



Supplement of

Climate change effects on river droughts in Bavaria using a hydrological large ensemble

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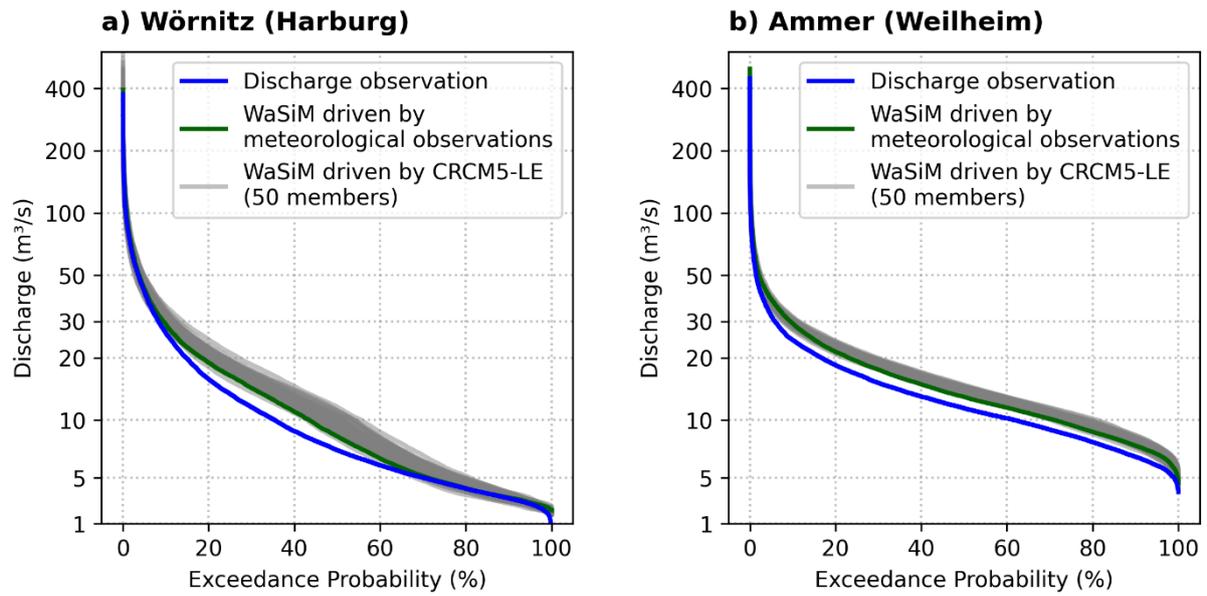


Figure S1: Flow duration curves for the Wörnitz (a) and Ammer (b) catchments. Blue lines are based on discharge observations in the period 1981 – 2010. The green line shows the WaSiM simulation driven by meteorological observations (1981 – 2010). The grey lines represent the 50 members of the WaSiM-LE simulations driven by the bias-adjusted CRCM5-LE (1981 – 2010).

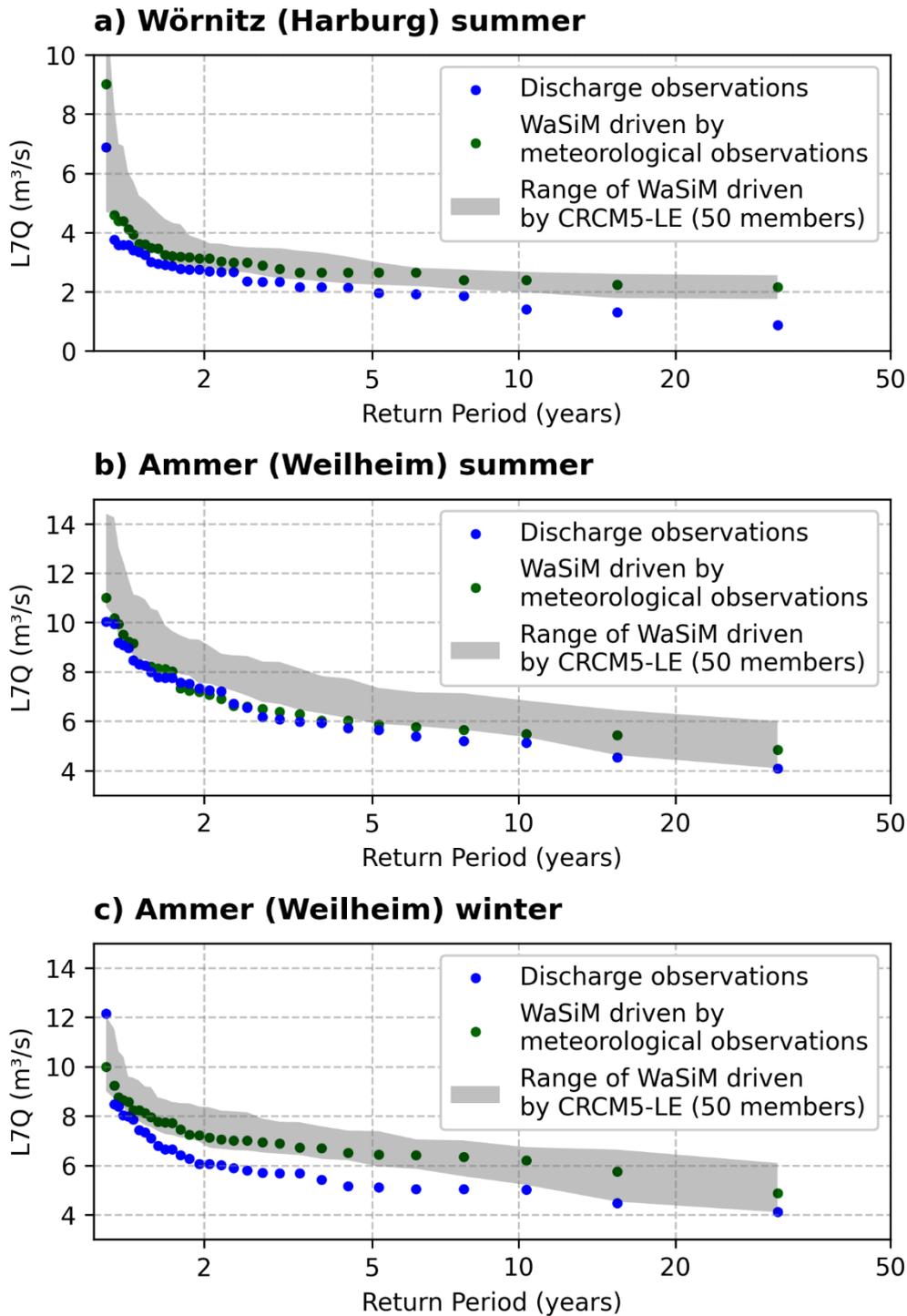


Figure S2: Evaluation of the L7Q during the reference period for the Würnitz (a) and Ammer in summer (b) and winter (c). The return periods are plotted via Weibull plotting positions. Blue dots are based on discharge observations in the period 1981 – 2010. The green dots show the WaSiM simulation driven by meteorological observations. The grey area represents the full range of the 50 members of the WaSiM-LE simulations driven by the CRCM5-LE.

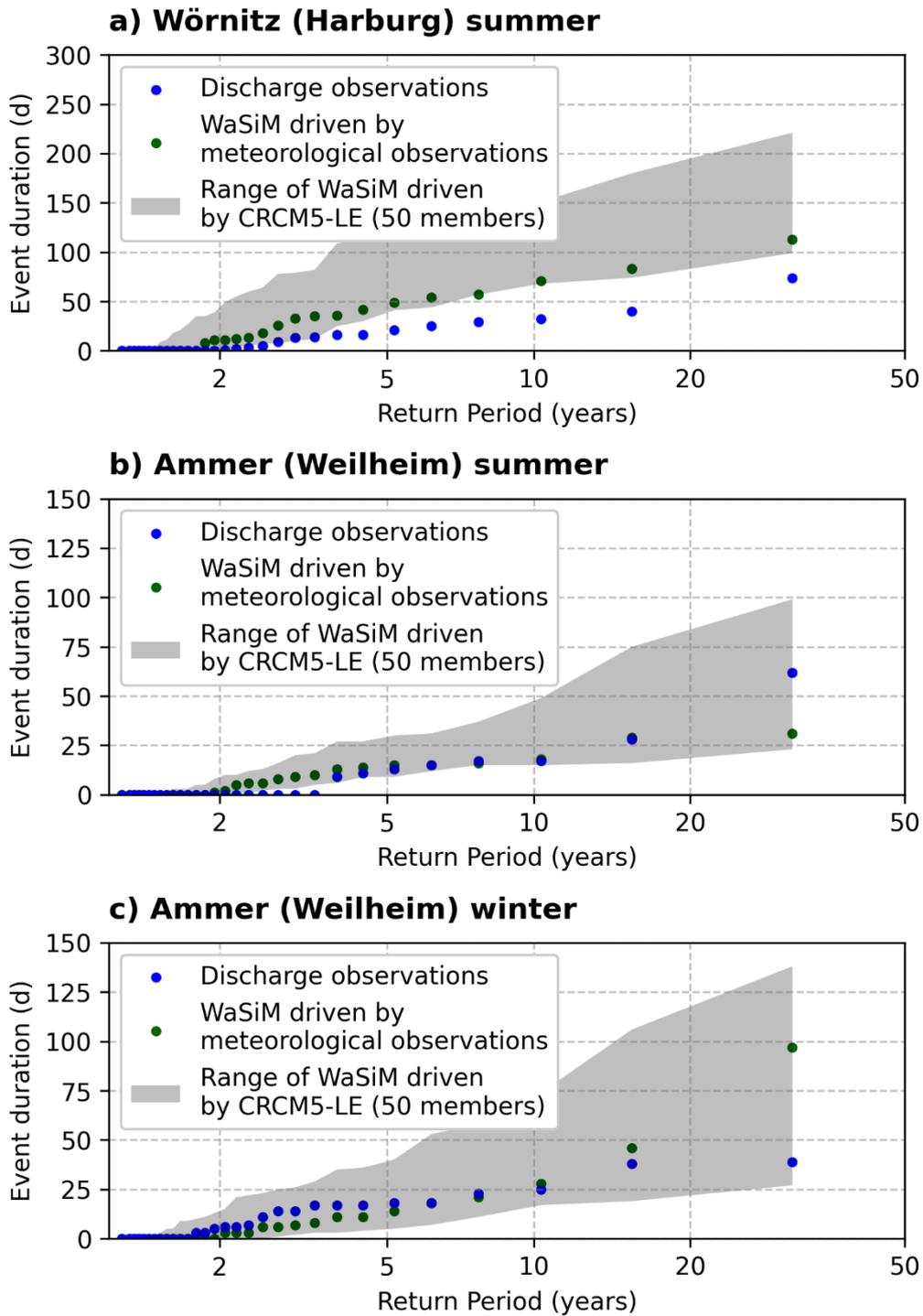


Figure S3: Evaluation of the event duration during the reference period for the Wörnitz (a) and Ammer in summer (b) and winter (c). The return periods are plotted via Weibull plotting positions. Blue dots are based on discharge observations in the period 1981 – 2010. The green dots show the WaSiM simulation driven by meteorological observations. The grey area represents the full range of the 50 members of the WaSiM-LE simulations driven by the CRCM5-LE.

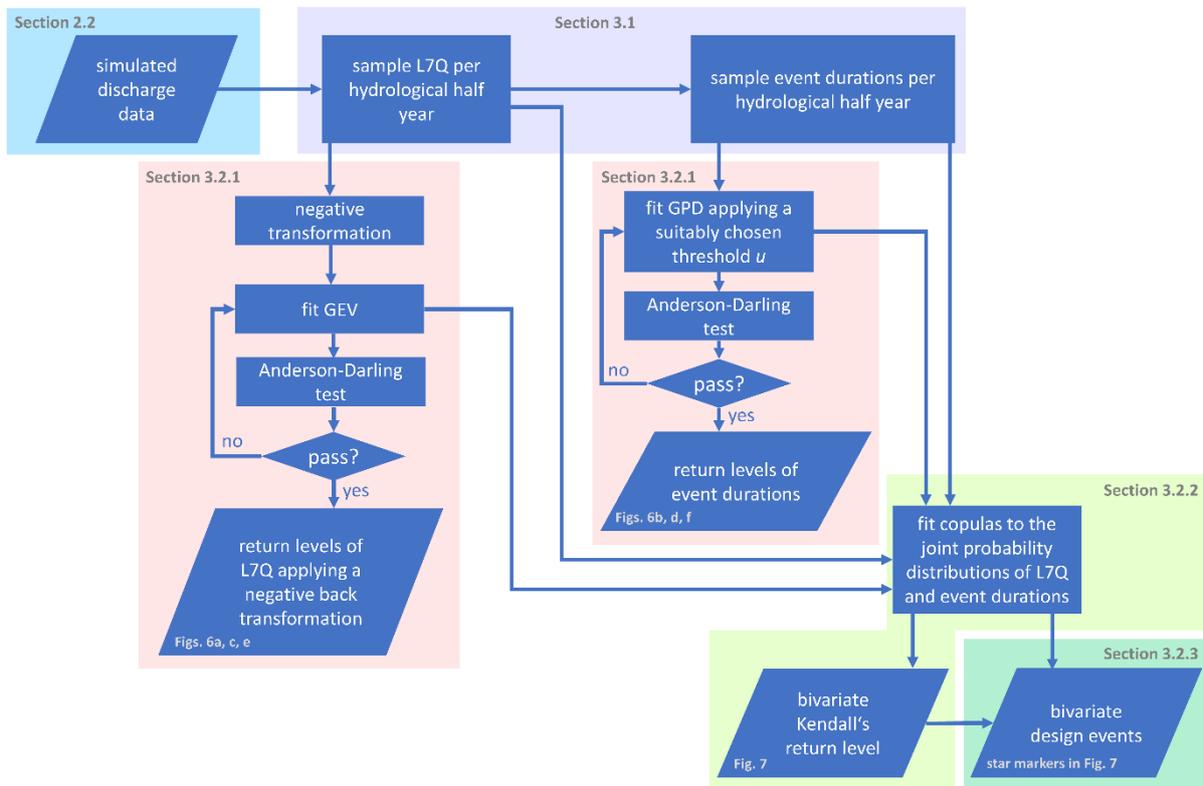


Figure S4: Schematic flowchart of the extreme value statistical workflow described in sections 2.2, 3.1, and 3.2 in the main article.

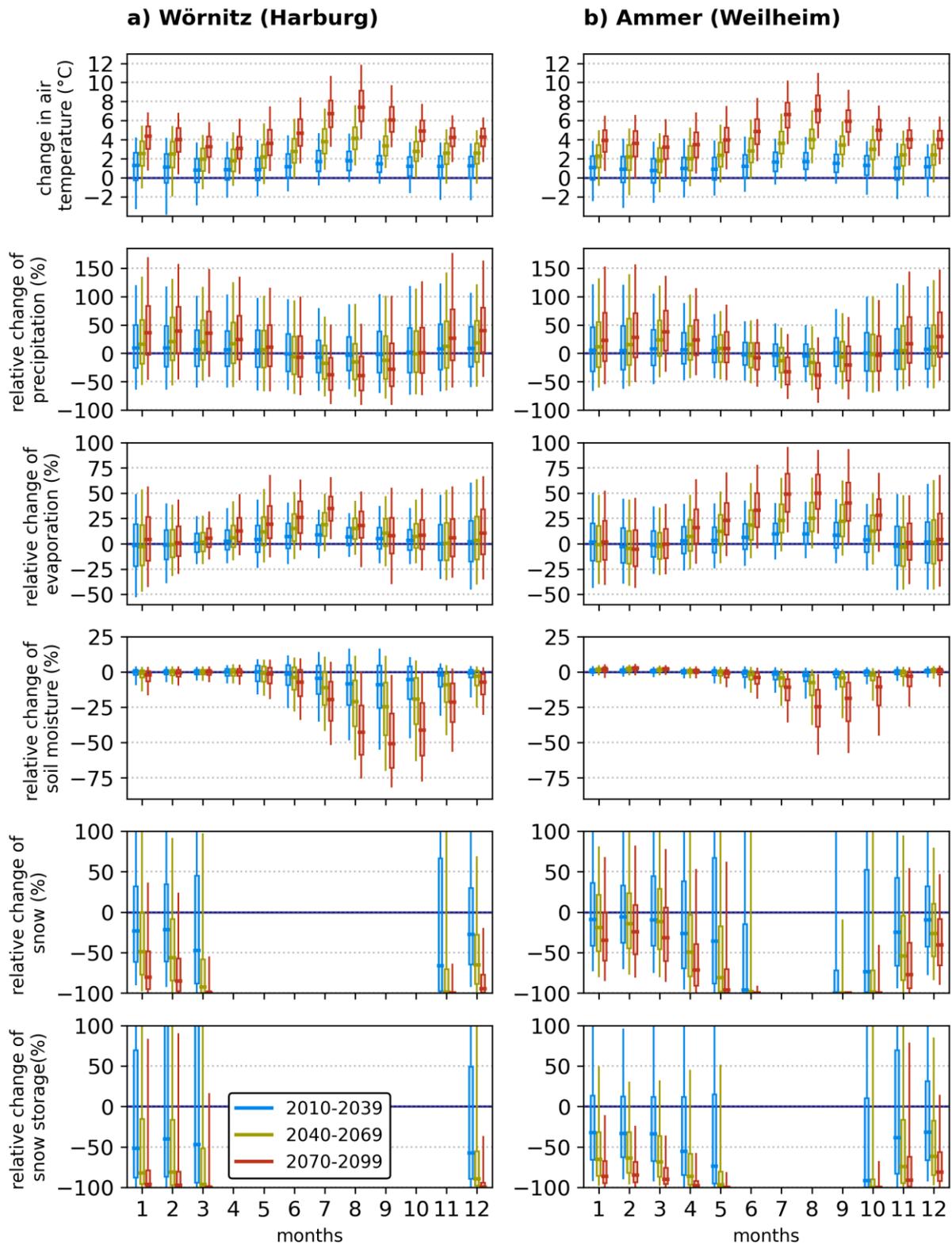


Figure S5: Changes of climatic and hydrological drivers in the (a) Wörnitz and (b) Ammer catchments. Absolute values are given in Figure 2 of the main article. Changes are calculated compared to the reference period of 1980 – 2009. The centerline of the boxplots shows the median over all 50 members and 30 years per period. The boxes represent the interquartile range of the 1500 years, where the whiskers extend to the 5th and 95th percentiles, respectively. Relative changes of the snow variables inflate due to low absolute values in the reference period. Hence, only the range of -100 % to +100 % is shown.

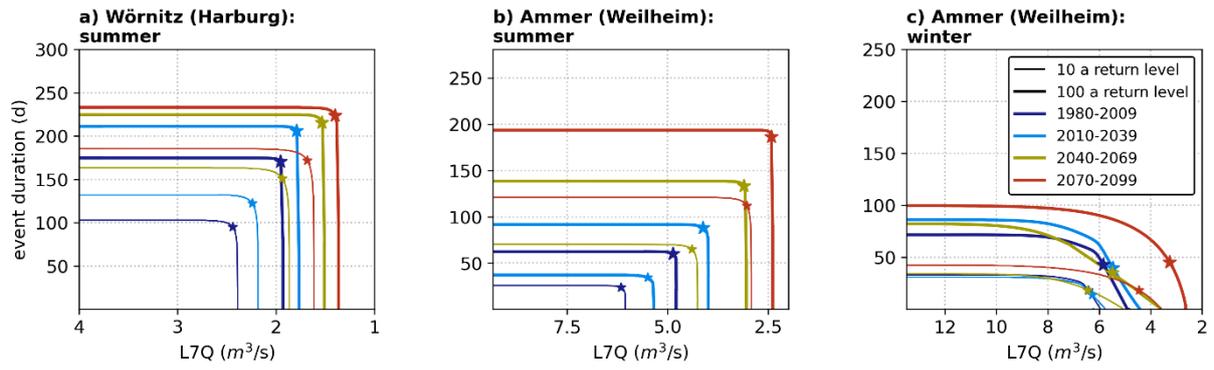


Figure S6: Bivariate survival Kendall's return levels of event duration and L7Q. The isolines show the 10-year (thin lines) and 100-year (thick lines) return levels, where the star marker represents the most likely combination of L7Q and event duration for the respective bivariate return periods. This is an alternative figure composition aligning with Figure 7 of the main article for a better visual comparability between the time periods.

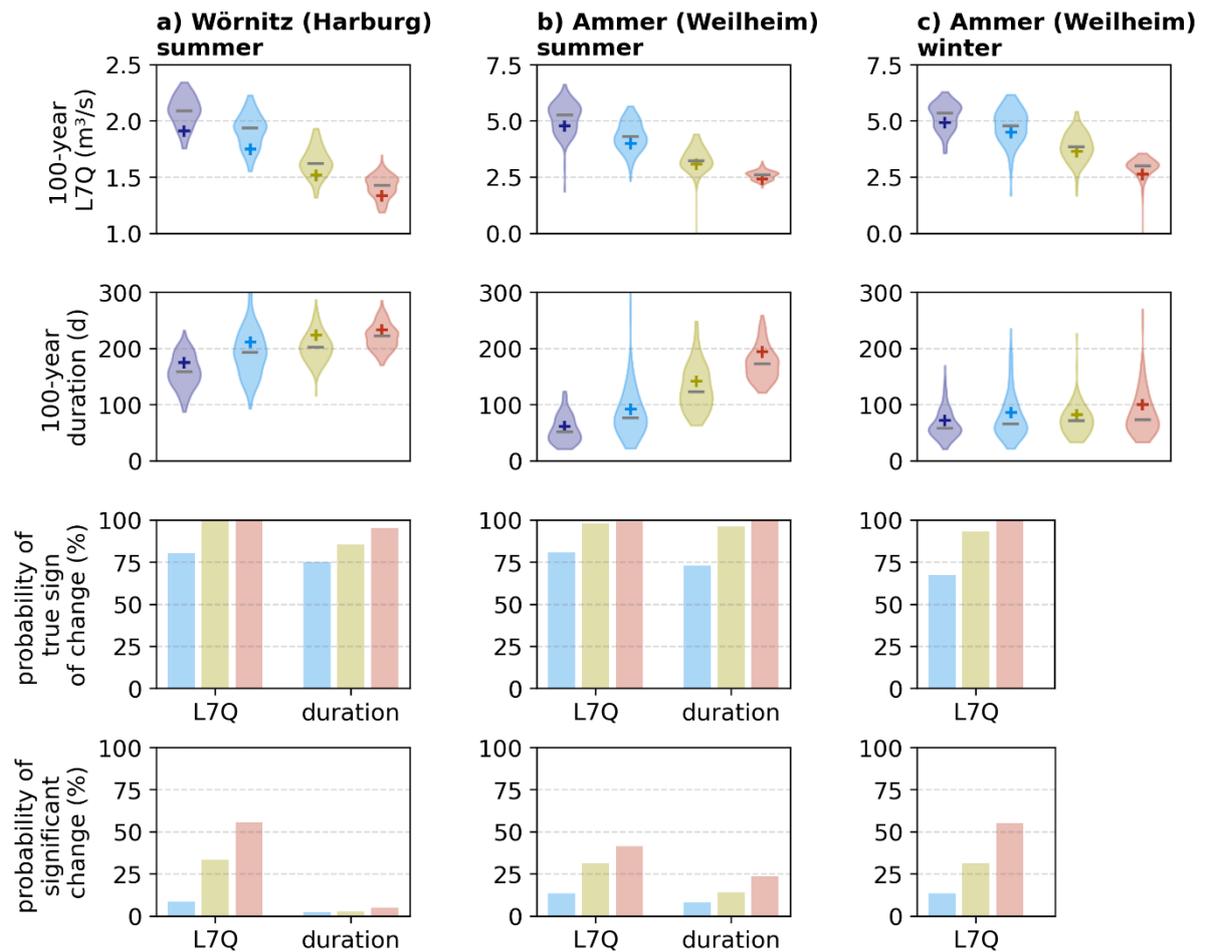


Figure S7: Bootstrap experiment: How would the respective 100-yr return levels of L7Q and event duration look like based on a single 30-year period? Violin plots indicate the range of 100 bootstrap iterations, where the cross denotes the “best estimation” based on the whole 50 members. Barplots (third row) show the probability to detect the “true” sign of change, when comparing CUR, NF, and FF to REF. Barplots (fourth row) indicate the probability that the detected change with one member is significant. Significant changes are defined by the estimation for the CUR, NF, FF 100-year return levels is outside the 95% confidence intervals of the REF (see Fig. 6 of the main article).