5.2.2 NASA AND USGS

CHANGE IMAGERY RESOURCES
NASA: Getting the Big Picture

Water Falls

Getting the Big Picture

[thunder, music]
World of Change: Snowpack in the Sierra Nevada

Wet and dry years cause the snow cover to fluctuate, but the overall trend has been downward for nearly a decade.

World of Change: Arctic Sea Ice

Several record-setting summer lows, combined with poor wintertime recoveries, have

https://earthobservatory.nasa.gov/world-of-change
https://earthobservatory.nasa.gov/world-of-change/SierraNevada
https://earthobservatory.nasa.gov/world-of-change/CapeCod

1984

2019
https://earthobservatory.nasa.gov/world-of-change/Athabasca/show-all
Snow Cover
Snow and ice influence climate by reflecting sunlight back into space. When it melts, snow is a source of water for drinking and vegetation; too much snowmelt can lead to floods. These maps show average snow cover by month.

Chlorophyll
Chlorophyll is used by algae and other phytoplankton—the grass of the sea—to convert sunlight and carbon dioxide into sugars. These maps show chlorophyll concentrations in the ocean, revealing where phytoplankton are thriving.

Net Radiation
Net radiation is the balance between incoming and outgoing energy at the top of the atmosphere. It is the total energy available to influence climate after light and heat are reflected, absorbed, or emitted by clouds and land.

Cloud Fraction
In addition to making rain and snow, clouds can have a warming or cooling influence depending on their altitude, type, and when they form. These maps show what fraction of an area was cloudy each month.
Global Maps
Mar 2000 – May 2020
Aerosol Optical Depth
Airborne aerosols can cause or prevent cloud formation and harm human health. These maps depict aerosol concentrations in the air based on how the tiny particles reflect or absorb visible and infrared light.

Global Maps
Jul 2002 – May 2020
Water Vapor
These maps show the average amount of water vapor in a column of atmosphere by month. Water vapor is the key precursor for rain and snow and one of the most important greenhouse gases in the atmosphere.

Global Maps
Mar 2000 – May 2020
Vegetation
Greenness is an important indicator of health for forests, grasslands, and farms. The greenness of a landscape, or vegetation index, depends on the number and type of plants, how leafy they are, and how healthy they are.

Global Maps
Feb 2000 – May 2020
Land Surface Temperature
Land surface temperatures rise and fall with the heat of the Sun, and they represent how hot or cold the surface would feel to touch. These maps show daytime land temperatures as measured from space.
**Global Maps**

**Fire**
Whether started by humans (farming, logging, or accidents) or by nature (lightning), fires are always burning somewhere on Earth. These maps show the locations of fires burning around the world each month.

**Land Surface Temperature Anomaly**
These maps depict anomalies in land surface temperatures (LSTs); that is, how much hotter or cooler a region was compared to the long-term average. LST anomalies can indicate heat waves or cold spells.

**Sea Surface Temperature**
Ocean temperatures can influence weather, such as hurricane formation, and climate patterns, such as El Niño. These maps show the temperature at the surface of the world's seas and oceans.

**Carbon Monoxide**
When fuels such as coal, wood, and oil burn incompletely, they produce carbon monoxide. The gas is spread by winds and circulation. These maps show monthly averages of CO in the lower atmosphere.
Net Primary Productivity

These maps show the ‘metabolism’ of Earth’s plants and trees. Net primary productivity is the difference between the amount of carbon dioxide absorbed during photosynthesis minus the amount released by respiration.

Total Rainfall

These maps depict monthly total rainfall around the world. Rainfall is the primary source of fresh water for humans, plants, and animals. Rain also moves heat between the atmosphere, oceans, and land.

Aerosol Size

Sea salt, volcanic ash, dust, wildfire smoke, and industrial pollution are types of airborne aerosols. Natural aerosols tend to be larger than human-made aerosols. These maps show when and where aerosols come from nature, humans, or both.

Sea Surface Temperature Anomaly

These maps depict how much hotter or cooler an ocean basin was compared to the long-term average. Temperature anomalies can indicate changes in ocean circulation or the arrival of patterns like El Niño and La Niña.
Images

Change and Preservation Around Paranapanema
Human activity and natural beauty merge in south-central Brazil.
Published Apr 24, 2022

Island Hopping in Tawi-Tawi
In this part of the southern Philippines, the aquatic life sustains the livelihoods of many islanders.
Published Apr 23, 2022

Spring Fire on the Steppe
The fast-moving blaze charred grassland in eastern Mongolia.
Published Apr 22, 2022

A Salty Sanctuary in Baja California Sur
Laguna Ojo de Liebre, a lagoon on the Baja California Peninsula, is a whale sanctuary and the site of one of the largest saltworks in the world.
Published Apr 26, 2022

Spring in the Tennessee Valley
Greening valleys and alpine reservoirs near Knoxville stand out in this April satellite image.
Published Apr 21, 2022

Images (nasa.gov)
Articles (nasa.gov)
Earth — A Photo-Essay

NASA has a unique vantage point for observing the beauty and wonder of Earth and for making sense of it. The images in this book tell a story of a 4.5-billion-year-old planet where there is always something new to see.

Published Apr 28, 2021

EO Explorer

Since 1999, Earth Observatory has published images and stories from all over our planet. Now you can explore more than 11,000 images in a different way: by location.

Published Jun 2, 2021

EO Explorer (nasa.gov)
Earth Observatory Blogs (nasa.gov)
April Puzzler

Published 4/17/2022 in Earth Matters

Your challenge this month has a new twist: tell us what you see.

read more ›
Dust: A True World Traveler

How far can dust travel? Where does it come from? Explore the answers to these questions and make a model of how dust affects sky visibility in Dust a True World Traveler.

We would appreciate any comments or feedback you could provide to us about this new publication (e.g., content, style, format): Let us know what you think.
https://earthshots.usgs.gov/earthshots/
Mountaintop coal mining is a major cause of land cover changes in the central Appalachian Mountains of the eastern United States. The landscape disturbance caused by mountaintop mining is different from others (such as forestry, urbanization, or agriculture) in that it can extend deeply into the ground, disturbing even the bedrock. Landsat imagery from the 1970s has catalogued the changes.

These false color images show the natural landscape of the area: forested mountains are bright green, and numerous streams and valleys give the land a wrinkled appearance. Mining areas are pink, and reclaimed mining land is usually light green.

The reason for the large-scale change caused by this type of mining is that one ton of coal is extracted for every 16 tons of terrain displaced. In the mountainous Appalachian landscape, the displaced material ends up in river valleys. More than just the look of the landscape changes—the drainage network itself is altered.

First mined in the 19th century, low-sulfur Appalachian coal can be extracted relatively cost-effectively by the mountaintop removal process. This method allows almost all of the coal in a seam to be removed. Understanding the hydrologic changes brought on by this mining practice is key to the future of the communities in the region.
Mountaintop Mining, West Virginia, USA

Hydrology
The effects on the hydrology in the region where mountaintop mining takes place is not well understood—how does this mining activity affect the movement of water?

Read More

Mining Operations
Appalachian coal lies underground in thin seams, too thin for underground mine shafts. The only way to extract the coal profitably is with surface mining.

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Reclamation
The Surface Mining Control and Reclamation Act of 1977 requires that mined lands be restored to an acceptable land cover. These images show some of the results.

Read More
In the Amazon basin, some rivers run wild. With no dams or levees to control them, they are free to meander—some more than others.

For example, the Rio Mamoré, which flows north across Bolivia, is one such wanderer. It flows from the Andes Mountains and across the Bolivian lowlands into Brazil. Watching this river meander in Landsat images over the past few decades shows us how much a river can meander under natural conditions. The Mamoré has a large sediment load, so it meanders more than most.

These meandering river dynamics are important for maintaining a healthy habitat. The floodplains here depend on the river migration to maintain the wetland habitats.

The growing city of Trinidad, with a population of over 100,000, can be seen in the upper right of these images, just east of the river.

Mamoré River, Bolivia | Earth Resources Observation and Science (EROS) Center (usgs.gov)
Oxbow Lakes
The more a river meanders, the more cutoffs form. Cutoffs form more frequently on rivers that have more sediment. Flanking the Mamoré River in these i...

Point Bars
The Mamoré River carries sediment from the rapidly eroding Bolivian Andes. The steep terrain coupled with high river discharge in the Andes causes a h...

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USGS SATELLITE IMAGES: CHANGE PAIR GAME


Tracking Changes to the Earth’s Surface
Interpreting Satellite Images

From 438 miles above the Earth, Landsat satellites capture all sorts of changes on the Earth’s surface. Scientists study these images to learn about changes happening on our planet.

Test your ability to see what a scientist sees!

We’re going to show you 10 pairs of satellite images. Figure out what changed and what might have caused it! Notice the dates the images were taken. Sometimes, they might be a strong clue to the correct answer.
What changed in this pair of Landsat images?

- A) Flooding
- B) Shrinking lake
- C) Hail storm damage
- D) Forest fire