are changing in~~  
1069 ~~favor of including broader terminology to comprise both natural and man-made disasters (IFRC,~~  
1070 ~~2007).~~

#### 1071 **4 Disaster frameworks in the Danube basin and Tisza sub-basin**

1072 Response to natural and man-made disasters, including natech accidents, is governed by a  
1073 range of global, regional and national laws, policies, and soft-law instruments. In the Danube  
1074 basin and Tisza sub-basin this includes the Industrial Accidents Convention and the Seveso  
1075 Directive, the Water Framework Directive and the Floods Directive, as well as treaties and  
1076 policies developed at the level of the Danube and Tisza. ~~Here~~As such, natural and man-made  
1077 disasters continue to be treated as distinct and separate issues, where monitoring and response  
1078 are managed independently.

#### 1079 ~~4.1 Introduction to Danube basin and Tisza sub-basin~~

1080 In 1994, the Danube countries developed the Danube River Protection Convention  
1081 (DRPC), ~~a legally binding instrument that ensures~~to ensure sustainable management of the  
1082 Danube River. Through the International Commission for the Protection of the Danube River  
1083 (ICPDR), the DRPC requested the ICPDR to coordinate the activities of the EU Water  
1084 Framework Directive (WFD) and EU Floods Directive among the Danube member states. The  
1085 WFD and Floods Directive are legally binding to members of the European Union, but through  
1086 the DRPC become legally binding to all Danube member states, regardless of EU member status.  
1087 ~~among the EU member states~~. The WFD combines the monitoring and assessment of ~~surface and~~  
1088 groundwater quality in the basin, and the Floods Directive instructs national authorities to

1089 establish flood risk management plans by 2015, linking the objectives of the WFD and the risk to  
 1090 these objectives from flooding or coastal erosion through the Floods Directive, and integrating  
 1091 them into basin level activities via the ICPDR. However, because not all countries of the Danube  
 1092 are EU member states, not all measures and outcomes of the WFD and Floods Directive are  
 1093 implemented equally among the basin countries.

1094 The Danube ~~basin~~ and the Tisza ~~sub-basin~~ have experienced numerous natural and man-  
 1095 made disasters, including natech accidents (e.g., Baia Mare Cyanide Spill, Hungarian Chemical  
 1096 Accident, and recent Serbian landslides) ([European Commission, 2016](#)). These are tallied in  
 1097 Table [24](#). However, the frameworks for disaster response at the levels of the United Nations, the  
 1098 European Union, and those utilized by the ICPDR ~~and implemented at the national level by the~~  
 1099 ~~Danube countries~~, are restricted to particular types of disaster – monitoring and response to  
 1100 flooding is the most advanced throughout the basin, while pollution is monitored, but does not  
 1101 have the same frameworks for response. Additionally, there remain a variety of natural and man-  
 1102 made disasters that ~~occur throughout the basin~~ that are not integrated into any type of basin  
 1103 monitoring or response framework, including fire, ~~and~~ drought, ~~and other types of predictive~~  
 1104 ~~climate modeling~~.

1105 **Table 4. Natural and man-made disasters in the Danube basin, reported by country, 2000-2012**

1106 ~~Table 2. Natural and man-made disasters in the Danube basin, reported by country (2000-~~  
 1107 ~~2012).~~ (Adapted from [European Commission, 2016](#).)

2000	Mine tailing failure/cyanide and heavy metal pollution (natech) Landslide/avalanche Extreme temp./drought Flooding  Severe ice storms Wildfires Factory fire	Romania, Hungary, Bulgaria, Macedonia Austria, Slovenia Bulgaria, Croatia, Slovenia Croatia, Hungary, Romania, Slovenia Moldova, Ukraine Croatia, Slovakia Slovenia
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2001	Mining accident (natech) Flooding	Slovenia Croatia, Hungary, Romania, Slovakia, Ukraine
2002	Industrial fire at waste dump	Slovenia
2003	Mining accident (natech) Extreme temp./drought  Flash floods/severe storms Wildfires	Slovenia Austria, Croatia, Germany, Slovenia, Bosnia and Herzegovina Hungary Slovenia
2004	Drinking water pollution (natech) Dam failure Earthquake Flooding/severe storms Drought	Hungary Romania Slovenia Hungary, Slovakia Bosnia and Herzegovina
2005	Landslides Flooding/Severe Storms	Slovenia All Danube Countries, except Ukraine
2006	Avian (H5N1) flu pandemic Aircraft accident Earthquake Extreme Temp. Wildfires	Hungary, Romania, Slovenia Hungary Hungary Bulgaria Slovenia
2007	Wildfires/forest fires Hurricane Extreme temp./drought  Flash floods/severe storms	Bulgaria, Croatia Germany Austria, Bulgaria, Croatia, Hungary, Romania, Slovakia, Bosnia and Herzegovina, Montenegro, Serbia, Moldova Bulgaria, Germany, Hungary, Romania, Slovenia, Montenegro, Serbia, Ukraine
2008	Transportation accident Extreme temp. Forest fires Flash floods/severe storms Flooding	Croatia Bulgaria Bulgaria Hungary Romania, Slovakia, Slovenia, Serbia, Moldova, Ukraine
2009	Swine (H1N1) flu pandemic Ice storms/blizzard	All Danube Countries Croatia, Romania, Bosnia and Herzegovina, Ukraine
2010	Chemical accident (natech) Earthquake	Hungary Serbia



2012

Ice storms/blizzards

Bulgaria, Hungary,  
Romania, Montenegro,  
Serbia, Moldova, Ukraine

Extreme temp./drought

Moldova

1108 -Note that economic losses, deaths and displacements are not reported to either European Commission or ICPDR.  
1109 - Where indicated, natech accidents occurred because of initial flood event that led to subsidiary release of chemicals/pollutants.  
1110 -Adapted from European Commission, 2016.

1111

#### 1112 **4.2-1 How disasters are treated differently within response frameworks**

1113 ~~In the absence of a centralized institution for disaster response, the development of a~~  
1114 ~~large and diverse international disaster relief community has occurred. Initially, the large-scale~~  
1115 ~~relief work after natural disasters was undertaken by the Red Cross movement at the end of the~~  
1116 ~~19<sup>th</sup> century, but eventually the disaster relief community expanded capacity and function to~~  
1117 ~~include a variety of disaster assistance activities and involve other international initiatives and~~  
1118 ~~organizations (IFRC, 2007). The United Nations (UN) began humanitarian work shortly after~~  
1119 ~~World War II with agencies such as the United Nations High Commission for Refugees~~  
1120 ~~(UNHCR), and predecessor agencies such as the United Nations Office for the Coordination of~~  
1121 ~~Humanitarian Affairs (UN OCHA) are now regularly engaged in disaster response and relief~~  
1122 ~~(IFRC, 2007).~~

1123 Numerous frameworks for response to natural disasters exist (Table 31). Apart from  
1124 natural disasters, the United Nations Economic Commission for Europe’s (UNECE) Industrial  
1125 Accident Convention applies to land-based, non-military, and non-radiological industrial  
1126 accidents (UNECE, 2009). Through the convention, response for industrial accidents is provided  
1127 through bilateral or multilateral arrangements. If no prior agreements exist, an affected country  
1128 can request assistance from other parties through mutual assistance agreements. However, in  
1129 these situations, it is the responsibility of the requesting country to cover all costs, unless  
1130 otherwise agreed upon among the responding countries (UNECE, 2009). One example is the  
1131 2002 UN General Assembly Resolution 57/150 on “Strengthening Effectiveness and

1132 Coordination of Urban Search and Rescue Assistance” (UN, 2003). While non-binding, the  
 1133 resolution highlights the importance of national responsibility to victims of natural disasters  
 1134 within country borders, but in the event that an incident exceeds country capacity, Urban Search  
 1135 and Rescue (USAR) assistance through the International Search and Rescue Advisory Group  
 1136 (INSARAG) can supplement local rescuers, and the coordination of these resources, particularly  
 1137 following earthquakes or other events leading to structural collapse (INSARAG, 2016).

1138 Table 3. List of legally binding mechanisms for Danube basin and Tisza sub-basin.

1139

1140 ~~Table 3. List of legally binding mechanisms for Danube basin and Tisza sub-basin.~~

<u>Governing Body</u>	<u>Convention</u>	<u>Type of Instrument</u>	<u>Description of Instrument</u>
<u>UN Economic Commission for Europe</u>	<u>Industrial Accidents Convention</u>	<u>Legally binding for parties to convention.</u>	<u>Determines actions of request for assistance and response for industrial accidents specifically.</u>
<u>European Commission</u>	<u>Water Framework Directive</u>	<u>Legally binding for EU member states, and through Danube Convention.</u>	<u>Sets basin-level management of water quality and quantity.</u>
<u>European Commission</u>	<u>Floods Directive</u>	<u>Legally binding for EU member states, and through Danube Convention.</u>	<u>Requires action regarding flood mapping at the basin level.</u>
<u>European Commission</u>	<u>Seveso Directives</u>	<u>Legally binding for EU member states.</u>	<u>Requires corporations to list possible risk of industrial accident, and develop preparedness plans.</u>
<u>European Commission</u>	<u>Civil Protection Mechanism Directive</u>	<u>Legally binding for EU member</u>	<u>First EU-wide law to include</u>

		<u>states,</u>	<u>multiple hazards in disaster risk strategies.</u>
<u>International Commission for the Protection of the Danube River (ICPDR)</u>	<u>Danube River Protection Convention</u>	<u>Legally binding for Danube member states.</u>	<u>Provides integrated framework for all Danube countries to participate in basin level management, regardless of EU affiliation.</u>

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Apart from natural disasters, the United Nations Economic Commission for Europe's (UNECE) Industrial Accident Convention applies to land-based, non-military, and non-radiological industrial accidents (UNECE, 2009). Through the convention, response for industrial accidents is provided through bilateral or multilateral arrangements developed in advance among the parties. If no prior agreements exist, an affected country can request assistance from other parties through mutual assistance agreements. However, in these situations, it is the responsibility of the requesting country to cover all costs incurred for disaster response, unless otherwise agreed upon among the responding countries (UNECE, 2009). Flooding in the Danube in 2013 and 2014 caused approximately €15 billion in damage (Table 453), and while the economic cost from industrial and other man-made accidents are not monitored or reported in the same manner (Table 24), such accidents have occurred quite frequently and make apparent the need for improved agreements on bilateral or multilateral relief (ICPDR 2015b).

**Table 5. Estimated human and economic loss in Danube per flood event, 2002-2014**

**Table 43. Estimated human and economic loss in Danube per flood event (2002-2014) (Adapted from ICPDR, 2008b and ICPDR, 2015b).**

<b>Flood Year</b>	<b># Deaths or # Displaced</b>	<b>Economic Losses €</b>
2002	N/A	N/A
2006	N/A	> €6 billion

2010	35 deaths	€2 billion
2013	9 deaths	€2.4 billion
2014	79 deaths; 137,000 displaced	€4 billion

\*N/A – Data not available

[-Adapted from ICPDR, 2008b and ICPDR, 2015b](#)

1157  
1158  
1159  
1160 The facilitation of international disaster response can be inadequate if mobilization is  
1161 untimely, or fails to include sufficient financial support. Response frameworks may neglect or  
1162 place disproportionate attention on certain types of disasters, which could become more  
1163 problematic with growing concerns over climate change and increased urbanization. ~~For~~  
1164 ~~example, there is visible delayed response for sudden-onset disasters such as the 2005 Indian~~  
1165 ~~Ocean tsunami and the 2010 Haiti earthquake which received the majority of funding support~~  
1166 ~~within one to three months of the initial request, compared to the slow-onset drought events of~~  
1167 ~~the 2011 appeals by Kenya and Somalia where funding was not provided until nearly 7–12~~  
1168 ~~months after the initial request (GHA, 2013). In 2005, nearly three quarters of all UN~~  
1169 ~~contributions for natural disasters arrived within a month of their appeal; the comparable figure~~  
1170 ~~for complex emergencies was only seven percent (IFRC, 2007).~~

1171 ~~While differences exist among slow-onset and sudden-onset disasters, they can create~~  
1172 ~~cumulative impacts to the community that increase vulnerability and lead to larger disasters in~~  
1173 ~~the future—precipitation deficiencies in soil and water lead to drought and when combined with~~  
1174 ~~high temperatures and dry conditions, this can lead to wildfires (e.g., extreme fire hazard~~  
1175 ~~situations in the eastern US and south-east Australia) (Smith, 2013).~~

1176 ~~The growing size and diversity of international responders to disasters can have~~  
1177 ~~ramifications for the facilitation, coordination, and quality of response efforts (IFRC, 2007).~~

1178 Diverse systems of response are implemented among the Danube basin countries due to the  
1179 variety of disasters experienced. Some utilize a single Civil Protection Mechanism, while others  
1180 rely on multiple parties among Ministries of the Interior, Ministries of Rural Development,

1181 Water Directorates, and a variety of additional local protection committees [4, 5]. Interviews  
1182 indicated that not all responders/parties are sufficiently trained, and many lack managerial or  
1183 technical capacity to manage specific disasters appropriately [4]. There is also large  
1184 compartmentalization of tasks at lower levels – both regional and local – where integration  
1185 among the various types of disaster, as well as increased cooperation is needed [2, 3]. Other than  
1186 the fact that these diverse actors are providing certain types of disaster assistance, there is  
1187 nothing uniting them – no international or regional disaster response system. Given the increased  
1188 frequency of natural and man-made disasters and the growing number of actors involved in  
1189 disaster response efforts, ensuring effectiveness of aid should not detract from response and  
1190 assistance (IFRC, 2007).

1191 Besides the diverse ensemble of international organizations with a mandate and capacity  
1192 for responding to natural disasters and/or specific types of technological or industrial accidents,  
1193 there are also agencies experienced in particular types of international disasters, but which may  
1194 not necessarily have the mandate or capacity for response. In 1994, the United Nations  
1195 Environment Programme (UNEP) and the UN Department of Humanitarian Affairs (DHA, the  
1196 predecessor of OCHA), developed an administrative arrangement through an exchange of letters  
1197 (Bruch et al., 2016). The arrangement relies on the environmental mandates of UNEP and the  
1198 humanitarian mandates of the DHA. Through UNEP’s Governing Council Decision  
1199 UNEP/GC.26/15 on “Strengthening International Cooperation on the Environmental Aspects of  
1200 Emergency Response and Preparedness”, the Joint UNEP/UN OCHA Environment Unit (JEU)  
1201 plays a leading role in facilitating coordination among international organizations in the event of  
1202 natural and man-made disasters, including natech accidents, which are more broadly termed  
1203 environmental emergencies (UNEP, 2011). The JEU has a number of existing agreements and

1204 interface procedures in place with these organizations, in order to facilitate response, ~~particularly~~  
1205 ~~because there is a lack of familiarity among UN member states regarding existing regional and~~  
1206 ~~international systems for response to the various types of disasters, as well as the coordination~~  
1207 ~~between them.~~ For example, the JEU facilitated international agreements and interface  
1208 procedures to aid with response between UN Disaster Assessment and Coordination (UNDAC)  
1209 and the EU Civil Protection Mechanism to the 2014 Serbian landslides following Cyclone  
1210 Tamara (NERC, 2014). During the 2000 Baia Mare natech accident in the Tisza River sub-basin,  
1211 sixteen experts from seven countries deployed for response to the natech accident, and the JEU  
1212 assisted to coordinate response efforts among UNDAC, the European Commission, the Military  
1213 Civil Defence Unit, the World Health Organization, and a variety of other actors (JEU, 2000).

1214         At the regional level, the European Union’s Civil Protection Mechanism (EU CPM) is an  
1215 instrument for disaster response that protects people, the environment, property, and cultural  
1216 heritage in the event of natural or man-made disasters, occurring within or outside of the  
1217 European Community (European Commission, 2016). Disasters are monitored internationally  
1218 through the Emergency Response Coordination Centre (ERCC) in cooperation with the JEU and  
1219 with participating states.

1220         The European Union’s Seveso Directives (I enacted in 1982, II enacted in 1996, and III  
1221 enacted in 2012) are some of the earliest pieces of legislation to address disaster risk (European  
1222 Community, 1982; European Community, 1996; European Community, 2012). The various  
1223 iterations of the Directive govern the establishments where dangerous substances are present,  
1224 and require the establishments to classify and report the amounts, types, and locations of  
1225 dangerous substances present. The majority of the Directives’ focus is on notification  
1226 requirements and accident prevention, ~~including notification to the public due to the increased~~

1227 ~~risk by natural disasters associated with the location of the establishment and associated risks~~  
1228 ~~from natech accidents~~ (European Union, 2012). The responsibility for response under the  
1229 Directives falls on the establishment industries for developing preparedness response measures  
1230 in advance of an accident, and notifying the competent authority in case of a major accident  
1231 (European Union, 2012). However, a 2012 study by the European Commission indicated that  
1232 industry in nearly half of the EU countries is believed to insufficiently consider natech risks in  
1233 their preparedness response measures (Krausmann and Baranzini, 2012).

1234         The EU Floods Directive provides a framework for addressing risk from natural disasters,  
1235 specifically floods. While inspired not only by the damaging effects of floods, but also by  
1236 increasing flood risks as a result of climate change, the main objective of the Directive is to  
1237 require member states to assess and manage risks of flooding ~~within their territories~~ and to  
1238 develop flood risk management plans. Though the plans are restricted to areas considered at high  
1239 risk of floods, these are not integrated into other types of plans and maps available – such as the  
1240 Inventory of Potential Accidental Risk Spots in the Danube<sup>5</sup> – nor are they used for developing  
1241 preparedness response measures in advance of an accident or natural disaster, such as in the case  
1242 of the Seveso Directive. Though the Flood Directive was expected to reduce flood risk,  
1243 interviewees voiced disappointment regarding the limitations of integrating disaster risk more  
1244 broadly, particularly in relation to water quality and accidental pollution [3]. These present as  
1245 policy limitations to the Water Framework Directive and Flood Directive, as neither of the two  
1246 directives require the integration of disaster risk of both floods and accidental pollution.

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<sup>5</sup> Pursuant to the 2001 Baia Mare natech accident in Romania, the ICPDR conducted a qualitative evaluation of the hazardous locations in the Danube catchment area, with reference to location of possible water pollution. The report of Inventory of Potential Accidental Risk Spots was released in 2001, and has not been updated since (ICPDR, 2001; ICPDR, 2015a).

1247           The European Union also developed a set of macro-regional strategies for the Adriatic  
1248 and Ionian, Alpine, Baltic Sea, and Danube regions (European Commission, 2010). While the  
1249 intent ~~from the EU~~ was to not provide new EU funding, these integrated frameworks are  
1250 supported by EU Structural and Investment Funds in order to address common challenges faced  
1251 in each defined area ~~in order to strengthen cooperation and achieve greater economic, social, and~~  
1252 ~~territorial cohesion~~. In the Danube Strategy, risks from floods and industrial accidents are  
1253 reflected as having substantially negative transnational impacts, and are listed as requiring  
1254 preventive and disaster management measures that are implemented jointly, with the  
1255 understanding that work undertaken in isolation in one place (e.g., to build levees) displaces the  
1256 problem and places neighboring regions at greater risk of flooding (European Commission,  
1257 2010). Other man-made disasters are integrated in the discussion of risks, as well as the need to  
1258 account for climate change by taking a regional focus at the basin level (European Commission,  
1259 2010, p. 8). In a 2015 European Commission Communication report ~~following implementation~~  
1260 ~~of the Danube Strategy~~, several limitations were highlighted, including: the need to improve  
1261 efforts to reduce the Danube region’s risk of exposure to major floods and accidental hazardous  
1262 material releases; limited political commitment, funding, and capacity among countries and  
1263 institutions in the Danube; lack of staff, funding, and expertise impeding participation,  
1264 particularly in lesser-developed areas of Danube – the report also acknowledged that these  
1265 challenges are more acute in non-EU countries (EPRS, 2015). The limitations in funding,  
1266 technical expertise, and capacity were confirmed in interviews with experts at various levels,  
1267 who also noted how this leads to uneven implementation of EU Directives within the basin that  
1268 can create pockets of vulnerability to both flood risk and risks from industrial accidents [2, 3, 4].



1269 While the Danube Strategy does not provide a framework for response to natural and  
1270 man-made disasters, it does highlight the EU’s continued support for managing multi-hazard  
1271 response at multiple levels, particularly through Priority Area 5 “To Manage Environmental  
1272 Risks”. Specifically, it requests that the countries “strengthen operational cooperation among  
1273 emergency response authorities in the Danube countries and improve the interoperability for  
1274 risks that are common to an important number of countries in the region (i.e., floods and risks of  
1275 other natural and man-made disasters)”, and advises that each country’s civil protection  
1276 mechanism have an ~~updated~~ understanding of neighboring country’s systems so that response  
1277 teams can function smoothly in case of emergencies ~~involving bilateral, European, or~~  
1278 ~~international response~~ (EUSDR, 2015). Experts also expressed the need for formal agreements  
1279 with specific language on integrated mapping of complex disasters, as well as provisions  
1280 addressing response to both natural and man-made disasters, particularly if additional grants  
1281 could be given from the EU to support these activities [2, 3, 4, 5]. Some interviewees reflected  
1282 that the regional Strategy depended on stronger countries helping the weaker ones, but  
1283 limitations with funding and capacity are difficult to overcome [2]. In the 2015 Annual Report on  
1284 implementation of the Danube Strategy produced by the Danube countries, all projects focused  
1285 on implementation of the Floods Directive. The only mention of industrial accidents was to  
1286 reflect the failure to include an updated Inventory of Potential Accidental Risk Spots along the  
1287 Danube, which is also discussed in the 2015 Danube River Basin Management Plan (DRBMP)  
1288 (EUSDR, 2015; ICPDR, 2015b). Given past issues with mine tailing collapses and other  
1289 pollution disasters associated with flooding, the 2015 DRBMP acknowledged the need to update  
1290 the Inventory of Potential Accidental Risk Spots promptly (ICPDR, 2015b). Unfortunately, this

1291 recommendation from the 2015 DRBMP, and initially expressed in first Danube River Basin  
 1292 Management Plan of 2009, has yet to be realized.

1293 Through the [1994](#) Danube River Protection Convention, Article 17 provides for mutual  
 1294 assistance “where a critical situation of riverine conditions should arise”. While “critical  
 1295 situation” is not defined, Article 17 indicates that the ICPDR will elaborate procedures for  
 1296 mutual assistance including the facilities and services to be rendered by the contracting party,  
 1297 the facilitation of border-crossing formalities, arrangements for compensation, and methods of  
 1298 reimbursement (ICPDR, 1994). These elaborations have not occurred through the ICPDR, but  
 1299 rather in the form of bilateral agreements regarding transboundary flood measures among  
 1300 Danube countries; however virtually no bilateral agreements exist regarding response to man-  
 1301 made disasters in the basin (Table [52](#)).

1302

<b>Countries</b>	<b>Transboundary Watercourses</b>	<b>Disasters/ Emergencies</b>
Austria—Czech Republic	1967**	1994 (Floods Only)
Austria—Germany	1987	1991 (Floods Only)
Austria—Hungary	1956	1959 (Floods Only)
Austria—Slovakia	1967**	1994 (Floods Only)
Austria—Slovenia	1956***	1956* (Floods Only)
Bosnia and Herzegovina—Croatia	1996	1996 (Natural/Manmade Disasters)
Bosnia and Herzegovina—Serbia and Montenegro**	-	2011 (Flood EWS)
Bulgaria—Romania	2004	2004 (Floods Only)
Bulgaria—Serbia	Draft	Draft (Floods Only)
Croatia—Hungary	1994	1994 (Floods Only)
Croatia—Serbia	-	-
Croatia—Slovenia	No Date	1977*** (Coastal Pollution)
Czech Republic—Slovakia	1999	-
Hungary—Romania	1986	2003 (Floods Only)

**Table 54.** Bilateral agreements on transboundary watercourses and disasters among Danube countries (Adapted from ICPDR, 2009a; ICPDR, 2015a; UNEP, 2002).

Hungary—Slovakia	1956 <sup>***</sup>	2014 (Floods Only)
Hungary—Slovenia	1994	1994 (Floods Only)
Hungary—Ukraine	1997	1998 (Floods Only)
Moldova—Romania	2010	2010 (Floods Only)
Moldova—Ukraine	1994	-
Serbia and Montenegro— Hungary	1955 <sup>**</sup>	1955 <sup>*</sup>
Serbia and Montenegro— Romania	1955 <sup>**</sup>	Under Discussion
Ukraine—Romania	1997	1952 <sup>***</sup> (Floods Only)
Ukraine—Slovakia	1995	2000 (Floods Only)

\* Agreement formed with Czechoslovak Socialist Republic

\*\* Agreement formed with Yugoslavia

\*\*\* Agreement formed with Union of Soviet Socialist Republics

- No Information Available

To bridge the gap regarding man-made accidents, some Danube basin countries have engaged in such agreements. Bulgaria, Moldova, Romania, Serbia, and Ukraine are parties to the DRPC, but have separately engaged in the BSEC Agreement on Response to Natural and Man-made disasters (Bruch et al., 2016). Furthermore, the Danube Delta countries (Moldova, Romania, and Ukraine) are working together with the UNECE Industrial Accidents Convention due to the large concentration of oil-related industries in the area in order to improve hazard management, increase transboundary cooperation, and strengthen operational response [1].

At the Danube basin level, the countries have engaged in a series of non-binding Memoranda of Understanding (MOU) referred to as the Danube Declarations, first in 2004, revised in 2010, and updated in 2016. The Declarations reinforce the language of the 1996 Danube River Protection Convention to sustainably manage the waters of the Danube, and reinforce the countries' commitment to continue the work of the WFD and Floods Directive. The 2016 Declaration recognizes the need for increased investment and improved warning systems for flood protection and contamination, as well as improving the exchange of information throughout the Danube (ICPDR, 2016). The Danube River basin countries engage currently in

1323 two separate systems for flood monitoring and monitoring pollution from man-made accidents –  
1324 the Emergency Flood Alert System and the Principal International Alert Centres (PIACs) of the  
1325 Danube Accident Emergency Warning System (Danube AEWS), respectively. The Emergency  
1326 Flood Alert System has been functioning since 2003 at the Joint Research Centre, a Directorate  
1327 General of the European Commission, and works in collaboration with the national authorities of  
1328 the member states and with a variety of meteorological services. The Emergency Flood Alert  
1329 System provides two medium-range flood forecasts each day, with 3-10 day advance warning for  
1330 flooding in the main stem of the Danube. An MOU has been signed with several, but not all of  
1331 the Danube countries (Austria, Bulgaria, Czech Republic, Germany, Hungary, Moldova, Serbia,  
1332 Slovakia, Slovenia, and Romania, and negotiations are underway with Bosnia and Herzegovina  
1333 and Croatia), and information is available 24 hours a day through an online service managed by  
1334 the Joint Research Centre (ICPDR, 2010). The Emergency Flood Alert System gives national  
1335 authorities the ability to prepare response measures, including opening temporary flood retention  
1336 areas, building temporary flood protection structures such as sandbag walls, and adopting civil  
1337 protection measures such as closing down water supply systems (ICPDR, 2009b). These  
1338 responses reduce further threat of flooding downstream, and prevent loss of lives and  
1339 infrastructure. The MOU does not include tributaries draining areas less than 4,000 km<sup>2</sup>,  
1340 therefore the Emergency Flood Alert System does not address flood risks in the Tisza, nor in  
1341 certain basin countries where significant flood concerns arise, such as Ukraine [1].  
1342 Transboundary floods typically affect larger areas, can be more severe, result in a higher number  
1343 of deaths, and cause increased economic loss than non-transboundary rivers (Baaker, 2009).  
1344 Therefore, the repeated occurrence of such large, costly flood events (Table 453) highlights the  
1345 ongoing need for improved strategies for flood preparedness and response, particularly in the

1346 absence of coordinated, multi-hazard bilateral and multilateral agreements among basin  
1347 countries.

1348         The Principle International Alert Centres (PIACs) of the Danube Accident Emergency  
1349 Warning System monitor accidental water pollution incidents in the Danube River basin. Unlike  
1350 the Emergency Flood Alert System, which is linked to monitoring conducted by the European  
1351 Commission and is transmitted to national authorities (without involving the ICPDR in the  
1352 monitoring process); the Danube AEWS system is managed by the ICPDR, but does not involve  
1353 the European Commission. While all contracting parties of the DRPC cooperate with the Danube  
1354 AEWS, they also are expected to have national policies regarding response to accidental  
1355 pollution in the Danube that connects to the Principle International Alert Centres. The PIACs  
1356 are expected to operate on a 24-hour basis within each country, and are in charge of all  
1357 international communications. When a message regarding potentially serious accidental pollution  
1358 occurs, the PIAC is responsible for communicating the accident to the ICPDR, and decides  
1359 whether it is necessary to notify downstream countries, engages experts to assess the impacts of  
1360 the pollution, and decides what response activities need to be taken at the national level (ICPDR,  
1361 2014). Challenges to the Danube AEWS monitoring include territorial gaps (several areas along  
1362 the Danube and Tisza are not monitored) [3, 4, 5], a limited number of bilateral agreements for  
1363 response in case the accident exceeds national capacity (Table 524), and even though a variety of  
1364 natural and man-made accidents occur (Table 24), not all types of man-made accidents are  
1365 monitored. Increasing pressures are felt by downstream countries from the failure to monitor  
1366 pollution events in a consistent and effective manner [4]. Furthermore, in order to keep the  
1367 AEWS operational, there is increasing reliance on citizen reporting of pollution events in some  
1368 countries [4, 5]. This is particularly problematic in the Tisza countries where the lack of

1369 monitoring of both flood and accidental pollution events, combined with limited bilateral  
1370 agreements raise concern among several countries [4, 5].

1371 In the most recent Tisza River sub-basin MOU (from 2011), the Tisza countries agreed,  
1372 among other things, to “take coordinated steps to prevent accidental risks, and develop  
1373 harmonized mitigation and response measures, with the aim to present an updated Inventory of  
1374 Potential Accidental Risk Spots by the end of 2012” (ICPDR, 2011). This complements the 2009  
1375 request in the Danube basin (but as reflected above, has yet to be updated) (ICPDR, 2015b). To  
1376 date, this has not occurred for the Tisza-~~sub-basin~~, but the language in the MOU does reflect an  
1377 interest at the sub-basin level to prioritize not only the mapping and development of an Inventory  
1378 of Potential Accidental Risk Spots, but also the development of harmonized response measures  
1379 among floods and man-made hazards.

## 1380 **5 Questioning the distinction**

1381 While “natural” disasters may be a commonly used term, no disaster can be regarded as  
1382 entirely natural if people have the capacity to avoid, mitigate, or reduce the risk from ~~it an~~  
1383 ~~entirely natural hazard~~ (Picard, 2016). ~~However~~ Generally, the vulnerability to lives and  
1384 livelihoods can be ~~avoided-reduced~~ with ~~proper~~ disaster preparedness and response, such as the  
1385 proper placement, function, and use of early warning systems, ~~flood maintenance~~, and mitigation  
1386 works such as levees and controlled flood outlets and properly timed dam releases.

1388 There is an additional shift in what is considered truly a natural disaster as well – not only  
1389 from the perspective of mitigation or vulnerability, but in acknowledgement of the anthropogenic  
1390 influences on natural disasters. Climate change is one aspect, but there are also induced  
1391 earthquakes occurring as a result of slipping faults from fluid injection in hydraulic fracturing  
1392 (Legere, 2016) ~~and from the weight of shifting water impoundments from Three Gorges (Stone,~~

1393 [2008](#)), landslides from subsidence and increased land use activities including urbanization  
1394 (Smith, 2013), and pandemics from deforestation and habitat conversion (Greger, 2007), to name  
1395 a few. ~~Holistic frameworks that include multiple types of disasters are needed in order to respond~~  
1396 ~~effectively.~~

1397 ~~Human intervention in the physical environment exposes populations to natural hazards~~  
1398 ~~from the built environment, such as housing and associated infrastructure, including industrial~~  
1399 ~~facilities, drainage works, and planning—especially when the built environment is not~~  
1400 ~~appropriately designed or built to account for the risks~~hazards. Human, economic, and  
1401 environmental losses can be worse in highly populated, urbanized areas; with increased  
1402 urbanization and climate change, they are placed at increased risk to natural and man-made  
1403 hazards (Bruch and Goldman, 2012; Huppert and Sparks, 2006). For this reason, natech  
1404 accidents and other cascading disasters are particularly problematic types of disasters.  
1405 Simultaneous response efforts are required to attend to both the industrial, chemical, or  
1406 technological accident as well as the triggering natural disaster. Therefore, expanded definitions  
1407 of that reflect multiple types of disaster, as well as broad-improved frameworks for response to  
1408 multiple types of disaster, are needed in order to recognize that many disasters can arise from  
1409 multiple, potentially co-located hazards—and to take the necessary measures to reduce the risks  
1410 of those hazards.

1411 ~~While distinctions among disasters are still claimed for liability in some cases (including~~  
1412 ~~in determining deliberate conduct or negligence), the distinction between natural and man-made~~  
1413 ~~disasters is largely irrelevant from the perspective of humanitarian response and the humanitarian~~  
1414 ~~consequence of multi-hazard events and those that are caused by natural or technological~~  
1415 ~~hazards. Furthermore, in the event that disasters are slow-onset, or when the ability to mitigate or~~

1416 ~~respond to risk is not timely or effective, the long-term effects of the disaster can be magnified~~  
1417 ~~and lead to further vulnerability, such as famine, malnutrition, or mortality (IFRC, 2006).~~

1418         The 2011 Fukushima nuclear disaster in Japan, triggered by the Great East Japan  
1419 Earthquake and resultant tsunami, illustrated the complex relationship of natural hazards and the  
1420 built environment and human factors, resulting in natech vulnerabilities. In part as a response to  
1421 the earthquake, tsunami, and nuclear accident at Fukushima and as a more general approach to  
1422 providing a comprehensive, multidimensional and multi-sectoral approach to reducing disaster  
1423 risk, the United Nations member states adopted the Sendai Framework for Disaster Risk  
1424 Reduction in 2015. To some experts, the preceding 2005 Hyogo Framework for Action focused  
1425 too much on disaster risk reduction from natural disasters, and ignored industrial accidents and  
1426 complex accidents like natech accidents [6]. In fact, in a 2011 study by the European  
1427 Commission, out of 14 EU countries that experienced natech accidents, more than half of the  
1428 accidents resulted in the release of toxic substances, fires, or explosions (Krausmann and  
1429 Baranzini, 2012).

1430         The Sendai Framework places unprecedented emphasis on the interaction between  
1431 hazards (natural and man-made), exposure levels, and pre-existing vulnerability (Aitsi-Selmi and  
1432 Murray, 2016). It calls to action for improving decision making through a stronger science-  
1433 policy-practice interface, with four priority areas for action –including strengthening disaster  
1434 governance with regard to shared resources and at the basin level (UNISDR, 2015).

1435         The Organization for Economic Cooperation and Development (OECD) also provides  
1436 guidance for the planning and operation of facilities where hazardous substances are located  
1437 through the use of their 2003 Guiding Principles for Chemical Accident Prevention,  
1438 Preparedness, and Response. Recognizing the gaps in natech risk management and



1439 methodologies, the OECD developed an addendum in 2015 to the Guiding Principles that  
1440 include 1) an investigation of the prevention of chemical accidents, as well as preparedness for  
1441 and response to chemical accidents resulting from natural hazards that are not a part of national  
1442 chemical accident programs; and 2) recommendations for best practices with respect to  
1443 prevention of, preparedness for, and response to natech accidents (OECD, 2015).

1444         Regional frameworks for response to natural and man-made disasters have been  
1445 developed by member states of the Black Sea Economic Cooperation (BSEC) and the  
1446 Association of South East Asian Nations (ASEAN). These regional agreements have also  
1447 progressed to include national efforts, such as the coordination of technical assistance and  
1448 resource mobilization during response to natural and man-made disasters (ASEAN, 2010; BSEC,  
1449 1998).

## 1450 **6 Building holistic approaches for integrating multilevel disaster response**

1451         The transition toward a multi-hazard approach for response to natural and man-made  
1452 disasters, and the acknowledgement of the risks of natech accidents is occurring at many levels.  
1453 It is present in the work of the United Nations and the multilevel response frameworks of the EU  
1454 Civil Protection Mechanism; some regional agencies are also adopting similar agreements (i.e.,  
1455 ASEAN, BSEC). However, there remains a disparity in managing natural and man-made  
1456 disasters in a holistic manner at the national level, as well as in the monitoring of these types of  
1457 events at the Danube basin and Tisza sub-basin levels. The challenges are not insurmountable;  
1458 this section proposes two sets of options for reducing and eventually eliminating the historic  
1459 dichotomy among approaches to disaster response and monitoring.

### 1460 **6.1 Multi-hazard approaches**

1461 The process of building holistic approaches to planning, preparedness, and response can  
1462 strengthen systems for responding to natural and man-made disasters in a more integrated  
1463 manner (i.e., adopting a multi-hazard approach). ~~Building holistic disaster risk processes~~ These  
1464 processes may be done at the global (e.g., Sendai), regional (e.g., BSEC), bilateral, and national  
1465 levels. By adopting a multi-hazard framework for disaster response, the expertise and practices  
1466 of responders can be enhanced to include improved modeling and assessment approaches,  
1467 response methodologies and tools, and heightened measures to prevent or mitigate the  
1468 consequences from natech accidents (Krausmann, Cruz, and Salzano, 2017).

1469 The review of legal and policy frameworks and interviews reflected that while some  
1470 planning and preparedness activities take place regarding flood hazard, this generally is not the  
1471 case for accidental pollution (at least in the Danube and Tisza context), and natech accidents are  
1472 largely removed or ignored [2, 3, 4, 5, 6] (European Commission, 2010; ICPDR, 2015a). Gaps in  
1473 monitoring were cited along the length of both the Danube and the Tisza in regard to both  
1474 flooding and accidental pollution, which should also be improved in future planning efforts. The  
1475 Tisza sub-basin and smaller water bodies are beyond the scope of the WFD, consequently, no  
1476 holistic monitoring or response measures are in place; regional agreements at the basin or sub-  
1477 basin level could aid in developing improved response frameworks [2, 3] (McClain et al., 2016).

1478 Improving the mapping of hazards to reflect not only flood hazard, but also risks from  
1479 man-made disasters and natech events – and integrating these risks into a holistic map of  
1480 vulnerability to disaster – would provide a foundation for more holistic policies and  
1481 programming to manage disaster risks. It would also aid in improving measures for preparedness  
1482 at the national and local levels. Multi-hazard response frameworks provide the opportunity to  
1483 intervene and mitigate the size of future disasters. Interviews indicate that harmonized

1484 approaches to natural and man-made disasters offer additional opportunities to strengthen  
1485 capacity among transboundary actors [1, 4].

## 1486 **6.2 Multi-hazard response modalities**

1487 In order to avoid fragmentation among response to natural and man-made disasters, and  
1488 empower, guide, and facilitate the institutional arrangements and mandates necessary to improve  
1489 ~~response to natural and man-made disasters~~these activities, the legal and policy frameworks need  
1490 to provide the necessary mandates and procedures – this is accomplished by incorporating an  
1491 integrated, multi-hazard approach to disaster response. In regard to the Danube basin, this could  
1492 be done in a variety of ways. The Danube River Protection Convention has not been updated or  
1493 amended since it was originally drafted in 1994, but it unites all countries of the Danube basin  
1494 and its tributaries under a formal, legal agreement. Cooperation among Danube countries was  
1495 generally reported as good [3]; therefore, continuing the use of the ICPDR and its expert groups  
1496 as a mechanism to gain cooperation among the countries on a regional framework for improving  
1497 monitoring and response could be considered [3, 4, 5]. Another possibility would be to expand  
1498 the numerous bilateral agreements among the Danube and Tisza countries regarding flooding to  
1499 also include man-made disasters and natech events. Working on agreements at a regional level  
1500 improves communication, breaks down barriers (particularly in transboundary situations), and  
1501 aids in the development of a common legal language among participating parties [1, 2].

1502 Updating conventions and other hard law can be difficult; countries often find soft law to  
1503 be more flexible, they are sometimes unwilling to adopt binding obligations, particularly in the  
1504 face of uncertainty (e.g., climate change), or when they feel there might be a need to act quickly  
1505 to changing circumstances. In this regard, updating the Danube Declaration and the  
1506 corresponding Tisza MOUs can provide particularly viable options. Through the Declarations

1507 and MOUs, the Danube or Tisza countries could decide whether to engage in a particular action  
1508 through a separate strategy, or pilot project, or whether to incorporate the issue into the broader  
1509 basin or sub-basin management plan (e.g., improvement of accidental pollution and flood  
1510 monitoring, integrated accidental pollution and flood maps). Improved vertical and horizontal  
1511 cooperation was a request of several interviewees, particularly in regard to the risks posed from  
1512 man-made accidents and how to respond to these accidents [4, 5].

## 1513 **7 Conclusions**

1514  
1515 The historic distinction between natural and man-made disasters is outdated,  
1516 counterproductive, and ultimately flawed. Natural disasters have the potential to trigger  
1517 simultaneous technological or chemical accidents from one or multiple sources. With  
1518 anthropogenic climate change influencing the frequency and intensity of disasters, the  
1519 distinctions in ~~preventing, monitoring,~~ and responding to disasters from either natural or man-  
1520 made sources are further called into question. Moreover, increased urbanization and shifting  
1521 populations are placing more people at greater risk in times of disaster (whether natural or man-  
1522 made). As a result, it is increasingly clear that there are no purely natural disasters.

1523 Recognizing that the historic distinctions between natural and man-made disasters are no  
1524 longer relevant, there is increasing recognition of the need to address disasters holistically,  
1525 regardless of the contributing causes and aggravating factors. This trend is noted in the Sendai  
1526 Framework, which adopts a multi-hazard risk approach and provides tools for ~~managing~~  
1527 ~~responding to~~ disasters that are both natural and man-made (UNISDR, 2015). While the current  
1528 policy frameworks in the Danube basin and Tisza sub-basin do not address ~~preparedness~~  
1529 ~~monitoring~~ and response holistically across types of disasters, the basin countries have several  
1530 options for more integrated response. A key opportunity is the development or amendment of

1531 agreements governing response to natural and man-made disasters. This could be negotiated  
1532 through updates to the Danube Convention or through bilateral treaties between the basin  
1533 countries. Improving planning and preparedness through more integrated monitoring and  
1534 mapping of natural and man-made disasters, such as combining the flood risk areas with the  
1535 Inventory of Potential Accidental Risk Spots, could be elaborated upon in Declarations and  
1536 MOUs at the basin and sub-basin levels.

1537           A coordinated approach to natural and man-made disasters, including natech accidents, is  
1538 currently taken through the European Union Civil Protection Mechanism and BSEC. This is not  
1539 unique to Europe alone, and other similar regional approaches exist from which to draw lessons  
1540 (including the ASEAN agreement). The Danube and Tisza countries are well versed in the  
1541 transboundary impacts from natural and man-made disasters, and natech accidents; climate  
1542 change is likely to increase the frequency and severity of these events in the foreseeable future.  
1543 Nevertheless, while approaches for integrating holistic frameworks for disaster response are  
1544 recognized at multiple levels, implementation within the Danube basin and Tisza sub-basin  
1545 remains distinct and fragmented.

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1 **What Does Nature Have to Do with It?**  
2 **Reconsidering Distinctions in International Disaster Response Frameworks in the Danube**  
3 **Basin**

4  
5 Shanna N. McClain<sup>1</sup>, Carl Bruch<sup>2</sup>, Silvia Secchi<sup>1,3</sup>, Jonathan W.F. Remo<sup>3</sup>

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12  
13 **Abstract**

14  
15 This article examines the policy and institutional frameworks for response to natural and man-  
16 made disasters occurring in the Danube basin and the Tisza sub-basin. Response to these types of  
17 incidents has historically been managed separately, as has the monitoring of these types of  
18 incidents. ~~Given policy distinctions in response to natural and man-made disasters, W~~we discuss  
19 whether the policy distinctions in response to natural and man-made disasters remain functional  
20 given recent international trends toward holistic response to both ~~natural and man-made~~kinds of  
21 disasters. We suggest that these distinctions are counterproductive, outdated, and ultimately  
22 flawed, ~~a conclude by reflecting on the lessons learned and eonclude~~by proposing an integrated  
23 framework for disaster response in the Danube basin and Tisza sub-basin~~and conclude with a~~  
24 reflection of the lessons learned, and propose an integrated framework in the Danube basin and  
25 Tisza sub-basin.

26  
27 **Keywords:** International Disaster Response Frameworks; Natural Disasters; Man-made  
28 Accidents; Industrial Accidents; Natech Accidents; Danube River basin; Tisza River Sub-basin  
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## 1 Introduction

44           What are the benefits of maintaining the distinction between natural and man-made  
45 disasters? What are the consequences of eliminating this distinction? When a disaster occurs,  
46 local and national capacities for disaster response can be overwhelmed, often triggering a request  
47 for external, international assistance. The actors engaged in disaster response<sup>1</sup> have historically  
48 been determined by the nature of the disaster (i.e., natural disaster, industrial accidents, nuclear  
49 accidents, marine oil spills) and legal frameworks typically divide response between natural  
50 disasters and response to man-made disasters. However, there is ~~;~~ ~~but with~~ growing recognition  
51 that anthropogenic climate change and other human activities such as land use change are  
52 driving more ~~extreme,~~extreme and sometimes cascading events. Cascading events (e.g., refer to  
53 the phenomencases on associated with events in which a primary threat is followed by a  
54 sequence of secondary or additional hazards; Pescaroli and Alexander, 2015) ~~where the effects~~  
55 ~~of disasters are multiplied, or where they are composite, or concurrent~~) that require complex and  
56 often overlapping types of response (Pescaroli and Alexander, 2015). Thus, ~~;~~ the question of  
57 eliminating ~~this~~ the natural/man-made dichotomy is brought to the forefront. The complexity of  
58 disaster events increases with cascading events, both temporally and spatially, due to the  
59 interaction of multiple hazards, threats, and vulnerabilities — thus, creating challenges in response

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<sup>1</sup> While disaster response is considered part of the disaster management cycle, disaster management includes the application of policies and actions regarding disaster risk (i.e., prevention, preparedness and mitigation, response, and recovery). Each have their own set of policy frameworks, actors and mechanisms for implementation. This paper focuses on the disaster response phase specifically, and on the policy frameworks and actors related to requesting and receiving assistance immediately following a disaster, and the legal mechanisms by which responders are deployed.

60 fragmented response frameworks since the main impact from a disaster event can be from its  
61 subsidiary events and not necessarily from the triggering event (Pescaroli and Alexander, 2015).

62 In Europe, natural and man-made disasters combined caused total losses of US\$ 13  
63 billion in 2015 of which only US\$ 6 billion were insured; the predominant losses came from  
64 flood events (Swiss Re, 2016). Flooding and pollution are considered to be the primary  
65 transboundary pressures of the Danube River basin; however, a number of other man-made  
66 accidents occurred in the region (ICPDR, 2015a).

67 Specifically, in 2000, the Baia Mare and Baia Borsa mine-tailing pond failures  
68 mobilized approximately 100,000 m<sup>3</sup> of metal-contaminated water into the Tisza River,  
69 eventually polluting the Danube River and Black Sea. Since the industrial accidents occurred  
70 originally as a result of significant rainfall and flooding, these events are an example of what are  
71 commonly referred to as natech accidents, technological accidents triggered by natural disasters.  
72 In 2010, an industrial accident occurred in the Hungarian portion of the Danube River when a  
73 dam containing alkaline red sludge collapsed, releasing 1.5 million m<sup>3</sup> of sludge into the  
74 surrounding land (approximately 4000 hectares) and waterways (including Kolontár, Torna  
75 Creek, and the Danube River), killing 10 people and injuring several hundred more (ICPDR,  
76 2010). In 2014, following Cyclone Tamara, over 1,000 landslide events occurred in Serbia as  
77 well as significant flooding, resulting in damage to properties and infrastructure and the  
78 inundation of agricultural land. Due to concern over possible breaches in infrastructure to mine  
79 tailing dams in the surrounding area, and the harmful effects to human health, technical experts  
80 investigated mining sites and provided recommendations for local evacuations (NERC, 2014). In  
81 all three disasters, the need for disaster response exceeded the capacity of national actors;

82 therefore, international response involved the United Nations, the European Commission, and  
83 various other international organizations.

84 While international humanitarian law is generally well defined, the law of international  
85 disaster response is still incomplete (Fisher, 2008). Historically, a distinction has been drawn  
86 between the scope of response to natural disasters and man-made disasters; however, this  
87 distinction is absent from the 2015 Sendai Framework for Disaster Risk Reduction, which adopts  
88 a multi-hazard risk approach providing management tools for disasters that are both natural and  
89 man-made (UNISDR, 2015). The European Union’s disaster response framework is also holistic  
90 and includes natural and man-made disasters, and some multilateral sub-regional agreements are  
91 also taking similar approaches, such as those adopted by the Association of South East Asian  
92 Nations (ASEAN) and the Baltic Sea Economic Cooperation (BSEC). Adopting a multi-hazard,  
93 or all-hazards, approach to disaster response allows for recognition of all conditions, natural or  
94 man-made, that have the potential to cause injury, illness or death; damage to or loss of  
95 infrastructure and property; or social, economic and environmental functional degradation  
96 (Kappes, Keiler, von Elverfeldt and Glade, 2012).

97 With international policies starting to shift toward more holistic frameworks of response  
98 that incorporate both natural and man-made disasters, this article explores what this trend will  
99 mean for regional institutions in the Danube basin and Tisza sub-basin, whose policy  
100 frameworks for monitoring and response continue to distinguish between types of disasters, and  
101 resultantly have separate policy response options depending on the type of disaster.

102 This article begins with an overview of the study area and a description of the methodology.  
103 Next is a discussion of the distinctions between natural disasters and industrial accidents – how  
104 and why they have been treated differently and how recent developments in international law and



105 practice are raising questions about the merits of these distinctions. It is followed by an  
106 examination of the international frameworks governing disaster response in the Danube basin  
107 and Tisza sub-basin. Subsequently, the differences in how natural disasters and industrial  
108 accidents are monitored, and how they are responded to, are explored. The article discusses the  
109 transition of international policies toward more holistic frameworks for response, and concludes  
110 with a reflection of how this might affect the Danube basin and Tisza sub-basin.

## 111 **2 Overview of study area and methodology**

112 The Danube River basin covers more than 800,000 km<sup>2</sup> – over 10 percent of continental  
113 Europe – and flows through the territories of 19 countries with nearly 80 million people residing  
114 within the basin. Today, 14 of the 19 countries, plus the EU, have committed to transboundary  
115 cooperation in protecting the Danube via the Danube River Protection Convention (DRPC), and  
116 work jointly toward the sustainable management of the Danube basin and the implementation of  
117 both the European Union’s Water Framework Directive (WFD) and Floods Directive (EU FD)  
118 (ICPDR 2015a).

119 Among the tributaries of the Danube River, the Tisza sub-basin has the largest catchment  
120 area, and covers approximately 160,000 km<sup>2</sup> (20 percent of the Danube basin’s area), with  
121 approximately 14 million people (Fig. 1). There exists a distinct socio-economic contrast in the  
122 basin between western and former socialist countries, and since the end of communism in the  
123 late 1980s, the central and lower Danube has experienced a rapid shift to free market democracy  
124 within the context of increased globalization, privatization, and deregulation. This has led to  
125 rural decline as well as increased poverty, unemployment, and depopulation (WWF, 2003).

126 ~~Additionally, as a result of the continuing conflict in Syria and neighboring states, countries in~~  
127 ~~the Danube and throughout Europe are experiencing a significant increase in population from~~

128 refugees, displaced persons, and other migrants who are escaping persecution, conflict, and  
129 poverty, and are settling in empty buildings, hotels, or refugee camps that have become ad hoc  
130 shelters (UNHCR, 2016)



131  
132 **Fig. 1** Map of Danube River basin and Tisza River sub-basin.

133 **The headwaters of the Danube are located in the Black Forest of Germany. After leaving**  
134 **the Black Forest the Danube flows generally south-east through Central and Eastern Europe to**  
135 **the Black Sea in eastern Romania (Fig. 1; ICPDR, 2009a).** International measures regulating the  
136 Danube were first undertaken in 1882 for flood protection and navigation. Dams were  
137 constructed within the upper Danube basin for flood mitigation, hydroelectric power generation,  
138 and regulation of river levels for navigation. The operation of these dams for these services has

139 been attributed with altering the flow regime of this segment of river and consequently varying  
140 the ecological disturbance regime within the river and on the floodplain resulting is substantial  
141 changes in the riverine ecosystem (ICPDR, 2009a). The flow regulation provided by the dams  
142 and the construction of levees has allowed for the conversion of floodplains and riverine  
143 wetlands into area suitable for agricultural and urban development. Today only 12 small reaches  
144 (<1 km in length) of the Upper Danube relatively remain relatively untransformed (Schneider,  
145 2010). In the Middle and Lower Danube, the river bed has been dredged repeatedly to maintain a  
146 navigable river channel. Along these segments of the Danube River, levees and dams mitigate or  
147 prevent inundation of over 72 percent of the floodplain. The substantial reduction in Danube's  
148 connection with its floodplain combined with wastewater discharge from agricultural and  
149 industrial sources, and increasing levels of pollutants along these river segments have  
150 substantially altered or damaged riverine ecosystem and reduced resiliency of urban and rural  
151 communities to large floods which exceed the protection level of their flood mitigation measures  
152 (Schneider, 2010; UNECE, 2011). The degree of industrial development and amount of pollution  
153 created by the industrial sector varies among Danube countries. In general, pulp and paper  
154 industries represent the largest contributors of pollution, followed by chemical, textile, and food  
155 industries (ICPDR 2009a).

156 The Tisza headwaters are located in the Carpathian Mountains in Ukraine. From these  
157 headwaters the Tisza River flows southwest across central portions of the great Hungarian Plain  
158 into the Danube River in Serbia (Fig. 1; ICPDR, 2008a). ~~Precipitation within the Tisza basin is~~  
159 ~~generally concentrated in the Carpathian mountains within the upper portion of the watershed.~~  
160 ~~The intense, concentrated ity of the~~ rainfall and the steep terrain coupled with deforestation and  
161 channelization of many streams ~~within this portion of the Tisza watershed,~~ results in some of the

162 most sudden and high-energy flooding in Europe. ~~Flood levels along the upper reaches of the~~  
163 ~~Tisza can range up to 12 m deep within as little as 24–36 hours~~ (Nagy et al., 2010). The sudden  
164 water level rises coupled with the high energy of the flows often threaten human lives and result  
165 in substantial damage to infrastructure and croplands (ICPDR, 2008a).

166 While industrial production has dropped drastically in the Tisza since the 1990s, there  
167 remain a variety of industries that contribute to the economy of the region, and the legacy of  
168 heavily concentrated industrial activities continues to threaten the surrounding ecosystems. The  
169 main industrial regions of the Tisza are located in Romania and Hungary, where the potential for  
170 ~~greatest~~ flood damage and losses is also greatest. Chemical and petrochemical industries  
171 (including oil refinery, storage and transport) are important for both Hungary and Ukraine, and  
172 the cellulose and paper, textile, and furniture industries are also present predominantly in the  
173 upper portion of the Tisza in Slovakia, Romania, and Ukraine (ICPDR, 2011). ~~Beyond the threat~~  
174 ~~of mobilizing hazardous materials from industrial activities directly into the Danube or Tisza~~  
175 ~~Rivers, the risks posed from industrial accidents to the surrounding communities, particularly~~  
176 ~~with increasing urbanization, is of growing concern.~~

177 Mining activities, and the accidental spills of chemical substances, have affected the  
178 aquatic environment and water quality within the Tisza sub-basin since the 2000 Baia Mare and  
179 Baia Borsa natech accidents ([JEU, 2000](#)). Natech accidents present significant challenges, as  
180 natural events can trigger multiple and simultaneous accidents in one installation, or depending  
181 on the impact of the natural hazard, in several hazardous facilities at the same time (Krausmann  
182 and Baranzini, 2012). ~~Furthermore, natechs present additional difficulties to already fragmented~~  
183 ~~disaster response activities, as they remain absent from disaster response frameworks~~  
184 ([Krausmann, Cruz, and Salzano, 2017](#)). A 2009 assessment identified more than 92 potential

185 sources for industrial and waste deposits; however, the list does not include abandoned mine  
 186 sites and their mine tailing dams – only those from currently operational mines [\(ICPDR, 2015a\)](#).  
 187 Therefore, the potential risk of accidental pollution could be substantially higher (ICPDR,  
 188 2015a).

189

## 190 **2.1 Methodology**

191 The ~~analysis-examination~~ of policy and institutional frameworks for monitoring and  
 192 responding to natural disasters and man-made accidents in the Danube ~~River basin~~ and Tisza  
 193 ~~River sub-basin was conducted~~~~occurred~~ through a combination of primary and secondary data  
 194 collection and analysis. The primary data ~~collection and analysis~~ consisted of semi-structured  
 195 interviews, while the secondary data ~~analysis~~ included [analysis of the legally binding](#)  
 196 [mechanisms in the region, including conventions and directives \(Table 1\), of bilateral](#)  
 197 [agreements \(Table 2\), and a](#) literature review of peer-reviewed publications [and white papers,](#)  
 198 [providing for -and](#) an analysis of international laws, policies, and institutions within the Danube  
 199 basin and Tisza sub-basin [regarding the provision of disaster response](#). Semi-structured  
 200 interviews were conducted over an eight-month period from January to August 2013. [This](#)  
 201 [format of interviews was chosen so that the pre-determined set of interview questions could be](#)  
 202 [expanded through the natural course of conversation and allow for a more thorough](#)  
 203 [understanding of what was initially queried – in particular, each expert interviewed was provided](#)  
 204 [with the freedom to express their personal views in their own terms.](#)

205 **Table 1.** [List of legally binding mechanisms for Danube basin and Tisza sub-basin.](#)  
 206

<a href="#">Governing Body</a>	<a href="#">Convention</a>	<a href="#">Type of Instrument</a>	<a href="#">Description of Instrument</a>
<a href="#">UN Economic Commission for Europe</a>	<a href="#">Industrial Accidents Convention</a>	<a href="#">Legally binding for parties to</a>	<a href="#">Determines actions of request</a>

		<a href="#">convention.</a>	<a href="#">for assistance and response for industrial accidents specifically.</a>
<a href="#">European Commission</a>	<a href="#">Water Framework Directive</a>	<a href="#">Legally binding for EU member states, and though Danube Convention.</a>	<a href="#">Sets basin-level management of water quality and quantity.</a>
<a href="#">European Commission</a>	<a href="#">Floods Directive</a>	<a href="#">Legally binding for EU member states, and though Danube Convention.</a>	<a href="#">Requires action regarding flood mapping at the basin level.</a>
<a href="#">European Commission</a>	<a href="#">Seveso Directives</a>	<a href="#">Legally binding for EU member states.</a>	<a href="#">Requires corporations to list possible risk of industrial accident, and develop preparedness plans.</a>
<a href="#">European Commission</a>	<a href="#">Civil Protection Mechanism Directive</a>	<a href="#">Legally binding for EU member states.</a>	<a href="#">First EU-wide law to include multiple-hazards in disaster risk strategies.</a>
<a href="#">International Commission for the Protection of the Danube River (ICPDR)</a>	<a href="#">Danube River Protection Convention</a>	<a href="#">Legally binding for Danube member states.</a>	<a href="#">Provides integrated framework for all Danube countries to participate in basin-level management, regardless of EU affiliation.</a>

207

208 **Table 2.** List of bilateral agreements within countries in the Danube basin and Tisza sub-basin.

<a href="#">Countries</a>	<a href="#">Transboundary Watercourses</a>	<a href="#">Disasters / Emergencies</a>
<a href="#">Austria – Czech Republic</a>	<a href="#">1967*</a>	<a href="#">1994 (Floods Only)</a>
<a href="#">Austria – Germany</a>	<a href="#">1987</a>	<a href="#">1991 (Floods Only)</a>
<a href="#">Austria – Hungary</a>	<a href="#">1956</a>	<a href="#">1959 (Floods Only)</a>

<a href="#">Austria – Slovakia</a>	<a href="#">1967*</a>	<a href="#">1994 (Floods Only)</a>
<a href="#">Austria – Slovenia</a>	<a href="#">1956***</a>	<a href="#">1956* (Floods Only)</a>
<a href="#">Bosnia and Herzegovina – Croatia</a>	<a href="#">1996</a>	<a href="#">1996 (Natural/Manmade Disasters)</a>
<a href="#">Bosnia and Herzegovina – Serbia and Montenegro**</a>	<a href="#">-</a>	<a href="#">2011 (Flood EWS)</a>
<a href="#">Bulgaria – Romania</a>	<a href="#">2004</a>	<a href="#">2004 (Floods Only)</a>
<a href="#">Bulgaria – Serbia</a>	<a href="#">Draft</a>	<a href="#">Draft (Floods Only)</a>
<a href="#">Croatia – Hungary</a>	<a href="#">1994</a>	<a href="#">1994 (Floods Only)</a>
<a href="#">Croatia – Serbia</a>	<a href="#">-</a>	<a href="#">-</a>
<a href="#">Croatia – Slovenia</a>	<a href="#">No Date</a>	<a href="#">1977*** (Coastal Pollution)</a>
<a href="#">Czech Republic – Slovakia</a>	<a href="#">1999</a>	<a href="#">-</a>
<a href="#">Hungary – Romania</a>	<a href="#">1986</a>	<a href="#">2003 (Floods Only)</a>
<a href="#">Hungary – Slovakia</a>	<a href="#">1956*</a>	<a href="#">2014 (Floods Only)</a>
<a href="#">Hungary – Slovenia</a>	<a href="#">1994</a>	<a href="#">1994 (Floods Only)</a>
<a href="#">Hungary – Ukraine</a>	<a href="#">1997</a>	<a href="#">1998 (Floods Only)</a>
<a href="#">Moldova – Romania</a>	<a href="#">2010</a>	<a href="#">2010 (Floods Only)</a>
<a href="#">Moldova – Ukraine</a>	<a href="#">1994</a>	<a href="#">-</a>
<a href="#">Serbia and Montenegro – Hungary</a>	<a href="#">1955**</a>	<a href="#">1955*</a>
<a href="#">Serbia and Montenegro – Romania</a>	<a href="#">1955**</a>	<a href="#">Under Discussion</a>
<a href="#">Ukraine – Romania</a>	<a href="#">1997</a>	<a href="#">1952*** (Floods Only)</a>
<a href="#">Ukraine – Slovakia</a>	<a href="#">1995</a>	<a href="#">2000 (Floods Only)</a>

\* [Agreement formed with Czechoslovak Socialist Republic](#)

\*\* [Agreement formed with Yugoslavia](#)

\*\*\* [Agreement formed with Union of Soviet Socialist Republics](#)

- [No Information Available](#)

209  
210  
211  
212  
213

214           Seventy-one interviews were conducted in various locations throughout Europe. The  
215 interviews took place with experts [working within](#) the International Commission for the  
216 Protection of the Danube River, [within](#) the expert groups of the International Commission for the  
217 Protection of the Danube River (i.e., Tisza group, river basin management, flood protection, and  
218 accident prevention and control), with respondents working at the national ministries, water  
219 management directorates, and non-governmental organizations in the Tisza and Danube

220 countries, as well as with experts ~~working within in~~ the European Commission, and the United  
 221 Nations ~~involved in the Danube basin and Tisza sub-basin~~. Those interviewed were chosen based  
 222 on their knowledge of and work within the Danube River basin and Tisza sub-basin. Given  
 223 public roles, the interviews are intentionally left anonymous to ensure candidness in the  
 224 responses ~~(Table 1)~~. Thus, only the kind of organization the experts work for is identified - the  
 225 numbers appearing in brackets in the table below refer to the interview citations in text; ~~reflect~~  
 226 multiple interviews ~~were~~ conducted ~~withinat~~ each level of governance indicated (Table 13). The  
 227 questions focused on how Danube basin and Tisza sub-basin policies and laws were  
 228 implemented in practice, as well as the perceptions of the experts regarding the frameworks and  
 229 implementation of disaster monitoring and response throughout the Danube basin and Tisza sub-  
 230 basin.<sup>2</sup>

231 **Table 13.** Organizations from which experts were drawn for interviews.

		232
<b>International</b>	United Nations, United Nations Economic Commission for	233
	Europe, and United Nations Environment Programme	234
	(UNEP)/UN Office for the Coordination of Humanitarian	235
	Affairs (OCHA) Joint Environment Unit [1]	236
<b>Regional</b>	European Commission [2]	237
	International Commission for the Protection of the Danube	238
	River (ICPDR) and Expert Groups (Tisza Group, River Basin	239
<b>National</b>	Management, Flood Protection, and Accident Prevention	240
	and Control) [3]	241
	National Ministries of Environment, Rural Development,	242
<b>Non-State Actors</b>	Interior, Environment Agency [4]	243
	Water Directorates [5]	244
	NGOs [6]	245
		246

247 \* Numbers in brackets refer to interview citations in text.

### 248 **3 Distinctions between natural disasters and man-made accidents in policy frameworks**

<sup>2</sup> Questions relevant to international frameworks for disaster response included: (1) What are the respective roles in multilevel governance in regard to response for natural and man-made disasters? (2) To what extent are natural and man-made disasters included in policy frameworks for response; in what context and at what level, and what is the language being used? (3) What gaps exist between policies and practice in regard to response for natural and man-made disasters? (4) What constraints or opportunities exist in including policies for response to natural and man-made disasters; which type would be most effective and at what level?



250  
251 ~~Traditionally~~ The approaches used for describing, limiting, and categorizing disasters  
252 fundamentally shapes the methods for monitoring and responding to disasters. They determine  
253 the solutions utilized, the resources allocated, and the governance frameworks selected by  
254 categorizing the types of disaster into that which is natural or man-made. It is therefore important  
255 to ~~understand~~ recognize the etiology of disaster in order to understand why the distinctions  
256 among the various types of disasters still remain. These are discussed below.

### 257 258 **3.1 Rationale for different treatment between natural and man-made disasters**

259  
260 ~~The manner in which disasters are framed by society has evolved over time, still the role~~  
261 ~~of human responsibility features prominently in disaster narratives.~~ Natural ~~disasters~~ hazards are  
262 naturally occurring physical phenomena, which can include earthquakes, landslides, tsunamis,  
263 volcanoes, and floods. Disasters disrupt individuals and communities at various scales due to  
264 hazardous events interacting with conditions of exposure, vulnerability, and risk – leading to  
265 human, material, economic and environmental losses and impacts.<sup>3</sup> Natural disasters have  
266 historically been characterized either (1) as a direct form of punishment from God for the sins of  
267 humanity, or (2) in more recent history ~~more recently~~ as an “act of God” that removed humans  
268 from culpability (Rozario, 2007). ~~The framing of natural disasters continues to shift, and some~~  
269 ~~natural events—earthquakes, hurricanes, tsunamis—only become disasters as they impact and~~  
270 ~~interact with individuals and communities.~~ The consequences of natural disasters become a  
271 function of where people reside ~~—along coastlines, in floodplains, in vicinity of fault lines, and~~  
272 ~~within mountainous regions—~~ and their overall vulnerability, including aging infrastructure and a

---

<sup>3</sup> Exposure is understood as people, infrastructure and housing, production capacities and other human assets located in hazard-prone areas. Vulnerability is defined as a set of physical, social, economic and environmental factors or processes that increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards. Disaster risk is the potential loss of life, injury, or damaged assets occurring to an individual or community as a function of hazard, exposure and vulnerability (UNISDR, 2015).

273 function of their ability to monitor and prepare for these events [\(Peel and Fisher, 2016\)](#).

274 Vulnerability within and between populations can vary, and occurs for multiple reasons – social

275 inequalities, community demographics (e.g., age and poverty), lack of access to health care, and

276 limited access to jobs or to lifelines (e.g., emergency response, goods, services) (Cutter and

277 Emrich, 2006). While building in disaster-prone areas is not the sole responsibility of

278 individuals, they do share responsibility for investing in the risk involved. ~~The existence of moral~~

279 ~~hazard<sup>4</sup> can increase the amount of damage from disaster and reduce the capacity of insurance to~~

280 ~~cover disaster loss; this occurs due to individuals acting irresponsibly and because of those who~~

281 ~~erroneously believe there is coverage for any loss incurred (Smith, 2013). For example, offering~~

282 ~~insurance encourages people to build and live in flood-prone areas, in spite of the known risks –~~

283 ~~if insurance were not available, the household would absorb the entirety of the risk and~~

284 ~~prospective buyers would most likely choose to reside elsewhere. Additionally, as seen with~~

285 ~~some large disasters such as Hurricane Katrina, losses suffered by policyholders can be several~~

286 ~~times larger than collected premiums, consuming insurers’ capital and, if the losses are severe~~

287 ~~enough, not only jeopardize claim payments, but also cause insurance companies to declare~~

288 ~~bankruptcy before covering any – or only some – insured losses (Nekoul and Drexler, 2016). For~~

289 ~~example, while the total economic loss incurred during Hurricane Katrina is assessed at~~

290 ~~approximately US\$ 125 billion, insured losses covered an estimated US\$ 45 billion, however,~~

291 ~~only an estimated US\$ 2 million in insurance claims were paid (Munich Re, 2005). Moral~~

292 ~~hazard can also exist in disaster preparedness and response activities when actors believe they~~

---

<sup>4</sup>For purposes of this paper and described by Munich Re (2007), moral hazard is a lack of incentive by an individual to guard or protect against risk (or to enter into a situation of risk), knowing that they are protected from risk through insurance, which results in higher insurance loss claims. Examples provided are assured compensation for flood damage, leading to increased building in flood-prone areas and assured compensation for crop losses in drought-prone areas that encourage farmers to grow more compensated crops instead of planting alternative crops or adopting alternative land uses.

293 ~~are sufficiently prepared to respond to any event or crises. During Hurricane Katrina, despite~~  
294 ~~emergency preparations, preexisting social vulnerabilities and the collective failure to adequately~~  
295 ~~respond to the emergency made response inadequate for the type of complex emergency relief~~  
296 ~~needed (Cutter and Emrich, 2006).~~

297 Industrial accidents and other man-made accidents are traditionally ~~considered~~ governed  
298 and responded to separately from natural disasters. The role of human agency features even more  
299 prominently in these events, due to potential moral or legal obligations to mitigate risk (e.g.,  
300 preparedness, insurance, disaster aid). Man-made disasters suggest potential moral and legal  
301 obligations to both aid the victims of the disaster in a response capacity in the period  
302 immediately following the disaster, as well as to compensate those who are harmed during their  
303 long-term recovery (Verchick, 2012). The liability is only effective if a polluter can be identified  
304 or liability can be assigned. As disasters continue to multiply, ~~cascade become more complex,~~  
305 and their costs mount, responsibility for the disaster also becomes more complex. For example,  
306 in assigning liability to the 2010 red sludge spill in Hungary, early reports from the Hungarian  
307 Prime Minister Victor Orbán indicated that the breach was likely due to human error, and that  
308 “there was no sign the disaster was caused by natural causes, therefore it must be caused by  
309 people” (Dunai, 2010). In ongoing efforts to determine human negligence, it was determined that  
310 flooding and subsidence led to structural breaches in the reservoir containing the alumina, yet it  
311 remained difficult to prove whether officials at the MAL alumina facility knew of the weakened  
312 infrastructure (NDGDM, 2010).

313 The degree of uncertainty related to the amount of damage and probability of occurrence  
314 is very high with disasters, particularly those influenced by climate change (Greiving et al.,  
315 2012; Munich Re, 2016). Liability can be more difficult to calculate and assign in these cases, in

316 part because disaster loss agencies (i.e., Munich Re, Swiss Re), are often accounting for specific  
317 losses from flooding and sudden-onset disasters that are more easily quantified, whereas the  
318 impact of slow-onset, or “silent”, disasters ~~related to climate change~~ can be more difficult to  
319 quantify ~~since they occur slowly over time~~ (IFRC, 2013). Therefore, due to numerous  
320 anthropogenic influences on these events (including anthropogenic effects of climate  
321 change/slow onset events), it is misleading to continue the differentiation in terminology  
322 between “natural” versus “man-made” disasters, and the frameworks that govern mechanisms for  
323 disaster response.

### 324 **3.2 Dimensions for different treatment**

325  
326 Increased frequency of major disasters, legal barriers to disaster response, and the  
327 absence of unified response ~~to both natural disasters and man-made accidents~~ have led to  
328 increased attention at a variety of levels for more integrated international frameworks ~~for disaster~~  
329 ~~response~~ (IFRC, 2007). The fragmented nature of disaster response has emerged from the need to  
330 address specific types of disasters, in specific regions, or response modalities. Furthermore,  
331 while natural disasters and industrial and nuclear accidents have established frameworks for  
332 response, natech accidents are often missing from chemical accident response programs (OECD,  
333 2015). Natech accidents can lead to the release of toxic substances, fires, or explosions and result  
334 in injuries and fatalities; therefore, the lack of consideration for natech response mechanisms,  
335 planning tools or response programs can be an external risk source for chemical and nuclear  
336 facilities (Krausmann and Baranzini, 2012). Some international instruments, such as the  
337 Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency and the  
338 Convention on Early Notification of a Nuclear Accident apply only to specific types of disaster.  
339 While the Nuclear Accidents Conventions were adopted almost immediately following the

340 Chernobyl nuclear accident, there still remains no similar overarching global framework for  
341 notification or assistance in response to industrial accidents, or for environmental emergencies  
342 more broadly (Bruch et al., 2016). Other disaster frameworks, like the Tampere Convention,  
343 apply only to a single sector or area of relief (~~such e.g., as the provision of importing~~  
344 ~~telecommunication resources following disasters caused by nature or human activity, or whether~~  
345 ~~occurring suddenly or as the result of complex, long-term processes~~). ~~Conversely~~ However, the  
346 ability to provide disaster response for natural disasters is quite broad and is included in a  
347 number of international frameworks. A question of applicability of agreements arises, however,  
348 when a complex disaster occurs and multiple institutions have a mandate for response, but it is  
349 unclear which institution should take the lead in responding or coordinating response efforts  
350 (Bruch et al., 2016). ~~During the Lebanon crisis in 2006, international assistance was requested in~~  
351 ~~response to the bombing of fuel storage tanks at a power station, and over 70 countries and~~  
352 ~~organizations responded—it was unclear who should take lead, and the need for coordination~~  
353 ~~was reflected among response efforts (Nijenhuis, 2014).~~

354 An additional ~~difficulty~~ challenge with fragmented disaster response frameworks lies in  
355 the types of international actors engaged in natural disasters and man-made accident response.  
356 Generally, there is a failure to include non-state actors, the private sector, or individuals in  
357 response efforts to disasters (IFRC, 2007). The Tampere Convention and the sub-regional Black  
358 Sea Economic Cooperation (BSEC) and Association of South East Asian Nations (ASEAN)  
359 agreements are exceptions. With the Tampere Convention, for example, the decision to offer  
360 assistance, the type of assistance provided, and the terms of assistance are up to the discretion of  
361 the non-state actors offering assistance (Bruch et al., 2016). Given the increasing role of private  
362 funds in disaster response and relief operations, ~~considering the inclusion of~~ considering the inclusion of these actors in

363 disaster frameworks can be beneficial. ~~Oftentimes, there is the assumption that assets and~~  
364 ~~personnel are provided as a favor to an affected state government, where when in reality they~~  
365 ~~might are normally be expected to reimburse costs and manage how assistance is carried out~~  
366 ~~(Bruch et al., 2016). However, efforts are increasingly being made to clarify the respective roles~~  
367 ~~of actors and institutions in regard to disaster response, and more recently laws are changing in~~  
368 ~~favor of including broader terminology to comprise both natural and man-made disasters (IFRC,~~  
369 ~~2007).~~

#### 370 **4 Disaster frameworks in the Danube basin and Tisza sub-basin**

371 Response to natural and man-made disasters, including natech accidents, is governed by a  
372 range of global, regional and national laws, policies, and soft-law instruments. In the Danube  
373 basin and Tisza sub-basin this includes the Industrial Accidents Convention and the Seveso  
374 Directive, the Water Framework Directive and the Floods Directive, as well as treaties and  
375 policies developed at the level of the Danube and Tisza. ~~Here~~As such, natural and man-made  
376 disasters continue to be treated as distinct and separate issues, where monitoring and response  
377 are managed independently.

#### 378 **4.1 Introduction to Danube basin and Tisza sub-basin**

379 In 1994, the Danube countries developed the Danube River Protection Convention  
380 (DRPC), ~~a legally binding instrument that ensures~~to ensure sustainable management of the  
381 Danube River. Through the International Commission for the Protection of the Danube River  
382 (ICPDR), the DRPC requested the ICPDR to coordinate the activities of the EU Water  
383 Framework Directive (WFD) and EU Floods Directive among the Danube member states. The  
384 WFD and Floods Directive are legally binding to members of the European Union, but through  
385 the DRPC become legally binding to all Danube member states, regardless of EU member status.

386 ~~among the EU member states.~~ The WFD combines the monitoring and assessment of ~~surface and~~  
 387 ~~groundwater~~ water quality in the basin, and the Floods Directive instructs national authorities to  
 388 establish flood risk management plans by 2015, linking the objectives of the WFD and the risk to  
 389 these objectives from flooding or coastal erosion through the Floods Directive, and integrating  
 390 them into basin level activities via the ICPDR. However, because not all countries of the Danube  
 391 are EU member states, not all measures and outcomes of the WFD and Floods Directive are  
 392 implemented equally among the basin countries.

393 The Danube ~~basin~~ and the Tisza ~~sub-basin~~ have experienced numerous natural and man-  
 394 made disasters, including natech accidents (e.g., Baia Mare Cyanide Spill, Hungarian Chemical  
 395 Accident, and recent Serbian landslides) (European Commission, 2016). These are tallied in  
 396 Table 24. However, the frameworks for disaster response at the levels of the United Nations, the  
 397 European Union, and those utilized by the ICPDR ~~and implemented at the national level by the~~  
 398 ~~Danube countries,~~ are restricted to particular types of disaster – monitoring and response to  
 399 flooding is the most advanced throughout the basin, while pollution is monitored, but does not  
 400 have the same frameworks for response. Additionally, there remain a variety of natural and man-  
 401 made disasters that ~~occur throughout the basin~~ that are not integrated into any type of basin  
 402 monitoring or response framework, including fire, and drought, ~~and other types of predictive~~  
 403 ~~climate modeling.~~

404 Table 4. Natural and man-made disasters in the Danube basin, reported by country, 2000-2012

405 ~~Table 2. Natural and man-made disasters in the Danube basin, reported by country (2000-~~  
 406 ~~2012).~~ (Adapted from European Commission, 2016.)

2000	Mine tailing failure/cyanide and heavy metal pollution (natech) Landslide/avalanche Extreme temp./drought Flooding	Romania, Hungary, Bulgaria, Macedonia Austria, Slovenia Bulgaria, Croatia, Slovenia Croatia, Hungary, Romania, Slovenia
------	--	--

2001	Severe ice storms	Moldova, Ukraine
	Wildfires	Croatia, Slovakia
	Factory fire	Slovenia
	Mining accident (natech)	Slovenia
	Flooding	Croatia, Hungary, Romania, Slovakia, Ukraine
2002	Industrial fire at waste dump	Slovenia
2003	Mining accident (natech)	Slovenia
	Extreme temp./drought	Austria, Croatia, Germany, Slovenia, Bosnia and Herzegovina
2004	Flash floods/severe storms	Hungary
	Wildfires	Slovenia
	Drinking water pollution (natech)	Hungary
	Dam failure	Romania
	Earthquake	Slovenia
2005	Flooding/severe storms	Hungary, Slovakia
	Drought	Bosnia and Herzegovina
	Landslides	Slovenia
	Flooding/Severe Storms	All Danube Countries, except Ukraine
	2006	Avian (H5N1) flu pandemic
2007	Aircraft accident	Hungary
	Earthquake	Hungary
	Extreme Temp.	Bulgaria
	Wildfires	Slovenia
	Wildfires/forest fires	Bulgaria, Croatia
2008	Hurricane	Germany
	Extreme temp./drought	Austria, Bulgaria, Croatia, Hungary, Romania, Slovakia, Bosnia and Herzegovina, Montenegro, Serbia, Moldova
	Flash floods/severe storms	Bulgaria, Germany, Hungary, Romania, Slovenia, Montenegro, Serbia, Ukraine
	Transportation accident	Croatia
	Extreme temp.	Bulgaria
2009	Forest fires	Bulgaria
	Flash floods/severe storms	Hungary
	Flooding	Romania, Slovakia, Slovenia, Serbia, Moldova, Ukraine
	Swine (H1N1) flu pandemic	All Danube Countries
	Ice storms/blizzard	Croatia, Romania, Bosnia



2010	Chemical accident (natech)	and Herzegovina, Ukraine
	Earthquake	Hungary
2012	Ice storms/blizzards	Serbia
		Bulgaria, Hungary,
		Romania, Montenegro,
		Serbia, Moldova, Ukraine
	Extreme temp./drought	Moldova

-Note that economic losses, deaths and displacements are not reported to either European Commission or ICPDR.

- Where indicated, natech accidents occurred because of initial flood event that led to subsidiary release of chemicals/pollutants.

-Adapted from European Commission, 2016.

#### 4.2.1 How disasters are treated differently within response frameworks

~~In the absence of a centralized institution for disaster response, the development of a large and diverse international disaster relief community has occurred. Initially, the large-scale relief work after natural disasters was undertaken by the Red Cross movement at the end of the 19<sup>th</sup> century, but eventually the disaster relief community expanded capacity and function to include a variety of disaster assistance activities and involve other international initiatives and organizations (IFRC, 2007). The United Nations (UN) began humanitarian work shortly after World War II with agencies such as the United Nations High Commission for Refugees (UNHCR), and predecessor agencies such as the United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA) are now regularly engaged in disaster response and relief (IFRC, 2007).~~

Numerous frameworks for response to natural disasters exist [\(Table 31\)](#). [Apart from natural disasters, the United Nations Economic Commission for Europe’s \(UNECE\) Industrial Accident Convention applies to land-based, non-military, and non-radiological industrial accidents \(UNECE, 2009\). Through the convention, response for industrial accidents is provided through bilateral or multilateral arrangements. If no prior agreements exist, an affected country can request assistance from other parties through mutual assistance agreements. However, in these situations, it is the responsibility of the requesting country to cover all costs, unless](#)

429 otherwise agreed upon among the responding countries (UNECE, 2009). One example is the  
 430 2002 UN General Assembly Resolution 57/150 on “Strengthening Effectiveness and  
 431 Coordination of Urban Search and Rescue Assistance” (UN, 2003). While non-binding, the  
 432 resolution highlights the importance of national responsibility to victims of natural disasters  
 433 within country borders, but in the event that an incident exceeds country capacity, Urban Search  
 434 and Rescue (USAR) assistance through the International Search and Rescue Advisory Group  
 435 (INSARAG) can supplement local rescuers, and the coordination of these resources, particularly  
 436 following earthquakes or other events leading to structural collapse (INSARAG, 2016).

437 **Table 3. List of legally binding mechanisms for Danube basin and Tisza sub-basin.**  
 438

439 ~~**Table 3. List of legally binding mechanisms for Danube basin and Tisza sub-basin.**~~

<u>Governing Body</u>	<u>Convention</u>	<u>Type of Instrument</u>	<u>Description of Instrument</u>
<u>UN Economic Commission for Europe</u>	<u>Industrial Accidents Convention</u>	<u>Legally binding for parties to convention.</u>	<u>Determines actions of request for assistance and response for industrial accidents specifically.</u>
<u>European Commission</u>	<u>Water Framework Directive</u>	<u>Legally binding for EU member states, and through Danube Convention.</u>	<u>Sets basin level management of water quality and quantity.</u>
<u>European Commission</u>	<u>Floods Directive</u>	<u>Legally binding for EU member states, and through Danube Convention.</u>	<u>Requires action regarding flood mapping at the basin level.</u>
<u>European Commission</u>	<u>Seveso Directives</u>	<u>Legally binding for EU member states.</u>	<u>Requires corporations to list possible risk of industrial accident, and develop</u>

			<u>preparedness plans.</u>
<u>European Commission</u>	<u>Civil Protection Mechanism Directive</u>	<u>Legally binding for EU member states.</u>	<u>First EU-wide law to include multiple hazards in disaster risk strategies.</u>
<u>International Commission for the Protection of the Danube River (ICPDR)</u>	<u>Danube River Protection Convention</u>	<u>Legally binding for Danube member states.</u>	<u>Provides integrated framework for all Danube countries to participate in basin-level management, regardless of EU affiliation.</u>

440

441           Apart from natural disasters, the United Nations Economic Commission for Europe’s  
442 (UNECE) Industrial Accident Convention applies to land-based, non-military, and non-  
443 radiological industrial accidents (UNECE, 2009). Through the convention, response for  
444 industrial accidents is provided through bilateral or multilateral arrangements developed in  
445 advance among the parties. If no prior agreements exist, an affected country can request  
446 assistance from other parties through mutual assistance agreements. However, in these situations,  
447 it is the responsibility of the requesting country to cover all costs incurred for disaster response,  
448 unless otherwise agreed upon among the responding countries (UNECE, 2009). Flooding in the  
449 Danube in 2013 and 2014 caused approximately €15 billion in damage (Table 453), and while  
450 the economic cost from industrial and other man-made accidents are not monitored or reported in  
451 the same manner (Table 24), such accidents have occurred quite frequently and make apparent  
452 the need for improved agreements on bilateral or multilateral relief (ICPDR 2015b).

453 **Table 5.** Estimated human and economic loss in Danube per flood event, 2002-2014  
454

455 **Table 43.** Estimated human and economic loss in Danube per flood event (2002-2014) (Adapted from ICPDR, 2008b and ICPDR, 2015b).

<b>Flood Year</b>	<b># Deaths or # Displaced</b>	<b>Economic Losses €</b>
2002	N/A	N/A
2006	N/A	> €6 billion
2010	35 deaths	€2 billion
2013	9 deaths	€2.4 billion
2014	79 deaths; 137,000 displaced	€4 billion

\*N/A – Data not available

[-Adapted from ICPDR, 2008b and ICPDR, 2015b](#)

456  
457  
458  
459

The facilitation of international disaster response can be inadequate if mobilization is

460 untimely, or fails to include sufficient financial support. Response frameworks may neglect or

461 place disproportionate attention on certain types of disasters, which could become more

462 problematic with growing concerns over climate change and increased urbanization. ~~For~~

463 ~~example, there is visible delayed response for sudden-onset disasters such as the 2005 Indian~~

464 ~~Ocean tsunami and the 2010 Haiti earthquake which received the majority of funding support~~

465 ~~within one to three months of the initial request, compared to the slow-onset drought events of~~

466 ~~the 2011 appeals by Kenya and Somalia where funding was not provided until nearly 7-12~~

467 ~~months after the initial request (GHA, 2013). In 2005, nearly three-quarters of all UN~~

468 ~~contributions for natural disasters arrived within a month of their appeal; the comparable figure~~

469 ~~for complex emergencies was only seven percent (IFRC, 2007).~~

470 ~~While differences exist among slow-onset and sudden-onset disasters, they can create~~

471 ~~cumulative impacts to the community that increase vulnerability and lead to larger disasters in~~

472 ~~the future—precipitation deficiencies in soil and water lead to drought and when combined with~~

473 ~~high temperatures and dry conditions, this can lead to wildfires (e.g., extreme fire hazard~~

474 ~~situations in the eastern US and south-east Australia) (Smith, 2013).~~

475 ~~The growing size and diversity of international responders to disasters can have~~

476 ~~ramifications for the facilitation, coordination, and quality of response efforts (IFRC, 2007).~~

477 Diverse systems of response are implemented among the Danube basin countries due to the

478 variety of disasters experienced. Some utilize a single Civil Protection Mechanism, while others  
479 rely on multiple parties among Ministries of the Interior, Ministries of Rural Development,  
480 Water Directorates, and a variety of additional local protection committees [4, 5]. Interviews  
481 indicated that not all responders/parties are sufficiently trained, and many lack managerial or  
482 technical capacity to manage specific disasters appropriately [4]. There is also large  
483 compartmentalization of tasks at lower levels – both regional and local – where integration  
484 among the various types of disaster, as well as increased cooperation is needed [2, 3]. Other than  
485 the fact that these diverse actors are providing certain types of disaster assistance, there is  
486 nothing uniting them – no international or regional disaster response system. Given the increased  
487 frequency of natural and man-made disasters and the growing number of actors involved in  
488 disaster response efforts, ensuring effectiveness of aid should not detract from response and  
489 assistance (IFRC, 2007).

490       Besides the diverse ensemble of international organizations with a mandate and capacity  
491 for responding to natural disasters and/or specific types of technological or industrial accidents,  
492 there are also agencies experienced in particular types of international disasters, but which may  
493 not necessarily have the mandate or capacity for response. In 1994, the United Nations  
494 Environment Programme (UNEP) and the UN Department of Humanitarian Affairs (DHA, the  
495 predecessor of OCHA), developed an administrative arrangement through an exchange of letters  
496 (Bruch et al., 2016). The arrangement relies on the environmental mandates of UNEP and the  
497 humanitarian mandates of the DHA. Through UNEP’s Governing Council Decision  
498 UNEP/GC.26/15 on “Strengthening International Cooperation on the Environmental Aspects of  
499 Emergency Response and Preparedness”, the Joint UNEP/UN OCHA Environment Unit (JEU)  
500 plays a leading role in facilitating coordination among international organizations in the event of

501 natural and man-made disasters, including natech accidents, which are more broadly termed  
502 environmental emergencies (UNEP, 2011). The JEU has a number of existing agreements and  
503 interface procedures in place with these organizations, in order to facilitate response, ~~particularly~~  
504 ~~because there is a lack of familiarity among UN member states regarding existing regional and~~  
505 ~~international systems for response to the various types of disasters, as well as the coordination~~  
506 ~~between them.~~ For example, the JEU facilitated international agreements and interface  
507 procedures to aid with response between UN Disaster Assessment and Coordination (UNDAC)  
508 and the EU Civil Protection Mechanism to the 2014 Serbian landslides following Cyclone  
509 Tamara (NERC, 2014). During the 2000 Baia Mare natech accident in the Tisza River sub-basin,  
510 sixteen experts from seven countries deployed for response to the natech accident, and the JEU  
511 assisted to coordinate response efforts among UNDAC, the European Commission, the Military  
512 Civil Defence Unit, the World Health Organization, and a variety of other actors (JEU, 2000).

513         At the regional level, the European Union’s Civil Protection Mechanism (EU CPM) is an  
514 instrument for disaster response that protects people, the environment, property, and cultural  
515 heritage in the event of natural or man-made disasters, occurring within or outside of the  
516 European Community (European Commission, 2016). Disasters are monitored internationally  
517 through the Emergency Response Coordination Centre (ERCC) in cooperation with the JEU and  
518 with participating states.

519         The European Union’s Seveso Directives (I enacted in 1982, II enacted in 1996, and III  
520 enacted in 2012) are some of the earliest pieces of legislation to address disaster risk (European  
521 Community, 1982; European Community, 1996; European Community, 2012). The various  
522 iterations of the Directive govern the establishments where dangerous substances are present,  
523 and require the establishments to classify and report the amounts, types, and locations of

524 dangerous substances present. The majority of the Directives' focus is on notification  
525 requirements and accident prevention, ~~including notification to the public due to the increased~~  
526 ~~risk by natural disasters associated with the location of the establishment and associated risks~~  
527 ~~from natech accidents~~ (European Union, 2012). The responsibility for response under the  
528 Directives falls on the establishment industries for developing preparedness response measures  
529 in advance of an accident, and notifying the competent authority in case of a major accident  
530 (European Union, 2012). However, a 2012 study by the European Commission indicated that  
531 industry in nearly half of the EU countries is believed to insufficiently consider natech risks in  
532 their preparedness response measures (Krausmann and Baranzini, 2012).

533         The EU Floods Directive provides a framework for addressing risk from natural disasters,  
534 specifically floods. While inspired not only by the damaging effects of floods, but also by  
535 increasing flood risks as a result of climate change, the main objective of the Directive is to  
536 require member states to assess and manage risks of flooding ~~within their territories~~ and to  
537 develop flood risk management plans. Though the plans are restricted to areas considered at high  
538 risk of floods, these are not integrated into other types of plans and maps available – such as the  
539 Inventory of Potential Accidental Risk Spots in the Danube<sup>5</sup> – nor are they used for developing  
540 preparedness response measures in advance of an accident or natural disaster, such as in the case  
541 of the Seveso Directive. Though the Flood Directive was expected to reduce flood risk,  
542 interviewees voiced disappointment regarding the limitations of integrating disaster risk more  
543 broadly, particularly in relation to water quality and accidental pollution [3]. These present as

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<sup>5</sup> Pursuant to the 2001 Baia Mare natech accident in Romania, the ICPDR conducted a qualitative evaluation of the hazardous locations in the Danube catchment area, with reference to location of possible water pollution. The report of Inventory of Potential Accidental Risk Spots was released in 2001, and has not been updated since (ICPDR, 2001; ICPDR, 2015a).

544 policy limitations to the Water Framework Directive and Flood Directive, as neither of the two  
545 directives require the integration of disaster risk of both floods and accidental pollution.

546 The European Union also developed a set of macro-regional strategies for the Adriatic  
547 and Ionian, Alpine, Baltic Sea, and Danube regions (European Commission, 2010). While the  
548 intent ~~from the EU~~ was to not provide new EU funding, these integrated frameworks are  
549 supported by EU Structural and Investment Funds in order to address common challenges faced  
550 in each defined area ~~in order to strengthen cooperation and achieve greater economic, social, and~~  
551 ~~territorial cohesion~~. In the Danube Strategy, risks from floods and industrial accidents are  
552 reflected as having substantially negative transnational impacts, and are listed as requiring  
553 preventive and disaster management measures that are implemented jointly, with the  
554 understanding that work undertaken in isolation in one place (e.g., to build levees) displaces the  
555 problem and places neighboring regions at greater risk of flooding (European Commission,  
556 2010). Other man-made disasters are integrated in the discussion of risks, as well as the need to  
557 account for climate change by taking a regional focus at the basin level (European Commission,  
558 2010, p. 8). In a 2015 European Commission Communication report ~~following implementation~~  
559 ~~of the Danube Strategy~~, several limitations were highlighted, including: the need to improve  
560 efforts to reduce the Danube region's risk of exposure to major floods and accidental hazardous  
561 material releases; limited political commitment, funding, and capacity among countries and  
562 institutions in the Danube; lack of staff, funding, and expertise impeding participation,  
563 particularly in lesser-developed areas of Danube – the report also acknowledged that these  
564 challenges are more acute in non-EU countries (EPRS, 2015). The limitations in funding,  
565 technical expertise, and capacity were confirmed in interviews with experts at various levels,



566 who also noted how this leads to uneven implementation of EU Directives within the basin that  
567 can create pockets of vulnerability to both flood risk and risks from industrial accidents [2, 3, 4].

568 While the Danube Strategy does not provide a framework for response to natural and  
569 man-made disasters, it does highlight the EU's continued support for managing multi-hazard  
570 response at multiple levels, particularly through Priority Area 5 "To Manage Environmental  
571 Risks". Specifically, it requests that the countries "strengthen operational cooperation among  
572 emergency response authorities in the Danube countries and improve the interoperability for  
573 risks that are common to an important number of countries in the region (i.e., floods and risks of  
574 other natural and man-made disasters)", and advises that each country's civil protection  
575 mechanism have an ~~updated~~ understanding of neighboring country's systems so that response  
576 teams can function smoothly in case of emergencies ~~involving bilateral, European, or~~  
577 ~~international response~~ (EUSDR, 2015). Experts also expressed the need for formal agreements  
578 with specific language on integrated mapping of complex disasters, as well as provisions  
579 addressing response to both natural and man-made disasters, particularly if additional grants  
580 could be given from the EU to support these activities [2, 3, 4, 5]. Some interviewees reflected  
581 that the regional Strategy depended on stronger countries helping the weaker ones, but  
582 limitations with funding and capacity are difficult to overcome [2]. In the 2015 Annual Report on  
583 implementation of the Danube Strategy produced by the Danube countries, all projects focused  
584 on implementation of the Floods Directive. The only mention of industrial accidents was to  
585 reflect the failure to include an updated Inventory of Potential Accidental Risk Spots along the  
586 Danube, which is also discussed in the 2015 Danube River Basin Management Plan (DRBMP)  
587 (EUSDR, 2015; ICPDR, 2015b). Given past issues with mine tailing collapses and other  
588 pollution disasters associated with flooding, the 2015 DRBMP acknowledged the need to update

589 the Inventory of Potential Accidental Risk Spots promptly (ICPDR, 2015b). Unfortunately, this  
 590 recommendation from the 2015 DRBMP, and initially expressed in first Danube River Basin  
 591 Management Plan of 2009, has yet to be realized.

592 Through the [1994](#) Danube River Protection Convention, Article 17 provides for mutual  
 593 assistance “where a critical situation of riverine conditions should arise”. While “critical  
 594 situation” is not defined, Article 17 indicates that the ICPDR will elaborate procedures for  
 595 mutual assistance including; the facilities and services to be rendered by the contracting party,  
 596 the facilitation of border-crossing formalities, arrangements for compensation, and methods of  
 597 reimbursement (ICPDR, 1994). These elaborations have not occurred through the ICPDR, but  
 598 rather in the form of bilateral agreements regarding transboundary flood measures among  
 599 Danube countries; however virtually no bilateral agreements exist regarding response to man-  
 600 made disasters in the basin (Table [52](#)).

601

<b>Countries</b>	<b>Transboundary Watercourses</b>	<b>Disasters/ Emergencies</b>
Austria—Czech Republic	1967 <sup>***</sup>	1994 (Floods Only)
Austria—Germany	1987	1991 (Floods Only)
Austria—Hungary	1956	1959 (Floods Only)
Austria—Slovakia	1967 <sup>***</sup>	1994 (Floods Only)
Austria—Slovenia	1956 <sup>***</sup>	1956 <sup>*</sup> (Floods Only)
Bosnia and Herzegovina— Croatia	1996	1996 (Natural/Manmade Disasters)
Bosnia and Herzegovina— Serbia and Montenegro <sup>**</sup>	-	2011 (Flood EWS)
Bulgaria—Romania	2004	2004 (Floods Only)
Bulgaria—Serbia	Draft	Draft (Floods Only)
Croatia—Hungary	1994	1994 (Floods Only)
Croatia—Serbia	-	-
Croatia—Slovenia	No Date	1977 <sup>***</sup> (Coastal Pollution)
Czech Republic—Slovakia	1999	-

**Table 54.** Bilateral agreements on transboundary watercourses and disasters among Danube countries (Adapted from ICPDR, 2009a; ICPDR, 2015a; UNEP, 2002).

Hungary—Romania	1986	2003 (Floods Only)
Hungary—Slovakia	1956 <sup>**</sup>	2014 (Floods Only)
Hungary—Slovenia	1994	1994 (Floods Only)
Hungary—Ukraine	1997	1998 (Floods Only)
Moldova—Romania	2010	2010 (Floods Only)
Moldova—Ukraine	1994	-
Serbia and Montenegro— Hungary	1955 <sup>**</sup>	1955 <sup>*</sup>
Serbia and Montenegro— Romania	1955 <sup>**</sup>	Under Discussion
Ukraine—Romania	1997	1952 <sup>***</sup> (Floods Only)
Ukraine—Slovakia	1995	2000 (Floods Only)

\* Agreement formed with Czechoslovak Socialist Republic

\*\* Agreement formed with Yugoslavia

\*\*\* Agreement formed with Union of Soviet Socialist Republics

- No Information Available

To bridge the gap regarding man-made accidents, some Danube basin countries have engaged in such agreements. Bulgaria, Moldova, Romania, Serbia, and Ukraine are parties to the DRPC, but have separately engaged in the BSEC Agreement on Response to Natural and Man-made disasters (Bruch et al., 2016). Furthermore, the Danube Delta countries (Moldova, Romania, and Ukraine) are working together with the UNECE Industrial Accidents Convention due to the large concentration of oil-related industries in the area in order to improve hazard management, increase transboundary cooperation, and strengthen operational response [1].

At the Danube basin level, the countries have engaged in a series of non-binding Memoranda of Understanding (MOU) referred to as the Danube Declarations, first in 2004, revised in 2010, and updated in 2016. The Declarations reinforce the language of the 1996 Danube River Protection Convention to sustainably manage the waters of the Danube, and reinforce the countries' commitment to continue the work of the WFD and Floods Directive. The 2016 Declaration recognizes the need for increased investment and improved warning systems for flood protection and contamination, as well as improving the exchange of information

621 throughout the Danube (ICPDR, 2016). The Danube River basin countries engage currently in  
622 two separate systems for flood monitoring and monitoring pollution from man-made accidents –  
623 the Emergency Flood Alert System and the Principal International Alert Centres (PIACs) of the  
624 Danube Accident Emergency Warning System (Danube AEWS), respectively. The Emergency  
625 Flood Alert System has been functioning since 2003 at the Joint Research Centre, a Directorate  
626 General of the European Commission, and works in collaboration with the national authorities of  
627 the member states and with a variety of meteorological services. The Emergency Flood Alert  
628 System provides two medium-range flood forecasts each day, with 3-10 day advance warning for  
629 flooding in the main stem of the Danube. An MOU has been signed with several, but not all of  
630 the Danube countries (Austria, Bulgaria, Czech Republic, Germany, Hungary, Moldova, Serbia,  
631 Slovakia, Slovenia, and Romania, and negotiations are underway with Bosnia and Herzegovina  
632 and Croatia), and information is available 24 hours a day through an online service managed by  
633 the Joint Research Centre (ICPDR, 2010). The Emergency Flood Alert System gives national  
634 authorities the ability to prepare response measures, including opening temporary flood retention  
635 areas, building temporary flood protection structures such as sandbag walls, and adopting civil  
636 protection measures such as closing down water supply systems (ICPDR, 2009b). These  
637 responses reduce further threat of flooding downstream, and prevent loss of lives and  
638 infrastructure. The MOU does not include tributaries draining areas less than 4,000 km<sup>2</sup>,  
639 therefore the Emergency Flood Alert System does not address flood risks in the Tisza, nor in  
640 certain basin countries where significant flood concerns arise, such as Ukraine [1].

641 Transboundary floods typically affect larger areas, can be more severe, result in a higher number  
642 of deaths, and cause increased economic loss than non-transboundary rivers (Baaker, 2009).

643 Therefore, the repeated occurrence of such large, costly flood events (Table 453) highlights the

644 ongoing need for improved strategies for flood preparedness and response, particularly in the  
645 absence of coordinated, multi-hazard bilateral and multilateral agreements among basin  
646 countries.

647 The Principle International Alert Centres (PIACs) of the Danube Accident Emergency  
648 Warning System monitor accidental water pollution incidents in the Danube River basin. Unlike  
649 the Emergency Flood Alert System, which is linked to monitoring conducted by the European  
650 Commission and is transmitted to national authorities (without involving the ICPDR in the  
651 monitoring process); the Danube AEWS system is managed by the ICPDR, but does not involve  
652 the European Commission. While all contracting parties of the DRPC cooperate with the Danube  
653 AEWS, they also are expected to have national policies regarding response to accidental  
654 pollution in the Danube that connects to the Principle International Alert Centres. The PIACs  
655 are expected to operate on a 24-hour basis within each country, and are in charge of all  
656 international communications. When a message regarding potentially serious accidental pollution  
657 occurs, the PIAC is responsible for communicating the accident to the ICPDR, and decides  
658 whether it is necessary to notify downstream countries, engages experts to assess the impacts of  
659 the pollution, and decides what response activities need to be taken at the national level (ICPDR,  
660 2014). Challenges to the Danube AEWS monitoring include territorial gaps (several areas along  
661 the Danube and Tisza are not monitored) [3, 4, 5], a limited number of bilateral agreements for  
662 response in case the accident exceeds national capacity (Table 524), and even though a variety of  
663 natural and man-made accidents occur (Table 24), not all types of man-made accidents are  
664 monitored. Increasing pressures are felt by downstream countries from the failure to monitor  
665 pollution events in a consistent and effective manner [4]. Furthermore, in order to keep the  
666 AEWS operational, there is increasing reliance on citizen reporting of pollution events in some

667 countries [4, 5]. This is particularly problematic in the Tisza countries where the lack of  
668 monitoring of both flood and accidental pollution events, combined with limited bilateral  
669 agreements raise concern among several countries [4, 5].

670 In the most recent Tisza River sub-basin MOU (from 2011), the Tisza countries agreed,  
671 among other things, to “take coordinated steps to prevent accidental risks, and develop  
672 harmonized mitigation and response measures, with the aim to present an updated Inventory of  
673 Potential Accidental Risk Spots by the end of 2012” (ICPDR, 2011). This complements the 2009  
674 request in the Danube basin (but as reflected above, has yet to be updated) (ICPDR, 2015b). To  
675 date, this has not occurred for the Tisza-sub-basin, but the language in the MOU does reflect an  
676 interest at the sub-basin level to prioritize not only the mapping and development of an Inventory  
677 of Potential Accidental Risk Spots, but also the development of harmonized response measures  
678 among floods and man-made hazards.

## 679 **5 Questioning the distinction**

680 While “natural” disasters may be a commonly used term, no disaster can be regarded as  
681 entirely natural if people have the capacity to avoid, mitigate, or reduce the risk from ~~it an~~  
682 ~~entirely natural hazard~~ (Picard, 2016). ~~However~~ Generally, the vulnerability to lives and  
683 livelihoods can be ~~avoided-reduced~~ with ~~proper~~ disaster preparedness and response, such as the  
684 proper placement, function, and use of early warning systems, ~~flood maintenance~~, and mitigation  
685 works such as levees and controlled flood outlets and properly timed dam releases.  
686

687 There is an additional shift in what is considered truly a natural disaster as well – not only  
688 from the perspective of mitigation or vulnerability, but in acknowledgement of the anthropogenic  
689 influences on natural disasters. Climate change is one aspect, but there are also induced  
690 earthquakes occurring as a result of slipping faults from fluid injection in hydraulic fracturing

691 (Legere, 2016) ~~and from the weight of shifting water impoundments from Three Gorges (Stone,~~  
692 ~~2008)~~, landslides from subsidence and increased land use activities including urbanization  
693 (Smith, 2013), and pandemics from deforestation and habitat conversion (Greger, 2007), to name  
694 a few. ~~Holistic frameworks that include multiple types of disasters are needed in order to respond~~  
695 ~~effectively.~~

696 ~~Human intervention in the physical environment exposes populations to natural hazards~~  
697 ~~from the built environment, such as housing and associated infrastructure, including industrial~~  
698 ~~facilities, drainage works, and planning—especially when the built environment is not~~  
699 ~~appropriately designed or built to account for the risks~~ hazards. Human, economic, and  
700 environmental losses can be worse in highly populated, urbanized areas; with increased  
701 urbanization and climate change, they are placed at increased risk to natural and man-made  
702 hazards (Bruch and Goldman, 2012; Huppert and Sparks, 2006). For this reason, natech  
703 accidents and other cascading disasters are particularly problematic types of disasters.  
704 Simultaneous response efforts are required to attend to both the industrial, chemical, or  
705 technological accident as well as the triggering natural disaster. Therefore, expanded definitions  
706 of that reflect multiple types of disaster, as well as broad-improved frameworks for response to  
707 multiple types of disaster, are needed in order to recognize that many disasters can arise from  
708 multiple, potentially co-located hazards—and to take the necessary measures to reduce the risks  
709 of those hazards.

710 ~~While distinctions among disasters are still claimed for liability in some cases (including~~  
711 ~~in determining deliberate conduct or negligence), the distinction between natural and man-made~~  
712 ~~disasters is largely irrelevant from the perspective of humanitarian response and the humanitarian~~  
713 ~~consequence of multi-hazard events and those that are caused by natural or technological~~

714 ~~hazards. Furthermore, in the event that disasters are slow-onset, or when the ability to mitigate or~~  
715 ~~respond to risk is not timely or effective, the long-term effects of the disaster can be magnified~~  
716 ~~and lead to further vulnerability, such as famine, malnutrition, or mortality (IFRC, 2006).~~

717         The 2011 Fukushima nuclear disaster in Japan, triggered by the Great East Japan  
718 Earthquake and resultant tsunami, illustrated the complex relationship of natural hazards and the  
719 built environment and human factors, resulting in natech vulnerabilities. In part as a response to  
720 the earthquake, tsunami, and nuclear accident at Fukushima and as a more general approach to  
721 providing a comprehensive, multidimensional and multi-sectoral approach to reducing disaster  
722 risk, the United Nations member states adopted the Sendai Framework for Disaster Risk  
723 Reduction in 2015. To some experts, the preceding 2005 Hyogo Framework for Action focused  
724 too much on disaster risk reduction from natural disasters, and ignored industrial accidents and  
725 complex accidents like natech accidents [6]. In fact, in a 2011 study by the European  
726 Commission, out of 14 EU countries that experienced natech accidents, more than half of the  
727 accidents resulted in the release of toxic substances, fires, or explosions (Krausmann and  
728 Baranzini, 2012).

729         The Sendai Framework places unprecedented emphasis on the interaction between  
730 hazards (natural and man-made), exposure levels, and pre-existing vulnerability (Aitsi-Selmi and  
731 Murray, 2016). It calls to action for improving decision making through a stronger science-  
732 policy-practice interface, with four priority areas for action –including strengthening disaster  
733 governance with regard to shared resources and at the basin level (UNISDR, 2015).

734         The Organization for Economic Cooperation and Development (OECD) also provides  
735 guidance for the planning and operation of facilities where hazardous substances are located  
736 through the use of their 2003 Guiding Principles for Chemical Accident Prevention,



737 Preparedness, and Response. Recognizing the gaps in natech risk management and  
738 methodologies, the OECD developed an addendum in 2015 to the Guiding Principles that  
739 include 1) an investigation of the prevention of chemical accidents, as well as preparedness for  
740 and response to chemical accidents resulting from natural hazards that are not a part of national  
741 chemical accident programs; and 2) recommendations for best practices with respect to  
742 prevention of, preparedness for, and response to natech accidents (OECD, 2015).

743 Regional frameworks for response to natural and man-made disasters have been  
744 developed by member states of the Black Sea Economic Cooperation (BSEC) and the  
745 Association of South East Asian Nations (ASEAN). These regional agreements have also  
746 progressed to include national efforts, such as the coordination of technical assistance and  
747 resource mobilization during response to natural and man-made disasters (ASEAN, 2010; BSEC,  
748 1998).

## 749 **6 Building holistic approaches for integrating multilevel disaster response**

750 The transition toward a multi-hazard approach for response to natural and man-made  
751 disasters, and the acknowledgement of the risks of natech accidents is occurring at many levels.  
752 It is present in the work of the United Nations and the multilevel response frameworks of the EU  
753 Civil Protection Mechanism; some regional agencies are also adopting similar agreements (i.e.,  
754 ASEAN, BSEC). However, there remains a disparity in managing natural and man-made  
755 disasters in a holistic manner at the national level, as well as in the monitoring of these types of  
756 events at the Danube basin and Tisza sub-basin levels. The challenges are not insurmountable;  
757 this section proposes two sets of options for reducing and eventually eliminating the historic  
758 dichotomy among approaches to disaster response and monitoring.

### 759 **6.1 Multi-hazard approaches**

760 The process of building holistic approaches to planning, preparedness, and response can  
761 strengthen systems for responding to natural and man-made disasters in a more integrated  
762 manner (i.e., adopting a multi-hazard approach). ~~Building holistic disaster risk processes~~ These  
763 processes may be done at the global (e.g., Sendai), regional (e.g., BSEC), bilateral, and national  
764 levels. By adopting a multi-hazard framework for disaster response, the expertise and practices  
765 of responders can be enhanced to include improved modeling and assessment approaches,  
766 response methodologies and tools, and heightened measures to prevent or mitigate the  
767 consequences from natech accidents (Krausmann, Cruz, and Salzano, 2017).

768 The review of legal and policy frameworks and interviews reflected that while some  
769 planning and preparedness activities take place regarding flood hazard, this generally is not the  
770 case for accidental pollution (at least in the Danube and Tisza context), and natech accidents are  
771 largely removed or ignored [2, 3, 4, 5, 6] (European Commission, 2010; ICPDR, 2015a). Gaps in  
772 monitoring were cited along the length of both the Danube and the Tisza in regard to both  
773 flooding and accidental pollution, which should also be improved in future planning efforts. The  
774 Tisza sub-basin and smaller water bodies are beyond the scope of the WFD, consequently, no  
775 holistic monitoring or response measures are in place; regional agreements at the basin or sub-  
776 basin level could aid in developing improved response frameworks [2, 3] (McClain et al., 2016).

777 Improving the mapping of hazards to reflect not only flood hazard, but also risks from  
778 man-made disasters and natech events – and integrating these risks into a holistic map of  
779 vulnerability to disaster – would provide a foundation for more holistic policies and  
780 programming to manage disaster risks. It would also aid in improving measures for preparedness  
781 at the national and local levels. Multi-hazard response frameworks provide the opportunity to  
782 intervene and mitigate the size of future disasters. Interviews indicate that harmonized

783 approaches to natural and man-made disasters offer additional opportunities to strengthen  
784 capacity among transboundary actors [1, 4].

## 785 **6.2 Multi-hazard response modalities**

786 In order to avoid fragmentation among response to natural and man-made disasters, and  
787 empower, guide, and facilitate the institutional arrangements and mandates necessary to improve  
788 ~~response to natural and man-made disasters~~these activities, the legal and policy frameworks need  
789 to provide the necessary mandates and procedures – this is accomplished by incorporating an  
790 integrated, multi-hazard approach to disaster response. In regard to the Danube basin, this could  
791 be done in a variety of ways. The Danube River Protection Convention has not been updated or  
792 amended since it was originally drafted in 1994, but it unites all countries of the Danube basin  
793 and its tributaries under a formal, legal agreement. Cooperation among Danube countries was  
794 generally reported as good [3]; therefore, continuing the use of the ICPDR and its expert groups  
795 as a mechanism to gain cooperation among the countries on a regional framework for improving  
796 monitoring and response could be considered [3, 4, 5]. Another possibility would be to expand  
797 the numerous bilateral agreements among the Danube and Tisza countries regarding flooding to  
798 also include man-made disasters and natech events. Working on agreements at a regional level  
799 improves communication, breaks down barriers (particularly in transboundary situations), and  
800 aids in the development of a common legal language among participating parties [1, 2].

801 Updating conventions and other hard law can be difficult; countries often find soft law to  
802 be more flexible, they are sometimes unwilling to adopt binding obligations, particularly in the  
803 face of uncertainty (e.g., climate change), or when they feel there might be a need to act quickly  
804 to changing circumstances. In this regard, updating the Danube Declaration and the  
805 corresponding Tisza MOUs can provide particularly viable options. Through the Declarations

806 and MOUs, the Danube or Tisza countries could decide whether to engage in a particular action  
807 through a separate strategy, or pilot project, or whether to incorporate the issue into the broader  
808 basin or sub-basin management plan (e.g., improvement of accidental pollution and flood  
809 monitoring, integrated accidental pollution and flood maps). Improved vertical and horizontal  
810 cooperation was a request of several interviewees, particularly in regard to the risks posed from  
811 man-made accidents and how to respond to these accidents [4, 5].

## 812 **7 Conclusions**

813  
814 The historic distinction between natural and man-made disasters is outdated,  
815 counterproductive, and ultimately flawed. Natural disasters have the potential to trigger  
816 simultaneous technological or chemical accidents from one or multiple sources. With  
817 anthropogenic climate change influencing the frequency and intensity of disasters, the  
818 distinctions in ~~preventing, monitoring,~~ and responding to disasters from either natural or man-  
819 made sources are further called into question. Moreover, increased urbanization and shifting  
820 populations are placing more people at greater risk in times of disaster (whether natural or man-  
821 made). As a result, it is increasingly clear that there are no purely natural disasters.

822 Recognizing that the historic distinctions between natural and man-made disasters are no  
823 longer relevant, there is increasing recognition of the need to address disasters holistically,  
824 regardless of the contributing causes and aggravating factors. This trend is noted in the Sendai  
825 Framework, which adopts a multi-hazard risk approach and provides tools for ~~managing~~  
826 ~~responding to~~ disasters that are both natural and man-made (UNISDR, 2015). While the current  
827 policy frameworks in the Danube basin and Tisza sub-basin do not address ~~preparedness~~  
828 ~~monitoring~~ and response holistically across types of disasters, the basin countries have several  
829 options for more integrated response. A key opportunity is the development or amendment of

830 agreements governing response to natural and man-made disasters. This could be negotiated  
831 through updates to the Danube Convention or through bilateral treaties between the basin  
832 countries. Improving planning and preparedness through more integrated monitoring and  
833 mapping of natural and man-made disasters, such as combining the flood risk areas with the  
834 Inventory of Potential Accidental Risk Spots, could be elaborated upon in Declarations and  
835 MOUs at the basin and sub-basin levels.

836 A coordinated approach to natural and man-made disasters, including natech accidents, is  
837 currently taken through the European Union Civil Protection Mechanism and BSEC. This is not  
838 unique to Europe alone, and other similar regional approaches exist from which to draw lessons  
839 (including the ASEAN agreement). The Danube and Tisza countries are well versed in the  
840 transboundary impacts from natural and man-made disasters, and natech accidents; climate  
841 change is likely to increase the frequency and severity of these events in the foreseeable future.  
842 Nevertheless, while approaches for integrating holistic frameworks for disaster response are  
843 recognized at multiple levels, implementation within the Danube basin and Tisza sub-basin  
844 remains distinct and fragmented.

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