DELAWARE and Landsat

Delaware's status as the first State to ratify the U.S. Constitution is a well-known point of pride. "The First State" is among Delaware's nicknames, alongside "the Blue Hen State," "the Diamond State," and "the Small Wonder," the last of which relates to Delaware's diminutive land area—larger only than Rhode Island.

Less well known, perhaps, is Delaware's geographic distinction as the State with the lowest average elevation. Most of its land area rises no more than 80 feet above sea level. In fact, about 32,000 acres of Cypress Swamp, sometimes called the Great Cypress Swamp, stretch across its southern border.

These low elevations put Delaware at particular risk of sea level rise associated with climate change. Sea levels are rising more quickly than average for the Mid-Atlantic Region, which includes Delaware. The State has seen its coastal waters rise more than 1 foot over the past century (Delaware Department of Natural Resources and Environmental Control, 2022).

The Landsat Program's 50-year archive of repeat Earth observations offers an indispensable record of land change along the Nation's coastlines. Imagery collected by Landsat satellites can inform studies of the coastline losses, flooding extents, and land cover conversions that affect climate resilience in Delaware. Landsat data also can support plans to mitigate those effects. Here are a few examples of the ways Delaware benefits from Landsat.

National Land Imaging Program Benefits—Delaware

The U.S. Geological Survey (USGS) National Land Imaging Program provides a wide range of satellite imagery and other remotely sensed and geospatial data to Government, commercial, academic, and public users. Those users can get worldwide access to Landsat satellite data through the National Land Imaging Program-funded USGS Earth Resources Observation and Science (EROS) Center.

Tracking Coastal Change

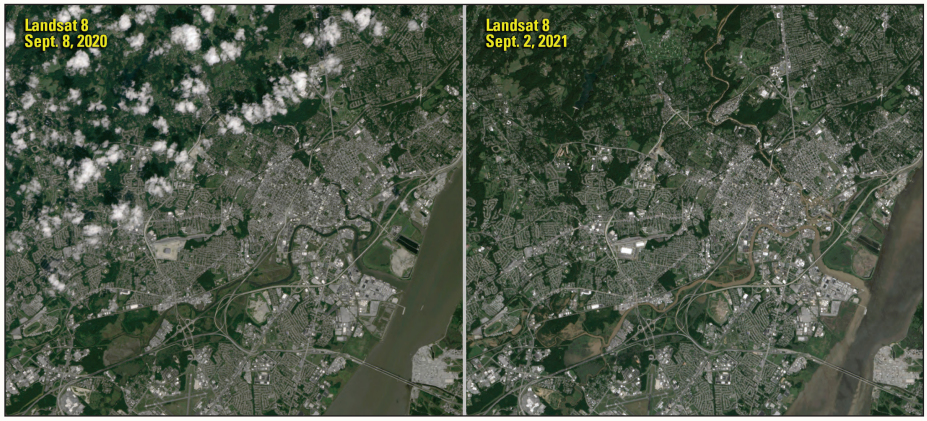
The twin factors of subsidence and sea level rise on Delaware's low-lying land area and coastal estuaries have led to substantial coastal losses. More than 1 foot of sea level rise has been recorded at Lewes tide gate since 1900, and another 9–23 inches of sea level rise are projected by 2050 (Callahan and others, 2017). These changes threaten aquatic species, shorebirds, and the State's tourism industry, which is its fourth-largest employer and contributed $3.5 billion to its economy in 2018 (Delaware Tourism Office, 2020). Coastal restoration and resilience planning are key pillars of the Delaware Climate Action Plan (Delaware Department of Natural Resources and Environmental Control, 2021). Landsat imagery, currently collected every 8 days and stretching back through five decades, contributes to the understanding of coastal change. It allows users to map shoreline losses and land cover conversions that can place pressure on coastal areas and affect drainage. Landsat imagery formed the basis of one of the most widely cited studies on shoreline loss in Delaware Bay (Kearney and others, 2002). Landsat has since continued to play an important role in mapping and understanding the State's coasts.

The morning after a full-moon high-tide spawn, thousands of horseshoe crabs wait on the mud flats for the high tide to return at Slaughter Beach in Delaware. Photograph credit: Conor McGowan, U.S. Geological Survey.

The Landsat series is a joint effort of the USGS and NASA. NASA develops and launches the spacecraft; the USGS manages satellite operations, ground reception, data archiving, product generation, and data distribution. Funding for the National Land Imaging Program's Landsat operations and data management is provided through the USGS.

Watching over Wetlands

Wetlands make up more than one-quarter of Delaware's land area—73,000 acres of tidal wetlands alone. Human activity and climate factors have affected the health of these wetlands. Landsat's scientific precision offers more consistent, repeat coverage of these wetlands than other available data sources on wetland type, extent, and flooding potential. Research teams seeking to assess the current state of coastal wetlands and the trends in change over time, therefore, often rely on land cover data derived from Landsat, such as the data available through the National Oceanic and Atmospheric Administration Coastal Change Analysis Program. Landsat data serve as the primary input to the Coastal Change Analysis Program dataset, which offers detailed analysis of wetlands every 5 years.



The remnants of Hurricane Ida dumped heavy rain on the Mid-Atlantic coast in the days following its landfall in Louisiana on August 29, 2021. The city of Wilmington, Delaware, saw flooded roads, power outages, and road closures. Compared to 1 year earlier, the southern part of the Landsat image on the right reveals flooding effects in lighter brown. Image credits: U.S. Geological Survey.

Documenting Deluges

Flooding and other damage from hurricanes and powerful storm systems are a part of life for Mid-Atlantic States, and Delaware residents have seen the damage firsthand. About 22,000 residents are at risk of flooding; another 9,000 could be at risk by 2050 (States at Risk, 2015). In 2021, Hurricane Ida brought some of the worst flooding in decades to the city of Wilmington. Landsat imagery allows first responders to catalog flood damage at landscape scales, understand floodwater recession rates, and enable recovery efforts. Flooding and increasing precipitation also threaten the State's agriculture industry, which contributes $8 billion to the State's economy. Landsat imagery can contribute to models of potential crop damage from storm surges and can support landscape and coastal change projections that can aid authorities in future planning.

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Landsat—Critical Information Infrastructure for the Nation

Landsat is the most widely used land remote sensing data source within Federal civilian agencies. Local, State, Tribal, and Federal agencies use Landsat to monitor and forecast a wide range of land surface phenomena. Information from Landsat contributes to day-to-day decisions on land, water, and resource use that protect life and property; safeguard the environment; advance science, technology, and education; support climate change resiliency; and grow the U.S. economy. Landsat's imagery provides a landscape-level view of land surface, inland lake, and coastal processes, both natural and human-induced. Landsat enables us to better understand the scope, nature, and speed of change to the natural and built environment.

Businesses draw upon Landsat data to provide customer-specific applications to improve logistics, resource allocation, and investment decisions. Commercial space-imaging firms leverage Landsat data to refine product offerings and support new information services. A 2017 USGS study determined the total annual economic benefit of Landsat data in the United States to be $2.06 billion, far surpassing its development and operating costs (Straub and others, 2019).

Landsat 8 and Landsat 9 provide 8-day repeat coverage of the Earth's land surfaces. The National Aeronautics and Space Administration (NASA) and the USGS are currently reviewing the findings from a joint Architecture Study Team, which will inform the design and implementation approach for Landsat Next, the follow-on mission to Landsat 9. Landsat 9 and its successors are planned to provide a sustainable, space-based system to extend the 50-year Landsat series of high-quality global land imaging measurements—the world's longest time series of the Earth's land surface.

The long-term availability of consistent and accurate Landsat data, combined with a no-cost data policy, allows users to analyze extensive geographic areas and to better understand and manage long-term trends in land surface change. New cloud computing and data analytics technologies use Landsat data in a wide range of decision-support tools for Government and industry. Much like global positioning system and weather data, Landsat data are used every day to help us better understand our dynamic planet.

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