Does Weather has an significant impact on the number of highway traffic accidents?

Felix Büppelmann

2023-06-16

Summary

Analysis of weather events on German highways and accidents in 2018-19.

Rationale

It analyses whether highway segments that are particularly exposed to extreme weather events result in more car crashes than usual.

Datasources

Highway Weather Data

- Metadata: URL
- Data: URL
- Data Type: CSV
- Description: Weather events on specific routes were studied using reanalysis data from all of Germany from Dec. 1, 2017-Nov. 30, 2019. The weather values of 3160 points with 1 km distance were read from the data and averaged or summed up, depending on the parameter. The values were normalized and the highest was given the value 100, the lowest the value 0.

CrashData

- Metadata: URL
- Data: 2017 2018 2019
- Data Type: ZIP/CSV
- Description: Road traffic accident data of 2017 to 2019 of Germany.

Transformations

1. Preporcessing of the weather data
   - Give each weather measure point a unique ID
   - As the measure points are distributed one kilometer apart from each other, each points gets an kilomter marker
2. Preprocessing of the crash data
   - Dropping rows with irrelevant data (turn accidents, bike accidents, etc.)
   - Drop columns with irrelevant data
3. Connect the crash data with the weather data
   - For each crash, find the closest weather measure point (Treshold: 600m)
     - Drop rows where no point is within the treshold
     - If there are multiple points within the treshold, select the one closest
   - Merge crash data to the weather data
4. Normalize the combined data per Route

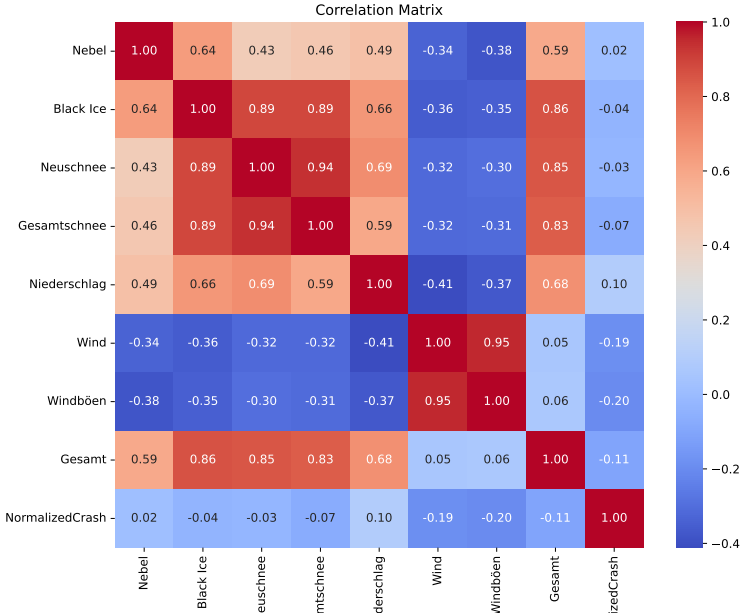
Analysis of all routes combined

Crashes of all routes

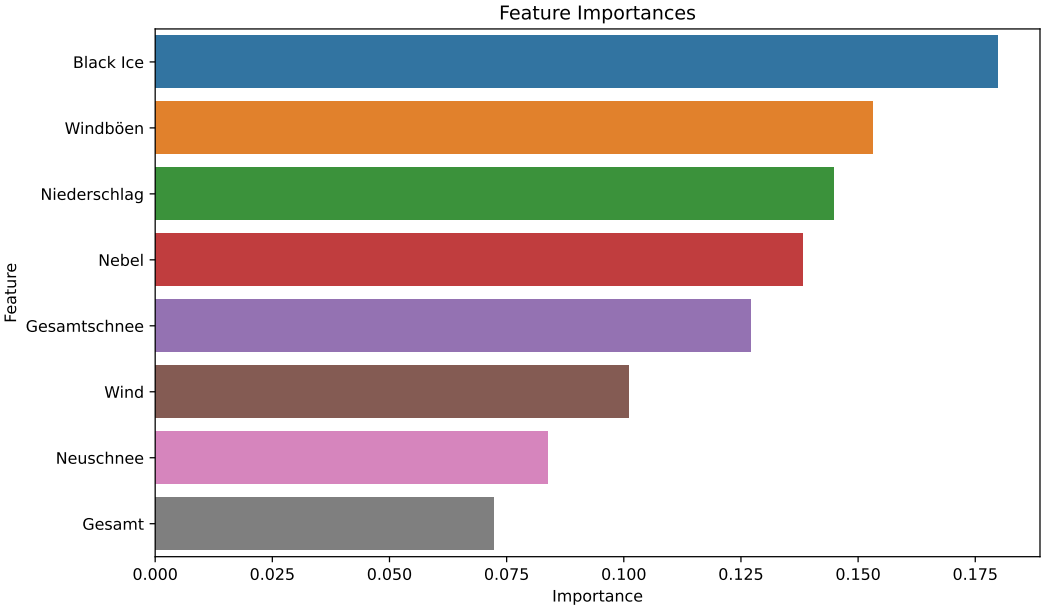
Weather of all routes

Map of the weather events combined along the routes

Correlation Analysis

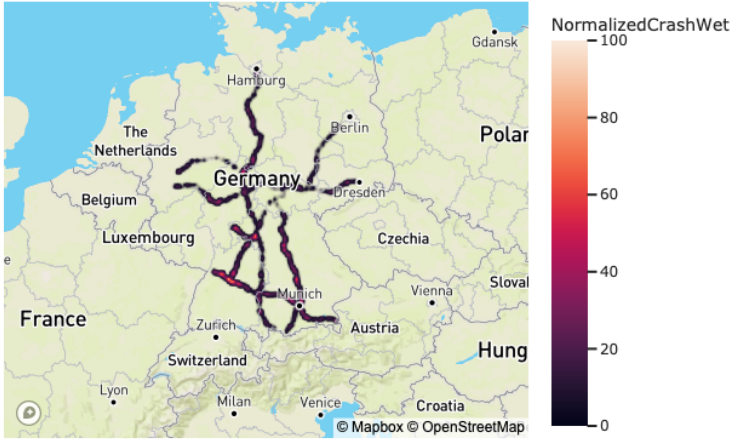


Feature Importance



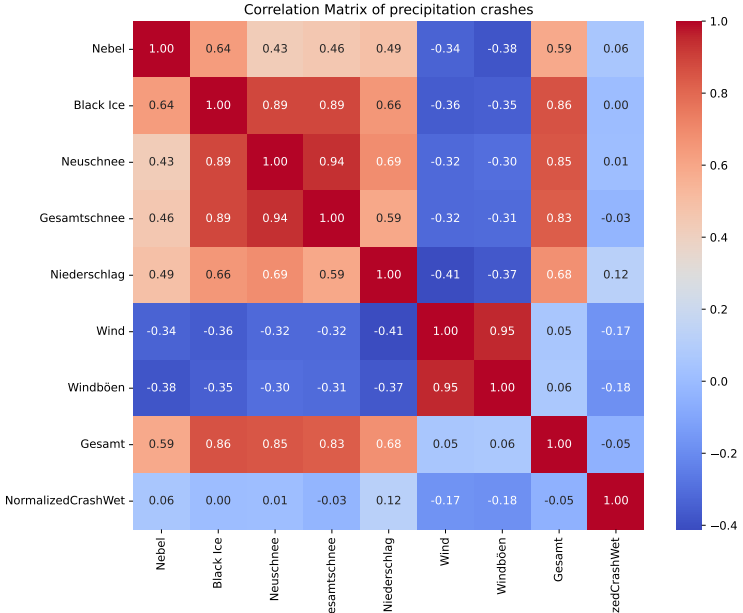
Analysis of crashes during precipitation

Map of all the crashes in the Wet along the routes

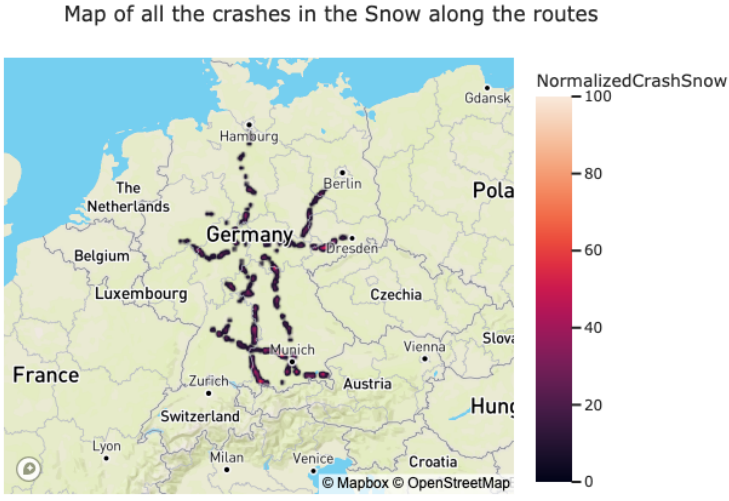


Precipitation Map

Correlation Analysis of wet weather crashes



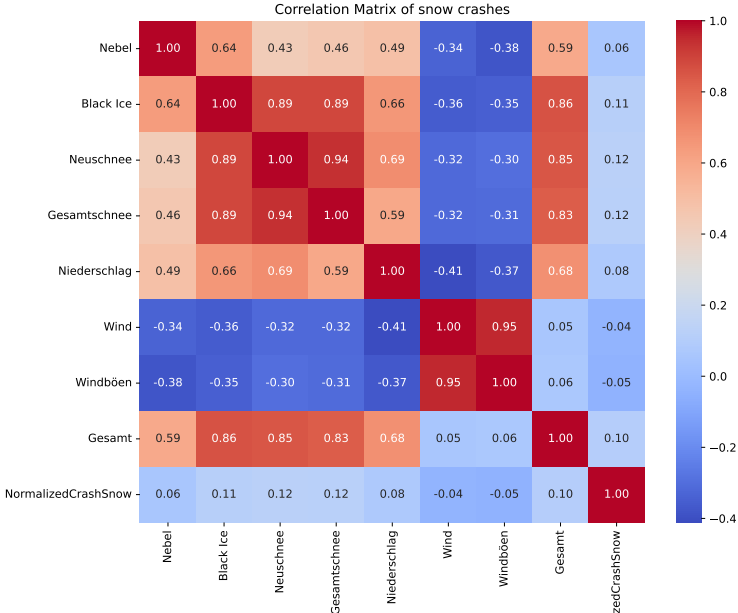
Analysis of crashes due to snow



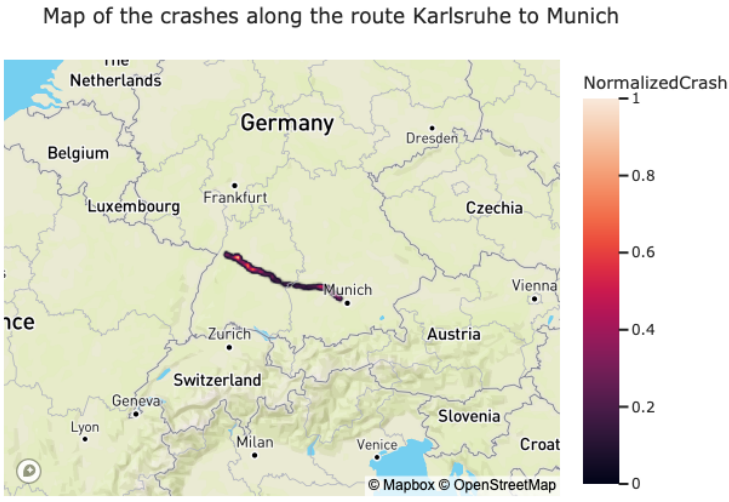
Snow Map


Map of the snow along the routes
Gesamtschnee
100
80
60
40
20
0
Gdansk
Hamburg
Berlin
Poland
The
Netherlands
Germany
Dresden
Belgium
Luxembourg
Czechia
Slovakia
Munich
Vienna
France
Zurich
Austria
Hungary
Switzerland
Lyon
Milan
Venice
Croatia
© Mapbox © OpenStreetMap

Correlation Analysis



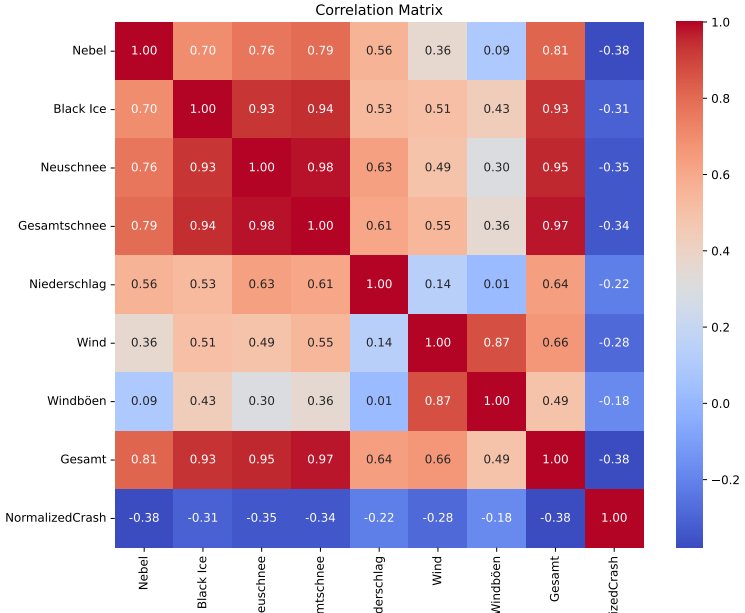
Analysis of one route with relativ high crash occurence (Karlsruhe - Munich)



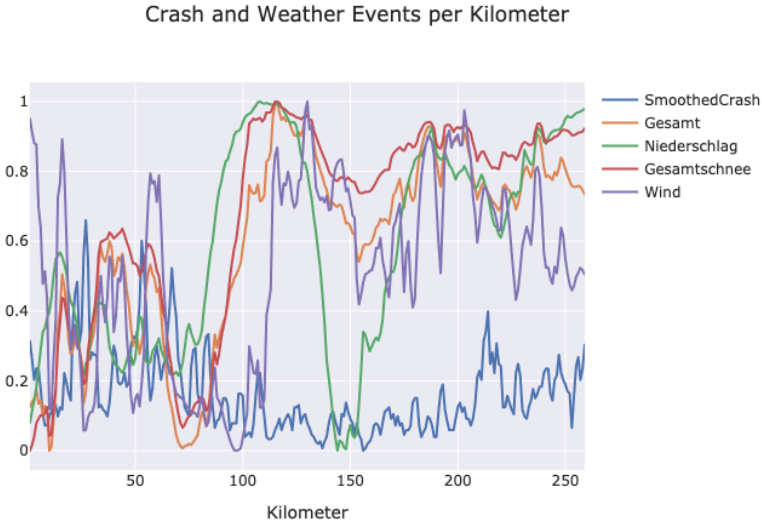
Weather Map

Map of the weather events combined along the route Karlsruhe to Munich

Karlsruhe - Munich Correlation Analysis



Karlruhe to Munich Weather Events and Crashes per Kilometer



Conclusion

The analysis investigates whether highway segments exposed to extreme weather events lead to more car crashes. Here are the key findings:

1. Initial Analysis:
   - The number of crashes is higher in the south of Germany, where severe weather events also occur more frequently.
2. Correlation Analysis:
   - The correlation between the number of crashes and weather events is not strong.
   - Wind-related events are negatively correlated with crashes, indicating that more wind on the highway is associated with fewer crashes.
   - 'Niederschlag' (precipitation) shows a positive correlation, meaning that more precipitation leads to more crashes.

Conclusion Part 2

3. Random Forest Regressor:
   - 'Black Ice' and 'Windböen' are the most important weather factors for predicting crash likelihood.
   - None of the features stand out significantly in predicting crash likelihood.
4. Analysis of Wet Conditions:
   - Areas with more precipitation tend to have more crashes, but the correlation is not strong.
5. Analysis of Snow Conditions:
   - Areas with more snow tend to have more crashes, but the correlation is not strong.

Conclusion Part 3

6. Analysis of A8 Route (Karlsruhe - Munich):
   - The A8 route shows a relatively high occurrence of crashes.
   - Contrary to expectations, areas with more severe weather events on this route have fewer crashes.
   - There is a negative correlation between weather events and crashes on this particular route.
   - Weather events may not be the primary cause of crashes on the A8 route.

Summary

In summary, the analysis does not strongly support the hypothesis that highway segments exposed to extreme weather events result in more car crashes. The correlation analysis and specific route analysis suggest that weather events may not be the main contributing factor to the observed crashes.