National Aeronautics and Space Administration

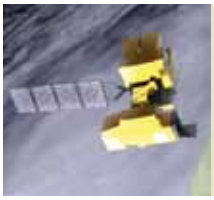
Landsat's Critical Role in Urban Planning: Hot Times in the City

Cities are places of light, action, complex social interactions, multi-faceted cultures, and fast-paced living. It's no wonder cities are growing faster than rural areas. Earth experienced a milestone in the history of urban landscapes in 2008-09. More than 50 percent of the world's human population now lives in areas of contiguous urban development. People are driving landscape-scale changes on our planet.

Considering that people change the land surface, vegetation, water cycle, radiant heat, and other aspects of the landscape, the nature of this milestone has important implications for life. Using Landsat data, people can monitor urban change and also forecast patterns of change in future urban landscapes. Landsat sensors employ a spatial resolution of 30 m, an ideal scale for observing human impacts on the land. The sensors detect urban growth with visible and infrared reflectivity consistently, objectively, and dependably over time.

Landsat Data for Local and Global Decision-making

- monitoring urban sprawl and land use efficiency
- measuring impervious surface area
- observing heat island effects
- linking urban growth and rainfall pattern change



ABOUT LANDSAT

Landsat satellites provide an unparalleled record of Earth's varying landscapes. Landsat's 30 m resolution is ideal for measuring human impacts on the land. The consistency of Landsat's digital image data from sensor to sensor and year to year makes it possible to trace land cover changes from 1972 to the present.

USGS science for a changing world

landsat and urban planning

Monitoring urban sprawl and land use efficiency

Using Landsat, researchers create land-use maps that distinguish urban surfaces from vegetation. They use computer models to quantify land use efficiency; assess the impact of urbanized land on energy, water, and carbon balances; and project growth. Landsat brings "a major advance in monitoring capability because aerial photo mapping can't keep up with the pace of change," says Scott Goetz, Senior Scientist at Woods Hole Research Center. "Our maps of counties and cities capture new development and can be repeated much more quickly than the tedious and expensive traditional photo interpretation work."

Measuring impervious surface area

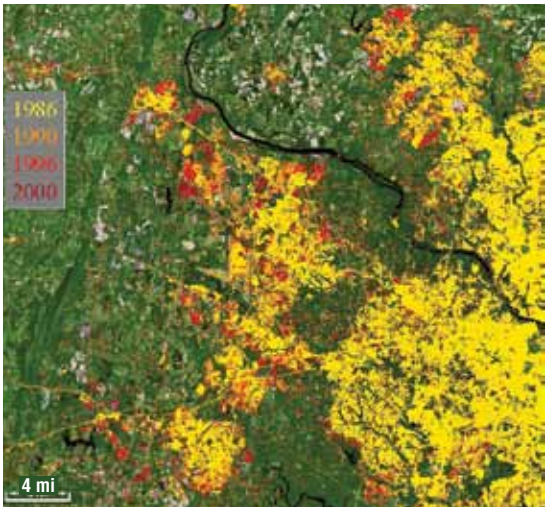
Highly impervious surfaces, such as concrete, asphalt, and rooftops, prevent precipitation from infiltrating soils. Impervious surfaces concentrate pollutants into streams and ultimately into rivers, lakes, bays, and oceans. They alter the hydrological regime and cause soil erosion by inducing faster runoff from land. Landsat observations of visible and infrared reflectivity are highly effective at quantifying changes in land use from pervious to impervious surfaces.

Observing heat island effects

Urban construction materials such as metal, concrete and asphalt absorb, reflect, emit, and store heat differently than tree or grass-covered land. During the day, urban materials absorb heat and hold it long after the sun sets, creating a warm bubble (heat island) over a city that can be as much as 6 degrees Celsius (10 degrees Fahrenheit) higher than temperatures in surrounding rural areas. Landsat's thermal imaging capacity clearly indicates where temperatures are heightened by urban landscapes.

Linking urban growth and rainfall pattern change

Landsat observations of urban land cover together with weather and other data have helped to show that urban heat islands can influence where and how much it rains. The heating of the surface and the overlying air creates instability in the atmosphere that encourages air to rise. As it rises, it cools, and water vapor condenses into rain that falls downwind of the city. Rainfall downwind of major urban areas can be as much as 20 percent greater than in areas upwind.



Maps derived primarily from Landsat data were analyzed to produce this image of change over time in Northern Virginia between 1986 and 2000. Oranges and reds indicate increases in impervious surfaces such as asphalt, concrete, and rooftops, of more than 20 percent between eras.

Further Reading

NASA Landsat: http://landsat.gsfc.nas.gov

USGS Landsat: http://landsat.usgs.gov/

Landsat Images Offer Clearer Picture of Changes in Chesapeake Watershed
http://landsat.gsfc.nasa.gov/news/news-archive/soc_0024.html

Landsat Links Urban Growth and Rainfall Pattern Change
http://landsat.gsfc.nasa.gov/news/news-archive/sci_0015.html

Ecosystem, Vegetation Affect Intensity of Urban Heat Island Effect
http://landsat.gsfc.nasa.gov/news/news-archive/sci_0025.html

Contact

Dr. James R. Irons, *LDCM Project Scientist*
james.r.irons@nasa.gov