Weather Impact Analysis on Formula 1 Driver Performance

Cat Weiss, Akin Akinlabi, Gia Nguyen
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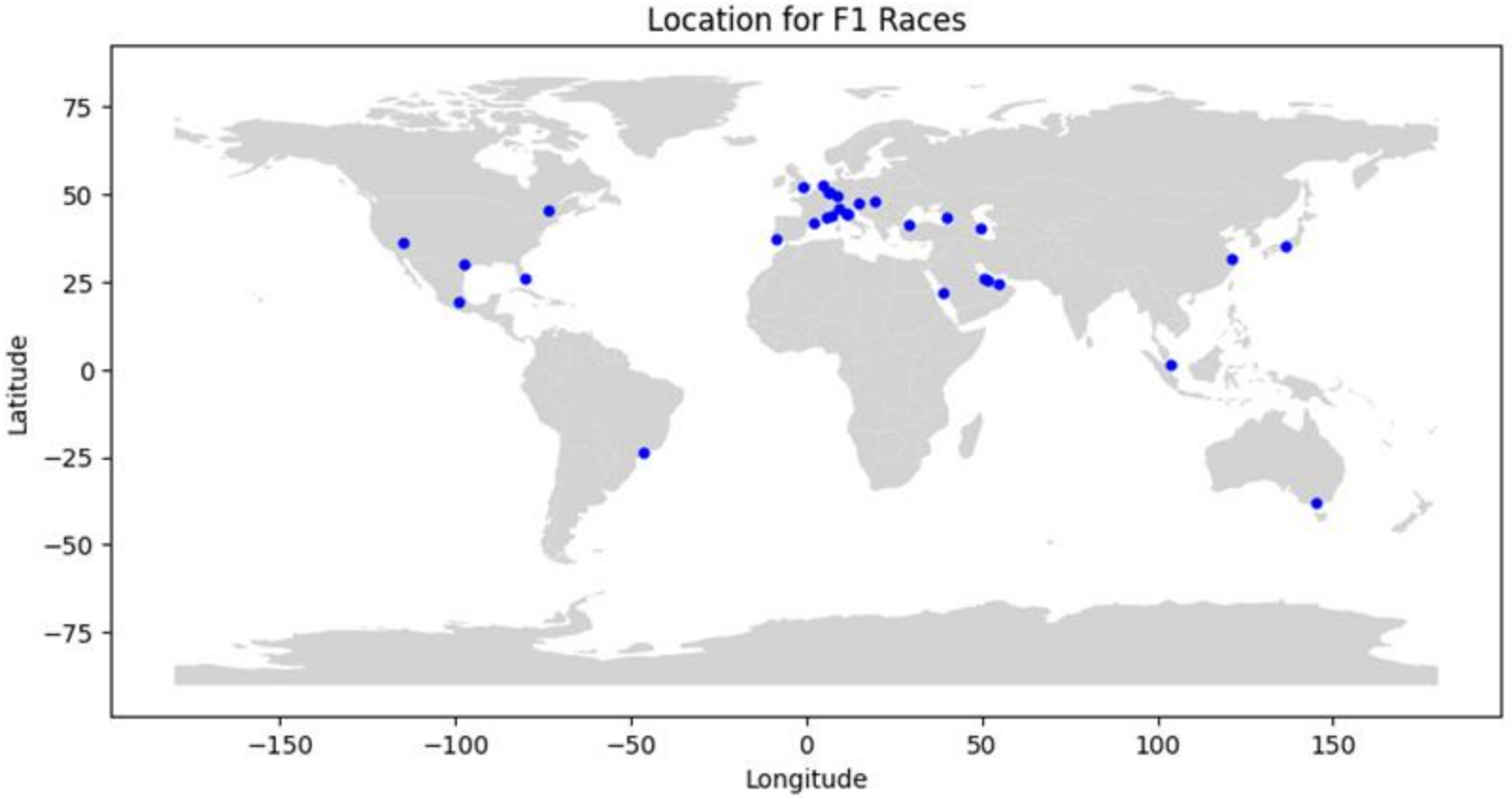
Introduction

- Increase in Formula 1 popularity
- New circuits
- Driver reputation in varying weather patterns



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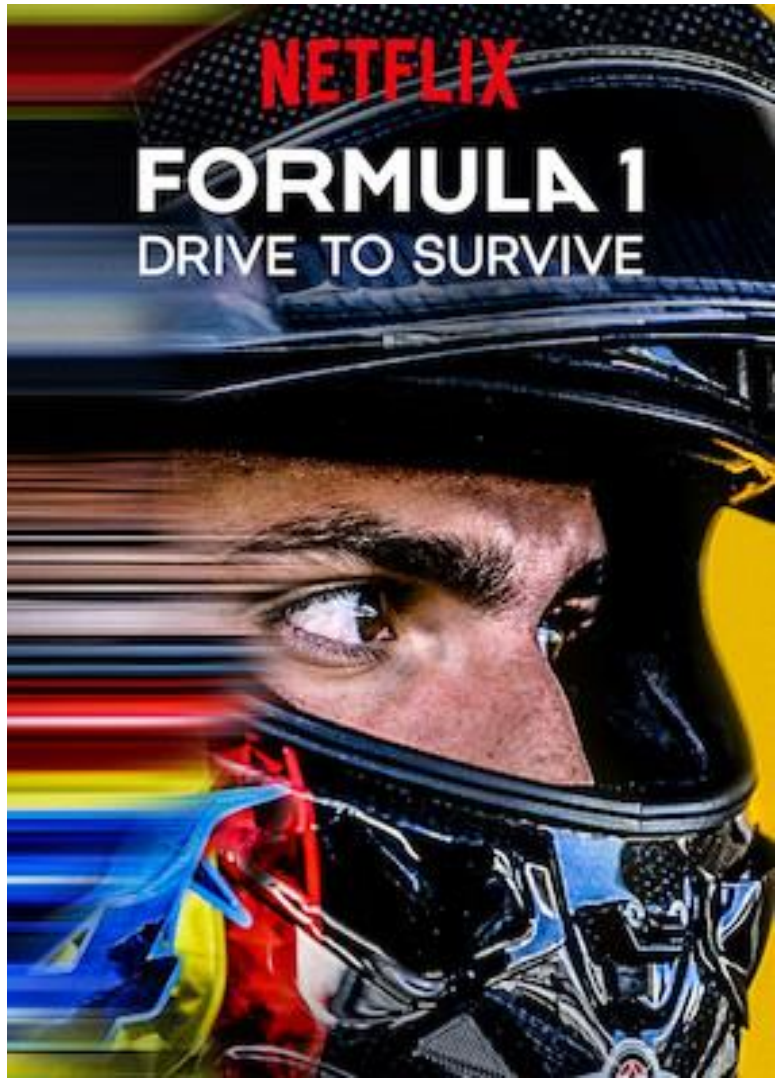
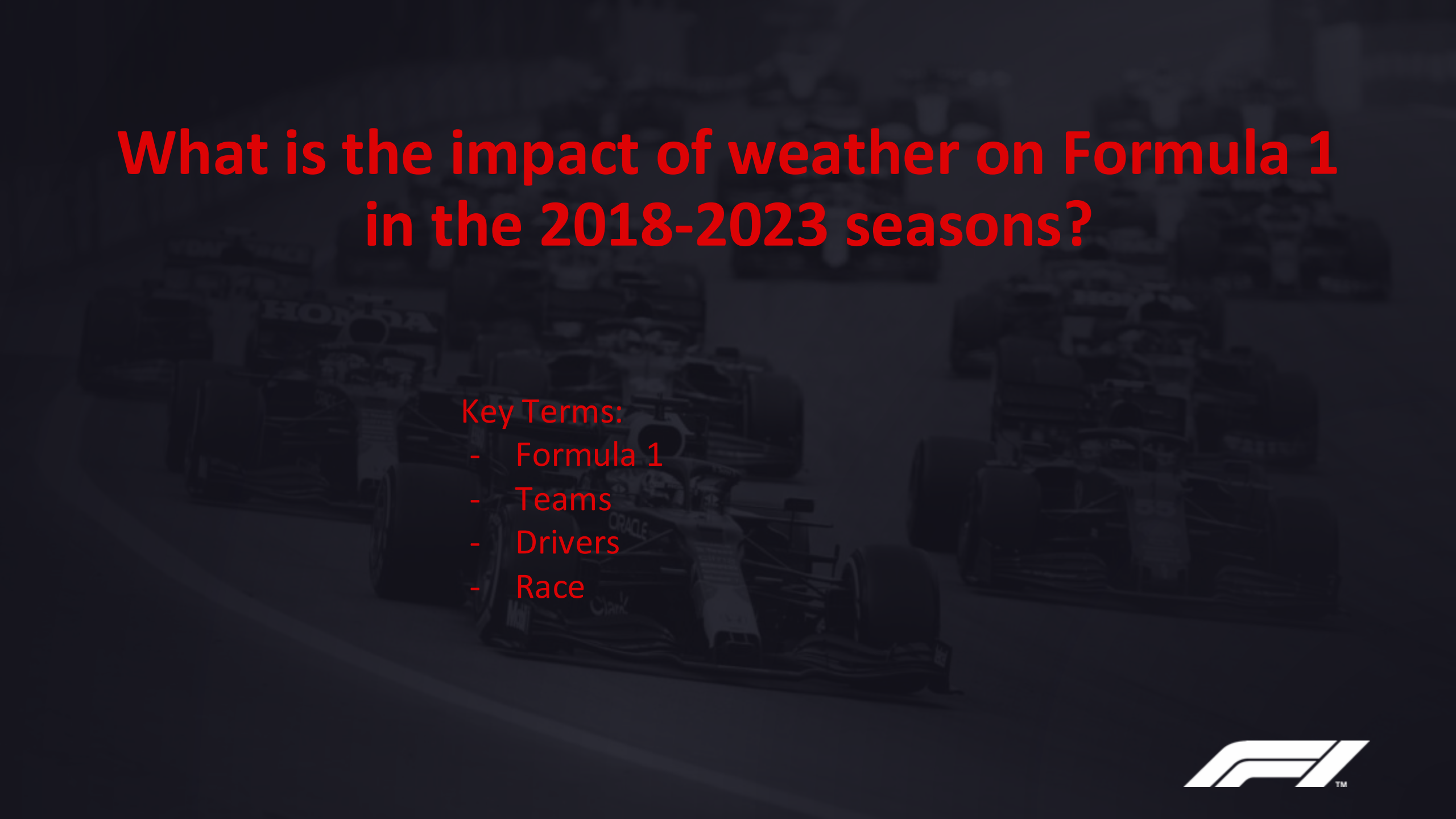


What is the impact of weather on Formula 1 in the 2018-2023 seasons?



Key Terms:

- Formula 1
- Teams
- Drivers
- Race

Datasets

Race Dataset

Ergast API

Weather Dataset

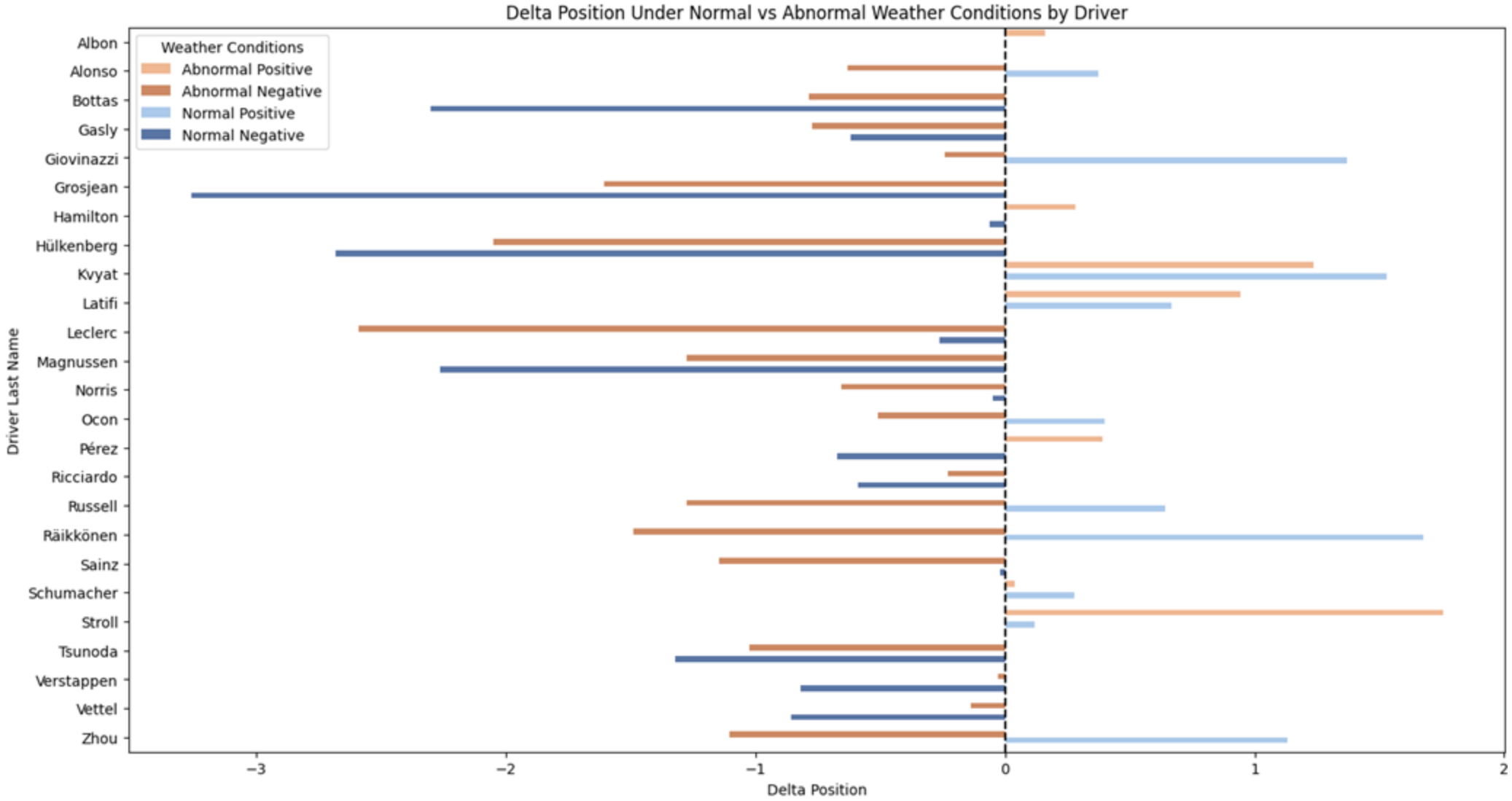
Open-Meteo API

Master Dataset

Exploratory Data Analysis

1. How have abnormal weather conditions influenced driver standings at the end of each race from 2018-2023?

Position Change



Position Change

- Average position change over one
  - Abnormal Conditions: only 2 drivers
  - Normal Conditions: 4 drivers
- Most consistent drivers have minimal change
  - Albon
  - Hamilton

	last_name	Normal	Abnormal
0	Leclerc	-0.261905	-2.590164
1	Hülkenberg	-2.681818	-2.048780
2	Grosjean	-3.260870	-1.606061
3	Räikkönen	1.676471	-1.488889
4	Russell	0.642857	-1.274194
5	Magnussen	-2.263158	-1.274194
6	Sainz	-0.020000	-1.146667
7	Zhou	1.133333	-1.103448
8	Tsunoda	-1.320000	-1.024390
9	Bottas	-2.300000	-0.786667
10	Gasly	-0.620000	-0.773333
11	Norris	-0.047619	-0.655738
12	Alonso	0.375000	-0.629630
13	Ocon	0.400000	-0.507937
14	Giovinazzi	1.370370	-0.242424
15	Ricciardo	-0.590909	-0.230769
16	Vettel	-0.857143	-0.137931
17	Verstappen	-0.820000	-0.026667
18	Schumacher	0.277778	0.040000
19	Albon	0.000000	0.160000
20	Hamilton	-0.061224	0.283784
21	Pérez	-0.673469	0.391892
22	Latifi	0.666667	0.941176
23	Kvyat	1.529412	1.238095
24	Stroll	0.120000	1.753425

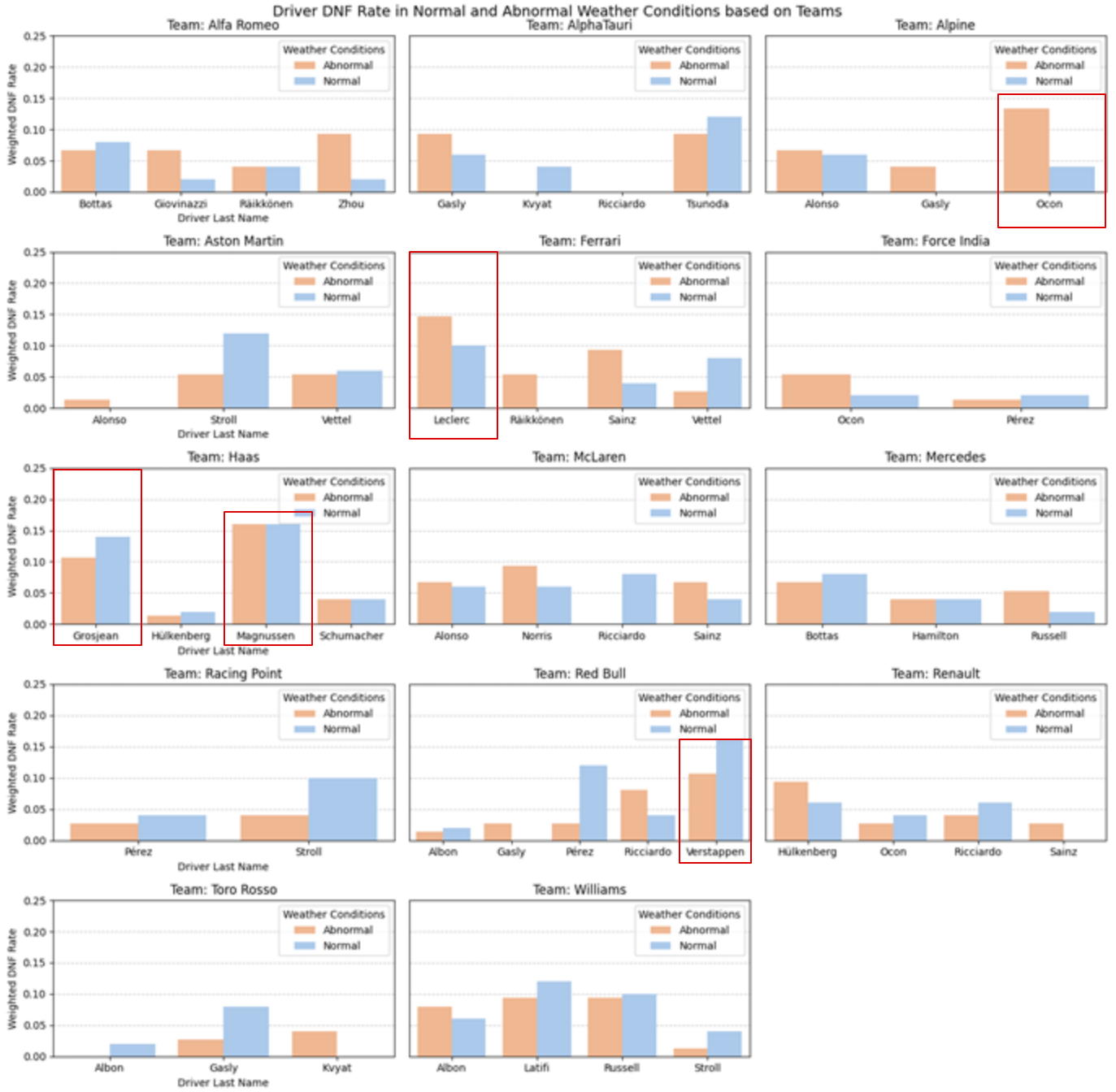
sorted by Abnormal

Exploratory Data Analysis

2. Do specific drivers exhibit different DNF(Did Not Finish) rates under varying weather conditions?

DNF Rate

- The majority of drivers displayed higher DNF rates in abnormal weather conditions compared to normal conditions
  - Leclerc, Magnussen, Grosjean, and Verstappen are notable for their high DNF rates across both abnormal and normal weather conditions
  - Ocon, representing Alpine, is particularly challenged by abnormal weather conditions, standing out in this category



DNF Rate

- 50% of the teams exhibited DNF rates exceeding 10% in abnormal weather conditions
  - Ferrari and Haas are at the forefront with DNF rates of 16%
  - Alongside Haas, both Red Bull and Williams teams face challenges with DNFs in normal weather conditions
- Mercedes and Aston Martin maintain DNF rates surprisingly below 10% in both abnormal and normal weather conditions

	team_name	Abnormal	Normal
0	Ferrari	0.160000	0.11
1	Haas	0.160000	0.18
2	Williams	0.140000	0.16
3	Alfa Romeo	0.133333	0.08
4	Red Bull	0.126667	0.17
5	Alpine	0.120000	0.05
6	McLaren	0.113333	0.12
7	AlphaTauri	0.093333	0.11
8	Renault	0.093333	0.08
9	Mercedes	0.080000	0.07
10	Aston Martin	0.060000	0.09
11	Force India	0.033333	0.02
12	Racing Point	0.033333	0.07
13	Toro Rosso	0.033333	0.05

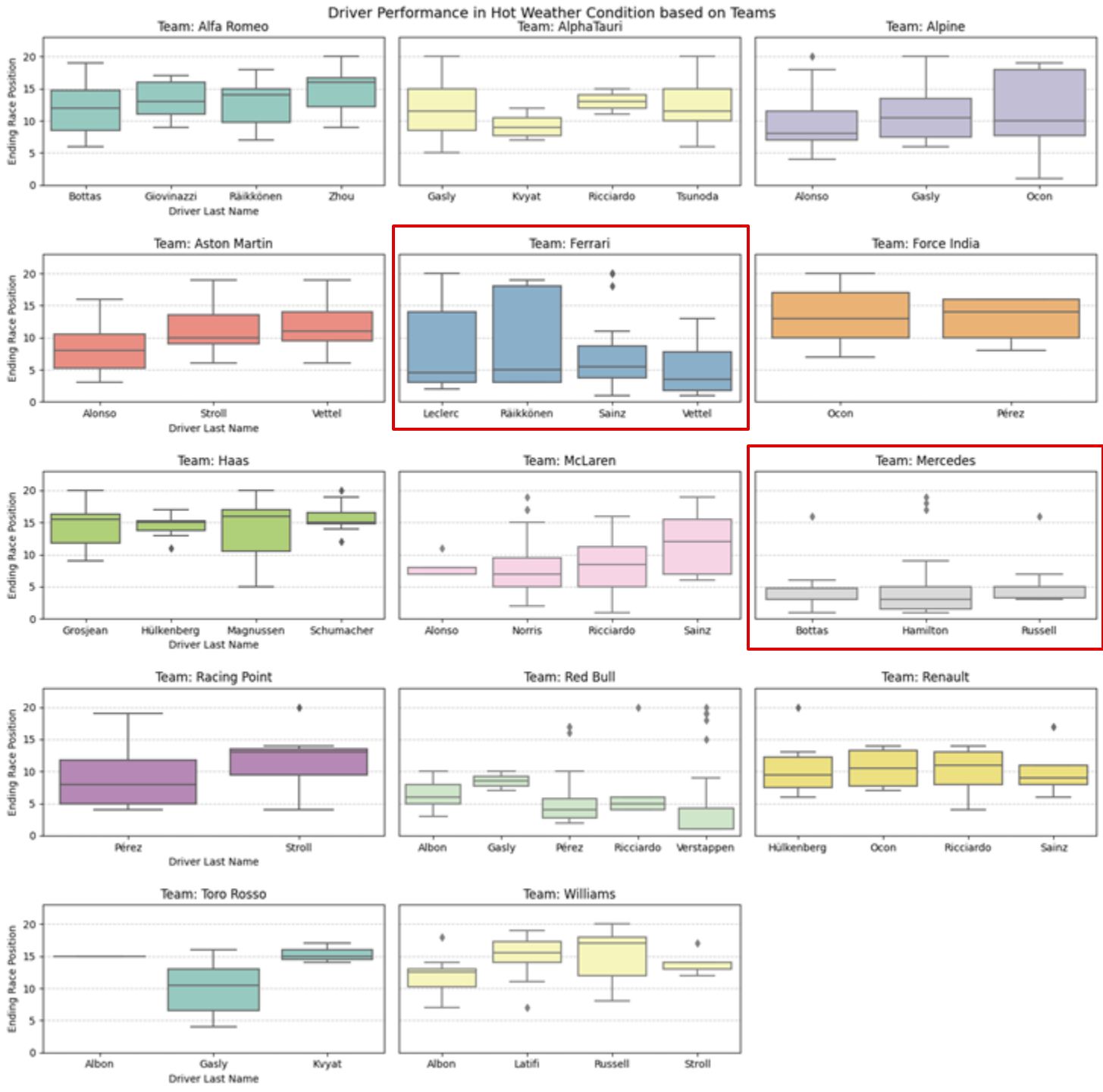
Exploratory Data Analysis

3. What patterns emerge in driver’s performance across different weather conditions?

Hot Conditions

Key Takeaways:

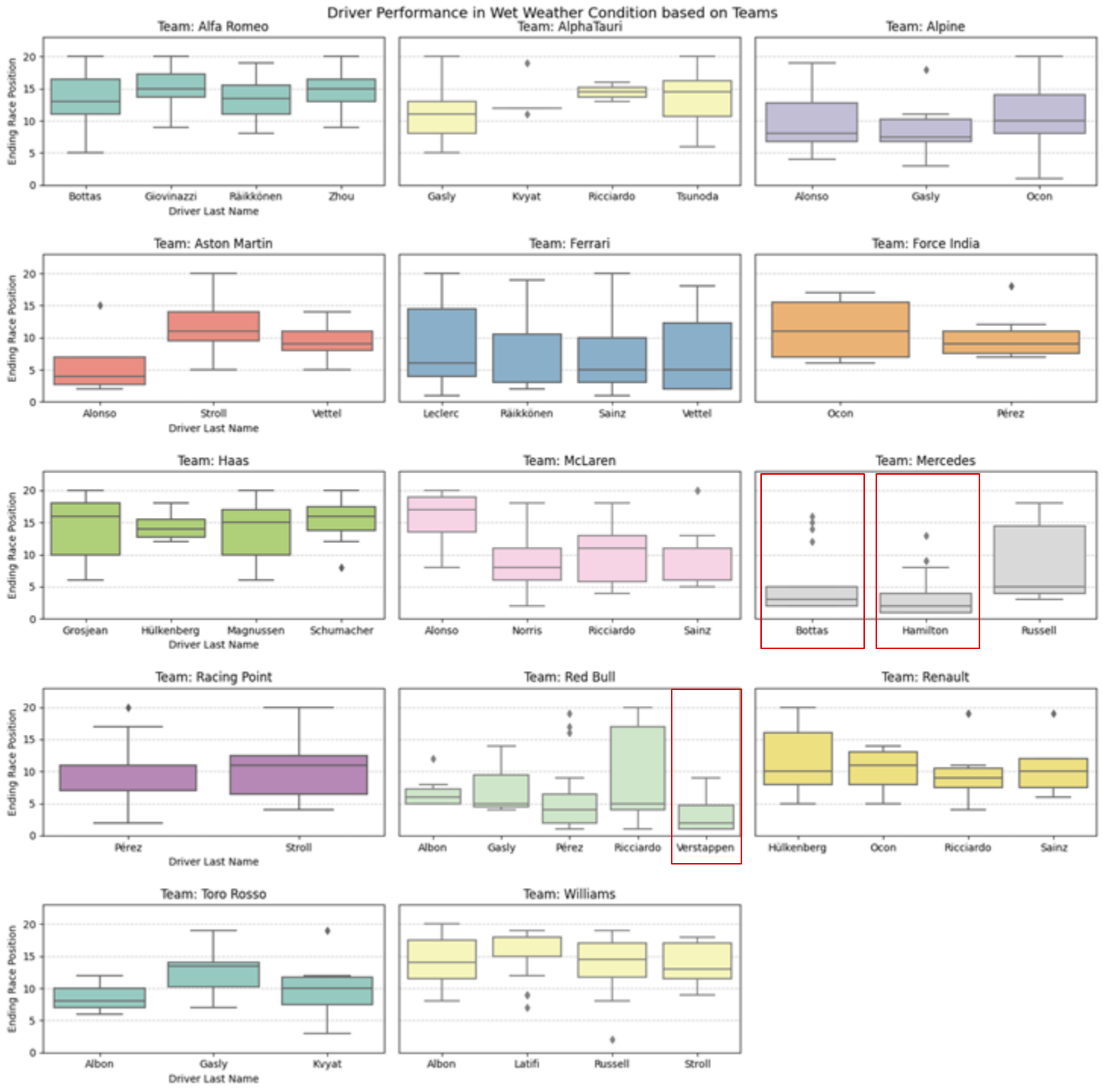
- ➢ Mercedes performs the best due to tighter interquartile (IQR) range with lower ending race positions
- ➢ Ferrari have wider IQR range → more variability in their finishes



Wet Conditions

Key Takeaways:

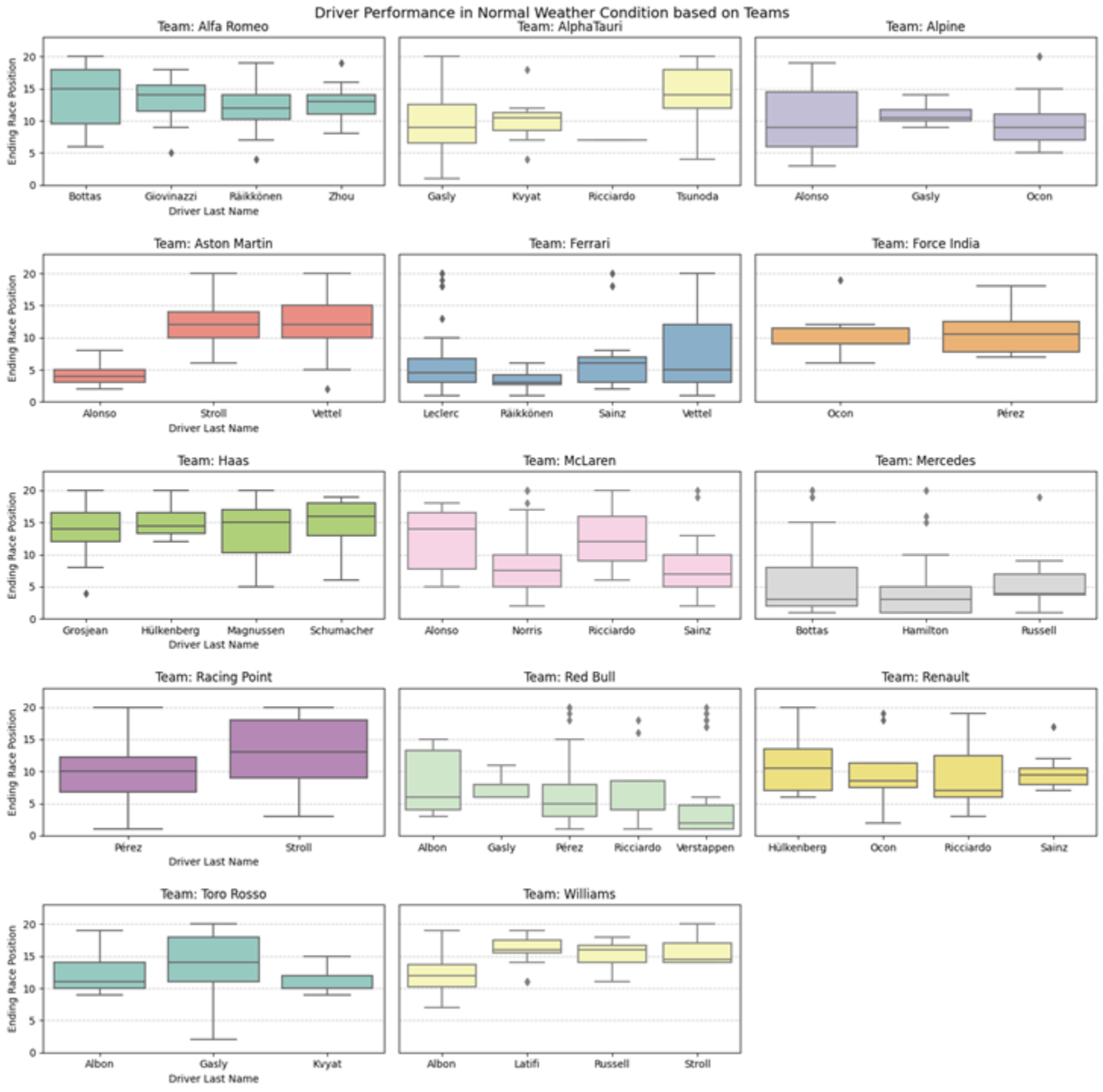
- Verstappen, Hamilton, Bottas performs exceptionally well under wet conditions with a few outliers
- These 3 drivers are known for driving under wet conditions



Normal Conditions

Key Takeaways:

- More variability due to more data points
- Lots of drivers did better under a specific abnormal weather conditions
- Theory: under controlled weather, drivers tend to take more risks



Conclusion

- Abnormal weather conditions contribute to a high volume of races per season, posing frequent challenges for F1 drivers
- These conditions lead to an increased DNF (Did Not Finish) rate of 15%, compared to a 14% rate in normal weather
- Haas experiences the highest DNF rates in both weather categories
  - Kevin Magnussen has the highest individual DNF rates across all weather categories.
  - Romain Grosjean, his teammate, is also close behind in terms of high DNF rates
- Max Verstappen has one of the highest DNF rates in both weather categories, yet he consistently ranks among the top performers
- Mercedes and Aston Martin demonstrate remarkable reliability, maintaining lower DNF rates in both weather categories
  - Lewis Hamilton stands out as one of the few drivers with DNF rates below 5% in both weather categories and consistently ranks among the top performers

Q&A

Appendix

Abnormal Weather Criteria

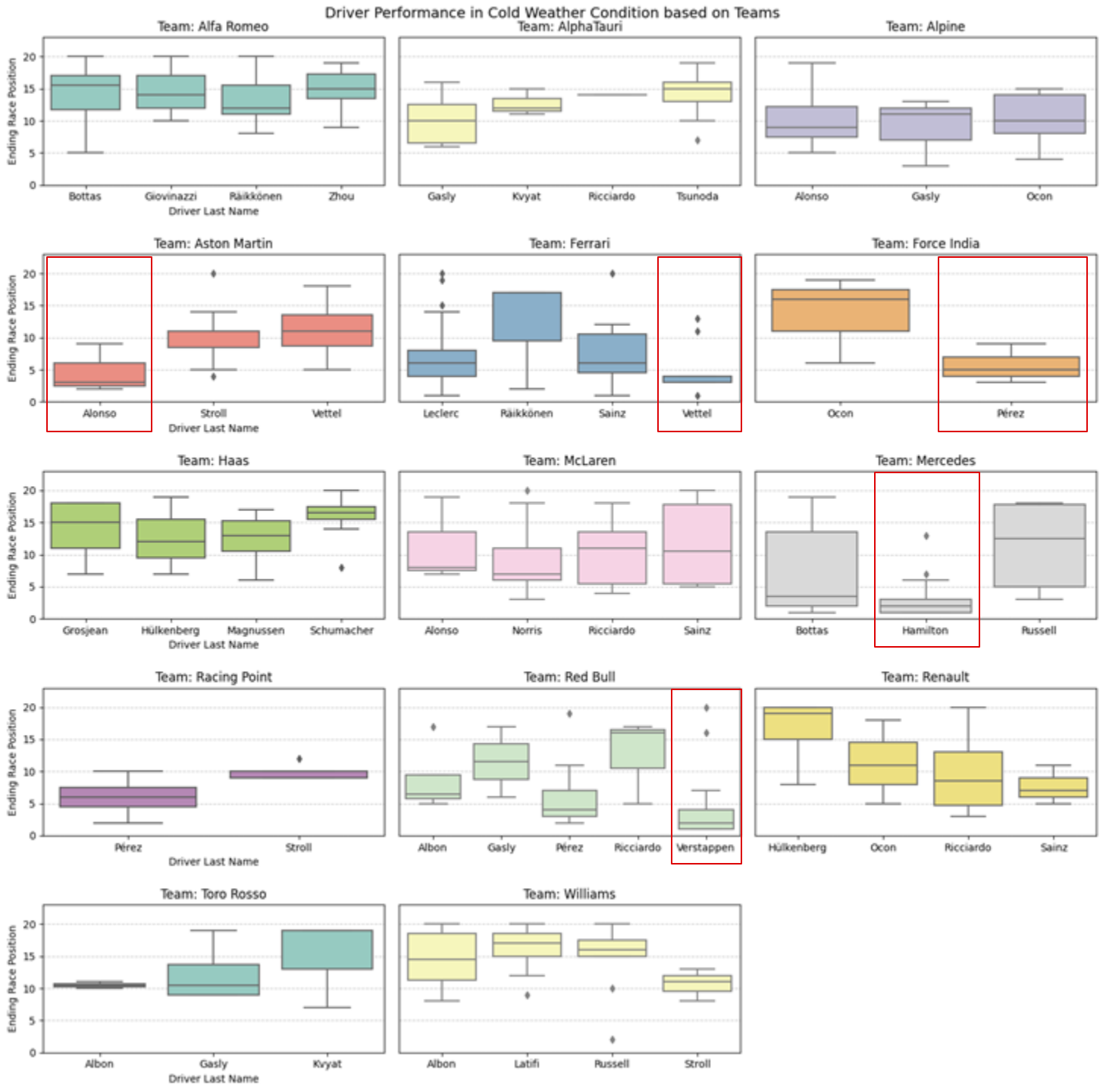
We defined the criteria for abnormal weather conditions as follows:

- Wet conditions: any race where precipitation is greater than 0 inches
- Windy conditions: any race where the wind speed was greater than 25 miles per hour
- Cold conditions: the bottom 10% of races by temperature, includes all races 62.4 degrees and below
- Hot conditions: the top 20% of races by temperature, includes all races 80.3 degrees and above

Cold Conditions

Key Takeaways:

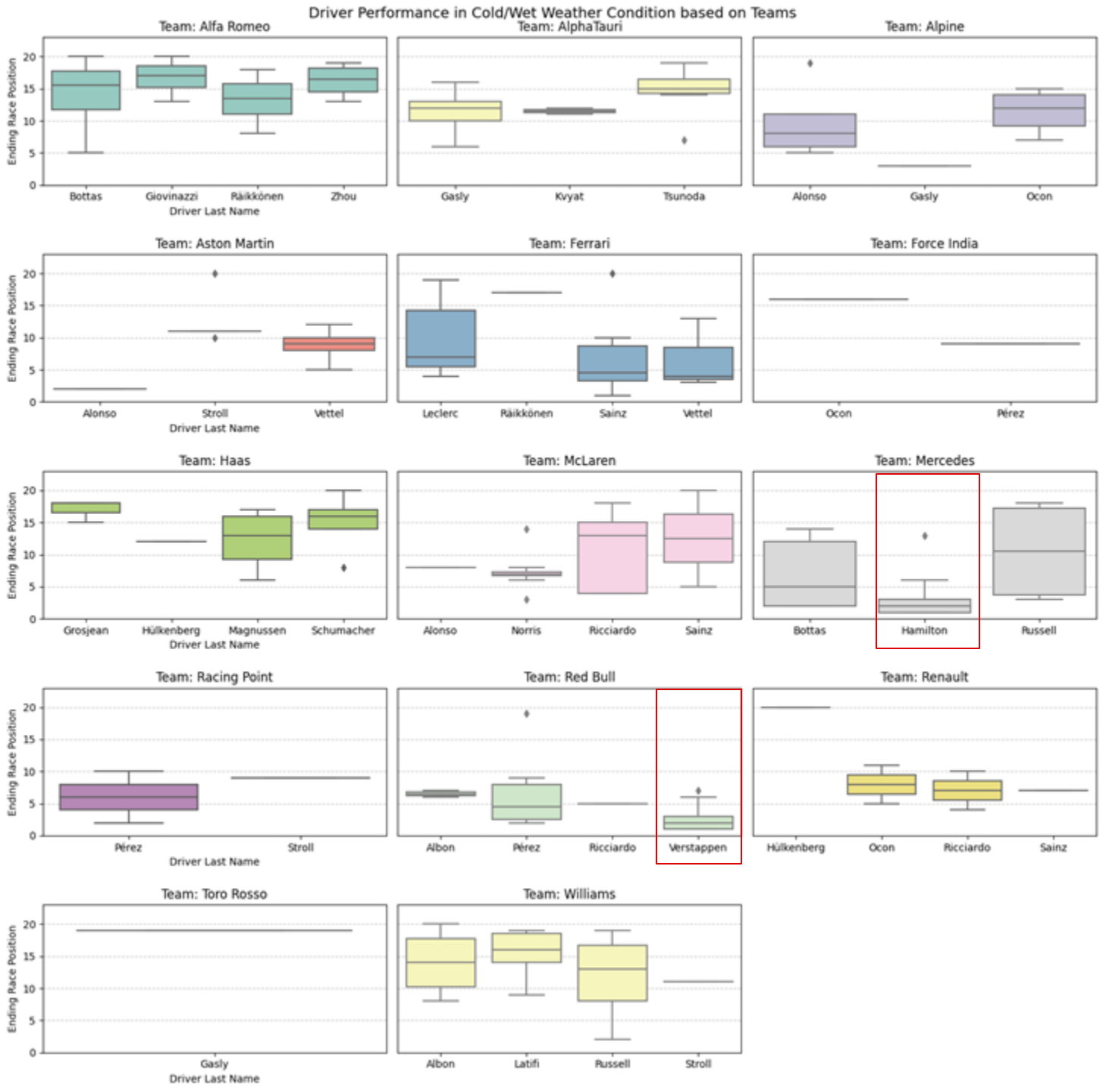
- Verstappen, Hamilton, Perez, Vettel and Alonso performs exceptionally well under cold conditions with a few outliers
- Bottas, Russell and Ricciardo performs worse in this weather



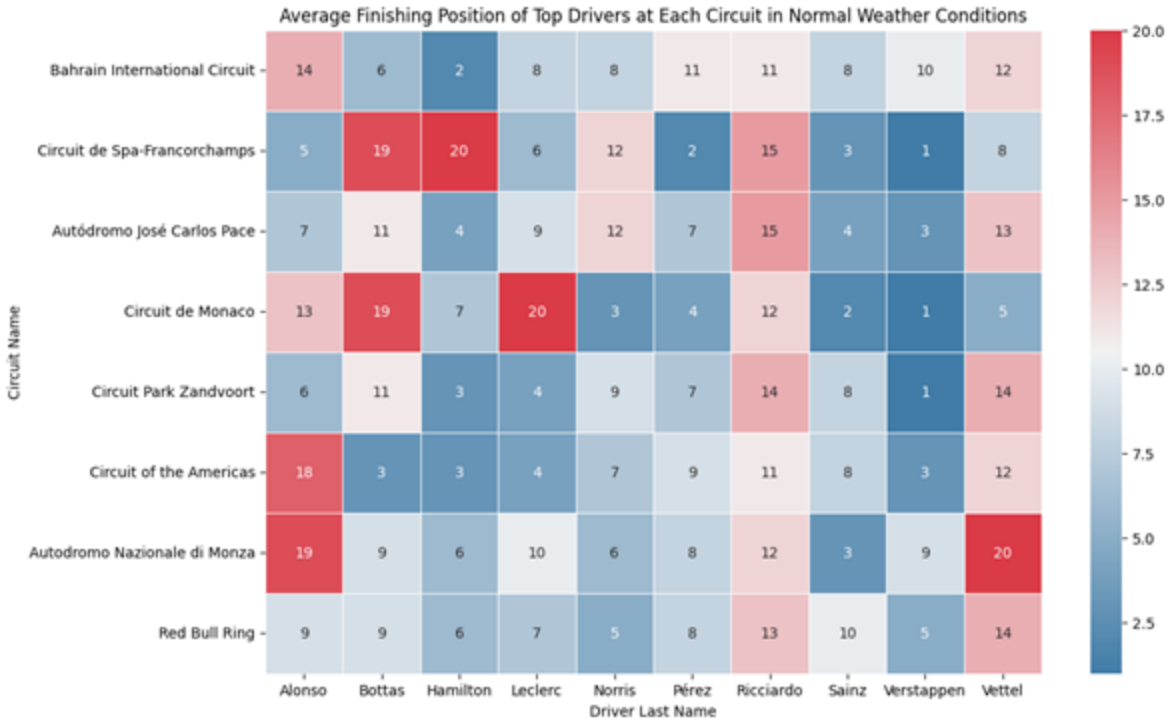
Cold/Wet Conditions

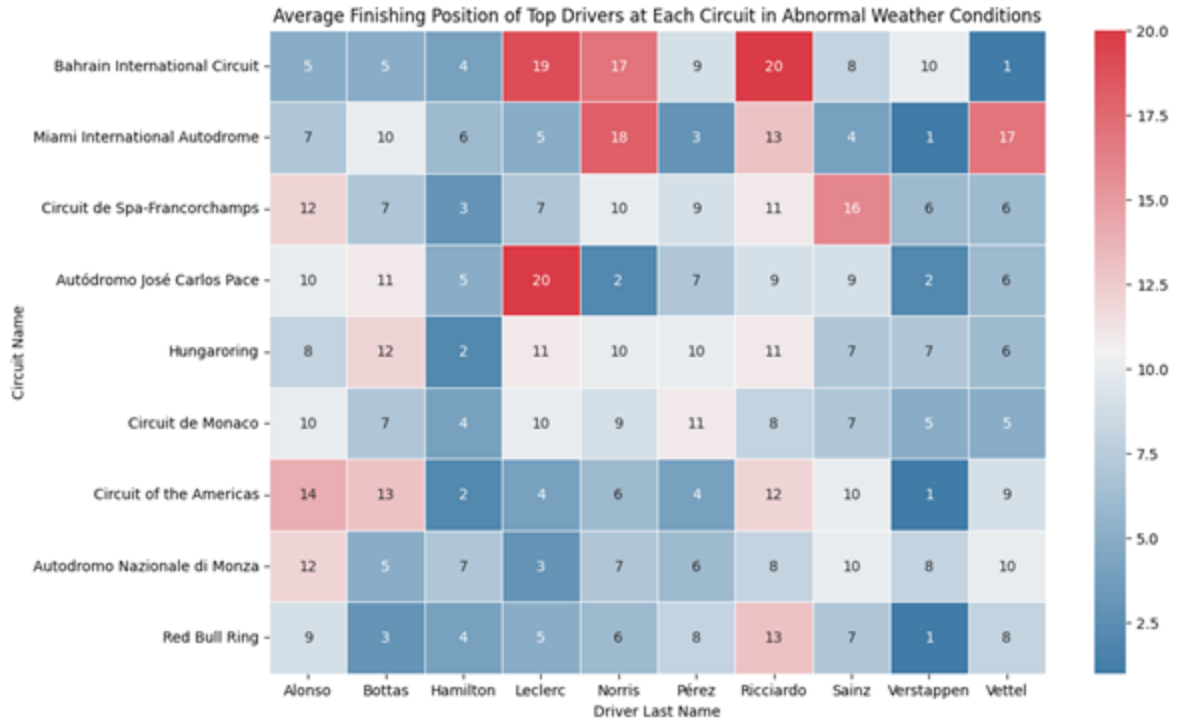
Key Takeaways:

- 169 entries for this combination of weather
- Lots of drivers have only raced once
- Hamilton and Verstappen stands out



Heatmaps


Average Finishing Position of Top Drivers at Each Circuit in Normal Weather Conditions
Bahrain International Circuit 14 6 2 8 8 11 11 8 10 12
Circuit de Spa-Francorchamps 5 19 20 6 12 2 15 3 1 8
Autódromo José Carlos Pace 7 11 4 9 12 7 15 4 3 13
Circuit de Monaco 13 19 7 20 3 4 12 2 1 5
Circuit Park Zandvoort 6 11 3 4 9 7 14 8 1 14
Circuit of the Americas 18 3 3 4 7 9 11 8 3 12
Autodromo Nazionale di Monza 19 9 6 10 6 8 12 3 9 20
Red Bull Ring 9 9 6 7 5 8 13 10 5 14
Circuit Name
Alonso Bottas Hamilton Leclerc Norris Pérez Ricciardo Sainz Verstappen Vettel
Driver Last Name
20.0 17.5 15.0 12.5 10.0 7.5 5.0 2.5


Average Finishing Position of Top Drivers at Each Circuit in Abnormal Weather Conditions
Bahrain International Circuit 5 5 4 19 17 9 20 8 10 1
Miami International Autodrome 7 10 6 5 18 3 13 4 1 17
Circuit de Spa-Francorchamps 12 7 3 7 10 9 11 16 6 6
Autódromo José Carlos Pace 10 11 5 20 2 7 9 9 2 6
Hungaroring 8 12 2 11 10 10 11 7 7 6
Circuit de Monaco 10 7 4 10 9 11 8 7 5 5
Circuit of the Americas 14 13 2 4 6 4 12 10 1 9
Autodromo Nazionale di Monza 12 5 7 3 7 6 8 10 8 10
Red Bull Ring 9 3 4 5 6 8 13 7 1 8
Circuit Name
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Driver Last Name
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