Data Article

Datasets of disrupted transportation networks on Canada’s West Coast in a plausible M9.0 Cascadia Subduction Zone earthquake scenario

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A R T I C L E   I N F O

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A B S T R A C T

This article presents a database with geographical and demographic information characterizing the impacts to road and maritime networks, and coastal communities, of a plausible magnitude M9.0 megathrust Cascadia Subduction Zone earthquake scenario near Vancouver Island in British Columbia, Canada. The database consists of a medium and a high impact case associated with the earthquake scenario. The data include the geographical location of communities, ports, and airports/helipads/heliports, the structure of the roads network and their expected damage levels, the resilience level and population size of the communities on Vancouver Island, and the trajectories, expected delays and capacities of ferries and barges. The data originates from government and carriers’ open available reports and external datasets, and several impact models. The primary purpose of this database is to support disaster management researchers working to develop and test network models that focus on road repair and restoration, and on the multi-modal distribu-

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Specifications Table

| Subject | Management Science and Operations Research |
|---------|--------------------------------------------|
| Specific subject area | Disaster management, humanitarian logistics, relief-aid planning, multi-modal supply chain operations |
| Type of data | Table |
| How the data were acquired | The data was acquired from open access government databases, federal and provincial records, transportation services databases, and derived synthetic (model-based) data from impact models (road network, maritime routes, and community resilience). |
| Data format | Raw, Cleaned, Filtered |
| Description of data collection | The data were collected from public sources databases. Three types of data were collected: shape files (".shp"), electronic spreadsheets, and text information. After cleaning and filtering the data to the location of the earthquake using ArcGIS Pro 2.7.0, the data were consolidated on six files ("BC_MediumImpact.xlsx", "BC_MediumImpact.accdb", "BC_HighImpact.accdb", "BC_HighImpact.xlsx", "Ships_trajectories.xlsx", and "Roads_points.xlsx"). Available at Souza Almeida et al. [1] |
| Data source location | Region: Pacific Northwest |
| Country: Canada |
| Raw data sources: | Statistics Canada, “Census Profile, 2016 Census,” Statistics Canada, 2016. [Online]. Available: https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/search-recherche/lst/results-results.cfm?Lang=E&TABID=1&G=1&Geo1= &Code1=&Geo2=&Code2=&GEOCODE=59&type=0 (accessed 8 January 2020) |
| GeoBC, “First Responders.” The Province of British Columbia, Mar. 08, 2016. Accessed: 24 July 2020. [Online]. Available: https://catalogue.data.gov.bc.ca/dataset/first-responders |
| Data accessibility | The data files are available in a public repository |
| Repository name: Mendeley Data |
| Data identification number: 6fw6ymjm58 |
| Direct URL to data: https://data.mendeley.com/datasets/6fw6ymjm58 |

Value of the Data

- The dataset characterizes impacts on the road network, maritime transportation operability, and coastal community resilience, in a medium and a high impact plausible scenarios associated with a M9.0 Cascadia Subduction Zone earthquake on Canada’s West Coast. The data is intended to be used in the development phase of disaster management and humanitarian logistics models, as it allows the visualization and analysis of the model’s features in two illustrative Cascadia scenarios.
• The datasets are relevant to researchers working with the disruptions of the supply chain after natural disasters, especially those who aim to test and represent their models on real-world instances. Additionally, this database is expected to be used as a tool to improve the discussion between model developers and practitioners. As stated in Souza Almeida et al. [2], there are no datasets that enable such applications in real-world contexts.
• The proposed database is not recommended to be used for prediction purposes. As recommended in uncertainty-based risk perspectives in modern frameworks on societal risk governance (e.g. IRGC [3] and Renn et al. [4]), the scenarios are meant to serve as a basis for stakeholder discussion in an analytic-deliberative model development and application process, as recommended also by Stern and Fineberg [5].
• The data can be reused on a series of network optimization problems including but not limited to connectivity problems (e.g. arc routing for connectivity problem, prize collecting arc routing for connectivity problem, and multi-vehicle arc routing for connectivity problem), accessibility problems in the aftermath of natural disasters, facilities location, vehicle routing and other transportation problems. Another use for the data is for benchmarking purposes in the development of heuristic and metaheuristic solution approaches to these above-mentioned problems.

1. Data Description

This dataset includes two hypothetical impact cases associated with a plausible earthquake scenario, focused on Vancouver Island and its surroundings. The characteristics of the scenario and the two cases associated with this, are detailed in Section 1.1. The database consists of six files. Section 1.2 describes the content of the “BC_MediumImpact.accdb”, “BC_HighImpact.accdb”, “BC_MediumImpact.xlsx” and “BC_HighImpact.xlsx” files. Section 1.3 explains the “Roads_points.xlsx” file, whereas Section 1.4 defines “Ships_trajectories.xlsx”.

1.1. Characteristics of the earthquake scenario

Canada’s West Coast is located in what is called “the Pacific Ring of Fire”, a region with a high frequency of earthquakes [6]. In this region, there are two adjacent tectonic plates: Juan de Fuca and North American, in which cities like Vancouver, Seattle, and Portland are located. The Juan de Fuca Plate is sinking back into the earth's mantle and is locked up to the North American Plate. This lock-up accumulates energy until it reaches an inflection point, upon which a sudden release of tectonic stresses, a megathrust earthquake occurs [6,7]. According to Natural Resources Canada [6], thirteen megathrust earthquakes have been identified in the Cascadia Subduction Zone, with an average time interval of 500 to 600 years. A series of tsunamis are expected to occur for approximately 6 to 8 hours after the mainshock, with the second and third waves being the highest [8].

This paper considers a hypothetical but plausible M9.0 Cascadia Subduction Zone earthquake scenario, occurring during the daytime of March 11th [9]. The Peak Ground Acceleration (PGA) of this earthquake scenario in fractions of the gravity constant \( g = 9.81 \text{m/s}^2 \) is depicted in Fig. 1. Areas with a PGA close to 0.64 are taken to have an extreme impact, whereas areas with a PGA close to 0.024 are deemed to be only lightly impacted. In addition to PGA, the peak ground deformation (PGD), fragility curves, and probabilistic restoration activity times have been determined by Geological Survey of Canada [10], but as those are not made publicly available, these are not further considered in the presented dataset. The authors recommend contacting Geological Survey of Canada for further information about the Cascadia Earthquake scenario.

Based on the PGA in Fig. 1, plausible medium and a high impact cases associated with the earthquake scenario were proposed by Chang et al. [9]. In the medium impact case, it is assumed that the earthquake causes a severe damage to the road network on Vancouver Island, leading
Fig. 1. Peak Ground Acceleration (PGA) of the Cascadia Earthquake Scenario in fractions of the gravity constant (g=9.81 m/s²) (Based on Bell and Bristow [11]).

Fig. 2. Damages to the road network in the medium impact case, associated with the plausible M9.0 Cascadia Subduction Zone earthquake scenario shown in Fig. 1.

To a partial disconnection of communities to one another, and to ports. Nevertheless, some maritime routes and road segments remain functional. Fig. 2 illustrates the damages to the road network in the medium impact case. The high impact case considers an extensive disconnection of the road network, with almost all transportation links between the communities and ports in the Vancouver Island region rendered inoperable. Fig. 3 illustrates the expected damages to the road network in the high impact case.
1.2. Medium and high impact cases: database overview

The data associated with the medium and high impact cases are stored in the files “BC_MediumImpact.accdb”, “BC_MediumImpact.xlsx”, and “BC_HighImpact.accdb”, “BC_HighImpact.xlsx”. The only difference between the Access and Excel files is their extension.

The Access and Excel files are structured in the same way, but with the data corresponding to each specific impact case. To keep consistency in this article, the Excel files are used as for describing the database content. Each database associated with each impact case contains seven spreadsheets: “Nodes”, “Roads distances”, “Unblocking time”, “Vessel”, “Ships time matrix”, “Port opening times”, and “Helicopters distances”.

This Section is divided as follows. Section 1.2.1 explains the “Nodes” spreadsheet and its input spreadsheets, Section 1.2.2 explains the “Roads distances” and “Unblocking times” sheets, Section 1.2.3 describes the “Vessel”, “Ships time matrix”, and “Ports opening times”.

1.2.1. Node

The main spreadsheet in the database is “Nodes”, which includes the characteristics of the nodes in the network, summarized in Table 1. As described in the classification column, there are six categories of nodes: ‘community’, ‘intersection’, ‘helipad’, ‘heliport’, ‘airport’, and ‘port’. Intersection nodes represent where roads cross each other.

If a node is classified as ‘community’, then its population size is available in the “Community” spreadsheet. Otherwise, the value is zero. Fig. 4 displays the communities, ports, and airports/helipads/heliports included in the datasets for both impact cases. In this database, only the airports/helipads/heliports located in Mainland British Columbia are considered as it is assumed that it is possible to land with helicopters in each community. Additionally, all the airports are assumed to be open.

1.2.2. Roads distances and unblocking times

The spreadsheet “Roads distances” describes all the edges in the network according to the Nodes ID defined in Section 1.2.1. The first column (‘From’) is the ID of the origin node, the second column (‘To’) is the ID of the destination node, and the third column (‘Distance’) is their
Table 1
Summary of the nodes’ characteristics in the medium and high impact cases.

| Column Label                      | Description                                                                                                                                 |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Node ID                           | Each node has an associated ID, which is used throughout the database while specifying the distances, road segments, vessel trajectories, and helicopters trajectories. |
| Latitude                          | The latitude of the node's geographic coordinates (in degrees).                                                                                       |
| Longitude                         | The latitude of the node's geographic coordinates (in degrees).                                                                                       |
| Subdivision                       | The geographical subdivision where the node is situated according to Statistics Canada's definition [12].                                           |
| Classification                    | The nodes in the database are divided into six categories: airport, intersection, helipad, heliport, community, and port.                             |
| Location                          | Nodes can be in Mainland British Columbia, Vancouver Island, and nearby Islands.                                                                           |
| Resilience level                  | The nodes classified as “community” have a resilience level ranging in a scale from 1 to 5, where 1 indicates the most resilient community and 5 the least resilient. |
| Node status (Open/closed)         | The node status column indicates whether the ports are open or closed in the following 72 hours after the disaster.                                     |

Fig. 4. Location of the communities, ports, and airports/heliports/helipads in the region.

distance in kilometers. The ‘Unblocking time’ spreadsheet indicates the estimated time (in hours) required for a single team to unblock a road damaged by the disaster. Similar to the “Roads distances” spreadsheet, in the “Unblocking time” spreadsheet, ‘From’ and ‘To’ are the edges’ endpoints, whereas the ‘Time’ column is the total time (in hours) required for one road clearing team to unblock that specific edge. If the unblocking time is zero, the edge is expected not to be damaged by the disaster, or at least not to the extent that it is blocked for traversing traffic. Figs 2 and 3 depict the road network after the disaster, with roads indicated in green having an unblocking time of zero.
1.2.3. Maritime transportation

The data associated with the maritime transportation are available in the “Vessels”, “Ships time matrix”, and “Ports opening times” spreadsheets. The vessels are heterogenous, which means that they have different capacities, traversing times, and trajectories. The “Vessel” spreadsheet lists 56 ferries and barges ('Vessel ID'), along with their respective capacities in terms of how many trucks transporting 20-foot containers that each vessel can carry ('Capacity'). There are four shipping companies operating in the region ('Operators'). As mentioned, there are two types of vessels considered (ferries and barges), which is indicated in the 'Vessel Type' column.

The other spreadsheet associated with the maritime transportation is the “Ships time matrix”, which indicates the start and end ports of each vessel, and the respective traveling time in hours. The columns 'From' and 'To' indicate the start and the destination port, 'Time' is the total time (in hours) required for the vessel to travel along the specific trajectory, whereas 'Vessel ID' indicates which vessels are capable of operating on the trajectory. Fig. 5 represents all the trajectories of barges and ferries included in the scenario.

The “Ports opening times” spreadsheet indicates the expected time delay following which a certain vessel trajectory is resumed. 'From' and 'To' are the endpoints of the vessel's trajectory, 'Vessel ID' is the specific vessel that traverses that trajectory, and 'Start time route is available' is the moment in the time horizon when it is possible for the specific vessel to resume the route (in hours). If the time is 72 hours, the trajectory is not expected to be open during the immediate response phase of the disaster.

Note that if a given trajectory or port opening time has an expected time equivalent to the time horizon (i.e., 72 hours), this means that the start/end point was damaged or there is no personnel availability to navigate the specific vessel to the destination. The use of the time horizon in these tables are equivalent as stating that a specific trajectory or port is closed. If other time spans are used, the 'closed' state should be updated with the corresponding time horizon.

1.2.4. Air transportation

The geodesic distances for helicopters are available in the spreadsheet “Helicopters distances”. The column 'From' indicates the starting airport located on Mainland British Columbia, whereas 'To' indicates the communities located in Vancouver Island. The column 'Distance' indicates the distance in kilometers between the communities and airports/helipads/heliports.
Table 2
Sample of the “Roads_points.xlsx” file.

| From | To   | Latitude  | Longitude  |
|------|------|-----------|------------|
| 109  | 2293 | 48.459829 | -123.5505  |
| 109  | 2293 | 48.460825 | -123.5509  |
| 110  | 2294 | 50.252808 | -125.6528  |
| 110  | 2294 | 50.253028 | -125.6541  |
| 111  | 701  | 48.457895 | -123.4366  |
| 111  | 701  | 48.458469 | -123.4379  |
| 111  | 701  | 48.458839 | -123.4392  |
| 111  | 701  | 48.459165 | -123.4406  |
| 111  | 701  | 48.459656 | -123.4419  |
|      | 701  | 48.460003 | -123.4423  |

1.3. Roads’ segments database

Another file in the database is named “Roads_points.xlsx”, which describes all the points composing each edge. Consider the sample data in Table 2, the first and the second column (‘From’ and ‘To’) indicate the edge to which the point belongs, while the third and fourth columns contain the geographic coordinates of the point. For example, edge (110,2294) has four points ((50.252808, -125.6528), (50.253028, -125.6541), (50.253552, -125.6554), (50.253915, -125.6559)). The file “Roads_points.xlsx” includes all the points in all the edges and thus describes the shape of the road network.

1.4. Vessels’ trajectories database

The vessels trajectories are available in the file “Ships_trajectories.xlsx”. As mentioned, the vessels are assumed to be heterogenous and thus each vessel has a specific trajectory. Similar to the roads, each point of a shipping trajectory is given to determine the shape of the trajectory. Thus, in the file, the first and the second column (‘From’ and ‘To’) determine the edge where the point is located, the ‘Latitude’ and ‘Longitude’ are the geographical coordinates of the points, and ‘Vessel ID’ is the indication of which vessel traverses that point. Note that the ‘Vessel ID’ is the same as defined in Section 1.2.3. Table 3 exemplifies the trajectory of vessel zero starting on port 2471 going to 2422. The trajectory has 36 points, and their geographic coordinates are ((49.143333, -123.04), ..., (49.15, -123.87)). These points can be plotted and linked in order so that the trajectory available in Fig. 6 is obtained.
### Table 3
Example of a ferry’s trajectory.

| From | To   | Latitude       | Longitude   | Vessel ID |
|------|------|----------------|-------------|-----------|
| 2471 | 2422 | 49.143333      | -123.04     | 0         |
| 2471 | 2422 | 49.129984      | -123.0636   | 0         |
| 2471 | 2422 | 49.117022      | -123.0874   | 0         |
| 2471 | 2422 | 49.112777      | -123.1144   | 0         |
| 2471 | 2422 | 49.110807      | -123.1347   | 0         |
| 2471 | 2422 | 49.11942       | -123.1688   | 0         |
| 2471 | 2422 | 49.120209      | -123.1948   | 0         |
| 2471 | 2422 | 49.129548      | -123.2204   | 0         |
| 2471 | 2422 | 49.125348      | -123.247    | 0         |
| 2471 | 2422 | 49.115487      | -123.2724   | 0         |
| 2471 | 2422 | 49.106066      | -123.2975   | 0         |
| 2471 | 2422 | 49.100728      | -123.3238   | 0         |
| 2471 | 2422 | 49.108253      | -123.3501   | 0         |
| 2471 | 2422 | 49.115839      | -123.3765   | 0         |
| 2471 | 2422 | 49.12275       | -123.4007   | 0         |
| 2471 | 2422 | 49.130304      | -123.4269   | 0         |
| 2471 | 2422 | 49.138567      | -123.4527   | 0         |
| 2471 | 2422 | 49.146805      | -123.4788   | 0         |
| 2471 | 2422 | 49.155077      | -123.505    | 0         |
| 2471 | 2422 | 49.163355      | -123.5311   | 0         |
| 2471 | 2422 | 49.169382      | -123.5578   | 0         |
| 2471 | 2422 | 49.175053      | -123.5847   | 0         |
| 2471 | 2422 | 49.180724      | -123.6115   | 0         |
| 2471 | 2422 | 49.186394      | -123.6383   | 0         |
| 2471 | 2422 | 49.192065      | -123.6651   | 0         |
| 2471 | 2422 | 49.197735      | -123.692    | 0         |
| 2471 | 2422 | 49.203406      | -123.7188   | 0         |
| 2471 | 2422 | 49.209077      | -123.7456   | 0         |
| 2471 | 2422 | 49.214747      | -123.7724   | 0         |
| 2471 | 2422 | 49.219104      | -123.7994   | 0         |
| 2471 | 2422 | 49.217926      | -123.8266   | 0         |
| 2471 | 2422 | 49.211089      | -123.8532   | 0         |
| 2471 | 2422 | 49.203707      | -123.8795   | 0         |
| 2471 | 2422 | 49.178637      | -123.8778   | 0         |
| 2471 | 2422 | 49.152105      | -123.8711   | 0         |
| 2471 | 2422 | 49.15           | -123.87     | 0         |

**Fig. 6.** Representation of vessel 0's trajectory starting on node 2471 and docking on node 2422.
2. Experimental Design, Materials, and Methods

This section describes the process of data collection, filtering, and consolidation for data related to communities (Section 2.1), maritime transportation (Section 2.2), air transportation (Section 2.3), and road network (Section 2.4). Finally, the level of confidence to each data is discussed in Section 2.5.

2.1. Communities

The nodes representing the communities and their respective population sizes are determined based on a combination of census subdivision locations and the locations of first responders’ infrastructure. First, a list with all the census subdivisions in British Columbia was extracted from the 2016 census available from Statistics Canada [12]. Only the census subdivisions located in Vancouver Island and the Gulf Islands were retained, as these are within the study area. Fig. 7 illustrates the census subdivisions in the study area. Some small islands such as Mount Waddington A, Strathcona B, Strathcona C, Alert Bay, and Cape Mudge 10 were not included as they were out of the scope of the scenario. In addition, the “Southern Gulf Islands” subdivision was divided into its constituent Designated Places (i.e., Galiano Island Trust Area, Mayne Island Trust Area, North Pender Island Trust Area, Saturna Island Trust Area, and South Pender Island Trust Area). Census subdivisions with population zero or without available data were not considered.

After applying the filters mentioned, the scenario contained 127 subdivisions. However, as depicted in Fig. 7, each subdivision corresponds to a large geographical area on the map. Therefore, considering that the scenario is designed for use in network models, it was decided to use at least one node to represent each subdivision. To select reasonable nodes within the subdivisions, the First Responders BC Database [13] was downloaded to identify the location of the fire stations. It was assumed that each fire station would represent the location where relief supplies would be distributed.

Fig. 7. Subdivisions in the study area [12].
The first filter applied to the First Responders catalogue was the region of Vancouver Island, and the second filter was fire stations. Out of the 127 subdivisions, 55 did not have a fire station. Then, other responders' facilities were added to the subdivisions that did not have a fire station (e.g., police station, town hall). If after this process, the subdivision did not have a facility, the population size was transferred to the closest first responder facility. If a subdivision had more than one fire station, then the population size would be divided equally between the fire stations. In summary, the scenario has total of 122 nodes representing communities.

The community impact factor is simplified in a scale ranging from 1 (low impact) to 5 (high impact), proposed by Chang and Tanner [14] and summarized in Fig. 8. Chang and Tanner [14] define impact as the “degree of functional disruption in a community” and estimate the factor as an unweighted average of earthquake disruption within the community and disruption to the transportation system, adjusted by the capacity of the community to handle the disruption. Note that only roads and maritime transportation are considered in the second criterion.

As summarized in Fig. 8, both the earthquake disruption within the community and the disruption to transportation networks are assessed using a scale ranging from 1 to 5, whereas the community’s capacity to handle the disruption is assessed on a scale from -2 to +2. Communities with a negative value in the capacity criterion are deemed to have abundant resources, extensive preparedness, and significant political priority. In contrast, communities with a positive value are considered to have large deficiencies in resources, preparedness, and political priority. The authors refer to Chang and Tanner [14] for a detailed explanation of how the community impact factor is defined, and how the communities in Vancouver Island are assessed in the high and medium impact cases in the considered Cascadia earthquake scenario.

The study performed by Chang and Tanner [14] made available the resilience level of the same census subdivisions in Vancouver Island as mentioned above. ArcGIS Pro 2.7.0 was used to match the location of each community to its respective subdivision, and therefore identify its community impact level. Note that some of the communities included in the network were not studied by Chang and Tanner [14]. In these cases, their level was assumed to be the same as its closest neighbor for which data was available.
2.2. Maritime transportation

The dataset with the Automatic Identification System (AIS) information near Vancouver Island developed by Rodrigues [15] was used as the basis of the maritime transportation network. The vessels’ trajectories and identification numbers (Maritime Mobile Service Identity – MMSI, and International Maritime Organization number – IMO) were obtained in Rodrigues [15]. The location of the ports was also based on Rodrigues [15].

The majority of the vessel specifications were collected from the websites of two vessel operators [16,17]. However, if the specifications were not found, the vessel’s name, MMSI, and IMO numbers available on the MarineTraffic website [18] were used to obtain the specifications. The vessels’ dimensions and deadweights were used to calculate the capacities. As mentioned, in our database, the capacity of the ships is described in terms of the number of 20-foot containers loaded with relief supplies. It was assumed that barges can transport just the containers, whereas ferries need the containers to be attached to a truck. Based on the vessel dimensions and deadweight data, the number of containers transported by a given vessel was estimated considering the maximum number of 20-foot containers that could fit in the vessel, further limited by the maximum weight that the vessel can transport. Note that an extra space of one meter was added on each end of the truck’s width and length. This was included to consider that it is not possible for trucks to park too close from each other, and to account for the space needed for lashings. The truck’s cabin was assumed to have a dimension of approximately 2.3x2.5 m.

The delays on each ship trajectory were determined using the Bayesian Network model introduced by Goerlandt and Islam [19]. This model provides a probability distribution for plausible delays for a particular ship trajectory, considering several contextual factors. The inputs required by the model are the identification of the port of origin and the port of destination, the peak ground acceleration at the port of origin and destination, the vessel type (barge or ferry), and whether there is a bridge spanning the navigation route. These inputs were used to provide estimates of the damage to navigational infrastructures (related to communication, waterways, and ports), for the system safety requirements (related to whether vessels are expected to be allowed to sail for operational safety and security reasons), and social impacts (related to the urgency of disaster supplies and the availability of personnel). The model outputs were obtained as a discrete probability distribution over a range of possible delays in each one of the ship’s trajectories. The delays considered were 0, 0-6, 6-12, 12-24, 24-48, and over 48 hours. The port opening time in the medium impact case was the median of the probabilities within the range of possible delays, whereas the high impact case considered the mean of the probabilities.

The information of the ports which are expected to be damaged in the aftermath of the medium and impact case associated with the Cascadia earthquake scenario is based on the work by Bell and Bristow [11]. This data was used to determine which ports and trajectories would be open and closed during the response phase. For the additional ports that we had in our database, we extrapolated the data from Chang et al. [9], and assumed that such a port has the same state as the closest port for which data is available.

2.3. Air transportation

The airports/helipads/heliports were identified and their information extracted using the BC Airports catalogue [20]. The first filter applied to the catalogue was “airport, heliport, and helipad”, after which only the structures near the coast of Mainland British Columbia were selected. The geodesic distances (in kilometers) between each airport/helipad/heliport and the communities were calculated using ArcGIS. Given that the airports/helipads/heliports considered in the plausible scenarios are located outside Vancouver Island, they are assumed to be operable.
2.4. Road network

The road network was developed using the four steps depicted in Fig. 9. The “Road Network File – 2010 – British Columbia” [21] with all the roads in British Columbia was used as the primary source for determining the roads included in the scenario.

After identifying a suitable database, the roads outside Vancouver Island were removed, and the filter applied on ArcGIS was “Highways, major roads, bridges, and avenues”. Then, the surroundings of each one of the communities was analysed to ensure that their region was connected by roads.

The following step was to clean the data, and manually remove redundant roads in some locations. The reason why some redundant roads were removed from the scope was to keep the network with a reasonable size (i.e., fewer than 5000 vertices) and consequently allow faster runs of optimization models. Finally, in case the coordinate of a community or port was not directly connected to a road because its node was determined to be in the middle of a neighbourhood and not bordering a road, an artificial road segment with zero traversing time was included. In addition, if the network was disconnected because of the filters applied (e.g., highway), the filter for the types of roads in that specific area was broadened to also find smaller roads, which were then used to reconnect the network.

The unblocking times were calculated considering the expected level of damage in each road provided by Bell and Bristow [11], and the length of each road segment. Bell and Bristow [11] determined whether the roads are expected to be passable or unpassable in both the medium and high impact cases. Note that their assessment only includes roads surfaces and not damage to transport structures like bridges and retaining walls. We overlaid our network to their damaged network, and the roads that were not included in their data were assumed to be unpassable. For the roads considered to be passable, the unblocking time was set to zero. However, the roads expected to be unpassable have a positive time calculated by the length of the road multiplied by a factor. For the medium scenario, this factor was 4.8 hours, which follows the average time of a superficial repair to roads in the case of a natural disaster [22]. Considering that in the high impact scenario the roads are expected to be extremely damaged, the factor was determined to be proportional to the time horizon, and thus, 72 hours.

2.5. Strength of evidence

Table 4 shows the confidence level of each class of data included in the proposed database. There are four classes (i.e. communities, maritime transportation, air transportation, and roads), and the data is classified according to its evidence type, which can be data collected from a primary database, results of a model, or data generated with assumptions, following ideas on assessing the strength of evidence presented by Goerlandt and Reniers [23].

The last column of Table 4 categorizes the strength of evidence, which can be high, medium, or low. Even though this categorization is subjective, in this table, “high” means that the data was extracted, filtered, and consolidated from a primary database with few assumptions. A “medium” strength implies that the data results from a model, and consequently has some as-
Table 4
Strength of Evidence of the data included in the developed database.

| Class                  | Data                                      | Evidence type | Strength of evidence |
|------------------------|-------------------------------------------|---------------|----------------------|
|                        |                                           | Primary database | Model | Assumption |                     |
| Communities            | Population                                | x             | x                   | High                |
|                        | Location                                  | x             | x                   | High                |
|                        | Resilience level                          |               |                     |                     |
| Maritime Transportation | Vessel’s capacities                       | x             | x                   | High                |
|                        | Ships trajectories                        | x             |                     | High                |
|                        | Ships traversing times                    | x             | x                   | High                |
|                        | Damages to marine infrastructures         |               |                     |                     |
|                        | Delays to ships trajectories              |               |                     |                     |
| Air transportation     | Distances                                 | x             | x                   | High                |
|                        | Damages to air infrastructures            |               | x                   | Low                 |
| Roads                  | Distances                                 | x             |                     | High                |
|                        | Trajectories                              | x             |                     | High                |
|                        | Damages to roads                          |               | x                   |                     |
|                        | Roads unblocking times                    |               | x                   |                    |

Assumptions. A “low” strength of evidence means that the data was created with many assumptions, it is likely not very accurate (i.e. it has a high level of uncertainty and actual values may be significantly different), and should therefore be used with appropriate caution.

As presented in Table 4, most of the geographical information has a high level of precision because they originate from official Canadian databases, which are frequently updated.

The communities’ resilience level, damages to infrastructures (i.e. ports and roads), and delays to ships trajectories are classified as medium. Even though these data are generated using models developed specifically to Vancouver Island in the context of a Cascadia earthquake event, and are published in peer-reviewed journal articles, the models represent simplifications of impacts of the scenario, and involve several assumptions and limitations as recognized in those articles [11,14,19].

Finally, the damages to air infrastructures and roads unblocking times are classified as “low” strength of evidence. As mentioned in Section 2.3, the airports, helipads, and heliports are located on Mainland British Columbia, a region that is expected to be less impacted in a Cascadia earthquake scenario than Vancouver Island. Thus, it was assumed that those infrastructures will be operational (even if partially). The roads unblocking times (mentioned in Section 2.4) were developed with a major assumption: the road repair rate. Based on the road categorization into passable and unpassable originated from Bell and Bristow [11], the unblocking times were calculated as a multiplication of the road repair speed from a highway maintenance report [22] and the length of the road.

Ethics Statements

This work meets the requirements of ethics as stated in (https://www.elsevier.com/journals/data-in-brief/2352-3409/guide-for-authors) and (https://www.elsevier.com/about/policies/publishing-ethics#Authors). This work also does not involve studies with animals and humans.
Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Disrupted transportation networks in a plausible megathrust earthquake scenario on Canada’s West Coast (Original data) (Mendeley Data).

CRediT Author Statement

Luana Souza Almeida: Conceptualization, Methodology, Investigation, Data curation, Writing – original draft, Visualization; Lauryne Rodrigues: Conceptualization, Methodology, Software, Investigation, Data curation, Visualization; Floris Goerlandt: Conceptualization, Methodology, Data curation, Writing – review & editing, Supervision, Funding acquisition; Jose Ancona-Segovia: Data curation; Ronald Pelot: Conceptualization, Writing – review & editing, Supervision, Funding acquisition; David Bristow: Conceptualization, Investigation, Data curation, Supervision, Funding acquisition; Stephanie Chang: Conceptualization, Investigation, Data curation, Supervision, Funding acquisition.

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