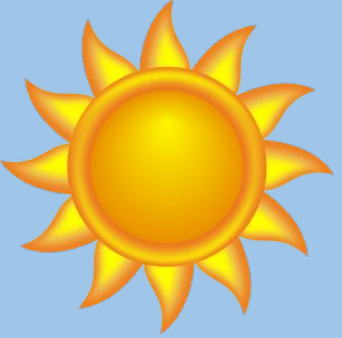


# How Do Weather Conditions Influence Traffic Flow in A$^2$?

Katie Forrest & Mya Gibson

# APIs Used

## TomTom Api

We used the TomTom API to find traffic flow in Ann Arbor by measuring:

- traffic speed
- travel time
- road closures
- confidence of predicted traffic conditions

## OpenWeather API

We used the OpenWeather API to find weather conditions by measuring:

- current temperature
- daily maximum temperature
- daily minimum temperature
- weather conditions (sunny, cloudy, etc.)
- specified descriptions (light rain, light clouds, etc.)

# Tables Created For Databases in SQLite3

We created four tables, which all recorded a unique datetime to ensure no duplicate data was collected. Each time all four tables were run, only 12 lines of total data were collected across all tables. The Weather and Temperature tables shared a key.

Table: Temperature

New Record | Delete R

| | query | datetime | temp | max_temp | min_temp |
|---|---|---|---|---|---|
| | Filter | Filter | Filter | Filter | Filter |
| 1 | Ann+Arbor | 1575508801.0 | 32.4 | 35.01 | 30.0 |
| 2 | Ann+Arbor | 1575542567.0 | 32.81 | 35.01 | 30.99 |
| 3 | Ann+Arbor | 1575566087.0 | 37.42 | 41.0 | 33.8 |
| 4 | Ann+Arbor | 1575604800.0 | 35.69 | 37.4 | 33.01 |
| 5 | Ann+Arbor | 1575668585.0 | 35.29 | 39.0 | 32.0 |
| 6 | Ann+Arbor | 1575693439.0 | 26.46 | 30.2 | 21.99 |
| 7 | Ann+Arbor | 1575755590.0 | 32.05 | 34.0 | 30.0 |
| 8 | Ann+Arbor | 1575774836.0 | 30.22 | 33.01 | 28.0 |
| 9 | Ann+Arbor | 1575833758.0 | 43.14 | 46.4 | 41.0 |
| 10 | Ann+Arbor | 1575840413.0 | 44.56 | 48.2 | 41.0 |
| 11 | Ann+Arbor | 1575907654.0 | 46.78 | 48.2 | 45.0 |
| 12 | Ann+Arbor | 1575929847.0 | 48.87 | 51.01 | 46.99 |
| 13 | Ann+Arbor | 1575929702.0 | 48.87 | 51.01 | 46.99 |
| 14 | Ann+Arbor | 1575929847.0 | 48.87 | 51.01 | 46.99 |
| 15 | Ann+Arbor | 1575938945.0 | 48.83 | 51.01 | 46.4 |
| 16 | Ann+Arbor | 1575939485.0 | 48.81 | 51.01 | 46.4 |
| 17 | Ann+Arbor | 1575941013.0 | 48.96 | 51.8 | 46.4 |

Table: Weather

New R

| | query | datetime | main | description |
|---|---|---|---|---|
| | Filter | Filter | Filter | Filter |
| 1 | Ann+Arbor | 1575508801.0 | Snow | light snow |
| 2 | Ann+Arbor | 1575542567.0 | Clouds | overcast clouds |
| 3 | Ann+Arbor | 1575566087.0 | Clouds | overcast clouds |
| 4 | Ann+Arbor | 1575604800.0 | Clouds | overcast clouds |
| 5 | Ann+Arbor | 1575668585.0 | Clear | clear sky |
| 6 | Ann+Arbor | 1575693445.0 | Clear | clear sky |
| 7 | Ann+Arbor | 1575755590.0 | Clouds | overcast clouds |
| 8 | Ann+Arbor | 1575774836.0 | Clouds | broken clouds |
| 9 | Ann+Arbor | 1575833749.0 | Haze | haze |
| 10 | Ann+Arbor | 1575840413.0 | Haze | haze |
| 11 | Ann+Arbor | 1575907654.0 | Rain | moderate rain |
| 12 | Ann+Arbor | 1575929847.0 | Mist | mist |
| 13 | Ann+Arbor | 1575929702.0 | Mist | mist |
| 14 | Ann+Arbor | 1575929847.0 | Mist | mist |
| 15 | Ann+Arbor | 1575938945.0 | Clouds | overcast clouds |
| 16 | Ann+Arbor | 1575939485.0 | Clouds | overcast clouds |
| 17 | Ann+Arbor | 1575941013.0 | Rain | light rain |

# Tables Created For Database Continued

The TrafficFlow and Confidence tables also shared a key and used bounding boxes with 5 different sets of coordinates to define the area that they would record traffic data.

Table: TrafficFlow

New Record | Delete R

| | coordinates | datetime | speed | travel_time | road_closure |
|---|---|---|---|---|---|
| | Filter | Filter | Filter | Filter | Filter |
| 1 | 52.41072,4.842... | 2019-12-04 20... | 75 | 40 | 0 |
| 2 | 42.271883,-83.... | 2019-12-04 20... | 25 | 134 | 0 |
| 3 | 42.264093,-83.... | 2019-12-04 20... | 55 | 36 | 0 |
| 4 | 42.235923,-83.... | 2019-12-04 20... | 68 | 23 | 0 |
| 5 | 42.293234,-83.... | 2019-12-04 20... | 54 | 33 | 0 |
| 6 | 52.41072,4.842... | 2019-12-05 05... | 75 | 40 | 0 |
| 7 | 42.271883,-83.... | 2019-12-05 05... | 25 | 134 | 0 |
| 8 | 42.264093,-83.... | 2019-12-05 05... | 55 | 36 | 0 |
| 9 | 42.235923,-83.... | 2019-12-05 05... | 68 | 23 | 0 |
| 10 | 42.293234,-83.... | 2019-12-05 05... | 54 | 33 | 0 |
| 11 | 52.41072,4.842... | 2019-12-05 12... | 75 | 40 | 0 |
| 12 | 42.271883,-83.... | 2019-12-05 12... | 25 | 134 | 0 |
| 13 | 42.264093,-83.... | 2019-12-05 12... | 55 | 36 | 0 |
| 14 | 42.235923,-83.... | 2019-12-05 12... | 68 | 23 | 0 |
| 15 | 42.293234,-83.... | 2019-12-05 12... | 54 | 33 | 0 |
| 16 | 52.41072,4.842... | 2019-12-05 22... | 75 | 40 | 0 |

Table: Confidence

| | coordinates | datetime | confidence |
|---|---|---|---|
| | Filter | Filter | Filter |
| 1 | 52.41072,4.842... | 2019-12-04 20... | 0.94999998807... |
| 2 | 42.271883,-83.... | 2019-12-04 20... | 0.98000001907... |
| 3 | 42.264093,-83.... | 2019-12-04 20... | 0.97000002861... |
| 4 | 42.235923,-83.... | 2019-12-04 20... | 0.95999997854... |
| 5 | 42.293234,-83.... | 2019-12-04 20... | 0.97000002861... |
| 6 | 52.41072,4.842... | 2019-12-05 05... | 0.95999997854... |
| 7 | 42.271883,-83.... | 2019-12-05 05... | 0.95999997854... |
| 8 | 42.264093,-83.... | 2019-12-05 05... | 0.95999997854... |
| 9 | 42.235923,-83.... | 2019-12-05 05... | 0.95999997854... |
| 10 | 42.293234,-83.... | 2019-12-05 05... | 0.97000002861... |
| 11 | 52.41072,4.842... | 2019-12-05 12... | 0.93999999761... |
| 12 | 42.271883,-83.... | 2019-12-05 12... | 0.97000002861... |
| 13 | 42.264093,-83.... | 2019-12-05 12... | 0.97000002861... |
| 14 | 42.235923,-83.... | 2019-12-05 12... | 0.97000002861... |
| 15 | 42.293234,-83.... | 2019-12-05 12... | 0.97000002861... |
| 16 | 52.41072,4.842... | 2019-12-05 23... | 0.88999998569... |

# Calculations from Data

- After collecting that data, we calculated the average confidence of traffic conditions, average speed, average temperature and average weather condition. The calculated data was written to the text file.
- Time stamps for weather data and traffic data were collected in different formats, so we converted those formats and then used the timestamp to the day, not the hour or second, in order to ensure we would get matches when we did a database join.

Table: final_averages

New Record | Dele

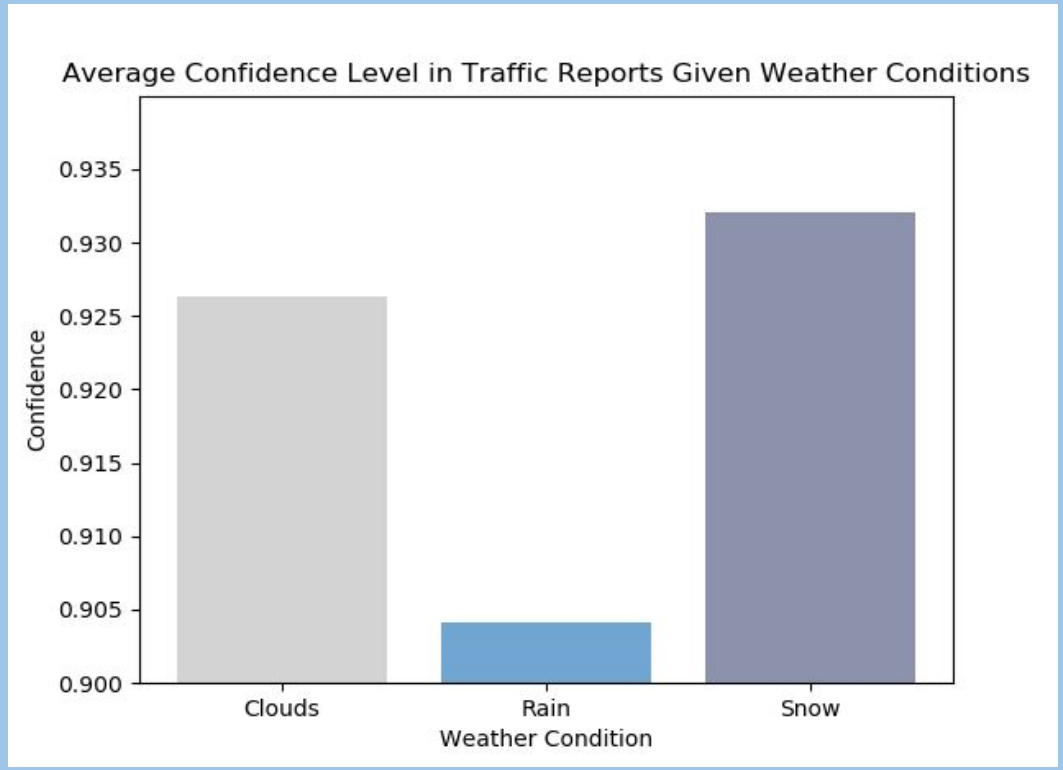
| | query | datetime | avg_temp | avg_speed | confidence | weather |
|---|---|---|---|---|---|---|
| | Filter | Filter | Filter | Filter | Filter | Filter |
| 1 | Ann Arbor | 20191204 | 46.775 | 50.5 | 0.96714286719... | Clouds |
| 2 | Ann Arbor | 20191205 | 46.995 | 54.0 | 0.95727272873... | Clouds |
| 3 | Ann Arbor | 20191206 | 44.1005882352... | 51.4444444444... | 0.88793104681... | Clouds |
| 4 | Ann Arbor | 20191207 | 45.0017647058... | 52.5555555555... | 0.91827588656... | Clouds |
| 5 | Ann Arbor | 20191208 | 50.6858823529... | 53.2222222222... | 0.89103450446... | Clouds |
| 6 | Ann Arbor | 20191209 | 52.2320670391... | 54.8989898989... | 0.90411372567... | Rain |
| 7 | Ann Arbor | 20191210 | 42.0387850467... | 54.1694915254... | 0.93597766873... | Clouds |
| 8 | Ann Arbor | 20191211 | 40.9734615384... | 53.3571428571... | 0.93204547600... | Snow |
| 9 | Ann Arbor | 20191204 | 46.775 | 50.5 | 0.96714286719... | Clouds |
| 10 | Ann Arbor | 20191205 | 46.995 | 54.0 | 0.95727272873... | Clouds |
| 11 | Ann Arbor | 20191206 | 44.1005882352... | 51.4444444444... | 0.88793104681... | Clouds |
| 12 | Ann Arbor | 20191207 | 45.0017647058... | 52.5555555555... | 0.91827588656... | Clouds |
| 13 | Ann Arbor | 20191208 | 50.6858823529... | 53.2222222222... | 0.89103450446... | Clouds |
| 14 | Ann Arbor | 20191209 | 52.2320670391... | 54.8989898989... | 0.90411372567... | Rain |
| 15 | Ann Arbor | 20191210 | 42.0387850467... | 54.1694915254... | 0.93597766873... | Clouds |
| 16 | Ann Arbor | 20191211 | 40.9734615384... | 53.3571428571... | 0.93204547600... | Snow |

# Visualizations

Using Matplotlib

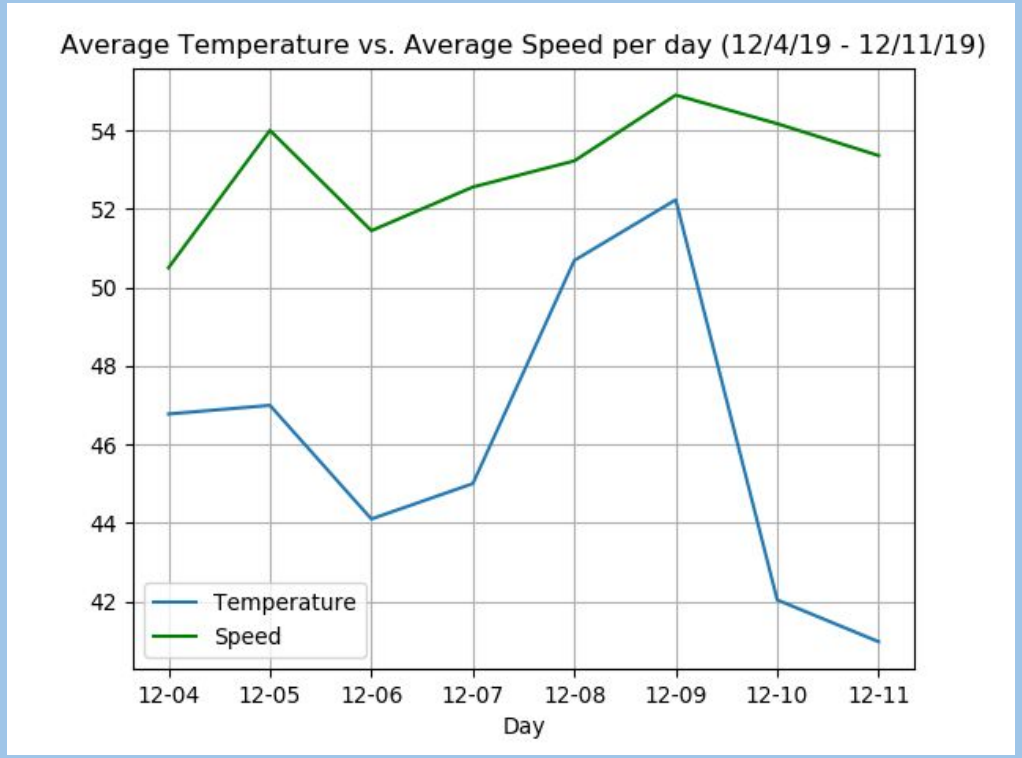
# Average Confidence Level in Traffic Reports Given Weather Conditions

Visualization 1 (Bar Graph) showed that the confidence in traffic reports was highest when snowing (93%), second highest when cloudy (92.6%), and significantly low when raining (90.5%).



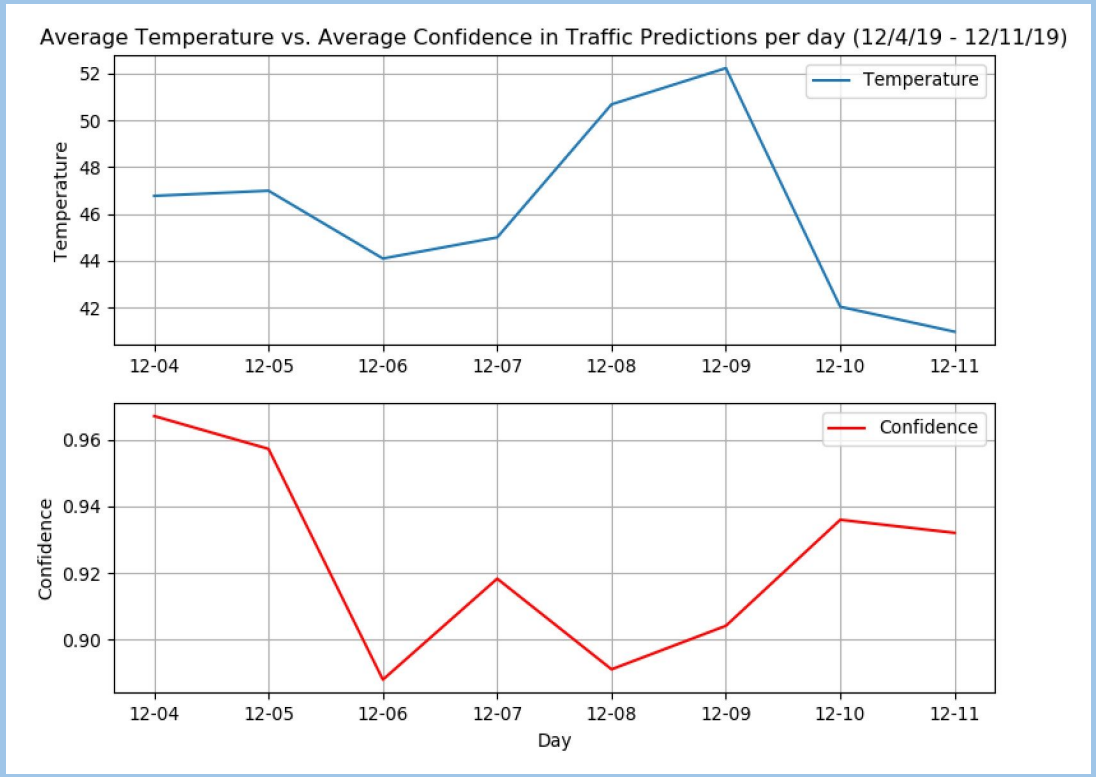
# Average Temperature vs. Average Speed Per Day (12/4/19-12/11/19)

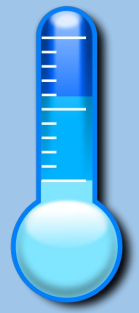
Visualization 2 (Double Line Graph) demonstrated a direct relationship between temperature and average speed. When the temperature rose, the speed increased, and vice versa.




# Average Temperature vs. Average Confidence per day (12/4/19-12/11/19)

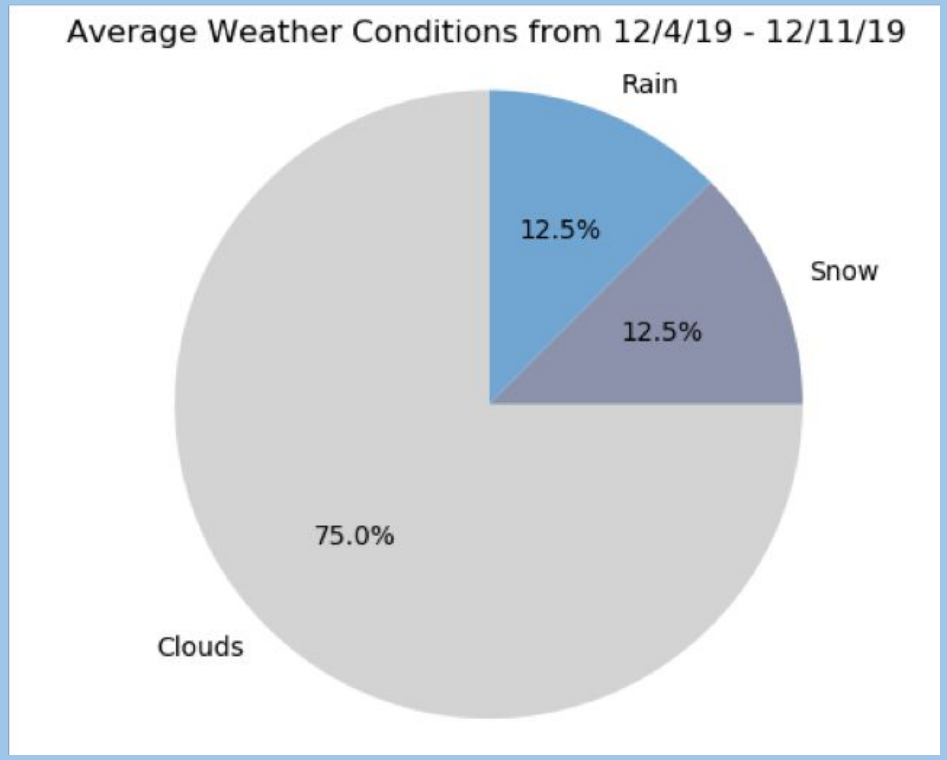
Visualization 3 (Subplot Line Graphs) showed that, on average, when the temperature was higher, the average confidence in traffic predictions was lower.



# Average Temperature vs. Average Speed Per Day (12/4/19-12/11/19)

Visualization 4 (Pie Chart) showed that 75% of the time, the weather was reported to be cloudy, 12.5% rain, and the remaining 12.5% to be snow.



# Problems During the Project

**Problem #1:** Unable to retrieve past year's live traffic & live incident data due to API restrictions → *Solution:* Moved forward only using data from specified dates

**Problem #2:** Converting between regular latitude longitude to World Geodectic System (1984) for bounding box. → *Solution:* Found an online converter so we could ensure we were inputting the data into the code and communicating with the API correctly.

**Problem #3:** Collected timestamps from traffic data in human-readable time, but timestamps from weather data in unix epoch time, while recording hours + sec. → *Solution:* Convert the format of the timestamps. Then limited the timestamp to the hour in order to get matches when we joined the data

**Problem #4:** Weather description data is not numerical. → *Solution:* To calculate the average, used a counter.

**Problem #5:** Visualization #3 y-axis ranges too different. → *Solution:* Used a sub-plot line graph instead.

**Problem #6:** X-axis ticks were not showing the first date that we started recording data, causing scale to be off → *Solution:* Created an empty string placeholder.