

Aral Sea, Kazakhstan and Uzbekistan



Aral Sea, Kazakhstan and Uzbekistan 1977-2013

The Aral Sea was once the 4th largest lake in the world. Beginning in the 1960s, the water from the two major rivers that flow into the Aral Sea has been diverted to irrigate cotton and rice farms. Consequently, the volume of the Aral Sea has reduced dramatically.

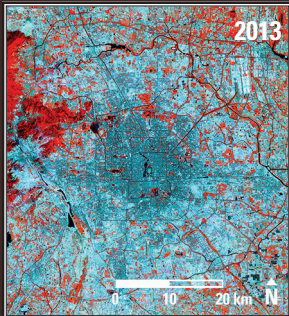
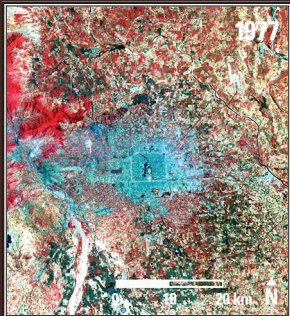
Date	Satellite	Bands	Res	Path	Row
Sept. 1–3, 1977	Landsat 2 MSS	5,7,4	79 m	172–174	27–30
June/July 2013	Landsat 8 OLI	6,5,4	30 m	160–162	27–30

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The U.S. Geological Survey Earth Resources Observation and Science (EROS) Center archives data from the Landsat satellites (1972–present). Earthshots presents environmental changes using Landsat images.



Beijing, China



Beijing, China 1977-2013

Beijing has changed remarkably in recent decades. The blue and gray tones in the images represent buildings and pavement spreading outward, replacing the red tones of natural and agricultural vegetation. The city has grown far beyond its traditional core around the Inner City, visible as a clear rectangle in the center.

Date	Satellite	Bands	Res	Path	Row
June 17, 1977	Landsat 2 MSS	6,5,4	79 m	132	32
May 12, 2013	Landsat 8 OLI	5,4,3	30 m	123	32

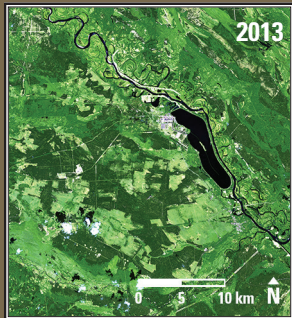
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Chernobyl, Ukraine



Chernobyl, Ukraine 1986-2013

A nuclear accident devastated the region near Chernobyl, Ukraine, on April 26, 1986. Farm fields are the bright green and tan shapes in the 1986 image. Those farms have converted to natural vegetation, the flat gray-green in the 2013 image.

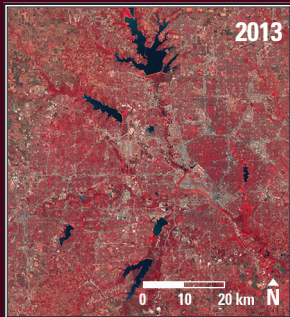
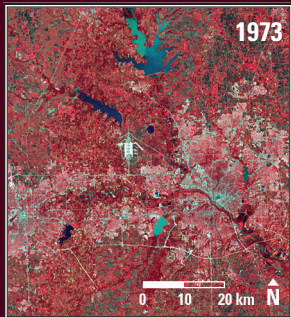
Date	Satellite	Bands	Res	Path	Row
Apr. 29, 1986	Landsat 5 TM	7,5,3	30 m	182	24
Aug. 13, 2013	Landsat 8 OLI	7,6,4	30 m	182	24

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Dallas, Texas, USA



Dallas, Texas, USA 1973-2013

These images show the Dallas–Fort Worth metropolis in northeastern Texas. Over the last few decades, Dallas' urban and suburban areas have expanded rapidly in almost every direction. Joe Pool Lake, in the bottom center of the 2013 image, is not present in the 1973 image.

Date	Satellite	Bands	Res	Path	Row
Oct. 19, 1973	Landsat 1 MSS	7,5,4	79 m	29	37
Aug. 31, 2013	Landsat 8 OLI	5,4,3	30 m	27	37

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Dead Sea, Israel, Jordan, West Bank



Dead Sea, Israel, Jordan, West Bank 1973-2013

The Dead Sea has no outlet. The only way water exits the sea is by evaporation. When the water evaporates, it leaves behind dissolved minerals, making the water even saltier. The salt and potash industries use water from the southern part of the sea in evaporation ponds.

Date	Satellite	Bands	Res	Path	Row
Jan. 1, 1973	Landsat 1 MSS	7,5,4	79 m	187	38
June 18, 2013	Landsat 8 OLI	5,4,3	30 m	174	38

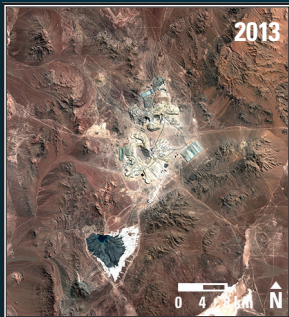
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Escondida Mine, Chile



Escondida Mine, Chile 1989-2013

Isolated in Chile's Atacama Desert, the open-pit Escondida Mine is the world's largest source of copper. To conserve water and minimize environmental impacts, Escondida created a tailings impoundment that has expanded along with its mining operations.

Date	Satellite	Bands	Res	Path	Row
Oct. 27, 1989	Landsat 4 TM	4,3,2	30 m	233	77
Aug. 18, 2013	Landsat 8 OLI	5,4,3	30 m	233	77

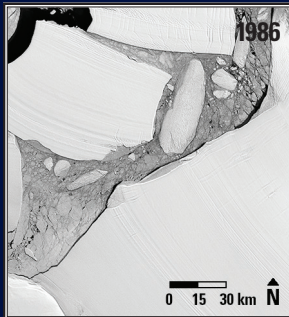
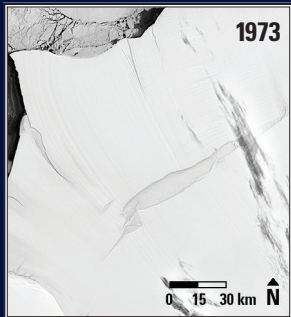
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Filchner Ice Shelf, Antarctica



Filchner Ice Shelf, Antarctica 1973-1986

Ice shelves form where glaciers flow into the ocean. In 1986, an area the size of Connecticut broke off the Filchner Ice Shelf, forming several large icebergs that traveled as far as South America. These images show near-infrared reflectance, which discriminates well between ice and water.

Date	Satellite	Bands	Res	Path	Row
Nov. 11, 1973	Landsat 1 MSS	7	79 m	194	117
Nov. 10, 1986	Landsat 5 MSS	4	79 m	187	116

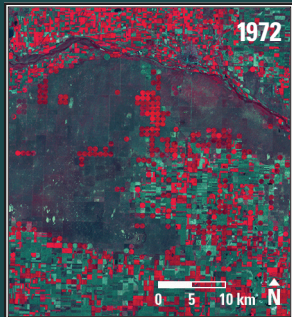
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Garden City, Kansas, USA



Garden City, Kansas, USA 1972-2013

These images feature the significant growth in the use of center-pivot irrigation—enormous sprinkler systems—in Kansas between 1972 and 2013. Much of the former shortgrass prairie of western Kansas is now irrigated cropland. Common crops in this area are corn, wheat, and sorghum and are shown as bright red circles.

Date	Satellite	Bands	Res	Path	Row
Aug. 16, 1972	Landsat 1 MSS	7,5,4	79 m	32	34
Aug. 4, 2013	Landsat 8 OLI	5,4,3	30 m	30	34

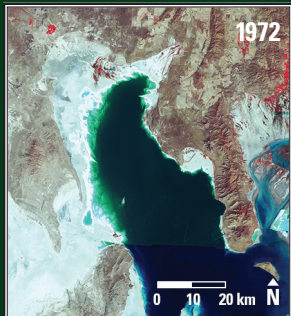
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Great Salt Lake, Utah, USA



Great Salt Lake, Utah, USA 1972-1987

Great Salt Lake is shallow for its size—about 70 miles long and 30 miles wide, but only about 40 feet deep. Even a small rise in water level means large changes in the surface area of the lake. Rainy weather in the 1980s brought the lake to high levels.

Date	Satellite	Bands	Res	Path	Row
Sept. 13, 1972	Landsat 1 MSS	7,5,4	79 m	42	31
Dec. 18, 1987	Landsat 5 MSS	4,2,1	79 m	39	31

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Gulf of Fonseca, Honduras



Gulf of Fonseca, Honduras 1987-2011

Honduras is one of Latin America's top producers of cultured shrimp. Huge areas around the Gulf of Fonseca delta have been converted to shrimp farms. When active and filled, the ponds appear dark. When drained, the ponds are pink.

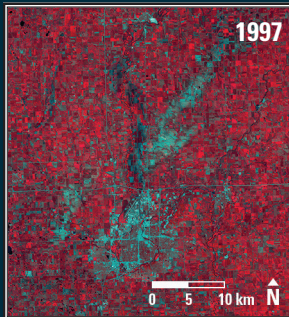
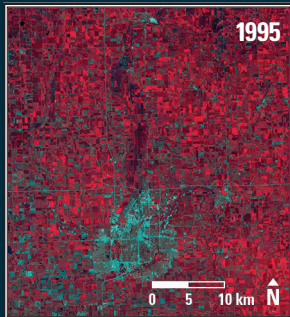
Date	Satellite	Bands	Res	Path	Row
Jan. 6, 1987	Landsat 5 TM	7,5,3	30 m	17	51
Jan. 8, 2011	Landsat 5 TM	7,5,3	30 m	17	51

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Hailstorm, Sioux Falls, SD, USA



Hailstorm, Sioux Falls, SD, USA 1995-1997

On Sunday, July 13, 1997, an unusually severe hailstorm just missed Sioux Falls, SD. But it pounded the surrounding cropland with baseball- to softball-sized hail. Healthy crops appear bright red. Some of these fields turned gray where the hailstorm converted the cropland into bare soil.

Date	Satellite	Bands	Res	Path	Row
July 27, 1995	Landsat 5 TM	4,3,2	30 m	29	30
July 16, 1997	Landsat 5 TM	4,3,2	30 m	29	30

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Huang He Delta, China



Huang He Delta, China 1979-2010

China's second longest river, the sediment-choked Huang He (Yellow River), is one of the muddiest rivers on earth. The sediments it carries are deposited at the river's mouth, where the beak-shaped delta protrudes into the sea.

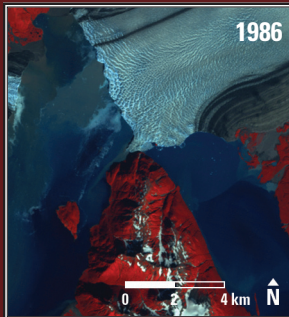
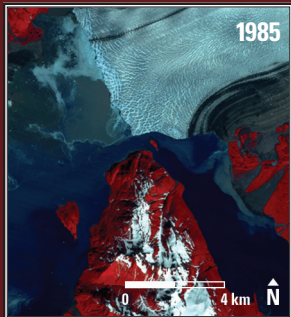
Date	Satellite	Bands	Res	Path	Row
May 27, 1979	Landsat 3 MSS	6,7,4	79 m	130	34
Sept. 11, 2010	Landsat 5 TM	7,5,3	30 m	121	34

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Hubbard Glacier, Alaska, USA



Hubbard Glacier, Alaska, USA 1985-1986

An unusual event on the coast of Alaska was observed with satellite imagery in 1986. A glacier slid down a valley and blocked a fiord from the rest of the bay. The fiord then turned into a temporary lake. The water's level rose 25 meters before the glacier dam gave way a few months later.

Date	Satellite	Bands	Res	Path	Row
Aug. 7, 1985	Landsat 5 TM	4,3,2	30 m	62	18
Sept. 11, 1986	Landsat 5 TM	4,3,2	30 m	62	18

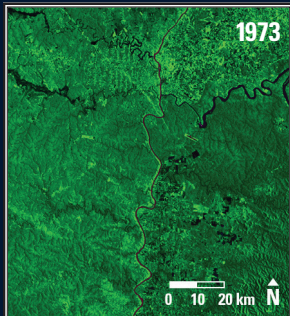
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Iguazú, South America



Iguazú, South America 1973-2013

Iguazú National Park is the bright green in the lower right of these images. Deforestation begins in the 1973 image with the fishbone pattern in the upper left. The reservoir seen in the 2013 image formed behind the Itaipú Dam in 1982.

Date	Satellite	Bands	Res	Path	Row
Feb. 23, 1973	Landsat 1 MSS	7,5,4	79 m	240	78
Aug. 19, 2013	Landsat 8 OLI	7,5,3	30 m	224	78

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IJsselmeer, Netherlands



IJsselmeer, Netherlands 1973-2010

The IJsselmeer is a lake on the coast of the Netherlands (pronounced EYE-ssel-mare). People in the Netherlands have been using various strategies to control water levels for centuries. The south-central part of the images has converted from just drained to covered with active farming. Amsterdam can be seen in the lower left.

Date	Satellite	Bands	Res	Path	Row
Mar. 23, 1973	Landsat 1 MSS	7,5,4	79 m	214	23
Sept. 6, 2010	Landsat 5 TM	4,3,2	30 m	198	23,24

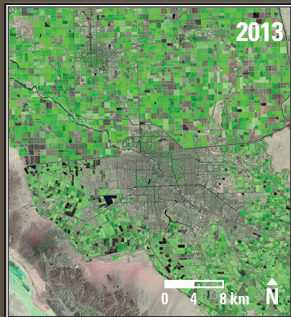
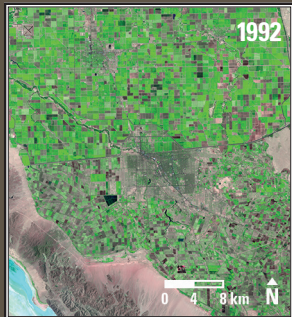
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Imperial Valley, California, USA



Imperial Valley, California, USA 1992-2013

The Imperial Valley lies on the border of California and Mexico. The international border is visible because of the different intensity of vegetation, shown in bright green. The dark area in the upper left is the Salton Sea. The lower part of the images shows the growing cities of El Centro, Calexico, and Mexicali.

Date	Satellite	Bands	Res	Path	Row
June 30, 1992	Landsat 4 TM	7,4,2	30 m	39	37
June 16, 2013	Landsat 8 OLI	7,5,3	30 m	39	37

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Isahaya Bay, Japan



Isahaya Bay, Japan 1993-2010

The controversial Isahaya Bay Reclamation Project has been blamed for recent reduced harvests of fish and seaweed (nori). The 1993 image shows the bay before a sea wall was built. In the 2010 image, reclaimed land extends into the area lying behind the 7-km (4-mile) wall.

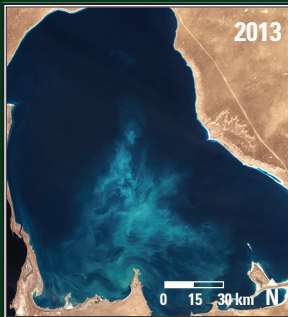
Date	Satellite	Bands	Res	Path	Row
May 15, 1993	Landsat 5 TM	7,5,3	30 m	113	37
Sept. 3, 2010	Landsat 5 TM	7,5,3	30 m	113	37

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Kara-Bogaz-Gol, Turkmenistan



Kara-Bogaz-Gol, Turkmenistan 1987-2013

This shallow lagoon of the Caspian Sea is called the Kara-Bogaz-Gol. Its water is far saltier than the Caspian, and its water level changes over time. The 1987 image shows the lagoon with little water, the light blue color indicating dry or shallowly covered salt beds. The 2013 image shows it full of water.

Date	Satellite	Bands	Res	Path	Row
Sept. 25, 1987	Landsat 5 TM	4,3,2	30 m	164	31,32
Aug. 31, 2013	Landsat 8 OLI	5,4,3	30 m	164	31,32

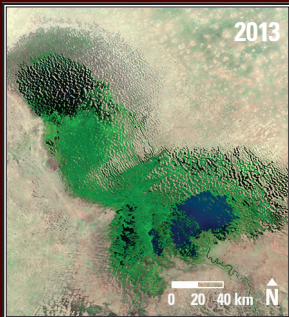
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Lake Chad, West Africa



Lake Chad, West Africa 1973-2013

Lake Chad lies between Chad, Niger, Nigeria, and Cameroon in West Africa. This area's prolonged drought and increased water use have shrunk the lake from about 25,000 km² in 1963 to less than 2,000 km² today. Old dunes are again uncovered, and wetlands (shown as green) have replaced open water.

Date	Satellite	Bands	Res	Path	Row
Jan. 1973	Landsat 1 MSS	5,7,4	79 m	198,199	50,51
May 2013	Landsat 8 OLI	7,5,4	30 m	184–186	50–52

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Lake Hamoun, Iran



Lake Hamoun, Iran 1976-2013

Lake Hamoun lies near the Iran-Afghanistan border. This closed basin receives most of its water from Afghanistan's Helmand River. In the mid-1970s, when rivers in Afghanistan were flowing well, the lake was full. But recent droughts have kept the lake nearly dry for the past decade.

Date	Satellite	Bands	Res	Path	Row
Nov. 14, 1976	Landsat 2 MSS	6,5,4	79 m	169	38,39
July 13, 2013	Landsat 8 OLI	5,4,3	30 m	157	38,39

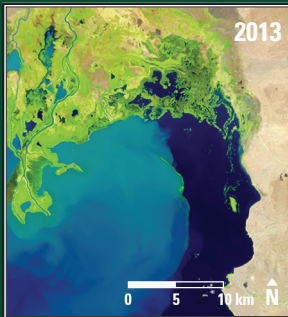
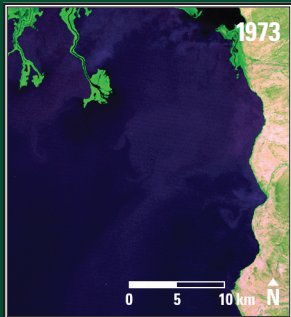
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Lake Turkana, Kenya and Ethiopia



Lake Turkana, Kenya and Ethiopia 1973-2013

Lake Turkana lies in the Rift Valley of East Africa. These images show the delta of the Omo River, which provides more than 80% of the water to the lake. Bright green indicates aquatic vegetation on the Omo River delta. The delta expands and shrinks in response to the high rainfall variability in the region.

Date	Satellite	Bands	Res	Path	Row
Feb. 1, 1973	Landsat 1 MSS	5,7,4	79 m	182	57
July 1, 2013	Landsat 8 OLI	6,5,4	30 m	169	57

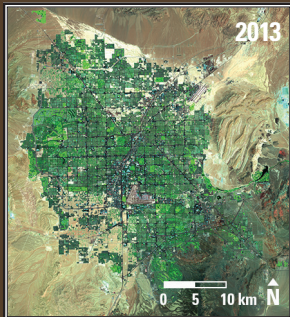
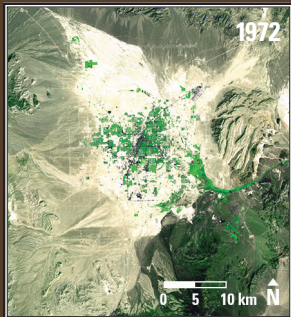
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Las Vegas, Nevada, USA



Las Vegas, Nevada, USA 1972-2013

Between 1972 and 2013, the population of Las Vegas grew from 273,000 to over 2 million. Spurred by expansion of the gaming and tourism industries, Las Vegas is one of the fastest growing metropolitan areas in the United States. The urban growth is steadily infringing on the arid ecosystems surrounding the city.

Date	Satellite	Bands	Res	Path	Row
Sept. 13, 1972	Landsat 1 MSS	5,7,4	79 m	42	35
June 16, 2013	Landsat 8 OLI	7,5,4	30 m	39	35

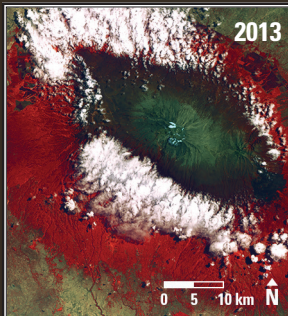
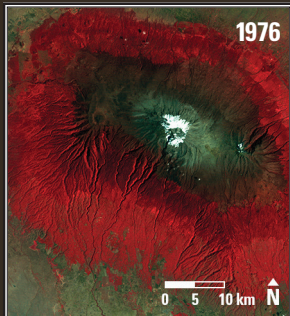
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Mount Kilimanjaro, Tanzania



Mount Kilimanjaro, Tanzania 1976-2013

Though only about 200 miles from the equator, Mount Kilimanjaro has been capped by glaciers and snow for 11,000 years. Those glaciers are now shrinking. In these false-color images, vegetation appears red, and glaciers and snow bright white. White clouds surround the mountain in the 2013 image.

Date	Satellite	Bands	Res	Path	Row
Jan. 24, 1976	Landsat 2 MSS	7,5,4	79 m	180	62
Aug. 27, 2013	Landsat 8 OLI	5,4,1	30 m	168	62

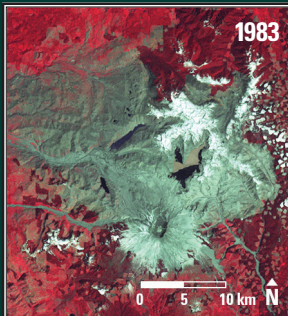
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Mount St. Helens, Washington, USA



Mount St. Helens, Washington, USA 1973-1983

The eruption of Mount St. Helens on May 18, 1980, destroyed 150 square miles of forest, blew ash 15 miles into the air, and killed 60 people. The mountain's elevation dropped from 9,677 feet to 8,364 feet. Forest appears red; ash and mud appear gray. Ice and snow are white, and water is black.

Date	Satellite	Bands	Res	Path	Row
Sept. 15, 1973	Landsat 1 MSS	7,5,4	79 m	49	28
May 22, 1983	Landsat 4 MSS	4,2,1	79 m	46	28

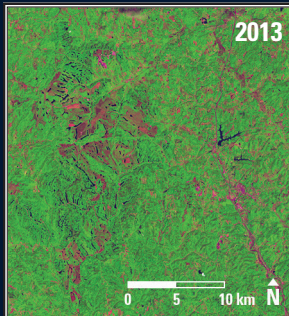
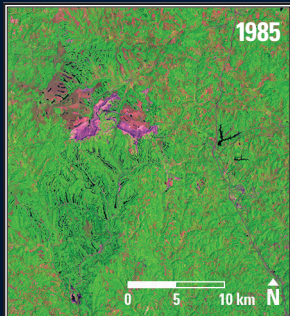
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Muskingum Mines, Ohio, USA



Muskingum Mines, Ohio, USA 1985-2013

Strip mines in eastern Ohio show up as pink in these images. The reclaimed land is replanted as grassland or forest. In the 2013 image, some of the reclaimed former coal mines are distinguishable from the surrounding vegetation as mottled maroon and green.

Date	Satellite	Bands	Res	Path	Row
July 18, 1985	Landsat 5 TM	5,4,3	30 m	18	32
July 15, 2013	Landsat 8 OLI	7,5,1	30 m	18	32

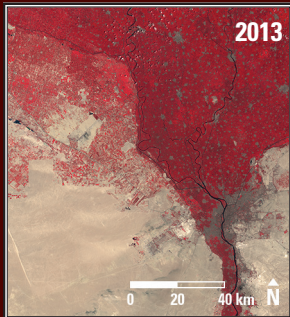
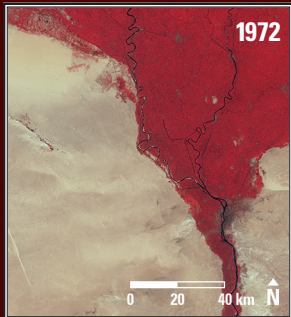
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Nile River Delta, Egypt



Nile River Delta, Egypt 1972-2013

These images show the dramatic urban growth within the Nile River Delta and the expansion of agriculture into adjoining desert areas. Red indicates vegetation, and the contrast is clear between the lush vegetation of irrigated fields and the white or tan barren desert. Cairo is the gray expanse near the lower right.

Date	Satellite	Bands	Res	Path	Row
Aug. 31, 1972	Landsat 1 MSS	7,5,4	79 m	190	39
Aug. 3 and 10, 2013	Landsat 8 OLI	5,4,3	30 m	176,177	39

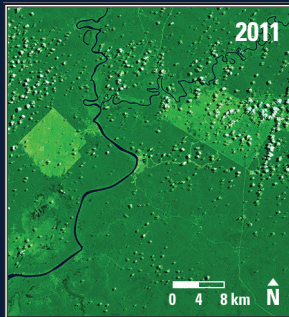
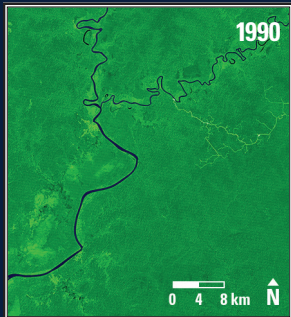
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Papua, Indonesia



Papua, Indonesia 1990-2011

Papua is a province of Indonesia, which produces a little over half of the world's palm oil. The palm oil plantations show up clearly in Landsat images as the light green blocks in the middle of the undisturbed rain forest.

Date	Satellite	Bands	Res	Path	Row
Nov. 20, 1990	Landsat 5 TM	7,5,3	30 m	100	65
Apr. 4, 2011	Landsat 5 TM	7,5,3	30 m	100	65

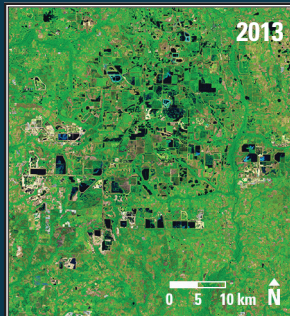
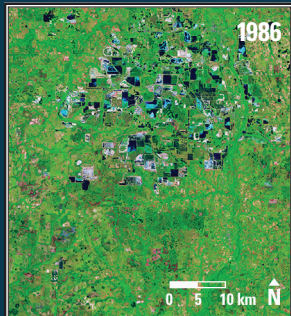
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Phosphate Mines, Florida, USA



Phosphate Mines, Florida, USA 1986-2013

The world's most productive source of phosphate, a critical nutrient for modern agriculture, lies south of Orlando, FL. These images show the expansion of the mined area. As the mines shift southward, the land is reclaimed and returns to green.

Date	Satellite	Bands	Res	Path	Row
Apr. 2, 1986	Landsat 5 TM	7,4,1	30 m	16	41
May 14, 2013	Landsat 8 OLI	7,5,1	30 m	16	41

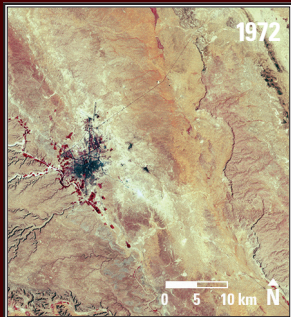
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Riyadh, Saudi Arabia



Riyadh, Saudi Arabia 1972-2013

These images of Saudi Arabia's capital show its rapid growth. The city grew from under a half million people in 1972 to over 5 million people in 2013. The street patterns appear as dark grids, and vegetation appears red.

Date	Satellite	Bands	Res	Path	Row
Sept. 24, 1972	Landsat 1 MSS	7,5,4	79 m	178	43
June 3, 2013	Landsat 8 OLI	5,4,3	30 m	165	43

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Rondônia, Brazil



Rondônia, Brazil 1975-2013

These images show tropical forest in western Brazil, where land has been cleared for farming and grazing. Cutting starts along roads and fans out to create a “fishbone” pattern. Deforested land and urban areas appear pink; healthy vegetation appears green.

Date	Satellite	Bands	Res	Path	Row
June 19, 1975	Landsat 2 MSS	6,7,5	79 m	249	67
Aug. 27, 2013	Landsat 8 OLI	7,6,4	30 m	232	67

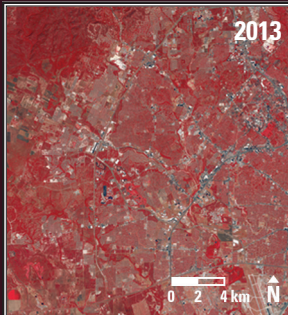
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San Antonio, Texas, USA



San Antonio, Texas, USA 1974-2013

Suburban expansion is visible from space as shown on the western side of San Antonio, Texas. New residential areas push beyond outer loop highways. New retail development can be seen as small bright white shapes along these highways.

Date	Satellite	Bands	Res	Path	Row
Sept. 8, 1974	Landsat 1 MSS	6,5,4	79 m	29	40
Aug. 31, 2013	Landsat 8 OLI	5,4,3	30 m	27	40

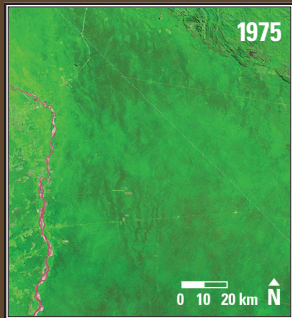
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Santa Cruz, Bolivia



Santa Cruz, Bolivia 1975-2013

In a few decades, the lowlands surrounding Santa Cruz were transformed from dense forest into a grid-patterned expanse of agricultural lands. Many of these rectangular, light-colored fields are soybeans cultivated for export.

Date	Satellite	Bands	Res	Path	Row
June 17, 1975	Landsat 2 MSS	5,7,4	79 m	247	72
July 28, 2013	Landsat 8 OLI	7,5,3	30 m	230	72

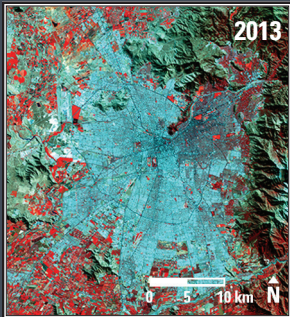
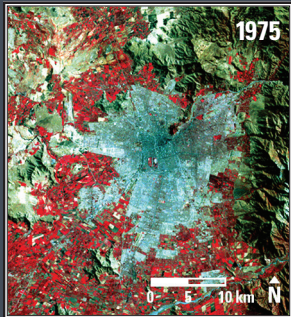
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Santiago, Chile



Santiago, Chile 1975-2013

From 1975 to 2013, Santiago's population increased from under 3.5 million to about 6 million. After World War II, Chile's population urbanized earlier than many other countries, already 68% urban by 1960 and 89% by 2010. Agricultural lands west and south of the city are shown in bright red. The Andes Mountains are to the east.

Date	Satellite	Bands	Res	Path	Row
Mar. 22, 1975	Landsat 2 MSS	6,5,4	79 m	250	83
Apr. 12, 2013	Landsat 8 OLI	5,4,3	30 m	233	83

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Selkirk Island, Chile



Selkirk Island, Chile 1999

These swirling clouds appeared over Selkirk Island in the southern Pacific Ocean. The island's highest point is nearly a mile (1.6 km) above sea level. Wind-driven clouds flow around this obstacle and form these large, spinning eddies. The second image is a closer look at the well-defined swirls nearest to the island.

Date	Satellite	Bands	Res	Path	Row
Sept. 15, 1999	Landsat 7 ETM+	7,4,1	30 m	6	83

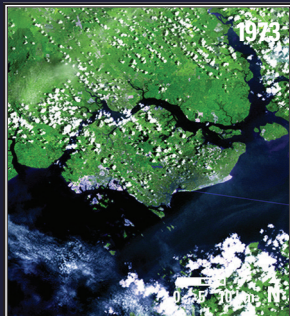
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Singapore



Singapore 1973-2009

These images show the island-nation of Singapore, where new land is being created for airports, shipping, and oil refineries. Vegetation is green and water is blue-black. Bare soil and pavement look almost pale or pink. Singapore is often cloudy; these images are among the clearest in the archive.

Date	Satellite	Bands	Res	Path	Row
Oct. 17, 1973	Landsat 1 MSS	6,7,5	79 m	134	59
Feb. 8, 2009	Landsat 5 TM	7,5,3	30 m	125	59

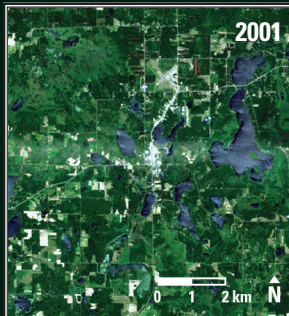
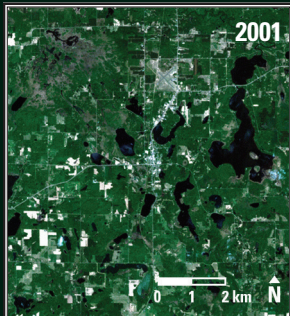
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Siren, Wisconsin, USA



Siren, Wisconsin, USA 2001

An F3 tornado struck Siren, WI, on June 18, 2001. The tornado cut a west-to-east swath half a mile wide and more than 20 miles long. These images are shown in simulated natural color. The lakes look brighter on June 19 than on May 18, most likely from the sun glinting off waves.

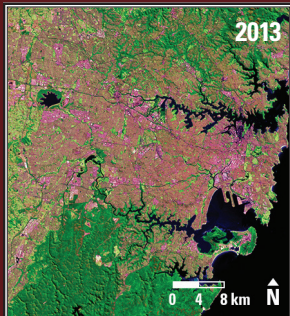
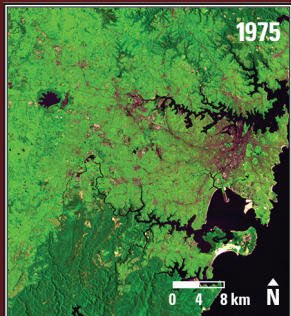
Date	Satellite	Bands	Res	Path	Row
May 18, 2001	Landsat 7 ETM+	3,2,1	30 m	27	28
June 19, 2001	Landsat 7 ETM+	3,2,1	30 m	27	28

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Sydney, Australia



Sydney, Australia 1975-2013

With over 4.5 million people, Sydney is Australia's largest city. Except for the shoreline to the east, national parks and preserves surround Sydney on all sides. Over the past several decades, Sydney's expansion has been mostly westward, toward the Blue Mountains.

Date	Satellite	Bands	Res	Path	Row
Oct. 12, 1975	Landsat 2 MSS	5,7,4	79 m	95	84
Aug. 17, 2013	Landsat 8 OLI	7,5,3	30 m	89	84

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Toshka Project, Egypt



Toshka Project, Egypt 2001-2013

Egypt's Toshka Project diverted water from the Nile River to the Sahara Desert. The project's lofty goal was to cultivate a half million acres of land and create a "second Nile Valley." The Toshka lakes formed in 1998 and reached a peak in size in 2001. Since then, the lakes have been shrinking.

Date	Satellite	Bands	Res	Path	Row
Aug. 19 and 26, 2001	Landsat 7 ETM+	7,4,2	30 m	175,176	44
Aug. 19 and 28, 2013	Landsat 8 OLI	7,5,3	30 m	175,176	44

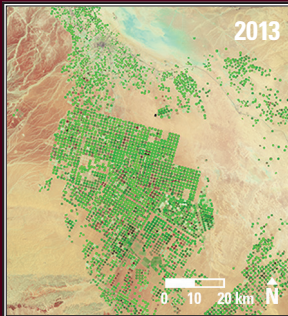
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Wadi As-Sirhan Basin, Saudi Arabia



Wadi As-Sirhan Basin, Saudi Arabia 1986-2013

These two images reveal the effects of center-pivot irrigation systems in Saudi Arabia's desert region known as Wadi As-Sirhan. This landscape has been transformed from wasteland into cropland covered with circular green fields. The fields are watered with groundwater, which in this arid region is a nonrenewable resource.

Date	Satellite	Bands	Res	Path	Row
Feb. 2, 1986	Landsat 5 TM	7,4,2	30 m	172	39
Aug. 23, 2013	Landsat 8 OLI	7,5,3	30 m	172	39

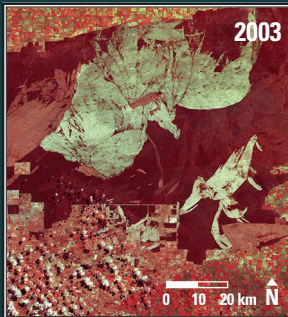
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Wyperfeld National Park, Australia



Wyperfeld National Park, Australia 2000-2003

Native shrubland—the Australian “bush”—appears deep red and distinguishes Wyperfeld National Park in western Victoria, Australia. Fires sweep the park almost yearly. The age of the burn scars can be estimated by their color; old scars are almost as darkly red as the bush, partially regrown areas are lighter red, and the newest scars are bright.

Date	Satellite	Bands	Res	Path	Row
June 13, 2000	Landsat 7 ETM+	4,3,2	30 m	95	85
Apr. 3, 2003	Landsat 7 ETM+	4,3,2	30 m	95	85

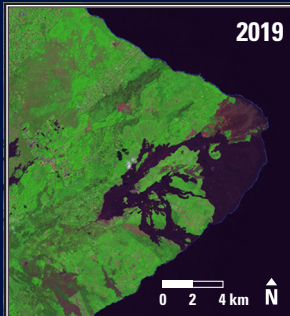
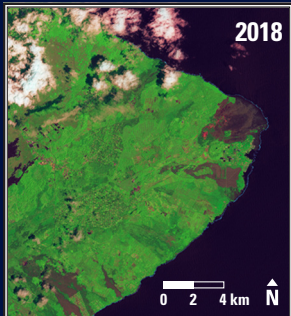
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Kilauea, Hawaii, USA



Kīlauea, Hawaii, USA 2018–2019

In 2018, Hawaii was in the news as fresh lava covered 13.7 square miles (35.5 km²) of the eastern tip of the Big Island. The lava flows were from Kīlauea, one of the world's most active volcanoes. This eruptive event started April 30, 2018, and ended on August 4, 2018.

Date	Satellite	Bands	Res	Path	Row
Mar. 27, 2018	Landsat 8 OLI	7,5,4	30 m	62	47
Feb. 26, 2019	Landsat 8 OLI	7,5,4	30 m	62	47

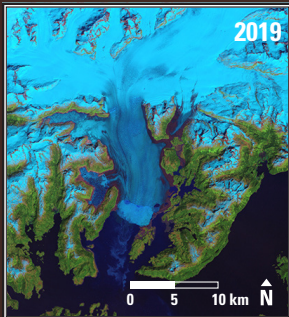
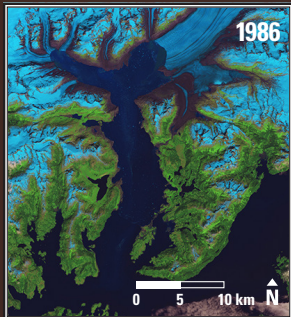
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Columbia Glacier, Alaska, USA



Columbia Glacier, Alaska, USA 1986–2019

Since 1980, the terminus of Columbia Glacier has retreated 20 kilometers, making it one of the most rapidly changing glaciers in the world. A 300-meter deep fjord now replaces the portion of the valley once occupied by the glacier.

Date	Satellite	Bands	Res	Path	Row
June 26, 1986	Landsat 5 TM	7,4,2	30 m	67	17
June 21, 2019	Landsat 8 OLI	7,5,3	30 m	67	17

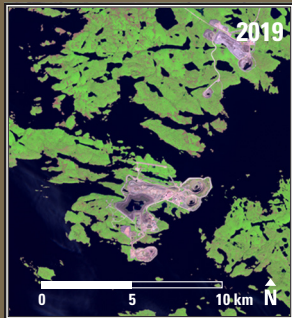
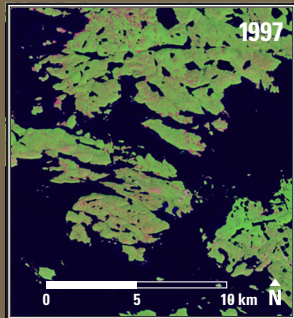
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Diamond Mines, Northwest Territories, Canada



Diamond Mines, Northwest Territories, Canada 1997–2019

Diamonds are created under intense heat and pressure, yet they are mined in the frozen tundra of northern Canada. Some of the diamond ore is under Lac de Gras, so these mine pits of the Diavik Mine were built in the lake.

Date	Satellite	Bands	Res	Path	Row
Aug. 17, 1997	Landsat 5 TM	7,4,2	30 m	45	15
July 29, 2019	Landsat 8 OLI	7,5,1	30 m	45	15

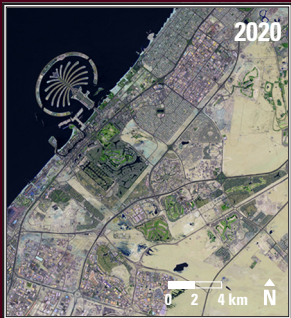
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Dubai, United Arab Emirates



Dubai, United Arab Emirates 1984–2020

As Dubai expands, roads, buildings, and irrigated fields spread out over the desert. But the most prominent project in Dubai, and an impressive engineering feat, is the artificial islands built off its coast. The islands were built from sand dredged from the sea floor.

Date	Satellite	Bands	Res	Path	Row
Apr. 29, 1984	Landsat 5 TM	7,4,2	30 m	160	43
June 19, 2020	Landsat 8 OLI	7,6,4	30 m	160	43

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Hurricane Katrina, New Orleans, Louisiana, USA



Hurricane Katrina, New Orleans, Louisiana, USA 2005

Hurricane Katrina was one of the most intense and costliest hurricanes to hit the United States. It made landfall the morning of August 29, 2005, as a strong category 3 storm with sustained winds of 125 miles per hour. These Landsat images show the region of storm damage. The flooded areas are dark, giving the city a bruised appearance.

Date	Satellite	Bands	Res	Path	Row
Aug. 22, 2005	Landsat 5 TM	5,4,3	30 m	22	39
Sept. 7, 2005	Landsat 5 TM	5,4,3	30 m	22	39

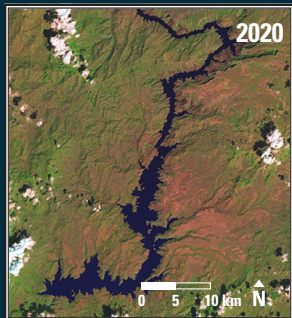
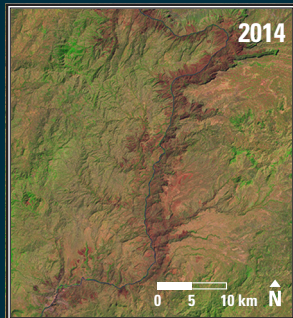
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Gibe III Dam, Ethiopia



Gibe III Dam, Ethiopia 2014–2020

Large hydropower projects can have a massive effect on the landscape. At nearly 244 meters tall, Gibe III is Africa's tallest dam and the continent's third largest hydroelectric plant. The reservoir, now 155 kilometers long, began filling in February 2015. The reservoir fills the entire canyon that the river flowed through.

Date	Satellite	Bands	Res	Path	Row
Jan. 25, 2014	Landsat 8 OLI	7,5,4	30 m	169	55
Jan. 10, 2020	Landsat 8 OLI	7,5,4	30 m	169	55

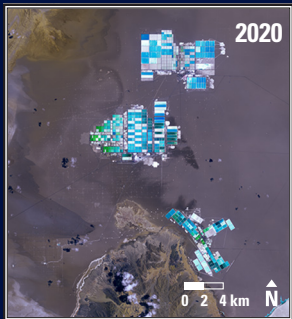
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Salar de Atacama, Chile



Salar de Atacama, Chile 1991–2020

This desolate salt flat is one of the world's largest sources of lithium, a key ingredient in rechargeable batteries. The rectangular shapes are evaporation ponds, which vary in color because of varying amounts of salts in the water. The brighter ponds contain more concentrated salts, and the deep blue ponds indicate more water content.

Date	Satellite	Bands	Res	Path	Row
Dec. 28, 1991	Landsat 5 TM	4,3,1	30 m	233	76
Jan. 26, 2020	Landsat 8 OLI	5,4,1	30 m	233	76

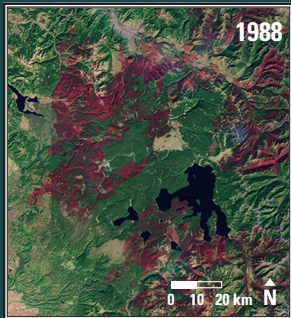
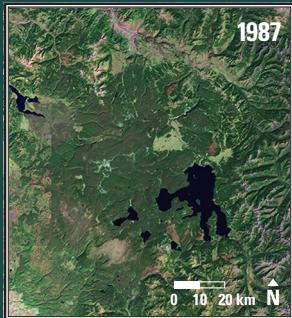
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Yellowstone National Park, USA



Yellowstone National Park, USA 1987–1988

Dry conditions, along with dry cold fronts that brought lightning but no rain, created extreme fire danger in the summer of 1988. These images show old forest as dark green, occasionally broken up by lighter green grassy meadows or plains. Land just burned is dark red. More than 793,000 acres, or 36% of the park, burned that summer.

Date	Satellite	Bands	Res	Path	Row
Sept. 22, 1987	Landsat 5 TM	7,4,2	30 m	38	29
Oct. 10, 1988	Landsat 5 TM	7,4,2	30 m	38	29

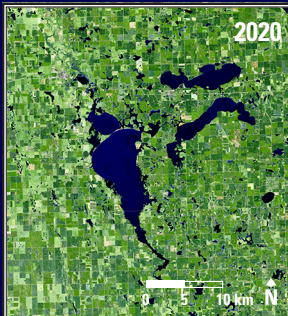
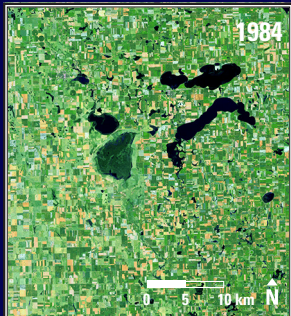
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Lake Thompson, South Dakota, USA



Lake Thompson, South Dakota, USA 1984–2020

Above normal rainfall in the 1980s resulted in the dramatic filling of Lake Thompson, South Dakota, along with other nearby lakes and sloughs. Water levels continue to fluctuate depending on annual precipitation. Lake Thompson, a crucial habitat for migratory birds, is now South Dakota's largest natural lake.

Date	Satellite	Bands	Res	Path	Row
Aug. 29, 1984	Landsat 5 TM	7,5,3	30 m	29	29
Sept. 1, 2020	Landsat 8 OLI	7,6,4	30 m	29	29

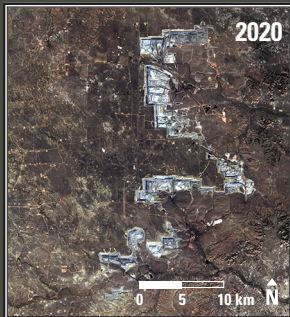
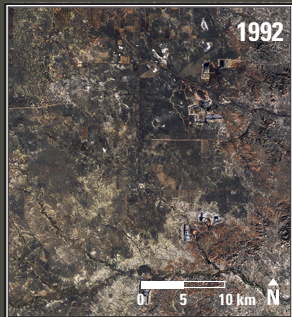
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Powder River Basin, Wyoming, USA



Powder River Basin, Wyoming, USA 1992–2020

Surface mining for coal takes place in Wyoming's Powder River Basin. Landsat shows the progression of mining operations and the beginnings of the reclamation process. The black lines are layers of underground coal. Lighter straight lines are stepped benches that allow trucks to drive in and out of the mines.

Date	Satellite	Bands	Res	Path	Row
Sept. 23, 1992	Landsat 5 TM	3,2,1	30 m	34	30
Sept. 20, 2020	Landsat 8 OLI	4,3,2	30 m	34	30

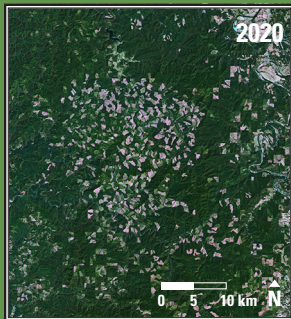
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Logging in Oregon, USA



Logging in Oregon, USA 1999–2020

The 30-meter resolution imagery from Landsat is enough detail to reveal logging clearcuts and the harvest rotation cycle. Dark green indicates taller trees and an older forest. Light green areas are beginning to recover from past logging, so the young trees in these areas are not very tall yet. The tan areas are fresh clearcuts.

Date	Satellite	Bands	Res	Path	Row
July 5, 1999	Landsat 7 ETM+	7,5,3	30 m	46	30
Aug. 7, 2020	Landsat 8 OLI	7,3,2	30 m	46	30

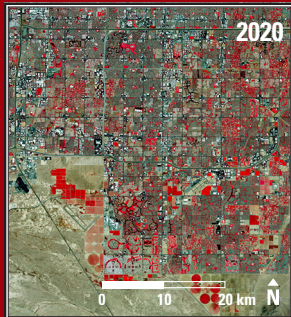
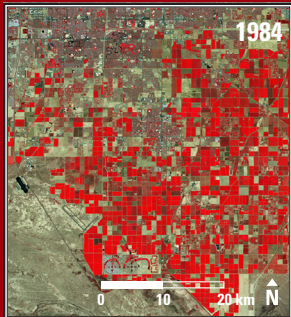
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Phoenix, Arizona, USA



Phoenix, Arizona, USA 1984–2020

Landsat images show residential areas spreading over agricultural fields, which appear as bright red squares and rectangles. Phoenix's southeastern suburb of Chandler was once separated from the other suburbs. Chandler is now indistinguishable from the rest of the rapid suburban expansion.

Date	Satellite	Bands	Res	Path	Row
Sept. 22, 1984	Landsat 5 TM	4,3,2	30 m	37	37
Aug. 8, 2020	Landsat 8 OLI	5,4,3	30 m	37	37

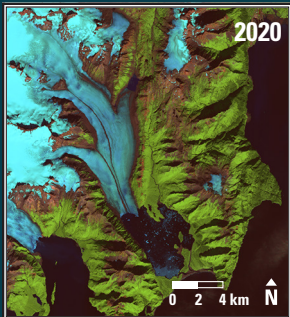
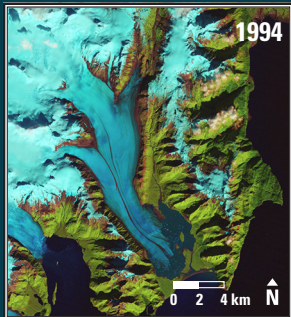
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Bear Glacier, Alaska, USA



Bear Glacier, Alaska, USA 1994–2020

Bear Glacier is an outlet glacier of the Harding Icefield in Kenai Fjords National Park, Alaska. As it retreats, its proglacial lake, called Bear Glacier Lagoon, has expanded. Large icebergs now float in the lagoon, visible in the Landsat images as light blue spots in the water. People can go kayaking among the icebergs.

Date	Satellite	Bands	Res	Path	Row
Sept. 27, 1994	Landsat 5 TM	7,4,2	30 m	68	18
Sept. 9, 2020	Landsat 8 OLI	7,5,4	30 m	69	18

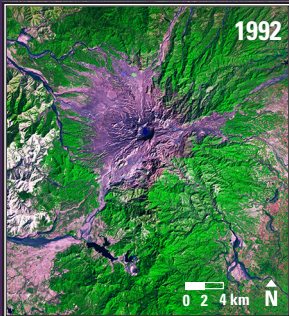
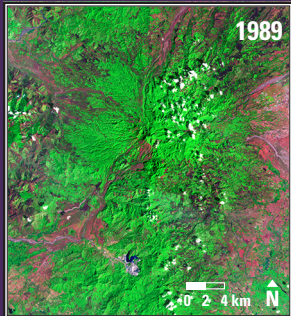
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Mount Pinatubo, Philippines



Mount Pinatubo, Philippines 1989–1992

Mount Pinatubo erupted explosively on June 15, 1991, marking one of the largest volcanic eruptions of the 20th century. Volcanic ash blanketed the region. The eruption caused the summit to collapse into a caldera about 2.5 kilometers wide. Water has collected in the crater to form a small lake.

Date	Satellite	Bands	Res	Path	Row
Feb. 18, 1989	Landsat 5 TM	7,4,2	30 m	116	50
Jan. 26, 1992	Landsat 5 TM	7,4,2	30 m	116	50

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Sabah Al Ahmad Sea City, Kuwait



Sabah Al Ahmad Sea City, Kuwait 1994–2021

Rather than build artificial islands in the sea to extend the country's coastline, this project brings the sea to the desert. The design of Sea City follows existing tidal creeks to bring water inland from the Persian Gulf. The tides naturally flush the lagoons to keep the water circulating.

Date	Satellite	Bands	Res	Path	Row
July 1, 1994	Landsat 5 TM	7,4,2	30 m	165	40
Apr. 6, 2021	Landsat 8 OLI	7,5,4	30 m	165	40

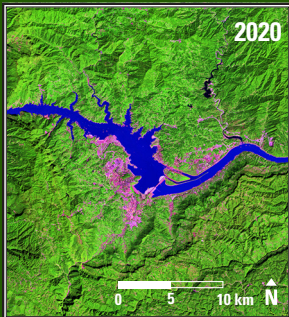
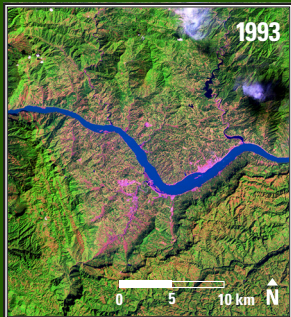
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Three Gorges Dam, China



Three Gorges Dam, China 1993–2020

Construction on the Three Gorges Dam began in 1992, and the reservoir began to fill in June 2003. The name “Three Gorges” refers to the narrow gorges the Yangtze River flows through in this mountainous region. The world’s largest hydroelectric power plant, it has a generating capacity of 22,500 megawatts.

Date	Satellite	Bands	Res	Path	Row
Sept. 24, 1993	Landsat 5 TM	7,4,2	30 m	125	39
Sept. 18, 2020	Landsat 8 OLI	7,5,4	30 m	125	39

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Shanghai, China



Shanghai, China 1984–2021

It seems the term megacity was created for places like Shanghai, China. Home to 22 million people in 2021, it's the largest city in China and 8th largest in the world. Smaller populated areas outside of Shanghai expanded over time and then were absorbed by the urban expansion.

Date	Satellite	Bands	Res	Path	Row
Apr. 23, 1984	Landsat 5 TM	7,5,3	30 m	118	38,39
Apr. 29, 2021	Landsat 8 OLI	7,6,4	30 m	118	38,39

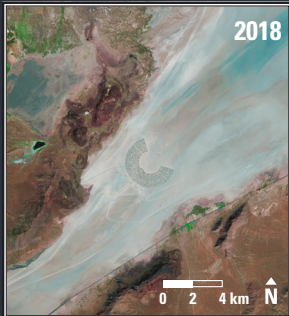
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Black Rock Playa, Nevada, USA



Black Rock Playa, Nevada, USA 1996–2018

A dry, dusty, desolate lakebed is the site of Burning Man, a weeklong arts and culture festival that ends during Labor Day weekend with the burning of a huge wooden effigy. Part of the event is the construction of a temporary metropolis named Black Rock City. The pentagonal “trash fence” surrounding the city catches wind-blown garbage.

Date	Satellite	Bands	Res	Path	Row
Sept. 1, 1996	Landsat 5 TM	7,4,2	30 m	43	42
Aug. 29, 2018	Landsat 8 OLI	7,5,4	30 m	43	42

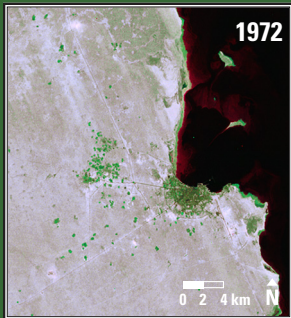
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Doha, Qatar



Doha, Qatar 1972–2022

Doha, the capital of Qatar, used to be a small fishing and pearl diving village. It's now Qatar's largest city. After the turn of the 21st century, Doha's growth involved adding land area. A new airport and a development called the Pearl-Qatar were added to the coastline, including a string of nine artificial islands called Isola Dana.

Date	Satellite	Bands	Res	Path	Row
Sept. 3, 1972	Landsat 1 MSS	4,7,5	60 m	175	42
Sept. 2, 2022	Landsat 8 OLI	6,5,4	30 m	163	42

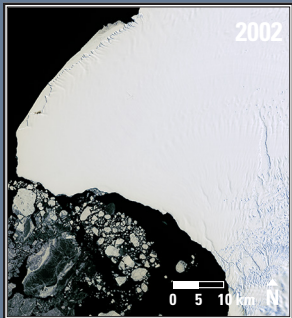
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Brunt Ice Shelf, Antarctica



Brunt Ice Shelf, Antarctica 2002–2022

A feature known as Chasm 1 on the Brunt Ice Shelf reactivated in December 2012 after no movement for 35 years. In early 2019, Chasm 1 was extending north as fast as 4 kilometers per year, and from 2012 to 2021, the rift widened almost threefold. Chasm 1 also moves westward with the flow of the ice shelf.

Date	Satellite	Bands	Res	Path	Row
Dec. 13, 2002	Landsat 7 ETM+	3,2,1	30 m	182	114
Feb. 8, 2022	Landsat 9 OLI-2	4,3,2	30 m	185	114

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Sharq El Owainat, Egypt

1985

0 5 10 km N

2022

0 5 10 km N



Sharq El Owainat, Egypt 1985–2022

Green fields appear on the dry sands of the Sahara Desert. Precipitation is extremely rare in this region of southern Egypt, so how is there enough water for all these crops? Groundwater is pumped from the Nubian Sandstone Aquifer System and spread to the fields via center-pivot irrigation sprinklers.

Date	Satellite	Bands	Res	Path	Row
Apr. 23, 1985	Landsat 5 TM	7,4,2	30 m	177	44
Jan. 23, 2022	Landsat 8 OLI	7,5,4	30 m	177	44

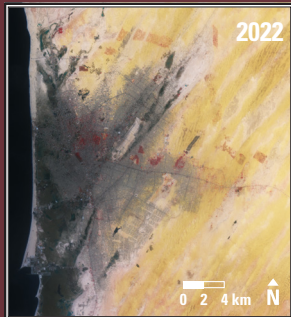
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Nouakchott, Mauritania



Nouakchott, Mauritania 1973–2022

From small fishing town to rapidly expanding national capital, Nouakchott is surrounded by shifting sand dunes from the north and east, threatened by sea level rise from the west, and facing rising salty groundwater from below. As recently as 1950, the city only had about 200 residents. It now has nearly 1.5 million people.

Date	Satellite	Bands	Res	Path	Row
Sept. 25, 1973	Landsat 1 MSS	7,6,5	60 m	220	48
Aug. 15, 2022	Landsat 9 OLI-2	5,4,3	30 m	205	47

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Mesopotamian Marshes, Iraq



Mesopotamian Marshes, Iraq 1972–2022

Imagery from Landsat's first few weeks of operation in summer 1972 shows the Mesopotamian Marshes at nearly their maximum extent. Throughout the 1990s, the marshes declined dramatically. A partial recovery began after 2003, but the region remains vulnerable to drought, human activities upstream, and international conflict.

Date	Satellite	Bands	Res	Path	Row
Aug. 1,2, 1972	Landsat 1 MSS	4,3,2	60 m	178,179	38,39
May 10,11, 2022	Landsat 8,9 OLI	5,4,3	30 m	165,166	38,39

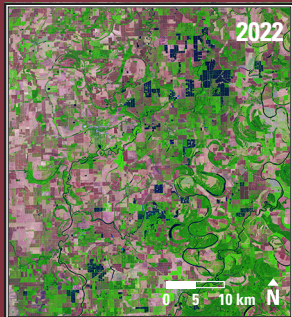
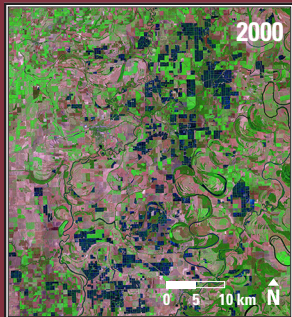
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Catfish Farms, Mississippi, USA



Catfish Farms, Mississippi, USA 2000–2022

In northwestern Mississippi, the catfish industry grew during the 1980s and 1990s. Pond acreage reduced after 2000. The blue-tinted shapes mark the ponds where catfish are raised. The ponds are built above ground with levees, and the water in the ponds is 4–6 feet deep. The washed-out pink areas are harvested fields.

Date	Satellite	Bands	Res	Path	Row
Sept. 16, 2000	Landsat 5 TM	7,4,2	30 m	23	37
Sept. 13, 2022	Landsat 9 OLI	7,5,4	30 m	23	37

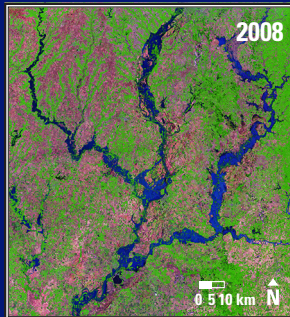
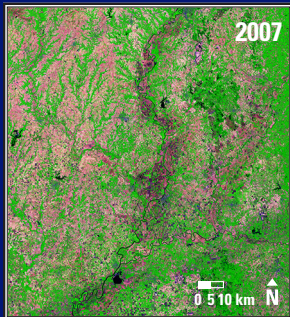
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Illinois/Indiana, USA



Illinois/Indiana, USA 2007–2008

Rainfall amounts ranging from about 2 inches to more than 10 inches fell in this area on June 6–7, 2008. Springtime that year was wetter than normal, so the heavy rain easily saturated the ground. The rivers quickly rose to exceed flood stage. Landsat shows the Embarras, Wabash, Eel, and White Rivers all overflowing their banks.

Date	Satellite	Bands	Res	Path	Row
June 9, 2007	Landsat 5 TM	5,4,3	30 m	22	33
June 11, 2008	Landsat 5 TM	5,4,3	30 m	22	33

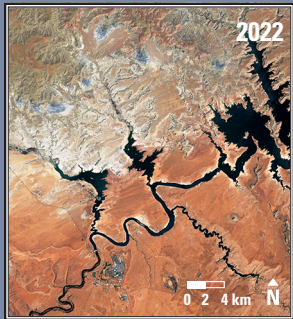
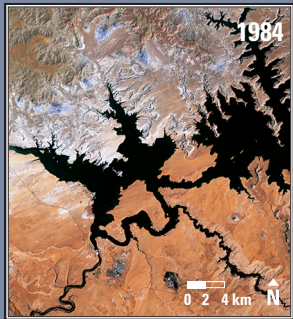
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Lake Powell, Utah and Arizona, USA



Lake Powell, Utah and Arizona, USA 1984–2022

Glen Canyon Dam on the Colorado River was completed in 1963 and formed Lake Powell. The reservoir finished filling in 1980. The highest water level recorded was in July 1983. An extended drought since 2000 has reduced the reservoir's size. Near the dam is Page, Arizona, which began in 1957 as a housing camp for workers building the dam.

Date	Satellite	Bands	Res	Path	Row
July 4, 1984	Landsat 5 TM	3,2,1	30 m	37	34
June 27, 2022	Landsat 8 OLI	4,3,2	30 m	37	34

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Bakken Oil Boom, North Dakota, USA



Bakken Oil Boom, North Dakota, USA 2001–2022

The Bakken oil boom has made North Dakota the second leading oil producing state—behind only Texas. Evidence of this boom is apparent on the landscape. Well pads are scattered across the region. These rectangular shaped areas of land cover 4–7 acres each.

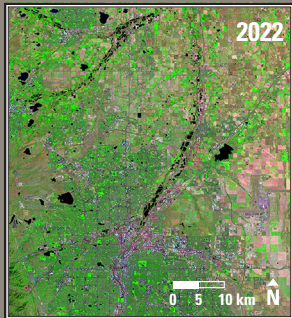
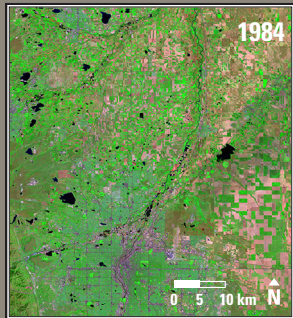
Date	Satellite	Bands	Res	Path	Row
July 6, 2001	Landsat 7 ETM+	3,2,1	15 m	34	26,27
July 16, 2022	Landsat 9 OLI-2	4,3,2	15 m	34	26,27

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Denver, Colorado, USA



Denver, Colorado, USA 1984–2022

Purple hues represent streets and highways in the expanding city of Denver. Bright green is vegetation, so parks and golf courses are the brightest green. Denver International Airport, northeast of the city and completed in 1995, sits on 34,000 acres of land, making it the second largest airport in the world.

Date	Satellite	Bands	Res	Path	Row
June 22, 1984	Landsat 5 TM	7,4,2	30 m	33	32
June 15, 2022	Landsat 8 OLI	7,5,4	30 m	33	32

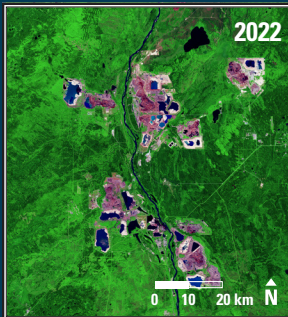
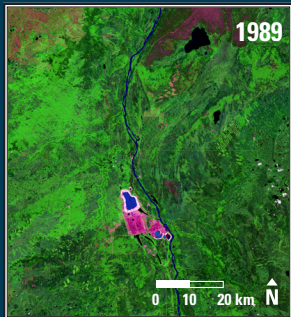
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Athabasca Oil Sands, Alberta, Canada



Athabasca Oil Sands, Alberta, Canada 1989–2022

One of the world's largest oil reserves sits under the boreal forest of northwestern Alberta, Canada. In the Athabasca region near Fort McMurray, the oil sands are shallow enough for surface mining. Once the forest is cleared, the soil and rock above the oil sand is removed. This creates the maroon or gray irregularly shaped open pits.

Date	Satellite	Bands	Res	Path	Row
Aug. 6, 1989	Landsat 5 TM	7,4,2	30 m	42	20
Aug. 25, 2022	Landsat 9 OLI	7,5,4	30 m	42	20

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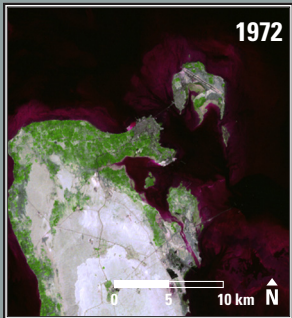
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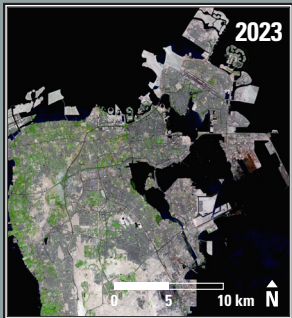
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Bahrain, Middle East

1972



2023



Bahrain, Middle East 1972–2023

The most noticeable land change in Bahrain is the addition of land itself. Added land is dredged from the seabed in massive reclamation projects. The country's urban areas are expanding onto these artificial islands and inland into the desert.

Date	Satellite	Bands	Res	Path	Row
Sept. 3, 1972	Landsat 1 MSS	4,7,5	60 m	175	42
Aug. 28, 2023	Landsat 9 OLI	7,5,4	30 m	163	42

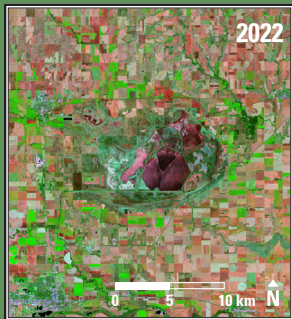
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Cheyenne Bottoms, Kansas, USA



Cheyenne Bottoms, Kansas, USA 2021–2022

Cheyenne Bottoms in central Kansas is the largest inland wetland in the United States. Two intermittent streams flow into the Bottoms from the northwest. Canals were built to divert water from the Arkansas River and Wet Walnut Creek to provide a source of supplemental water to the wetland. However, a drought in 2022 left the Bottoms dry.

Date	Satellite	Bands	Res	Path	Row
Oct. 22, 2021	Landsat 8 OLI	7,5,4	30 m	29	33
Oct. 25, 2022	Landsat 8 OLI	7,5,4	30 m	29	33

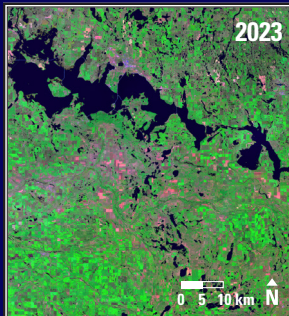
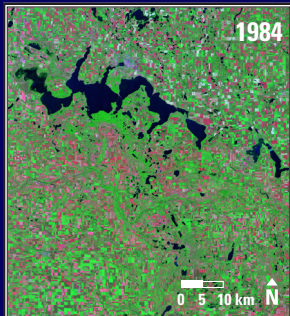
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Devils Lake, North Dakota, USA



Devils Lake, North Dakota, USA 1984–2023

Devils Lake in northeastern North Dakota doesn't have an outlet. This makes the lake more prone to significant lake level variations. A trend of above average precipitation in the region has caused Devils Lake's water level to rise. The loss of farmland to the growing lake has been occurring for 3 decades.

Date	Satellite	Bands	Res	Path	Row
Aug. 11, 1984	Landsat 5 TM	7,4,1	30 m	31	27
Aug. 15, 2023	Landsat 9 OLI	7,5,1	30 m	31	27

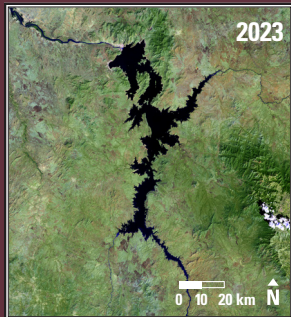
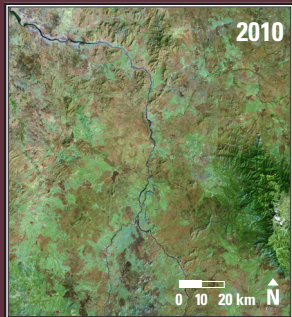
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Grand Ethiopian Renaissance Dam, Ethiopia



Grand Ethiopian Renaissance Dam, Ethiopia 2010–2023

Under construction since 2011, the Grand Ethiopian Renaissance Dam spans the Blue Nile River in Ethiopia. The curved shape southwest of the main dam is referred to as the Saddle Dam, and the reservoir's water level reached it for the first time in 2022. The dam's power generation will double Ethiopia's previous output of electricity.

Date	Satellite	Bands	Res	Path	Row
Jan. 12, 2010	Landsat 5 TM	7,5,3	30 m	171	52, 53
Jan. 8, 2023	Landsat 9 OLI	7,6,4	30 m	171	52, 53

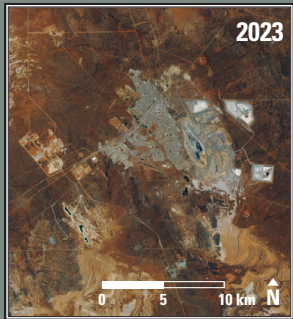
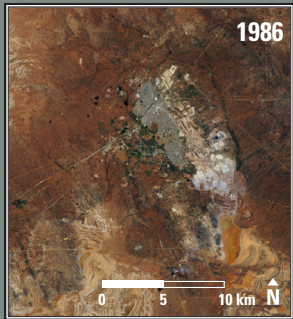
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Kalgoorlie, Western Australia



Kalgoorlie, Western Australia 1986–2023

The Super Pit at Kalgoorlie, Western Australia, is the largest open-pit gold mine in Australia. Trucks haul tons of rock and dirt out of the pit every day. Large quantities of ore need to be moved to get to the gold. Sparse vegetation surrounds Kalgoorlie and the mine.

Date	Satellite	Bands	Res	Path	Row
Sept. 21, 1986	Landsat 5 TM	3,2,1	30 m	109	81
Jan. 6, 2023	Landsat 9 OLI	4,3,2	30 m	109	81

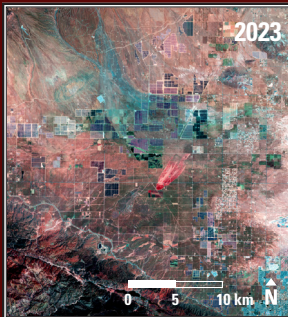
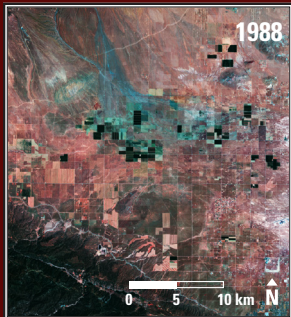
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Antelope Valley, California, USA



Antelope Valley, California, USA 1988–2023

Antelope Valley in southern California is the western part of the Mojave Desert. The region has plenty of clear, sunny days, making it ideal for solar farms. The state's solar farms have expanded for 3 decades on land that once required extensive irrigation to produce crops.

Date	Satellite	Bands	Res	Path	Row
June 9, 1988	Landsat 5 TM	7,2,1	30 m	41	36
June 26, 2023	Landsat 8 OLI	7,3,2	30 m	41	36

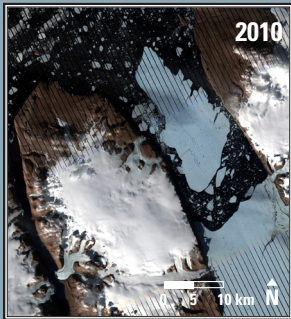
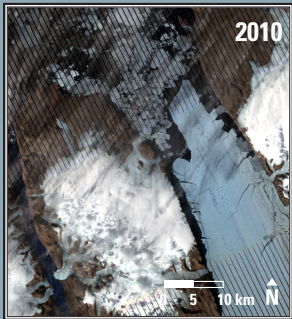
Earthshots: Satellite Images of Environmental Change

The U.S. Geological Survey Earth Resources Observation and Science (EROS) Center archives data from the Landsat satellites (1972–present). Earthshots presents environmental changes using Landsat images.



eros.usgs.gov/earthshots

Petermann Glacier, Greenland



Petermann Glacier, Greenland 2010

A huge iceberg broke off Petermann Glacier in 2010. Located on the northwestern coast of Greenland, Petermann Glacier is the longest floating glacier in the Northern Hemisphere. The massive calving event removed 28 kilometers of the ice shelf. The result was an ice island four times the size of Manhattan.

Date	Satellite	Bands	Res	Path	Row
July 28, 2010	Landsat 7 ETM+	4,3,2	30 m	45	1
Aug. 13, 2010	Landsat 7 ETM+	4,3,2	30 m	45	1

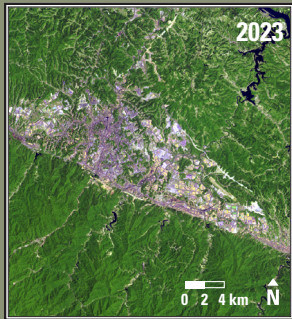
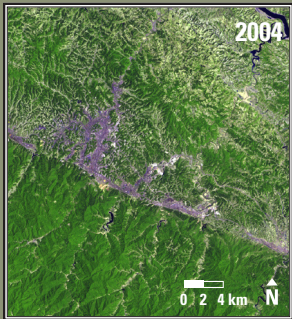
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Shiyan, China



Shiyan, China 2004–2023

In Shiyan, China, land is being prepared for building by flattening mountaintops. Explosives are used to level the hills, and the displaced soil and rock are then used to fill in the valleys. Most of the new land is used for warehouses and industry.

Date	Satellite	Bands	Res	Path	Row
May 17, 2004	Landsat 5 TM	7,5,3	30 m	125	37
May 14, 2023	Landsat 9 OLI	7,6,4	30 m	125	37

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Atchafalaya Delta, Louisiana, USA



Atchafalaya Delta, Louisiana, USA 1984–2022

The Atchafalaya River, a distributary of the Mississippi River, has been building two deltas for several decades. The Atchafalaya flows slowly, which allows sediment to settle out, creating the deltas. The rest of the Louisiana coastline is retreating because the swift moving Mississippi River waters don't allow the sediment to settle.

Date	Satellite	Bands	Res	Path	Row
Nov. 7, 1984	Landsat 5 TM	7,4,2	30 m	23	39,40
Sept. 21, 2022	Landsat 9 OLI	7,5,4	30 m	23	39,40

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These Earthshots change pair images introduce remote sensing by showing how satellite imagery is used to track change over time. Go to eros.usgs.gov/earthshots to see landscape change at locations around the world.



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