National Aeronautics and Space Administration

# A Tour of the CRYOSPHERE

## the Earth's Frozen Assets

The cryosphere has a global reach, extending beyond the polar regions. It consists of those parts of the Earth's surface where water is found in solid form, including areas of snow, sea ice, glaciers, permafrost, ice sheets, and icebergs. NASA Earth observing satellites are providing scientists with unparalleled insight into how the cryosphere behaves, how it is changing, and what implications those changes have on the Earth's global systems, including weather and climate.

## Ice Shelves & Glaciers

Glaciers in western Greenland produce most of the icebergs in the North Atlantic. After decades of stability, Greenland's Jakobshavn glacier, one of the fastest flowing in the world, has changed dramatically. Warmer temperatures have thinned the ice causing the calving front to retreat and the glacier's flow to nearly double in speed between 1997–2003. This Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) image compares recession in the calving fronts (based on Landsat-7 data) from 2001 (orange), 2002 (yellow), 2003 (red), and 2004 (purple) to the historical 1942 measurement (blue).

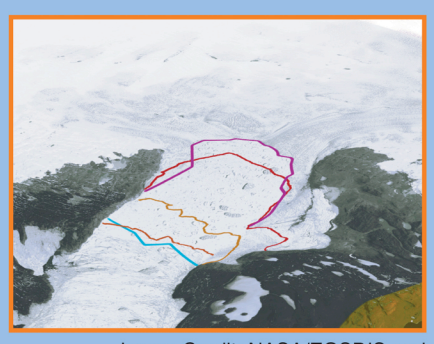
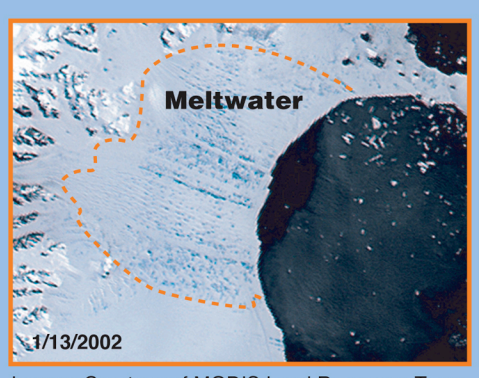
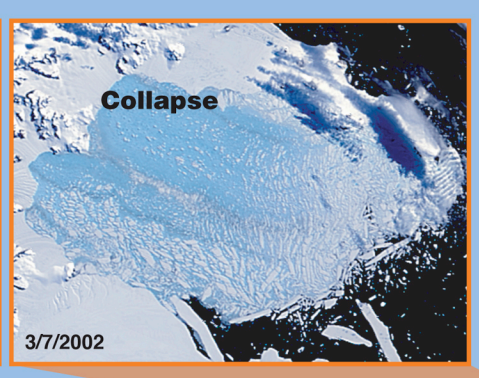


Image Credit: NASA/EOSDIS and NASA/GSFC Scientific Visualization Studio




Images Courtesy of MODIS Land Response Team

Ice shelves surround half of Antarctica playing an important role in slowing the advance of land ice into the ocean, which contributes to sea level rise. NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) shows meltwater (1/13/2002) starting to form on the Larsen-B Ice Shelf prior to its collapse. After 12,000 years of stability, this collapse on 3/7/2002 occurred in just five weeks within the Larsen-B region.

## Ice Sheets and Surface Topography

This detailed MODIS Mosaic of Antarctica (images acquired between 11/20/2003 and 2/29/2004) reveals detailed features on the ice sheet, ice shelves, and ice flows of the continent.

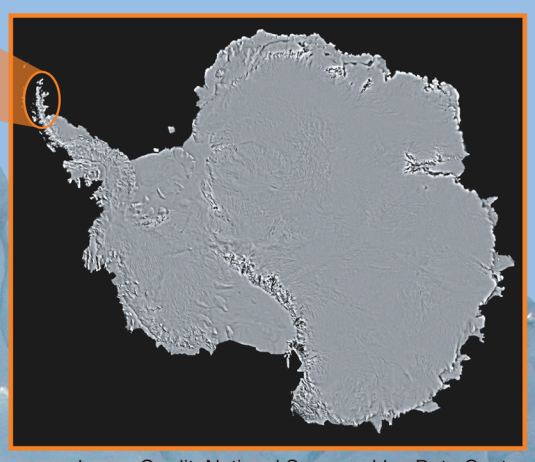


Image Credit: National Snow and Ice Data Center at the University of Colorado

## Sea Ice

Because the poles are covered in ice, they help regulate our planet's temperature. Snow, ice, and clouds reflect significant amounts of sunlight, helping to keep the planet cool. In contrast, open water absorbs sunlight, a process that heats the Earth. Sea ice varies from season to season and from year to year. This Special Sensor Microwave/Imager (SSM/I) image shows the minimum sea ice extent for 2004 occuring in September. The red line indicates the average September minimum between 10/78 and 9/02 derived from monthly averages.

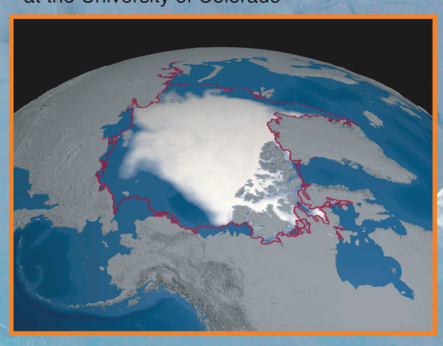


Image Credit: National Snow and Ice Data Center at the University of Colorado, and NASA/GSFC Scientific Visualization Studio

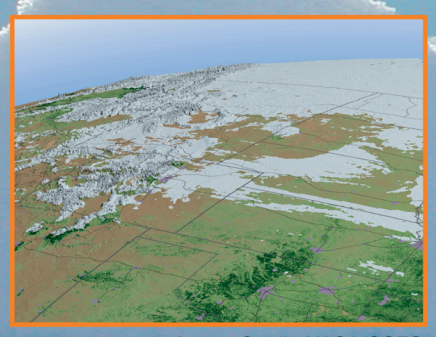


Image Credit: NASA/GSFC Scientific Visualization Studio

## Snow

The extent and occurrence of seasonal snowfall affect mountain winter snowpacks. These snowpacks store significant amounts of water in the western United States. When the snow melts, the water flows into the local water table, as does water from snowfall over the western high plains. The risk for drought, wildfires, and flooding is influenced by how fast or how slow this snow melts. This image shows MODIS Daily Snow Cover and MODIS Landcover over the western United States on 2/24/2003. Purple indicates populated areas (derived from the Global Population of the World (GPW) data set).

Background Image Credit: Tropical Glaciology Group, Dept. of Earth and Atmospheric Sciences, University of Innsbruck, Austria.