The interest in stochastic models for daily precipitation has grown in recent years due to their application in climate change studies. The intermittent nature of precipitation, the high skewness of precipitation distributions, and low-frequency variability are some of the challenges facing modellers.

Most stochastic precipitation models are based on modelling the occurrence and precipitation depth on wet days as two independent processes. For example, a 1st-order Markov Chain may be used to model the sequence of wet and dry days, and a gamma distribution may be used to model the amount of precipitation on wet days. In this presentation, we investigate properties of a daily precipitation model based on a latent Gaussian autoregressive process. The AR-process defines a wet day to be any day on which a certain threshold is exceeded. When the process is below the threshold, the day is considered dry. The values above the threshold can be transformed to conform to any analytical or empirical distribution of precipitation amounts. We present an efficient method for parameter estimation based on the principle of maximum likelihood estimation of censored samples. The single-site case is extended to the multi-site case and we show how a contemporaneous AR model can provide a good representation of a set of precipitation records in a region.

The potential advantage of the investigated model over more conventional methods is that the continuity of the latent variable allows for more streamlined integration into downscaling models and for such tasks as filling-in missing data in precipitation records.