

Observing Earth for 40 years with Landsat

1972-2012



Landsat

Since 1972

“The opening of the Landsat archive to free, web-based access is like giving a library card for the world’s best library of Earth conditions to everyone in the world.”

—Adam Gerrand, United Nations Food and Agriculture Organization

Landsat's History

1966

1965



Director of the USGS, William T. Pecora, inspired by Mercury and Gemini photos of Earth, proposes idea of an Earth-observing satellite program to gather facts about Earth's natural resources.



Secretary of the Interior, Stewart L. Udall, announces that the Department of the Interior (DOI) is going to proceed with its own Earth-observing satellite program. This spurs NASA into action.

1972



Landsat 2 is launched on January 22, 1975.

1970

By 1970, NASA has the green light to build the first Landsat.



Landsat 1 is launched on July 23, 1972.

1975

The name "Landsat" is officially designated. Prior to this Landsat was known as the Earth Resources Technology Satellite (ERTS).

1978



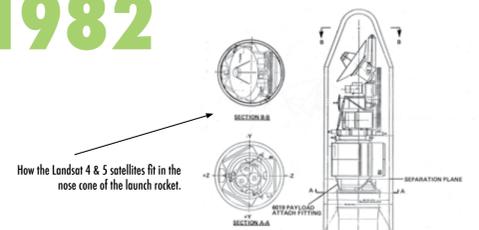
Landsat 3 is launched on March 5, 1978.

1982



The new Thematic Mapper instrument flown on Landsat 4.

Landsat 4 carrying a new more sophisticated sensor is launched on July 16, 1982.



How the Landsat 4 & 5 satellites fit in the nose cone of the launch rocket.

1984



Landsat 5 was launched on March 1, 1984. This satellite is still in orbit!

“The Landsat program was created in the United States in the heady scientific and exploratory times associated with taming the atom and going to the Moon.”

—Dr. John Barker, Landsat Calibration Scientist

Observing Earth since 1972.



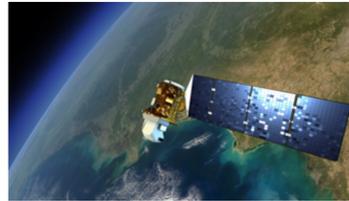
2009



The USGS Earth Resources Observation and Science (EROS) Center in Sioux Falls, SD where the Landsat archive is housed.

The entire Landsat archive was made available at no cost to users in 2009.

2013



The next satellite, the Landsat Data Continuity Mission, will be launched in January 2013. Once on orbit it will be called Landsat 8.

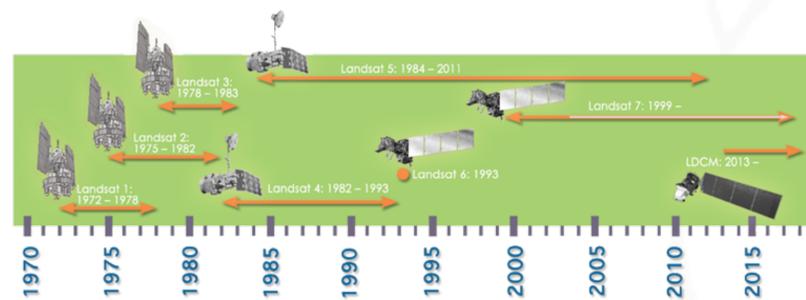


Landsat 7 was successfully launched on April 15, 1999.

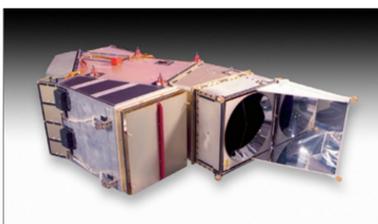


The engineering team that built the Enhanced Thematic Mapper-Plus instrument for Landsat 7

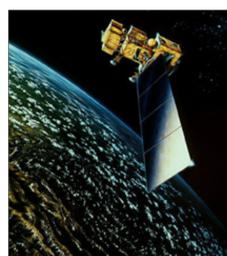
1999



1993

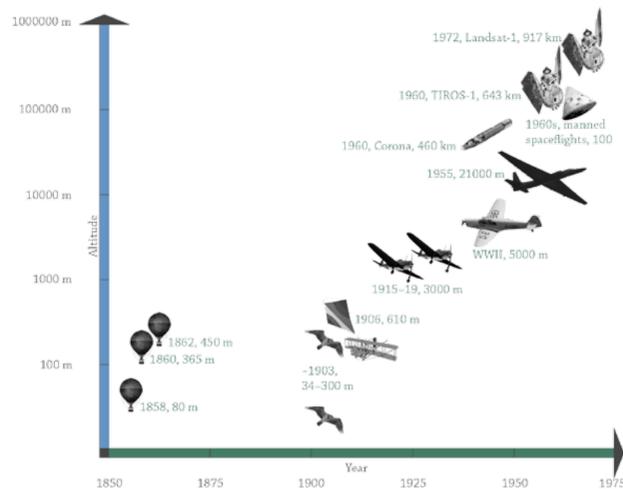


The Enhanced Thematic Mapper instrument launched on Landsat 6.



Landsat 6 was launched on October 5, 1993, but failed to achieve proper orbit.

Why Landsat?



Humans have always sought out a bird's-eye view, starting with climbing hills to get the lay of the land. With time, our technology has become more sophisticated and our vantage point higher.



Secretary of the Interior Stewart Udall shakes hand with John Marburger, during tour of the Manned Spacecraft Center in Houston, Texas.

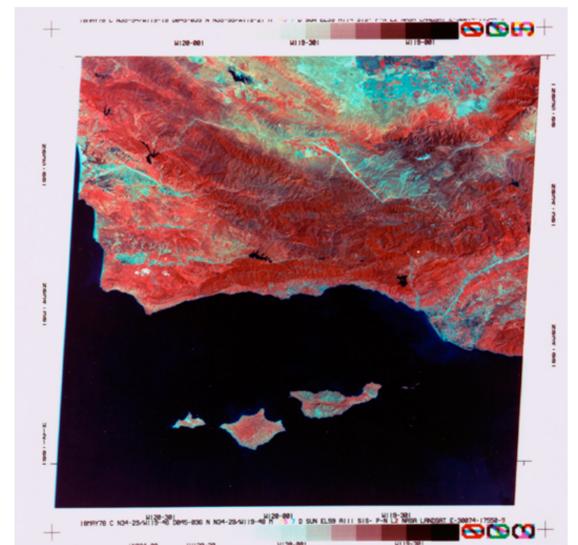
During early test bed missions for Apollo, the Mercury and Gemini manned-spaceflights returned photographs of Earth. Land managers within the Department of the Interior realized how this new way of looking at Earth could aid their mission to manage lands and resources.



The Synoptic View

Land managers had long been using aerial photography for their work, but the space-based Landsat offered a number of advantages:

- + *Landsat imagery was acquired at the same time of day so the solar illumination (i.e., light conditions) stayed relatively uniform.*
- + *The down-looking perspective (i.e., the nadir look) made image analysis easier than that of aircraft data.*
- + *Landsat imaged 10,000 square miles in seconds; it would take planes days to collect data over the same area.*
- + *Topographic features were accentuated by shadows thanks to Landsat's morning collect time.*
- + *The early Landsat Multispectral Scanner (MSS) instrument could see light that aerial film cameras of the time could not (the 0.8-1.1 μm band).*
- + *Landsat could collect data globally and repeatedly.*



False-color Landsat 2 Multispectral Scanner (MSS) image of Channel Islands and Santa Barbara, CA

“The [Landsat] spacecraft represent the first step in merging space and remote-sensing technologies into a system for inventorying and managing the Earth’s resources.”

Dr. V. E. McKelvey Director of U.S. Geological Survey



Wow, Landsat!

Discoveries

The new synoptic view afforded by Landsat led to many discoveries:

- + Sediment laden waters seen in Landsat images provided information about near-shore ocean circulation patterns*
- + New islands were discovered (one was named Landsat Island)*
- + New geologic features such as faults and other lineaments were found (in some cases this led to the discovery of minerals such as copper, water sources, and geologic hazards).*
- + An impact crater was found in Brazil*
- + For the first time, accurate maps could be made of remote locations (e.g. many errors on maps of Antarctica were fixed using Landsat)*

But by far, it has been Landsat's ability to monitor change to Earth's surface at a human-scale that has made it such an indispensable data source



Landsat 1 image of the Mississippi Delta taken on June 10, 1976, sediment-laden waters are light blue.



Landsat 1 images of Lake Faguibine in Mali collected on January 3, 1974 and December 26, 1978; many geologic features are visible.

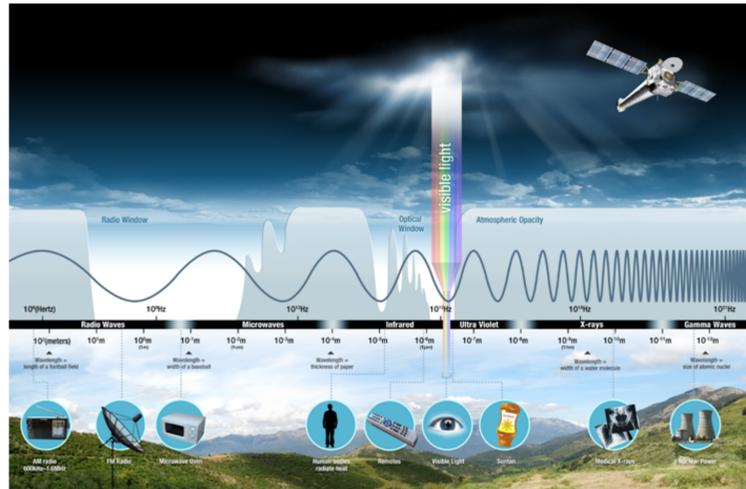
“Within days [Landsat 1] had stunned geologists, rewritten the textbooks of forestry and land use, and revolutionized cartography”

—Stephen Hall, Mapping the Next Millennium

Understanding a Landsat Image

Landsat records energy from the visible and infrared portions of the electromagnetic spectrum.

Electromagnetic Spectrum ->



ETM+ Band	Wavelength (µm)	Color
1	0.450 - 0.515	Blue
2	0.525 - 0.605	Green
3	0.63 - 0.69	Red
4	0.75 - 0.90	Near Infrared
5	1.55 - 1.75	Infrared
7	2.09 - 2.35	Shortwave Infrared
6	10.40 - 12.50	Thermal Infrared
8	0.52 - 0.90	Panchromatic

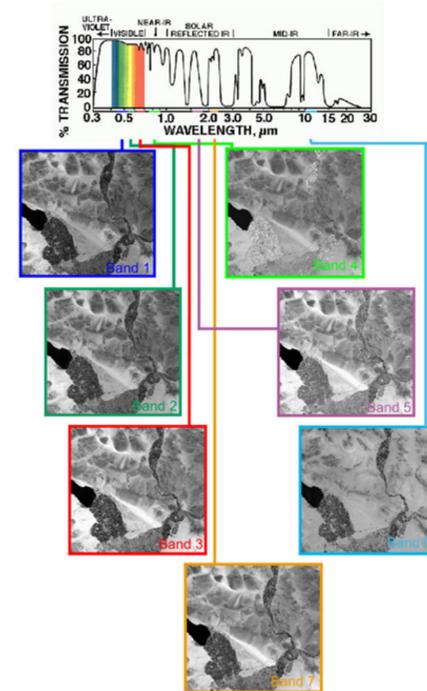
Landsat spectral bands

Image compositing

The various spectral bands provide different information depending on the reflective properties of the object being imaged.

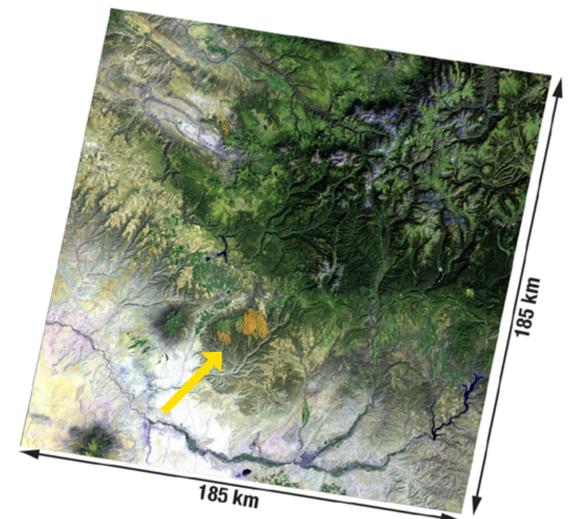


<- Natural color and false-color infrared aerial photographs (akin to Landsat 3,2,1 and 4,3,2 image composites). Can you find the astroturf?



Electromagnetic Spectrum Image from Virtual Hawaii.

Landsat spectral bands



A Landsat image composite using Landsat bands 7, 5, and 2. Can you find the fire scar?



Different Band Combinations

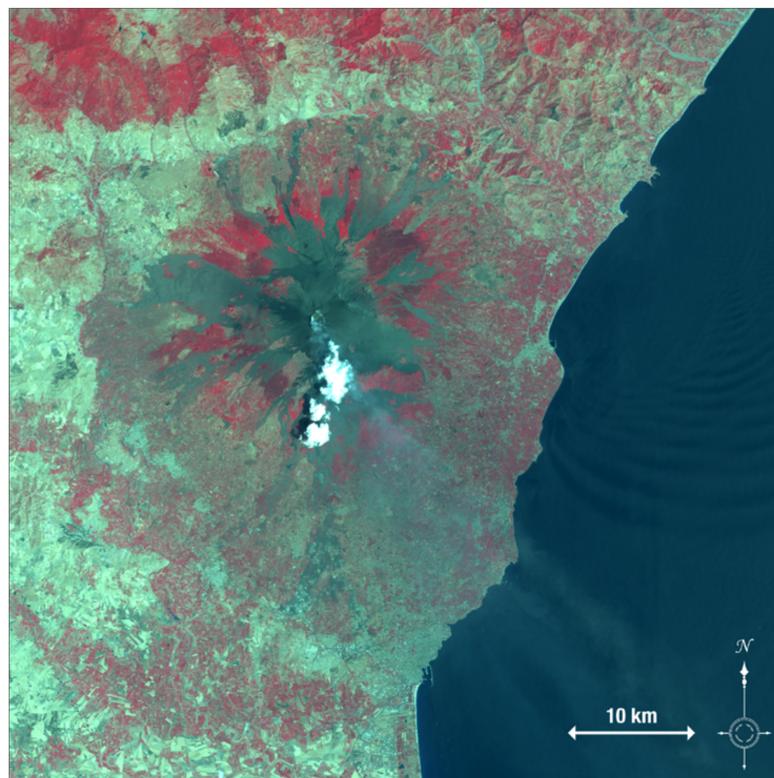
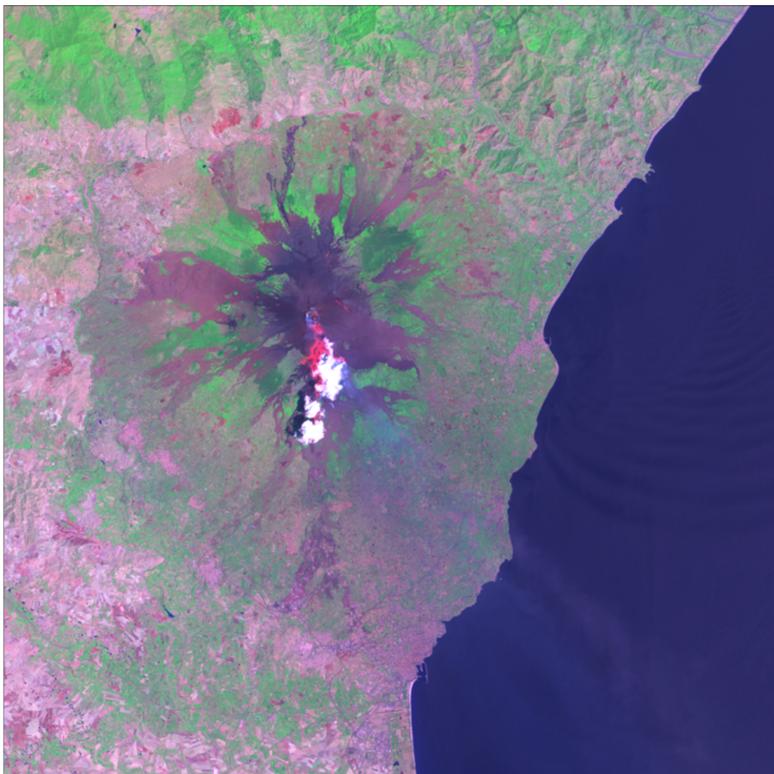
Mt. Etna (Italy)

Here are three different band combinations from a July 29, 2001 Landsat image showing an eruption of Sicily's Mt. Etna. Can you find the lava?



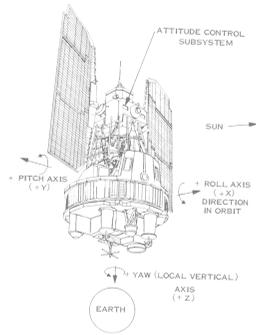
Bands 3,2,1

Bands 7,4,2

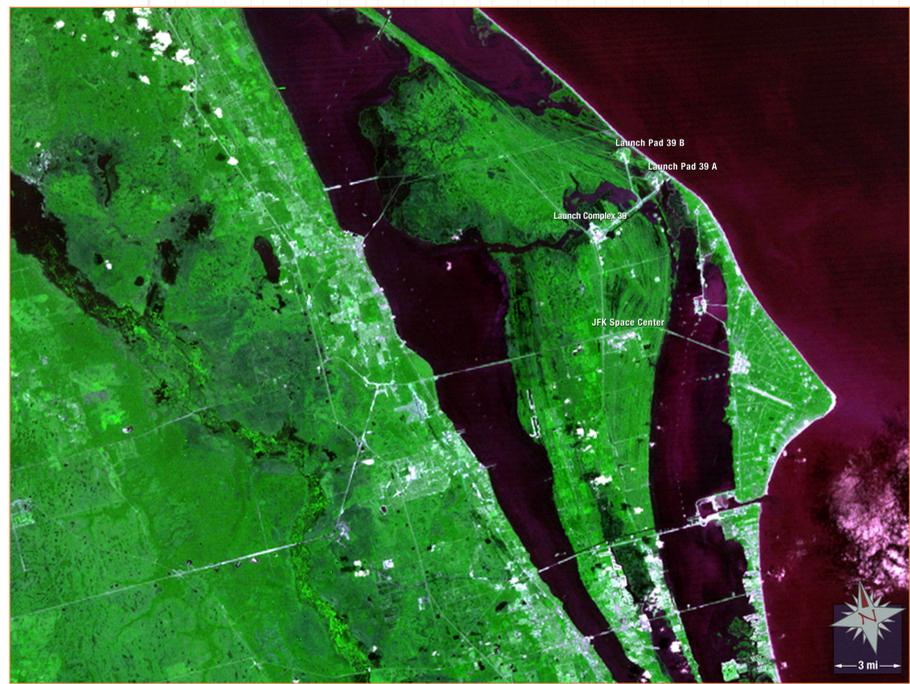


Bands 4,3,2

A journey through time...

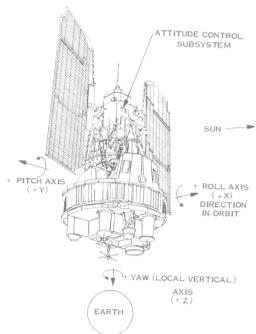


1972

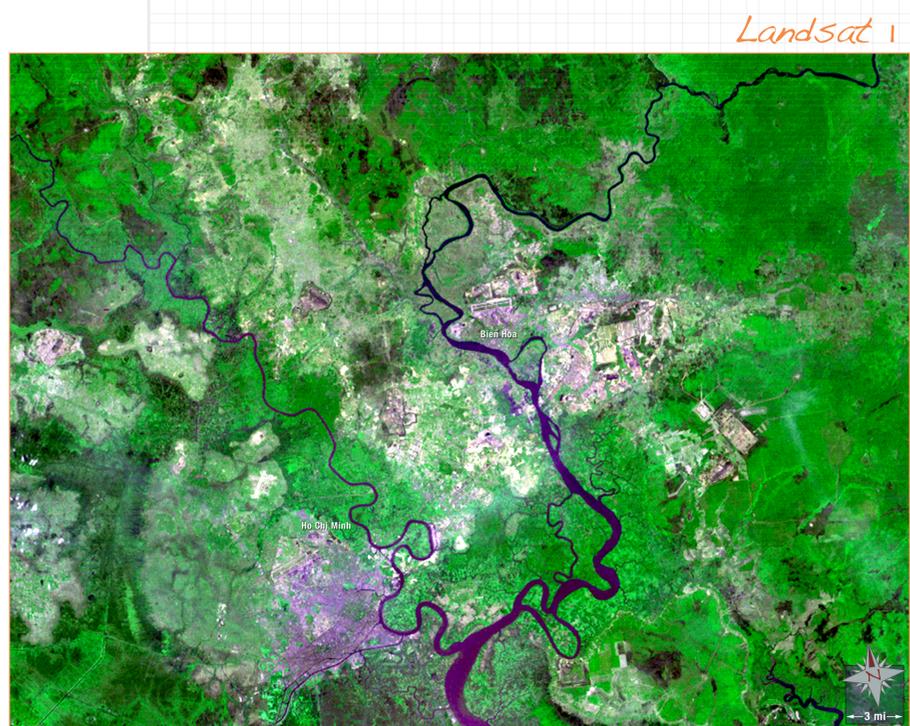


U.S. Space Shuttle Program Begins

On January 5, 1972 President Richard Nixon initiated the U.S. Space Shuttle program. The first shuttle launch would take place on April 12, 1981 with the launch of Columbia. The final Space Shuttle mission ended on July 21, 2011 with the landing of Atlantis at NASA's Kennedy Space Center. All 135 Space Shuttle launches originated from Kennedy Space Center's Launch Complex 39 located on Cape Canaveral, Florida. In this Landsat 1 image vegetation is a bright green, manmade structures appear white, and water is a reddish black.



1973



Last U.S. Combat Soldiers leave South Vietnam

By the close of March 1973, all American combat soldiers have left South Vietnam, nearly 58,000 American soldiers lost their lives during this conflict. In this Landsat 1 image the embattled Saigon can be seen in the lower left. Saigon fell to the North Vietnamese on April 30, 1975 and was renamed Ho Chi Minh City in 1976. Here, vegetation appears green, urban areas appear purple, and rivers are dark blue.

with Landsat

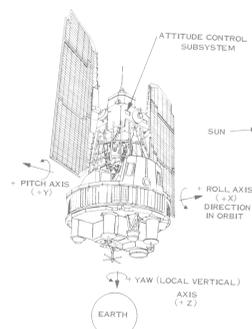


Landsat 1



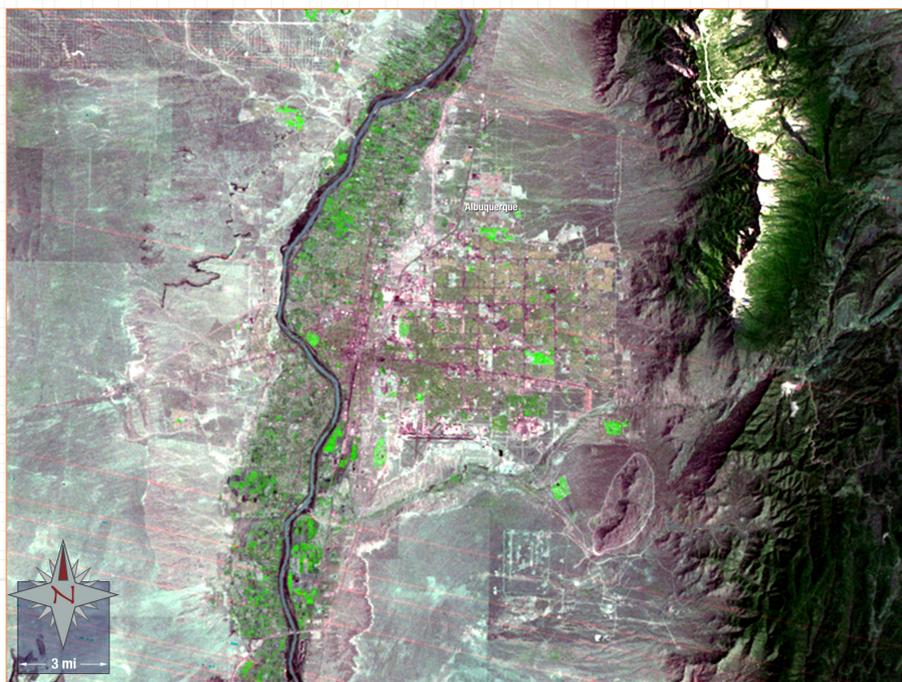
Home Run Record in Cincinnati

On April 4, 1974 Hank Aaron tied the great Babe Ruth's all-time home run record when he batted in his 714th homer at Cincinnati's Riverfront Stadium. In this false-color Landsat 1 image, the city appears pink, vegetation appears green, and the Ohio River is a reddish-black.



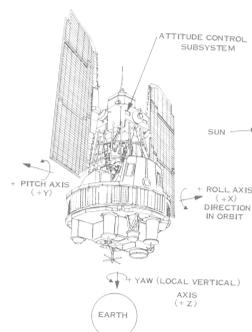
1974

Landsat 1



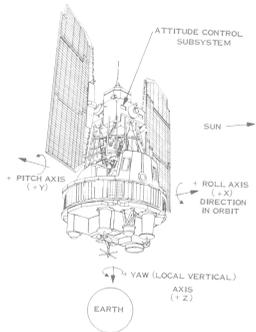
Microsoft Comes into Being

In 1975 Bill Gates founded Microsoft in Albuquerque, New Mexico. In this Landsat 1 image, the desert city appears pink and green. White snow can be seen on the northeastern slopes of the Sandia Mountains just east of the city. The Rio Grande River runs from north to south on the westernmost edge of the city.



1975

A journey through time...



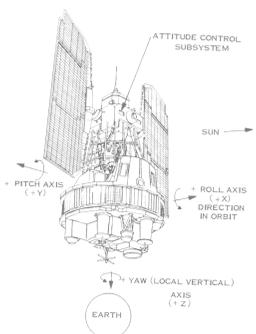
1976

Landsat 2



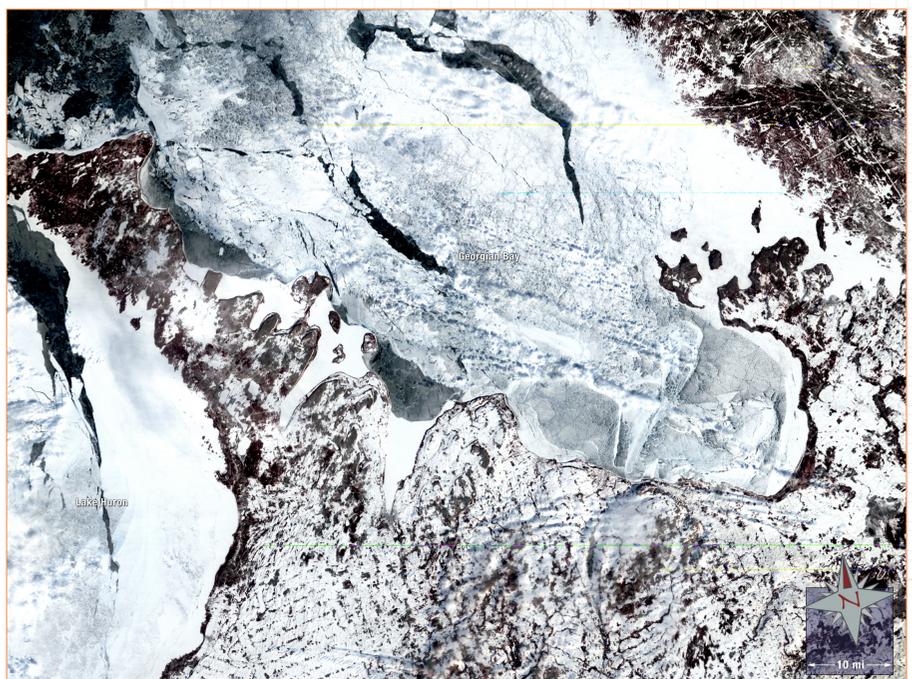
Apple of Your i...

In April 1976 Steve Jobs and Steve Wozniak form Apple Computer Company in Cupertino, California. In this Landsat 2 image, vegetation appears green and the road network of the South Bay region (today known world-over as Silicon Valley) appears a pinkish-red. The southernmost portion of the San Francisco Bay is visible at the top of the image.



1977

Landsat 2



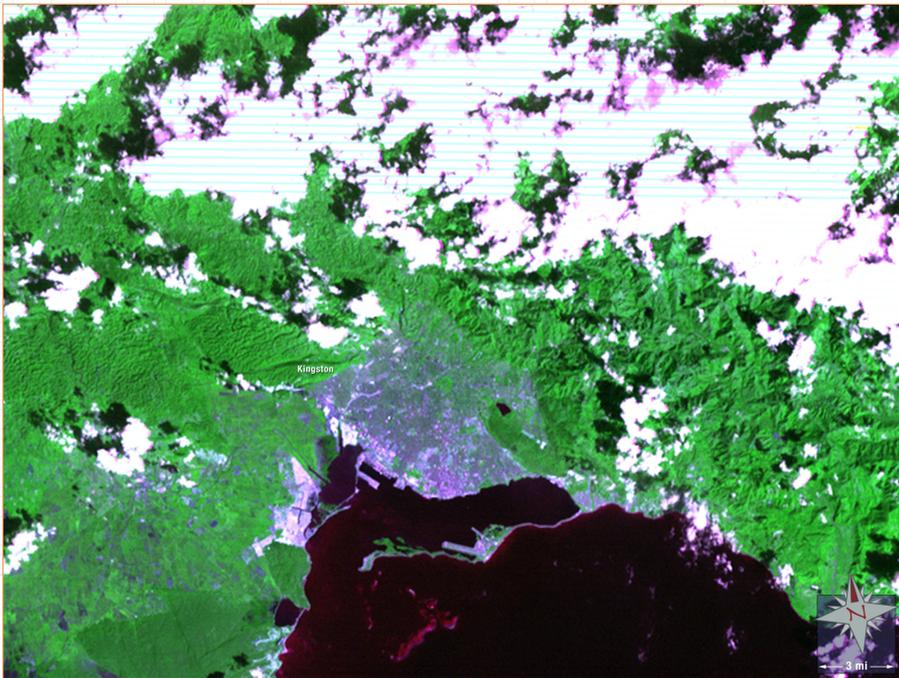
Blizzard of 1977 Blankets Southern Ontario and Upstate New York

On January 28, 1977 a five-day blizzard brought freezing temperatures, low-visibility, wind gusts of up to 60 mph, and snowdrifts as high as 30 feet to a region extending from southern Ontario to Buffalo, New York. In this Landsat 2 image taken on February 6, 1977 nearly everything is blanketed by snow including Lakes Huron and the Georgian Bay which were larger frozen over. Canada's South Bruce Peninsula can be seen in-between the two massive frozen bodies of water.



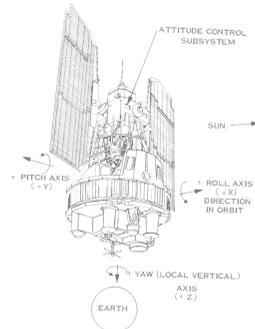
with Landsat

Landsat 3



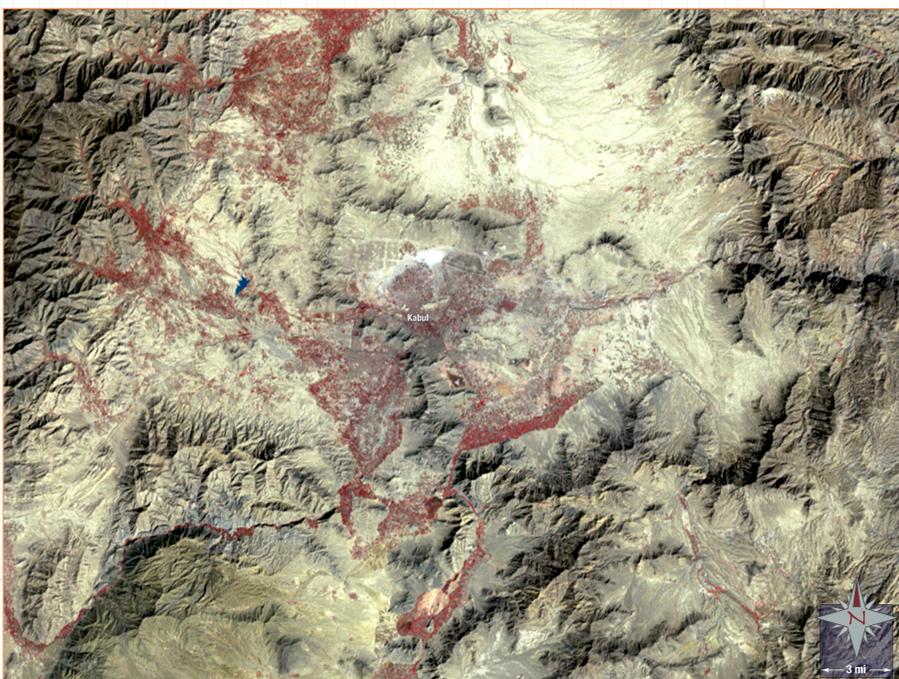
One Love Peace Concert in Jamaica

Reggae legend Bob Marley performed at the One Love Peace Concert at the National Hero's Stadium in Kingston, Jamaica on April 22, 1978. Marley famously joined the hands of two political rivals during his performance of "Jammin." 32,000 concertgoers witnessed this peaceful gesture. In this Landsat 3 image, the city of Kingston appears a purple hue, vegetation is green, water is black, and the large cloudbank north of the city is white.



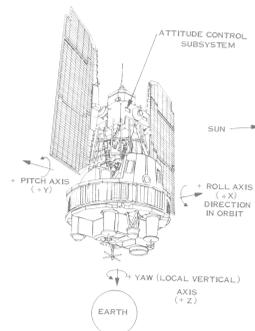
1978

Landsat 3



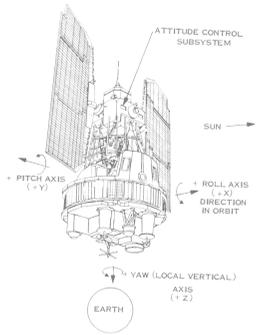
Soviet Union in Afghanistan

On December 1979 the Soviet Union invaded Afghanistan in an attempt to bolster a communist regime. This Landsat 3 image shows the capital city of Kabul nestled in a mountainous region of eastern Afghanistan between the rugged Asmai and Sherdawaza mountain ranges. In this image, pockets of vegetation appear red, dry desert landscapes appear tan, and dark shadows hug the mountains which make Kabul a geographic fortress.

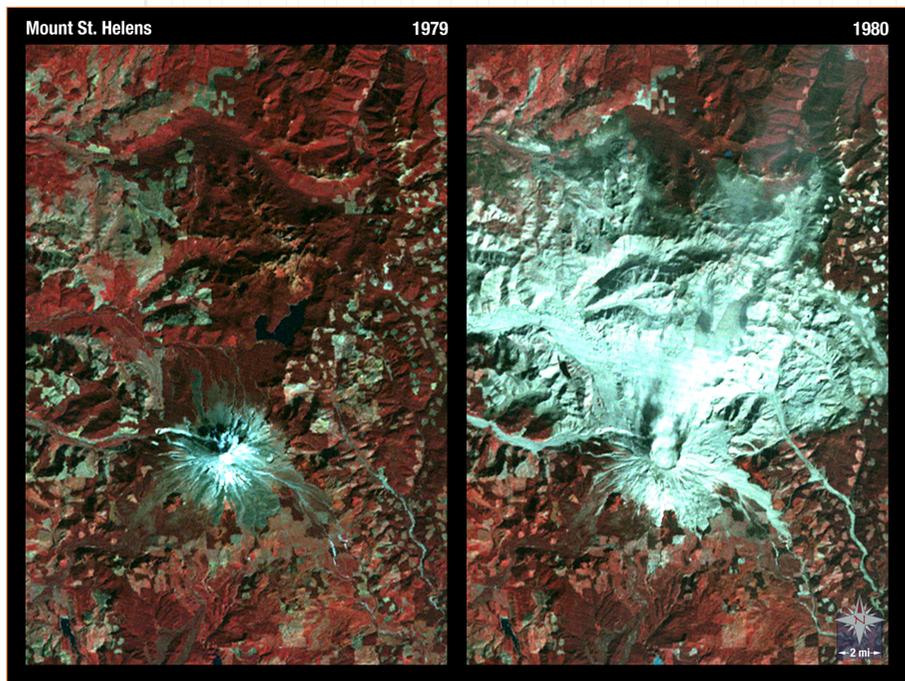


1979

A journey through time...

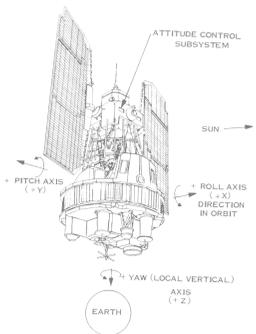


1980

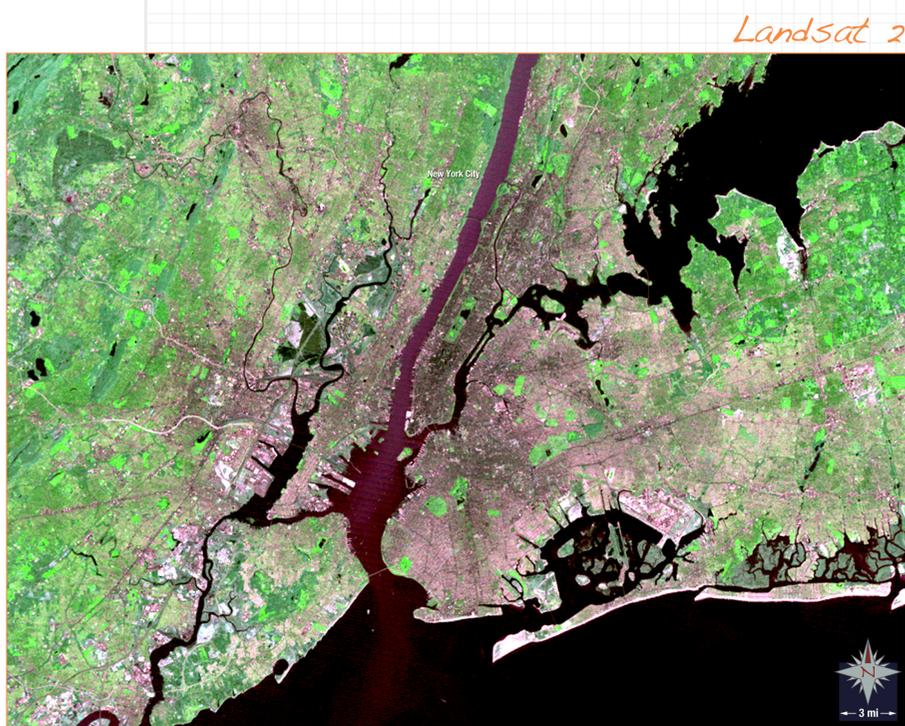


Eruption of Mount St. Helens

On May 18, 1980 Mount St. Helens in Washington state erupted ejecting ash and stone 80,000 feet into the air and scattering ash debris over 11 states. The eruption killed 57 people and caused \$1 billion in damages. In this before and after image pair vegetation is red. On the left-hand image the snow-covered Mount St. Helens can be seen in the image center. On the right-hand image the immense ash plume left by the eruption spills northward from the volcano. A massive new caldera can be seen where the mountaintop once stood.



1981



MTV is Takes to the Air

On August 1, 1981 the New York City-based Music Television—or MTV—network was launched. Suddenly music videos became a major part of the music landscape. In this Landsat 2 image the built areas of New York appear a blackish-pink, vegetation is green, and water is black (the Hudson River appears a reddish-black). Central Park is the long rectangular green shape in the middle of Manhattan.

with Landsat

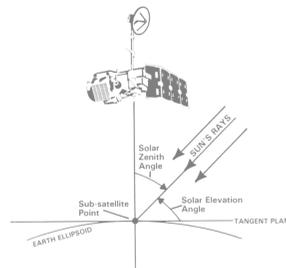


Landsat 4



Landsat 4 Launches

On July 16, 1982 Landsat 4 was successfully launched from Vandenberg Air Force Base in central California. Landsat 4 carried the Multispectral Scanner System (MSS) instrument, as well as a sensor with improved spectral and spatial resolution known as the Thematic Mapper (TM). In this image the ocean is dark blue, the bare ground is brown, agricultural fields are various shades of green, and Vandenberg's landing strip is bright white.



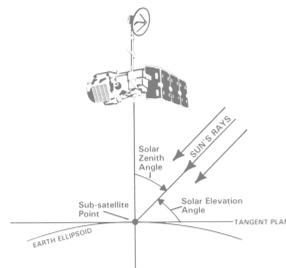
1982

Landsat 4



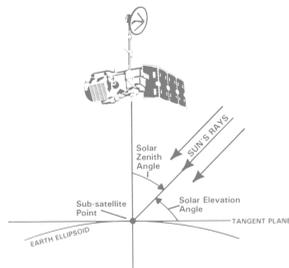
MLK Day Becomes Law

In 1983 President Ronald Reagan signed into law Martin Luther King Jr. Day commemorating the birthday of the slain civil rights leader. The holiday was first observed in 1986. Martin Luther King Jr.'s famous "I have a dream" speech was delivered from the steps of the Lincoln Memorial to over 200,000 people gather in Washington D.C. In this Landsat 4 image, light clouds are found over D.C., but the network of the capital's wide avenues can still be seen. Vegetation is green and the Potomac and Anacostia rivers are a dark blue.

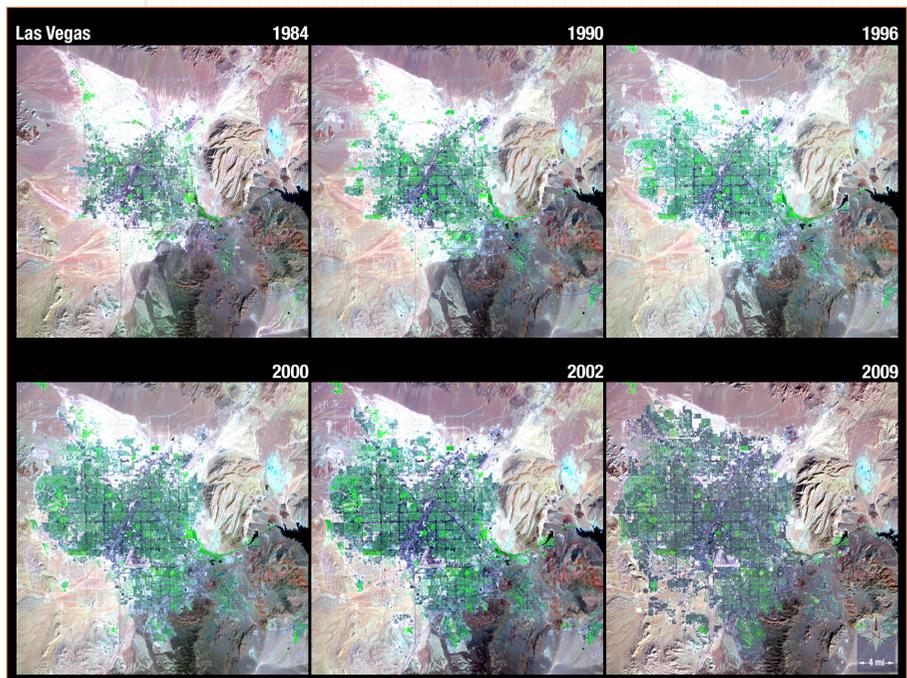


1983

A journey through time...

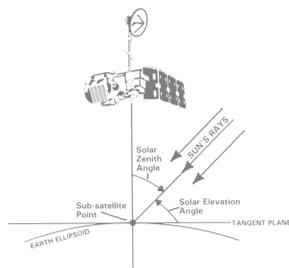


1984



A Desert City Blooms

In the 25 years that Landsat 5 has been in orbit, the desert city of Las Vegas has gone through a massive growth spurt. The outward expansion of the city is shown here with a series of false-color images. The dark purple grid of city streets and the green of irrigated vegetation grow out in every direction into the surrounding desert. These images were created using reflected light from the shortwave infrared, near-infrared, and green portions of the electromagnetic spectrum (Landsat 5 TM bands 7,4,2).



1985



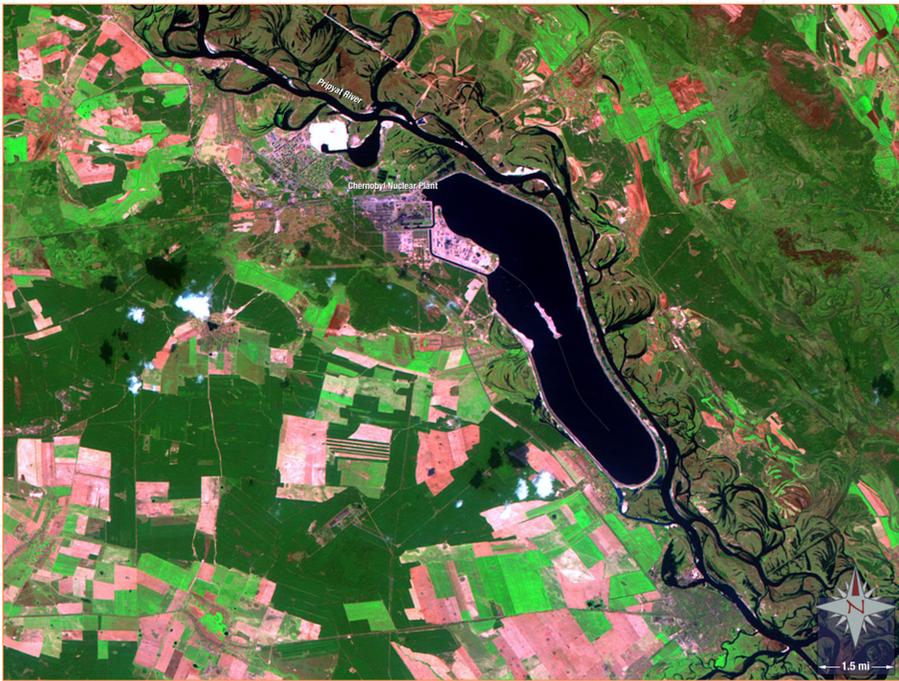
A Shaken Capital

The vast metropolis of Mexico City is located in Mexico's tectonically active high plateaus, about 500 miles south of the Texas border. The sprawling city, featured here on Jan. 31, 1985, experienced a massive earthquake in September 1985 that killed 10,000 residents. Today Mexico City is home to nearly 9 million people. This natural color Landsat 5 image of Mexico City was created using Thematic Mapper bands 3,2,1.

with Landsat

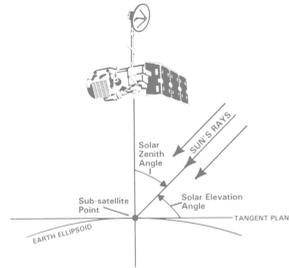


Landsat 5



Nuclear Meltdown

The abandoned city of Pripyat, home to the infamous Chernobyl Nuclear Power Plant, lies on the Pripyat River in northern Ukraine, near the Belarus border. Three days after the April 26, 1986, nuclear accident, Landsat 5 acquired this image of the region. The power plant explosion and ensuing fire released highly radioactive nuclear fallout into the atmosphere, affecting region tens to hundreds of miles from the plant. This natural color Landsat 5 image uses TM bands 3,2,1.



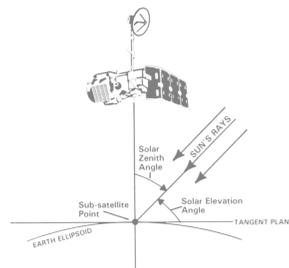
1986

Landsat 5



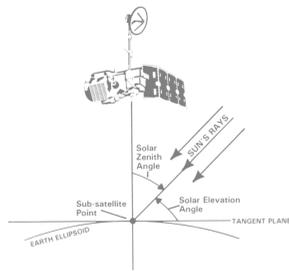
A Divided City

This natural-color image shows the divided city of Berlin in April 1987. In June of that year, President Ronald Reagan would stand next to the Berlin Wall and declare: "Mr. Gorbachev, tear down this wall!"



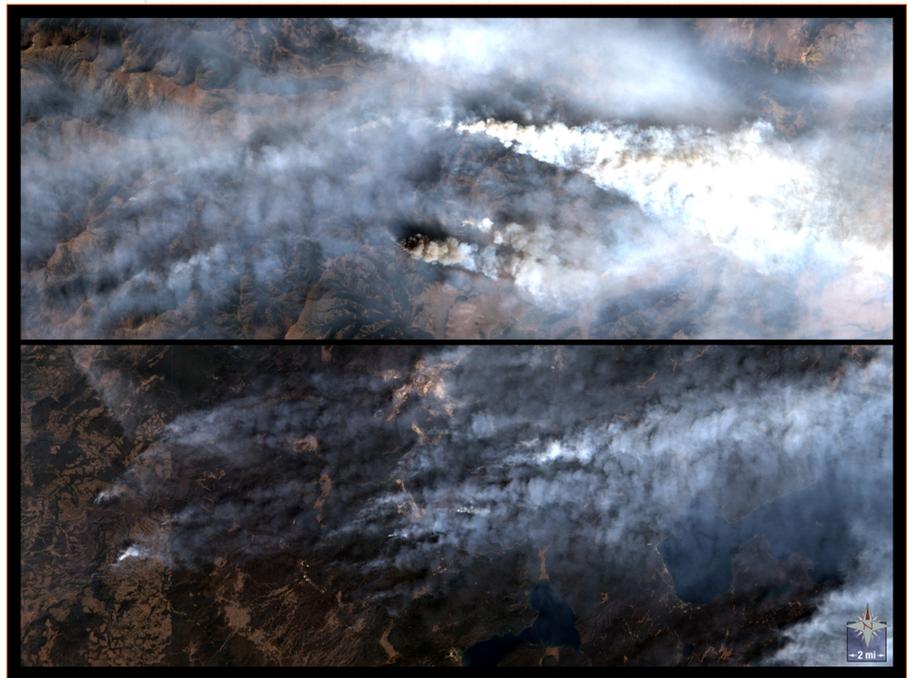
1987

A journey through time...



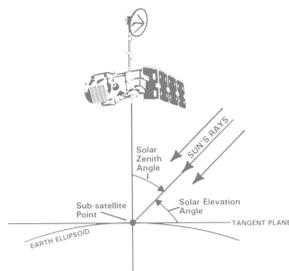
1988

Landsat 5



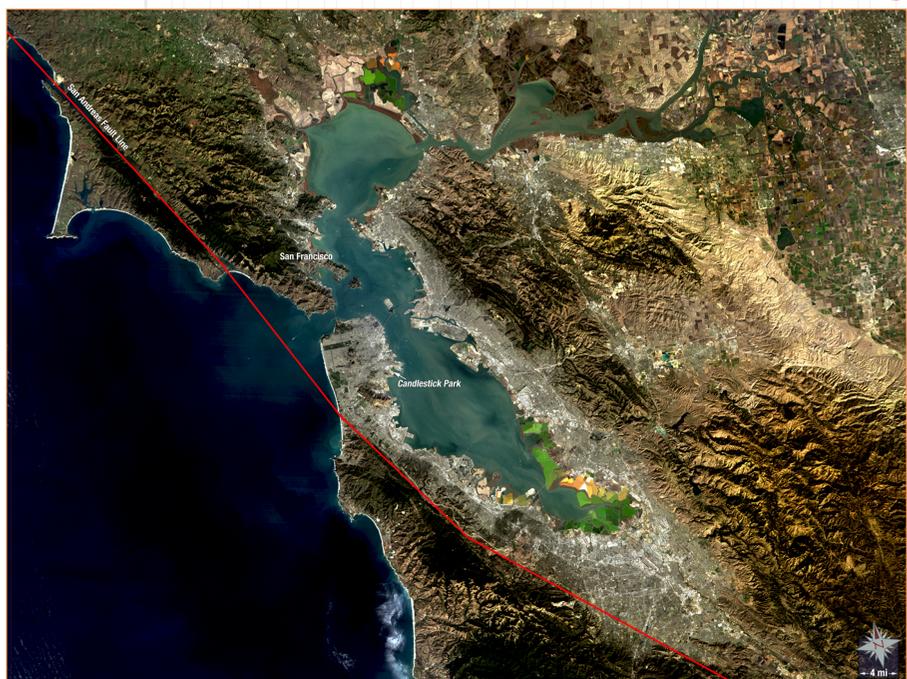
Yellowstone in Flames

Smoke plumes billow from the Yellowstone National Park in this natural-color image. The Yellowstone forest fires of 1988 were the worst in the park's recorded history.



1989

Landsat 5



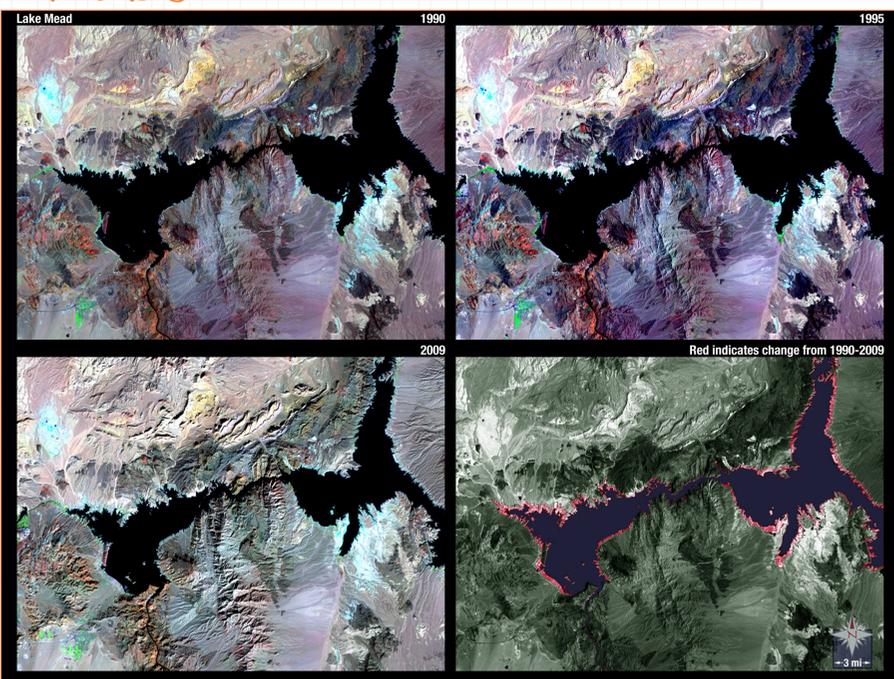
The World Series Quake

As millions of people watched the baseball World Series from San Francisco on Oct. 17, 1989, the magnitude 6.9 Loma Prieta earthquake struck the Bay Area, killing 63 people and injuring nearly 4,000 others. This natural-color image was acquired three weeks after the quake.

with Landsat

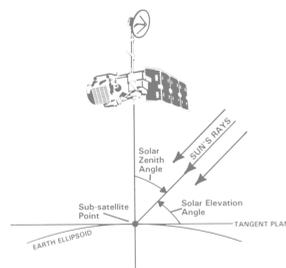


Landsat 5



A Diminishing Reservoir

In this image series from Lake Mead, we can see the diminishing water level of the reservoir between the 1990s and 2009. The red color in the lower right image shows where the water level has dropped. These false-color images use TM bands 7,4,2.



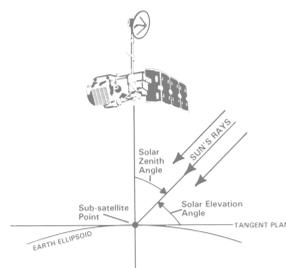
1990

Landsat 5



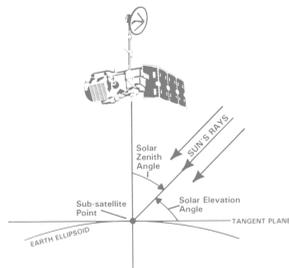
Ravages of War

Inky-black smoke pours into the atmosphere from burning oil wells in this 1991 natural-color image of Kuwait. As defeated Iraqi military forces retreated from Kuwait, they set fire to oil wells in their wake.



1991

A journey through time...

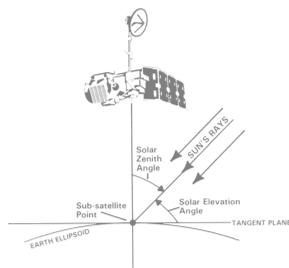


1992

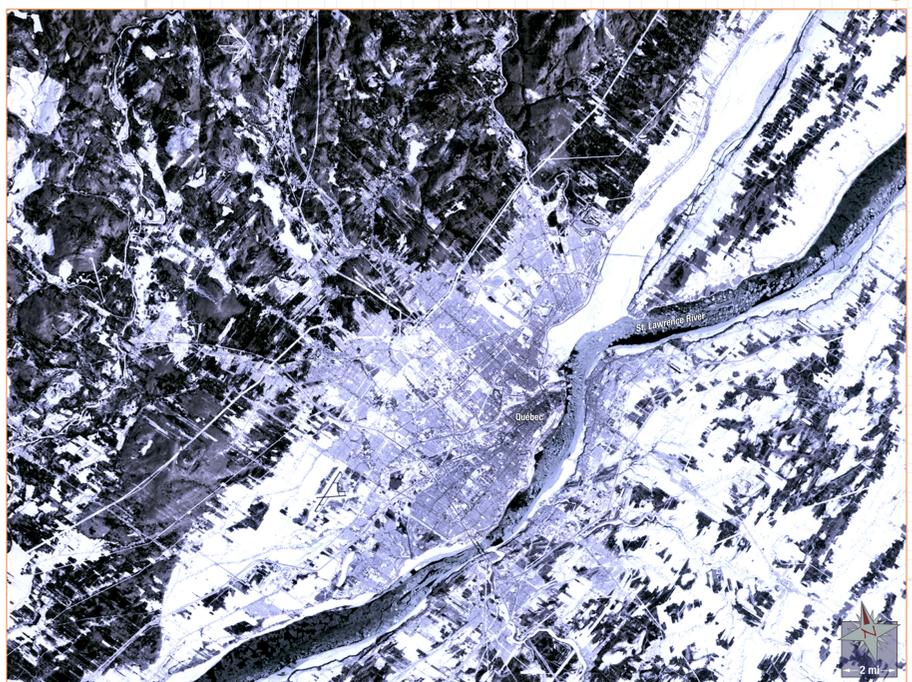


Yugoslavia Splinters

This image of Belgrade, in the former Yugoslavia, was captured in 1992, the year that the Bosnian Serbs proclaimed "The Republic of Serb People of Bosnia and Herzegovina." Today, Belgrade is the capital and most populous city of Serbia. Lying at the confluence of the Sava and Danube Rivers, Belgrade is thought to be one of the oldest European cities.



1993



Storm of the Century

Landsat 5 captured this natural-color image of Quebec just after the Great Blizzard of March 1993, a nor'easter also called the "white hurricane." The storm brought heavy precipitation, severe winds, and freezing temperatures to an area stretching from Northern Florida to Eastern Canada.

with Landsat

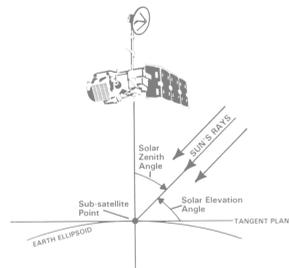


Landsat 5



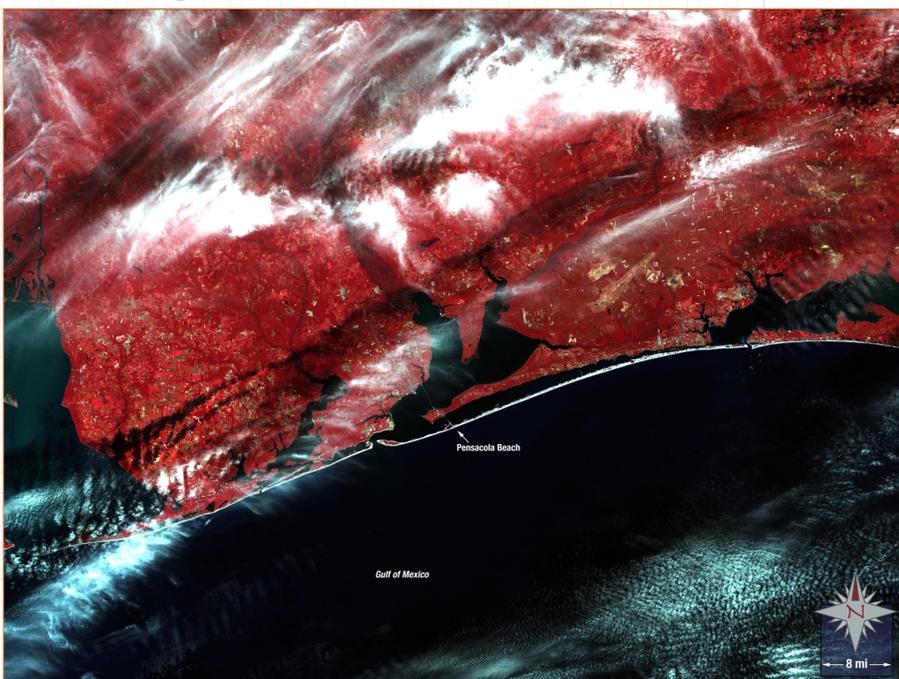
Earthquake in the Valley

This natural-color image shows the San Fernando Valley of northern Los Angeles on Jan. 17, 1994, hours after the 6.7 Northridge earthquake shook the region and caused 57 deaths and extensive structural damage.



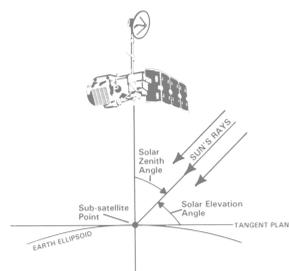
1994

Landsat 5



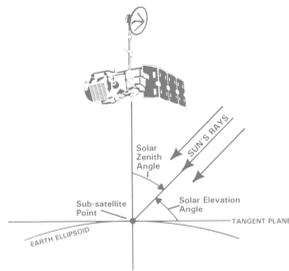
Opal Aftermath

This false-color infrared image shows the eastern panhandle of Florida about 12 days after the Category 4 Hurricane Opal made landfall near Pensacola. The hurricane season of 1995 was abnormally active, with 19 named storms and 11 hurricanes, five of which reached "major" intensity.



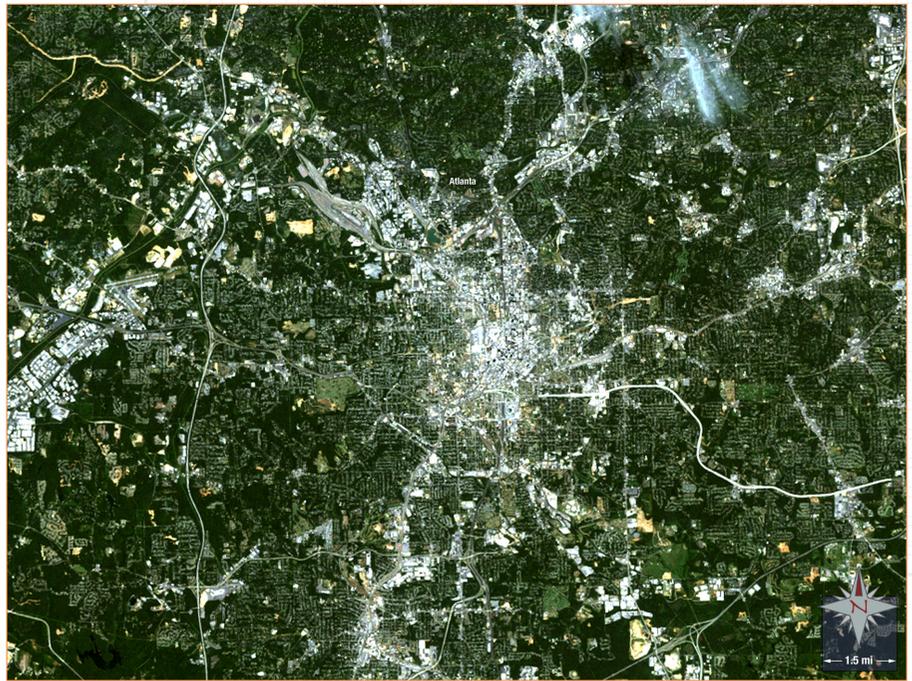
1995

A journey through time...



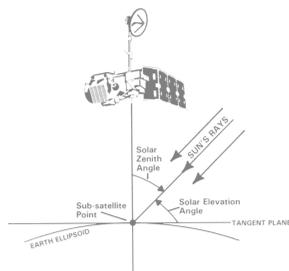
1996

Landsat 5



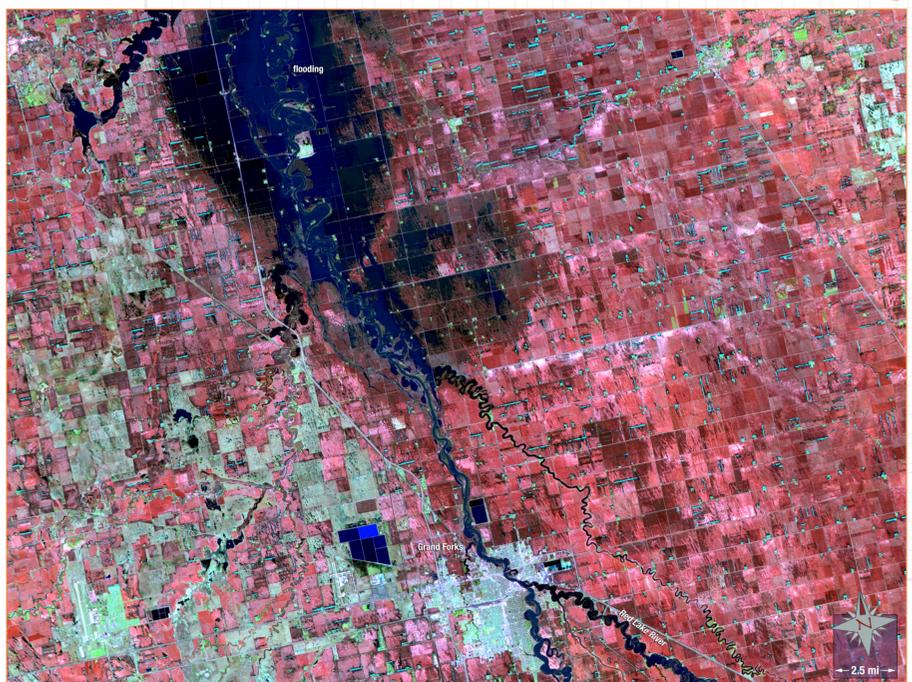
Atlanta Hosts the Summer Games

The 1996 Summer Olympics were held in Atlanta, Ga., shown here a few weeks after the games. Many consider the games to have had a transformative effect on the southern city.



1997

Landsat 5



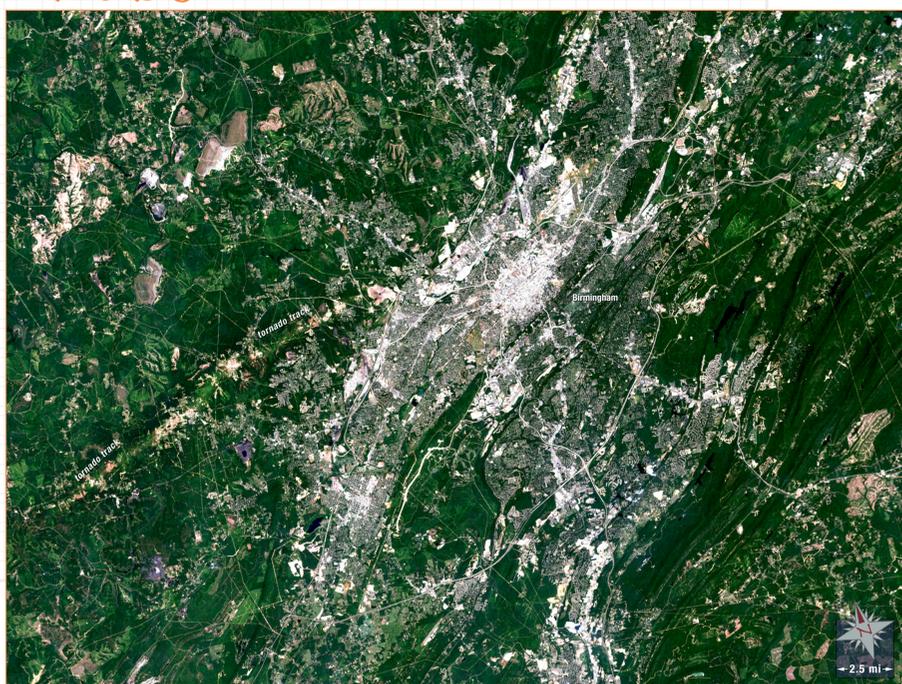
Flooding in the Heartland

This false-color image of Grand Forks, North Dakota, was acquired on May 4, 1997, just after the Red River flood inundated the area. 50,000 people had to be evacuated, and damages exceeded \$3 billion.

with Landsat

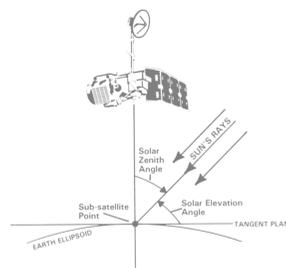


Landsat 5



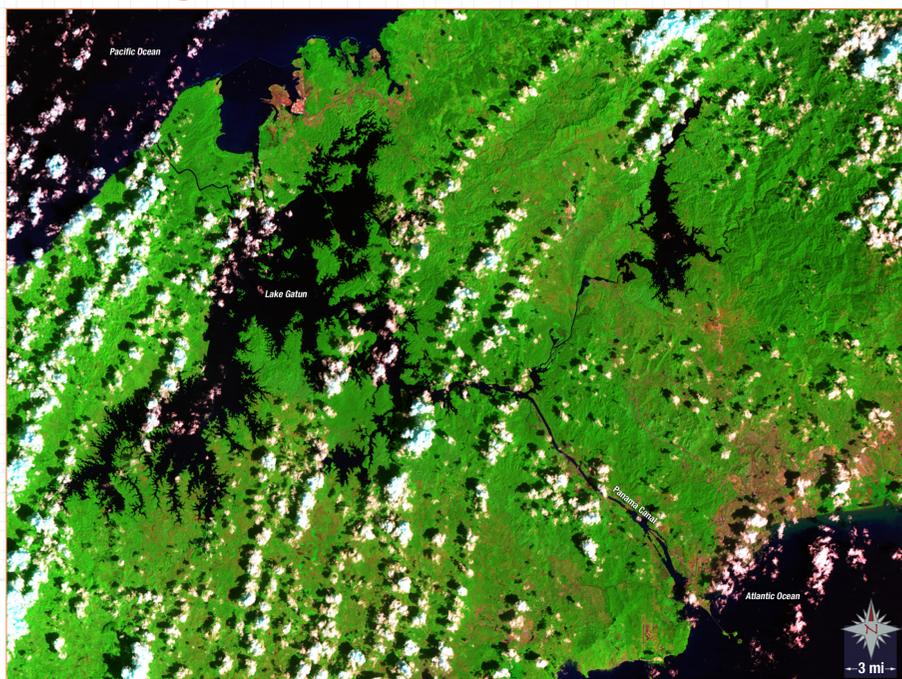
Tornado Alley

In this 1998 natural-color Landsat 5 image, the city of Birmingham, Ala., is shown a month after a category F5 tornado ripped through the region, killing 32 people. A portion of the 31-mile tornado track can be seen as a light green line stretching southwest away from the city.



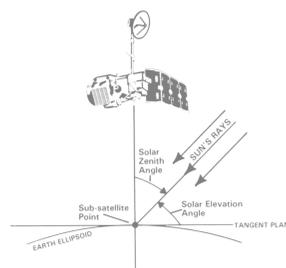
1998

Landsat 5



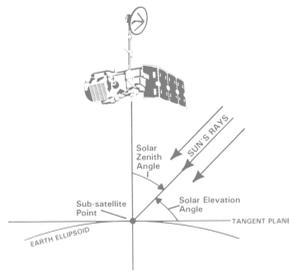
The Panama Canal

The Panama Canal stretches like a ribbon of dark blue from the Pacific Ocean through Lake Gatún and out to the Atlantic. At noon on Dec. 31, 1999, the U.S. handed control of the canal over to Panama.



1999

A journey through time...



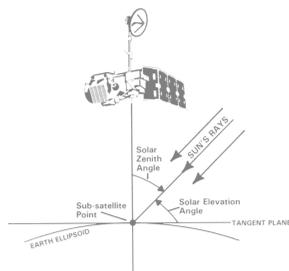
2000

Landsat 5



U.S.S. Cole Bombed

In Yemen, an ancient harbor lies between an extinct volcano crater and the mainland. The natural harbor at Aden, which has been in use for 28 centuries, was made infamous in October 2000 when the U.S.S. Cole was bombed while moored there.



2001

Landsat 5



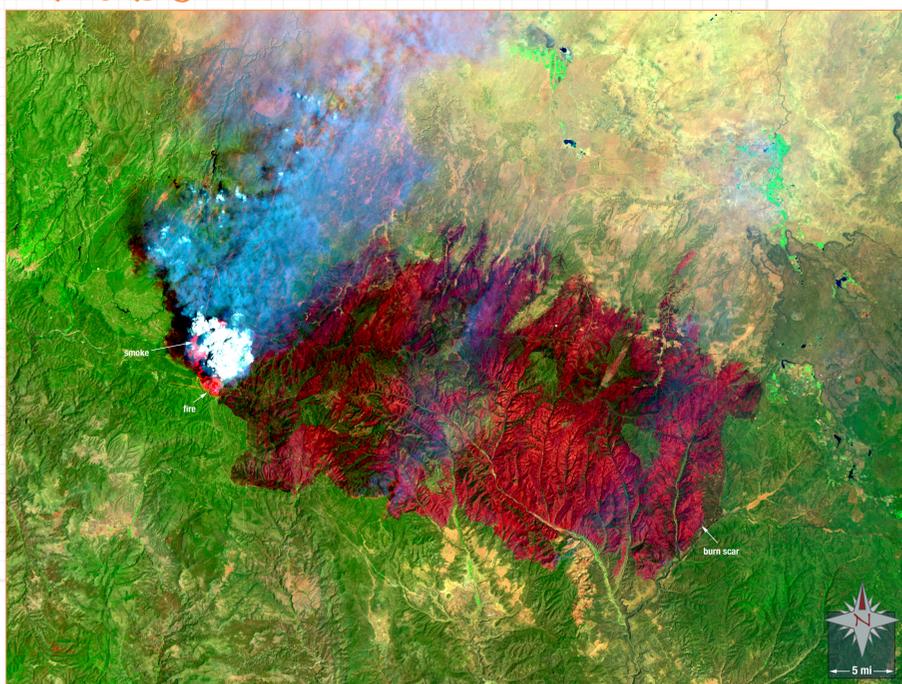
9/11 Still Smolders

This Landsat 5 image of New York City was acquired on Sept. 13, 2001, two days after the terrorist attacks that destroyed the Twin Towers of World Trade Center. In this natural-color image, you can still see smoke emanating from lower Manhattan.



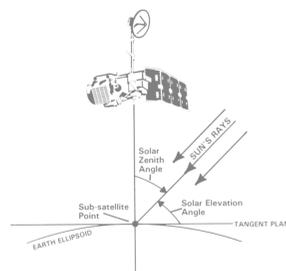
with Landsat

Landsat 5



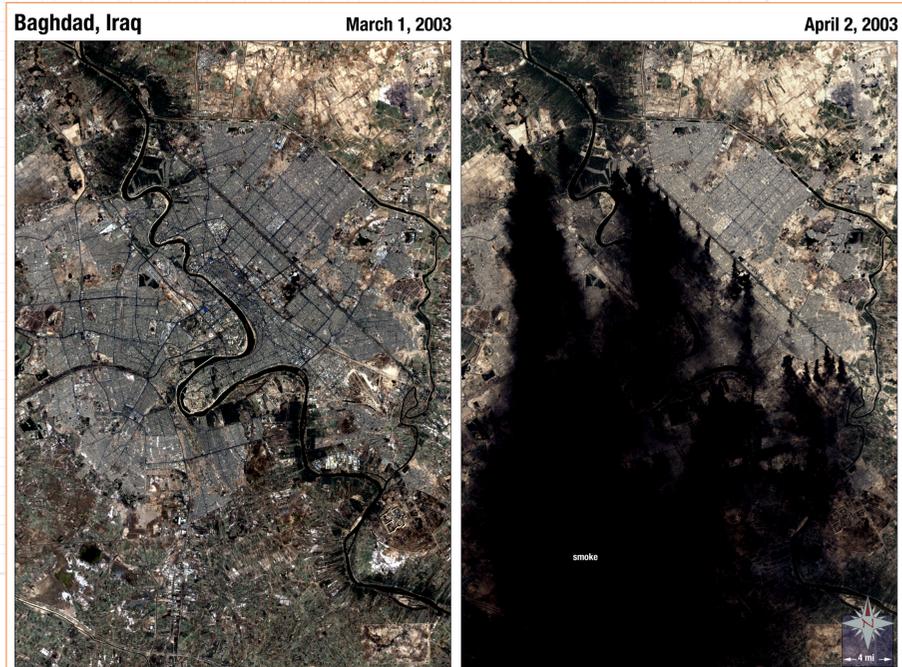
The Roaring Rodeo-Chediski Fire

In June 2002, the Rodeo-Chediski Fire burned nearly 500,000 acres in eastern Arizona, making it the worst wild fire in the state's history. This false-color Landsat 5 image, acquired on June 29, shows the active fire front and the massive burn scar created by the blaze.



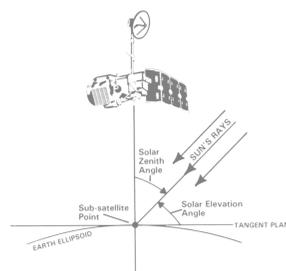
2002

Landsat 5



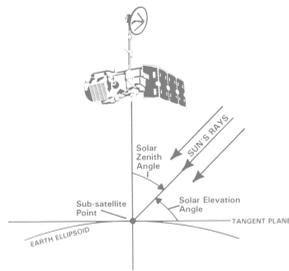
Invasion of Iraq

On March 19, 2003 the U.S. along with UK, Australian, and Polish troops invaded Iraq toppling leader Saddam Hussein over the course of three weeks of combat. While the initial invasion phase was swift, the Iraqi War did not come to a close until December 2011. During the initial invasion, 44 oil wells were set on fire by Iraqis in an attempt to thwart the invading air forces. These fires were quickly extinguished and the wells were capped. In the Landsat X image on the right, the inky black smoke from the burning oil wells can be seen obscuring large parts of southern and western Iraq. In the before image on the left, the city is a silver-gray and bare ground is brown. The Tigris River can be seen flowing through the ancient city.



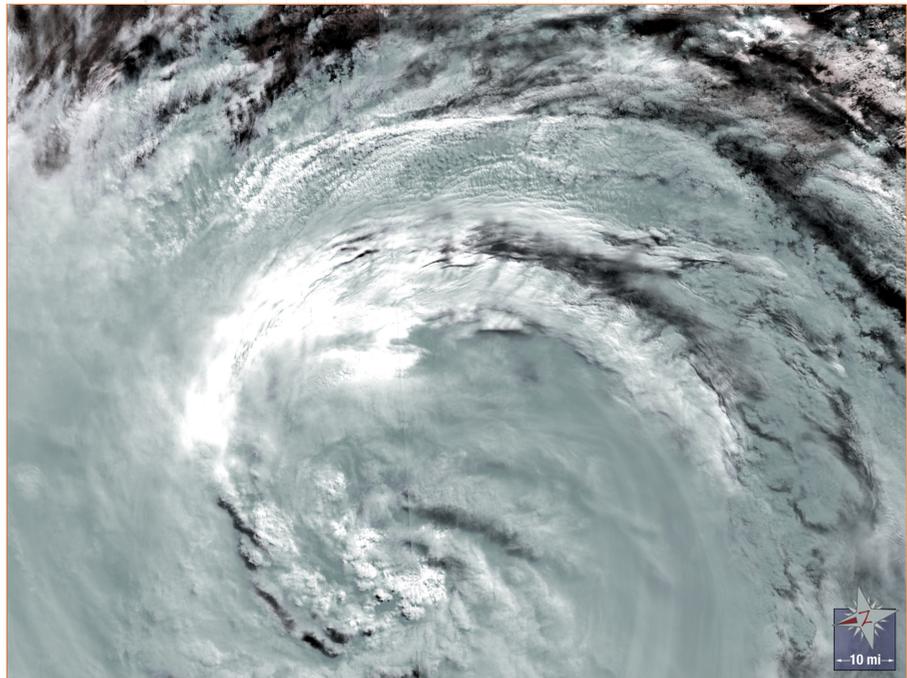
2003

A journey through time...



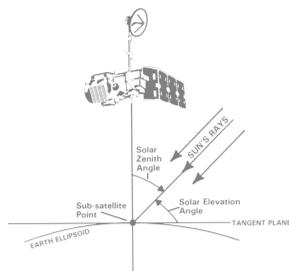
2004

Landsat 5



Hurricane Jeanne

Landsat 5 caught a glimpse of Hurricane Jeanne on Sept. 26, 2004, as it made landfall in Florida. In the United States, the storm resulted in five deaths and an estimated \$6.9 billion in damages, according to the National Hurricane Center. Reuters reported that there were more than 3,000 deaths in Haiti from the storm.



2005

Landsat 5



Katrina's Deluge

Two weeks after Hurricane Katrina made landfall in 2005, Landsat 5 captured the image on the bottom of flooded New Orleans. In these false-color image, vegetation appears red and man-made structures appear whitish blue.

with Landsat

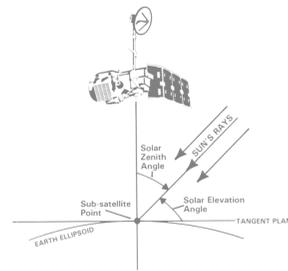


Landsat 5



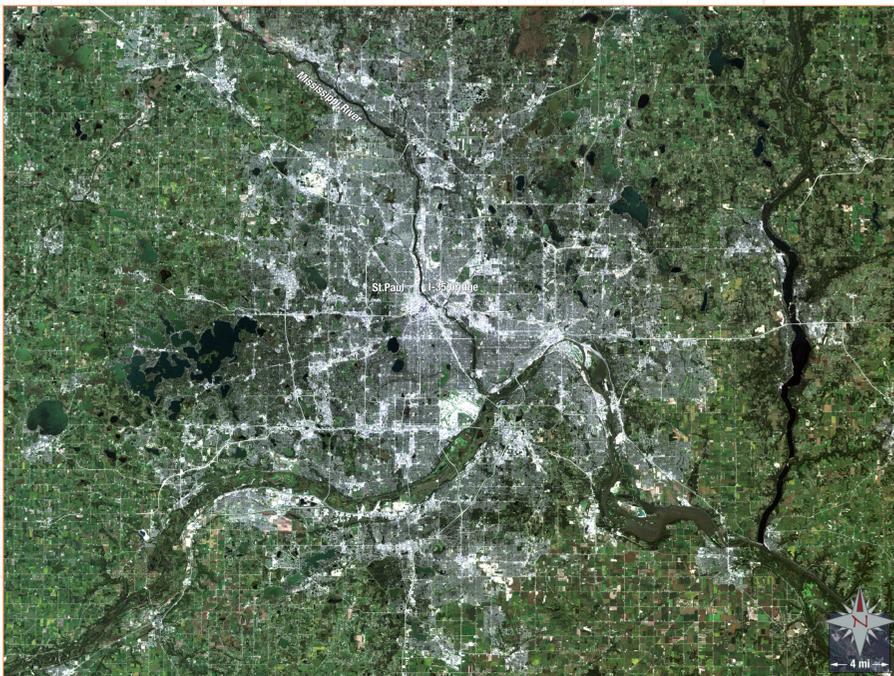
From Forest to Farmland

This natural-color Landsat 5 time series shows the progression of deforestation in Rondonia, Brazil, from 1986 to 2006.



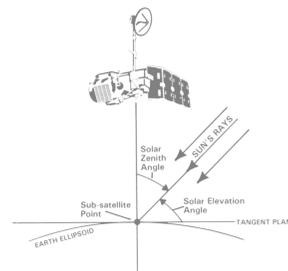
2006

Landsat 5



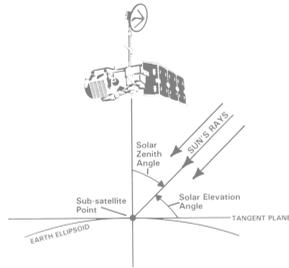
Interstate Bridge Collapses

On Aug. 1, 2007, the Mississippi River Bridge in Minneapolis collapsed, killing three people. This natural-color image of the Twin Cities was acquired later that month. Note the multitude of bridges that span the Mississippi.

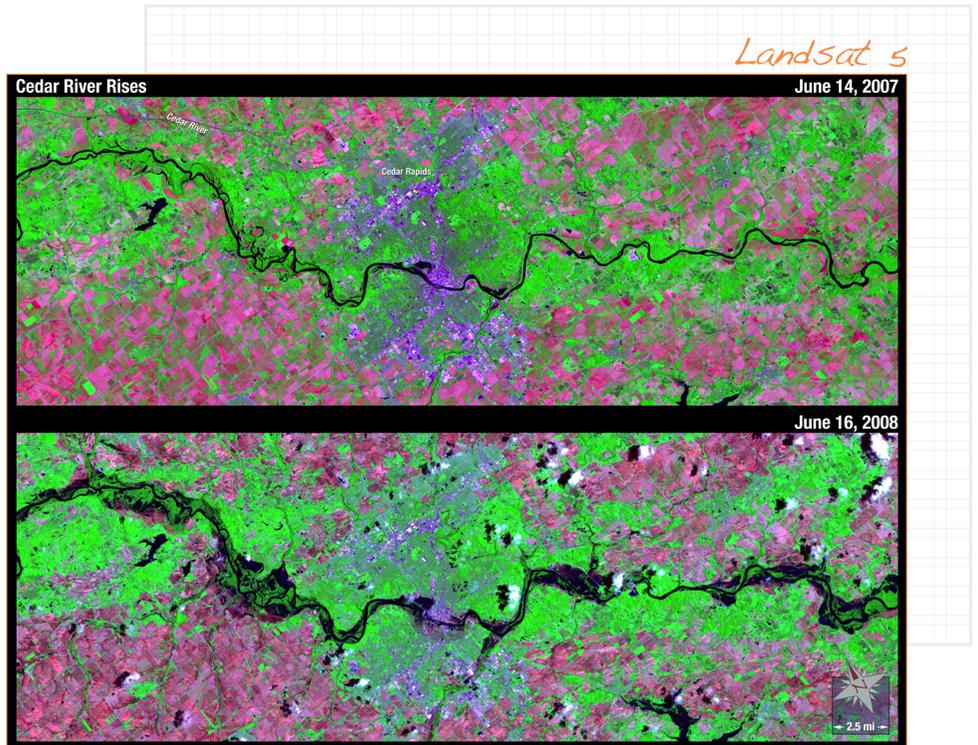


2007

A journey through time...

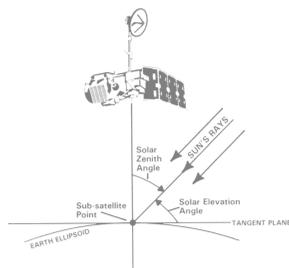


2008

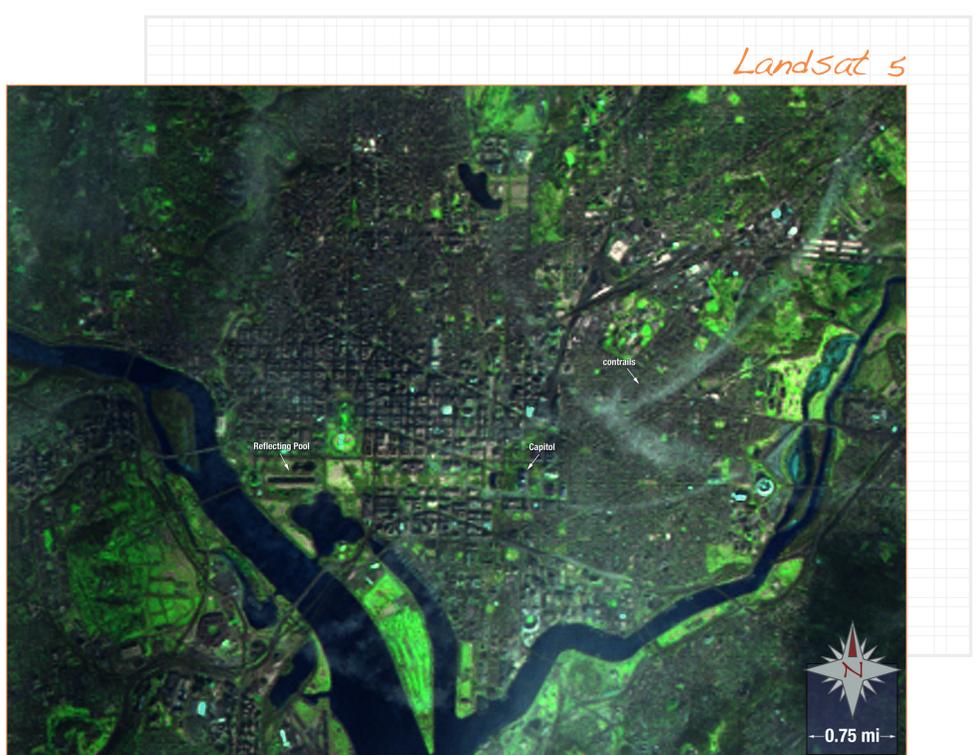


Cedar River Rises

In June of 2008 Cedar Rapids, Iowa, was severely flooded when heavy rains coupled with melting snow creating a 500-year flood event. The swollen Cedars River winds through these false-color Landsat 5 image acquired on June 16, 2008. The city of Cedar Rapids is the bright spot adjacent to the river in the image center. At its peak, the flood inundated 14 percent of Cedar Rapids.



2009



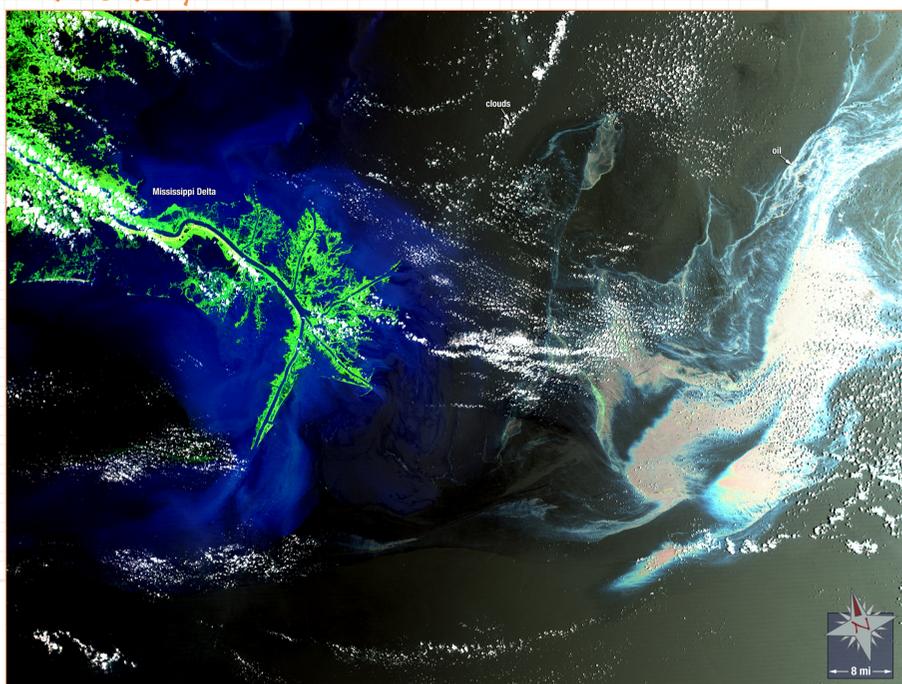
An Inaugural Crowd

An estimated two million people descended upon the nation's capital on Jan. 20, 2009, to witness the inauguration of Barack Obama as the 44th U.S. president. In this false-color image, the National Mall appears green and brown; the large brown spot visible between the Capitol Building and its reflecting pool is a result of the large crowd that was already gathered there when this image was acquired at 10:31 a.m. High-altitude wispy clouds and jet contrails can also be seen above the city.



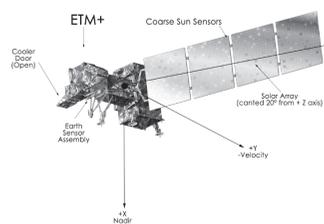
with Landsat

Landsat 7



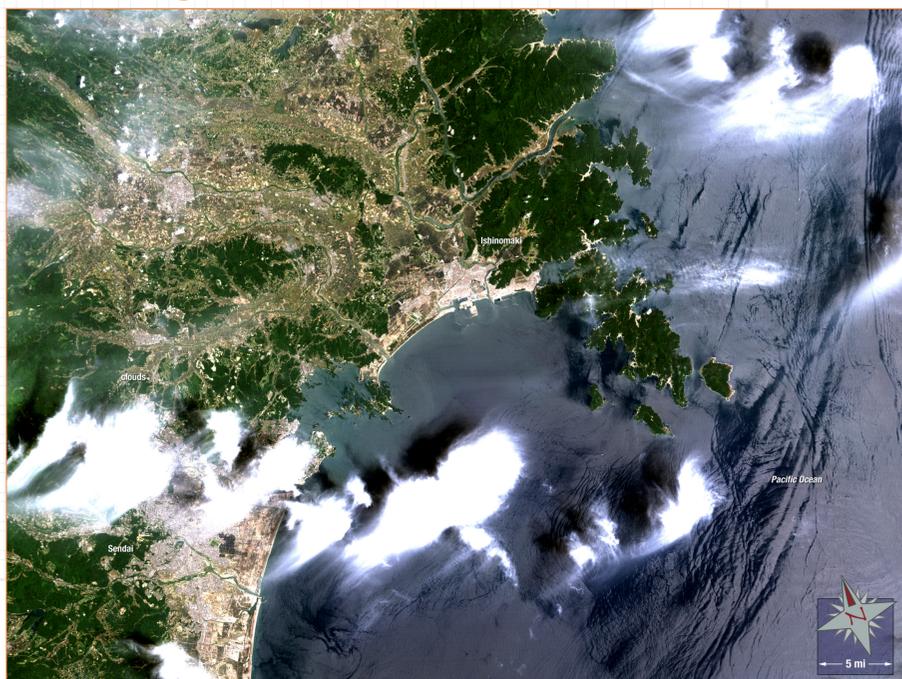
Deepwater Horizon Oil Spill

On April 20, 2010 an explosion on the Deepwater Horizon oil platform in the Gulf of Mexico killed eleven workers, sunk the platform, and left its seafloor well gushing. This initiated a massive offshore oil spill—the largest in U.S. history. The spill continued until July 15, 2010 causing immense surface oil slicks and ecological damage to the U.S. coastline. In this false-color Landsat 7 image, a colossal oil slick can be seen floating southeast of the Mississippi Delta. The slick has a bluish-white/gray color. Vegetation on the delta appears bright green. Near-shore sediment-laden waters appear bright blue while offshore waters appear dark blue and black.



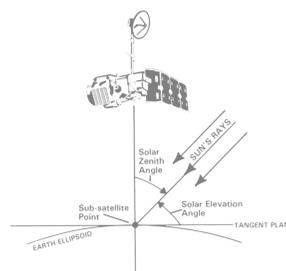
2010

Landsat 5



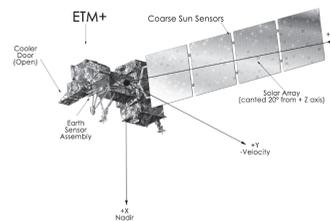
Great East Japan Earthquake

On March 11, 2011 a 9.1 magnitude earthquake triggered a massive tsunami that struck eastern Japan killing more than 15,000 people. In this Landsat 5 image the port city of Ishinomaki is shown. The tsunami was 16 feet high when it struck the port destroying nearly everything in its path. In this image vegetation is green, water is blue, developed areas are light brown, and clouds are white.



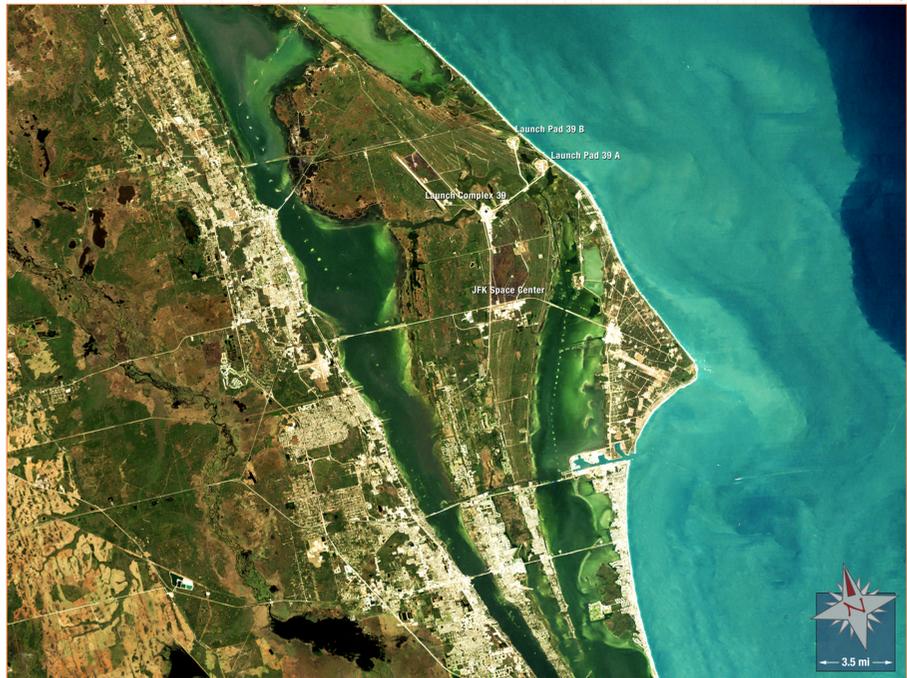
2011

A journey through time...



2012

Landsat 7



Quiet on the Cape

The final Space Shuttle mission ended on July 21, 2011 when the Atlantis landed at NASA's Kennedy Space Center on Cape Canaveral. 2012 is the first post-Space Shuttle program year at Cape Canaveral. In this Landsat 7 image vegetation is green, marshy areas are a greenish brown and developed areas are white. Water in the image is greenish-blue (Indian and Banana Rivers), bright turquoise-blue (just offshore), and a deep blue (out at sea).



2013

Landsat Data Continuity Mission



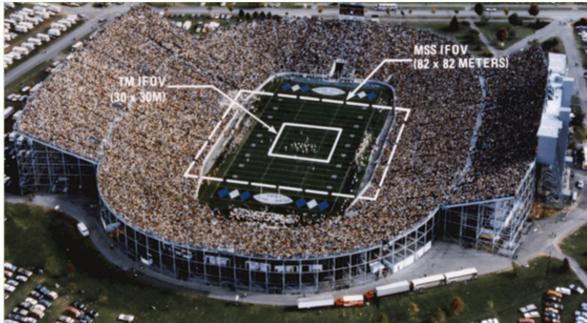
Launch of the Landsat Data Continuity Mission

The eighth Landsat satellite, the Landsat Data Continuity Mission—to be renamed Landsat 8 once on orbit—is scheduled for launch in February 2013. The LDCM satellite payload consists of two science instruments—the Operational Land Imager (OLI) and the Thermal Infrared Sensor (TIRS). These two sensors will provide seasonal coverage of the global landmass at a spatial resolution of 30 meters (visible, NIR, SWIR); 100 meters (thermal); and 15 meters (panchromatic). The spectral coverage and radiometric performance are designed to detect and characterize multi-decadal land cover change in concert with historic Landsat data. In this photograph TIRS and OLI can be seen in their payload positions on the LDCM spacecraft. TIRS (top left) is covered with gold-hued Multi-layer Insulation, and OLI (top right) is covered with white Tedlar insulation. Photo credit: Orbital Sciences Corp.



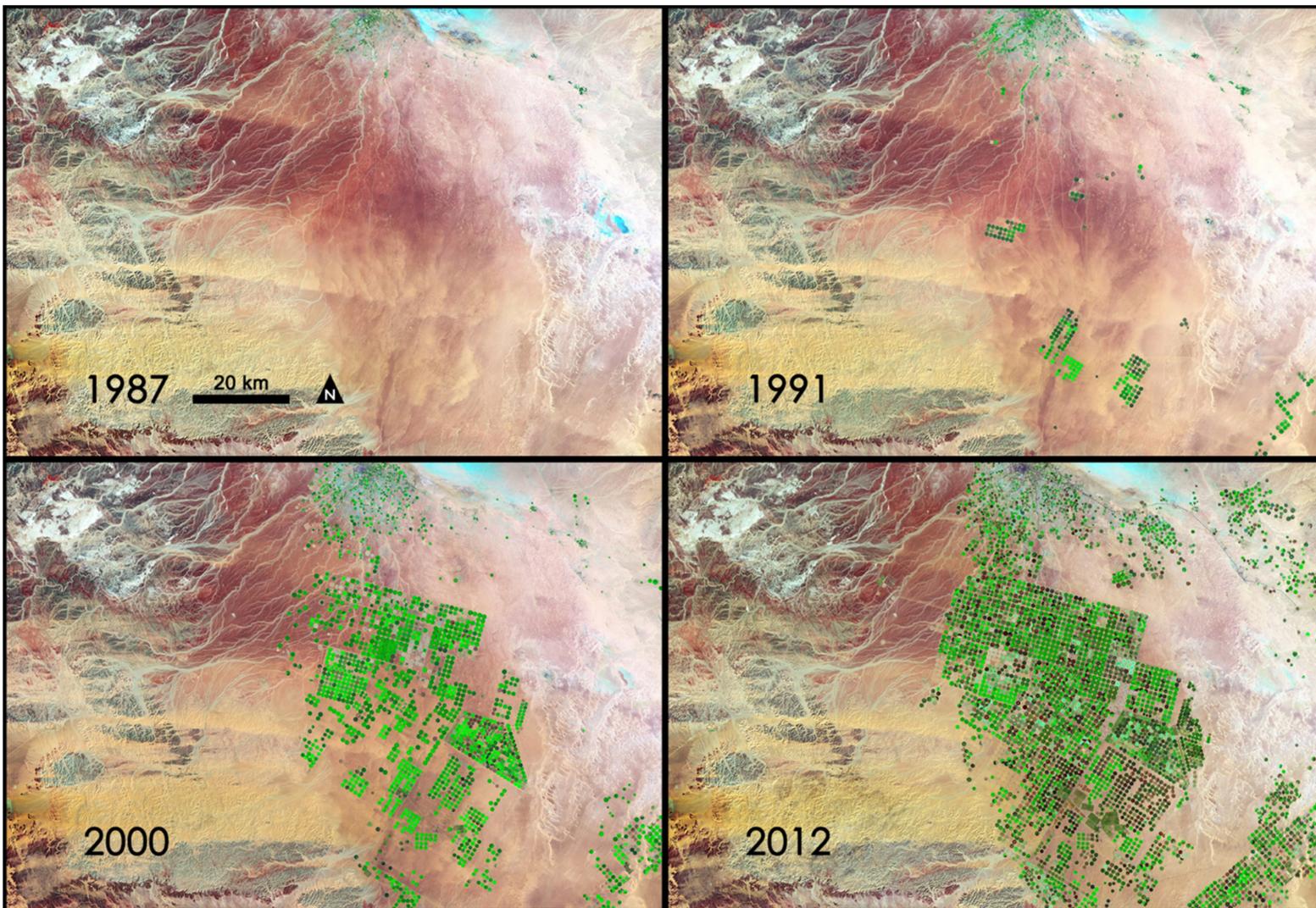
Watching Change Over Time

Landsat records images of the same spot on Earth's surface at regular intervals at a scale that can show both natural and human-caused change.



Each Landsat pixel represents a 30 meter x 30 meter area on the ground (TM and ETM+ data. For 1972-1982 only the coarser MSS Landsat data are available.) This scale is commensurate with human-scale processes such as urban growth and agriculture.

} data at a human scale



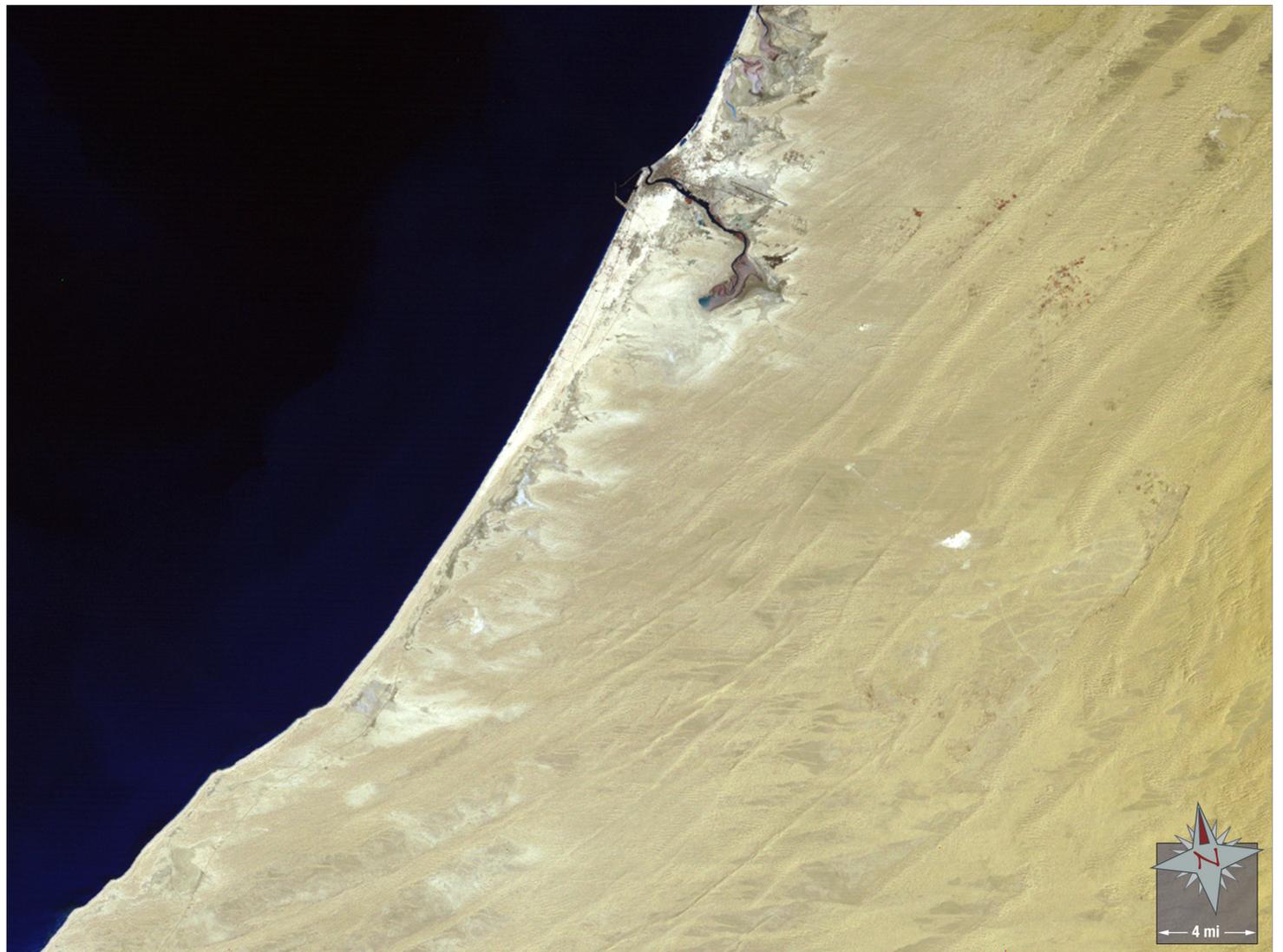
Over the last 24 years, Saudi Arabia has tapped hidden reserves of water to grow wheat and other crops in the Syrian Desert. In this series of four Landsat images, the agricultural fields are about one kilometer (.62 miles) across. The images were created using reflected light from the short wave-infrared, near-infrared, and green portions of the electromagnetic spectrum (bands 7, 4, and 2 from Landsat 4 and 5 TM and Landsat 7 ETM+ sensors). Using this combination of wavelengths, healthy vegetation appears bright green while dry vegetation appears orange. Barren soil is a dark pink, and urban areas, like the town of Tabarjal at the top of each image, have a purple hue.

“Landsat data, now more widely available, is helping close the gap in some parts of the world where the lack of basic data has proven to be an obstacle to decision making.”

—Alliance for Earth Observations, Forum on Earth Observations V: Final Report

Landsat sees change ->

Landsat 1



When Landsat 1 imaged Dubai on January 22, 1973, the city was barely visible against the desert landscape. Long straight roads sweep down the coast, and a single harbor juts into the Gulf. Though it seems small in this image, the city was growing quickly as a trade center, oil producer, and member of the newly formed United Arab Emirates.

1973



Dubai, UAE

Landsat 7

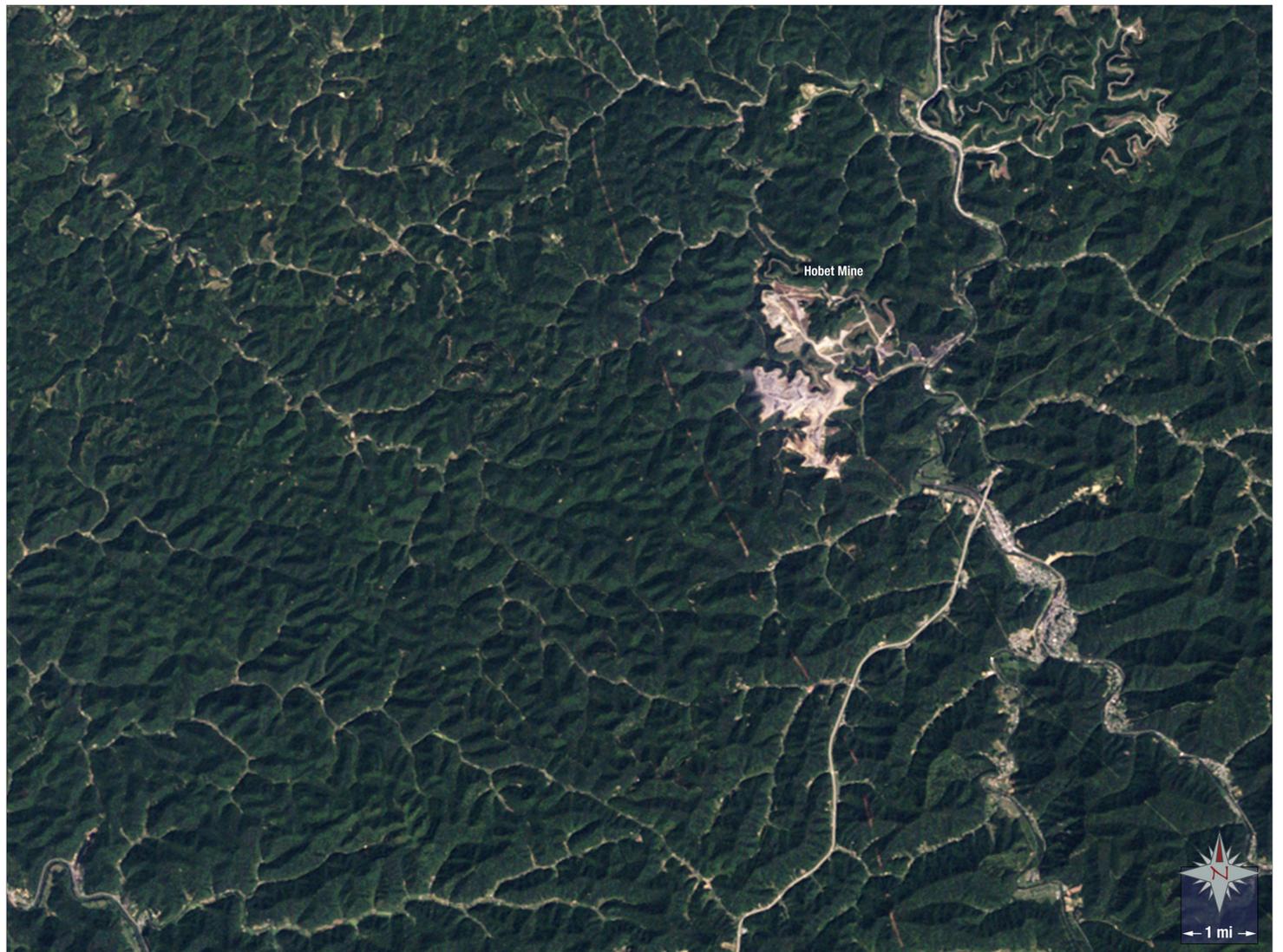


2010

Between 1973 and 2010, Dubai transformed entirely. In this Landsat 7 image, taken on October 6, 2006, dense gray city blocks are surrounded by plant-covered land, which is red. Artificial islands dot the coast. Dubai's growth is built on tourism, trade, and oil.

Landsat sees change ->

Landsat 5



Below the densely forested slopes of southern West Virginia's Appalachian Mountains is a layer cake of thin coal seams. To uncover this coal profitably, mining companies engineer large—sometimes very large—surface mines. This image, taken by Landsat 5 on September 17, 1984, shows one of the largest surface mines in West Virginia, Hobet mine in Boone County.

1984



Mountaintop Mining, WV

Landsat 5

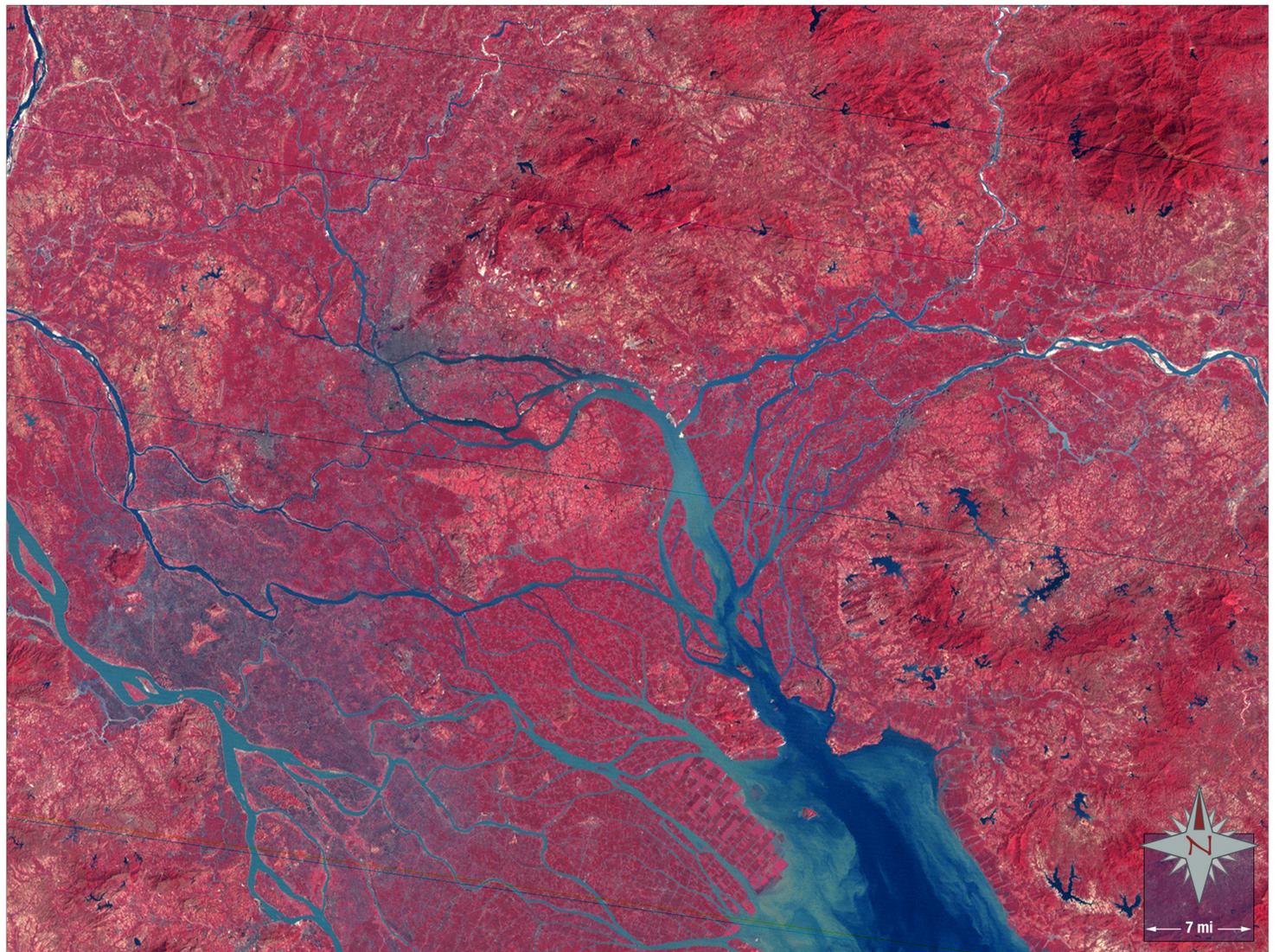


2009

The mine has expanded across several ridges since 1984. Landsat 5 acquired this image on August 8, 2010. The natural landscape of the area is dark green, forested mountains, creased by streams and indented by hollows. The active mining areas appear off-white, while areas being reclaimed with vegetation appear light green. A pipeline roughly bisects the images from north to south.

Landsat sees change ->

Landsat 3



In 1979, China established two special economic zones around the Pearl River Delta, north of Hong Kong. This image, taken by Landsat 3 on October 19, 1979, shows that the region was rural when the zone was established. Plant-covered land, which is red in this false-color image, dominates the scene. Square grids are agriculture.

1979



Pearl River Delta, China

Landsat 7



2003

By January 10, 2003, when Landsat 7 took this image, the Pearl River Delta was a densely populated urban corridor with several large cities. The urban areas are gray in this image. The region is a major manufacturing center with an economy the size of Taiwan's. As of 2010, the Pearl River Economic Zone had a population of 36 million people.

Landsat sees change ->

Landsat 5



“We’re losing about a football field worth of forest every four seconds of every minute of every day,” says Alan Belward from the Institute for Environment and Sustainability. Belward uses Landsat to track the world’s forest cover. This image, taken by Landsat 5 on August 21, 1990, shows forest loss in Papua New Guinea. Pale green and brown shapes and lines define where crops or other land cover have replaced the deep green forest.

1990



Papua New Guinea

Landsat 7



2009

Deforestation patterns are much more extensive in this image taken by Landsat 7 on October 31, 2001. Logging, subsistence agriculture, fires, and the development of mines and plantations drove the rapid deforestation and degradation. In 2001, some 362,000 hectares (3,620 square kilometers) were deforested or degraded in Papua New Guinea. A 2008 study warned that, if current deforestation rates continued, the country might lose half its tree cover by 2021.

Landsat sees change ->

Landsat 5



Change happens everywhere, including Washington, D.C. Can you think of changes you've seen in the region? Landsat allows us to look back in time to objectively track change. The Landsat 5 satellite captured this view of Washington, D.C. in 1984. Did your neighborhood exist in 1984?

1984



Washington D.C.

Landsat 5



2011

Since 1984, the Washington, D.C. region has grown dramatically. This image, taken by Landsat 5 in 2011, shows that greatest growth occurred outside of the city, particularly in the west near Dulles International Airport. Densely built areas, which are bright tan, and darker tan residential areas replaced the dark green forest and lighter green fields that surrounded the airport in 1984.



To stay in touch:

On the web:

www.nasa.gov/landsat

landsat.usgs.gov

landsat.nasa.gsfc.gov

Facebook:

www.facebook.com/NASA.Landsat

Twitter:

[@NASA_Landsat](https://twitter.com/NASA_Landsat)

[@USGSLandsat](https://twitter.com/USGSLandsat)

Flickr:

www.flickr.com/photos/usgslandsat

**“The Landsat archive is certainly one of the most important assets
that this country has given the world.”**

—Frank Biasi

Director of Digital Maps and Atlases, National Geographic Maps