

Air Quality and Visibility

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'A Systems Approach to Air Pollution (ASAP) - East Africa' funded by **DFID East African Research Hub**. The programme brings together UK and East African researchers in air pollution, engineering, urban planning, economic geography, public health, social sciences and development studies to provide a framework for improved air quality management in East African cities.



Covid, lockdown and visibility



Kenya Pics @kenyapics · 16 Apr



Both of Africa's tallest peaks, Mt. Kilimanjaro and Mt. Kenya clearly visible from Nairobi this morning at almost 180° apart. Photos by [@marquington](#)



66

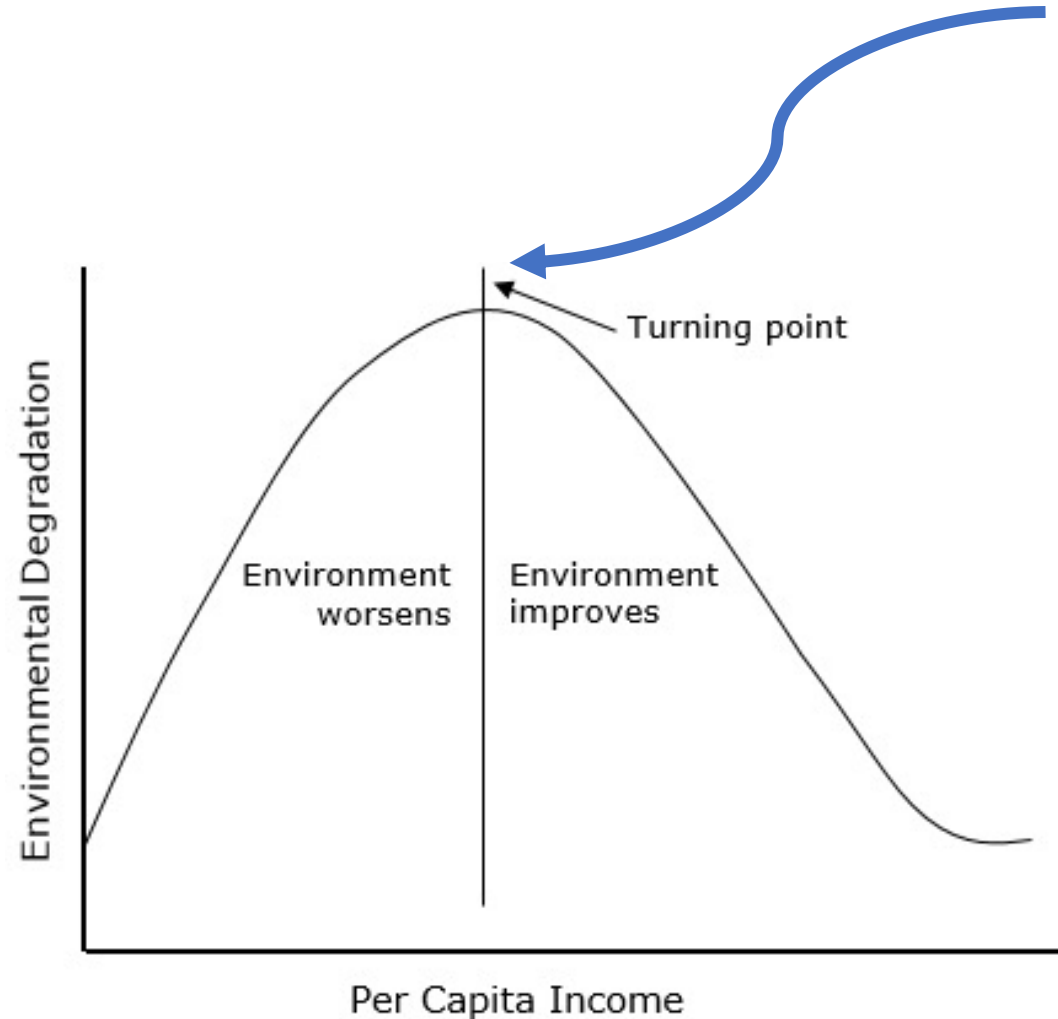
736

1.7K



The need for historical data (there is a paucity)

Environmental Kuznet's
Curve (EKC)

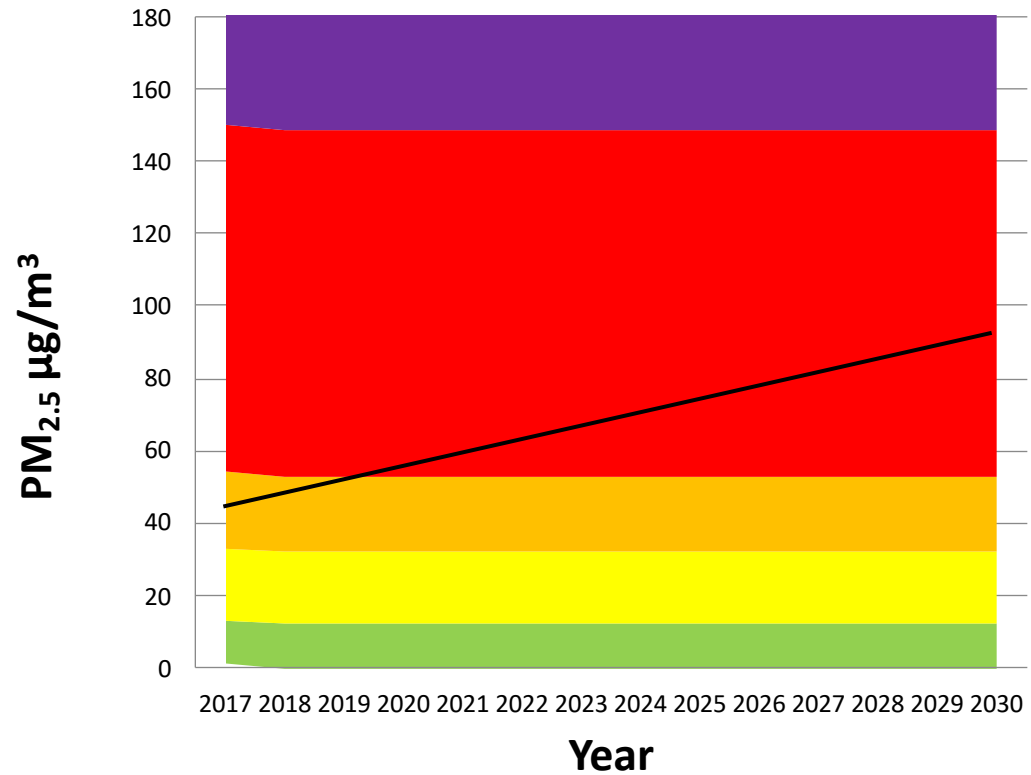


The great London smog of 1952

Future scenarios for Nairobi, Kenya

Business as Usual

- Pollution emissions per capita **remain the same**
- Air pollution will **double** compared to current levels due to increasing population

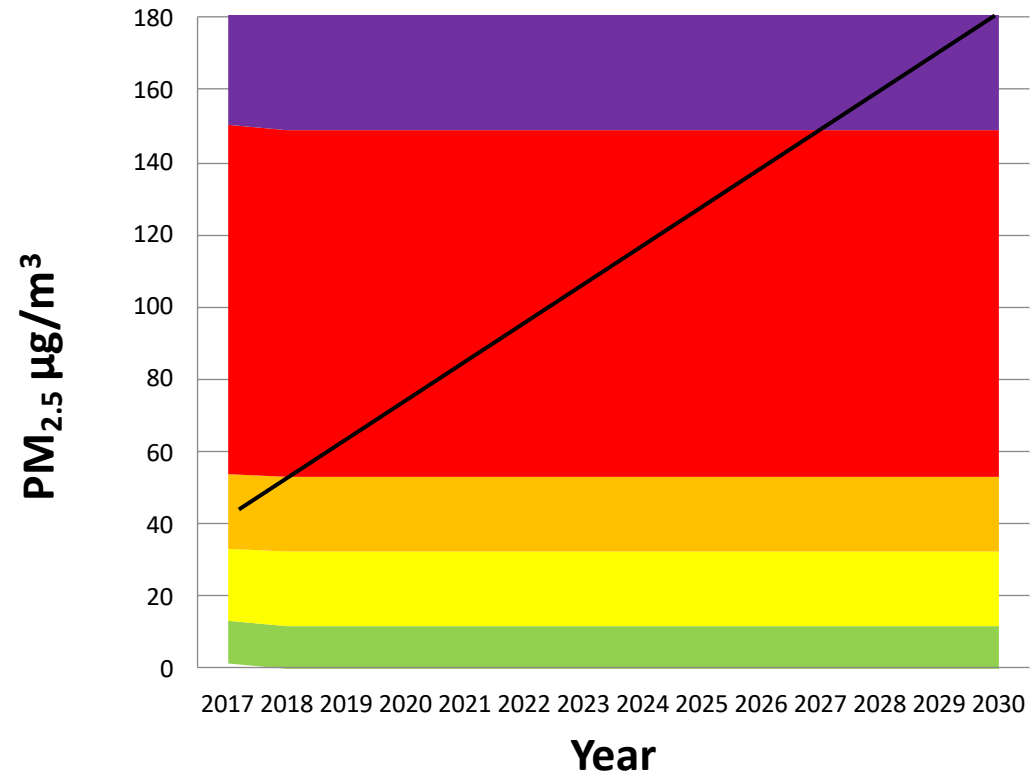


Unhealthy Unhealthy for Sensitive Groups Moderate Good

Future scenarios for Nairobi, Kenya

Worst Case

- Pollution emissions per capita **double** due increasing wealth and therefore increased fossil fuel and motorization use.
- Air pollution **quadruples** due to increasing population and increasing per capita emissions.



Unhealthy Unhealthy for Sensitive Groups Moderate Good

Visibility Measurements

- Measured worldwide especially at airports
- Historically, generated by human line of site measurements
- Nowadays – visimeters
- Measurements available in Africa from at least the 1950s to present.



Koschmeider Equation:

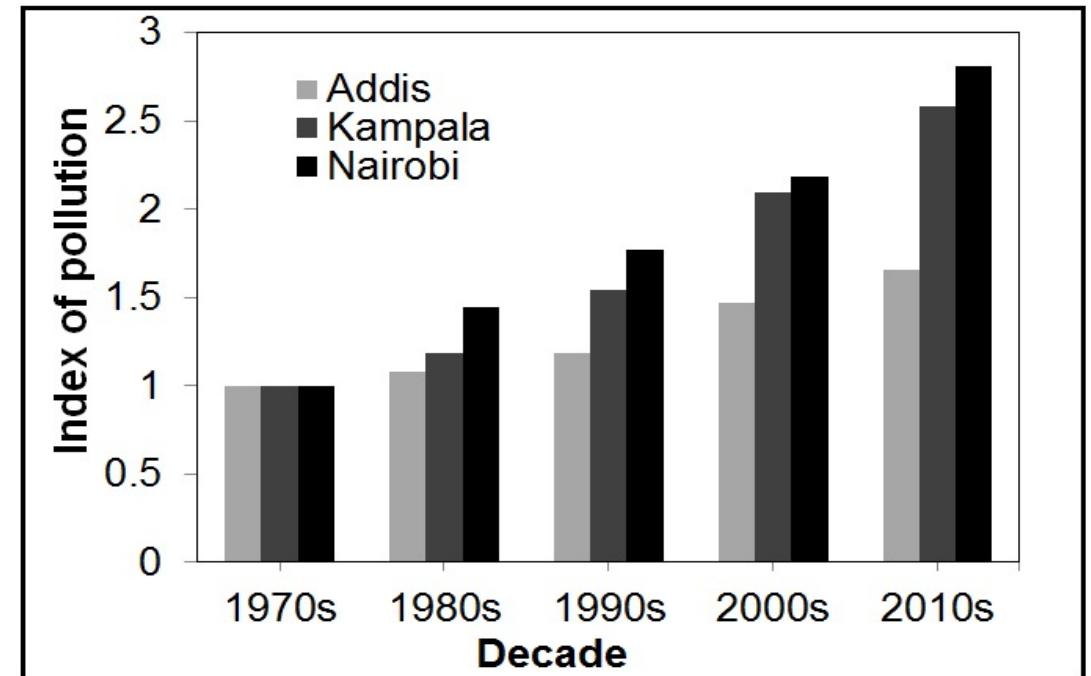
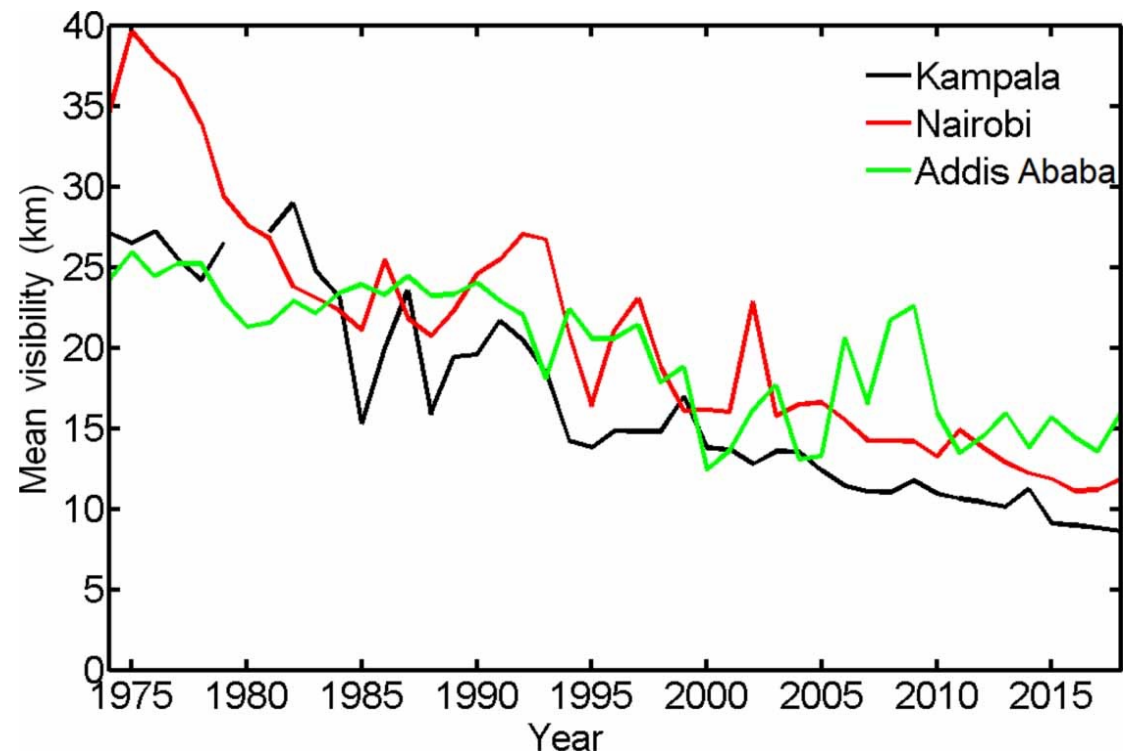
$$\text{Visibility} = 3.912 / \beta_{\text{ext}}$$

$$\beta_{\text{ext}} \approx f(\text{PM}, \text{RH})$$

$$\beta_{\text{ext}} = \beta_{\text{sca,PM}} + \beta_{\text{abs,PM}} + \beta_{\text{sca,gas}} + \beta_{\text{abs,gas}}$$

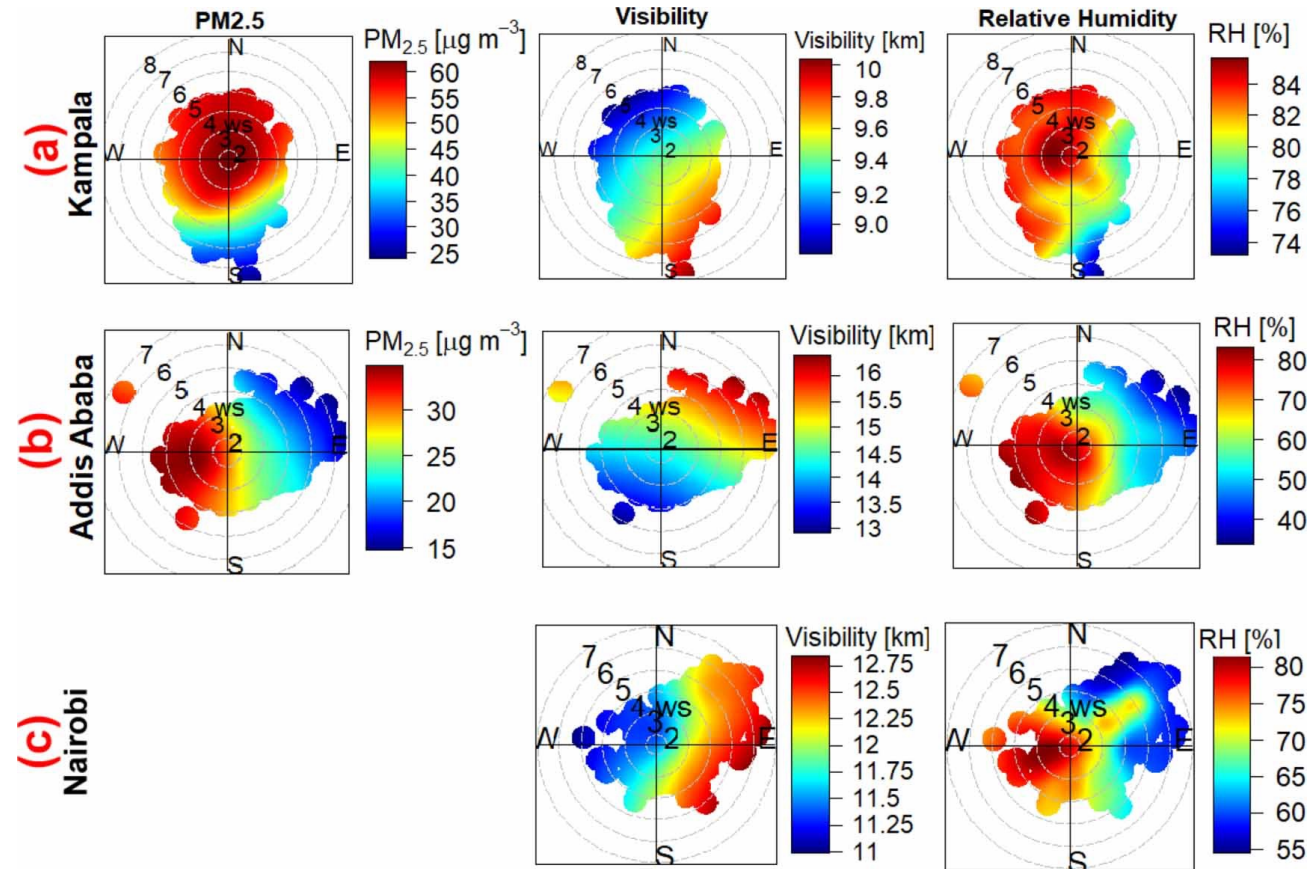
$$\beta_{\text{scat}} = \int_0^{\infty} \pi \left(\frac{D}{2} \right)^2 Q_{\text{scat}}(\alpha, \lambda, n) N f(D) dD,$$

Visibility in the capital cities of: Ethiopia, Kenya and Uganda



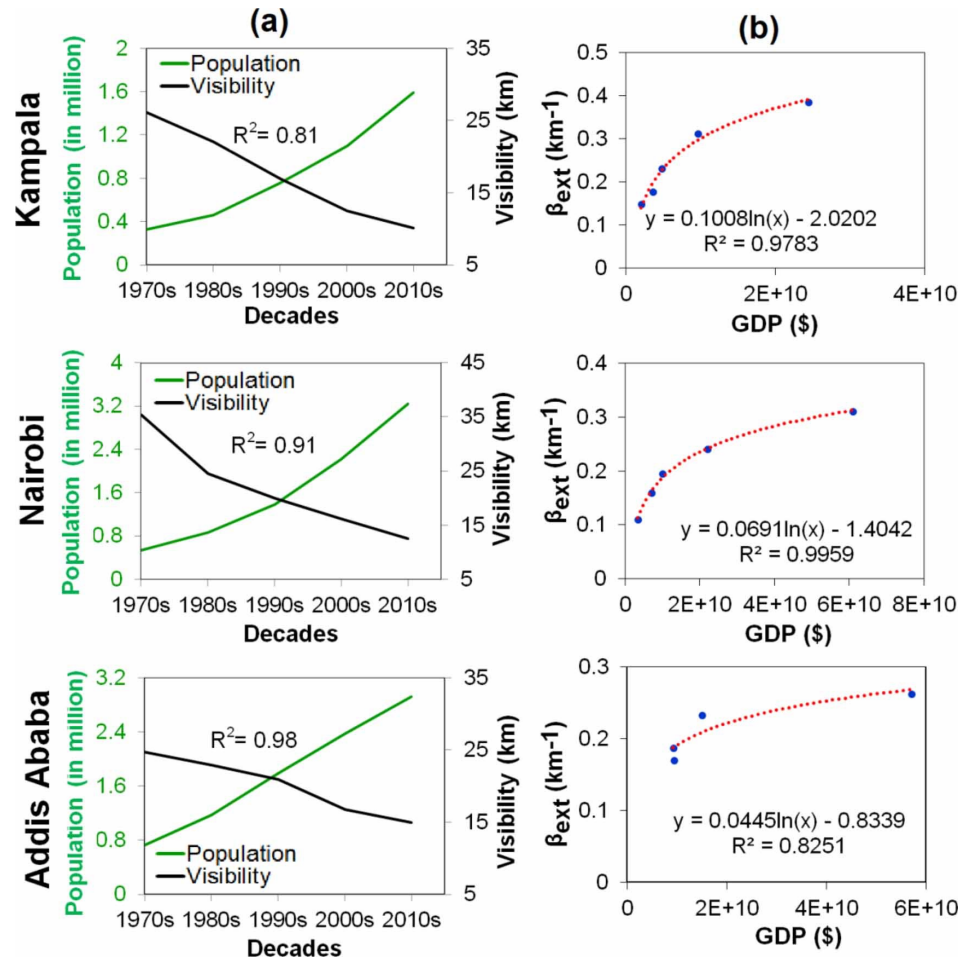
Singh, Avis, Pope. "Visibility as a proxy for air quality in East Africa."
Environmental Research Letters 15, no. 8 (2020): 084002.

Visibility in the capital cities of: Ethiopia, Kenya and Uganda



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Linking air pollution to economic metrics



Visibility study of Nairobi, Kampala and Addis Ababa reveals big air pollution problems

June 4, 2020 3:25pm BST



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Disclosure statement

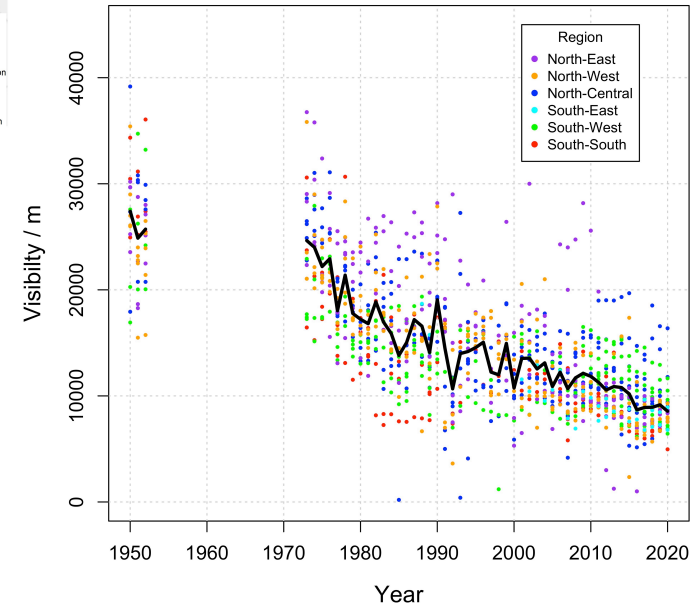
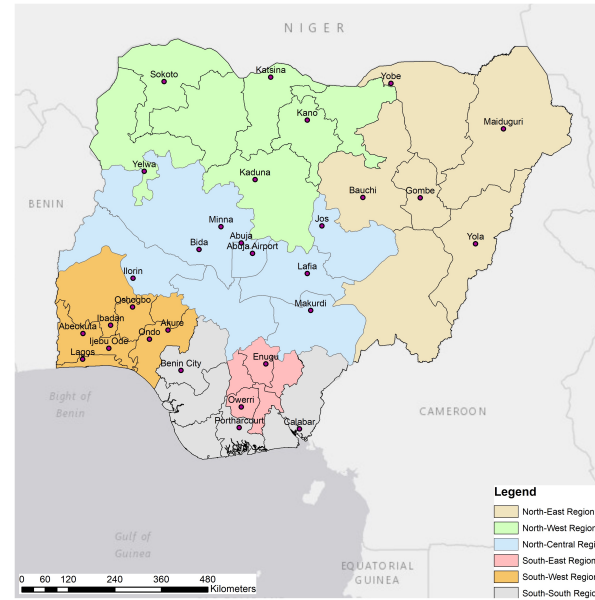
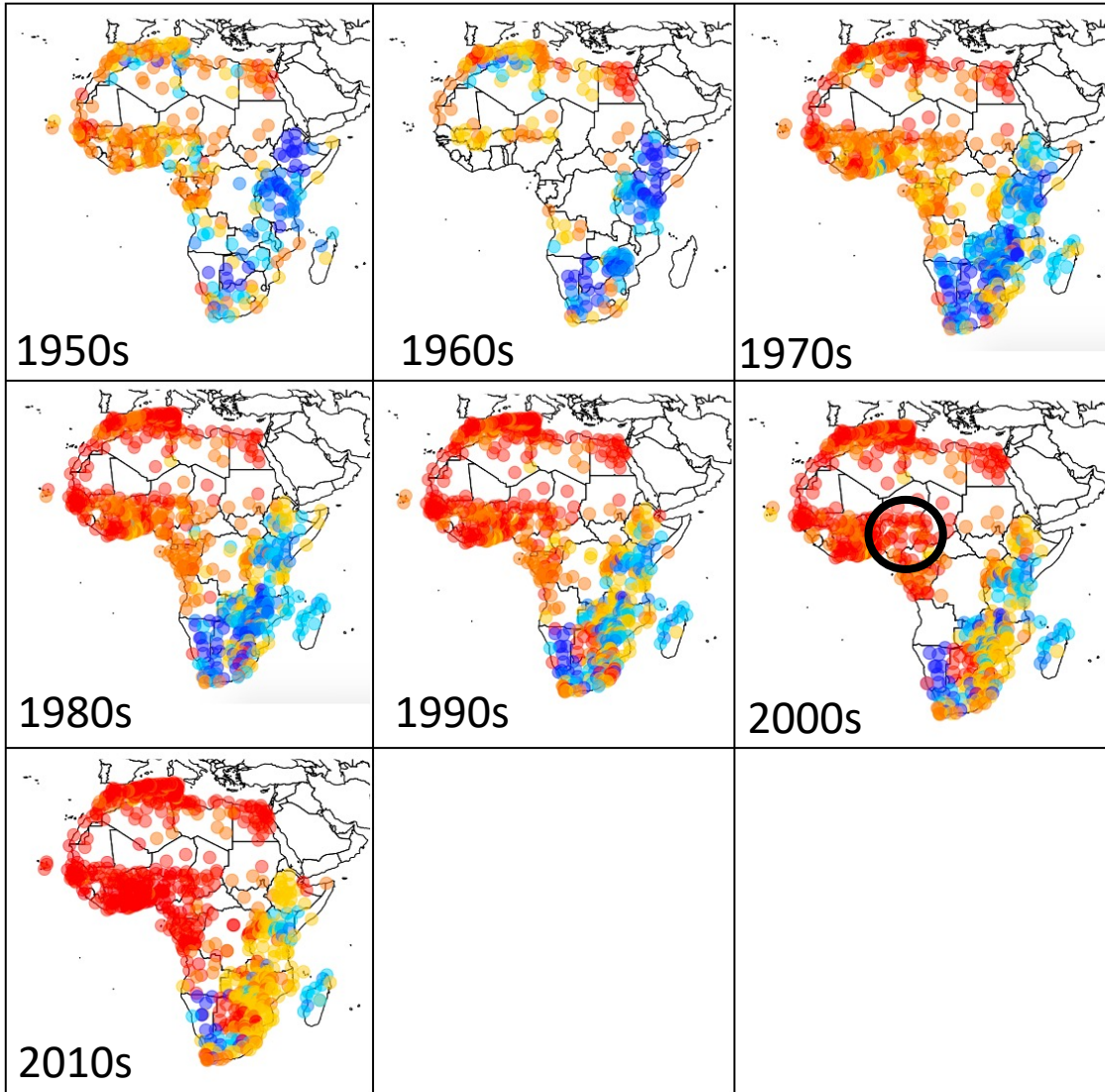
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<https://theconversation.com/visibility-study-of-nairobi-kampala-and-addis-ababa-reveals-big-air-pollution-problems-138967>

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Applying technique to the rest of Africa



Summary

- Visibility provides a useful proxy for PM concentrations in Africa
 - Data exists from at least 1950s but patchy
 - Data becomes very useful from 1970s onwards
- Approach exemplified in East Africa
 - For example, PM concentrations are currently rising at approximately 4% per annum in Nairobi
- This long-term data set allows for relationships with meteorological and socioeconomic data to be generated
 - Leading to predictive capacity