

Dear editor,

Please find attached our revised manuscript (normal version and tracked-changed version) and below our point-to-point response to both reviewers and community comments (in bold, with original reviewer comment in normal font). We have made two new figures (Fig. 4 & 5), rephrased the abstract and large parts of the Introduction and Reflections sections, and added many details on the pilot study. We hope we have now adequately addressed all concerns and suggestions and are looking forward to hearing your (positive) response about our manuscript.

Best regards,

Anne Van Loon (on behalf of all authors)

RC1

We want to thank Louise Arnal for reviewing our manuscript and for the positive words about our paper. In the revised version of the paper we addressed her comments. Below our point-to-point response to the questions raised in RC1, with page and line numbers referring to the tracked-changed version of the revised manuscript.

Main comments:

1. The authors seem to suggest throughout the paper that the impacts of using creative practice should be analysed against using more traditional methodologies. E.g. on P1 L16-17 and P16 L398-399. In my opinion however, and as raised by the authors in the last bullet point on P16, creative practice should be used in combination with more traditional methodologies. As such, the aim should not be to compare the impact of both processes, but rather to investigate the added value of creative practices within more traditional current processes.

>> We agree with the point raised that creative practices and more conventional processes should be combined. In the earlier version of the manuscript we did indeed discuss this in Section 4 and suggested it in our list of suggestions, but have now also mentioned it in the abstract (l.29-30), at the start of the manuscript (l.82), added a few sentences in Section 2 (l.285-289) and Section 4 (l.459-460 & l.562-566), and rephrased the conclusion (l.630).

2. As a succession to this point, it would be great if you could strengthen your point on how creative practice can complement more traditional methodologies, perhaps in the discussion. This is very nicely reflected in the methodology you follow for the pilot project, as explained on P10 L228-229: the use of model outputs to prompt the participants' imagination. A few questions it would be great to have your opinions on are: 1) How can creative practice tackle the point you raise on P1-2 L23-26? E.g. you mention on P15-16 L375-379 that creative methods can help increase resilience if previous extreme events happened a long time ago or for future events outside of previous experience (which is expected to happen more frequently with climate change). 2) Another point is that the success of increasing dialogues between groups in a community is better measured on the long-term (P10 L216-217). Could you please reflect on how creative practice has a role in insuring this "longevity" of the success of a project. E.g. I would argue that art is timeless, whereas other more traditional methodologies might not be. 3) As hinted by your comment on P11 L230, different art forms appeal to different communities given their culture. E.g.

some communities might prefer storytelling, others dancing, etc. as these are art forms already deeply rooted within their culture. This is where creative practice can help over more traditional methodologies, by echoing a community's culture

>> In the revised manuscript we have now elaborated on how creative practice can be used in conjunction with other (more conventional) methodologies. For example, we discuss more on the aspect of longevity of effects (as also suggested by SC1) and highlight more the cultural embeddedness of the creative practice. With regard to the former we do want to point out that in this study we are not focussing on art as a product, but more on art as a process. This means that we are not looking at the artistic products themselves being timeless, but that we are more wondering how long-lasting the effects of engaging in artistic practice on resilience are. With regard to the latter we now point out that this embeddedness is important just like conventional engineering flood and drought measures also only work if they are tuned correctly to the local circumstances (both natural, socio-economic and cultural) (I.548-559).

3. I found it interesting to read about the different examples of creative practices and their goal, doer and audience on P3-4 L70-110, but found it hard to understand the exact purpose of these paragraphs. It appears to already be a part of the literature mapping and hence might fit better in the next sub-section? If their purpose is to give examples of different combinations of the three dimensions you put forward earlier, it would be helpful to clarify this. It might also help guide the reader to be consistent and use the same language as introduced earlier regarding the three dimensions within these five example paragraphs. E.g. For the first point, the goal is to raise awareness by passing on knowledge between generations, the doer and audience are the community.

>> As the reviewer suggests, we now clarify how these examples fit the classification introduced before (I.108-109, 116-118, 119-120, 132, I.140-141, 148-150). We still include them in the introductory section, because they include references outside those identified in the systematic literature review.

4. Where do games stand in the midst of the creative processes you looked at? I would argue that they are a creative practice. However, there is very little mention of games until P11 L230 (if I'm not mistaken). On P4 L109-110 you say that there is no example to your knowledge of artistic products in decision-making. I think that there are plenty of resources on the use of games in decision-making which it would be great to highlight. E.g. the numerous workshops organised by the Red Cross using "serious games":
<https://www.climatecentre.org/resources-games/games>, the IHE Delft games:
<https://www.un-ihe.org/serious-games-decision-making>, or the HEPEx games:
<https://hepex.inrae.fr/resources/hepex-games/>.

>> We agree that there are some very good examples of using games in decision making on water-related issues. For this paper, we see these as outside the scope of our review. In the revised version of the manuscript we have added some text to the Introduction (I.49-54) and citing a number of excellent (review) papers.

5. I found it hard to understand Fig. 4 and visualise the results you mention on P9-10 L196-203. I think another graphic format may be more suitable to highlight these results and the gaps in the existing literature. Pie charts may be more intuitive? Could you please also change "Method" to "Doer", to be consistent with language introduced on P3 L63. It is not clear to me why 2 of the CS and one F5 circles are lighter in colour. Additionally, I think it would be

very interesting to be able to map the wider literature onto this graphic to see how the flood- & drought-related literature compares to it.

>> We implemented the suggestions for improving Fig.4. With regard to the graphic format of Fig.4 we tried different options and decided use a spider diagram. It would indeed be very interesting to also map the wider literature into these categories for comparison, but this would be an enormous task, because it requires carefully re-reading all 267 journal articles selected during the literature review and manually classifying them into the categories.

6. Could you please reflect in the “reflections & perspectives” on: 1) how your findings may be limited by the mapping methodology you used: searching for research papers. There are surely a lot more creative practice examples out there, less researchoriented and with different goals, audience and doer, but not mentioned in any research paper. 2) What worked very well and less well in your pilot project: would you do anything differently now? What tips would you give to people who want to create such projects? 3) How do you foresee the continuation of the project? Do you plan to put in place methods to evaluate the long-term impacts this project may have on the community and decision-makers?

>> Thanks for the suggestions for chapter 4.

- **We actually did search for creative practice examples outside the scientific literature and agree that a lot can be found there. We decided however not to include these in this paper as we found that the search methodology was less robust (much more dependent on Google search terms). We now mention this in the revised manuscript (l.467-470).**
- **In the previous version of the manuscript we already summarised the challenges we encountered in the case study (which often were also reflected in the literature) in lines 341-352 (previous version) and mentioned some lessons-learned in lines 353-355 (previous version). In the revised manuscript we added a specific subsection with limitations of our pilot study (l.476-484) and included more examples from our pilot study throughout the Reflections section.**
- **Since we only had funding for a short pilot project, we unfortunately cannot evaluate the longer term effect of our project. This is a common problem with most funders funding implementation of innovative ideas and not necessarily its longer-term impacts. We now make this more explicit in the revised version of the manuscript (l. 484) and discuss the aspect of timescales for evaluation (l.503-512).**

Specific comments:

In response to the specific comments, we will define Global South communities, give examples of creative practice and artistic artefacts, and explain the critiques of the term resilience (see our response to SC1). The issue with the goals (P3 L63-64 and P4 L112) relates to point 3 above. The combination of goal, doer and audience leads to different types of using artistic practice in resilience research. Hopefully with rephrasing the examples in sub-section 2.1, this becomes clear.

- P1 L20: Could you please define here what you mean with Global South communities, perhaps by moving the definition on P2 L33-34 here. **>> DONE, thanks.**
- P2 L25-28: These 2 sentences seem like a repetition. Please considering merging and/or reformulating. **>> We merged these sentences.**
- P2 L31-32: This statement puzzled me at first. Could you maybe give examples of creative practice (with and without end products) and of artistic artefacts. **>> We rewrote this sentence and added a few examples.**

- P2 L37: Could you please clarify what you mean by “suitable traditional structural or non-structural measures”. >> **We added some examples.**
- P2 L41: Could you please explain briefly what the main critiques of the term “resilience” are. >> **We expanded on the most relevant critique for this paper, but for additional critiques we refer to the papers mentioned.**
- P3 L63-64: The examples of goals you mention here do not correspond to the goals you mention on P4 L112. Please consider updating this list, as well as throughout the paper. >> **We rephrased the latter sentence, also based on the changes made to the earlier paragraphs with the examples of the combinations of the three dimensions. We hope this is clearer now.**
- P3 L73-74: Please specify what is the purpose of the practice described by McEwen et al. >> **This has been added.**
- P4 L93: I would argue that here the audience would also be the end-users of the research product, for example the readers of the research paper if the research is published, who may or may not be researchers. >> **This is indeed the case for most categories. We now discuss this more clearly in the paper.**
- P4 L106: Could you please clarify what you mean by “mental models”. >> **We have now added an explanation.**
- Fig. 1: If you have the data to plot this, it would be great to be able to visualise the separation per wider topics as well (i.e. hazards and disasters, climate change, other environmental issues, health, social and economic inequality, violence and conflict; or broader topics even), as different colours/patterns on the bars, to see how these change over time. E.g. Are the natural hazard articles more recent, even if they make a small overall portion of all papers? >> **We agree that this would be interesting, but we currently do not have the data ready to plot this.**
- P6 L 140-141: Could you please clarify what is “Photovoice (or Photo-Elicitation Methods or Camera-User-Study)” for less familiar readers like me. >> **We added an explanation of Photovoice.**
- P6 L 145-146: I understood this sentence only after having finished reading the whole paragraph. Could you please rephrase to clarify what is meant by “asking participants to develop new material”. >> **We have added some text on the creation of new material in the previous subsection (I.117-118). This will hopefully make this sentence easier to understand.**
- P7 L166-167: Would you be able to give an estimate of the % for all environmental papers you looked at in the literature mapping? It would be nice to have it to compare the % with those for papers on droughts & floods later on, on P10 L200-201. >> **This figure was added (67%).**
- P7 L167: Could you please clarify what you mean by “medium or high” (also on P8 L169). >> **We added this information to the Appendix and added a reference to the Appendix in the text.**
- P8 L176: Please clarify that these papers are D1&2. >> **Done.**
- P8 L184-185: This is a repetition of the line on P8 L180-182. Please consider merging. >> **We rephrased this sentence.**
- P8 L186: Please clarify that these papers are F1-5. >> **Done.**
- P9 L192: Please specify here that this is referring to Fig. 4. >> **Done.**
- P9-10 L196-199: This is not clear to me. Are the 2 categories you mention within the “goal” and “audience” categories? If so, could you please rephrase these sentences. The choice of the words “Firstly” and “Secondly” may be confusing me. Could you please also discuss what

results are with regards to the “Doer” (or “Method”). >> **Yes, these two categories relate to the “goal” and “audience” dimensions. We clarified this (l.268). The doer dimension is discussed later, which we have now also indicated more clearly.**

- P10 L199: Is “instigating action” pre-disaster similar to “raising awareness”? >> **No, it is not. In these cases, the community would implement measures to be better prepared for flood/drought. We added an explanation.**
- P10 L201: It would be great if you could mention again here what the percentages are of studies with a co-creation aspect, for comparison, for: floods & droughts, health issues and environmental issues. >> **Done.**
- P10 L210: Could you please clarify what you mean by “experimentation”. >> **This is taken from Biggs (2012) paper. We refer the reviewer and readers to this paper for further clarification.**
- P10 L212: You use the plural form of “approach” on P10 L207. Is this because the project was made of several approaches which your creative approach was a part of? Please clarify in the text. >> **We changed this to singular “approach”.**
- P11 L230: This is very interesting and merits further discussion. It appears that participants preferred storytelling as it is an art form already rooted in their culture perhaps? It would be great if you could add a few lines in the discussion about how processes/media might not be transferrable across communities as different communities have different histories/sensitivities to different arts. This perhaps complements your second point on P16: the goal, doer and audience are situation-specific, but so is the creative form/media used. >> **We added a paragraph on this in the Discussion section (l.550-557).**
- P11 L240: Do you have any reference you could cite here for the SHETRAN model? >> **Two references added.**
- P11 L252-253: I imagine the phrasing of these scenarios was worked on with care as they could lead to different responses from the participants. Could you please say a bit more on how the storylines were written? And maybe give a written example of a model output and the attached storyline in the paper? >> **We added some more information on the storylines and an additional figure (Fig. 5). For more details we refer to the paper by Rangelcroft et al. (2018).**
- P11 L254: Are the workshop categories in Phase 3 the same as in Phase 1? >> **Not completely, but using the same groupings. We explain this now.**
- P12 L287-289: Do you think this is just because of the age difference of these groups? These sentences would fit better in the former paragraph I think. >> **We expanded on this.**
- P13 L296-297: Please specify that you are referring for the workshops of phase 3. >> **Done.**
- P13 L311: Do you mean “request for government support”? >> **Yes, changed.**
- Fig. 5: It would be great, if possible, to have tangible narrative content in the paper as well. Only if possible, please consider adding perhaps parts of a narrative transcript, or a few quotes from several narratives, to the paper. >> **This is an interesting idea, but we feel that by adding one transcript we put too much emphasis on this one group’s view whereas very different views were expressed during the workshops. The narrative transcripts will be explored in more detail in Rohse et al. (in prep.).**
- P14 L329-330: Could you please share opinions on why you think that is? >> **We added some thoughts on this.**
- P14 L333-335: I am not sure I understand this sentence. Could you please clarify. >> **We rewrote this paragraph.**
- P14 L336-340: I think you are being too harsh with yourselves. While you couldn’t, as part of this project, evaluate the long-term benefits of your creative practice, there are some clear

short-term benefits that are worth mentioning again in the discussion. E.g. the fact that policymakers found the images you captured useful, the intergenerational exchanges your workshops led to, the fact that your workshops encouraged participants to use their imagination and exchange ideas vs referring to God in an uncertain future: : : These are already brilliant outputs which should feature here. >> **Thanks. We added this to this section.**

- P15 L371-373: This feels like an important point. Could you maybe answer this question using your pilot study? As you have seen both aspects in phase 1 and 3 of your workshops. >> **We added some evidence for this from our pilot study.**
- P15-16 L375-379: This is where creativity can foster exchanges across communities. E.g. A community who has not yet experienced a drought and may be confronted by these events in the future (for example due to climate change) could get an idea of what it is like on the ground by learning from communities facing droughts on a regular basis. >> **Thanks. We expanded on this point.**
- P16 L382-386: Could you please explain the purpose of this point further. >> **We added some text here.**
- P16 L404: Could you please clarify what “longitudinal studies” are. >> **We added the explanation.**
- P16 L396-405: Could the effectiveness of creative practice be measured by comparing different communities and how they have coped with environmental issues? For example aboriginal communities where the use of art seems to be deeply rooted in culture vs a culture where art is very rarely used. >> **Thanks. We added this point.**
- P17: Please summarise briefly what your paper is about before mentioning results. >> **We added a sentence.**

Technical corrections:

- P1 L21: Remove “and”. >> **Done.**
- P1 L22: Replace “and” after “water demands” by a comma. >> **Done.**
- P3 L73: Add a dot after “environmental stress”. >> **This is an enumeration, so the comma is needed.**
- P3 L73: “describe” without an s. >> **Done.**
- P4 L89: “built on” with a t. >> **Done.**
- P4 L111: Add “we” before “will”. >> **Done.**
- P4 L112: “instigating”. >> **Done.**
- P7 L156: “developed”. >> **Done.**
- P10 L209: “redundancy” might not be the adequate wording. Do you mean “repetition”? >> **No, we mean redundancy. Biggs et al. (2012) write: “Redundancy is essentially the opposite of disparity and provides “insurance” for ES provision by allowing some system elements to compensate for the loss or failure of others.”**
- P10 L217: “members’ travel to”. >> **We mean travel as verb here.**
- P11 L247: “3C”. >> **Done.**
- P11 L247: Remove “a” in front of “climate”. >> **Done.**
- P12 L294-295: “We used one climate change scenario and two scenarios related to human activities”. >> **Done.**

We want to thank Susanne Maciel for reviewing our manuscript and for the positive words about our paper. In the revised version of the paper we addressed her comments. Below our point-to-point response to the questions raised in RC2, with page and line numbers referring to the tracked-changed version of the revised manuscript.

1) General comments:

- The authors mention their project in South Africa as a pilot project, and they fit it in the narrative as filling a gap identified in the reviewed literature, when using creative process to promote awareness on floods and droughts issues in a co-production approach. In my opinion, the project should be described more as a complete research project rather than a pilot one, and include more aspects on the materials and methods, such as including pictures of the models that were presented to the community, and describing with more details how the workshops were conducted. This might be useful information for other groups that are conducting similar research. >> **We are happy to provide more details of the pilot study and answer the reviewers questions. For more information on the modelling, but we refer the reader to the paper published about this part of the research (Rangecroft et al., 2018). We do not think it is appropriate to add figures of the model results in this paper, since they would distract too much from the main message of this paper and they are already provided in Rangecroft et al. (2018). We did, however, add a figure on the process of translating model results into storylines that were discussed with the workshop participants (new Figure 5). We also added some more detail on the storylines and the workshops (l.345-347 & l.396-397) and updated the reference to the part of the project working with policy makers (Makaya et al., 2020). However, we prefer not to present our pilot study as a complete research project in this paper, partly because this would upset the balance between the two parts of the paper (the literature review and the pilot study) and partly because the results of the research are discussed in other publications (Rangecroft et al., 2018; Makaya et al., 2020; Rohse et al., in prep), and so we cannot fully reproduce this information.**
- Still about the project in South Africa, it was unclear to me what is the relation between the researchers and the community. Why and how that specific community was chosen, and how the researchers are related to the community are important aspects when dealing with marginalized communities. >> **We have now described in more detail the choice of community and how we relate to the community (l.311-315).**
- The authors recognize the sensitivity of the research topic, when dealing with marginalized communities that are often denied access to structural measures (L42-45). This makes me comfort to point out some narrative aspects that might reinforce a hegemonic view on the subject. For example, it is repeated several times throughout the text that creative practices are useful to elevate hidden voices, but I think the authors should make it explicit to whom these voices are hidden. Also, the authors make an analysis of increasing number of papers in the literature focusing on art-based and creative practice in the research field of environmental and health issues. I was struck by the fact that “most art-based research is carried out in the United States, Canada and the United Kingdom” (L129-130)”, and that Africa is the continent where most of these research projects are conducted. I am aware of several art-based projects happening in Latin America, by Latin American researchers. I can imagine that the same happen in other continents, and that these projects are usually not published in English. My point is that the authors could make a comment on the fact that since the keywords used by the authors are English words, you are automatically excluding a large number of papers written in other languages, and this turns your analysis biased. I don't think this is a problem, but I think it should be explicitated in the text. >>
 - o **With regards to the surfacing of hidden voice: we do point out to whom they are hidden. For example, on l.72-73 we state that “According to Gibson et al. (2018),**

cultural resourcefulness and coping capacities of rural populations are rarely acknowledged within state-expert modelling of resilience.” And we talk about how our videos were used more widely within the community and in conversations with policy makers. We have now strengthened this last point (l.302-304, l.434-435, l.480-483, l.526-527) and have also revised the wording throughout the paper.

- Thanks for pointing out the language bias in our search. We fully agree that we are missing a lot of art-based research on this topic written in other languages. We have addressed the issue of language when discussing the pilot study, but not the literature search, which is an important omission. We added this now to Section 4 Reflections & Perspectives (l.471-474).
- I personally don't like the term "Global South", and I will explain why. According to Wikipedia, the term 'Global South' originated in postcolonial studies, and was first used in 1969. The term is highly used from 1980 till 2008, and even more afterwards, to define the set of countries that are poor, less-developed or oppressed and powerless. First of all, the term is inaccurate, because it refers to economic development notion by a geographic term. In this case, it includes communities in the North (L33), which is confusing and vague. Secondly, it homogenizes all countries in the southern hemisphere, and obscures important differences between them. The authors mention that "most researchers do not use the keyword 'Global South' in their titles or keywords" (L436), and I don't think this is a coincidence or lack of knowledge of the term. If the authors want to mention "poor communities", or "less developed communities", they should use these words, instead of highlighting a confusing term such as Global South. I highly recommend the authors to rethink the usage of the term. >> **We agree that the use of the term 'Global South' to denote poor, less-developed or marginalised communities has geographic connotations that are confusing. However, the term 'less-developed' equally has important downsides. For example, using the terms developing / less-developed has connotations of a western standard of development and a narrow focus on economic growth. There appears to be no consensus within the scientific community which term is best, but we do find that the term Global South is widely used. Although we do recognise that the term has limitations, we suggest to stick with Global South in this paper. We have, however, expanded the explanation of our choice for the term in the revised version of the manuscript (l.55-64).**
- I agree with Louise Arnal's comments about Figure 4. I also found it difficult to follow. I would suggest that Table 1 be presented before Figure 4. >> **We have changed Figure 4 into a spider / polar diagram, which addresses the points made by both reviewers (Louise Arnal & Susanne Maciel). We feel that in this way the results are much easier to grasp in one glance. You can now see the connection between the different axes of one paper, which was very difficult before. Also, the two categories we explain in the paper (l.268-271) now show more clearly, namely the papers focussing on action mostly have the participants themselves as audience (D2, F3) and those focussing on raising awareness with the audience being the general public (D1, F2) or researchers (F4, F5). We also moved Table 1 to be presented before Figure 4.**
- The authors emphasize the need of evaluate the impacts of creative practice projects. In my experience, creative practice approaches usually show results in long term actions, and maybe this is an aspect that the autors could explore a little bit more in their literature review. The authors argue that the papers reviewed often describe a methodology without clear evaluation of its efficacy (L339), but how many of these papers describe long term projects? Still about evaluation, I would like to read how art-based projects usually evaluate their results, when they do. An interesting example is described by Strickert and Bradford: Of Research Pings and Ping-Pong Balls: the use of forum theatre for engaged water security research, *International Journal of Qualitative Methods*, 14, 1-14, <https://doi.org/10.1177/1609406915621409>, 2015.) They use the Forum Theater to engage

the community and policy makers for water security issues, and they evaluate the impacts of the approach by analysing the audience interferences into the play for each scenario. It is a very interesting example of evaluation of how creative practice can foster communication between researchers, community and policy makers. >> **In the revised version of the manuscript (in Section 4 Reflections & Perspectives, l.486-531) we now discuss in more detail how effects of creative practice will often will only become visible in the long term and added a few examples of how effects are evaluated if they are (l.497-498).**

- Just for the sake of knowledge, and perhaps to complement the analysis made in L39-40, I also would like to mention some works that are carried out in Brazil, where long-term theater based projects are conducted with rural populations, that might interest the authors: Boas, R. L. V., Pinto, V. C., and Rosa, S. M.: The School of Political Theater and Popular Video of Federal District: formation by praxis, *Urdimento*, 1, 36–47, <https://doi.org/10.5965/1414573101342019036>, 2019. and Gomide, C. S., Villas Boas, R. L., Martins, M. L., Gouveia, L. R., and Dias, A. L.: Rural Education and Pedagogy of Alternance: UnB experience in the Kalunga historical site and cultural heritage, *The Brazilian Scientific Journal of Rural Education*, 4, 1–27, <https://doi.org/10.20873/uft.rbec.e7187>, 2019. >> **Thanks for the paper suggestions.**
- L303, the authors mention that “in the workshops the narrative approach supported by data from the model scenarios allowed participants to use their imagination and exchange ideas”. I think this is a really important result of your work, and should be more explored in the text. >> **We agree that how ‘the narrative approach supported ... participants to use their imagination and exchange ideas’ is an important part of the results of our work. These aspects are explored in more detail in another paper that is under development (Rohse et al., in prep). In the revised version of this paper we added a few more observations on how the narrative approach supported imaginative exploration and exchange of ideas (l.421-424, l.523-525).**

2) Specific comments:

- Could you please give some reference on the usage of the term Traditional Ecological Knowledge? (L70) >> **We included a reference.**
- Could you please specify how did you inferred the “preference for storytelling compared to other (more visual) methods”? (L230) >> **This is further explored in the Results section, where we stated that “We talked about visual methods like artistic maps or other methods like board games for the community to interact with potential future changes in water availability and use. However, from the start it was clear that the idea of ‘stories’ was most resonant with the community. The participants of phase 1 and the village elders of the royal council indicated their interest in developing stories.” (l.380-383).**
- L255: “attendance was low for some groups”. How low? >> **We rephrased this sentences and added the numbers.**
- How participants to the workshop were selected? >> **Participants were selected by the village leadership. This has now been added.**
- In L273: Could you explain why and how did you inferred that the community members did not show understanding of how different types of drought were linked and space and time? >> **We added an example.**
- In L296 the authors mention it was more difficult to communicate about scenarios related to human activities. Could you please explain why? >> **We added a possible explanation and refer back to the example mentioned earlier.**
- I would like to see references on the usage of the SHETRAN model, and if possible, some figures of how these models were presented to the community. >> **We added the SHETRAN references and added more details on the storylines of model results that were presented**

to the community. We also added an additional figure. For more details we refer to Rangecroft et al. (2018).

- L324: Do you think your images could lead to biased illustrations of the community to the policymakers? Why? >> **We added a sentence.**

3) Technical corrections

- L4 – In this study, (add a comma) >> **DONE**
- L7 Art and creativity are for example often used for raising awareness of climate change and for encouraging behavioural change in relation to health issues. (change in relation to ! concerning?) >> **DONE**
- L14 These kinds or this kind of methodologies. >> **CHANGED**
- L354 - Remove spaces between practioners/artists >> **DONE**
- L32, Fig 4 caption, L194, L195, L330, L396 and L414 – Add an hyphen in end-product >> **DONE**
- L247 3oC >> **DONE**
- L358 Change “can lead to fatalistic views that are not helpful for instigating” to “can lead to fatalistic views that do not help instigate” >> **CHANGED**
- L436 – Change specify to specified >> **DONE**
- L437- 438 – Add an hyphen in Middle-Income and High-Income -L437 – Remove preposition “and vulnerable (indigenous) group >> **DONE**

SC1

We want to thank Zareen Bharucha for commenting on our manuscript. In the new version of the paper we addressed her comments and fixed the textual errors. Below our point-to-point response to the questions raised in SC1, with page and line numbers referring to the revised manuscript.

1. References are done automatically and cannot be changed at this stage. We will follow the journal guidance on this in the proofing stage.
2. As also suggested by SC2, we now provide a more complete definition of creative practice, including a few examples (l.44-53).
3. We mean marginalised communities, not (necessarily) rural communities. This encompasses vulnerable and socio-economically disadvantaged groups in society, which are more abundant in the South, amongst ethnic minorities in both South and North, and amongst more rural populations, but not exclusively. There might be marginalised communities in big cities and some rural populations might be wealthy and well-protected against natural hazards. We will clarify this distinction in the manuscript. Also based on the comment by RC2, we have adjusted and expended our description of Global South communities (l.55-64).
4. On line 43 we do highlight one aspect of these critiques, namely the “risk of marginalised communities being denied access to structural measures”. In the revised manuscript, we added a sentence on the term resilience being used to mean ‘self-reliance’ by those in power (l.76-77). Also, we give a definition of building resilience, as “addressing and mitigating the complex interaction of social and economic vulnerability of communities and supporting their way of preparing for, coping with and recovering after disasters”. We feel that with this there is no need for an additional definition of resilience.
5. Changed.

6. Changed.
7. Changed.
8. We totally agree with this point. In the previous version of the manuscript, we suggest long-term empirical research on the effects of methods: “One of the methodological challenges in evaluating effects and drivers is that change can happen many months after an intervention. Longitudinal studies and being embedded in the communities would be needed (Donovan, 2010).” In the revised paper, we added a cross-reference to Section 4 (I.245) and extended the paragraph discussing this aspect (I.493-512), also following suggestions by RC2.
9. Another good point: we added some reflections on different types of impact (I.504-507).
10. Thank you! 😊
11. Solved.
12. Corrected.
13. Changed.
14. We were not sure what the reviewer meant with this comment. But we have made some changes in this paragraph also based on the comments by RC2 (I.421-424, I.434-436, I.499-502). We hope this answers her questions.
15. We (re)clarified the research gap in Section 4 (I.438-445).

SC2

We want to thank Mathew Stiller-Reeve and the 6 peer-reviewers from The National Graduate School in Infection Biology and Antimicrobials in Norway for commenting on our manuscript. We are very grateful for their suggestions. In the new version of the paper we have completely rewritten the abstract addressing their comments. We followed their suggestion to remove the word “potential” from the title and added more results to the abstract. We also added the definition of ‘creative practice’ (see below) to the Introduction (I.44-54).

“Where creativity can be seen as the production of a novel and appropriate response to a particular concern (Sternberg, 1999), creative practice is commonly associated with arts-led techniques. The term stretches to cover writing, theatre, dancing and a host of other imaginative activities (Light et al. 2018), not all of which need to result in a conventional product of aesthetic merit (Field, 1950).”

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Creative practice as a **potential** tool to build **drought and flood** resilience **to natural hazards** in the Global South

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Abstract. Global South communities are increasingly exposed and vulnerable to natural hazards such as floods and droughts. Preparing for future ~~extremes requires including diverse knowledges, elevating under-represented voices,~~ hazards requires developing an idea of an uncertain future, thinking out of the box for possible solutions, enhancing communication between diverse groups, and instigating organisational and behavioural change. In this study ~~we investigate whether artistic and creative processes could support,~~ we explore whether art and creativity could support this process, by presenting a literature mapping and a case study. Our search for journal articles, focusing on Global South communities ~~in improving their preparedness to extremes. A literature review of~~ and topics like environmental issues, hazards, and health, yielded 267 journal articles papers published between 2000 and ~~2018 showed that there is a growing body of research on using creative practice in environmental issues. Art and creativity are for example often used for raising awareness~~ 2018. These used a diversity of art forms, including photography & other forms of visual art, music & song, and drama & storytelling. We found that papers on the topic of climate change ~~and for encouraging behavioural change in relation to health issues. Research using creative practice to increase resilience to natural hazards, such as earthquakes, volcanic eruptions, tsunamis, floods and droughts is, however, still very rare. An opportunity exists to better understand the application of the wide range of creative methods currently used for environmental and health-related issues also to enhance resilience to droughts and floods. We tested this in~~ generally had lower co-creation (62% medium to high) than those on health (90% medium to high). A subset of seven papers focusing on drought and flooding fell into two categories: those aiming to raise the general public's awareness of these hazards and those aiming to instigate adaptation action by the participants. In our case study, we explored the middle ground between these categories. In a pilot project in South Africa, ~~in which~~ we designed storytelling workshops ~~to create community,~~ in which community members explored scientific data on future droughts, exchanged ideas between groups, and developed narratives about impacts of and preparedness for future drought. These narratives were filmed and edited and shared both with the community and with governance actors. ~~Although this was a short pilot project and the effects have not been thoroughly researched, we see potential for these kind of methodologies. We noticed that the approach allowed people~~ We found that this approach allowed participants to imagine future droughts ~~and that,~~ it opened up conversation conversations about potential adaptation measures. ~~Based on the literature and pilot study we call for more research on the use of creative practice in building resilience to extreme events. It is especially important to investigate how the use of creative methods compares to other methods, and how effective~~

~~creative practice is to make a difference, either in people's own behaviour or in communicating people's needs to decision makers.~~ encouraged intergenerational exchange, and increased awareness of local issues by policy makers. Both in the wider literature and in our case study, the long-term effects of creative interventions are rarely evaluated. Feedback from participants, however, indicates a number of short-term benefits, which shows the potential of combining creative practice approaches and more conventional approaches into a more holistic preparation for future natural hazards.

1 Introduction

Global South communities are vulnerable to the impacts of hazards like floods and droughts, and are expected to be even more at risk in the future (Winsemius et al., 2015b), as increased climate variability ~~and~~ is likely to lead to more floods and droughts (IPCC, 2012) and water demands ~~and~~, exposure and vulnerability are growing (Wanders and Wada, 2015; Winsemius et al., 2015a). Better resilience and preparedness to floods and droughts are urgently needed. Preparing for future extremes requires including diverse knowledges, elevating under-represented voices, thinking out of the box for possible solutions, enhancing communication between diverse groups, and instigating organisational and behavioural change. In this paper, we investigate ~~whether there is a potential for~~ how creative and art-based methods to can support this transition to more resilience –

~~Our aim is to investigate the potential for creative practice in building resilience to~~ to natural hazards, and more specifically droughts and floods, in Global South communities. ~~To do that~~ To achieve that aim we systematically map the literature on how art ~~& and~~ creativity are used in relation to floods and droughts and ~~in related other other natural hazards, and in related~~ fields (climate change, health), and further discuss a specific case study of our own as an exemplar of using creative practice to increase resilience to drought.

We will use the word ~~creative practice~~ 'creative practice' to mean all artistic and creative processes (Niedderer and Roworth-Stokes, 2007). ~~The reason for focusing on creative practice rather than artistic artefacts is that the end product does not necessarily have to be of aesthetic value, and there need not be an end product at all.~~ Where creativity can be seen as the production of a novel and appropriate response to a particular concern (Sternberg, 1999), creative practice is commonly associated with arts-led techniques. The term stretches to cover writing, theatre, dancing and a host of other imaginative activities (Light, 2018), not all of which need to result in a conventional product of aesthetic merit (Field, 1950). Games could be classed as creative practice because they might include an element of creative exploration of possible options. However, in this study, we exclude games, but point to some excellent overview papers on how 'serious games' can be used for disaster risk management (Solinska-Nowak et al., 2018), climate change adaptation (Flood et al., 2018), environmental management (Madani et al., 2017; Aubert et al., 2018), and flood management (e.g. Ramos et al., 2013; Crochemore et al., 2016; Arnal et al., 2016)

~~With By~~ 'Global South communities, we mean marginalised and vulnerable' we mean poor, vulnerable, less-powerful communities living in the geographic South as well as ~~the~~ North (Barreto, 2014, p.404). ~~We focus on marginalised~~ We use the term Global South, recognising that this has developed from the merely geographical to more of a political and economic characterisation. It is commonly used to refer to, but is not completely overlapping with, issues of inequality, power

imbalance, and deep relative poverty. It therefore encompasses a variety of vulnerable and socio-economically disadvantaged groups, including much of the rural populations in the geographic South, those in informal settlements, and groups who are marginalised because of race, gender, age. We note that the geographic South also contains privileged and wealthier communities who might better be classed as global North (Mahler, 2018). In our mobilisation of the definition, we have also included indigenous communities, refugees, and children and young people located in the geographic North, although have not stretched as far as to include more socio-economically deprived communities of the geographic North.

We focus on Global South communities because they often do not have access to large-scale structural (i.e. engineering-based flood and drought) mitigation options such as dikes or reservoirs protecting against flooding or reservoirs to overcome dry periods, either because these are too expensive or considered poor 'value for money' or because they are not feasible in the region these communities inhabit (e.g. Johnson and Priest, 2008; Ikeda et al., 2016). Also, these communities might have knowledge of suitable traditional structural or non-structural measures (Berkes et al., 2000; Altieri and Nicholls, 2013) and, such as qanats (water capturing systems), soil management, food storing systems, social support mechanisms (Barontini et al., 2017; Berkes et al., 2000). In both cases, there is a need to surface their hidden voices and to explore which measures work best in the local context. According to Gibson and Gordon (2018), cultural resourcefulness and coping capacities of rural populations are rarely acknowledged within state-expert modelling of resilience.

There is an important body of literature that critiques the term 'resilience', alerting us to the need to use it cautiously (e.g. Davoudi et al., 2012; MacKinnon and Derickson, 2012; Moser et al., 2019). (e.g. Davoudi et al., 2012; Moser et al., 2019). For example, MacKinnon and Derickson (2012) argues that resilience could be used by people in power to denote 'self-reliance', thereby putting the onus of risk management on individuals or communities that do not have the means and power to effectively achieve this. We are acutely aware of the sensitivity of our research topic, with the risk of marginalised communities being denied access to structural measures and potentially being offered creative practice as an alternative. Here/Therefore, we use the term 'building resilience' to denote addressing and mitigating the complex interaction-interactions of social and economic vulnerability of communities and supporting their way of preparing for, coping with and recovering after disasters. We focus on the added value of creative practices alongside more established processes of resilience building and we explicitly include decision makers in this investigation, to also study the added value of creative practice for those with more agency.

In the following sections, we first map the existing literature on this topic and identify research gaps (Sect. 2). Then, we discuss methods and results of a case study (Sect. 3), indicating potential for the research gaps to be filled. Finally, based on the literature mapping and the case study, we share reflections and perspectives for future research (Sect. 4). We see potential for creative methods as a currently under-explored way to surface the hidden voices of give voice to marginalised communities and to empower them to take action or seek support to increase preparedness to extreme events. We envisage creative methods to be part of a portfolio of methods to build community resilience to hazards and call for more research on the effectiveness of these tools in communicating about flood and drought risk or as a way for communities to imagine future risk or potential preventive actions.

2 Literature

2.1 Literature framework

Research on art and creativity to produce change shows that these are used by a range of people in different ways with a variety of goals, participants, and audiences. There are different ways to categorise such art-based practice. Miles (2010), who studied art exhibitions on the topic of climate change distinguish two types of aims: raising awareness and intervention. Guba and Lincoln (1989) adds the dimension of the audience or receiver: is the creative process or art product enhancing the insights of the participants or of others? Rathwell and Armitage (2016) noted the same categories, but added the aspect of the experience of the artistic process, noting "art as a site of knowledge coproduction" (Rathwell and Armitage, 2016, p.1).

From these categorisations, three dimensions emerge that characterise creative practice to produce change in / with / for communities: the goal of the creative practice, the doer, and the audience. The goal of the this type of creative activity can be to raise awareness, instigate action, or both. The doer of the creative practice then refers to whether the creative practice is carried out by community members, or by an academic or artist, or whether it is eo-created-between-co-developed by community and academics / artists. The intended audience of the artistic product or those who benefit from the creative practice can be the participants themselves, or other community members, decision makers, the general public, or researchers. The existing literature on creative practice used by or with communities shows these three dimensions in various combinations. Various types of art-based research, for example, are aimed at the participants of the creative process.

First, research there are examples of where the creative practice is community-led, with other community members as the audience. Research on Traditional Ecological Knowledge (TEK) often focuses on¹) shows how TEK is often passed on within communities using traditional stories, songs, dance, etc. Researchers have described and documented these methods doing participant observation. For example, Rigby et al. (2011) and Zurba and Berkes (2013) showed-show how art is used by aboriginal communities to (re-)connect to the land in periods of environmental stress, McEwen et al. (2012) describes-describe the practice of archiving diverse flood information including narratives and songs with the aim to provide a rich recourse to communities living with flooding, and there are various examples of how traditional songs and stories are used to pass on knowledge between generations (Moncada, 2018; Simpson, 1999). Here, the creative practice is community-led, with other community members as audience In these cases, the goal of the creative practice can be both raising awareness or instigating action. Also interesting to note is that during this kind of research no new material is created and all creative practice happened before the researchers step in.

Second, the art therapy (Rubin, 2016; Slayton et al., 2010) is an example of creative practice used with the goal to instigate action (or behavioural change) and done by the participants. The use of art and creativity in therapeutic way is a therapeutic way has been studied extensively (Snyder, 1997; Edwards, 2014), for instance as a post-disaster recovery and healing therapy (e.g. Huss et al., 2016; Zerrudo, 2016; Whittle et al., 2012). With regard to droughts and floods more specifically, there is some evidence from Australia that art and music festivals provide an escape from the hardship of prolonged drought, bring

¹TEK refers to 'all types of knowledge about the environment derived from the experience and traditions of a particular group of people'. (Usher, 2000, p.185)

the community together, and enhance emotional well-being (Gibson and Connell, 2015). Here, the creative activities are used
125 to forget the economic impacts of environmental issues or natural hazards and lessen their social impacts (e.g. feelings of
isolation, loss of community, depression, suicide; Gibson and Connell, 2015). In other examples, psychological impacts are
lessened by using artistic ~~process~~ processes to more deeply explore feelings and experiences (Whittle et al., 2012). In this form
of art therapy, ~~either~~ traditional creative methods can be used or ~~ones imposed~~ new ones chosen by the therapist, and both the
doer and the audience are the individual participant or ~~community~~ the wider community. A review by Rubin (2016) found that
130 there is 'quantifiable data to support the claim that art therapy is effective in treating a variety of symptoms, age groups, and
disorders' (Rubin, 2016, p.108).

Third, art and creativity can be used ~~with a~~ as an active process (where new material is created during the research) with the
goal of instigating action or behavioural change in the participants in a broader sense. This is, for example, studied in education
(Bequette, 2007; Silo and Khudu-Petersen, 2016; Cramer et al., 2017) and health (Schmid, 2006). In these cases, researchers
135 often have a more active role in guiding the process, sometimes in collaboration with artist(s). Again, traditional art forms can
be used or ~~build on or the art form can be imposed~~ built on or new art forms can be proposed by the researcher. There is an
emerging literature on using art in this way to build social-ecological resilience (Rathwell and Armitage, 2016) or to deal with
floods and droughts (Mason, 2015). ~~The focus still is on the~~ Like in art therapy, the focus is on participants as the audience, but
there is more involvement from the researcher in this category.

In a fourth category, the aim is scientific awareness (or creating new knowledge) and the audience of the creative process ~~or~~
~~user of the art product can be researchers themselves~~ are the researchers themselves and the scientific community. If creative
practice is used as research tool, the aim often is to reach deeper layers of people's lived experience of environmental issues
or natural hazards (Skains, 2018). In this case, the process is used by the researcher(s) as a qualitative data collection method
to increase their understanding and knowledge on the topic (e.g. Kloetzel, 2017; Miller and Brockie, 2015). Using art and
145 creativity in this way has been argued to give vulnerable people a voice and ~~for~~ to allow the message and emotions to travel
beyond those who experienced the event, but there seems to be no empirical research confirming this (Miller and Brockie,
2015).

Finally, ~~the audience can consist~~ there are examples of art and creative processes used with the goal of raising awareness
of the general public or instigating behavioural change of large groups of people. In those cases, the doer can be an artist or
150 members of the general public themselves. Researchers have investigated how various ~~people (e.g. artists, NGOs)~~ organisations
(NGOs) and artists have used creative practice in public-facing endeavours (e.g. Curtis et al., 2012). These creative 'interven-
tions' can have a range of aims, including communicating to an audience about environmental issues, raising awareness,
reshaping public perceptions, enhancing engagement, and promoting action (Rice et al., 2019). On the topic of climate change,
for example, art is often used with a focus on the general public, for communication and awareness raising (Nurmis, 2016) and
155 instigating behavioural change (Burke et al., 2018). In some of these the audience is quite passive, but there are also examples
of how the public is engaged in participatory art (Candy et al., 2006). The reasons for using art as an engagement tool include
that it can help people understand complex information (Curtis et al., 2012), can support the development of new mental mod-
els, changing paradigms and beliefs (Lozano, 2011), and is a powerful way to make people care about a topic because it can

invoke strong emotions (Matravers, 2001; Silvia and Brown, 2007; Barbour and Hitchmough, 2014). Interestingly, existing
160 studies on the effectiveness of art-based climate change communication offer only limited and inconsistent evidence of their
impact. Some researchers also mention a potential use of artistic products in decision making (e.g. Symons, 2016), but to our
knowledge no published examples of this exist.

~~In this paper~~ There is of course overlap between these types and studies often do not fall only in one category. For example,
when participants are the audience (when archiving TEK or in art therapy, when the aim is instigating action), the results can
165 travel to others in the community and to policy makers and when creative practice is used as a research tool, also policy makers
or the general public could read the academic papers. In our literature review, we will use the three dimensions (goal, doer and
audience) and focus on the primary audience and aim, but discuss mixed cases and secondary audiences and aims as well. In
most of these examples new material is created during the research process, except for the first example of documenting TEK,
in which the material was already created before the research and creative practice was done without the involvement of the
170 researcher (making co-creation impossible).

In this paper, we will focus on all aspects of these combinations of the three dimensions of using creative practice (sharing
traditional knowledge; instigation action; engaging the public; art as research tool), except for goal, doer and audience),
excluding its therapeutic use. ~~Indeed, there is~~ There is already much research on art therapy ~~and~~ (e.g. Rubin, 2016; Slayton et al., 2010)
, whereas here we are mostly interested in how art-based information can be used to make voices heard, enhance communica-
175 tion between diverse groups, think out of the box for possible solutions, and instigate organisational and behavioural change.

2.2 Literature mapping

We mapped the ~~scientific~~ anglophone academic literature to find papers reporting on uses of creative practice to raise awareness
or build resilience to drought and flood risk in the Global South. We also looked at other hazards (earthquakes, volcanic
eruptions, etc.) and environmental issues, including climate change, more generally. As there is a more established praxis of
180 using creative practice in instigating behavioural change in health-related issues (notably HIV), social and economic inequality,
and violence and conflict, we have also reviewed the literature on those topics. More details on the literature mapping exercise
can be found in Appendix A.

Our iterative search process with manual screening resulted in a selection of 267 journal articles. These show a clear increase
in number per year over time, especially after 2008 (Fig. 1), which is consistent with reviews focusing on art and climate change
185 (Galafassi et al., 2018) and art and vulnerable populations (Coemans and Hannes, 2017). Most of the papers focus on topics
related to health (21% of total no. of papers) and climate change (18%); just over 15% discuss the use of creative practice in
topics of environmental management and resource access. Papers on using creative practice in relation to natural hazards and
disasters (volcanic eruptions, earthquakes, tsunamis, drought, and flooding) only make up 1-3% of the total sample each.

~~Recent review articles on the use of different art-based methods in environmental and health research found that most~~
190 ~~art-based research is carried out in the United States, Canada, the United Kingdom and France (Nurmis, 2016; Galafassi et al., 2018; Coema~~
~~. Research on arts and health is often also done in Africa (Teti et al., 2018) and water-related creative practice research is~~
~~concentrated in water-searce regions in Africa and Australia (Fantini, 2017).~~ In this study, we searched for papers focusing

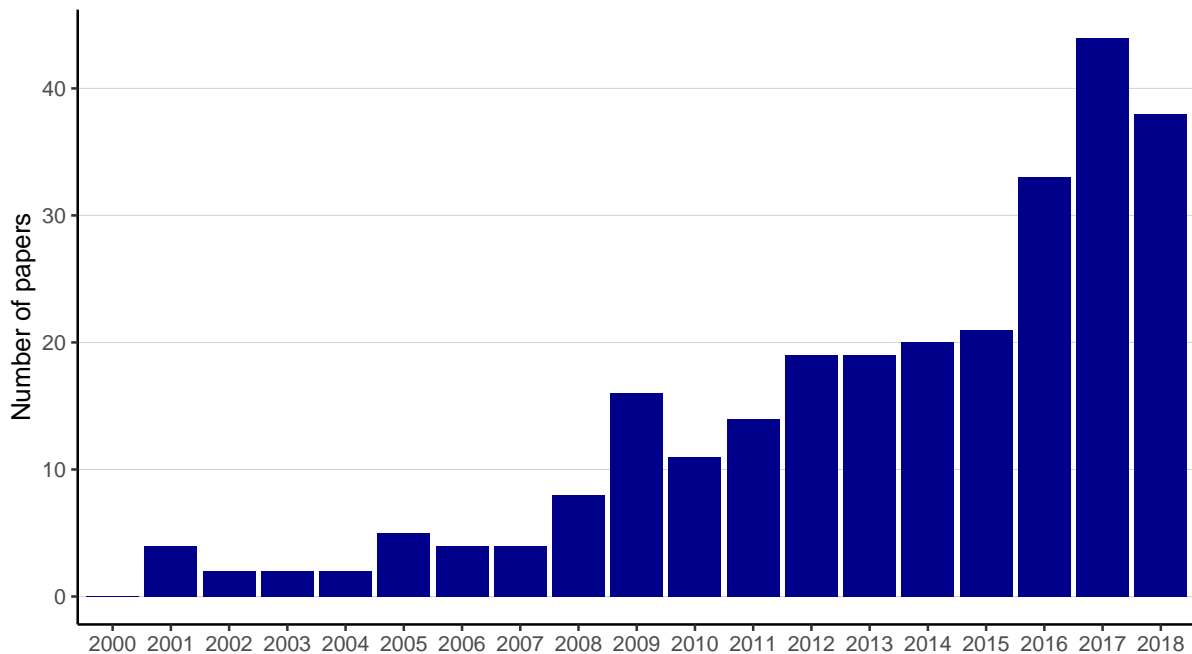


Figure 1. Peer-reviewed journal articles (in no. per year) found via a literature mapping exercise, focusing on the use of art-based and creative practice in the research fields of hazards and disasters, climate change, other environmental issues, health, social and economic inequality, and violence & conflict in Global South context (for details see Appendix A).

on Global South ~~and vulnerable communities~~communities, encompassing vulnerable, less-powerful groups in society. The resulting selection was spread across the globe (Fig. 2). ~~Most~~In the results of our search, most of this type of research is done in Africa (29% of total no. of papers), followed by Oceania (25%) and Asia (16%). There is also a lot of work with indigenous communities and vulnerable groups (refugees / asylum seekers, children / young people) in North America (16%), but only a small amount in Europe (3%). Recent more generic review articles also found that research on arts and health is often done in Africa (Teti et al., 2018) and water-related creative practice research is concentrated in water-scarce regions in Africa and Australia (Fantini, 2017). Other reviews on the use of different art-based methods in environmental and health research found that most art-based research is carried out in the United States, Canada, the United Kingdom and France (Nurmis, 2016; Galafassi et al., 2018; Coemans and Hannes, 2017).

The creative methods and art forms used are very diverse (Fig. 3). Photography is the most-used method (mentioned 63 times), followed by music & song (59 times), other forms of visual art (48 times), drama (46 times), storytelling (43 times), and video & film (37 times). Art forms such as dance and poetry are used less (17 and 12 times, respectively). One reason for the large amount of papers on photography is that it is often used as a participatory research methodology in which participants can highlight issues of importance to them. Photovoice (or Photo-Elicitation Methods or Camera-User-Study)

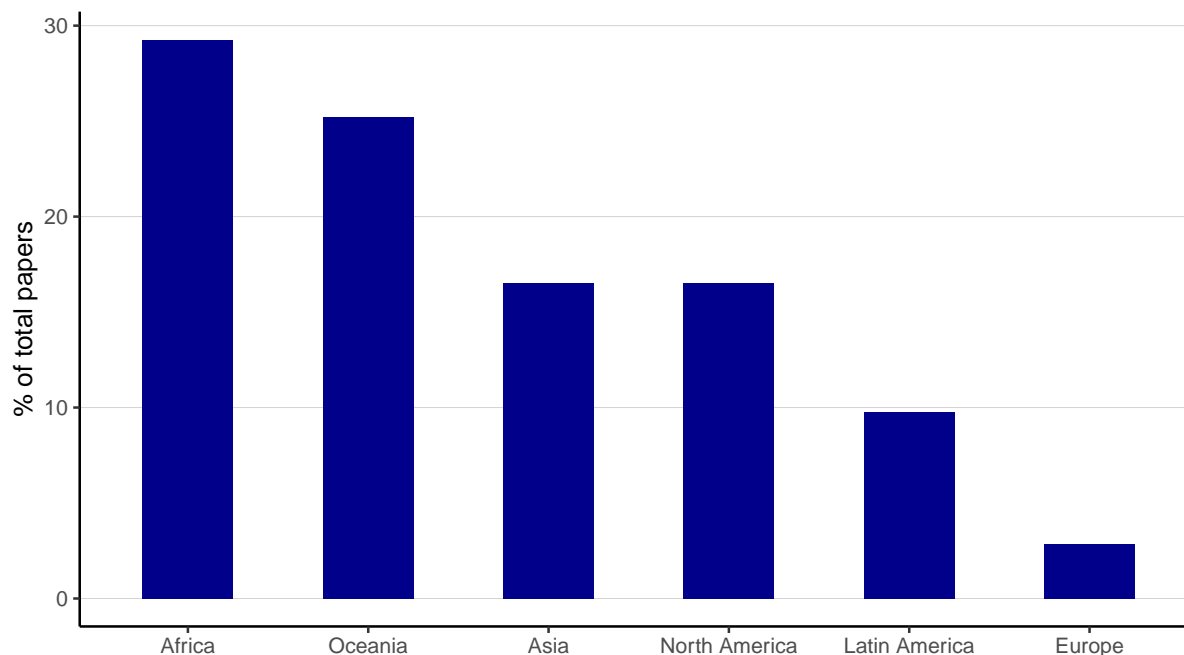


Figure 2. Continents (in % of total papers) where the research was carried out that we found via a literature mapping exercise (for details see Appendix A).

is ~~often~~ a participatory method that asks community members to photographically document their environment or situation and share stories about these photographs. In our literature review, we found that Photovoice has often been used to explore communities' view on HIV / ~~AIDs~~ AIDS (e.g. Jacobs and Harley, 2008; Mitchell et al., 2005; Umurungi et al., 2008; Wood, 2012; Fournier et al., 2014; Adegoke and Steyn, 2017), environmental issues (e.g. Belcher and Roberts, 2012; Bennett and Dearden, 2013), conservation (e.g. Beh et al., 2013), water use and governance (e.g. Fantini, 2017; Bisung et al., 2015), and hazards and disasters (e.g. Yoshihama and Yunomae, 2018; Schumann et al., 2018). This means that photography is mostly used as a research method asking participants to develop new material. Papers on music and song, on the other hand, mostly study existing traditional songs and music on a variety of topics (e.g. Stone, 2003; Saroli, 2005; Wu, 2016; Grant, 2018; Dirksen, 2019). They are rarely used to co-create new material; some examples where new ~~material~~ music is created are: Steiner (2015), Anderson et al. (2018) and Plush and Cox (2019).

We also looked at the degree of co-creation between the researchers and communities, because we were interested to see how much the researchers were involved in the creative practice, including initiating, supporting, guiding or even leading the creative practice, and how much of the creative practice was pre-existing in the community prior to the research or was completely carried out by the community without researcher involvement. The degree of co-creation is very variable between papers. In some cases, the methodology ~~is~~ was given to a community by researchers (for example in participatory photography), but the resulting product was made without the researcher's involvement (e.g. Belcher and Roberts, 2012). In other cases, the

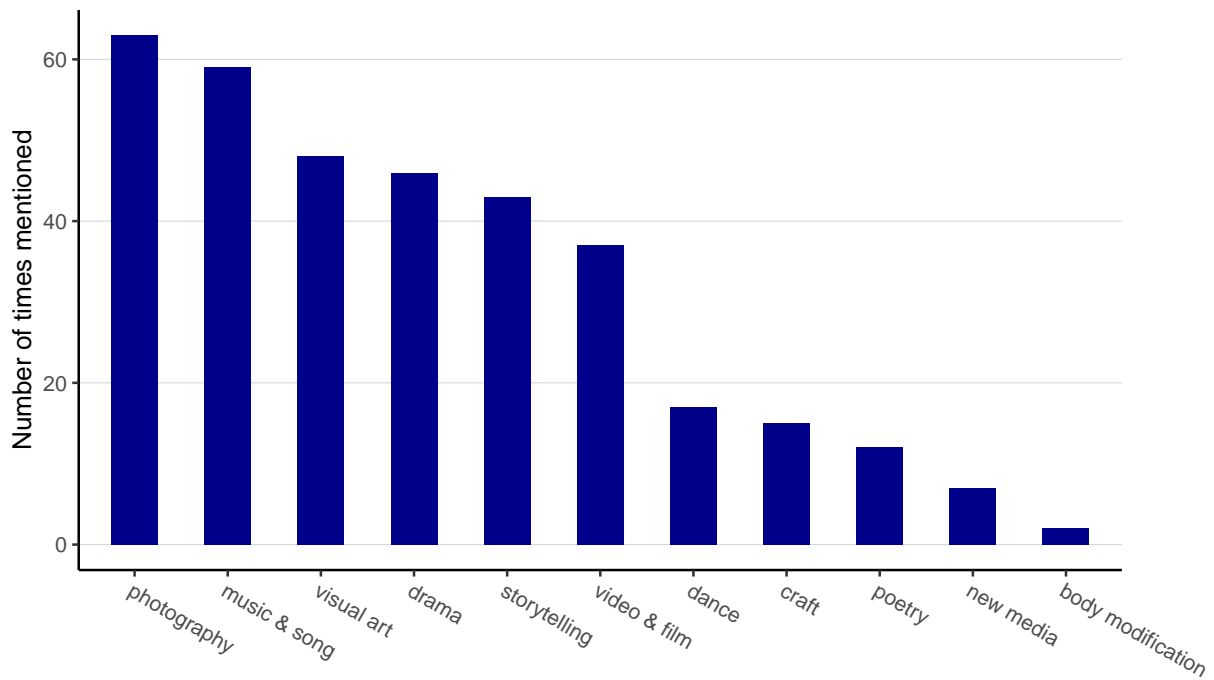


Figure 3. Art forms / creative methods used or researched (in no., multiple art forms per paper possible) in the journal articles that we found via a literature mapping exercise (for details see Appendix A).

participants communicated to the researchers what the greatest environmental threats to their community are, and then artists develop developed this into an artistic product (e.g. Steiner, 2015). There are also many examples of researchers observing and documenting creative practice traditionally used in Global South communities to pass down traditional knowledge on natural hazards or environmental issues, for example using storytelling (e.g. Swanson, 2008; Cashman and Cronin, 2008; Johnson and Beamer, 2013; Troll et al., 2015; Fepuleai et al., 2016). These have a low degree of eo-productionco-creation, because they work with existing material, often in a form of participant observation. Others build on traditional creative practice to develop new stories (e.g. Fuertes, 2012; Somerville, 2014; Ayala et al., 2016; Fernández-Llamazares and Cabeza, 2017). These often have a high degree of eo-productionco-creation with the researcher guiding the process.

The aim of the art-based research also strongly affects the degree of eo-productionco-creation. In many papers, the goal of developing an artistic product is communication, for example to raise awareness of an environmental issue and its impact on vulnerable communities. There is a wealth of projects aiming at raising awareness of the general public on climate change and its impacts (Nurmis, 2016; Galafassi et al., 2018). Papers on the topic of climate change generally have a slightly lower degree of eo-productionco-creation (62% medium or high, compared to 67% medium or high for all papers included in the literature review; see Appendix A). In other research, the goal of the creative practice is instigating some kind of action, for example to bring about behavioural change in relation to health (for example HIV / AIDS). Papers on the topic of health generally have a

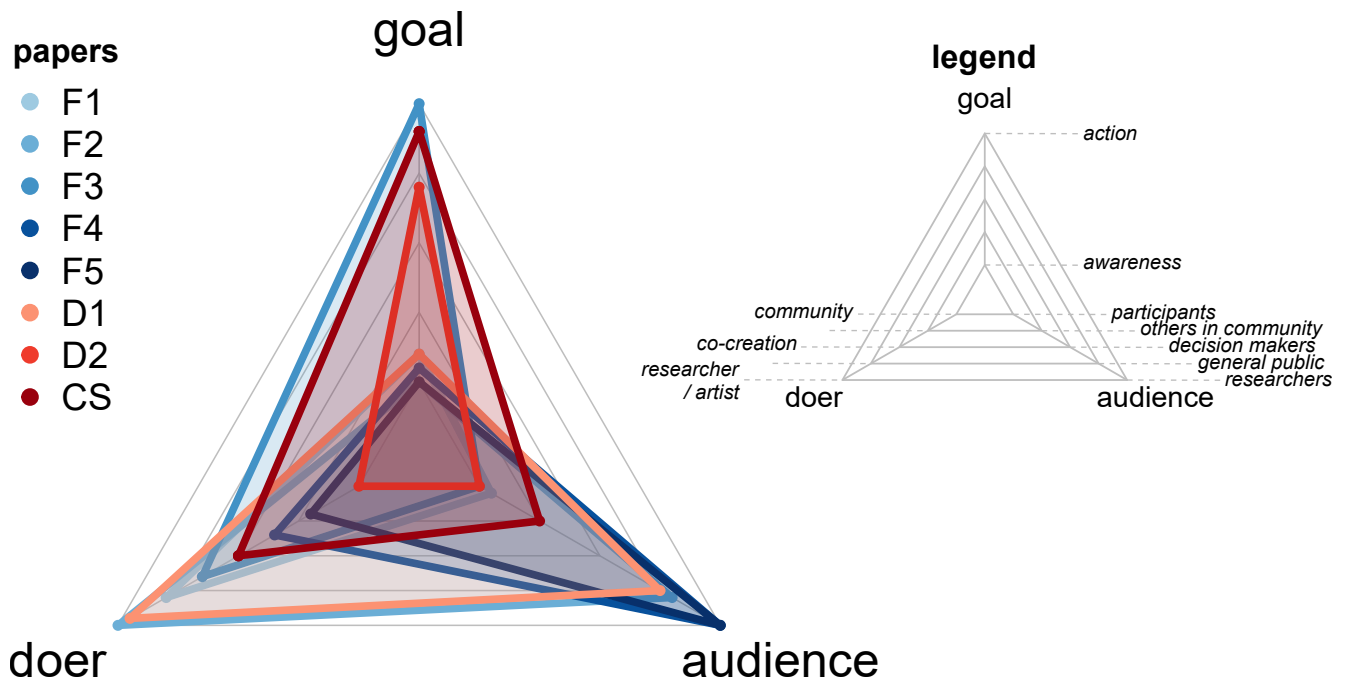


Figure 4. Papers on drought and flooding classified in three categories: goal of the creative practice (GOAL 'goal'), doer of the creative practice / creator of the end-product end-product (METHOD 'doer'), audience of the creative practice / the end-product end-product (AUDIENCE 'audience'). Abbreviations and paper details: see Table 1. The goal axis is gradually going from Awareness close to the centre to Action at the top and a combination in between. The doer axis has Community close to the centre, Artist and Researcher at the left-lower end and co-creation in between. The audience axis has five points on the axis: Participants, Others in the community, Decision makers, General public and Researchers. All papers have different colours, the Drought papers and Case Study in red and the Flood papers in blue. The location of the papers on these axes is not accurate but a best estimate.

higher degree of co-production co-creation (90% medium or high, compared to 67% medium or high for all papers included in the literature review).

240 Only rarely is the effect of the creative practice evaluated. Fantini (2017) highlights that creative participatory methods such as Photovoice are claimed to be effective in communicating community concerns, but that empirical evidence for these claims is missing. There are some examples where results are reported. In Contreras et al. (2018), theatre-based workshops were a significant success, encouraging almost half of the participants to seek out government-provided health services after a disaster. However, a comparison with a control case, in which other, non-creative methods were used or in which no activity was done

245 at all, is hardly ever done. This important aspect will be further explored in Section 4.

Table 1. Papers on drought (D1, D2) and flooding (F1-F5) found in the literature mapping exercise focusing on creative practice and Global South communities, and the case study (CS) described in Sect. 3

No.	Title	Author(s) & Year	Journal	Region
D1	Bridging Mediterranean cultures in the International Year of Soils 2015: a documentary exhibition on irrigation techniques in water scarcity conditions	Barontini et al. (2017)	Hydrology Research	Europe, Africa
D2	If the land's sick, we're sick:* the impact of prolonged drought on the social and emotional well-being of Aboriginal communities in rural New South Wales.	Rigby et al. (2011)	The Australian Journal of Rural Health	Oceania
F1	Knowledge Sharing for Disaster Risk Reduction: Insights from a Glacier Lake Workshop in the Ladakh Region, Indian Himalayas	Ikeda et al. (2016)	Mountain Research and Development	Asia
F2	The disaster flood experience: Older people's poetic voices of resilience	Miller and Brockie (2015)	Journal of Aging Studies	Oceania
F3	Community strengthening and mental health system linking after flooding in two informal human settlements in Peru: a model for small-scale disaster response	Contreras et al. (2018)	Global Mental Health	South America
F4	Social practices of flood (risk) management – a visual geographic approach to the analysis of social practices in an empirical case in Chiapas, Mexico	Stephan (2018)	Erdkunde	Central America
F5	Displacement: Critical insights from flood-affected children	Mort et al. (2018)	Health & Place	Europe
CS	Hydrological modelling as a tool for interdisciplinary workshops on future drought	Rangecroft et al. (2018)	Progress in Physical Geography	Africa
	Using a narrative method to imagine preparedness to future droughts in South Africa	Rohse et al. (in prep.)	Geo: Geography and Environment	Africa

In our search, we found only two papers focusing on drought and/or water scarcity (Table 1: [D1 and D2](#)). Barontini et al. (2017) used arts as a communication tool. They documented traditional irrigation techniques to cope with water scarcity in the Mediterranean and, together with other researchers and students, developed a travelling exhibition for students and the general public. In this example, the exhibition was used to raise awareness and understanding of historical water conservation techniques. In contrast, Rigby et al. (2011) used arts as a tool to change behaviour and coping capacity. They investigated the use of creative and artistic practice in response to drought and discuss how encouraging Aboriginal arts in Australia can increase resilience to drought as it enhances the connection with the land. They mention a whole suite of art forms used traditionally to highlight the Aborigines' connection to land, e.g. painting, printing, photography, film, theatre, music and dance. This research

255 did not develop new artistic products or ask participants to engage in new forms of creative practice. Instead, they studied how traditional art can help people cope with drought by ~~reconnecting them to the land~~ using existing material previously developed by the community (so without co-creation).

Five papers focusing on flooding were identified (Table 1: F1-F5). They ranged from studies on using community workshops to merge scientific and local knowledge of flooding (Ikeda et al., 2016) to a researcher / poet developing poems from interview transcripts of older people's lived experience of flooding (Miller and Brockie, 2015). Three studies used participatory creative methods: participatory theatre to help young people cope with mental health issues related to flooding post-disaster (~~Contreras2018~~) (Contreras et al., 2018), participatory photography to explore questions of flood management (Stephan, 2018), and participatory drawing to understand flood impacts on young children (Mort et al., 2018).

We In Figure 4, we have classified these seven papers on drought and flooding (Table 1) ~~into in three categories,~~ following the three dimensions introduced in Sect. 1: i) the goal of the creative practice (raising awareness, instigating action, or both), ii) the doer of the creative practice / the creator of the ~~end-product~~ end-product (completely led by the community, an academic or artist, or co-created between community and academics / artists), and iii) the audience of the creative practice / the ~~end-product~~ end-product (the participants themselves, other community members, decision makers, the general public, or researchers). Figure 4 shows that the papers generally fall into two categories related to the goal and audience dimensions. Firstly, those discussing creative practice aimed at communicating the impacts of drought or flooding to the general public (D1, F2) or to researchers (F4, F5). And secondly, those discussing creative practice aimed at instigating action in the participants themselves, either ~~pre-pre-disaster~~ (D2, F1) for improving preparedness or post-disaster (F3) for improving recovery.

This shows that there is a gap in the academic literature on the use of creative practice with the combined goal of awareness raising and instigating action (middle part of goal axis in Figure 4), and with a broader audience of decision makers and general public (middle part of audience axis in Figure 4). However, when studying these papers in more detail, we found that they often mention secondary audiences. For example, when researchers were the audience (in F4), indirect impacts on community were noted. And when the community was the audience, insights could 'travel' further to policy makers (in F1, also mentioned in F5), or governmental stakeholders were even included as participants in the creative process (D2). The doer dimension in Figure 4 shows more mixed results between the papers. Compared to the wider literature on environmental issues and health described above, however, these studies on floods and droughts show limited co-creation (Fig. 4; with 5 out of 7 papers having low co-creation, compared to 33% in all reviewed papers), leaving an opportunity to also explore this aspect further. ~~Additionally, despite the mention of how the artistic products could travel to other communities and could be used to inform decision-making, this has not yet been investigated in these studies (Fig. 4). This shows that there is a gap in the use of co-created creative practice both for awareness-raising / communication and for instigating action, especially with a broader audience.~~ In the next sections, we show an example case study of how this gap might be filled.

285 All papers assessed here focus only on creative practice as a tool for building resilience to floods and droughts and no combination or comparison with more conventional flood / drought measures (for example structural measures or forecasting and early-warning) was done. Only F1 and D1 briefly mention the importance of this, with F1 stating that: "more attention

needs to be paid to combining structural and nonstructural measures" (Ikeda et al., 2016, p.39). This aspect will be discussed in Section 4.

290 3 Pilot study

The pilot project CreativeDrought (<https://creativedrought.wordpress.com/>) aimed to develop ~~approaches-an~~ approach to local level preparedness to future drought. According to Biggs et al. (2012), important aspects of resilience building are maintaining diversity and redundancy, managing connectivity, managing slow variables and feedbacks, fostering complex adaptive systems thinking, encouraging learning and experimentation, broadening participation, and promoting polycentric governance systems.

295 In this project, we focused on participation, learning and experimentation, and connectivity, and wanted to explore how creative practice could support these. We designed an approach that allowed members of the community to actively engage with potential futures including sharing of existing local knowledge, experience and strategies (‘imaging futures’; Anderson, 2010), and inclusion of scientific information (‘calculating futures’; Anderson, 2010). The goal was to create stories about potential future drought impact and preparation / adaptation via a multiple method approach developing text-based narratives, 300 performance, and visuals (video). We used this process to increase dialogue between groups in the community and used the visuals to make the voices of the community members ‘travel’ to ~~polycymakers~~ policy makers’ circles, where they would not normally be ~~routinely heard~~ heard. So the creative practice was jointly conducted between the community and the researchers in an iterative process (doer), aimed at instigating action and raising awareness (goal) by the participants, others in the community and policy makers (audience) (see CS in Table 1 and Fig. 4).

305 3.1 Methods

As case study region we selected a village in Limpopo Province in South Africa. This (anonymous) village was chosen because of its vulnerability to drought and because the villagers get their water supply from a number of different sources and use it for a range of different purposes, i.e. a groundwater borehole for domestic water supply, two reservoirs for irrigation of agricultural land, and a river for washing, bathing, brickmaking, etc. (Rangecroft et al., 2018). The village has a population of c. 2800 310 (StatsSA, 2017) and is led by a chief and his royal council. Drinking water supply is organised by the Department of Water and Sanitation and irrigation water is regulated by the Department of Agriculture (Makaya et al., 2020). The village was selected by our local research partner at the University of Venda and our research assistants were from the village and surrounding area. After a few short initial visits to become acquainted with the area, the community, and its leadership, also building trust and getting permission for the research, the research team spent four periods of one to four weeks over the course of one year working intensively with the community.

315 We developed and tested an interdisciplinary approach with, as final output, videos of narratives produced by groups of community members in the village (Rohse et al., in prep.). These were produced in small-scale workshops guided by an interdisciplinary team of researchers and local research assistants, in which the participants were asked to reflect imaginatively on future drought scenarios produced by a hydrological model. Focusing on narratives as the creative method was a pragmatic

320 choice related to participants' preference for storytelling compared to other (more visual) methods, for example maps or games, and familiarity with these methods by the research team. Additionally, because we focused on imagining of future events, we could not use methods that are rooted in the current or past situation, such as Photovoice.

The development of the narrative videos happened in three phases. In the first phase, we carried out group narrative interviews on the topic of past drought events (~~Rohse et al., in prep.~~)(Rangecroft et al., 2018; Rohse et al., in prep.). These allowed us to
325 collect rich and contextualised information on past droughts and their impacts on different groups in the community, but also to ~~surface~~hear potentially hidden voices and explore the potential for future drought narrative workshops. We used oral history techniques in small group conversations. We did 12 ~~groups~~group interviews with 2 to 7 participants each covering a range of different groups within the village (occupation, gender, age). The participants were selected by the village leadership. The interviews were recorded, transcribed, and translated from Venda (the local language) into English by the research assistants.

330 In the second phase, we set up a hydrological model for the area that could be used to model future scenarios (see Rangecroft et al., 2018). We used the SHETRAN hydrological model (Ewen et al., 2000; Birkinshaw et al., 2010) developed from available datasets and catchment observation. Topography was based on DEM data, precipitation and potential evapotranspiration input came from climate datasets, geology, soil type, land use, and information on location and amount of water abstraction was derived from field observations, dam level and release data, and discussions with knowledgeable locals. The model was
335 qualitatively validated with water level data and with information about the drought events shared by the participants of the narrative interviews in phase 1. The model was run for a baseline run and for three different scenarios (Rangecroft et al., 2018). The scenarios were designed based on conversations with the villagers and with a number of government representatives. The “Warmer Temperatures” scenario was based on an increase of ~~3C~~3°C compared to present day temperatures representing a climate change expectations for the region. The “Larger Irrigation Scheme” scenario represents a possible increase in water demand in the future with the area of the irrigation scheme expanded to be twice as large as present day. The “No Dams” scenario was based on the expectation that without maintenance the dams, which were built in the 1960s, might not be available for the community any more in the future. ~~On~~A drought analysis was then performed on the model results for the scenarios ~~a drought analysis was performed~~ and the resulting drought characteristics were compared with the baseline scenario to determine the difference between future and historic droughts (Rangecroft et al., 2018). These results were then translated into storylines for
345 easy communication with the community. These storylines included carefully-phrased information on the expected duration of a lack of rainfall, dryness of the soil in the community plots, and lack of water in the river or irrigation canal (for more details, see Rangecroft et al., 2018).

In the third phase, we organised 6 workshops, in which we brought together different groups in the community~~-,~~ matching the grouping in phase 1 and with some overlap in participants. Again, participants were selected by the village leadership.
350 Our aim was to have around 4 people per group, so 8 per workshop, but due to various reasons attendance was ~~low for some~~ variable between groups. These are the workshops we organised (for more information see Rohse et al., in prep.):

- 2 workshops with orchard farmers and livestock farmers (8 participants in each)
- 2 workshops with young married mothers and elderly women (11 participants and 2 participants)

– 1 workshop with irrigation farmers (older and younger generation) (8 participants)

355 – 1 workshop with traditional leaders (3 participants)

In these workshops, the participants first listened to the storylines of the possible future droughts, translated and explained by the local research assistants. They then discussed what the impacts of these droughts would be on them and their community and developed these into ‘stories’ that were filmed. Next, the groups within each workshop exchanged these stories and had a discussion with the whole group about possible responses and preparedness measures. They then went back to their smaller
360 groups to develop this into a story about coping strategies to future drought, which was also filmed. This resulted in two stories about the future for each group, one on future drought impacts and one on future drought preparedness (which took into account the exchange with the other group). The recorded stories were transcribed and translated from Venda into English by the research assistants, allowing us to subtitle the videos.

After the narrative videos were produced, the results of the workshops were discussed in a community forum, shared with
365 community via YouTube, USBs and transcripts, and used in conversations with water management actors. The aim of these conversations was to make marginalised community voices heard to powerful actors and decision makers.

3.1.1 Results

The first phase provided very useful information in preparation for the second and third phases. It gave us an understanding of historic drought events and their impacts on the community. The group stories, for example, showed how different groups
370 in society were influenced by different types of drought (livestock farmers by meteorological drought, irrigation farmers by hydrological drought, and ~~drinking domestic~~ water supply by groundwater drought), which all had their different timings and characteristics. The community members, however, did not show understanding of how these types of drought were linked in space and time and their relation with water use (for example, mining activity and a new groundwater borehole for drinking water were not linked to the drying up of springs in the area), but their responses were very helpful in setting up and validating
375 the hydrological model in phase 2. Phase 1 also yielded useful observations for the preparation of the workshops in phase 3. It provided contextual understanding of the challenges the community faced. It highlighted the importance of faith in framing their stance towards possible future drought (“God decides”) and difficulties to imagine and talk in imagining and talking about the future. We also found that there was seemingly little intergenerational exchange of drought coping strategies, although there were some ambiguous testimonies on this point. And importantly, we tested which creative method would resonate most with
380 the community. We talked about visual methods like artistic maps or other methods like board games for the community to interact with potential future changes in water availability and use. However, from the start it was clear that the idea of ‘stories’ was most resonant with the community. The participants of phase 1 and the village elders of the royal council indicated their interest in developing stories.

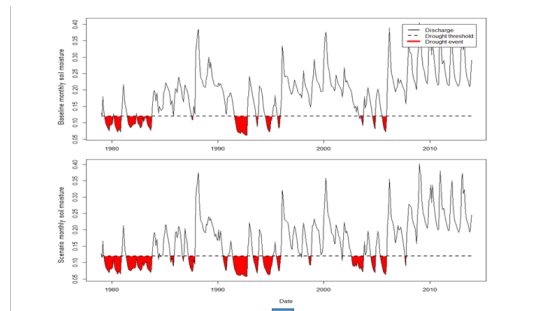
In phase 2, the information collected in phase 1 and during catchment observation was used to set up and test the model.
385 Because the model was used for the development of scenarios, which were then used as starting point for discussion in the workshops, accuracy of model results was not our main aim (Rangecroft et al., 2018). We wanted the model to represent

the past droughts relatively well so that we could trust the modelled potential futures. ~~From In phase 1, we found that the~~
~~community had highlighted droughts in 1983 (mostly mentioned by farmers and elderly men and women talked mostly about the~~
~~1983 drought, whereas the~~), 1992 and 1994-95 (mostly mentioned by young people, married mothers and civic group ~~discussed~~
390 ~~the impacts of the 1992 and 1994-95 droughts on the community (Rangecroft et al., 2018).~~) and these were reproduced by the
~~model (Rangecroft et al., 2018).~~

The model was then used to extrapolate and calculate several scenarios that were mentioned by community members and
government representatives. Instead of predicting the future, we were exploring plausible futures. Droughts were calculated and
compared between the scenario and the baseline. These were transformed into storylines including information on the duration
395 ~~and severity~~ of future droughts ~~compared to previous experience and a qualitative indication of severity~~ (e.g. more severe than
has been experienced in the past 40 years ~~or twice as long as the drought in the early 1980s). We used both a~~). ~~Figure 5 shows~~
~~the process of creating and communicating the storylines to the workshop participants. We used one~~ climate change scenario
and ~~two~~ scenarios related to human activities (i.e. increased water use for irrigation and decreased water availability due to lack
of dam maintenance), but found that the latter were more difficult to communicate ~~so we ended up mostly using~~, ~~possibly due~~
400 ~~to the limited knowledge of the relationship between water use and water availability (as mentioned before) or because there~~
~~were some political sensitivities related to water use by neighbouring communities, so in the end, we used~~ the climate change
scenario in ~~the most of the phase 3~~ workshops.

The workshops generated very rich information on potential future drought impacts and possible coping and preparedness
strategies. These did not necessarily develop into fully-formed stories, but they did clearly communicate strong emotions and
405 allowed for imagining positive options. Compared to ~~the first phase phase 1~~, in which narrative-style answers were also used
but where people found it hard to engage with uncertain futures ~~and referred mostly to God or their own death~~, in the workshops
the narrative approach supported by data from the model scenarios allowed participants to use their imagination and exchange
ideas. Some participants now made the link between water use for irrigation and water available for domestic purposes, which
did not happen in the phase 1 group interviews (Rohse et al., in prep.). We found that the intergenerational exchange was
410 very powerful, with older farmers willing to share traditional techniques and younger farmers eager to learn. The exchange
between participants with different professions also worked well, although there was already an awareness of the needs of
different groups in the community, mostly because these are not strictly separated, with for example livestock farmers also
having a small plot to grow vegetables and being domestic water users as well. We also found that there were very different
preparedness and coping strategies brought forward in the different workshops, including ~~proposals for~~ individual actions
415 (digging for water in the river bed, selling livestock, saving food), community actions (collective maintenance of the irrigation
system, drilling a new borehole), and ~~requests for~~ government support (providing food, fodder, drinking water, and jobs).

The approach allowed participants to use their imagination and consider future drought events, their impacts and preparation,
and to exchange ideas between different intergenerational groups and across different professional occupations. The research
assistants who carried out the bulk of the facilitation in the local language, reported that whilst some participants were a bit
420 concerned with how long the workshops were, there was general enthusiasm for the topics discussed and participants had many
ideas to contribute, and valued the opportunity to have a platform to exchange and learn from ~~their peers, in particular those~~



e.g. “the river will run dry for 9 months”
 “crop failure conditions will persist for 1.5 years”
 “in Sept the soil on the irrigation scheme will
 become too dry for crops”

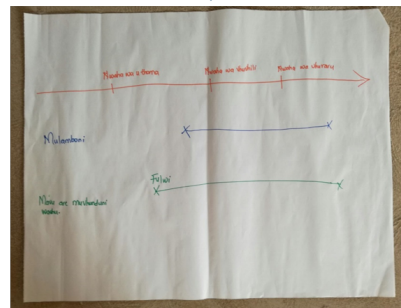


Figure 5. The process of translating model scenario results into storylines in the local language that were then explained to the workshop participants by the research assistants (photos by Sally Rangelcroft).

from the younger generation. other community members. For example, younger people were eager to learn from older people about the traditional methods for community and household resilience (e.g. food storage techniques) that had largely fallen out of use.

425 The recorded and edited narratives (Fig. 6) were given back to the community with the idea that these could be used in schools and community gatherings. The narratives were also a useful tool for creating space for conversations with government

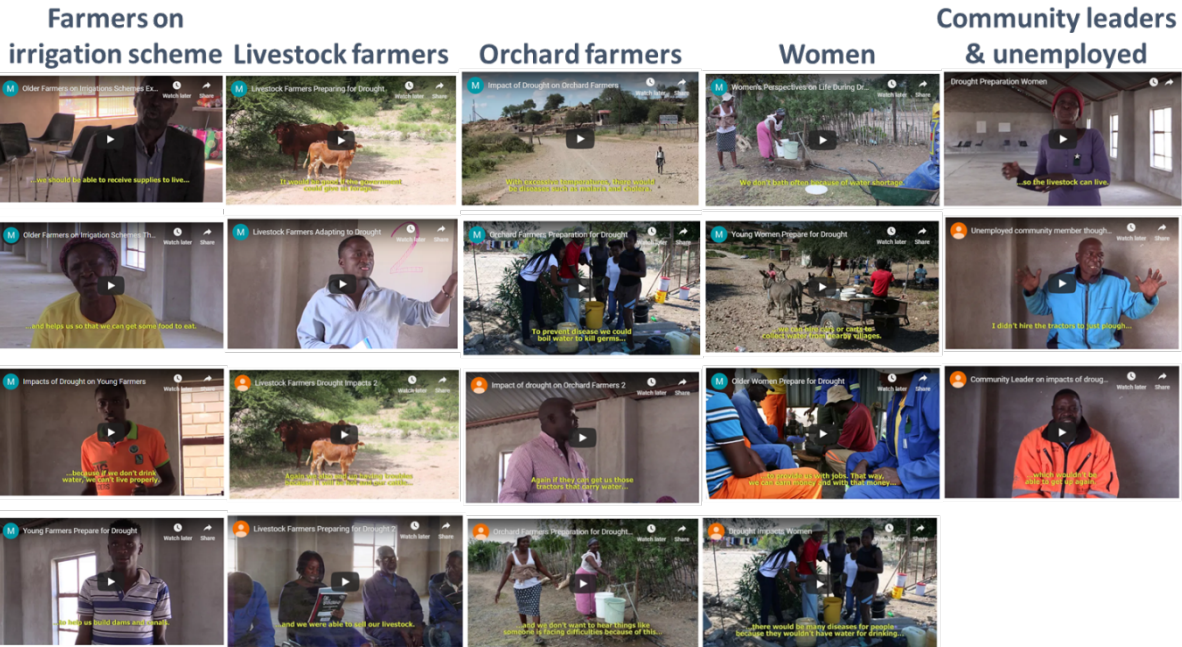


Figure 6. Recorded and edited future drought narratives developed in community workshops in the CreativeDrought project (see <https://createdrought.wordpress.com/videos/>).

representatives about local perspectives on drought management. ~~Whilst on the outset the local policymakers we interacted with were uncertain about the videos and their content, through careful facilitation,~~ Whilst initially, the local policy makers we followed up with were more interested in the model data than in the community narratives that were developed from the model results, after carefully facilitated discussion they acknowledged the value of the videos in sharing the concerns of the community. The videos proved to be stimulating prompts for conversations on drought preparedness and on the current situation facing the community. In addition, the ~~policy makers~~ policy makers found some of the images useful as illustrations of the specific conditions facing the villagers, as they explained it is sometimes difficult to get reliable information on villagers' situations. It was clear that they struggled with their role balancing between supporting the community and empowering them to face drought challenges without relying too much on government support, reflecting some of the tensions in the notion of resilience that we referred to in Section 1.

4 Reflections & perspectives

~~Through mapping existing~~ We identified a clear gap in the academic literature on using creative practice to build resilience to ~~droughts and floods by hazards with a focus on~~ Global South communities, ~~we identified a clear research gap.~~ The seven studies ~~we found either focused on creative practice as research tool,~~ on floods and droughts we analysed (Figure 4) either used

creative practice for raising awareness of the general public ~~-, or or researchers (by using it as research tool) or~~ for instigating action by the participants. ~~There was relatively little co-creation and little evidence of how the end products could travel or~~ Although there was some mention of secondary audiences of the creative practice (for example others in the community or the general public) and of how end-products could be used in decision making. ~~The 267-~~, these aspects were not explored further. Also, the creative practice was mostly either done by the community or by the researcher team and co-creation was limited. The other 260 studies with a wider focus ~~than solely drought and flooding~~ selected in our literature mapping exercise ~~-, (encompassing other environmental issues and disasters, climate change, health, socio-economic inequalities, and violence & conflict)~~ showed a similar pattern with most art-based climate change communication focused on raising awareness ~~with little co-production of the general public with little co-creation,~~ and most creative practice in the field of health focused on encouraging behavioural change ~~with high co-production. Our case study on developing narratives to increase preparedness to future drought in southern Africa was most similar to the second type, but we felt that there was potential to explore the middle space between these two contrasting types of participants with high co-creation.~~

This gap is what we aimed to explore with our pilot study. In an iterative process, we developed stories with the community with the aim to instigate action to build resilience to future drought, both by the participants and others in community. By filming and editing the stories developed by the community, we ~~could- were able to~~ use them as a discussion starter with decision makers ~~-and bring some of the community voices to more powerful actors. In this way the products of the creative practice also had the goal of raising awareness.~~ Unfortunately, due to the short nature of the pilot project funding, we ~~have not been- were not~~ able to evaluate the effectiveness of communicating via stories compared to more ~~traditional- established~~ ways of communicating and to investigate how these art-based ways of building resilience can be combined with more conventional ways of dealing with drought. This is a common feature among much of the research on art and creativity in environmental and health-related issues. Most papers ~~are merely describing- we reviewed described~~ a methodology and promoting a potential beneficial method without clear evaluation of its efficacy. In this section, we discuss the limitations of our study and share our reflections and thoughts on the ways forward.

4.1 Limitations

The results of both our literature study (reported in Section 2) and our pilot study (Section 3) should be seen in the light of possible limitations. The limitations of our literature study include:

- focus on academic literature: we only mapped academic papers and did not include the wealth of creative practice for resilience building used by artists, NGOs and other organisations. These projects are often shared via reports and on websites and video platforms and we found that searching these led to a strong bias related to the keywords and platforms used.
- language bias: we only investigated papers published in English. This leaves out much published research on the topic of creative practice and environmental issues in other languages. In particular, Latin America featured less in our literature review than expected (Figure 2), because research from that region is mostly published in Spanish or Portuguese

(e.g., Gomide et al., 2019). The same language bias is visible in other review papers on this subject (Nurmis, 2016; Galafassi et al., 2018).

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The potential limitations of our pilot study are mostly related to the short duration of the project, which was funded for only 1.5 years. This led to the following issues:

- We were not as embedded in the community as we would have liked, which meant that we were dependent on the village leadership and our local research assistants for selecting and communicating with participants.
- Interaction with policy makers was limited to a few exchanges at the start and end of the project. Although government representatives showed interest in testing our approach in other communities, we did not have the time in the project to embed our creative practice in the decision making process and combine it with more conventional measures for dealing with droughts, which were more familiar to the decision makers.
- Within the timeframe of the project, we could not evaluate the long-term benefits of our approach.

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485 4.2 Reflections

At the start of this paper, we asked the question whether creative methods can support preparedness to different types of hazards. Based on our results there is no clear answer to this question, mostly because there is a lack of evaluation of the effects of approaches using creative practice. For example, it is as yet unclear whether narrative workshops, like those used in our pilot study (Rangecroft et al., 2018; Rohse et al., in prep.), are more effective than more conventional workshops, as used by Ikeda et al. (2016). Only in (mental) health research where art-based methods are used therapeutically there is some evidence for their effectiveness (e.g. Stuckey and Nobel, 2010; Van Lith et al., 2013; Slayton et al., 2010). Photovoice (participatory methods using photography) has also been found to have tangible effects on social justice, albeit mostly on raising awareness and causing only limited transformation (Sanon et al., 2014). One of the issues is that this transformation often only happens on longer timescales, beyond the lifetime of many research projects.

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Many of the papers we reviewed in our literature review did mention short-term benefits of the creative practice (e.g. Contreras et al., 2018) and also in our pilot study we noticed some positive effects of our methodology. Feedback from participants can be used to give an indication of these short-term effects. For example, Strickert and Bradford (2015) reported that participants of a theater performance found the experience ‘interesting, legitimate, and effective’ for learning about water management challenges. In our pilot study, both younger and older participants enjoyed the intergenerational exchanges that our approach encouraged. This was in stark contrast with the phase 1 interviews, in which we often heard the complaint from the older generation that young people did not want to listen to their stories. Also most local decision makers indicated that they found the community stories we captured interesting and useful.

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When evaluating the efficacy of creative practice for building resilience to hazards, the timescales of potential effects need to be taken into account. Creative practice with the goal of instigating action will mostly have short-term and tangible effects, in our pilot study for example fixing leakage in irrigation channels, not building structures in the floodplain, storing food,

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510 Creative practice with the goal of raising awareness could have more long-term and intangible effects, for example a change in beliefs or values. However, both might have long-lasting side-effects such as changed interactions within the community or between the community and government. It is on these longer timescales that creative practice could be a catalyst of deeper transformations. Artistic products are often enduring in their relevance and might be used long after they were developed, but a question is whether benefits are mostly coming from the creative process (benefiting the doer) or from the product (benefiting the audience). This determines how long-lasting the effects of engaging in artistic practice are for building resilience against natural hazards. To evaluate these long-term outcomes, longer research projects are needed.

515 Some scholars have critiqued the use of art-based methods, for example by noting that art distances the problem (Miles, 2010) or by questioning whether art-based methods can actually achieve any change (see Nurmis, 2016). Apocalyptic climate change art, for example, can lead to fatalistic views that do the opposite of instigating action and behavioural change (Nurmis, 2016). In our pilot study, this was not the case, rather the reverse happened: we noticed a first fatalistic reaction to the future scenario storylines, but the further engagement, exchange and narrative development actually transformed this fatalism into ideas and suggestions for adaptation measures.

520 Based on our studies, we see a large potential for using art-based methods. In the introduction, we mentioned that preparing for future extremes requires including diverse knowledges, elevating under-represented voices, thinking out of the box for possible solutions, enhancing communication between diverse groups, and instigating organisational and behavioural change. For some of these elements, creative practice seems to be useful. In our pilot study, we could see effects of thinking out of the box, enhancing communication, and elevating under-represented voices. For example, we saw a clear difference between the focus group interviews in phase 1 and the narrative workshops in phase 3, with participants in phase 3 showing more imagination of potential futures and how adaptive measures could help, and more exchange between groups in community.

525 Furthermore, the community message was conveyed to policy makers in a way that was unfamiliar but interesting to them and they noted that they got a better picture of the challenges the community were facing. Creativity can also foster exchanges in space and time. For example, a community that has not yet experienced a drought and may be confronted by these events in the future (for example due to climate change) could get an idea of what it is like on the ground by learning from communities facing droughts on a regular basis. This increased understanding of the challenges and possible preparedness measures could help them to be better prepared.

530

Both in the reviewed literature and in our case study, we encountered many barriers and practical challenges to using creative practice in resilience-related research in the Global South. These practical challenges include:

- language: in cases where the researcher does not speak the local language or is not from the area being researched, knowing the full breadth of traditional art-based methods or translating the details of creative practice activities and intended outcomes can be challenging. However, language might be less of a problem in some non-verbal art and creativity than when using other more verbal methodologies, such as interviews or archival research.
- 535

- time: creative methods often take a lot of time, both from the participants and from the researchers. Researchers need to gain in-depth insights of their case studies and if translators are involved (see language), they need to be well-briefed. Also, if art-forms are used that the community is not familiar with, a thorough explanation is needed.
- unfamiliarity: participants are not always comfortable in engaging in creative practice and some decision makers tend to prefer quantitative outputs with a specified (un)certainly instead of contextualised stories, photographs, songs or other art products (Owens, 2005).

To overcome these challenges, good facilitation is crucial. Ideally, the research team is interdisciplinary and including local researchers and the work is guided and facilitated by creative practitioners / artists speaking the local language and familiar with participatory art-based research (see ²e.g. ‘social volcanology’³; Donovan, 2010). ~~Some scholars have critiqued the use of~~

~~Just like it is important for more conventional structural solutions to floods and droughts to be adapted to the local climate and land surface conditions to be effective, it is important for non-structural solutions also to be embedded in local circumstances (both natural, socio-economic and cultural). With art-based methods, for example by noting that art distances the problem (Miles, 2010) or by questioning whether art-based methods can actually achieve any change (see Nurmis, 2016). Apocalyptic climate change art, for example, can lead to fatalistic views that are not helpful for instigating action and behavioural change (Nurmis, 2016).~~ the latter could potentially be done more easily when art forms are used that are deeply rooted within the culture of the community. This would potentially ensure the longevity and effectiveness of the intervention. In our pilot study, participants preferred storytelling as it is an art form already rooted in their culture. This also means that creative practice methods and art forms might not be transferable across communities as different communities have different histories / sensitivities to different creative practice. Also policy makers have their own preferences for certain types of evidence in policy making (e.g. Jasanoff, 2013). In our interaction with policy makers, we noticed more familiarity with and interest in more quantitative types of information (model results) instead of qualitative ones (stories).

~~Whether creative practice leads to action improving resilience to droughts and floods in marginalised communities is an unresolved question~~

It is important to stress that both types of information are still needed for better preparedness for future hazards. Structural measures, improved early-warning systems, all of that is indispensable for reducing socio-economic impacts of hazards and loss of life. However, without acknowledging local knowledge, circumstances, and challenges, and without empowering local communities, changing their behaviour, encouraging uptake of both structural and non-structural solutions, these more conventional measures might not be used or not used effectively. It is widely recognised that improvements in flood and drought resilience need to come both from communities and government as a shared responsibility between public and private partners (Trim, 2004; Amaratunga et al., 2009). However, Global South communities often face many challenges and barriers for actions ~~include~~, including lack of resources (land and financial resources), unemployment, and lack of information (such as drought early-warning) and creative practice on its own is unlikely to be able to solve these. In our pilot study, for example, it emerged that for the severe future drought scenarios (outside previous experiences) community members suggested that bigger

infrastructural changed were needed (either done as community or provided by the government). However, if the creative practice is part of a larger programme that integrates local and scientific knowledge and combines community-focused activities with activities aimed at decision makers, it may have greater impact potential.

575 McMillen et al. (2016) showed, based on an example from Hawai'i, that arts-based approaches to community resilience have alternating phases of being more and less important, in relation to socio-ecological shifts over time. We feel that globally we are now living in a time that asks for more creativity in relation to environmental issues and disasters. Traditional methods for natural resource management are either forgotten (Janif et al., 2016) or inadequate in the Anthropocene (McDowell and Hess, 2012; Kareiva and Fuller, 2016; Head, 2016). Adaptation based on experience might have worked in the past. For example, the
580 process of sharing oral history accounts can contribute to community resilience (Osterhoudt, 2018), but how does it apply to future events? There is evidence that damage from natural hazards decreases after repeated events due to adaptation (for floods: Kreibich et al., 2017). Memory of a previous event has been found to decrease damage in the next event (Viglione et al., 2014), but this memory decreases over time (Lopez et al., 2017). A big question is how to increase resilience if the previous extreme event was very long ago or when future events are outside of previous experience? Alternative ways are needed that require
585 out-of-the-box thinking to imagine how the future might be different from the past and what actions are needed to prepare for this future. Creative methods might be able to enhance this process, especially if they are embedded in or making use of traditional ecological knowledge (e.g. Laidler, 2006).

~~However, much more research is needed on various aspects of~~

4.3 Suggestions for future work

590 For future research on using creative practice to build resilience to future drought and flooding~~-,~~ we suggest to focus on the following aspects:

- Firstly, we believe ~~that more knowledge on traditional ways of using~~ we can learn more from cultures and times where / when art and creativity were used for coping with environmental issues ~~is useful~~. Indigenous knowledge systems have had to deal with climatic and anthropogenic change (McMillen et al., 2016; Gibson and Gordon, 2018) and might show
595 ways to use art and creativity for natural resource management under changing conditions (e.g. Berkes et al., 2000; Whyte, 2018). An interesting example is Aboriginal use of art for connecting to the land in Australia (Rigby et al., 2011; Zurba and Berkes, 2013). More knowledge on traditional ways of using art and creativity for building resilience could support contemporary initiatives.
- Secondly, research is needed on evaluating the three dimensions of creative practice (goal, doer, audience; see Sect. 1).
600 Is the aim to communicate information or awareness, or to instigate action? And who needs to have more awareness or take action: the participants of the creative practice or others, such as the general public, researchers or decision makers? It is especially important to evaluate whether the methodology of the creative practice fits the intended outcomes.
- Thirdly, we want to encourage more research on ~~co-production~~ co-creation during the creative process. How can artists and researchers work together with local communities to ensure mutual learning? Can / should decision makers be

605 included in the creative process and not only be receivers of the ~~end-product~~end-product? We feel that the use of participatory art is currently underexplored. As Rathwell and Armitage (2016) noted: "collaborative art making is a platform for knowledge coproduction, whereby novel ideas or products emerge from different ways of knowing".

– Fourthly, more evidence is needed on the effectiveness of creative methods. ~~Only in (mental) health research, where art-based methods are used therapeutically, there is some evidence for their effectiveness (e.g. Stuekey and Nobel, 2010; Van Lith et al.~~

610 ~~–~~We call for empirical research comparing creative methods to more ~~traditional~~traditional-conventional methods of doing research, communicating information, or instigating action in relation to droughts and flood. ~~For example, it is as yet unclear whether narrative workshops, like those used by Rangecroft et al. (2018) and Rohse et al. (in prep.), have more effect than traditional workshops, as used by Ikeda et al. (2016).~~ Research is needed on the drivers of any observed change: is the reason for change that the members of a community are coming together and exchanging ideas, or is it the creative practice allowing participants to think outside the box? One of the methodological challenges in evaluating effects and drivers is that change can happen many months after an intervention. Longitudinal studies (i.e. doing research in the same community over a longer period of time) and being embedded in the communities would be needed (Donovan, 2010). Also comparative studies might shed some light on this issue, for example between coping with drought in aboriginal communities where the use of art seems to be deeply rooted in culture vs. in a culture where art is very rarely used.

620 – And finally, we suggest research to investigate how creative practice can be embedded in a holistic strategy for building resilience. Can creative practice support communities in Global South settings to communicate their worries or traditional methods of dealing with environmental issues more effectively? How can art-based non-structural methods be combined with more ~~traditional~~traditional-conventional structural measures to mitigate drought and flooding? Like Whittle et al. (2012), we argue that creative side of resilience cannot be separated from the physical and socio-economic aspects of resilience.

625 5 Conclusions

In this study, we investigated how creative and art-based methods can support a transition to more resilience to natural hazards, and more specifically droughts and floods, in Global South communities. We mapped the existing literature on this topic (Sect. 2), presented a pilot case study (Sect. 3), and shared the limitations of our work, our reflections, and perspectives for future research (Sect. 4). Our literature mapping and case study ~~have~~–indicated that there is a potential for artistic and creative methods to be used more for building resilience to drought and flooding–, complimenting more conventional methodologies.

630 Currently, research ~~on this topic~~–focusing specifically on creative practice for flood / drought resilience is limited, ~~especially on creative co-production of the end-product~~–although there is a wealth of research on using creative practice in fields of health, environmental issues, and climate change communication. Within the literature there is scope to explore more on creative co-creation of artistic products and on audiences beyond the participants themselves and the general public. Several advantages of using creative practice ~~are mentioned: it has been suggested to~~–emerge from our literature mapping and pilot study: it can surface hidden voices, communicate issues on a deeper, more emotional level, travel to wider audiences, increase engagement

and behavioural change. Potential challenges are language barriers between researcher and participants, time investment of both researchers and participants, and possible unfamiliarity of participants with artistic or creative methods or products.

640 Whether creative practice leads to action improving resilience to droughts and floods in marginalised communities is an unresolved question. An important reason for this is the long-term and intangible effects of these types of interventions, which are rarely evaluated. Feedback from participants indicates a number of short-term benefits of creative practice approaches, including more understanding of the issues, increased interaction within the community, and less fatalistic, more positive ideas for adapting to future drought.

645 Based on the literature mapping and pilot study we call for more research on the use of creative practice in building resilience to extreme events. It is especially important to investigate how the use of creative methods compares to other methods, and how effective creative practice is at bringing about change, either in people's behaviour or in measures implemented by decision makers. We also think future research should address the question how to combining creative methods with more ~~traditional~~ conventional scientific methods and decision making. For decision makers a combination of quantitative, qualitative, and creative information might be most successful in supporting marginalised communities in coping with drought and flooding.

650 *Data availability.* The literature review database (Sect. 2 and Appendix A) will be made openly available upon publication of the article.

Video supplement. The narrative videos developed in the pilot study (Sect. 3) are available here: <https://createdrought.wordpress.com/videos/>

Appendix A: ~~Appendix A~~ Methodology literature review

In the literature mapping exercise, we reviewed peer-reviewed journal articles. We searched the databases of Science Direct, Web of Knowledge, JSTOR, Taylor and Francis Online, ProQuest, Academia.edu, Project MUSE, and Dimensions. We limited
655 our search to the period 2000-2018, as in previous reviews on related topics art-based research has been found to be limited before 2000 (Coemans and Hannes, 2017; Galafassi et al., 2018). When searching these databases we used a combination of keywords describing different sectors, different art and creative forms, specific regions in the Global South, and words like 'participatory', 'indigenous', 'community'. The search process was iterative, with search terms adapted when they did not yield the expected results. Like Coemans and Hannes (2017), we found that searching by specific art type works
660 better than using 'art' in general. This yielded many papers on the 'state of the art' in certain research field. The same holds for geographic area: most researchers do not use the keyword 'Global South' in their titles or keywords, but rather mention the ~~specify~~ specified region or country/countries. We focused our search on ~~Low and Middle Income~~ Low- and Middle-Income Countries and on vulnerable ~~(indigenous) groups within High Income Countries~~ groups within High-Income Countries (indigenous groups, refugees / asylum seekers, children / young people). We limited the search to papers in which
665 art was used as research process and art was developed as product from the research. Articles on art therapy and projects using

art therapeutically were excluded. This required a manual and iterative search process of removing duplicates and irrelevant articles by screening titles and reading abstracts. We then further explored the articles using a descriptive coding scheme to filter out information (aim, art form, ~~amount of co-production~~degree of co-creation). This coding scheme was designed based on the first few papers and then refined during the analysis. For art form, a range of detailed categories were used that were later merged into the main categories: photography, music & song, visual art, drama, storytelling, video & film, dance, craft, poetry, new media, and body modification. For degree of co-creation, we used a qualitative distinction between low, medium and high co-creation. Data were extracted from the abstract and rest of the paper if needed. The papers on the topics of drought and flooding were classified into a matrix based on the following categories: goal, doer, audience. Finally, the papers were summarised to easily extract information.

675 *Author contributions.* AVL conceived the study with input from MR, PJ, and RD. AVL, PJ, and RD designed the literature mapping exercise and ILM carried it out. MR designed and carried out the community workshops in the pilot study, supported by AVL and RD. AVL prepared the manuscript with contributions from all co-authors.

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