

Reply to Referee 2

We would like to thank you for your constructive comments and feedback on this manuscript. We think that the suggested revisions based on the Referee's comments will certainly improve the article. Please find our responses (in blue) to the main points raised (shown in black) below. We ordered the specific comments to the main sections of the paper in order to supply the same structure to all reviews.

Both the data retrieval and the characteristics of the dataset need to be described further. For instance, the period covered by the dataset should be clearly stated in the text and the relationship between the EU and the Alps dataset in terms of counts and repeated entries should be explicitly addressed. I agree with Reviewer 1 that it would be interesting to describe and discuss the difference found for the overlap region (i.e. Alpine NUTS in the EDIIeu dataset and the EDII Alps dataset) as a result of the new impact retrieval process.

→ Corresponding to our answer to Anne van Loon, we agree that this needs to be more clear. We will rephrase the parts describing how we updated EDII and subsetted respectively defined the different regions. Further we will clearly add the period covered by our dataset. Regarding the effect of our impact retrieval process we reran the analysis with a previous version of the database (i.e. status from September 2019) and suggest that we will elaborate further the effect of our update on the presented analysis and then decide how to include it in the manuscript or provide it as additional information in the Supplementary Material.

It would be useful to strengthen the discussion in terms of the policy relevance of the database and of the trends that emerged from the data analysis. How could policy makers use them? What type of decisions could they inform?

→ Foremost we consider our contribution research work that will have to be analysed and adapted further to be used by practitioners and/or policy makers. However we can add a more elaborated paragraph in the discussion or conclusion about ways towards applications based on the relevance of our data and findings. These may include that the two seasonally differently occurring impact groups and the different regions may need respectively different seasonal indices in an impact-targeted drought monitoring and early-warning system across the Alpine region. More generally, we may highlight the benefit to implement systematic drought impact information/data collection to inform necessary risk assessments at smaller scales or for more complete spatial coverage.

The manuscript presents and analyzes a large body of data and it is always challenging to present large datasets and complex patterns. In some paragraphs I had some difficulties following the text. I have noted down the sentences that I found particularly challenging.

→ Thanks for pointing that out. We will improve the sentences you noted so that the reader can follow our ideas.

Specific comments:

→ Thanks for the notes to all sentences or paragraphs you suggest to rephrase. We will go through them and improve the phrasing.

Introduction:

p. 2 line 49 Please check the definition of socioeconomic drought. I would expect it to be "insufficient water availability to meet the ordinary demands of society and economic activities" (now it says "inadequate supply of some economic good...").

→ According to the suggestion by Anne van Loon, we would like to remove the drought type DSE. Then, we would also not need to discuss the definition of this drought type further.

p.3 Please check the leading questions and may sure that they can be clearly differentiated. The first and the third one seems very similar to me.

→ The first question deals with drought impacts in the Alpine mountains and in the Alpine regions compared to drought impacts in whole Europe. In contrast, the third question deals with the distribution of the different impact *types* in the Alpine space. We especially focus on the question if a specific impact type (e.g. impacts caused by hydrological drought), occurs in a specific season. We will clarify the difference in the revised version.

Methods:

p.3-4 Please specify the altitude ranges used to delineate the different spatial domains and based on what they were defined.

→ On p. 4 line 95 we defined the high-altitude region and the pre-Alpine region as follows:

(3) The "high-altitude region" identified with NUTS 3 regions for which ≥ 30 % of the area are higher than 1000 masl versus (4) the "pre-Alpine region" covering all remaining NUTS 3 regions.

p. 5 Please specify in the text the time period covered by the drought impact search. IT would be useful also to know more about the search process: did the authors use a search by key words? If so, what words did they use and how effective the search was?

→ EDII first impact report goes back to 1448. This very historical information for southwestern Germany was retrieved from the collaborative research environment tambora.org (<https://www.tambora.org/>; Glaser et al., 2015; Glaser, 2013). However, most collected reports stem from the late 20th century as shown in Fig. 3. We applied the same search method as described in Stahl et al. (2016) in order to be consistent and will add this information in our revised manuscript.

p. 6 line 167 "loess": do you mean "loss"?

→ According to the applied method, we mean "loess".

p. 7 line 183: Do the events identified in this new search partially overlap with the EDIIeu ones? How many about of the 3,200 are also counted among the 10,600 ones?

→ As EDIIalps is part of EDIIeu all of the reports within the Alpine Space region are also counted for EDIIeu. For further details see our response to Anne van Loon:

We agree that our explanation of how we defined the different regions was not clear enough and thus raised your questions. We will rephrase the parts describing how we updated EDII and subsetted respectively defined the different regions.

To clarify for further comments:

- 1. We considerably updated the original EDII database (a) with sources that had not been investigated before (Unwetterchronik in AT, Propluvia in FR), (b) with several other reports we compiled ourselves (especially German and Italian text-based reports), and with sources that had been used previously by EDII, but which did not receive an update for the more recent years (Drought.ch, DCMSEE). The updated version is called EDIIeu throughout the preprint.*
- 2. We then subsetted the reports located in the Alpine Space from EDIIeu and called this EDIIalps, which is thus a part of EDIIeu.*
- 3. We further split EDIIalps two times to compare different climatic and altitudinal conditions: Northern vs. Southern region and pre-Alpine vs. high-altitude region.*

Results:

p. 8 line 225-226: please rephrase the sentence “Thus, the frequency ...” (difficult to follow)

→ We agree and will rephrase it.

p. 9: Could you please explain the usefulness of comparing the NUTS 2 regions (Table 1)? What information does this comparison provide?

→ We wanted to compare not only the national parts of the Alpine Space, but as well smaller regions, as the mountainous terrain is very heterogeneous. Therefore, we included the comparison of between the NUTS 2 regions. In Table 1 we show the several NUTS 2 regions located in Italy differed to NUTS 2 regions in Austria, Switzerland and Germany. An effect we did not see in the comparison between the countries.

p.10 lines 238-252 the text is difficult to follow. I recommend simplifying it.

→ We agree and will rephrase it.

Discussion:

p.14 the authors conclude that the chosen data sources proved to be suitable as impacts were clearly linked to the drought occurrence. I suggest revising this statement: the data collection was set up to detect only impacts that are explicitly linked to drought in reports that are being searched, so it is no surprise that the retrieved impacts met that requirements. Instead, the authors could discuss (or at least mention as a caveat/limitation) to what extent they may have missed drought impacts that were not explicitly linked to drought in the reports.

→ We agree with you that the statement needs revision and we will do that.

p.16 line 364, I think “common” (or similar word) is missing between “most impact”.

→ Thanks. We will revise it to “The second most frequent impact category...”

p.16 line 370-372: please rephrase the sentence starting with “Whether upstream”, it is difficult to follow.

→ We agree and will rephrase it.

p.17 line 414: why would impacts in the Southern region be “too local”?

We agree that this phrasing is not precise enough and requires clarification. What we meant is that due to the better coverage of the Northern Region with impact reports and hence ‘data’, we assume a more regionally complete representativeness. In the Southern Region, impact report data is more scarce and hence may have gaps in the spatial representation.

p.18 line 445: the text says that the Southern region reported the most impacts in spring while on the same page, on line 417, it is said “summer and early autumn are the seasons with the most drought impacts in all domains”. Please clarify this apparent contradiction.

→ Thanks for pointing that out. We see that this phrasing raises questions. On line 417 we state that “summer and early autumn are the seasons with the most drought impacts in all domains” supported by Figure 4. The total counts of the reports for each season show that the most impacts were reported in summer and autumn for all plots (a) - (f). If we compare the Southern region with the other regions within the Alpine Space, then this is the region reporting relatively the most (14 % of all reports stem from spring). We will rephrase the sentence on line 445 to clarify this.

p.19 line 460 please rephrase (unclear sentence)

→ We agree and will rephrase it.

p.19 lines 465-466 Please rephrase (unclear sentence)

→ We agree and will rephrase it.

Conclusions:

p.20, line 483: the conclusion “impact data collection EDII alps is therefore shaped by national priorities and societal effects “is unclear. Also the recommendation about customization EDII (lines 485.487) require some more elaboration in terms of what that “customization” would be.

→ We agree that the sentence is unclear and will rephrase it. What we wanted to express is that the data collection might be influenced by the different national foci and different collection efforts.

p.20 Line 488: I recommend to rephrase the sentence starting with “our study...” as the fact of being water rich does not make a place not vulnerable to drought.

→ We agree with you that the natural hazard of drought can occur everywhere, since drought is defined as a deviation from normal. However, drought impacts as an expression of vulnerability or exposure or just as an issue of public awareness are not typically associated with the entire Alpine region. We will consider a more nuanced rephrasing and might add a reference.

p.20 line 493-494: please elaborate on the idea of the growing diversity of impacts over time. Is it really due to an increasing complexity of the socioeconomic system in the Alpine Space? Beyond the use of water to produce snow in ski resort, I would expect all the other uses and sectors affected by impacts in 2018 to exist and be well established also in the 1970s and later.

→ We agree that the increase in diversity of impacts may warrant a bit of weighing of possible causes for this observation that in fact we cannot disentangle easily. One aspect

which influences the database is the increase in information and access to information in general and this will be reflected in the breadth of impacts. A real growth in diversity of impacts over time, however, can also not be excluded as an explanation. Winter tourism is not the only sector which has changed since 1976. There was also an increase in population, summer tourism, water use etc. In the Alpine forelands the agriculture sector changed a lot and in the Alpine regions new infrastructure for energy and water use was established and subject to more market competition.

p.20 lines 498-501. As it is written now, the reader could think that the authors have compared the impact patterns with actual precipitation patterns or drought indices. It is my understanding that this comparison is beyond the scope of the paper. Instead, in section 4.3 the authors made an interesting attempt to explain the occurrence of impacts throughout a generic year based on the literature. I recommend rephrasing these lines to make sure that they reflect the actual content of paper's analysis.

→ We agree and suggest rephrasing: "For the mountainous regions, we could demonstrate the delay between impacts classified as related to soil-moisture drought and those classified as related to hydrological drought."

p.20, line 501-02. Please rephrase the sentence "all these...starting point" (unclear)

→ We agree and will rephrase it.

References

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