Geophysical Research Abstracts,
Vol. 11, EGU2009-2048, 2009
EGU General Assembly 2009

Takagi-Sugeno-Kang fuzzy models of the rainfall-runoff transformation

A P Jacquin (1) and A Y Shamseldin (2)

(1) Departamento de Obras Civiles, Universidad Técnica Federico Santa María, Valparaíso, Chile (alejacquin@yahoo.com / +56 32 2654115), (2) Department of Civil and Environmental Engineering, The University of Auckland, Auckland, New Zealand (a.shamseldin@auckland.ac.nz / +64 9 3737462)

Fuzzy inference systems, or fuzzy models, are non-linear models that describe the relation between the inputs and the output of a real system using a set of fuzzy IF-THEN rules. This study deals with the application of Takagi-Sugeno-Kang type fuzzy models to the development of rainfall-runoff models operating on a daily basis, using a system based approach. The models proposed are classified in two types, each intended to account for different kinds of dominant non-linear effects in the rainfall-runoff relationship. Fuzzy models type 1 are intended to incorporate the effect of changes in the prevailing soil moisture content, while fuzzy models type 2 address the phenomenon of seasonality. Each model type consists of five fuzzy models of increasing complexity; the most complex fuzzy model of each model type includes all the model components found in the remaining fuzzy models of the respective type.

The models developed are applied to data of six catchments from different geographical locations and sizes. Model performance is evaluated in terms of two measures of goodness of fit, namely the Nash-Sutcliffe criterion and the index of volumetric fit. The results of the fuzzy models are compared with those of the Simple Linear Model, the Linear Perturbation Model and the Nearest Neighbour Linear Perturbation Model, which use similar input information.

Overall, the results of this study indicate that Takagi-Sugeno-Kang fuzzy models are a suitable alternative for modelling the rainfall-runoff relationship. However, it is also observed that increasing the complexity of the model structure does not necessarily produce an improvement in the performance of the fuzzy models. The relative importance of the different model components in determining the model performance is evaluated through sensitivity analysis of the model parameters in the accompanying study presented in this meeting.

Acknowledgements: We would like to express our gratitude to Prof. Kieran M. O'Connor from the National University of Ireland, Galway, for providing the data used in this study.