Scenarios in stories: Communicating flood inundation modelling in the Cooper Creek using interactive StoryMaps

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Abstract: The Cooper Creek floodplain is one of Australia's most complex and largest inland flood systems. It spans more than 30,000 km² across Queensland and South Australia. Its dynamic water flow patterns support vital ecosystems, cultural values, and regional industries, but they also create risks for infrastructure and resource development. Understanding how flood inundation might change due to future climate and development is crucial for guiding strong planning and clear engagement with stakeholders. A 2D hydrodynamic model (MIKE21 flexible mesh) covering the Queensland and South Australian parts of the floodplain was calibrated and validated using LiDAR-derived topography, waterhole bathymetry, soil characteristics, rainfall, evapotranspiration, gauged flows, and satellite-derived inundation data for historical flood events. The results clearly show that the model can reproduce the observed historical inundation patterns. The calibrated model was used as baseline scenario. Two groups of scenarios were developed to explore impacts: infrastructure developments which include the effects of roads and tracks, borrow pits, and well pads; and climate change futures which include a drier, medium, and wetter climate. These scenarios were co-designed with stakeholders so that regional priorities and insights are considered in the assessments. Using 37 Global Climate Models (GCMs), the 10th percentile, 50th percentile, and 90th percentile estimates of future rainfall, potential evapotranspiration, and runoff were used to determine the drier, medium, and wetter hydroclimatic conditions, respectively.

Prioritising accessible results, the modelling outputs were presented as a set of interactive online storymaps. These storymaps enable users to explore the impacts of various scenarios by combining hydrodynamic simulations, geospatial layers, explanatory text, and visualisations of flood metrics that are relevant to the region. These metrics include flood depths, velocities, and depth of infiltration which are visualised at thresholds that are relevant to ecological predictors (e.g grazing, connectivity, lignum habitat, bird life) and societal or economic predictors (e.g. town water supply, vehicle access, flood fringe). For instance, the storymaps show the differences in flood depth exceeding 0.3m and flood velocities over 0.3m/s between a historical flood with a 1 in 10-year frequency and a predicted wet climate; these thresholds are crucial for ensuring access to vehicles and livestock during flood events. The storymaps empower users to examine results using simplified tools, enhancing understanding of flood behaviour among community members, planners, and industry representatives. By merging detailed hydrodynamic modelling with accessible delivery methods, the Cooper Creek Flood Modelling project demonstrates how scenario modelling science can help address climate change and infrastructure challenges while ensuring transparency. The storymaps provide a decision-support tool for governments, industries, and communities, demonstrating how a large-scale flood inundation model can advance in the effective management of resources in complex, arid inland river systems.

Keywords: *Cooper Creek floods, Hydrodynamic modelling, MIKE21FM, Interactive scenarios analysis*

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