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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Developing drought impact functions for drought risk management" *by* Sophie Bachmair et al.

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Thank you to reviewer 1 for the supportive feedback and pointing out issues that require more discussion in the manuscript. The reviewer's concern mainly centers on the applicability of the methodology in reality: "My only concern is the limited applicability of the methodology in reality. As the authors acknowledge, a caveat of the impact functions is that they do not incorporate the dynamics of vulnerability." Further posed questions are: "How do the authors expect to cope with scarce data availability? How would the authors expect the impact function concept translates into water resources planning and management?"

We propose to add content to the Discussion section of the paper on the topics outlined

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below.

1) Applicability in reality, particularly to water resources planning and management

We acknowledge that there are still some hurdles towards an operational applicability, and that these could be better discussed. We will expand the current discussion paragraph on the applicability of our concept for monitoring and early warning purposes (see page 11 lines 3-18). In general, this being a science paper rather than a guideline for operational use, we hope that the proposal of a new concept will find further test beds and provide some seeds to further developments.

As we point out in the above mentioned discussion paragraph, drought impact functions may provide different usage options. Generally, they may be applied for planning and risk management or in a real-time, early warning context. For the case of water resources planning and management, in particular, scenarios provide a common tool to test and improve existing drought plans. Currently such tests are mostly done at the level of individual water suppliers with very specific failure functions. An application of the impact functions may allow a more regional to country scale assessment of the risk of certain sectors to drought and hence enable the improvement of emergency plans across sectors. In a real time context, an impact function will allow to interpret the given monitoring of drought indices as a threshold or trigger of action. Impact functions thereby translate drought intensity expressed by a hydro-meteorological indicator into the possibility of experiencing socio-economic or ecological effects. Since the impact functions are based on historical experience, they can be interpreted as a warning that a certain currently experienced drought condition resulted in negative effects on specific sectors in the past. This information can be used to trigger management actions. Currently, operational systems like the US Drought Monitor or the European Drought Observatory allow the user to select different drought indices. We propose that in the future users should ideally also be able to select an index that provides information on whether socio-economic or ecological effects can be expected for this drought intensity, which could be addressed by impact functions.

2) Dynamics of vulnerability

As correctly pointed out, the dynamics of vulnerability play an important role when designing impact functions. We included the year of impact occurrence as additional variable that may cater for trends in vulnerability or impact reporting to some extent as suggested by Stagge et al. (2015b). To our knowledge, the issue of dynamics of vulnerability also applies to other natural hazards impact or damage functions and is not trivial. If a drought impact function is designed for a specific application and region, expert elicitation could be used to gain an understanding of dynamics of adaption measures over time. One would need to test whether quantifying such information and adding it as further predictor variable would improve the reliability of impact functions. Further approaches for considering the dynamics of vulnerability are presented by Blauhut et al. (2015a).

3) Data availability

To overcome the data scarcity, a number of suggestions have been made and appear possible given the will and resources. Options include semi-automated newspaper clippings and other big data approaches as well as trained observer networks as explored with the USA drought impact monitoring (see e.g. Smith et al. (2014)). They also include a more directed and targeted monitoring of drought impacts in general as part of the environmental and water resources monitoring.

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