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A data-driven approach to understand spatio-temporal water quality variability from long-term records

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Degraded water quality in rivers and streams can have large economical, societal and ecological impacts. Stream water quality can be highly variable both over space and time, so modelling these variabilities is critical to developing catchment water quality management strategies. However, this is currently limited by the lack of understanding of the key factors driving spatio-temporal variability in water quality. To address this, we use a data-driven approach to explore spatio-temporal variability in stream water quality across multiple catchments in Victoria, Australia. We use monthly water quality monitoring data collected at 102 sites over 20 years, focusing on three key water quality indicators: total suspended solids (TSS), nitrate-nitrite (NO_x) and salinity (EC). The key drivers of spatial variability include human-influenced catchment characteristics (land use) and other natural characteristics such as climate and topography. The key drivers of temporal variability are changes in streamflow, climate and vegetation cover. We build these key drivers into a Bayesian hierarchical model, which can simulate at different spatial and temporal scales. The model explains a reasonable proportion of spatio-temporal variability across different water quality constituents. We are currently extending the operational capacity of this model to support catchment managements.