H21L-01: Continuous Sub-daily Rainfall Simulation for Regional Flood Risk Assessment – Modelling of Spatio-temporal Correlation Structure of Extreme Precipitation in the Austrian Alps

Tuesday, 12 December 2017
08:00 - 08:15
New Orleans Ernest N. Morial Convention Center - 293-294

Generation of realistic synthetic spatial rainfall is of pivotal importance for assessing regional hydroclimatic hazard as the input for long term rainfall-runoff simulations. The correct reproduction of observed rainfall characteristics, such as regional intensity-duration-frequency curves, and spatial and temporal correlations is necessary to adequately model the magnitude and frequency of the flood peaks, by reproducing antecedent soil moisture conditions before extreme rainfall events, and joint probability of flood waves at confluences.

In this work, a modification of the model presented by Bardossy and Platte (1992), where precipitation is first modeled on a station basis as a multivariate autoregressive model (mAr) in a Normal space. The spatial and temporal correlation structures are imposed in the Normal space, allowing for a different temporal autocorrelation parameter for each station, and simultaneously ensuring the positive-definiteness of the correlation matrix of the mAr errors. The Normal rainfall is then transformed to a Gamma-distributed space, with parameters varying monthly according to a sinusoidal function, in order to adapt to the observed rainfall seasonality. One of the main differences with the original model is the simulation time-step, reduced from 24h to 6h. Due to a larger availability of daily rainfall data, as opposite to sub-daily (e.g. hourly), the parameters of the Gamma distributions are calibrated to reproduce simultaneously a series of daily rainfall characteristics (mean daily rainfall, standard deviations of daily rainfall, and 24h intensity-duration-frequency [IDF] curves), as well as other aggregated rainfall measures (mean annual rainfall, and monthly rainfall). The calibration of the spatial and temporal correlation parameters is performed in a way that the catchment-averaged IDF curves aggregated at different temporal scales fit the measured ones.

The rainfall model is used to generate 10.000 years of synthetic precipitation, fed into a rainfall-runoff model to derive the flood frequency in the Tirolean Alps in Austria. Given the number of generated events, the simulation framework is able to generate a large variety of rainfall patterns, as well as reproduce the variograms of relevant extreme rainfall events in the region of interest.

Plain Language Summary

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