National Aeronautics and Space Administration

Landsat's Critical Role in Understanding Climate Change

Long-term weather patterns averaged over 30 years or more make up our climate. Human well-being—our infrastructure and agriculture—depend on a reliable climate. This reliability allows farmers to plant seeds in the spring with confidence that temperatures and rainfall will sustain crops in the coming months. It allows communities to build and maintain roads, buildings, and drainage systems best suited to local conditions.

Earth's climate is controlled by the amount of energy that flows through the atmosphere, oceans, and land. By adding heat-trapping gases to the atmosphere—primarily carbon dioxide—people are increasing the amount of energy in the Earth system that would otherwise escape to space. This increase in energy is changing Earth's climate, and consequently, the weather patterns that people rely on are shifting.

Changes in long-term weather patterns have wide-ranging impacts on ecosystems and peoples' lives. Designed to observe land and coastal ecosystems, Landsat instruments provide an unparalleled space-based record of the impact of climate change on Earth's landscapes, the growth and loss of carbon-storing forests, and land use related to local climate change. The Landsat record provides context for planning adaptation strategies.

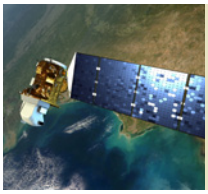
A consistent record of change

Starting in 1972 and extending unbroken to the present, Landsat provides the longest and most complete space-based record of Earth's landscapes. It is the only satellite record that is both long and consistent enough to track changes related to climate change at the scale of cities and farms.

Photo by Monkey Business

Data for Decision Making

- Monitoring Earth's carbon on land
- Understanding how land use affects climate change
- Tracking the impacts of climate change
- Adapting to climate change



ABOUT LANDSAT

Landsat satellites provide an unparalleled record of Earth's varying landscapes. Landsat's 30-meter 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.

NASA

USGS science for a changing world

Landsat and Climate Change

■ Monitoring Earth's carbon on land

Carbon dioxide, a greenhouse gas, is at the heart of climate change. Landsat helps track carbon stored in plants on land. Forests store more carbon than any other ecosystem on land, and deforestation releases carbon into the atmosphere. Landsat has offered an impartial, consistent assessment of the extent of Earth's forests since 1972. Organizations like the UN Food and Agriculture Organization and scientific efforts like the North American Carbon Program use Landsat to assess carbon stocks and rates of deforestation. Such assessments can help governments set and implement land use and climate policies.

■ Understanding how land use affects climate

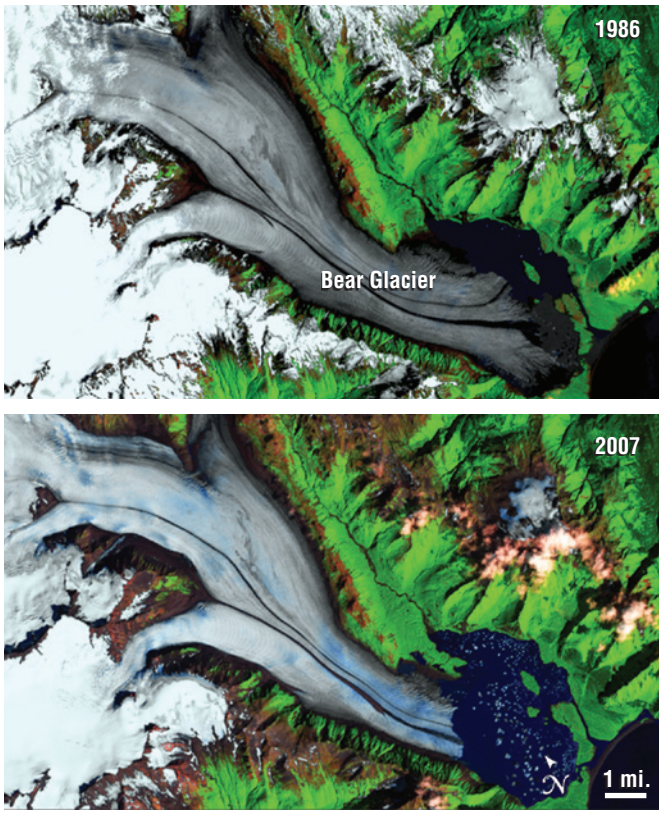
Land use decisions can alter both temperature and precipitation on a local scale. A city absorbs and re-radiates heat and is therefore warmer than a forest or a field. Landsat's landscape-scale data helps researchers make connections between land use and regional climate change. For example, Dr. Karen Seto found that rapid urban growth in China's Pearl River Delta resulted in drier winters. "Primarily it is caused by the conversion of vegetated land to asphalt, roads and buildings. As a result, the soils have significantly less ability to absorb water, so in the winter months there is less moisture in the atmosphere and therefore a reduction in precipitation," says Seto.

■ Tracking the impact of climate change

Landsat's consistent decades-long record makes it possible to track changes, including those related to a warming climate. Landsat has recorded the retreat of most of the world's mountain glaciers and ice caps, the disintegration of polar ice shelves, declines in coral reefs, and offers a baseline to detect future change. In recent Landsat observations of northern Canada, Drs. Doug Morton and Jeff Masek detected shrubs and grasses growing where temperatures had been too cold to support abundant plant growth just a few decades ago. Landsat is also used to track new insect infestations in forests, the erosion of coastal wetlands and islands, and the conditions that support vector-borne diseases like Rift Valley Fever and malaria—all impacts of climate change.

■ Adapting to climate change

Landsat observations of land use and disasters provide key information useful in adapting to climate change. Landsat measurements are used to track water use in irrigated fields in arid Western states. The four decades of imagery reveal changes in agricultural patterns across the globe as farmers adapt to increasing food demand in a changing climate. Landsat is also used to map human settlements and infrastructure susceptible to climate-driven hazards, such as sea level rise, severe storms, and fire.



More than 99 percent of Alaska's large glaciers are retreating. These images show the Bear Glacier, located in the Kenai Fjords National Park in south central Alaska in 1986 and 2007. The glacier has retreated significantly.

Further Reading

Land Cover Land-Use Change Program
http://lcluc.umd.edu/

UN Food and Agriculture Org. Global Forest Resources Assessment
http://www.fao.org/forestry/fra/remotesensingsurvey/en/

NASA Landsat: http://www.nasa.gov/landsat

Landsat Science http://landsat.gsfc.nasa.gov

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

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