Comparing methods for assessing suspended sediment and turbidity trends in rivers: A Melbourne example

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Abstract: Maintaining high riverine water quality is of utmost importance to protect waterway values. Identifying trends in water quality is a critical part of assessing the trajectory of water quality and identifying key locations where management interventions are required, and which management interventions are required to prevent water quality deterioration.

There are multiple approaches available in the literature for analysing, modelling and identifying trends in water quality. There include simple monotonic statistical tests such as Sen's slope (Yu, Zou, and Whittemore 1993), linear statistical modelling approaches such as simple linear models (Guo et al. 2023) and non-linear models such as general additive models (Morton and Henderson 2008) and Weighted Regression on Time, Discharge and Season (Hirsch et al., 2010). Whilst there is an abundance of examples globally where these methods have been applied to assess water quality, less available is a critical assessment and comparison of the trend outputs from each of these methods. As a result, we lack a solid understanding of the circumstances in which each method should be used to assess and model trends.

Using the long-term water quality monitoring network operated by Melbourne Water, we compare four approaches for identifying and modelling trends. These four approaches are: Sen's Slope (Yu, Zou, and Whittemore 1993), Simple Linear Models (Guo et al. 2023), General Additive Models (Morton and Henderson 2008), Weighted Regression on Time Discharge and Season (Hirsch et al., 2010). The Melbourne Water monitoring network spans 137 sites, with monitoring data available between 1994 and 2024 at many of these sites. For the purposes of this study, we focus on two parameters – suspended sediments, and turbidity over a 17-year period (2007-2024). For the methods that require streamflow inputs, we also assessed the impact of using instantaneous streamflow (i.e., streamflow measured at the time of the water quality sample) or the mean daily streamflow on trend results. This analysis of streamflow was conducted on a smaller subset of monitoring sites (40 sites) over a 5-year period (2020-2025).

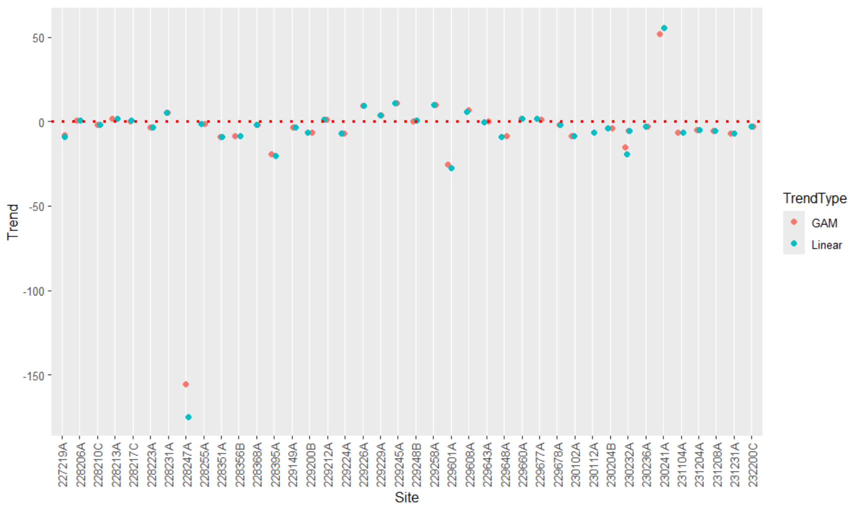

Figure 1: Comparison of trend values from GAM and Linear Models for TSS

Our analysis indicates that there are only minimal differences between some of the outputs from the different approaches (e.g., trends for TSS for general additive models vs simple linear models shown in Fig 1).

Further work is required to compare these more traditional statistical approaches to machine learning approaches such as random forest modelling, and assess where and when each of these trend estimation methods should be used by catchment managers.

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