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# Two-dimensional hydrodynamic modelling of wetlands in non-urban catchments

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**Abstract:** Wetland hydrodynamics play an important role in determining the effectiveness of wetlands for pollution treatment. Hydrodynamics control the residence time of pollutants within wetlands, which in turn governs the extent to which pollutants can be treated through physical and bio-chemical processes. Therefore, accurate representation of wetland hydrodynamics is a crucial step for reliable wetland water quality modelling.

Unlike constructed wetlands commonly used in urban stormwater treatment, natural and non-urban wetlands are often irregular in form and more complex in their hydrodynamics. For this reason, a spatial representation of wetland hydrodynamics is important to identify the key factors that need to be considered if a simpler modelling approach, such as 1D models, is used.

The aim of this study is twofold: (i) to present the numerical hydrodynamic modelling of four wetlands located in the Great Barrier Reef catchments, and to demonstrate variations in hydrodynamic behaviour in relation to wetland-to-catchment area ratio and structural configuration; and (ii) to share lessons learnt in the application of hydrodynamic modelling to wetlands in non-urban contexts.

The four study wetlands displayed a range of wetland-to-catchment area ratios from 0.4 to 6.3% with varying depths, and flow paths varying from linear to non-linear. Hydrodynamic models were constructed using the 2D TUFLOW FV platform, incorporating field observation data and reconstructed LiDAR. For three of the four wetlands, models were calibrated against observed wetland water levels.

Model outputs indicate that the wetland-to-catchment area ratio influenced the capacity of wetlands to retain water during high flow events. In contrast, wetland structures such as depth and flow path controlled residence times under low flow conditions. In some cases, structural features caused short-circuiting, which significantly reduced residence time regardless of wetland-to-catchment ratio.

Several findings were identified in the process of modelling hydrodynamics in non-urban wetlands. Firstly, inflows were difficult to define, as catchment boundaries were not well constrained due to flat terrain and complex canal systems. In addition, non-calibrated hydrological models were found to underestimate contributions from baseflow. Secondly, wetland boundaries required careful definition, as floodplain interaction with wetlands could contribute additional inflows beyond those entering through main inlets. Floodplains also acted as temporary storage, with water subsequently returning to wetlands. Thirdly, wetland topography in existing systems often differed from designed conditions and can change significantly overtime.

Overall, this study improves understanding of the hydrodynamics of non-urban wetlands and highlights important dynamic processes, such as floodplain interaction, that should be accounted for when modelling similar systems.

***Keywords:*** *Wetland hydrodynamics, Great Barrier Reef, TUFLOW FV, 2D hydrodynamic modelling*