Using Automatic Vehicle Location System Data to Assess Weather Impacts on Bus Journey Times and Bus Route Types

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***Abstract*— Weather has the largest collective effect on transport systems, affecting users of all modes at the same time over a wide area. The aim of the research is to use Automatic Vehicle Location System (AVLS) data to investigate the impact of adverse weather, using rainfall, temperature and wind speed as indicators, on bus journey time. It will also assess if the impacts are dissimilar across three bus route types: bus lanes on the entire route, bus lanes on part of the route and buses running in mixed traffic.**

Previous research tends to use bus ridership levels as the key variable of interest when exploring weather impacts whereas the approach taken here will examine bus journey times. Multiple linear regression and in-depth analyses are used to explore which weather variables have the greatest effects.

Results indicate that more bus journey time variation can be explained by weather on weekdays than on weekends. Increases in rainfall, wind speed and temperature resulted in longer journey times, but the extent depends on the season and route type. The results will be useful to bus operators and local authorities in preparing mitigation strategies and for longer term planning, particularly in the context of climate change.

I. Introduction

Several factors influence transport mode choice including travel time, distance, socio-demographic characteristics, attitudes and perceptions. However the factor that has the largest collective effect on a transport system is weather, affecting users of all modes at the same time over a wide area. In Ireland, it is expected that due to the effects of climate change mean annual temperatures will increase between 1–1.6°C, mean precipitation amounts will decrease although the frequency of heavy precipitation events will increase significantly especially during winter and autumn, and extended dry periods are expected to increase substantially [1].

The aims of this research are to determine, using AVL data, how adverse weather impacts bus route operation, to identify which weather characteristics (rainfall, temperature, wind speed) have the greatest effects, to explore temporal variations (time of day, day of week, time of year) and to determine if the impacts are similar across different bus route types (all bus lane, routes that are partially bus lane with the remainder of the route in mixed traffic and routes that operate only in mixed traffic).

The paper is structured along the following lines. Section II covers related work and in particular the methods others have used to examine weather impacts. This is followed in Section III by a description of the data and how they were used, and Section IV covers the methods used. In Section V, the results of the multiple linear regression and the in-depth analysis used to focus on specific bus routes and other aspects are presented. Section VI follows with a discussion of the results and Section VII presents the conclusions.

II. Related Work

Most previous related research examines weather effects on congestion and travel times for a range of vehicles and not just buses. However, an investigation into the impacts of winter weather on bus travel time in China used GPS data from the winters of 2011 and 2012 for the city of Harbin, where the minimum temperature can reach -38ºC, and found that cumulative snowfall increased travel time [2]. The weather conditions for Dublin, Ireland, the location for the work described here, are very different to those in [2] but the regression analysis approach used in that study is a useful technique and will also be employed here, albeit using a more comprehensive set of weather variables.

Another study in China [3], this time in Shenzhen, analyzed smart card data over one month and found that an increase in humidity, wind, and rainfall was associated with a transit ridership decrease. Although the analysis period was relatively short, the population was >10 million generating over 63 million bus trips in the month of analysis. Whether bus stop shelters have an effect on mitigating ridership losses due to adverse weather conditions in Salt Lake City, US, was examined by [4] using smart card data over a longer period from January 2010 to December 2015. In this case, the population was much smaller at 200,000 [5] and the bus system had an average daily bus ridership of approximately 63,000 [6]. Determining the most suitable time frame for analysis needs therefore to be based on the population of the city under analysis and the number of bus users as these factors will dictate the number of records.

AVLS data has been used in the past for mainly assessing reliability and performance. AVLS data was used by [7] to conduct research on perceived journey times in Stockholm along a high frequency bus line. Other work [8] studied whether the introduction of AVLS on London buses in 2009 improved network operations and service reliability, and found that using AVLS data enables operation planners to refine schedules producing more robust schedules.

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Research on the impacts of weather on bus travel times is limited. One study [9] considered travel time along an entire bus route using data from an electronic fare collection system finding that average trip times increased on rainy days. Using AVLS data to determine the effects of weather on bus journey times does not appear to have been used previously but its comprehensiveness and robustness provide a strong basis for the research.

III. DATA

The location chosen for the research was Dublin, the capital city of Ireland, which had a population at the time of the 2016 Census of 1,173,179 and an area of 318km^2 [10]. Ireland is situated on the west of Europe and its weather is dominated by the Gulf Stream in the Atlantic resulting in a temperate climate not prone to extreme temperatures but rainfall is common.

To investigate the impact of weather on bus journey times, the AVLS data used by Dublin Bus and Dublin City Council [11] were used to generate bus journey times for selected routes and dates. Rain, wind speed and temperature data from the Dublin airport weather station for 2018 were also used in the analysis [12].

A. AVL Data

All Dublin Bus buses are equipped with GPS units which provides an AVLS with bus location (~1,000 buses) every 20 sec. The budget for the research did not allow for all routes to be analyzed so a sample were selected. Six bus routes in total were selected: two have bus lanes for the entirety of their route (R15 and R46a), two have bus lanes for part of the route and use general traffic lanes for other parts (R7 and R9), and two routes have no bus lanes (R14 and R130) and operate exclusively in mixed traffic. The routes selected are shown in Figure 1.

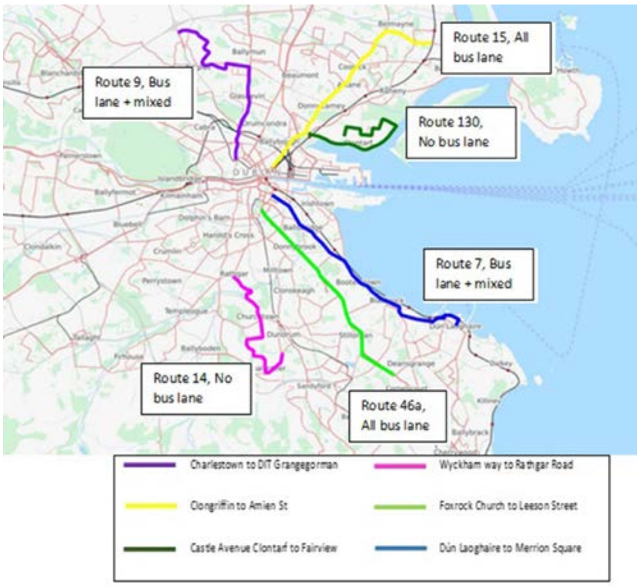

Figure 1. Bus routes for analysis

To fully capture the effects of weather variations, data from one month in each season were analyzed. A new Light Rail line crossing the city center opened in January 2018 and as a number of bus routes were altered to accommodate it, it was decided not to include data from January in the analysis. An unexpected and highly unusual weather event, featuring excessive snow in early March, resulted in buses being grounded for a number of days; hence March was also ruled out. February 2018 was therefore selected for analysis along with May, August and November resulting in a total of 35,107 bus journey times analyzed.

The details recorded for each journey are date, bus arrival and departure times at each stop, the vehicle reference number, bus route number and the duration of the journey between stop in seconds. The bus route data needed to be matched with the separate weather data (available by hour) and so an average hourly route journey time was calculated and matched with the rain, temperature and wind variables for each hour. The process was repeated for the six routes for the four months under consideration.

B. Weather Data

Using the weather data recorded in 2018, hourly temperature was found to range between -4.8°C to 26.3°C, with an average of 9.7°C. During 2018, there were periods of uncommon extremes for Ireland in relation to temperature. Extremely cold temperatures occurred early in March during which the public were advised not to travel and an unusual period of prolonged high temperatures occurred in July. Wind speeds were reasonably consistent throughout the year ranging from 0.5 m/s to 18.5 m/s with an average of 5.4 m/s. Rainfall ranged from 0 – 7.7 mm with an average of 0.08 mm. The weather variables were only very weakly correlated and so all three could be used in the analysis. The results of Pearson’s correlation tests are as follows: rain and temperature ($r = -0.078$, $p \leq 0.01$), rain and wind ($r = 0.082$, $p \leq 0.01$) and wind and temperature ($r = -0.157$, $p \leq 0.01$). The weather variable bands used in the analysis are presented in Table 1.

TABLE 1. Weather variable bands used in analysis

Rain	**Temperature**	**Wind**
No Rain	< 0 °C	0 – 10m/s
0 – 1mm	0 - 10°C	10 – 20 m/s
1 – 2mm	10 - 20°C	20 – 30m/s
2 – 3mm	20 - 30°C	
3 – 4mm		
4 – 5mm		
>5mm		

IV. METHODS

Two methods were used in the analysis. Multiple linear regression was used with the bus journey time as the dependent variable with rain in mm, temperature range in ºC and wind range in m/s as the independent variables with an additional variable to indicate if the bus journey took place between 7 – 10am in the morning (peak period) [13]. The model used is shown in (1).

$$Y_{jt} = b_0 + b_1R + b_2T + b_3W + b_4M \quad (1)$$

where:

Y_{jt} = bus journey time
R = rain (mm)
T = temperature (°C)
W = wind speed (m/s)
M = 1 if the bus journey took place between 7am and 10am and 0 otherwise.

In addition, an in-depth analysis was conducted to enable a comparison of the journey times to a standard journey time. A number of approaches to determine a standard journey time were undertaken:

1. Using the average journey time for the month. This was easily computed but it contained journey times from different times of the day and all weather conditions.

2. Using the expected journey time. This was obtained from the Transport for Ireland Journey Planner [14]. It was useful as it allowed the exact same bus stops to be entered as the journey time reports. However, it only allows for future trips within the next two months to be calculated and so was not useful for this research.

3. Using an average journey time calculated in periods of favorable weather conditions for each route and for each month. Favorable weather conditions were considered to apply when all of the following occurred at the same time: Low wind speed (0 to 10m/s), no rain and mild (between 0 - 10°C for February and November and between 10 – 20°C for May and August).

Option 3 was considered to be the most appropriate as it considers the monthly variations and provides a good weather base condition against which to compare the impact of adverse weather conditions.

V. RESULTS

The aims of the analyses were to:

- Determine if there is an effect of adverse weather on bus operations.
- Identify which weather characteristics (rainfall, temperature, wind speed) have the greatest effect
- Consider if there are different effects based on time of day, day of the week, time of year
- Determine if weather has more impact on bus travel times if a bus route runs on bus lanes or is mixed with general traffic

A. *Multiple Linear Regression Analyses*

As mentioned previously, a multiple linear regression (MLR) analysis was carried out for each bus route for the months of February, May, August and November of 2018 for both weekday and weekend. The results for the weekday analysis are presented in Table 2. (A lightly shaded cell and * in a cell indicates statistical significance at the $p < 0.05$ level and a darkly shaded cell and ** in a cell indicates statistical significance at the $p < 0.01$ level).

As can be seen in Table 2, the results for February show that all the models are statistically significant at the $p < 0.001$ level for all routes. The Durbin Watson (DW) test, which tests for autocorrelation, found almost of the models falling within the required range of 1 - 3 except in the case of a few that were marginally outside (0.9): the R46a in Feb and Nov. The adjusted R^2 values indicate that 24% and 38% of the variance in the journey time can be explained by the independent variables. Not all predictor variables in the February models are statistically significant. Rain is only statistically significant at the $p < 0.05$ level for the R46a (all bus lane) and the R7 (mixed) routes. Temperature is statistically significant at the $p < 0.001$ level for the R46a (all bus lane) route and the R7 (mixed route) and at the $p < 0.05$ level for the R9 (mixed) route and for the R14 route (no bus lane) route. Wind is only statistically significant for R46a (all bus lane) and, as might be expected, taking a journey in the morning peak period increases journey time in all cases with statistical significance at $p < 0.001$ for all routes.

Examining the predictor variables that are statistically significant in the case of February, it is clear that the greatest increase in journey time is caused by the trip taking place in the morning peak period. Where temperature is statistically significant, it also causes an increase a journey time though to a much lesser extent than morning peak period travel. In the cases where rain is statistically significant, it causes a decrease in journey time, which was somewhat unexpected. Both routes in which the statistical significance is evident involve some level of bus lanes which are shared with cyclists so one explanation may be that if rain causes a reduction in the number of cyclists, buses may have freer use of the bus lanes. Tests for multicollinearity using the Variance Inflation Factor (VIF) gave values from 1.0 – 1.11 indicating this was not an issue in the models.

The results in Table 2 for May show that all the models are statistically significant ($p < 0.001$) for all routes. The DW values are within range between 1.1 and 2. The adjusted R^2 indicate that between 10% and 49% of the variance in journey time is explained by the independent variables. All predictor variables are statistically significant ($p<0.001$) apart from rain. Journeys in the morning peak again generated a much larger coefficient in all models than for the other variables. Increases in temperature and wind both cause an increase in journey time. The VIF range is 1.0-1.13.

All models for August were statistically significant to the $p < 0.001$ level and the DW values are within the 1-3 required range. The positive adjusted R^2 values indicate that 13% and 35% of the variance in journey time can be explained by the independent variables. For one of the all bus lane routes (R46a) and the two mixed routes (R9 and R7) all predictor variables are statistically significant at some level and all coefficients are positive. Again peak morning time has the greatest effect in increasing the journey time, but the coefficients are lower than in February and May indicating a lower effect. The VIF values are in the range 1.02 – 1.14.

Looking at the last set of models in Table 2 for November, all were again statistically significant ($p < 0.001$).

The DW values were in range except in the case of route R46a having a value of 0.9, marginally outside. The adjusted R^2 values indicate between 9% and 35% of the variance in journey time was explained. Not all predictor variables are statistically significant. Where rain is statistically significant (R46a, R9, R7 and R14) an increase in rainfall causes an increase in journey time. Temperature is not statistically significant for any route in this case. Wind is only statistically significant at the $p < 0.05$ level for R9 and R7 (both mixed) and also causes an increase to journey times. Morning is statistically significant for all routes and once again causes the largest increase to journey times. The VIF values are all between 1.01 and 1.2.

A similar set of MLR regression models were run for weekends and typically generated weaker outputs with less of the journey time variation explained by the weather variables than in the case of weekdays. In February, rain gave a significant result in the case of one route (R9) with an increase generating a substantial decrease in journey time. No explanation could be found for this somewhat unexpected result. Where temperature was significant, an increase caused an increase in journey time suggesting that, when the weather is good there is more traffic on roads at weekends. In May, only temperature and wind were significant for some months with again showing lower coefficients than in the case of weekdays. Similar trends were evident in August where increases in temperature and wind caused increases in journey times. Only temperature and wind were significant for some routes in November. In those cases, an increase in temperature caused an increase in journey time but an increase in wind caused a reduction.

A. *In-depth Analyses*

The effects of adverse weather were further explored by time period (i) Weekday morning (7am to 10am), (ii) Weekday evening (4pm to 7pm), (iii) Weekday off-peak and (iv) Weekend by considering:

- The percentage difference in average journey time for different weather events compared to ideal conditions and
- The average journey time by route for ideal conditions and different weather events

As mentioned earlier, ideal weather events are defined when all of the following weather conditions occur at the same time: low wind speed (0 to 10m/s), no rain and mild (between 0 - 10°C degrees for February and November and between 10 – 20 °C and degrees for May and August).

The percentage difference between the journey times during ideal conditions and at different weather conditions by bus route for the month of February are shown in Figure 2. In the case of weekday mornings, a temperature less than 0°C caused the greatest increase in journey time. However, in the evening, temperature falling below 0°C generated the greatest decrease in journey time. A possible reason is that people have more discretion in the evening choosing not to undertake a trip in those conditions whereas in the morning many passengers are commuters and have no choice but to undertake the trip regardless of the weather. During the off-peak period almost all weather conditions across all routes had a journey time lower than the ideal condition journey time. This is partly due to the ideal journey time being an average of all journey times occurring under the conditions defined above for the ideal. At the weekend, a temperature less than 0°C is again the weather condition that causes the greatest decrease in journey times while milder temperatures of between 0 and 10°C cause the greatest increase suggesting that more discretionary trips could be influenced by temperature.

An analysis of the impact of type of bus facility (bus lane, mixture or no bus lane) on bus journey time was also carried out. In the morning, the type of bus facility was found to have little impact as all weather conditions cause a journey time larger than the ideal conditions. In the evening, rain increases the journey times on all routes apart from R46a (bus lane) where higher wind speeds cause the greatest increase. On three of the routes, low temperatures cause a decrease in journey time. Off-peak there is more variability; higher wind speeds cause higher journey times on the two bus lane routes (R15 and R46a) and on the mixed R7 route, higher temperatures increase journey times on R9 (mixed) and R14 (no bus lane) whilst rain caused the largest increase on R130 (no bus lane). At the weekend, mild temperatures (0 to 10°C) were the cause for the largest increased journey time on two routes (R46a (bus lane) and R7 (mixed)) whilst wind was the cause of the highest journey times for all other routes.

Similar analyses were completed for the other months. A summary of the weather effect having the greatest impact during each time period, across all routes and months is presented in Table 3. High wind speed is the most frequently occurring event which is perhaps surprising. There is rarely consistency across the network in the same period suggesting that the type of bus route and local factors are also contributing to journey times.

VI. DISCUSSION

The models for bus trips made between 7:00 - 10:00am were the most consistent in terms of statistical significance and showed the greatest increase in journey times. This was not unexpected, given morning peak hour traffic, but the level of consistency might offer some potential to improve bus operations. One possibility would be to use this information to enhance real-time information at bus stops and online by incorporating weather predictions into bus scheduling. Reliability of public transport cannot be underestimated in terms of its potential to attract or maintain ridership so improving the reliability of scheduling in this way could result in significant gains for operators and traffic management authorities.

Not all predictor variables were statistically significant but, when they were, increasing levels of rain increased journey times apart from in February when it caused a decrease. Temperature and wind were both statistically significant in May and August and increases in both caused increases to journey times. In May, an increase in temperature caused a larger increase than higher wind levels whereas in August increases in wind increased journey times more than an increase in temperature. These results show that different weather events result in varied impacts on journey times depending on season. This is important in the context of climate change and for changing weather patterns.

Of the months analyzed, November was the wettest (with three times as much rainfall as August, five times as much as February and seven times as much as May) and the results showed that rain caused the largest increase in journey times. February was the coldest of the months analyzed and increasing temperatures caused the journey time to increase. Increasing wind speed always increased journey times where it was statistically significant.

TABLE 2. Multiple Linear Regression model results for bus journey times

Multiple Linear Regression Model Results for Bus Journey Times								
	Feb		**May**		**August**		**Nov**	
Bus Lane (R15)								
	B	**SE**	**B**	**SE**	**B**	**SE**	**B**	**SE**
Constant	1,803.65**	50.62	1,471.01**	55.29	1,600.15**	76.83	1,821.96**	53.81
Rain	-12.97	160.10	107.59	89.23	26.56	32.28	26.14	19.45
Temp	2.61	5.54	15.92**	3.40	6.48	4.04	3.24	5.61
Wind	2.78	3.50	15.32**	2.67	14.61**	3.58	1.68	3.72
Morning	424.50**	41.19	448.26**	28.74	278.20**	33.64	497.30**	37.73
Adj. R^2	0.3, $p < 0.001$		0.435, $p < 0.001$		0.19, $p < 0.001$		0.33, $p < 0.001$	
Bus Lane (R46a)								
Constant	1,463.59**	36.78	1,162.13	53.87	989.65**	57.58	1,528.22**	61.11
Rain	-202.71*	98.80	117.68	91.00	71.01**	26.08	85.25**	20.69
Temp	13.57**	3.79	22.21**	3.34	19.90**	3.07	11.47	6.33
Wind	7.81**	2.49	14.42**	2.71	22.03**	2.74	6.80	4.19
Morning	340.54**	31.37	464.65**	30.62	314.30**	26.39	161.67**	43.55
Adj. R^2	0.28, $p < 0.001$		0.4, $p < 0.001$		0.35, $p < 0.001$		0.09, $p < 0.001$	
Mixed (R9)								
Constant	1,646.89**	61.78	1,188.21**	68.06	1,266.46**	92.68	1,646.90**	85.45
Rain	-82.17	218.89	119.09	101.85	126.14**	43.68	85.35**	33.44
Temp	13.48*	6.04	26.60**	4.20	11.23*	4.75	9.49	8.44
Wind	4.21	4.21	18.26**	3.38	19.91**	4.13	11.98*	5.92
Morning	558.61**	49.68	563.57**	35.47	262.44**	36.56	620.26**	56.09
Adj. R^2	0.38, $p < 0.001$		0.49, $p < 0.001$		0.2, $p < 0.001$		0.35, $p < 0.001$	
Mixed R7								
Constant	1,573.51**	48.91	1,143.97**	72.44	1,031.32**	91.07	1,489.90**	72.20
Rain	-268.35*	128.68	86.42	65.35	83.79*	39.02	83.27**	25.61
Temp	23.47**	5.02	22.95**	4.51	18.54**	4.78	12.34	7.55
Wind	5.14	3.29	19.25**	3.86	38.32**	4.18	10.05*	4.97
Morning	394.84**	40.53	432.26**	42.54	239.01**	40.74	533.33**	50.89
Adj. R^2	0.24, $p < 0.001$		0.27, $p < 0.001$		0.24, $p < 0.001$		0.27, $p < 0.001$	
No bus lane (R130)								
Constant	799.33**	28.44	732.28**	39.12	685.61**	50.59	849.19**	28.42
Rain	-52.89	77.83	-101.22	61.16	17.44	18.77	-0.61	8.87
Temp	2.00	2.92	5.26**	2.38	6.96**	2.55	3.04	3.05
Wind	3.43	1.94	5.35**	1.83	3.58	2.18	-1.85	1.93
Morning	168.51**	21.90	95.04**	19.56	136.74**	20.47	184.30**	19.02
Adj. R^2	0.24, $p < 0.001$		0.1, $p < 0.001$		0.14, $p < 0.001$		0.24, $p < 0.001$	
No bus lane (R14)								
Constant	1,165.67**	38.28	962.24**	39.62	984.76**	38.43	1,136.08**	46.99
Rain	-180.05	102.14	82.03	66.12	21.88	17.27	37.25*	15.93
Temp	8.53*	3.95	14.30**	2.51	7.98**	2.05	7.99	4.88
Wind	2.89	2.58	9.80**	2.00	10.72**	1.83	2.51	3.22
Morning	426.30**	32.31	194.25**	21.87	134.52**	17.50	342.08**	33.52
Adj. R^2	0.35, $p < 0.001$		0.24, $p < 0.001$		0.19, $p < 0.001$		0.23, $p < 0.001$	

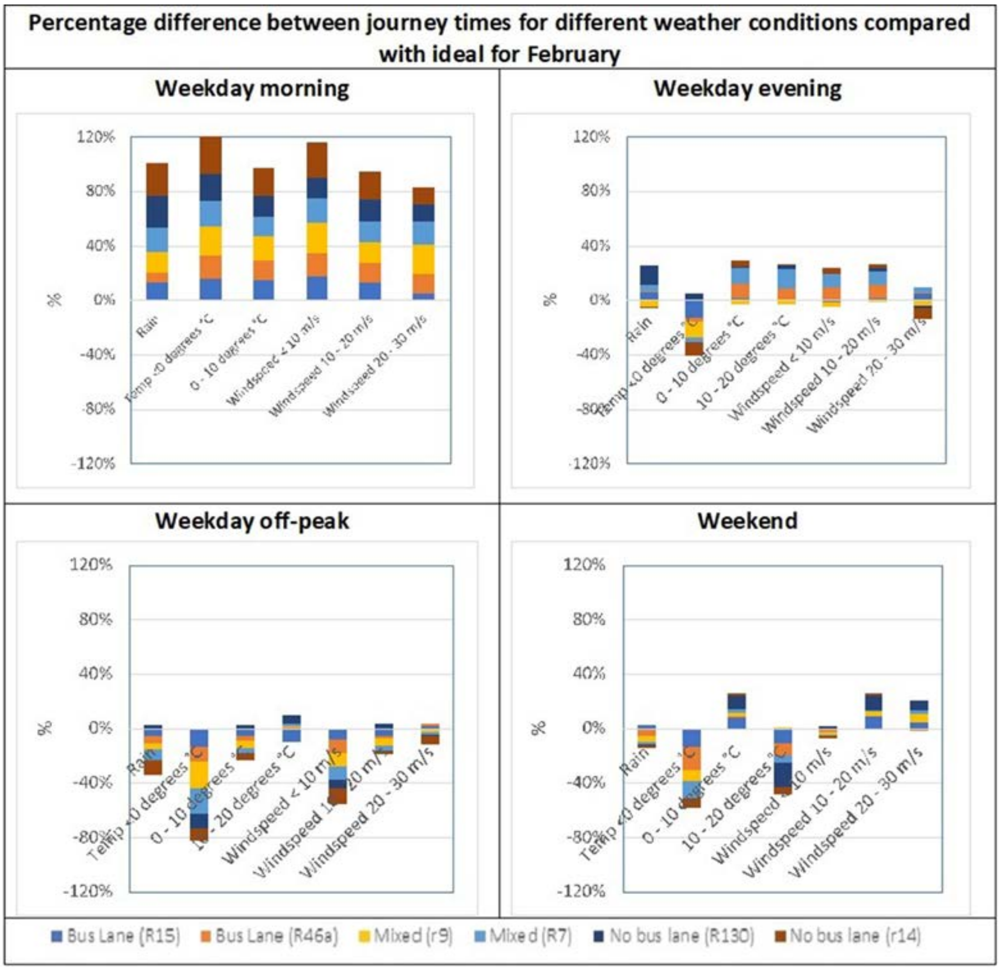

Figure 2. Percentage difference between journey time for different weather conditions compared with ideal.

The in-depth analyses showed that although higher rain levels increase journey times it was actually higher wind speeds, especially those greater than 20 m/s, that caused the largest increase in journey times. This is unexpected as rainfall is typically the focus of many studies and most findings have been focused on how rain increases bus ridership numbers. High winds can be associated with stormy weather conditions leading to difficult road conditions so this may explain this outcome. However, as discussed previously these are quite rare events only occurring 2% of all the hours analyzed whereas rainfall occurs more regularly.

Comparing the results for different types of bus routes revealed no great difference between routes that had bus lanes for the full length of the route, routes that were partially covered by bus lanes and those routes that had no bus lanes on any part of the route. However, the MLR results generally had higher adjusted R^2 values for the bus lane routes on weekdays compared with routes with no bus lane (with some exceptions) indicating that more variability in travel times for the bus lane routes can be explained by the weather conditions than on other routes. This may be due to the fact that traffic congestion is likely to cause much higher levels of variability in travel times for those bus routes operating in mixed traffic compared with bus lane routes which are segregated from general traffic. The models for the bus lane routes also tend to generate more statistically significant outcomes.

The results for the weekend models were similar to those for weekdays and the adjusted R^2 values were (with some exceptions) greater for the bus lane routes than those without and again typically had more statistically significant results. The weekday models across all routes had higher adjusted R^2 values than at the weekends meaning that more of the journey time variation is explained by the weather variables on weekdays. In contrast, [3] noted that weather impacts accounted for a larger percentage of variation in bus ridership numbers on weekends rather than on weekdays.

VII. Conclusions

The main findings are:

- The use of AVLS data to study the effects of adverse weather on bus journey times is a novel approach and worked well in this context.
- MLR analysis produced statistically significant models for bus journey times, although, for the most part, the statistical power was at best moderate.

- More journey time variation can be explained by weather variables on weekdays than on weekends.
- The effects of weather variables on bus journey times changed throughout the year with different variables having greater impacts in different months. Increases in rainfall (apart from in February), increases in wind speeds and increases in temperature were found to increase journey times but the amount by which varied throughout the year, between weekends and weekdays and on different routes.
- More variability in bus journey times can be explained by weather for bus lane routes than for those running in mixed traffic lanes. This is possibly due to other factors that non-bus lane routes encounter such as mixing with general traffic. Traffic congestion is likely to generate more variability in travel times for buses in mixed traffic than routes that are effectively segregated from general traffic.

TABLE 3 Summary of weather variables having largest impact on journey times at different times across all months and routes.

Time period	Bus Lane (R15)	Bus Lane (R46a)	Mixed (R9)	Mixed (R7)	No bus lane (R130)	No bus lane (R14)
			February			
Morning	Wind speed < 10 m/s	Wind speed 20 - 30 m/s	Temp <0°C	Temp <0°C	Temp <0°C	Temp <0°C
Evening	Rain	Wind speed 10 - 20 m/s	Rain	Rain	Rain	Rain
Off peak	Wind speed 20 - 30 m/s	Wind speed 20 - 30 m/s	Temp 10 - 20°C	Wind speed 20 - 30 m/s	Rain	Temp 10 - 20°C
Weekend	Wind speed 10 - 20 m/s	Temp 0 - 10 degrees °C	Wind speed 20 - 30 m/s	Temp 0 - 10 degrees °C	Wind speed 10 - 20 m/s	Wind speed 10 - 20 m/s
			May			
Morning	Temp 0 - 10 °C	Temp 0 - 10 °C	Wind speed 10 - 20 m/s	Rain	Rain	Temp 0 - 10 °C
Evening	Wind speed 20 - 30 m/s	Wind speed 10 - 20 m/s	Wind speed 20 - 30 m/s	Wind speed 10 - 20 m/s	Wind speed 10 - 20 m/s	Wind speed 10 - 20 m/s
Off peak	Rain	Wind speed 20 - 30 m/s	Wind speed 10 - 20 m/s	Wind speed 20 - 30 m/s	Wind speed 20 - 30 m/s	Wind speed 20 - 30 m/s
Weekend	Wind speed 10 - 20 m/s	Wind speed 10 - 20 m/s	Wind speed 10 - 20 m/s	Rain	Wind speed 10 - 20 m/s	Wind speed 10 - 20 m/s
			Aug			
Morning	Temp 0- 10 °C	Temp 0-10 °C	Temp 0-10 °C	Temp 0-10°C	Temp 0-10 °C	Temp 0-10 °C
Evening	Rain	Rain	Rain	Rain	Rain	Rain
Off peak	Rain	Wind speed 20 - 30 m/s	Wind speed 20 - 30 m/s	Wind speed 20 - 30 m/s	Temp 20 - 30 °C	Wind speed 20 - 30 m/s
Weekend	Wind speed 10 - 20 m/s	Wind speed 10 - 20 m/s	Wind speed 10 - 20 m/s	Wind speed 10 - 20 m/s	Wind speed 10 - 20 m/s	Rain
			November			
Morning	Wind speed 20 - 30 m/s	Rain	Wind speed 20 - 30 m/s	Rain	Rain	Rain
Evening	Wind speed 20 - 30 m/s	Wind speed 20 - 30 m/s	Wind speed 20 - 30 m/s	Rain	Temp 10 - 20 degrees °C	Wind speed < 10 m/s
Off peak	Wind speed 20 - 30 m/s	Wind speed 20 - 30 m/s	Wind speed 20 - 30 m/s	Wind speed 20 - 30 m/s	Temp 10 - 20 °C	Wind speed 20 - 30 m/s
Weekend	Wind speed 10 - 20 m/s	Temp 10 - 20 °C	Temp 10 - 20 °C	Temp 10 - 20 °C	Temp 10 - 20 °C	Temp 10 - 20 °C

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