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A time-varying parameter approach to quantifying rating curve changes

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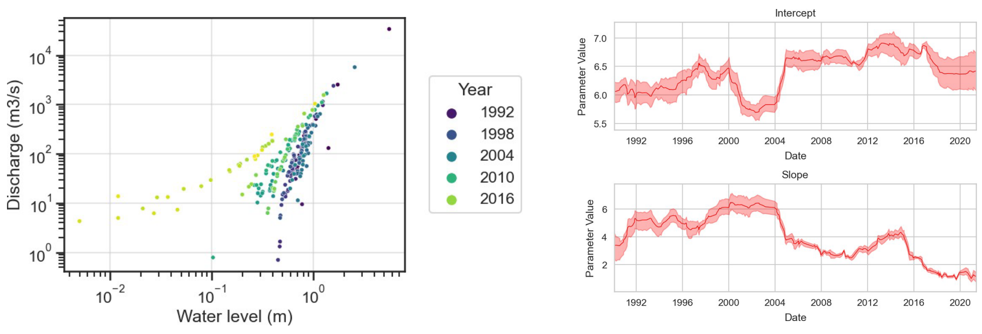
Abstract: This talk focuses on the application of time-varying parameter (TVP) models with shrinkage priors to track changes in streamflow rating curves. These changes are particularly important when quantifying uncertainty for water balance accounting at catchment scales. While there are many contributing components to the overall volumetric balance, surface water inflows and outflows from to the system form an important part. When quantifying these the uncertainty in rating curves, used to convert measured water level to volumetric discharge, can be large. Rating curves are fit at each station measuring water level using discharge data from irregular surveys (given the water level at the time of the survey).

The dynamic nature of channel processes drives non-stationarity in the rating curve. Changes can be due to large flow events causing scour and other river channel morphology changes; the presence of debris at the gauging site; and changes to the vegetation around the gauging site. Two paradigms have developed to quantify changes, the first modelling these as abrupt changes and segmenting the timeseries into periods of time during which the rating curve parameters remain static, and the second modelling the parameters as continuously varying to capture gradual change. While recent work has remained focussed on abrupt changepoint methods, advances in TVP models have the potential to bridge the divide between these two approaches. These advances include Bayesian modelling of time-varying parameters using shrinkage inducing priors to exert a pressure towards parameters being static and to avoid overfitting.

Our paper explores how modelling dynamic rating curves with shrinkage methods provides a productive middle ground to capture both sudden and gradual changes in the rating curve. TVP models are fit to describe the evolution of the rating curve through time at 36 gauging stations in the Namoi River Catchment (e.g., Figure 1) in northern NSW. The use of this dataset overlaps the gauges used in the work of Tomkins (2014), taking a new statistical approach to derive further insights on rating curve changes. The evolution of time-varying parameters is investigated relative to potential forcing parameters (e.g., flooding events and sedimentation processes) across the gauging stations to draw conclusions about efficient programs for gauging measurements.



(a) Rating curve gauging points

(b) Time-varying parameters of rating curve fit

Figure 1. Time-varying parameters (mean with 68% credible interval) of a log linear rating curve model of the gauging points for a station on the Peel River near Keepit Dam

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