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Predictive Uncertainty in Hydrological Forecasting

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This work aims at discussing the role and the relevance of "predictive uncertainty" in flood forecasting and water resources management .
Predictive uncertainty, is here defined as the probability of occurrence of a future value of a predictand (such as water level, discharge or water volume) conditional on prior observations and knowledge as well as on all the information we can obtain on that specific future value, which is typically embodied in one or more hydrological /hydraulic model forecasts.
The aim of this work is also to clarify questions such as: What is the conceptual difference between "total model uncertainty" (commonly used when dealing with model verification) from the predictive uncertainty (which is used when forecasting into the future)? What is the difference between models, parameters, input output measurement errors, initial and boundary conditions, etc. uncertainty and predictive uncertainty? How one can incorporate all these uncertainties into the predictive uncertainty and, most of all, is it really necessary?
The presently available uncertainty processors are then introduced and compared on the basis of their relative performances using operational flood forecasting systems. The uncertainty processors can be continuous (Hydrologic Uncertainty Processor, Bayesian Model Averaging, Model Conditional Processor, etc.) or binary (Logistic Regression, Binary Multivariate Bayesian Processor, etc.) depending on the scope for which they are developed and the type of decision one must take.
Finally, the benefits of incorporating predictive uncertainty into the decision making process will be compared, on actual real world derived examples, to the ones obtainable when using deterministic forecasts, as currently done in practice.