

'Satellites and the city'

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Just how does society's desire to live in densely populated areas have the potential to change our Earth's climate? According to a new paper, satellites can help us answer that question.

"More and more people live in cities. This means that cities will grow rapidly over the next several decades. Evidence continues to mount that cities affect the climate," said J. Marshall Shepherd, Deputy Project Scientist of the Global Precipitation Measurement Mission at NASA's Goddard Space Flight Center, Greenbelt, Md. and co-author of a paper that appeared in the May 2005 issue of Bulletin of the American Meteorological Society.

"Recent U.S. Climate Change Science Program (CCSP) and Weather Research Program (USWRP) documents highlight the need for improved understanding of how cities affect weather and climate, yet current climate models don't represent urban areas very well," said Shepherd. "Our research suggests that, using satellite data and enhanced models, we will be able to answer several critical questions about how urbanization may impact climate change 10, 25 or even 100 years from now."

Shepherd and co-author Menglin Jin, a research scientist at the University of Maryland-College Park, suggest that satellite-observed urban information is extremely useful for advancing our ability to simulate urban effects in climate models. They go on further to propose that satellite data is the only feasible way to represent the expanse of global urban surfaces and related changes to the Earth's surface,

vegetation and aerosols.

According to the United Nations Population Division, urban regions only cover 0.2 percent of Earth's land surface, but contain nearly half of the world's population. By 2025, 60 percent of the world's population will live in cities and urban landscapes will likely expand well beyond 0.2 percent. However, to date, global climate models (GCMs) and regional climate models (RCMs) do not reflect urban landscapes, according to the paper's authors.

GCMs and RCMs are models, or complex mathematical computer simulations of the atmosphere and the oceans, and are the primary tool for predicting the response of the climate to increases in carbon dioxide and other greenhouse gases. GCMs and RCMs combine a model of land surfaces with an atmosphere model through exchanges of heat fluxes, water and momentum.

What is it about urban areas like New York City, Paris, Tokyo or Sydney that the paper's authors believe would lend value to climate models, and subsequently, to climate predictions? According to scientific studies presented at a recent American Geophysical Union session organized by the authors, "the construction of buildings, parking lots, houses, urban areas dramatically change the smoothness of a surface, thermal conductivity (the ability of a material to transmit heat), hydraulic conductivity (measure of the ability of soil to transmit water), albedo (reflectivity off of Earth's surfaces) emissivity (the ratio of radiation emitted by a body or surface) and vegetation cover."

As such, urban landscapes change the typical physical processes of land surfaces, and importantly, also add new and unique characteristics to land surfaces and atmosphere.

Structures like the Empire State Building in New York City can change

the basic wind flow in and around cities that can alter air quality, temperature, cloud distribution and precipitation patterns. It is increasingly evident that such atmospheric changes near cities can be captured by NASA satellites such as Aqua, Landsat, Terra, and the Tropical Rainfall Measurement Mission (TRMM). These same urban structures also alter the land surface and atmospheric conditions as measured by satellite instruments such as Aqua's and Terra's Moderate Resolution Imaging Spectroradiometer (MODIS).

The paper's authors believe that the story of satellites and the city deserves further review, and can be of great value to our understanding of how our global inclination to be urban dwellers can also change the climate of our home planet.

"Our goal with this paper and with our research is to raise attention to the need for including urban lands into climate models, and for using satellite observations in simulating those urban landscapes in climate models," said Jin. "It's important for everyone to know that urbanization affects things we all care about like the amount and frequency of rainfall or how hot or cold the outdoor temperature may be."

Source: NASA/Goddard Space Flight Center--EOS Project Science Office

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