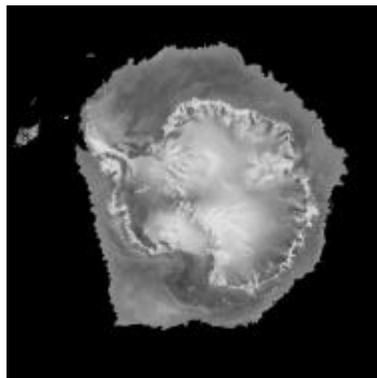
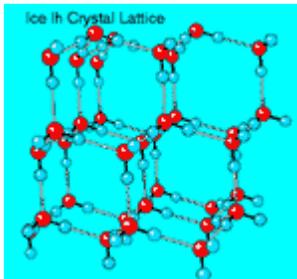
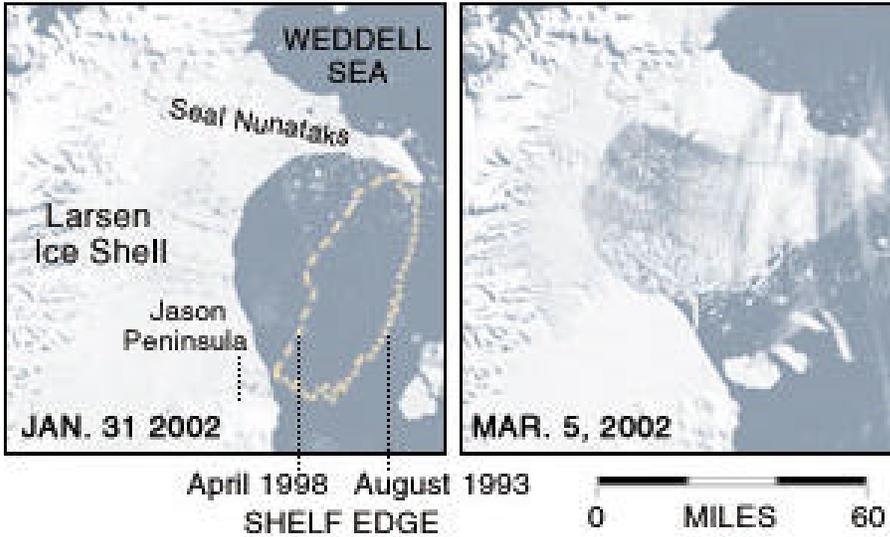


1. Solid water consists of ordered molecules that are tightly bonded to one another. Ice crystal has a hexagonal structure – ice is “plastic”. Density of ice =  $917 \text{ kg/m}^3$ . Less dense than water. Ice occupies a greater volume than the same mass of liquid water.
2. Ice exists in many forms: Glaciers are thick ice mass that form over hundreds or thousands of years. Ice fields or ice sheets exist on much larger scale (Greenland and Antarctica). Sea ice forms from insitu freezing of sea water. Icebergs result from calving of glaciers. Permafrost means frozen soils. Ice clouds are found at high altitudes and high latitudes.
3. Present-day: 75% of the world’s freshwater is in glaciers, which cover 10% of the land area. During the last glacial maximum, 32% of land surface was covered by glaciers.
4. Glacial ice flows in two ways. With sufficient pressure (equivalent to weight of 50 meters of ice), ice behaves as a plastic material and flow begins. The upper 50 m of ice is brittle, and is referred to as the zone of fracture. A second mechanism consists of the whole ice mass slipping along the ground.
5. Glaciers erode in two ways. Plucking: freezing/expansion of meltwater in cracks → pries the rock loose, and incorporates sediments into the glacier’s load. Abrasion: glowing ice with rock fragments grinds the surface below as well as rocks within the ice.
6. Abundant life in the cryosphere. Photosynthetic cyanobacteria have been found in Antarctic ice.
7. Role of glaciers and sea ice in climate:
  - Ice has high albedo (70%) compared to water (6%). Ice reduces the absorption of solar energy.
  - Melting and formation of sea ice changes salinity (density) of sea water, and may alter the thermohaline circulation and cause climate fluctuation
  - Glaciers record past climate (e.g.  $\text{CO}_2$  concentration in air bubbles)
8. Changes in glacial amount affect sea level. Sea level was 120 m lower during the Last Glacial Maximum. If all of the present-day land ice melted, sea level would rise by 70-80 meters worldwide.
9. Ice caps and glaciers are a seasonal reservoir of water for human consumption.
10. On Antarctica, Larsen B glacier is disintegrating while the Amery glacier is growing.



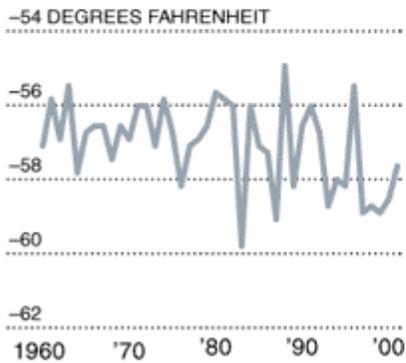


## Two Stations, Two Trends

Temperatures vary across the continent, as with these annual averages at two research stations.



**FALLING** AMUNDSEN-SCOTT  
SOUTH POLE (UNITED STATES)



Source: British Antarctic Survey

**RISING**  
BELLINGSHAUSEN (RUSSIA)

