



## **Exploring the basin of attraction for flow and residence time responses in a small catchment**

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The Multiple Interacting Pathways (MIPs) particle tracking model was first applied at the basin scale to the data set collected by Allan Rodhe and colleagues at the small Gårdsjön catchment in Sweden. It was shown to reproduce flow and tracer data at both plot and catchment scales reasonable well. The implication was that the model could reproduce both the distribution of flow velocities and the celerity responses in the catchment. This allows it then to be used in an exploration of the state space of the modelled catchment, with the advantage that the boundary conditions are known precisely and every particle of water is accounted for (a limitation of using observational data sets for this purpose). The exploration of both discharges and nonstationary residence time information is made on a relatively long model run of 20 years of available data. The results demonstrate quite clearly the hysteresis in flow and residence times that results from differences in velocities and celerities. In such a forced system, of course, there is always with potential for a new, more extreme, response to lie outside the range of past behaviours and this is seen as multiple outliers in the phase space plots. There is some evidence that the time series have the characteristics of fractal processes but there is no clear structure within the main region of behaviour. This basin model, at least, is just endlessly variable within the domain defined by the pattern of inputs.