

Spatial Assessment of Air Quality Index in Italy

Joseph Abeiku Paintsil and Sirak Asfaha
NOVA Information Management School



What one thing do all of us seated here have in common?



Introduction

We all have unique aspects that make us different from others



We come from
different cultures

你好 HALLO 안녕
CIAO HOLA নমস্তে
γεια HELLO こんにちは привет
BONJOUR مرحبا OLÁ

We may know
different languages



There are different
things we love doing

There are also things we have in common



We one way or another
use GIS



We are all currently in
Münster, Germany



We are all currently at
Geomundus

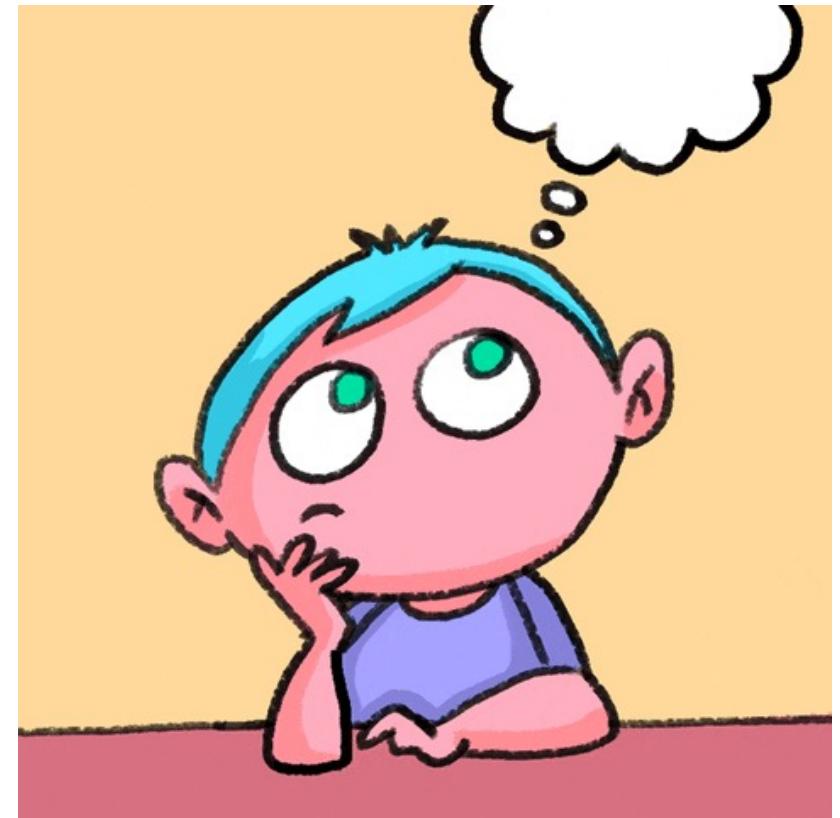


But there is one
thing we all have
more in common...

Could you guess
what it is ?...

Still wondering what it is?

Hint: Every Human in the world does it



2nd Hint: We are all doing it right now!!

If your answer was
Breathing in Air, you are
absolutely right!!

One thing we all have in
common is that we all
breathe in air !!!



And as such the quality of air we breathe in is of vital importance.

And that is where Air Quality Index comes in.

Outline



Air Quality Index (Air Quality Index)



Pollutants Used in this Study



Calculation of AQI (Individual Pollutants)



Generation of Final AQI map

So what is Air Quality Index?



Air Quality Index (AQI) is a numerical scale used to determine the degree of air contamination in an area



Different Pollutant such as No₂, PM10 and PM2.5 are used to determine it

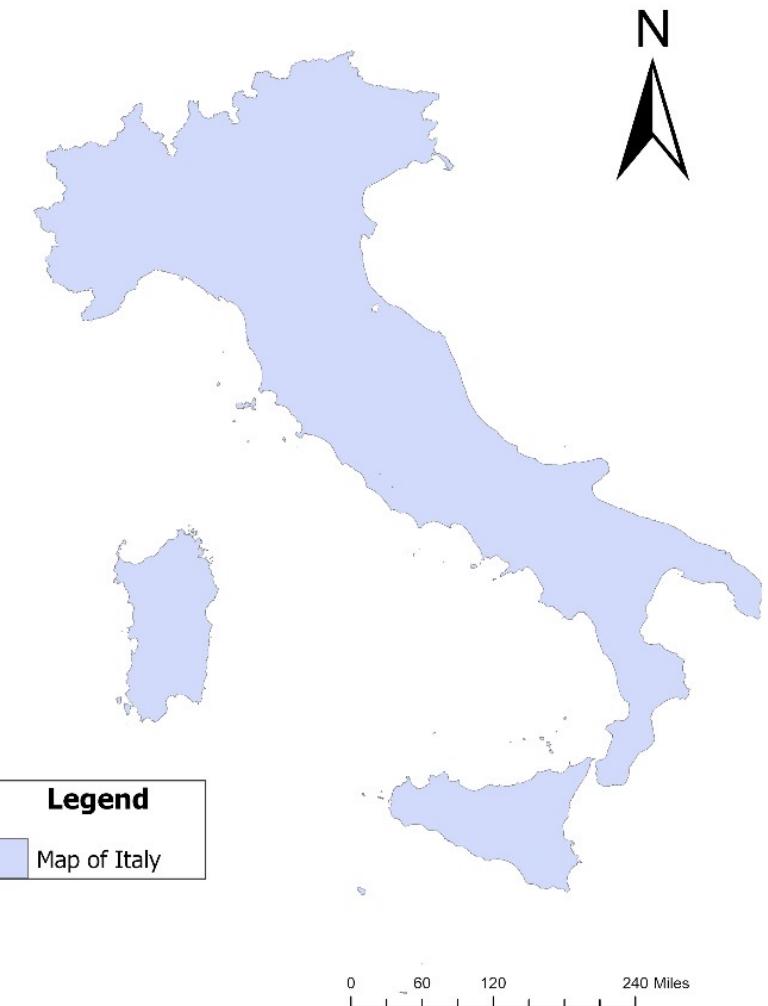


AQI between 0-50 is considered good AQI by the European Union

Study Region

- In this Study, AQI across Italy was determined
- Data Source: European Environment Agency Website
- Concentrations of 3 pollutants were used: NO₂, PM_{2.5}, and PM 10 (for 2019)
- Concentration of pollution are measured by AQ Stations in Italy

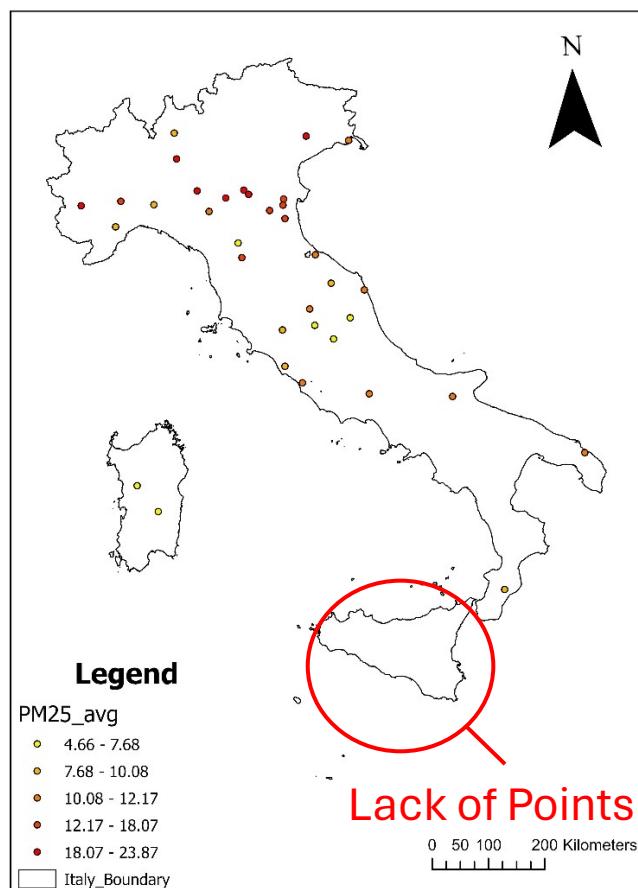
MAP OF ITALY



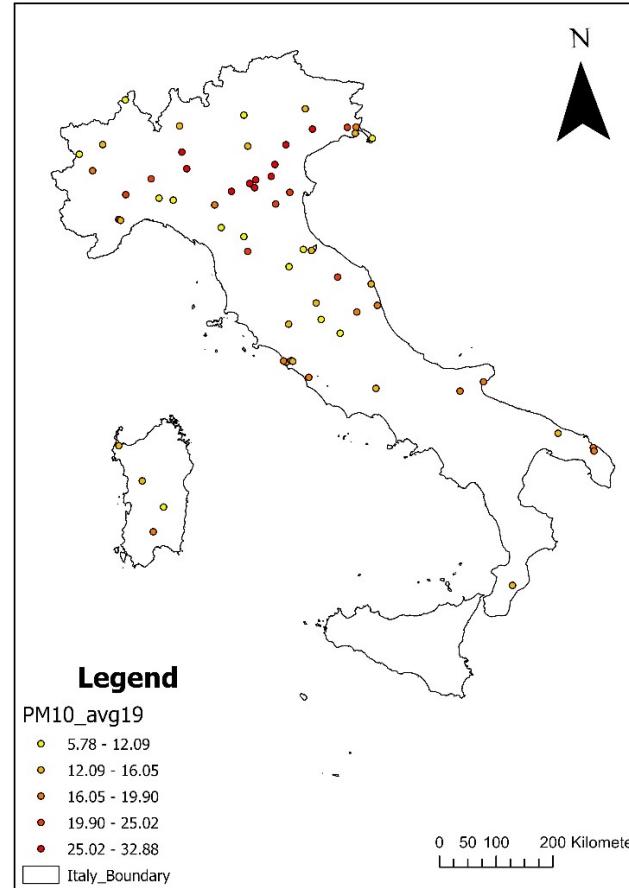
Pollutant Measurements

Distribution of various pollutants measured by Air Quality Stations in Italy

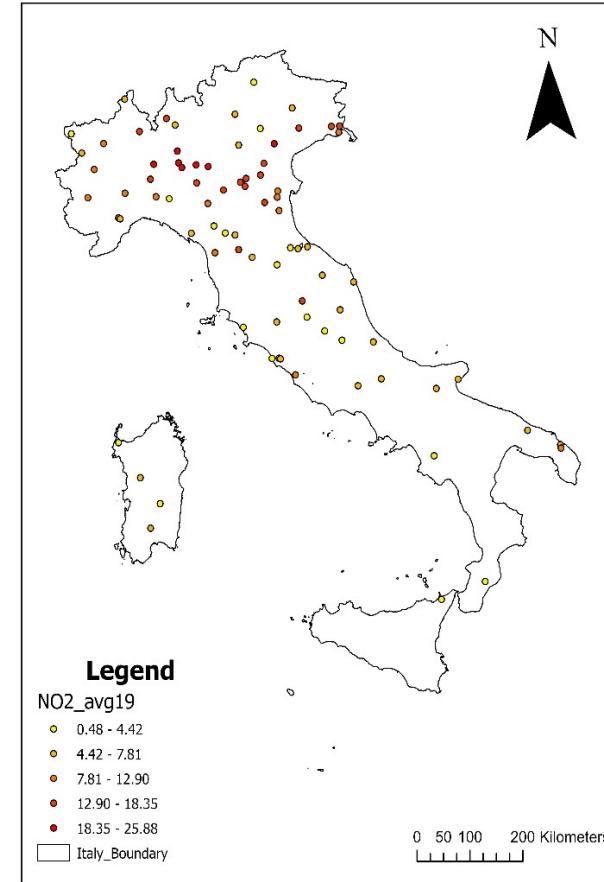
PM 2.5



PM 10



NO2



Pollutant AQI



AQI for every pollutant was calculated at every station



Spatial autocorrelation needed to be present for interpolation



Global Moran I was carried out to determine if there was spatial autocorrelation



P-values of all pollutants were less than 0.05 indicating the presence of spatial autocorrelation

AQI Calculation

AQI Category	AQI	Concentration range*							
		PM ₁₀	PM _{2.5}	NO ₂	O ₃	CO	SO ₂	NH ₃	Pb
Good	0 - 50	0 - 50	0 - 30	0 - 40	0 - 50	0 - 1.0	0 - 40	0 - 200	0 - 0.5
Satisfactory	51 - 100	51 - 100	31 - 60	41 - 80	51 - 100	1.1 - 2.0	41 - 80	201 - 400	0.5 - 1.0
Moderately polluted	101 - 200	101 - 250	61 - 90	81 - 180	101 - 168	2.1 - 10	81 - 380	401 - 800	1.1 - 2.0
Poor	201 - 300	251 - 350	91 - 120	181 - 280	169 - 208	10 - 17	381 - 800	801 - 1200	2.1 - 3.0
Very poor	301 - 400	351 - 430	121 - 250	281 - 400	209 - 748*	17 - 34	801 - 1600	1200 - 1800	3.1 - 3.5
Severe	401 - 500	430+	250+	400+	748+*	34+	1600+	1800+	3.5+

$$I_p = \frac{I_{Hi} - I_{Lo}}{BP_{Hi} - BP_{Lo}}(C_p - BP_{Lo}) + I_{Lo}$$

I_p = Air Quality index of the pollutant

C_p = Concentration of pollutant

BP_{Hi} = Concentration breakpoint that is greater than or equal to C_p

BP_{Lo} = Concentration breakpoint that is less than or equal to C_p

I_{Hi} = the AQI value corresponding to BP_{Hi}

I_{Lo} = the AQI value corresponding to BP_{Lo}

(Aravinna, 2022)

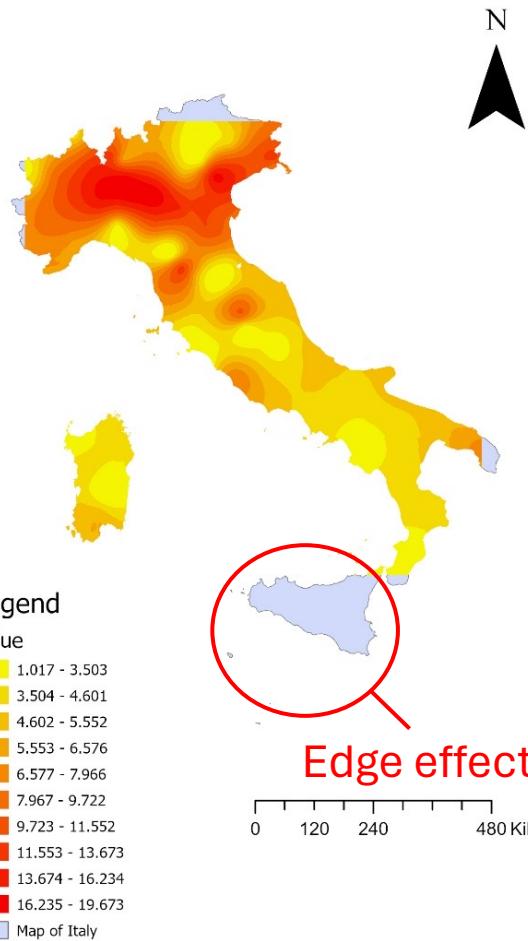
Methodology

Exploratory Analysis was carried out to see which interpolation method would be considered best for each pollutant

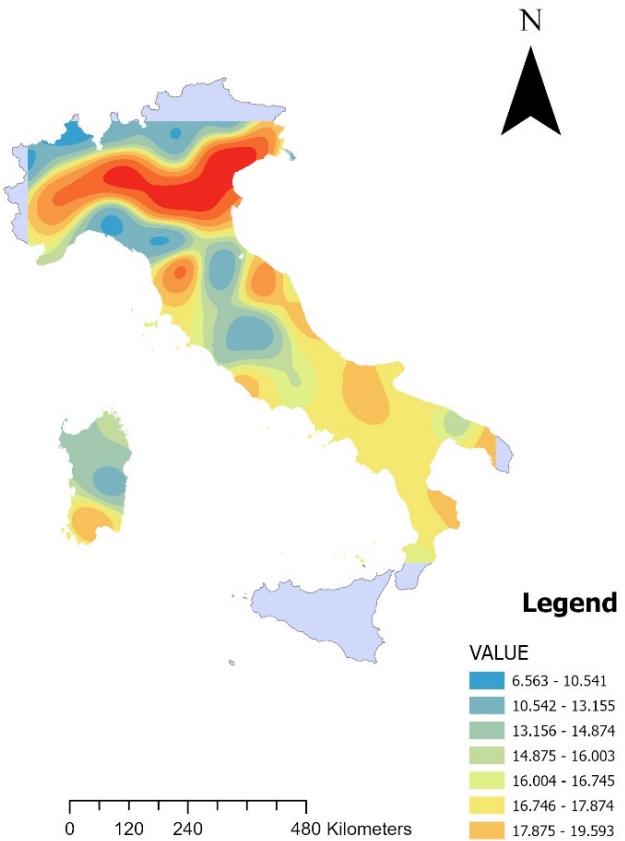
PM2.5	Empirical Bayesian Kriging
PM10	Empirical Bayesian Kriging
NO2	Universal Kriging

AQI interpolated map for individual Pollutant

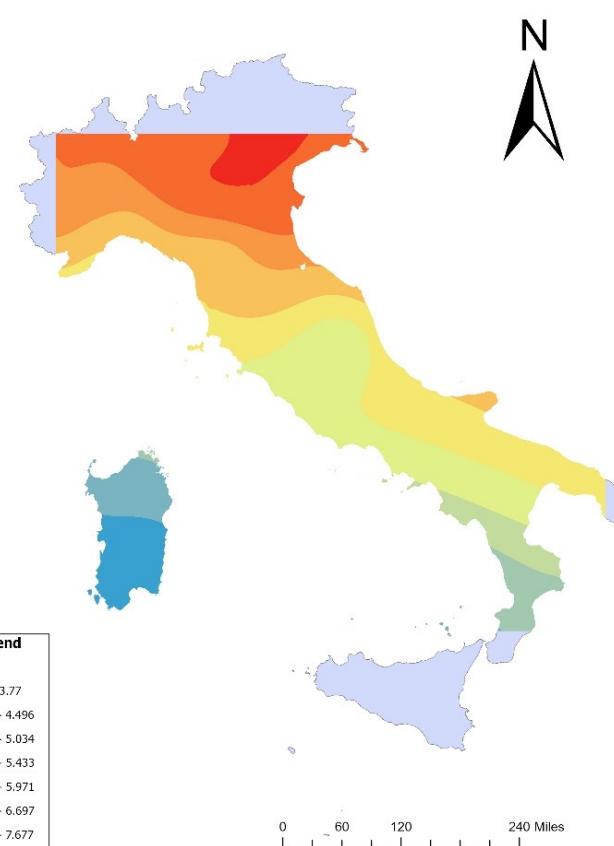
AQI SURFACE MAP FOR NO₂



AQI SURFACE MAP FOR PM 10



AQI MAP OF PM 2.5



Creating Final AQI Map



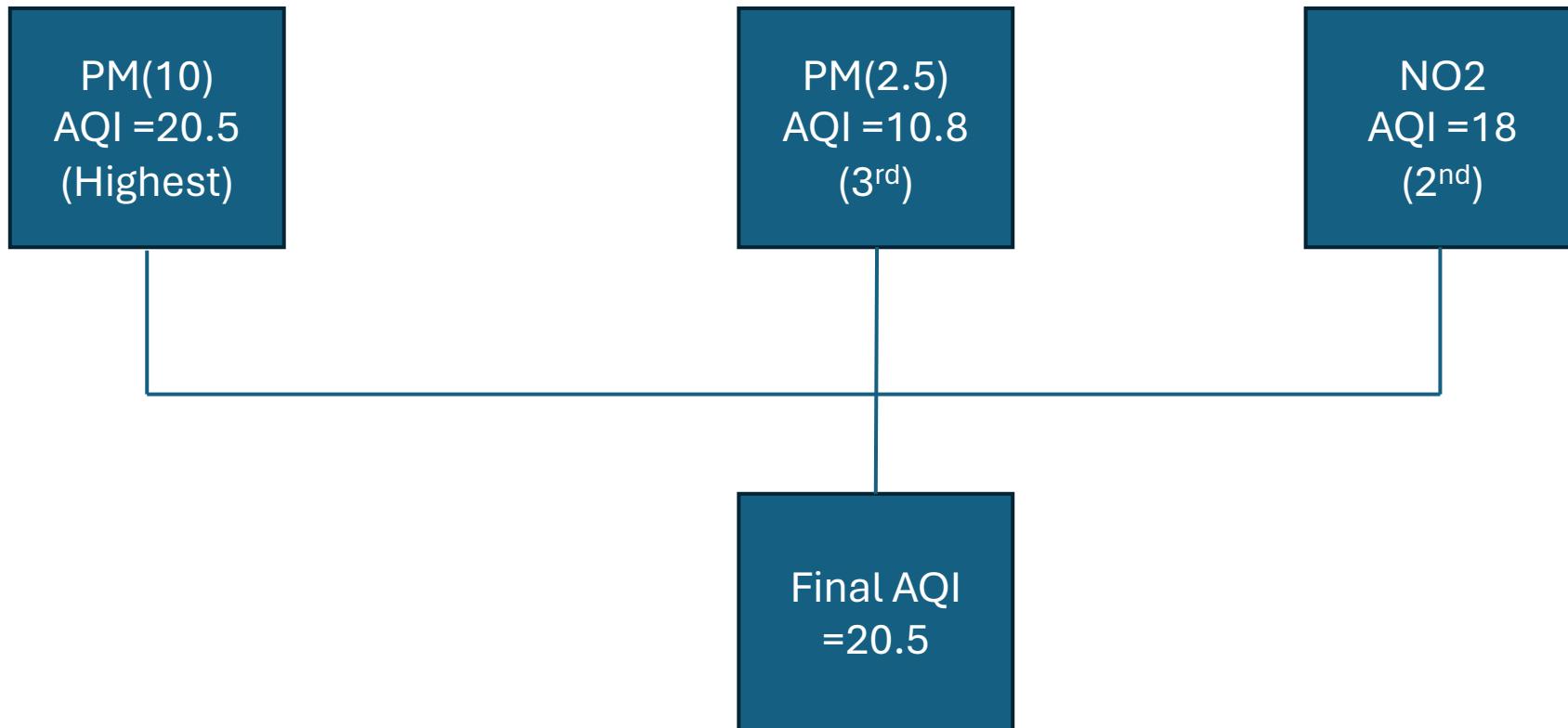
Pollutant with the highest AQI at a point is chosen to represent the overall AQI at that point



The lower the AQI value, the healthier the air.

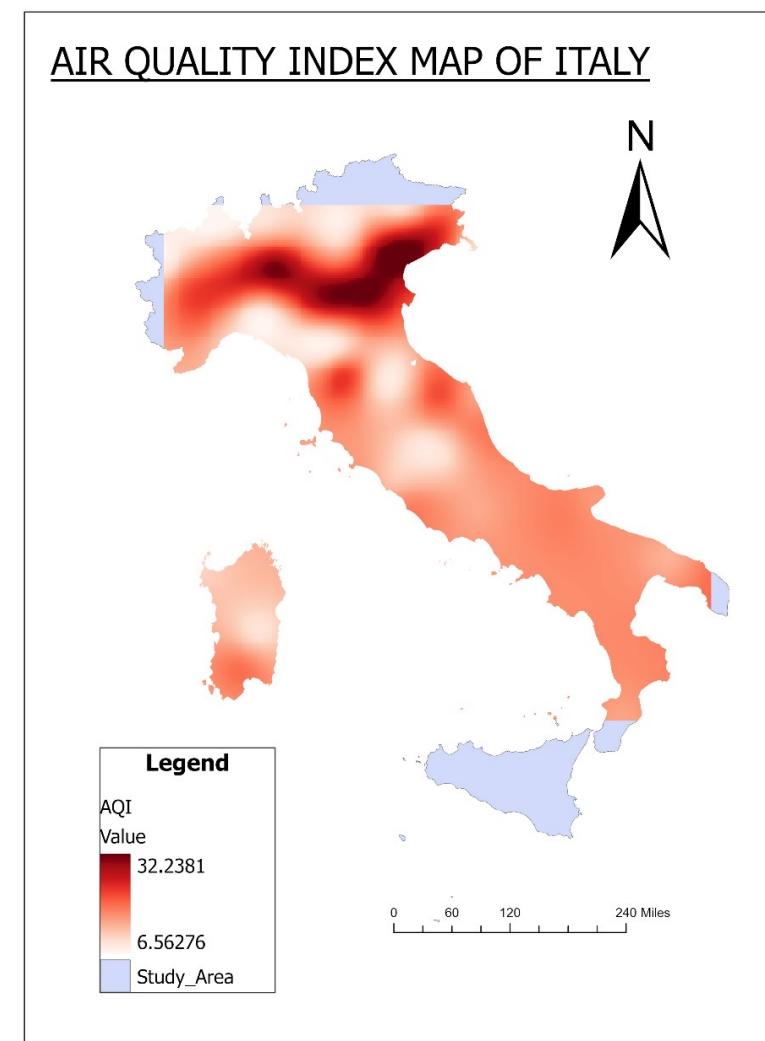
Creating Final AQI map Cont

Highest AQI of Pollutant at a pixel is selected as the overall AQI for that pixel



Overall AQI Map

- Highest AQI was 32.2381 (below 50) indicating good AQI over Italy
- Northern part of Italy however had higher AQI indicating relatively poor AQI
- Decision makers should implement policies to reduce air pollution in Northern Italy



Conclusions and Limitations

- General AQI of Italy is good
- Northern part has relatively poor AQI hence the need for targeted pollution mitigation strategies
- Lack of sample points near the edges caused edge effect



Thank You

Danke Schön

Gracias

Obrigado



Questions?



Follow me on my social channels!