CITIES & CLIMATE CHANGE: AN INTRODUCTION

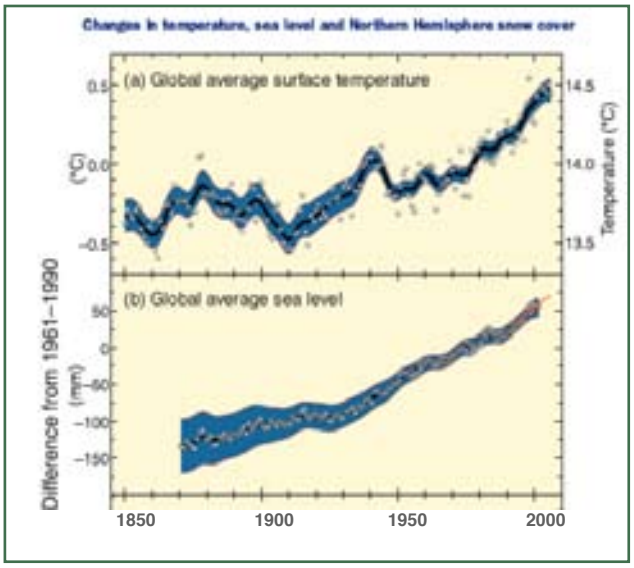
Decision-makers who guide urban development need the most reliable and current information possible upon which to act. Unfortunately a good deal of information – some contradictory, not all trustworthy – is in circulation regarding climate change and its potential effects upon cities. It is not always clear what represents the scientific consensus.

To help counteract this situation, this paper offers urban decision-makers in the global South a briefing on up-to-date scientific thinking on cities and climate change. This paper is based primarily on the Fourth Assessment Report, released in 2007 by the United Nations Intergovernmental Panel on Climate Change (IPCC). This authoritative document[1], prepared by the lead scientific and intergovernmental body on climate change, is widely regarded as the most extensively reviewed scientific document in history.

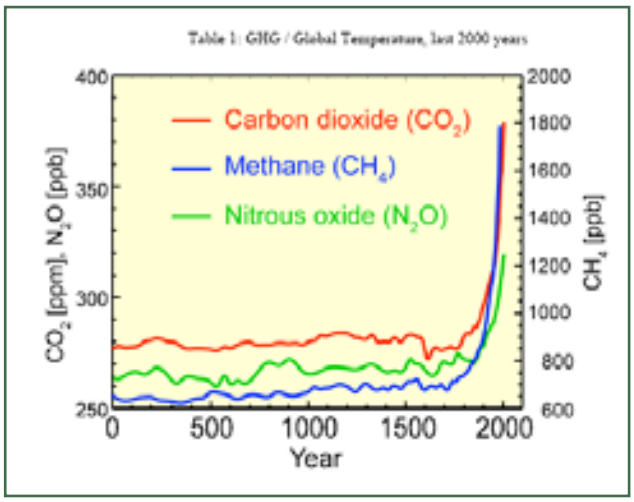
HAS CLIMATE CHANGE ALREADY BEGUN? WHAT ARE ITS CAUSES?

After reviewing all the evidence, the IPCC concludes[2]: "Warming of the climate system is unequivocal". Measurements show that global average surface temperature increased by 0.74 degrees Celsius (C) from 1906 to 2005. Moreover: "rising sea level is consistent with warming". Since 1961, global average sea level has risen at an average rate of 1.8 millimetres (mm) a year.
The expansion of water when it is heated, combined with the release of liquid from melting glaciers, ice caps, and the polar ice sheets, have contributed to this increase. Satellite data show that, since 1978, the annual average extent of Arctic sea ice has shrunk by 2.7 percent per decade.

Further, the IPCC reports: "There is very high confidence [i.e., > 90 percent certainty] that the net effect of human activities since 1750 has been one of warming". Human activities during the industrial era (e.g., the burning of fossil fuels) have released greenhouse gases (GHGs) into the atmosphere. Greenhouse gases, the most important of which is carbon dioxide (CO2), absorb and emit radiation; the absorption of radiation by the atmosphere in turn warms the Earth. Over the last 650,000 years, the "natural range" of CO2 has fluctuated between 180 and 300 parts per million (ppm). In 2005, however, atmospheric concentrations of CO2 stood at 379 ppm; such levels "far exceed" the natural range. Moreover, the annual emissions of CO2 grew by about 80 percent between 1970 and 2004. Scientists conclude: "Most of the observed increase in global average temperatures since the mid-20th century is very likely [i.e., over 90 percent certain] due to the observed increase in anthropogenic greenhouse gas concentrations [i.e., those brought about by human activities]". Likewise: "Human influences have… very likely contributed to sea level rise during the latter half of the 20th century".



Graphic 1: Changes in Temperature, Sea Level
Based on IPCC (2007): Climate Change 2007, Synthesis Report. Summery for Policymakers. p.3



Graphic 2b: Green House Gases in the last 2000 years
Source: Vincent di Norcia (2008), University of Sudbury: Global Warming is Man-made. Key Points in the Panel on Climate Change 2007 Report. p. 2

WHAT DOES THE 21ST CENTURY HAVE IN STORE FOR US?

IPCC scientists have developed several alternative scenarios for the future, based in part on whether we pursue a path of more rapid economic growth or greater environmental sustainability over the next several decades. Bearing in mind these "high" and "low" scenarios, they offer the following projections for conditions after a century of climate change – for the decade 2090 to 2099 compared to the period 1980 to 1999:

- Temperature change – the best estimate for a low scenario is a 1.8˚C increase in the global average from 1980-99 to 2090-99 (within a likely range of 1.1 to 2.9˚C). The best estimate for a high scenario is a 4.0 ˚C increase (between 2.4 and 6.4˚C) during this period.
- Sea level rise – 18 to 38 centimetres increase over this period for a low scenario, and 26 to 59 centimetres for a high scenario[3].
- Tropical cyclones – likely (> 66 percent) increase in cyclone intensity during this period.
- Precipitation – likely decrease in most subtropical land regions over this period.

These projections represent global averages; values may be higher or lower in specific places. Additionally the IPCC's Fourth Assessment Report offers more specific projections by region[4]. Likewise other regional climate change models, based in large part on data and scenarios used by IPCC scientists, offer more localised projections.

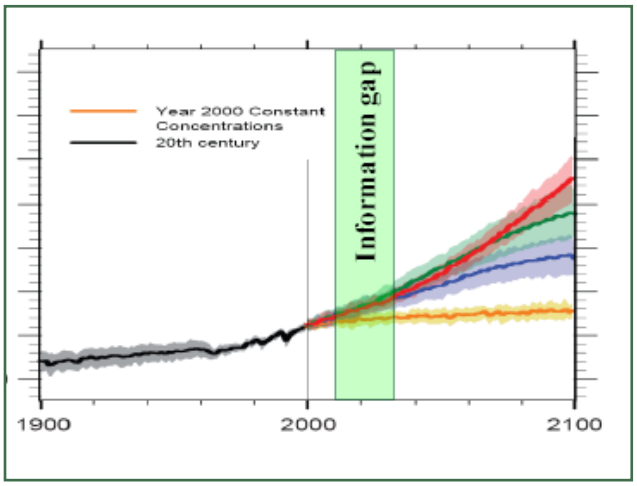
The IPCC does not offer specific projections past the end of the present century. However scientists do conclude that, even if we radically change our GHG emissions today, we will still continue to feel the impacts of climate change for centuries. For example: "Sea-level rise has substantial inertia and will continue beyond 2100 for many centuries".

HOW WILL CLIMATE CHANGE AFFECT CITIES IN DEVELOPING COUNTRIES?

The IPCC concludes that: "Climate change is almost certain to affect human settlements, large and small, in a variety of significant ways". They point out that settlements "…are important because they are where most of the world's population live, often in concentrations that imply vulnerability to location-specific events and processes". Likewise they are distinctive for "…the presence of physical capital (buildings, infrastructures) that may be slow to change".

Scientists are particularly concerned about the vulnerability of cities to "…extreme weather events, rather than to gradual climate change (very high confidence)". The IPCC points out: "Extreme weather events associated with climate change pose particular challenges to human settlements, because… populations in both developed and developing countries are increasingly located in coastal areas, slopes, ravines and other risk-prone regions". Likewise, various systems that serve human settlements, such as "…water, food supply, energy, information systems and waste disposal…, can [also] be subject to climate-related extreme events such as floods, landslides, fire and severe storms". Catastrophic damage wrought in low-lying New Orleans in 2005 by a hurricane-induced storm surge (1,100 persons killed, economic costs estimated at over US$ 100 billion) offers a tragic example of this vulnerability.

Cities located in coastal areas represent one topic of "widespread concern" in part because, as the New Orleans example suggests, these settlements are vulnerable to tropical cyclones. Cyclones are dangerous: in 1970, some 300,000 people were killed in Bangladesh by a single cyclone; between 1980 and 2000, "…more than 250,000 deaths were associated with tropical cyclones". At the same time, cyclones are becoming more intense. The IPCC Report finds that the intensity of cyclones increased over the past three decades, in a way "…consistent with the



Graphic 3.Global Surface Warming
Source: IPCC (2007): Climate Change 2007. Synthesis Report. Summery for Policymakers. p. 7

Flooding in Manila@ Jason Gutierrez/IRIN
Description: Residents use a makeshift raft to relocate children in the flooded section of Manila. Two weeks after unprecedented flooding in Manila and surrounding areas, the country has again plunged into crisis after continued rains by tropical storm Parma caused fresh flooding in the northern Philippines

observed changes in sea surface temperature". Scientists find it "likely" that (as noted above) cyclone intensity will continue to increase in the 21st century. Furthermore: "Extreme wave heights will likely increase with more intense storms".

Scientists anticipate that the risks to coastal settlements will increase in future decades, not only because they expect cyclones to intensify but also because of other climate change impacts, exacerbated by human development patterns. As researchers point out: "Sea-level rise raises extreme water levels", including those experienced during cyclone events. Analysts project that the number of persons who live in coastal flood plains will increase from around 197 million in 1990 to between 313 and 561 million in the 2080s. Of particular concern are coastal cities that experience significant subsidence – often settlements built in deltaic plains such as Bangkok and Shanghai. In fact some parts of Bangkok are subsiding at a rate of 30 mm per

year[5]. Such deltaic cities "…will experience larger relative rises in sea level". This is not an isolated circumstance: "Nearly 300 million people inhabit a sample of 40 deltas globally, including all the large megadeltas…."

Yet not only coastal communities are vulnerable to the effects of climate change: inland cities are at risk as well. Along with coastal cities, settlements located along rivers are also considered "high-risk locations". One such vulnerability that many cities will confront is from "…increased flooding potential from more sizeable rain events". Conversely, "…any change in climate that reduces precipitation and impairs underground water resource replenishment would be a very serious concern for [affected] human settlements, particularly in arid and semi-arid areas, in settlements with human-induced water scarcity, and in regions dependent on melted snowpack and glaciers". Further more, salt water intrusion can limit the availability of fresh water in coastal areas. One scientist cited by IPCC estimated that "…billions [of people] are at risk of water shortages".

Another issue that many cities will confront involves increases in temperatures. Scientists conclude that: "Climate change is likely to increase heat stress in summers". Heat stress represents a serious public health concern, as shown by the summer 2003 heat wave in Western Europe, blamed for an estimated 35,000 deaths[6]. Urban residents are particularly at risk for heat stress, given the fact that higher temperatures occur in urban than in rural areas due to the so-called "urban heat island effect". Further, typically it will be the poor who "…lack access to climate-controlled shelters" and other means of coping with heat waves.

Climate change may result in other impacts to human health and livelihoods as well. Scientists conclude that: "… changes in temperature, precipitation and/or humidity… [can] create conditions for disease outbreaks". At the same time: "Coastal communities that rely on marine resources for food… are vulnerable to climate-related impacts". Due to such impacts as well as drought, one scientist estimated that "many tens of millions of the world's population are at risk of hunger due to climate change…."

Vulnerability is a complex concept that reflects not only exposure to hazards such as climate change impacts, but also the adaptive capacity of communities. The IPCC Report finds: "Adaptive capacity is… unevenly distributed across and within societies". More bluntly: "Poor communities can be especially vulnerable". Scientists point out that more than 90 percent of the deaths related to natural disasters occur in developing countries, where "… the poor tend to live in informal settlements, with… substandard houses, lacking adequate water, drainage and other public services and often situated in risk-prone areas". They find that: "The poor, who make up half of the world's population and earn less than US$2 a day, cannot afford… adaptation mechanisms… such as air conditioning, heating or climate risk insurance…." At the same time: "Rapid urbanisation in most low and middle income nations, often in relatively high-risk areas, is placing an increasing proportion of their economies and populations at risk".

Flooding in a poor Neighborhood in Bangkok @ UN-habitat

WHAT CAN CITIES DO?

As the IPCC points out: "The two major forms of climate risk management are the mitigation of climate change through the abatement of greenhouse gas emissions and GHG sequestration, and adaptation to the consequences of a changing climate". Cities and their local governments have an important role to play in both areas.

Cities can help to mitigate climate change by reducing the emission of greenhouse gases within their jurisdictions[7]. Already hundreds of cities have committed themselves to reducing their annual GHG emissions, or meeting other targets for more sustainable urban development. While most of these cities are in the Global North, others such as Bangkok (Thailand) and Bhubaneswar (India) are in the South[8]. Examples of more specific measures taken to reduce urban emissions include construction of an urban wastewater methane gas capture project, undertaken in Santa Cruz (Bolivia) with financing via the Clean Development Mechanism; energy efficiency audits of municipal buildings by Cape Town (South Africa); and development of rapid transport systems and other measures designed to reduce the use of single occupancy vehicles in a number of cities.

Cities can also begin to adapt to the impacts of climate change via effective urban management. Planning and land use controls can prevent people from building in zones at risk of flooding and landslides (e.g., restrictions on building within 50 year floodplains in South Africa). Guidelines and regulations, such as a decision issued in 2006 by the Thua Thien Hue provincial authorities in Vietnam to encourage cyclone-resistant building practices, can increase resiliency. Likewise governments can design infrastructure so that it is climate-proof: an example is the US$ 1 billion Confederation Bridge in Canada, which was built one metre higher than current conditions would require, to accommodate anticipated sea-level rise.

Likewise local governments can mobilise stakeholders to contribute their technical and even financial resources towards joint endeavours. Such adaptation measures make economic sense. As the IPCC Report points out: "[The] adaptation costs for vulnerable [areas] are much less than the costs of inaction (high confidence)". Finally, some local governments such as Durban, South Africa are beginning to address both adaptation and mitigation measures (as well as other development goals) within the same broader strategic planning framework.

Notes

1 "By endorsing the IPCC reports, governments acknowledge the authority of this scientific document". www.ipcc.ch/.

2 Except where otherwise noted, the present Primer summarizes and cites material primarily from the IPCC's 2007 Fourth Assessment Report. The present section ("Has climate change already begun?") and the following ("What does the 21st century…?") are drawn from that Report's Summary for Policymakers (pp. 1-22). The section on "How will climate change affect cities?" is drawn from Chapters 6 (pp. 316-57) and 7 (pp. 358-90) of that Report. "What can cities do?" is drawn from Chapters 2 (pp. 134-71) and 6. For the Summary and the full Report, see www.ipcc.ch/.

3 "[These] projections do not include uncertainties in climate-carbon cycle feedbacks nor the full effects of changes in ice sheet flow, therefore the upper values of the ranges are not to be considered upper bounds for sea level rise".

4 See Table SPM.2 of the Summary for Policymakers document, as well as chapters on individual regions (e.g., Chapter 10, "Asia") from the full Report.

5 United Nations Environment Programme, Bangkok Assessment Report on Climate Change 2009, p. 51. While some subsidence occurs naturally, human actions such as withdrawing groundwater and constructing drainage systems can accelerate subsidence.

6 See http://www.earthpolicy.org/Updates/Update29.htm.

7 For the technical and definitional difficulties in estimating the proportion of greenhouse gas emissions for which cities are to blame, see David Dodman and David Satterthwaite, "Are cities really to blame?", in UN-Habitat's Urban World, Vol 1. Issue 2 (March 2009), pp. 12-13.

8 See ICLEI's "World Climate Catalogue of City Commitments to Combat Climate Change", at http://www.iclei-europe.org/index.php?id=6870.

Informal Settlement Angola@ Jaspreet Kindra/IRIN
Description: A view of Boa Vista informal settlement, Luanda, Angola, August 2007. Most Luanda residents live in tin and mud shacks built in mounds of waste.

Photo 8: Bus Rapid Transit System in Bogotá, Colombia
@Laura Petrella/UN-habitat
Description: CDM (Clean Development Mechanism) Project Bus Rapid Transit System in Bogotá, Colombia

For further information, Contact:

The United Nations Human Settlements Programme (UN-Habitat) is working through its Cities and Climate Change Initiative to help cities in developing countries to address climate change. For more information please contact Mr. Raf Tuts at raf.tuts@unhabitat.org.