



Catchment Prediction In Changing Environments (CAPICHE): A Model Inter-Comparison Experiment

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In order to improve societal resilience to the impacts of changes in climate and land-use, improved understanding of how catchments respond to changing forcing conditions is required. Such understanding may help better identify the range of effective interventions to improve overall integrated catchment management. For example, re-forestation catchment headwaters may reduce high flows, but also reduce low flows through increased evapotranspiration, creating a potential trade-off that needs to be reliably understood when considering benefits for both water supply and flood mitigation.

Catchment modelling may be useful to inform such management decisions by simulating future forcing changes, so that we can assess the relative benefits of different catchment management scenarios. However, numerical models are known to be uncertain, and their ability to simulate future change is compromised by the fact that model parameters can show non-stationary and compensatory effects for different forcing conditions, notwithstanding errors and uncertainties in the future forcings themselves. In order to first identify, and second develop the most appropriate models to simulate catchments under environmental change, we argue that model inter-comparisons are required that move beyond a simple comparison of predictive performance alone, towards a controlled comparison of how different models simulate change.

We present the development of a methodology for model inter-comparison under changing forcings to analyse, in this case, how models simulate landscape change, built upon time-varying sensitivity analysis of model parameters. First, for a given catchment, hydrologic signatures are calculated over consecutive windows covering the period of forcing change to analyse how the catchment responds hydrologically to change. Then, each model is calibrated to each window, and within each window, to each signature, which allows us to analyse the time-varying relationship between catchment forcing, hydrological response and model parameter metrics (e.g. posterior distribution, parameter interactions).

As part of the EUFP7 funded project Switch-On, the method is first applied in a collaborative model inter-comparison using open data from paired headwater catchments to analyse how different models simulate the effect of deforestation and subsequent re-growth on hydrological response. The simulation of paired catchments allows us to differentiate the effect of climate forcing and land-cover change on model parameters. In order to make the experiment open, the analysis code will be made available for re-use and therefore subsequent model inter-comparison.