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Hydroclimatic drivers of stream water quality over 27 years: The role of streamflow, temperature and seasonality

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Abstract: Investigating trends in stream water quality is vital for protecting ecosystems and public health. Previous studies have identified that hydro-climatic drivers such as streamflow, temperature and seasonality can be crucial drivers of water quality changes over time. The importance of each of these drivers can vary spatially, with different streams having different key drivers that affect temporal trends in water quality. The aim of this study is to assess the key drivers of temporal variability in stream water quality, using a 27-year (1995–2022) water quality monitoring record from 136 stream monitoring sites across the state of Victoria (Australia). We investigate the key hydro-climatic drivers of temporal change in stream water quality.

In this study, we address six key water quality parameters: dissolved oxygen (DO), electrical conductivity (EC), pH, turbidity, total phosphorus (TP) and total nitrogen (TN).

We investigated the trends in water quality using a multiple linear regression model (Equation 1), fitted for each of the 136 sites and for each of the six constituents. This multiple linear regression model predicts concentration at site *t* (C_t) as a function of: streamflow (Q_t), seasonality (*seasonality*), and a long-term underlying trend (*t*). β_t, β_Q, $\beta_{seasonality}$ are regression coefficients for trend, streamflow and seasonality (respectively).

$$C_t = t \times \beta_{tC} + f((Q_t)) \times \beta_Q + f(seasonality) \times \beta_{seasonality} \quad \text{(Eq. 1)}$$

For DO, a separate water temperature term was included in the multiple linear regression model, due to its importance in influencing dissolved oxygen. The regression coefficients from the fitted models from each site were used to assess the importance of streamflow and seasonality on temporal variability in water quality.

The modelling results indicated that streamflow is the most important driver of most water quality parameters (EC, turbidity, TP, TN). Water temperature was the most important driver for DO, and the long-term underlying linear trend was the most important factor affecting pH. Investigating the trend components for each of the constituents, the majority of sites in Victoria have experienced an increasing trend in pH, turbidity and TP, a decreasing trend in EC, and no statistically significant trends in DO and TN over the last 27 years.

Keywords: *Water quality trends, statistical analysis, streams, catchment management*