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A large-scale flexible mesh 2D hydrodynamic model for the Cooper Creek floodplain

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Abstract: The Cooper Creek floodplain, which spans across Queensland and South Australia, is one of the most complex floodplains in Australia. It is characterized by long river reaches with anastomosing channels that form in very low gradients. Although the floodplain is frequently flooded, the region is sparsely gauged and observed.

Extreme floods could pose problems for gas facilities and agriculture in the floodplain. However, less frequent flooding may also pose challenges to the delicate balance of wetland ecosystems. These ecosystems rely on flood pulses to replenish waterholes and other ecological assets in the floodplain. To address these concerns, stakeholders of the Geological Bioregional Assessment (GBA) have asked for developing a catchment scale model to simulate floodplain inundation in Cooper Creek. A hydrodynamic model will help in understanding how floods propagate under current and future development scenarios.

A 2D hydrodynamic model using the MIKE21 flexible mesh (MIKE21FM) was implemented to investigate flooding under different historical flood events for the Cooper Creek floodplain. Two models were developed for each section of Cooper Creek: the Queensland section which covers an area of around 23000 km^2 and the South Australia section which covers an area of around 8600 km^2. The model utilized a 1m LiDAR DEM merged with waterhole bathymetry information from survey data, flow data from observation gauges, simulated total runoff using Sacramento hydrological model at ungauged inflow points, climate data from AWAP, Landsat-derived water extent data, distributed manning's roughness derived from land use data, and infiltration parameters derived from soil characteristics data (from AWRA-L spatial layers).

The models were calibrated using smaller but more frequent flood events (i.e., 1 in 2 and 1 in 5-year events) which are important for replenishing water in ecological assets. The calibrated models were able to accurately predict the complex flood dynamics in the area and were found to agree with Landsat images. The models were also able to predict the flood extents of more extreme 1 in 10-year flood events. The outputs of the models, such as flood depths, velocities, and soil saturation, were useful for assessing the impacts of floods on development structures and ecological assets in the floodplain.

A comprehensive 2D hydrodynamic model has been created for the Cooper Creek floodplain, offering valuable insights into the intricate flood dynamics of the area. This model can aid in better preparation and management of future floods. The calibrated models have proven useful in assessing the effects of structural development and anticipated climate change scenarios in the floodplain. These assessments are currently ongoing as part of the GISERA Cooper Creek flood modelling scenarios project.

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