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Cities lead the way in climate-change action

Scientists should do the research to help mayors prepare for a warming world, say **Cynthia Rosenzweig**, **William Solecki**, **Stephen A. Hammer** and **Shagun Mehrotra**.

For years, the focus on the world's response to climate change has been on nation states, which have been mostly unsuccessful in brokering comprehensive agreements or taking action. Cities, by contrast, are preparing risk assessments, setting greenhouse-gas emission reduction targets, and pledging to act. Urban areas, home to more than half of the world's people, are emerging as the 'first responders' in adapting to and mitigating climate change.

Cities were initially ignored by most climate-change scientists. Early impact studies focused on ecosystems and agriculture. Many researchers assumed that cities in developed countries were inherently 'adaptable' — an assumption shattered by Hurricane Katrina's devastation of New Orleans in 2005. Furthermore, researchers needed complex models on small scales to examine the combined effects of heat islands, air pollution, engineering, architecture and urban design — models that haven't been possible until recently.

What the world needs is the same science-based foundation for cities that the Intergovernmental Panel on Climate Change (IPCC) provides for nations. Scientists including ourselves are now coming together to provide this information, with several groups formed in recent years and influential publications due out soon. Physical scientists, health scientists and engineers are starting to answer specific questions about how cities and the urban environment will interact in the face of climate change. Social scientists are addressing the human and economic costs, specifically for at-risk populations. And all are learning to take a more holistic approach, considering mitigation alongside ▶

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adaptation and disaster planning.

Cities are crucial to global mitigation efforts. The International Energy Agency estimates in its most recent survey that urban areas are responsible for 71% of global energy-related carbon emissions, although the numbers vary widely depending on how cities or urban areas are defined. This percentage will grow as urbanization trends continue. The United Nations estimates that by 2050, the world's urban population will almost double from 3.4 billion to 6.3 billion, representing most of the global population growth over that time[1]. Cities are also centres of wealth and innovation, and so have the tools and resources with which to tackle climate-change challenges.

At the same time, cities, nearly all being built on coasts or riverbanks, are particularly vulnerable to climate-change effects[2,3]. For example increases in sea level and large storm surges will threaten crucial infrastructure. More frequent and intense floods and droughts will put demands on essential and often scarce water supplies. Climate change will exacerbate urban pressures of rapid population growth and sprawl, poverty and pollution. There will also be other knock-on effects because of cities' concentrated and integrated economic activity, highly complex infrastructure systems and social services, and multilayered governance.

WILLING AND ABLE

Compared to national politicians, city leaders seem willing and able to take action to protect their cities against these threats and to help make a global difference. In recent years, several high-profile alliances have been forged between the mayors of cities around the world.

The World Mayors Council on Climate Change (WMCCC) was founded by Kyoto's mayor in December 2005, following the entry into force of the Kyoto Protocol. The WMCCC and its chair Marcelo Ebrard, mayor of Mexico City, will host the World Mayors' Summit there the week before the 16th Conference of the Parties to the Kyoto Protocol in Cancun, Mexico, this November. Mayors will be invited to sign the Mexico City Pact, which seeks to strengthen cities' commitment to mitigation measures, monitoring and adaptation (see 'Urban action'). The summit also gives city leaders the opportunity to demand a seat at the UN Framework Convention on Climate Change negotiations, helping them to get funding to implement their policies. There are currently more than 50 members (mayors and former mayors) of the WMCCC.

The C40 Cities Climate Leadership Group of large cities, launched in October 2005, now has 40 participating and 19 affiliate cities. It is focused on reducing greenhouse-gas emissions through a range of energy-efficiency and clean-energy programmes, such as one helping to retrofit nearly 300 municipal buildings in Seoul, Johannesburg, Houston, London and Melbourne.

Some individual cities have been especially proactive. New York has won considerable recognition for its long-term growth and sustainability plan, PlaNYC 2030. This aims to reduce greenhouse-gas emissions by 30% from 2005 levels over the next 20 years — roughly the same as the US federal government's goal of reducing the country's emissions by 28% from 2005 levels by 2020. Because nearly 80% of New York City emissions come from buildings, the New York plan includes compulsory energy audits of city and commercial buildings of more than 4,645 square metres (50,000 square feet). New York City also has a Climate Change Adaptation Task Force composed of 40 public and private entities that manage the city's essential energy, water and waste, natural resources, transportation and communications infrastructure. The NYC Panel on Climate Change, a group of scientists and experts led by two of us (CR and WS), provided climate-change risk information for the task force, including projections of sea level rise with and without rapid ice melt, as well as a framework for the development of the city's climate-resilience planning effort[4]. A key recommendation was to focus on win–win strategies, such as improving road drainage, developing green roofs and improving hazard-event evacuation plans.

> ***"The world needs the same science-based foundation for cities that the IPCC provides for nations."***

These policy efforts place urgent demands on the scientific community to provide new and timely information about how the changing climate will affect urban areas — including long-term trends, potential tipping points and possibilities for surprise. Local leaders need to know how hot their cities will become, and the most effective ways to combat that. The carbon dioxide 'domes' that form over urban areas need to be better understood, so that local officials can measure and verify changes in local emissions. There are important questions about how air pollution will interact with future temperatures to affect population health. The ecosystems of cities need to be studied, including the role of parks as coolants, of coastal wetlands as storm-surge buffers, and the effect of climate change on urban disease vectors such as rats or allergens such as pollen. Scientists must answer questions about the combined effects of changing migration patterns and climate, and help to estimate resulting response costs — particularly for poorer people and other at-risk populations.

City-based climate work is still in its early stages, but progress is rapid. In 2007, we (the authors) hosted about 150 climate researchers in New York City to form the Urban Climate Change Research Network (UCCRN) — an international coalition of researchers dedicated to providing information and data to urban decision-makers. The UCCRN has attracted more than 200 members from about 60 cities, creating a network linking large and small cities from developing and developed countries, and scholars and policy-makers, with an emphasis on cutting-edge science, science-policy linkages, and local adaptive capacity. Thus far, it has succeeded in

URBAN ACTION

Cities throughout the world are participating in the World Mayors Council on Climate Change and the C40 Cities Climate Leadership Group

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OLIVER MUNDAY

bringing together about 100 authors from more than 50 cities to answer questions from a survey of dozens of city leaders.

Cambridge University Press aims to publish, by February 2011, the first UCCRN assessment report on climate change and cities[3] (edited by us).

Other scientific initiatives include the ten-year Urbanization and Global Environmental Change project of the International Human Dimensions Programme, established in 2005. The UN-Habitat's 2011 Global Report on Human Settlement will focus on climate change and cities, as will the World Bank Institute's Urban and Climate Change Practice Group.

STAYING ABOVE WATER

Throughout these research initiatives, special attention is being given to the most at-risk urban residents. Poor people concentrated in rapidly growing slums are projected to face even greater economic and social stress. In Lagos, for example, home to 9 million people in 2006 — with about 400,000 added each year — about 70% of the people live in slums, many of which are located less than 5 metres above mean sea level. A sea level rise of 1 metre could displace 3.6 million people in Lagos alone[5,6]. As in Lagos, the urban poor everywhere are more likely to live in high-risk zones, and are less able to move in the event of a disaster.

It is becoming ever more common for scientists and policy-makers to consider adaptation and mitigation side-by-side, to help see the synergies between them — a trend that is particularly important for cities, where these factors are deeply intertwined. When a city introduces tax credits to encourage energy system retrofits in existing buildings, for example, it helps by adapting to future temperature swings and by reducing the demand for energy-intensive heating and cooling services. In contrast, when a city considers new housing developments to limit urban sprawl or new public transportation networks to cut carbon emissions, adaptation measures might be forgotten. Often these new features are built along urban waterways, because the adjacent land is frequently derelict or government-owned, and thus easily developed. Unfortunately, the same areas are often most at risk from flooding by heavy rains, rising sea levels and bigger or more frequent storm surges.

City planners need to link climate-change issues to broader agendas. Discussions about whether to invest in a more efficient fossil-fuel power plant or renewable energy sources, for example, need to be connected to discussions about the cost of energy and localized pollution impacts of power plant operations. Issues such as sustainable water supplies and sewage-treatment strategies must be evaluated for their links to climate concerns.

Cities will also be safer if they consider climate change and disasters together in their risk-reduction assessments. The IPCC is starting to do this — working group II, which is focused on impacts, adaptation and vulnerability, is due to release a special report in 2011 on *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. Hurricane evacuation planning in cities such as New York and Miami, for example, must take into account the potential for further inland coastal flood inundation. Both the climate-change community and the disaster-risk reduction community are working to open lines of communication and get both of these things into the daily consideration of city planners and other officials

There is a need to link on-the-ground scientific expertise to the needs and requirements of local city decision-makers. Groups such as the UCCRN can help. But the research networks need to be expanded to include more cities across both the developed and the developing worlds — especially small or medium-sized cities, in which limited resources need to utilized as efficiently as possible. To be effective, these efforts must be based on the best-possible, city-focused climate-change science, monitored consistently and updated regularly. Hopefully then, significant progress can be made in the face of the climate-change challenge — as cities go, so goes the world. ■

SCIENCE AND THE CITY
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The views expressed are those of the authors and do not represent the position of NASA.

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