Modelling and visualisation tools for water quality in the Clyde Estuary

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One month Report

The River Clyde has been monitored by the Scottish Environment Protection Agency (SEPA) for over four decades. This effort, dubbed the “river run”, has produced an extensive dataset which allows for the generation of a complex statistical model describing the health and quality of the river. The dissolved oxygen level, a reliable measure of water quality, will be the response variable. Quantities such as temperature, salinity, river flow, semi-diurnal tide (M2) level, spring/neap tide level, day of year, year, and location (distance downstream of a reference point) will play the role of the explanatory variables. An additive mixed model will be used for the flexibility warranted by environmental data and the random effects warranted by the sampling structure. This will be explored at different depths.

The model will also include interaction terms to reflect the complexity of the river system. For example, adjustments are needed over time, as the river has been monitored over more than four decades, and as the sampling position changes upstream and downstream. The resulting model will aid in assessing the evidence for significant changes in water quality which can be attributed to external events such as upgrades to sewage treatment plants, the decline of industry along the river, and the halting of frequent river dredging. It is our intention to use partial derivatives with respect to year as a more sensitive means of identifying rapid changes in levels of dissolved oxygen. Interaction terms will help to pinpoint the location and year of these changes. Means of visualising the behaviour of each main effect and interaction will also be developed in order to present our findings to the interested parties of SEPA and other stakeholders. It is our hope this project will lead to further research collaborations which target increased understanding of the river system.

Some research which extends the scope of the SECURE Feasibility Project has already been undertaken. For example, additive models have been used to compare high frequency measurements from the Inner Clyde Estuary (ICE) buoy with the river run data.