

Visual Analytics Tool for Air Quality Index

Visual Analytics project 2023/24

ELISA DE BELLIS 1858927

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Introduction

Air pollution emissions have declined in the last decade, resulting in better air quality. Despite this improvement, air pollution remains the largest environmental health risk in Europe.



Air Quality Index Visual-Analytics tool has the aim to analyze concentration of pollutants and explore insights to capture an overview of the last 10 years about the situation of Italy.

Dataset

The dataset is taken from ISPRA
(Istituto Superiore per la Protezione e
la Ricerca Ambientale).

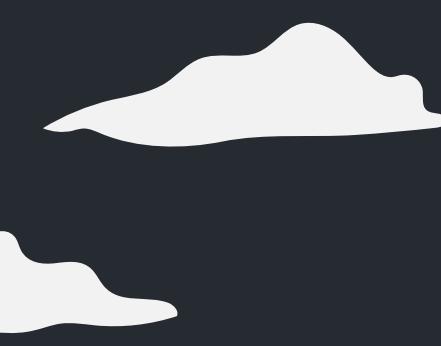
It is divided into four files, one for
each pollutant: PM2.5, PM10, NO2,
O3

- station_eu_code
- id_regione
- id_provincia
- id_comune
- station_code
- Regione
- Provincia
- Comune
- nome_stazione
- tipo_zona
- tipo_stazione
- TIPO
- Lon
- Lat
- yy
- n
- sup25
- sup15
- media_yy
- minimo
- massimo

Dataset

To establish air quality on the basis of previous pollutants, reference is made to the European Environment Agency (EEA)

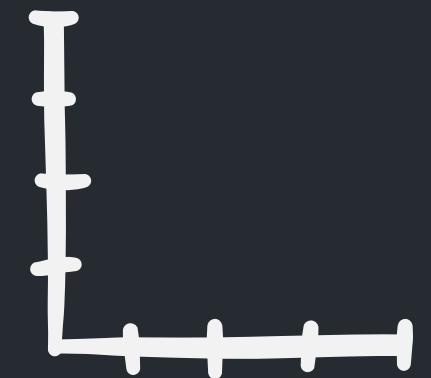
Pollutant	Index Level (based on concentration in $\mu\text{g}/\text{m}^3$)					
	Good	Fair	Moderate	Poor	Very Poor	Extremely poor
PM2.5	0-10	10-20	20-25	25-50	50-75	75-800
PM10	0-20	20-40	40-50	50-100	100-150	150-200
NO2	0-40	40-90	90-120	120-230	230-340	340-1000
O3	0-50	50-100	100-130	130-240	240-380	380-800



Pre-Processing

2016

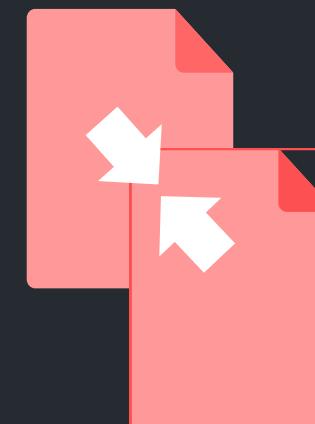
Divide data by year



Select numerical value for
t-SNE analysis



Group data by
Regions



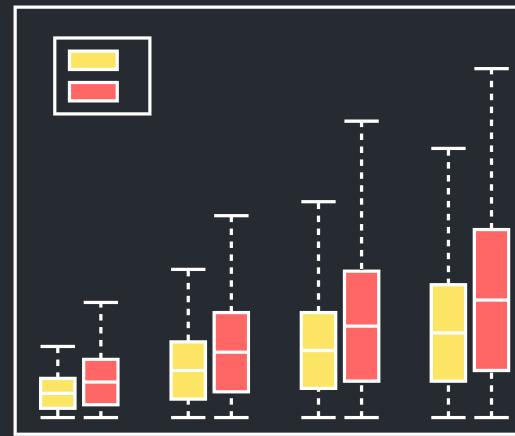
Create one file for all
pollutants divided by years.

Visualizations

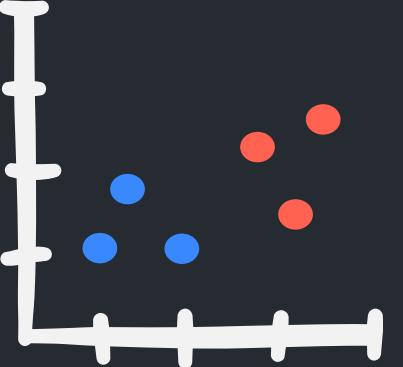
Map



Box-Plot



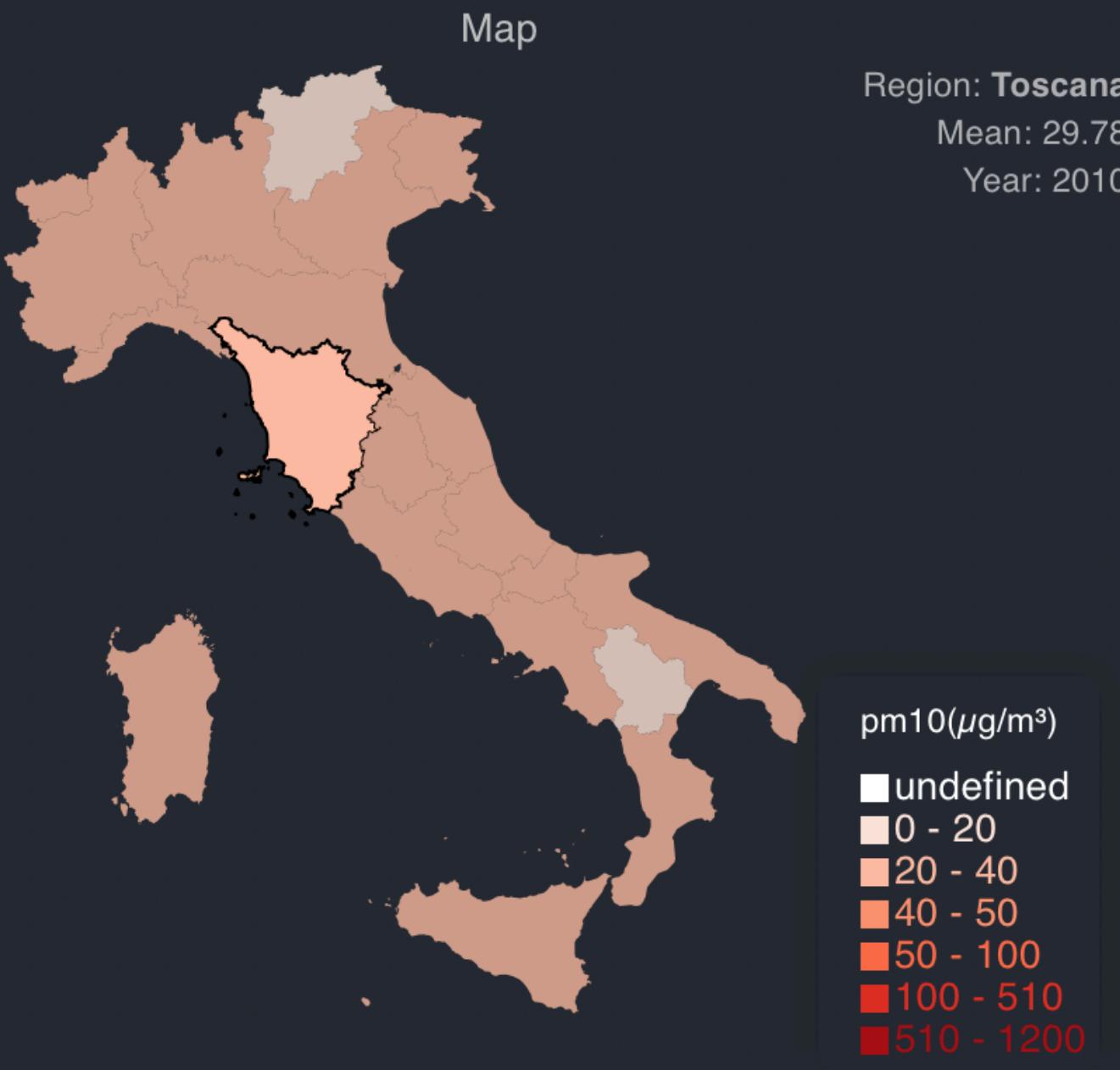
Scatter-plot



Time-Series



Map



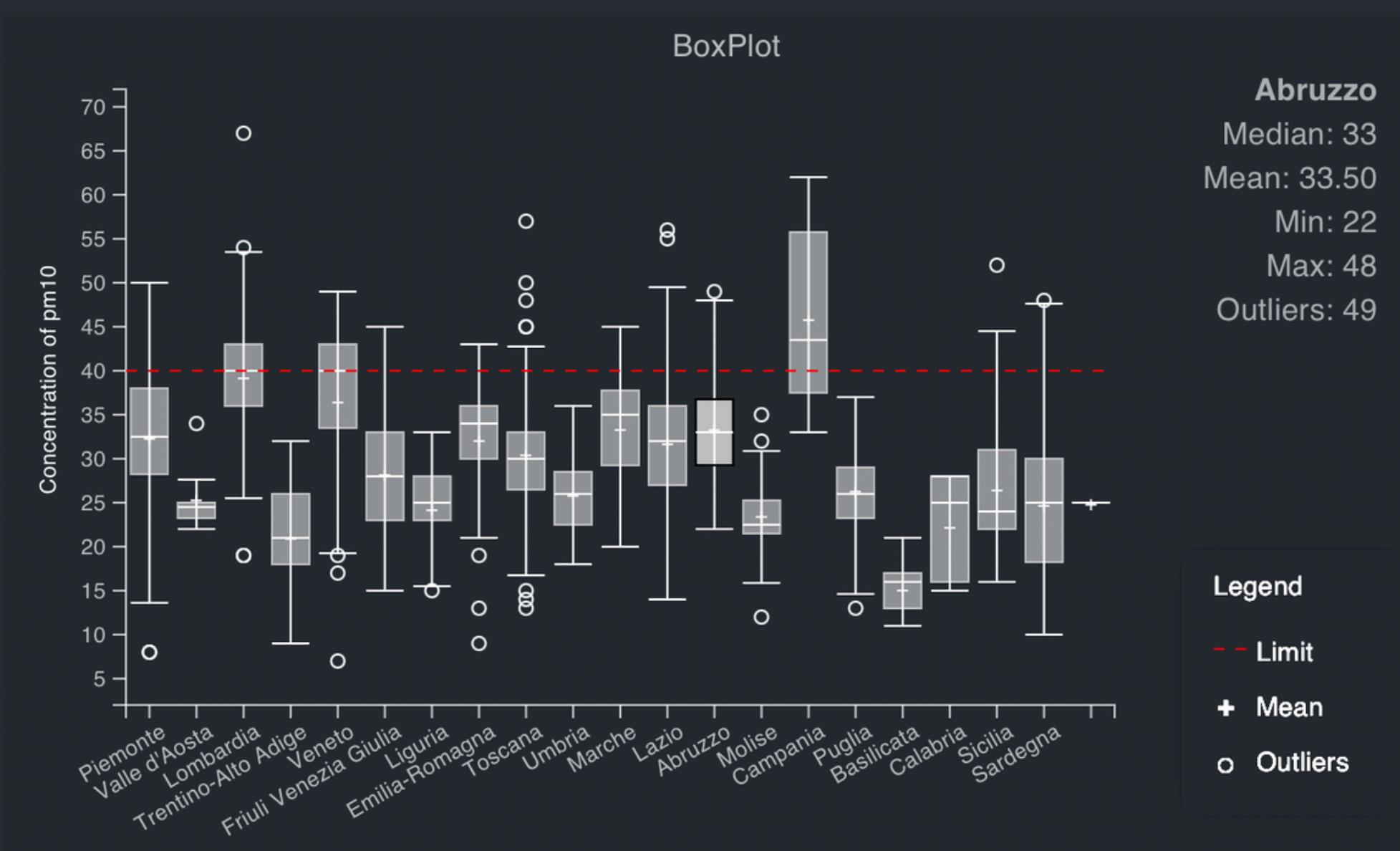
Visualization

The Map allow to show the mean concentration of the different pollutants in the Italy's regions. It consist of a map divided into 20 regions, each colour according to a shade of a red scale, according to the concentration of the selected pollutant.

Insight

- Critical regions and province
- Overview of the general situation

Box-Plot



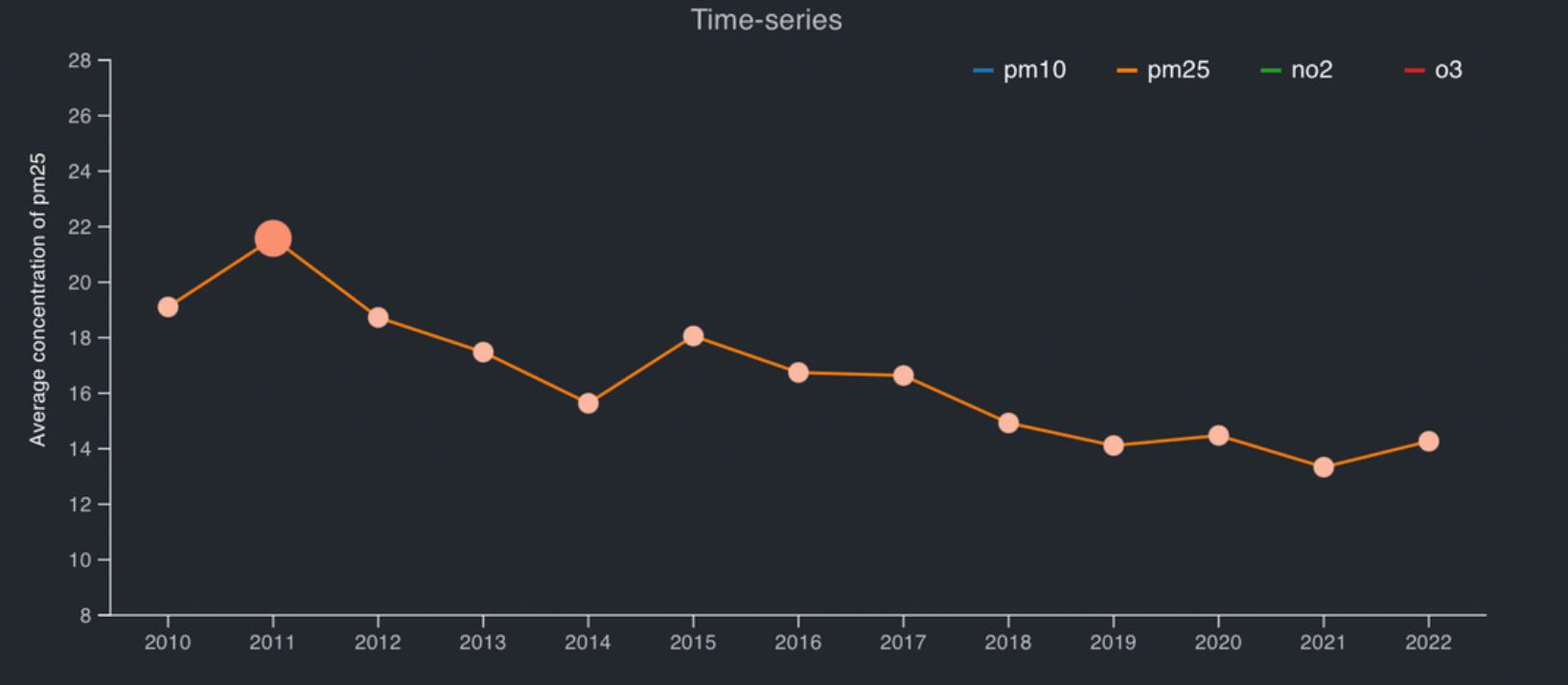
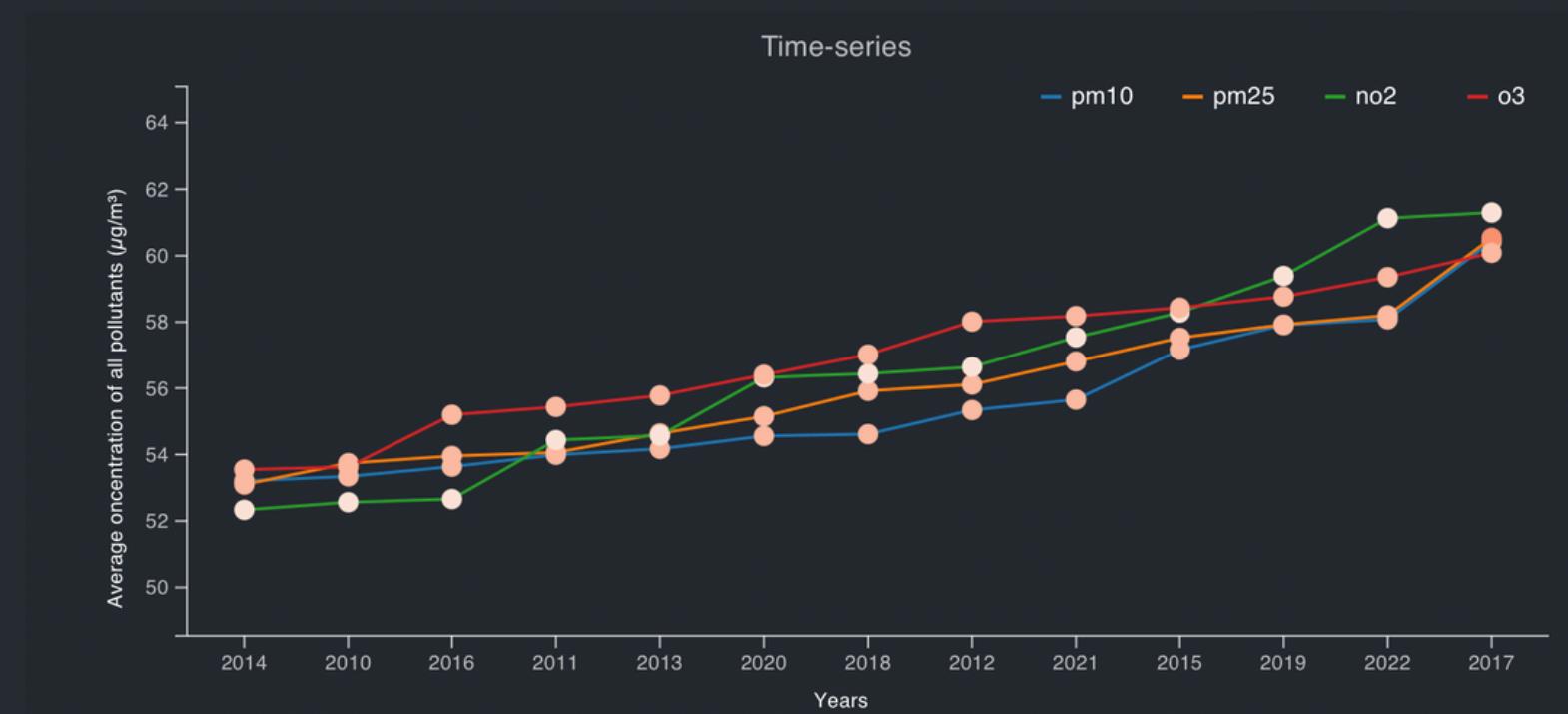
Visualization

The box-plot depicts the data for each region and allows comparison of data from all regions, showing the mean, median, maximum and minimum values and outliers. The graph also shows a threshold indicating the European limit allowed for that pollutant.

Insight

- Critical regions and province
- Comparison between different regions and provinces

Time-Series



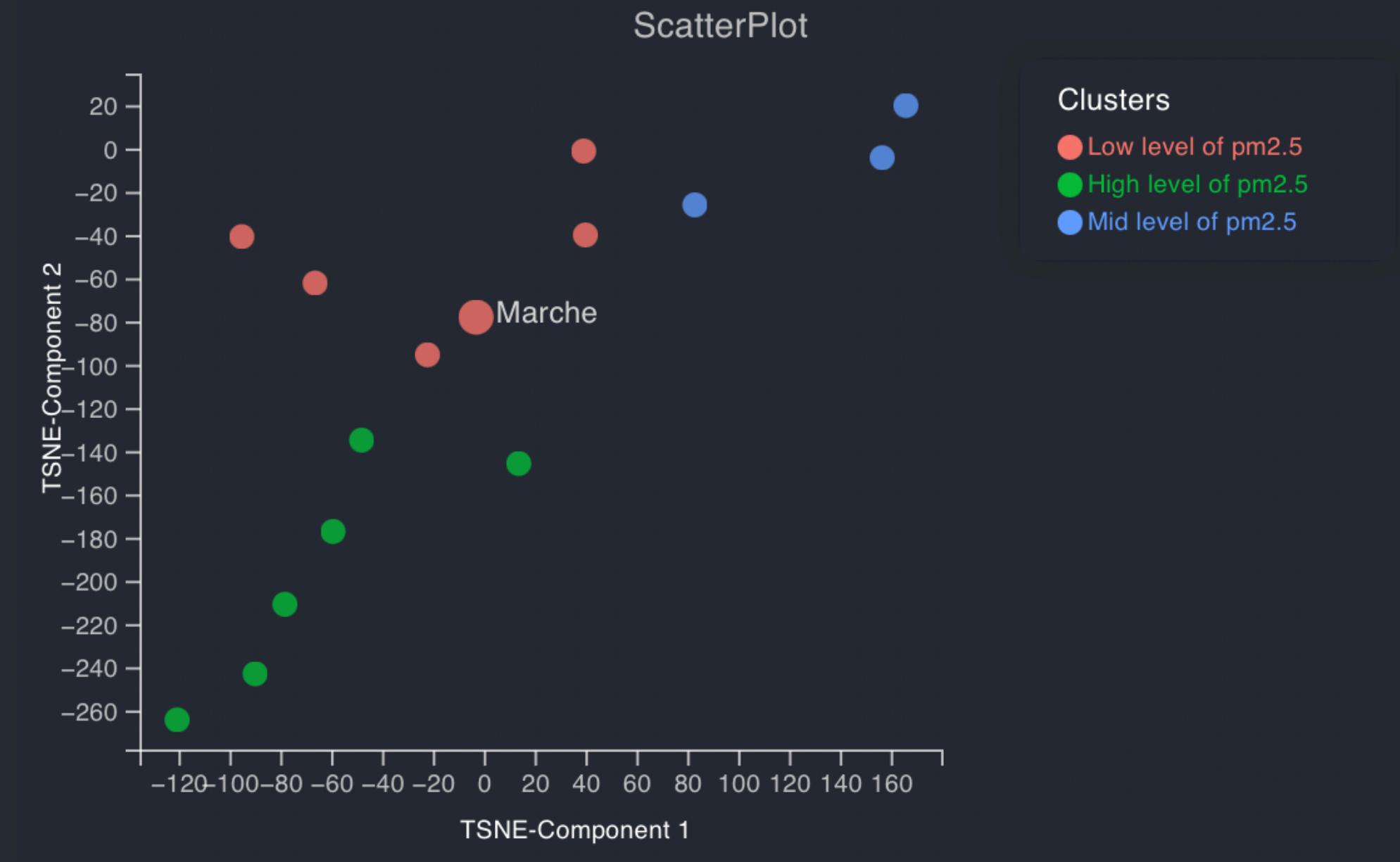
Visualization

The Time Series depicts how the average concentration in Italy in general has changed over the years. On the x-axis we have the different years taken into consideration, from 2010 to 2022, on the y-axis the average of all regions.

Insight

- Decrease in pollutants over years
- Impact of Lockdown

Scatter-Plot



Visualization

The Scatter-Plot is the result of dimensionality reduction using t-SNE. This is a two-dimensional representation of all four agents where each point is associated with a region. The two components represent the differentiation of the points, so the more similar two regions have similar agent characteristics, the closer they will be to each other.

Insight

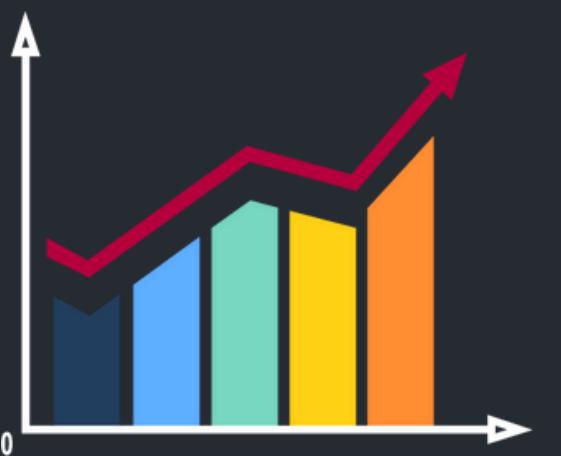
- Cluster models based on agent concentration

Analytics

The analytical process of the project focuses on applying t-distributed stochastic neighbor embedding (t-SNE) as a technique for dimensionality reduction. The following steps were undertaken to achieve the objective:



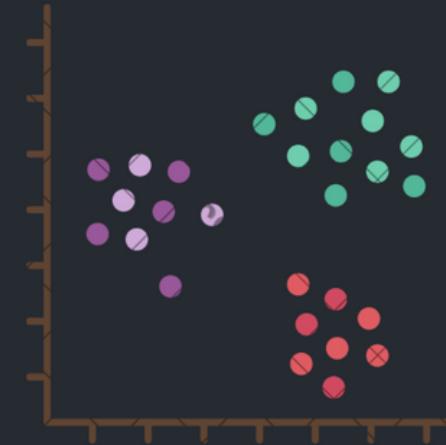
PRE-PROCESSING



STANDARDIZATION



t-SNE



K-Means

Application & Utilities

Intended Users

The Visual Analytics tool for the Air Quality Index is designed to be a valuable resource for environmental analysts, policymakers, and urban planners.



ANALYSTS



POLICYMAKERS



URBAN PLANNER

Application & Utilities

Use Cases

In this subsection, two distinct use cases are presented: practical applications in enhancing environmental quality and public health.

1. Urban Planning and Development

A city planner uses air quality data to identify pollution hotspots, focusing on NO₂ and PM₁₀.

By analyzing trends, they collaborate with experts to design traffic flow and green spaces to reduce pollution.

2. Public Health Intervention

A public health official uses real-time air quality data to identify affected areas and key pollutants. They issue health advisories and work with authorities to reduce pollution by restricting vehicles and suspending industrial activities.

A black and white photograph of a dense forest. The trees are tall and thin, their branches reaching upwards. The sky is bright, creating a strong contrast with the dark trunks and branches. The overall effect is one of a dreamlike or surreal landscape.

DEMO