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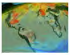
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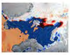
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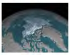
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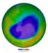
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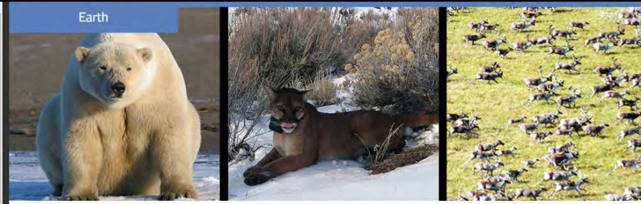

https://www.nasa.gov/feature/goddard/2016/how-animals-will-fare-in-a-changing-climate

Dec. 12, 2016

What Satellites Can Tell Us About How Animals Will Fare in a Changing Climate

AGU 2016 Briefing Materials - What Satellites Can Tell Us About How Animals Will Fare in a Changing Climate

From the Arctic to the Mojave Desert, terrestrial and marine habitats are rapidly changing. These changes impact animals that are adapted to specific ecological niches, sometimes displacing them or reducing their numbers. From their privileged vantage point, satellites are particularly well-suited to observe habitat transformation and help scientists forecast impacts on the distribution, abundance and migration of animals.

In a press conference Monday at the American Geophysical Union meeting in San Francisco, three researchers discussed how detailed satellite observations have facilitated ecological studies of change over time. The presenters discussed how changes in Arctic sea ice cover have helped scientists predict a 30 percent drop in the global population of polar bears over the next 35 years. They also talked about how satellite imagery of dwindling plant productivity due to droughts in North America gives hints of how both migratory herbivores and their predators will fare. Finally, they also discussed how satellite data on plant growth indicate that the concentration of wild reindeer herds in the far north of Russia has not led to overgrazing of their environment, as previously thought.

Long-term polar bear declines

Polar bears depend on sea ice for nearly all aspects of their life, including hunting, traveling and breeding. Satellites from NASA and other agencies have been tracking sea ice changes since 1979, and the data show that Arctic sea ice has been shrinking at an average rate of about 20,500 square miles (53,100 square kilometers) per year over the 1979-2015 period. Currently, the status of polar bear subpopulations is variable; in some areas of the Arctic, polar bear numbers are likely declining, but in others, they appear to be stable or possibly growing.

"When we look forward several decades, climate models predict such profound loss of Arctic sea ice that there's little doubt this will negatively affect polar bears throughout much of their range, because of their critical dependence on sea ice," said Kristin Laidre, a researcher at the University of Washington's Polar Science Center in Seattle and co-author of a study on projections of the global polar bear population. Eric Regehr of the U.S. Fish and Wildlife Service in Anchorage, Alaska, led the study, which was published on December 7 in the journal *Biology Letters*.

"On short time scales, we can have variable responses to the loss of sea ice among subpopulations of polar bears," Laidre said. "For example, in some parts of the Arctic, such as the Chukchi Sea, polar bears appear healthy, fat and reproducing well — this may be because this area is very ecologically productive, so you can lose some ice before seeing negative effects on bears. In other parts of the Arctic, like western Hudson Bay, studies have shown that survival and reproduction have declined as the availability of sea ice declines."

A young polar bear sitting on the shore in southern Beaufort Sea, Alaska. In some parts of the Arctic, sea ice loss is causing polar bears to spend longer periods on shore each summer.
Credits: U.S. Fish and Wildlife Service/Eric Regehr

Regehr, Laidre and their colleagues' results are the product of the International Union for Conservation of Nature's (IUCN) Red List assessment for polar bears. To determine the level of threat to a species, IUCN requests scientists to project what the species population numbers will be after three generations. Using data collected from adult females in 11 subpopulations of polar bears across the Arctic, Regehr and Laidre's team calculated the generation length for polar bears—the average age of reproducing adult females—to be 11.5 years. They then used the satellite record of Arctic sea ice extent to calculate the rates of sea ice loss and then projected those rates into the future, to estimate how much more the sea ice cover may shrink in approximately three polar bear generations, or 35 years.

Lastly, the scientists evaluated different scenarios for the relationships between polar bear abundance and sea ice. In one of them, the bear numbers declined directly proportionally with sea ice. In the other scenarios, the researchers used the existing, albeit scarce, data on how polar bear abundance has changed with respect to sea ice loss, using all available data from polar bear subpopulations in the four existing polar bear eco-regions, and projected forward these observed trends. They concluded that, based on a median value across all scenarios, there's a high probability of a 30 percent decline in the global population of polar bears over the next three to four decades, which supports listing the species as vulnerable on the IUCN Red List.

"It is difficult to predict what population numbers will be in the future, especially for animals that live in vast and remote regions," Regehr said. "But at the end of the day, polar bears need sea ice to be polar bears. This study adds to a growing body of evidence that the species will likely face large declines as loss of their habitat continues."

Drought and mountain lions

The southwestern United States is expected to become more prone to droughts with climate change. The resulting loss of vegetation will not only impact herbivores like mule deer; their main predator, mountain lions, might take an even larger hit.

To estimate the numbers and distribution of mule deer and mountain lions in Utah, Nevada and Arizona, David Stoner, a wildlife ecologist at Utah State University in Logan, Utah, used imagery of plant productivity from the Moderate Resolution Imaging Spectroradiometer, flown on NASA's Terra and Aqua satellites, plus radio-telemetry measurements of animal density and movements. He found that there is a very strong relationship between plant productivity and deer and mountain lion density.

"Measuring abundance of mule deer in the western United States is logistically difficult, hazardous and very expensive. For mountain lions, it's even worse," Stoner said. "But measuring changes in vegetation is relatively easy and more affordable. With this research, we've provided a model that wildlife managers can use to estimate the density of deer and mountain lions, two big game species of great economic importance."

Using maps of vegetation productivity during a severe drought that occurred in the southwestern United States in 2002, Stoner modeled what would be the deer and mountain lion distribution and abundance, should extreme drought become the norm.

Adult female mountain lion in Oquirrh Mountains, Utah. This collared female was part of a study examining mountain lion population dynamics that ran from 1997 to 2013.
Credits: Utah State University/David Stoner

"During 2002, there was a 30 percent decrease from the historical record mean in precipitation," Stoner said. "Using measurements of vegetation stressed by drought, our model predicted a 22 percent decrease in deer density. For mountain lions, the decline was 43 percent. Mountain lions occur at far lower densities than deer, and so any loss of their prey can have disporportionate impacts on their reproductive rates and overall abundance."

Mule deer are popular game animals, bringing in hundreds of millions of dollars to rural areas through recreational hunting and tourism. But deer can also have adverse economic impacts; they cause vehicle collisions, devour crops and damage gardens.

"Droughts will make human landscapes more attractive to deer, because farms and suburban areas are irrigated and would remain fairly green," Stoner said. "And mountain lions will go wherever the deer are. We're going to lose some of the economic benefits of having those animals, because they'll be fewer of them, but the costs are going to increase because the remaining animals will be attracted to cities and farms."

Longer journeys for wild reindeer

The Taimyr reindeer herd in the northernmost region of Russia is the largest wild reindeer herd in the world and a key of source of food for the indigenous population of the Taimyr Peninsula.

"Reindeer populations are declining all over the world, in some places catastrophically; in Taimyr, there has been an about 40 percent drop since 2000 and the herd is now at 600,000 animals," said Andrey Petrov, an associate professor at the University of Northern Iowa, in Cedar Falls.

Petrov examined historical data going back to 1969 and determined that there are ongoing changes in the distribution and migration patterns of the wild reindeer due to climate change and human pressure. The reindeer have moved east, away from human activity. At the same time, the herd is now traveling farther north and higher in elevation during the summer, possibly to avoid increasing temperatures and more abundant mosquitoes.

"Taimyr reindeer now have to travel longer distances between their winter and summer grounds, and this is causing a higher calf mortality," Petrov said. "Other factors contributing to the higher mortality are the increased mosquito harassment and the fact that rivers are opening earlier than before and the animals have to cross them during their migration."

Taimyr reindeer in northern Russia, summer of 2003.
Credits: Leonid Kolpashchikov

Petrov also used imagery from the NASA/United States Geological Survey Landsat satellite program to determine how the presence of reindeer in their summer grounds impacts vegetation. He found that, as expected, plant biomass decreased while the reindeer were grazing, but it bounced back a few weeks after the animals left the area. This finding argues against overgrazing as a possible factor for the Taimyr reindeer population decline that occurred after 2000.

"The work discussed at today's press conference is emblematic of the many ways in which satellite remote sensing supports our efforts at natural resource management and wildlife conservation," said Woody Turner, program scientist for NASA's Biological Diversity Program at NASA Headquarters in Washington.

Laidre and Stoner's research projects received funding from NASA. The National Science Foundation funded Petrov's research.

AGU 2016 Briefing Materials - What Satellites Can Tell Us About How Animals Will Fare in a Changing Climate

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By Maria-José Viñas
NASA's Earth Science News Team

Media contact: Patrick Lynch, NASA's Goddard Space Flight Center, Greenbelt, Md.

Last Updated: Dec. 12, 2016
Editor: Rob Garner

Tags: Aqua Satellite, Benefits to You, Climate, Earth, Goddard Space Flight Center, Ice, Landsat, LDCM (Landsat Data Continuity Mission), Terra Satellite

Earth

Dec. 13, 2016

Eye-Popping View of CO2, Critical Step for Carbon-Cycle Science

A new NASA supercomputer project builds on the agency's satellite measurements of carbon dioxide and combines them with a sophisticated Earth system model to provide one of the most realistic views yet of how this critical greenhouse gas moves through the atmosphere.

Scientists have tracked the rising concentration of heat-trapping carbon dioxide for decades using ground-based sensors in a few places. A high-resolution visualization of the new combined data product – generated by the Global Modeling and Assimilation Office at NASA's Goddard Space Flight Center in Greenbelt, Maryland, using data from the agency's Orbiting Carbon Observatory-2 (OCO-2) satellite build and operated by NASA's Jet Propulsion Laboratory in Pasadena, California – provides an entirely different perspective.

Tags: Air, Climate, Earth, Goddard Space Flight Center, Jet Propulsion Laboratory, OCO-2 (Orbiting Carbon Observatory 2)

Read Full Article

Earth

Dec. 13, 2016

Earth's Magnetic Fields Could Track Ocean Heat, NASA Study Proposes

AGU 2016 Briefing Materials - Earth's Magnetic Field Could Track Ocean Heat, NASA Study Proposes

As Earth warms, much of the extra heat is stored in the planet's ocean – but monitoring the magnitude of that heat content is a difficult task.

A surprising feature of the tides could help, however. Scientists at NASA's Goddard Space Flight Center in Greenbelt, Maryland, are developing a new way to use satellite observations of magnetic fields to measure heat stored in the ocean.

Tags: Climate, Earth, Goddard Space Flight Center, Water

Read Full Article

Landsat

Dec. 13, 2016

NASA/USGS Satellite Provides Global View of Speed of Ice

AGU 2016 Briefing Materials - NASA/USGS Satellite Provides Global View of Speed of Ice

Glaciers and ice sheets move in unique and sometimes surprising patterns, as evidenced by a new capability that uses satellite images to map the speed of flowing ice in Greenland, Antarctica and mountain ranges around the world.

With imagery and data from Landsat 8, a joint mission of NASA and the U.S. Geological Survey, scientists are providing a near-real-time view of every large glacier and ice sheet on Earth. The NASA-funded Global Land Ice Velocity Extraction project, called GoLIVE, is a collaboration between scientists from the University of Colorado, the University of Alaska and NASA's Jet Propulsion Laboratory in Pasadena, California. It

Tags: Climate, Earth, Goddard Space Flight Center, Ice, Landsat

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IceBridge

Nov. 18, 2016

NASA Nears Finish Line of Annual Study of Changing Antarctic Ice

Operation IceBridge, NASA's airborne survey of changes in polar ice, is closing in on the end of its eighth consecutive Antarctic deployment, and will likely tie its 2012 campaign record for the most research flights carried out during a single Antarctic season.

"We are probing the most remote corners of Spaceship Earth to learn more about changes that affect all of us locally, such as how ice sheets are contributing to sea level rise," said NASA Deputy Administrator Dava Newman on her very first flight over Antarctica with the IceBridge team on Nov. 17. "At NASA we explore: not only space, but also our home planet."

IceBridge Flies 300 Hours of Antarctic Science Flights

Tags: Climate, Earth, Goddard Space Flight Center, Ice, IceBridge

Read Full Article

Earth

Climate Change (2050s) and ARC32 Cities

Nov. 16, 2016

From NYC to Rio: NASA Helps Cities Address Climate Risks

Editor's Note: A video archive of this presentation is available here. More information on NASA's Rio de Janeiro partnership is available here.

After Hurricane Sandy rocked the U.S. East Coast in 2012, the New York City government set out to repair the city — and asked for NASA's help. The mayor's office didn't want NASA scientists out there with hammers or hard hats. Instead, they asked for information to include in their blueprints on how climate change, specifically increased risk of flooding, will affect the nation's most populous city.

The city is not only repairing the city to the current risks of coastal flooding, but also reflecting future projections of coastal flooding due to

Tags: Benefits to You, Climate, Earth, Goddard Institute for Space Studies, Goddard Space Flight Center

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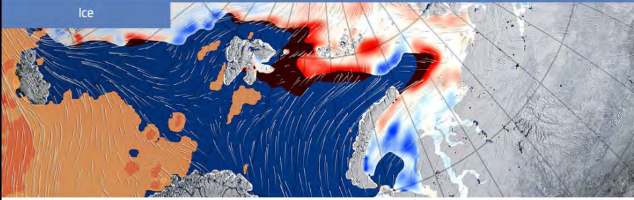
Ice



Nov. 15, 2016

Extremely Warm 2015-'16 Winter Cyclone Weakened Arctic Sea Ice Pack

A large cyclone that crossed the Arctic in December 2015 brought so much heat and humidity to this otherwise frigid and dry environment that it thinned and shrunk the sea ice cover during a time of the year when the ice should have been growing thicker and stronger, a NASA study found.

Warm Winter Cyclone Damaged Arctic Sea Ice Pack

Tags: Aqua Satellite, Climate, Earth, Goddard Space Flight Center, Ice

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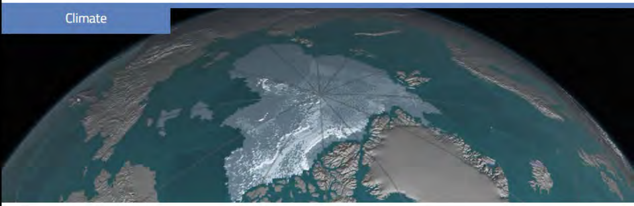
Climate



Oct. 28, 2016

See How Arctic Sea Ice Is Losing Its Bulwark Against Warming Summers

Arctic sea ice, the vast sheath of frozen seawater floating on the Arctic Ocean and its neighboring seas, has been hit with a double whammy over the past decades: as its extent shrunk, the oldest and thickest ice has either thinned or melted away, leaving the sea ice cap more vulnerable to the warming ocean and atmosphere.

"What we've seen over the years is that the older ice is disappearing," said Walt Meier, a sea ice researcher at NASA's Goddard Space Flight Center in Greenbelt, Maryland. "This older, thicker ice is like the bulwark of sea ice: a warm summer will melt all the young, thin ice away but it can't completely get rid of the older ice. But this older ice is becoming weaker because there's less of it and the remaining old ice is more broken up and thinner, so that bulwark is not as good as it used to be."

Tags: Climate, Earth, Goddard Space Flight Center, Ice, IceBridge, ICESat-2

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Earth

Oct. 25, 2016

2016 Antarctic Ozone Hole Attains Moderate Size, Consistent With Scientific Expectations

The hole in Earth's ozone layer that forms over Antarctica each September grew to about 8.9 million square miles in 2016 before starting to recover, according to scientists from NASA and the National Oceanic and Atmospheric Administration (NOAA) who monitor the annual phenomenon.

"This year we saw an ozone hole that was just below average size," said Paul A. Newman, chief scientist for Earth Sciences at NASA's Goddard Space Flight Center in Greenbelt, Maryland. "What we're seeing is consistent with our expectation and our understanding of ozone depletion chemistry and stratospheric weather."

Tags: Aura, Benefits to You, Climate, Earth, Goddard Space Flight Center, Suomi NPP (National Polar-orbiting Partnership)

Read Full Article

Earth

Sept. 15, 2016

Arctic Sea Ice Annual Minimum Ties Second Lowest on Record

Arctic sea ice appeared to have reached its annual lowest extent on Sept. 10, NASA and the NASA-supported National Snow and Ice Data Center (NSIDC) at the University of Colorado at Boulder reported today.

An analysis of satellite data showed that at 1.60 million square miles (4.14 million square kilometers), the 2016 Arctic sea ice minimum extent is effectively tied with 2007 for the second lowest yearly minimum in the satellite record. Since satellites began monitoring sea ice in 1978, researchers have observed a steep decline in the average extent of Arctic sea ice for every month of the year.

Sea Ice Minimum 2016

Tags: Climate, Earth, Goddard Space Flight Center, Ice, IceBridge, ICESat-2

Read Full Article

IceBridge

Aug. 3, 2016

NASA: First Map Of Thawed Areas Under Greenland Ice Sheet

NASA researchers have helped produce the first map showing what parts of the bottom of the massive Greenland Ice Sheet are thawed – key information in better predicting how the ice sheet will react to a warming climate.

Greenland's thick ice sheet insulates the bedrock below from the cold temperatures at the surface, so the bottom of the ice is often tens of degrees warmer than at the top, because the ice bottom is slowly warmed by heat coming from the Earth's depths. Knowing whether Greenland's ice lies on wet, slippery ground or is anchored to dry, frozen bedrock is essential for predicting how this ice will flow in the future. But scientists have very few direct observations of the thermal conditions beneath the ice sheet, obtained through fewer than two dozen boreholes that have reached the bottom. Now a new study synthesizes several methods to infer the Greenland Ice Sheet's basal thermal

Tags: Aqua Satellite, Climate, Earth, Goddard Space Flight Center, Ice, IceBridge, Jet Propulsion Laboratory, Terra Satellite

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Earth

April 26, 2016

Carbon Dioxide Fertilization Greening Earth, Study Finds

From a quarter to half of Earth's vegetated lands has shown significant greening over the last 35 years largely due to rising levels of atmospheric carbon dioxide, according to a new study published in the journal *Nature Climate Change* on April 25.

An international team of 32 authors from 24 institutions in eight countries led the effort, which involved using satellite data from NASA's Moderate Resolution Imaging Spectrometer and the National Oceanic and Atmospheric Administration's Advanced Very High Resolution Radiometer instruments to help determine the leaf area index, or amount of leaf cover, over the planet's vegetated regions. The greening represents an increase in leaves on plants and trees equivalent in area to two times the continental United States.

Tags: Aqua Satellite, Climate, Earth, Earth Research Findings, Goddard Institute for Space Studies, Goddard Space Flight Center, Terra Satellite, Water

Read Full Article

Earth

April 20, 2016

IceBridge Begins Eighth Year of Arctic Flights

Operation IceBridge, NASA's airborne survey of polar ice, completed its first Greenland research flight of 2016 on April 19, kicking off its eighth spring Arctic campaign. This year's science flights over Arctic sea and land ice will continue until May 21.

During its seven years of operations in the Arctic, IceBridge has gathered large volumes of data on changes in the elevation of the ice sheet and its internal structure. Measurements from IceBridge have revealed a 460-mile-long (740 kilometers) canyon hiding under a mile of ice and mapped the extent of a vast liquid water aquifer beneath the snow in southern Greenland. IceBridge's readings of the thickness of sea ice and its snow cover have helped scientists improve forecasts for the summer melt season and have enhanced the understanding of variations in ice thickness distribution from year to year.

Tags: Climate, Earth, Goddard Space Flight Center, Ice, IceBridge, ICESat-2, NOAA

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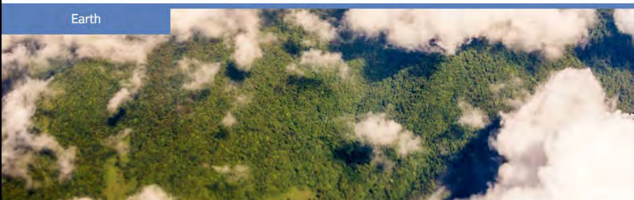
Earth



April 14, 2016

Study Shows Cloud Patterns Reveal Species Habitat

Much of Earth's biodiversity is concentrated in areas where not enough is known about species habitats and their wider distributions, making management and conservation a challenge. To address the problem, scientists at the University at Buffalo and Yale University used NASA satellite data to study cloud cover, which they found can help identify the size and location of important animal and plant habitats.

Clouds influence such environmental factors as rain, sunlight, surface temperature and leaf wetness—all of which dictate where plants and animals can survive. As part of their study, researchers examined 15 years of data from NASA's Earth-orbiting Terra and Aqua satellites and built a database containing two images per day of cloud cover [illegible]

Tags: Aqua Satellite, Benefits to You, Earth, Earth Research Findings, Goddard Space Flight Center, Land, Terra Satellite

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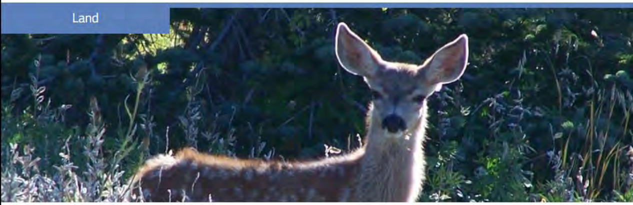
Land



March 30, 2016

Tracking Deer by NASA Satellite

Mule deer mothers are in sync with their environment, with reproduction patterns that closely match the cycles of plant growth in their habitat. And new research using NASA satellite data shows that tracking vegetation from space can help wildlife managers predict when does will give birth to fawns.

Raising a fawn is no easy task – a doe needs a rich supply of vegetation for the late stages of pregnancy and for nursing. Mule deer birth rates peak shortly before the peak of annual plant growth, when food sources are increasing. Through a combination of satellite measurements and ground-based population counts, researchers can forecast the timing of fawning seasons based on vegetation.

Tags: Aqua Satellite, Benefits to You, Earth, Goddard Space Flight Center, Land, Terra Satellite

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Landsat

March 11, 2016

Satellites and Shipwrecks: Landsat Satellite Spots Foundered Ships in Coastal Waters

An estimated 3 million shipwrecks are scattered across the planet's oceans. Most maritime mishaps take place close to shore where hazards to navigation — such as rocks, reefs, other submerged objects and vessel congestion — are abundant. While there is a romantic association of shipwrecks and buried treasure, it is desirable to know where they are located for many other practical reasons. The ships may be of historical significance or, if the hard substrate of the ship has created a reef, of ecological significance. Modern-era shipwrecks are also commonly sources of pollution, leaking onboard fuel and corroded heavy metals. Nearshore shipwrecks can be navigational hazards themselves.

Tags: Benefits to You, Earth, Goddard Space Flight Center, Hazards, Landsat, LDCM (Landsat Data Continuity Mission)

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Earth

Jan. 13, 2016

Satellite Data Help Australian Ranchers Meet the Rising Demand for Meat in a Changing World

When Russell Lethbridge walks his property in northern Australia — kicking-up clouds of dust that catch the sunlight as he assesses the grasses, shrubs and brush that fill the landscape with muted tones of green — he carries the legacy of five generations before him on his shoulders.

“Werrington Station has been in our family for 117 years,” Lethbridge said, “and each generation does its best to leave the property in a better condition than the one that came before it.” Today, the Lethbridges maintain that tradition with the aid of NASA

Tags: Aqua Satellite, Benefits to You, Earth, Goddard Space Flight Center, Land, Landsat, Terra Satellite

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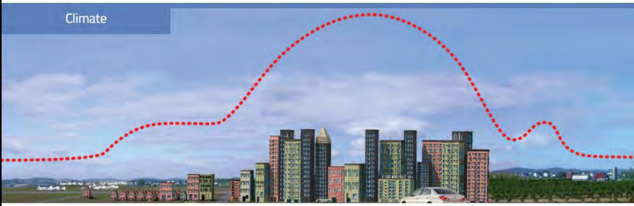
Climate



Aug. 26, 2015

NASA Finds Vegetation Essential for Limiting City Warming Effects

Tags: Aqua Satellite, Climate, Earth, Goddard Space Flight Center, Landsat, Terra Satellite

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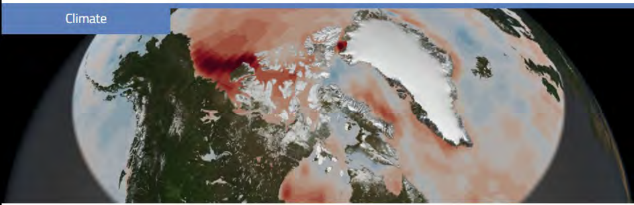

Dec. 17, 2014
RELEASE 14-043

NASA Satellites Measure Increase of Sun's Energy Absorbed in the Arctic

NASA satellite instruments have observed a marked increase in solar radiation absorbed in the Arctic since the year 2000 – a trend that aligns with the steady decrease in Arctic sea ice during the same period.

While sea ice is mostly white and reflects the sun's rays, ocean water is dark and absorbs the sun's energy at a higher rate. A decline in the region's albedo – its reflectivity, in effect – has been a key concern among scientists since the summer Arctic sea ice cover began shrinking in recent decades. As more of the sun's energy is absorbed by the climate system, it enhances ongoing warming in the region, which is more pronounced than anywhere else on the planet.

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Tags: Air, Aqua Satellite, Climate, Earth, Earth Research Findings, Goddard Space Flight Center, Ice, Suomi NPP (National Polar-orbiting Partnership), Terra Satellite

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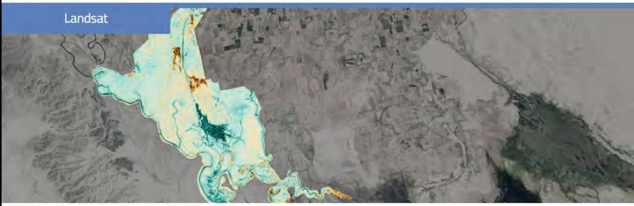

Dec. 17, 2014

NASA/USGS Satellite Sees Green-up Along Colorado River's Delta After Experimental Flow

A pulse of water released down the lower reaches of the Colorado River last spring resulted in more than a 40 percent increase in green vegetation where the water flowed, as seen by the Landsat 8 satellite. The March 2014 release of water – an experimental flow implemented under a U.S.-Mexico agreement called "Minute 319" – reversed a 13-year decline in the greenness along the delta.

The year 2000 was the last time the Colorado River reached the Sea of Cortez, between Mexico's mainland and Baja California. Since then, said Pamela Nagler of the [illegible]

Tags: Climate, Earth, Goddard Space Flight Center, Land, Landsat, LDCM (Landsat Data Continuity Mission), Water

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National Aeronautics and Space Administration
Page Last Updated: Dec. 12, 2016
NASA Official: Brian Dunbar