

Snow and ice



Ice sheet topography

The state of the polar ice sheets and their volumes are both indicators and causes of climate change. Consequently it is important to monitor and study them in order to investigate the impact of global warming and to forecast future trends. The IPCC expects that ice sheets will continue to react to climate warming and contribute to sea level rise for thousands of years after climate has been stabilised. They note that:

- climate models indicate that the local warming over Greenland is likely to be one to three times the global average;
- ice dynamic models suggest that melting of the West Antarctic ice sheet could contribute up to 3 metres of sea level rise over the next 1000 years, but such results are strongly dependent on model assumptions regarding climate change scenarios, ice dynamics and other factors.

Satellite remote sensing allows observations of the changes in the shape of ice sheets, and identification of the shape and size of large icebergs that have detached from the ice sheet.

SAR instruments are one source of data on the polar ice sheets. RADARSAT provides routine surveillance of polar regions, and has created the first high resolution radar images of Antarctica – enabling detection of changes in the polar ice sheet and improved understanding of the behaviour of the Antarctic glacier. The AMI instrument on ESA's ERS 2 mission has been collecting data on the polar ice

to assist derivation of indicators of climate change, and ASAR on the Envisat mission will continue to provide data on polar ice topography.

Analysis of interferometric measurements by PALSAR, together with observations by the AVNIR-2 instrument on NASDA's ALOS mission, will contribute to understanding the ice sheet mass balance and glacier variation in the South Pole and in Greenland.

Altimeters provide useful data on ice sheet topography. While many have high vertical resolution, their limited horizontal resolution means that their observations over smoother, near-horizontal portions of ice sheets are of greatest value. The RA-2 instrument on Envisat is providing improved mapping of icecaps.

Given the significance of information on changes in the continental ice sheets, two missions dedicated to their study are planned for the coming decade: NASA's ICESat (late 2002) and ESA's Cryosat (2004). CryoSat will provide an instrument for the ice sheet interiors, the ice sheet margins, for sea ice and other topography, with three-mode operation:

- conventional pulse-limited operation for the ice sheet interiors (and oceans if desired);
- synthetic aperture operation for sea ice;
- dual-channel synthetic aperture/interferometric operation for ice sheet margins.

