Incorporating prior knowledge in neural network rainfall-runoff models

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In the last ten years neural networks have been extensively used for hydrological modelling. Numerous experiments have demonstrated that they are very powerful tools for modelling complex hydrological relations and that they are very good rivals to traditional hydrological models. However, in spite of good operational modelling outcomes, neural networks are still often demonised for being black-box models that are unable to provide transparent solutions or incorporate prior hydrological knowledge. This paper focuses on incorporating prior hydrological knowledge about catchment behaviour in a neural network rainfall-runoff model. The neural network used in this study is the multi-layer feed-forward network which is widely used in hydrological modelling. To illustrate how specific prior knowledge can be incorporated into a neural network rainfall-runoff model, daily records of two different catchments are used. The catchments are Sunkosi located in Nepal and Blue Nile located in East Africa. Prior hydrological studies have demonstrated that both catchments have a strong seasonal response. In this study, prior knowledge of catchment seasonality is incorporated into the model by providing the neural network with additional input information to reflect changing climatological conditions i.e. seasonal expectations of rainfall and evaporation. Thereafter a 'track and trace' approach is adopted to examine how this additional seasonal information is utilized in the neural network. The response of the hidden neurons is analysed and interpreted in terms of the effect that the additional input information has on the modelling throughput and output processes.