Wildfires Case Study

Overview

Purpose & Context

Whilst in France in 2022 I witnessed the smoke from the wildfires on the west coast, and have heard a lot about wildfires in Europe the last couple of years. I thought I would take a quick look in to data and see what it says in terms of trends.

Project Goal

Uncover more information about wildfires in 3 countries: France, Germany and Greece, then take a closer look at one. Perform an initial data and exploratory analysis in order to derive insights regarding the occurrence of wildfires since the year 2000.

Key Objectives

- Use data from NASA.
- Identify wildfires locations in France, Germany and Greece.
-Find which countries, if any, have an upward trend.
- See whether any increasing trends show patterns of increasing fire intensity, or geographic location spread.

Overview

Datasets

Dataset:

MODIS Collection 6 Hotspot / Active Fire Detections MCD14ML distributed from NASA FIRMS. Available on-line https://earthdata.nasa.gov/firms. doi:10.5067/FIRMS/MODIS/MCD14ML

Skills

Python
Data wrangling
Data merging
Grouping data
Aggregating data
Visualisations in tableau
Python visualisations
Trend analysis

Tools


Steps

Data Preparation

Process

- Downloaded data for years 2000 - 2022 for France, Germany and Greece. Imported into notebook as a pandas dataframe
- Conducted basic descriptive exploratory tasks
- Combined datasets for years 2000 – 2022 for France, Germany, Greece
- Removed columns - source name, scan, track, satellite, instrument, version

The first step was to check whether the datasets needed cleaning, skipping this stage can result in inaccurate results, therefore it is very important. This involved checking for missing values, inconsistent data types, duplicates and removing unnecessary columns. Python proved to be a great, and fast, tool for this process.

Analysis Process

- Creating new dataframes based on a certain criteria

- There was a column named “Type”. This was either filled with 0, 1, 2, or 3.
0 = presumed vegetation fire
1 = active volcano
2 = other static land source
3 = offshore
I removed all rows apart from those marked “0” as we want to look at vegetation fires.

- Another column “confidence” represented confidence levels in the detection of the fires. I omitted all those in the “low confidence” category.

- Due to data collection problems with the satellite, i removed the data from year 2000 as it was incomplete.

- Created bar charts, line charts, and heatmaps with Python, looking at wildfire patterns over time.

- Created an interactive geospatial heatmap on Tableau focussing on wildfires in Germany.

- Made line charts with trend lines on Tableau looking at incidences of wildfires by year, FRP and finally day / night fires over the years.

Results & Recommendations

From the analysis process I was able to come up with the following insights:

- The number of recorded wildfires from 2001 to 2022 show a downward trend in Greece and France, and an upward trend in Germany.

- When looking at the trend from 2010 to 2022, Greece still shows a downward trend, whereas France and Germany are both upward.

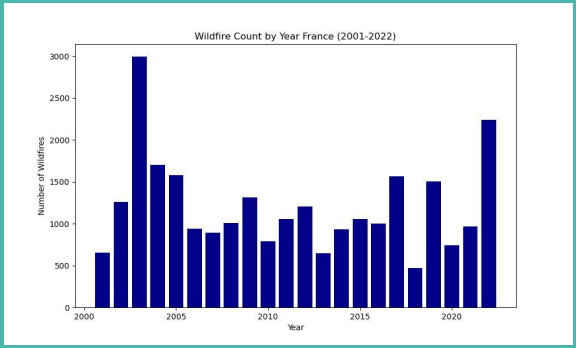
- The increasing number of fires in Germany also appear to show a trend of more fires in the north and east than previously.

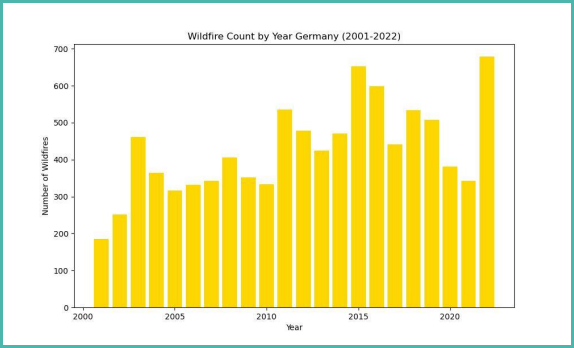
- The FRP (fire radiative power), meaning intensity of the fires also shows an upward trend suggesting the fires are hotter and more intense over the years.

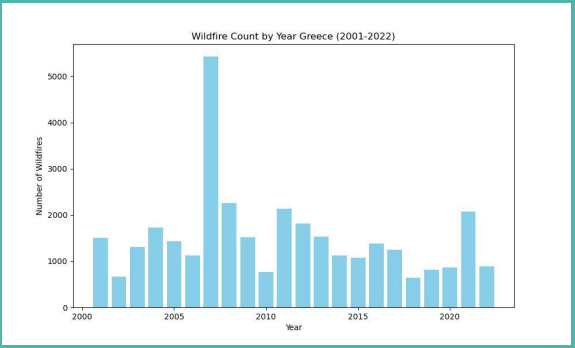
- This underlines that Germany should maintain climate awareness and their wildfire prevention, detection and suppression systems and measures.

Visualisations

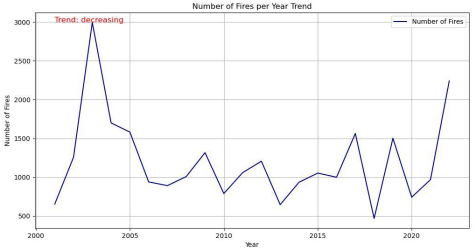
In the following pages are selected visualisations from the analysis

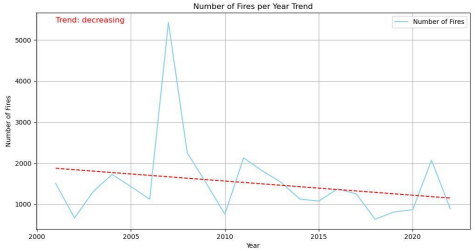




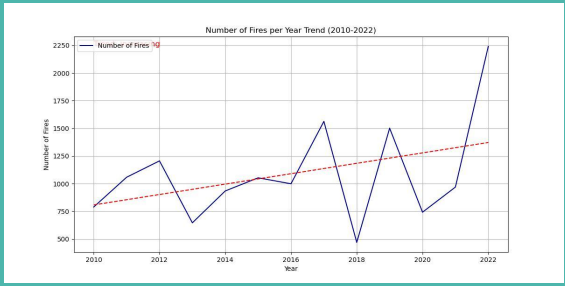


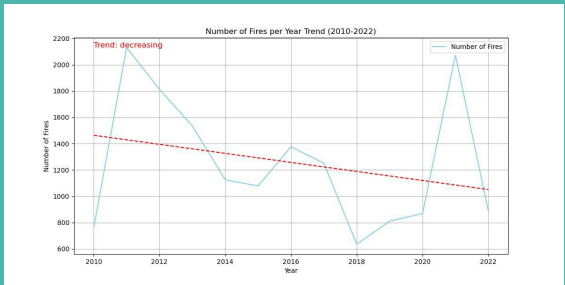
Python line charts with trends



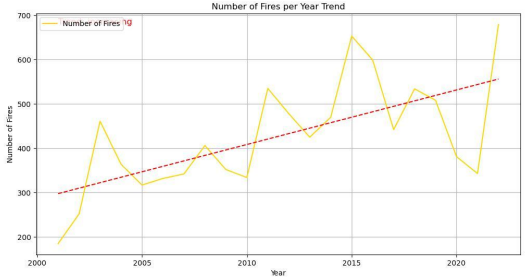


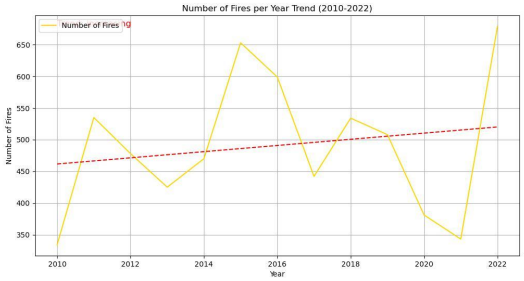
These line charts represent wildfire numbers in France (dark blue) and Greece (light blue).
To the left are the years 2002 - 2022, both showing an overall downwards trend in wildfires.
Below are the years 2010 - 2022, Greece still showing a downward trend, yet France showing an increasing trend with 2022 the worst year.



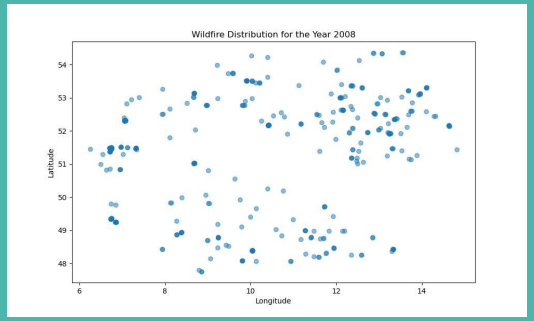


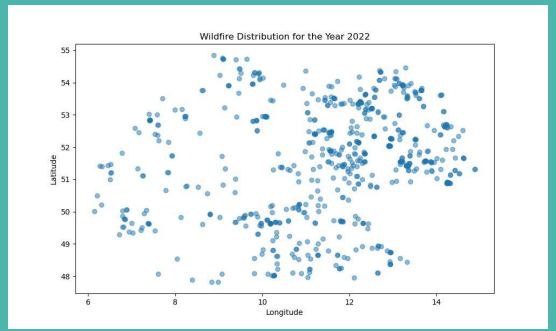
Germany charts



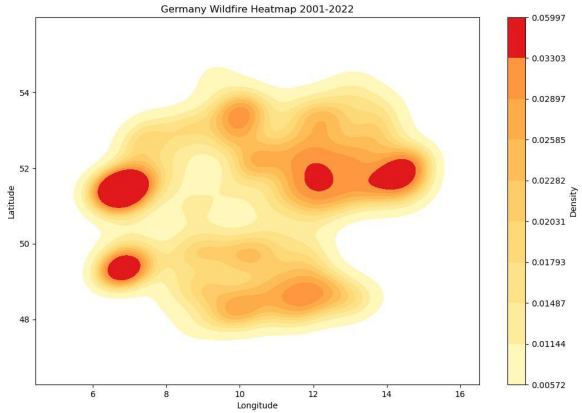


To the left we have the line charts made with Python showing the increasing trend in wildfires across Germany from 2001 - 2022, and also 2010 - 2022.
Below we have the geographic scatterplots showing wildfire locations in Germany in 2008 and then 2022. An increase in fires is evident but also a noticeable increase in the north and east.





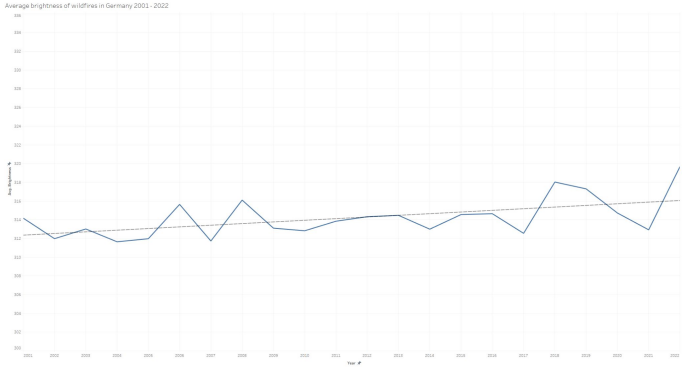
Geospatial charts

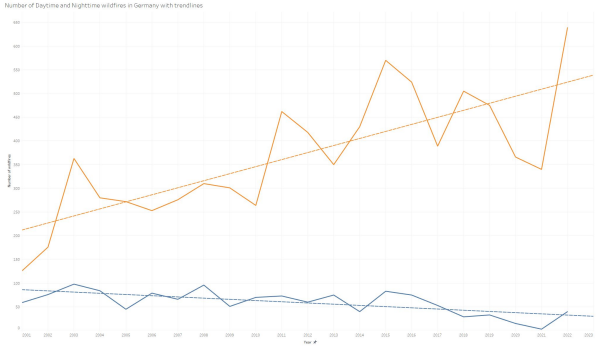


To the left is a Python heatmap showing the frequency of wildfires in Germany from 2001 - 2022. As this isn't interactive, is appears that they occur most frequently in the east and west.

Below is the interactive map made in Tableau where it is possible to move the slider to select the year. This way it becomes visible that the incidence of wildfire location is becoming more frequent in the north and east of Germany. Open in Tableau

Tableau line charts

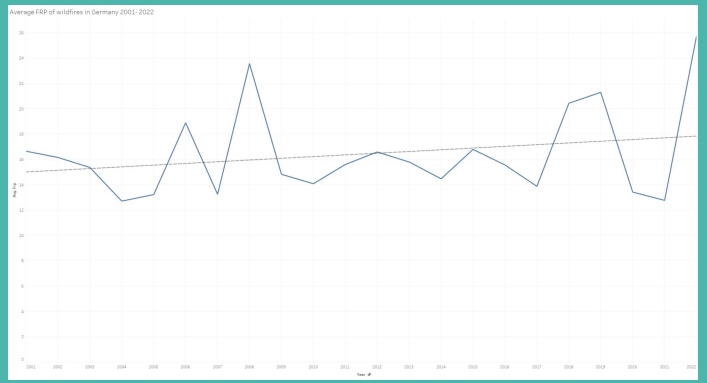




Below is a chart showing the average FRP (Fire Radiative Power) of wildfires in Germany from 2001 - 2022. Overall there is an upward trend in the FRP meaning that fires have become more intense.

Bottom left shows the number of day time fires (orange) and night time fires (blue) from 2001 - 2022. Interestingly the incidence of daytime fires is increasing, and nighttime fires decreasing.

Top left is a chart which supports the chart below, showing that average fire brightness is increasing over time, again suggesting more intense fires.



Python Code

Below are some examples of code used throughout the analysis.

removing entries where the confidence rating is below 50 and therefore low confidence

```
In [36]: df1 = df1[df1['confidence'] >= 50]

In [37]: df2 = df2[df2['confidence'] >= 50]

In [38]: df3 = df3[df3['confidence'] >= 50]

In [39]: df1 . shape
Out[39]: (26508, 10)

In [40]: df2. shape
Out[40]: (9392, 10)

In [41]: df3 . shape
Out[41]: (33308, 10)
```

Above: Removing fires from the dataset which were recorded with a low confidence level.
Centre: Line chart to investigate the trend of wildfires in France since 2001.

```
In [93]: fires_per_year = df1.groupby('Year').size().reset_index(name='FireCount')

         # Fit a linear regression model to analyze the trend
         X = sm.add_constant(range(len(fires_per_year)))
         model = sm.OLS(fires_per_year['FireCount'], X).fit()
         slope = model.params[1]  # Get the slope of the regression line

         # Check if the trend is increasing or decreasing
         if slope > 0:
             trend_label = "Trend: increasing"
         elif slope < 0:
             trend_label = "Trend: decreasing"
         else:
             trend_label = "Trend: no significant change"

         # Create a line chart
         plt.figure(figsize=(12, 6))
         plt.plot(fires_per_year['Year'], fires_per_year['FireCount'], label='Number of Fires', color='darkblue')
         plt.title('Number of Fires per Year Trend')
         plt.xlabel('Year')
         plt.ylabel('Number of Fires')
         plt.legend()
         plt.grid(True)

         # Add the trend label as text on the chart
         plt.text(2001, max(fires_per_year['FireCount']), trend_label, fontsize=12, color='red')

         # Save the plot as a JPEG image
         plt.savefig('France_Number_of_Fires_Per_Year_Trend.jpg', format='jpeg')

         plt.show()
```


```
In [108]: year_to_analyze = 2022  # Replace with the year you want to analyze

          # Filter data for the specified year
          data_for_specific_year = df3[df3['Year'] == year_to_analyze]

          # Extract latitude and longitude columns
          latitudes = data_for_specific_year['latitude']
          longitudes = data_for_specific_year['longitude']

          # Create the scatter plot using Matplotlib
          plt.figure(figsize=(10, 6))
          plt.scatter(longitudes, latitudes, alpha=0.5)

          plt.title(f'Wildfire Distribution for the Year {year_to_analyze}')
          plt.xlabel('Longitude')
          plt.ylabel('Latitude')
          # Save the plot as a JPEG image
          plt.savefig('Greece_Fire_locations_2022.jpg', format='jpeg')

          plt.show()
```

Geographic representation of Greek wildfires.

Thanks

Github link