

# Un caso di studio del mondo reale per l'analisi di serie temporali finalizzato al controllo della qualità dell'aria

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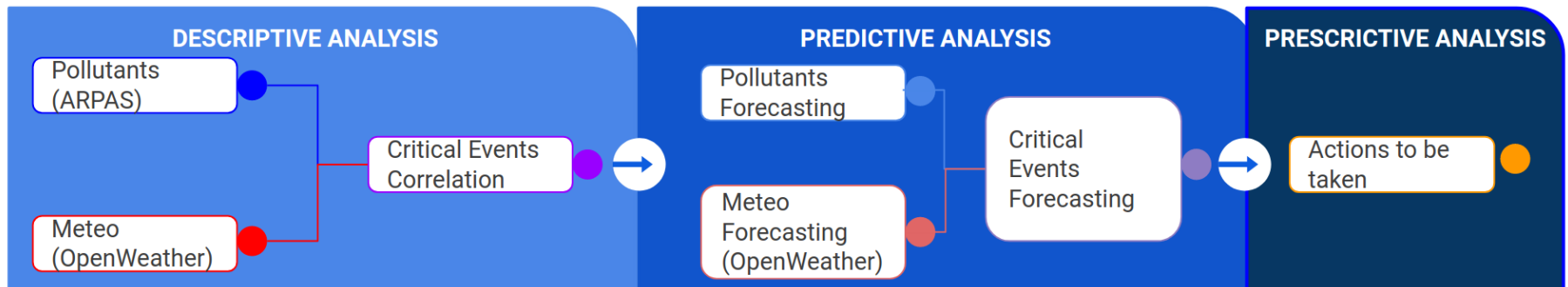
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Conferenza GARR 2022  
Palermo 18-20 maggio

# Ricerca di correlazioni

## Cagliari case study: pollutants and weather correlations



# European Air Quality Index

POLLUTANT	INDEX LEVEL <i>(based on pollutant concentrations in <math>\mu\text{g}/\text{m}^3</math>)</i>					
	 1 Very good	 2 Good	 3 Medium	 4 Poor	 5 Very Poor	 6 Extremely Poor
Ozone (O <sub>3</sub> )	0-50	50-100	100-130	130-240	240-380	380-800
Nitrogen dioxide (NO <sub>2</sub> )	0-40	40-90	90-120	120-230	230-340	340-1000
Sulphur dioxide (SO <sub>2</sub> )	0-100	100-200	200-350	350-500	500-750	750-1250
Particules less than 10 $\mu\text{m}$ (PM <sub>10</sub> )	0-20	20-40	40-50	50-100	100-150	150-1200
Particules less than 2.5 $\mu\text{m}$ (PM <sub>2,5</sub> )	0-10	10-20	20-25	25-50	50-75	75-800

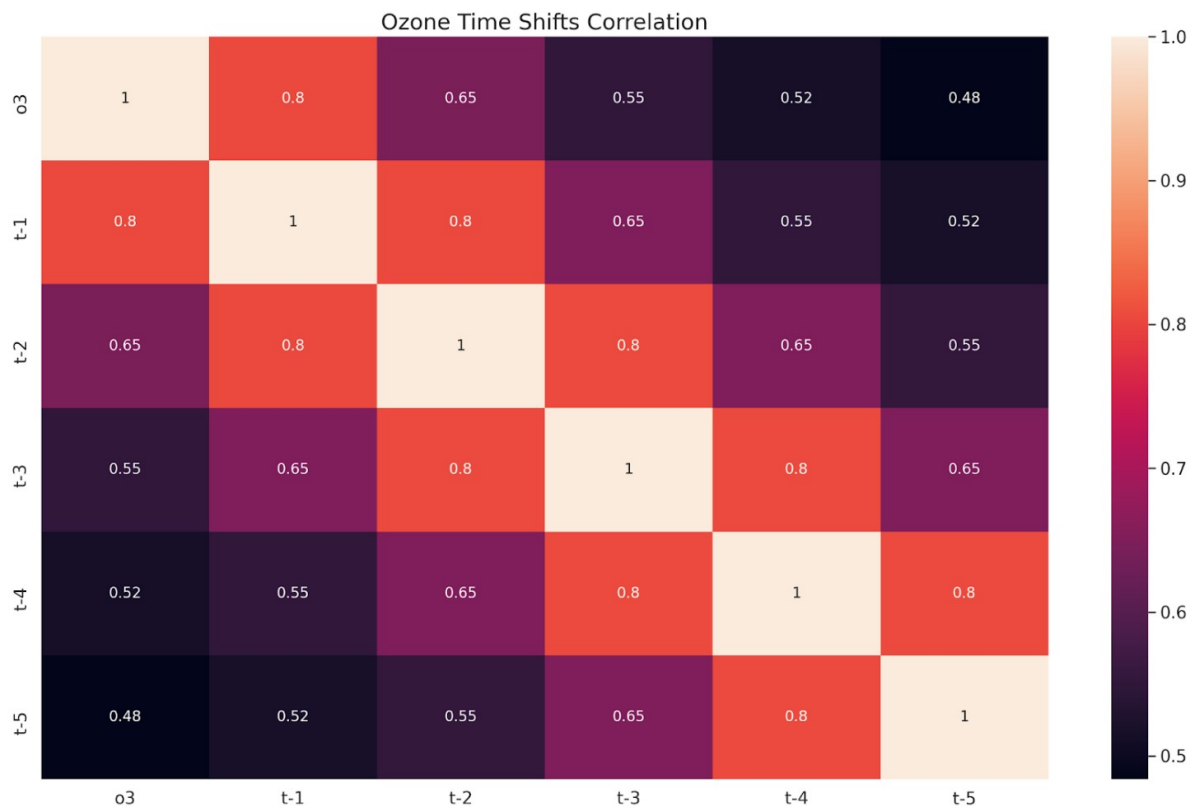
**Note:** PM10 and PM2.5 values are based on 24-hour running means

The EU AQI is managed and calculated for many locations by the Copernicus Atmosphere Monitoring Service

# ARIMA Algorithms

Acronym	Name	Stationarity	Seasonality	Exogenous parameters
<b>ARMA</b>	AutoRegressive Moving Averages	yes	no	no
<b>ARIMA</b>	AutoRegressive Integrated Moving Averages	no	no	no
<b>SARIMA</b>	Seasonal AutoRegressive Integrated Moving Averages	no	yes	no
<b>ARIMAX</b>	AutoRegressive Integrated Moving Averages with eXogenous regressors	no	no	yes
<b>SARIMAX</b>	Seasonal AutoRegressive Integrated Moving Averages with eXogenous regressors	no	yes	yes

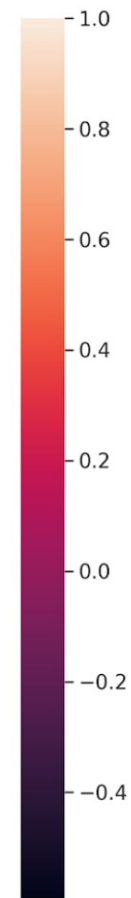
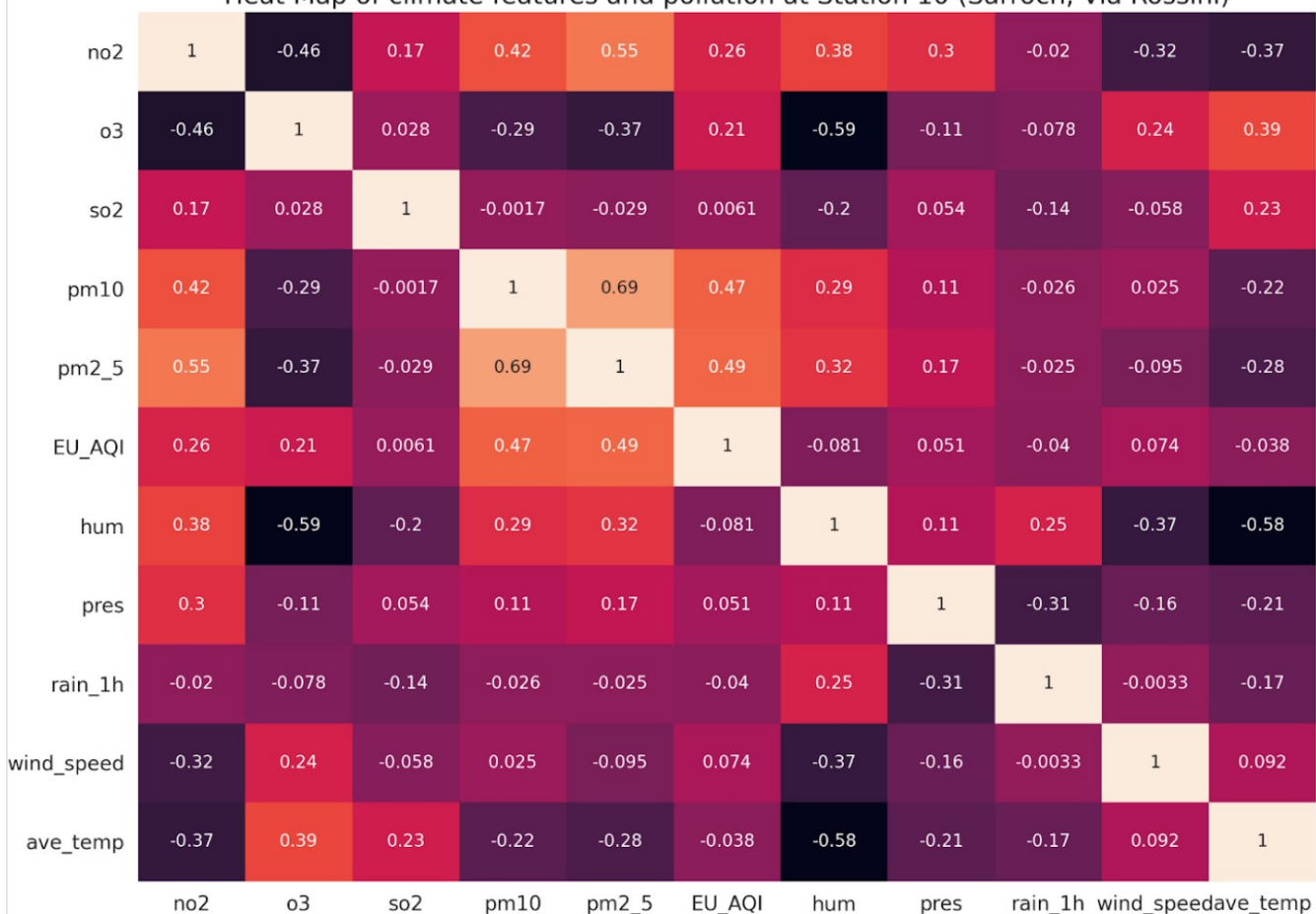
# Analysis for each pollutant and detection unit



Il valore di ozono ha elevata correlazione con il valore del giorno precedente (0.8) e fino a 5 giorni prima (0.48 col valore di 5 giorni prima).

# Linear correlation

Heat Map of climate features and pollution at Station 10 (Sarroch, Via Rossini)



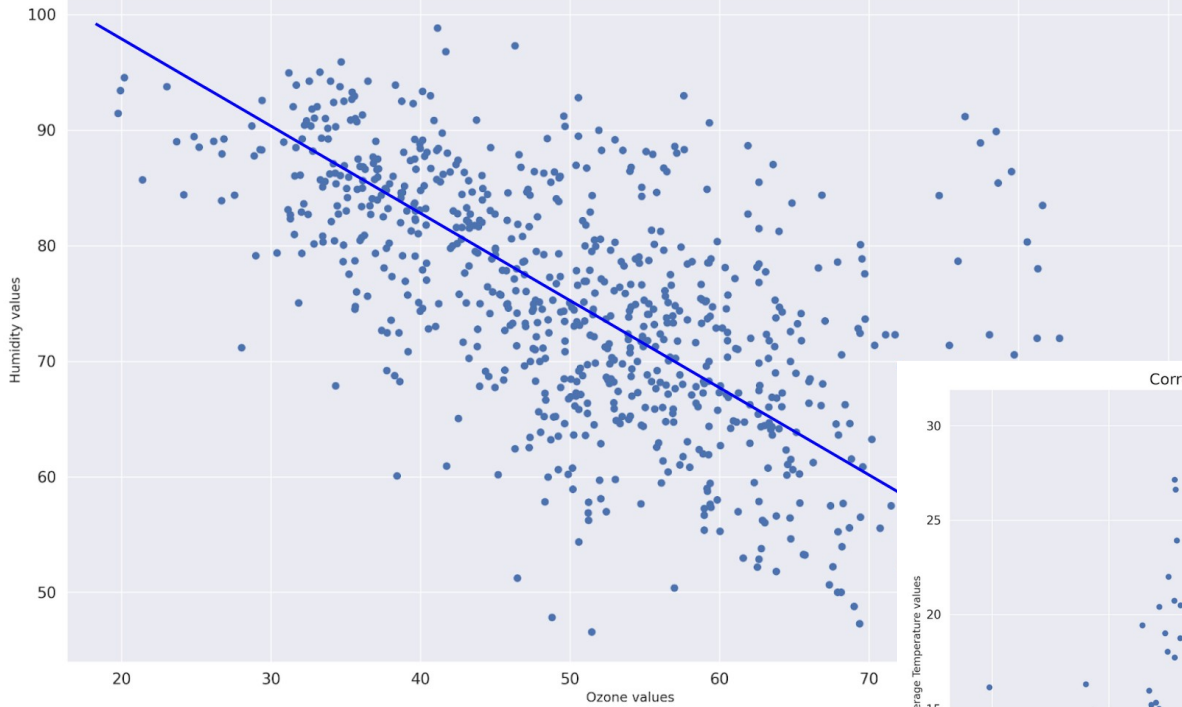
Il valore di correlazione maggiore si nota tra l'**ozono in correlazione inversa con l'umidità (r = -0.59)** e correlazione con la **temperatura media (r = 0.39)**.

Si notano poi correlazioni elevate tra diversi inquinanti, per esempio tra **pm 2.5 e pm 10 (r = 0.69)**, tra **pm2.5 e NO2 (r = 0.55)**.

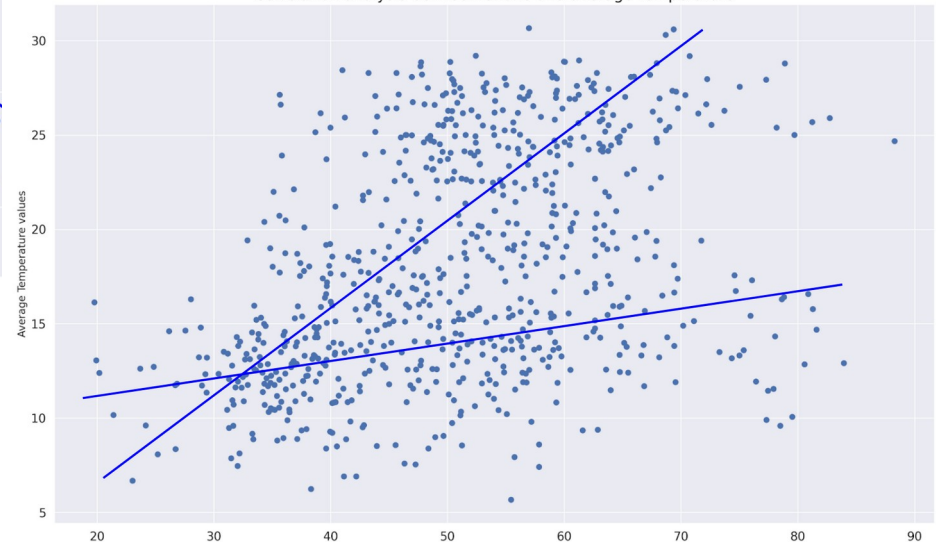
Correlazioni anche tra parametri delle condizioni meteo: **temp media e umidità (r = -0.55)**.

# Looking for correlations

Correlation analysis between Ozone and humidity



Correlation analysis between Ozone and average temperature



# Stationarity with Augmented Dickey-Fuller (ADF) test

p-value  $> 0.05$  non-stationary hypothesis

p-value  $\leq 0.05$  stationary hypothesis

Some time series resulted not stationary.

For these series, the Auto Correlation Function (ACF) was used which brought to the conclusion that the series were semi stationary.



Thank you!  
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