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Identifying a regional model for extreme rainfall in current climates – quo vadis?

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Establishing a regional model for intensity-duration-frequency (IDF) curves remain a vital task for design of urban infrastructures such as sewer systems and storm water detention ponds. However, identifying a suitable model remains tricky as subjective decisions and assumptions, that easily can be challenged, is needed. The talk will focus on recognizing and overcoming these shortcomings to develop a framework that is trusted by the users, i.e., the engineering professionals.

Since 1999 a regional model for IDF-curves has been developed and employed in Denmark. The model consists of a Partial Duration Series (PDS) framework using covariates to explain the regional variation supplemented with a regression across different durations. The first model was based on 41 series with a total of 650 station-years. Currently a fourth model based on a total of 132 series with almost 3000 station-years is being developed. The underlying data for all models come from a network of tipping bucket gauges initiated in 1979.

While the PDS modelling framework to describe extreme rainfall data has been applied and validated every time, the model setup has changed during each of the three updates. The second model, released in 2006, focussed on describing a significant increase in the design intensities and identifying a new regionalization, reducing the number of regions in the country from three to two. The third model, released in 2014, further increased the design intensities substantially, but more importantly, a cycle of precipitation extremes in Denmark with a frequency of around 35 years was acknowledged, and new co-variates were identified, enabling a description of Denmark as one region with variations that could be explained by two spatially continuous covariates.

Presently a new model is being developed. Most parts of the model are unchanged. However, inclusion of many recent relatively short series (10-20 years) both increase the sampling uncertainty and bias the model towards the very peak of the cyclic variation of the precipitation extremes, whereby the mean intensities will increase, as well as the overall uncertainty of the model. Hence the short series have been excluded. As a result hereof, the engineering community expresses a concern that such an update will not, in general, increase design intensities in a current climate that is regarded as non-stationary with increasing extreme rainfall. For the

scientists it could be an indication that the model may have reached a mature state, where the changes are small and random over a 5-year horizon. For the practitioners there is a concern that this may lead to infrastructure design that over time proves inadequate and fails to meet the service levels set to protect the citizens and important assets.

As indicated above having much data at hand for a regional model does not hinder large structural uncertainties. What are reasonable assumptions and how can they be communicated to the users? When looking across Europe the structural differences in the model setups are even larger, not only reflecting variations in climate, but also choices made by different groups of scientists.