World Glacier Inventory, Version 1

USER GUIDE

How to Cite These Data

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

WGMS, and National Snow and Ice Data Center (comps.). 1999, updated 2012. *World Glacier Inventory, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NSIDC: National Snow and Ice Data Center. https://doi.org/10.7265/N5/NSIDC-WGI-2012-02. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/G01130

National Snow and Ice Data Center

TABLE OF CONTENTS

1 DETAILED DATA DESCRIPTION

1.1 Overview

The World Glacier Inventory (WGI) contains information for over 130,000 glaciers. Inventory parameters include geographic location, area, length, orientation, elevation, and classification. The WGI is based primarily on aerial photographs and maps with most glaciers having one data entry only. The data set can be viewed as a snapshot of the glacier distribution in the second half of the 20th century. It is based on the original WGI (WGMS 1989) from the World Glacier Monitoring Service (WGMS).

There are a number of ways to retrieve the data. You can download the entire database in a single ASCII text file from the FTP site: wgi_feb2012.csv (39.5 MB). You can search the entire WGI by glacier id, glacier name, or latitude/longitude (as well as other parameters) using the main Search Inventory interface . You can also search using the Extract Selected Regions interface.

1.2 Background

The history of systematic glacier monitoring on a large scale began in 1894, with the establishment of the International Glacier Commission at the 6th International Geological Congress in Zurich, Switzerland. Over time, observational procedures were standardized and the number of glaciers for which measurements were available grew. In 1986, the WGMS was established under the auspices of the United Nations Environment Programme (UNEP) and other international organizations (Haeberli 1998). WGMS collects measurements of glaciers from organizations around the world and compiles these regional inventories into one baseline world inventory with the aim to update it every few decades (the response time for glacier mass balance).

The need for a worldwide inventory of existing perennial ice and snow masses was first considered during the International Hydrological Decade (IHD) declared by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) for the period of 1965-1974 (Hoelzle and Trindler 1998, UNESCO 1970). The Temporal Technical Secretariat for the World Glacier Inventory (TTS/WGI) was established in 1975 to prepare guidelines (Müller et al. 1977, Müller 1978, Scherler 1983, UNESCO 1970) for the compilation of such an inventory and to collect available data sets from different countries resulting in a status report in the late 1980's (WGMS 1989).

In 1998, WGMS and NSIDC agreed to work together to make the WGI widely available online. The original WGMS WGI (WGMS 1989) consisted of data from about 25,000 glaciers from North America, South America, Europe, and New Zealand. NSIDC maintained its own Eurasian Glacier Inventory of glacier parameters from over 34,000 glaciers in the former Soviet Union and China

(Bedford and Haggerty, 1996). These data were acquired through a NOAA Environmental Services Data and Information Management (ESDIM) project. Between 1995 and 1998, NSIDC and WGMS exchanged files of glacier parameters, with NSIDC providing WGMS with glacier data from China and the former Soviet Union, and WGMS providing NSIDC with the WGMS WGI data. This version of the WGI contained data for more than 67,000 glaciers and was made available online at NSIDC in 1999. In 2012, another update was undertaken by the WGMS that brings the total number of glacier records to over 130,000.

NSIDC is continuing to work with the WGMS to coordinate any needed corrections or updates for the WGI. Updates would take the form of corrections or the addition of data from historical inventories that for some reason had not yet been added to the WGI. This work contributes to the Global Terrestrial Network for Glaciers (GTN-G).

The WGI documents glaciers as they were at some time in the past. From around the time the Global Land Ice Measurements from Space (GLIMS) project began, new glacier inventories were likely to include glacier outlines in the form of shapefiles. See the GLIMS Glacier Database for more recent information, where inventory parameters, congruent with those in the WGI, are reported along with each glacier's shapefile.

1.3 Format

The entire contents of the WGI database are available on the NSIDC FTP site stored in a single comma separated value text file:

- **CSV File:** wgi_feb2012.csv (39.5 MB).

The file contains one glacier record per line (over 130,000) and 50 fields per record. Fields are separated by commas and are arranged in the order that they are listed in the Database Field Descriptions section below. You may also subset the data and search via different fields through two WGI web interfaces: Search the World Glacier Inventory and Extract Selected Regions.

In addition to the .csv file with the contents of the database, we also provide the contents of the database as a shapefile for those who use GIS software, as a Generic Mapping Tools (GMT) file for those familiar with GMT software, and as a KML file for easy viewing in Google Earth or other virtual globe software. Note: The database field names in these files were abbreviated due to limits on the length of variables allowed. See a list of the abbreviations in the wgi-db-field-abbreviation.pdf file.

- **Shapefile:** wgi_shapefile_feb2012.zip (9 MB)
- **GMT File:** wgi_feb2012.gmt (46.4 MB)
- **KML File:** wgi_feb2012.kml (238 MB)

1.4 Database Field Descriptions

Note: The example used in the description of the fields below is the record for the Grosser Aletschgletscher (Great Aletsch Glacier) in Switzerland (Glacier ID: CH4N01336026).

Note: Only fields denoted as mandatory have a value stored in them for all glaciers in the database, for example WGI_GLACIER_ID. Fields not denoted as mandatory may not have entries for some glaciers, for example GLACIER_NAME.

WGI_GLACIER_ID

Description: A 12-character unique glacier identifier. The ID number is assigned to the glacier as defined by the WGMS convention that forms the glacier ID number by combining the five following elements:

- 2-character political unit
- 1-digit continent code
- 4-character drainage code
- 2-digit free position code
- 3-digit local glacier code

No Data Value: Mandatory field; WGMS has replaced any missing digit with zero.
Example: CH4N01336026

POLITICAL_UNIT

Description: 2-character abbreviation for the name of the country or territory in which the glacier is located. These codes are ISO3166 country codes from the ISO Maintenance Agency for Country Codes. Table 1 contains the country codes used in the WGI.
No Data Value: Mandatory field
Example: CH

Table 1. Political Unit Abbreviations

Abbreviation	Country/ Territory	Abbreviation	Country/ Territory	Abbreviation	Country/ Territory
AF	AFGHANISTAN	ES	SPAIN	NZ	NEW ZEALAND
AQ	ANTARCTICA	FR	FRANCE	PE	PERU
AR	ARGENTINA	GL	GREENLAND	PK	PAKISTAN
AT	AUSTRIA	GS	SOUTH GEORGIA	SE	SWEDEN

Abbreviation	Country/ Territory	Abbreviation	Country/ Territory	Abbreviation	Country/ Territory
BO	BOLIVIA	HM	HEARD ISLAND AND MCDONALD ISLANDS	SU	USSR
BT	BHUTAN	ID	INDONESIA	TF	FRENCH SOUTHERN TERRITORIES
CA	CANADA	IN	INDIA	TZ	TANZANIA
CH	SWITZERLAND	IS	ICELAND	UG	UGANDA
CL	CHILE	IT	ITALY	US	UNITED STATES
CN	CHINA	KE	KENYA	VE	VENEZUELA
CO	COLOMBIA	MX	MEXICO	ZA	SOUTH AFRICA
DE	GERMANY	NO	NORWAY	ZR	ZAIRE
EC	ECUADOR	NP	NEPAL		

CONTINENT_CODE

Description: 1-digit code for the continent in which the glacier is located. The six continent codes used in the database are listed in Table 2.

No Data Value: Mandatory field

Example: 4

Table 2. Continent Codes

Code	Continent
1	South America
2	North America including Greenland
3	Africa
4	Europe
5	Asia
6	New Zealand and Antarctic Islands
7	Antarctica

DRAINAGE_CODE

Description: 4-character drainage basin code in which the glacier is located. "The study area must then be divided and subdivided into drainage basins of first-order (A-Z), second-order (0-9), third-order (0-9) and, if necessary, fourth-order (A-Z), see supplement Identification" (Müller et al. 1977). According to WGMS 1989 the fourth-order digit of the drainage code may also be (0-9).

No Data Value: Mandatory field; WGMS has replaced any missing digit with zero.
Example: N013

FREE_POSITION_CODE

Description: 2-digit identification numbers freely chosen by the investigator, usually used as logical continuation of the DRAINAGE_CODE.
No Data Value: Mandatory field; WGMS has replaced any missing digit with zero.
Example: 36

LOCAL_GLACIER_CODE

Description: 3-digit local glacier code freely chosen by the investigator, usually used as logical continuation of the DRAINAGE_CODE and FREE_POSITION_CODE
No Data Value: Mandatory field; WGMS has replaced any missing digit with zero.
Example: 026

GLACIER_NAME

Description: 30-character name of the glacier. "If a name is too long a meaningful abbreviation of it should be entered. The spelling of the name must be in the Latin alphabet and may consist only of the following characters: A B C D E F G H I J K L M N O P Q R S T U V W X Y Z" (Müller et al. 1977). Note: If necessary, the name can be abbreviated; in which case the full name is given in the REMARKS field.
No Data Value: Null
Example: ALETSCHGL. GR.

LAT

Description: The latitude of the glacier in decimal degrees North or South; up to 7 digits. Positive values indicate the Northern Hemisphere and negative values indicate the Southern Hemisphere. Latitude is given to a maximum precision of 4 decimal places."The point on the glacier whose coordinates are given should be in the upper part of the ablation area, in the main stream and sufficiently high so as not to be lost if the glacier retreats" (Müller et al. 1977).
No Data Value: Mandatory field
Example: 46.5012

LON

Description: The longitude of the glacier in decimal degrees East or West; up to 7 digits. Positive values indicate east of the zero meridian and negative values indicate west of the zero meridian. Longitude is given to a maximum precision of 4 decimal places.

No Data Value: Mandatory field
Example: 8.039

EASTING

Description: Easting of local coordinate in UTM or other nationally determined format, up to 9 digits. Format is described in the COORDINATE_DESCRIPTION field.
No Data Value: Null
Example: 646000

NORTHING

Description: Northing of local coordinates in UTM or other nationally determined format, up to 9 digits. Format is described in the COORDINATE_DESCRIPTION field.
No Data Value: Null
Example: 150000

COORDINATE_DESCRIPTION

Description: Datum and projection or type of other formats can be given here (UTM zone, name of coordinate system, etc.), up to 50 characters.
No Data Value: Null
Example: Swiss Coordinate System

NUM_BASINS

Description: The number of basins a glacier drains into, 1-digit integer. According to Müller et al (1977), "An ice mass will often drain into several drainage basins (treated as separate units of the identification code) but cannot be split into separate units. The total number of drainage basins should be given in this field, e.g. 1 for one drainage basin. For identification purposes, however, the ice mass should be assigned to the drainage basin which contains the largest portion of the surface area."
No Data Value: Null
Example: 1

TOPO_YEAR

Description: The 4-digit year of the topographic map used for measurements of glacier elevation.
Note: If more than one topographic map was used, the most relevant year is recorded in this field; and the others used are recorded in the REMARKS field.
No Data Value: Null
Example: 1969

TOPO_SCALE

Description: The scale of the topographic map used for measurements of glacier parameters, up to 7 digits. The values in this field are filled in as the reciprocal of the scale (1:25000 for the example below). Note: If more than one topographic map was used, the most relevant scale is recorded here; and the others used are recorded in the REMARKS field.
No Data Value: Null
Example: 25000

PHOTO_YEAR

Description: The 4-digit year of the photograph used for measurements of glacier parameters.
Note: If more than one photograph were used, the most relevant year is recorded here; and the others used are recorded in the REMARKS field. In general, the glaciers outlines; and hence, the values for area and length; were determined from aerial photographs, so we recommend using the PHOTO_YEAR for glacier area values. However, the elevation information usually comes from topographic maps, so TOPO_YEAR should be used for elevation values.
No Data Value: Null
Example: 1973

MAX_ELEV

Description: Maximum elevation of the highest point of the glacier in meters above sea level, up to 4 digits.
No Data Value: Null
Example: 4140

MEAN_ELEV

Description: The mean elevation is the altitude of the contour line, in meters above sea level, that halves the area of the glacier, up to 4 digits.
No Data Value: Null
Example: 3140

MIN_ELEV

Description: The minimum elevation of the lowest point of the glacier in meters above sea level, up to 4 digits.
No Data Value: Null
Example: 1520

MIN_ELEV_EXP

Description: Minimum elevation exposed is the altitude of the lowest point of the total surface area of the glacier, in meters above sea level, that is not covered with coarse stone material, up to 4 digits.
No Data Value: Null
Example: 1720

MEAN_ELEV_ACC

Description: Mean elevation accumulation is the altitude of the contour line, in meters above sea level, that halves the accumulation area of the glacier, up to 4 digits.
No Data Value: Null
Example: Null

MEAN_ELEV_ABL

Description: Mean elevation ablation is the altitude of the contour line, in meters above sea level, that halves the ablation area of the glacier, up to 4 digits.
No Data Value: Null
Example: Null

PRIMARY_CLASS

Description: A 1-digit code that describes the primary classification of the glacier. The codes are described in Table 3.
No Data Value: Null
Example: 5

Table 3. Primary Class Codes

Code	Name	Description
0	Miscellaneous	Any type not listed below.
1	Continental Ice Sheet	Inundates areas of continental size.
2	Ice Field	Ice masses of the sheet or blanket type with a thickness that is insufficient to obscure the subsurface topography.
3	Ice Cap	Dome-shaped ice masses with radial flow.
4	Outlet Glacier	Drains an ice sheet, ice field, or ice cap, usually of valley glacier form; the catchment area may not be easily defined.
5	Valley Glacier	Flows down a valley; the catchment area is well defined.

Code	Name	Description
6	Mountain Glacier	Cirque, niche type, crater type, or hanging glacier; also includes ice aprons and groups of small units.
7	Glacieret and Snowfield	Small ice masses of indefinite shape in hollows, river beds, or on protected slopes that have developed from snow drift, avalanches, and/or particularly heavy accumulation in certain years. Usually no marked flow pattern is visible; and it has been in existence for at least two consecutive years.
8	Ice Shelf	Floating ice sheet of considerable thickness attached to a coast nourished by a glacier or glaciers; snow accumulation on its surface or bottom freezing.
9	Rock Glacier	Lava-stream-like debris mass containing ice in several possible forms and moving slowly downslope.

FORM

Description: A 1-digit code that describes the form of the glacier. Table 4 describes the glacier form codes.

No Data Value: Null

Example: 1

Table 4. Glacier Form Codes

Code	Name	Description
0	Miscellaneous	Any type not listed below.
1	Compound Basins	Two or more individual valley glaciers issuing from tributary valleys and coalescing (Fig. 1a).
2	Compound Basin	Two or more individual accumulation basins feeding one glacier system (Fig. 1b).
3	Simple Basin	Single accumulation area (Fig. 1c).
4	Cirque	Occupies a separate, rounded, steep-walled recess which has formed on a mountain side (Fig. 1d).
5	Niche	Small glacier in a V-shaped gully or depression on a mountain slope (Fig. 1e); generally more common than genetically further-developed cirque glacier.
6	Crater	Occurring in extinct or dormant volcanic craters.
7	Ice Apron	Irregular, usually thin ice mass which adheres to mountain slopes or ridges.
8	Group	A number of similar ice masses occurring in close proximity to one another but are too small to be assessed individually.
9	Remnant	Inactive, usually small ice masses left by a receding glacier.

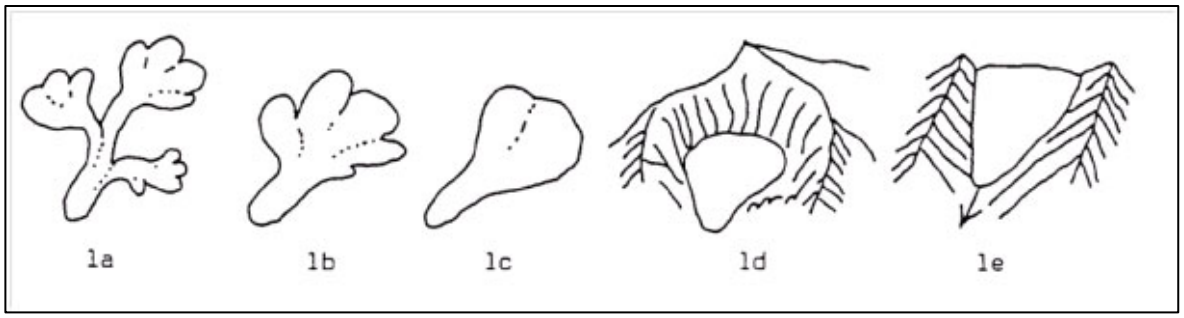

Figure 1. Glacier Forms. Müller et al (1977).

FRONTAL_CHAR

Description: A 1-digit code that describes the frontal characteristics of the glacier. Table 5 lists the frontal characteristic codes.

No Data Value: Null

Example: 0

Table 5. Frontal Characteristic Codes

Code	Name	Description
0	Miscellaneous	Any type not listed below.
1	Piedmont	Ice field formed on a lowland area by lateral expansion of one or coalescence of several glaciers (Fig. 2a, 2b).
2	Expanded Foot	Lobe or fan formed where the lower portion of the glacier leaves the confining wall of a valley and extends on to a less restricted and more level surface (Fig. 2c).
3	Lobed	Part of an ice sheet or ice cap, disqualified as an outlet glacier (Fig. 2d).
4	Calving	Terminus of a glacier sufficiently extending into sea or lake water to produce icebergs; includes- for this inventory- dry land ice calving which would be recognizable from the "lowest glacier elevation."
5	Confluent	Coalescing, non-contributing (Fig. 2e).
6	Irregular, mainly clean ice (mountain or valley glaciers).	
7	Irregular, mainly debris-covered (mountain or valley glaciers).	
8	Single lobe, mainly clean ice (mountain or valley glaciers).	
9	Single lobe, mainly debris-covered (mountain or valley glaciers).	

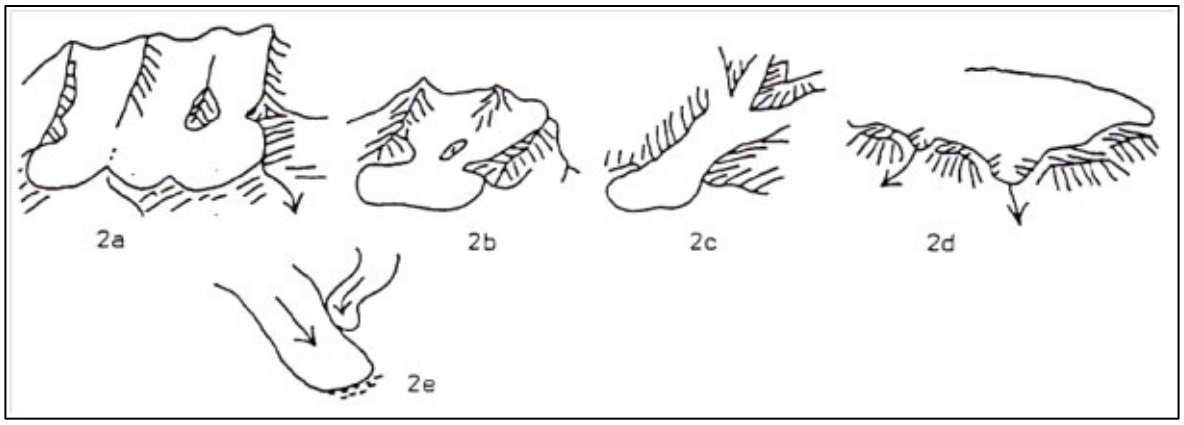

Figure 2. Glacier Frontal Characteristics. Müller et al (1977).

LONGI_PROFILE

Description: A 1-digit code that describes the longitudinal profile of the glacier. Table 6 describes the codes.

No Data Value: Null

Example: 4

Table 6. Longitudinal Profile Codes

Code	Name	Description
0	Miscellaneous	Any type not listed below.
1	Even/Regular	Includes the regular or slightly irregular and stepped longitudinal profile.
2	Hanging	Perched on a steep mountain side, or in some cases issuing from a steep hanging valley.
3	Cascading	Descending in a series of marked steps with some crevasses and sÃ©racs.
4	Ice Fall	A glacier with a considerable drop in the longitudinal profile at one point causing heavily broken surface.
5	Interrupted	Glacier that breaks off over a cliff and reconstitutes below.

SOURCE_NOURISH

Description: 1-digit code that describes the source of nourishment for the glacier. Table 7 lists the source nourishment codes.

No Data Value: Null

Example: 1

Table 7. Source Nourishment Codes

Code	Name
0	Unknown
1	Snow
2	Avalanches
3	Superimposed ice

TONGUE_ACTIVITY

Description: A 1-digit code that describes the activity of the tongue of the glacier. Table 8 lists the tongue activity codes.

No Data Value: Null

Example: 1

Table 8. Tongue Activity Codes

Code	Name
0	Uncertain
1	Marked retreat
2	Slight retreat
3	Stationary
4	Slight advance
5	Marked advance
6	Possible surge
7	Known surge
8	Oscillating

MORAINES1

Description: 1-digit code that refers to moraines in contact with the present-day glacier. Table 9 describes the moraine codes.

No Data Value: Null

Example: 2

Table 9. Moraine Codes

Code	Name
0	No moraines
1	Terminal moraines
2	Lateral and/or medial moraine
3	Push moraine

Code	Name
4	Combination of 1 and 2
5	Combination of 1 and 3
6	Combination of 2 and 3
7	Combination of 1, 2, and 3
8	Debris, uncertain if morainic
9	Moraines, type uncertain or not listed

MORAINES2

Description: A 1-digit code that refers to moraines farther downstream of the glacier. Table 9 describes the moraine codes.
No Data Value: Null
Example: 2

PERIOD_ACTIVITY_START

Description: 4-digit start year of the period for which the tongue activity was assessed. Note: If the period for which the tongue activity was assessed is shorter than one year, this year will be recorded in both fields PERIOD_ACTIVITY_START and PERIOD_ACTIVITY_END.
No Data Value: Null
Example: 1972

PERIOD_ACTIVITY_END

Description: 4-digit end year of the period for which the tongue activity was assessed. Note: If the period for which the tongue activity was assessed is shorter than one year, this year will be recorded in both fields PERIOD_ACTIVITY_START and PERIOD_ACTIVITY_END.
No Data Value: Null
Example: 1972

SNOW_LINE_ELEV

Description: Altitude of the snow line of the glacier in meters above sea level, up to 4-digits. Note: The glacier data from the former Soviet Union often uses an estimation technique to calculate the snowline. The type of technique used is recorded in the REMARKS field.
No Data Value: Null
Example: Null

SNOW_LINE_ACY

Description: 1-digit snow line accuracy rating. Table 10 lists the rating values.

No Data Value: Null

Example: Null

Table 10. Snow Line Accuracy Ratings

Rating	Accuracy (meters)
1	0 - 25
2	25 - 50
3	50 - 100
4	100 - 200
5	> 200

SNOW_LINE_DATE

Description: 8-digit date of observation of the snowline of the form YYYYMMDD where YYYY is the 4-digit year, MM is the 2-digit month, and DD is the 2-digit day of month. If part or all of the date is missing, that missing parts are filled with 9's. Note: Snow line elevation is the altitude of the transient snowline at the end of the ablation season or, in most cases and for practical reasons, at the time the photograph was taken.

No Data Value: 99999999

Example: 99999999

MEAN_DEPTH

Description: The physical depth of the glacier in meters, up to 4 digits. Note I: Mean depth is only be given if actually measured (for instance by drilling or radio-echo soundings). Note II: Many of the values in this field were estimated using a thickness-area relation (Müller et al. 1997 and Müller et al. 1976).

No Data Value: Null

Example: Null

DEPTH_ACY

Description: 1-digit depth accuracy rating. Table 11 lists the depth accuracy ratings and their values.

No Data Value: Null

Example: Null

Table 11. Depth Accuracy Ratings

Rating	Accuracy (%)
1	0 - 5
2	5 - 10
3	10 - 20
4	20 - 30
5	> 30

TOTAL_AREA

Description: The total area of the glacier in a horizontal projection in square kilometers, up to 6 digits.

No Data Value: Null

Example: 86.76

AREA_ACY

Description: 1-digit area accuracy rating of the total area. Table 12 lists the area accuracy ratings and their values.

No Data Value: Null

Example: 1

Table 12. Area Accuracy Ratings

Rating	Accuracy (%)
1	0 - 5
2	5 - 10
3	10 - 15
4	15 - 30
5	> 30

AREA_IN_STATE

Description: The total area of the glacier that resides in the political state concerned in a horizontal projection in square kilometers, up to 6 digits.

No Data Value: Null

Example: 86.76

AREA_EXP

Description: The area of the exposed ice of the glacier in a horizontal projection in square kilometers, up to 6 digits
No Data Value: Null
Example: 80.86

MEAN_WIDTH

Description: The mean width of the glacier in a horizontal projection in kilometers, up to 4 digits.
No Data Value: Null
Example: 1.2

MEAN_LENGTH

Description: Mean length of the glacier in a horizontal projection in kilometers, up to 4 digits.
No Data Value: Null
Example: 22.6

MAX_LENGTH

Description: Maximum length of the glacier in kilometers measured along the most important flowline in a horizontal projection, up to 4 digits.
No Data Value: Null
Example: 24.7

MAX_LENGTH_EXP

Description: Maximum length, in kilometers, of the exposed ice of the glacier in a horizontal projection, up to 4 digits.
No Data Value: Null
Example: 22.3

MAX_LENGTH_ABL

Description: Maximum length, in kilometers, of the ablation area of the glacier in a horizontal projection, up to 4 digits.
No Data Value: Null
Example: Null

ORIENTATION_ACC

Description: The 1- to 2-character main orientation of the accumulation area using the 8 cardinal points: N, NW, W, SW, S, SE, E, and NE.
No Data Value: Null
Example: SE

ORIENTATION_ABL

Description: The 1- to 2-character main orientation of the ablation area using the 8 cardinal points: N, NW, W, SW, S, SE, E, and NE.
No Data Value: Null
Example: S

DATA_CONTRIBUTOR

Description: The institution or persons who contributed the data to NSIDC, up to 255 characters. For full references see Table 13.
No Data Value: Mandatory field
Example: Cogley (2008), from WGMS and NSIDC (1989, updated 2009) based on WGMS (various regions)

REMARKS

Description: Any important information or comments not included in the other fields above are given here, up to 255 characters.
No Data Value: Null
Example: Null

1.5 Spatial Coverage

This data set covers the following approximate geospatial area:

Northern and Southern Hemispheres:
Southernmost Latitude: 71.66° S
Northernmost Latitude: 89.30° N
Westernmost Longitude: 179.92° W
Easternmost Longitude: 179.68° E

1.6 Temporal Coverage

This data set covers the years 1900 to 2003 with a median year of 1972. The WGI is based primarily on aerial photographs and maps with most glaciers having one data entry only. The data set can be viewed as a snapshot of the glacier distribution in the second half of the 20th century.

1.7 Parameter or Variable

The main parameters of this data set are the following glacial parameters:

- Geographic location (latitude/longitude)
- Area (total)
- Length (mean and max)
- Width (mean)
- Elevation (minimum, mean, and maximum)
- Glacier classification and form
- Orientation
- Ablation and accumulation area

For a full list, see section 1.4 Database Field Descriptions of this document.

2 SOFTWARE AND TOOLS

2.1 Get Data

2.1.1 Downloading the Entire Database

The entire WGI database output to a comma separated value text file can be obtained from the FTP site:

- **CSV File:** wgi_feb2012.csv (39.5 MB).

The shapefile, GMT file, and KML file are also available from the FTP site.

- **Shapefile:** wgi_shapefile_feb2012.zip (9 MB)
- **GMT File:** wgi_feb2012.gmt (46.4 MB)
- **KML File:** wgi_feb2012.kml (238 MB)

2.1.2 Using the Search Interface

There are two different search interfaces for the WGI. To search the entire glacier inventory by entering a keyword or words, entering latitude/longitude, or select one or more inventory

parameters, use the Search the World Glacier Inventory interface. To search by a desired location name (for example, New Zealand), use the Extract Selected Regions interface.

The default output for the entire inventory interface includes glacier number, glacier name, lat/lon, total area, mean elevation, and primary classification. You can choose to include everything from each parameter by selecting ALL or you can display only a selection of available fields. Note that selecting the ALL option for any parameter overrides any other selections for that parameter.

The results are displayed in your Web browser as comma-delimited ASCII text. A blank space between commas indicates a missing value. To save the output data to a file, you can do a File --> Save as command in most web browsers.

Search tips for inventory search

- You must select at least one input parameter.
- Queries for glaciers in Caucasus will return only those glaciers in the Caucasus that drain to the Black Sea or to the Caspian Sea.
- In the query result, missing data may be by indicated by a blank (null).
- Queries on the glacier number or glacier name are not case sensitive. Wild-cards are not allowed in searches.
- For the String Search, the search will return anything that contains the characters entered into the search box. For instance, if you type "ice" the search will return records containing "ice," but it will also return such terms as Mont***ice***llo, Pr***ice***, Erp***ice***, ***Ice***fall, and Carn***ice***ro.
- To extract all the information about glaciers for a specific country, enter the country code and continent code in the glacier number search box. For instance, the string CH4 will return all the records for Switzerland. Alternatively, you can use the Extract Selected Regions interface.
- Note that the output form shows the database query that was generated from your input and may not exactly match the terms that you entered.
- If you are building your query using the "Extract Data for Selected Regions" form, you can select more than one region. The largest geographic region selected in each area takes precedence over any subregions selected from the same area.
- In Longitude/Latitude Searches, 0 is not a valid input.

Search tips for region search

- When you choose a continent, the top of the output format form tells you what continent you selected, but when you choose a region, the top of the output form lists the subregions within that region.

3 DATA ACQUISITION AND PROCESSING

3.1 Data Acquisition Methods

This data set has been compiled with the help of numerous scientists and institutions from all over the world. A detailed summary of the sources is given in the status report from 1988 (WGMS 1989). The Data Contributors are listed in Table 13 and changes in the contributors through time are noted in section 4.2.1 Update History of this document.

Table 13. Data Contributors

Abbreviation	Full Detail on Data Source
1-WGMS	Cogley (2008) from WGMS and NSIDC (1989, updated 2009) based on WGMS (various regions)
2-Institute of Geography, Russian Academy of Science	Cogley (2008) from WGMS and NSIDC (1989, updated 2009) based on Institute of Geography, Russian Academy of Science, Moscow (U.S.S.R.; Eurasian Glacier Inventory)
3-WDC-Glaciology, Lanzhou (CAREERI and Chen)	Cogley (2008) from WGMS and NSIDC (1989, updated 2009) based on WDC-Glaciology, Lanzhou (China; Eurasian Glacier Inventory) originally from CAREERI and X. Chen. [Note: This is a subset of the original 2007 CAREERI update that were corrected based on Cogley (2008). The rest of the CAREERI data can be found under data contributor "7-WDC-Glaciology, Lanzhou (CAREERI)."]
4-University of Alaska, Fairbanks	Cogley (2008) from WGMS and NSIDC (1989, updated 2009) based on University of Alaska, Fairbanks (glacier in southern Alaska)
5-Weidick	Cogley (2008) from WGMS and NSIDC (1989, updated 2009) based on Weidick et al. 1992 (southwestern Greenland)
6-Bhagat/Mool/Sah	Cogley (2008) based on Bhagat et al. 2004 (Himachal Pradesh) and Mool et al. 2001a, b, 2004, 2005 (Nepal, Buthan, Pakistan, Indus) and Sah et al. 2005 (Uttarakhand)
7-WDC-Glaciology, Lanzhou (CAREERI)	Cogley (2008) based on WDC-Glaciology, Lanzhou (China, Arunachal Pradesh) originally from CAREERI.
8-Garin	Cogley (2008) based on Garin 1987 (northern Chile)
9-Hagen	Cogley (2008) based on Hagen et al. 1993 (Svalbard, Jan Mayen)
10-Trent University	Cogley (2008) based on Trent University (Scott, Peter I, S Shetlands, S Orkneys, Bouvet, Heard, Ballenys)
11-Holdgate and Baker	Cogley (2008) from Trent University based on Holdgate and Baker 1979 (S Sandwich Is)
12-Langenegger and Verwoerd	Cogley (2008) from Trent University based on Langenegger and Verwoerd 1971 (Marion I)

Abbreviation	Full Detail on Data Source
13-Institut Géographique National	Cogley (2008) from Trent University based on Institut Géographique National 1967 (Kerguelen)
14-Trent University	Cogley (2008) based on Trent University (Canada: eastern Yukon, N.W.T., Melville I, Labrador)
15-U.S. Geological Survey, Tacoma	Cogley (2008) based on U.S. Geological Survey, Tacoma (Brooks Range, Alaska)
16-Ames	Cogley (2008) based on Ames et al. 1988 (southern Peru)
17-Kaul	Cogley (2008) based on Kaul 1999 (India: Kashmir, Himachal Pradesh (part), Sikkim)
18-Katalog Lednikow SSSR	Cogley (2008) based on Katalog Lednikow SSSR (U.S.S.R.; parts not in source 2)
19-Sedov	Cogley (2008) based on Sedov 1997 (Tajgonos Peninsula, northeastern Siberia)
20-Gellatly	Cogley (2008) based on Gellatly et al. 1994 (Abruzzi, Italy)
21-WGMS 1993	Cogley (2008) based on WGMS 1993 (Germany)
22-Lorenzo/White	Cogley (2008) based on Lorenzo 1964 and White 2002 (Mexico)
23-Allison and Peterson	Cogley (2008) based on Allison and Peterson 1988 (Indonesia)
24-Aniya	Cogley (2008) based on Aniya 1998 (South Patagonian Ice Field, Patagonia)
25-Aniya	Cogley (2008) based on Aniya et al. 1996 (North Patagonia Ice Field, Patagonia)
26-Casassa	Cogley (2008) based on Casassa et al. 2002 (Cordova Peninsula, Isla Riesco, Patagonia)
27-Rivera and Casassa	Cogley (2008) based on Rivera and Casassa 2004 (South Patagonia Ice Field, Patagonia)
28-Bertone	Cogley (2008) based on Bertone 1960 (part of Argentinian Patagonia)
29-Fernandez	Cogley (2008) based on Fernandez et al. 2005 (Minchinmavida volcano, Patagonia)
30-Schneider	Cogley (2008) based on Schneider et al. 2005, 2007 (Muñoz Gamero Peninsula, Patagonia)
31-Calkin	Cogley (2008) based on Calkin et al. 1998 (Kigluaik Mountains, Alaska)
32-Trent University	Cogley (2008) from Trent University (Canada: Baffin I and Bylot I)
33-WGMS	WGMS and NSIDC (1989, updated 2009) based on WGMS (south of Northern Patagonian Ice Field; Yukon)
34-CEAZA	WGMS and NSIDC (1989, updated 2009) based on CEAZA (central Chile)

Abbreviation	Full Detail on Data Source
35-University of Alaska, Fairbanks	WGMS and NSIDC (1989, updated 2009) based on University of Alaska, Fairbanks, Echelmeyer / Valentine (Kenai Peninusla , Alaska)
36-Sigurðsson/Arendt	Radić and Hock 2010 based on the Icelandic Inventory provided by O. Sigurðsson and Arendt et al. 2002 (Iceland, Alaska)
37-Rau	Rau et al. 2004 (Antarctic Peninsula)

3.2 Quality Assessment

Data obtained from WGMS prior to 1999 were subjected to plausibility checks at WGMS. Errors uncovered during the plausibility check were printed out and sent to the individual data collectors for review. The data collectors are responsible for the accuracy of their submission (Hoelzle and Trindler, 1998). NSIDC checked data received from X. Chen (for glaciers in China) and V. Kotlyakov (for glaciers in the former Soviet Union) for impossible values that might indicate digitizing errors. These records were corrected or removed. The data set may have records that are irregular but not impossible. For example, glacier CN5Y812B0008 has a frontal characteristic value that indicates calving. Though the glacier's high altitude might indicate an error in the classification, calving into a small lake is not impossible.

In 1999, prior to publishing the data as part of its online catalog, NSIDC checked data quality. General checks were applied to all fields and included ensuring that data were recorded in a consistent manner. Field-specific checks included ensuring that maximum lengths, minimum lengths, and mean lengths were accurate in relation to each other (the maximum exceeds the mean which exceeds minimum), that maximum and minimum elevations of glaciers and snowlines were appropriate for their location, and that total areas and ablation areas were accurate in relation to each other (ablation area must be less than total area). NSIDC asked the data contributor about incorrect data values. Data that were corrected on recommendation from data contributors are indicated in the glacier quality field. After these checks took place, data for glaciers in China and the former Soviet Union were sent to WGMS for incorporation into later versions of the WGMS database.

In 2012, WGMS and NSIDC performed a major overhaul of the WGI database (see section 4.2.1 Update History). We added records, quality checked data, and revised documentation. This version (WGMS and NSIDC, 1989, updated 2012) includes additional data compiled from Rau et al. (2004), Cogley (2008), and Radi and Hock (2010). A major part of the data records (see sources 1 to 32 in Table 13) have undergone detailed checks and corrections by Cogley (2008). Records

from sources 33 to 37 (see Table 13) were directly compiled from these sources, and all data records have been checked and adjusted to the present revised documentation.

Note: Some regional or national inventories use a slightly different coding scheme (for example source 18, Cogley (2008) based on Katalog Lednikow SSSR, Nr. 18 in Table 13). The glacier ID numbers assigned by former Soviet Union (FSU) catalogues (Catalog of USSR Glaciers) diverge from the WGMS protocol. The numbering scheme for the FSU glaciers is as follows:

- 2 character country code
- 1 character continent code
- 1 character basin code
- 2 character volume code
- 1 character issue code
- 2 character part code
- 3 character local glacier code

For instance, for the glacier ID SU5T09101001, the SU is the country code (Soviet Union), the 5 is the continent code (Asia), the T is the drainage basin code, the 09101 refers to volume 9, issue 1, part 1 of the Catalogue of USSR Glaciers, and the 001 is a local glacier code.

3.2.1 Update History

January 2012

This is a major update of the WGI database. The update was undertaken by the WGMS to add more glaciers and to improve database consistency; it is based on Cogley (2008). The WGMS merged the Cogley (2008) inventory with WGMS and NSIDC (1989, updated 2009) inventory and added two other data sets, to make a more complete inventory. NSIDC brought the database into our system, completely replacing the old database. The following major improvements were made:

- More than 25,000 glacier records added, increasing the number from 107,009 to 132,890.
- Added latitude and longitude information to all records. Previously, approximately 12,400 records did not have lat/lon values associated with them.
- Standardized the mandatory glacier ID to 12 digits. Previously, the glacier ID was not consistent; approximately 15,300 records had ID's that ranged from 9 to 14 digits.
- Almost doubled the glacial area covered from 240,000 km^2 to 470,000 km^2. Major regions added include: the Yukon, Baffin Island, Greenland, Iceland, Central Andes, South Patagonia, Antarctic Islands, and the Antarctic Peninsula.
- Two new data sets added:
    - Radić and Hock 2010: Iceland and Alaska
    - Rau et al. 2004: Antarctic Peninsula
- Now contains almost 85% of total estimated number of glaciers and ice caps in the world and about 70% of the total estimated area covered by glaciers and ice caps (cf. Dyurgerov and Meier 2005).

- Database field additions, deletions, and changes
    - Added fields: REMARKS
    - Deleted fields: MORPHOLOGIC_TYPE, DATE_RECEIVED, DATE_ADDED, and DATE_PUBLISHED
    - Renamed/Changed fields:
        - GLACIER_NUM is now WGI_GLACIER_ID
        - RIVER_BASIN broken up into CONTINENT_CODE and DRAINAGE_CODE
        - COUNTRY_CODE changed to POLITICAL_UNIT
        - COORDINATES is now three fields: EASTING, NORTHING, and COORDINATE_DESCRIPTION
        - PERIOD_ACTIVITY broken up into PERIOD_ACTIVITY_START and PERIOD_ACTIVITY_END

During this update, the database stored at NSIDC was reformatted to be more like the original guidelines of Müller et al. (1977). The database contains 50 fields stored in two tables:

- A static table containing all of the mandatory fields: wgi_glacier_id, political_unit, continent_code, drainage_code, free_position_code, local_glacier_code, glacier_name, lat, lon, easting, northing, and coordinate_description.
- A variable table that contains glacier statistics and information that is comprised of all other fields not listed above in the static table.

These two tables are linked via the primary key, `wgi_glacier_id`.

In addition, the Data Contributor Search dropdown on the WGI Search Interface was updated to more specific. Previously, there were seven data contributors; and now these have been broken down into 37 groups. Table 14 describes the mapping from the previous seven contributors to the new schema.

Table 14. Data Contributor Mappings

Previous Data Contributor Name (prior to 2012)	**New Data Contributor Name**
CEAZA	34-CEAZA
CAREERI, Lanzhou, China. Che/Wu**	7-WDC-Glaciology, Lanzhou (CAREERI)
Institute of Geography, Russian Academy of Science. Chernova	2-Institute of Geography, Russian Academy of Science
Institute of Geography, Russian Academy of Science. Kotlyakov/Kunakhovitch	2-Institute of Geography, Russian Academy of Science
U. of Alaska-Fairbanks, Echelmeyer/Valentine	35-University of Alaska, Fairbanks
WDC-Glaciology, Lanhzou. Chen**	3-WDC-Glaciology, Lanzhou (CAREERI and Chen)
WGMS	1-WGMS

**Note:The original 43 records from the data contributor "WDC-Glaciology, Lanhzou. Chen" have been merged into the data contributor "3-WDC-Glaciology, Lanzhou (CAREERI and Chen)" that contains over 12,000 records. To access just those 43 original records from X. Chen, you must select "3-WDC-Glaciology, Lanzhou (CAREERI and Chen)" from the data contributors and then, in the results returned, search for the glacier IDs in the file original-chen-data-ids.txt. Further, two glacier IDs from the original Chen data set were updated to reflect changes in glacier naming schema. These were CN5Y4243C006 and CN5Y472A0013 which were changed to CN5Y424D0006 and CN5Y742A0013, respectively. In addition, approximately 12,000 records from the 2007 CAREERI data set were corrected based on Cogley (2008) and were split between two contributors: "7-WDC-Glaciology, Lanzhou (CAREERI)" and "3-WDC-Glaciology, Lanzhou (CAREERI and Chen)." To get all of the CARREERI data, you must do two searches, one for each contributor mentioned previously.

July 2010

In July 2010, some errant lat/lon values were discovered. The values that formerly appeared as -10165.6500 and 10165.6500 were determined to be missing data values. They are now displayed in the ASCII search interface output as blank spaces between commas in the lat and lon columns. Approximately 24,000 values were affected.

December 2009

In December 2009, NSIDC changed all of the -9999 values (which indicate a missing value) in the ASCII search interface output to a blank space between commas. Before making the change, the NOAA@NSIDC team discussed it with a scientist at NSIDC and also with a scientist at the World Glacier Monitoring Service to ensure that the change would have a minimal impact (if any at all) on users who have already downloaded the data. The original WGMS database did not contain -9999 values.

Also in December, incorrect values for the Topographic Scale were noticed in the database. Occasionally, these values were listed as "1:-99990". After some investigation, it was determined that these values indicate missing data, so they are now displayed as a blank space between commas in the ASCII search interface output.

June 2009

In June of 2009, 157 glaciers from the Huasco Catchment in Chile were added to the database. These were provided by CEAZA. The elevation ranges were obtained from Chilean topographical maps (1955 aerophotogrammetrical restitution). The glacier areas and lengths were taken from ASTER data.

March 2008

In March of 2008, the World Glacier Inventory Extract Selected Regions interface and maps were updated.

November 2007

In November 2007, 46,394 glaciers from the Chinese glacier inventory were supplied to NSIDC by Dr. Tao Che. Many had contributed to this data collection, including Dr. Xin Li and Mr. Lizong Wu. The data were retrieved from the book titled "Chinese Glacier Information System, Chinese Edition" (Wu and Li 2004). T. Che provided a file listing the regions covered by this update. These regions include Ertix He (Kara Irtysh), Yellow River, Yangtze River, Lancang Jiang, Nu Jiang, Ganga River, Indus River, Central Asian Drainage Basin, Eastern Asian Drainage Basin, and the Tibet Drainage Basin. To see the direct mapping between codes in the Glacier ID and the regions they represent, see the files first.txt, second.txt, third.txt, fourth.txt, and fifth.txt in the nov2007_update directory on the FTP site.

Of the 46,394 glaciers that T. Che provided to NSIDC, 34,254 glaciers were added to the World Glacier Inventory and the other 12,140 glaciers replaced existing glacier entries in the database. Many corrections were applied to the data. The file glacier_replaced_ids.txt provides a list of Glacier IDs that were replaced. Note: the orginal 43 Chinese glaciers from the first release of the WGI still remain from the original Chinese glacier inventory under data provider "WDC-Glaciology, Lanhzou. Chen." To access the new Chinese data from this update, go to the WGI Search interface and select "CAREERI, Lanzhou, China. Che/Wu" from the Data Contributor Search pull-down menu. **Note:** As of July 2012, the data contributor titles were updated. To see a mapping of the old titles to the new ones, see Table 14.

NSIDC performed a basic quality check on the new Chinese glacier inventory. B. Raup identified and corrected five coordinates that were incorrect, wrote a script to convert the coordinates from degrees and minutes to decimal degrees, and identified inconsistencies with certain coordinates based on a visual assessment using a map. For example, the Glacier ID CN5O282A0448 contains latitude (20.228) and longitude (95.83017) coordinates that are most likely too far south to be in the Chinese glacier inventory. The bulleted list below shows changes made at NSIDC to the original data given to us by T. Che:

- For a list of changes we made at NSIDC per recommendations by B. Raup, see the file chinese_outliers_and_corrections.txt.
- For the snow_line_date column, we changed two digit values to four digit values, but we kept 0 values. For example, 80 was changed to 1980.

- L. Ballagh reformatted the data to facilitate input to the database and separated the six-digit GLA_CLASS field into these six corresponding fields: primary classification, form, frontal characteristic, longitudinal profile, major source of nourishment and tongue activity.
- The data contained a two-digit field for moraines. L. Ballagh separated the two-digit field into a one-digit moraines1 field and a one-digit moraines2 field.
- Blank fields were converted to -9999 by I. Wang (NSIDC) in the database.

Users will notice that some columns contain multiple values. For example, there may be one, two, or three years listed in the topographic year field. According to Mr. Wu, "There are only one reference data in a five level glacier catchment, and if a glacier catchment uses different (two or more) reference data, there will be multiple values." We interpret this to mean that there is a many to many relationship between glaciers and the reference data (maps).

Note that some fields given to us by T. Che were not added to the WGI database because they are not valid WGI fields. For example, Ice Volume is not a valid WGI field. In addition to the WGI update, glacier outlines were also provided and these outlines are now available through the Global Land Ice Measurements from Space (GLIMS) Glacier Database interface.

August 2007

In August 2007, the database was updated with data from Lyudmila Chernova. Between 2002 and 2004, NSIDC corresponded with L. Chernova concerning errors in glacier IDs that she had identified in glaciers from Volume 13 of the approximately 80 volume set Catalog of USSR Glaciers. These glaciers had the drainage basin incorrect, with A where X should have been. She provided corrected glacier IDs, which were fixed in the database in August 2007. A complete list of the 368 corrected glacier IDs is available in the text file 20070815_corrected_glacier_ids.txt. A map of the former Soviet Union regions (fsu_regions.pdf) provided by L. Chernova provides data users with a view of the different regions. The map visually shows how regions 5A and 5X differ geographically.

L. Chernova also noted that glaciers from Vol. 15 Issue 1 Chapters 5, 6, 7 and 8, and Vol. 15 Issue 2 Chapter 1 were missing from the WGI as well as glaciers from Vol. 14 Issue 3 Chapter 9; Vol. 13 Issue 2 Chapter 5; and Vol. 16 Issue 2 Chapter 2. L. Chernova provided NSIDC with the missing data, which were added to the database in August 2007.

The data files from L. Chernova included a six-digit Classification Code field (for example, 650100). These codes relate to four one-digit WGI fields and to one newly added two-digit Morphologic Type field. The Classification Code field was added to the database (August 2007) and only contains values for data provided by L. Chernova. Using the six-digit example above, the first two-digit value corresponds to the Morphologic Type (65) and the following four fields correspond to Frontal

Characteristic (0), Longitudinal Profile (1), Major Source of Nourishment (0) and Tongue Activity (0). Table 15 shows the relationship between morphological types and their description.

Table 15. Morphological Type Description

Morphologic Type	Morphological Description
36	slope glacier
37	flat summit glacier
51	dendritic
52	compound
53	valley
63	corrie valley
64	corrie
65	hanging
75	niche
76	crater
77	ice apron

Some of the records supplied by L. Chernova have a glacier name with one, two, or three digits that correspond to the last digits of the glacier ID.

L. Chernova followed the descriptions in this document for the orientation of the accumulation and orientation of the ablation fields. These values are provided in degrees rather than direction (for example, 360 versus N). Other data contributors provide values for these two fields using direction rather than degree. To convert between degrees and direction (per L. Chernova's description): 360 = N, 90 = E, 180 = S, 270 = W, 45 = NE, and so forth.

Records from L. Chernova listed area accuracy as a range (for example, 10%-20%). Since the area accuracy field is generally a single number in the WGI database, we converted this to a single value by taking the mean (for example, 12.5, based on the 10%-15% range). A precision in estimating area accuracy is not implied by the precision of this statistic. We thank Ian Evans for reformatting the data files provided by L. Chernova.

February 2007

In February 2007, a user informed NSIDC that a glacier with an area of 5360 square kilometers does not exist in the Pamirs. The total area field for glacier number SU5X14319097 was changed from 5360 to -9999 (the missing value).

January 2004

In January 2004, a user notified NSIDC about probable errors in the WGI orientation fields. It was found that the Soviet Union Glacier Inventory and data from China had errors in the Orientation Ablation and Orientation Accumulation fields of the database. Specifically, glaciers with a country code of CN (for China) and SU (for Russia) had east and west reversed. We corrected these fields by swapping E and W, NE and NW, and SE and SW. The glacier Orientation Ablation and Orientation Accumulation fields have been corrected and the data have been reloaded as of 05 May 2005.

March 2003

In March 2003, NSIDC discovered discrepancies between glacier locations in the online WGI database and glaciers in the WGMS database. The locations for the glaciers in the WGI at NSIDC had errors with a magnitude of 0.005 degrees or approximately 500 m. We hypothesize that the differences were due to a rounding error that occurred during a database migration in September 2001. The glacier locations have been corrected as of 15 March 2003.

May 2001

In 2001, former Soviet Union data were found to contain corrupted geodetic coordinate data as a result of a mistake in processing that took place at NSIDC. In detail, data were corrupted when the latitude/longitude coordinates for the glaciers between +33.00 and +181.17 degrees longitude and between +33.00 and +81.85 degrees latitude were converted twice from degrees-minutes format to decimal degree format in the process of putting the data in the database. The ASCII text file of the whole database, wgi06102009.dat, contained uncorrupted data in decimal degree format for these particular glaciers, while the coordinates for the rest of the glaciers were in degrees-minutes format. Both the ASCII file of the entire database and the data in the Web-accessible database have been corrected as of 04 May 2001. They contain only decimal degree formatted latitude/longitude data.

1999

In 1998, WGMS and NSIDC agreed to work together to make the WGI widely available online, and in 1999, NSIDC published the WGI as part of its NOAA-supported collection.

4 REFERENCES AND RELATED PUBLICATIONS

Relevant publications and guidelines

Allison, I., and J.A. Peterson. 1988. Glaciers of Irian Jaya, in Williams, R.S., Jr., and J.G. Ferrigno, eds. Satellite Image Atlas of Glaciers of the World - Glaciers of Irian Jaya, Indonesia, and New Zealand. U.S. Geological Survey Professional Paper 1386-H.

Ames, A., S. Dolores, A. Valvedere, P. Evangelista, D. Corcino, W. Ganvini, J. Zúñiga and V. Gomez. 1988. Inventario de Glaciares del Perú, Part II. Unidad de Glaciología e Hidrología, Hidrandina SA, Huaraz. 105p.

Aniya, M. 1988. Glacier inventory for the Northern Patagonia Icefield, Chile, and variations 1944/45 to 1985/86. Arctic and Alpine Research 20(2), 179-187.

Aniya, M., H. Sato, R. Naruse, P. Skvarca and G. Casassa. 1996. The use of satellite and airborne imagery to inventory outlet glaciers of the Southern Patagonia Icefield. South America, Photogrammetric Engineering and Remote Sensing 62(12),1361-1369.

Arendt, A.A., Echelmeyer, K.A., Harrison, W.D., Lingle, S.C. and Valentine, V.B. 2002. Rapid wastage of Alaska glaciers and their contribution to rising sea level. Science 297: 382-386. doi:10.1126/science.1072497.

Bedford, D. and C. Haggerty. 1996. New digitized glacier inventory for the former Soviet Union and China. *Earth System Monitor*, ISSN 1068-2678, NOAA Environmental Information Services Office, 6(3): 8-10.

Bertone, M. 1960. Inventario de los Glaciares Existentes en la Vertiente Argentina entre los Paralelos 47° 30′y 51° S. Publication 3, Instituto Nacional del Hielo Continental Patagónico, Buenos Aires. 103p.

Bhagat, R.M., V. Kalia, C. Sood, P.K. Mool and S.R. Bajracharya. 2004. Himachal Pradesh Himalaya India - Inventory of Glaciers and Glacial Lakes and the Identification of Potential Glacial Lake Outburst Floods (GLOFs) Affected by Global Warming in the Mountains of Himalayan Region. International Centre for Integrated Mountain Development, Kathmandu. CD-ROM, report (254p.), data.

Calkin, P.E., D.S. Kaufman, B.J. Przybyl, W.B. Whitford and B.J. Peck. 1998. Glacier regimes, periglacial landforms, and Holocene climate changes in the Kigluaik Mountains, Seward Peninsula, Alaska, U.S.A. Arctic and Alpine Research 30(2): 154-165.

Casassa, G., K. Smith, A. Rivera, J. Araos, M. Schnirch and C. Schneider. 2002. Inventory of glaciers in Isla Riesco, Patagonia, Chile, based on aerial photography and satellite imagery. Annals of Glaciology 34: 373-378.

Cogley, J. G. 2008. Extended format for the World Glacier Inventory. *Trent Technical Note* 2005-1.

Fernández A., J. Araos and J. Marín. 2005. Inventario de glaciares del Volcán Michimahuida utilizando Sistemas de Información Geográfica (SIG): resultados preliminares, poster presented at CEQUA Symposium, Puerto Natales, Chile, 4-9 April 2005.

Garin, C. 1987. Inventario de glaciares de los Andes Chilenos desde los 18° a los 32° de latitud sur. Revista de GeografÃa Norte Grande 14 35-48.

Gellatly, A.F., C. Smiraglia, J.M. Grove and R. Latham. 1994. Recent variations of Ghiaccaio del Calderone, Abruzzi, Italy. Journal of Glaciology 40(136): 486-490.

Haeberli, W. 1998. Historical evolution and operation aspects of worldwide glacier monitoring in Into the second century of worldwide glacier monitoring: prospects and strategies. Studies and reports in hydrology, No. 56. Edited by W. Haeberli, M. Hoelzle, and S. Suter. UNESCO Publishing, Paris: 36-52.

Hagen,J.O., O. Liestøl, E. Roland and T. Jørgensen. 1993. Glacier Atlas of Svalbard and Jan Mayen. Meddelelser 129, Norsk Polarinstitutt, Oslo. 141p.

Hoelzle, M. and Trindler, M. 1998. Data management and application. In: Haeberli, W. (ed.), Into the second century of world glacier monitoring: prospects and strategies. UNESCO, Paris, 56: 53-72.

Holdgate, M.W., and P.E. Baker. 1979. The South Sandwich Islands: I. General Description. Scientific Report 91, British Antarctic Survey, Cambridge. 76p. 11 plates.

Institut Géographique National.1967. Terres Australes et Antarctiques Françaises: Iles Kerguelen. Reconnaisssance map at 1:100 000 in 3 sheets. Imprimérie de l'Institut Géographique National, Paris.

Kaul, M.K. 1999. Inventory of the Himalayan Glaciers. Special Publication 34, Geological Survey of India, Calcutta. 165p.

Langenegger, O., and W.J. Verwoerd. 1971. Topographic survey, in van Zinderen Bakker, E.M., Sr., J.M. Winterbottom and R.A. Dyer, eds., Marion and Prince Edward Islands, 32-39 and two maps at 1:50 000 scale. A.A. Balkema, Cape Town. 427p.

Lorenzo, J.L. 1964. Los Glaciares de México. Monograph 1, Instituto de Geofísica, Universidad Nacional Autónoma de México, Mexico City. 2nd ed. 114p.

Mool, P.K., S.R. Bajracharya and S.P. Joshi. 2001a. Inventory of Glaciers, Glacial Lakes and Glacial Lake Outburst Floods - Monitoring and Early Warning Systems in the Hindu Kush-Himalayan Region: Nepal. International Centre for Integrated Mountain Development, Kathmandu. CD-ROM, report (197p.), data.

Mool, P.K., D. Wangda, S.R. Bajracharya, K.Kunzang, D.R. Gurung and S.P. Joshi. 2001b. Inventory of Glaciers, Glacial Lakes and Glacial Lake Outburst Floods - Monitoring and Early Warning Systems in the Hindu Kush-Himalayan Region: Bhutan. International Centre for Integrated Mountain Development, Kathmandu. CD-ROM, report (127p.), data.

Mool, P.K., S.R. Bajracharya, R. Roohi, A. Ashraf and S.A. Hussain. 2004. Upper Indus, Jhelum, Shingo, Shyok, and Shigar River Basins, Pakistan Himalaya: Inventory of Glaciers and Glacial Lakes and the Identification of Potential Glacial Lake Outburst Floods (GLOFs) Affected by Global Warming in the Mountains of Himalayan Region. International Centre for Integrated Mountain Development, Kathmandu. CD-ROM, report (343p.), data.

Mool, P.K., S.R. Bajracharya, B. Shrestha, S.P. Joshi, R. Roohi, A. Arshad, R. Naz. S.A. Hussain and M.H. Chaudhry. 2005. Indus Basin: Inventory of Glaciers and Glacial Lakes and Identification of Potential Glacial Lake Outburst Floods (GLOFs) Affected by Global Warming in the Mountains of Himalayan Region. International Centre for Integrated Mountain Development, Kathmandu. CD-ROM, report (321p.), data.

Müller, F. (ed.). 1978. Instructions for the compilation and assemblage of data for a world glacier inventory; Supplement: Identification/glacier number IAHS(ICSI)/UNEP/UNESCO report, Temporal Technical Secretariat for the World Glacier Inventory (TTS/WGI), ETH Zurich, Switzerland.

Müller, F., Caflisch, T. and Müller, G. (eds.). 1977. Instructions for the compilation and assemblage of data for a world glacier inventory. IAHS(ICSI)/UNESCO report, Temporal Technical Secretariat for the World Glacier Inventory (TTS/WGI), ETH Zurich, Switzerland.

Müller, F., Caflisch, T. and Müller, G. 1976. Firn und Eis der Schweizer Alpen: Gletscherinventar. (Geographisches Institut Publ 57). ETH Zurich, Switzerland.

Radić, V., and R. Hock. 2010. Regional and global volumes of glaciers derived from statistical upscaling of glacier inventory data. J. Geophys. Res. 115, F01010. doi:10.1029/2009JF001373.

Rau, F., Mauz, F., De Angelis, H., Jaña, R., Arigony Neto, J., Skvarca, P., Vogt, S., Saurer, H., Gossmann, H. 2004. Variations of glacier frontal positions on the Northern Antarctic Peninsula. Annals of Glaciology 39: 525-530.

Rivera, A., and G. Casassa. 2004. Ice elevation, areal, and frontal changes of glaciers from National Park Torres del Paine, Southern Patagonia Icefield. Arctic, Antarctic and Alpine Research 36(4): 379-389.

Sah, M., G. Philip, P.K. Mool, S. Bhajracharya and B. Shrestha. 2005. Uttaranchal Himalaya India: Inventory of Glaciers and Glacial Lakes and the Identification of Potential Glacial Lake Outburst Floods (GLOFs) Affected by Global Warming in the Mountains of Himalayan Region. International Centre for Integrated Mountain Development, Kathmandu. CD-ROM, report (176p.), data.

Scherler, K. (ed.). 1983. Guidelines for preliminary glacier inventories. IAHS(ICSI)/ UNEP/UNESCO report, Temporal Technical Secretariat for the World Glacier Inventory (TTS/WGI), ETH Zurich, Switzerland.

Schneider, C., M. Schnirch, G. Casassa, C. Acuña and R. Kilian. 2005. Gran Campo Nevado, Chile, 1:65,000 (aerial photogrammetric map and glacier inventory), in Haeberli, W., M. Zemp, M. Hoelzle, R. Frauenfelder, M. Hoelzle and A. Kääb, Fluctuations of Glaciers, 1995-2000 (Vol. VIII), 66. With 1:65,000-scale topographic orthoimage map Gran Campo Nevado, Península Muñoz Gamero, Patagonia, Chile. International Commission on Snow and Ice of International Association of Hydrological Sciences/UNESCO, Paris.

Schneider, C., M. Schnirch, C. Acuña, G. Casassa and R. Kilian. 2007. Glacier inventory of the Gran Campo Nevado Ice Cap in the southern Andes and glacier changes observed during recent decades. Global and Planetary Change 59: 87-100.

Sedov, R.V. 1997. Ledniki poluostrova Tajgonos. Materialy Glyatsiologicheskikh Issledovaniy 82: 218-221.

UNESCO. 1970. Perennial ice and snow masses - a guide for compilation and assemblage of data for the World Glacier Inventory. Technical Papers in Hydrology No. 1.

Weidick, A., Bøggild, C.E., and Knudsen, N.T. 1992. Glacier Inventory and Atlas of West Greenland. Report 158, Grønlands Geologiske Undersøgelse, Copenhagen. 193p. Digital data available from the National Snow and Ice Data Center, University of Colorado, Boulder, Colorado.

WGMS and NSIDC. 1989, updated 2012. World glacier inventory. Compiled and made available by the World Glacier Monitoring Service, Zurich, Switzerland, and the National Snow and Ice Data Center, Boulder CO, USA. Digital media.

WGMS and NSIDC. 1989, updated 2009. World glacier inventory. Compiled and made available by the World Glacier Monitoring Service, Zurich, Switzerland, and the National Snow and Ice Data Center, Boulder CO, USA. Digital media.

WGMS. 1993. Fluctuations of Glaciers 1985-1990 (Vol. VI). Haeberli, W. and Hoelzle, M. (eds.), IAHS (ICSI) / UNEP / UNESCO, World Glacier Monitoring Service, Zurich, Switzerland: 322 pp.

WGMS (1989): World Glacier Inventory - Status 1988. Haeberli, W., Bösch, H., Scherler, K., Østrem, G. and Wallén, C. C. (eds.), IAHS (ICSI) / UNEP / UNESCO, World Glacier Monitoring Service, Zurich, Switzerland: 458 pp.

White, S.E. 2002. Glaciers of Mexico, in Williams, R.S., Jr., and J.G. Ferrigno, (eds.), Satellite Image Atlas of Glaciers of the World - North America. U.S. Geological Survey Professional Paper 1386-J, 383-405. U.S. Government Printing Office, Washington, D.C.

Wu, L. and X. Li. 2004. *China Glacier Information System*. Tianjin: China Ocean Press.

Scientific publications using WGI data

Cogley, J.G., R. Hock, L.A. Rasmussen, A.A. Arendt, A. Bauder, R.J. Braithwaite, P. Jansson, G. Kaser, M. Möller, L. Nicholson and M. Zemp. 2011. Glossary of Glacier Mass Balance and Related Terms. *IHP-VII Technical Documents in Hydrology* No. 86, IACS Contribution No. 2, UNESCO-IHP, Paris.

Cogley, J. G. 2010. A more complete version of the World Glacier Inventory. Annals of Glaciology, 50(53), 32-38. doi: 10.3189/172756410790595859.

Dyurgerov, M.B. and Meier, M.F. 2005. Glaciers and the changing earth system: A 2004 snapshot. Occasional paper 58. Institute of Arctic and Alpine Research, University of Colorado, Boulder.

Evans, I.S. 2005. Global variations of local asymmetry in glacier altitude: separation of north-south and east-west components. J. Glaciology 51(174): 469-482.

Evans, I.S. 2006. Glacier distribution in the Alps: statistical modeling of altitude and aspect. Geogr. Ann., 88 A (2):115-133.

Evans, I.S. 2006. Local aspect asymmetry of mountain glaciation: A global survey of consistency of favoured directions for glacier numbers and altitudes. Geomorphology 73: 166-184.

Haeberli, W. and M. Hoelzle. 1995. Application of inventory data for estimating characteristics for and regional climate change effects on mountain glaciers: a pilot study with the European Alps. Annals of Glaciology 21: 206-212.

Meier, M.F. and Bahr, D.B. 1996. Counting glaciers: use of scaling methods to estimate the number and size distribution of the glaciers on the world. In: Colbeck, S.C. (ed.) Glaciers, Ice Sheets and Volcanoes: a tribute to Mark F. Meier. Cold Regions Research and Engineering Laboratory (CRREL) Special Report, 96-27: 1-120.

Radić, V., and R. Hock. 2010. Regional and global volumes of glaciers derived from statistical upscaling of glacier inventory data. J. Geophys. Res. 115, F01010. doi:10.1029/2009JF001373.

Ohmura, Atsumu 2010. Completing the World Glacier Inventory. Annals of Glaciology 50 (53):144-148.

Paul, F., R.G.Barry, J. G. Cogley, H. Frey, W. Haeberli, A. Ohmura, C. S. L. Ommanney, B. Raup, A. Rivera, M. Zemp. 2010. Recommendations for the compilation of glacier inventory data from digital sources. Annals of Glaciology, 50(53), 119-126. doi: 10.3189/172756410790595778.

WGMS. 2008. Global Glacier Changes: facts and figures. Zemp, M., Roer, I., Kääb, A., Hoelzle, M., Paul, F. and Haeberli, W. (eds.), UNEP, World Glacier Monitoring Service, Zurich, Switzerland: 88 pp. [http://www.grid.unep.ch/glaciers/pdfs/glaciers.pdf] [25 MB].

4.1 Related Data Collections

- Global Terrestrial Network for Glaciers (GTN-G)
- Dyurgerov, Mark. 2002, updated 2005. *Glacier Mass Balance and Regime: Data of Measurements and Analysis.* INSTAAR Occasional Paper No. 55, ed. M. Meier and R. Armstrong. Boulder, CO: Institute of Arctic and Alpine Research, University of Colorado. Distributed by National Snow and Ice Data Center, Boulder, CO
- Echelmeyer, K.A., V.B. Valentine, and S.L. Zirnheld. 2002, updated 2004. *Airborne Surface Profiling of Alaskan Glaciers*. Boulder, CO: National Snow and Ice Data Center. Digital Media.
- NSIDC/WDC for Glaciology, Boulder, compiler. 2002, updated 2009. *Glacier photograph collection*. Boulder, Colorado USA: National Snow and Ice Data Center/World Data Center for Glaciology. Digital media.
- Weidick, A., Boeggild, C. E., and Knudsen, N. T. 1992. *Glacier Inventory of West Greenland.* Boulder, CO: National Snow and Ice Data Center. Digital media.
- Global Land Ice Measurements from Space (GLIMS)
- A number of glacier inventory and mass balance data sets are available from the World Glacier Monitoring Service based in Zurich, Switzerland.
- Fluctuations of Glaciers from the WGMS has information on the net mass balance of the world's glaciers.
- NSIDC's State of the Cryosphere Web page.

5 CONTACTS AND ACKNOWLEDGMENTS

World Glacier Monitoring Service
Department of Geography
University of Zurich
Winterthurerstrasse 190
CH-8057 Zurich Switzerland
www.wgms.ch
wgms@geo.uzh.ch
+41 44 635 5139

5.1 Acknowledgments

This data set was originally made available as the result of an informal collaboration between Martin Hoelzle of the World Glacier Monitoring Service (WGMS) in Zurich, Switzerland, and Christopher Haggerty, formerly of the National Snow and Ice Data Center (NSIDC) in Boulder, Colorado, under the guidance of Wilfried Haeberli, WGMS director, and Roger Barry, NSIDC director. The NOAA ESDIM program funded the first acquisition of glacier data from China and the former Soviet Union.

Sincere thanks go to Kathrin Naegeli and Michael Zemp of WGMS for initiating and leading the 2012 update work. Ann Windnagel, Jon Davis, Bruce Raup, and Daniel Crumly carried out the work at NSIDC.

Data were first made available online from NSIDC in 1999 based on WGMS (1989). In 2001, a number of errors were corrected (see sections 4.2 Quality Assessment and 4.2.1 Update History of this document), online subsectioning capabilities were improved, data were migrated to a Sybase database, and the documentation was revised. Bruce Raup, Alejandro Machado, I-Pin Wang, Robin Welsh, and Michon Scott, all of NSIDC, performed this work.

We are grateful to Dr. Ian S. Evans, Department of Geography at Durham University, for bringing errors in glacier orientation to our attention in 2004. His generous contribution of time and expertise has resulted in an improved data product.

The NOAA@NSIDC team maintains this product. Distribution of this data set from NSIDC is supported by funding from NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) and the National Geophysical Data Center (NGDC).

6 DOCUMENT INFORMATION

6.1 Document Authors

C. Haggerty prepared the original documentation in 1999. Fetterer, L. Ballagh, and A. Windnagel were responsible for major revisions.

6.2 Publication Date

August 1999

6.3 Document Revision Date

April 2018: A. Windnagel moved the Data Contributors table from its own web page into this document. It is now Table 13.
October 2015: A. Windnagel added information about the mappings of the data contributor list prior to the January 2012 update to the one after.
January 2013: A. Windnagel updated the documentation to include information about the shapefile, GMT file, and KML file now provided for added value to the user.
January 2012: A. Windnagel updated this document for the newest release of the database based on text from Kathrin Naegeli.
March 2011: A. Windnagel and F. Fetterer reviewed the document, made minor edits, and added an overview table.
July 2010: A. Windnagel added a note to the update history section.
June 2010: A. Windnagel added the schemas for accuracy ratings for area accuracy, snowline accuracy, and depth accuracy to Table 1.
December 2009: A. Windnagel changed the missing data value from -9999 to NULL. Also, reformatted the Data Field Descriptions section (put text into a table) and reversed the order of the Update History section so the newest updates are listed first.
June 2009: L. Ballagh added the Chilean glacier updates from CEAZA. Updates were made to the Data Sources, Data Format, Quality Assessment and History of Updates, and Revision Date sections of this document.
March 2008: L. Ballagh added a comment in the Quality Assessment section about the updates to the Select Extract Regions section of the World Glacier Inventory interface.
November 2008: L. Ballagh added updates for the Chinese glacier inventory. Updates were made to the Quality Assessment and History of Updates, the Summary, Citing These Data and Data Sources sections of this document.
November 2007: L. Ballagh updated the Quality Assessment section.

August 2007: F. Fetterer and L. Ballagh made an addition to the section on Quality Assessment and History of Updates

February 2007: L. Ballagh made an addition to the section on Quality Assessment and History of Updates

May 2005: F. Fetterer revised the format and added to the section on Quality Assessment and History of Updates