Statistical Modeling of Long Historical Rain Series

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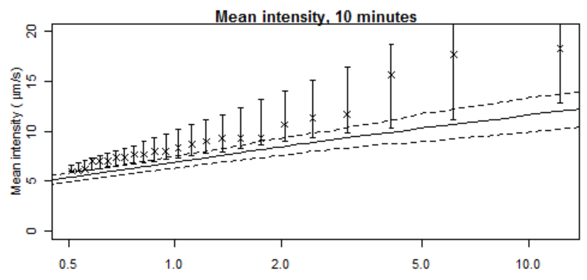
Abstract
Climate change will impact precipitation and notably precipitation extremes. Much research is directed towards understanding and describing changes on large scale variations. However, many applications need precipitation input at a scale much finer than what can be modelled by global and regional climate models. Some of the processes are poorly understood and must be described by stochastic models.

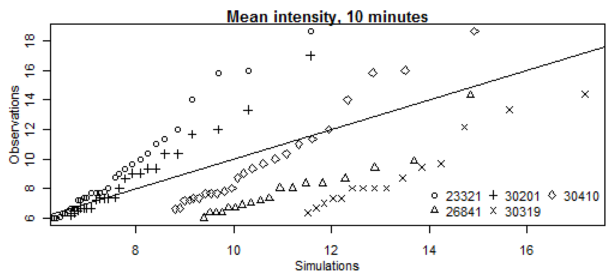
The purpose is to find models that can describe the stochastic properties of precipitation. The main means of testing the models is to generate long historical rain series using Markov chain models. If the properties of an entire historical series can be captured by the model the stochastic properties of the model can be used to infer properties of precipitation.

The data is extracted from tipping bucket rain gauge measurements from the Danish SVK system. The data has a temporal resolution of one minute and a volumetric resolution of 0.2 mm. The waiting times between consecutive tips is modelled. Precipitation is regarded as a continuous evolving process measured discretely, and the probability density functions of the states in the Markov chain models, are modelled using Box-Cox transformations and normal distributions. The distribution parameters are then modelled across states using continuous functions. The influence of a seasonal external explanatory variable is modelled as well. The seasonal variable seems very essential for the model behaviour.

Synthetic precipitation time series are simulated using a Monte Carlo algorithm, and are compared with the original time series. The comparison is done based on average properties of the extremes, based on one long historical time series, using the common Danish event definition and extreme precipitation definitions from Spildevandskomitéen. Furthermore the preferred model is tested with precipitation from four tipping bucket rain gauges that are completely independent of the one used for the modelling. None of the models reproduced the precipitation time series perfectly, but the preferred model performed acceptable. The model is a first step towards a better understanding of the precipitation process. The presentation will discuss a palette of options to extend the model.

Figures: **Left** – Simulated values of the best seasonal model (full line) with 95 % confidence interval (dashed lines) against the observations (crosses) with a 95 % confidence interval (whiskers) under the assumption that the extreme values are Generalized Pareto Distributed **Right** – Q-Q plot of the observed extreme values from five different rain gauges against their respective fitted models.





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