RITIS Data Analysis for Air Quality Application

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Summer 2023

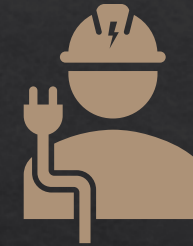- A case study in Collin County, Texas

About Alireza

Computer engineering junior

Working for TTI since October 2022

Interested in Machine Learning, Transformers and Data Analysis/Visualization

Research Objective

Analyze RITIS data to understand the distribution of speeds at the Collin County for different source types.

Examine how speed distributions vary based on time of day and day of the week during the 2022 summer season.
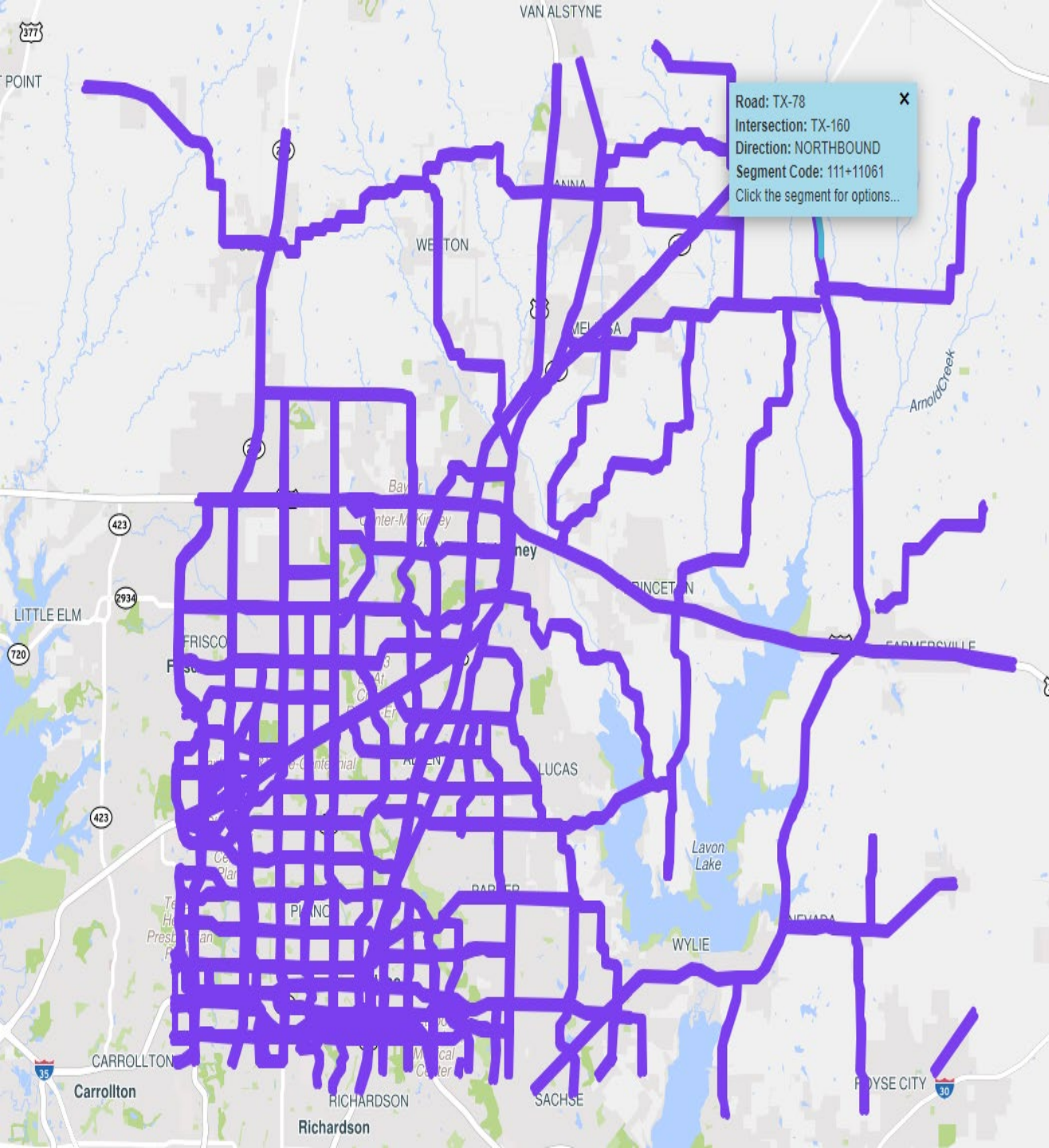
Compare the speed distributions derived from RITIS and Travel Demand Models(TDMs) or Highway Performance Monitoring System(HPMS) used in the current emission estimation process.

Utilize the MOVES3 emission model to calculate speed-based emission rates.

Conduct a comparison between updated emission rates and the data present in existing emission inventories.

Road: TX-78
Intersection: TX-160
Direction: NORTHBOUND
Segment Code: 111+11061
Click the segment for options...

Data Source

- RITIS: Regional Integrated Transportation Information System

  - We used Probe Data Analytics Suite

  - Employs a massive data downloader to collect and process real-time probe data.

  - Data is from Collin County, during the month of June, in 2022.

  - Data from Passenger Vehicles and Trucks

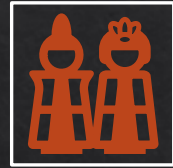 - Our data is limited to "Urban Unrestricted Access " road type.

We need from RITIS data:

- ◈ TMC-code
- ◈ Speed
- ◈ Date
- ◈ Hour
- ◈ Data density

Data Processing

Process the time stamp (MM/DD/YYY HH:MM)

Match the TMC-Values with street names

Match the street Names with area types and Moves road Type
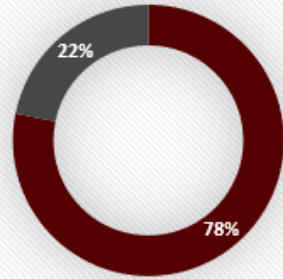
Find the FUNCL value

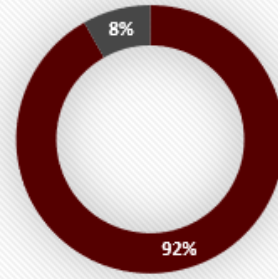Match The speed Bins

Data Summary

Speed Bin Definitions

AvgSpeedBinID	avgSpeedBinDesc
1	speed <2.5mph
2	2.5mph <= speed <7.5mph
3	7.5mph <= speed <12.5mph
4	12.5mph <= speed <17.5mph
5	17.5mph <= speed <22.5mph
6	22.5mph <= speed <27.5mph
7	27.5mph <= speed <32.5mph
8	32.5mph <= speed <37.5mph
9	37.5mph <= speed <42.5mph
10	42.5mph <= speed <47.5mph
11	47.5mph <= speed <52.5mph
12	52.5mph <= speed <57.5mph
13	57.5mph <= speed <62.5mph
14	62.5mph <= speed <67.5mph
15	67.5mph <= speed <72.5mph
16	72.5mph <= speed

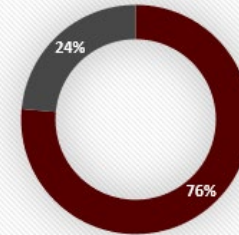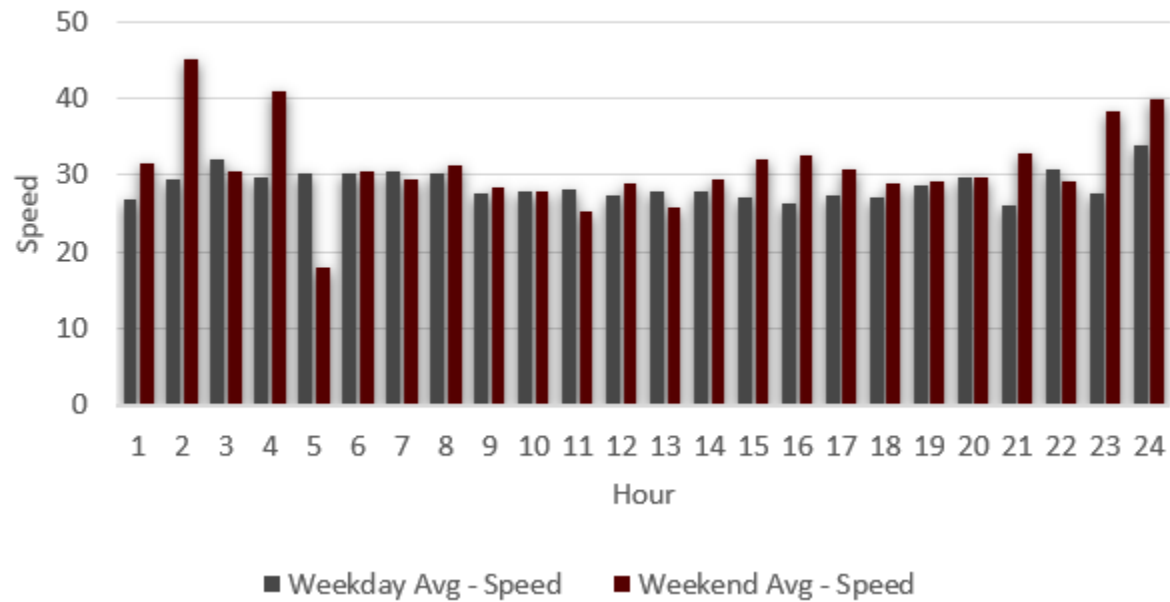|	Weekday	Weekend
Total records	72384	20188
Passenger vehicles	62874	19338
Trucks	9510	850

Passenger vehicles

24-hour hourly average – Passenger Vehicle

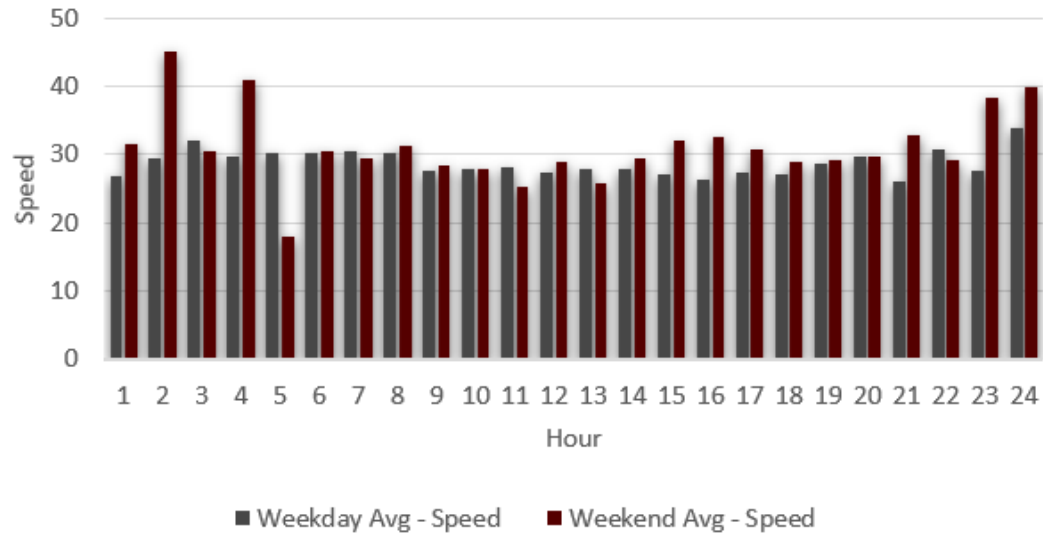| hour	Weekday Avg - Speed	Weekend Avg - Speed
1	30.0479	30.2553
2	30.4495	29.4623
3	31.0351	28.4091
4	34.4082	31.9375
5	29.3393	29.5357
6	32.3776	32.3429
7	29.9681	32.2719
8	26.6673	29.4
9	26.7216	28.4261
10	26.7693	27.0891
11	26.7685	26.4477
12	26.3925	26.3314
13	25.3032	25.8253
14	26.0711	25.6991
15	25.9252	25.9677
16	25.3851	26.038
17	25.1971	26.8499
18	24.6307	26.5203
19	26.4359	26.8185
20	26.5713	27.6486
21	26.9314	27.6746
22	26.9809	27.6835
23	27.955	29.6139
24	28.7729	29.1852

24-hour hourly average – Trucks

|	Weekday	Weekend
hour	Avg - Speed	Avg - Speed
1	26.8	31.5714
2	29.4545	45
3	32.1	30.6
4	29.75	41
5	30.25	18
6	30.2407	30.5
7	30.5789	29.4
8	30.1209	31.3529
9	27.4985	28.4194
10	27.9708	27.8857
11	28.1286	25.2258
12	27.3121	28.898
13	27.799	25.88
14	27.7513	29.4474
15	27.1995	32.0606
16	26.4078	32.6087
17	27.337	30.6667
18	27.1341	28.9545
19	28.5808	29.1818
20	29.5769	29.7857
21	26.0519	32.7059
22	30.6667	29.2
23	27.6875	38.4
24	33.9375	40
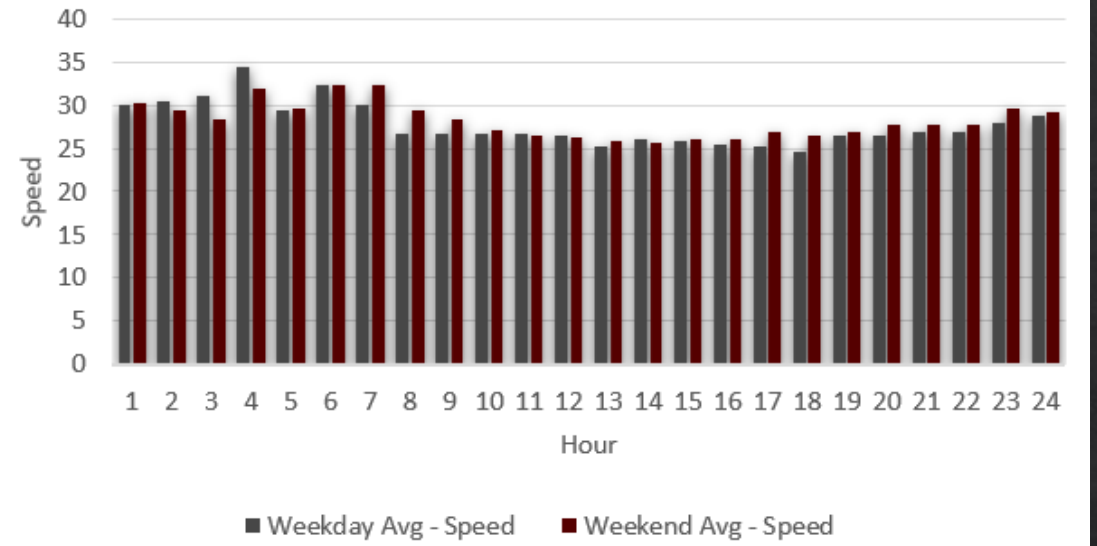
24-hour hourly average

Trucks Source IDs

- 21: Passenger Car
- 31: Passenger Truck
- 32: Light Commercial Truck
- 52: Single Unit Short-haul Truck
- 53: Single Unit Long-haul Truck
- 61: Combination Short-haul Truck
- 62: Combination Long-haul Truck

Avg Speed Distribution for passenger vehicles during a peak and off-peak hours.
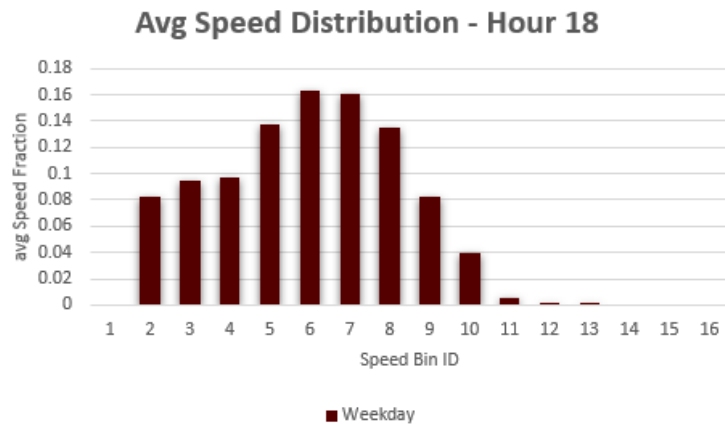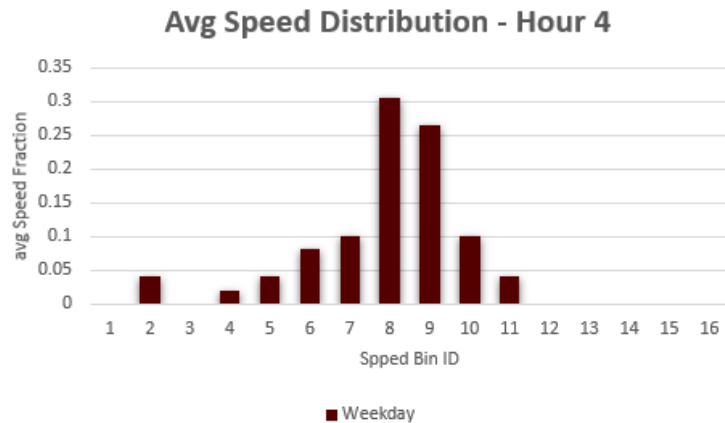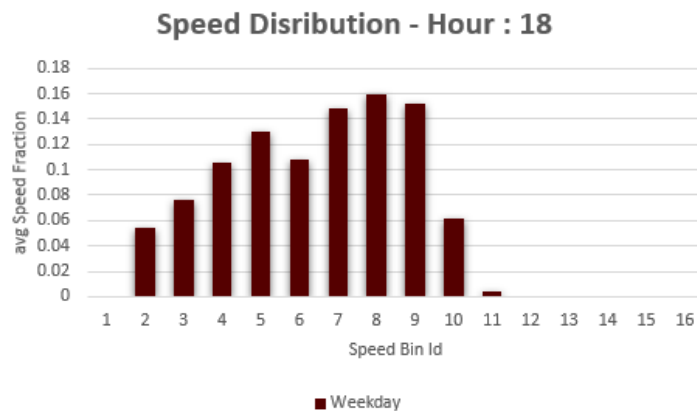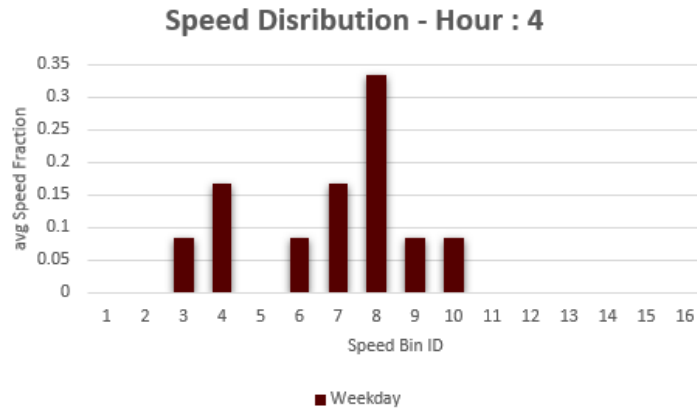
Source Type: 21, 31, 32

Road Type: Urban Unrestricted Access

Hours: 4, 18

Avg Speed Distribution for Trucks during a peak and off-peak hours.

Source Type :52, 53, 61, 62

Road Type: Urban Unrestricted Access

Hours: 4, 18

Emissions

Background Project

- In the following slides The data referenced to as original/before is from "Trend Emissions Inventory project"

- Analysis year: 2022

- Scenario: summer weekday

- Location: Collin County, Texas

Pollutant Name	Pollutant Id	Total Emission - org (kg)	Total Emissions - RITIS (kg)
Carbon Monoxide (CO)	2	45278.05	46823.12
Oxides of Nitrogen (NOx)	3	1139.43	1218.42
Volatile Organic Compounds	87	703.72	777.2
Atmospheric CO2	90	4962238.03	5452331
Primary Exhaust PM10 - Total	100	32.51	35.45
Primary PM10 - Brakewear Particulate	106	548.79	615.13
Primary PM10 - Tirewear Particulate	107	159.67	161.79
Primary Exhaust PM2.5 - Total	110	29.02	31.67

Total weekday emissions by pollutants before and after – Passenger Vehicles
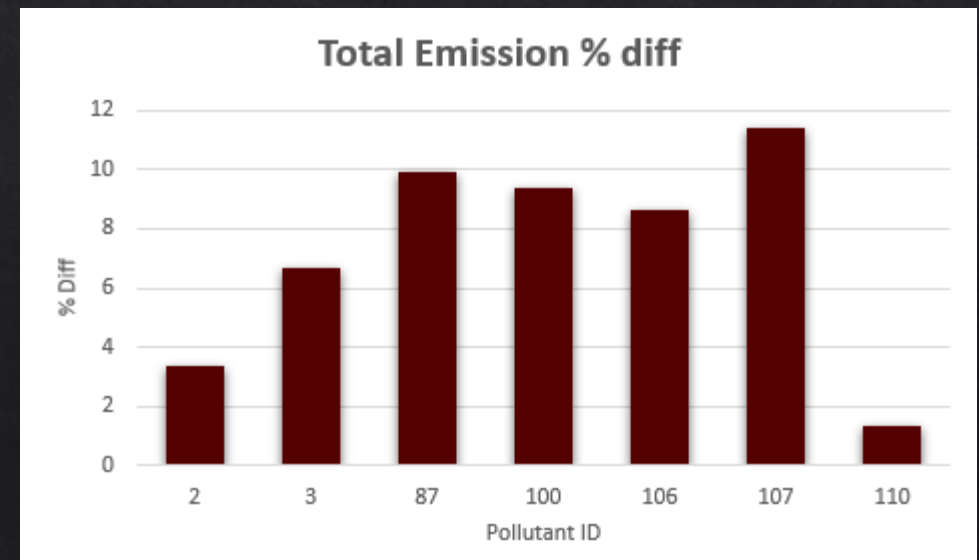
Pollutant Name	Pollutant Id	Total Emission - org (kg)	Total Emissions - RITIS (kg)
Carbon Monoxide (CO)	2	2017.39	2108.01
Oxides of Nitrogen (NOx)	3	1516.38	1575.58
Volatile Organic Compounds	87	81.32	87.71
Atmospheric CO2	90	949959.7	964726.7
Primary Exhaust PM10 - Total	100	32.17	31.65
Primary PM10 - Brakewear Particulate	106	112.57	130.7
Primary PM10 - Tirewear Particulate	107	18.78	18.85
Primary Exhaust PM2.5 - Total	110	29.53	29.05

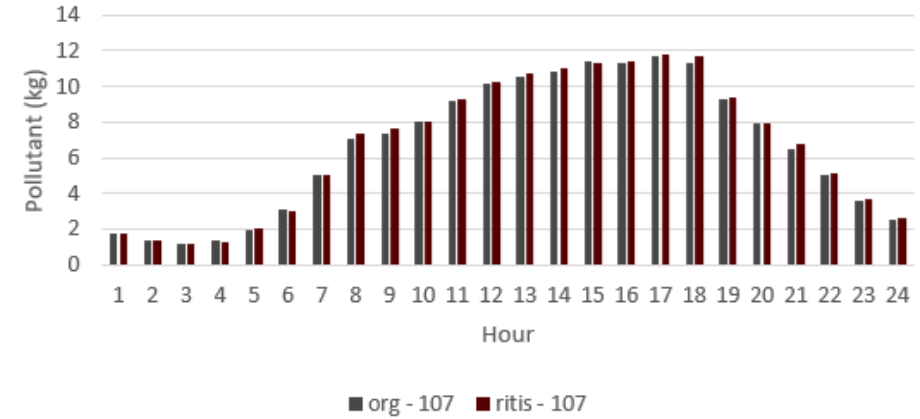Total weekday emissions by pollutants before and after – Trucks

Total Emission % diff
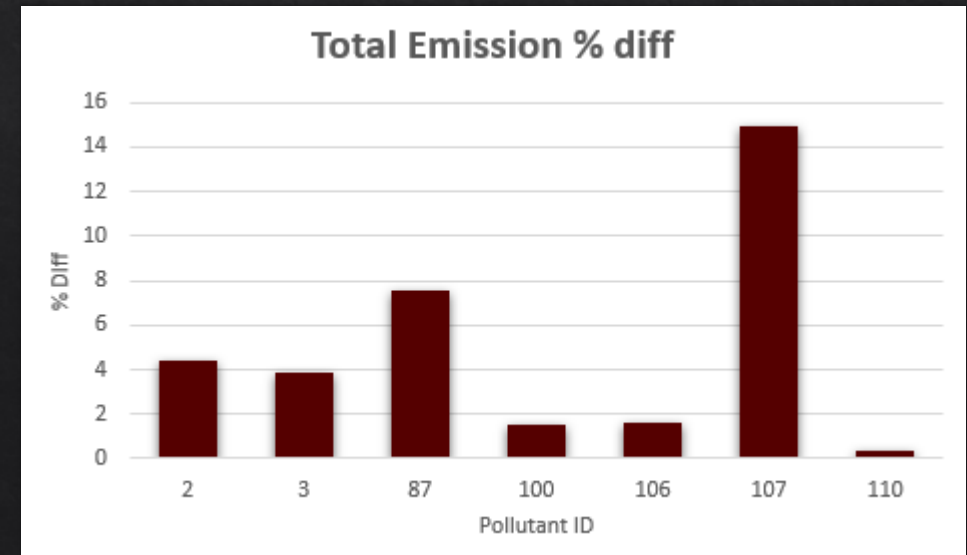
weekday 24-hour hourly emissions by pollutants before and after
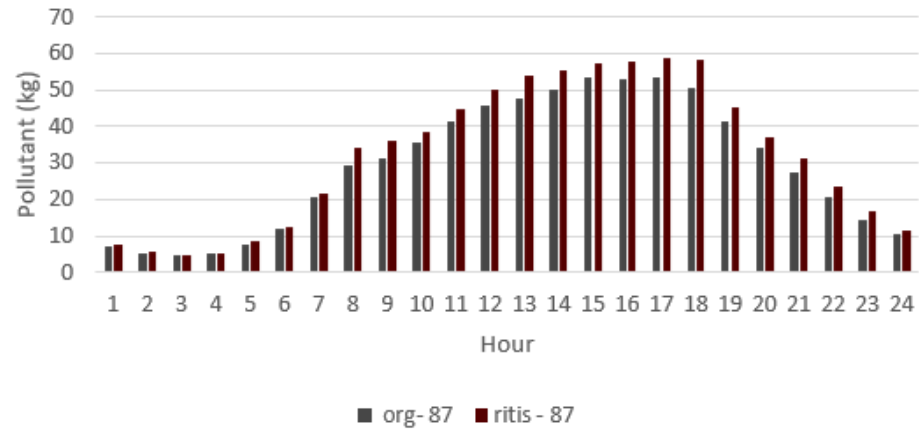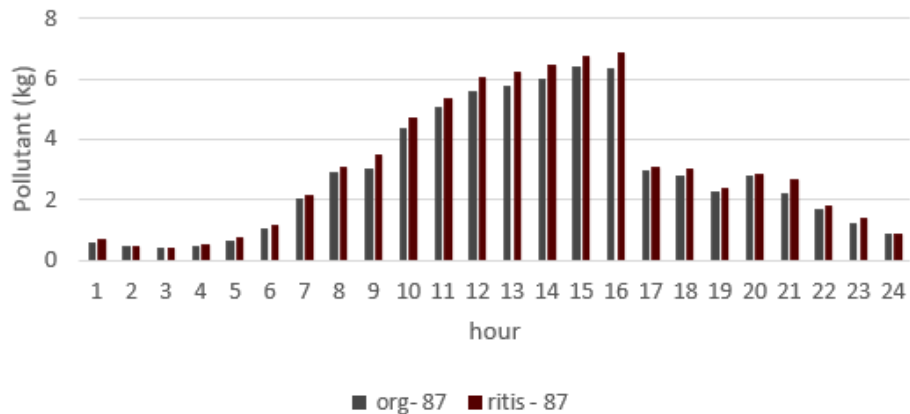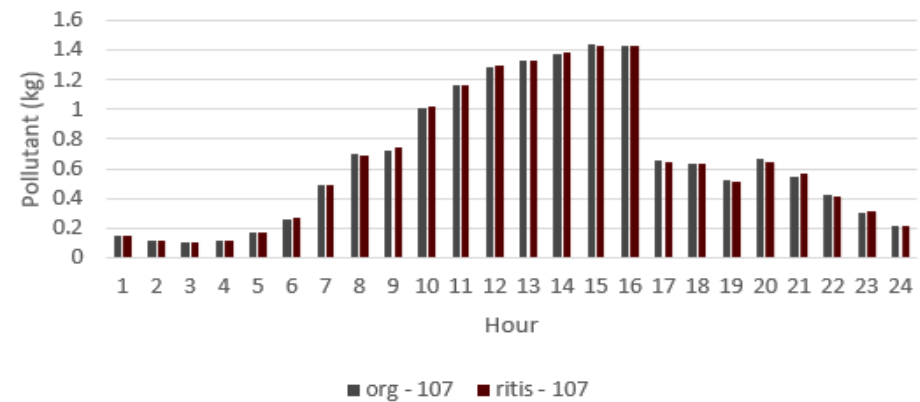
highest differences by pollutants before and after – Passenger
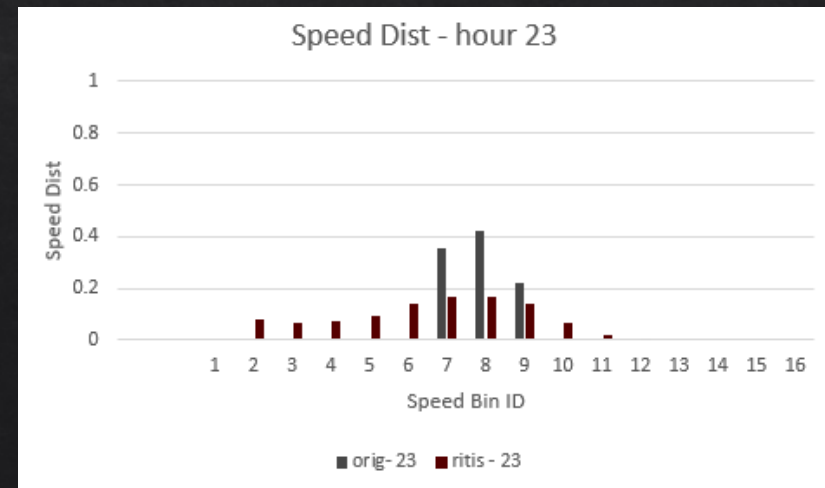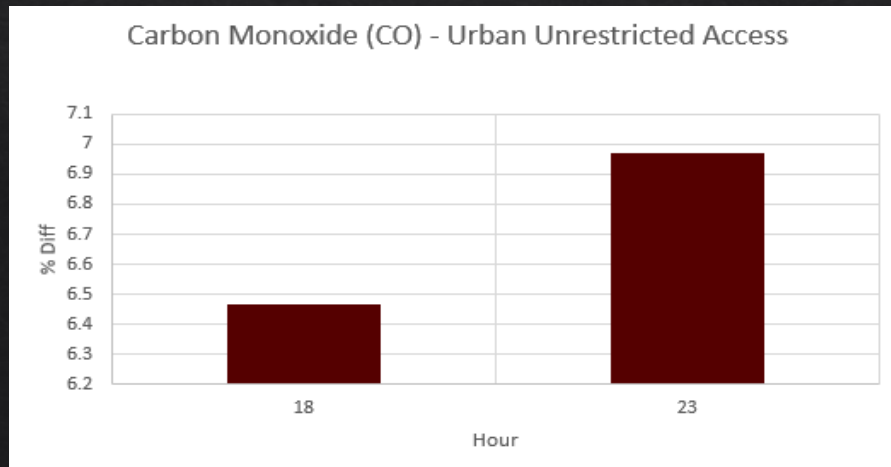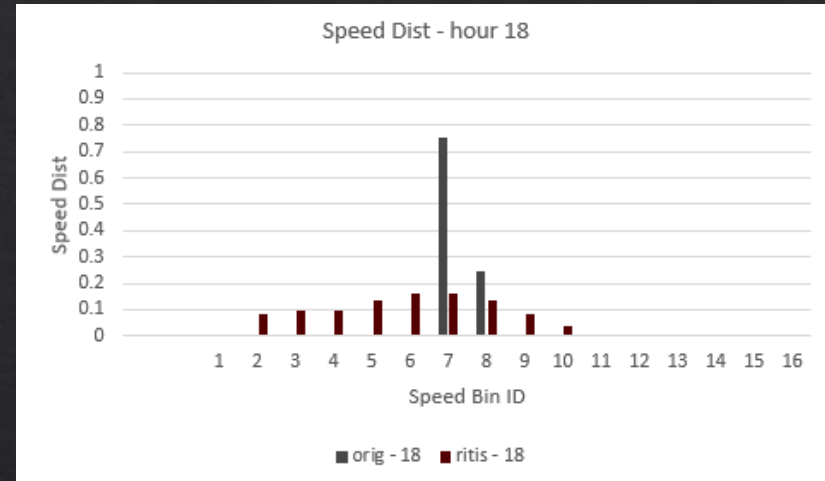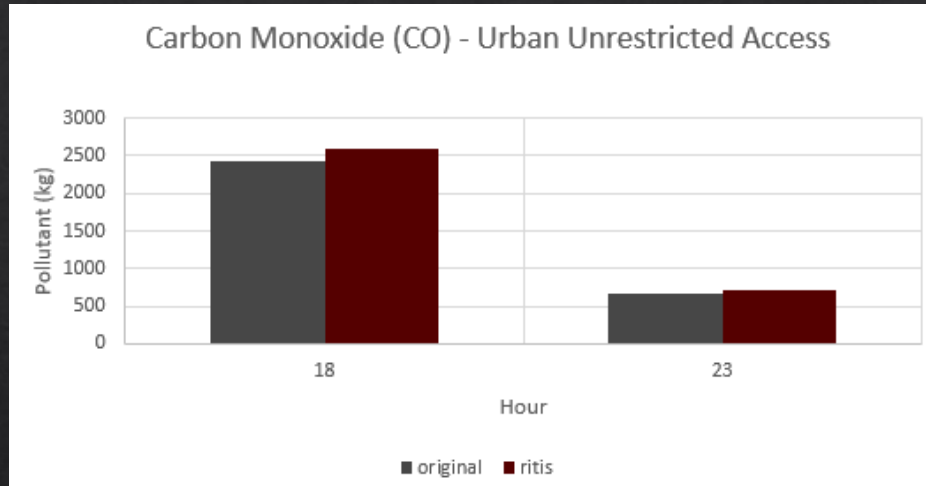
Conclusion

- RITIS data aligns with our original dataset's traffic patterns.

- RITIS data is an alternative source for emission inventory estimation in urban unrestricted access areas.

- Observed average speed distribution differs from speed model predictions, emphasizing the importance of real-world data.

- Significant emission differences found in Volatile Organic Compounds and Primary PM10 - Tirewear Particulate.
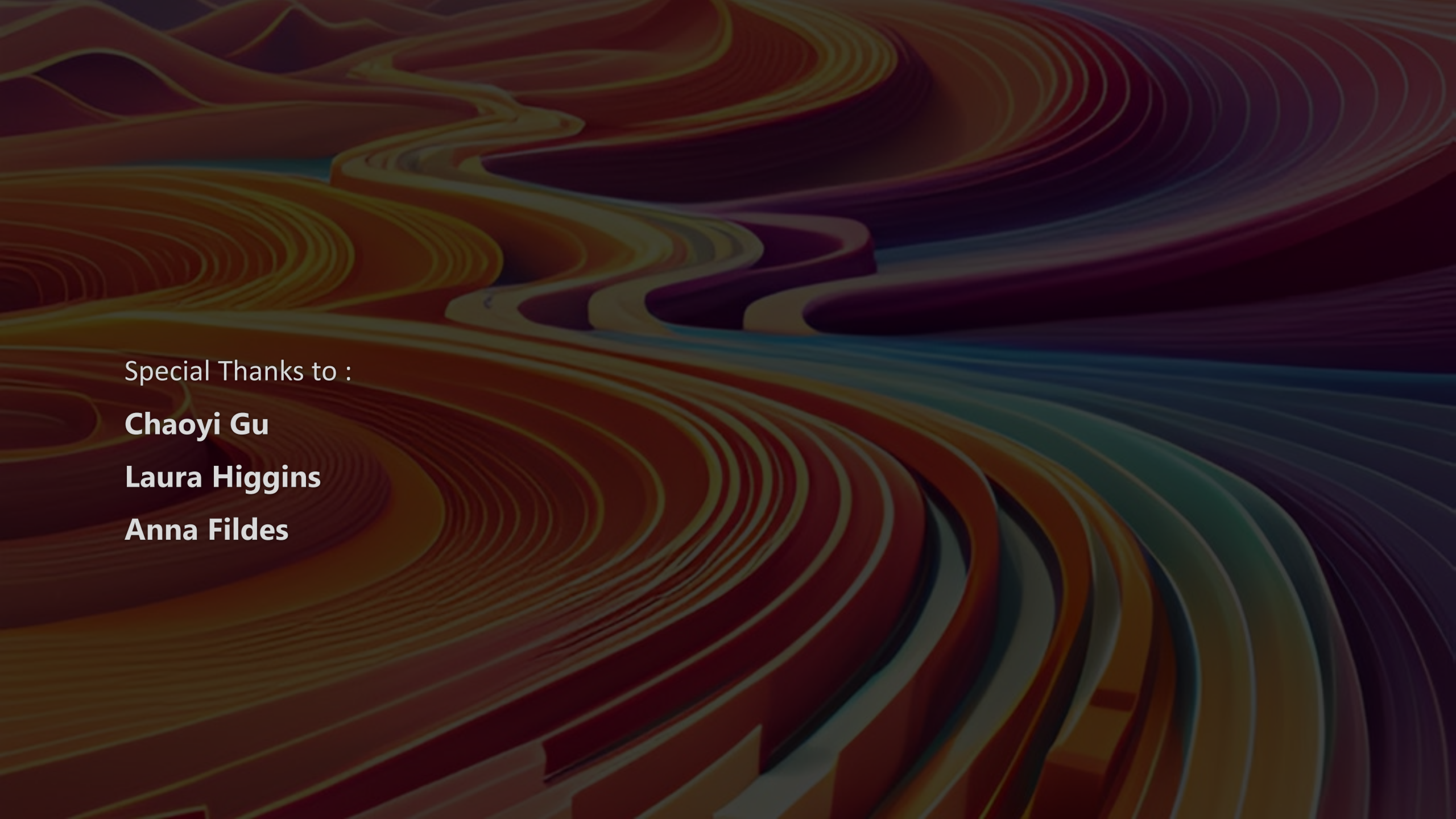
- Limitations include data gaps in certain road types and less truck speed data compared to passenger vehicles.

Future work

- Explore the potential to expand RITIS data collection to cover a wider geographical area beyond the current scope.

- Consider increasing the time span of data collection in RITIS to capture long-term transportation trends and patterns.

- Examine the data and results for different seasons to identify potential seasonal variations in transportation patterns and emissions.

Special Thanks to :

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