

Satellite Glaciology of Iceland

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ABSTRACT

The glaciers of Iceland have been studied by scientists for nearly 200 years, and variations have been monitored for about 50 years. Although maps of the principal glaciers appeared in 1792 (Pálsson), 1844 (Gunnlaugsson), and 1901 (Thoroddsen), modern maps were not available until the Danish Geodetic Survey conducted plane-table surveys from 1904 until just before World War II. Several series of modern maps prepared by using aerial photogrammetric techniques, by the Defense Mapping Agency (U.S.) and/or the Icelandic Geodetic Survey, have been published since World War II. Aerial photographs of Iceland's glaciers were first acquired in the 1930's. Aerial photographs of most of Iceland have been acquired twice by the United States in 1944-45 and in 1956 and 1969-61. During this same period the Icelandic Geodetic Survey has also acquired aerial photographs of selected areas of Iceland.

Periodic monitoring of Iceland's glaciers, usually on an annual basis, was begun by Eythórsson in the 1930's. After his death, the annual measurement of glacier variation has been carried out by Rist. At the present time about 40 positions are measured annually, including the 34 International Hydrological Decade (IHD) index-numbered glacier margins. This represents about 12 percent of the total number of named and unnamed glaciers and outlet glaciers that could be monitored annually (total about 330).

For the past 10 years (1972-82) the Landsat series of satellites has been imaging Iceland's glaciers. Successive Landsat images acquired by U.S., Canadian, and Swedish receiving stations have provided new information about the glaciers of Iceland and have also provided a new way of monitoring changes in glacier area and changes in positions of glacier termini and margins of ice caps. Although satellite glaciology of Iceland is only in its infancy, the following studies have been completed by different scientists: glacier advance and recession (including surging glaciers), effect on the glacier surface of subglacial volcanic and geothermal activity, effect of jökulhlaups, glacier flow, ablation phenomena, and geomorphic, structural, and tectonic studies of the subglacial terrain. Landsat images have also been used to produce special image maps of Iceland's glaciers.

INTRODUCTION

Iceland abounds in dynamic geological phenomena which, for over 200 years, has attracted the attention of geologists. Special scientific emphasis have been directed at: (1) its geothermal areas (especially the occurrence of hot springs and geysers), (2) its frequent volcanic activity and great diversity of volcanic landforms, and (3) its glaciers and the landforms produced by glacier action. It is Iceland's glaciers that are the subject of this paper, including a discussion of how the rapidly developing technology of satellite remote sensing is being used to provide a periodic and permanent record, in image form, of changes in the following physical characteristics of its glaciers: surface area, ice cap margins and glacier termini, and surface features caused by glacier flow or subglacial volcanic and geothermal activity.

OCCURRENCE OF GLACIERS

Glaciers in Iceland occur principally as ice caps or outlet glaciers from ice caps. Figure 1 is a sketch map showing the 13 principal ice caps of Iceland. According to published maps, books, and journal articles there are 33 separate glaciers (geographic place names of ice caps (not including outlet glaciers) and cirque glaciers where the suffix jökull occur) in Iceland. Most of these glacier names were listed by Thorarinsson (1943) in his discussion of the areas of Iceland's glaciers. From published maps, books, and journal articles, however, there are actually a total of 85 separately named outlet glaciers of the 13 individual ice caps out of a potential total of about 330 separate named and unnamed ice caps, outlet glaciers, and other types of glaciers (mostly cirque-type) which can be identified on maps of Iceland at a scale of 1:100,000 or smaller. The 13 major ice caps, all of whose areas exceed 20 km², are listed in Table 1.