# An innovative algorithm automatically finds the quickest way to calamity-affected sites using open-source map data

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Credit: AI-generated image (disclaimer)

A new mapping tool makes preparing for natural disasters and responding to their aftermath easier than ever. Researchers from the A*STAR Institute of High Performance Computing in Singapore have developed a computer model that analyzes networks of interconnected

roads to predict the speediest routes for rescuers to take using real-time data uploaded by aid workers on the ground.

The hours and days following disasters such as typhoons or earthquakes are a critical time for relief operations. However, efforts to reach victims and distribute supplies are often hindered by infrastructure challenges. For example, when Typhoon Haiyan—one of the strongest cyclones on record—devastated the central Philippine city of Tacloban in 2013, survivors were stranded for weeks in hard-to-reach areas (see image).

This catastrophe motivated Christopher Monterola and co-workers at A*STAR to tackle the problem of disaster relief using the tools of 'network science'. These techniques aim to quantify relationships in complex networks by graphing the connections, or 'edges', between individual objects known as 'nodes'. Mathematical analysis of these parameters can reveal important properties such as the size and strength of connections between particular nodes.

The researchers developed a procedure that automatically transforms street maps into a network of nodes (road intersections) and edges (road segments). Powerful algorithms then calculate the minimum time needed and best route for rescuers to traverse between any two nodes. Built-in flexibility enables continuous updating of the input map data using crowd-sourced sites such as the Humanitarian OpenStreetMap. Furthermore, municipalities can use this tool to model infrastructure destruction scenarios before they occur.

The team tested how parameters such as the flow of goods to and from relief centers evolved in two different model networks: a grid lattice common in cities and a 'scale-free' road network that represents a mix of urban hubs and rural spokes. These investigations revealed that traditional, idealized models are inherently different from actual roads found in cities such as Tacloban. According to Monterola, this means

that the conventional assumptions used in planning may not apply, and that reliable, high-resolution data are needed to quantify the robustness and accessibility of road structures for relief efforts.

"This work can be crucial in formulating contingency plans for disaster relief operations," says Monterola. "It shows that a network-science-based tool, driven by actual data, can guide logistics planning in areas hit by calamities. Specifically, it allows for fast yet accurate humanitarian logistics planning even in the absence of complete information about the extent of damage."

**More information:** Valenzuela, J. F., Legara, E. F., Fu, X., Goh, R. S. M., De Souza, R. & Monterola, C. "A network perspective on the calamity, induced inaccessibility of communities and the robustness of centralized, landbound relief efforts." *International Journal of Modern Physics C* 25,1450047 (2014). dx.doi.org/10.1142/S0129183114500478

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