Research on the activity level of key diesel trucks in Tianjin based on the access control system

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Abstract. Through the installation of an access control system for key vehicle enterprises in Tianjin, the real-time monitoring of heavy-duty diesel vehicles in use by key enterprises in Tianjin is carried out, and the information of heavy-duty diesel vehicles in Tianjin is counted, and the activity level is analyzed. The results show that the proportion of heavy-duty diesel vehicles used by key enterprises in Tianjin is about 10%; foreign vehicles accounted for 50%, of which Hebei accounted for 71%, most of which came from Tangshan City and Cangzhou City, accounting for 32% and 14% respectively; the change cycle of traffic flow is M-shaped, the peak of traffic flow is 9:00 and 16:00, and it is relatively stable at night; during the Spring Festival and the heavy pollution supervision period, the traffic volume decreased significantly by 50% and 30% respectively. The research of activity level can get the structure and use status of heavy-duty diesel vehicles in Tianjin, and provide effective data for emission inventory simulation and pollution control research.

1. Introduction
With the increasing number of motor vehicles in China, the emission of motor vehicles is rising, and air pollution is becoming more and more serious. The motor vehicle is the main contributor to the total emission of air pollutants, and has become one of the important sources of urban air pollution in China. Diesel vehicle is the main contributor to the total emission of air pollutants, and the emission of pollutants from diesel vehicle accounts for more than 80% of the total emission of air pollutants from motor vehicles. Diesel vehicles have become the focus of pollution control. Therefore, studying the activity level of key diesel trucks is an important basis for formulating accurate control measures.

The activity level of diesel trucks is an important parameter to calculate the emission inventory of diesel trucks and is the necessary data to understand the activity characteristics. To get the activity level of motor vehicles, Wang Zhiwei and others analyzed the activity level of diesel trucks in Tangshan city through onboard diagnostic system and road remote sensing monitoring data, providing data support for traffic management and emission inventory establishment of Tangshan city. Li Xiaoyu, others used radiofrequency technology to obtain real-time traffic flow, fleet composition, and other information of main and secondary roads in Nanjing, providing important basic data for Nanjing's high spatial and temporal resolution emission inventory. Fan Shubin et al. Obtained the traffic flow data of Beijing through model simulation and survey statistical methods, and calculated the actual road emission characteristics of motor vehicles in Beijing. Ye Shenbin and others recorded the traffic by setting up
digital cameras on key road sections, roadsides or overpasses, then obtained the traffic flow data by slow playback of the video and obtained the activity level of motor vehicles on the road in Tianjin through the combination of parking scene investigation and traffic video. To sum up, many scholars obtain the traffic flow of motor vehicles through various ways, which provides an important basis for emission inventory research.

Tianjin, as the core city of the integration of Beijing, Tianjin, and Hebei, has many typical industries in China, and the use of diesel trucks is large. In recent years, the number of diesel trucks in Tianjin is increasing, which further increases the difficulty of governance. At present, the research on diesel trucks in Tianjin is relatively rare, and the data accuracy is low, and the accurate emission inventory calculation is still lack of activity level data support. Therefore, this paper uses the access control system of key enterprises in Tianjin and the information management platform data of key vehicle enterprises in Tianjin to analyze the activity level of diesel trucks in Tianjin, heavy pollution weather, and Spring Festival period, to provide important data support for accurate calculation of vehicle emission inventory in Tianjin and provide the basis for local diesel truck traffic control.

2. Experiment and method

2.1. Study area distribution
The monitoring points are distributed in all districts and counties of Tianjin, and all districts and counties are covered. The key research areas and counties are Binhai New Area, Ninghe District, Jinnan District, and Dongli District. The vehicle monitoring data of monitoring enterprises come from the Tianjin motor vehicle pollution emergency monitoring platform, and the distribution of monitoring enterprises is shown in figure 1.

![Figure 1 Enterprise distribution map](image-url)
2.2. Research method
The license plate scanning and recognition system mainly use the intelligent transportation camera to obtain the edge computing ability through the advanced deployment of intelligent ISP, vehicle, and personnel attribute detection. It is oriented to the structured transmission algorithm analysis conclusion and simple and efficient target features of the central cloud big data system and helps the cloud big data system to carry out more efficient and accurate supervision of heavy diesel vehicles in Tianjin through system linkage. The supervision of key enterprises provides a guarantee for the establishment of emission inventory in Tianjin. License plate scanning recognition system can realize intelligent perception, real-time recognition of vehicle license plate, logo, body color, vehicle type, emission stage, and other vehicle identity information, and provide accurate and effective data guarantee for comprehensive traffic management.

2.3. Analysis method
According to the statistical results of the Yearbook and access control system, this paper analyzes the actual operation status and vehicle source composition of heavy diesel trucks in Tianjin. Further through the Spring Festival, heavy pollution supervision period and daily operation of the vehicle characteristics of comparative analysis.

This study collected monitoring data of access control systems from 50 key enterprises in Tianjin for two months. The installation point of access control equipment is located at the entrance of key vehicle enterprises in each district of Tianjin. Through cleaning and screening the statistical data. The final data of all vehicles are yellow brand diesel trucks. Through the screening and analysis of the vehicles entering and leaving the key enterprises, according to the vehicle emission standards, the vehicle number can be divided into the national six, national five, national four, national three and below, and the unrecognized vehicle emission stage. Because the unrecognized vehicle number can not be counted, the statistical data does not include the unrecognized vehicles. Because the number of vehicles driving in the city is small, the research only carries out the statistics outside the urban area.

The number of diesel trucks entering and leaving the enterprise was 186111, with a total of 23965 vehicles. The proportion of enterprise vehicle emission in different periods, vehicle activity statistics in each period, local/foreign vehicle proportion, and vehicle structure type are obtained respectively. From the daily operation, during the Spring Festival, and heavy pollution weather emergency management and control three periods of activity level comparative analysis.

3. Fleet composition

3.1. Proportion of vehicle emission stage
The proportion of vehicle emission stage is shown in Figure 3. The number of substandard vehicles and their contribution to emissions can be seen more directly from the proportion of vehicle emission stage. It is found that the contribution rate of Tianjin diesel freight vehicles in the fifth and above national emission stage is 93% and that in the fourth and below national emission stage is 7%.

![Figure 2 Proportion of vehicle emission of key enterprises in Tianjin](image-url)
3.2. Distribution of vehicle operation area

In the statistical traffic volume, the vehicles are mainly distributed in the four districts around the city. Figure 3 shows the proportion of diesel trucks in each district of Tianjin. The results show that there are 6 districts with more than 10% traffic flow, Dongli District has the highest traffic flow, accounting for 23.2% of the total traffic flow, Jinghai District accounts for 18.95%, Jinnan District 13.69%, Xiqing District 13.10%, Binhai New Area 12.10%, Ninghe District 11.11%.

![Figure 3 Distribution of diesel trucks in Tianjin](image)

3.3. Vehicle source

As shown in Figure 4, local vehicles account for 51.36%, foreign vehicles 48.64%, and local vehicles are only 3% higher than foreign vehicles.

As shown in Table 1, it shows the average weekly contribution of vehicles in two months. Most of the foreign vehicles come from Hebei Province, followed by Shandong Province and Shanxi Province. As shown in Figure 5, more than 70% of the foreign vehicles come from Hebei, with an average of 21276 vehicles per week from Hebei, accounting for 8.42% in Shandong, 5.39% in Shanxi, and 14.89% in other 27 provinces.

![Figure 4 Distribution of vehicle sources](image)
Table 1  Traffic flow from provinces (weekly average)

| Region | Traffic volume (vehicles) |
|--------|--------------------------|
| Ji (冀) | 21276                    |
| Lu     | 2509                     |
| Jin    | 1606                     |
| Liao   | 1245                     |
| Jing   | 876                      |
| Yu     | 483                      |
| Su     | 475                      |
| Hei    | 278                      |
| Ji (吉) | 188                     |
| Meng   | 158                      |
| Hu     | 138                      |
| Wan    | 124                      |
| Cuan   | 77                       |
| E (鄂) | 48                       |
| Gan (赣) | 42                 |
| Shan   | 39                       |
| Xiang  | 37                       |
| Min    | 36                       |
| Zhe    | 31                       |
| Yun    | 27                       |
| Gan (甘) | 25                 |
| Ning   | 16                       |
| Yu     | 16                       |
| Xin    | 16                       |
| Gui (桂) | 15               |
| Yue    | 11                       |
| Zang   | 3                        |
| Qiong  | 2                        |
| Gui (贵) | 2                |

Hebei, as the key source of diesel trucks in Tianjin, accounts for 34.5% of the total traffic flow in Tianjin and 71.4% of the traffic flow in other places, while Tangshan, Hebei, accounts for 32.12% and Cangzhou, 14.98%. The details are shown in Figure 5.

![Figure 5 Vehicle source](image)
4. Result analysis
Through the statistical analysis of the use of diesel trucks by key enterprises, it can represent the operation law and activity level of diesel trucks in Tianjin to a certain extent.

4.1. Proportion of vehicle emission stage
From the change of traffic flow in different periods (Figure 7), the traffic flow decreased significantly during the Spring Festival and heavy pollution supervision period. The Spring Festival is 56.54% lower than the daily, and the heavy pollution monitoring period is about 19.23%. The proportion of emissions in the three periods is basically the same, with the highest in the fifth country, accounting for about 70%, and 18%, 8%, and 4% respectively in the sixth, fourth and third country.

![Figure 6 Changes of traffic flow in different study periods](image)

4.2. Daily period
During the study period, statistics show that 5686 heavy diesel trucks are used in Tianjin key enterprises on average. The daily flow changes in one day are shown in Figure 7. Two peak cars will appear in a day: 9:00 am is the first peak of vehicle volume. This point is characterized by large vehicle accumulation overnight and short duration. 14:00-16:00 is the second peak of vehicle volume, which has a small accumulation. The duration is long and the nighttime is relatively stable. There will be two sharp changes in the day, 7:00 a.m. and 16:00. During the period from 7:00 to 8:00, the vehicle is in a period of rapid increase, with the traffic volume more than doubled in an hour, with an increased rate of 100%.

The overall change is "M" type. Generally speaking, the peak period of daily vehicles is 8:00-18:00 in the daytime, with an average of 330 vehicles per hour, while the traffic volume of 21:00-7:00 at night is relatively small, with an average of 125 vehicles per hour, accounting for 70% of the traffic in the daytime and only 30% of the traffic in the evening.
4.3. Analysis method

Figure 8 shows the change in the activity level of enterprises in Tianjin during the Spring Festival and heavy pollution supervision. It can be seen from the figure that the change characteristics of the traffic flow in the three periods are basically the same, and the overall performance is that the peak period of the vehicle is from 8:00 to 17:00 in the daytime, and a significant decrease occurs from 12:00 to 13:00 in the daytime, but it will rise rapidly at 13:00, and then decrease to the low traffic stage from 20:00 to 21:00. at night, and the traffic flow will decrease at night and the traffic flow will be basically stable.

Heavy diesel trucks of key enterprises have dropped significantly during the Spring Festival, with the largest drop in the range of 8:00-17:00 in the daytime, and the decline rate of the whole world is maintained at 37% - 56%. 2668 heavy diesel trucks are used on average every day, which is 53% lower than the daily average,

According to the emergency response notice of heavily polluted weather in this city, the use of heavy diesel vehicles in this city is restricted in heavily polluted weather. The results show that 2985 heavy diesel trucks are used in heavy pollution weather on average, which is down by 50% from 0:00 to 7:00, 8:00-17:00 in the daytime, and 30% in the daytime, which is close to the daily vehicles. As shown in Figure 8, vehicle use does not decrease compared with daily life, but increases by 17% between 22:00 and 24:00 p.m., possibly due to the negligence of control during 22:00-24:00 p.m.
5. Conclusion

1) Heavy-duty diesel trucks used by key enterprises in Tianjin accounted for 18%, 71%, 8%, and 4% of the vehicles in China 6, 5, 4, 3 and below, respectively; Among them, local diesel trucks accounted for 51.36%, and foreign vehicles accounted for 48.64%; Foreign vehicles mainly came from Hebei, Shandong, and Shanxi, accounting for 71.40%, 8.42%, and 5.39% respectively. Hebei vehicles mainly came from Tangshan and Cangzhou, accounting for 32.12% and 14.98% respectively.

2) During the Spring Festival holiday, the daily average number of diesel trucks used by key enterprises is 2985, which is 53% lower than that of daily use.

3) During heavy pollution weather, due to control reasons, the overall activity level of heavy diesel trucks in key enterprises decreased significantly, and the control measures achieved good results. However, between 22:00 and 24:00 in the evening, the number of vehicles is basically the same as the daily traffic, and there is no downward trend, indicating that it is still necessary to strengthen the emergency supervision of heavy pollution weather. Under heavy pollution weather, there are still frequent vehicles driving in the third grade or below.

4) There are two peaks in the flow of diesel trucks of key enterprises in Tianjin, which are at 9 am and 4 PM respectively. During the emission control period, we can first improve the peak traffic flow period. The traffic flow is mainly concentrated in the daytime, and has a significant decline at night, with a decline rate of about 50%.

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