Randolph Glacier Inventory:
A Dataset of Global Glacier Outlines
Version: 1.0
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GLIMS Technical Report

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Dataset Description

The Randolph Glacier Inventory (RGI) is a global inventory of glacier outlines. It is supplemental to the Global Land Ice Measurements from Space initiative (GLIMS). Production of the RGI was motivated by the forthcoming Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5) and the inventory is being released initially with little documentation in view of the IPCC's tight deadlines during 2012. Updates beyond the IPCC 2012 deadlines will take the form of additions to the database of GLIMS.

Data Distribution Policy

The Randolph Glacier Inventory (RGI 1.0) is made available under certain transitional usage constraints:

1) It is intended for the estimation of total ice volumes and glacier mass changes at global and large-regional scales;
2) It is not to be used for reporting that focuses primarily on the properties of the inventory itself, such as global size distributions, or area/elevation distributions of glaciers; and
3) It is not to be distributed.

Data Sources

The RGI is a combination of both new and existing published glacier outlines. New outlines were provided by the glaciological community in response to requests for data on the GLIMS and cryolist e-mail listservers. We visualized the data in a GIS by overlaying outlines on modern satellite imagery, and assessed their quality relative to other available products. In several regions the outlines already in GLIMS were used for RGI. Data from the World Glacier Inventory (WGI, http://nsidc.org/data/docs/noaa/g01130_glacier_inventory/) were used for some glaciers of northern and central Asia, with outlines approximated by circles of area equaling those reported in the WGI (WGMS, 1989). Where no other data were available we relied on data from the Digital Chart of the World (Danko, 1992).

Dataset Reference

The following reference should be used when citing RGI.

Arendt, A., T. Bolch, J.G. Cogley, A. Gardner, J.-O. Hagen, R. Hock, G. Kaser, W.T. Pfeffer, G. Moholdt, F. Paul, V. Radić, L. Andreassen, S. Bajracharya, M. Beedle, E. Berthier, R. Bhambri, A. Bliss, I. Brown, E. Burgess, D. Burgess, F. Cawkwell, T. Chinn, L. Copland, B. Davies, E. Dolgova, K. Filbert, R. Forester, A. Fountain, H. Frey, B. Giffen, N. Glasser, S. Gurney, W. Hagg, D. Hall, U.K. Haritashya, G. Hartmann, C. Helm, S. Herreid, I. Howat, G. Kapustin, T. Khromova, Kienholz, M. Koenig, J. Kohler, D. Kriegel, S. Kutuzov, I. Lavrentiev, R. LeBris, J. Lund, W. Manley, C. Mayer, X. Li, B. Menounos, A. Mercer, N. Moelg, P. Mool, G. Nosenko, A. Negrete, C. Nuth, R. Pettersson, A. Racoviteanu, R. Ranzi, P. Rastner, F. Rau, J. Rich, H. Rott, C. Schneider, Y. Seliverstov, M. Sharp, O. Sigurðsson, C. Stokes, R. Wheate, S. Winsvold, G. Wolken, F. Wyatt, N. Zheltyhina. 2012, Randolph Glacier Inventory [v1.0]: A Dataset of Global Glacier Outlines. Global Land Ice Measurements from Space, Boulder Colorado, USA. Digital Media.

The first 11 authors comprise an ad-hoc committee that was responsible for assembly of the RGI. The remaining authors are data contributors, listed in alphabetical order. Note that some of the 11 committee members also contributed data. Although efforts have been made to trace the names of GLIMS contributors whose outlines are now in RGI, it is possible that some have been missed. We also do not include the name of every contributor to the WGI who provided information that may now be in RGI. Users are encouraged to access http://glims.org/About/contributors.php for more information on GLIMS contributors, and http://nsidc.org/data/docs/noaa/g01130_glacier_inventory for more documentation on the WGI.

Region Definitions

We define 19 glacier regions drawn mostly from Radić and Hock (2010), with some small modifications (Figure 1).

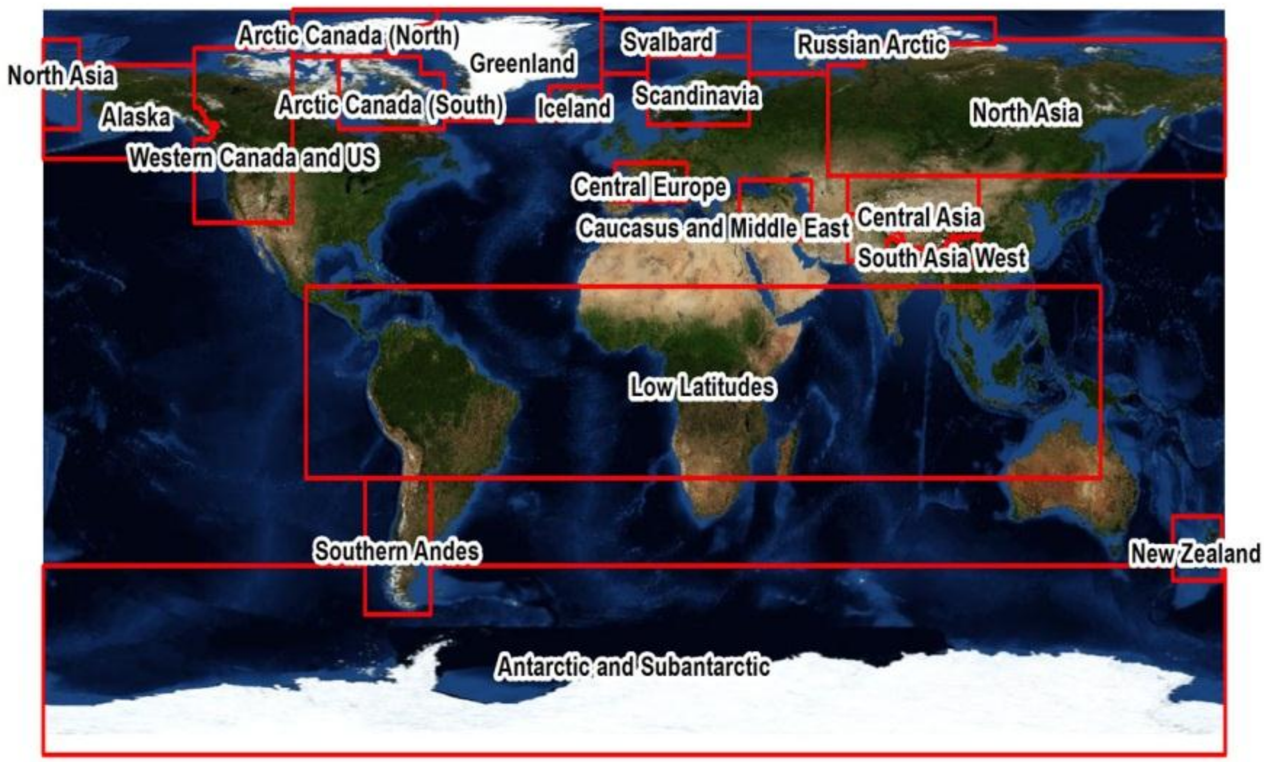

Figure 1: Location of the 19 RGI glacier regions.

Technical Specifications

Data are provided as shapefiles containing the outlines of glacier complexes in geographic coordinates (latitude/longitude, in degrees) and are referenced to the WGS84 datum. We define a glacier complex as a collection of contiguous glaciers that meet at glacier divides. Some but not all regions have individual glaciers delineated as separate polygons. Data are organized by region, with one shapefile containing all glaciers for each region. Some glacier polygons have glacier area in km^2 included. For some of the regions included in this dataset more detailed information about the glaciers is available from the GLIMS database or in the World Glacier Inventory (WGI).

DESCRIPTION OF DATA BY REGION

REGION 1: Alaska

Contributor	**Institution**	**Project/Funding**
Arendt, A.	University of Alaska, Fairbanks, USA	National Park Service, Geophysical Institute, NASA Cryospheric Sciences, Geographic Information Network of Alaska
Herreid, S.		
Hock, R.		
Kienholz, C.		
Rich, J.		
Beedle, M.	University of Northern British Columbia, Canada	
Berthier, E.	CNRS-OMP-LEGOS, France	
LeBris, R.	University of Zurich, Switzerland	GlobGlacier funded by ESA
Frey, H.		
Paul, F.		
Bolch, T.		
Burgess, E.	University of Utah, USA	
Forester, R.		
Lund, J.		
Giffen, B.	National Park Service, USA	
Hall, D.	NASA Goddard Space Flight Center, USA	
Manley, W.	INSTAAR, USA	

Overview:

The Alaska region encompasses all glaciers in the State of Alaska, USA, as well as all glaciers in the Yukon Territory and British Columbia, Canada, that are part of the icefields that straddle the US/Canada Border. On its southeastern boundary, the region ends just north of Prince Rupert, British Columbia and just south of the end of the Alaska border. From there the region extends inland to the divide between Gulf of Alaska and Arctic drainages.

Numerous groups have contributed to Alaska glacier outlines. Le Bris et al. (2011) mapped the Kenai Peninsula, Tordillo, Chigmit and Chugach Mountains using Landast TM scenes acquired between 2005-2009. They used automated (band-ratioing) glacier mapping techniques with additional manual editing to deal with incorrect classification of debris-covered glaciers. Drainage divides in the accumulation region were derived from the USGS DEM.

As part of a two-year mapping effort by the National Park Service (NPS), the University of Alaska Fairbanks (UAF) has been mapping all glaciers in NPS boundaries, as well as glaciers connected to but not within park boundaries, for two time periods (USGS 1950s map dates, and most recent satellite imagery). For this effort UAF has in many regions started with existing, older outlines and updated them to the most modern imagery available. These include outlines from

Berthier (Berthier et al, 2010), Beedle (Beedle et al, 2007), Giffen, Hall and Manley. UAF has updated these outlines to circa 2010 Landsat 7 ETM+ scenes, as well as imagery from the SPOT SPIRIT initiative (dating approximately 2007; Korona et al., 2009). The Denali Park and Glacier Bay regions have been completed using these methods, and are based on imagery from about 2005-2010. UAF Geophysical Institute internal funding has also been used to support digitizing efforts of Alaska Range, Chugach Mountains and Juneau Icefield glaciers. Nearly all of these regions are based on 2010 imagery.

The University of Utah (Burgess, Forester, Lund) created outlines for the Stikine Icefield region derived from 1980s Landsat 5 imagery.

Manley provided all outlines for Brooks Range glaciers.

The largest incomplete region is the Wrangell/St. Elias mountains. What is included in RGI V1.0 is a partially edited version of Berthier et al's (2010) and Beedle et al's (2007) outlines, updated to circa 2010 Landsat 7 ETM+ imagery.

A small portion of Alaska glacier outlines (estimated less than 5%) is from Berthier et al (2010) or Digital Chart of the World outlines.

Glaciers other than those mapped by Le Bris and others (2011) were delineated using an automated algorithm developed by C. Kienholz (manuscript in prep). USGS digital elevation models as well as the ASTER GDEM v1 were used as sources of elevation information for the algorithm.

REGION 2: Western Canada and US

Contributor	Institution	Project/Funding
Bolch, T.*	UNBC, Canada * now at: University of Zurich, Switzerland	WC2N funded by CFCAS
Menounos, B.		
Wheate, R.		
Fountain, A.	Portland State University, USA	

Glaciers in BC and Alberta were mapped using orthorectified Landsat 5 TM scenes from the years 2004 and 2006 obtained by British Columbia Government, Ministry of Forests and Range. We selected the TM3/TM5 band ratio for glacier mapping. For the entire study area, we used improved British Columbia TRIM glacier outlines as a mask to minimize misclassification due to factors such as seasonal snow. When using this mask, we assumed that glaciers did not advance between 1985 and 2005, an assumption that holds for practically all non-tidewater glaciers in western North America. The mask also maintained consistency in the location of the upper glacier boundary and the margins of nunataks. This consistency is important in case of seasonal snow that hampers correct identification of the upper glacier boundary. We mapped only glaciers larger than 0.05 km^2 as a smaller threshold would include many features that were most likely snow patches. In addition, all snow and ice patches that were not considered to be perennial ice in the TRIM data were eliminated and hence, we minimize deviations in glacier areas that could arise from interpretative errors or major variations in snow cover. The resulting glacier polygons were visually checked for gross errors based on the procedures previously discussed, and overall, less than 5% of the glaciers were manually improved. We derived glacier drainage basins based on a flowshed algorithm using the TRIM DEM and a buffer around each glacier. More information can be found in Bolch et al. (2010a).

Data for the remaining US locations were derived from the GLIMS database. Metadata are located at http://glaciers.us.

REGIONS 3 and 4: Arctic Canada

Contributor	Institution	Project/Funding
Gardner, A.	University of Michigan, USA	
Wolken, G.	Department of Geological and Geophysical Surveys, Alaska, USA	
Cawkwell, F.	University of Alberta, Canada	
Copland, L.		
Filbert, K.		
Hartmann, G.		
Sharp, M.		
Wyatt, F.		
Burgess, D.	Natural Resources Canada	
Paul, F.	University of Zurich, Switzerland	GlobGlacier funded by ESA

Region 3: Northern Arctic Canada

Glacier outlines were created from late summer, cloud free 1999-2003 Landsat 7 (ETM+) imagery and from 2000-2003 ASTER imagery. A normalized-difference snow index (NDSI) was calculated for all Landsat imagery to classify all snow and ice covered terrain. Empirically derived thresholds were applied to refine these classifications and isolate snow and glacier ice components. A clumping procedure was then applied to the classified snow and ice data to delineate contiguous groups of pixels, followed by an elimination procedure, which removed small non-glacier ice pixels. Gridded snow and ice data were then converted to polygons and edited manually to correct misclassifications. Small portions of some areas within this region were not adequately imaged by Landsat, either due to persistent cloudiness or shadowing. Consequently, in these areas manual (heads-up) digitization of ASTER imagery was used to capture glacier outlines.

Outlines for Devon Island were provided by D. Burgess and were derived from 1999/2000 velocity maps.

Region 4: Southern Arctic Canada

Glacier complex outlines were compiled from 214 individual CanVec maps, a digital cartographic reference product produced by Natural Resources Canada. An additional 5500 km2 of glacier area on Baffin Island not covered by Edition 9 of the CanVec data set were taken from an expanded inventory of based on Paul and Kääb (2005) and Svoboda and Paul (2009). All outlines were created from late-summer Landsat 7 ETM+ imagery acquired between 1999 and 2002 with the exception of 13 CanVec maps that used late-summer SPOT 5 imagery acquired between 2006-2010 and 7 CanVec maps that used 1958 or 1982 aerial photographs. A small fraction of ice coverage is missed by the CanCev dataset because of incorrect classification over debris covered ice and supraglacial lakes. The misclassification is very noticeable for outlet glaciers where medial moraines are not identified as glacier ice. Glacier complexes were delineated using a basin delineation algorithm developed by C. Kienholz (manuscript in prep.). Note that these are raw outputs from the delineation algorithm and need to be edited. Users are encouraged to contact RGI data coordinators if they wish to assist in merging and cleaning polygons to improve this dataset.

REGION 5: Peripheral Greenland Glaciers

Contributor	Institution	Project/Funding
Bolch, T.	University of Zurich, Switzerland	ice2sea funded by EU FP7 GlobGlacier funded by ESA Glaciers_cci funded by ESA
Rastner, P.		
Moelg, N.		
LeBris, R.		
Paul, F.		
Howat, I.	Byrd Polar Research Center, Ohio State University, USA	
Negrete, A.		

Overview:

There are numerous glaciers surrounding the periphery of the Greenland ice sheet. Distinguishing between what is considered ice sheet versus glaciers is a challenge, and depends on the scientific application. While the distinction is clear for the numerous fully detached glaciers, there are several regions where, although there is a physical connection to the main ice sheet, the ice mass is either a valley glacier in mountainous terrain, or it forms its own ice dome and is largely uncoupled to the ice sheet dynamics. Therefore, for applications such as extrapolation of laser altimetry data, some researchers believe such ice masses should be categorized as glaciers rather than as part of the ice sheet.

The extents that are now provided for RGI 1.0 considers all ice masses with a possible but uncertain drainage divide to the ice sheet (e.g. the Geikie Plateau) and all others to the local (or peripheral) glaciers and icecaps (GIC). The latter are either:

- not connected to the ice sheet at all
- clearly separable (e.g. by mountain ridges) in the accumulation region, or
- only in contact with ice sheet outlets in the ablation region.

Indeed, there is room for discussion on individual decisions, but for the purpose of the RGI we just need to start somewhere. The individual GIC are currently separated and topographic information is appended. If possible, this information will be included for RGI 2.0. The separation in the accumulation area is done with the drainage divides as derived from DEM-based watershed analysis.

The glaciers in northern sector of Greenland were not availble from Landsat data and were provided by the Greenland Mapping Project (Howat and Negrete, in prep).

Method (data from Zurich group)

The semi-automated glacier mapping applied to the 64 Landsat scenes that were processed is based on a band ratio (ETM+ band 3 / 5) with an additional threshold in band 1 for better mapping of glacier areas in cast shadow. It is based on Paul and Kääb (2005) and described for a part of western Greenland in Citterio et al. (2009). Debris-covered glacier parts as well as wrongly classified sea ice, ice bergs or lakes were corrected manually in the vector domain. A 3 by 3 median filter is applied for image smoothing and glaciers smaller than 0.05 km^2 are not considered. Wrongly classified regions with seasonal snow could not always be corrected.

REGION 6: Iceland

Contributor	Institution	Project/Funding
Sigurðsson, O.	National Energy Authority, Iceland	

Outlines of glacier complexes in Iceland were added to the GLIMS database by O. Sigurðsson and extracted therefrom by G. Cogley, who merged nunataks and removed them from the glacier complexes containing them. All outlines were acquired from the 1999-2004 ASTER and SPOT5 imagery.

REGION 7: Svalbard

Contributor	Institution	Project/Funding
Koenig, M. J. Kohler	Norwegian Polar Institute, Norway	Cryoclim funded by ESA
Hagen, J-O.		Cryoclim and Glaciers_cci funded by ESA
Nuth, C.		
Moholdt, G.	University of Oslo, Norway	
Pettersson, R.	Uppsala University, Sweden	

Three primary data sets are used to compile the glacier inventory. The main dataset are SPOT5-HRS DEMs and orthophotos provided within the framework of the IPY-SPIRIT (SPOT 5 stereoscopic survey of Polar Ice: Reference Images and Topographies) Project (Korona et al., 2009). The SPOT5-HRS collects 5m panchromatic stereo images that are stereoscopically processed into 40m DEMs, then used for the orthophoto generation of the original images. Five SPIRIT scene acquisitions from 2007-2008 are responsible for covering 71% of the glacier area. The secondary dataset are from the ASTER satellite in the form of automatically generated DEMs and orthophotos (AST14DMO products downloaded from NASA). These have a smaller swath width (60 km), and therefore 23 scenes are used to cover 16% of the glacier area. Cloud-free scenes are not available for 2007-2008, and therefore data from as early as 2001 are used. For less than 14% of the glacier area, a suitable SPOT5-HRS or ASTER scene was not available. For these glaciers, 11 orthorectified Landsat scenes are used. Furthermore, additional Landsat and ASTER scenes are used to aid digitization decisions about the seasonal snow cover.

The original glacier delineation and glacier identification system is based on the Hagen et al. (1993) atlas which conforms to WGI standards, but is only available as a hard-copy rather than GIS data. Therefore, digitized national datasets are the base glacier masks from which to begin the inventory (König et. al, in press). From this original dataset, we manually re-delineated the individual glacier basins based upon the Hagen et al. (1993) *Atlas* and updated by trimming the front position and the lateral edges below the ELA. Since the original national dataset was derived by cartographers, much of the mask segments above the ELA contained snow covered valley walls and gullies (not perennially snow covered). These are, to the best of our ability, clipped from the masks by visually analyzing the recent satellite archives of ASTER and Landsat.

Figure 2 summarizes the distribution of imagery dates used to generate the Svalbard outlines.

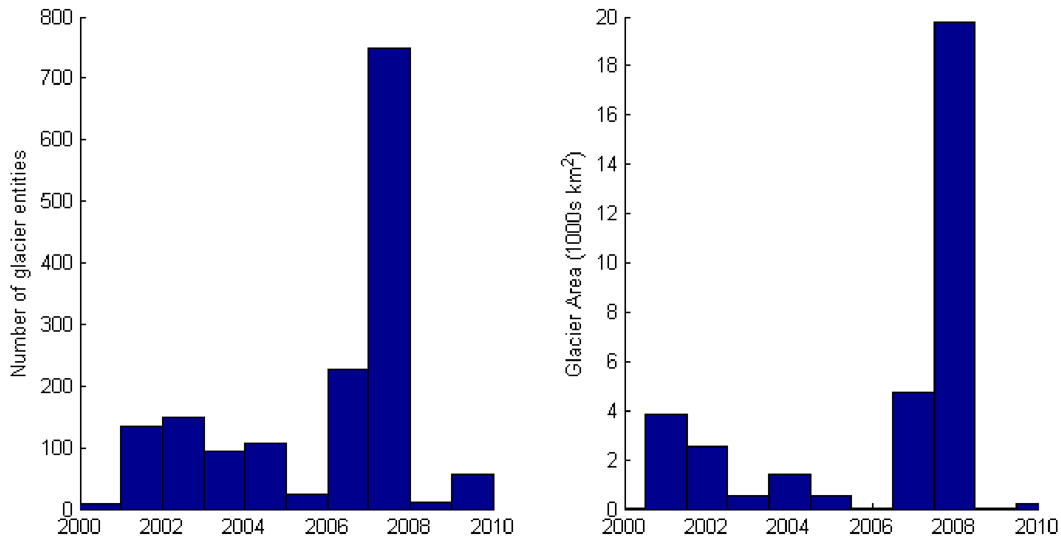

Fig. 2. Time distribution of the imagery used to generate the Svalbard portion (Region 7) of the RGI glacier database showing the number of glaciers (left) and the total glacier area (right) as a function of image year.

REGION 8: Scandinavia

Contributor	Institution	Project/Funding
Andreassen, L.	Norwegian Water Resources and Energy Directorate, Norway	
Winsvold, S.		
Hagen, J-O.	University of Oslo, Norway	
Paul, F.	University of Zurich, Switzerland	GlobGlacier funded by ESA
Mercer, A.	University of Stockholm, Sweden	
Brown, I.		

The glacier outlines for Norway are based on Landsat (TM and ETM+) imagery from 1999-2006.

The Swedish glacier outlines use imagery from SPOT5 and SPOT4 (dates not provided). In some regions these outlines were updated against September 2008 Swedish Land Survey imagery available on Google Earth.

The glacier mapping where GlobGlacier contributed to is documented in Andreassen et al. (2008) for Jotunheimen, Paul and Andreassen (2009) for Svartisen, and Paul et al. (2011) for the Jostedalsbreen region.

REGION 9: Russian Arctic

Contributor	Institution	Project/Funding
Moholdt, G.	University of Oslo, Norway	ice2sea, grant number 226375

This basic inventory was constructed as a part of a mass balance study of the Barents/Kara Sea region in the Russian High Arctic (Moholdt et al., submitted). It covers all glaciers and ice caps in Novaya Zemlya (22,100 km^2), Severnaya Zemlya (16,400 km^2), Franz Josef Land (12,700 km^2), Ushakov Island (320 km^2) and Victoria Island (6 km^2). Glacier complexes were manually digitized from orthorectified satellite imagery acquired during summers between 2000 and 2010. SPIRIT SPOT5 scenes (Korona et al, 2009) were used for most of Novaya Zemlya, while the best available Landsat scenes were used elsewhere. All visible nunataks were cut out from the glacier polygons, and snowfields were only included if they seemed to be a part of a glacier. Ice shelves in Franz Josef Land (<50 km^2) were included as parts of the glacier polygons, while the Matusevich Ice Shelf in Severnaya Zemlya (~200 km^2) was delineated into a separate polygon. The estimated total glacier area of the region (51,500 km^2) is 9% smaller than that of the World Glacier Inventory (Ohmura, 2009). This large deviation is probably due to a combination of long-term glacier retreat and methodological differences in glacier delineation.

REGION 10: North Asia

Contributor	Institution	Project/Funding
Stokes, C., Gurney, S.	Durham University, UK	
Khromova, T.	Institute of Geography, Russian Academy of Science, Moscow, Russia	

Most of the glacier outlines within North Asia were manually delineated based on Landsat TM/ETM+ or ASTER data. Data from missing areas were filled by a glacier layer compiled by B. Raup (Raup et al., 2000) based on data from the ESRI's digital chart of the world (DCW) and the World Glacier Inventory (WGMS, 1989; Haeberli et al., 1998). The DCW data includes layers of geographic information covering the whole world, is basedon the United States Defense Mapping Agency's Operational Navigation Charts, and includes a GIS coverage of land ice.

The WGI data base locates each glacier with only a single latitude-longitude pair rather than a polygon. These glaciers are presented as approximately circular polygons of correct area, which are listed in the data base.

It is intended to replace the uncertain DCW and WGI data with polygons mapped using satellite data for the second release of the RGI.

REGION 11: Central Europe

Contributor	Institution	Project/Funding
Frey, H.	University of Zurich, Switzerland	GlobGlacier funded by ESA
LeBris, R.		
Paul, F.		

The glacier outlines for this region are derived from ten Landsat TM images acquired during 2 months in the summer of 2003 using band ratio images. Drainage divides for individual glaciers were derived from the void-filled SRTM DEM (from CGIARS) in a resampled version with 60 m spatial resolution. All further details are documented in Paul et al. (2011b). About 30-50 km^2 of glaciers are not mapped, mainly very small glaciers located in Italy (Brenta and Dolomites) and Germany, covered by debris or located under local orographic clouds. A more complete version is planned for the RGI 2.0. The original data sets (in UTM projection) can be downloaded from the globglacier.ch website (link Data access).

REGION 12: Caucasus and Middle East

Contributor	Institution	Project/Funding
Khromova, T.	Institute of Geography, Russian Academy of Science, Moscow, Russia	

The Caucasus is covered by the database of the Global Land Ice Measurements from Space initiative (GLIMS) (Raup et al., 2007).

Glaciers located in Iran and Turkey will be included in RGI 2.0.

REGION 13: Central Asia

Contributor	Institution	Project/Funding
Bolch, T.	Technische Universität Dresden, Germany; University of Zurich, Switzerland	DynRG-TiP and Asku-Tarim-RS funded by the German Research Foundation (DFG)
Moelg, N.		
Kriegel, D.	GFZ Potsdam, Germany	CAWa, German Federal Foreign Office
Hagg, W.	LMU Munich, Germany	
Mayer, C.	Commission for Glaciology, Munich	
Khromova, T.	Institute of Geography, Russian Academy of Science, Moscow, Russia	

Large parts of Central Asia are covered by the database of the Global Land Ice Measurements from Space initiative (GLIMS). The GLIMS database consists in China of data from the first Chinese glacier inventory (Shi et al., 2009) and is of heterogeneous and generally slightly lower quality (more generalized) than the other glacier data used here. Is has also to be noted that some of the GLIMS data in Central Asia have a shift in location. Large parts of the Tien Shan in Kazakhstan and Kyrgyzstan were mapped semi-automatically using ratio images from ASTER data (e.g. Kutusov and Shahgedanova, 2009). Important missing areas like in the Central Pamirs, Naryn basin, northern Tien Shan (Bolch, 2007) and the Dzungar Alatau were mapped semi-automatically with manual corrections using Landsat TM/ETM+ scenes. The glacier inventory for Nyainqentanglha / Tibet were provided by Bolch et al. (2010b).

Data from remaining missing areas were filled by a glacier layer compiled by B. Raup (Raup et al., 2000) based on data from the ESRI's digital chart of the world (DCW) and the World Glacier Inventory (WGMS, 1989; Haeberli et al., 1998). The DCW data includes layers of geographic information covering the whole world, is based on the United States Defense Mapping Agency's Operational Navigation Charts, and includes a GIS coverage of land ice.

The WGI data base locates each glacier with only a single latitude-longitude pair rather than a polygon. These glaciers are presented as approximately circular polygons of correct area, which are listed in the data base.

It is intended to replace the uncertain DCW and WGI data with polygons mapped using satellite data for the second release of the RGI.

REGION 14/15: South Asia West/South Asia East

Contributor	Institution	Project/Funding
Bolch, T.	University of Zurich, Switzerland	GlobGlacier funded by ESA
Frey, H.		
Paul, F.		
Bajracharya, S.	ICIMOD, Nepal	
R. Bhambri	Center for Glaciology, Wadia Institute of Himalayan Geology, Dehradun India	

Large parts of the Himalaya, Karakoram and Pamir are covered by the database of the Global Land Ice Measurements from Space initiative (GLIMS) (Raup et al., 2007). For the present study, GLIMS data was used in cases where no other data was available, mainly on the northern slopes of the Himalayas and the northeastern part of Karakoram. In these regions, the GLIMS database consists mostly of data from the first Chinese glacier inventory (Shi et al., 2009) and is of heterogeneous and generally slightly lower quality than the other glacier data used here. Glacier outlines compiled by the International Centre for Integrated Mountain Development (ICIMOD) were used for large parts of the Karakoram, as well as the central and eastern Himalayas (ICIMOD, 2007, DVD). For Nepal, more recent data from 2008 and 2009 is available and was used here (ICIMOD, 2011, DVD). For large parts of northwestern India, glacier inventory data compiled by the GlobGlacier project of the European Space Agency (ESA) (Paul et al., 2009) was used; the information was compiled from Landsat ETM+ and ALOS PALSAR data (Frey et al., in rev.). For a few regions in the Karakoram Range, no suitable glacier data was available. We therefore compiled new glacier outlines in these regions based on Landsat ETM+ data from the years 2002, 2009, and 2010.

REGION 16: Low Latitudes

Contributor	Institution	Project/Funding
Sharp, M.	University of Alberta, Canada	
Wyatt, F.		

Shapefiles were created from late summer, cloud free Landsat 7 ETM+ imagery acquired prior to the 2003 scan line corrector (SLC) failure. To identify glacier surfaces, a normalized difference snow index (NDSI) was calculated using bands 5 and 2 for the red and near-infrared bands respectively. A threshold of approximately 0.5-0.65 was used to identify dirty/shady/bare ice, and one from 0.65-0.99 to identify snow-covered ice. Gridded files were then converted to polygons and additional manual editing was carried out to eliminate incorrectly classified regions.

REGION 17: Southern Andes

Contributor	Institution	Project/Funding
Sharp, M.	University of Alberta, Canada	
Wyatt, F.		

Shapefiles were created from late summer, cloud free Landsat 7 ETM+ imagery acquired prior to the 2003 SLC failure. To identify glacier surfaces, a normalized difference snow index (NDSI) was calculated using bands 5 and 2 for the red and near-infrared bands respectively. A threshold of approximately 0.5-0.65 was used to identify dirty/shady/bare ice, and one from 0.65-0.99 to identify snow-covered ice. Gridded files are then converted to polygons and additional manual editing is carried out to eliminate incorrectly classified regions.

REGION 18: New Zealand

Contributor	Institution	Project/Funding
Chinn, T.	Cantebury University, NZ	

New Zealand outlines are derived from 1978 aerial imagery at a scale of 1:150,000 as used for the NZ Topo50 maps (Chinn, 2001). The shapefile can be downloaded from:

http://data.linz.govt.nz/#/layer/287-nz-mainland-ice-polygons-topo-150k/

REGION 19: Antarctic and Subantarctic

Contributor	Institution	Project/Funding
Bliss, A.	University of Alaska, Fairbanks, USA	
Hock, R.		
LeBris , R.	CNRS-OMP-LEGOS, France	
Berthier, E.		
Cogley, G.	Trent University, Canada	

Outlines of glacier complexes on islands peripheral to the mainland of Antarctica were obtained from the Antarctic Digital Database (ADD Consortium, 2000). A. Bliss manually classified the ADD's "land" polygons into continent, ice rise, ice cap, and glacier complex polygons. Continental ice areas and ice rises are not included in this inventory. The classification was based on the surface morphology and surface flow velocities observed in data from Landsat, RADARSAT Antarctic Mapping Project DEM, and MEaSUREs InSAR-Based Antarctic Velocity Map. For islands with prominent nunataks, glacier complexes were subdivided into individual glaciers using a semi-automated algorithm developed by C. Kienholz (manuscript in prep.).

Outlines of glaciers on the Subantarctic islands were obtained by G. Cogley, mostly by digitizing various sources including satellite imagery and maps. For King George Island in the South Shetland Islands, outlines were downloaded from KGIS, the King George Island Geographic Information System, a now defunct web site created by F. Rau and S. Vogt, University of Freiburg. Separate outlines of "glacier basins" and ice-free areas were harmonized and merged to form glacier outlines containing nunataks. For Kerguelen, outlines are from Berthier et al. (2009). Outlines of South Georgia glaciers have been mapped by F. Paul from a Landsat ETM+ scene from 2003 using a band 3/5 ratio and manual corrections for icebergs and water (removed), and debris-cover (added). Some regions covered by seasonal snow might be included and will be removed for the RGI 2.0.

Dates of coverage, in the form *yyyymmdd* with unknown months and days represented by "00", are summarized in the table.

Region	*Date of coverage*
Scott I	19950000
Peter the First I	19870000
South Shetland Is	
Clarence I	19570100
Elephant I	19570100
Gibbs Is	19570100

King George I	20000223
Nelson I	19570100
Robert I	19570100
Greenwich I	19570100
Livingston I	19570100
Deception I	19790000
Snow I	19560200
Low I	19570100
Smith I	19570100
South Orkney Is	
Laurie I	19790107
Weddell Is	19790107
Powell I	19790107
Robertson Is	19790000
Coronation I	19790000
Signy I	19680100
South Sandwich Is	
Zavodovski I	19620300
Visokoi I	19620300
Candlemas Is	19640300
Saunders I	19620300
Montagu I	19640300
Bristol I	19640300
S Thule Is	19640300
South Georgia	n/a
Bouvet I	19850000
Marion I	19660300
Kerguelen	19640401
Heard I	19880000
Balleny Is	19610000

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