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Urban Planners and Urban Geographers Turn to Landsat for Answers

"A vision to observe Earth for the benefit of all..."

Interior Secretary
Stewart Udall, 1966

Government organizations that manage and mitigate the continued growth of cities are looking increasingly to the sky for assistance.

Global population has shifted dramatically in the more than 50 years since former Interior Secretary Stewart Udall first proposed using remote satellite sensing to monitor the impact of humanity on the environment of Earth. In 1960, more than 1 billion people lived in urban centers. Today (2019) that population is nearly 4 billion.

In the entire United States, 8 in 10 people reside in cities occupying roughly 4 percent of the country's land mass. Although a small percentage, urban land use is growing with important, long-term ramifications. Regulatory officials dealing with environmental and natural resource issues need to account for woodland flora and fauna when forests are replaced by busy, high-density urban cover. Regulatory officials want to know where rainfall goes when farms or other natural fields are paved over into city parking lots. Meeting the needs of urban America for food, shelter, and energy often requires resources found in rural areas, thus impacting land use, land cover, and the environment outside city limits.

Landsat satellites can help answer those questions.

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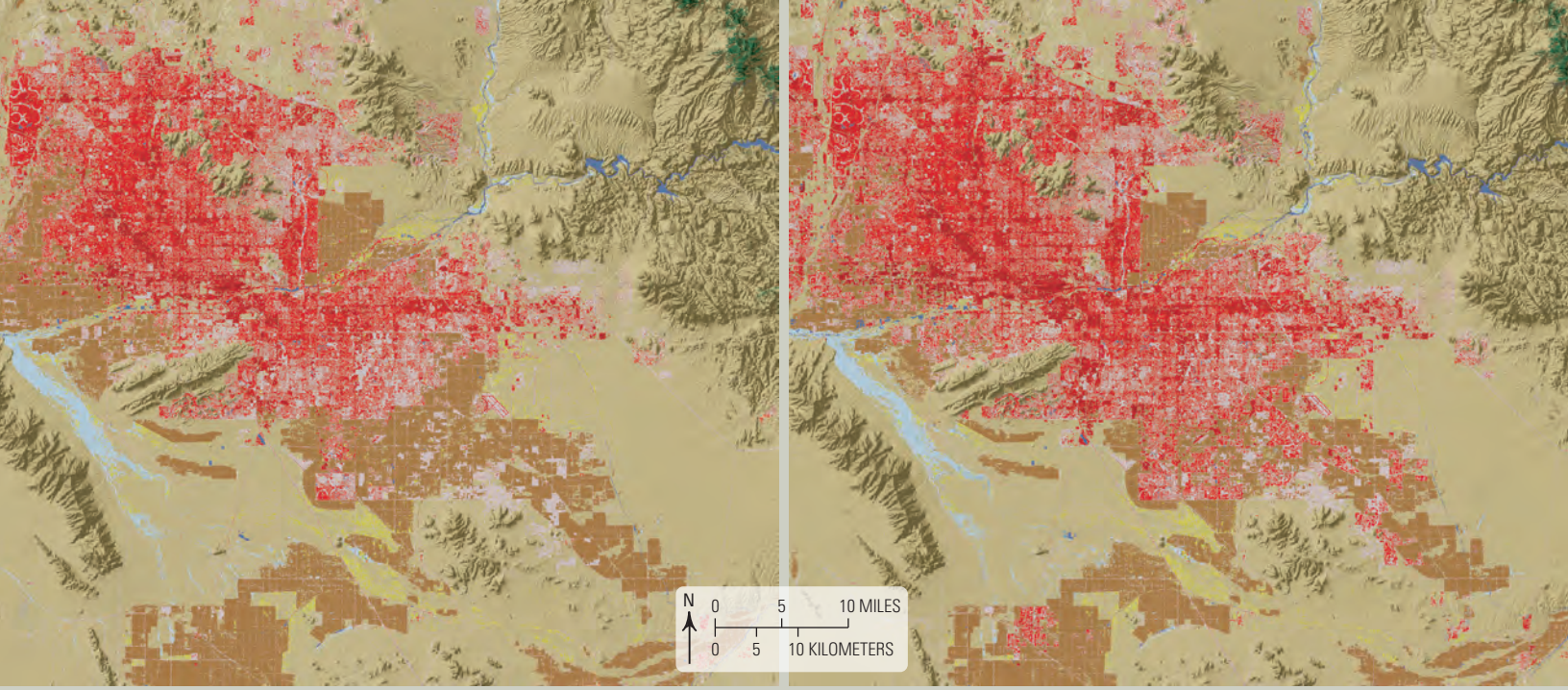

Figure 1. These National Land Cover Database images from 2001 and 2011 show dramatic growth in suburban southeastern Phoenix, Arizona. The suburbs shown (in red) expanding in the center of the images include Mesa, Gilbert, Chandler, and Apache Junction. The red at the lower left is the emergence of the community of Maricopa during that decade. Data from U.S. Census Bureau (2016) and Pacific Northwest Regional Economic Analysis Project (2016).

Unlike other satellite systems acquiring images for the last 10 to 15 years, Landsat has been used to monitor urban change worldwide for 47 years, notes Collin Homer, land characterization project chief for the U.S. Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center. Landsat has mid-level resolution that captures the bigger picture of urban growth on a much wider scale than most other finer-resolution satellites.

That repeat coverage led to the creation of the National Land Cover Database (NLCD), massive datasets released every 5 years from the USGS EROS Center to track land-cover change nationally. The datasets created in 2001, 2006, 2011, and 2016 are so valuable that users pushing for future editions to come out more frequently will now benefit from land-cover and land-change products produced annually through the Land Change Monitoring, Assessment, and Projection (LCMAP) initiative led by EROS.

To help produce the NLCD datasets, maps are derived from Landsat data for the entire lower 48 states in cells 98 feet long by 98 feet wide. Each cell categorizes land cover into as many as 16 different classifications under the broader umbrellas of natural vegetation, agriculture, and urban areas. Products from the NLCD show the amount of tree canopy cover in a cell. Some NLCD products can characterize cropland in each cell. Other NLCD products can identify the percentage of urban surface imperviousness—that is, how much land is covered by asphalt, concrete, rooftops, and other man-made constructs.

Mapping impervious surfaces is important for many reasons. When land is paved, rainfall cannot soak directly into the soil. The rainfall runs down streets, across parking lots, off rooftops, and ends up pooling in areas of low elevation, increasing the risk of local flooding. Chemicals on pavement at the time of rainfall often are carried away with runoff, reducing water quality and threatening rivers and other water ecosystems downstream. Rainfall runoff issues can be identified and studied by using the NLCD.

Homer says NLCD also can offer insights into how urban growth affects wildlife at the fringe of urban areas. Products from the NLCD can be used to model the pathways of disease borne by ticks, mice, and mosquitoes. Knowing the land cover and habitat where such vectors live, and the routes pests are likely to follow across an urban landscape to find that habitat, can be invaluable to disease detectives.

Urban geographers use the NLCD as a tool in assessing livability in metropolitan areas. Social quality can be influenced by everything from how many parks there are to housing density. Landsat and NLCD can provide data relevant to social issues. In fact, the U.S. Census Bureau has formally adopted the impervious layer product from the NLCD as a way to better understand population distribution, Homer says.

Government agencies are not the only organizations that rely on Landsat and the NLCD. State governments, natural resource offices, and more are all looking to the sky by way of remote sensing for answers. Answers that can be found—in Landsat.

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