Investigating Air Pollution Emissions Exposure in Greater Cairo

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Agenda

• Motivation & Goal
• MENA Region
• Exposure Assessment
• Control Scenarios
• A Global View
Research Motivation

- Cairo 6th largest Megacity globally
- 20% of Egyptian population in 0.2% of Egypt’s area
- Urban growth > Development + Control
- Greater Cairo has 3.5m vehicles (37% of Egypt)
- Unfavorable geography and meteorological conditions
- 20m direct receptors - emissions >WHO limits
- Air pollution → the invisible disease
- Extent of Problem? What is being done about it?

First – The Middle East and North African Region

An overview of monitoring and reduction strategies for health and climate change related emissions in the Middle East and North Africa region

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Health Emissions Exposure Assessment in Transport Microenvironments
Megacity – Cairo
High Activity Zones

Zone 1
Heliopolis

Zone 2
Maadi

Zone 3
New Cairo

Zone 4
Downtown

Zone 5
Mohandeseen

Zone 6
6th of October

20 Nov 2019
@AirPollSurrey surrey.ac.uk/gcare
Vehicle Transport

Modal Share of Motorized Trips (%)

- Car + Taxi
- Bus + Minibus
- Light Rail Tram
- Metro

Years
- 1970
- 1975
- 1980
- 1985
- 1990
- 1995
- 2000

Modal Share of Motorized Trips (%)

- Car + Taxi: 70%
- Bus + Minibus: 1%
- Light Rail Tram: 9%
- Metro: 1%
- Public Transport: 1%
- Trucks: 9%
- Buses: 1%
- Others: 19%
- Private cars: 70%

(Huzayyin et al. 2009)

Vehicle Type Distribution in GC area

(CAPMAS 2017)
### Data Collection Plan

**Settings of Transport:** S1: Open window, S2: Closed Window, S3: AC On

**Sessions:** Morning rush-hour, Evening rush-hour, Weekend

**Parameters:** \( \text{PM}_{2.5}, \text{PM}_{10}, \text{CO}, \text{NO}_2 \)

**Areas of Focus around Greater Cairo:**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Main Street</th>
<th>Residential Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z1 Heliopolis</td>
<td>Nozha st. + Thawra st.</td>
<td>Korba villas</td>
</tr>
<tr>
<td>Z2 Al-Maadi</td>
<td>Al-Nasr st. + Al-Lasilki st.</td>
<td>Degla + CAC school</td>
</tr>
<tr>
<td>Z3 New Cairo</td>
<td>90 st.</td>
<td>Al-Rehab area</td>
</tr>
<tr>
<td>Z4 Downtown</td>
<td>Tahrir Sq.</td>
<td>Falaki st.</td>
</tr>
<tr>
<td>Z5 El-Mohandesseen</td>
<td>Al-Dokki st.</td>
<td>Seliman Riad st.</td>
</tr>
<tr>
<td>Z6 6th of October City</td>
<td>Mehwar st.</td>
<td>Dr. Khairy El-Samar st.</td>
</tr>
</tbody>
</table>

**Cross-city roads**

- Autostrad
- 6th of October Bridge
- Ring Road

Preliminary Results

Transport Emissions Control Scenarios
Instruments to address congestion:

- Behavioral – staggering work start times
- Fiscal – subsidy removal
- Investment – public transport + road capacity
- Regulatory – technical + economic
- Urban Planning

Countries successfully addressing congestion adopted a coherent package combining several of those instruments.

(About Ali and Thomas 2011)
National Efforts

- Banning leaded gasoline
- Replace old taxis + scrapping programs
- Fuel alternatives eg. CNG taxis
- New roads
- Public transport improvements
- I/M programs
- Subsidy removal

→ Inconsistent efforts + increase in traffic > control instruments implementation

Future Work
CArE-Cities Experiment

Latin America

Middle-East

South-East Asia

Africa
A Global View on Transport
Business As Usual Costs

10% Economic loss of GDP

$\text{\$\$\$}$ Contribute to more than

1.24m Traffic fatalities every year

2.1m premature deaths from air pollution every year

Transport GHG emissions increase by 80% by 2050

(Mahendra 2016)
Technology-Driven Transport

BRT AND BUSWAY SYSTEMS IN THE WORLD

Evolution of the number of cities per year

Global Growth of Car Sharing 2000-2012

(Mahendra 2016)
Conclusions & Challenges

- Regional Monitoring + ILR + Control – inconsistent
- Transport has opportunities for pollution reduction
- Cairo suffers air pollution (urbanization, modal shift, heavy subsidies, environmental conditions)
- High pollutant concentrations under construction zones and in evening rush hour
- Data availability – an obstacle
- Highest Exposure during EP, S1 runs
- Novelty: no scientific studies on matter (regional, exposure, control scenario assessment and nexus)
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