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The Earth's Dynamic Cryosphere and the Earth System

Ice Cores, High-Mountain Glaciers, and Climate

By Lonnie G. Thompson[1]

The global retreat of high-mountain glaciers, the shrinkage of ice fields and ice caps, and the retreat of their associated outlet glaciers represent perhaps the most visible evidence for 20th-century climate change and for the recent increase in globally averaged near-surface temperatures of the Earth. The loss (melting) of high-mountain glaciers, including ice fields, ice caps, and other glaciers, not only diminishes regional water supplies but also destroys the scientifically valuable long and often detailed climatic histories that no other type of terrestrial or marine record makes available. In a few cases, the paleoclimate histories contained within ice cores from these shrinking ice fields and ice caps can provide a much longer perspective and the critical temporal context for questions concerning the significance of the retreat of 20th-century glaciers. The ongoing rapid retreat of mountain glaciers globally (figs. 1, 2) threatens fresh water supplies in many of the world's most populous regions, even as it contributes to the rise in global sea level.

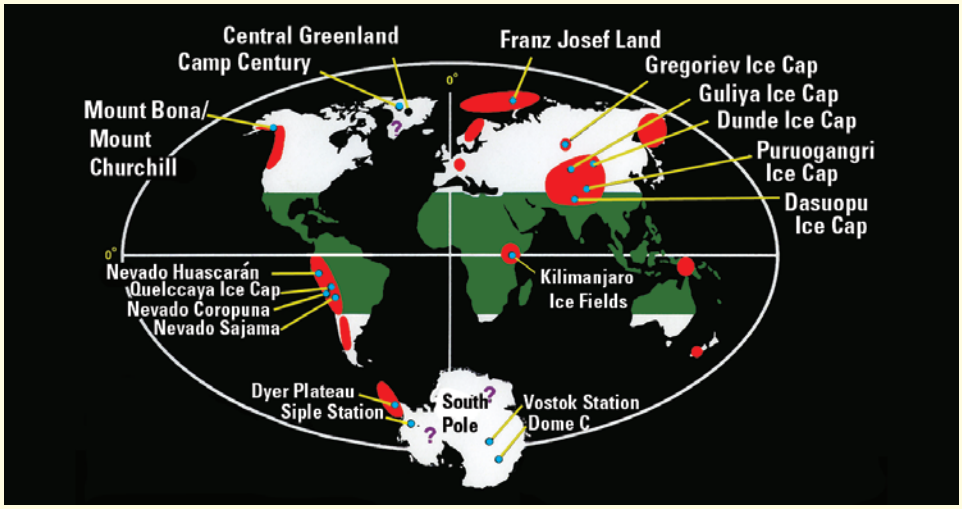

Figure 1. Geographic locations of areas of glaciers that were retreating during the 20th century and of the ice-core sites in many of these areas. Map compiled by the Byrd Polar Research Center, The Ohio State University, Columbus, Ohio.

Figure 2. Two views of the receding margin of the *Quelccaya ice cap*, Perú's largest glacier and the Earth's largest tropical ice cap. The margin of the ice cap was photographed from the same camera station in 1977 (top) and in 2002 (bottom). Photographs by Lonnie G. Thompson, Byrd Polar Research Center, The Ohio State University, Columbus, Ohio.

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Recent innovations in lightweight drilling technology have expanded paleoclimatic research on ice cores from the polar regions (for example, from ice cores from the Greenland and Antarctic ice sheets) to ice fields and ice caps in many of the highest mountains on Earth (fig. 3). During the last few decades, much effort has been focused on the retrieval of ice cores from glaciers in subpolar regions, such as western Canada and eastern Alaska, from the mid-latitudes such as the Rocky Mountains and the Alps, and from tropical mountains in Africa, South America (fig. 4), and China. Unlike records from polar ice cores, climate records from lower latitude high-mountain glaciers, including ice caps, ice fields, and other types of glaciers, present information that is necessary for studying climatic processes where human activities are concentrated. This is true especially in the tropics and subtropics where 70 percent of the world's population lives (fig. 1). During the past 100 years, regional and global-scale climatic and environmental change has been accelerating. Human beings are vulnerable to such change, which will increasingly affect us in the present and future centuries.

URL Addresses:

http://bprc.osu.edu/Icecore/

http://www.ncdc.noaa.gov/paleo/icgate.html

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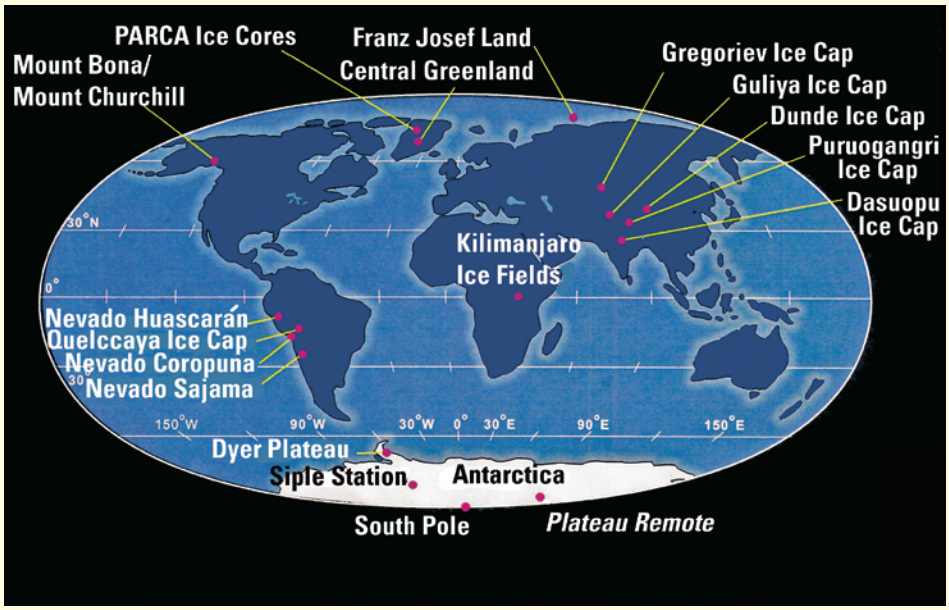

Figure 3. Glacier sites worldwide from which glaciologists have obtained ice cores containing paleoclimate histories and compared them with current climate records to better understand climate change. Map compiled by the Byrd Polar Research Center, The Ohio State University, Columbus, Ohio.

Figure 4. Glaciologist extracting glacier ice core from a drilling barrel on the 6,100 meters col (pass) of Huascarán, Perú, in July 1993. Photograph by Lonnie G. Thompson, Byrd Polar Research Center, The Ohio State University, Columbus, Ohio.