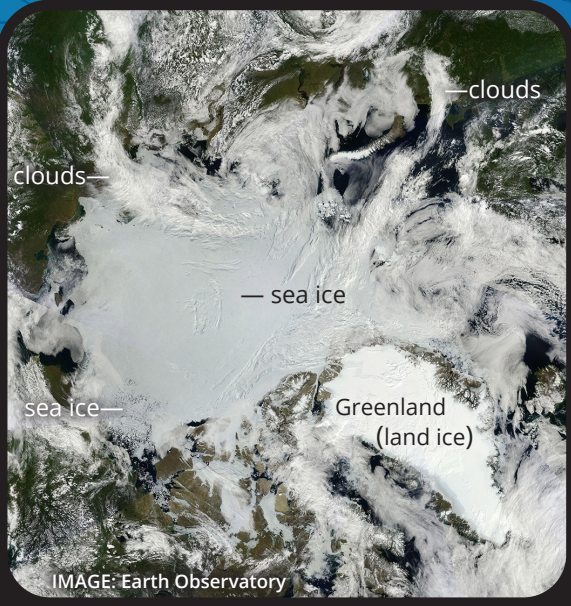
Ice on Earth: By Land & By Sea

eo Kids
earth observatory for kids

Ice is found on every continent and ocean basin, from the highest peak in Africa to the icy North and South Poles. Almost two-thirds of all fresh water is trapped in ice. Scientists study Earth's ice because it can affect the amount of fresh water available in our rivers, lakes, and reservoirs.

Earth scientists study two types of ice on the Earth's surface: land ice and sea ice. Land ice forms when snow piles up year after year, then gets compressed and hardens. Ice sheets and glaciers on Greenland and Antarctica hold much of our planet's land ice. Sea ice forms when sea water freezes and is found in the Arctic Ocean, the Southern Ocean around Antarctica, and other cold regions.

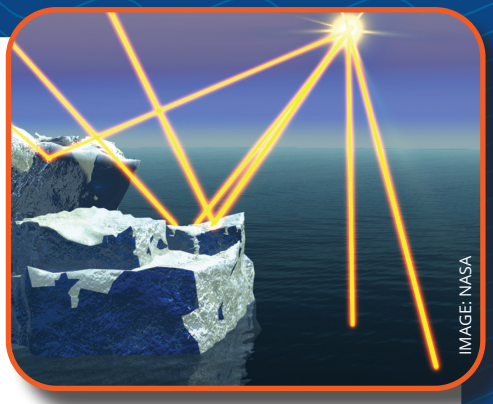


On July 11, 2011, NASA's Terra satellite captured this image of the north polar region. Natural-color images of ice on the Arctic Ocean can be compared with older images to detect seasonal and long-term changes in sea ice cover.

Monitoring Ice from Space

Much of Earth's ice is found in remote and dangerous places. NASA uses sensors on satellites and airplanes to measure ice in places that are hard to visit. Satellite images also provide scientists with a global view of how ice is changing on our planet.

Melting Ice



Light-colored surfaces that reflect more sunlight have a high albedo, and dark surfaces that absorb more sunlight have a lower albedo. Ice reflects a lot of sunlight back into space; it has a high albedo. When ice melts, darker water and land surfaces with lower albedos warm up as they absorb the Sun's energy. As surfaces around ice warm, more ice melts and exposes more surfaces to sunlight.

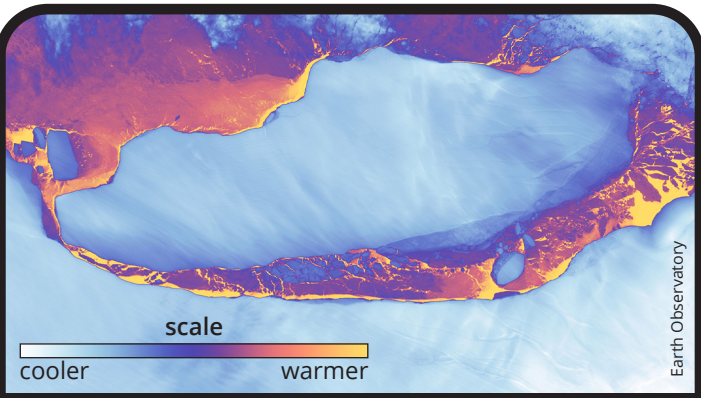
When land ice melts, it adds stored water into rivers, lakes, and the ocean. But when sea ice melts, it does not add water to the ocean. Sea ice is like floating ice cubes in a cup of water. When they melt they don't change the level of the water.

Vocabulary:

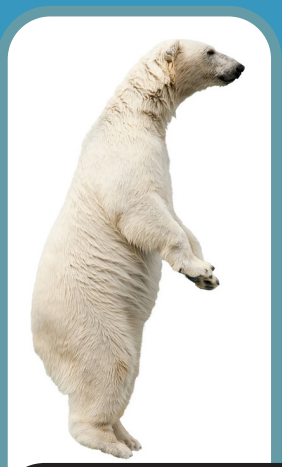
Albedo (al-bee-doh) is the fraction of incoing light that is refected by a surface without being absorbed.

Seeing in the Dark

In winter, there are a few weeks when the Sun never rises in Antarctica. Satellites that use visible light sensors do not collect data because there is no reflected light to sense. But a sensor that measures heat can show the differences in surface temperatures such as cold ice shelves surrounded by warmer water. These satellite measurements helped scientists track Iceberg A-68 after it broke off Antarctica's Larsen C ice shelf in July of 2017.



A sensor on the Landsat satellite measured surface temperatures around the Larsen C ice shelf in September 2017. In this false-color image, water appears orange because it is warmer than the ice shelf and iceberg surfaces (in blue and white).

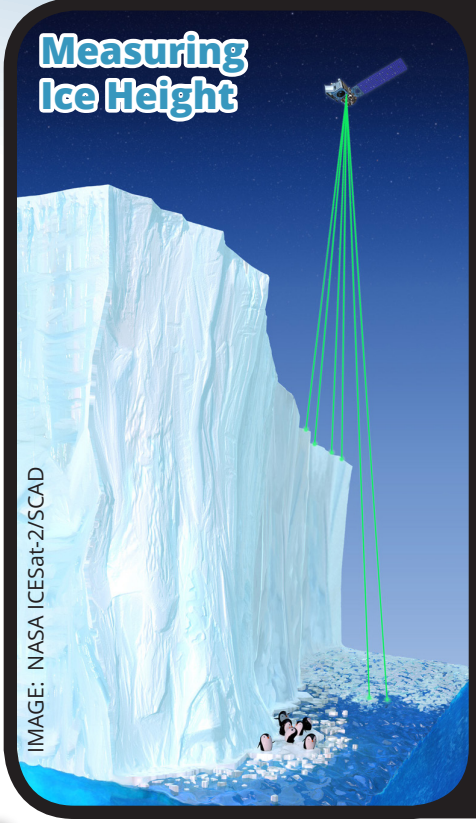


Did you know?

Polar bears live only in the Arctic, and penguins live only in the Southern Hemisphere, especially Antarctica. Except in zoos, their paths never cross.

Both animals live in very harsh environments and they depend on ice for their survival.

Measuring Ice Height



NASA's Ice, Cloud, and land Elevation Satellite-2 (ICESat-2) is scheduled for launch in 2018. Its main instrument will be a laser altimeter, which can measure the height of the Earth's surface, particularly its icy parts. The instrument sends out small pulses of visible laser light and measures how long they take to reflect off the surface and back to the satellite.

Repeated measurements over several years can help scientists track the movement and melting of the ice. Tiny changes in the height of ice sitting on top of Greenland or Antarctica can mean large amounts of melt water pouring into the ocean and raising sea level.

Indigenous Words for Snow and Ice

Native people of the Arctic have many different words to describe the icy environments in which they have lived for thousands of years.

"Pukak" — Inuktitut word for powdery snow that looks like salt.

"Siguliaksraq" — Inupiaq word for the layer of ice crystals that forms when the sea begins to freeze.

"Utuqaq" — Inupiaq word for ice that lasts year after year.

Notes from the Field

Sledding Around Antarctica

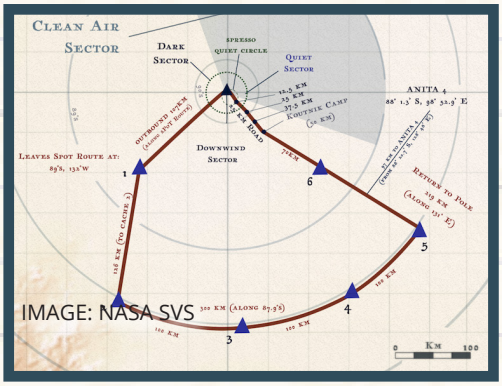
Ice scientists Kelly Brunt and Tom Neumann recently took an extreme camping trip for science. They made a 470-mile expedition to collect measurements of the height (elevation) of an unexplored stretch of Antarctic ice. They also work on ICESat-2 and, after it launches later this year, they will check what they can measure from space against what they just measured from the ground.

PistenBullys are large tractors, like those used to groom ski areas. The team used these to tow their sled of gear along the traverse.

"This traverse provides an extremely challenging and extremely cold way to see how well ICESat-2 is working," said Kelly. "The new data sets are going to tell us incredible things about how Earth's ice is changing and what that means for things like sea level rise."

After a stop in Christchurch, New Zealand, the team arrived at McMurdo Station, along the coast of Antarctica. Kelly and Tom spent a few weeks training to camp and work in the extreme cold of the icy and rocky continent. Then they flew to Amundsen-Scott South Pole Station, where it was summer and the Sun was up 24 hours a day. The South Pole Station sits on top of the East Antarctic Ice Sheet at almost 10,000 feet above sea level, which is a big jump from the sea level at McMurdo. The team took a few days to adjust and to prepare their equipment for the expedition. The temperature was a balmy -22 degrees Fahrenheit (-30 degrees Celsius).

The team then spent a few weeks traveling along a 470-mile route, collecting data at 88 degrees south latitude, the closest to the pole that ICESat-2's orbit will reach.



The team's route made an arc around the South Pole at 88°S latitude.

Read more about the team's experience during their ICESat-2 Antarctic Traverse at: https://go.usa.gov/xnVcR

— Adapted from a blog by Kelly Brunt and Tom Neumann, and a NASA story by Kate Ramsayer

Living on a Sled

A thick plastic sled, about 8 feet wide and 60 feet long, held all of the gear needed for Kelly and Tom's journey. From left to right, the modules include: 1) sleep module; 2) cargo module; 3) fuel and generator module; 4) kitchen module; and 5) the bathroom module.

Images by Kelly Brunt and Tom Neumann

Data Viz

How Thick is Greenland's Ice?

Most of Earth's fresh water is locked up in ice. After the Antarctic ice sheet, the Greenland ice sheet is the second largest ice body in the world. Ice sheets form in areas where snow that falls in winter does not melt entirely in the summer, building up over thousands of years. ICESat, a NASA satellite, measured heights across the Greenland ice sheet. Scientists can estimate the ice sheet thickness, using the difference between the height at the top of the ice sheet and the ground below.

—V. Casasanto and G. Butcher

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0.7	0.1	0.8	1.2	0.6	0.2	0	0	0	0	0
0	0	0	0.3	1.1	1.1	1.4	1.8	1.4	1.2	0.5	0.0	0	0	0
0	0	0.3	0.9	1.3	1.7	2.0	2.0	1.9	1.4	0.8	0.1	0	0	0
0.8	1.1	1.2	1.6	1.8	2.0	2.2	2.2	2.0	1.6	1.1	0.6	0	0	0
0.7	0.9	1.7	2.0	2.1	2.3	2.4	2.4	2.2	1.9	1.4	0.7	0.1	0	0
0.4	1.0	1.6	2.0	2.3	2.5	2.6	2.5	2.4	2.2	1.9	1.3	0.6	0	0
0	0.1	0.7	1.6	2.2	2.5	2.7	2.7	2.6	2.4	2.3	1.9	1.4	0	0
0	0	0.1	1.2	2.1	2.5	2.8	2.8	2.7	2.7	2.6	2.2	1.6	0.7	0
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0	0	0	0	0.9	1.8	2.3	2.7	2.9	3.0	2.8	2.5	2.2	1.8	0.7
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0	0	0	0	1.0	1.7	2.2	2.5	2.4	2.5	2.6	1.2	0	0	0
0	0	0	1.2	1.1	1.8	2.3	2.4	2.1	1.5	1.1	0.6	0	0	0
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0	0	0	0.4	1.5	2.2	2.6	2.3	1.1	0	0	0	0	0	0
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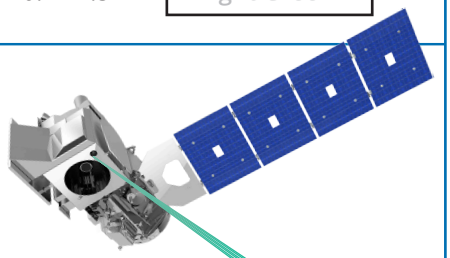
0	0	0	0	0	0	1.2	0.9	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Instructions: The numbers in each square represent height in kilometers. Color in the scale bar from light green to purple, then fill in the squares in the grid using the same scale.

Scale: Height in Kilometers

2.9 - 3.4 km	Purple
2.3 - 2.8 km	Dark Blue
1.6 - 2.2 km	Light Blue
0.1 - 1.5 km	Light Green



Discover how ICESat-2 uses lasers to measure ice: http://icesat-2.gsfc.nasa.gov

Question:

Where is the highest elevation? Why?

Answer on page 15