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Using Swan Canning Estuarine Response Model to optimise oxygenation plant efficiency

BCS Rivers and Estuaries Science

Project Core Team

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Context

Understanding spatiotemporal variability in hydrodynamic and biogeochemical conditions of the Swan River estuary is essential to improve the distribution of oxygen-saturated water injected via side-stream supersaturation oxygenation plants in Guildford and Caversham. The information of dissolved oxygen distribution and likelihood of benthic water experiencing hypoxia in each season are needed to ensure the plants operating optimally.

In addition, climate change (IPCC, 2022) needs to be factored into management of the oxygenation plants to proactively define the necessary adaptation approach for oxygenation over the coming decade. In 2030, a 1.2m increase in sea level rise is estimated. In southwest of WA, since 1970 a decline rainfall approx. 15% in April to October and 19% in May to July is reported (seventh biennial State of Climate report), leading to a significant decrease in streamflow. More seawater and less freshwater inputs to the estuary will likely change the oxygenation dynamics of the estuary.

Aims

- Understanding the seasonal variation of hydrodynamic (temperature and salinity) and dissolved oxygen of the Swan River estuary using a validated SCERM result ran with TUFLOW-FV (TFV) and TFV Water Quality module.
- Understanding salt wedge dynamics influence oxygen distribution.

Progress

- Prepared a localized modelling domain SCERM29 from Belhus (U/S) to the Narrows (D/S) by extracting the domain from the original SCERM44 (44 inflows).
- Prepared boundary conditions for 2018-2022 for both SCERM44 and SCERM29: 44 catchment inflows simulated using Swan Caning Catchment Model eWater SOURCE, 2D meteorological forcing, and 2D water level and quality at the Narrows.
- Processed all available catchment (SCCATCH), estuarine (SCEST), oxygenation plants water quality monitoring data for model inputs and validation.
- During validation processes, it was shown that simulated temperatures in autumn experiencing significant overheating. Further investigation suggests evident of flow constriction from Belhus to West Swan. Application of TFV functionality and heat parameters reduced the issue but it is still not enough, indicating bathymetry is not correct. Bathymetry data from Belhus to West Swan is not available.
- A decision was made to award DoT to conduct the hydrography survey from Belhus to Bayswater.

Management implications

The project will provide key understandings on the Swan River estuary's hydrodynamic (water level, temperature and salinity) and oxygen dynamic based on the 5-years (2018-2023) validated oxygen model, which will assist the oxygenation plants managers in optimizing the plants operation and adaptation of climate change impact on the operation.

Future directions

- Swan River hydrographic survey from Bayswater Boat Ramp to Yagan Bridge (Belhus) be conducted by DoT Survey Team in July 2023.

- New meshgrids creation for SCERM44 and SCERM29. The grids size and depth fraction will be adjusted to match up the oxygenation plants critical footprints.
- Flow measurements using a boat-mounted Acoustic Doppler Current Profiler (ADCP) performing continuous transects across the estuary around Guilford and Caversham over a tide cycle in July/August 2023, and November 2023.
- Re-run SCERM44 and SCERM29 validation using new meshgrids for simulation period 2018-2023.