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# Weather trends in Canada over the last 10 years (2011 – 2021)

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COURSE | MGSC5127 Data Visualization F2021
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## PROJECT DESCRIPTION

The objective of this group project would be analysing and visualising weather trends from 2011 to 2021 in Canada. Maximum and Minimum temperature, Heat degree days, Cool degree days, Total rain, Total snow, Total precipitation, and snow on the ground are the attributes of the dataset which will cover in this project to visually answer our set of questions. Apart from this, we will demonstrate how the actual weather trends differ from the expected weather trends.

## DATA SET DESCRIPTION

All the data is from 1 file having Metadata with 24 fields, comprising 85810 rows of data in total. The dataset contains all the weather fields like Longitude, Latitude, City Name, Date, Year, Month, Day, Total Snow, Snow on Ground, Direction Max Gust, Speed Max Gust, Mean Temperature, Min Temperature, Max temperature, Relative humidity (min and max), heating and cooling degree days and, total Precipitation of Canada. Here we targeted only two popular cities from each province of Canada to limit the volume of the data set.

| No | Field name | Measurement | Data type | Description |
|---|---|---|---|---|
| 1 | Longitude | Interval | Number (Decimal) | The longitude of each site if given to the nearest second or to the nearest 0.003 of a degree |
| 2 | Latitude | Interval | Number (Decimal) | The latitude of each site if given to the nearest second or to the nearest 0.003 of a degree |
| 3 | City Name | Categorical | String | Canada's city name |
| 4 | Climate Identifier | Categorical | Number (Decimal) | Unique 7-digit ID number assigned for province |
| 5 | ID | Categorical | Number (Decimal) | Unique ID number of the official weather observations taken |
| 6 | Date | Interval | String | Date format for which observation was taken |
| 7 | Province Code | Categorical | String | Canada's province code |
| 8 | Year | Interval | String | Year format |
| 9 | Month | Interval | String | Month format |
| 10 | Day | Interval | String | Day format |
| 11 | Mean Temperature | Interval | Number (Decimal) | Average of maximum and minimum temperature in degree Celsius(°C) |
| 12 | Min Temperature | Interval | Number (Decimal) | Lowest temperature in degree Celsius(°C) observed for a specific location for specified time interval |
| 13 | Max Temperature | Interval | Number (Decimal) | Highest temperature in degree Celsius(°C) observed for a specific location for specified time interval |
| 14 | Total Precipitation | Ratio | Number (Decimal) | Sum of total rainfall (mm) and water equivalent of the total snowfall (mm) observed for a specific location for specified time interval |
| 15 | Total Snow | Ratio | Number (Decimal) | Total snow or amount of frozen precipitation (cm) such as snow and ice |

| | | | | |
|---|---|---|---|---|
| | | | | pellets observed for a specific location for specified time interval |
| 16 | Snow on Ground | Ratio | Number (Decimal) | The depth of snow in centimetres (cm) on the ground |
| 17 | Cooling Degree Days | Ratio | Number (Decimal) | Cooling degree-days for a given day are the number of degrees Celsius that the mean temperature is above 18 °C |
| 18 | Heating Degree Days | Ratio | Number (Decimal) | Heating degree-days for a given day are the number of degrees Celsius that the mean temperature is below 18 °C |
| 19 | Min Rel Humidity | Ratio | Number (Decimal) | The minimum percentage (%) value of all hourly relative humidity values observed at a specified location for a specified time interval |
| 20 | Max Rel Humidity | Ratio | Number (Decimal) | The maximum percentage (%) value of all hourly relative humidity values observed at a specified location for a specified time interval |
| 21 | Total Rain | Ratio | Number (Decimal) | The total rainfall, or amount of all liquid precipitation in millimetres (mm) such as rain, drizzle, freezing rain, and hail, observed at the location during a specified time interval |
| 22 | Direct Max Gust | Interval | Number (Decimal) | The direction (in degrees) of the maximum gust (true or geographic, not magnetic) from which the wind blows |
| 23 | Speed Max Gust | Ratio | Number (Decimal) | The speed in kilometres per hour (km/h) of the maximum wind gust during the day |
| 24 | Date (group) | Interval | String | Grouped 2 years 2011 and 2021 for Q1 |

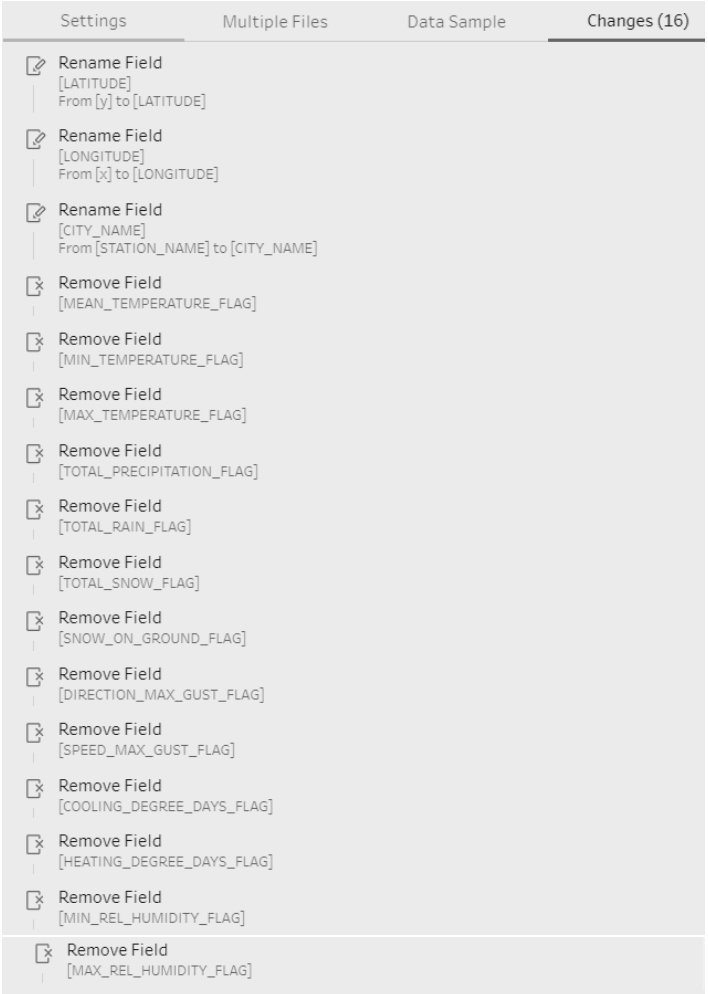
## DATASET NAME AND URL

Canada Weather, https://climate.weather.gc.ca/historical_data/search_historic_data_e.html
Weather Glossary, https://climate.weather.gc.ca/glossary_e.html#a

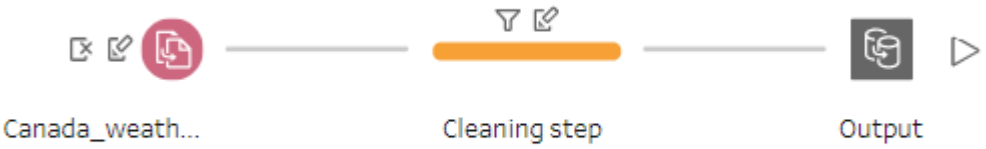
## DATA CLEANING USING TABLEAU PREP BUILDER

- Renamed fields x, y, station_name
- As there were many null values in the columns – Total Snow, Snow on Ground, Min Rel Humidity, Max Rel Humidity, Total Rain, Direct Max Gust, Speed Max Gust we have made those fields hidden and not considered in our project.
- Removed fields that contain flag value (0 or 1): MEAN_TEMPERATURE_FLAG, MIN_TEMPERATURE_FLAG,MAX_TEMPERATURE_FLAG,TOTAL_PRECIPITATION_FLAG, TOTAL_RAIN_FLAG,TOTAL_SNOW_FLAG,SNOW_ON_GROUND_FLAG,DIRECTION_MAX_GUST_FLAG,SPEED_MAX_GUST_FLAG,COOLING_DEGREE_DAYS_FLAG,HEATING_DEGREE_DAYS_FLAG, MIN_REL_HUMIDITY_FLAG, MAX_REL_HUMIDITY_FLAG.

- Grouped values under the field City Name as part of the cleaning process to better yield the visualization results.



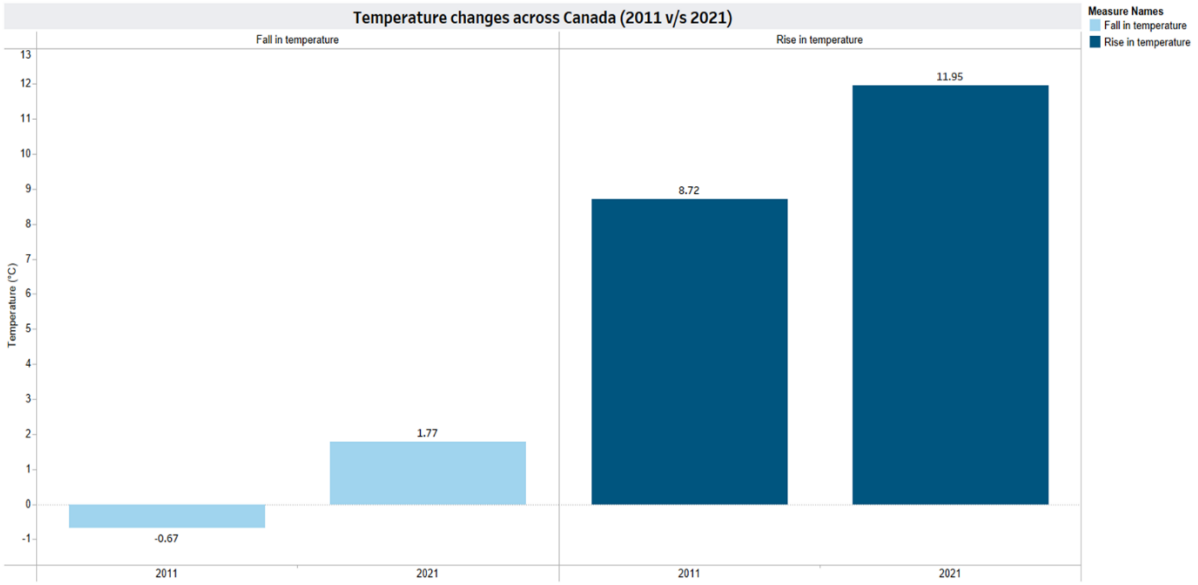

- Below is the flow for the cleaned data.




- As we proceeded with the plotting charts, we renamed fields logically in Tableau. The final columns were – LONGITUDE (deg), LATITUDE (deg), City Name, Climate Identifier, ID, Date, Province Code, Year, Month, DAY, Mean Temperature (°C), Min Temperature (°C), Max Temperature (°C), Total Precipitation (mm), Cooling Degree Days, Heating Degree Days, Date (group).

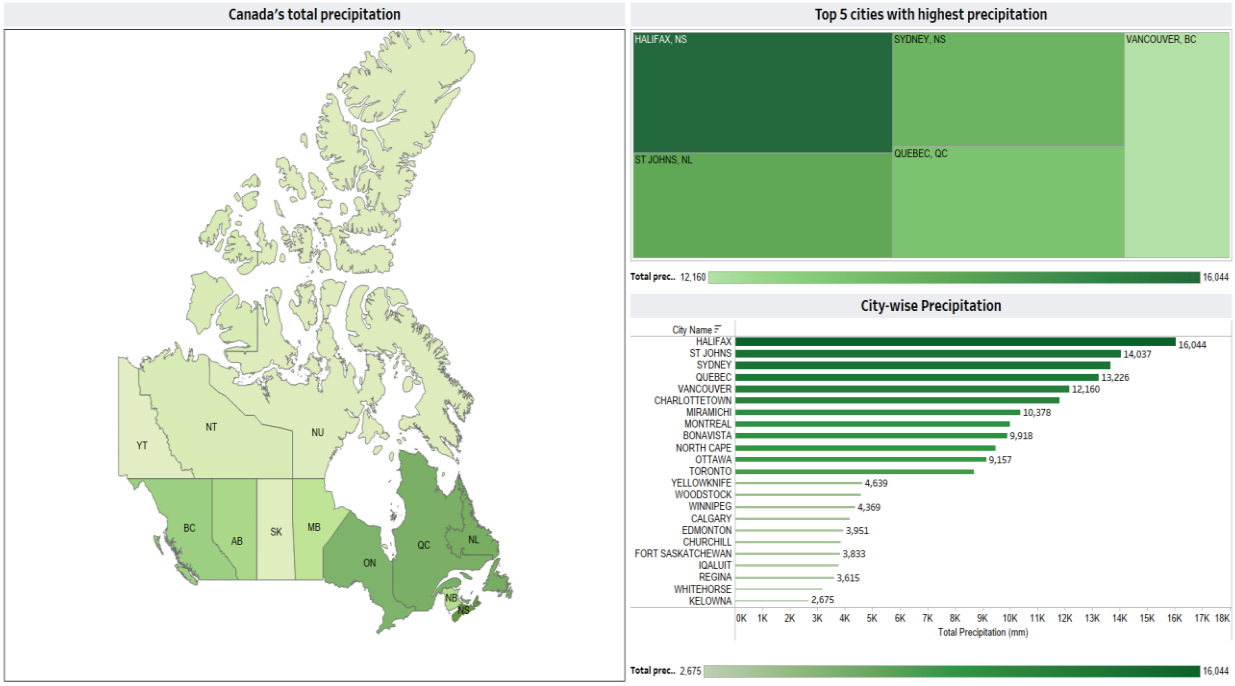
## QUESTIONS AND VISUALIZATION USING TABLEAU

### 1. What are the changes in the temperature (Hot/Cold) across Canada from 2011 v/s 2021?




Here we wanted to showcase the comparison between the Year 2011 vs the Year 2021 for the temperature rise and fall (min and max temperature) all over Canada. Here we used a vertical bar chart for visualization and added the only years 2011 and 2021 in the filter. By seeing the visualization, we can clearly state that there is around a 4°C rise in temperature in Canada in the past 10 years.

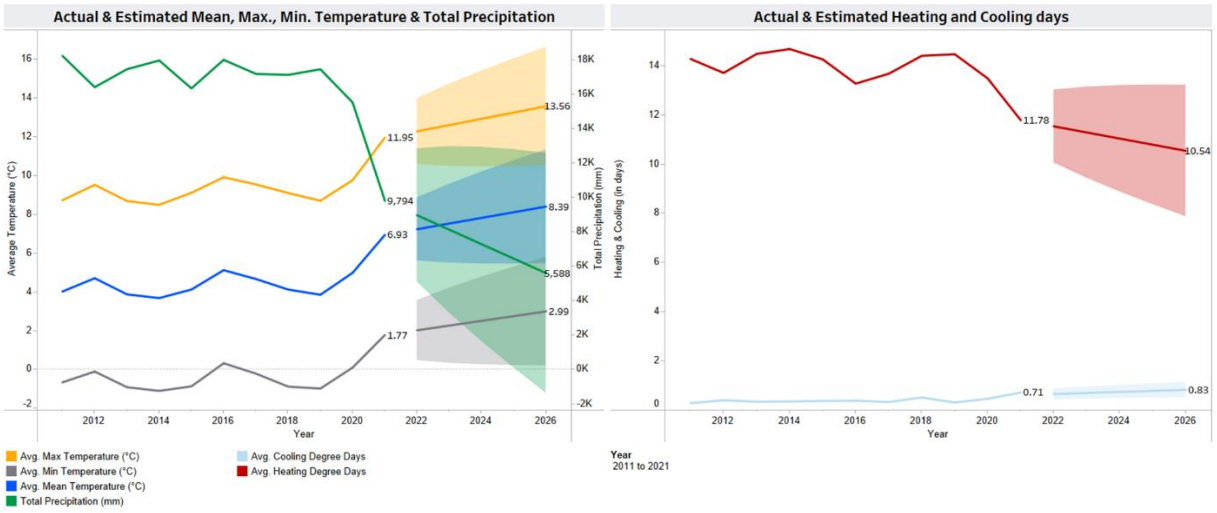
### 2. Top 5 Cities with highest total precipitation?




From this question, we wanted to know the highest precipitation of the top 5 most cities in Canada. Here for visualization, we used geographical, treemap, and horizontal bar charts. In the final dashboard of the question, we used the action function to link all 3 charts. We used the province filter

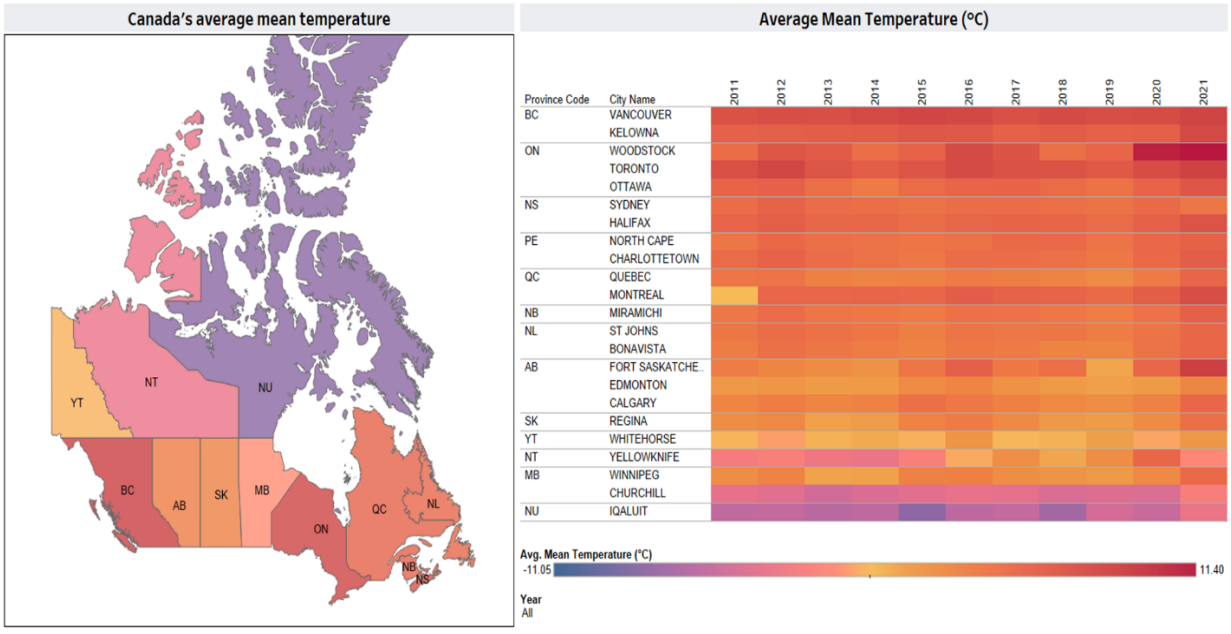
to know if that province has any city which comes under the top 5 cities which are having the highest precipitation in Canada.

### 3. How do the actual trends in Canadian weather (mean, max., min., precipitation, heating, cooling days) differs from the expected weather trends?




Here we forecasted the weather trends in Canada for the next 5 years (2022-26) based on the data from the past 10 years (2011-2021) using the Tableau forecast function. All forecasts were computed using exponential smoothing with an Additive trend & seasonal effect. We used a line chart for the clear and easy visualization. From the visualization, we can predict that only precipitation and heating degree days are falling, whereas min, max and mean temperature, and cooling degree days are rising.

### 4. Mean temperature across Canada?




Here we are comparing the mean temperature for all Canada province wise. We used province name and year as a filter to check the mean temperature variation of a specific province at a given year. We used geographical map0 and heat map. The provinces in the North like Nunavut has very harsh and

cold temperature whereas the southern and west coast province British Columbia has the highest mean temperature in Canada.

## CONCLUSION

Given the large geographic expanse of Canada, historical climate changes have varied across the country, and projected future changes will vary as well. Annual and seasonal mean temperatures across Canada have increased. Likewise, many other aspects of climate that are important to Canadians are also changing because of global-scale climate change Canada's climate is intimately linked to the global climate. Thus, changes in Canada's climate are a manifestation of changes in the global system, modulated by the effects of Canada's mountains, coastlines, and other geographical features.

## CONTRIBUTION

We would like to thank Dr. Enayat Rajabi for his utmost guidance at every step of this project. This project was done as group work using Microsoft Teams as a medium. We had meetings twice a week to discuss the status and work on the visualization. All four of us bring different skills and we were able to leverage each of them to enhance each worksheet through collaboration. It would be difficult for us to exactly quantify the efforts of each person as we worked on it collaboratively. Data collection is done Ajay and Manik, Data cleaning by Jinal and Akshay, Plotting and Visualization is divided into 4 questions done by each one us - Q1 Manik, Q2 Akshay, Q3 Jinal and Q4 Ajay, Storytelling by Jinal and Akshay, and documentation by Ajay and Manik.