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Applying a hierarchical approach to develop a regional truck traffic volume model

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Abstract

Assessing the resilience and safety of road freight transport requires reliable estimates of network-wide truck traffic volumes. However, in many Canadian provinces, a lack of data and inconsistent practice have led to a persistent gap in the availability of these estimates. To address this gap, this research constructs a regional truck traffic volume model for the Canadian Prairie and Northern Region (i.e., Alberta, Saskatchewan, Manitoba, and Northwest Territories). Extending earlier work by Regehr and Reimer (2013), the research focuses on the application of a hierarchical approach for developing network-wide truck traffic volume estimates in Manitoba.

The hierarchical approach categorizes traffic data sites into three levels. Level 1 sites continuously classify vehicles. These sites provide a complete data record but are sparsely distributed geographically. Level 2 sites provide short-duration classification data, typically up to about 48 hours. While only providing a short-duration sample, Level 2 sites provide better spatial coverage of the network. Level 3 sites have (total) traffic volume data but do not have any available classification data. Classification distributions are estimated for these sites based on observed roadway and operational characteristics.

Data from Level 1 sites were used to generate truck traffic pattern groups (TTPGs) that represent the variation of single-unit trucks, single-trailer trucks, and multiple-trailer trucks by day-of-week, hour-of-day, and month-of-year. Cluster analysis using Euclidean distance between each data vector was used to group sites with similar temporal trends in these three vehicle classes. Engineering judgment was used to define the TTPGs in terms of identifiable roadway and operational characteristics for the grouped sites. Finally, an assignment algorithm was developed and applied to assign Level 2 sites to the appropriate TTPG, enabling those counts to be factored into representative annual average volumes.

Using a similar process, TTCGs were created using Level 1 site classification data. This began with a cluster analysis using the classification distribution of classes 5, 6, 9, 10, and 13, as well as the total proportion of trucks to all vehicles at each Level 1 site. Each TTCG was defined in terms of identifiable roadway and operational characteristics to enable assignment of Level 3 sites to the appropriate TTCG.

To visualize the results, truck traffic volume—expressed as annual average daily truck traffic—was estimated at all sites by dividing the network into truck traffic segments, based on an assumption of volume homogeneity (Ominski et al., 2021) and applying data attribution rules. The results for Manitoba were combined with truck volume estimates available from other jurisdictions to produce a regional truck traffic volume model (see figure). While methodological differences exist between jurisdictions, the model represents the first known regional-scale estimate of truck volumes.

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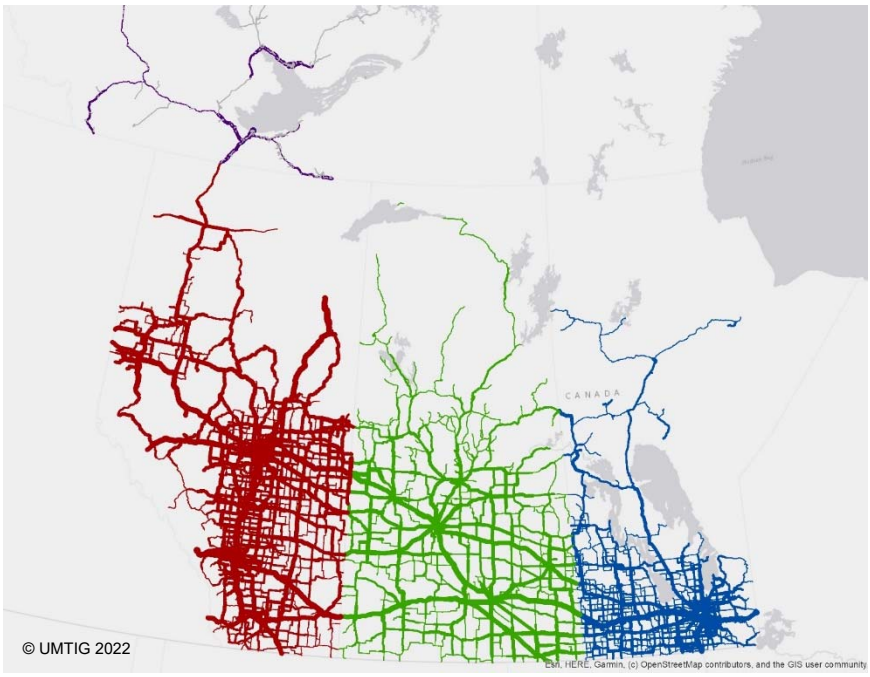

Truck traffic volume model for the Canadian Prairie and Northern Region, 2019

Keywords: truck volume, traffic monitoring, vehicle classification, hierarchical approach, cluster analysis

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