# The effect of the coronavirus on the CO2 emissions on the transport sector.

Project Group - 4

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GitHub: https://github.com/woutersouge/TIL6022

## Contribution Statement

**Tim Traas**: Writing of the text, generating the streamlit and making a worldmap

**Max Hendriks**: Answering the research question by calculating the delta and normalized delta of the co2 emissions for each data and visualizing it in a table.

**Wouter Sougé**: Writing the code to create an interavtive graph. These loops have been further used to obtain the delta, which Max calculated. Writing of the text and creating the final notebook.

## Research Objective

We will research the following question: "What is the effect of COVID-19 on different transport sectors, looking at CO2 emissions?"

To answer this research question we will look into the dataset found [1]. This dataset shows emissions for different sectors, including transport sectors for major countries worldwide. Using this dataset we would like to visualize an online interactive dashboard including:

A world map visualizing the emissions per country with a drop-down menu to select dates and specific countries. Bar graphs visualizing emissions per country on a fixed time period. Sectorial effects per country group Analysis of peaks and comparing this to measures taken by governments The major transport sectors that can be found are aviation, ground transport and shipping.

References:

1. Liu, Z., Ciais, P., Deng, Z. et al. Near-real-time monitoring of global CO2 emissions reveals the effects of the COVID-19 pandemic. Nat Commun 11, 5172 (2020). https://doi.org/10.1038/s41467-020-18922-7
2. https://datahub.io/core/geo-countries#resource-countries

# Introduction

Introduction

The aviation industry is one of the most important and rapidly growing industries in the world. The industry has seen massive growth in recent years, with the number of passengers traveling by air reaching new heights. At the same time, the aviation industry has come under increased scrutiny, with concerns about the environmental impact of air travel and the safety of air travel. This essay will explore the aviation industry and the ground transport industry, and will consider the impact of the coronavirus on these industries.

**What's the effect of Corona on aviation and ground transport industry?**

One of the most significant disruptions has been to transportation. The global supply chain has been thrown into chaos. The transportation sector is a critical part of the global economy. It is responsible for moving people and goods around the world. It is essential for connecting businesses and consumers. The disruptions caused by the coronavirus have had a significant impact on the sector.

To answer our main research question and to support statements made in the introduction, a couple of sub questions have been introduced.

1. Is there a big difference in the decline of CO2 emission by country?
2. Which industry took the biggest hit?
3. Which country took the biggest hit?
4. Could we predict with our data on which dates certain COVID-19?

# Data Used

The data used can be found in 'country_bb' and 'TIL6022_Emission_Dataset'. We have filtered the data in 'dashboard_v3.ipynb'. This data was obtained from a researcher from our faculty.

In the data a weekly cycle was noticed. Therefore we used a week average to plot our graphs below. When hoovering on the plot, different dates can been seen. This is caused by the fact that each week in a specific year picks a day to plot the data. Because a year doesn't have a perfect 52 weeks, this day differs slightly. Python shows the nearest point for the other years.

All the figures shown in this report are created by using the interactive figure at the end of this notebook.

# Streamlit

A streamlit environment is also created to make have everything together and make it easily accesible. A video of streamlit is provided in github and the code used can be found in 'dashboard.py'.

To run the code for yourself, run 'streamlit run path/dashboard.py' in your terminal.

# Is there a big difference in the decline of CO2 emission by country?

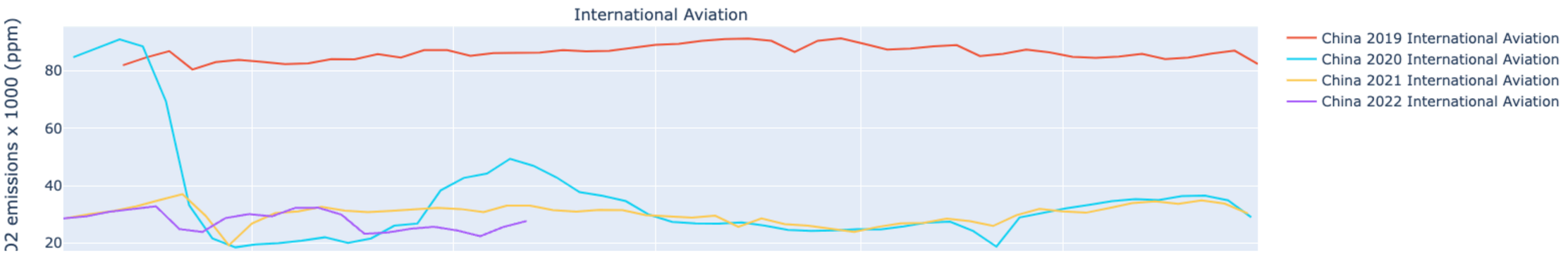
As shown in the table there is not a big difference in the decline of CO2 emission by country in general however there are some outliers such as China and Russia and the international aviation sector in specific. There it is shown that the percentage of the biggest delta is drastically bigger than the other countries, 71 and 80 compared to the 20-30% average.

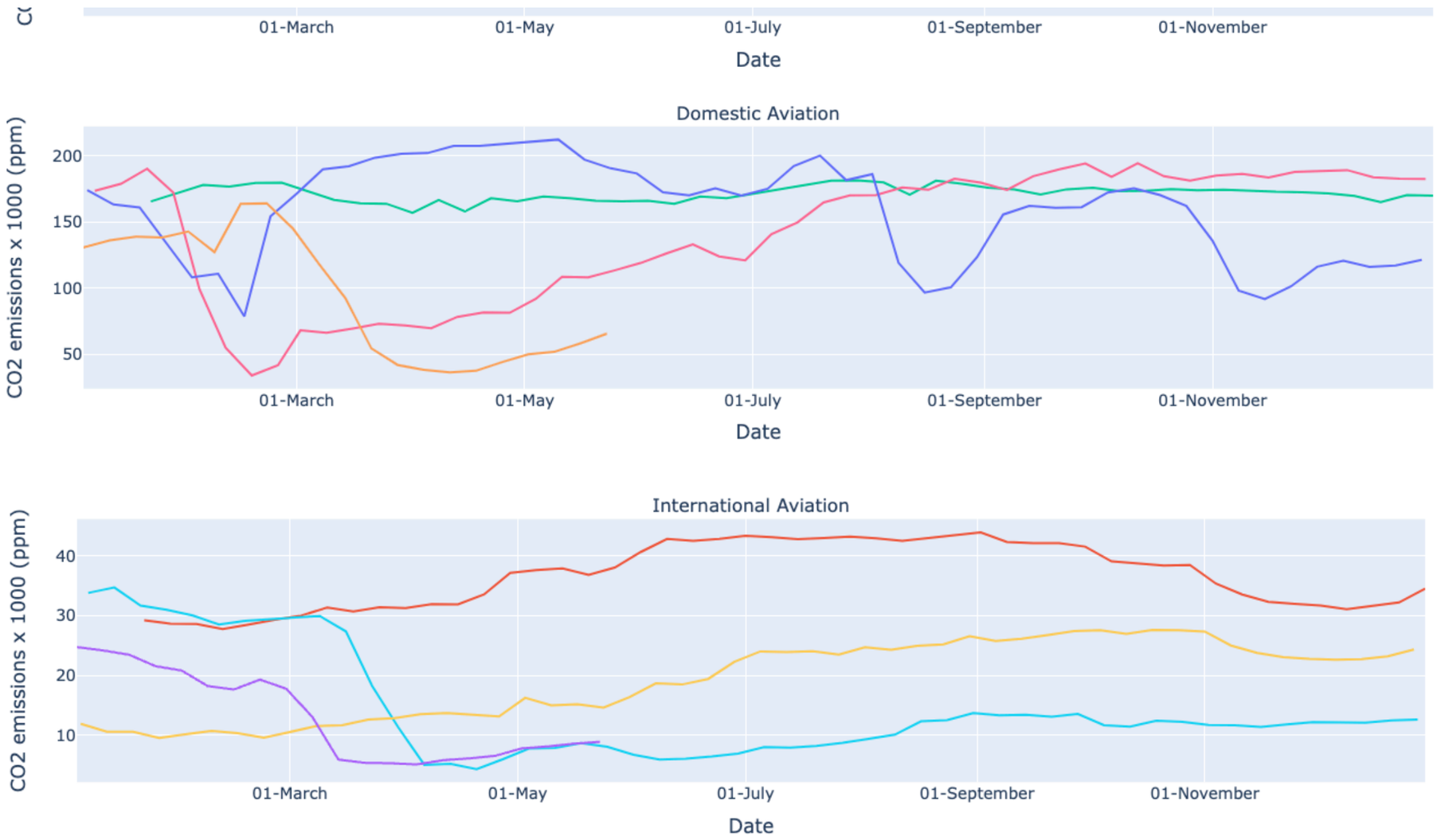
In [ ]:
```
%store -r DeltaTable

DeltaTable
DeltaTable.style.background_gradient(cmap='Blues')
```

Out[ ]:

| Country | Biggest Delta [ppm] | Percentage biggest Delta [%] | Date biggest Delta | Biggest Ground Transportation Delta [ppm] | Percentage biggest Ground Transportation Delta [%] | Date biggest Ground Transportation Delta | Biggest Domestic Aviation Delta [ppm] | Percentage biggest Domestic Aviation Delta [%] | Date biggest Domestic Aviation Delta | Biggest International Aviation Delta [ppm] | Percentage biggest International Aviation Delta [%] | Date biggest International Aviation Delta |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brazil | 170 | 12 | 2020-03-30 | 51 | 11 | 2020-03-30 | 7 | 25 | 2020-03-30 | 4 | 32 | 2020-03-30 |
| China | 3425 | 11 | 2022-01-24 | 410 | 18 | 2020-01-20 | 39 | 77 | 2020-02-03 | 18 | 71 | 2020-02-10 |
| EU27 & UK | 905 | 8 | 2021-12-20 | 218 | 9 | 2020-03-23 | 9 | 21 | 2020-03-16 | 91 | 20 | 2020-03-23 |
| France | 149 | 13 | 2020-03-30 | 43 | 13 | 2020-03-23 | 1 | 23 | 2020-03-23 | 10 | 21 | 2020-03-23 |
| Germany | 284 | 13 | 2020-12-14 | 26 | 6 | 2019-12-16 | 1 | 33 | 2020-03-16 | 13 | 20 | 2020-03-23 |
| India | 863 | 11 | 2020-03-23 | 153 | 19 | 2020-03-23 | 5 | 28 | 2020-03-30 | 8 | 30 | 2020-03-16 |
| Italy | 104 | 10 | 2020-03-09 | 24 | 9 | 2020-03-09 | 1 | 18 | 2020-03-09 | 7 | 21 | 2020-03-09 |
| Japan | 282 | 10 | 2020-12-07 | 30 | 6 | 2021-01-18 | 4 | 15 | 2020-04-13 | 7 | 34 | 2020-03-23 |
| Russia | 295 | 7 | 2020-03-23 | 50 | 8 | 2020-03-23 | 7 | 18 | 2020-04-06 | 6 | 80 | 2020-03-23 |
| Spain | 114 | 12 | 2020-03-09 | 37 | 15 | 2020-03-23 | 3 | 20 | 2020-03-16 | 13 | 21 | 2020-03-16 |
| UK | 150 | 11 | 2020-03-23 | 39 | 12 | 2020-03-30 | 1 | 24 | 2020-03-16 | 18 | 21 | 2020-03-23 |
| US | 1471 | 7 | 2020-03-30 | 434 | 7 | 2020-03-30 | 82 | 19 | 2020-03-30 | 36 | 20 | 2020-03-23 |



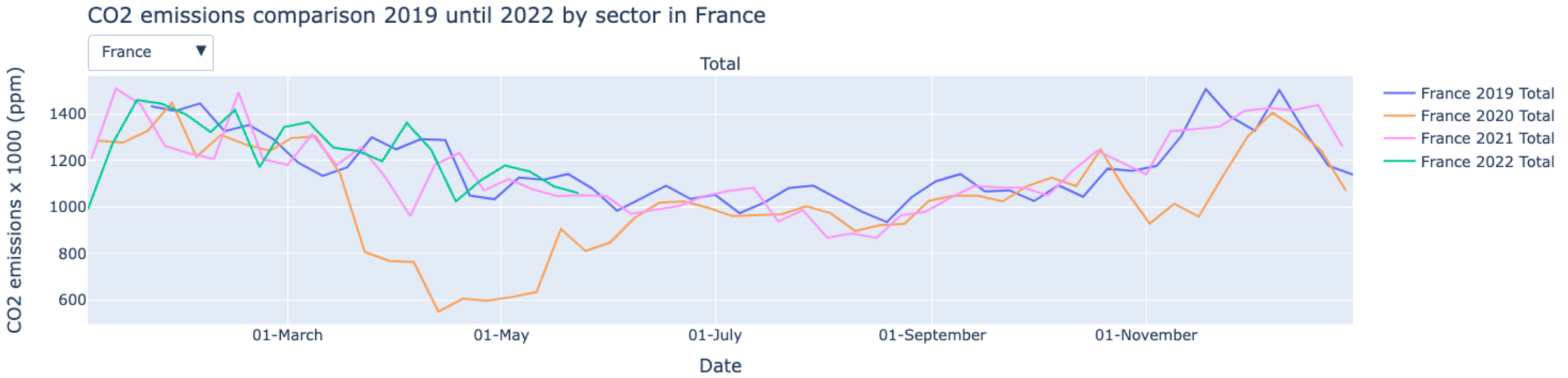

01-March
01-May
01-July
01-September
01-November
Date
Domestic Aviation
CO2 emissions x 1000 (ppm)
200
150
100
50
China 2019 Domestic Aviation
China 2020 Domestic Aviation
China 2021 Domestic Aviation
China 2022 Domestic Aviation
International Aviation
40
30
20
10
Russia 2019 International Aviation
Russia 2020 International Aviation
Russia 2021 International Aviation
Russia 2022 International Aviation
Domestic Aviation
60
50
40
30
20
10
Russia 2019 Domestic Aviation
Russia 2020 Domestic Aviation
Russia 2021 Domestic Aviation
Russia 2022 Domestic Aviation

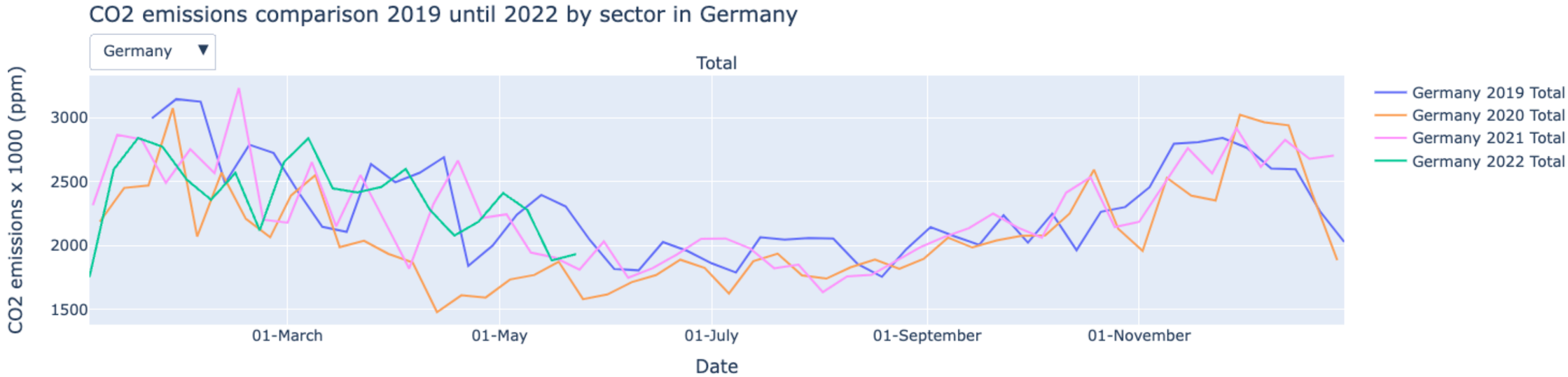
# Which industry took the biggest hit?

Air travel has been the most severely impacted. Airlines canceled flights and closed airports. This has resulted in massive delays and cancellations of cargo shipments.

# Which country took the biggest hit?

In the data it is clear that China has the biggest delta in absolute value. In China, the epicenter of the outbreak, the virus has had a devastating effect on the economy and on daily life. One of the most severely affected sectors has been transportation, as airlines have canceled flights and railway stations have been closed. However it needs to be noted that china also has a very big population therefore making it not the biggest percentage delta. This was France and Germany.




## Could we predict with our data on which dates certain COVID-19?

| x | First legislation |
|---|---|
| Brazil | 17 march 2020 |
| China | 22 january 2020 |
| EU & UK | 16 march 2020 |
| France | 17 march 2020 |
| Germany | 16 march 2020 |
| India | 23 march 2020 |
| Italy | 8 march 2020 |
| Japan | 3 february 2020 |
| Russia | 28 march 2020 |
| Spain | 16 march 2020 |
| UK | 2 march 2020 |
| USA | 13 march 2020 |

The table above shows the biggest difference between two datasets for each country (delta). The algorithm not only calculates the biggest delta for each country but it also calculates the biggest percentage delta to normalize the data and make it possible to compare the different delta's of different countries. It also extracts the dates at which the biggest delta occurs. This date of the biggest delta is of vital importance in order to answer the sub research question. Because it is then used to predict with our data which dates certain covid legislation were implemented. As shown in the data it is clearly visible that most of the biggest delta values are shown in march which corresponds with the data for which the first legislation is implemented with some delay. The delay is due to the first legislation being, most often, not very drastic and therefore doesn't directly impact the transportation sector. First rules were often the cancellation of big gatherings etc and not travel restrictions directly.

# Conclusion

In conclusion, in order to answer the research question. Analyzing the effect of Corona on aviation and the ground transport industry We have answered the different sub research questions. From the different sub research questions we can conclude that the transportation sector in China was impacted the most when considering parts per million (ppm) due to the coronavirus. However, France and Germany had the biggest percentage delta, which means that they were more drastically impacted when analyzing it in perspective. It is also clearly visible that the aviation sector was impacted the most by the coronavirus. Of which the international aviation sector was impacted the most in specific. Further analyzing which countries were impacted the most in the most impacted sector zoned in on the drastic outliers China and Russia who canceled almost all their aviation at the peak to fight the corona outbreak. This led to the conclusion that corona had a devastating impact on the transportation industry.

# Import Figures and Table from 'dashboard_v3.ipynb'

In [ ]:
```
%store -r fig_transport
%store -r fig

fig.show()
fig_transport.show()
```