Cross catchment transfer of model parameters - is it realistic?

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Prediction of stream flow in ungauged catchments is a long-term goal, perhaps the greatest challenge in modern hydrology. Many attempts have been made and one common approach is to calibrate a model on a catchment deemed "similar" to the one of interest, and then transpose the model and the calibrated parameters to the new catchment to simulate its response. While there have been many attempts to defined appropriate measures of similarity, few have yielded convincing results and we often fall back on the simplest, namely use parameters from a nearby catchment, preferably the closest available. We have recently completely a large scale intensive modelling project using over 100 gauged catchments to project future mean annual stream flows using a range of climate projections to 2040. We needed to project streamflows in ungauged as well as the gauged catchments. We tested a previously derived similarity approach, that includes proximity as the most significant variable as well as many other physical attributes, with the results from models transferring parameters using proximity only. We found that including the physical similarity significantly improved the parameter transferability. The exercise showed up some interesting issues over stationary and transferability of model parameters.