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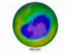
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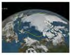
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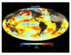
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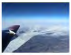
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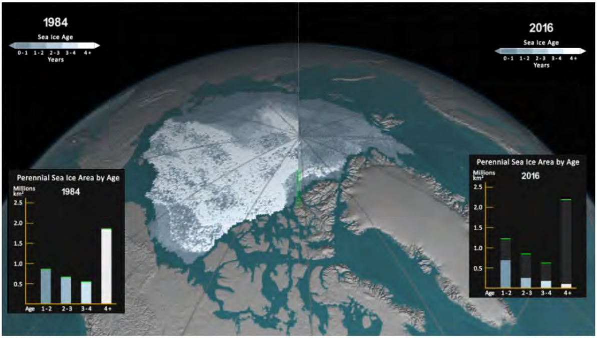
Oct. 28, 2016

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."



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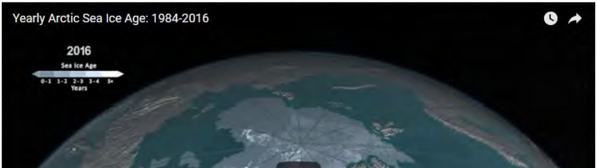
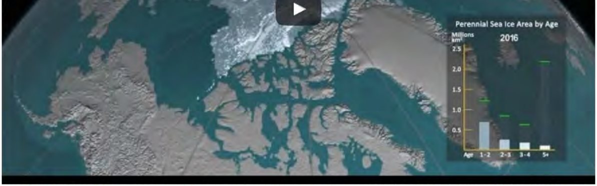
Compare the extension of older sea ice in the Arctic in September 1984 and September 2016. The older ice is thicker and more resistant to melt than new ice, so it protects the sea ice cap during warm summers. In September 1984, there were 1.86 million square kilometers of old ice (5 years or older) left throughout the Arctic sea ice cap during its yearly minimum extent; in September 2016, there were only 110,000 square kilometers of older sea ice left.
Credits: NASA's Scientific Visualization Studio

Direct measurements of sea ice thickness are sporadic and incomplete across the Arctic, so scientists have developed estimates of sea ice age and tracked their evolution from 1984 to the present. Now, a new NASA visualization of the age of Arctic sea ice shows how sea ice has been growing and shrinking, spinning, melting in place and drifting out of the Arctic for the past three decades.





This animation shows the annual change in sea ice age in the Arctic at each year's minimum extent. Younger sea ice is shown in a dark shade of blue while the ice that is five years old or older is shown as white. A bar graph displayed in the lower right corner quantifies the area covered by the ice in each age category on the day of the annual minimum. In addition, memory bars (shown in green) portray the maximum annual value for each age range seen since January 1, 1984 on the day of the annual sea ice minimum extent.
Credits: NASA's Scientific Visualization Studio/Cindy Starr
Download this video in HD formats from NASA Goddard's Scientific Visualization Studio

"Ice age is a good analog for ice thickness because basically, as ice gets older it gets thicker," Meier said. "This is due to the ice generally growing more in the winter than it melts in the summer."

In the early 2000s, scientists at the University of Colorado developed a way to monitor Arctic sea ice movement and the evolution of its age by using data from a variety of sources, but primarily satellite passive microwave instruments. These instruments gauge brightness temperature: a measure of the microwave energy emitted by sea ice that is influenced by the ice's temperature, salinity, surface texture and the layer of snow on top of the sea ice. Each floe of sea ice has a characteristic brightness temperature, so the researchers developed an approach that would identify and track ice floes in successive passive microwave images as they moved across the Arctic. The system also uses information from drifting buoys as well as weather data.

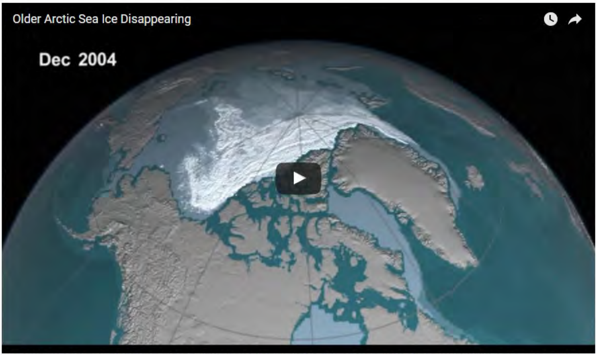
"It's like bookkeeping; we're keeping track of sea ice as it moves around, up until it melts in place or leaves the Arctic," said Meier, who is a collaborator of the group at the University of Colorado and the National Snow and Ice Data Center in Boulder, Colorado, the center that currently maintains the Arctic sea ice age data.

Ice in motion

Every year, sea ice forms in the winter and melts in the summer. The sea ice that survives the melt season thickens with each passing year: newly formed ice grows to about 3 to 7 feet of thickness during its first year, while multi-year ice (sea ice that has survived several melt seasons) is about 10 to 13 feet thick. The older and thicker ice is more resistant to melt and less likely to get pushed around by winds or broken up by waves or storms.

Arctic sea ice has not only been shrinking in surface area in recent years, it's becoming younger and thinner as well. In this animation, where the ice cover almost looks gelatinous as it pulses through the seasons, cryospheric scientist Dr. Walt Meier of NASA Goddard Space Flight Center describes how the sea ice has undergone fundamental changes during the era of satellite measurements.

"On a week-to-week basis, there are weather systems that come through, so the ice isn't moving at a constant rate: sometimes the Beaufort Gyre reverses or breaks down for a couple weeks or so, the Transpolar Drift Stream shifts in its direction … but the overall pattern is this one," Meier said. "Then the spring melt starts and the ice shrinks back, disappearing from the peripheral seas."



Arctic sea ice has not only been shrinking in surface area in recent years, it's becoming younger and thinner as well. In this animation, where the ice cover almost looks gelatinous as it pulses through the seasons, cryospheric scientist Dr. Walt Meier of NASA Goddard Space Flight Center describes how the sea ice has undergone fundamental changes during the era of satellite measurements.
Credits: NASA's Scientific Visualization Studio/Cindy Starr

The new animation shows two main bursts of thick ice loss: the first one, starting in 1989 and lasting a few years, was due to a switch in the Arctic Oscillation, an atmospheric circulation pattern, which shrunk the Beaufort Gyre and enhanced the Transpolar Drift Stream, flushing more sea ice than usual out of the Arctic. The second peak in ice loss started in the mid-2000s.

"Unlike in the 1980s, it's not so much as ice being flushed out –though that's still going on too," Meier said. "What's happening now more is that the old ice is melting within the Arctic Ocean during the summertime. One of the reasons is that the multiyear ice used to be a pretty consolidated ice pack and now we're seeing relatively smaller chunks of old ice interspersed with younger ice. These isolated floes of thicker ice are much easier to melt."

"We've lost most of the older ice: In the 1980s, multiyear ice made up 20 percent of the sea ice cover. Now it's only about 3 percent," Meier said. "The older ice was like the insurance policy of the Arctic sea ice pack: as we lose it, the likelihood for a largely ice-free summer in the Arctic increases."

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

Last Updated: Nov. 1, 2016
Editor: Karl Hille

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

Climate

Oct. 28, 2016

NASA & NOAA Celebrate Five-Year Anniversary of Suomi NPP Launch

After five years in space, the NASA/NOAA Suomi National Polar-orbiting Partnership (Suomi NPP) mission continues to contribute significant advances in severe weather prediction and environmental monitoring leading to better forecasts and situational awareness for the nation and users worldwide.

Launched on Oct. 28, 2011, Suomi NPP is a bridge to National Oceanic and Atmospheric Administration's (NOAA) next generation Joint Polar Satellite System (JPSS) weather satellites. The JPSS-1 satellite is scheduled to launch in 2017 to

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

Read Full Article

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)

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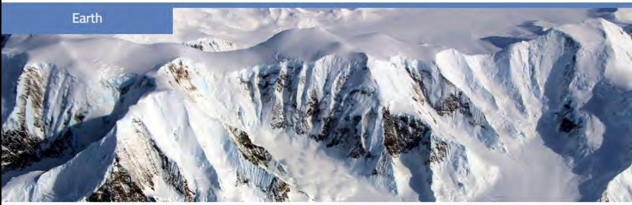
Earth



Oct. 17, 2016

NASA Launches Eighth Year of Antarctic Ice Change Airborne Survey

At the southern end of the Earth, a NASA plane carrying a team of scientists and a sophisticated instrument suite to study ice is returning to surveying Antarctica. For the past eight years, Operation IceBridge has been on a mission to build a record of how polar ice is evolving in a changing environment.

The information IceBridge has gathered in the Antarctic, which includes data on the thickness and shape of snow and ice, as well as the topography of the land and ocean floor beneath the ocean and the ice, has allowed scientists to determine that the West Antarctic Ice Sheet may be in irreversible decline. Researchers have also used IceBridge data to evaluate climate models of Antarctica and map the bedrock underneath Antarctic ice

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

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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

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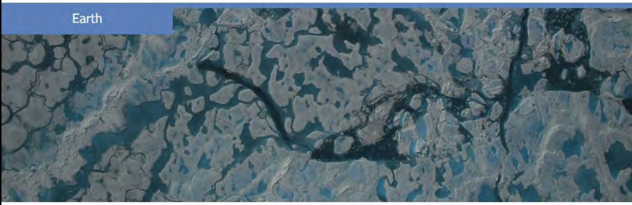
Earth



Sept. 14, 2016

Polar Bears Across the Arctic Face Shorter Sea Ice Season

Polar bears are among the animals most affected by the seasonal and year-to-year decline in Arctic sea ice extent, because they rely on sea ice for essential activities such as hunting, traveling and breeding.

A new study by University of Washington researchers, funded by NASA and using satellite data from NASA and other agencies, found a trend toward earlier sea ice melt in the spring and later ice growth in the fall across all 19 polar bear subpopulations, which can negatively impact the feeding and breeding capabilities of the bears. The paper, published on Sept. 14 in the journal *The Cryosphere*, is the first to quantify the sea ice changes in each polar bear subpopulation across the entire Arctic region using metrics that are specifically relevant to polar bear biology

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

Read Full Article

Earth

Sept. 13, 2016

After Strong El Niño Winter, NASA Model Sees Return to Normal

Not too hot, not too cold – instead, water temperatures in the equatorial Pacific Ocean should be just around normal for the rest of 2016, according to forecasts from the Global Modeling and Assimilation Office, or GMAO. With these neutral conditions, scientists with the modeling center at NASA's Goddard Space Flight Center say there is unlikely to be a La Niña event in late 2016.

Last winter saw an extremely strong El Niño event, in which warmer-than-normal water sloshed toward the eastern Pacific Ocean. Historically, some of the larger El Niño events are followed by a La Niña event, in which deep, colder-than-normal water surfaces in the eastern Pacific Ocean, off the coast of South America.

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

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Climate

Sept. 6, 2016

NASA Science Flights Study Effect of Summer Melt on Greenland Ice Sheet

Operation IceBridge, NASA's airborne survey of polar ice, is flying in Greenland for the second time this year, to observe the impact of the summer melt season on the ice sheet. The IceBridge flights, which began on Aug. 27 and will continue until Sept. 16, are mostly repeats of lines that the team flew in early May, so that scientists can observe changes in ice elevation between the spring and late summer.

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

Read Full Article

Climate

Aug. 19, 2016

NASA Monitors the 'New Normal' of Sea Ice

This year's melt season in the Arctic Ocean and surrounding seas started with a bang, with a record low maximum extent in March and relatively rapid ice loss through May. The melt slowed down in June, however, making it highly unlikely that this year's summertime sea ice minimum extent will set a new record.

"Even when it's likely that we won't have a record low, the sea ice is not showing any kind of recovery. It's still in a continued decline over the long term," said Walt Meier, a sea ice scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland. "It's just not going to be as extreme as other years because the weather conditions in the Arctic were not as extreme as in other years."

[illegible]

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

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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 [illegible]

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

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Climate

July 19, 2016

2016 Climate Trends Continue to Break Records

Two key climate change indicators -- global surface temperatures and Arctic sea ice extent -- have broken numerous records through the first half of 2016, according to NASA analyses of ground-based observations and satellite data.

Each of the first six months of 2016 set a record as the warmest respective month globally in the modern temperature record, which dates to 1880, according to scientists at NASA's Goddard Institute for Space Studies (GISS) in New York. The six-month period from January to June was also the planet's warmest half-year on record, with an average temperature 1.3 degrees Celsius (2.4 degrees Fahrenheit) warmer than the late nineteenth century.

Tags: Climate, Earth, Goddard Institute for Space Studies, Goddard Space Flight Center, Ice

Read Full Article

IceBridge

July 19, 2016

NASA Science Flights Target Melting Arctic Sea Ice

This summer, with sea ice across the Arctic Ocean shrinking to below-average levels, a NASA airborne survey of polar ice just completed its first flights. Its target: aquamarine pools of melt water on the ice surface that may be accelerating the overall sea ice retreat.

NASA's Operation IceBridge completed the first research flight of its new 2016 Arctic summer campaign on July 13. The science flights, which continue through July 25, are collecting data on sea ice in a year following a record-warm winter in the Arctic.

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

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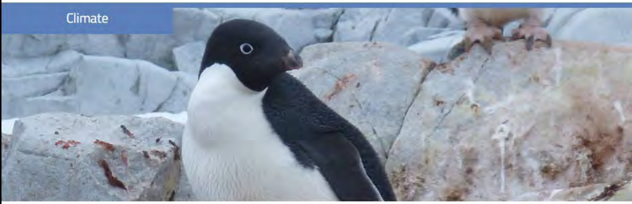
Climate



July 8, 2016

Climate Change May Shrink Adélie Penguin Range By End of Century

Climate has influenced the distribution patterns of Adélie penguins across Antarctica for millions of years. The geologic record tells us that as glaciers expanded and covered Adélie breeding habitats with ice, penguins in the region abandoned their colonies. When the glaciers melted during warming periods, the Adélie penguins were able to return to their rocky breeding grounds.

Now, a NASA-funded study by University of Delaware scientists and colleagues at other institutions reports that this warming may no longer be beneficial for Adélie penguins. In a paper published June 29 in the journal *Scientific Reports*, the researchers project that approximately 30 percent of current Adélie colonies may be in decline by 2060, and approximately 60 percent of the present population might be dwindling by 2099. They also found the penguins at more southerly sites in Antarctica may be less affected by climate change.

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

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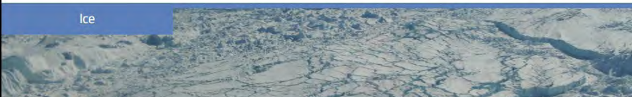
Ice



June 6, 2016

NASA's Operation IceBridge Completes 2016 Arctic Spring Campaign

Operation IceBridge, NASA's airborne survey of polar ice, ended its eighth spring Arctic campaign on May 21. During their five weeks of operations, mission scientists carried out six research flights over sea ice and ten over land ice.

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

Read Full Article

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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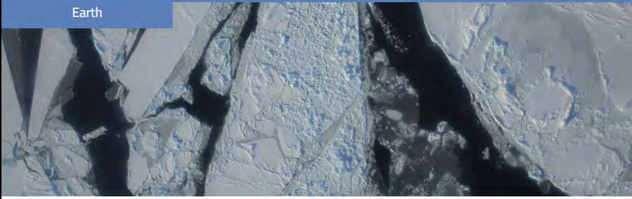

March 29, 2016

2016 Arctic Sea Ice Wintertime Extent Hits Another Record Low

Arctic sea ice appears to have reached a record low wintertime maximum extent for the second year in a row, according to scientists at the NASA-supported National Snow and Ice Data Center (NSIDC) and NASA.

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

Read Full Article

IceBridge

Nov. 24, 2015

NASA's Operation IceBridge Completes Twin Polar Campaigns

NASA's Operation IceBridge, an airborne survey of polar ice, recently finalized two overlapping campaigns at both of Earth's poles. Down south, the mission observed a big drop in the height of two glaciers situated in the Antarctic Peninsula, while in the north it collected much needed measurements of the status of land and sea ice at the end of the Arctic summer melt season.

This was the first time in its seven years of operations that IceBridge carried out parallel flights in the Arctic and Antarctic. Every year, the mission flies to the Arctic in the spring and to Antarctica in the fall to keep collect an uninterrupted record of yearly changes in the height of polar ice.

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

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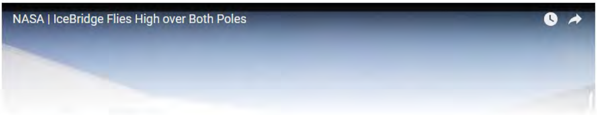
IceBridge

Sept. 23, 2015

NASA to Fly Parallel Science Campaigns at Both Poles



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

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Jan. 24, 2015

NASA Data Peers into Greenland's Ice Sheet

A three-dimensional view of the age and structure of the Greenland Ice Sheet

Scientists using ice-penetrating radar data collected by NASA's Operation IceBridge and earlier airborne campaigns have built the first-ever comprehensive map of layers deep inside the Greenland Ice Sheet.

NASA | Greenland's Ice Layers Mapped in 3D

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

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ICESat-2

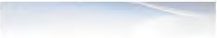
Jan. 28, 2014

New NASA Laser Technology Reveals How Ice Measures Up

New results from NASA's MABEL campaign demonstrated that a photon-counting technique will allow researchers to track the melt or growth of Earth's frozen regions.

When a high-altitude aircraft flew over the icy Arctic Ocean and the snow-covered terrain of Greenland in April 2012, it was the first polar test of a new laser-based technology to measure the height of Earth from space.

Aboard that aircraft flew the Multiple Altimeter Beam Experimental Lidar, or MABEL, which is an airborne test bed instrument for NASA's ICESat-2 satellite mission slated to launch in 2017. Both MABEL and ICESat-2's ATLAS instrument are photon



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

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National Aeronautics and Space Administration
Page Last Updated: Nov. 1, 2016
NASA Official: Brian Dunbar