A top-down modelling approach to understand hydrologic similarity

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Catchment classification is an active area of study in hydrology, though an agreed upon strategy for identifying similarity and dissimilarity between catchments has yet to be identified. Top down modelling is one strategy to understand the dominant controls on hydrologic behaviour, and hence to catchment classification through understanding similarity in controls. In this strategy, a range of increasingly complex model structures is applied to each catchment and the minimum complexity needed to represent the system behaviour is identified. We apply 16 different model structures of increasing complexity to about 300 catchments distributed across the Eastern United States. A priori information is embedded in a Monte Carlo framework to consider uncertainty in the model parameters. We evaluate simulated streamflow from these models with respect to signature indices that are estimated at different time scales to test model complexities across scales (daily, monthly, seasonally, inter-annually). The result of this study is an overview about which catchments require models of similar complexity to represent observed signatures, hence suggesting similarity in controls. We test this strategy in both gauged and ungauged basins, and compare the study outcome to a parallel study using a bottom up modelling strategy.