Geophysical Research Abstracts
Vol. 18, EGU2016-16081, 2016
EGU General Assembly 2016

The capability of headwater areas to mitigate the risk of (flash) floods for downstream locations at different spatial scales

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The concept of decentralised flood protection is based on localising and using the natural capability of a catchment to retard run off as early as possible, and at several places at the same time, by means of a combination of different small-scale technical and non-technical measures (Assmann, 1999; DWA, 2006; DWA, 2013a; Schulte et al., 2007).
Intense rainfall and heavy floods in August 2002, which caused extraordinarily high levels of inundation and damage, affected the Ore Mountains, a low range mountain region in eastern Germany. Against this background, the objective of this investigation has been developed to analyse the capability of headwater areas to mitigate floods for downstream locations at different spatial scales. Based on this idea, the hydrological effect of selected small, well-placed retention facilities was analysed for the Natzschung catchment.
The above-mentioned concept is well established in German literature and recent studies have been reviewed, but it is also well known in the international context (Liaw et al., 2006; Mendel & Liebscher, 2010; Poulard et al., 2010; Scholz & Yang, 2010). Over recent years, several approaches and investigations have analysed the performance of these measures in terms of retention or detention ponds and other techniques (Reinhardt et al., 2011; Rieger, 2012). The discussion of pros and cons is still in progress, but the lack of data clearly remains an issue, especially concerning the capability and the effect of retention facilities at different spatial scales and for varying flood return periods (McMinn et al., 2010; Mendel & Liebscher, 2010).
The analysis of the Natzschung catchment offered the potential for uncontrolled retention facilities at several locations, in the upper and middle basin. These facilities were implemented in a distributed hydrological model (NASIM) to simulate local and regional flood retarding effects.
For all analysed locations in the catchment, a distinct effect concerning the peak reduction and the temporal shift of the peak could be observed. This is not only important for the main objective of flood protection, as a reduction in discharge also means a decrease in stream power, erosion and the sediment transport capacity of fluvial systems (Borga et al., 2011).
This flood retention concept considers regional and local flood protection targets and the specific hydrological conditions and capabilities of a catchment. The implementation of these kind of measures in stream headwaters could be a feasible way to establish an effective and additional flood protection for the local and downstream settlements of the Ore Mountains, and for other low range mountain systems.