Today, advances in remote sensing, the use of highly sensitive instruments aboard satellites and aircraft, have enabled scientists to examine the mass balance of the ice sheets and to determine just where and how quickly the ice is growing or shrinking. Of particular importance is the mass balance of the ice sheet, which is the difference between how much ice it has lost versus gained over a period of time, and is a direct measure of an ice sheet's contribution to sea level rise.

With increases in the number of ways researchers can now measure changes in the landscape and rate of change of the ice sheets, there have come some variations in scientific results that some may find confusing. However, a closer look tells a fairly consistent story.

"The media has reported a lot about how ice is changing, particularly in Greenland, but the numbers vary depending on the time period examined and the technique used. As a result, there may be some confusion out there about what's really happening," said Walt Reid Abdalati, a glacier expert and head of the Cryospheric Sciences Branch at NASA's Goddard Space Flight Center.

NASA's ICESat measures changes in the thickness of ice sheets in Greenland and in Antarctica. This image is of glacial ice along Greenland's shoreline, which is thinning rapidly up to 60 cm per year while the interior ice is thickening at a rate of only 10 cm per year. (Credit: NASA)

Nasa’s ICESat measures changes in the thickness of ice sheets in Greenland and in Antarctica. This image is of glacial ice along Greenland's shoreline, which is thinning rapidly up to 60 cm per year while the interior ice is thickening at a rate of only 10 cm per year. (Credit: NASA)

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Researchers now use aircraft altimetry, satellite radar and laser altimetry, radar interferometry, gravity measurements from NASA's Gravity Recovery and Climate Experiment (GRACE) mission and precise elevation change measurements from NASA's Ice, Cloud, and Land Elevation (ICESat) satellite. Each tool has its own strengths, and when used together, these technologies produce a comprehensive picture of how rapidly it's taking place.

NASA's Ice, Cloud, and Land Elevation (ICESat) satellite. Each tool has its own strengths, and when used together, these technologies produce a comprehensive picture of how rapidly it's taking place.
look into the ice sheets’ behavior that have changed the way the world thinks of climate change and its impact on ice sheets and glaciers.

Each of these provides important information for unraveling the behavior of the ice sheets, and collectively they tell a story. In Greenland, they reveal an ice sheet that is shrinking dramatically at the edges and growing at its higher interior elevations, such that there is a net loss of ice that is far greater than it was in the last decade. These losses are a result of increased melting, and faster flow at the edges, as the floating ice that surrounds parts of Greenland and buttresses some of the outlet glaciers melts.

In Antarctica, these observations tell us that the West Antarctic ice sheet is currently shrinking substantially, and has been for the last decade. They also tell a story of a second much larger ice sheet in East Antarctica that has been growing slowly. The net result in Antarctica is that the ice sheet as a whole has been shrinking, contributing to rising sea levels, and probably much more so in recent years.

"We did not appreciate in the past how the changes in ice sheets respond so quickly to changes in climate. The story these measurement techniques are all telling is that the ice sheets are shrinking more than they were 10 years ago," said Abdalati. "The borders of the ice sheets are melting in waters that are warming."

"Of the techniques for measuring ice sheet change, the laser altimetry approach of the ICESat mission is the most effective because it provides a detailed look at the overall integrated changes in the ice sheets," offered Abdalati. "And continuous observations like those by ICESat would greatly enhance our ability to understand what's really happening to the Earth's dramatically changing ice cover. The most telling comprehensive picture, however, is created when all the techniques are used together."

Note: This story has been adapted from a news release issued by NASA/Goddard Space Flight Center.

NASA Study Finds Rapid Changes In Earth’s Polar Ice Sheets (September 2, 2002) -- Recent NASA airborne measurements and a new review of space-based measurements of the thickness of Earth’s polar ice sheets conclude they are changing much more rapidly than previously believed. ... > full story

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NASA’S ICESat: One Billion Elevations Served (November 26, 2005) -- NASA’s Ice, Cloud and land Elevation Satellite (ICESat) fired its one billionth laser shot earthward on Nov. 18, to obtain elevations from objects on the land, sea and in the air. ICESat measures the ... > full story

Greenland Ice Sheet Flows Faster During Summer Melting (June 25, 2002) -- New measurements show that the flow of ice in the Greenland ice sheet has been accelerating since 1996 during the summer melt season. The results suggest that the ice sheet may be responding more ... > full story

Greenland ice sheet, with an area about one-fifth the size of the continental United States, is the second largest element of Earth's polar ice sheets and is home to supporting the vast Greenland ice cap. The Greenland ice sheet contributes about 0.7 millimeters to sea level rise each year. The ice sheet is at least 80 percent ice, with the remaining 20 percent consisting of debris and water.