Geophysical Research Abstracts
Vol. 13, EGU2011-145-1, 2011
EGU General Assembly 2011

Non-Gaussian Hydrological Simulation using Copula Based Autoregressive Model

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Global climate change can have the impact on characteristics of rainfall-runoff event and also on the water regime in the catchment. It is of importance to investigate the exiting data for detecting the impact of structural modification of river, change of land use and hydrological regime beside the simulations with complex physically based models. The objective of the research is to develop the stochastical methodology for the identification of hydrological characteristics in the catchment, which is transferable for the different catchments, being multinational and global long-term runoff data from GRDC[1] offered.

For this aim, statistical dependency should be analysed for a large number of hydrological time series data. Up until now the widely used time series model such as ARMA are based on the correlation and covariance. However, such statistical measure can't describe all the details of the dependence structure, subsequently could lose the crucial information. Instead the statistical concept like Copula has the advantage for the capability of measuring more detailed dependency and possibly be able to reveal the significant information about dependency from a variety of datasets.

As is the correlation matrix in autoregressive process of order n, n-dimensional empirical Copula can be constructed and the new value is simulated based on conditional distribution of corresponding copula model. In this way, the simulated time series data is not only accounting for the correlation matrix of given time series, but also more detailed characteristics of original data such as asymmetry [*Jing* 2008]:

Now, v-transformed normal copula[Bardossy 2008] is applied as non-Gaussian copula model for the representation of asymmetry, its parameters are estimated for the observed time series datum and new time series is simulated in autoregressive way. This successfully demonstrates the possibility to simulate further statistical aspects of time series data, which can't be described by the existing time series model, and further applicability in the real data should be discussed.

[1]The Global Runoff Data Center(GRDC) in Federal Institute of Hydrology in Germany , which fosters multinational and global long-term hydrological studies and offered world wide runoff data collected since 1988.