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Reply to Comment on "Significance of "high probability/low damage" versus "low probability/high damage" flood events" by C. M. Rheinberger (2009)

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Abstract. In a comment to our recently published paper on the "Significance of "high probability/low damage" versus "low probability/high damage" flood events" (Merz et al., 2009), C. M. Rheinberger questions the use of relative damage as a suitable indicator for risk aversion and the use of the resulting risk aversion functions in judging flood mitigation measures. While the points of criticism are important and should be accounted for, most of these points are considered in our original paper. More importantly, we do not agree with the conclusion that the use of relative damage as indicator for risk aversion is generally not appropriate in decision making about flood mitigation measures.

1 Introduction

The comment of C. M. Rheinberger touches very important issues and stimulates the discussion on risk aversion and on the influence of scale in risk reduction decisions. It can be summarized as follows: (1) risk aversion as function of relative damage should be replaced by directly estimating additional indirect costs, and (2) the use of relative damage as indicator of risk aversion leads to distortions in the appraisal of costs, and therefore, to inefficient decision making. In the following, we respond to these statements separately.

2 Estimation of additional indirect costs

In the conclusions section of our paper we stated that the "...mismatch between technical risk appraisals and the perception of society stems from the limitations of today's flood risk analyses..." and that "...a larger emphasis should be placed on considering indirect, intangible and long-term consequences of floods. If a complete quantification of all flood impacts in a technical risk analysis were possible, this mismatch would be closed...". Therefore, in our paper we agreed with the position of C. M. Rheinberger that the ideal approach would be to estimate indirect costs. However, we also concluded that "...realistically, a complete quantification is a long way ahead. Therefore, attempts to compensate the effects of missing consequences are valuable. To this end, risk aversion may be included in the risk assessment, trying to quantify the perceived societal risk instead of the technical risk...". Although the direct estimation would be the ideal approach, there are currently no satisfying methods to estimate indirect economic costs of floods (Schwarze, 2010; Merz, 2006; van der Veen et al., 2003; Munich Re, 2001).

Compared to direct losses, indirect effects are much more difficult to measure and to quantify, and there are limited sources of data available. This data limitation has led to attempts to quantify indirect losses using economic models of the type that have long been utilized for economic forecasting, such as Simultaneous equation econometric models or Input-output models (Rose, 2004). However, it has been suggested that these models tend to overstate indirect effects of disasters (R. Schwarze, personal communication, 2009). These models have been designed primarily to quantify the effects of a lasting impact, and there are hints that dynamic features during floods, such as recovery or changes in labour supply, are not properly reflected in these models (R. Schwarze, personal communication, 2009). However, we also acknowledge that there are promising attempts, such as modelling supply shocks, post event supply constraints and time phased reconstruction in disaggregated spatial settings, as applied in van der Veen and Logtmeijer (2005) and Yamano et al. (2007) to overcome this methodological gap.

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C. M. Rheinberger does not touch the issue of intangible direct consequences of floods. Research has shown that to flood victims some of the intangible losses are regarded as far more important than the costs of the damage to their home and its contents (e.g. Green, 2003; Siegrist and Gutscher, 2008). Similarly to indirect tangible consequences, they are very difficult to quantify. There are methods to monetize damages to non-market goods, for example, life and limb, amenities and eco-system service, as well as other "intangible losses" associated with floods such as contingent valuation or hedonic price analysis. However, these methods are not widely accepted by practitioners, in legal conflicts or flood risk management either because of the large variance of results or their sensitivity to study settings (R. Schwarze, personal communication, 2009).

3 Distortion in damage estimates – system borders

The concept of using relative damage stands and falls with the definition of system borders. Damage must always be related to a space (and time) domain. Most indirect losses at the local level disappear at the national or even international level, since local production losses are compensated by production gains in regions outside the flood-affected area. Depending on the choice of the temporal and spatial boundaries, there will be considerably larger or smaller indirect economic damages. An appropriate approach to this problem is to choose the temporal and spatial boundaries of the damage assessment in accordance with the temporal and spatial boundaries of the public policy project to be evaluated.

In our paper we use the municipality-level as an example: "...In this example, risk aversion is assumed to be a function of the relative damage of the municipalities. They are seen as the entity for which the decision on flood mitigation is made...". The system is identical with the municipality. Relative damages are related to the damage potential of the municipality, and the decision maker's focus is on setting up the most efficient flood mitigation measures in this community. For Germany, this is a reasonable example. While higher-level authorities in the field of flood risk mitigation exist, the federal structure of the country strengthens the responsibilities of relatively small units, often on the municipality level.

We compare the implications of our assumptions for municipalities of different size, but we do not compare the municipalities to each other. In the comment of C. M. Rheinberger, this discrimination between different systems is not maintained consequently: comparing possible flood mitigation measures in Doebeln to measures in Cologne would require a decision maker who would be responsible for flood mitigation in both municipalities; in the real world this decision maker would be positioned on the national level. Such an authority does not exist in Germany.

If such an authority existed, the system border could be set at the national scale. Theoretically, this would lead to an optimum economic solution at the national scale. Money for flood mitigation would be spent in those locations where the highest return in terms of reduced damage would be expected. In our example, this could lead to very high safety in locations with high damage potential and very low safety in locations with low damage potential. Such an economically optimal solution does not take into account important societal aspects, such as the right of people within one country to obtain a similar degree of safety against floods.

In our paper, we start from the premise that the municipality level is a reasonable system domain for decisions on flood mitigation. We conclude that at this spatial scale indirect costs may be very important. We are convinced that the methods for quantifying indirect loss are in their infancy, and propose risk aversion functions as a means for taking them into account. In our view, the important innovations of the paper are (1) the quantification that the expected annual damage is governed by "high probability/low damage" events, and (2) the illustration that different types of flood mitigation measures are preferable if "low probability/high damage" events are taken into account.

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