



Glacier Photograph Collection, Version 1

USER GUIDE

How to Cite These Data

As a condition of using these data, you must include a citation:

National Snow and Ice Data Center (comp.). 2002, updated 2015. *Glacier Photograph Collection, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NSIDC: National Snow and Ice Data Center. <https://doi.org/10.7265/N5/NSIDC-GPC-2009-12>. [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT NSIDC@NSIDC.ORG

FOR CURRENT INFORMATION, VISIT <https://nsidc.org/data/G00472>



National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

1.1 Overview

The Glacier Photograph Collection (GPC) is a database of digital photographs, both scanned from physical objects and ones that originated in digital form (born digital), of glaciers from around the world. Some images date back to the mid-19th century and provide an historical reference for glacial extent. The GPC is a component of the [Global Terrestrial Network for Glaciers](#) (GTN-G). GTN-G is the framework for the internationally coordinated monitoring of glaciers and ice caps in support of the United Nations Framework Convention on Climate Change. Most of the photographs are of glaciers in the Rocky Mountains, the Pacific Northwest, Alaska, and Greenland. However, the collection does include a smaller number of photos of glaciers in Europe, South America, the Himalayas, and Antarctica. Updates to the GPC occur at irregular intervals. The collection includes a number of sub-collections or Special Collections that are distinguished in some way, as described in the documentation. For example, there is special collection of Repeat Photography of Glaciers that provides a unique look at changes in glaciers over time. The photos are available online via a [searchable interface](#) and are retrievable by glacier name, photographer name, date, country, state, and geographic coordinates.

Note that the analog material upon which part of this digital data set is based moved from the NSIDC archives to the University of Colorado (CU) Libraries Archives in August 2018, where it is part of the [Roger G. Barry glaciology collection](#).

If you are interested specifically in the analog collection, you can search for "NSIDC Glacier Photograph Collection" from the [CU search interface](#), but be aware that it may not yet be catalogued, or it may be catalogued under a different name. If you have questions, contact sca@colorado.edu.

1.2 Background Information

Glaciers are sensitive to the temperature and precipitation fluctuations accompanying climate change. Many of the world's glaciers are retreating in response to warmer temperatures. This retreat is often marked by an obvious change in glacier terminus location. For an example, see [Mountain Glaciers](#) on the NSIDC State of the Cryosphere Web page. Because of this sensitivity to climate change, historical photographic collections of glaciers are important to the study of the climate record.

Prior to 2018, NSIDC held an analog archives collection that housed more than 20,000 glacier photograph prints as well as approximately 100,000 images on microfilm. These photographs, of

glaciers taken from the ground, the air, and from space, constitute an important historical record, as well as a data collection of interest to those studying the response of glaciers to climate change. The collection of prints is fragile and users were required to travel to Colorado to view the collection. Because of this, the climatologically and historically significant analog collection had relatively few users. To help rectify this situation, in 2002, NSIDC partnered with the NOAA Climate Database Modernization Program (CDMP) to digitize selected photographic prints and make them available through a [searchable online interface at NSIDC](#) and retrievable by glacier name, photographer name, date, country, state, and geographic coordinates. NSIDC released the first iteration of the digital GPC in December 2002.

The CDMP was a partnership between NOAA and private industry to image and key paper and microfilm records and then make them available online to members of the climate and environmental research community, as well as the public at large. In partnership with NOAA and the CDMP program, additional glacier photographs, numbering in the thousands, were scanned and added to the online collection at NSIDC. The CDMP program ended in 2011 before all of the photographic prints could be digitized. This left the remaining prints in peril due to a lack of funding to continue to archive them.

In 2016, NSIDC entered into a new partnership with the Digital Library at the University of Colorado at Boulder (CU) and began to digitize the remaining photographic prints in the analog collection. This partnership was made possible by a grant from the Council on Library and Information Resources (CLIR). In 2016, the Council of Library Information Resources (CLIR) awarded NSIDC, in conjunction with CU Boulder Libraries, a grant to complete scanning and metadata transcription of photographic prints in the collection and to move the analog collection to its new home at the CU libraries. In August of 2018, the analog archive was relocated to CU Boulder Libraries, *Special Collections, Preservation and Archives* department for preservation and long term storage. As of February 2019, roughly 8,500 photographic prints have been digitized and, with respective metadata, added to the GPC under the terms of the CLIR grant. The GPC is also viewable through a [CU Digital Library](#) web interface.

The digital Glacier Photograph Collection began with a little over 1,000 photographs in 2002 but has grown to just under 25,000 as of March 2019. Through the years, it has also grown to encompass special collections of glacier photographs that include Repeat Photography of Glaciers, the Antarctica Dry Valleys Glacier Photographs, NASA Astronaut Glacier Photographs, International Geophysical Year 1957-58 Glacier Photographs, National Park Service Glacier Surveys Report, and photographs from the World Glacier Monitoring Service. For more information on these, see section 3.1.3 Special Collections in this document.

1.3 Citing Individual Photographs

Each image in the digital GPC has its own citation. To cite individual photographs, please use the following citation:

Photographer's name. Year photograph was taken. *Name of glacier*: From the *Glacier Photograph Collection*. Boulder, Colorado USA: National Snow and Ice Data Center. Digital media.

If using many images, the user may simply cite the entire collection:

National Snow and Ice Data Center (comp.). 2002, updated 2019. *Glacier Photograph Collection, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NSIDC: National Snow and Ice Data Center. doi: <https://doi.org/10.7265/N5/NSIDC-GPC-2009-12>. [Date Accessed].

1.4 Format

Images are available in JPEG (.jpg) and TIFF (.tif) format and are provided in three sizes: thumbnail, reference, and high-resolution archive (see Table 1). When you order the high-resolution image, it is accompanied by an associated metadata file in ASCII text (.txt) format. Table 1 provides information about image dimension and size and Appendix A – Photo Metadata Description describes the metadata fields provided with each image.

Table 1. Image Format, Dimension, and Size

Type	Format	Width (pixels)	Size
Thumbnail	JPEG	150	~20 KB
Reference	JPEG	640	15 KB to 2 MB
High-resolution	JPEG and TIFF	Ranges from 640 to 6600	29 KB to 320 MB

1.5 File Naming Convention

This section explains the file naming convention used for this product with examples. The file names of many of the photographs were created with the Digital File ID followed by the image format extension. Most GPC Digital File IDs are assigned at NSIDC based on the name of the glacier, the year/month/day of the photograph, and an index number starting with 01 for images in a series; however, there are exceptions to this rule that are noted in section 1.5.1 Exceptions to File Naming Convention. Note that all three sizes of the image of a particular glacier photo (thumbnail, reference, and archive) have the same base file name but have a different extension (.jpg or .tif) depending on the format. The associated ASCII text metadata file also has the same filename as the photograph but with a .txt file extension.

Example File Name: agassiz1913081501.tif

Generic File Name: GlacierNameYYYYMMDDXX.ext

Where:

Table 2. File Naming Convention

Variable	Description
GlacierName	The name of the glacier
YYYY	4-digit year that the photo was taken. If the year is not known 9999 is the fill value.
MM	2-digit month of the year the photo was taken. If the month is not known 99 is the fill value.
DD	2-digit day of month that the photo was taken. If the day is not known 99 is the fill value.
XX	2-digit photo index number
.ext	File extension: .jpg, .tif, or .txt

1.5.1 Exceptions to File Naming Convention

NoGlacier and Unknown Glaciers

Users should note that photographs without glaciers generally have a Digital File ID starting with noglacier. Images without glaciers are provided as a reference for historical context. For example, some of the *No Glacier* images are photographs of the surrounding area of the glacier. Unidentified images where the name of the glacier is not known are generally given a Digital File ID starting with unknown. There are exceptions to this rule depending on the cataloger that did the naming.

Photographs by Reid

For the Reid collection, the Digital File IDs are similar to charpentier1892_353, which refers to the glacier name, the 4-digit year the photograph was taken, and the 3-digit number assigned to the photograph by Reid. See section 3.1.1 The Analog Collection for more information about these photographs.

Photographs of Greenland Glaciers

For the Greenland collection, the Digital File IDs are based on the glacier name, followed by the characters GI, then a 2-digit box number, and finally a 2-digit slide number within each box. For example, the glacier identifier of hayesGI01_02 refers to Hayes Glacier in Box 1 and it is the second slide from that box. See section 3.1.1 The Analog Collection for more information about these photographs.

National Park Service Glacier Survey Reports

The Digital File IDs for the National Park Service (NPS) Rocky Mountain National Park (RMNP) Glacier Survey Reports are assigned based on the 4-character park code, the 4-digit year of the RMNP report, the name of the glacier, the 4-digit year of the glacier photograph, and a 2-digit unique identifier used with every photograph. The first eight characters of the Digital File ID are coded to match the photographs in the original report. For example, the Digital File ID of `rmnp1939_andrews190901` refers to the RMNP report from 1939 with a photo of Andrews Glacier which was taken in 1909, and it was the first in the series of Andrews glacier photos from that report. See section 3.1.3 Special Collections for more information on these photographs.

Austin Post and United States Geological Survey (USGS) Ice and Climate Project Aerial Photographs

The Digital File IDs for the Austin Post and USGS Ice and Climate Project (ICP) aerial photographs are assigned based on the original photograph print number beginning with USGS, the 2-digit year the photograph was taken, camera angle (V: vertical, H: horizontal), 1-digit roll number, and 3-digit image number. For example, the Digital File ID of `USGS92V1_053` references that USGS was the supporting project, that the photograph was taken in 1992, that the image was a vertical camera angle, and that it was Image 53 on Roll 1. See section 3.1.1 The Analog Collection for more information about these photographs.

Antarctica Dry Valleys Glacier Photographs

The Digital File IDs for the Dry Valleys photographs were created by the [Data Conservancy](#) group at Johns Hopkins University. They begin with `McDV_FieldPhoto` referring to the McMurdo Dry Valleys, followed by the 4-digit year the photo was taken, and then a 5-digit photo counter number. For example, `McDV_FieldPhoto_1993_00311` is photo 311 of the 1993 season. See section 3.1.3 Special Collections for more information on these photographs.

Lake Clark National Park and Preserve Collection

The Digital File IDs for the Lake Clark National Park photographs all begin with `lacl_` followed by the photograph date and the glacier name, if known. The rest of the ID is a differing combination of the image number. For example, `lacl_1987_ahoglacier_870817_diff8`, `lacl_dsc00195`, and `lacl_img_0034`. See section 3.1.3 Special Collections for more information on these photographs.

Photographs Digitized during the CLIR Grant

Digital File IDs for photographs catalogued and digitized under the CLIR grant from 2016 through 2018 were recorded under the following format:

Source_LastInitial_YYYY_FlightNumber_PhotographicNumber

This naming scheme was chosen because it helped distinguish these images from images that were catalogued and digitized prior to the grant. It also eliminated the chances for duplicate file names. The file name convention is based on how scientists William O. Field, Marion T. Millett, and Charles C. Morrison identified their photographs from field expeditions. This style is also similar to how the International Boundary Commission identified their glass plate negatives during boundary surveys between 1893 and 1907. Including this file name format also extends opportunities to identify photographs that were taken on the same day in the same location but are filed under other glacier names or locations. This pattern specifically assists with connecting flight patterns for aerial photographs, field expeditions of William O. Field, and photographs taken during the International Boundary Commission years.

Aerial photographs follow the same digital file format though most aerial photographs are not attributed to one photographer (with the exception of Austin Post and Bradford Washburn), so the initial of last name is left from the file name sequence. The sequence for aerials includes the flight number when available. This can help connect flight patterns and photographs taken on the same flight since glacier names and locations within a flight will vary.

Table 3. CLIR Grant File Naming Convention

Variable	Description
Source	The person or acronym for the entity that provided the photo if known.
LastInitial	The first initial of the last name of the photographer or initials for their full name. If the photographer is unidentified, this value is left blank.
YYYY	4-digit year the photo was taken. If the year is not known, this value is left blank.
FlightNumber	The number given as part of the flight information, if the image was taken from an airplane.
PhotographNumber	The number on the negative or photographic print if applicable. If this value was not visible on the photographic print, then a numerical value starting with 01 was added.

Examples of this file name scheme:

Example 1:

AGS_F_1950_R545

AGS: Source abbreviation for American Geographical Society.

F: Stands for the first initial in the photographer’s last name. In this example, F stands for photographer William O. Field.

1950: 4-digit year photograph was taken.

R351: The number on the photograph that indicates the photograph or negative number – written on the photograph by the photographer.

Example 2:

AGS_AEH_1968_2508

AGS: Source abbreviation for American Geographical Society.

AEH: Initials for the photographer's full name. In this example initials are for Arthur Elliot Harrison.

1968: 4-digit year photograph was taken.

2508: The number on the photograph that indicates the photograph or negative number – written on the photograph by the photographer.

Example 3:

USN_1957_047

USN: Source abbreviation for U.S. Navy.

1957: 4-digit year photograph was taken.

047: The number on the photograph that indicates the photograph or negative number.

Example 4:

AGS_1942_FL55_V1

AGS: Source abbreviation for American Geographical Society.

1942: 4-digit year photograph was taken.

FL55: Flight number 55.

V1: The number on the photograph that indicates the photograph or negative number.

1.6 Spatial Coverage

The photographs are primarily of glaciers in Alaska, Greenland, the Pacific Northwest (U.S. and Canada), and the Rocky Mountains, along with some from Europe and South America. The latitude and longitude reported for each photograph is the location of the glacier, not the point from which the photograph was taken. When available, photographer station name, photographer station latitude, and photographer station longitude are included which is where the photographer was while taking the photograph. The photographer station information was obtained by reviewing maps from field expeditions. Glaciers in the mountain ranges along the Alaskan/Canadian border are referred to as being located in both Alaska and Canada. Figure 1 shows a map with the location of glaciers in this data set.

Extra spatial coverage terms are included in some metadata records in the Dublin Core Spatial Coverage field as a structured resource that can be used to further identify locations of the landscapes and glaciers depicted in the photograph. The Dublin Core Spatial Coverage field is a Dublin Core data value standard using a controlled vocabulary that provides preferred names and

terms for geographic places. The structured classification schemes were located using the Getty Thesaurus of Geographic Names. If the coverage value for the area was not found in the Getty Thesaurus, then the coverage value was built using information from USGS Geographic Names Information System (GNIS) database. Place names in the Dublin Core Spatial Coverage field include name for nation, state/province, inhabited places, and physical features (glacier, mountain, inlet, etc.). Variant names that include historic place names are included when necessary.

Including Dublin Core Spatial Coverage in the metadata aids in understanding what location the photograph depicts without having to rely on coordinate values. This information is especially helpful for photographs that are listed as *Unknown* or *No Glacier* and for values where location area is known but coordinates cannot be determined. This added spatial information is intended to aid research and discovery of the photographs in this collection. This field was added during the CLIR grant work that occurred from 2016 through 2018.

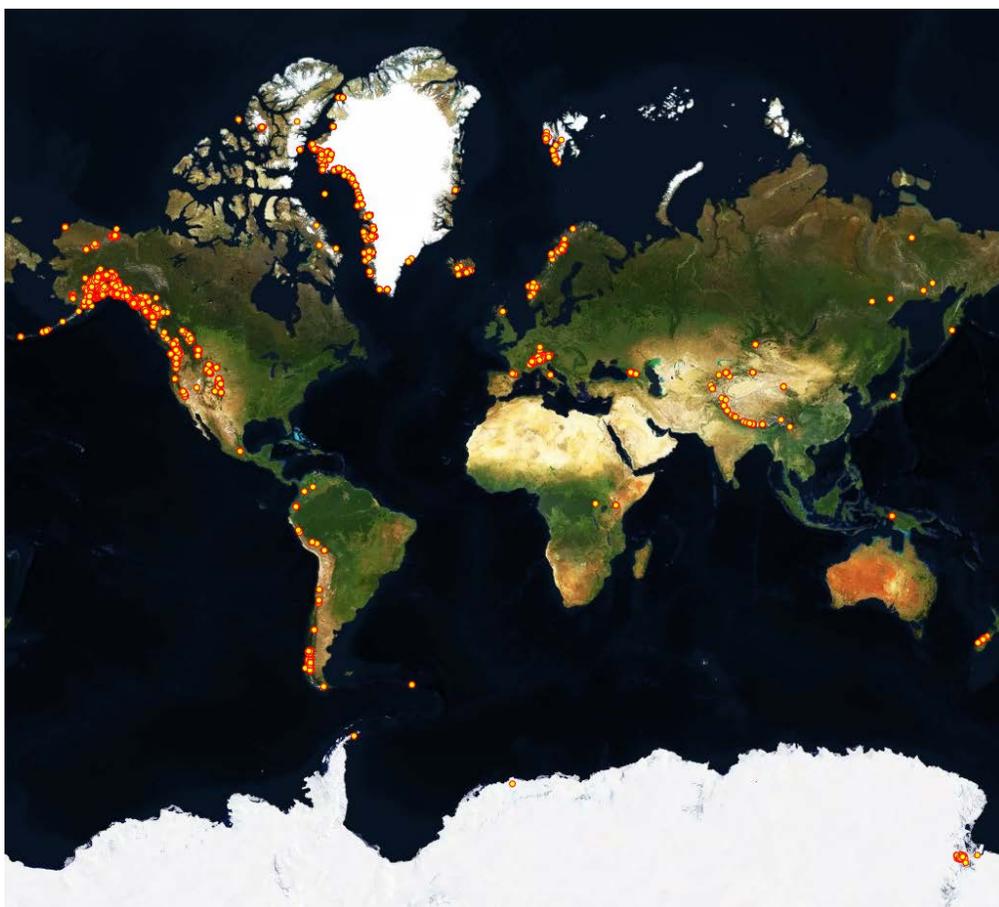


Figure 1. Map showing location of glaciers in this data set as of March 2019.

Image from the [GTN-G Glacier Browser](#).

1.7 Temporal Information

As of February 2019, the earliest glacier photograph in the digital GPC is from 1857, and the most recent is from 2015. Some photographs are of the same glacier and comprise a special Repeat Photograph Collection that provides a unique look at changes in glaciers over time. See 3.1.3 Special Collections for more information.

2 SOFTWARE AND TOOLS

2.1 Get Data

The digital GPC may be accessed at NSIDC through an online [Search & Order](#) interface. Note that this interface works best in the the following web browsers: Firefox, Chrome, and Internet Explorer.

In addition, you can access the photos via a map server available from the [GTN-G Glacier Browser](#) and from the [GLIMS Glacier Viewer](#). The collection is also accessible through the [CU Boulder Digital Libraries LUNA](#) catalog. Discovery of the collection in the CU Digital Library will open the collection to new audiences from different disciplines.

After completing a search using the NSIDC [Search & Order](#) interface, a list of the results with a thumbnail image is returned (Figure 2). To see the metadata and a reference image, click on the thumbnail image in the search results. This will load a separate web page with them (Figure 3). To order a high-resolution archive image along with an ASCII text file containing the metadata, check the box to the left of the thumbnail of the glacier photograph in the search results (Figure 2) or click the *Add Photo to Order* button on the reference image web page (Figure 3). If you are finished searching, click *Place My Order*; or to continue your search and add to your order, click *Start a New Search*.

Search Results

Your search results are displayed below. Please select the images or other materials you would like to order, or change your search by toggling "Define Your Search" above.

0 Selected Photos: [Remove All](#) [Start a New Search](#)

[Place My Order](#)

Number of matching results: 3

Summary of last search:

Collections : all
Countries : (Any values)
States/Provinces : (Any values)
Glacier Names : Muir Glacier
Photographer Names : "Andrews, Clarence Leroy"
Photograph Number :
Notes contain :

Spatial Criteria:
North : 90
West : -180
East : 180
South : -90

Temporal Criteria:
Minimum Year : 1913
Maximum Year : 1913
Month :

<< < Page 1 of 1 > >> 20 results per page

<input type="checkbox"/>	Click on the image for more information	Glacier Name ▲ (Other Glaciers)	Photographer Name ▲	Date (YYYY-MM-DD) ▲	Spatial Coverage ▲	Digital File ID ▲ Photograph Number GLIMS Glacier ID
<input type="checkbox"/>		Muir Glacier	Andrews, Clarence Leroy	1913-XX-XX	Muir Glacier (Skagway-Hoonah-Angoon, Alaska, United States) (glacier)	AGS_A_1913_3011 Photograph number 3011 G223569E59190N
<input type="checkbox"/>		Muir Glacier	Andrews, Clarence Leroy	1913-XX-XX	None	muir1913000001 None None
<input type="checkbox"/>		Muir Glacier	Andrews, Clarence Leroy	1913-XX-XX	None	muir1913000002 None None

<< < Page 1 of 1 > >> 20 results per page

[Place My Order](#) [Start a New Search](#)

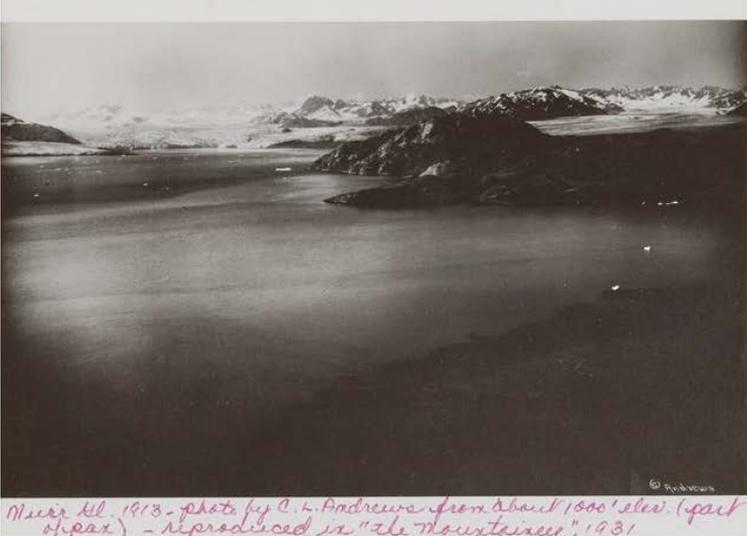
Figure 2. Example of results generated from a search of the Glacier Photograph Collection.

The following metadata and the image in Figure 3 are displayed if, for example, you click the Muir Glacier (AGS_A_1913_3011) thumbnail in the search results shown in Figure 2. **Note:** This metadata is provided as an ASCII text file when you order the high-resolution archive image.

Glacier Photograph Collection

[Add Photo to Order](#)

Digital File ID : AGS_A_1913_3011
GLIMS Glacier ID : G223569E59190N
Glacier Name : Muir Glacier
Country : United States
State/Province : Alaska
Latitude : 59.07830
Longitude : -136.36060
Dublin Core Spatial Coverage : Muir Glacier (Skagway-Hoonah-Angoon, Alaska, United States) (glacier)
Date of Original Media : 1913
Photographer Name : Andrews, Clarence Leroy
Image Dimensions (pixels) : 4200 x 3029
Image Type : TIFF
High Resolution Image File Size (kb) : 37284
Original Media : gelatin silver prints
Description : 1 photoprint; 24.8 x 30.5 cm. (9 3/4 x 12 in.) matboard; 12.7 x 17.8 cm. (5 x 7 in.) image
Photograph Number : Photograph number 3011
Documentation : <https://nsidc.org/data/g00472>
Source : American Geographical Society/World Data Center-A for Glaciology
Notes : Transcribed from item: Muir Glacier, St. Elias, Glacier Bay, Muir Inlet. Muir Glacier 1913 - photo by C.L. Andrews from about 1000' elevation (part of pan) - reproduced in "the mountaineer," 1931. Muir Glacier, St. Elias
Publisher : National Snow and Ice Data Center
Rights : Photograph held by the National Snow and Ice Data Center, Boulder. May be used freely if properly cited.
Citation : Andrews, Clarence Leroy. 1913. Muir Glacier. From the Glacier Photograph Collection. Boulder, Colorado USA: National Snow and Ice Data Center. Digital media.



Muir Gl. 1913 - photo by C. L. Andrews from about 1000' elev. (part of pan) - reproduced in "the mountaineer", 1931

[Add Photo to Order](#)

Figure 3. Muir Glacier photographed in 1913 by Clarence Leroy Andrews with associated metadata appearing as text above the image.

3 DATA ACQUISITION AND PROCESSING

3.1 Data Acquisition Methods

3.1.1 The Analog Collection

Prior to 2018, NSIDC housed thousands of glacier photographs as prints and on microfiche. The largest single collection of print images, comprised of roughly 5000 prints, is the *American Geophysical Union/American Geographical Society (AGU/AGS) Collection*. This collection originated with William Osgood Field in the late 1950s. Field was the head of the Department of Exploration and Field Research at the AGS from 1947 until he retired in 1969. Field took many of the photographs and assembled them for an AGU research committee. On the strength of this collection, in 1957, the International Geophysical Year (IGY) committee awarded the WDC for Glaciology in the United States to Field and named him as the first director. He maintained the collection until the WDC for Glaciology was moved to the United States Geological Survey (USGS) in Tacoma, WA in 1970 and then to what became the National Snow and Ice Data Center in Boulder, CO in 1976.

The photographs in the *AGU/AGS Collection* are primarily of Alaskan glaciers but also include the Pacific Northwest (U.S. and Canada), the Rocky Mountains, and Europe. Field indexed the photos by region and drainage system. For example, he indexed Alaskan glacier photos starting in the southeast corner of the state, continuing north and west, following each drainage basin in a counterclockwise direction. This method enables photos of neighboring glaciers to be filed next to each other. This filing system is used for Field's collection and some subsequent early donations are filed into this system as well. Other donations are arranged into sub-series by photographer name. It is from the *AGU/AGS Collection* that the first photographs were selected for the CDMP digitization project. See section 3.1.2 Analog to Digital for more information.

The *AGU/AGS Collection* that Field donated to NSIDC/WDC for Glaciology also included the Harry F. Reid collection. Reid, America's first geophysicist (Gillispie 1975, Louderback 1945), traveled to Glacier Bay, Alaska, in 1890 and 1892 in order to photograph and map the area. Collected by Field after Reid's death in 1945, the materials include approximately 600 glass plate negatives and prints, 22 expedition notebooks, and approximately one cubic foot of manuscript materials that include drafts of Reid's map of Glacier Bay. Also included are photographs taken during Reid's trips to the Alps from 1894 through 1901. Users should note that some of the photographs taken by Reid were of the local area and not of an actual glacier. The Reid photographs without glaciers were given a glacier name of *No Glacier* in the database.

Austin Post was a research scientist for the United States Geological Survey (USGS), known for his aerial photographs of glaciers in Alaska and the U.S. northwest. Copies of the Austin Post aerial photograph collection became a part of the WDC for Glaciology collection when the WDC was transferred to the USGS in Tacoma in 1970. This collection of photographs, the Post-Mayo-Krimmel (PMK) Collection, comprises approximately 100,000 photographs, almost all of which are only available on microfilm. However, over 6,500 Post photos are part of the digital GPC.

The Greenland photograph collection was donated to the WDC for Glaciology, Boulder, in the mid-1980s by Captain Ron Kollmeyer of the U.S. Coast Guard (USCG). Captain Kollmeyer was the lead for the Greenland Glacier Survey. More than 1,200 color slides have been digitized and are available via the online [Search & Order](#) interface. The photographs of western Greenland glaciers were taken between 1969 and 1980 from ground observation stations and from USCG helicopters at an altitude of between 100 and 1,000 feet.

Until becoming inactive in the mid-2000s, the WDC for Glaciology, Boulder, was an entity that had an interest in maintaining the analog archive of glacier photographic prints that are the bedrock of the original digital GPC. NSIDC and the WDC for Glaciology, Boulder, were collocated; and NSIDC, with monetary support from NASA and NOAA, provided a home for the analog archive. However, NASA support was lost in 2012; and NOAA@NSIDC support was insufficient to maintain the analog archive. In 2014, we could no longer maintain a full-time archivist. With preservation and longevity in mind, NSIDC instigated a move of the analog archive from NSIDC to the CU Boulder Libraries Special Collections, Preservation, and Archives department in August of 2018. The collection is now called the [Roger G. Barry Glaciology Collection](#). With materials under the care of CU Boulder Libraries the collection will continue to receive preservation care and future access to the materials will be made available through the CU Boulder Libraries.

3.1.2 Analog to Digital

3.1.2.1 NOAA CDMP Grant – 2000 to 2011

The [NOAA Climate Database Modernization Program \(CDMP\)](#) ran for 12 years from 2000 to 2011. In partnership with the [NOAA National Geophysical Data Center \(NGDC\)](#) (now the National Centers for Environmental Information) and SourceHOV, a CDMP corporate partner, NSIDC digitized selected analog photographs for online distribution. The goals of the CDMP Glacier Photograph Digitization Project were the following:

- Make the photographs better known among the glaciological community and others
- Increase availability of the images
- Provide the highest-quality digital reproductions of the photographs available
- Provide proper archival storage for the digitized subset of glacier photographs

NSIDC selected images for digitizing that were held by NSIDC with no copyright restrictions, that were of good quality, and that show substantial portions of glaciers. The original black-and-white photographic prints range in size from 2 x 3 inches to 8.5 x 11 inches. Figure 4 shows a picture of some of the analog archive holdings.

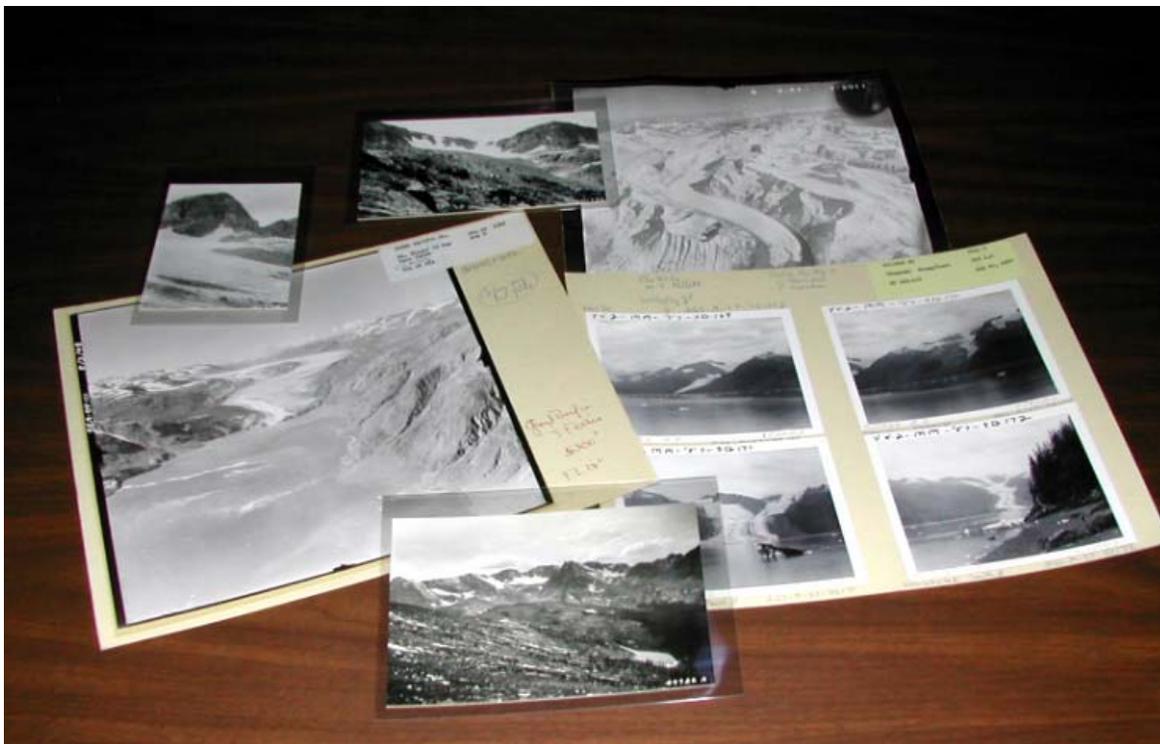


Figure 4. A selection of glacier photograph prints prepared for shipment to the CDMP contractor for digitizing.

The following requirements were provided to the CDMP contractor for digitizing the photographs:

- The reproductions should be an uncompressed archival image (TIFF), a compressed reference image (JPEG), and a thumbnail image (JPEG).
- The archival image should be the highest-quality image possible (TIFF) with version 6.0 headers, uncompressed, unedited, at 600 dpi. Use 24-bit RGB color, 1800 to 6600 pixels across the long dimension, depending on the size of the original print. This resolution should be the actual optical resolution of the capture and not achieved by interpolation.
- The compressed reference images should be saved in the JPEG format and will be 640 pixels on the long side of the image. This resolution should be the actual optical resolution of the capture and not achieved by interpolation. JPEG File Information Format (JFIF) headers will be used.
- The thumbnail images should have a size of 150 pixels on the long side of the image in the JPEG compressed format. JFIF format/headers will be used.
- The tonal range of the reproduced images should be representative of the original scene. General imaging industry standards, as well as standards established during the initial startup and testing phase, will be followed. There will be no clipping.

- The reference and thumbnail images should be reduced in scale and sharpened and compressed, but the methods used to accomplish this shall not degrade the image. All derivative images shall maintain the general look and character of the archival images.
- The software used to produce the digitized images shall meet requirements pertaining to spatial resolution, tonal distribution, and noise. Spatial resolution shall be determined by measuring the modulation transfer function of the capture system. The required resolution shall not be sampled up from a lower resolution.
- Scanners and monitors should be calibrated at the start of the project and scanners should be re-calibrated with a change in media size twice each day: at the beginning of each day of digitizing and halfway through the digitizing. If more than one scanner is used, each lot must be kept separate, so that quality control can take into account the calibration that was done for each batch. Set monitor to 24 millions of colors, set gamma to 2.2 (1.8 for Macintosh), set color temperature to 6500 degrees, and calibrate to Standard Red-Green-Blue (sRGB).

Through funding from the NOAA CDMP program, approximately 16,000 prints were scanned, assigned metadata, and added to the digital GPC.

3.1.2.2 CU CLIR Grant - 2016 to 2018

In 2016, the Council of Information Resources (CLIR) awarded a data rescue grant to NSIDC, in partnership with University of Colorado (CU) Boulder Libraries, to digitize and collect metadata transcription of roughly 9,000 photographs. This partnership provides that all digital surrogates (scanned images) in the GPC database will also be searchable in CU Boulder Libraries Digital Library platform as the [NSIDC Glacier Photograph Collection](#). Discovery of the collection in the CU Digital Library will open the collection to new audiences from different disciplines. In addition, the metadata fields added to meet the extended requirements of both NSIDC and CU Boulder library database systems present further opportunities for new users to engage with the material. Added fields include spatial coverage terms, object format terms, and latitude/longitude of photographer photo stations. At the end of the CLIR grant, approximately 8,800 photographs were cataloged and digitized.

Under the purview of the CLIR grant project archivist, photographic prints were preserved and stored for archival quality limiting the future amount of deterioration (Maness et al. 2017). The project archivist identified new subsets of the collection such as Edward and Asahel Curtis, William O. Field, Arthur Elliot Harrison, and the International Boundary Commission. The photographs in these subsets were reorganized by date and negative/photographic print number. This organizational format gives better insight into to the scientific expeditions and daily routines of the scientists. This method also allows for better connections between photographs taken from the same location subsequent years later by the same photographer. The remainder of the photograph collection that was not divided into a subset maintains the original index system of photos by region and drainage system (as described above).

With preservation and longevity in mind, NSIDC instigated a move of the analog archive from NSIDC to the CU Boulder Libraries *Special Collections, Preservation, and Archives* department in August of 2018. With materials under the care of CU Boulder Libraries the collection will continue to receive preservation care and future access to the materials will be made available through various CU collaborations.

3.1.2.3 The Digital Collection and its Metadata

When the digital GPC collection was first created in 2002, the metadata for the digitized images were compiled at NSIDC in an Excel spreadsheet that was uploaded to a Postgres database. The metadata for the initial release of about 1,000 glaciers in 2002 was derived primarily from the Glacier Photograph Collection Index, a project started in the late 1970s by NSIDC/WDC for Glaciology staff. The metadata covered many aspects of photographed glaciers or of the photograph itself. These often included the altitude at which a photograph was taken, date, photograph number, geographic coordinates, and mountain range and drainage system to which the glacier belongs. As the collection has progressed, new metadata fields have been added to further describe the digitized images as deemed necessary. Not all of the metadata descriptor fields were included in the metadata for all the digitized images. Table A - 1 in Appendix A – Photo Metadata Description shows all metadata fields, with a column to indicate those which are required for inclusion in the database and those which are optional.

The original keywords used for the Glacier Photograph Collection Index project were Terminus, Medial moraine, Terminal moraine, Lateral moraine, Firn line, All of glacier, Rock glacier, and Other. These were assigned to each indexed photograph to show if it included features that might interest a glaciologist. For example, if the glacier terminus could be seen in a photograph, those compiling the index in the 1970s would tick keyword Terminal Moraine in the Index entry for that photo. Transcribing the Index information and using it as metadata for photographs was the original intent of those at NSIDC who worked on the digital GPC. However, this was too labor intensive to be sustained, so NSIDC assigned Index keyword terms by simply looking at the scanned photographs. Glaciers in the first release of about 1,000 photographs have Index keywords assigned. During the CLIR grant period, an additional 1,400 photographs had keywords assigned and the number of keyword terms was increased from the original eight Index terms to nearly 60 (See the Keywords entry in Table A - 1 in Appendix A – Photo Metadata Description). All other images have no keywords assigned.

NSIDC used the USGS GNIS to look up geographic coordinates of most glaciers. For those glaciers that did not appear in the GNIS or when more than one entry for the same title appeared, NSIDC determined approximate coordinates by either referring to the original photos (for handwritten information from the photographer), or by doing web-based research, including [Topozone](#) or [Terraserver](#) (now PrecisionHawk), to estimate coordinates near the middle of the glacier.

In some glaciers for which the Index or the GNIS did not supply geographic coordinates, the Alaska Atlas & Gazetteer (2001) or Hormes et al. (2001) provided coordinates.

In 2015, in order to facilitate the addition of more photos from crowd sourced photographic web sites like [Flickr Creative Commons](#) and [Wikimedia Commons](#), the requirements for digital photos were loosened, thus some high-resolution photos are suitable for digital applications but are not suitable for print.

3.1.3 Special Collections

As the digital GPC has progressed over the years, a need to identify special collections within the main collection arose based on type of images, the region, or the entity that compiled them. It began with the Repeat Photography of Glaciers collection in 2006 with six other special collections added as of 2016. Table 4 has information on when these collections were added. The collections are the following:

- Repeat Photography of Glaciers
- National Park Service Glacier Survey Reports
- DAHLI IGY Glacier Photographs
- NASA Astronaut Glacier Photographs
- Antarctica Dry Valleys Glacier Photographs
- WGMS Glacier Photographs
- Lake Clark National Park and Preserve Collection

Repeat Photography of Glaciers

As Harrison wrote in 1960, "The glacier story is always changing, but it can be caught and preserved with the proper use of a camera" (Harrison 1960, pp 1). Repeat photography is the practice of taking multiple photographs of the same subject, from the same location, at different times. Glacier photographs taken from the same vantage point but years apart in time often reveal dramatic changes in the glacier terminus position that may be indicative of climate forcing. Tidewater glaciers may exhibit shorter term cycles of terminus advance and retreat as well. These repeat photographs are of special interest to glaciologists.

This special collection displays photographs taken from the same vantage points, at the same times of year, but taken many years apart. These photographs can show evidence of glacier and climate changes over time. Repeat photography reveal dramatic changes in the glacier terminus position, as a glacier either advances or retreats. Most glaciers around the world have retreated considerably over the last century. These pairs of photographs can provide striking visual evidence of climate change.

In order to make a repeat photograph of the same scene, a photographer must find the site of a previous photograph and reoccupy the original camera station while using best methods to recreate the original camera position. Scientists may revisit their own stations to recreate their photograph, or they may attempt to recreate photographs taken by others.

While there were few established systematic glacier monitoring programs, many in the field shared their resources and built upon each other's work. Often times, the scientists were returning to another scientist's photo station to make observations. For example, from 1931 to 1982, William Osgood Field revisited photo stations mapped by Harry F. Reid and the International Boundary Commission (IBC) of 1893-1907. In turn, USGS glaciologist Bruce Molnia returned to these same photo stations to document changes from 1990 into 2005.

In March 2006, Molnia collected and contributed repeat glacier photographs to this special collection. He had taken many of the later ones himself and had digitized the earlier ones from other data collections. These are identified in the *Source* metadata field as *U.S. Geological Survey* (distinguished from *USGS Photo Library*, which refers to USGS historic collections). *Notes* and *Keyword* metadata fields are based on information from Molnia. In June of 2006, Matt Nolan donated repeat photographs to this collection; and Lonnie G. Thompson contributed repeat photographs in July of 2007.

Photographic stations are an important aspect of the photo monitoring process in repeat photography. These stations are named, mapped, and returned to in various years. In the GPC collection photographers/scientists William Osgood Field, A.E. Harrison, and Charles C. Morrison Jr. have the most descriptive notes about photo stations they mapped and utilized. Field based his photo stations from the IBC and would often list the IBC's photo station name in connection to his own. By grouping photographs taken from a specific photo station, more information about the landscape can be conveyed. When it is available, photo station information has been transcribed from the photograph and recorded in the *Notes* field of the metadata.

Figure 5 shows an example of the glacier pairs found in this special collection of photographs. To access this subset, see the [Search & Order](#) interface; the *Choose a Collection* drop-down list will already have *Repeat Glacier Photographs* selected.



Figure 5. On the left is a photograph of Muir Glacier taken on August 13, 1941, by glaciologist William O. Field; on the right, a photograph taken from the same vantage on August 31, 2004, by USGS geologist Bruce F. Molnia. According to Molnia, between 1941 and 2004 the glacier retreated more than twelve kilometers (seven miles) and thinned by more than 800 meters (875 yards). Ocean water has filled the valley, replacing the ice of Muir Glacier; the end of the glacier has retreated out of the field of view. The glacier's absence reveals scars where glacier ice once scraped high up against the hillside. In 2004, trees and shrubs grow thickly in the foreground, where in 1941 there was only bare rock.

National Park Service Glacier Survey Reports

RMNP began conducting glacier surveys in 1932 at the request of geologist Francois E. Matthes. The NPS donated copies of the glacier survey reports to Matthes for the International Committee on Glaciers (now called the [International Association of Cryospheric Sciences](#)). For a history of the committee from 1894 to 1994 and its subsequent transformations, see the [The International Commission on Snow and Ice \(ICSI\) and its Precursors, 1894-1994](#) PDF document (Radok 1997). Matthes later donated his collection to NSIDC/WDC for Glaciology. NSIDC holds reports from the years 1932-1952; these reports include 265 glacier photographs. Several of the reports combine more than one year into one report, and not all of the reports contain photographs. The 265 images in the reports were digitized and added as the National Park Service Glacier Photographs special collection in January 2008. To view the photographs in context, see the associated PDF file listed below:

- [Topographic Map, RMNP, 1937, Area of Study](#) (TIFF, 82 MB)
- [Glacier Survey, RMNP, 1934, Dorr C. Yeager](#) (PDF, 513 KB)
- [Glacier Survey, RMNP, 1937, H.R. Gregg](#) (PDF, 1.8 MB)
- [Glacier Survey, RMNP, 1938, H.R. Gregg](#) (PDF, 2.2 MB)
- [Glacier Survey, RMNP, 1939, H.R. Gregg](#) (PDF, 1.7 MB)
- [Glacier Survey, RMNP, 1940, H.R. Gregg](#) (PDF, 2 MB)
- [Glacier Survey, RMNP, 1941, H.R. Gregg](#) (PDF, 1.1 MB)
- [Glacier Survey, RMNP, 1942, H.R. Gregg](#) (PDF, 1.8 MB)
- [Glacier Survey, RMNP, 1944, Russell Grater](#) (PDF, 296 KB)
- [Glacier Survey, RMNP, 1946, H.R. Gregg](#) (PDF, 1.9 MB)
- [RMNP, 1949 Glacier Report, Edwin C. Alberts](#) (PDF, 287 KB)

- [RMNP, 1950 Glacier Report, R.G. Bindelman](#) (PDF, 1.8 MB)
- [Glacier Measurement Report for 1951, RMNP, Edwin C. Alberts](#) (PDF, 15.9 MB)
- [Glacier Measurement Report for 1952, RMNP, Naturalist Office](#) (PDF, 14.5 MB)

Note: Metadata in the *Notes* field were taken from the captions associated with the photographs in the reports.

To obtain high-resolution versions of these 265 photographs from the park reports, see the [Search & Order](#) interface; the *Choose a Collection* drop-down list will already have *National Park Service Glacier Photographs* selected.

To cite the photographs from the reports, see section 1.3 Citing Individual Photographs. To cite the digital reports (PDF files) use the following format:

Author's last name, first name. Year published. *Title*. Boulder, Colorado USA: National Snow and Ice Data Center. URL to the PDF report at NSIDC.

For example:

Gregg, H. R. 1939. *Glacier Survey, Rocky Mountain National Park*. Boulder, Colorado USA: National Snow and Ice Data Center.

DAHLI IGY 1957-58 Glacier Photographs

This special collection is from Alaskan glacier surveys led by William O. Field during IGY, 1957-1958 that was a follow on to the first two International Polar Years (IPY) 1882-1883 and 1932-1933. Glaciology was one of the primary research areas studied during IGY. Discovery and Access of Historic Literature from the IPYs (DAHLI) program (now called the [International Polar Year Historical Data and Literature](#) collection) sought to locate, identify, preserve, catalog, and digitize data, literature, photographs and other materials from the first three IPY events: 1882-1883, 1932-1933, and 1957-1958 (IGY).

These photos, taken between 1957 and 1959, represent an attempt to systematically study glacier change in Alaska. These 2154 images comprise the DAHLI IGY Glacier Photograph collection and were added to the broader Glacier Photograph Collection in March 2008. To access this collection, see the [Search & Order](#) interface; the *Choose a Collection* drop-down list will already have *DAHLI IGY Glacier Photographs* selected.

NASA Astronaut Glacier Photographs

Added in June 2010, this special collection of 500 photographs was taken by NASA astronauts on the International Space Station and the Space Shuttle Endeavor. These photos were taken

between 1994 and early 2010. The photos were collected in collaboration with the NASA [Gateway to Astronaut Photography of Earth](#) project. The goal was to make these photos more widely available and discoverable. To see the photos, go to the [Search & Order](#) Interface; the *Choose a Collection* drop-down list will already have *NASA Astronaut Glacier Photographs* selected.

Antarctica Dry Valleys Glacier Photographs

This special collection of 24 photos, added in March 2011, consists of field photographs from the McMurdo Dry Valleys region of Antarctica. While the valleys themselves are notably ice-free, a number of glaciers terminate in the valleys, some acting as outlets to the East Antarctic Ice Sheet. Studies show that the majority of the glaciers in this area are receding. Glaciers were photographed in the course of geologic studies and help document the conditions of the glaciers and how they may have changed. These photos were originally made available through a pilot project of the [Data Conservancy](#) at Johns Hopkins University (JHU). Prior to December 2014, the high-resolution digital images were archived at JHU. After that, the collection of 24 images was moved to the archive at NSIDC when the pilot instance of the Data Conservancy was decommissioned. To see the photos, go to the [Search & Order](#) Interface; the *Choose a Collection* drop-down list will already have *Antarctica Dry Valleys Glacier Photographs* selected.

WGMS Glacier Photographs

The [World Glacier Monitoring Service \(WGMS\)](#) compiles and disseminates standardized observations on glacier fluctuations such as length, area, volume, and mass. This special collection of 1192 photos, added in May 2015, focuses on photographs of glaciers for which long fluctuation series are available, some of them dating back to the 19th century. The photos were assembled from the WGMS archive, from contributions from WGMS principal investigators, and from various other sources that provide freely available data. The main sources include the [WGMS Fluctuations of Glaciers \(FoG\)](#) database, the archive of [Bavarian Glaciers](#), the [Glaciers Online](#) collection prepared by Jürg Alean and Michael Hambrey, photos from the [Interactive Repeat Photo Comparisons of Various Swiss Glaciers](#) project conducted by Simon Oberli, the [Swiss Glacier Monitoring Network](#), and work shared by researchers and students associated with the WGMS. Additionally, photographers who freely share their work on platforms such as [Flickr Creative Commons](#) and [Wikimedia Commons](#) contributed significantly to this collection.

Most photographs in this collection were born digital. In some instances, photographer names are Wikimedia or Flickr usernames under which the photographers published their work. Image size and resolution vary widely; while some images may be of print quality, others offer resolutions limited to digital applications. The collection was assembled by WGMS/NSIDC graduate interns Rebecca Navarro, Julien Bodart, and Mylène Jacquemart in late 2014 and early 2015. For more details on the development of this special collection, see the [WGMS Internship Report: Growing](#)

the [Glacier Photograph Collection \(Jacquemart 2015\)](#). To see the photos, go to the [Search & Order Interface](#); the *Choose a Collection* drop-down list will already have *WGMS Glacier Photographs* selected.

Lake Clark National Park and Preserve Collection

This collection of 1173 photographs of glaciers in and around the Lake Clark National Park and Preserve in Alaska was compiled by Jacob Zanon while he was a Natural Resource Specialist Intern in the GeoSpatial Services Department at Saint Mary's University, MN. The collection, added in 2016, is comprised of many images of glaciers inside the park and preserve taken from both the air and the ground from 1987 through 1990 and in 2004 and 2007. J. Zanon collected all of the digital images and created the metadata for them. Once the images and metadata were transferred to NSIDC, they were reviewed for quality and accuracy by Ladina Glaus while she was interning at NSIDC as a graduate student in the Geography Department at the University of Zurich, Switzerland. She checked that all photographs, which show the same glacier, have the same coordinates. Google Earth was very helpful for this analysis. Because most of the photos did not provide a glacier name, she attempted to determine them. To this end, she uploaded a Microsoft Excel file with the Digital File IDs and the corresponding coordinates as a shape file into QGIS and then merged it, by location, with the corresponding outlines from the [GLIMS](#) database. Additionally, she consulted maps and a satellite image atlas of Alaska by Williams and Ferrigno (2008). She was able to determine some glacier names, however, most glaciers in Alaska are unnamed. To see the photos, go to the [Search & Order Interface](#); the *Choose a Collection* drop-down list will already have *Lake Clark National Park Glacier Photographs* selected.

3.2 Sensor or Instrument Description

The photographs that make up this collection were taken with a range of cameras from mid-1800's box cameras to 21st century digital SLRs depending on the age of the photo. The cameras were located on the ground, on aircraft, on the U.S. Space Shuttle Endeavor, and on the International Space Station.

3.3 Collection Update History

The Glacier Photograph Collection was initially created in 2002 with a little over 1,000 photographs. It has since grown to almost 25,000 images as of March 2019. Table 4 provides a brief history of the development of the collection.

Table 4. History of the Glacier Photograph Collection

Date	Event
February 2019	Publication of approximately 8,200 photographs that were cataloged, digitized, and added to the collection during the CLIR grant digitization project from August 2016 – February 2019. Additional metadata fields were added: spatial coverage and GLIMS glacier ID. The metadata field Photo ID was changed to Digital File ID. Expanded on the vocabulary that goes in the Original Media and Keyword fields. At this time, we estimate that about half of the larger GPC analog collection has been scanned and included in the digital GPC. This does not include images on microfilm.
August 2016	Lake Clark National Park and Preserve Collection added with 1173 photos.
May 2015	WGMS Glacier Photographs special collection added with 1192 photos.
March 2011	Antarctica Dry Valleys Glacier Photographs special collection created with 24 photos.
June 2010	NASA Astronaut Glacier Photographs special collection created with 500 photos.
June 2008	<p>The first batch of aerial photographs taken by Austin Post and members of the USGS ICP were added to the collection. This collection was digitized from a 35 mm roll of microfilm and consists of approximately 13,600 images. The vast majority of the images were taken by Post and are thus described but others were taken by members of the ICP for USGS. For more information about the ICP collection contact the GeoData Center of the Geophysical Institute at the University of Alaska, Fairbanks where the original negatives are housed.</p> <p>In addition, over 360 images of Arapaho Glacier, Colorado, USA were added. These images are part of the H. A. Waldrop Arapaho Glacier Thesis Research Papers. Waldrop collected photographs of Arapaho Glacier taken in the early 1900s by Junius Henderson, first curator of the CU Boulder Museum. Using repeat photography techniques, Waldrop recreated Henderson's photographs for his thesis research completed in 1962.</p>
March 2008	DAHLI IGY Glacier Photographs special collection created with 2154 photos.
February 2008	79 terrestrial photographs taken by Fred D. Ayres in Peru during the 1950s were added.
January 2008	National Park Service Glacier Photographs special collection created with 265 photos.
August 2007	Over 1,200 photographs of Greenland glaciers, donated by the U.S. Coast Guard, were added.
July 2007	Additional photos contributed to the Repeat Photography of Glaciers collection with photos from Lonnie G. Thompson bringing the collection to 131 photographs total.
October 2006	215 photographs from the Harry F. Reid collection were added.

Date	Event
June 2006	Additional photos contributed to the Repeat Photography of Glaciers collection with photos from Matt Nolan, UAF-Fairbanks glaciologist.
March 2006	Repeat Photography of Glaciers collection created with photos from Bruce Molnia, USGS glaciologist.
June 2005	Added Other Glacier and Notes fields to the metadata.
December 2002	Initial release of Glacier Photograph Collection with approximately 1,000 photos digitized during the CDMP.
February 2002	Began working with the CDMP to digitize a selection of analog glacier photographs that would be the beginning of the Glacier Photograph Collection.

4 REFERENCES AND RELATED PUBLICATIONS

This is a compiled list of references used for cataloguing materials and learning about the collection. Some of these are resources that were used to determine the geographic coordinates of glaciers or controlled vocabularies to describe the digital collection.

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4.1 Related Data Collections

- [World Glacier Inventory](#): The World Glacier Inventory (WGI) is a database that contains information for over 130,000 glaciers including geographic location, area, length, orientation, elevation, and classification.
- [Airborne Surface Profiling of Alaskan Glaciers](#): This data set consists of glacier outline, laser altimetry profile, and surface elevation change data for 46 glaciers in Alaska and British Columbia, Canada, measured with an airborne laser altimetry system.
- [Glacier Inventory of West Greenland](#): The inventory includes 5,297 Glaciers from western Greenland.
- [GLIMS Glacier Database](#): GLIMS is an international collaborative project that includes more than sixty institutions world-wide. Its goal is to create a globally comprehensive inventory of land ice including measurements of glacier area, geometry, surface velocity, and snow line elevation. Like the Glacier Photograph Collection, it is a component of the [Global Terrestrial Network for Glaciers \(GTN-G\)](#).
- [NSIDC Data on Google Earth](#): Locate and view glacier photos from the collection using Google Earth.

4.2 Related Websites

These links are offered as a convenience for users wanting to see other examples of glacier photo collections. We are not endorsing these sites, nor can we keep this section up to date.

- [GTN-G Glacier Browser](#): A map browser that combines a number of different layers of glacier information from different sources. The GPC is one of the viewable layers of data.
- [USGS Repeat Photography Project](#): Contains photographs from Glacier National Park, Montana USA.
- [Glacier Bay National Park Glaciers](#): Photographs and animations of glaciers available from USGS.
- [DOUBLEXPOSURE Project](#): Repeat glacier photographs project.
- [Glaciers Online: The Big Melt](#): Offers images of Swiss glaciers related to the rapid glacier recession observed during the last few years to decades.
- [Glaciers of the American West](#): Distributes data on glaciers located in the western United States.

- [GlacierChange.org](https://glacierchange.org): A portal for glacier change information that is clearly presented through imagery, science, and art.

5 ACKNOWLEDGMENTS

The NOAA Climate Database Modernization Program (CDPM) provided funding and programmatic oversight for digitizing many of the photos in the Glacier Photograph Collection. NOAA's Joseph Elms managed the program. The photos were digitized at CDMP Corporate Partner LASON Corporation, Beltsville, MD, under the direction of John Jacobs. Teresa Mullins, NSIDC Librarian from October 1999 through June 2004, initiated the digitization project, wrote the statement of work with imaging requirements for digitizing prints, and compiled metadata for the first set of images digitized. She also researched NSIDC's analog collection to provide background on W. O. Field's contribution of glacier photograph prints to the WDC for Glaciology, Boulder.

Allaina Wallace, NSIDC Data Archivist and Librarian from 2004 to 2014, curated the collection, overseeing the addition of thousands of scanned photographs through further work with the CDMP program and with the aid of a series of interns and student volunteers.

NSIDC glaciologist Richard Armstrong assisted in documenting the collection and with selecting photographs of greatest scientific interest for digitization. USGS glaciologist Bruce F. Molnia serves as an advisor to the project and assisted with the evaluation and documentation of our analog glacier photograph collection and has also contributed repeat photographs.

Sincere thanks go to Mylène Jacquemart and Michael Zemp of WGMS for initiating and leading the 2015 addition of the WGMS Glacier Photograph Collection. Sincere thanks to Ladina Glaus for her work in 2016 to add the Lake Clark National Park Glacier Photograph Collection. Ann Windnagel, Jon Davis, and Daniel Crumly carried out the work at NSIDC.

Athea Merredyth was Project Archivist during the CLIR grant from 2016-2019. Under her supervision, roughly 9,000 photographs were catalogued and digitized. Additional metadata fields were added to enhance information about the collection, location, or photographic print, along with updated guidelines and protocols. Physical care of photographic materials was improved under her direction. Katie Fletcher at CU Boulder Libraries, Metadata Services department, contributed to cataloguing and improved aerial photograph locations. Her cataloguing work made the collection discoverable through CU's digital platform. Sincere thanks goes to archivist Michele Beehner for her organization of the physical materials and persistent archival description of the collection.

The NOAA@NSIDC team maintains this product at NSIDC. This work is supported by funding from NOAA's [National Environmental Satellite, Data, and Information Service](https://www.noaa.gov/data) (NESDIS) and NOAA [National Centers for Environmental Information](https://www.noaa.gov/centers/ncei) (NCEI).

6 DOCUMENT INFORMATION

6.1 Document Author

This document was originally prepared by T. Mullins. It has been updated by F. Fetterer, L. Husted, J. Wolfe, L. Ballagh, D. Miller, and A. Windnagel.

6.2 Publication Date

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6.3 Document Revision Date

April 2019 - A. Windnagel updated the documentation to reflect the work done during the CLIR grant.

January 2017 - A. Windnagel made minor updates to the Background, File Naming Convention, and Acknowledgments sections.

August 2016 - A. Windnagel updated the documentation to reflect the addition of the new Lake Clark collection.

June 2015 - A. Windnagel added a new spatial coverage map, added the GTN-G Data Browser to the list of Related Collections and Resources, put the document into the newest template, and updated all content including adding a description of the metadata.

May 2015 - A. Windnagel added information for the new WGMS collection.

March 2011 - A. Windnagel added information about the new Dry Valleys collection.

June 2010 - A. Windnagel added information about the Astronaut Glacier Photo collection and the new metadata files that now accompany a photo order.

April 2010 - A. Windnagel removed the text on submitting photographs and added a link to the Web page with this information.

December 2009 - A. Windnagel updated the number of glaciers that are available.

July 2009 - A. Windnagel updated this document to reference the new search and order interface and added a glossary.

March 2008 - L. Ballagh added information about the DAHLI Special Collection and regarding the February 2008 update for 79 glaciers in Peru.

January 2008 - L. Ballagh added information about the second special collection (National Park Service reports) based on input from A. Wallace.

November 2007 - L. Ballagh changed all of the references to the repeat photography. The correct title is Repeat Photography of Glaciers.

October 2007 - L. Ballagh changed scan to digitize in several places and updated the data set title.

August 2007 - L. Ballagh added information about the Greenland collection based on input from A. Wallace.

October 2006 - L. Ballagh added documentation about the Reid collection and updated the file sizes, based on correspondence with A. Wallace, F. Fetterer and J. Kovarik.

July 2006 - L. Ballagh updated the GLIMS Glacier Database hyperlink and changed the hyperlink of the repeat photograph sample image of Muir Glacier.

March 2006 - Documentation was updated to reflect the addition of the Repeat Photography of Glaciers.

January 2006 - Noted that photos were added in January 2006.

September 2005 - F. Fetterer added the section on contributing photographs.

July 2005 - F. Fetterer revised the format, updated information, included relevant content from the PDF *Glacier Photograph Collection Users Guide*, and removed access to the Users Guide. A. Wallace added information on WDC's analog collection.

APPENDIX A – PHOTO METADATA DESCRIPTION

Table A - 1. Description of Metadata that Accompanies the High-Resolution Images

Metadata Field	Description	Required*
Digital File ID	A unique identifier for the digital surrogate of the photographic print or born digital photograph. See section 1.5 File Naming Convention for a description of how these are created.	Yes
GLIMS Glacier ID	The corresponding glacier ID used in the GLIMS Glacier Database , if it exists.	No
Glacier Name	The name of the glacier. If the name is unknown, then <i>Unknown Glacier</i> is used; and if the glacier does not have a name, then <i>Unnamed Glacier</i> is used. If the photograph does not actually contain a glacier then it is labeled as <i>No Glacier</i> .	Yes
Country	The country where the glacier resides.	No
State/Province	The state, province, region, or county where the glacier resides.	No
Latitude	The latitude of the glacier itself and not the location of the photographer.	No
Longitude	The longitude of the glacier itself and not the location of the photographer.	No
Dublin Core Spatial Coverage	This field provides the spatial coverage as defined by the Dublin Core metadata standard. It differs from state/province and country because it is more specific by describing a particular region and county. This field was added to help further identify locations of the landscapes and glaciers depicted in the photograph. This is of particular help with locations that have <i>Unknown Glacier</i> or <i>No Glacier</i> listed as the Glacier Name. Coverage terms were identified through the Getty Thesaurus of Geographic Names and/or a Countries Board on Geographic Names.	No
Date of Original Media	The date the photograph was taken in the form YYYY-MM-DD. If the date is not known, then it is left blank.	No
Photographer Name	Name of the photographer who took the photo. If the full name is known then it is used, otherwise first and/or middle initials are used. Note: Some photographer names may be Flickr and Wikimedia usernames. If the photographer name is not known, it is set to Unidentified Photographer.	Yes
Photographer Station Latitude	The latitude of the location of the photographer when the photo was taken.	No
Photographer Station Longitude	The longitude of the location of the photographer when the photo was taken.	No

Photographer Station Name	The name of the location that the photograph was taken, if known.	No
Image Dimensions (pixels)	The dimensions of the high-resolution image in pixels when displayed at full resolution.	Yes
Image Type	The format of the high-resolution image, either TIFF (.tif) or JPEG (.jpg).	Yes
High Resolution Image File Size	The file size of the high-resolution image in KB.	Yes
Format of Original Media	Describes the original photograph at time the image was created. For example, it may have been photographic print on photographic paper or a negative that was digitized or it may have been born digital, that is, taken with a digital camera. Values come from the Visual Resource Vocabulary that is part of the Visual Resource Association Cultural Object Catalog and include terms such as Gelatin Silver Print, Albumen Print, Chromogenic Print, Positive Transparency, Digital Photograph, Dye Diffusion Print, Inkjet Print, Photographic print, Photographic slide, Photographic negative, Microfilm, or Drawing.	Yes
Description	Further description of the Original Media field that includes dimension sizes of the photographic print.	No
Photograph Number	Photograph number is the negative or print number. Photograph number can also be the number assigned by the photographer or scientist. The photograph number shows order in a series, such as photos taken by William O. Field and aerial photographs. If no negative or print number exists, then a numeric number, beginning with 01, is added to distinguish prints and to fit the digital file naming convention.	No
Other Glaciers in Image	Lists other glaciers that are also visible in the photograph; multiple glaciers may be listed. Note: Other glacier information is usually only added if it was written as part of the information on the photograph, so the <i>Other Glaciers</i> field may be blank even if other glaciers are in the image.	No
Keywords	A keyword that can be set to describe what part of the glacier is shown in the photograph. The possible values are Terminus, Medial moraine, Terminal moraine, Lateral moraine, Firn line, All of glacier, Rock glacier, and Other. Note: Due to the labor intensive nature of adding keywords for each photograph, very few images have keywords. The first release of about 1,000 photographs in 2002 have keywords assigned, and additional keywords were added to 1,400 photographic records during the CLIR grant period between 2016-2018. See the file Keyword-Controlled-Vocabulary.pdf for a list of the controlled keyword vocabulary.	No

Documentation	The URL to the GPC user guide (this document).	Yes
Source	The person or entity that provided the photos if known.	No
Notes	Any additional notes that are pertinent to the photograph. The Notes field captures additional information that glaciologists using the database may be able to supply about individual images or to record errors or uncertainties in metadata, if they are known. In addition, the Notes field may contain descriptive information that NSIDC has transcribed from the photographs, photographers, or photo collector. This field also contains cataloger's notes about coordinates and locations of landscape depicted in the photograph.	No
Publisher	The entity or organization that published the photographs. This is almost always NSIDC.	Yes
Rights	Copyright information for the photograph.	Yes
Credit	Provides credit to the submitting entity, person, or journal article/book if needed.	No
Citation	The full citation for use of the image.	Yes

*If a field is listed as *Required*, metadata is provided for those fields. Fields that are not listed as *Required* may be blank.