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Data-based modelling of rainfall/runoff relationship in an agricultural catchment

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The identification of rainfall/runoff relationship is a challenging issue, mainly because of the complexity to find a suitable model for a whole given catchment. Conceptual hydraulic models are often too limited for long term forecasting and fail to describe correctly the dynamic changes of the system with respect to the characteristics for different rainfall events (*e.g.* intensity or length). However, the need for identification of such relationship grows with the size of drainage networks in urban catchments or with the water pollution increase in agricultural regions. The inherent difficulties to define correct models are different whether it concerns urban or rural catchments. In urban catchments, the nonlinearities involved in the model are mainly caused by the water processing infrastructures but most part of raw rainfall is channeled in the outlet. Therefore, even if linear models are less precise than nonlinear ones, they manage to deliver an acceptable forecasting in urban context. In rural catchments however, there is a high spatio-temporal variability of the soil property whether it lies in the vegetation, in the soil type or evapotranspiration and there is a high difference between the raw and efficient rainfall. In this given case, linear models completely fail in delivering a satisfying rainfall/flow relationship. Apart from the system inherent issues, there are intrinsic difficulties concerning the identification process. On the one hand, both inputs and outputs are measured and there is therefore no possibility of controlling the input of the system to achieve a suitable excitation for example. On the other hand, the usual noise hypothesis needed for applying certain identification methods are not verified. Finally, there is no general way of choosing the nonlinearity type of the model. Some nonparametric methods for estimating these nonlinearities such as state dependant parameters were introduced. Lately, a well-known type of model in the control field appears to be a suitable candidate for water processes identification: the *Linear Parameter Varying* (LPV) models. LPV models depend on so-called scheduling parameters and a challenging issue is to define which parameters the system depends on. By considering the previous declarations, this paper aims at identifying suitable models for rainfall/runoff relationship in rural catchments using a novel refined instrumental variable (RIV) based method for the identification of Input/Output LPV models with colored added noise. This method has the particularity of producing consistent estimates in case the noise assumption is not fulfilled. The main results of this paper are depicted using a data set acquired on a small agricultural catchment located in Alsace, France.