A multi-modal logistics model to assist preparedness planning for natural disaster impacts: the case of a megathrust earthquake on Canada's West Coast

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Problem definition

In the aftermath of a natural disaster, the road network can be covered with debris. Such road blockages can disrupt emergency activities such as the distribution of food, water, and medicine. Therefore, it is critical to use alternative transportation modes such as ferries, barges, and helicopters to reach vulnerable communities, while unblocking the road network. Canada's West Coast is located near the Cascadia Subduction Zone, where evidence indicates that past earthquakes with magnitudes over 8.0 on the moment scale have occurred.

Solution approach

A metaheuristic solution approach is proposed, which consists of a Greedy Randomized Adaptive Search Procedure. This approach is designed to model road clearing operations synchronized with the multi-modal distribution of supplies. The model is applied to an earthquake scenario in the region of Vancouver Island.

What insights for emergency preparedness and response can be obtained from a multi-modal logistics model addressing impacts of a M9.0 Cascadia earthquake scenario?

Preliminary results

Legend
- BC Ferries
- Seaspan Ferries
- Barges
- Trucks
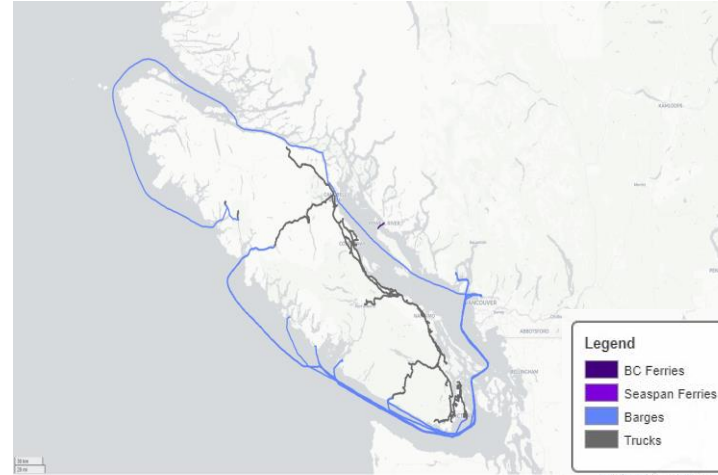
According to the preliminary results displayed in the figure on the left, barges are key assets for an effective response in the Cascadia scenario. In contrast, Rodrigues et al. (2022), find that it is likely that many barges will be severely damaged and unavailable during the immediate response phase. These preliminary results indicate the need for alternative precautions and mitigation measures to ensure resilient emergency response operations.

Resilient marine transportation is critical for emergency supply delivery to vulnerable communities following a Cascadia earthquake scenario.
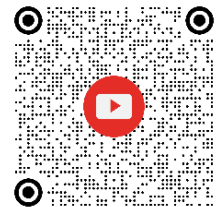
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Rodrigues, L. B. (2022) A network model for maritime transportation supply in British Columbia following an earthquake. MASc Dissertation, Dalhousie University (forthcoming).
Chang, S. E., Bristow, D., Goerlandt, F., Pelot, R., Goodchild, A., Lin, C., & Zhou, L. (2020). Planning for a catastrophic earthquake in British Columbia: Marine transportation disruption and coastal community resilience. (SIREN Project Report, p. 112).