

# Hydrological catchment modelling and forecasting uncertainty

**E. Todini**

Dipartimento di Scienze della Terra e Geologico Ambientali – University of Bologna  
Italy(ezio.todini@unibo.it)

The history of hydrological modelling ranges from the Rational Method to recent distributed physically-meaningful models. Over the same period, starting from the simple Unit Hydrograph, input-output models, now called data-driven models, have evolved into ANN models (and Data Based Mechanistic (DBM) models. From the wide range of models available, the choice of the one most appropriate for any specific task is difficult, particularly as each modeller tends to promote the merits of his/her own approach. Moreover, apart from the WMO intercomparison of conceptual models conducted in the seventies, no further objective comparisons using benchmarks, or test beds using standard data sets, have been proposed or effected.

Hydrological models serve many purposes, one of the most important applications being flood forecasting in which uncertainty plays a major role. Unfortunately, the implications of using uncertainty in the decision-making process and even the concept of uncertainty seem to deter hydrologists from addressing the problem. Indeed, many hydrologists do not appear to appreciate the need to quantify predictive uncertainty and tend to describe the uncertainty implicit in the model rather than in possible future values of the quantity to be predicted or forecasted, conditional upon the output of the model. To this confusion is added a lack of appreciation of the difference between parameter uncertainty (and the possible need to estimate the parameter values) and predictive uncertainty. Moreover, the introduction of the “equifinality” principle has not served to clarify this distinction.. Hence, in delineating possible future lines of research, the uncertainty problem must be viewed in the correct perspective.

After a brief history of the development of hydrological models, this paper discusses the problem of uncertainty in hydrological models together with the approaches aimed at describing predictive uncertainty in hydrological forecasting. On these lines, a new approach is introduced, which aims at reconciling the different forecasting model approaches by developing a general framework, broader than the Bayesian Processor proposed by Krzysztofowicz (1999) that allows to combine models of different nature, from the data driven to the physically based ones. Results are shown in the case of flood forecasting based upon flood routing models as well as on rainfall-runoff models.