



# Large Scale Climate Indices, Environmental Variability and Impact on Human Health

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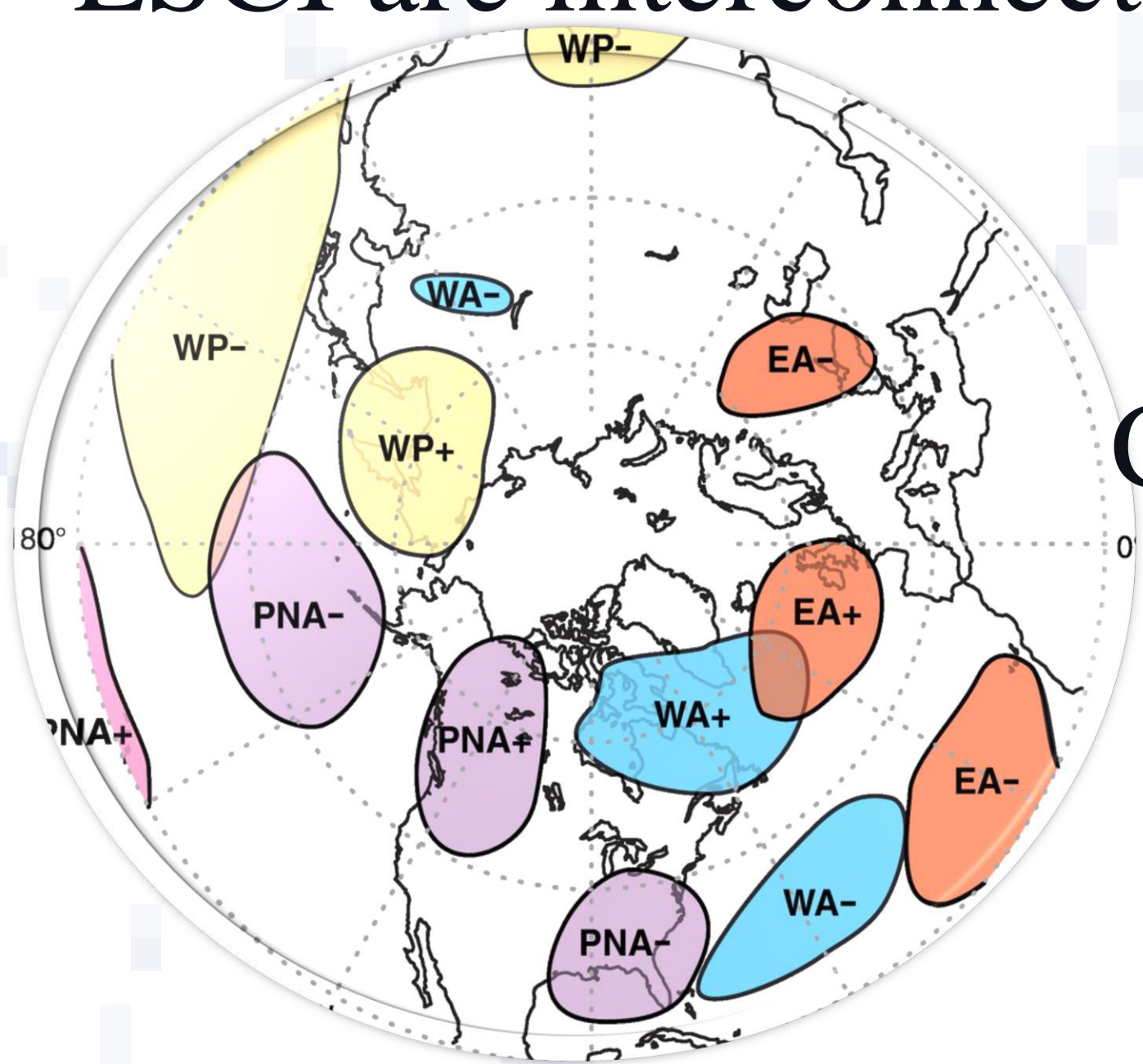
## 1 Matter

Large-Scale Climate Indices (LSCI) are numerical indicators of the strength and phase of teleconnections between the atmosphere, oceans, and continents for given regions.

LSCI are interconnected

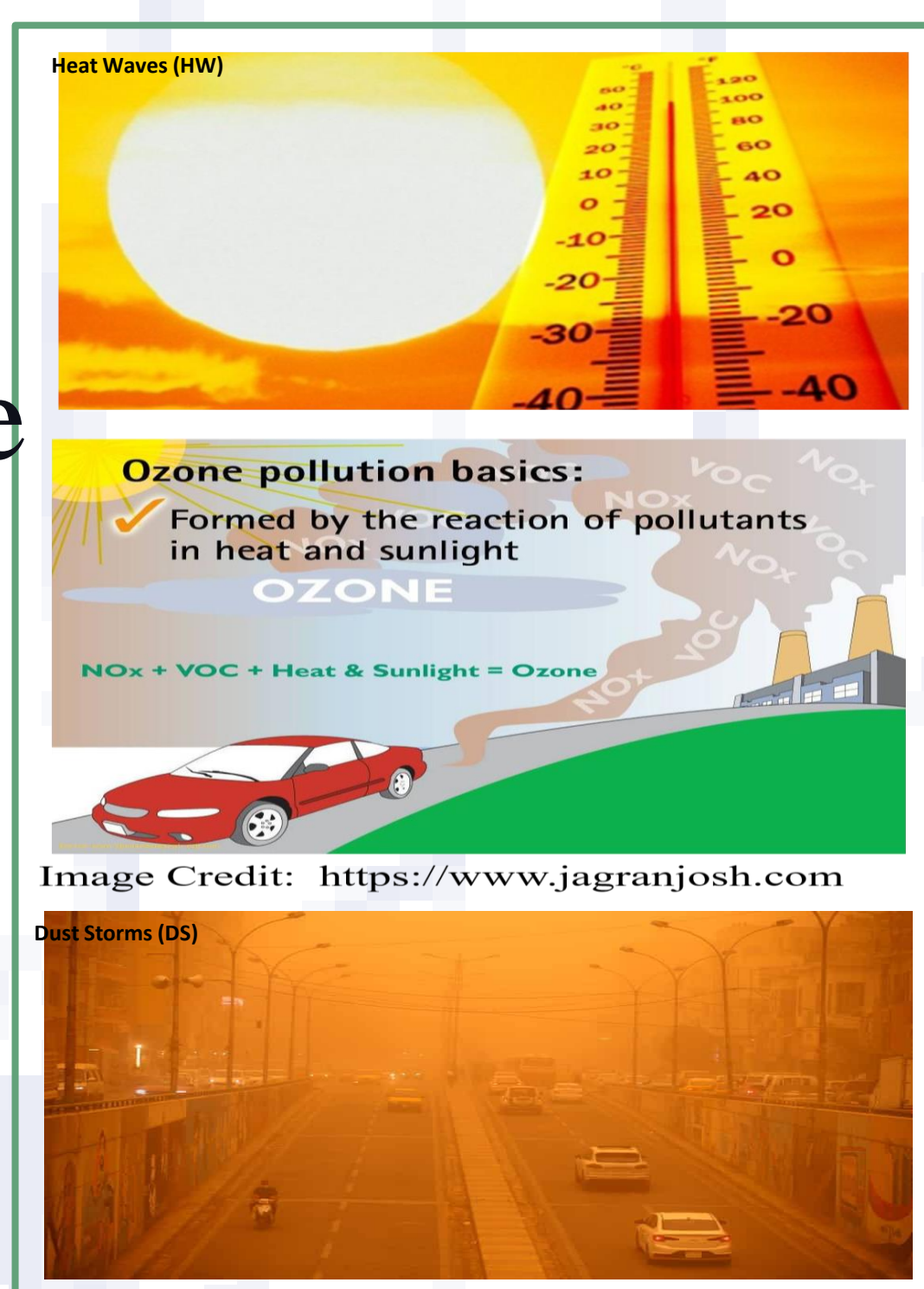
Environmental Extremes

Human Health



(An et al., 2021)

Contribute  
to



Impact

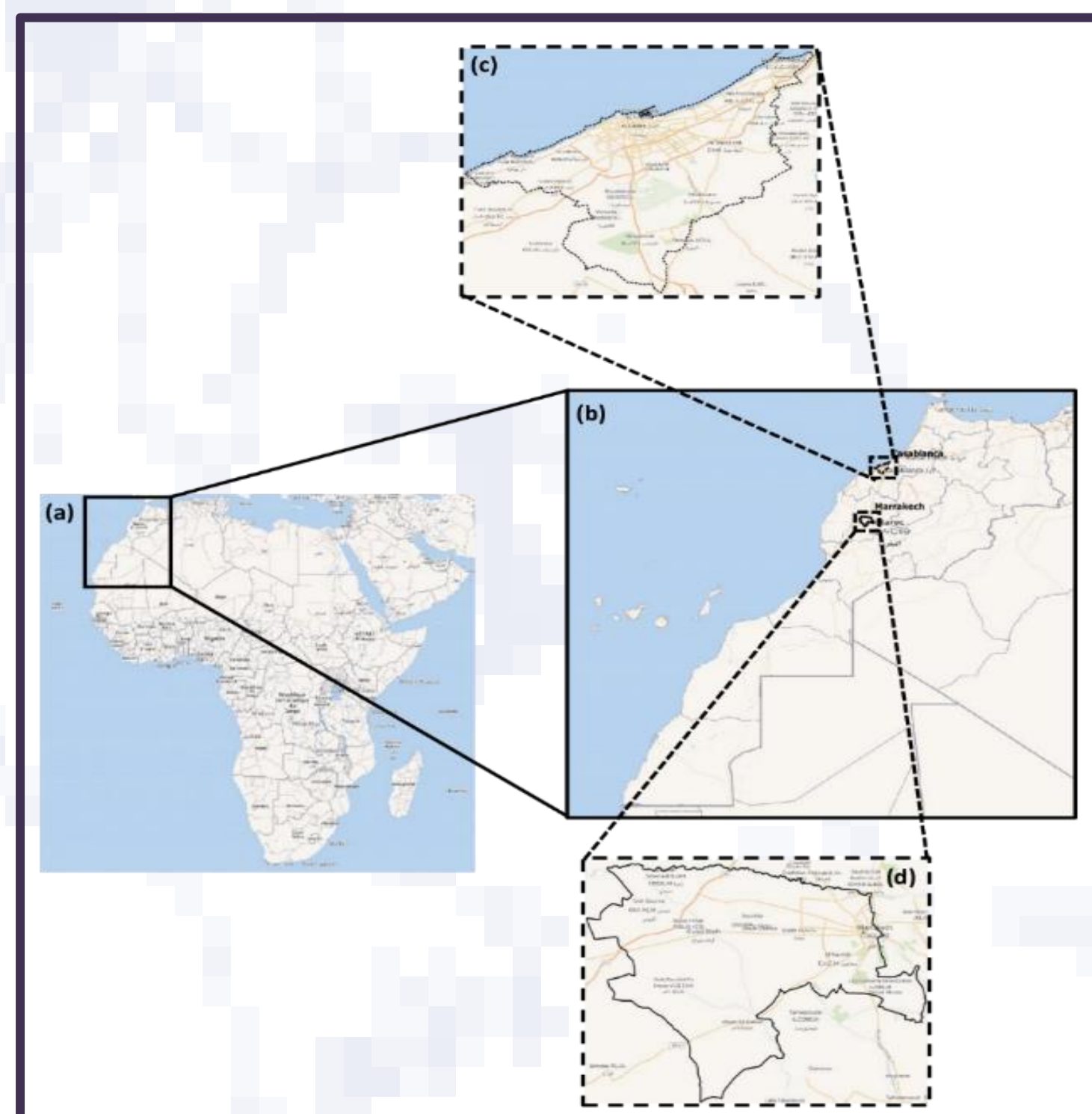


## 2 Aim

To further understand LSCI and their impacts on environmental variability, 2m, Skin and Sea Surface temperatures and pollution by PM10 in Morocco.

## 5 Area

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



## 3 Tools

- Daily data of the North Atlantic Oscillation (NAO), the Mediterranean Oscillation (MO) and the Saharan Oscillation (SaO) indexes from the CRU<sup>1</sup>;
- 2m temperature (2mT), Skin temperature (ST) and Sea Surface Temperature (SST) reanalysis data from ERA5<sup>2</sup>;
- Daily average PM10;
- Statistical approach for trends, ruptures and correlations.

1. <https://crudata.uea.ac.uk/cru/data/pci.htm>

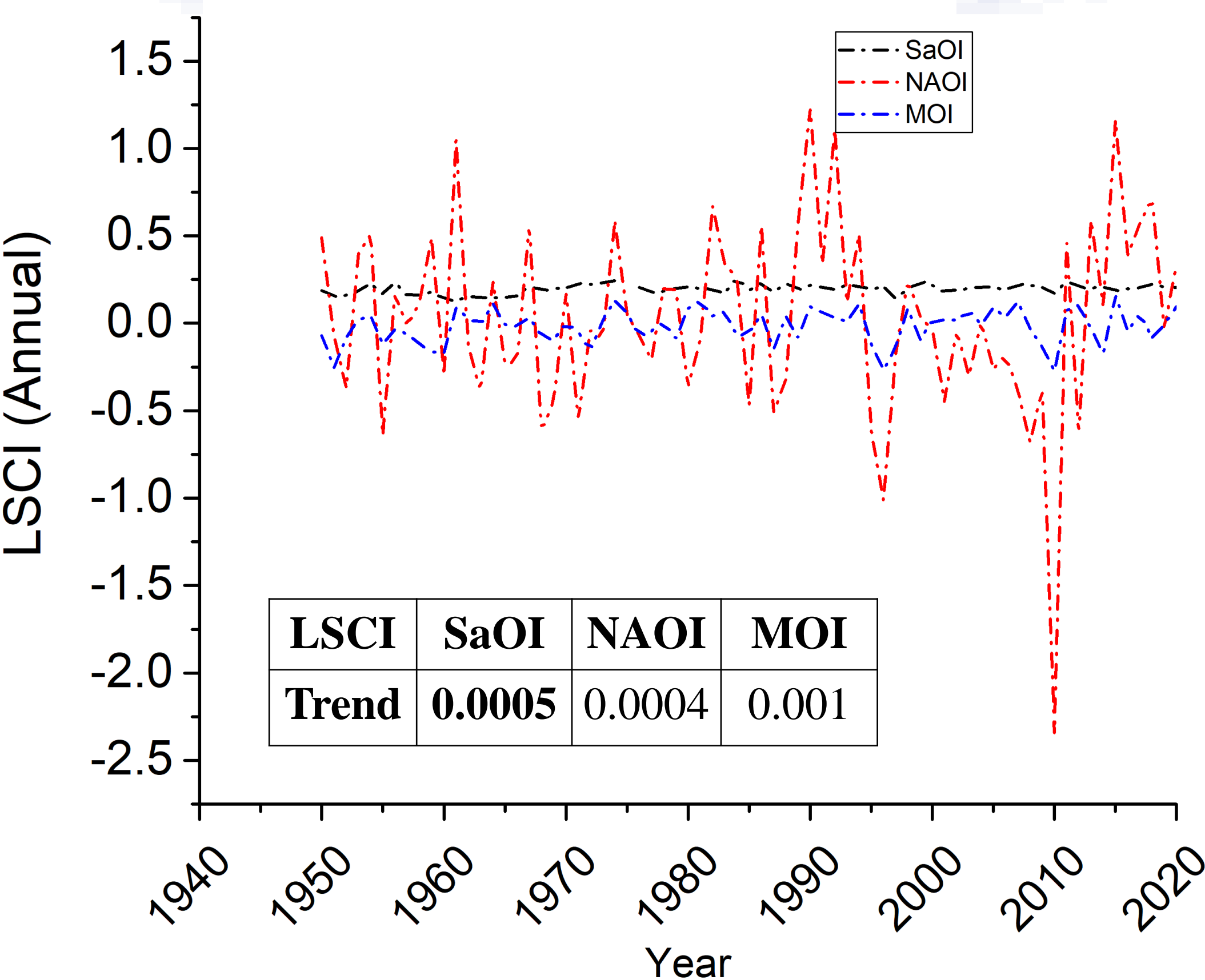
2. <https://cds.climate.copernicus.eu/#/search?text=ERA5&type=dataset>

## 4 Period

- 2013 to 2016 for PM10.
- 1950 to 2020 for all other parameters.

## 6 Results

Trends in annual LSCI are positive. The SaOI trend is statistically significant.



Trends in annual LSCI  
Bold: Statistically Significant

**Trends and Ruptures in LSCI annual and seasonal timeseries**  
**Bold Character:** Coefficient is statistically significant, NR: No Rupture, Significance level = 0.05  
DJF: December, January, February; MAM: March, April, May; JJA: June, July, August; SON: September, October, November

LSCI	Annual/ Seasonal	Trends	Rupture's Year	
			Pettitt	Hubert
SaOI	Annual	<b>+0.005</b>	NR	1959/1965
	DJF	<b>+0.002</b>	NR	NR
	MAM	<b>+0.007</b>	NR	1983/1995
	JJA	<b>+0.005</b>	NR	NR
	SON	<b>+0.01</b>	1988	1988
NAOI	Annual	<b>+0.004</b>	NR	NR
	DJF	<b>+0.14</b>	1988	2011
	MAM	<b>+0.03</b>	NR	NR
	JJA	<b>-0.1</b>	1994	2006/2012
	SON	<b>-0.12</b>	1987	1987
MOI	Annual	<b>+0.011</b>	NR	1960
	DJF	<b>+0.06</b>	1979	1979
	MAM	<b>-0.003</b>	NR	NR
	JJA	<b>-0.003</b>	NR	NR
	SON	<b>-0.009</b>	NR	NR

- Trends are mostly positive for all indexes.
- Negative trends may appear at the seasonal scale for the NAOI and MOI.
- Shifts in annual and seasonal large-scale patterns were recorded in early and mid-1960s for the annual scale and in the 1980s for the seasonal scale.
- Significant correlations appear between the SaOI and PM10 and the studied temperatures.

## 7 Conclusion

Skin temperature and thus the thermal comfort, and particulate pollution and thus their impacts on human health may be partly explained by large scale atmospheric indexes and patterns.

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**Spearman coefficient of correlation between averages in annual SaOI and PM<sub>10</sub>, 2mT, ST and SST.**  
**Bold Character:** Coefficient is statistically significant. Significance level = 0.05

Site/ Parameters	Casablanca			Marrakech			LSCI		SST		
	PM10	2mT	ST	PM10	2mT	ST	NAOI	MOI	(33,-11)	(22,-23)	(35,-21)
SaOI	<b>-0.17</b>	<b>0.1</b>	<b>0.14</b>	<b>-0.1</b>	<b>0.16</b>	<b>0.18</b>	0.06	-0.02	<b>-0.29</b>	<b>-0.33</b>	<b>-0.24</b>

## 8 References

- An, S.-I., Wang, C., Mechoso, C.R., 2021. Teleconnections in the Atmosphere, in: Interacting Climates of Ocean Basins. <https://doi.org/10.1017/9781108610995.003>
- Khoms, K., Najmi, H., Chelhaoui, Y. and Souhaili, Z. (2020). The Contribution of Large-scale Atmospheric Patterns to PM10 Pollution: The New Saharan Oscillation Index. Aerosol Air Qual. Res. 20:1038-1047. <https://doi.org/10.4209/aaqr.2019.08.0401>