



## **Towards low flow risk maps**

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Drought induced low flow extremes, despite a variety of management strategies, can cause direct and indirect impacts on socio economic and ecological functions of rivers. These negative effects determine local risk and are a function of the regional drought hazard and the river system's vulnerability. Whereas drought risk analysis is known to be essential for drought management, risk analysis for low flow is less common. Where no distributed hydrological models exist, merely the local hazard at gauging stations is available to represent the entire catchment. Vulnerability information are only sparsely available. Hence, a comprehensive understanding of the drivers of low flow risk along the longitudinal river profile is often lacking.

For two different rivers in southwestern Germany, this study analysed major low flow events of the past five decades. Applying a transdisciplinary approach, the hazard component is assessed by hydro-climatic analysis, hydrological modelling and forward looking stress test scenarios; the vulnerability component is estimated by a combination of impact assessment and vulnerability estimation, based on stakeholder workshops, questionnaires and regional characteristics. The results show distinct differences in low flow risk between the catchments and along the river. These differences are due to: hydrogeological characteristics that govern groundwater-surface water interaction, catchment-specific anthropogenic stimuli such as low flow decrease by near-stream groundwater pumping for public water supply or low flow augmentation by treatment plant discharge. Thus, low flow risk is anthropogenically influenced in both ways: positive and negative. Furthermore, the measured longitudinal profiles highlight the impracticability of single gauges to represent quantitative and qualitative conditions of entire rivers. Hence, this work calls for a comprehensive spatially variable consideration of flow characteristics and human influences to analyse low flow risk as the basis for an adequate low flow management.