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Optimal pluviograph network design using geostatistics and simulated annealing

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Pluviograph networks help to characterize the spatial repartition of rainfall intensity, as well as to estimate rainfall statistical features in order to assess hydraulic structures. More and more, such networks contribute with radar data to flood warning and forecasting systems. However, in many parts of the world (e.g. in Tunisia), the use of weather radar is still limited. That's why, in such regions, raingauges network constitutes the main source of rainfall data. So, in practice, hydrological services have to revise network patterns each time new needs are pointed out in relation with population and infrastructure protection as well as in response to land use change.

Hydrological impacts of rainfall intensity repartition are especially represented by volume runoff and river discharge. For specific land use, socio-economical environment and location, the area where the rainfall intensity is greater than some specific value defines vulnerable area likely to generate human and economic damages. That's why rainfall interpolation is required in order to assess regional hydrologic impacts.

In this presentation, a method for establishing an optimal pluviograph network design for the estimation of the spatial variability of maximum intensity of rainfall for a giving duration is proposed and implemented. The objective function consists of minimising the kriging variance of error. The well known geostatistical variance-reduction method is used in combination with simulated annealing as an algorithm of minimisation. Simulated annealing is a stochastic global minimization technique especially

suited for this kind of problem. To get a good solution, the implementation of the simulated annealing algorithm must specify the parameter set. This presentation proposes a procedure to determine the parameter set taking the interaction effects among all parameters into account.

This methodology is applied to the North part of Tunisia where the optimal augmentation of a previously existing network is studied. The cases studies are two extreme rainfall events recorded in Marsh 1973 and January 2003 in north Tunisia.