SPATIO-TEMPORAL ANALYSIS OF AEROSOL OPTICAL DEPTH IN THE TWO MOST POLLUTED METROPOLITANS

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Objective

This study aims to shed new light upon how temporal and spatial patterns of AOD respond to the dynamic urban environment.

(Los Angeles Metropolitan Area, and Phoenix Metropolitan Area)

1. both areas are among the most polluted areas in terms of air pollution (U.S. EPA, 2015) in the Northern America;

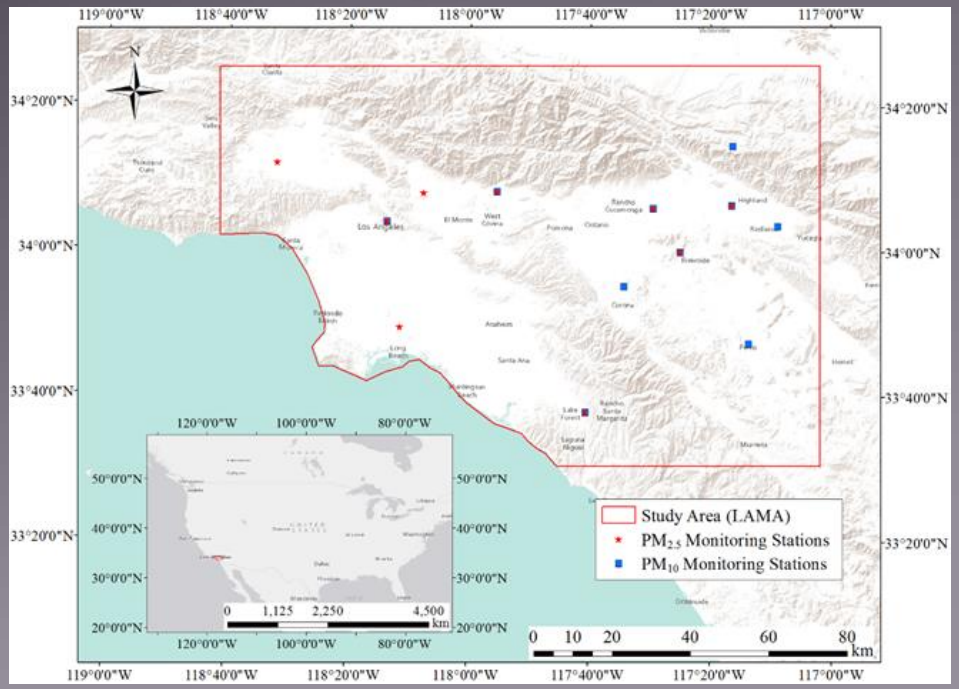
2. they are geographically close to each other but have different surrounding environment;

3. a comparative long-term spatio-temporal AOD analysis over these two areas is absent; and

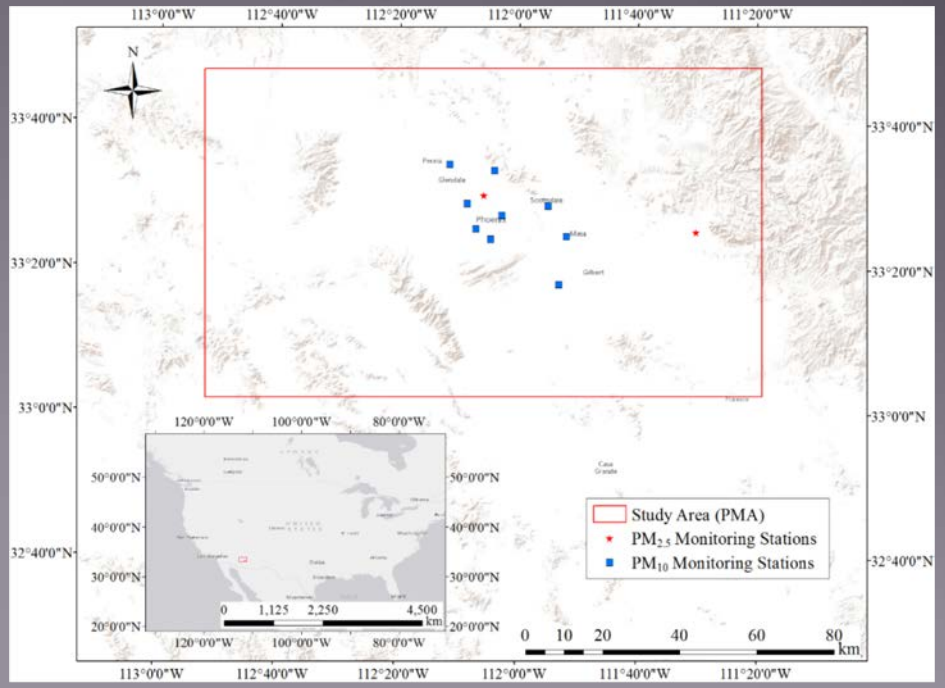
4. potential negative AOD-PM association in this region.

Study areas: (a) the LAMA and (b) the PMA, and locations of monitoring stations

(a) LA



(b) Phoenix



Data

MODIS Terra Atmosphere Aerosol Level 2 Product (MOD04_3K)

- Spatial resolution of 3 km starting from February 24, 2000
- It has been validated globally (Livingston et al., 2014; Remer et al., 2013)

Historical daily PM_{10} and $PM_{2.5}$ data collected by local environmental monitoring stations were retrieved from the US-EPA.

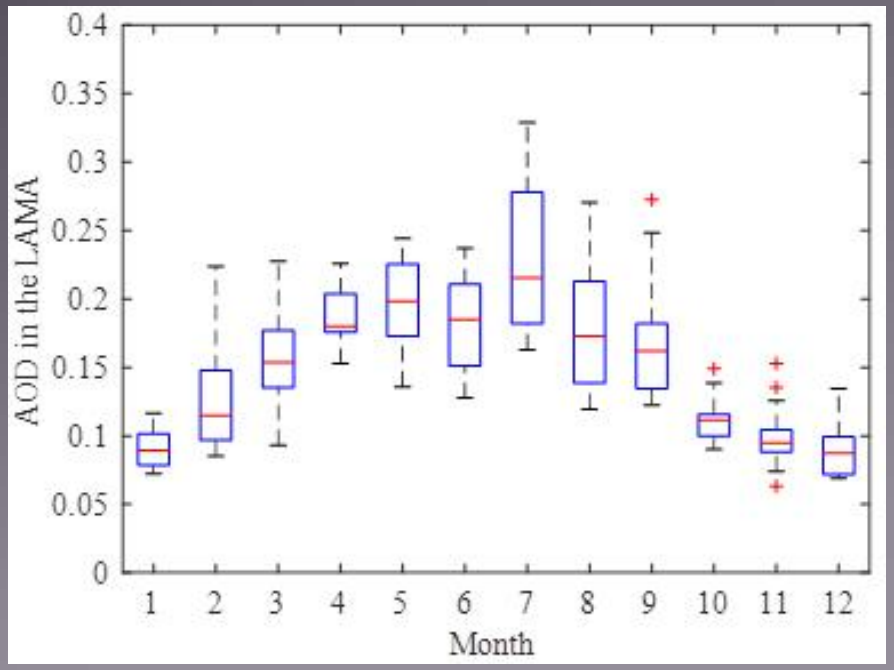
ASTER 30 m Global DEM Version 2 (NASA JPL, 2009).

2001 & 2011 NLCD data were used to generate percent Built-Up areas.

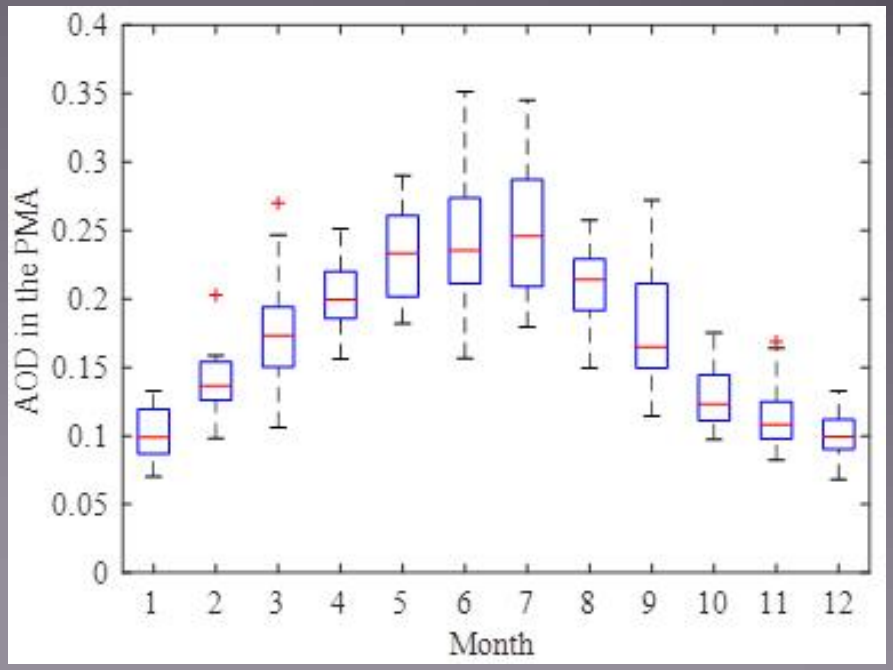
MODIS global monthly vegetation indices (NDVI) (MOD13A3.V006).

Temporal Pattern of Monthly Mean AOD values

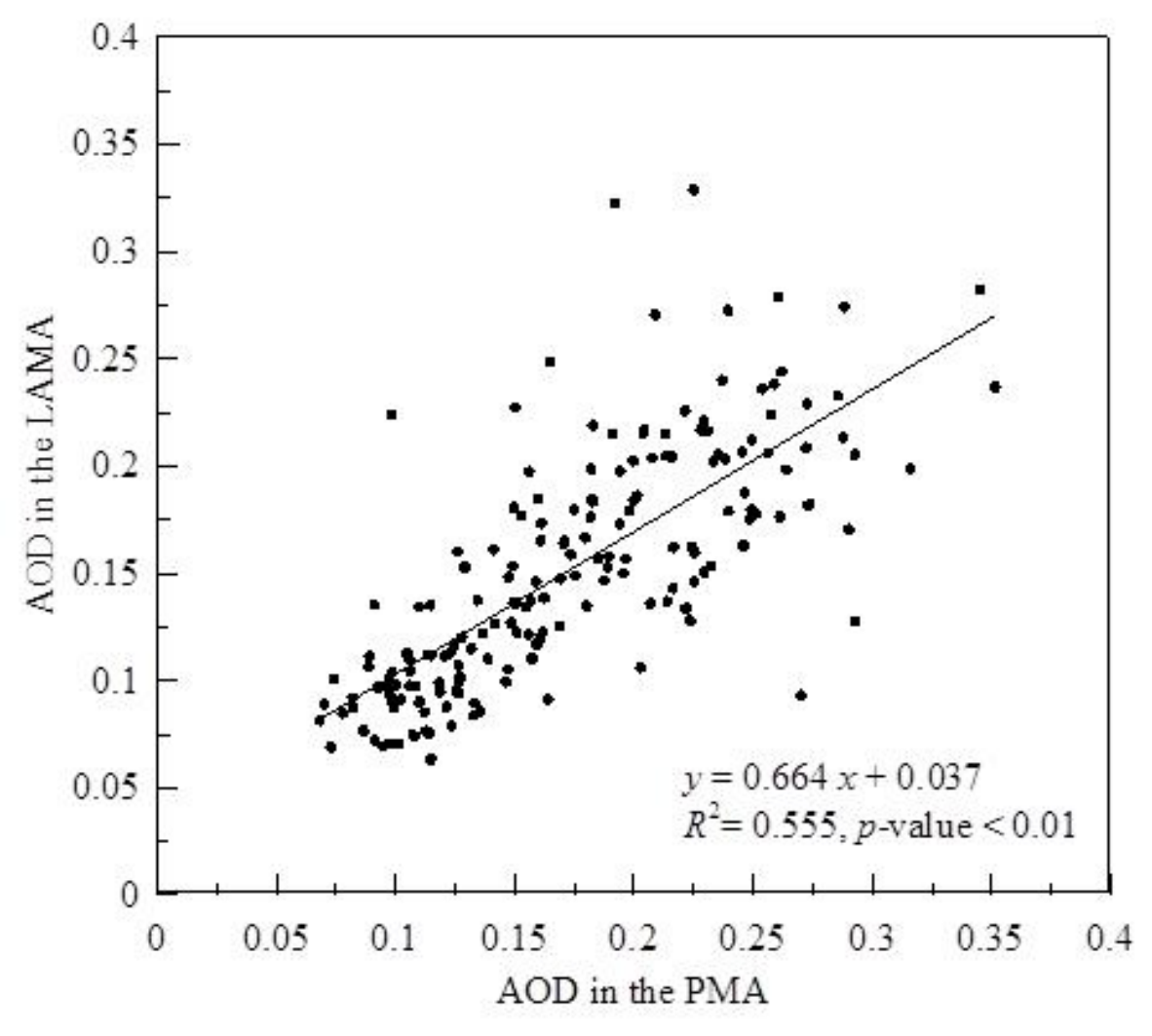
(a) LA



(b) Phoenix

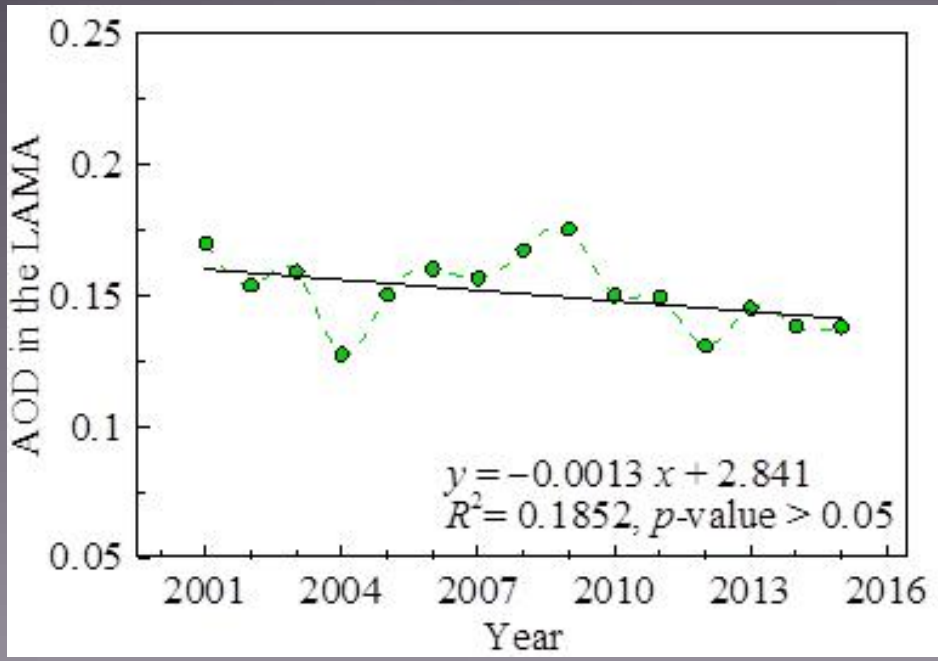


Relationship between Monthly Mean AOD of LA and PHX

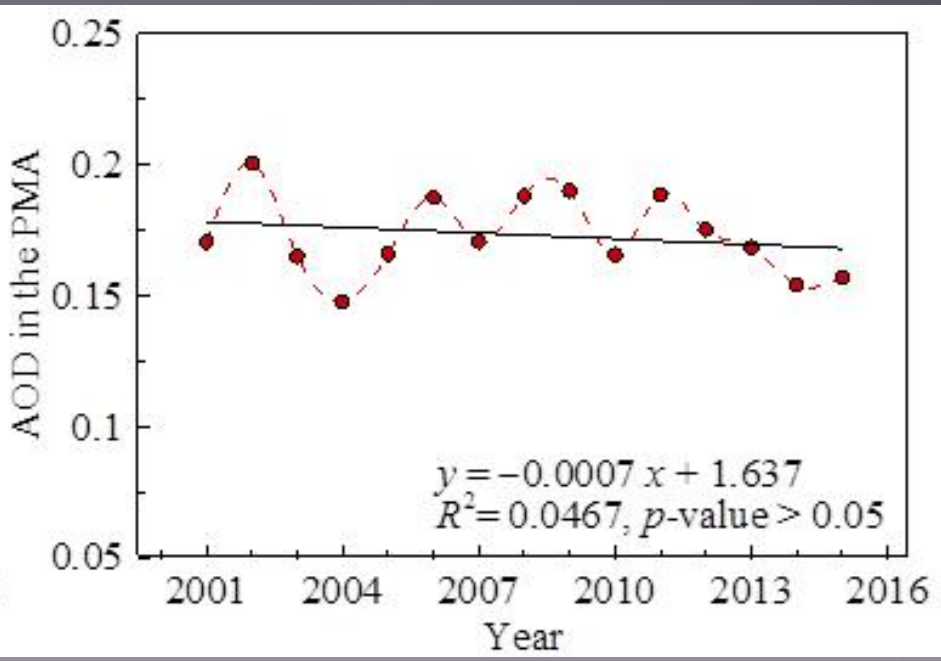


Trends of annual mean AOD in (a) LAMA and (b) PMA

(a) LA

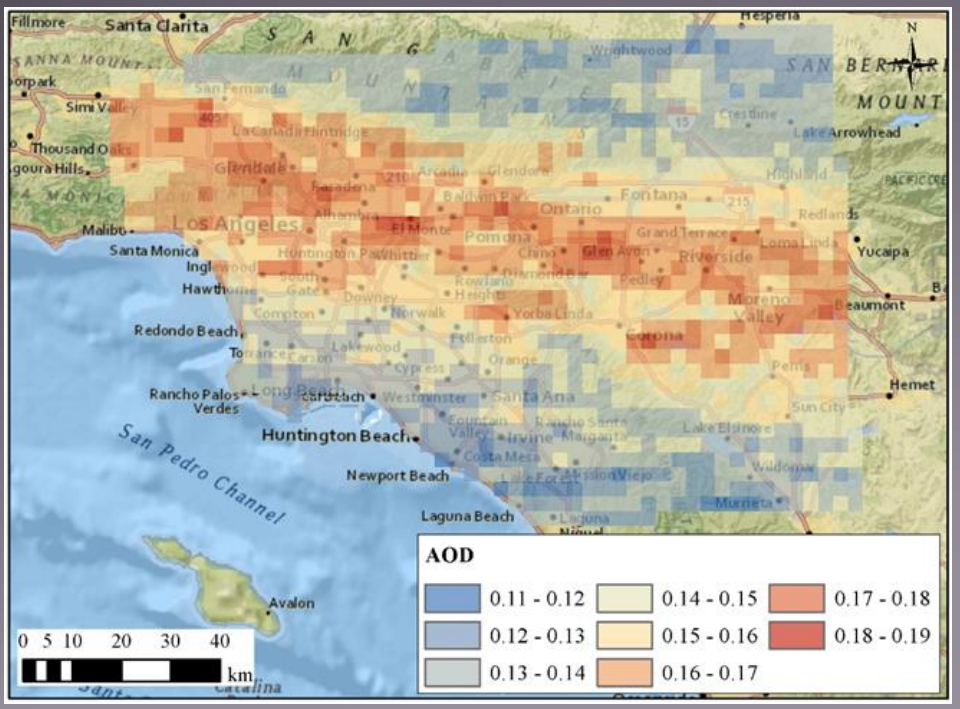


(b) Phoenix

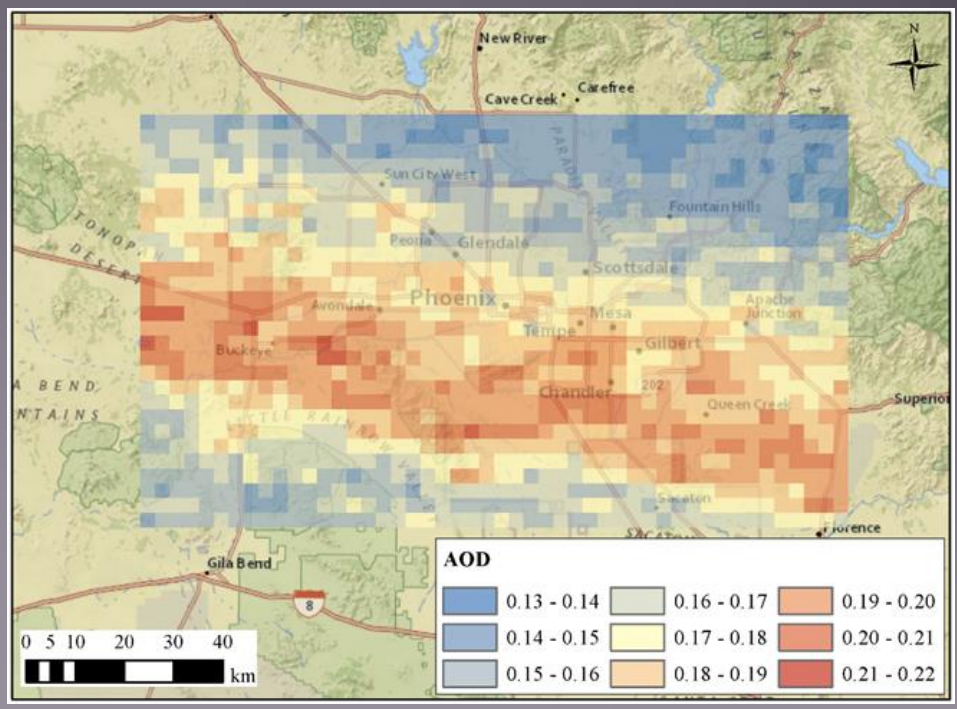


Spatial Pattern of Mean AOD for 2001–2015

(a) LA



(b) Phoenix

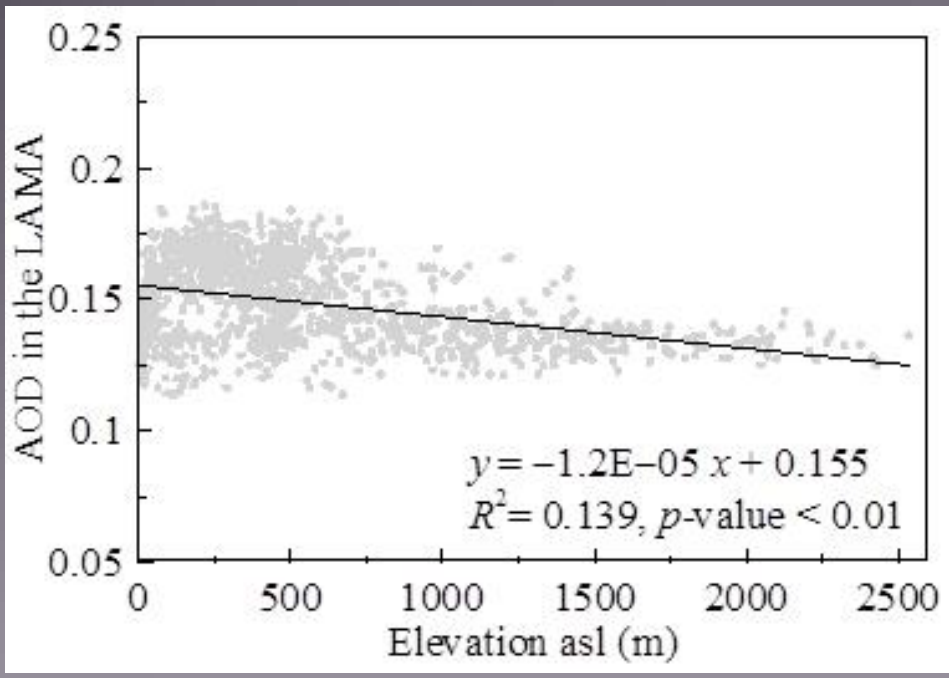


Comparison of measured PMs concentrations and components

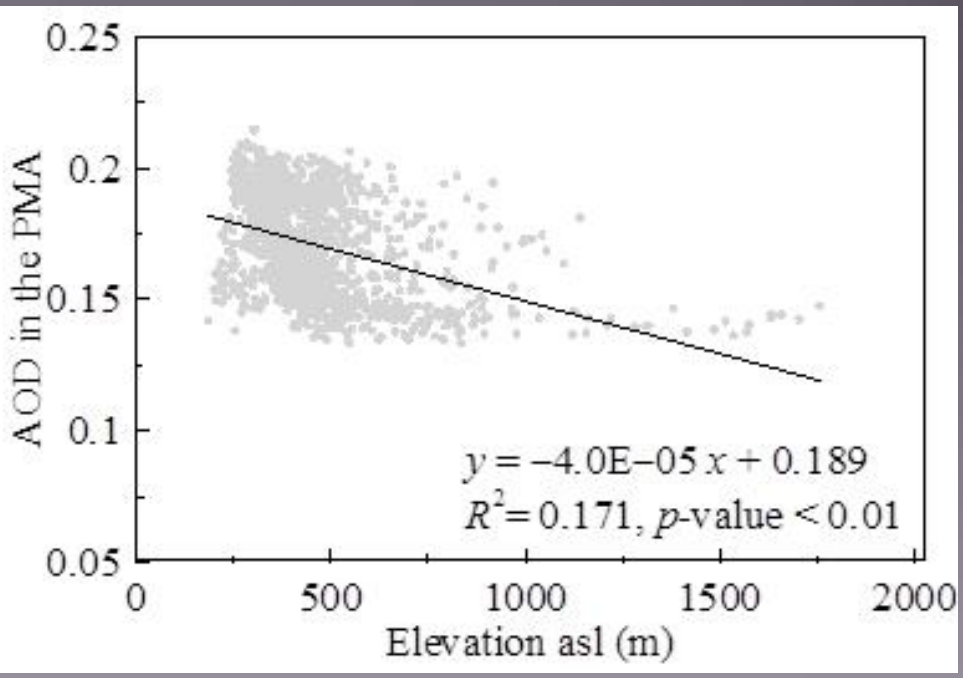
	LAMA	PMA
Mean $PM_{2.5}$ concentration ($\mu g/m^3$)	14.806	7.741
Mean PM_{10} concentration ($\mu g/m^3$)	34.698	35.922
Mean difference between concentrations of $PM_{2.5}$ and PM_{10} ($\mu g/m^3$)	19.700	28.181
Fine mode aerosol ratio (%)	42.670	21.551
Mean AOD	0.152	0.173

Relationships between mean AOD over the entire study period and elevation (asl)

(a) LA

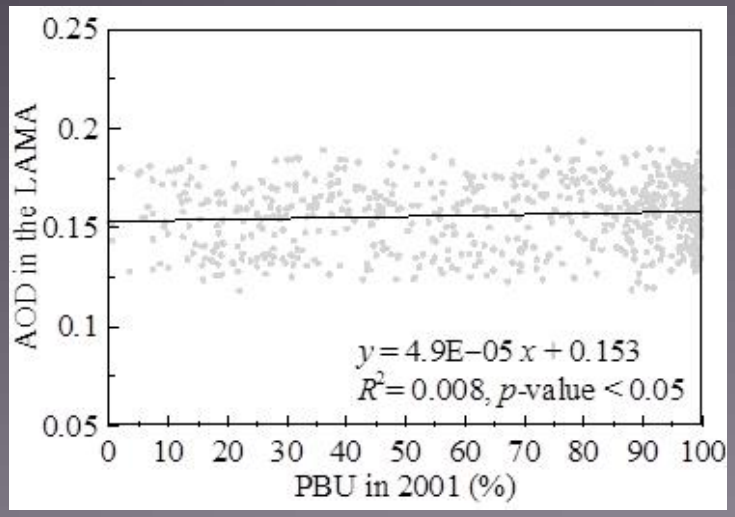


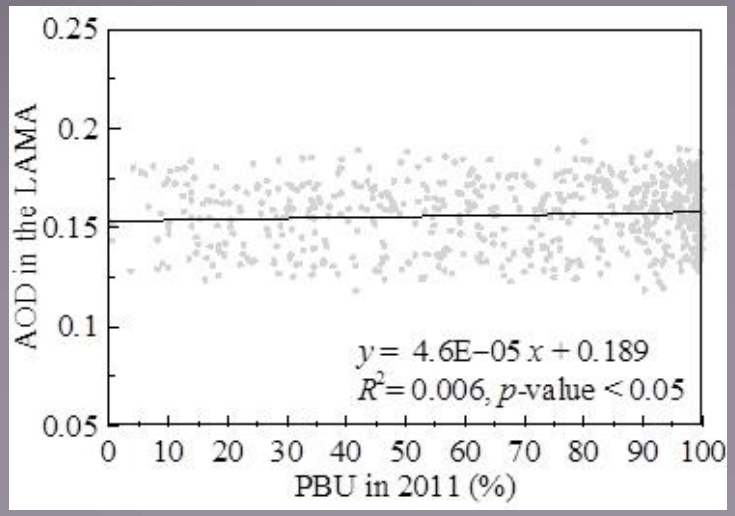
(b) Phoenix



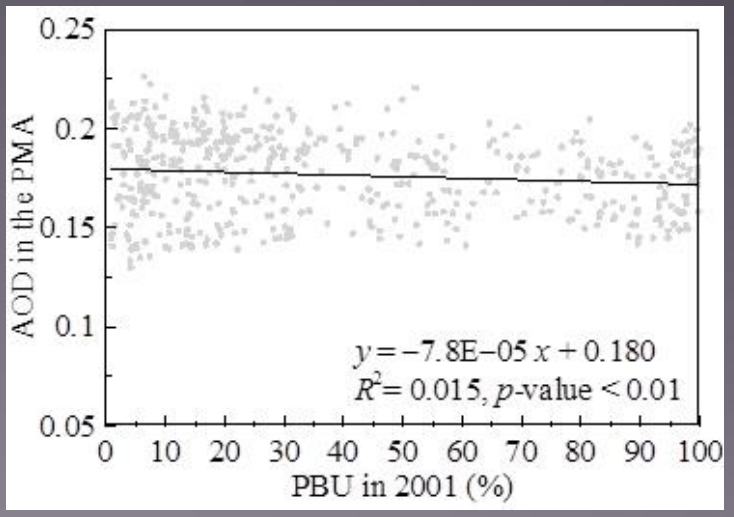
Relationships between Mean AOD and Percent Built-up

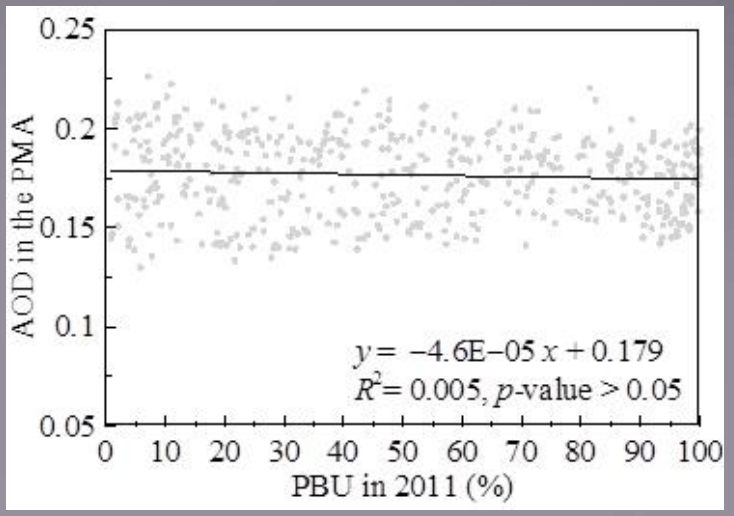
(a) LA





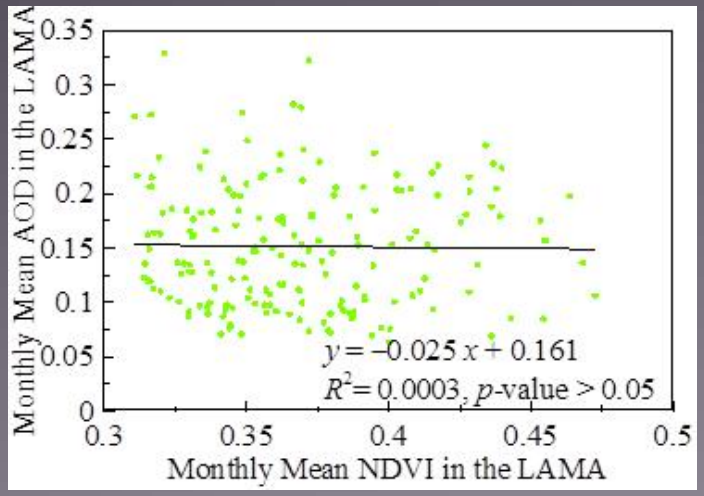
(b) Phoenix

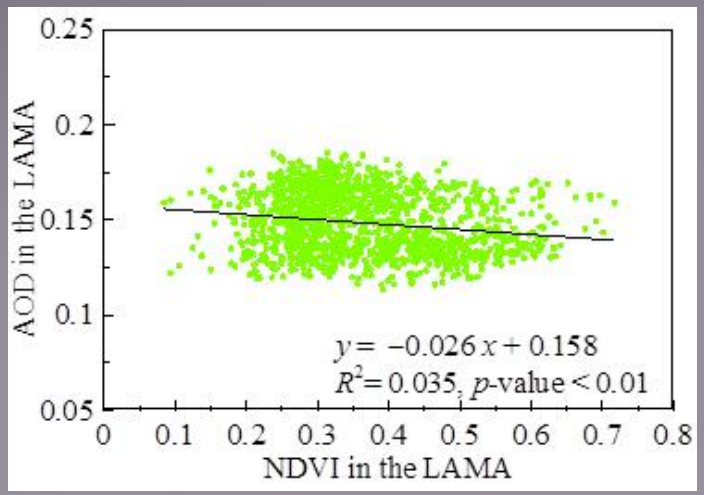




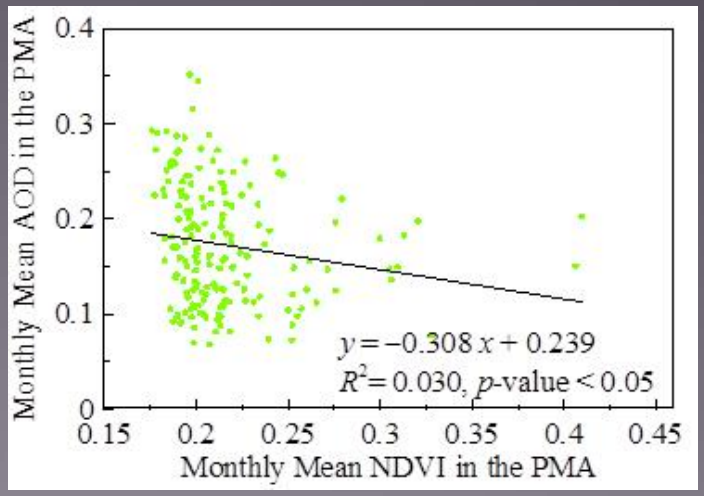
Relationships between Mean AOD and NDVI

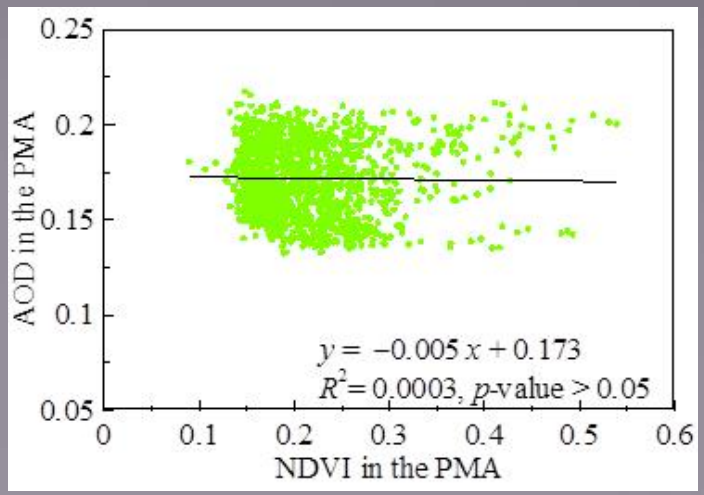
(a) LA





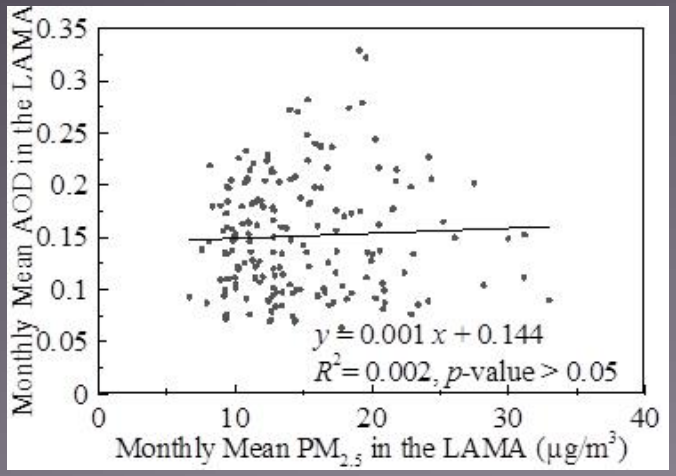
(b) Phoenix

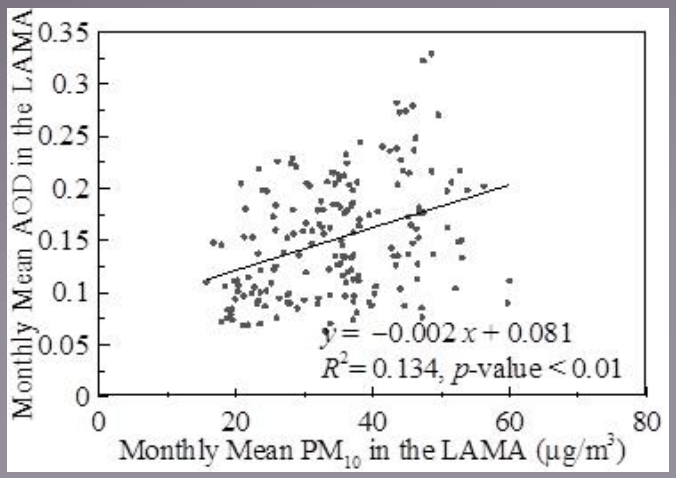




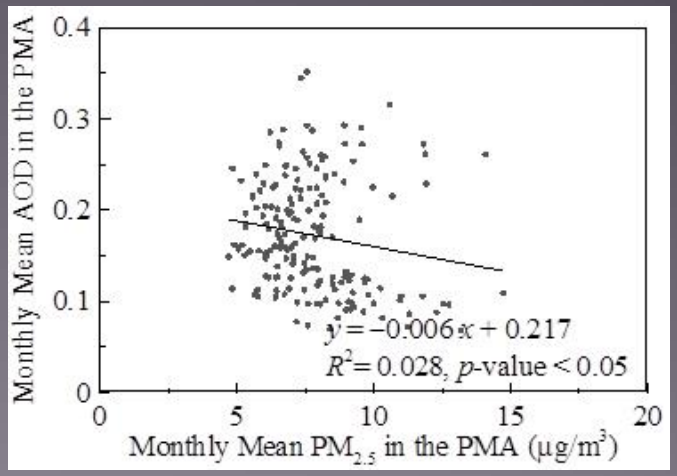
Relationships between AOD and Measured PMs

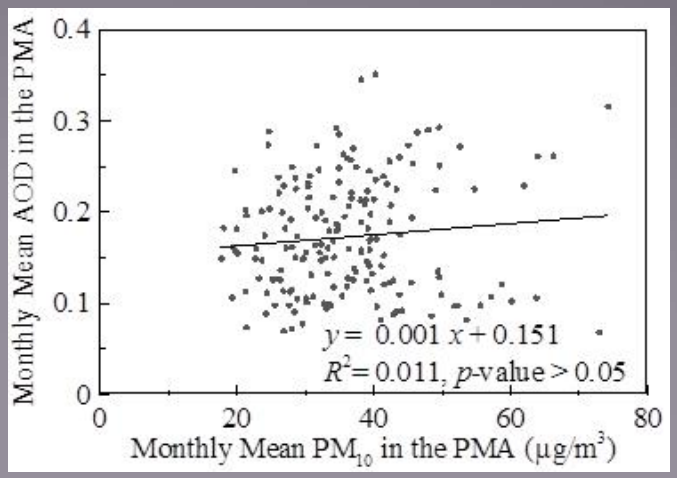
(a) LA





(b) Phoenix





Conclusion

- Strong similarity is found between the temporal trends of AOD in the two study areas, as a result of similar seasonal pattern of both natural and anthropogenic aerosol emissions.

- The correlation shows that the topography strongly modulates the AOD spatial pattern.

- Urbanization can be beneficial to air quality in desert areas.

- The effect of vegetation on lowering air pollution via dry and wet depositions can outweigh its potential organic emissions.

- No strong positive AOD-$PM_{2.5}$ associations is observed, and AOD in Phoenix is even strong negatively correlated with $PM_{2.5}$ measurements.

Wang, C, Wang, C., S.W. Myint, and Z. Wang, 2017. Landscape determinants of spatio-temporal patterns of aerosol optical depth in the two most polluted metropolitans in the United States, Science of the Total Environment, 609(2017):1556–1565.

Thank you!