Air Pollution knowledge Assessments (APnA) City Program in Asia & Africa

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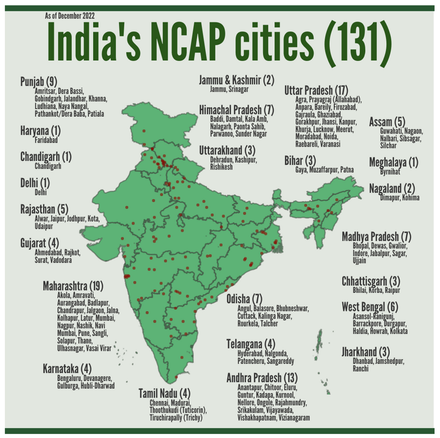
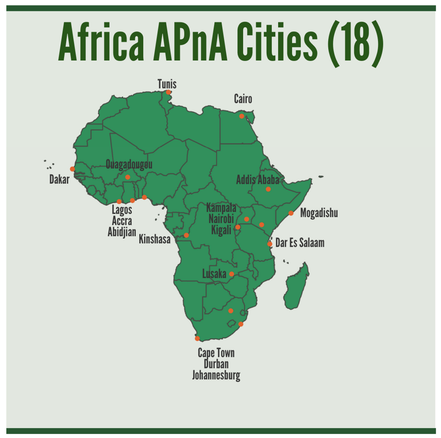
APnA CITY PROGRAMME — Clearing the air with data

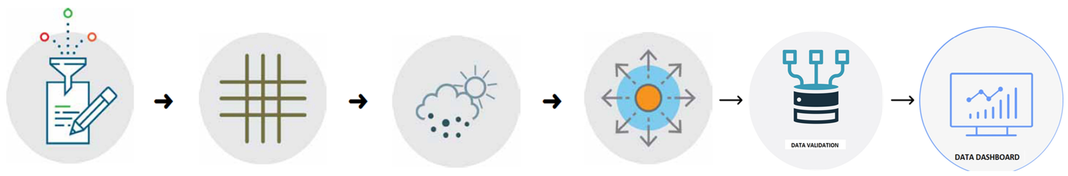


Other cities in Asia, where the program had/has applications

Bangkok (Thailand)
Bishkek (Kyrgyzstan)
Cebu (Philippines)
Dhaka (Bangladesh)
Hanoi (Vietnam)
Jakarta (Indonesia)
Kathmandu (Nepal)
Siem Reap (Cambodia)
Tashkent (Uzbekistan)



Methodology



Compile all the data resources for emissions inventory development of all the known sources.

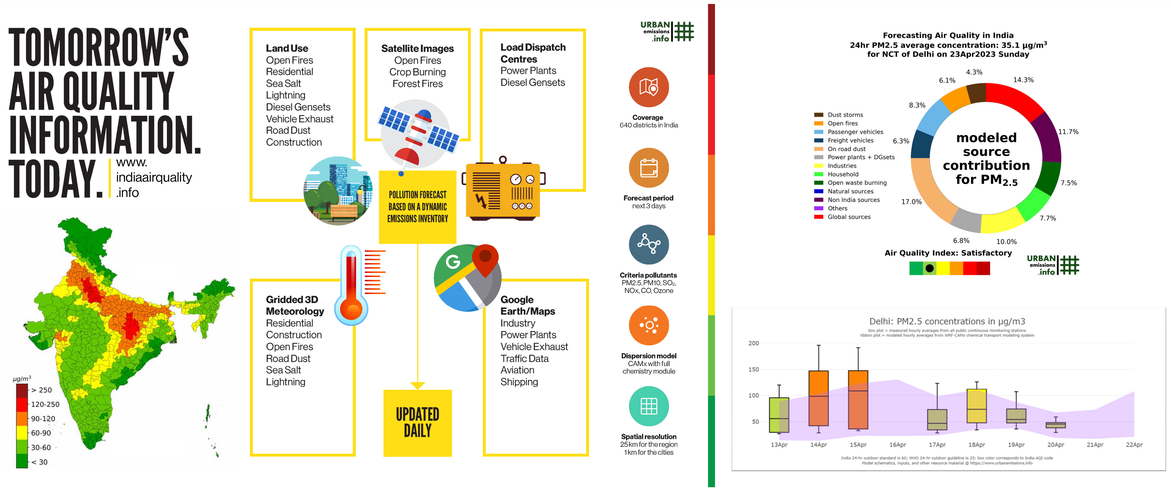
Spatially grid the emissions at 0.01 resolution (~1 km) to create an emissions heatmap for all the pollutants (PM_{10}, $PM_{2.5}$, BC, OC, SO_2, NO_x, CO, and VOC).

Use WRF meteorological model to construct all the necessary meteorological fields in 3D at model grid and temporal resolution.

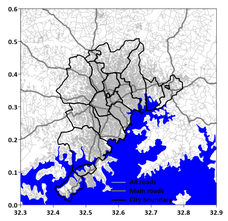
Use a chemical transport model (e.g., CAMx) to construct concentration and source apportionment profiles for the city airshed.

Validating modelled outputs using data from available monitoring networks (ground and remote).

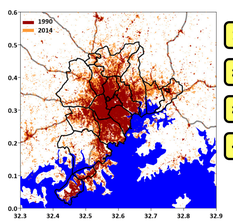
User interface to display the results and share the extracted emissions and air pollution fields.



Greater Kampala Airshed: 60 x 60 grids @ 0.01° resolution

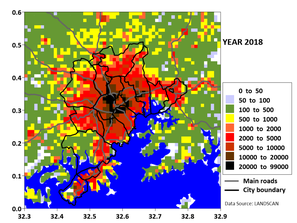


Roads (Open Street Maps)

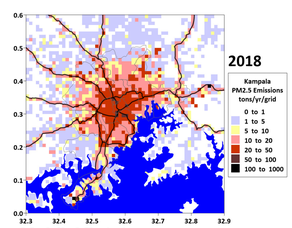


137 km² in 1975
200 km² in 1990
295 km² in 2000
438 km² in 2014

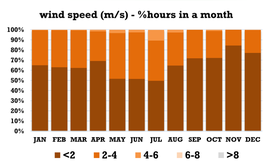
Urban-Rural Classification (ESA-GHS)

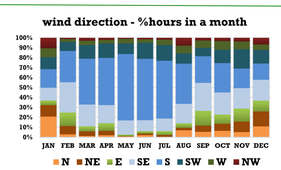


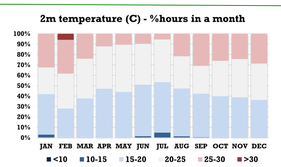
Gridded Population (LANDSCAN)

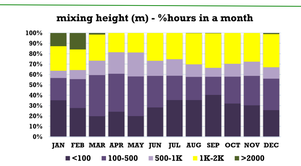


Modelled Emissions



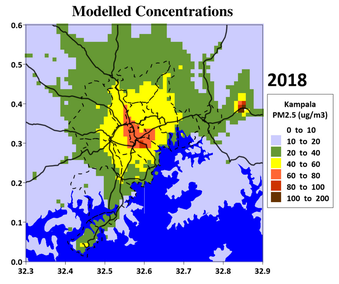


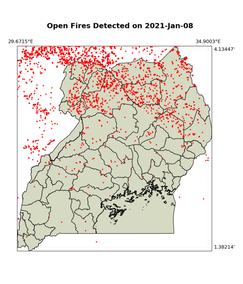


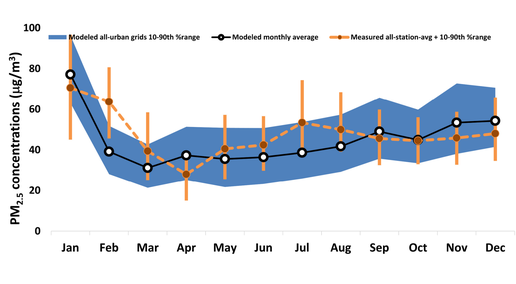


Meteorological data processed model grid resolution using NCEP reanalysis fields and WRF model

Point and diffused sources of air pollution in Kampala (a) Kiwanga power plant (b) Cement plant (c) Kitezi landfill (d) Example quarries from airshed scanning via Google Earth imagery







Study Highlights:

- Thanks to AirQo for providing the sensor monitoring data for the Greater Kampala region. Monitoring needs to currently met only via low-cost sensors with limited calibration. More reference grade monitors covering all the criteria pollutants is a must
- Study established 1-km resolution emissions inventory and conducted chemical transport modelling using WRF-CAMx system to establish source contributions. Inventory was established using open databases, census and national reports, and literature review.
- Model was able to replicate the measured trends qualitatively and quantitatively
- Vehicle exhaust, residential, resuspended dust, and industrial emissions dominate local contributions
- Jan-Feb highs from the boundary can be directly attributed to Northern fires and prevalent winds from that direction (secondary organic contribution from CAM-Chem was the highest along the Northern boundary)

Data resources and methodologies utilized for this analysis are documented @ https://www.urbanemissions.info, along with city application reports under the Air pollution knowledge Assessments (APnA) city program