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Floating car data for urban traffic flow analysis: a case study of Olomouc

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Abstract: This paper examines the potential and limitations of floating car data for the spatiotemporal assessment of urban traffic congestion in a medium-sized city. Using traffic flow data obtained from the HERE Traffic API, the study analyses congestion patterns in Olomouc, Czechia, with a focus on daily trends, hourly variations, changes on selected specific days, and the spatial distribution of congestion across road segments. The data were collected at 15-minute intervals and aggregated to identify recurring traffic patterns and deviations associated with holidays, school-related changes, and pandemic restrictions. The results show that aggregated floating car data provide a robust basis for identifying recurrent congestion patterns, peak periods, and problematic road sections within the city. At the same time, the analysis demonstrates that single-day anomalies are often difficult to interpret without additional contextual information. The study confirms that floating car data are a useful source for medium-scale urban traffic monitoring, logistics planning, and comparative assessment of congestion, although their explanatory value is constrained by limited transparency in the underlying data generation process and by the absence of direct traffic counts.

1 Introduction

Urban traffic congestion remains a persistent problem in both large and medium-sized cities. It affects travel time, economic efficiency, environmental conditions, and the overall functioning of urban transport systems, including the management of passenger and freight flows, urban logistics, and supply chain operations dependent on reliable road transport. For this reason, detailed traffic monitoring and analysis are essential for transport planning, traffic management, and the development of intelligent transport systems. From the perspective of smart cities, contemporary traffic monitoring can also be understood as part of a broader sensor-based urban information infrastructure combining fixed sensors, mobile devices, and vehicle-based positioning systems.

A key aspect of transport-system analysis is the use of computer models that simulate traffic volumes and dynamics in relation to urban development [1-3]. Intelligent Transport Systems (ITS) represent one possible response to urban traffic problems. Their important component is the collection and analysis of real-time traffic data, which support both road users and transport system operators in decision-making. Such data can contribute to improved traffic management, lower congestion, and more efficient use of existing transport infrastructure.

With the growing number of vehicles, the need for more effective traffic management is increasing. Traffic congestion is a daily phenomenon affecting both large and medium-sized cities. Under conditions of limited urban infrastructure and resources, one of the most effective ways to understand and manage congestion is through traffic-data collection, analysis, and prediction. Two closely related challenges therefore arise: obtaining suitable traffic data and interpreting them correctly.

1.1 Conventional traffic data collection

Data on car traffic are collected using conventional (traditional) and non-conventional (modern) methods. From a conceptual point of view, conventional traffic data collection methods can be regarded as fixed sensor networks, in which

Floating car data for urban traffic flow analysis: a case study of Olomouc

Jaroslav Burian, Karel Macků, Tomáš Pohanka, Karol Hrudkay, Michal Palčák

traffic-related phenomena are monitored at predefined locations using dedicated sensing technologies. Conventional methods focus on the collection of data using sensors placed on or near the roadway. Thus, it is only the location near the relevant sensors that is always monitored. A range of sensing technologies is used in this context, including pneumatic tubes, piezoelectric sensors, magnetic detectors, infrared sensors, radar, and acoustic systems [4]. One recent trend is the use of image and video detection methods, and these are expected to have huge potential in the future due to the rapid development of artificial intelligence. Despite the development of automatic sensing technologies, manual or semi-manual traffic surveys are still used in many situations. Their main advantages are flexibility in site selection, temporal deployment, and the possibility of recording movement directions and vehicle types in detail. Such approaches are therefore still used in national traffic censuses [5] and in one-off surveys where long-term automated monitoring is not necessary or feasible. Overall, however, conventional methods are usually limited to selected road sections. Their wider deployment requires substantial financial and personnel resources. A fundamental limitation of such fixed sensor networks is their spatial rigidity, which restricts continuous monitoring across the whole urban area and motivates the use of complementary mobile sensing approaches such as floating car data.

1.2 Floating car data

In addition to conventional methods, crowdsourcing-based traffic data collection has become increasingly common. This approach relies on GPS devices installed in vehicles or on mobile phones whose users share their location. From these data, information on speed and direction can be derived from successive positions. The observed speed is then compared with the characteristics of the relevant road segment and refined using other sources, including historical records. This makes it possible to assess whether traffic on a given segment is flowing normally or is affected by congestion. The primary data may be relatively imprecise, but this is partly compensated for by the large number of devices involved. As a result, reliability tends to be lower on lightly used roads and higher on heavily used ones [7].

The main advantage of this approach lies in the widespread availability of data-collecting devices, which allows large-scale and near real-time traffic monitoring. Because no dedicated roadside infrastructure is required, acquisition costs may also be lower than in the case of conventional methods [7].

This approach makes it possible to build large and continuously updated traffic databases containing information on congestion, travel times, average speeds, and incidents. Widely used examples include Google Maps, Apple Maps, Waze, TomTom, Bing Maps, and HERE WeGo [3,7]. Most of these services are designed primarily for navigation, and access to their data is usually limited. Although application programming interfaces exist, they are often restricted in terms of spatial coverage, temporal access, or usage conditions.

One important source of FCD is HERE (formerly HERE Maps / HERE WeGo), which collects large volumes of location data from smartphones, portable navigation devices, in-vehicle systems, and other sensor-equipped platforms. These data are further refined using additional traffic-event information from a wide range of sources, including official portals, historical records, and other external inputs. The resulting database provides a robust basis for traffic services and is continuously processed through the HERE traffic engine.

HERE provides this data in XML or JSON formats via a REST API that allows a relatively high number of requests to the database after registration with a free account. The services provided by the HERE Traffic API include Traffic Incident Data, Traffic Map Overlays (Traffic Tiles), Traffic Flow Availability and, most importantly, the Traffic Flow Data service, which provides traffic information for individual user-defined road segments [8,9]. The service does not offer the complete road network for download, only the main road skeleton (major roads), but this is sufficient for most analyses.

1.3 Application of floating car data

Data provided by these platforms are used primarily in navigation applications to improve route selection and travel-time estimation. This practical orientation is also reflected in many published studies, which focus mainly on road safety [10], traffic light control [11,12], and network-analysis algorithms [12].

FCD can also be used for other purposes, especially traffic visualisation [12] and congestion analysis [13]. Existing studies emphasise the relative ease of data acquisition, the high spatial and temporal detail, and the usefulness of these data for identifying congestion and approximating traffic conditions [14,15].

During the COVID-19 pandemic, several studies used large-scale traffic and mobility data, including floating-car and probe-based sources, to assess changes in urban traffic flows under different levels of restrictions [16,17]. Related studies have also used proprietary congestion indicators to characterise broader traffic congestion patterns at city scale [18]. However, some authors caution that such indices do not allow straightforward interpretation of traffic improvement or deterioration and should not be used for simple inter-city comparison.

One relatively little used aspect of FCD is in the assessment of traffic situations (especially traffic congestion and traffic intensity) in cities, because this is not the primary purpose of FCD and, moreover, cities still use more traditional data sources for traffic assessment. Traditional data sources rarely provide continuous and spatially extensive information on congestion. Even comprehensive transport strategies often lack this perspective because such data are unavailable.

Floating car data for urban traffic flow analysis: a case study of Olomouc

Jaroslav Burian, Karel Macků, Tomáš Pohanka, Karol Hrudkay, Michal Palčák

This also applies to the Czech context, including the Sustainable Urban Mobility Plan of Olomouc [19,20]. At the same time, only a limited number of studies have addressed the use of FCD for detailed congestion analysis in specific urban settings [21–23].

Recent research confirms that floating car data are increasingly used not only for navigation-oriented applications, but also for the spatiotemporal assessment of urban congestion patterns, traffic-flow modelling, and broader transport-planning tasks including urban logistics management and the optimisation of distribution flows [3,7,13]. At the same time, growing attention is being paid to the reliability, representativeness, and integration of FCD with complementary sensor sources, especially in urban environments where dense fixed-sensor networks are unavailable or spatially incomplete [24–29]. This is particularly relevant in medium-sized cities, where alternative sources of spatially continuous traffic information are often limited.

Against this background, this paper evaluates the potential and limitations of floating car data from the HERE Traffic API for the spatiotemporal assessment of urban traffic congestion in a medium-sized city. Olomouc is used as a case study to demonstrate how these data can be collected, stored, aggregated, and interpreted for the analysis of daily trends, hourly variations, specific-day effects, and spatial differences between road segments. The analysed period (2020–2021) is treated as a stress test of urban traffic behaviour under pandemic-related restrictions rather than as a representation of current traffic conditions. The main research question is whether HERE floating car data can serve as a meaningful source for assessing traffic intensity and congestion patterns in a medium-sized urban environment.

2 Data and methods

2.1 Study area

Olomouc (99,496 inhabitants in 2022; 103.33 km²) is the sixth largest city in Czechia and the administrative centre of the Olomouc Region. It represents a medium-sized urban centre with an important regional service, employment, and commuting function. The city is connected to the national motorway network, particularly via the D1/D46 and D35 corridors, and its road traffic is concentrated along the main tangential and radial routes (Figure 1). From the perspective of congestion analysis, these corridors form the key parts of the urban transport system and include both major transit links and heavily used inner-city sections. As Olomouc combines regional accessibility, daily commuting flows, and a relatively compact urban structure, it provides a suitable case study for assessing the potential of floating car data in a medium-sized city.

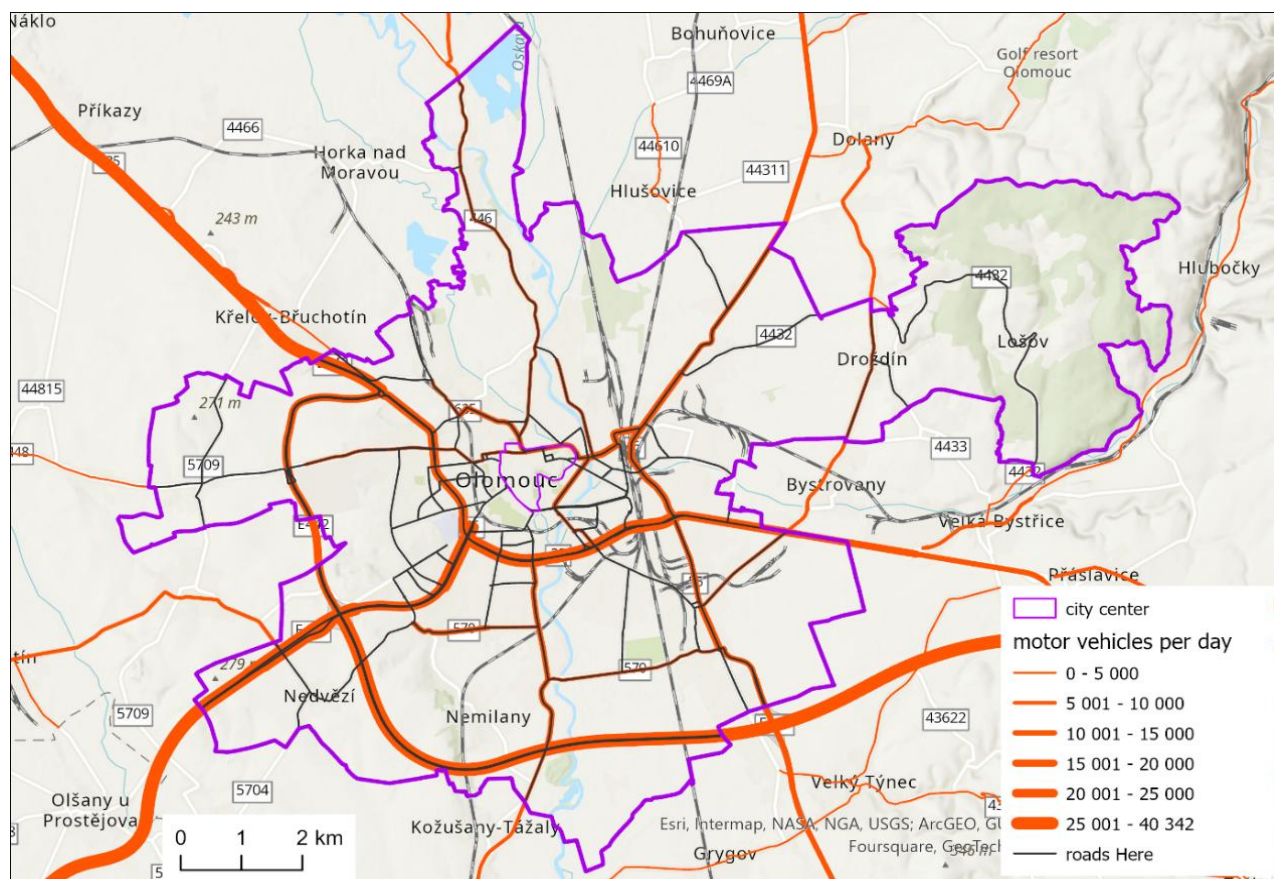


Figure 1 Study area - the city of Olomouc

2.2 Data

The main data source was the HERE Traffic Flow dataset obtained through the HERE Traffic API. The data were collected automatically at 15-minute intervals and stored on a local database server for subsequent analysis. The area of interest was defined using a bounding box corresponding to the functional urban area of Olomouc. Data collection started in May 2020 and continued until the end of 2021.

The downloaded records were stored in a PostgreSQL/PostGIS database designed for time-series traffic data. Geometry and traffic attributes were stored separately, as the geometry of road sections remained unchanged over time.

A Python script was used to download traffic-flow records for all road segments within the study area at 15-minute intervals. The data were retrieved in JSON format and parsed into PostgreSQL tables. The database structure distinguished between time-varying traffic records and static road-segment geometry (Figure 2). For the purposes of this study, the key variables were measurement time, confidence, free-flow speed, speed, and jam factor. Jam factor was used as the main indicator of congestion intensity, while free-flow speed and confidence were used as supporting attributes for interpretation.

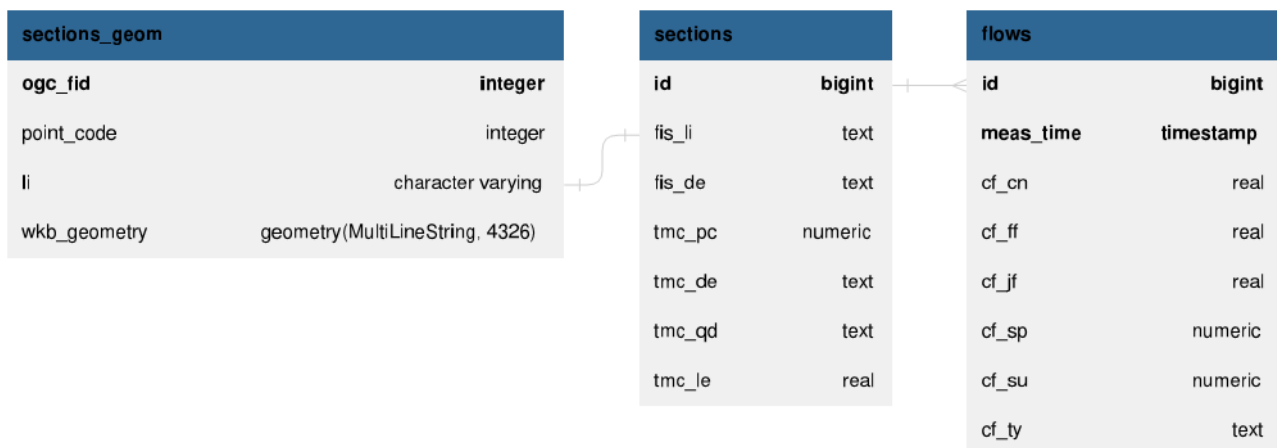


Figure 2 Data storage scheme

2.3 Methods

Data processing was carried out in the PostgreSQL/PostGIS environment using SQL queries, while aggregated outputs were further processed in Microsoft Excel. In addition to attribute data, the geometry of road sections was used to visualise spatial patterns. Because the HERE records are stored in UTC, timestamps were converted to local civil time, including daylight saving time where applicable. A key step in the workflow was the aggregation of 15-minute records into analytically meaningful time units. Because of occasional technical interruptions during the long download period, only complete and methodologically suitable time windows were selected for detailed analysis.

The analysis focused on representative time periods in which both long-term and short-term changes in congestion intensity could be observed. Time windows affected by obvious data failures or other distortions were excluded. For all analyses, the input data were aggregated into median hourly values for all road segments in the study area.

To demonstrate the analytical potential of HERE Traffic data, four model situations were selected: (i) daily congestion trends over a longer period (1 March 2021–30 June 2021), (ii) hourly congestion patterns during two selected weeks (17–23 August 2020 and 1–7 March 2021), (iii) changes on specific days compared with adjacent reference days (end of the school year, beginning of the school year, Christmas Eve, All Soul's Day, Good Friday, and Easter Monday), and (iv) the spatial distribution of congestion across the urban road network. In the analysis of specific days, the difference between the medians of two consecutive days was evaluated, with one of them treated as specific.

For the spatial assessment, a typical summer week was selected to represent standard non-holiday traffic conditions. Median jam factor values were calculated for a typical working day and a typical weekend day. In addition, the morning peak period (7–8 a.m.) was analysed in more detail to capture the most pronounced congestion pattern within the daily cycle.

The spatial visualisation of results was prepared in ArcGIS Pro. As most road sections contained separate information for each traffic direction, line offsets were used to display parallel directional segments clearly.

3 Results

This section presents the main results of the spatiotemporal analysis of congestion patterns in Olomouc based on HERE Traffic data, focusing on daily trends, hourly variations, specific-day effects, and spatial differences across the road network.

3.1 Daily changes of the jam factor

Figure 3 shows the daily development of mean and median jam factor values in Olomouc between 1 March and 30 June 2021. Although the values are aggregated across all road segments and therefore represent a highly generalised measure of congestion intensity, the recurring weekly cycle is clearly visible, particularly in the regular decline during weekends. The time series also reflects the broader context of the COVID-19 pandemic, especially the gradual easing of movement restrictions at the end of April 2021. While median values remained relatively stable, mean values increased more visibly, suggesting that higher congestion levels appeared only on part of the road network and did not affect the city uniformly. A short-term spike can be observed on 26–27 April 2021, which may be related to the partial return of pupils to schools and the re-opening of selected services. However, this effect was temporary and was not followed by a lasting increase in congestion intensity.

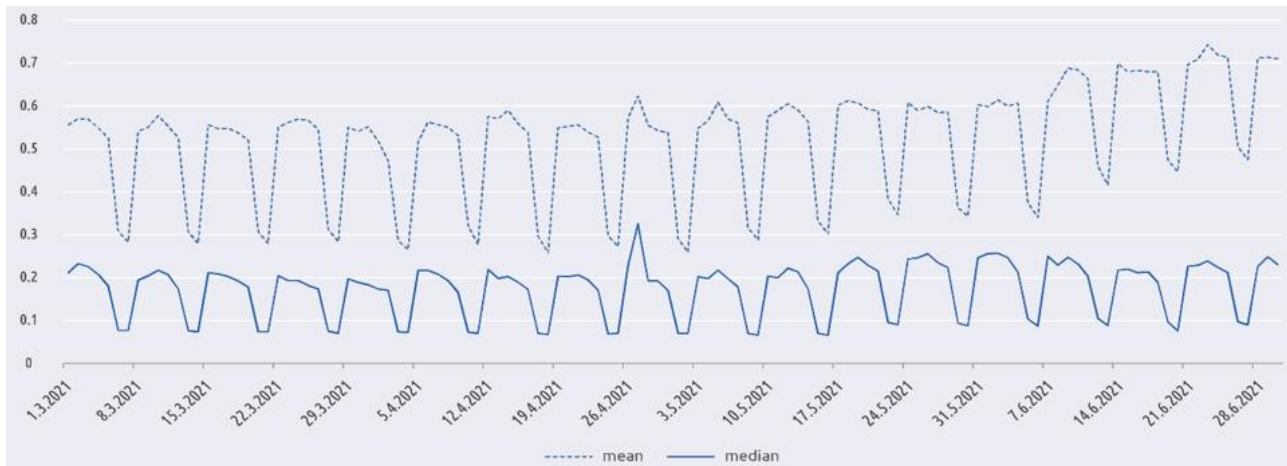


Figure 3 Time series of mean and median jam factor values between 1 March and 30 June 2021

3.2 Hourly variations in the jam factor

Because of the detailed timestamps, HERE Traffic data are also suitable for analysing intra-week congestion patterns in greater detail. In the next step, median hourly jam factor values were evaluated over a whole week and visualised as a heatmap (Figure 4). For comparison, a “normal” week (17–23 August 2020) and a “specific” week affected by COVID-19 restrictions (1–7 March 2021) were selected.

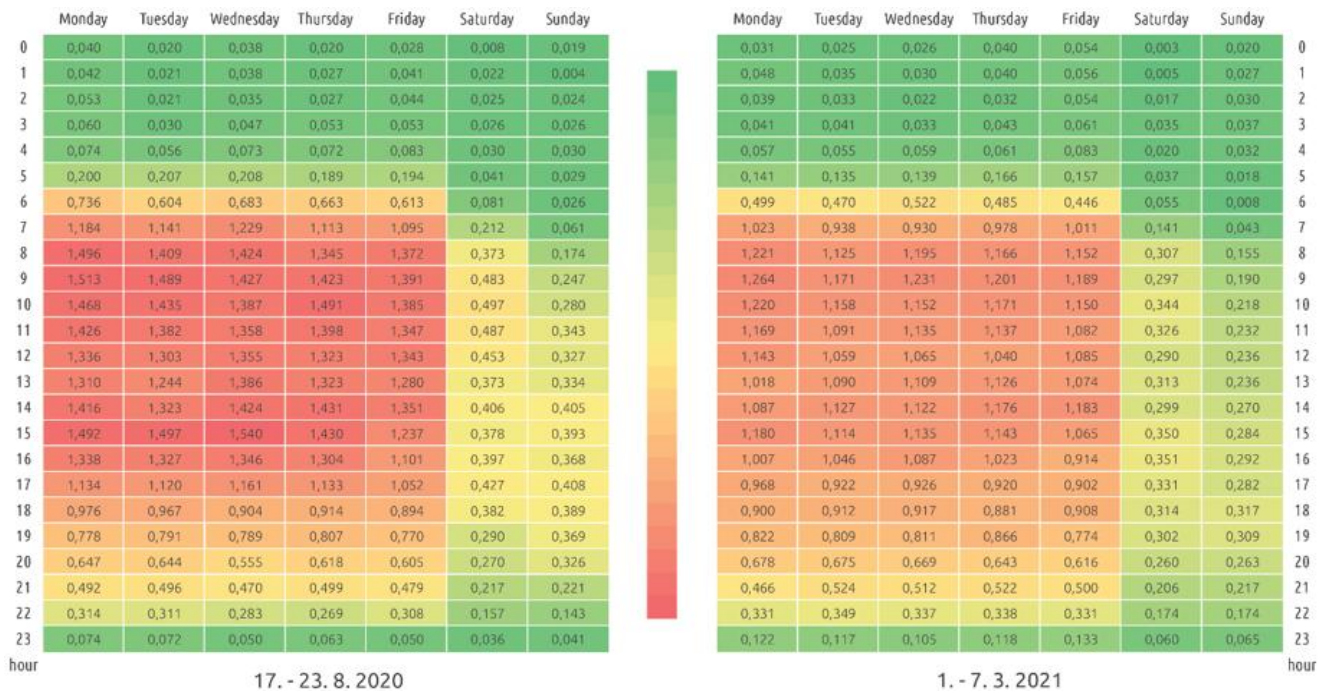


Figure 4 Matrix of daily-hour jam factor values during the regular week (left) and atypical week with the COVID-19 restrictions (right)

Floating car data for urban traffic flow analysis: a case study of Olomouc

Jaroslav Burian, Karel Macků, Tomáš Pohanka, Karol Hrudkay, Michal Palčák

In the normal week, a recurring daily pattern can be observed on all working days. Jam factor values remain very low at night, begin to increase between 4 and 5 a.m., and rise further during the morning peak between 7 and 9 a.m. Elevated values persist until midday and culminate again in the afternoon, especially around 3 p.m. From late afternoon onwards, congestion intensity gradually declines. A slight decrease can be observed towards the end of the working week, particularly on Thursday and Friday, when peak values are lower than on the preceding days.

The contrast between weekdays and weekends is pronounced. On Saturday, higher jam factor values are concentrated mainly in the first half of the day, while on Sunday they shift more towards the afternoon. Compared with weekdays, however, weekend congestion levels remain substantially lower.

Compared with the normal week, the week affected by COVID-19 restrictions shows an overall reduction in congestion intensity, especially on working days. The general daily pattern remains similar, but jam factor values are consistently lower and the late-week decline is less pronounced. Weekend values are also lower, although the contrast with a normal weekend is smaller than in the case of weekdays. These differences are consistent with reduced commuting and lower overall mobility during the period of pandemic-related restrictions.

3.3 Jam factor changes on specific days

In the next part of the analysis, selected specific days were examined to assess whether HERE Traffic data capture noticeable deviations from usual traffic patterns. The evaluation focused on the end of the school year, the first day of school after the summer holidays, the Christmas period, All Soul's Day, Good Friday, and Easter Monday.

At the end of the school year, a decrease in mobility might be expected due to reduced school commuting, especially trips made by parents taking children to school. However, it can be seen from Figure 5 that the expected decrease in the 7 a.m. morning commute is not observed. In contrast, a slight increase is observed in the afternoon. This may reflect the beginning of the holiday season and a slight increase in leisure-related mobility. Overall, however, the observed differences are very small.

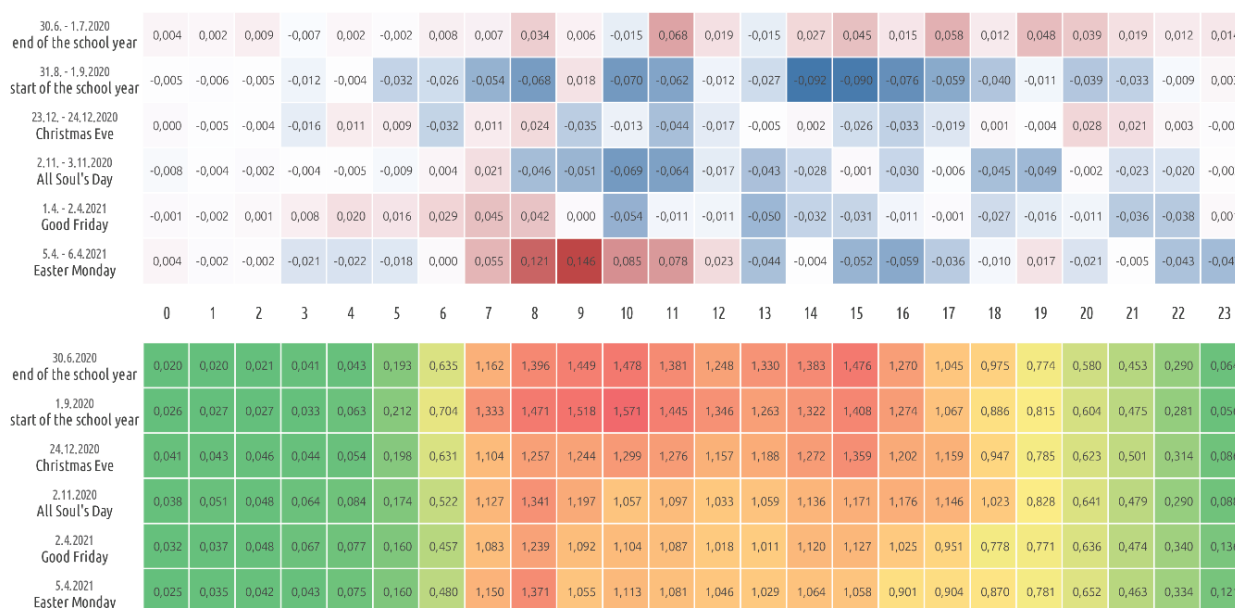


Figure 5 Difference in the median value of jam factor on two consecutive days (top); absolute median value of jam factor on a specific day (bottom)

An opposite effect was expected on the first day of school after the summer holidays, when traffic intensity should increase at times associated with pupils' journeys to school. The beginning of the school year coincided with the early stage of the autumn COVID-19 wave, although no mobility restrictions had yet been introduced. Therefore, the observed decrease in intensity is contrary to expectations and there is no clear interpretation for it. The Christmas period is typically associated with marked changes in mobility patterns compared to normal days. They are also influenced by changes in the opening hours of shops, restaurants, sports and entertainment facilities, and cultural events. The Christmas period is also characterised by frequent visits to family members and friends, which may further affect traffic patterns. In this case, we observe a slight decrease in intensity compared to 23 December (Wednesday), which corresponds to the expected behaviour. However, we would expect a more significant decrease, especially in the evening hours.

All Soul's Day in 2020 fell on 2 November (Monday) and may be considered specific because of increased visits to cemeteries in the late afternoon. To make a comparison with another weekday, a difference was observed on 3 November. A decrease in traffic intensity is observed, but the highest values still occur in the morning, which is not consistent with the expected pattern. In terms of absolute intensity measures, the jam factor is highest at 8 a.m., then holds fairly constant through the day until 5 p.m. Good Friday (2 April 2021) is a public holiday, so a decrease in traffic would be expected compared to Thursday. At the same time, people may use the day off for recreation and visits, so no clear expectations regarding the direction of change can be set. Compared with Thursday, a slight increase is observed in the morning, while afternoon and evening differences are negative but very small. In terms of the absolute value of the jam factor, the intensity was highest at 8 a.m. and decreased thereafter.

Although Easter Monday is traditionally associated in Czechia with visits to relatives and friends, the data show a marked increase in intensity on the following Tuesday (6 April 2021), especially in the morning hours. It can be concluded that despite the visits mentioned, Easter Monday is much quieter in terms of traffic than the following normal working day. The absolute values of the intensity on Easter Monday indicate increased activity at 8 a.m., which is in line with the tradition of morning visits.

3.4 Spatial distribution of the jam factor

The final analytical output is a spatial assessment of congestion intensity across individual road segments in the study area. This output was prepared by linking jam factor values with the spatial data of road segments in the city. Each segment was assigned an aggregated value expressing the median jam factor for the selected period. The assessment was performed for a typical working day, a typical weekend day, and the morning peak period on a working day.

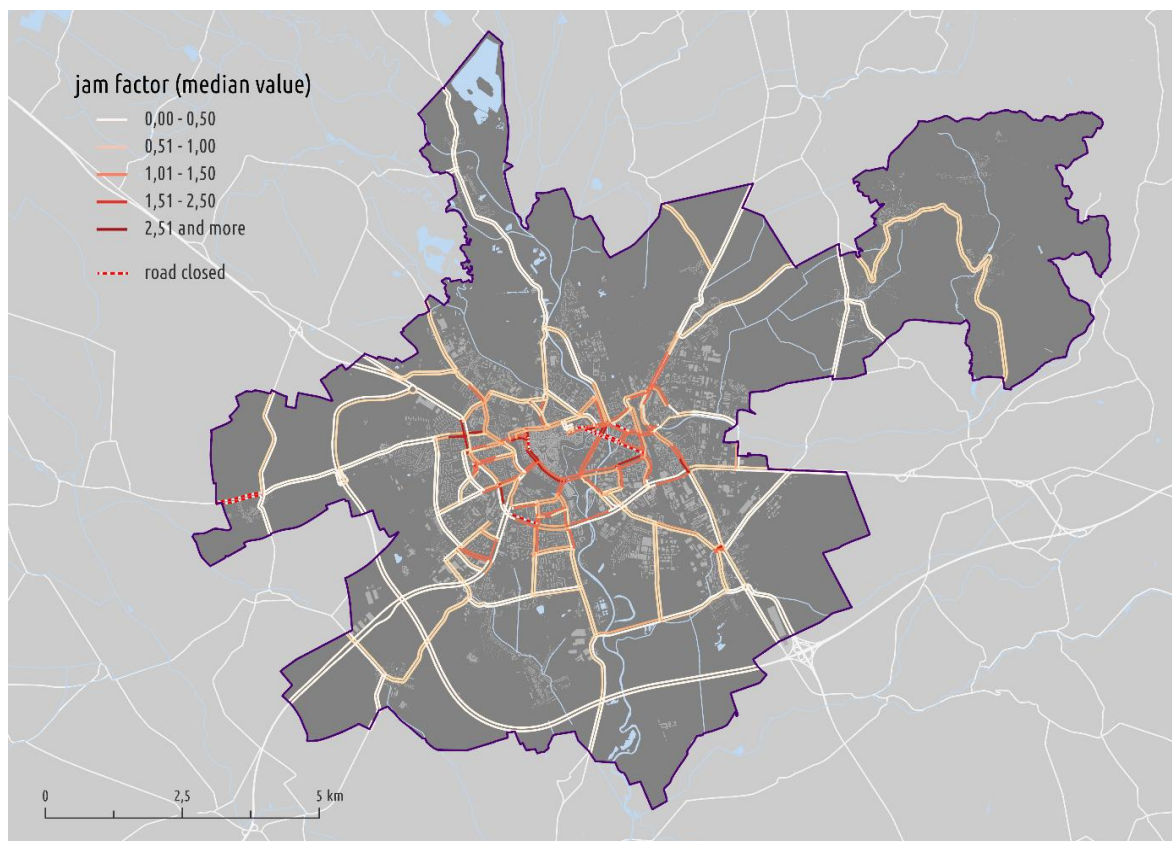


Figure 6 Jam factor on a typical working day
(median values for road segments during 17-21 August 2020)

Floating car data for urban traffic flow analysis: a case study of Olomouc Jaroslav Burian, Karel Macků, Tomáš Pohanka, Karol Hrudkay, Michal Palčák

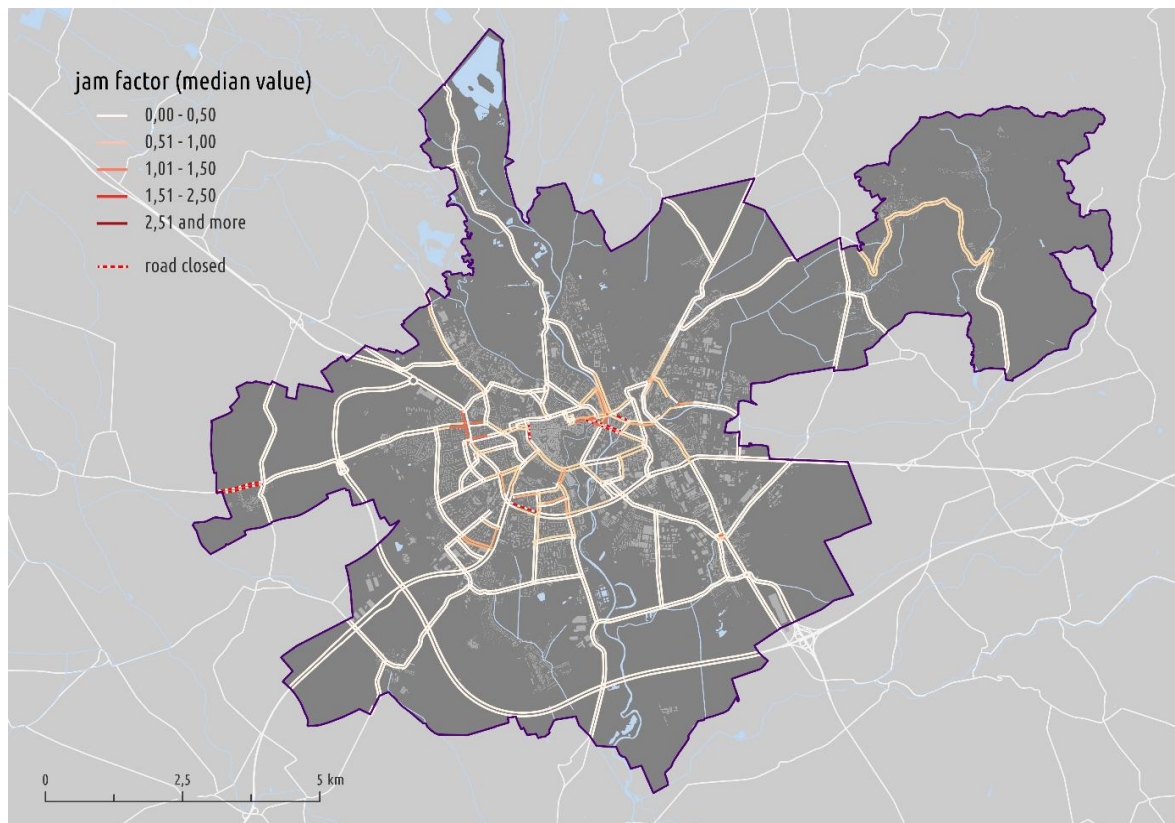


Figure 7 Jam factor during the weekend
(median values for road segments during 22-23 August 2020)

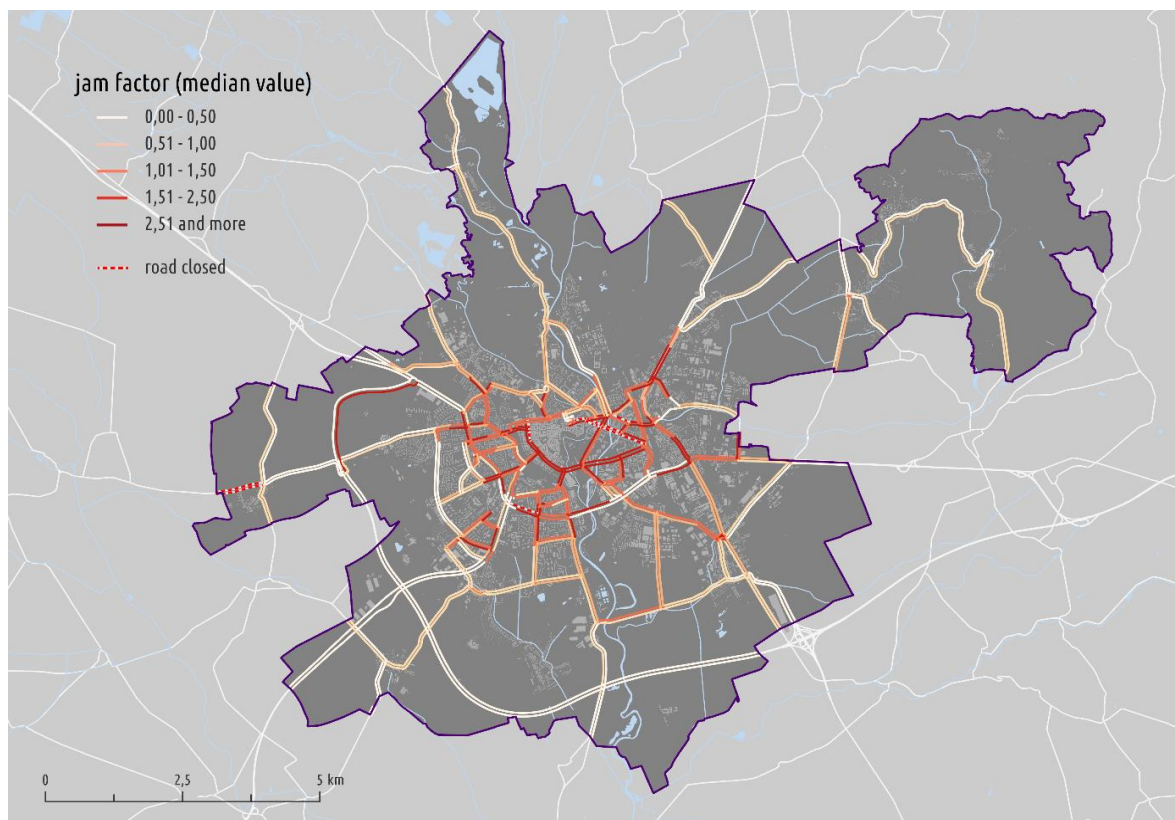


Figure 8 Jam factor on the morning peak on a typical working day
(median values for road segments during 17-21 August 2020, 7-8 a.m.)

Floating car data for urban traffic flow analysis: a case study of Olomouc

Jaroslav Burian, Karel Macků, Tomáš Pohanka, Karol Hrudkay, Michal Palčák

First, the spatial pattern of congestion on a typical working day was compared with that at the weekend. Although the median values for all hours of all weekdays were aggregated by road segment, Figure 6 shows a clear spatial pattern of congestion in Olomouc. Higher jam factor values are concentrated in the inner parts of the city. Tr. Svobody, which bypasses the historical centre, stands out as one of the most congested sections. Kosmonautů Street, linking the railway station with the city centre, shows a similarly high congestion intensity. These sections correspond well to everyday urban traffic experience. Importantly, the most congested sections are not necessarily those with the highest traffic flows, but rather local road segments where traffic flow is repeatedly slowed down. Higher jam factor values are also visible on some main outbound routes, particularly on the I/35 road towards the north of the city. The adjacent districts of Pavlovičky, Bělidla, and Chválkovice can therefore be regarded as problematic in terms of the regular occurrence of congestion. The city bypass carries high traffic flows as well, but congestion appears there less frequently than on the above-mentioned urban sections.

The weekend visualisation (Figure 7) shows substantially lower jam factor values across most parts of the city than on weekdays. The strong weekday–weekend contrast was already evident in Figure 4, but the spatial view confirms that no major part of the city experiences pronounced weekend congestion. Higher values remain visible mainly in the city centre, but even there they are markedly lower than on working days.

In addition, traffic conditions were examined in more detail for the morning peak on a typical working day in order to capture the most pronounced congestion pattern within the daily cycle. Based on previous findings on traffic behaviour in Olomouc [23], the interval from 7 to 8 a.m. was selected as the main peak period. The spatial visualisation is presented in Figure 8. Compared with the general weekday pattern, the morning peak confirms the concentration of congestion on the main radial and tangential routes, especially in the inner parts of the city and on key links connecting the centre with surrounding districts. No fundamentally different spatial pattern was observed, but the morning peak highlights the road sections where congestion intensity is most pronounced.

4 Discussion

During the evaluation period, traffic in Olomouc was also affected by the closure of some roads, which resulted in increased or decreased congestion intensity in some of the analysed sections. This was mainly due to the implementation of flood protection measures on the Morava River associated with the reconstruction of bridges on Komenského Street and Masaryk Avenue. These construction works required the diversion of traffic from closed roads to other routes. However, given the longer duration of these closures, the observed traffic patterns may still be regarded as relatively stable, as most drivers had already adapted to the changed traffic conditions. The affected sections are indicated in the map outputs.

The main limitation of the presented analyses lies in the nature of the input data. The HERE Traffic API technical documentation [8] provides only limited information on how the traffic indicators are generated. Despite the broad applicability of Floating Car Data (FCD) for traffic and infrastructure monitoring, their indirect nature and variable spatial coverage may limit the accuracy of derived traffic-state indicators when used in isolation. Recent review studies highlight that these limitations are increasingly addressed through the integration of FCD with heterogeneous sensor-based data sources, framing FCD as one component of broader traffic-sensing and data-fusion ecosystems rather than a standalone solution [3]. Recent research has shown that integrating FCD with complementary sensor sources can improve the robustness and interpretability of traffic and infrastructure measurements. For example, fusing commercial FCD with Bluetooth sensor data has been demonstrated to improve average link speed estimates and provide more consistent traffic performance assessment across urban corridors compared with single-source methods alone [25]. A similar direction is represented by recent multisource traffic-state estimation approaches, which show that combining heterogeneous sensor streams can improve the quality and stability of urban traffic assessment [27]. Moreover, the use of FCD has been extended beyond conventional traffic metrics, for example to the assessment of pavement roughness for maintenance planning, which illustrates the wider potential of probe-based data but also emphasises the need for validation against high-quality reference measurements [26].

A related issue is the substantial level of uncertainty inherent in the analysed data, which is not always sufficiently acknowledged in studies using FCD. Some important characteristics remain unknown, such as the number of vehicles contributing to the indicator on a given road segment and whether the number of probe vehicles is sufficient on marginal road sections for the published values to be considered representative. At the same time, previous studies have shown that acceptable estimates of aggregated traffic variables, especially speed-based indicators, can still be obtained even at relatively low probe-vehicle penetration rates; for example, [28] demonstrated that penetration levels of around 5% may already provide reasonable estimation quality for urban road segments when appropriate quality–penetration relationships are applied. Similar limitations are mentioned by [24], who identify the inability to validate data reliability as one of the main weaknesses of this type of data source. The automated processing by the HERE engine probably addresses reliability to some extent, as it provides a “confidence” attribute, but the user is not given sufficient information to evaluate how this reliability is derived. For these reasons, the data are not suitable for real-time operational traffic control tasks that require precise vehicle counts and very high temporal responsiveness. However, the analyses confirm that, when

Floating car data for urban traffic flow analysis: a case study of Olomouc

Jaroslav Burian, Karel Macků, Tomáš Pohanka, Karol Hrudkay, Michal Palčák

aggregated over longer time periods, Floating Car Data provide a robust basis for strategic and tactical traffic planning, including the identification of congestion patterns and travel time reliability assessment. The interpretability of these data could be further improved by systematic comparison with observations from independent urban sensor networks, which may help to refine the evaluation of congestion patterns and support local validation of derived traffic indicators. This limitation is particularly important in medium-sized cities, where congestion patterns are often shaped by a combination of recurrent daily commuting, local bottlenecks, and temporary traffic disturbances, and where the interpretation of probe-based indicators therefore requires careful contextualisation.

Another weakness is the partial spatial coverage of the data. Although the dataset covers a very large area, including all European countries, representativeness is likely to be highest on the backbone network of major roads with sufficient traffic flows. However, the rules according to which road segments are included are not known, and in some cities data may be missing for roads that are important for local traffic conditions.

The interpretation of jam factor values is also problematic. For the user, jam factor is essentially a numerical index whose absolute magnitude is difficult to translate into a clear verbal interpretation. Due to the aggregation of values over time or space, the observed differences within a day are often rather small. It is therefore difficult to determine with confidence whether a particular absolute difference between two jam factor values should be regarded as significant. This problem is particularly evident in the assessment of changes on selected specific days. The observed differences are often very small, and it is not possible to determine reliably whether they reflect the consequences of a specific event, natural variability, or other external influences such as weather-related changes in traffic behaviour. For this reason, the data are less suitable for detailed interpretation of small differences between selected individual days, especially where no strong external context is available.

At the same time, the results show that basic temporal and spatial traffic-flow trends can be captured by these data, especially over the long term. This is evident, for example, when comparing usual traffic conditions with the patterns observed during the COVID-19 restrictions, and similar conclusions are reported by [16]. Owing to the possibility of collecting data at 15-minute intervals over a long period of time, it is also possible to identify with reasonable precision the locations where the most pronounced congestion occurs, which is consistent with findings reported by [15]. In the study area, the most problematic locations correspond both to the general awareness of recurrent congestion in the city and to the conclusions of the Sustainable Mobility Plan [19], where problematic road sections were also identified through field survey. A major advantage of HERE Traffic data is that such assessment can be carried out in a uniform way over long time periods and across an almost unlimited spatial extent. In this respect, the present study is consistent with recent work showing that floating-car and probe-based data are particularly useful for identifying stable congestion structures and recurrent bottlenecks, whereas their explanatory value is lower for short-term deviations without additional contextual evidence [26,30].

In Czechia, where the most commonly available official traffic data are still based primarily on vehicle counts from the national Transport Census [5], HERE Traffic data represent a particularly valuable additional source of information. Beyond traffic engineering, such data have direct relevance for logistics operations, distribution planning, and supply chain management, where knowledge of recurring congestion patterns and freight flow conditions on specific road segments is essential. They can be used alongside existing traffic surveys, traffic models, and data from conventional sensors, which usually monitor only a limited number of locations or selected time periods. In this respect, HERE Traffic data offer an important advantage, as they can be analysed for almost any time frame without major limitations in spatial extent. At the same time, they should always be interpreted critically and in relation to other official or locally validated data sources.

A specific contribution of this study lies in showing that long-term aggregation of floating car data can reveal stable spatial and temporal structures of congestion in a medium-sized city, whereas short-term anomalies remain more difficult to interpret reliably. In this sense, the study contributes not only to the empirical understanding of traffic congestion in Olomouc, but also to the broader discussion on the applicability of commercial floating car data in urban traffic-flow assessment outside large metropolitan areas.

5 Conclusions

This paper evaluated the potential and limitations of floating car data from the HERE Traffic API for the spatiotemporal assessment of urban traffic congestion in a medium-sized city, using Olomouc as a case study. The analyses showed that long-term aggregation of jam factor values makes it possible to identify stable daily, weekly, and spatial patterns of congestion and to highlight problematic road sections and peak periods within the urban transport system. In this respect, the results confirmed that floating car data can capture the main structural features of urban traffic flows and provide a useful basis for the comparative assessment of congestion conditions across the road network.

At the same time, the study also showed that the interpretation of short-term anomalies observed on selected specific days is less straightforward and depends much more strongly on contextual knowledge. Small differences in aggregated jam factor values cannot always be interpreted reliably without additional information on the underlying causes of traffic

Floating car data for urban traffic flow analysis: a case study of Olomouc

Jaroslav Burian, Karel Macků, Tomáš Pohanka, Karol Hrudkay, Michal Palčák

changes. This applies in particular to situations where multiple external influences may overlap, such as holidays, weather conditions, temporary restrictions, or changes in daily routines.

The main contribution of the study therefore lies not only in the empirical assessment of congestion patterns in Olomouc, but also in demonstrating the analytical possibilities and limits of floating car data in a medium-sized city. From a practical perspective, these data can support transport planning, traffic management, urban logistics coordination, and the identification of bottlenecks affecting the flow of goods and passengers in situations where conventional traffic surveys do not provide sufficient spatial or temporal detail. Their main advantage lies in the possibility of repeated and spatially extensive monitoring of traffic conditions over long time periods, which is difficult to achieve using conventional field surveys alone.

At the same time, the study confirms that HERE Traffic data should not be interpreted as a direct substitute for conventional traffic counts or other validated sensor-based measurements. Rather, they should be understood as a valuable complementary source that is particularly suitable for the identification of long-term congestion patterns and spatial differences in traffic conditions. Future research should therefore focus on the combined use of floating car data with other reference sources, on the validation of congestion indicators under different urban traffic conditions, and on the wider use of such data for strategic assessment of urban traffic flows in medium-sized cities.

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Floating car data for urban traffic flow analysis: a case study of Olomouc

Jaroslav Burian, Karel Macků, Tomáš Pohanka, Karol Hrudkay, Michal Palčák

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