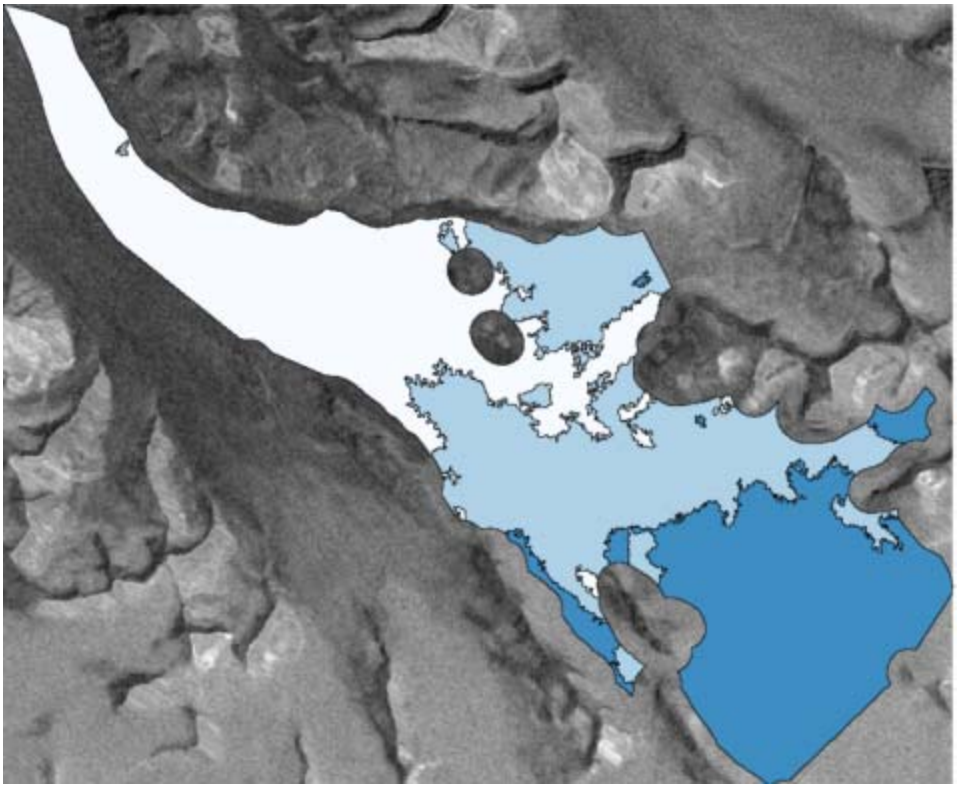
CryoClim
Monitoring Climate Change in the Cryosphere

CryoClim GST product documentation

CryoClim sub-service for glaciers Svalbard



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Document revision history

Rev.no.	Author	Description	Date
0.9	M. König	First version of document	1 Oct 2013
1.0	R. Solberg	Proofreading	14 Oct 2013

Contents

1 Introduction

CryoClim is an Internet service providing cryospheric climate products, primarily based on satellite observations. The service is delivered through a web service and web portal (www.cryoclim.net). The portal includes manual searching, viewing and downloading capabilities. CryoClim is an operational and permanent service for long-term systematic climate monitoring of the cryosphere. The product production and the product repositories are hosted by mandated organisations. The databases are connected over the Internet in a seamless and scalable network, open for inclusion of more databases/sub-services. CryoClim provides sea ice and snow products of global coverage and glacier products covering Norway (mainland and Svalbard). The service has been developed by CryoClim project (2008–2013) by the Norwegian Computing Center (NR; project coordinator), Norwegian Meteorological Institute (MET Norway), Norwegian Water Resources and Energy Directorate (NVE) and Norwegian Polar Institute (NPI). CryoClim was an ESA PRODEX project funded by the Norwegian Space Centre.

On many glaciers in Svalbard, three surface types are visible on SAR images, the dark glacier ice at the glacier's lower end, the brighter superimposed ice in the middle, and the white firn at the higher elevations. Surface classification of these types is valuable, especially since the retreat or advance of the firn area provides information on the status of the glacier. While the snowline reacts immediately to annual changes, the firn area smoothes out these short-term changes and shows, similar to the glacier front, longer-term changes of the glaciers. GST uses an Otsu three-category algorithm to separate the image into these three surface types for selected Svalbard glaciers. The method works very well on glacier with distinct surface types; the main weakness is crevasses and rough areas being classified as superimposed ice. A quality number indicates if an individual classification is ideal (1), good (2) or of medium quality (3). The quality number mainly indicates how much crevasses are classified as superimposed ice. The firn area should be displayed correctly for all selected glaciers.

2 Product overview

Category	Description
Cryospheric variable	Glacier Surface Type (GST)
Version	1.0
Sensor(s)	C-band SAR
Temporal aggregation periods	1991-2012
File format and version	Shapefile
Spatial coverage	Svalbard
Spatial resolution	Shapefile based on 20 m raster
Temporal coverage	1991-2012
Temporal resolution	Annual
Grid size	Shapefile based on 20 m raster
Projection	EPSG:32633 - WGS 84 / UTM zone 33N
Metadata format	DIF
Data file format	Shapefile
File size	2.5 MByte
Expected accuracy	Quality number in the Shapefile defines if the classification is ideal (1), good (2) or of medium quality (3).
Product access	http://data.npolar.no/dataset/d756f766-de33-11e2-8993-005056ad0004

3 Detailed product description

3.1 Product structure

The product is a Shapefile per year containing glacier surface type (GST) for selected glaciers in Svalbard.

3.2 Metadata

The global attributes and description are found at http://data.npolar.no/dataset/d756f766-de33-11e2-8993-005056ad0004.dif

Local attributes describing individual products.

Local attribute	Description
DN	Surface Type: 1 = glacier ice; 2 = superimposed ice; 3 = firn
Glacier	Glacier name
Quality	Classification quality ideal (1), good (2) or medium quality (3).

3.3 Datasets and coding

The data is available as one Shapefile per year containing all selected and classified glaciers. Contains each glacier coded as described in local attributes above.

3.4 Product time-series information

The products were created using a time series of numerous ERS-1, ERS-2 and ASAR images covering Svalbard annually in spring every year, as long as available.

3.5 File naming convention

Product example name: CryoClim_GST_SJ_1992

The name is composed of a set of string elements separated by "_" as shown by this generic file name: CryoClim_<product name>_<location>_<period>

The string elements are explained in the table below.

String element	Explanation
CryoClim	Service name
Product name	GST (Glacier Surface Type)
Location	Location using www country code – SJ=Svalbard
Period	Year or first year – last year (e.g. 1992 or 2001-2010)

3.6 Known limitations of the product

The method works at present in a good way only for glaciers when the three surface types glacier ice, superimposed ice and firn are distinct. More complex surfaces (crevasses, rougher areas, etc) are often misclassified.

3.7 Quality assessment

3.7.1 Cryospheric variable accuracy

The results have varying quality. A quality number in the Shapefile defines whether the classification is ideal (1), good (2) or of medium quality (3).

3.7.2 Positional accuracy

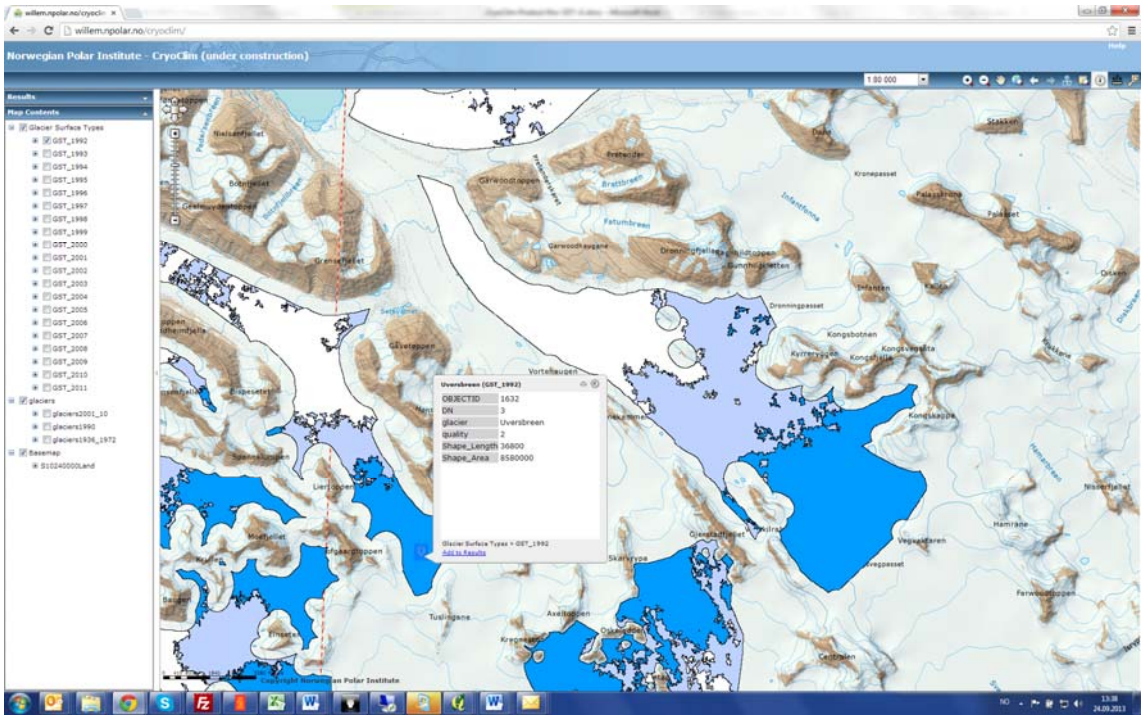
Estimated to be within one or two pixels (20-40 m).

3.8 Software and tools

Any GIS software capable of reading Shapefiles like, QuantumGIS, ArcGIS and GRASS.

4 Sample products

The screenshot below of http://willem.npolar.no/cryoclim shows a selected glacier in Kongsfjorden with its attributes.



5 Product version history

Version	Release date	Comments
1.0	August 2013	First full version available through CryoClim

6 Citing products

When CryoClim products are used in a publication, the data set is required to be cited. List the principal investigators, name of product, product version, year of product release, product producer and “Delivered by CryoClim service”, as shown in the following example:

M. König. Glacier Surface Type - Svalbard v1.0 (2013). http://data.npolar.no/dataset/d756f766-de33-11e2-8993-005056ad0004 Delivered by CryoClim service

7 Contact information

Data Centre Norwegian Polar Institute data@npolar.no

8 Acknowledgements

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König, M., J. Wadham, J-G. Winther, J. Kohler, and A-M. Nuttall. 2002. Detection of superimposed ice on the glaciers Kongsvegen and midre Lovénbreen, Svalbard, using SAR satellite imagery. *Annals of Glaciology*, 34, 335-342.

König, M., J-G. Winther, J. Kohler, and F. König. 2004. Two methods for firn area and mass balance monitoring of Svalbard glaciers with synthetic aperture radar (SAR) satellite images. *Journal of Glaciology*, 50(168).

Acronyms and definitions

AMSR-E	Advanced Microwave Scanning Radiometer - Earth Observing System
ASAR	Advanced Synthetic Aperture Radar
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
AVHRR	Advanced Very High Resolution Radiometer
CEOS	Committee of Earth Observation Satellites
CSW	Catalogue Services for the Web
DB	Data Base
DOKIPY	Data handling and coordination service for Norwegian IPY projects
DOS	Dark Object Subtraction
ECMWF	European Centre for Medium-Range Weather Forecasts
ECV	Essential Climate Variable
EEA	European Environment Agency
ERA-40	ECMWF 40 Year Re-analysis
ERS	European Remote-Sensing Satellite
ESA	European Space Agency
ETM+	Enhanced Thematic Mapper plus
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FCC	False Colour Composite
FCDR	Fundamental Climate Data Record
FMI	Finish Meteorological Institute
FSC	Fractional Snow Cover
FTP	File Transfer Protocol
GAO	Glacier Area Outline
GBA	Glacier Balance Area
GCOS	Global Climate Observing System
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GFL	Glacier Firn Lines
GLO	Glacier-dammed Lake Outline
GLOF	Glacier Lake Outburst Flood
GMES	Global Monitoring for Environment and Security
GPP	Glacier Periodic Photo series
GSL	Glacier Snow Lines
GST	Glacier Surface Type
GSV	Glacier Surface Velocity
HTTP	Hypertext Transfer Protocol
ICT	Information and Communication Technology
IGOS	Integrated Global Observing Strategy
IHS	Intensity-hue-saturation
INSPIRE	Infrastructure for Spatial Information in the European Community
IPY	International Polar Year
ISO 19115	Defines schema required for describing geographic info. and services
ISO 23950	Information retrieval, application service def. and protocol specification
LSA SAF	Land Surface Analysis Satellite Application Facility (EUMETSAT)
N50	The most detailed of the national map data bases in Norway
NASA	National Astronautic and Space Administration
NDWI	Normalized Difference Water Index
NetCDF	Network Common Data Form
NOAA	National Oceanic and Atmospheric Administration
NPI	Norwegian Polar Institute
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NR	Norwegian Computing Center

NRT	Near Real-Time
NSC	Norwegian Space Centre
NTNU	Norwegian University of Science and Technology
NVE	Norwegian Water Resources and Energy Directorate
METNO	Norwegian Meteorological Institute
MODIS	Moderate Resolution Imaging Spectroradiometer
MPI	Max Planck Institute for Meteorology
OAI-PMH	Open Archives Initiative - Protocol for Metadata Harvesting
OGC	OpenGeoSpatial Consortium
OpeNDAP	Open-source Project for a Network Data Access Protocol
OSI SAF	Ocean and Sea Ice Satellite Application Facility (EUMETSAT)
PHP	Originally, scripting language for web pages, now extended functionality
PMR	Passive Microwave Radiometer
PLT	Project Leader Team
PMB	Project Management Board
REST	Representational state transfer
RESTful	Systems following REST principles
RGB	Red Green Blue
SAR	Synthetic Aperture Radar
SCA	Snow Cover Area
SCE	Snow Cover Extent
SCF	Snow Cover Fraction
SCE	Snow Cover Extent
SD	Snow Depth
SIC	Sea Ice Concentration
SIE	Sea Ice Edge
SMMR	Scanning Multichannel Microwave Radiometer
SOA	Service Oriented Architecture
SRU	Search/Retrieve via URL
SSM/I	Special Sensor Microwave/Imager
STAG	Scientific and Technical Advisory Group
SWE	Snow Water Equivalent
THREDDS	Thematic Realtime Environmental Distributed Data Services
TM	Thematic Mapper
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNIDATA	Diverse community vested in sharing data and tools to access and visualize
URL	Uniform Resource Locator
UTM	Universal Transverse Mercator
WCRP	World Climate Research Programme
WCS	Web Coverage Service
Web portal	Presents information from diverse sources in a unified way
Web service	Supports interoperable machine-to-machine interaction over a network
WFS	Web Feature Service
WGS	World geodetic system
WIS	WMO Information System
WMO	World Meteorological Organisation
WMS	Web Map Service
WPS	Web Processing Service
XML	Extensible Markup Language

CryoClim

Monitoring Climate Change in the Cryosphere

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NVE	Norwegian Water Resources and Energy Directorate (NVE) P.O. Box 5091 Majorstua NO-0301 Oslo Contact person: Liss Marie Andreassen E-mail: lma@nve.no Role in project: Glacier service for mainland Norway
Norsk Polarinstitutt	Norwegian Polar Institute Polar Environmental Centre NO-9296 Tromsø Contact person: Max König E-mail: max.koenig@npolar.no Role in project: Glacier service for Svalbard

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esa

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