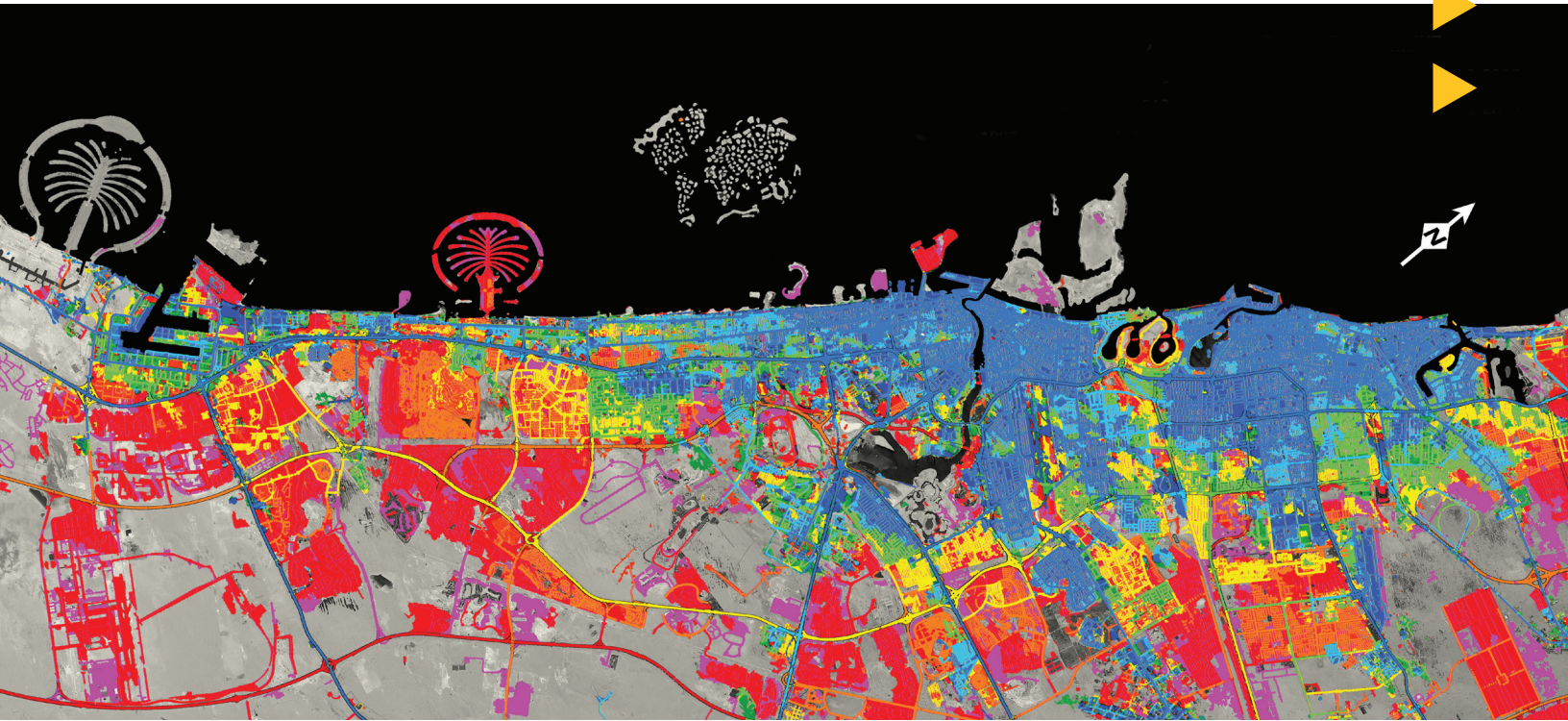# Roads Drive Better Understanding of Urban Growth

Satellite imagery and OBIA technology give new meaning to Dubai's explosive growth.

Trimble software supports efforts for sustainable growth in urban areas.

Solution

Trimble® eCognition® software

overview

Looking at years of satellite imagery, it is easy to see that the city of Dubai has experienced massive growth. To give more meaning to that expansion, a Colorado-based aerial and satellite data provider paired imagery with eCognition® object-based imagery analysis (OBIA) technology. The data showed how road development helped drive Dubai's growth.
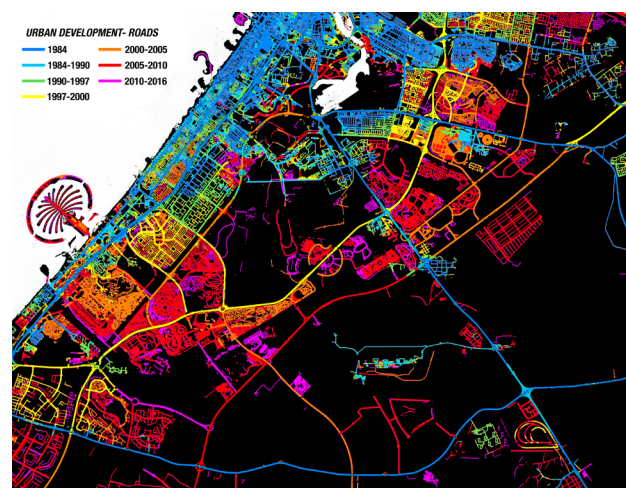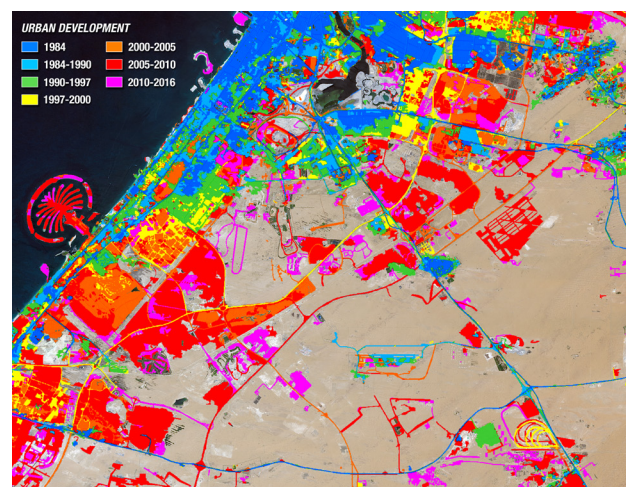

Location
DUBAI

As part of its Urban Expeditions initiative, a multi-year project spotlighting cities' sustainable solutions for managing urban growth, the National Geographic Society (NGS) wanted to study Dubai's road development over time as an indicator of its expansion. Focusing on five-year intervals between 1984 and 2016, the NGS commissioned Land Info Worldwide Mapping to classify and map Dubai's road development and expansion over that 32-year period.

"Road networks and how they have changed can enhance the story of a region's growth," said Chris Lowe, director of imagery analysis with Land Info. "Tightly packed roads may mean a significant influx of residential construction. Roads may have changed from one type to another or disappeared because of certain developments. Integrating roads with other metrics can help bring more meaning to expansion."

Given the nearly 40-year archive of Landsat optical satellite imagery, Lowe chose a series of 26 scenes from three satellites (Landsat 5, 7 and 8) to cover the 6,475 sq kilometer (2,500 sq miles) area of interest (AOI). He also acquired road data from OpenStreetMap (OSM), a global, crowd-sourced vector data collection.

Because the three Landsat satellites carry different sensors with different spatial resolutions, Lowe had to create slightly varied rule sets to accommodate the

URBAN DEVELOPMENT

1984	2000-2005
1984-1990	2005-2010
1990-1997	2010-2016
1997-2000	

URBAN DEVELOPMENT- ROADS

1984	2000-2005
1984-1990	2005-2010
1990-1997	2010-2016
1997-2000	

different information detail provided in the satellite bands. He also had to process each year individually.

To classify the data he used Trimble eCognition software, which employs user-defined processing workflows called rule sets to automatically detect and classify specified objects and map them.

After spending one day customizing the eCognition rule set, Lowe ran the first classification on the two Landsat scenes from 1984. Using a combination of common indices like Normalized Difference Vegetation (NDVI) and Normalized Difference Water (NDWI), along with proprietary spectral- and texture-based indices, he developed a rule set to distinguish objects into four land-cover classes: urban, barren, vegetation and hydrology. With that first

sorting complete, he integrated the OSM layer into eCognition and instructed the software to identify just the roads in the urban areas and map those––a two-tier classification process that took only 30 minutes to classify the entire AOI.

Lowe could then apply that master rule set— with slight modifications—to the remaining six classifications, and use each classified year as input for the next year's classification. Using a cumulative classification approach, eCognition produced all seven classifications in about 3.5 hours.

The final results showed that Dubai's road network grew from 4,692 km (2,915 miles) in 1984 to 13,000 km (8,077 miles) in 2016, an increase of 277 percent in 32 years. Lowe sent the classified road vectors, by

year, the classified urban polygons, by year, and a mosaic of the Landsat imagery for each year to the NGS.

"With this information, the NGS can incorporate the city's road expansion into their other metrics and develop a deeper understanding of Dubai's urban growth in the last three decades," said Lowe.

Indeed, the combination of the heightened data detail of remote sensing and the smartness of OBIA technology is proving to be a viable qualifier for those wanting to know not only what a particular object is, but how it relates to an area's overall story.

URBAN DEVELOPMENT
1984
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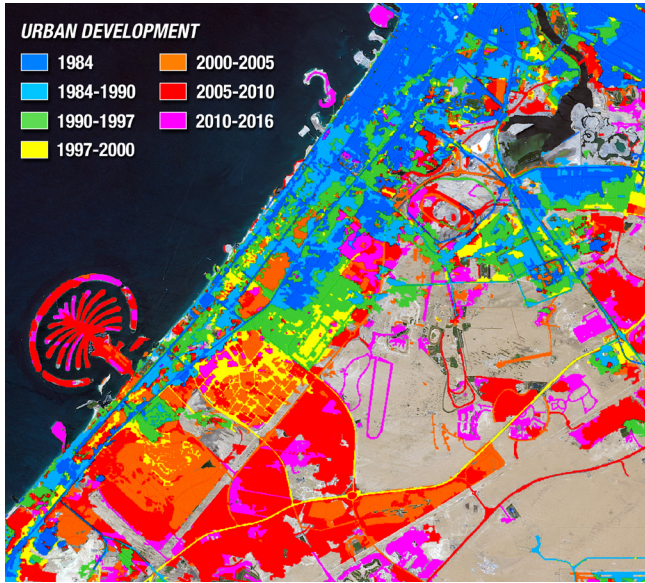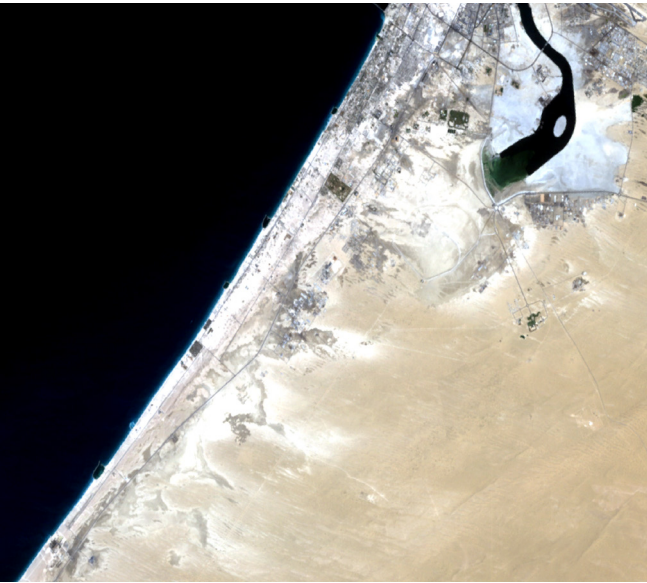
"One of the powers of OBIA is its ability to take in any spatial-based data and classify whatever you tell it to. It's way smarter and more efficient than pixel-based image processing software."

Chris Lowe
Director of Imagery Analysis
Land Info Worldwide Mapping, LLC

Trimble