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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Exploring the link between drought indicators and impacts" *by* S. Bachmair et al.

S. Bachmair et al.

sophie.bachmair@hydrology.uni-freiburg.de

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Response to referee # 1: reply addressing the minor comments

We thank referee #1 for the feedback to our manuscript. We much appreciate all comments and suggestions and will adopt most of them without reservation. In addition to the reply to the raised major concern, which convinced referee #1 about the appropriateness of the selection of years to include in the analysis, we now address all minor comments.

Abstract:

Thank you for the encouragement to include more tangible results in the abstract, all

suggestions will be incorporated into the revised manuscript.

Comment on "threshold" terminology: While we provide an explanation on our understanding of the term threshold on page 7592, line 7-9, we did not state this in the abstract. We will add this definition to the abstract.

Methods:

"In some states only a few data points are available, especially in small states. How was the 10th percentile of SPI / SPEI calculated from only a few grid cells and the 10th percentile of Q / G from 3 or 4 stations? I have some doubts in comparing states with a high and small number of data points for the calculation of indicators."

We assume you refer to the city states of Hamburg, Bremen, Berlin, and Saarland as "small states". Please note that we omitted Hamburg and Bremen from the analysis. For the SPI/SPEI calculation each grid cell was subdivided into hundredths, and the respective indicator metrics were calculated based on the sub-grid cells within or intersected by the state polygon. Regarding groundwater, no data that met our quality criteria was available for Berlin and Saarland; streamflow data was only available for Saarland (out of the small states), and streamflow percentiles were calculated based on 3 stations (as stated on page 7589, line 4-6). Given the small size of some states there are only a limited number of stations available. However, the coverage per state is rather even, except for Mecklenburg-Pomerania. We did discuss data limitations on page 7599 ("Given the "patchwork" nature of impact information, uncertainty associated with the indicator data seems of lower importance (e.g. dissimilar amount of streamflow and groundwater gauging stations per state; choice of probability distribution for SPI or SPEI calculation, e.g. Stagge et al., 2014b), but we can put more weight on this in the revised version.

"In Figure 2 we see quite a clear spatial distribution of impact report data. This might have a considerable influence on the results, e.g. higher correlations in states with more repsorted impacts or more bias toward certain impact types in states with less

reported impacts. You should explore this in the discussion."

We will discuss this in more detail, as suggested. However, we found differences in the strength of correlation for states with similar number of impacts, disproving the doubt. Page 7598: "For some states no to weak correlation may be an effect of very few months with impact occurrence (TH and SL), while this is not the case for the states MP, BB, and LS, which are comparable to SX and HE regarding the number of impact occurrences." For BW and BV, however, we cannot make this comparison and will add this to the discussion.

"Please mention how you did the differentiation of impacts to get Ih. An example would be helpful"

The differentiation between I and Ih is based on a keyword search of the impact description and does not strictly follow any impact category or impact subtype. When an impact is mentioned to be associated with surface or groundwater (keywords: stream, river, creek, lake, reservoir, groundwater, water supply, etc.) it is defined to be a hydrological drought impact. Impacts excluded from hydrological drought impacts are, e.g. agricultural and forest impacts, impacts due to heat waves, soil subsidence, or fire. We will add this additional information.

Results:

"The boxplots in Fig. 4 and 7 need more explanation. What are the blue dots? How should we read the figure?"

Thank you for this comment, we will consider this and add a more detailed explanation. The boxplots are based on number of months with I onset. If several impacts started to occur in a month this information is not reflected in the boxplots. Therefore, we overplotted the boxplots with the data points sized according to the number of impact onsets. For instance, while the median of the distribution may be around -1 (e.g. for BW), large dots plotted around -2 indicate that several impacts started to occur in

a month with SPI or SPEI of -2. Another option to show this would be to base the boxplots not on number of months with impact onset but on number of impact onsets (multiple counting of monthly indicator values if several impact onsets took place in one month).

"Why were SPEI10-3 en Q selected in Sect. 3.2?"

SPEI-3 seems to be the "best" indicator for many states according to the correlation between timeseries. For a visual comparison of hydrological impact patterns with an indicator we chose streamflow as indicator. Since we cannot show all indicators and already have a large number of figures we decided for these two exemplary indicators.

"I don't see the conclusion on page 7596 that drought events with geographical concentration have a higher number of indicators with moderate or strong correlation. Same for page 7599. Why do the years 1976, 1992, and 2011 have a higher spatial variability of indicator and/or impact data? I do not see that in Fig. 5. At the least the authors should explain how the figures should be read in order to come to this conclusion."

Figure 5 shows that for 1976, 1992 and 2011 the spatial differences between states are stronger than e.g. for 2003 and 2006. For instance, a concentration of a high number of impacts is discernible for the southwestern states in 2011 but no/ few impacts in the northwest, where also less negative indicator values occurred. The strength of correlation for 2011 is generally higher than for 2003 (Figure 6), where the variability in indicator values and number of impacts was low (drought conditions and impacts occurred rather evenly distributed in space). We will add more explanation in the revised version.

Small and textual comments:

general: use chronological order for references in text –> will be changed

Fig. 3 & 6: could a colour scale be found with more difference between moderate, strong and perfect correlation? Sometimes the differences pointed out in the text are

hard to spot in the figures, for example the slightly better performance of the 10th percentile compared to the mean in Fig. 6. –> Thanks for the suggestion; we already changed the color scale (see graphs relating to raised major concern).

Fig. 7: Ih onset used for Q and G? –> Yes, we will make this clearer in the figure caption.

p. 7587, l.2-3: “common tool” > include references –> will be done

p.7588: which period was used as reference period for SPI and SPEI calculations? Also 1970-2011 like for streamflow and groundwater? –> Yes, we will add this information.

p.7594, l.10: inverse direction, but not significant –> Correct, we will add this.

p.7595, l.5: later > latter –> will be changed

p.7595, l.26: negative > negative –> will be changed

p.7596: “better the mean” > insert than –> will be changed

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 2, 7583, 2014.