Geophysical Research Abstracts
Vol. 13, EGU2011-10126-2, 2011
EGU General Assembly 2011


# NiedSim-Klima: Generating Rainfall Time-Series of High Temporal Resolution under Future Climate Conditions

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Hydraulic applications like the dimensioning of tubes and channels in sewage system design require long rainfall time-series in a temporally high resolution of 1h or shorter. Sewage systems are very long lasting investments and changes in the hydrological conditions during their lifespan should be considered in the design. For that reason there is a strong demand for prediction of 1h rainfall intensities under future climate conditions.
The synthetic rainfall time-series generator NiedSim-Klima tries to satisfy this demand. It simulates 30 year long 1h-rainfall time-series under the climatic conditions of either a control period from 1961 to 1990 or a reference year in the future until 2050. The study area is Baden-Württemberg in Southwest Germany.
During the last few decades, Central Europe (as many parts of the world) experienced significant changes in the hydrological conditions. Statistical trend analyses reveal that the annual precipitation sum has significantly increased. In the same time, the annual cycle has been changing. The winter months have become dryer, the summer months wetter. It is assumed that these changes are an effect of the global climate change. However, the local response to this global change is highly depending on the temporal scale that is considered. An increase of the atmospheric temperatures in summer for example, as it is predicted for this region by several climate models, might lead to heavier thunderstorms due to increased convection. The result would be higher peaks in the short term rainfall intensities - even if the over all rainfall volume is decreasing and the summers become dryer.
For the set up of the NiedSim-Klima generator information on the precipitation regime of the study area were gathered from many different sources: A 40 year long archive of observed rainfall data from several hundred gauges was used to determine the characteristic statistics of the rainfall intensities and for trend analysis. NCEP/NCAR reanalysis data was used to link these statistics with typical atmospheric Circulation Patterns (CPs). The definition of the CPs then was applied to output of the Global Circulation Model ECHAM5 to gain a prediction of the CP sequence in the future. The daily precipitation values from Regional Circulation Models were used for a prediction of the extreme value statistics of the 24h-rainfall.
Some of the findings from these analyses:
- There is a general tendency towards higher rainfall intensities during short time intervalls. All over the study area the rainfall amounts that fall within five minutes or one hour are increasing compared to the daily rainfall values.
- The evolution of the daily rainfall values however is irregular. A prediction for the future is difficult since it is highly depending on the Regional Circulation Model that is inquired.
- The CP sequence is changing. Dry CPs become more frequent, especially in summer. And the CP's response in precipitation is temperature depending. In summer, the rainfall probability is decreasing if the atmosphere is hotter. In the same time the distribution of the 1h-rainfall intensities is shifted towards higher values. If it rains, it rains harder.

In my poster I will shortly present the NiedSim-Klima generator, give some details on the detected climate change signal and discuss the uncertainty and limitations of these analysis and findings.