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Artificial neural networks and high and low flows in various climate regimes

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An algorithm coupling linear least squares and simplex optimization (LLSSIM) is used to examine the ability of a three-layer feedforward artificial neural network (ANN) to simulate the high and low flows in various climate regimes over a mountainous catchment (the Mesochora catchment in central Greece). The plot of the long-term annual catchment pseudo-precipitation (rain plus snowmelt) simulated by the snow accumulation and ablation model (SAA) of the US National Weather Service (US NWS) showed trends of three climatically distinct periods, described by clearly descending, rising and moderately descending segments in pseudo-precipitation. The ANN model was calibrated for each of the three climate types and each was validated against the others. A set of statistical measures and graphs adapted for high and low flows showed the robustness of the ANN model under various climates and transient conditions. The ANN model proved capable of simulating well the daily high and low flows when it is calibrated for increasing pseudo-precipitation and validated for moderately decreasing pseudo-precipitation. For the entire period, the ANN model provided a better simulation of high and low flows than the conceptual soil moisture accounting (SMA) model of the US NWS, which was also employed in this study. Because the ANN is not a physically-based model, it is by no means a substitute for the SMA model. However, it is concluded that the ANN approach is an effective alternative for daily high- and low-flow simulation and forecasting in climatically varied regimes, particularly in cases where the internal dynamics of the catchment do not require an explicit representation.