Active Fires Monitoring Project

A visual tools to assist in assessing fire events across Europe

Leonardo Sarra, Alexandru Sarpe

Context

- Forest fires constitute a serious problem throughout Europe, there are more than 65000 fires every year.
- Forest fires are not just a problem of France, Italy, Greece, Spain and Portugal but in reality, they are widespread across the region.
- Europe is also subjected to fire events originated by volcanic activities and fire events inside human boundaries

The need for a tool for assessing forest fires led the EU to develop the EFFIS project.

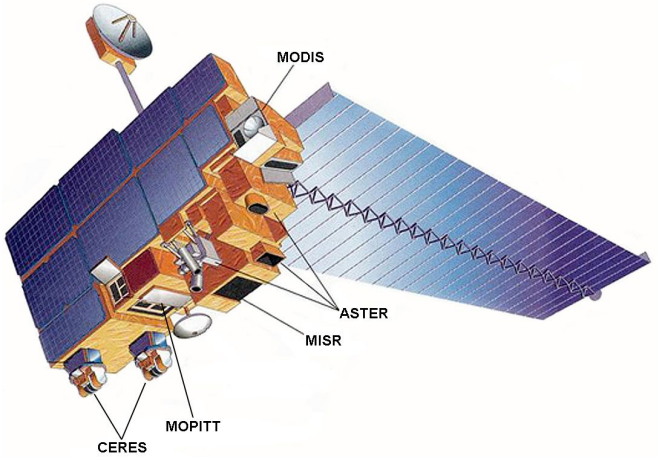
- **Our objective**: Develop a visual analytics tool that helps assessing and analyzing fire events by using publicly available data

Dataset

- NASA's dataset of fire events from the MODIS (Moderate-Resolution Imaging Spectroradiometer) instrument
- Fire events are captured by two satellites: Terra and Aqua.
- The data is publicly available but covers only the last 7 days (300 events on average).
- We merged data across multiple weeks to build our dataset (a total of 2428 events).

Each fire events is represented by the following attributes:

- Latitude
- Longitude
- Brightness temperature (channel 21)
- Brightness temperature (channel 31)
- Along scan pixel size
- Along track pixel size
- Acquisition date
- Acquisition time
- Satellite
- Version
- Fire radiative power (FRP)
- Day-time



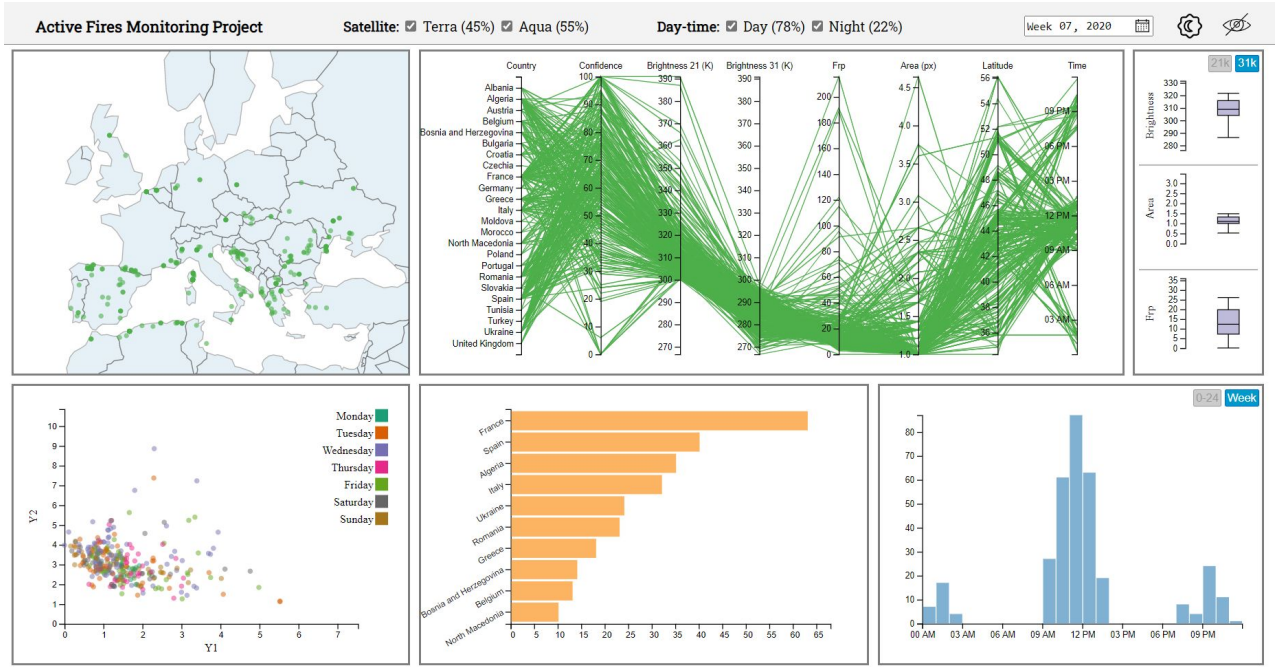
Dataset: Preprocessing

- Dataset is subject to a preprocessing phase during which features are standardized and then a PCA algorithm is executed.
- Not all attributes are used as features in PCA (“Satellite” and “Version” are excluded)
- PCA components are added directly to the dataset
- During this phase also two more attributes are added to the dataset:
  - “**Country**” attribute computed through reverse-geocoding
  - “**Area**” attribute (product of scan * track)

Views

The project comes with several type of graphs and charts:

- Geomap
- Parallel graph
- Scatterplot
- Histogram
- Box plots
- Bar chart

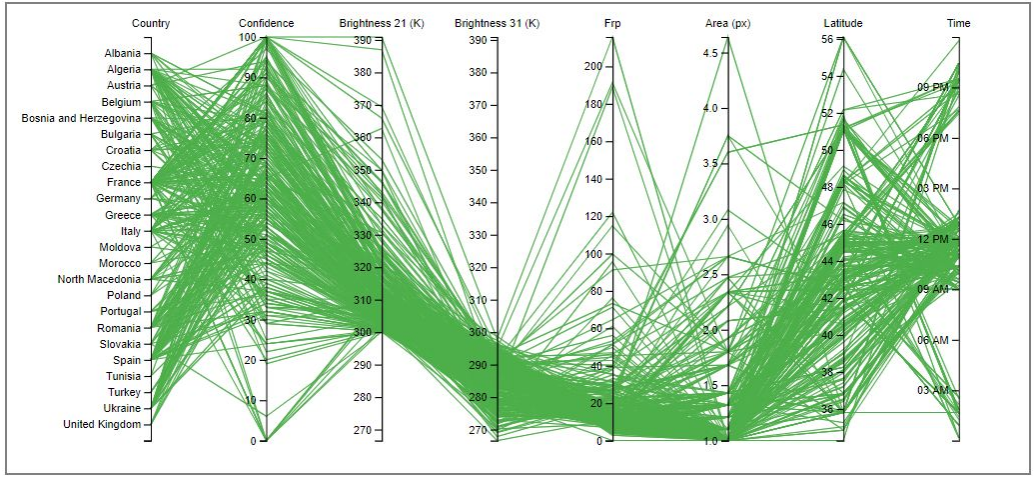


Visualization: Parallel Graph

The main view of the project is the Parallel Graph.

This graph raffigures the different dimensions of the dataset in a single plot.

Each axis has a filter, the user can select different range of values for each dimension represented. This selections conditions all the views making filters on the dataset.

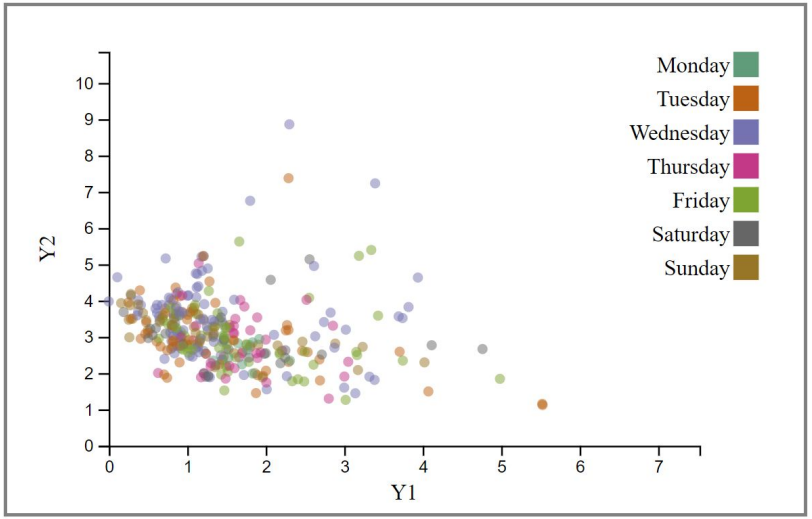


Visualization: Scatterplot

The scatterplot graph uses PCA components to represents the multiple fire events in a 2D space.

Each events has a color based on the day of the week in which it occurred.

It supports brushing and can be used to highlight outliers or group of events in the other views.

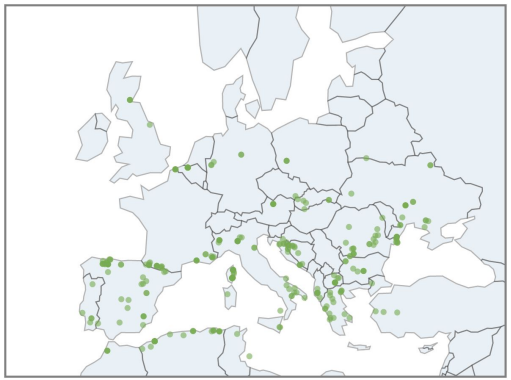


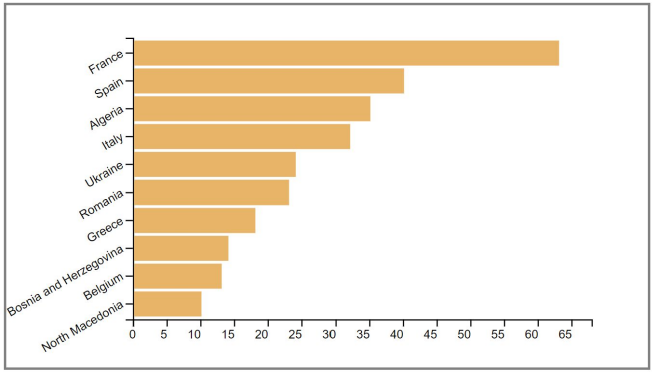
Visualization: Geographic map and bar chart

The map graph offers a clear visualization of the fire events over the different countries in which those events took place.
Each point represents a fire event and can be highlighted if selected in the scatterplot graph.

It supports pan and zoom actions.

The bar chart shows the top 10 countries ranked by the number of fire events that occurred inside their borders.

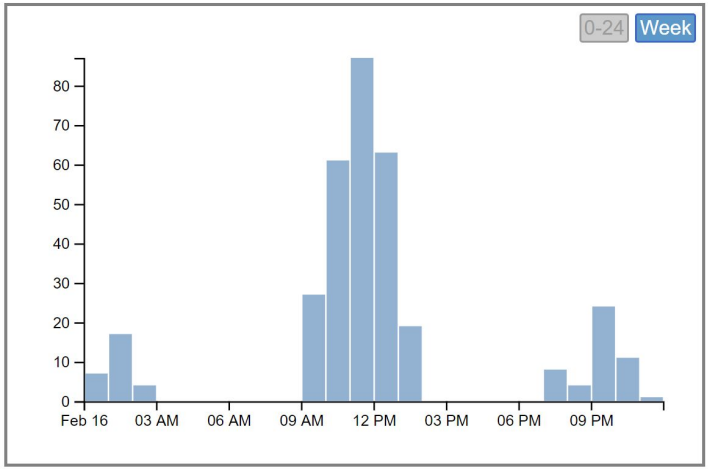




Visualization: Histogram and box plots

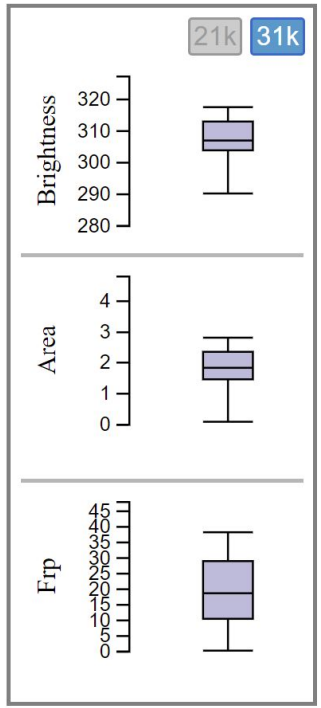
An histogram chart is used to represent the distribution of the different fire events. Two different domains are represented:

- Hours of the day
- Day of the week

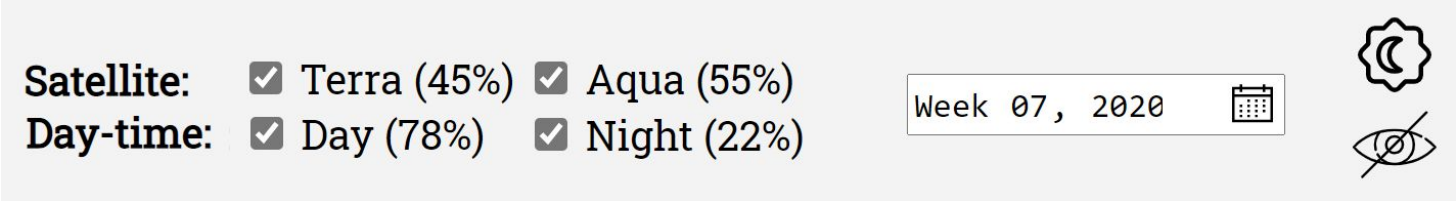


Three box plots are used to represent the distribution of 4 different attributes in the dataset:

- Brightness (channel 21)
- Brightness (channel 31)
- Area (product of scan * track)
- Frp (Fire Radiative Power)



Visualization: Header



- Checkboxes to filter dataset by satellite and day-time
- Shows percentage in text form (simple and effective way for those specific attributes
- Provides a week selector
- Buttons to enable dark mode and color-blindness friendly mode

User interactions

- **Header:** Filtering by week/satellite/day-time and managing of dark/colorblindness-friendly mode
- **Geomap:** Pan and zoom support
- **Parallel:** Brushing for each axis
- **Scatterplot:** Brushing
- **Box Plot:** Changing of brightness channel
- **Histogram:** Changing from hourly to weekly visualization and vice versa

Coordinated Interactions

Header -> *

- The usage of the week selector, the checkboxes or the color blindness/dark mode button trigger an update in all the view in order to change color and data elements.

Parallel graph -> * (except header)

- Brushing on one of the multiple axes of the parallel graph triggers an update in all the view that are going to show only a subset of the data
- The parallel graph itself changes the color of the elements that got filtered out

Scatterplot -> Scatterplot, Geomap, Parallel graph

- Brushing on the scatterplot will highlight with a different colors the element on the geomap and the parallel graph
- Selected elements on the scatterplot are also highlighted (opacity increased, black border added)

Why this approach?

- Parallel chart's filters provides a **fine-grained selection** on the events in the dataset.
- The header with the checkboxes and the week selector let the user select **'macro ranges' for the analysis**
- Scatterplot, together with boxplots and parallel help in **identifying outliers** while the map provide a **easy to ready location**.
- Bar chart and histogram, instead, offer a **high-level information** about the week
- Coordinated help in **focussing** the analysis **on a specific group of data**
- Animations of the views help in giving a **visual feedback of the changes** when filtering/selection is used

Links and Contacts

Project website: activefires-va19.github.io/visualization/
Detailed article: github.com/activefires-va19/doc
GitHub organization: github.com/activefires-va19

Alex's contacts:

- GitHub: github.com/AlexS1995

Leonardo's contacts:

- GitHub: github.com/LithiumSR/