Data-driven modelling of high flow-related poor water quality events in the Mid-Brisbane River

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Abstract

Due to the availability of high-frequency flow and water quality data at multiple stations, opportunities for a data-driven prediction and optimization model for Australia's Mid-Brisbane river were explored. This river receives water from Wivenhoe dam and a few tributaries, with raw water drawn for drinking water treatment and supply to the Brisbane region. A number of poor raw water quality events regularly occur, and such model would look at predicting and minimizing them. At this stage, a preliminary flow prediction model, including lag times among locations along the river, was developed. It was also established that high turbidity events can be predicted based on flows from certain tributaries, and that conductivity events are strongly related to the flow of a minor, but impactful, tributary. Future work will link the water quality modelling component to existing flow predictions, while also suggesting coping strategies (e.g. dam releases) and their best timing to minimize water quality issues at the treatment plant.

Keywords: Data-driven modelling; Floods; Mid-Brisbane River; Water treatment optimization .

Methods

- Data collection: 10 years hourly flow data, 5 years hourly water quality data, 7 river stations (Fig. 1)
- Daily water quality data from targeted Mt Crosby water treatment plant (WTP), rain data 5 stations
- Limitations with data after pre-processing
- Data analysis: visual inspections, times-series and regression analyses
- Explore flow-turbidity hysteresis for event classification
- Model development: machine learning, statistical and multivariate regression approaches.
- We used MATLAB, R, MS Excel.

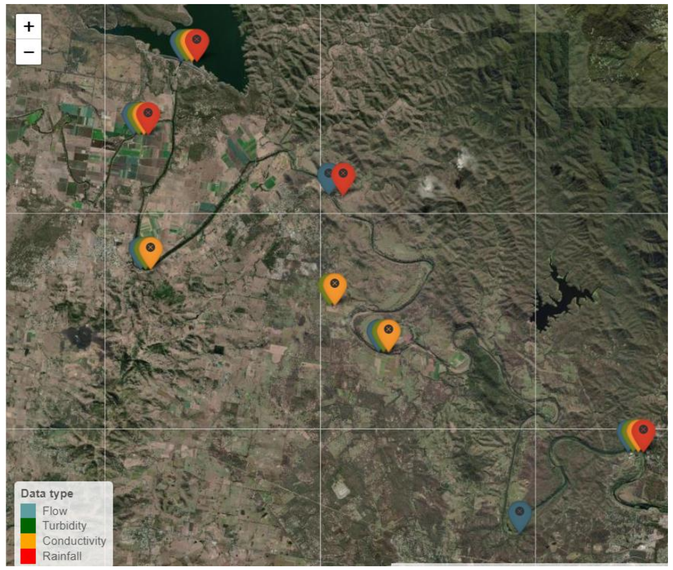

Figure 1: Data sources location

Results

- Strong relationships between historical flow rates of subsequent stations
- The drier the whole catchment, the more the flow increases moving downstream
- More rainfall downstream during an event, smaller peak flow downstream
- Preliminary user-friendly flow prediction model has RMSE of 165 m^3/s for 10-h ahead prediction (Fig. 2)
- Turbid flows recorded both before and after the flow peak, depending on flow magnitude
- Potential to predict magnitude and timing of turbidity based on flow predictions
- Turbidity originates in the river – use Wivenhoe dam for flushing
- Conductivity drops from tributary anticipating conductivity peaks at the WTP
- Minor tributaries are impactful

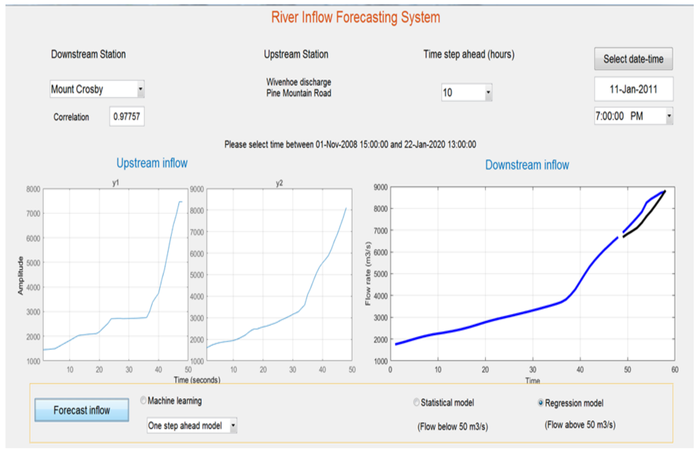

Figure 2: Graphical interface for flow forecasting model, Mid Brisbane River

Conclusions

- Preliminary data-driven water quantity–quality model developed for the Mid-Brisbane river.
- Water quality component will at first rely on detected turbidity relationships with flows and different locations (Fig. 3).
- Other machine learning approaches will be trialed too.

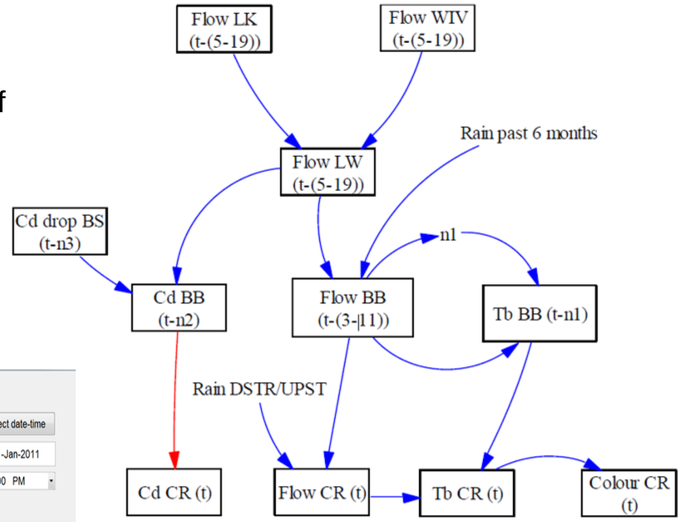

Figure 3: Conceptual model for flow/water quality prediction

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