ASSESSING TRANSPORT NETWORK PERFORMANCE UNDER CURRENT AND FUTURE FLOOD SCENARIOS: LINKING HAZARD MODELLING AND BEHAVIOURAL SIMULATION

ABSTRACT Road passenger transport networks are increasingly exposed to disruption from a range of climate-related hazards, such as surface water flooding, heatwaves, high winds, etc. To support performance assessment of infrastructure networks under such risks, this study presents an integrated modelling platform that links high-resolution rainfall generation, surface water flood modelling, and agent-based transport modelling. Using flooding as an illustrative case, this enables simulation of both physical asset disruptions and behavioural responses of travellers. Climate change considerations are incorporated into future scenarios, enabling exploration of impacts under changing conditions.

The platform is applied to the Tyne and Wear region in North East England. It tests a baseline rainfall event representing current 1-in-30 year risk and compares to future flood scenario consistent with projected climate change conditions. Three behavioural response cases are examined: a worst-case scenario where no adaptation is possible; an iterative adjustment scenario where travellers reroute or reschedule activities to avoid flooded links; and an early warning scenario where a share of trips are cancelled pre-emptively.

Results demonstrate substantial variation in disruption impacts across scenarios, measured through performance metrics covering operational, social, economic, and environmental dimensions. Both the iterative response and early warning cases significantly reduce journey delays, trip cancellations, and economic losses, with notable benefits for vulnerable demographic groups.

The modelling platform and associated performance metrics provide a transferable tool for stress-testing flood scenarios, quantifying the benefits of adaptation options, and supporting evidence-based planning. The paper will highlight the practical relevance of combining hazard modelling and transport simulation for assessing the performance of infrastructure networks under climate extremes, and offer insights for decision-makers seeking to build resilience across transport networks and asset lifecycle stages.