

DOWNSCALING SPATIAL RAINFALL FIELD FROM GLOBAL SCALE TO LOCAL SCALE USING IMPROVED MULTIPLICATIVE RANDOM CASCADE METHOD

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1. Introduction

The global data, for example the GCM output data, provides very coarse resolution of spatial rainfall field that does not serve as a data substitute to input directly in the hydrological model. A successful spatial disaggregation therefore has a promising possibility of using very coarse spatial rainfall field in the hydrological analysis, which may also fulfill the data demand of the distributed hydrological modeling.

The need of developing a proper method to downscale the spatial rainfall field arises from three major reasons. First, the spatial rainfall data, which is a major forcing input in the distributed hydro-meteorological modeling, is difficult to acquire over the needed region for needed time period. Huge investment may be necessary to acquire the data over large spatial domain with a satisfactory level of accuracy. Second, the research communities are paying much attention to understand the link between global scale phenomena to local or regional scale features recently, which has to handle the scaling effect of spatial rainfall field over a multiscale frame. Third, it is necessary to reduce the big gap between the applicability of coarse scale spatial rainfall field in catchment scale modeling of water cycle.

2. Overview

Some earlier researches have clearly shown the possibility of spatial rainfall field disaggregation using the Multifractal concept of scaling. Over and Gupta (1994, 1996) have formulated a procedure of Multifractal downscaling using a β -log normal model based on the discrete random cascade approach that disaggregates an average value of a coarser grid cell into finer grids in a successive cascade.

This model is able to reproduce statistical characteristic and spatial patterns of rainfall field upon downscaling in a longer time range. However, the downscaled results are quite random in almost snapshot comparisons, which is almost unacceptable to hydrologist community for river discharge simulation purpose.

3. New method and results

A new method is developed to improve the downscaling performance so as to control the random output and preserving the statistical features as well. This method is called as HSA method for its Hierarchical and Statistical Adjustments of random generators throughout the process of cascade development.

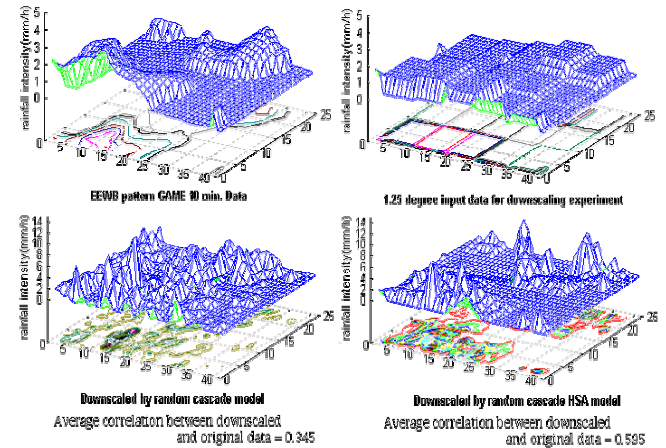


Figure. Comparison of the downscaled results

The HSA method is able to improve the performance of downscaling and attains higher degree of accuracy than the method proposed earlier. In addition, it is successful to obtain the same spatial patterns in almost every snapshot, exhibiting a good control over the randomness even after maintaining the random evolution of the cascade generators. The overall downscaling performance is improved to almost 60% from 34% after using the HSA method.