

# COVID-19 national lockdown in Morocco: impacts on air quality and public health

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## Abstract

On the 20th April 2020, the end of the first strict lockdown in Morocco, 2403410 cases of the corona Virus were confirmed globally. The number of Morocco confirmed cases attended 2990 and 143 deaths were recorded. Due to the pandemic, all avoidable activities in the country were prohibited since the kingdom announced the general lockdown on 20th March 2020. This study aims at comparing the air quality status in Casablanca and Marrakech from Morocco, before the pandemic and during the confinement to show whether COVID-19 compelled lockdown may have saved lives by restraining air pollution than by preventing infection. We used the difference-in-difference and the Theil and Sen non-parametric approaches for univariate time series. We defined the before quarantine period as between the 16th February and the 19th March and the during quarantine as between the 20th March and 20th April. We assessed changes in air quality during vs. before the quarantine period in 2020 and compared these with corresponding changes in the same lunar calendar periods in 2016-2019. Then we calculated the avoided cause-specific mortality attributable to the decreases in NO<sub>2</sub> and PM<sub>2.5</sub> based on the concentration-response functions from previous studies. We found that NO<sub>2</sub> dropped by -12  $\mu\text{g}/\text{m}^3$  in Casablanca and -7  $\mu\text{g}/\text{m}^3$  in Marrakech. PM<sub>2.5</sub> dropped by -18  $\mu\text{g}/\text{m}^3$  in Casablanca and -14  $\mu\text{g}/\text{m}^3$  in Marrakech. CO dropped by -0.04  $\text{mg}/\text{m}^3$  in Casablanca and -0.12  $\text{mg}/\text{m}^3$  in Marrakech. This air pollution reduction had created human health benefits and had reduced mortality and saved lives mainly from cardiovascular diseases. Our results are in complete agreement with the worldwide studies. Yet, they should be interpreted carefully because of the potential common impacts NO<sub>2</sub> and PM<sub>2.5</sub> may have on health. Further investigation may be undertaken to explore the reduction in the concentrations of industry-related pollutants.





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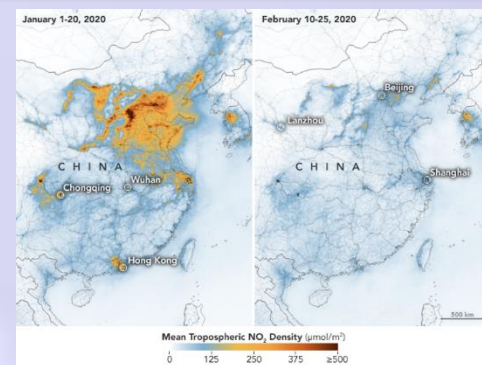
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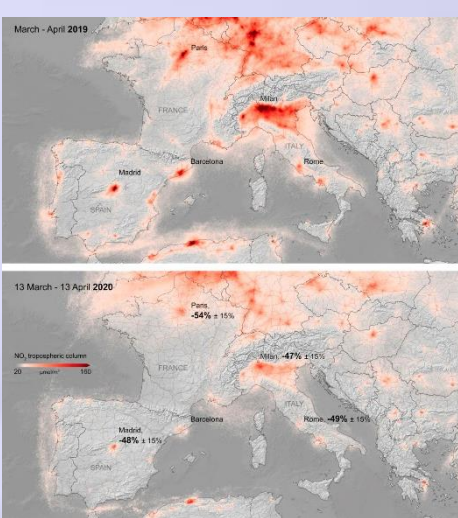
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## The Matter

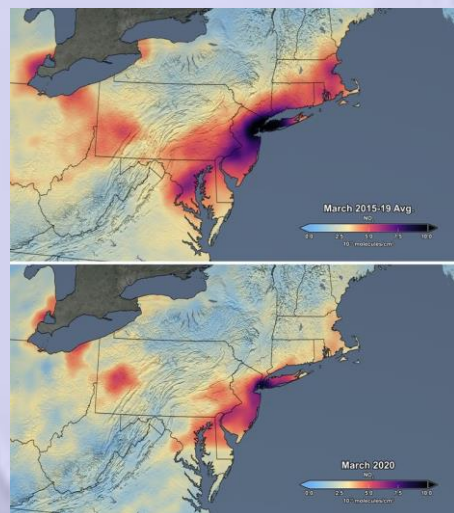


Nitrogen dioxide (NO<sub>2</sub>) reduction in China (NASA Image)

Covid-19 lockdown has caused traffic and industrial activities to shut down and reduced air pollution in many regions around the world. This will benefit human health.



Nitrogen dioxide (NO<sub>2</sub>) reduction in Europe (Image: © ESA/Copernicus Sentinel data (2019-20), processed by KNMI/ESA)



Nitrogen dioxide (NO<sub>2</sub>) reduction over parts of the USA (NASA Image)

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## The Period

- Before quarantine : 16<sup>th</sup> February to 19<sup>th</sup> March 2020.
- During quarantine: 20<sup>th</sup> March to 20<sup>th</sup> April 2020.
- Period as during quarantine in 2016-2019.

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## The Results

- NO<sub>2</sub> dropped by -12 µg/m<sup>3</sup> in Casablanca and -7 µg/m<sup>3</sup> in Marrakech.
- PM<sub>2.5</sub> dropped by -18 µg/m<sup>3</sup> in Casablanca and -14 µg/m<sup>3</sup> in Marrakech.
- CO dropped by -0.04 mg/m<sup>3</sup> in Casablanca and -0.12 mg/m<sup>3</sup> in Marrakech.
- TS slopes for 2020 are statistically significant and confirm the trends of the DDE.

Air pollution changes due to the quarantine in Casablanca and Marrakech using DDE

	During vs before (2020)		During vs before (2016-2019)		Difference in difference	
	Casablanca	Marrakech	Casablanca	Marrakech	Casablanca	Marrakech
NO <sub>2</sub>	-12.5	-7.5	-0.28	-0.74	-12.21	-6.76
PM <sub>2.5</sub>	-11.63	-16.26	5.87	-2.48	-17.5	-13.78
CO	-0.06	-0.21	-0.02	-0.1	-0.04	-0.12

- More than 60% of the avoidable deaths were from cardiovascular diseases.

Avoided cause-specific deaths due to air pollution reduction

	Casablanca		Marrakech	
	NO2	PM2.5	NO2	PM2.5
Total	185(145,223)	48(70,89)	30(24,37)	15(10,19)
Cardiovascular Disease	96(76,126)	45(30,59)	16(12,21)	10(6,13)
Hypertensive heart disease	8(5,11)	4(1,6)	1(1,2)	1(0,1)
Chronic respiratory diseases	8(6,10)	3(2,5)	1(1,2)	1(0,1)
Stroke	23(13,30)	4(2,5)	9(5,13)	2(1,3)
COPD	5(7,9)	2(3,4)	1(1,1)	1(0,1)

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## The References

Khomsi, K., Najmi, H., Amghar, H., Chelhaoui, Y., & Souhaili, Z. (2020). **COVID-19 national lockdown in Morocco: impacts on air quality and public health** Submitted to: *OneHealth*

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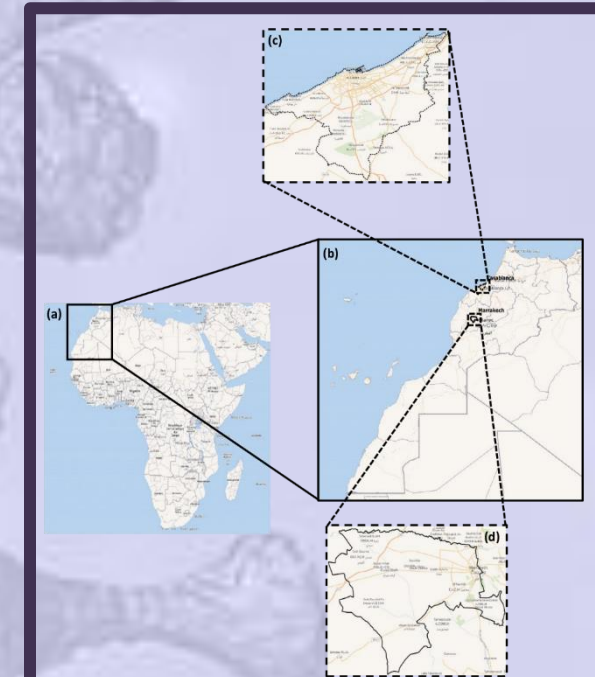
## The Aim

- To compare air quality status in Casablanca and Marrakech before the pandemic and during the confinement.
- To show whether COVID-19 lockdown may have saved lives by restraining air pollution than by preventing infection.

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## The Area

(a) Africa (b) Morocco (c) Casablanca (d) Marrakech



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What about North Africa?

What implications on Human Health?

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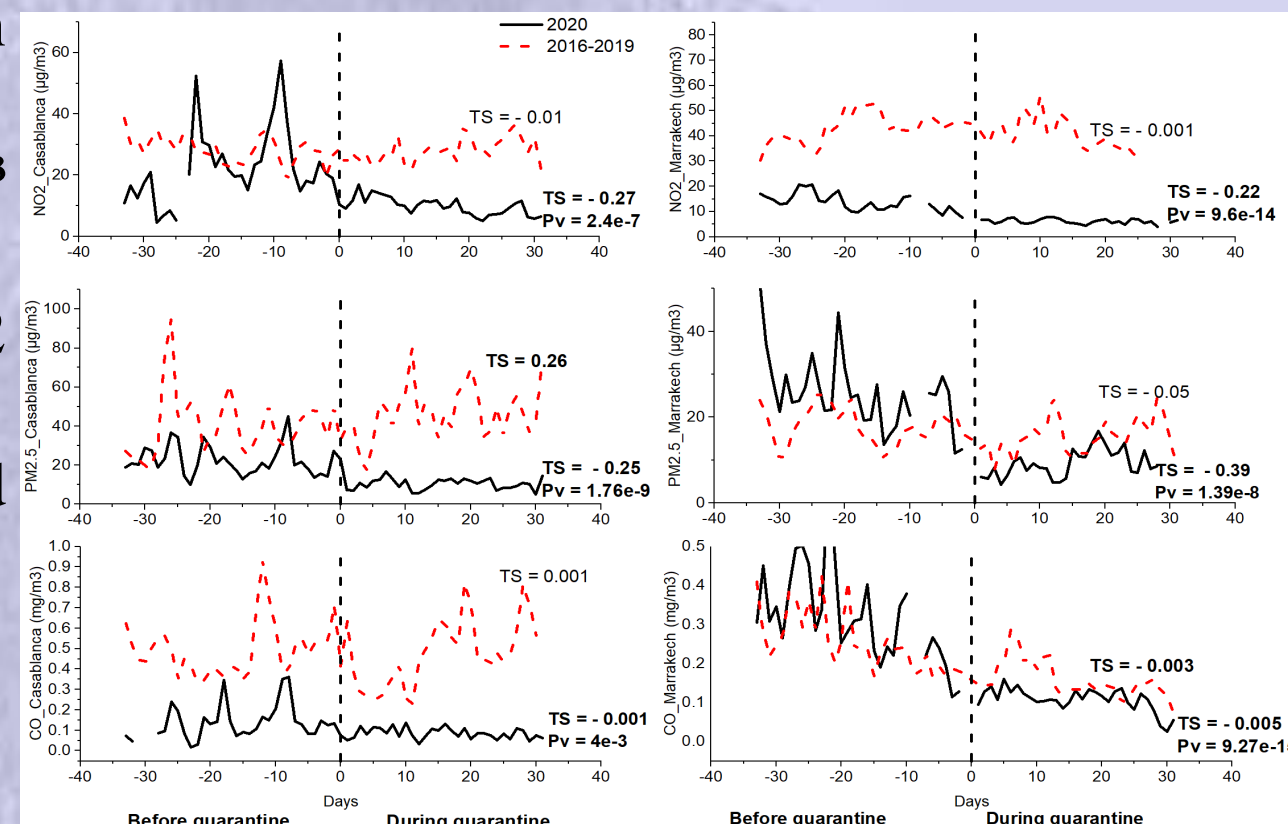
## The Tools

- Daily Means of NO<sub>2</sub>, PM<sub>2.5</sub> and CO concentrations;
- Difference-in-Difference (DDE), Theil and Sen approach (TS) & Mann-Kendall test;
- Concentration-response functions (CRF) from previous studies;
- The attributable fraction (AF) to estimate the daily avoided cause-specific mortality from air pollution reduction.

$$AF = 1 - e^{-\beta \Delta c}$$

$\beta$  : Cause-specific coefficient

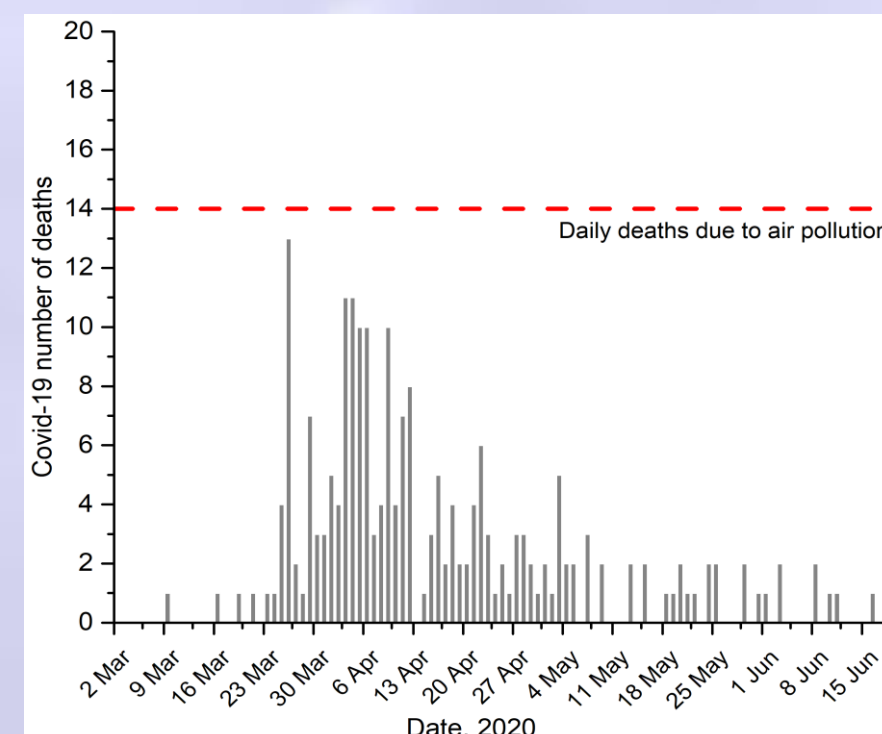
$\Delta c$  : Air quality changes.



Air pollution changes due to the quarantine using Theil-Sen slope  
**Bold character:** statistically significant

- The daily average deaths due to air pollution in Morocco is 14 deaths every day.

- This average exceeds the daily reported deaths due to COVID-19.



Daily deaths due to COVID-19 vs. averaged daily deaths due to poor air quality

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