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Influence of climate variability versus change at multi-decadal time scales on hydrological extremes

Patrick Willems
KU Leuven, Hydraulics division, Civil Engineering, Leuven, Belgium (patrick.willems@bwk.kuleuven.be, +32 16 321989)

Recent studies have shown that rainfall and hydrological extremes do not randomly occur in time, but are subject to multidecadal oscillations. In addition to these oscillations, there are temporal trends due to climate change. Design statistics, such as intensity-duration-frequency (IDF) for extreme rainfall or flow-duration-frequency (QDF) relationships, are affected by both types of temporal changes (short term and long term). This presentation discusses these changes, how they influence water engineering design and decision making, and how this influence can be assessed and taken into account in practice.

The multidecadal oscillations in rainfall and hydrological extremes were studied based on a technique for the identification and analysis of changes in extreme quantiles. The statistical significance of the oscillations was evaluated by means of a non-parametric bootstrapping method. Oscillations in large scale atmospheric circulation were identified as the main drivers for the temporal oscillations in rainfall and hydrological extremes. They also explain why spatial phase shifts (e.g. north-south variations in Europe) exist between the oscillation highs and lows.

Next to the multidecadal climate oscillations, several stations show trends during the most recent decades, which may be attributed to climate change as a result of anthropogenic global warming. Such attribution to anthropogenic global warming is, however, uncertain. It can be done based on simulation results with climate models, but it is shown that the climate model results are too uncertain to enable a clear attribution.

Water engineering design statistics, such as extreme rainfall IDF or peak or low flow QDF statistics, obviously are influenced by these temporal variations (oscillations, trends). It is shown in the paper, based on the Brussels 10-minutes rainfall data, that rainfall design values may be about 20% biased or different when based on short rainfall series of 10 to 15 years length, and still 8% for series of 25 years lengths. Methods for bias correction are demonstrated. The definition of "bias" depends on a number of factors, which needs further debate in the hydrological and water engineering community.

References:

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