Approaches to describe different hydrological extremes related to their impact and derived measures

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The climatological changes that have been forming for years have led to several different effects within the Wupper catchment area: the increasing of strong to extremely pronounced convective events lead on one hand (exacerbated by the strong topography within the “Bergische Land” region) to major damage events (e.g. in 2018 with several million of known damage costs), but also mean lower inflows to the drinking and usage water reservoirs due to the high level of interception and evaporation potential of the natural catchment areas (high proportion of forests, drinking water protection zones). The prolonged dry periods exacerbate the problem, because of the reduced groundwater recharge. While the annual precipitation is in the normal range, the changes in the distribution (in intensity, duration and seasons) cause big changes. In addition to the water volume capacity, this also affects the water quality of the streams and reservoirs. Resulting low levels in the reservoirs (often in combination with high temperature) e.g. to blue-green algae growth and require further efforts to achieve the needed water quality.

Purely stationary approaches are not sufficient for describing the processes properly and to transfer the results in a way that decision makers can understand the characteristics. Only a relative change of single precipitation periods in of percentage, cannot give any reference to the resulting effects and impacts. In addition, the different kind of data sets for hydrological and limnological impact modeling makes it difficult to compare the results. Historical point measurements (such as from climate stations or levels), areal (grid-based) historical recording e.g. precipitation by rain radar or soil parameters by satellite, weather forecasts in the range of hours to months and climate forecasts (e.g. decadal) or scenarios are each self-sufficient data sets, but must be linked in order to be able to derive appropriate measures.

Therefor methods to correlate past critical situations with indices / predictors, which are statistically sufficiently robust are suitable. This will enable us to make statements for the development in future periods and to represent changes in an impact-related manner. The presentation shows examples of how such approaches can be implemented for the phenomena described above (heavy rain / drought).