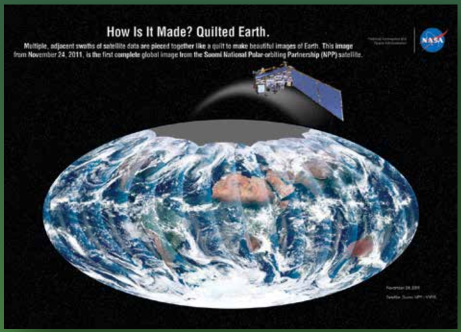
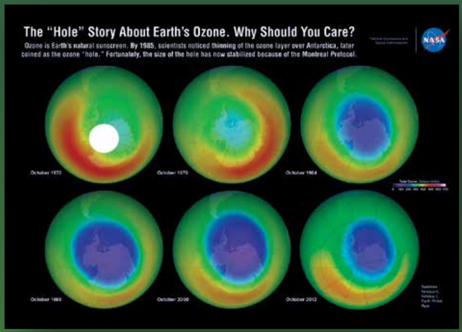
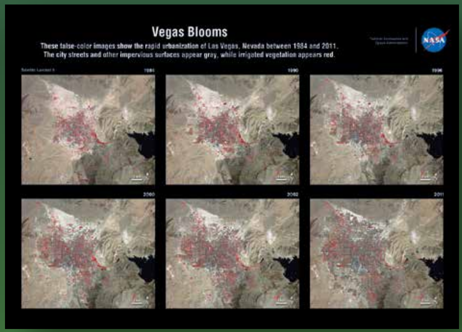
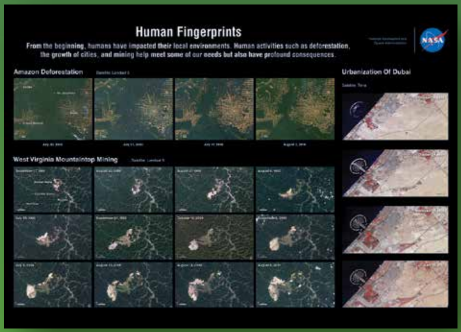
National Aeronautics and Space Administration

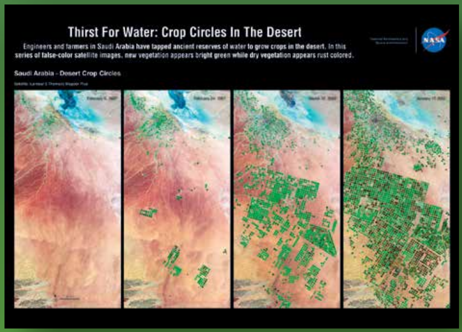
NASA Science Gallery

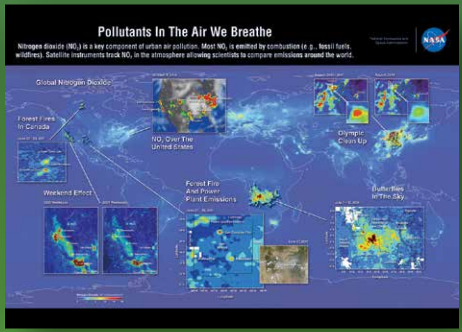






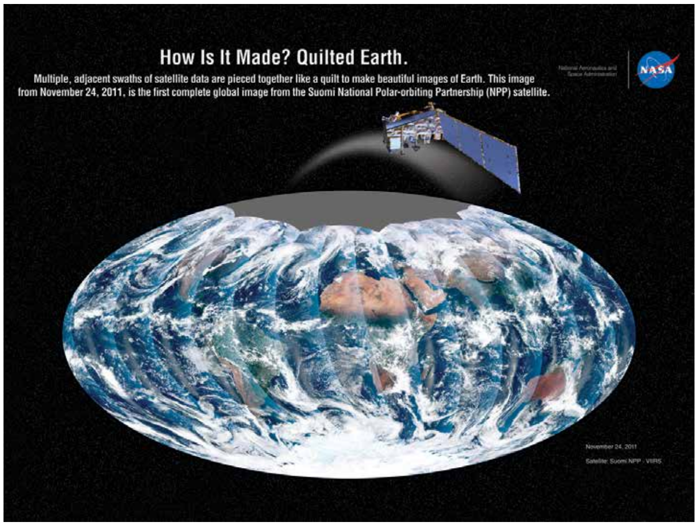






eospso.nasa.gov/sites/default/files/publications/sgb.pdf

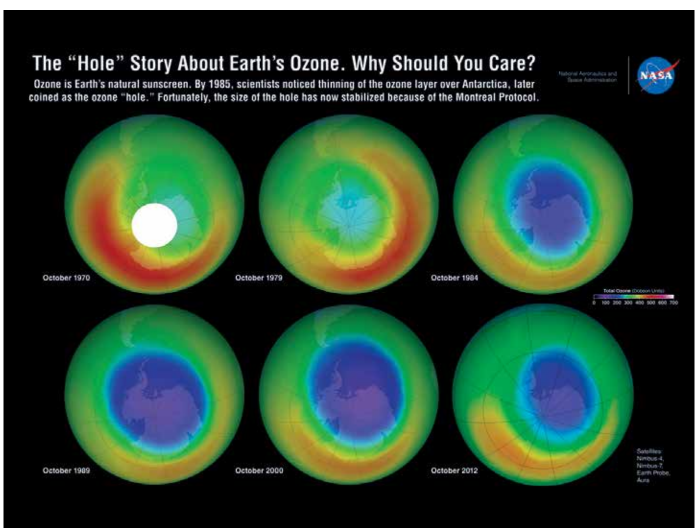
How Is It Made? Quilted Earth.



Satellites like Suomi National Polar-orbiting Partnership (NPP) get a complete view of our planet each day, which allows us to create beautiful images of Earth like the one pictured here. While it might seem simple, it is actually a rather complex process. Multiple, adjacent swaths of satellite data are pieced together like a quilt to make one global image. Suomi NPP was placed in a unique orbit around the planet that takes the satellite over the equator at the same local (ground) time every orbit. The satellite images the Earth's surface in long wedges measuring 1900 miles across. The swaths from each successive orbit overlap one another, so that at the end of the day, the satellite has a complete view of the world. Data over the Arctic are missing because the surface is too dark to view in visible light during the winter. This image from November 24, 2011, is the first complete global image from Suomi NPP.

For more information, visit:
earthobservatory.nasa.gov/IOTD/view.php?id=76674

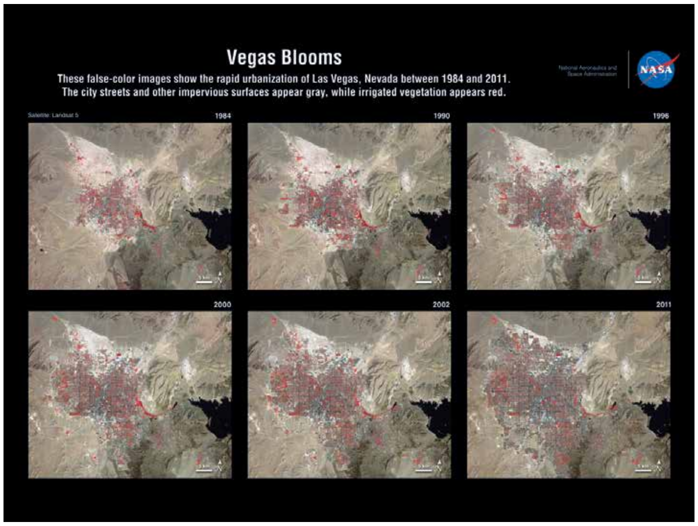
The "Hole" Story About Earth's Ozone. Why Should You Care?



Ozone is Earth's natural sunscreen, shielding life from dangerous solar ultraviolet radiation. Unfortunately, human-produced chemicals in our atmosphere—such as chlorofluorocarbons (CFCs), used as refrigerants and in aerosol spray cans—have depleted the Earth's ozone layer. By 1985, scientists had discovered something peculiar over Antarctica—a significant thinning of the ozone layer, later coined as the Antarctic ozone hole. In the 1980s, governments around the world negotiated the Montreal Protocol—an international treaty designed to protect the ozone layer by banning CFCs and similar ozone-depleting chemicals. The images show the monthly-averaged total ozone over Antarctica for 1970, 1979, 1984, 1989, 2000, and 2012 in October. Ozone typically reaches its maximum depletion over Antarctica in October due to special meteorological phenomena that exist nowhere else on the planet. The hole increased in severity from 1970-1995 as CFC levels increased. Fortunately, the size of the hole has now stabilized because of the Montreal Protocol, and it should return to pre-1980 levels by about 2065.

For more information, visit:
earthobservatory.nasa.gov/Features/WorldOfChange/ozone.php

Vegas Blooms

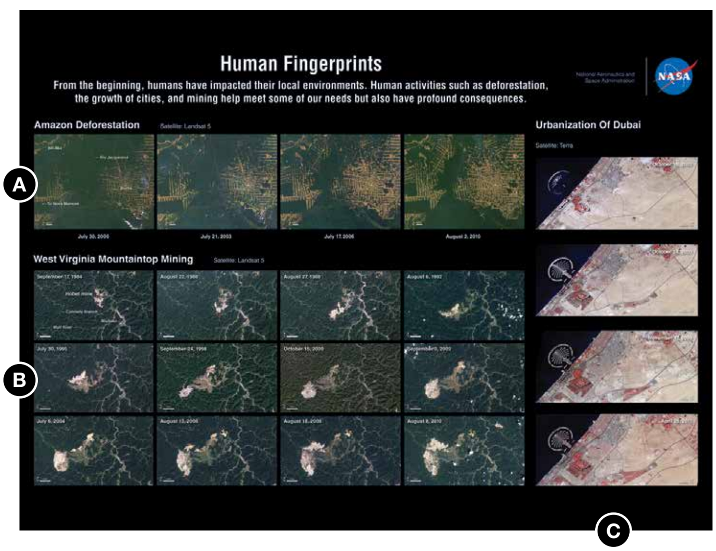


The city of Las Vegas—meaning the meadows—was established in 1905. Its grassy meadows and artesian springs attracted settlers traveling across the arid Desert Southwest in the early 1800s. In the 1930s, gambling became legal and construction of the Hoover Dam began, resulting in the city's first growth spurt. Since then, Las Vegas has not stopped growing. Population has reached nearly two million over the past decade, becoming one of the fastest growing metropolitan areas in the world. These false-color images show the rapid urbanization of Las Vegas between 1984 and 2011. The city streets and other impervious surfaces appear gray, while irrigated vegetation appears red. Over the years, the expansion of irrigated vegetation (e.g., lawns and golf courses) has stretched the city's desert bounds.

For more information, visit:
svs.gsfc.nasa.gov/goto?10721

Human Fingerprints

We have impacted local environments ever since the first humans arrived. From the beginning, walking, crawling, lying down, eating, breathing, and depositing waste have all had impacts on the immediate environment.



A) Amazon Deforestation

The state of Rondônia in western Brazil has become one of the most deforested parts of the Amazon. These satellite images show the rapid loss of forests across the area from 2000 to 2010. Intact forest is deep green, while cleared areas are tan (bare ground) or light green (crops, pasture, second-growth forest). Major tropical forests , such as these, are disappearing across the globe, mostly for human food production. Although tropical deforestation meets some needs, it also has profound consequences, including social conflict, extinction of plants and animals, and climate change—challenges that affect the whole world.

B) West Virginia Mountaintop Mining

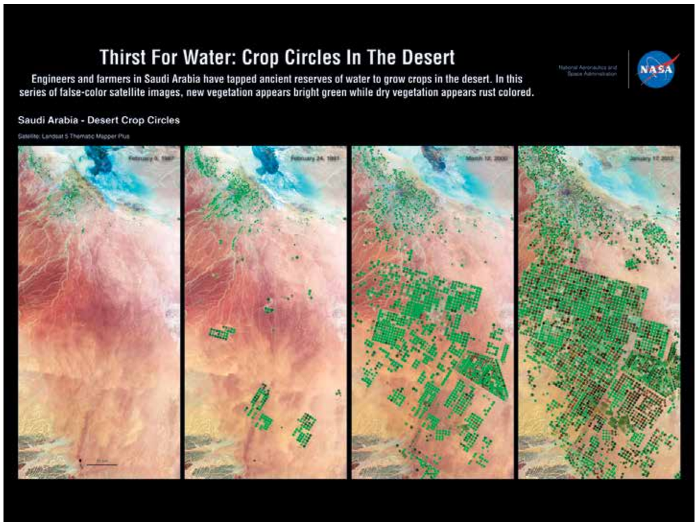
This time-series shows the growth of the Hobet mine, in West Virginia, from September 17, 1984 to August 8, 2010. Active mines appear off-white, while areas being reclaimed with vegetation appear light green. Over the 26-year period, the disturbed area grew to more than 10,000 acres. Some argue that current regulations and mitigation strategies are inadequate and that impacts on stream and groundwater quality, biodiversity, and forest productivity are irreversible.

C) Urbanization Of Dubai

To expand the possibilities for beachfront tourist development, Dubai undertook a massive engineering project to create hundreds of artificial islands. This image series shows the progress of the Palm Jumeirah Island between October 16, 2002 and April 25, 2011. In these false-color images, bare ground appears tan, vegetation appears red, water appears dark blue, and buildings appear light blue or gray.

For more information, visit:
earthobservatory.nasa.gov/Features/WorldOfChange

Thirst For Water: Crop Circles In The Desert

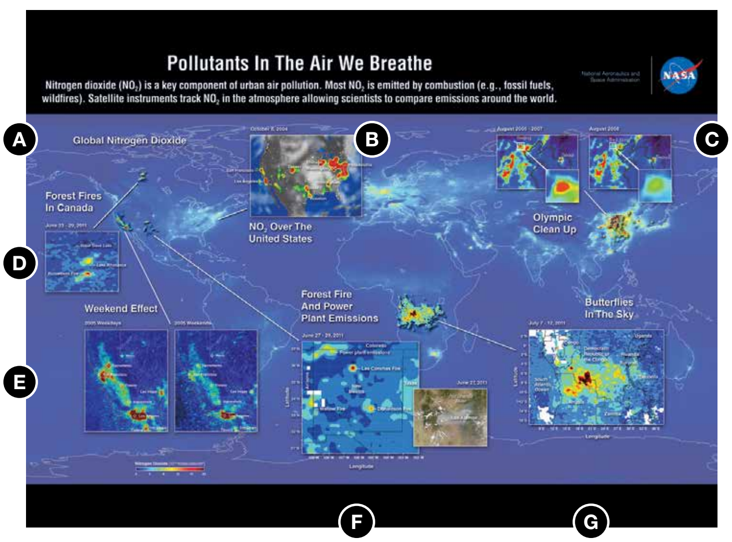


Over the past three decades, Saudi Arabia has been drilling for a resource more precious than oil. Engineers and farmers have tapped ancient reserves of water, dating back to the last Ice Age, to grow crops in the desert. This series of false-color satellite images show the evolution of agricultural operations in the Wadi As-Sirhan Basin. New vegetation appears bright green while dry vegetation or fallow fields appear rust colored. Dry, barren surfaces (mostly desert) are pink and yellow. Saudi Arabians have reached this underground water source by drilling wells through sedimentary rock, as much as a kilometer beneath the desert sands. Rainfall averages just 100 to 200 millimeters per year and usually does not recharge the underground aquifers, making the groundwater a non-renewable source. Although no one knows how much water lies beneath the desert—estimates range from 252 to 870 cubic kilometers—hydrologists believe it will only be economical to pump it for about 50 years.

For more information, visit:
earthobservatory.nasa.gov/IOTD/view.php?id=77900

Pollutants In The Air We Breathe

Nitrogen dioxide (NO_2) is a key component of urban air pollution.
Most NO_2 is emitted by combustion (e.g., fossil fuels, wildfires).



A) Global Nitrogen Dioxide

Satellite instruments track NO_2 in the atmosphere allowing scientists to compare NO_2 emissions around the world like those shown in this global image.

B) NO_2 Over The United States

Dominant NO_2 source regions in the U.S. correspond primarily to areas with high population and large industry.

C) Olympic Clean Up

The image on the left shows high levels of NO_2 over Beijing, China from August 2005-2007. In 2008, China temporarily shuttered some factories and banished many cars in a pre-Olympic sprint to clean up Beijing's air. As a result, levels of NO_2 plunged nearly 50 percent.

D) Forest Fires In Canada

This image shows NO_2 coming from forest fires in Canada's Northwest Territory from June 23-29, 2011. Concentrations near the Richardson Fire appear to be the highest (red).

E) Weekend Effect

A comparison between weekdays (left) and weekend days (right) shows dramatic decreases in NO_2 levels above urban cities in California. The decline is likely due to lighter travel on the weekends.

F) Forest Fire And Power Plant Emissions

In this image, the highest levels of NO_2 are located at the burn site of the Las Conchas Fire near Los Alamos, New Mexico. Elevated NO_2 levels from the Donaldson and Wallow Fire, as well as coal-burning power plants are also visible.

G) Butterflies In The Sky

Controlled agricultural fires in central Africa generated high amounts of NO_2 from July 7-12, 2011. The dark red butterfly shape reveals the highest concentrations.

For more information, visit:
eospso.gsfc.nasa.gov/sites/default/files/publications/NO2poster_508.pdf

What's Shrinking In The Arctic?

The most visible change in the Arctic region in recent years has been the rapid decline of sea ice, but that's not all.

A) Decline In Multi-year Arctic Sea Ice Area

This graphic shows the decline in multi-year Arctic sea ice area from 1980 to 2012. The disappearance of the multi-year ice—i.e., the oldest and thickest ice—makes Arctic sea ice more vulnerable to further decline in the summer.

B) Arctic Sea Ice Hits Smallest Extent In Satellite Era

On September 16, 2012, sea ice covering the Arctic Ocean declined to the lowest extent on record. This image shows the extent of sea ice on that date, compared to the average minimum extent from 1979-2000 (yellow line).

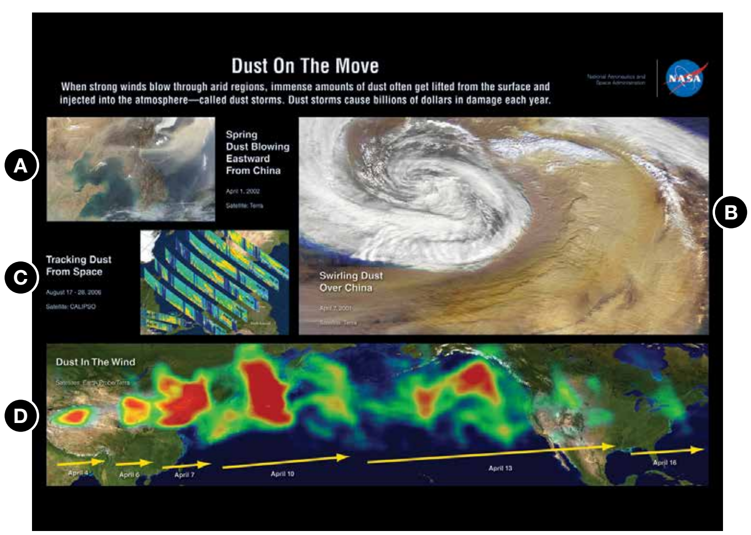
C) Glaciers On The Move

Jakobshavn Isbræ glacier is Greenland's largest outlet glacier and drains 6.5 percent of Greenland's ice sheet area. The ice front, where the glacier calves into the sea, receded more than 40 kilometers between 1850 and 2010. The movement of ice from glaciers on land into the ocean contributes to a rise in sea level.

For more information, visit:
earthobservatory.nasa.gov/Search/index.php?q=arctic

Dust On The Move

When strong winds blow through arid regions, immense amounts of dust often get lifted from the surface and injected into the atmosphere—called dust storms. Dust storms cause billions of dollars in damage each year. Human health, livestock, crops, and fish stocks can all be adversely affected.



A) Spring Dust Blowing Eastward From China

NASA's Terra satellite captured this true color image of a spring dust storm (tan) blowing eastward from China on April 1, 2002.

B) Swirling Dust Over China

NASA's Terra satellite captured this false-color image of a dust storm as it swirled over China on April 7, 2001.

C) Tracking Dust From Space

In this image, vertical slices through the atmosphere show dust from North Africa and smoke from Central Africa in bright orange and yellow, traveling westward across the Atlantic Ocean from August 17-28, 2006.

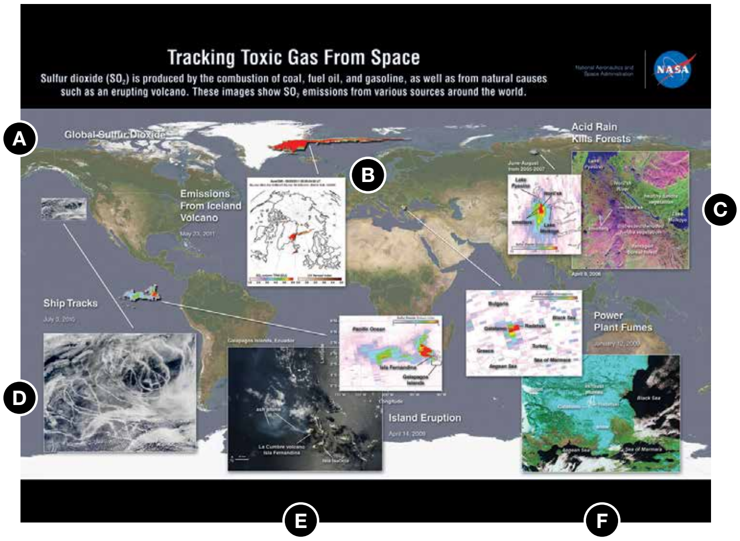
D) Dust In The Wind

This image illustrates the transport of dust from a huge storm in China that moved across the Pacific Ocean and North America to the Atlantic Ocean from April 4-16, 2001. Red areas indicate high Aerosol Index values and correspond to the densest part of the dust cloud. Yellows and greens indicate moderately high values.

For more information, visit:
earthobservatory.nasa.gov/Search/index.php?q=dust

Tracking Toxic Gas From Space

Sulfur dioxide (SO_2)—a colorless, toxic gas that has a pungent, irritating smell—is produced by the combustion of coal, fuel oil, and gasoline, as well as natural causes such as an erupting volcano.



A) Global Sulfur Dioxide

Satellite instruments track SO_2 in the atmosphere allowing scientists to compare SO_2 emissions around the world like those shown in this global image.

B) Emissions From Iceland Volcano

On May 21, 2011, Iceland's Grímsvötn Volcano erupted. This image shows the emission of SO_2 on that day.

C) Acid Rain Kills Forests

SO_2 is a precursor to sulfuric acid, a major ingredient of acid rain. The left image shows concentrations of SO_2 from Siberia's Noril'sk smelting facility. The right image shows expanses of dead forests (revealed in pink and purple shades) mainly caused by acid rain.

D) Ship Tracks

This image shows ship tracks—clouds formed by water vapor condensing on the aerosols coming from large ships. Scientists have discovered that the SO_2 released from ships' smokestacks could be forming sulfate aerosols, which cause clouds to be more reflective, carry more water, and possibly stop precipitating.

E) Island Eruption

The bottom left image shows the volcano plume from the La Cumbre volcano on April 14, 2009. The top image shows SO_2 concentrations from the same day—highest concentrations are red.

F) Power Plant Fumes

The top image shows SO_2 concentrations over one of the largest power plants in Eastern Europe on January 12, 2009. The bottom image shows exhaust plumes coming from the power plant on the same day.

For more information, visit:
eospso.gsfc.nasa.gov/sites/default/files/publications/SO2poster_508.pdf

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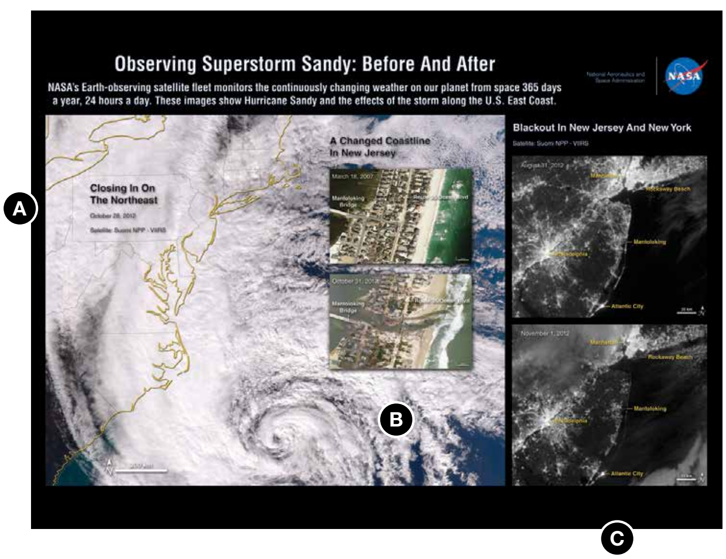
Observing Superstorm Sandy: Before And After



Twenty-four hours a day, seven days a week, NASA's Earth-observing satellite fleet monitors the continuously changing weather on our planet from space, but rarely do they observe storms north of Cape Hatteras, North Carolina as large and intense as Hurricane Sandy.

The rare combination of environmental conditions present during Hurricane Sandy's life cycle led to the development of the storm's unforgettable magnitude—hence, the nickname, "Superstorm Sandy."

A) Closing In On The Northeast

The Suomi National Polar-orbiting Partnership (NPP) satellite acquired this natural-color image of Hurricane Sandy at 1:50 PM Eastern Daylight Time on October 28, 2012.

B) A Changed Coastline In New Jersey

At landfall, heavy rains pelted states as far inland as Wisconsin and surging seawater washed away beaches and flooded streets, businesses, and homes. These two images show a portion of the New Jersey coastal town of Mantolokig, just north of where the storm made landfall, before (March 18, 2007) and after (October 31, 2012) the storm.

C) Blackout In New Jersey And New York

In the days following landfall, millions remained without power. This pair of images shows the difference in city lighting across New Jersey and New York before (August 31, 2012) and after (November 1, 2012) the storm.

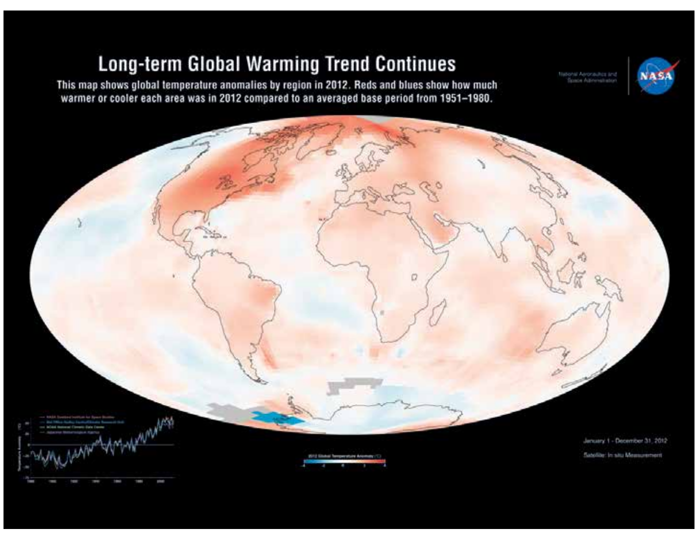
For more information, visit:
earthobservatory.nasa.gov/NaturalHazards/event.php?id=79504

Earth At Night

One way to study the spatial distribution, or arrangement, of human settlements is to view the planet from space during nighttime hours. The brightest areas are generally the most urbanized but not necessarily the most populated. The Visible Infrared Imaging Radiometer Suite (VIIRS) "day-night band" onboard the Suomi National Polar-orbiting Partnership (NPP) satellite can observe dim signals such as city lights (down to the scale of an isolated highway lamp), wildfires, gas flares, auroras, and reflected moonlight during nighttime hours. Swaths of data are processed to find moonless, non-cloudy picture elements, or pixels, for short. Over time, all moonless and non-cloudy pixels for a particular location during night-time hours on Earth are averaged to produce a global image that depicts the Earth's lights at night. Scientists use the Suomi NPP night-lights mosaic in many research applications. The data are used to determine atmospheric and surface characteristics, important when studying future settlement patterns and the effects of future population growth. Once other sources of light like fire and lightning are removed from the VIIRS data, the "human footprint" is revealed. The remaining light comes from stable light sources such as streetlights, headlights, store signs, etc. When a city or country is thriving, electricity is used to keep businesses, schools, and factories bustling with activity, so areas with more of these stable light sources are usually more economically developed. The image shown here is a composite of data acquired over nine days in April and thirteen days in October 2012.

For more information, visit:
earthobservatory.nasa.gov/NaturalHazards/event.php?id=79869

Long-term Global Warming Trend Continues



Scientists at NASA's Goddard Institute for Space Studies (GISS) say 2012 was the ninth warmest year since 1880, continuing a long-term trend of rising global temperatures. The ten warmest years in the 132-year record have all occurred since 1998. The last year that was cooler than average was 1976.

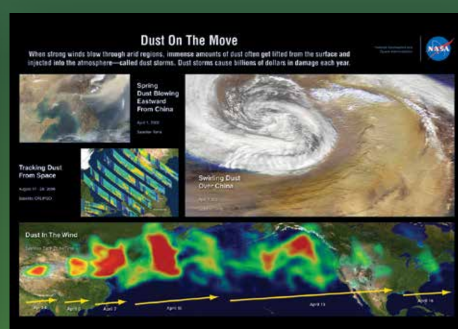
This map shows temperature anomalies, or changes, by region in 2012; it does not show absolute temperature. Reds and blues show how much warmer or cooler each area was in 2012 compared to an averaged base period from 1951–1980. The average temperature in 2012 was about 14.6 degrees Celsius (58.3 degrees Fahrenheit), which is 0.55 °C (1.0 °F) warmer than the mid-twentieth century base period. The average global temperature has increased 0.8 °C (1.4 °F) since 1880, and most of that change has occurred in the past four decades.

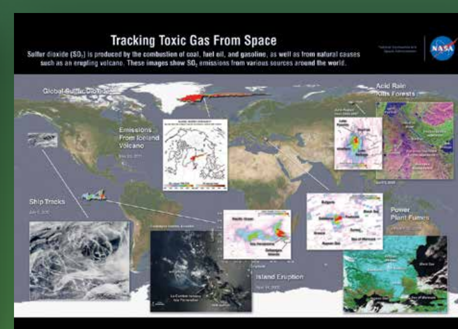
The graph shows yearly temperature anomalies from 1880 to 2011 as recorded by NASA GISS, the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center, the Japanese Meteorological Agency, and the Met Office Hadley Centre in the United Kingdom. All four institutions tally temperature data from stations around the world and make independent judgments about whether the year was warm or cool compared to other years. Though there are minor variations from year to year, all four records show peaks and valleys in sync with each other. All show rapid warming in the past few decades, and all show the last decade as the warmest.

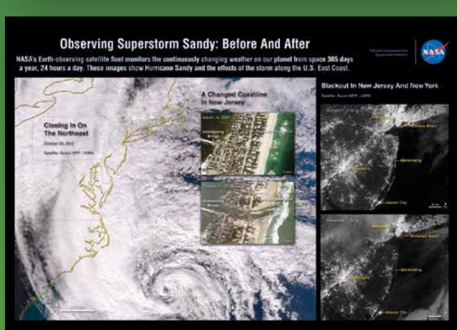
For more information, visit:
earthobservatory.nasa.gov/IOTD/view.php?id=80167

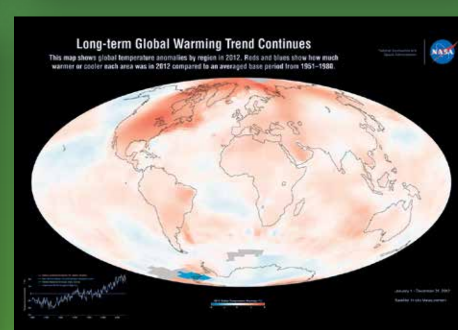
Science NASA Gallery

eospso.nasa.gov/sites/default/files/publications/sgb.pdf









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