World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:10, No:02, 2016

Rain Gauges Network Optimization in Southern Peninsular Malaysia

Authors : Mohd Khairul Bazli Mohd Aziz, Fadhilah Yusof, Zulkifli Yusop, Zalina Mohd Daud, Mohammad Afif Kasno

Abstract : Recent developed rainfall network design techniques have been discussed and compared by many researchers worldwide due to the demand of acquiring higher levels of accuracy from collected data. In many studies, rain-gauge networks are designed to provide good estimation for areal rainfall and for flood modelling and prediction. In a certain study, even using lumped models for flood forecasting, a proper gauge network can significantly improve the results. Therefore existing rainfall network in Johor must be optimized and redesigned in order to meet the required level of accuracy preset by rainfall data users. The well-known geostatistics method (variance-reduction method) that is combined with simulated annealing was used as an algorithm of optimization in this study to obtain the optimal number and locations of the rain gauges. Rain gauge network structure is not only dependent on the station density; station location also plays an important role in determining whether information is acquired accurately. The existing network of 84 rain gauges in Johor is optimized and redesigned by using rainfall, humidity, solar radiation, temperature and wind speed data during monsoon season (November – February) for the period of 1975 – 2008. Three different semivariogram models which are Spherical, Gaussian and Exponential were used and their performances were also compared in this study. Cross validation technique was applied to compute the errors and the result showed that exponential model is the best semivariogram. It was found that the proposed method was satisfied by a network of 64 rain gauges with the minimum estimated variance and 20 of the existing ones were removed and relocated. An existing network may consist of redundant stations that may make little or no contribution to the network performance for providing quality data. Therefore, two different cases were considered in this study. The first case considered the removed stations that were optimally relocated into new locations to investigate their influence in the calculated estimated variance and the second case explored the possibility to relocate all 84 existing stations into new locations to determine the optimal position. The relocations of the stations in both cases have shown that the new optimal locations have managed to reduce the estimated variance and it has proven that locations played an important role in determining the optimal network.

Keywords : geostatistics, simulated annealing, semivariogram, optimization
Conference Title : ICSWRM 2016 : International Conference on Sustainable Water Resources Management
Conference Location : London, United Kingdom
Conference Dates : February 25-26, 2016