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Estimation of extreme floods (design events) in Southwest Germany: comparison of a regionalization model with a precipitation-runoff model

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The objective of the presentation is to compare and discuss two methodologies for the estimation of extreme flood parameters: 1.) a regionalization model based on statistical and spatial informations as main tool on regional level and 2.) a precipitation-runoff model for selected areas/sites. The term "extreme" is especially refering to (design) events with return periods of 200 to 10000 years (e.g., as necessary for dam safety analyses or hazard maps). Definitely, the extrapolation of models to such extreme (unobserved) situations is confronted with the problem of uncertainties. Therefore, the special interest is directed towards the complementary agreement of the model results, especially regarding ungauged sites. The detailed background of this study can be described as follows. The regionalization model was developed since the late 1990ies on behalf of the State Institute for Environmental Protection Baden-Wuerttemberg (abbr.: LfU). The aim of the model is to provide hydrological parameters for the water management activities in the state (35752 kmˆ2 in Southwest Germany). The regionalization model consists of a multiple linear regression approach with eight parameters (e.g., catchment area, slope, land use, annual precipitation, empirical landscape factor depending on geological conditions). The model coefficients are calibrated on the base of frequency analyses for 335 gauges (average observation period: 45 years). The gauges are covering catchment areas between $<$ 10 kmˆ2 (˜7 % of all gauges) and $>$ 1000 kmˆ2 (˜7 %, as well), which were divided into $>$ 3400 hydrological sub-areas. In short, a variety of parameters for low, mean and high flow situations are nowadays available for all rivers respectively catchment areas and sub-areas. For example concerning floods, mean annual peak flows MHQ and annual peak flow HQ-T for different return periods T (T = 2 - 100 years) were distributed in 1999/2000. The re-

gionalization model shows very good results in comparison to those of to the flood frequency analyses for the gauges (Rˆ2 $>$ 0.994 for all mentioned HQ-T). The focus of this study is actually directed to the recent extension of the regionalization model to return periods of 1000 or even 10000 years. In view of the extrapolation, a verification and better funding of the regionalization approach is desired, in particular for smaller rivers where the data availability is more critical (few gauges, short time series). One option is therefore the diagnosis in comparison with the results of precipitation-runoff (PR) simulations in selected catchments (˜ 10 to 600 kmˆ2). For these purposes, the precipitation input of the PR simulations was statistically extrapolated, too. It can be outlined that the comparison of both approaches shows a fairly good agreement. For example the HQ-1000 from the regionalization model are similar to the outputs of the PR model at many sites. A first conclusion is that the two approaches can be used in a complementary sense (i.e., to estimate the values originating from different sides). In a more detailed discussion, further conclusions are expected.