Sustainability and the Megalopolis Seminar Series

UCL Environment Institute

Health, climate change and the megalopolis

18th March 2009

bridging the gaps

Supported by: Sustainable Urban Spaces

Speakers

Dr. David Satterthwaite (Development Planning Unit and IEDD)
'Health and climate change resilience in the world's megalopolises'.

Dr. Ka-Man Lai (Department of Civil, Environ and Geomatic Engineering)
'Healthy Infrastructure Research Centre - A hub for education and research to prepare for the 21st century infectious diseases'.

Dr. Ben Croxford (Bartlett School of Graduate Studies)
'Pollution, health and the home'.

Summary

In the third of the sustainability and the megalopolis seminar series, speakers drawn from UCL's Department of Civil, Environmental and Geomatic Engineering (CEGE), the Development Planning Unit (DPU), and the Bartlett School of Graduate Studies turned their attention to health and climate change in megalopolises—urban regions with complex internal inter-connections.

In the first presentation **'Health and climate change resilience in the world's megalopolises'**, **David Satterthwaite** examined the vulnerability of very large city regions to disease and the effects of climate change. Defining megalopolises, Satterthwaite argued it was better to think of them as mega-cities rather than megalopolises as many of the largest cities did not have the characteristics of megalopolises. Charting the growth of these cities, he stated that by 2010 there would be 20 cities with over 10 million inhabitants (fig.1). City growth has, on the whole, slowed with none of the 20 megalopolises growing by more than 5% per year and many having more people moving out than moving in. The perception that there is a tendency for ever-increasing city-size may, therefore, be false; while the tendency to agglomerate discreet urban centres and call them megalopolises could be misleading.

URBAN CENTRE	Popn c. 1800 ('000s)	Popn 2010 ('000s)
Tokyo	492	36,094
Mumbai (Bombay)	174	20,072
São Paulo	0	19,582
Ciudad de México	137	19,485
New York-Newark	60	19,441
Delhi	125	17,015

Shanghai	100	15,789
Kolkata (Calcutta)	200	15,577
Dhaka	110	14,796
Buenos Aires	43	13,089
Karachi	14	13,052
Los Angeles metro	0	12,773
Al-Qahirah (Cairo)	260	12,503
Rio de Janeiro	43	12,171
Beijing (Peking)	1,100	11,741
Manila	85	11,662
Osaka-Kobe	373	11,337
Lagos	5	10,572
Istanbul/Constantinople	570	10,530
Moskva (Moscow)	238	10,495

fig.1.

Addressing the impact of increased urban scale upon the health of urban inhabitants, Satterthwaite concluded that increased city size did not negatively affect life expectancy (LE), infant mortality rates (IMR), provision of water and sanitation, and quality of life (fig.2). As cities increase with size, he argued, so does the likelihood that they will have developed sanitation infrastructures that make urban inhabitants as healthy, or healthier, than their rural or smaller urban centre counterparts. Cities, in which inhabitants suffered worse health than the rest of the nation, were, Satterthwaite argued, historically either in the process of industrialisation or victim to specific circumstances in which social and political reforms had failed to catch up with the speed of economic growth and the city's subsequent expansion.

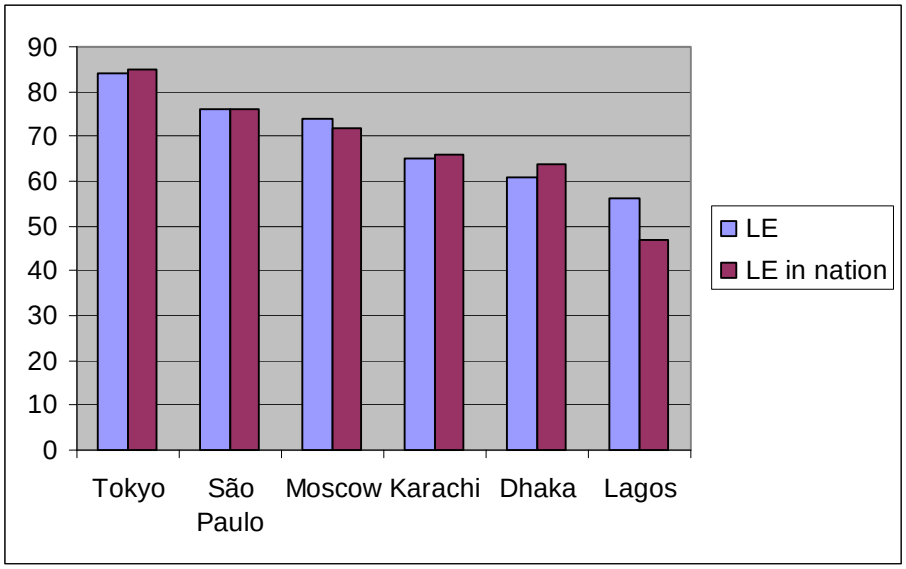


fig.2.

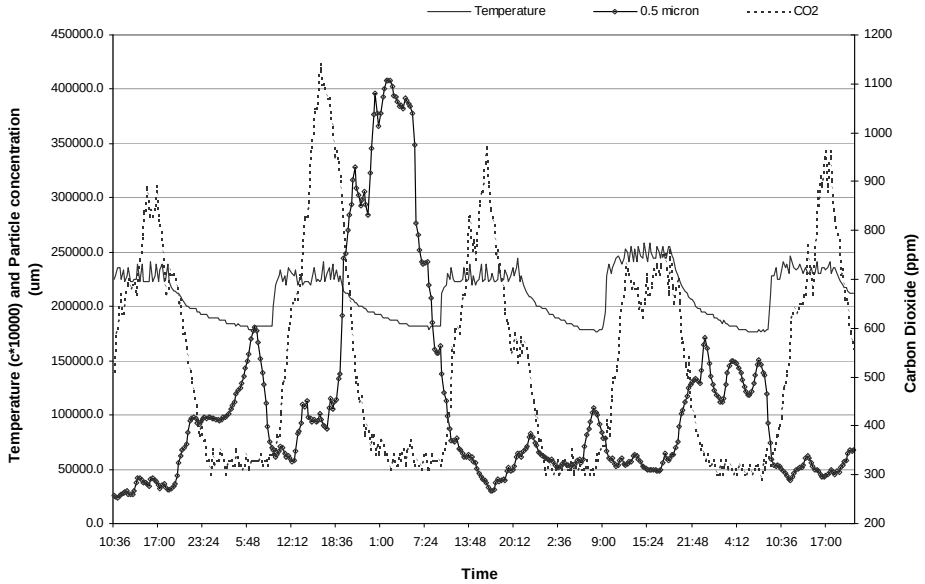
Focusing on the issue of climate change and sustainability, Satterthwaite then examined whether large urban agglomerations were inherently susceptible to the negative effects of climate change. Cities that lie on the coast and/or in areas in which extremes of climate are common, such as Dhaka, Tokyo, Shanghai, Lagos and Mumbai, are vulnerable to climate change. Satterthwaite argued, however, that these cities' increased economic capacity meant they were able to invest in climate change adaptation, thus making them more resilient to extremes in weather than poorer, smaller cities. With good urban governance, he concluded, megacities have the potential to combine better quality of life with low greenhouse gas emissions per person. But many do not have good governance.

Ka-Man Lai then went on to discuss the way in which urban infrastructures could positively and negatively impact on the health of megalopolitan populations in her presentation '**Healthy Infrastructure Research Centre - A hub for education and research to prepare for the 21st century infectious diseases**'. Infrastructures, she explained, support the operation of an organization. In a society there are both natural and engineering infrastructural systems, and the interaction of these systems has the potential to directly spread and indirectly facilitate the transmission of infectious diseases. New diseases are emerging every year, becoming increasingly resistant to drugs, and passing through often unknown paths of exposure.

Diseases such as *cryptococcus gattii*, formerly thought to only exist in tropical or sub-tropical areas, have recently been noted as causing human morbidity in the temperate rain forests around Vancouver Island, Canada. Severe Acute Respiratory Syndrome (SARS) spread from the Guangdong province of China to 37 different countries between November 2002 and July 2003, with 8,096 known infected cases and 774 deaths. The British Department of Health has stated that up to 750,000 extra deaths could be expected in Britain within 15 weeks of a flu pandemic. Population density, environmental damage, close contact between animals and humans, changing climate, migration, social and behavioural change, an aging population and incompetent infrastructure all contribute to the proliferation of infectious diseases such as these.

Infrastructure and the spread of infection are inextricably linked. Infrastructures are able to prevent the spread of disease by directly killing or removing pathogens, and facilitating other non-engineering control measures during a disease outbreak; while others, such as schools, unintentionally become a source or harbour of pathogens and create environments that facilitate disease transmission. The Urban Pathogen Research Network, funded by UCL Research Challenges, brings UCL academics together to look at urban pathogen research and use statistical and engineering data to understand, for instance, hospital pathogen control (fig.3), which can then inform decisions concerning pathogen control outside of hospitals. New monitoring and assessment strategies can thus help us better understand how healthy our infrastructures are.

fig.3.



In his presentation '**Pollution, Health and the Home'**, **Ben Croxford** went on to discuss research on urban air quality taking place at UCL's Bartlett, and pollution and health in the home. Particulate matter (PM10 and PM 2.5), nitrogen dioxide (NO2), carbon monoxide (CO) and ozone are the pollutants that cause most concern in the UK. The sources of air pollution are, broadly speaking, traffic outdoors, and heating indoors. Daily exposure to these pollutants depends on how much time is spent out of doors, which can be as little as 5% of the day, thus the home can be an important source of exposure.

Heating appliances, cookers, boilers and fires, building materials, and household products have shown to be the source of pollution by CO and NO2 as well as dust, volatile organic compounds (VOC), radon, and indoor noise. Smoking, however, is the major source of pollutant exposure. Air pollution negatively effects mortality, with the Committee on the Medical Effects of Air Pollutants (COMEAP) stating that a 10 µg m-3 increase in fine particles has been associated with a 6% increase in risk of death from all-causes.[1]

The Bartlett School of Graduate Studies has therefore been conducting research into outdoor pollution and street layout, indoor and outdoor office pollution, ventilation type and home pollutant concentration, and CO in the home. Studies conducted in the home have monitored fluctuating levels of carbon monoxide (fig. 4) and tried to identify possible causes (kitchen appliances/burning of joss sticks).

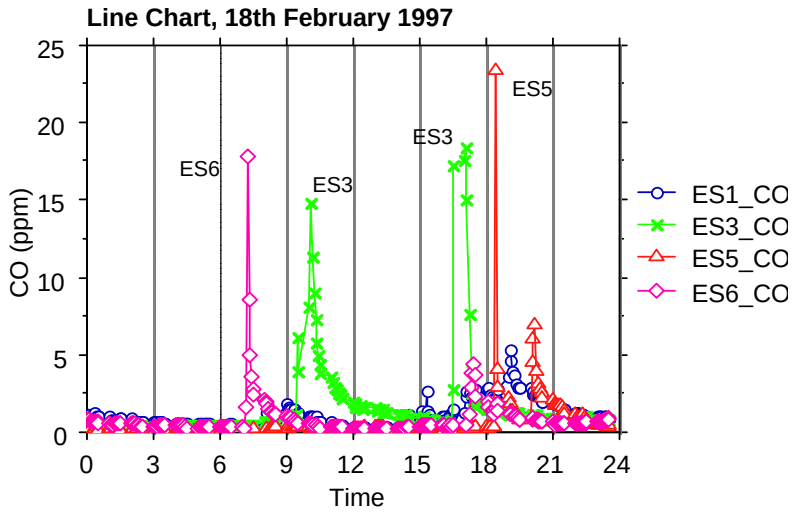


fig.4.

Individual exposure within the home varies depending on the personal habits of individuals. If well maintained, correctly installed appliances, with correct ventilation pose no threat to occupants. There are, however, approximately 16 fatalities and 200 non-fatalities each year in the UK caused by badly installed or badly ventilated appliances. Croxford has monitored the effects of less extreme cases in which occupants have suffered symptoms of some CO exposure (fig.5), finding that low income homes were more likely to have defective appliances.

The effects of climate change, urban density, and economic crises could, Croxford argued, have unforeseen health benefits and disbenefits in the UK. Milder winters, warmer summers, the effects of the urban heat island, and increases in fuel prices could lead to the reduced demand for fossil fuel based heating, and reduced exposure to combustion products in the home; however, CO exposure could rise, for example, if gas appliances are not replaced or serviced less regularly, and people burn more wood in open fires for example.

Three main themes emerged from the presentations and discussion that followed.

1. The Urban Scale and the Importance of Governance

When populations are concentrated in urban areas there are huge potential health advantages: sanitation and reticulated water supplies, emergency services, disaster preparedness. Urbanisation is very strongly associated with economic growth and cities tend to concentrate people with higher incomes. The Whitehall Study investigated the importance of social class, psychosocial factors and lifestyle as determinants of disease, and found that a person's health was influenced by the conditions in which he or she lived and worked. [2] In short, income is a determining factor in health. With the development of the European and North American city since the Victorian era, there has been a general move to the elimination of environmental health hazards. Higher standards of urban institutions, competence and capacity produce higher life expectancy. The importation of the obesity agenda and low-risk environmental health concerns to lower-middle income economies can become a concern at this stage.

Transport-related pollution is perhaps the one area in which there is a direct relationship between urban growth (and travel) and poor health. Air pollution will often peak in industrialising urban economies in which inhabitants are dependant on personal transport, before then reducing as large public transportation networks start to operate. Transportation (especially air travel) can also be a means of disease transmission, as the interconnectedness of global cities allows diseases such as SARS to travel quickly between cities, countries and even continents.

Increases in urban populations lead to concentrations of people and human to human contact that can spread infection. Attention paid to the impact of health crises revolving around SARS or BSE in wealthy nations rather than the effects of cholera or malaria in poorer ones, for instance, is, however, disproportionate to the numbers actually affected, and ignores the fact that cities have driven the health reforms that have doubled our standard of living and life expectancy. It is only when governments fail urban populations that they suffer substantial health risks.

2. The Impacts of Climate Change on Health.

Climate change exacerbates a city's existing vulnerability. Tokyo may not be destroyed by a storm; however, Dhaka may well be. Urban governments are now trying to fund climate change adaptation. This, however, only funds adaptation that deals with *increased* risks due to climate change. The framing of climate change fails to address the fact that already vulnerable cities that are without effective infrastructure need funds to deal with existing vulnerability to extreme weather, regardless of impacts caused by climate change.

As yet, it is still difficult to obtain city-scale models that will predict the impacts of climate change. There will only be specific discussions about the health impacts of climate change in urban contexts, when we are able to improve the capacity to locate them. We know that sea level rises, changes in rainfall patterns, and increased frequency and intensity of extreme weather events will happen for certain, and we should thus be adapting to cope. We do not know for certain, however, to what extent Greenland and Antartica's ice will melt and what the effects of that might be. However, competent urban governments with well-managed infrastructures should be able to cope with the health impacts of climate change in the coming decades.

3. Population growth and climate change

The significance of population growth on health and climate change mitigation was debated. The United Nations Population Division has made projections of population growth between now and

2050 that predict that, if fertility were to remain constant at the levels for 2005-2010, the population of less developed regions would increase to 9.8 billion in 2050; this contrasts with the figure of 7.9 billion projected by assuming that fertility declines, so that the world population could increase by nearly twice as much as currently expected.[3] The population of the United States, which is growing faster than most other wealthy countries, is projected to top 400 million in 2050. Given that Americans, per person, produce many more times more carbon dioxide emissions than people in developing countries, a population increase of this size would have serious significance for climate projections.

Increases in population in countries, such as the United States, with patterns of high consumption, are much more significant in terms of climate change than increases in those such as Mali, with low consumption levels. Improvements in health, and constant levels of fertility in developing countries thus will have little impact on climate change since consumption, and not increase in population, is the most significant factor in climate change.

How will improvements in infrastructure, and increasing wealth in large cities in developing countries affect patterns of consumption? And will the fossil fuel-reliant infrastructural paradigms of wealthy nations be those adopted by developing nations? Forward thinking urban governance could potentially change or institute different consumption patterns in developing economies, while new infrastructural paradigms could even be more easily introduced into contexts which lack any infrastructural precedent. Water treatment, for instance, is potentially one of the largest energy consumers in any urban centre; however, if methods such as anaerobic digestion are substituted for fossil fuel intensive methods, developing cities can introduce water treatment plants without significantly affecting urban energy usage and, at the same time, bring about significant health benefits for the urban population. Good urban governance and innovative infrastructures can thus counter the impacts of increased populations on climate change and provide for enhanced population health.

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26th March 2009

We would appreciate your comments, please email karolina.kendall-bush@ucl.ac.uk with any comments or corrections you may have.

[1] Marylebone has approximately 30ug/m3, North Kensington has 20ug/m3, and rural areas have 10ug/m3. http://www.advisorybodies.doh.gov.uk/comeap/statementsreports/longtermeffectsmort2007.htm
[2] http://www.ucl.ac.uk/whitehallII/findings/index.htm
[3] http://www.dotearth.blogs.nytimes.com/2009/03/11/un-young-old-boom-on-road-to-9-billion/