Integrating spatiotemporal dynamics for modelling disruption to road travel in flood events

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Abstract

Flooding can significantly disrupt road networks and the time of day or week in which a flood event happens has a large effect on how disruptive it is. For example, a flood event during the morning rush hour will likely affect more people than one which occurs on a Sunday morning as demand on the road network is greater. Previous GIS-based research has introduced disruptive hazard events to road network models, but have not considered the temporal nature of how risk arises from the interaction of population movement with flooding. This research examines how standard GIS methods compare to an enhanced method for assessing the effect of a storm event on the travel of two population groups, primary school children and commuters, in York, UK.

Figure 1 outlines the methods compared in this work. The standard method (1a) uses school catchment areas and origin-destination travel to work data to determine the output areas associated with a destination (school or workplace zone). These origin-destination pairs are used in ArcGIS network analyst to generate routes as a measure of travel function. The enhanced method (1b) utilises spatiotemporal population data generated using the Population 24/7 model (Martin et al., 2015), which uses census data and other administrative information to create gridded estimates of the number of people in an area at a given point in time. For example, in this work gridded population estimates are produced for a Tuesday morning in term time and out of term time. Origins are assigned a destination using an R code that statistically calculates the grid cells from which people most likely travel to a destination. Finally routes are generated using ArcGIS network analyst. Both methods will compare routes generated in a non-flood baseline scenario to the same flood scenario, generated using the Flowroute-i flood model from Ambiental Risk Analytics, in order to quantify the disruption to road travel from the flood. It also ensures any variation in results between the methods is due to their differences rather than the flood simulation.

It is expected that the enhanced method's use of temporally specific population estimates will provide more detailed information on the disruption to road travel than the standard method. This data could be used to create flood risk assessments tailored to specific day times of interest. These findings will be useful to those working in the field of spatiotemporal population data, but also those working on assessing disruption to road travel, particularly from natural hazards.

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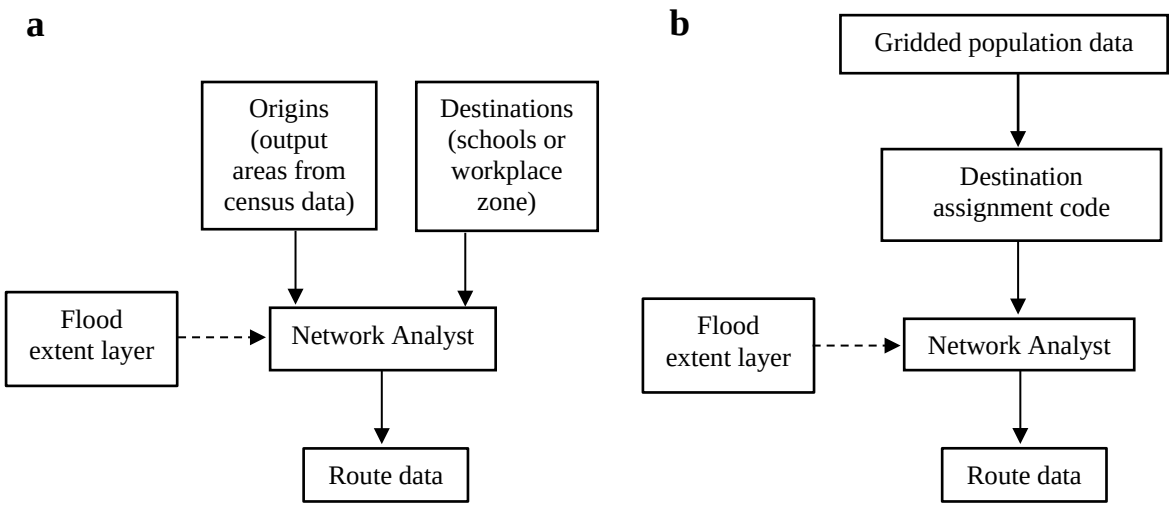

Figure 1: Standard method (a) and enhanced method (b) for assessing the impact of flooding on travel function. Dotted arrow indicates data which is included in the workflow when a flood scenario is considered.

References

Martin, D., Cockings, S., Leung, S, 2015 Developing a Flexible Framework for Spatiotemporal Population Modelling. *Annals of the Association of American Geographers*, 105(4), 754-772