Analysis of air pollutant emission

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Introduction

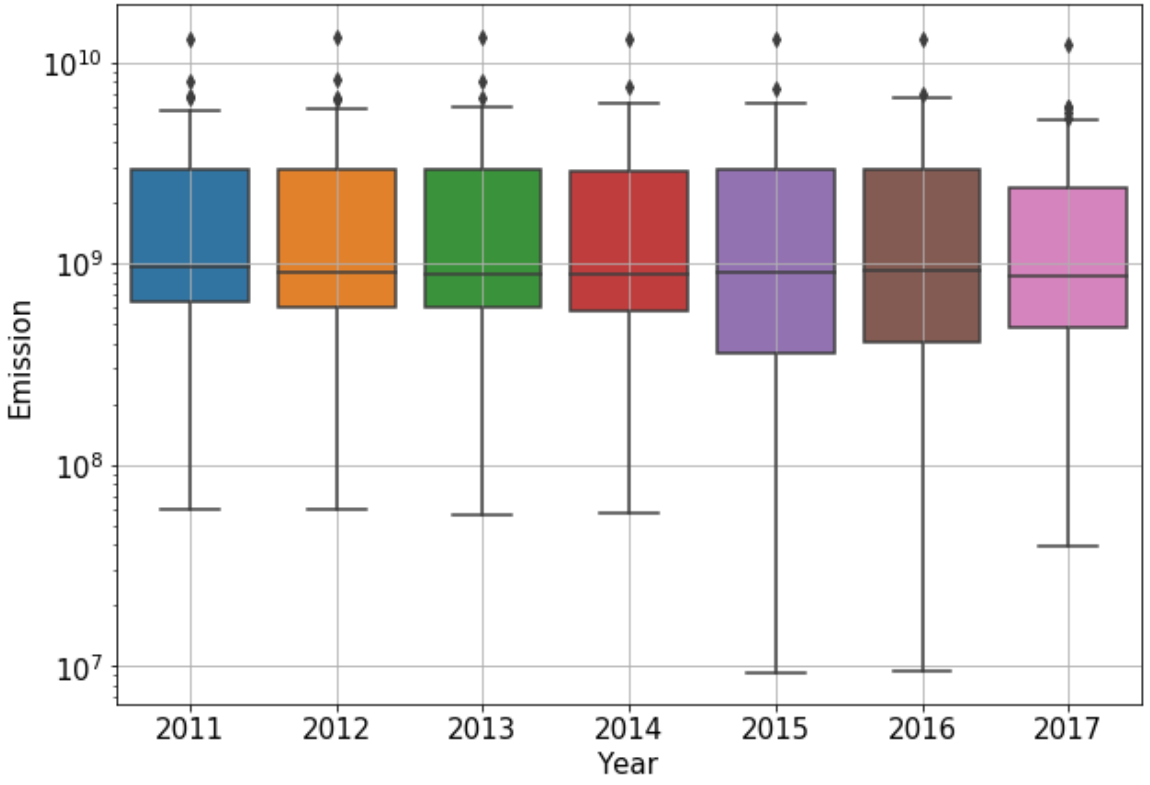
- Climate change poses a threat to the weather system, natural landscape and civilization.
- Air pollutant emission has an important impact on climate change.
- The public and policy makers shall be aware of current emission situation.
- Countries needs guides to reduce their emission in order to meet international protocols.

Data

- Air pollutant emission data was downloaded from https://stats.oecd.org/. It consists of emission from 37 countries from 2011 to 2017.
- Information from countries, area and population was produced with countryinfo package.
- “df_data” is the dataframe that keeps pollutant species and merged emission sources.
- “df_country” defines annual total emission. Missing values were filled with averaged annual emission.
- The area and population was appended to “df_country”
- Schools were restricted to 5 km around Cologne central station

Analysis: Descriptive statistics among countries

- Generally, in all countries, total emission was very slowly decreasing.
- Each year, there were some countries producing particularly high air pollutants
- Two countries in 2015 and 2016 largely reduced their emissior



Analysis: clustering

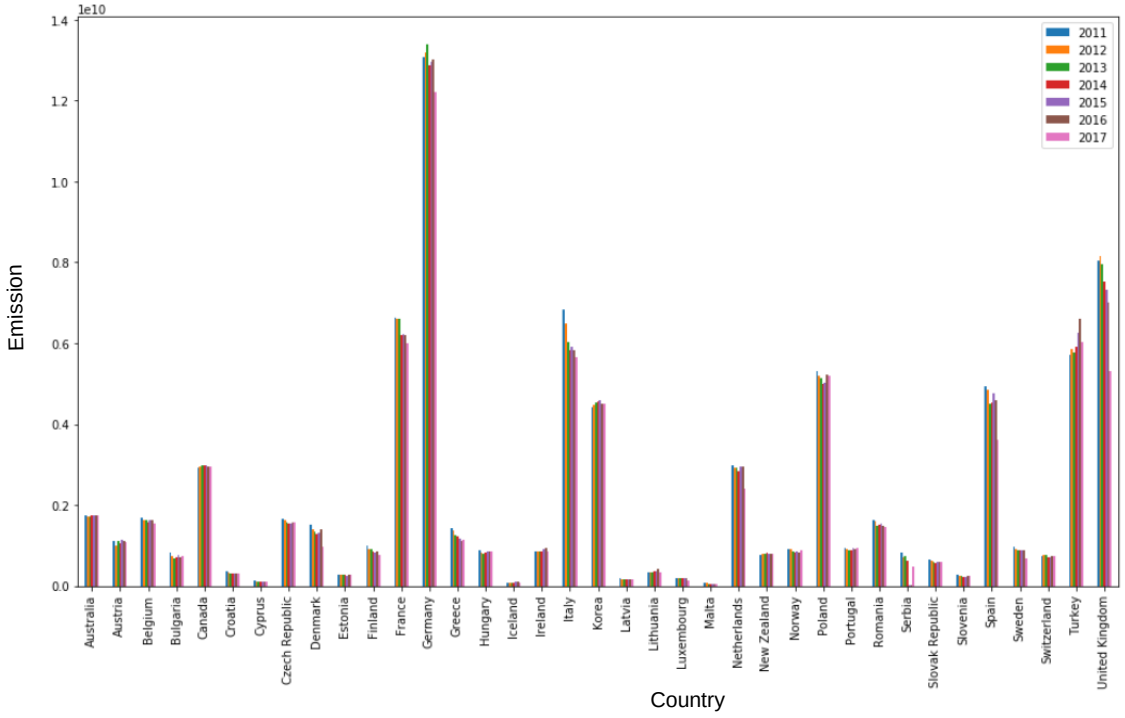
37 countries were divided into 4 groups:

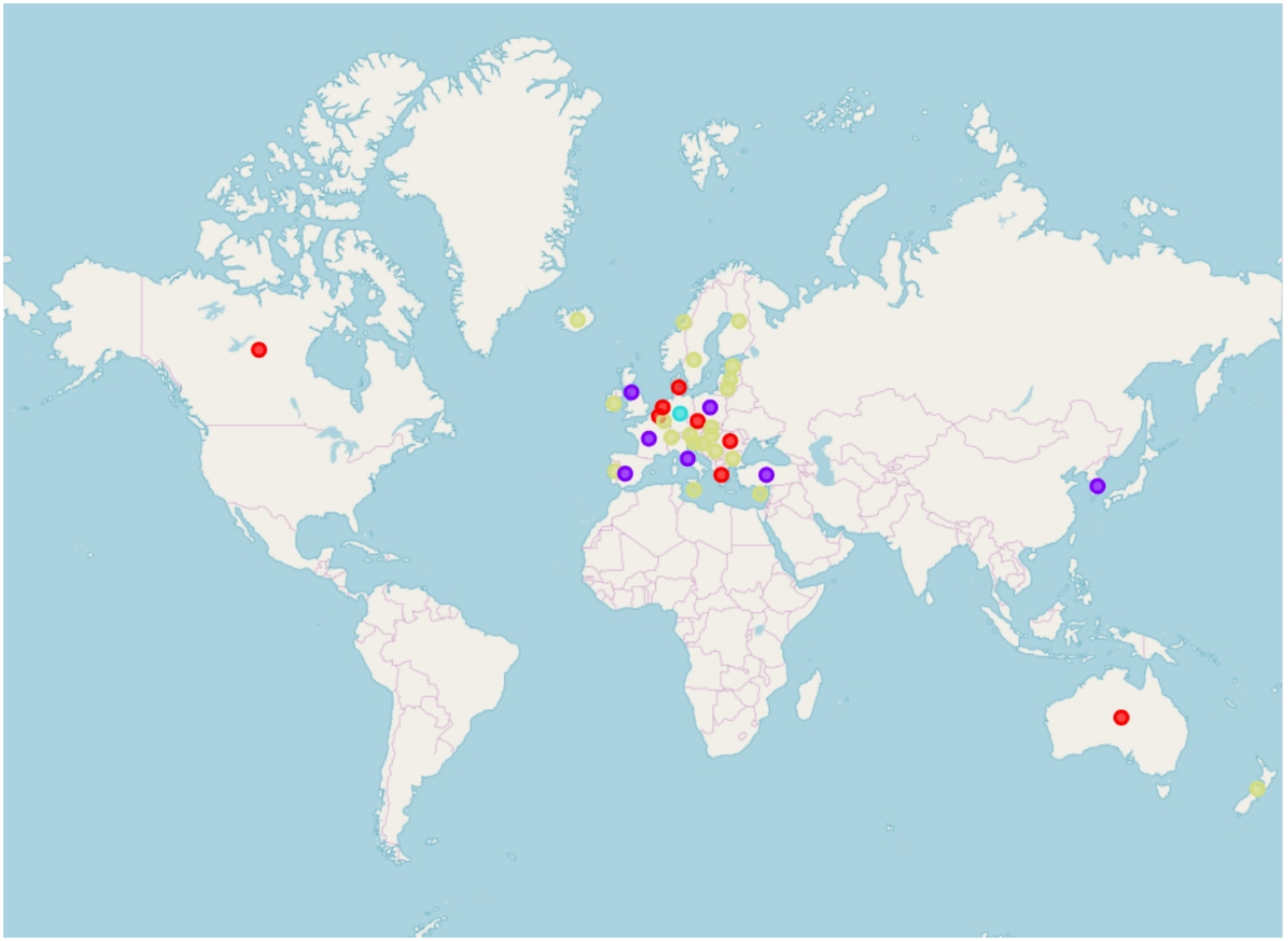
- Extremely high emission: Germany
- High emission: The Unite Kingdom, France, Italy, Turkey, Poland, Korea and Spain
- Medium emission:

  Australia, Austria, Belgium…
- Low emission:

  Croatia, Cyprus, Estonia…
- Countries shown on a map

  (see next slide)

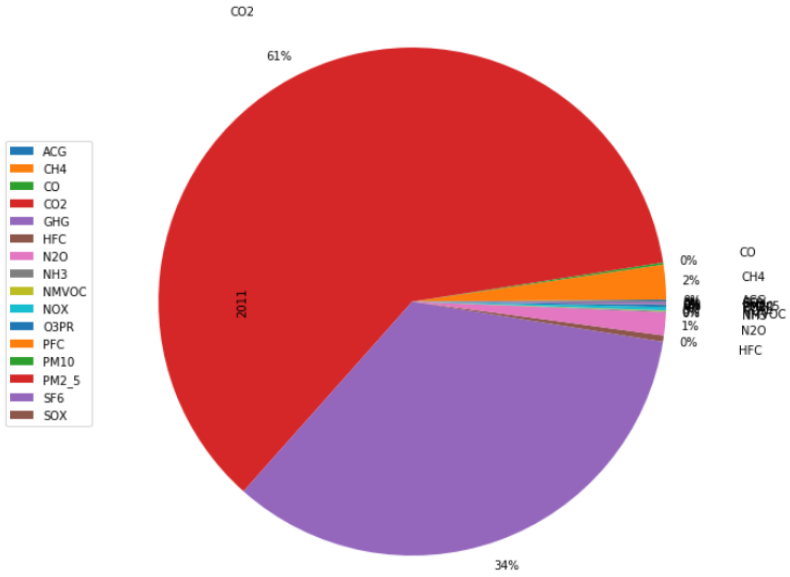


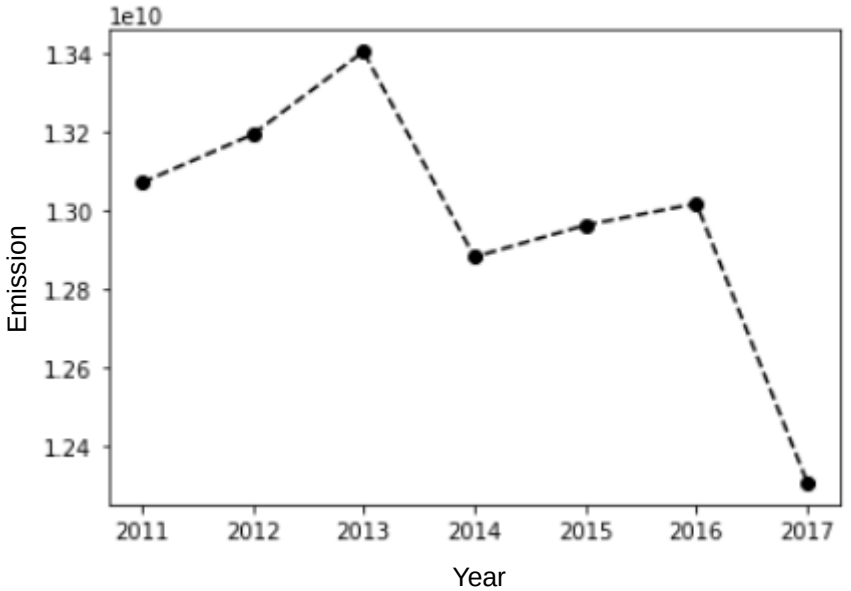


Analysis: Emission trends in clusters

Extremely high emission in Germany:

- CO2 and GHG (Green House Gas) emission made up 95 % of German total emission
- Germany in 2017 emitted relatively less air pollutants, but still far more than other listed countries
- Germany might produce slightly more emission in 2018 and 2019.

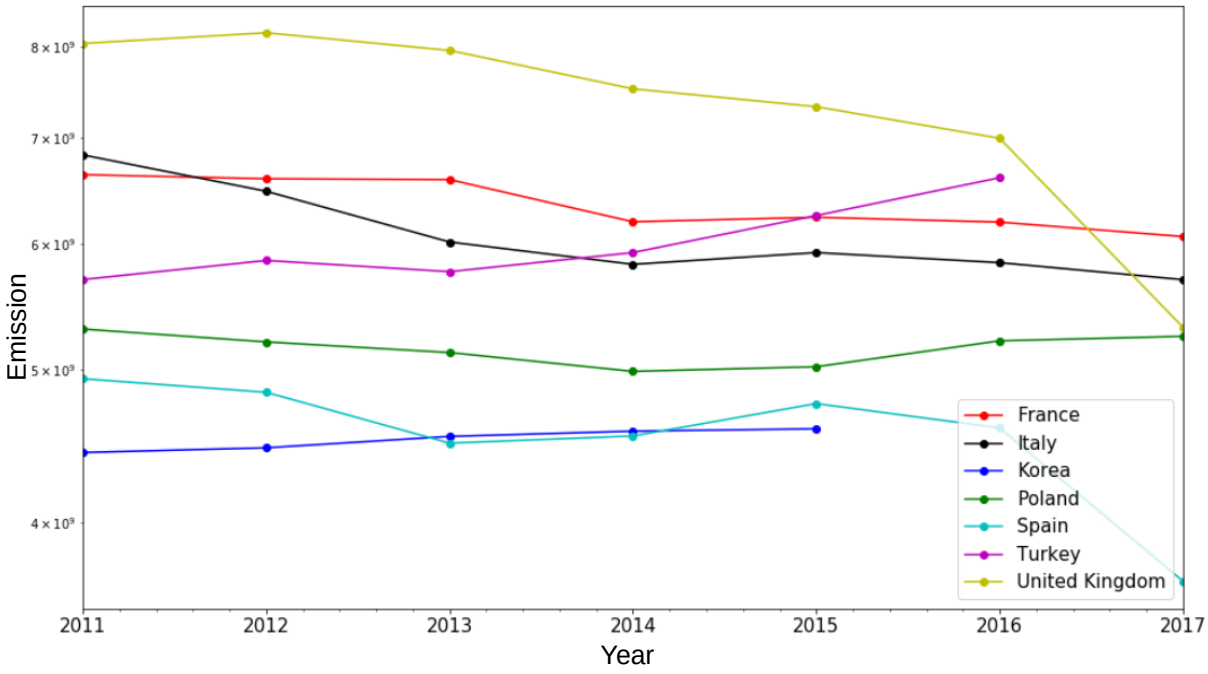




Analysis: clustering

High emission countries:

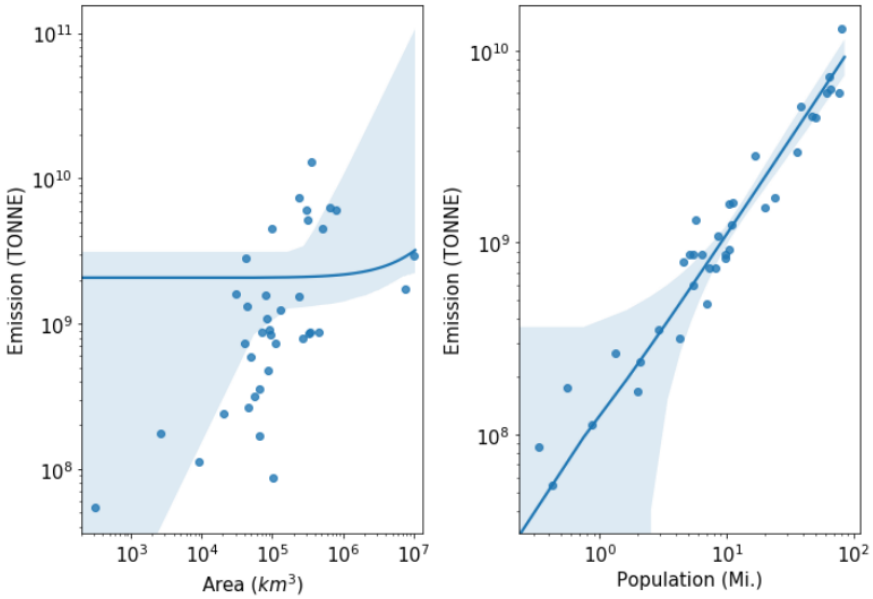
- A gradual decrease from 2012 in air pollutant emission showed up in most countries in this group, like UK and Spain.
- Turkey and Korea, on the contrary, steadily increased its emission
- The emission in 2016 in Poland bounced back to the amount in 2011 and kept it to 2017



Analysis: Linear regression model

The relationship between country size and air pollutant emission was studied:

- A hypothesis was raised when analyzing annual mean emissions among countries. Smaller country appeared to emit less pollutants, vice versa.
- Linear fitting was applied to get the relationship between emission and country size or population
- Air pollutant emission was found to be highly positively correlated with population of the country.
- The R2-score of the model was -0.65 for “Area” and 0.99 for “Population”

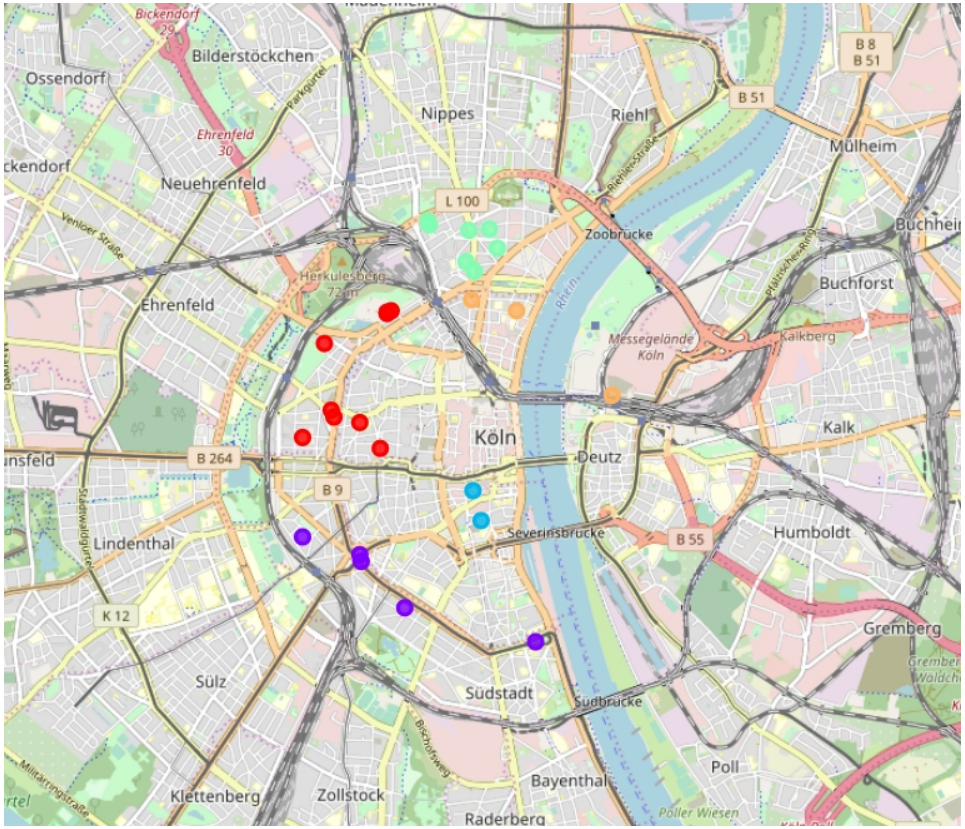


Analysis: Foursquare API application

- Search ID: schools
- Search range: within 2 km around Cologne central station
- Result: 26 schools
- Schools were clustered

  into 5 groups based on

  their distance to the station



Conclusion

- 37 countries were grouped into 4 categories according to their annual mean air pollutant emissions
- Emission trend was analyzed among countries in some clusters
- Linear relationship was found between air pollutant emission and population size.
- Foursquare API was applied to find schools within 2 km around Cologne central station to deliver the analysis
- Prospects:
  - Similar analysis applying to a larger range of countries
  - Retrieve detailed population data to explore deeper into its relationship with air pollutant emission
  - More factors, such as economy and domestic production, could be further digged to provide more accurate guides to emission reduction
  - Other models, SVM,