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Estimating the Contribution of the Summer Traffic Peak to $PM_{2.5}$, NO_x, and NMVOCs

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Abstract: Air quality is becoming an important asset of modern society. Europe is adopting regulations that will enable better air quality for residents and encourage detailed study of emissions sources. Transport is recognized as a flourishing sector with the yearly growth of vehicle numbers. Even if the transport emissions trend slightly decreases, there is a concern that the increase in vehicle numbers on the road will slow down the process. Data from the bottom-up approach, estimating emissions from transit vehicles and tourism activities, was identified as a critical knowledge gap. Our study identifies and evaluates the issue of vehicle congestion on the roads during the summer, primarily driven by transit demands and tourism activities. The methodology to capture an understanding of traffic-related emissions from the summer vehicle peak was developed. Summer traffic peak was estimated by comparing the summer vehicle numbers with those of other parts of the year. Vehicle numbers were recognized by vehicle counters located on a Slovenian highway junction in the year 2021. Moreover, the study also revealed the emissions from the summer traffic peak, calculated by the COPERT emission model. We observed that, on an average summer day, there are up to 11,520 additional vehicles on Slovenian roads. It was estimated that the peak in summer passenger cars contributes up to 41,875 kg, 9542 kg, and 3057 kg of NO_x, NMVOCs, and $PM_{2.5}$ emissions. The maximum emissions of NO_x and $PM_{2.5}$ from light duty vehicles are 17,108 kg and 867 kg. There are non-negligible emissions of NMVOCs from motorcycles and these represent up to 3042 kg.

Keywords: summer traffic peak; transit; tourist; COPERT; air pollution

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1. Introduction

On 12 May 2021, the European Commission adopted the EU Action Plan: "Towards a Zero Pollution for Air, Water and Soil" and annexes, which are key deliverables of the European Green Deal [1]. The main purpose of the document is the zero pollution vision for 2050, which is for air, water, and soil pollution to be reduced to levels no longer considered harmful to health and for natural ecosystems that respect the boundaries with which our planet can cope, thereby creating a non-toxic environment. At the same time, the European Commission's Communication on Zero Pollution put forward a goal for 2030 to reduce by 55% the health impacts of air pollution and by 30% the share of people chronically disturbed by transport noise compared to 2005. In that scope, the new ambient air quality directive [2] was established, updating the air quality standards to align with those set by the World Health Organization [3]. To achieve concentrations that comply with the lower air quality standards, it will be essential to identify and analyze emission sources in detail.

Transport is one of the crucial sectors, as it has been growing over the years. The only exception to this growth was during the COVID-19 pandemic [4–6]. On the contrary, emissions in Europe from traffic slightly fell or stayed at the same level during the last 10 years [7,8]. The highest drop was during the COVID-19 pandemic but the concentrations were at the same level compared to before COVID-19 [9]. Anyway, passenger cars remain the preferred mode of transport, with their numbers increasing in recent years. More than 75% of transport activities in Europe (measured in passenger km) involve cars. Even public transport, which is recognized as a more sustainable profile compared to private modes of transport, is used very little. Likewise, the electricity consumption in road transport is still very low, with a share of 0.3% in 2021. Moreover, 70% of freight transport in Europe is by road [8,10]. In addition, on the global scale, the prediction for the future estimated that passenger and freight transport demand will even increase from 2020 to 2050 by 196% and 200%, respectively. Meanwhile, the passenger transport demand will be dominated by the road sector [11]. To sum up, even if the transport emissions trend slightly decreases, there is concern that the increase in the number of vehicles on the road will slow down the process.

The expansion of the European Union and globalization enable greater transitions between countries. Consequently, tourism has flourished. Europe is the world's leading destination for international tourism with 2.92 billion nights spent in tourist accommodations in 2023 [12]. Due to COVID-19, tourism in Europe faced a severe decline with international arrivals dropping by 70% in 2020 and only a partial recovery in 2021. With the EU Digital COVID Certificate, which provided safe cross-border travel and the promotion of rural and nature-based tourism to avoid crowded urban areas, domestic travel became the primary driver of tourism during this period [13]. In the case of Slovenia, in the year 2021, the total tourist arrivals increased by 31% to over 4 million, and overnight stays rose by 22% to approximately 11.3 million. Despite this growth, the numbers remained below pre-pandemic levels in 2019, which saw 6.2 million arrivals and 15.8 million overnight stays. In the year 2024, tourism has exceeded pre-pandemic peaks [14]. Southern European and Mediterranean destinations remain the most popular choices among tourists in Europe [12,15].

Slovenian highways connect the southeast with the northwest, forming key routes on the pan-European Corridors V and X [16]. The cross-section of the highways is in the Ljubljana ring junction. The pan-European Corridors have been reorganized in the trans-European network or TEN-T. The defined trans-European corridors along the Slovenian network are the Baltic-Adriatic corridor, which crosses Slovenia between the Italian border at Trieste and the Austrian border, and the Mediterranean corridor, between the Italian border at Trieste and the Hungarian border in the northeast of the country. Slovenia is one of the transit countries for passenger and freight traffic, as well as a country of origin and destination [17]. According to the Slovenian Informative Report [18] vehicle emissions, more precisely passenger cars, light duty vehicles and heavy duty vehicles, present key categories of NO_x emissions sources with shares of 24%, 8.5%, and 7.2%. Meanwhile, passenger cars and gasoline evaporation are key categories of NMVOCs emissions sources with shares of 4.7% and 3.1% and tire and brake wear are key categories of $PM_{2.5}$ with a share of 2.7%.

Despite existing global estimates of efficient public transit traffic [19,20] and detailed assessments of transport emissions at urban [21] or national [22,23] levels, there remains a noticeable gap in evaluating transport emissions from transit, particularly during the summer. Most studies that focused on tourist transport emissions emphasize greenhouse gasses, particularly carbon emissions [23–25]. There is a minor scientific paper with an emphasis on other pollutants. In the study, Russo et al. [26] analyze the Portuguese emissions from tourism. They found that tourist transport is responsible for 13% of all national transport NO_x emissions and 15% of all national transport PM_{10} emissions. They used a top-down approach methodology, with a focus on the national standard Nomenclature for Reporting (NFR sectors). The study by Betta et al. [27] revealed that in Italy camper vans, caravans, and vans mainly influence the emissions of $PM_{2.5}$ and NO_x, at 26.2% and 18.6% of all national transport emissions. To estimate traffic-related emissions [28] there is a need to improve input data, such as traffic flow state and estimated emissions factors for different vehicle technologies and pollutions [29,30]. The literature review recognized the need to estimate the bottom-up approach emissions that are related to tourist and transit traffic, especially during the crowded period of the year. Moreover, a 1% increase in tourist numbers can be related to up to a 0.45% increase in PM_{10} concentration levels [31].

Our study focuses on developing the bottom-up methodology to capture an understanding of traffic-related emissions from summer vehicle peak, which mainly consists of tourist and transit vehicles. Moreover, our study deepens our knowledge about the traffic flow state during the summer. Additionally, the results of this study will assist decision-makers in formulating agreements that impact transit and tourist traffic, indirectly affecting atmospheric emission concentrations. The approach used in this study can be extended to other areas with a significant share of summer traffic peak. The air pollutants studied in this research include nitrogen oxides (NO_X), $PM_{2.5}$, and non-methane volatile organic compounds (NMVOCs). The year of focus is 2021.

2. Methods

2.1. Study Area Description

Slovenia has 616 km of highways, whose cross-section is in the Ljubljana ring junction. Due to that, the whole transit traffic is concentrated in the Ljubljana highway ring, which is the focus area of this study. The Ljubljana ring junction is 29.1 km long and is present in Figure 1. The Ljubljana ring junction has 27 vehicle counters, which are owned by the Slovenian Infrastructure Agency [32]. Seventeen are permanent, while ten are temporary. The description of vehicle counters used in the study is presented in Table S1. The table includes several counting places, the names of traffic sections, locations of the counters in the Slovenian coordinate system D96/TM (EPSG:3794), the average number of vehicles in the year 2021, and the average daily vehicle number. The vehicle counters recognized the traffic in both directions within the 8 different vehicle categories, which are motorcycles, passenger cars, buses, light duty trucks with a weight under 3.5 t, middle duty trucks with a weight between 3.5 and 7 t, light duty trucks with a weight more than 7 t, and semi-trailer trucks and tow trucks. The vehicle counters from the highway ring recognized that the average number of vehicles in the year 2021 was 59,479 with a median of 63,750 and minimum and maximum numbers of 33,020 and 87,001. On average, the daily number of vehicles was 3654, with a median of 3395 and a minimum and maximum of 1297 and 7495, respectively.

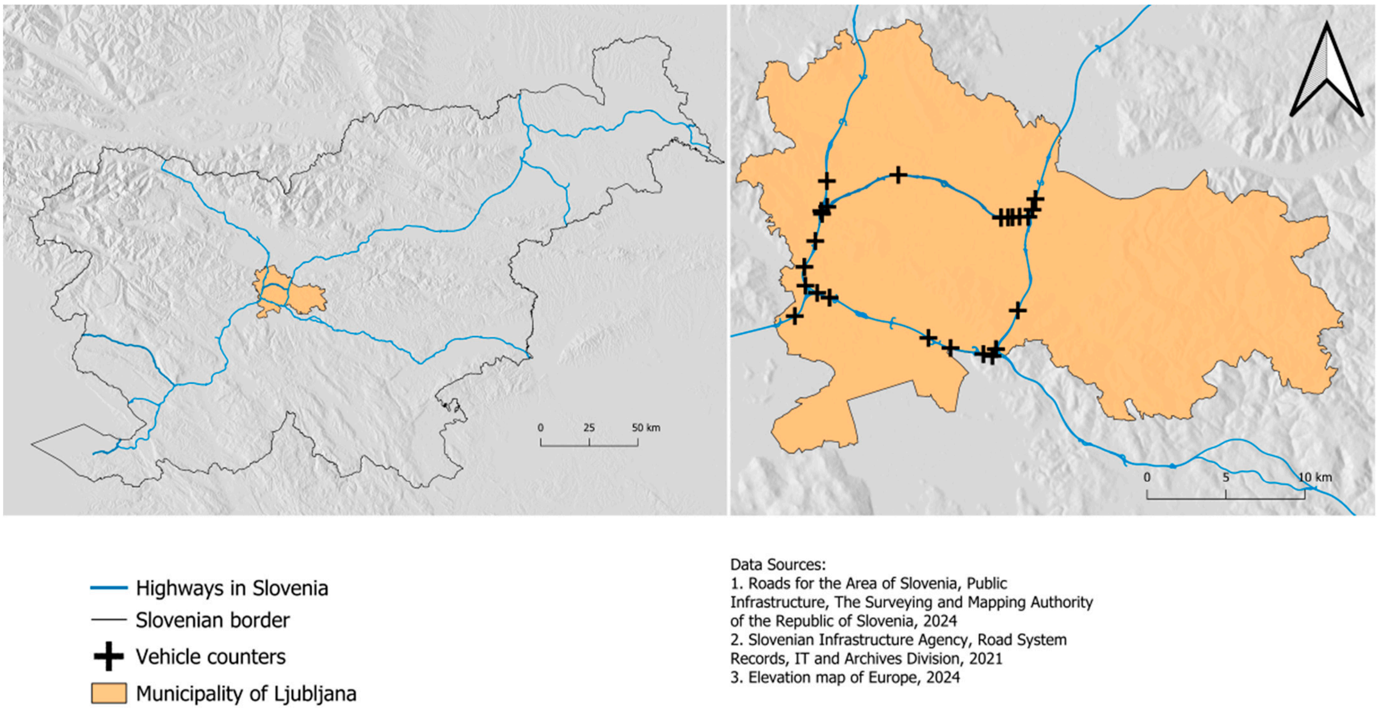

Figure 1. Location of the highways in Slovenia marked with a blue line and locations of vehicle counters on the Ljubljana highway ring junction.

2.2. COPERT Emissions Factors

COPERT model 5.7 was used to estimate traffic emission factors, and further, to estimate the traffic emissions [33,34]. The model's name is an abbreviation for Computer Program to Estimate Emissions from Road Transport. The model is widely used [35–38] since it was recommended by the European Environmental Agency (EEA) to be included in official annual national inventories [39]. Estimated emissions are categorized into emissions produced during thermally stabilized engine operation (hot emissions), emissions occurring during engine start from ambient temperature (cold-start and warming-up effects), particulate matter emissions from tire and brake wear, particulate matter emissions from road abrasion, and NMVOC emissions due to fuel evaporation [38].

To match the COPERT emissions factors and vehicle categories from counters, the light commercial vehicles were recognized as light duty trucks with a weight under 3.5 t and middle duty trucks with a weight between 3.5 and 7 t. Meanwhile, the heavy duty trucks were recognized as light duty trucks with a weight of more than 7 t, semi-trailer trucks, and tow trucks.

As input data, the COPERT requires meteorological data such as mean monthly relative humidity and minimum and maximum temperature; this data is represented in Table 1. The meteorological conditions were measured in the Ljubljana-Bežigrad location. The Slovenian Environment Agency takes care of the measurements [40]. Additionally, the COPERT needs the vehicle fleet data with vehicle activity, which is represented in Table 2, and the average driving speed. According to the Slovenian Traffic Safety Agency, the average driving speed on the Slovenian highway is 100 km/h [41].

Table 1. Meteorological information for Ljubljana in 2021 used in the COPERT model.

Month	Mean Minimal Temperature [°C]	Mean Maximal Temperature [°C]	Mean Relative Humidity [%]
January	−1.1	4.1	87
February	2	10.6	74
March	0.5	13.4	63
April	4.1	14.8	65
May	8.5	19.3	70
June	15.9	29.2	58
July	17.7	29.1	64
August	15.5	27.4	67
September	11.6	24.4	68
October	6.1	14.8	78
November	3.8	8.7	83
December	−0.6	3.4	88

Table 2. Emissions factors for NO_x, $PM_{2.5}$, and NMVOCs for 5 vehicle categories on highways, as calculated by the COPERT emission model, reported in unit g/km [39].

		NO_x [g/km]	$PM_{2.5}$ [g/km]	NMVOCs [g/km]
Engine Operation	Passenger Cars	0.452	0.020	0.058
	Light Commercial Vehicles	1.223	0.031	0.011
	Heavy Duty Trucks	0.587	0.058	0.026
	Buses	1.468	0.055	0.040
	Motorcycles	0.181	0.017	1.108
Tire and Brake Wear and Road Abrasion	Passenger Cars	/ [1]	0.013	/ [1]
	Light Commercial Vehicles	/ [1]	0.031	/ [1]
	Heavy Duty Trucks	/ [1]	0.020	/ [1]
	Buses	/ [1]	0.052	/ [1]
	Motorcycles	/ [1]	0.005	/ [1]
Gasoline Evaporation	Passenger Cars	/ [1]	/ [1]	0.045
	Light Commercial Vehicles	/ [1]	/ [1]	0.002
	Heavy Duty Trucks	/ [1]	/ [1]	0.00002
	Buses	/ [1]	/ [1]	0.00002
	Motorcycles	/ [1]	/ [1]	0.419

[1] The emissions factors are not available.

In 2021, the Slovenian vehicle fleet comprised 1,707,488 road vehicles [42,43]. The data were converted in the COPERT model with 1,551,706,488 road vehicles and are represented in the Supplementary Material (Table S2). The COPERT Slovenian vehicle data are composed of 82% passenger cars, 6% light duty vehicles, 2% heavy duty vehicles, and 9% motorcycles. The average Slovenian passenger car is 10.9 years old, meanwhile 46% of all cars are aged between 10 and 20 years [44].

The emission factors calculated for Slovenian conditions in the year 2021 are derived from COPERT, and presented in Table 2. They are divided into emissions from engine operation, gasoline evaporation, tire and brake wear, and road abrasion. The category of engine operation has the highest NO_x emissions, and in general, motorcycles have the highest NMVOC emissions. Light commercial vehicles and buses have almost 3 times higher NO_x emissions than heavy duty trucks and passenger cars. The $PM_{2.5}$ emissions from tire and brake wear and road abrasion are not negligible [45] and are the greatest in the vehicle categories which are the heaviest. Meanwhile, the NMVOC emissions from gasoline evaporation are the highest for motorcycles.

The emissions from vehicles that passed the Ljubljana junction in 2021 were calculated according to Equation (1), where emissions, represented as $E_{pol,v}$ and given in unit [g/year], were calculated as a summary of emission factors for each pollutant and each vehicle category ($E_{pol,v}$), and multiplied by the number of vehicles for each category (n_v) and the length of the Ljubljana junction, which is 29.1 km [34]. There is no evidence on the length of the distance that vehicles travel. The distance traveled of 29.1 km was assumed to capture uncertainty such as a lower speed due to road construction and stop/start driving behavior, which results in higher emissions than during smooth driving.

$$E_{pol,v} = \sum EF_{pol,v} \times n_v \times 29.1 \text{ km} \quad (1)$$

2.3. Estimation of Summer Traffic Peak

The summer traffic peak definition was employed to describe the congestion on the Slovenian highway junction during the summer, largely due to tourist and transit traffic. The approach in this study was already used in the study by M. Pandey et al. [46] and Ivanovski et al. [6] to establish the changes between the 2 different situations.

The summer traffic peak was defined as the variation in the number of vehicles on the highway during the summer period compared to other times of the year, categorized by different types of vehicles. It was calculated as a percentage difference ($\delta_{\overline{x,v}}$) according to Equation (2), where $\overline{x}_{sum,v}$ represents the mean number of different types of vehicles during the summer months, which are June, July, August, and September. Meanwhile, the $\overline{x}_{oth,v}$ represents the mean concentrations of different types of vehicles during other months, namely January, February, March, April, May, October, November, and December.

$$\delta_{\overline{x,v}}[\%] = \frac{\overline{x}_{sum,v} - \overline{x}_{oth,v}}{\overline{x}_{sum,v}} \times 100 \quad (2)$$

The difference in the number of vehicles was calculated in agreement with Equation (3), where the average vehicles for non-summer months were deducted from average vehicles during the summer. The vehicles were categorized into different types.

$$\delta_{\overline{x,v}} = \overline{x}_{sum,v} - \overline{x}_{oth,v} \quad (3)$$

To calculate the change in emissions of NO_x, $PM_{2.5}$, and NMVOCs ($\delta_{E,v}$), Equation (4) was used, where the changes in the number of vehicles on the highways ($\delta_{\overline{x}}, v$) by vehicle type have been multiplied by emissions ($E_{pol,v}$) calculated according to Equation (1). At least, the results have been multiplied by 122 to cover the 122 days long summer period.

$$\delta_{E,v} = \delta_{\overline{x,v}} \times E_{pol,v} \times 122 \quad (4)$$

3. Results

3.1. Traffic Analyses in the Ljubljana Ring Junction

The 8 years long data analyses, which include the average yearly vehicle numbers from counters located on Ljubljana's highways, are presented in Figure 2. From 2015 to 2019 there has been a yearly increase in vehicles (Figure 2, down), with a slight decrease in passenger cars in 2018 (Figure 2, up). The year 2020 was affected by COVID-19 stay-at-home policies [47,48]. But in the last 2 years, there has still been an increase in vehicle mobility, and in the year 2022, it was almost at the same level as before the COVID-19 pandemic. It is clear, that passenger cars present 83% of all vehicles. This is in line with the European statistics, where passenger cars' share of inland passenger transport ranged between 82.0% and 83.1% [4]. Light duty trucks with a weight under 3.5 t present from 8% to 10% of all vehicles with an increase over the years. The same trend was recognized in tow trucks with the range from 4% to 6% of all vehicles. The future trend of an increasing number of passenger cars on the road should be expected, mostly because the transformation towards new autonomous, connected, shared, and electric mobility is not only driven by technological development, but mainly by social conditioning, such as environmental values, behavioral change, or adaptability to users' habits, and socio-demographic features of citizens related to servitization [49].

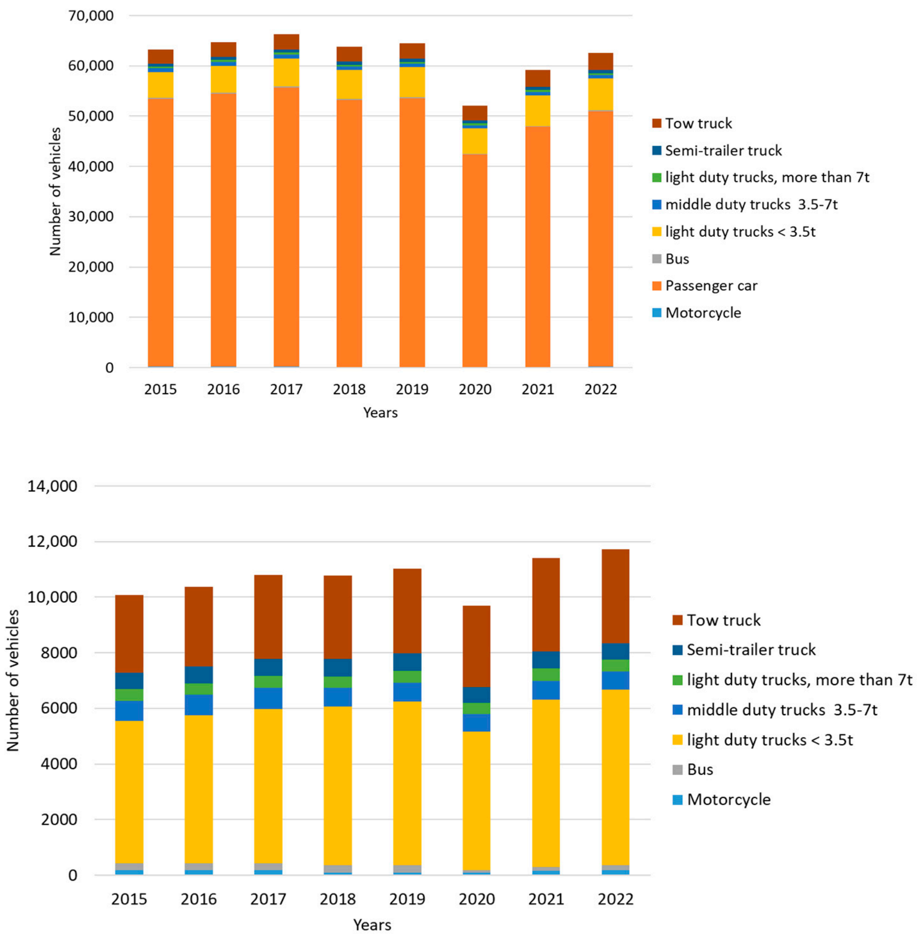

Figure 2. The average yearly vehicle number from counters located in the Ljubljana ring junction from the year 2015 to 2022 by eight vehicle types. The upper figure includes all vehicle categories and the lower figure excludes passenger cars.

The temporal analyses are presented in Figure 3. Figure 3a,b include all five vehicle categories, while Figure 3c,d exclude passenger cars. The busiest roads are during the week compared to the weekend, with the busiest day being Friday. The least busy day is Sunday. On Sunday, heavy duty trucks are not permitted to use the Slovenian highways. According to months, the busiest months are July and August, with an increase in vehicle numbers on the road also in June and September. The month with the least amount of vehicles is January. The motorcycles (Figure 3d) are recognized during the warm part of the year, in June, July, August, and September.

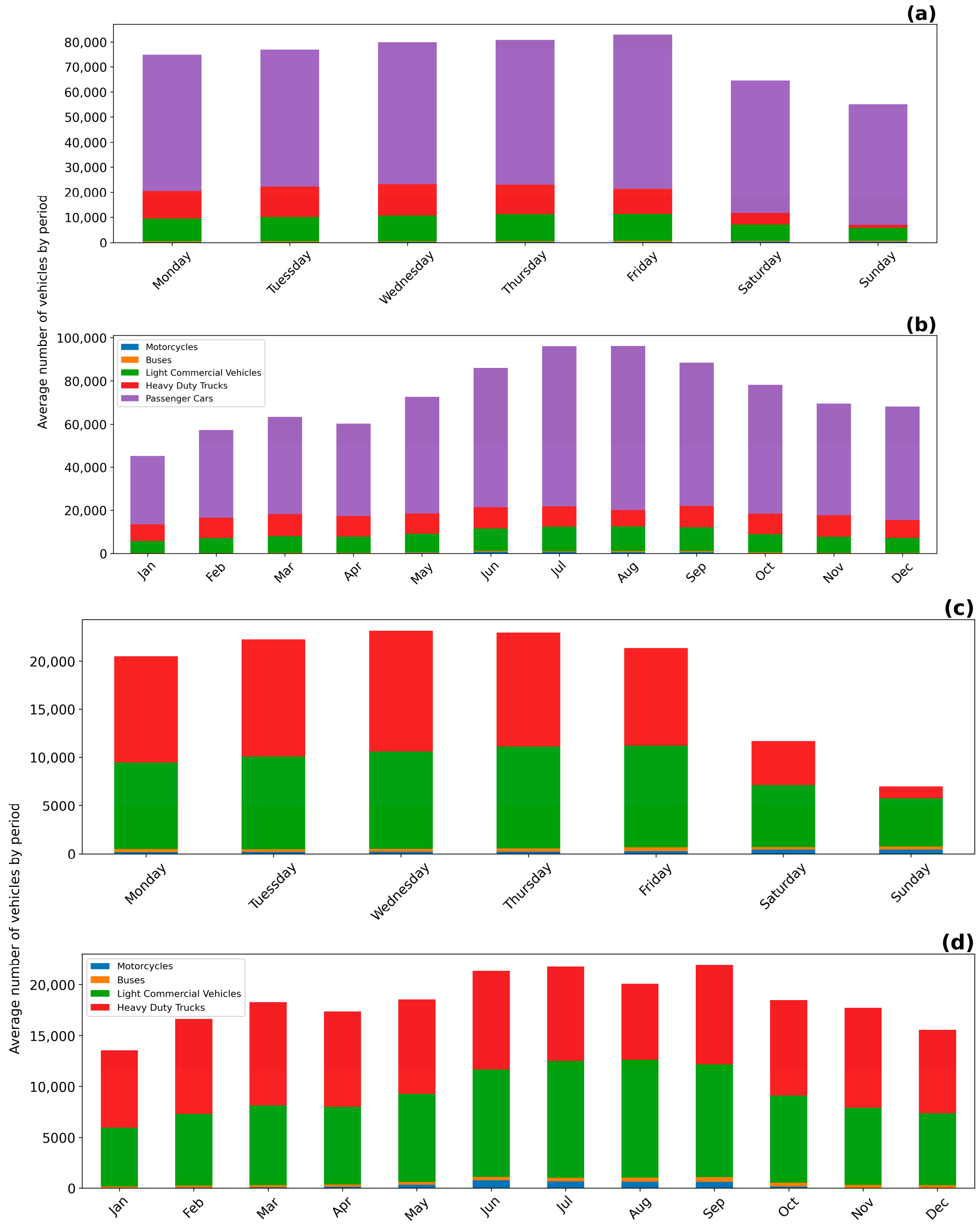

Figure 3. The average yearly sum of all vehicles is followed by weekly (**a**,**c**) and monthly (**b**,**d**) distributions. In (**c**,**d**) the passenger cars were excluded.

3.2. Summer Traffic Peak at the Ljubljana Junction by Vehicle Type

The calculation of traffic changes during the summer time in the year 2021 is presented in Figure 4, where Figure 4a presents the changes in percentage and Figure 4b presents the changes in average daily numbers of vehicles. On average, there was an increase of 85%, with a rise of up to 88%, in the number of motorcycles during the summer period compared to other times of the year. This is in accordance with the fact that most people use motorcycles for pleasure during their free time, mostly during the warm part of the year [50]. On average, there is a 34% increase in buses, with the rise reaching up to 63%. This is associated with the rise of tourists in Slovenia during that period [51]. The increase in passenger cars is on average 19%, with increases up to 33%. But it should be considered that during the summer there are fewer people with obligations, because of the summer break. As a result, the usual traffic load is lower. This is also reflected in the 15% fewer heavy duty vehicles on the Ljubljana highway junction compared to the yearly period. The heavy duty vehicles have the largest range, from –115% to 49%, depending on the location of the vehicle counters. This interesting result is related to the fact that during the summer there is a recognized increase in light duty vehicles of 17% on average, with increases up to 32%. These could also include holiday vans weighing more than 3.5 tons [27].

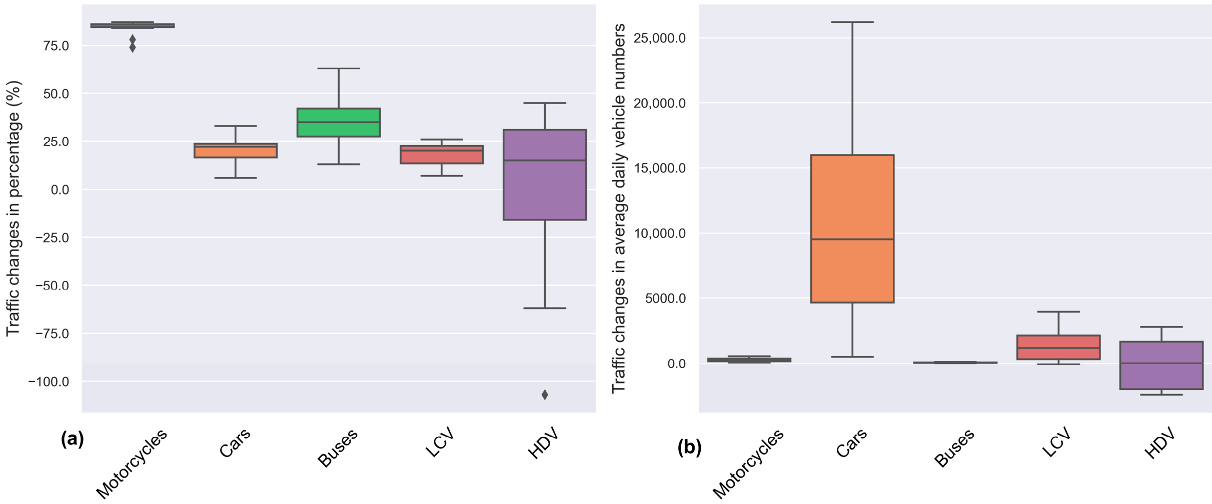

Figure 4. The summer traffic peak is presented in changes of percentage (**a**) and changes of average vehicle numbers (**b**). Vehicle types are motorcycles; passenger cars, noted as cars; buses; light commercial vehicles, represented as LCV; and heavy duty vehicles, represented as HDV. The boxplot graphs include results from 27 vehicle counters.

The changes in traffic by average daily vehicle number, depicted in Figure 4b, show that passenger cars have the greatest rise, which could be mostly transit and tourist traffic. This coincides with the upper figure in Figure 2, which depicts the average yearly vehicle numbers by year. On average, there are 11,520 more vehicles per day at the Ljubljana junction during the summer compared to other times of the year. From this, there are 9938 passenger cars, 1320 light duty vehicles, 278 motorcycles, and 54 buses. But there are less than 70 heavy duty vehicles on average.

3.3. Emissions of NO_x, $PM_{2.5}$, and NMVOCs from the Summer Traffic Peak at the Ljubljana Junction by Vehicle Type

From an emissions perspective (Figure 5), in the year 2021, the highest emissions were NO_x emissions from passenger cars, which reach up to 41,875 kg with an average of 15,893 kg. Also, emissions from light duty vehicles are not negligible, with an average of 5710 kg NO_x and a maximum of 17,108 kg. The emissions from heavy duty vehicles drop down to −145 kg on average. NMVOC emissions are mainly from passenger cars, with a peak of 9542 kg and an average of 3622 kg. The most interesting are motorcycles' NMVOC emissions, which are relatively high compared to the number of motorcycles on the highway cross section. This aligns with the NMVOC emission factors depicted in Table 2. Motorcycles have two times higher engine operation emissions than passenger cars and even nine times higher emissions from gasoline evaporation than passenger cars. The motorcycles' NMVOC emissions produce up to 3042 kg emissions with an average of 1504 kg. $PM_{2.5}$ emissions are the smallest and are also mostly contributed to by passenger cars, with a maximum of 3057 kg and an average of 1160 kg. The light duty vehicle contributes up to 867 kg with an average of 289 kg. The contributions of other vehicles are minor.

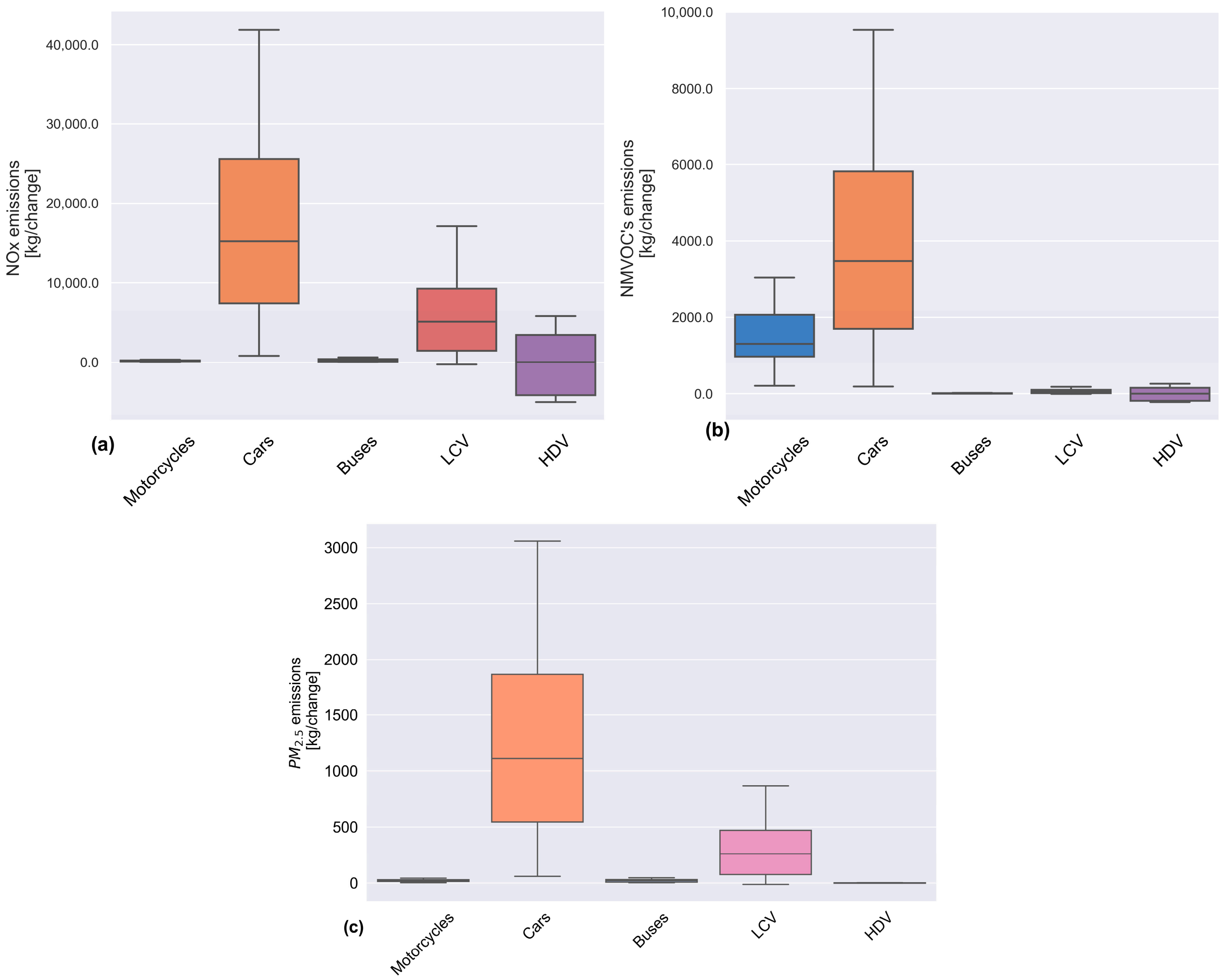

Figure 5. Calculation of NO_x (**a**), $PM_{2.5}$, (**b**) and NMVOC (**c**) emissions in units of kg from the summer traffic peak at the Ljubljana ring junction in the year 2021. Vehicle types are motorcycles; passenger cars, noted as cars; buses; light commercial vehicles, represented as LCV; and heavy duty vehicles, represented as HDV. The boxplot graphs include results from 27 vehicle counters.

4. Discussion

The findings of this study highlight the importance of evaluating the rise in vehicle traffic during the summertime for different vehicle types from an emissions perspective. The concentration of vehicles on the highways is the highest during the summer, mostly due to the increase in tourism and transit transport. Consequently, the emissions from transport are the highest at that time. With the bottom-up approach methodology, our study captures the emissions from transit and transport vehicles.

During the summer holiday, there are fewer daily workers on the road, so the increase in passenger cars belongs mostly to transit and tourism transport. The increase in light duty vehicles, which represent holiday vans, camper vans, and caravans could also be part of the transit and tourism traffic.

We recognized the decrease in the number of vehicles on the route during the COVID-19 period, but after that period there was a yearly recovery of vehicle numbers. Moreover, an increase in vehicles is also expected in the future [52]. One of the reasons for this situation was depicted in the study by Vega-Gonzalo et al. [53], where they found that remote work after the COVID-19 period compared to before the COVID-19 period did not change significantly in Europe. On the other hand, a positive relationship was observed between car purchases and the increased use of shared mobility services [54]. Although rail transport offers the greening of car fleets, road transport will likely remain dominant in the share of transport type and the share of emissions from road transport, in the years to come. This is mostly because nowadays over 80% of passenger transport and over 70% of freight transport is by road [55]. As a result, there is a need for a detailed understanding of the emissions sources and contributions in vehicle sectors. This will help decision-makers to accept the measures and legislation that will capture and limit the emissions from traffic.

Our study found that in the year 2021, on average, there were up to 11,520 more vehicles per day during the summertime compared to other times of the year. This includes 9938 passenger cars, 1320 light duty vehicles, 278 motorcycles, and 54 buses. But there were less than 70 heavy duty vehicles on average. From the perspective of the change in percentage, there were average increases of 85%, 19%, 34%, and 17% on average, with up to 88%, 33%, 63%, and 32% increases in motorcycles, buses, passenger cars, and light duty vehicles. Meanwhile, it is recognized that the decrease in heavy duty vehicles is, on average, −14%.

With the help of the COPERT emissions model [34], based on the Slovenian vehicle fleet in the year 2021, the emissions factors were estimated and applied during the summer traffic peak. A similar approach was used in the studies by Mantilla-Romo et al. [56] and Betta et al. [27]. It was estimated that the summer passenger car peak contributed, on average, 15,893 kg, 3622 kg, and 1160 kg with peaks of 41,875 kg, 9542 kg, and 3057 kg of NO_x, NMVOCs, and $PM_{2.5}$ emissions. The emissions of NO_x and $PM_{2.5}$ from light duty vehicles during the summer were 5710 kg and 289 kg with a maximum of 17,108 kg and 867 kg. There were non-negligible emissions of NMVOCs from motorcycles and these represented up to 3042 kg of emissions with an average of 1504 kg. The NO_x emissions from heavy duty vehicles dropped down to −145 kg on average. The emissions from other vehicle types and pollution types are minor.

Data on atmospheric pollutant emissions from road tourism and transit activities were identified as a critical knowledge gap. In Portugal, it was recognized that for PM_{10}, other than aviation, there is a significant contribution of tourism industries to emissions in the F_RoadTransport sector, accounting for 15.1% of total emissions (4 kilotons per year) [26].

There are some limitations to this study, which should be acknowledged. It was assumed that the driving conditions on highways were constant and smooth, but during the summer congestion, most vehicles used a stop and start type of driving. Also, the driving conditions during road construction were not included. Furthermore, during the summer break, there are fewer daily workers in the traffic, and so we expect that our methodology underestimates the emissions from the summer traffic peak. Our study does not include the traffic peaks during national holidays and working days off except during summer, and these could also be part of the transit transport and tourism.

Therefore, in future works, it is expected that there will be more data available, such as the characteristics of the vehicular fleet (traffic volume, speed, and categorization), as well as greater data to go beyond the analysis of the annual emissions. These details would empower our methodology and access the emissions from transit and tourism traffic.

5. Conclusions

The acknowledgment of the importance of air quality and new air quality standards force us to understand in detail every emission source that has an impact on the quality of the air we breathe. There is a gap in the literature about transit and tourist traffic emissions. Moreover, projections for the future predict a growth in the number of vehicles on the road. Our study estimates the contribution of the summer traffic peak to $PM_{2.5}$, NO_x, and NMVOCs, and this peak is mainly due to tourism and transit transport. The bottom-up methodological framework was presented. The same methodology could be easily applied to other countries. Additionally, the results of this study will assist decision-makers in formulating agreements that impact transit and tourist traffic, indirectly affecting atmospheric emission concentrations.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/atmos16010112/s1: Table S1: Description of vehicle counters used in the study. The table includes the number of counting places, name of traffic section, locations of the counters in Slovenian coordinate system D96/TM (EPSG:3794), average number of vehicles in the year 2021 and average daily vehicle number. Table S2: Slovenian Data Fleet in year 2021, categorized by COPERT model with number of vehicles by each category and their main activities in kilometers.

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Conflicts of Interest: The authors declare no conflicts of interest.

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