



CryoLand

GMES Service Snow and Land Ice

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Detailed Description of Service Characteristics

Deliverable D10.1

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<p>CryoLand has implemented standardized services on snow and land ice monitoring as a Downstream Service within Copernicus in a value added chain with the Land Monitoring Core Services.</p> <p>The CryoLand Service provides the following products derived from Earth observation satellite data, seasonal snow cover (main products are fractional snow extent, snow water equivalent (coarse resolution), glaciers (outlines of glaciers and glacier lakes, snow / ice maps), lake / river ice (lake ice classification, river ice extent).</p> <p>The products are provided to the user through the CryoLand GeoPortal for viewing, selection and downloading. The document gives an introduction to the products and how to use the system.</p>		
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1. INTRODUCTION

1.1 Scope

This document is written to give interested users of CryoLand Services the description of how the software and service can be used. The description of the thematic processing components and the thematic processing algorithms is not part of this document.

1.2 Objectives

The aim of the document is to both show the operations and features available within the CryoLand GeoPortal, as an introduction to how to use the system; in addition to show some key performance numbers.

1.3 Method

The document is worked out as a collaborative process involving project consortium partners as R&D resources and developers, originally as a tutorial to new end-users in the demonstration tasks performed.

1.4 Technology background

The CryoLand-project has been used to prepare the products for operational use (including product content standardisation and documentation) and demonstrate them to the user community. This demonstration required to develop and provide interfaces for interactive user access as well as for automated direct data access. These two paradigms have been realized by the development and operation of the CryoLand GeoPortal, providing both an intuitive webGUI for visual data inspection and direct data access (download) possibility based on interoperable OpenGeospatial Consortium (OGC) standards. The feedback to CryoLand products and access has so far been encouraging.

1.5 Acronyms

AMSR2	Advanced Microwave Scanning Radiometer 2
AOI	Area Of Interest
ASAR	Advanced Synthetic Aperture Radar
AT	Austria
CRS	Coordinate Reference System
ENVEO	Environmental Earth Observation IT GmbH
EO	Earth Observation
EOX	EOX IT Services GmbH
EPSG	European Petroleum Survey Group Geodesy
ESA	European Space Agency
EU	European Union
FMI	Finnish Meteorological Institute
FP7	7 th Framework Programme
FSC	Fractional Snow Cover
GAMMA	GAMMA Remote Sensing AG
GIS	Geographic Information System
GL	Greenland
GLIMS	Global Land Ice Measurements from Space
GLL	Glacier Lakes
GLO	Glacier Outlines
GMES	Global Monitoring for Environment and Security
GUI	Graphical User Interface
HTTP	Hypertext Transfer Protocol
IT	Information Technology
KSAT	Kongsberg Satellite Services
KVP	Key/Value Pairs
LIE	Lake Ice Extent
MODIS	Moderate Resolution Imaging Spectroradiometer
NASA	National Astronautic and Space Administration
NMA	National Meteorological Administration (Romania)
NORUT	Northern Research Institute
NR	Norsk Regnesentral (Norwegian Computing Center)
NRT	Near Real-Time
OGC	Open Geospatial Consortium
QGIS	Quantum GIS
RIE	River ice extent
RMSE	Root Mean Square Error
SAR	Synthetic Aperture Radar
SCA	Snow Cover Area
SCAW	Snow Cover Area Wet
SMHI	Swedish Meteorological and Hydrological Institute

SPOT	Système Pour l'Observation de la Terre
SSM/I/S	Special Sensor Microwave Imager/Sounder
SSPI	Standardized Snow Pack Indicator
SSW	Snow Surface Wetness
STS	Snow Surface Temperature
SWE	Snow Water Equivalent
SYKE	Finnish Environment Institute
TOI	Time Of Interest
WCS	Web Coverage Service
WMS	Web Mapping Service
WYSIWYG	What You See Is What You Get

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2. CRYOLAND – THE COPERNICUS SERVICE SNOW AND LAND ICE

The EU FP7 Project CryoLand develops, and implements standardized services on snow and land ice monitoring as a Downstream Service within Copernicus (former GMES) in a value added chain with the Land Monitoring Core Services.

The CryoLand Service provides the following products derived from Earth observation satellite data:

- seasonal snow cover (main products are fractional snow extent and coarse resolution snow water equivalent)
- glaciers (outlines of glaciers and glacier lakes, snow / ice maps)
- lake / river ice (lake ice classification, river ice extent)

The products are provided to the user through the CryoLand GeoPortal for viewing, selection and downloading.

Accessing the CryoLand GeoPortal: <http://www.cryoland.eu>

For the Demonstration Period 2013/14 of the CryoLand Service daily snow and lake ice products generated during the winter season 2013/2014 were provided in Near-Real Time. Additionally, glacier and river ice products are provided for selected dates. Products generated for former years are also made available via the CryoLand GeoPortal.

A description of the CryoLand snow, glacier and lake/river ice products are available at the CryoLand Website (<http://cryoland.eu>). A brief overview of the products provided by the GeoPortal is given in Chapter 3.

2.1 *Recommended Internet Browsers*

The CryoLand GeoPortal has been successfully tested with the following Internet browsers:

- Mozilla Firefox
- Google Chrome
- Safari



Thus, it is strongly recommended to use one of these browsers for accessing the CryoLand GeoPortal.

Note:

Please do not use Internet Explorer, as this browser has problems with handling the needed Java scripts.

2.2 Aim of this Tutorial

This document gives you information and guidelines how to view, select and download the snow and land ice products for your region and period of interest from the CryoLand GeoPortal using the

- CryoLand Interactive Map Tool (WebGUI)
- Locally installed GIS System
- Automatic access of products using scripts

The 3 different methods for accessing and downloading the CryoLand products are described step-by step in the Chapters 4 – 7.

3. PRODUCTS IN THE CRYOLAND SYSTEM

The CryoLand GeoPortal has been up and running continuously since May 2012. By mid of August 2014 more than 15.000 products are accessible on-line, and the number of provided products is increasing daily. Table 3.1 shows the number of particular products provided through the CryoLand GeoPortal on 19 August 2014.

Table 3.1:
Number of CryoLand products provided through the CryoLand GeoPortal on 19 August 2014.

<i>Area covered</i>	<i>Product Type</i>	<i>No. of Products *</i>
Pan-European	Fractional Snow Cover (FSC)	10121
	Snow Water Equivalent (SWE)	430
	Standardized Snow Pack Indicator (SSPI)	312
	10-day_cloud-free FSC (is daily newly calculated)	1
Alps	Fractional Snow Cover (FSC)	1258
Baltic	Fractional Snow Cover (FSC)	320
	Lake Ice Extent (LIE)	208
	10-day cloud free LIE (is daily newly calculated)	1
Scandinavia	Fractional Snow Cover (FSC)	1059
	Wet Snow Covered Area (SCAW)	1267
Southern Norway	Snow Surface Wetness (SSW)	280
	Snow Surface Temperature (STS)	280
Torne River	River Ice Extent (RIE)	1
Greenland	Glacier Images	8
	Glacier Lake Outlines	8
Austria	Glacier Images	1
	Glacier Outlines	1
	Total	15538

3.1 Snow Products

Three types of Snow Products are provided by the CryoLand GeoPortal:

- Pan-European Snow products, with large coverage and lower spatial resolution
- Regional Snow products, with smaller coverage and higher spatial resolution
- Demonstration snow products, new candidates for operational products

Additionally, locations of in-situ snow stations available at SYKE are provided as viewing service.

3.1.1 Pan-European Snow Products

3.1.1.1 Daily Fractional Snow Cover from Optical Satellite Data covering the Pan-European Area (daily_FSC_PanEuropean_Optical)

During the official demonstration phase (winter 2013/14) the “Pan-European” area extends from 72°N / 11°W to 35°N / 50°E. The Pan-European fractional snow cover product is generated daily based on optical MODIS/Terra data. The product provides the percentage of snow cover per pixel (0 – 100 %) for cloud free pixels with a pixel size of 0.005° x 0.005°, which is approximately 500 m x 500 m.

The product is generated daily in near-real time and is updated in the late afternoon at the CryoLand GeoPortal.

The product has also been reprocessed from archived Terra MODIS data for the full period from 2001 – present, so a homogenous time series of this product is available and can be downloaded through the CryoLand GeoPortal.

3.1.1.2 Daily Uncertainty Estimation of Fractional Snow Cover from Optical Satellite Data covering the Pan-European Area (daily_FSC_PanEuropean_Optical_Uncertainty)

For the Pan-European fractional snow cover product derived from optical satellite data the daily root mean square error per pixel is provided as measure for the product uncertainty. The uncertainty layer is also provided for the full reprocessed Pan-European FSC product set from 2001 – present.

3.1.1.3 Viewing Service showing the most recent Cloud Free pixel information of the Pan-European Fractional Snow Cover of the past 10 days (View_10day_FSC_PanEuropean_Cloudfree)

In order to provide a general overview on the current situation of the snow cover over the pan-European area, an aggregated map using the most recent cloud free pixel information of the past 10 days of the daily pan-European Fractional Snow Cover (FSC) map is available as viewing service. If a pixel is hidden by clouds continuously during the past 10 days then the pixel is shown as cloud cover in this viewing product.

3.1.1.4 Daily Snow Water Equivalent from Microwave Radiometer covering the Pan-European Area (daily_SWE_PanEuropean_Microwave)

The Pan-European Snow Water Equivalent (SWE) product covers the same area as the Pan-European Fractional Snow Cover product, and is based on the combination of satellite-based microwave radiometer (DMSP SSM/I, available from 1987 – present) and ground-based weather station snow depth data provided by European Centre for Medium-Range Weather Forecasts (ECMWF). Only non-mountainous areas are currently covered by the product. The Pan-European SWE maps have a pixel size of $0.10^\circ \times 0.10^\circ$, which is approximately 10 km x 10 km.

The product is generated with 2 days delay after satellite image acquisition and daily updated at the CryoLand GeoPortal during the winter season, from the beginning of October until the end of July.

3.1.1.5 10 and 30 days Average, respectively, of Standardized Snow Pack Indicator for Pan-Europe derived from Snow Water Equivalent of Microwave satellite data (avg_10day_SSPI_PanEuropean_Microwave, avg_30day_SSPI_PanEuropean_Microwave)

The Standardized Snow Pack Indicator (SSPI) gives snow pack values as standardized values between -3 and 3 (Table 3.2) calculated from time series of daily snow water equivalent in mm in water (=kg/m² of snow). The Standardized Snow Pack Indicator provides information on the relative volume of the snow pack on a 10 daily and 30 daily (monthly) basis compared to the reference period 1979 – 2010. The products extend from 72°N/11°W to 35°N/35°E, and are generated with $0.01^\circ \times 0.01^\circ$ pixel size, which is approximately 10 km x 10km. The products are provided daily during the winter and spring season with 2 days delay after satellite image acquisition. These two products are for example valuable parameters for supporting in combination with other parameters as precipitation, runoff or soil moisture the assessment of risk for floods.

Table 3.2:
SSPI classification. Reference period: 1979 – 2010.

SSPI Values	Category	Cumulative Probability	Probability of Event [%]
SSPI \geq 2.00	Highly more than normal	0.977 – 1.000	2.3%
1.50 < SSPI \leq 2.00	Much more than normal	0.933 – 0.977	4.4%
1.00 < SSPI \leq 1.50	More than normal	0.841 – 0.933	9.2%
-1.00 < SSPI \leq 1.00	Near normal	0.159 – 0.841	68.2%
-1.50 < SSPI \leq -1.00	Less than normal	0.067 – 0.159	9.2%
-2.00 < SSPI \leq -1.50	Much less than normal	0.023 – 0.067	4.4%
SSPI < -2.00	Highly less than normal	0.000 – 0.023	2.3%

3.1.2 Regional Snow Products

3.1.2.1 Daily Fractional Snow Cover from Optical Satellite Data covering the Alps (daily_FSC_Alps_Optical)

The Fractional Snow Cover Product over the Alps is based on a processing chain optimized for high alpine un-forested terrain. The product covers the area from 49.57°N / 4.66°E to 43.62°N / 17.77°E, and is generated daily based on optical MODIS/Terra data. The product provides the percentage of snow cover per pixel (0 – 100 %) for cloud free pixels with a pixel size of 0.0025° x 0.0025°, which is approximately 250 m x 250 m.

The product is provided daily and is updated in the late afternoon at the CryoLand GeoPortal.

3.1.2.2 Daily Fractional Snow Cover from Optical Satellite Data covering the Baltic Sea Region (daily_FSC_Baltic_Optical)

The Baltic Fractional Snow Product is based on an algorithm optimised for boreal forests. The covered area extends from 71°N / 5°E – 45°N / 45°E. The Baltic FSC product is generated daily based on optical MODIS/Terra data received at Sodankylä, Finland. The product provides the percentage of snow cover per pixel (0 – 100 %) for cloud free pixels with a pixel size of 0.005° x 0.005°, which is approximately 500 m x 500 m.

The product is provided daily and is updated in the evening at the CryoLand GeoPortal.

3.1.2.3 Multi-temporal Fractional Snow Cover from Optical Satellite Data covering Scandinavia (multitemp_FSC_Scandinavia_Optical)

The multi-temporal Fractional Snow Cover product over Scandinavia is aggregated based on single-day snow maps. These maps are based on optical data from NASA's Terra MODIS sensor. Daily products are presented based on the latest available information. When regions are covered by clouds, the most recent cloud free pixel information of the past 7 days is used.

The product is provided daily from April-July via the CryoLand GeoPortal.

3.1.2.4 Multi-temporal Fractional Snow Cover from combined Optical and Radar Sensors covering Scandinavia (multitemp_FSC_Scandinavia_Optical_Radar)

The Fractional Snow Cover Product over Scandinavia uses the advantages of optical and radar data for providing snow information over frequently cloud covered regions. The product is generated daily based on a combination of the optical MODIS/Terra and Radarsat-2 data of multiple days. The product provides the percentage of snow cover per pixel (0 – 100 %) for all pixels with a pixel size of 0.003° x 0.003°, which is approximately 250 m x 250 m.

The product is provided daily during the snow melting season, from beginning of April until end of July, via the CryoLand GeoPortal.

3.1.2.5 Daily Wet Snow Covered Area from Radar Data over Scandinavia (daily_SCAW_Scandinavia_Radar)

The Wet Snow Covered Area Product is available over Scandinavia. The product is currently generated based on Radarsat-2 data and is updated one to two times per week per pixel. The product provides the binary classification of snow free and wet snow cover for all pixels. The product has a pixel size of $0.000033^\circ \times 0.000033^\circ$, which is approximately 50 m x 50 m.

The product generation depends on the availability of radar satellite data, but is usually produced daily for particular areas, and provided via the CryoLand GeoPortal.

3.1.3 Demonstration Snow Products

3.1.3.1 Daily Snow Surface Wetness from Optical Satellite Data covering Southern Norway (daily_SSW_SouthNorway_Optical)

The Snow Surface Wetness is a demonstration product over southern Norway based on multi-temporal observations of snow surface temperature and snow grain size. Samples for southern Norway are available for 2013 and provided on a daily basis from 2014 for the snowmelt season. SSW is provided only for fully snow covered pixels. Partially snow covered pixels are indicated and clouds are masked. The spatial resolution of the product is $0.01^\circ \times 0.01^\circ$, which is approximately 1 km x 1 km.

3.1.3.2 Daily Snow Surface Temperature from Optical Satellite Data covering Southern Norway (daily_STS_SouthNorway_Optical)

The Snow Temperature of Snow is a demonstration product over southern Norway derived from optical satellite data. Samples for southern Norway are available for 2013 and provided on a daily basis from 2014 for the snowmelt season. STS is provided only for fully snow covered pixels. Partially snow covered pixels are indicated and clouds are masked. The spatial resolution of the product is $0.01^\circ \times 0.01^\circ$, which is approximately 1 km x 1 km.

3.1.4 In-Situ Snow Stations (Viewing Service only)

This layer shows the locations of SYKE's in-situ snow stations.

3.2 Glacier Products

3.2.1 Glacier Outlines

The product glacier outline is generated only on request for selected regions, but from satellite data with very high spatial resolution (0.5 m – 10 m). Product formats and the associated attribute tables meet the internationally accepted standards of GLIMS (Global Land Ice Measurements from Space). For visualizing the product in the interactive map, a high zoom factor is needed. For an easier navigation, the Overlay “Glaciermask” can be helpful.

3.2.2 Glacier Images

The glacier images layer provides previews of the RGB composites of the satellite image used for the product generation. Freely available high resolution satellite images as for example Landsat data are provided with the original pixel sizes. Previews of RGB composites from very high resolution satellite images provided for selected areas by the Copernicus Data Warehouse are resampled to pixel sizes of about 50 m x 50 m. These very high resolution satellite images are neither available for download via the CryoLand Services nor distributed on request, but are provided only as background layer for visualization purposes via the CryoLand WebGUI.

3.2.3 Snow / Ice Area on Glacier (coming soon)

The product snow / ice area on a glacier is generated only on request for selected glaciers, but from satellite data with very high spatial resolution (0.5 m – 10 m). Product formats and the associated attribute tables meet the internationally accepted standards of GLIMS (Global Land Ice Measurements from Space).

For visualizing the product in the interactive map, a high zoom factor is needed. For an easier navigation, the Overlay “Glaciermask” or the product “Glacier Outlines” can be helpful.

3.2.4 Glacier Lakes

The product glacier lake is generated only on request for selected regions, but from satellite data with high or very high spatial resolution (0.5 m – 30 m). Product formats and the associated attribute tables meet the internationally accepted standards of GLIMS (Global Land Ice Measurements from Space). If satellite data with very high spatial resolution are available over an area of interest for multiple dates or years, time series can be created monitoring the area changes of a glacier lake.

Note:

Currently, glacier products are available for selected glaciers in the Hohe Tauern, Austria, and on Nuussuaq Peninsula, West Greenland. Products can be visualized in the CryoLand WebGUI, but full data sets meeting the internationally accepted GLIMS standards are provided to users only on request.

3.3 Lake / River Ice Products

3.3.1 Lake Ice Classification

3.3.1.1 Lake Ice Classification (4 classes) from Optical Satellite Data covering the Baltic Sea Region (daily_LIE_Baltic_Optical)

The Lake Ice Extent product is provided over the Baltic Sea region. The product is generated daily based on MODIS data, and contains four (4) classes: full snow cover, partial snow/white ice, clear ice and open water. The lake ice extent product is generated with a pixel size of $0.0025^{\circ} \times 0.0025^{\circ}$, which is approximately 250 m x 250 m. While Scandinavia is fully covered by the product, the coverage in the southern part of the product extent changes depending on the image swaths of the MODIS / Terra satellite.

The product is provided daily during spring season, from May to June via the CryoLand GeoPortal.

3.3.1.2 Viewing Service showing the most recent Cloud Free pixel information of the Baltic Lake Ice Classification of the past 10 days (View_10day_LIE_Baltic_Cloudfree)

In order to provide a general overview on the Lake Ice Extent over the Baltic Sea region an aggregated map using the most recent cloud free pixel information of the past 10 days of the daily LIE product is available as viewing service.

3.3.1.3 Lakes in Baltic region selected for the Lake Ice Extent product generation (LIE_Analysed_Lakes_Baltic, Viewing Service only)

This layer includes the outlines of the lakes used for the Lake Ice Extent analysis over the Baltic Sea region.

3.3.2 River Ice Extent

3.3.2.1 River Ice Extent on Torne River along the border between Sweden and Finland in 2013 from Radar data (RIE_SE_FI_Torne_River_2013_Radar)

The River Ice extent product is provided on demand from very high or high resolution SAR data. This product provides a binary classification of river ice and water on Torne River, the border river between Sweden and Finland, observed in May 2013 from Radar data. The spatial resolution of the product depends on the satellite data available over the area of interest, and can vary between approximately 1 m x 1 m to 50 m x 50 m. The observation of river ice extent is of major interest during the melting season when river ice break-up can result in river ice jams.

Note:

Snow and Lake / River Ice Products can be accessed by the user and downloaded for a specified sub-area of interest (AOI) and specified time of interest (TOI) in a user selectable file format and projection, provided directly from the CryoLand GeoPortal.

4. HOW TO ACCESS THE CRYOLAND SYSTEM

4.1 CryoLand Website – <http://www.cryoland.eu>

The CryoLand Website is the starting point for CryoLand information, products and services:

- General information about the project
- News of upcoming events and progress
- Specification of CryoLand products
- Link to the CryoLand GeoPortal providing access to CryoLand Products
- Contact information



4.2 CryoLand GeoPortal

The CryoLand GeoPortal is the main access point to the snow and ice products offered by CryoLand. Its implementation is based on OGC standardized interfaces. The GeoPortal can be accessed in various ways. Three of them are discussed here:

1. Manual access using the CryoLand Interactive Map-Tool (WebGUI)

<http://neso.cryoland.enveo.at/cryoland/cryoclient/>

The CryoLand Interactive Map-Tool combines a Viewing Service (OGC Web Mapping Service [WMS]) and a Downloading Service (OGC Web Coverage Service [WCS]). The interface is mainly intended for human use to explore the data offerings.

Read more in Chapter 5.

2. Access through a Geographic Information System (GIS)

The CryoLand products can be accessed by most GIS systems, supporting WMS and WFS layers. By this way, the products can be included directly in the GIS analysis of the operator.

Read more in Chapter 6.

3. Automated access using HTTP

The system supports also automated download of products using WMS and WCS requests. This can be realized by simple scripts which generate an HTTP-KVP (HTTP – Key/Value Pairs) request. This method is mainly intended for automated usage e.g. as a machine-to-machine interface for decision systems developed by the user.

Read more in Chapter 7.

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5. HOW TO USE THE INTERACTIVE WEB INTERFACE

5.1 *What you see is what you get (WYSIWYG)*

The CryoLand Interactive Map Tool, accessible at <http://neso.cryoland.enveo.at/cryoland/cryoclient>, provides online access to the snow, glacier and lake/river ice products available in the CryoLand GeoPortal.

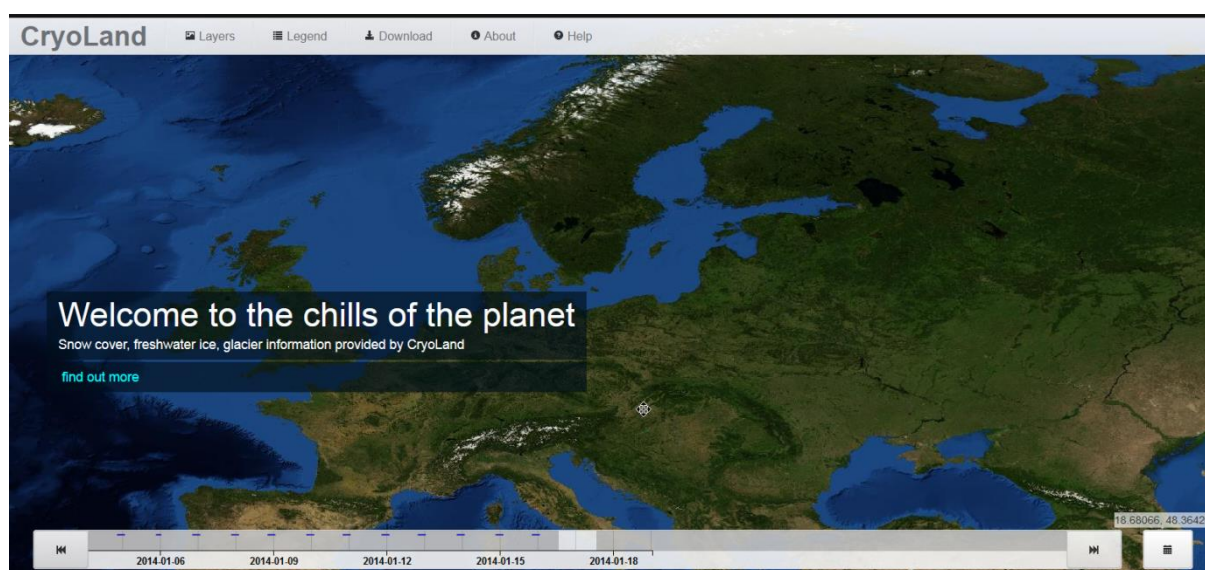


Figure 5.1: Starting page of CryoLand Interactive Map Tool. The time line automatically shows the most recent date for which any product is available. The Fractional Snow Cover Product over the Pan-European area is shown as default product on the welcome page. If any other product is available for a more recent date, only the default background layer is shown, as in this figure.

The Interactive Map Tool (WebGUI) provides the possibility to select and view as well as to download CryoLand products. The web interface follows new paradigm of "zooming to the data". This means looking at previews of the data rather than searching in a catalogue in order to find the right data.


An OGC-WMS (together with its EO extension) is used for the previews whereas OGC-WCS (with its EO extensions), is used to download the previously viewed data. This paradigm could also be called WYSIWYG (what you see is what you get) or "product centric operation" since it focuses on the products and their interactive selection, rather than on entering parameters into search masks.

5.2 Navigation and functionalities

The design of the WebGUI (Human Interaction Service) is kept simple.

At the top of the WebGUI a menu bar (cf. Figure 5.2) provides access to the various functionalities which upon clicking will open a small widget for each specific purpose. Navigation and selection in the map are controlled by using the mouse.

The following functionalities are provided in the WebGUI:

- Zoom-In (scroll-wheel or double-click)
- Zoom-Out (scroll-wheel)
- Pan (click and drag) for navigation and selection
- WebGUI Menu at top of map window
- Time slider at bottom of map window (click, drag and drop)
- Calendar (Download menu, Start date)
- Symbol  when a layer or product is loading, indicating that the WebGUI is busy (appears on the right side of the WebGUI Menu bar)
- Coordinates of current cursor position as decimal degrees (grey values on the right of the time slider at the bottom of the map window – can be barely visible when background layer is dark as for example with Blue Marble base layer)

5.3 WebGUI Menu

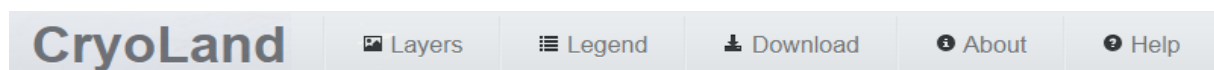


Figure 5.2: WebGUI menu bar.

5.3.1 CryoLand

Clicking on “CryoLand” on the left hand of the menu directly links to the CryoLand Webpage.

5.3.2 Layers

The offered CryoLand product layers are organized in *groups* and *sub-groups* (as described below) to provide an intuitive access and selection. The user may select one or multiple of the following layers (status: 13 January 2014):

Snow

Pan-European

avg_30day_SSPI_PanEuropean_Microwave
avg_10day_SSPI_PanEuropean_Microwave
View_10day_FSC_PanEuropean_Cloudfree
daily_FSC_PanEuropean_Optical_Uncertainty
daily_FSC_PanEuropean_Optical (=default selection)
daily_SWE_PanEuropean_Microwave

Regional

daily_SSW_SouthNorway_Optical
daily_STS_SouthNorway_Optical
multitemp_FSC_Scandinavia_Optical_Radar
daily_FSC_Alps_Optical
daily_SCAW_Scandinavia_Radar
multitemp_FSC_Scandinavia_Optical
daily_FSC_Baltic_Optical
daily_FSC_Alps_Optical

In-Situ

SYKE-Snow Stations

Lake / River Ice

Lake Ice Classification

LIE_Analysed_Lakes_Baltic
View_10day_LIE_Baltic_Cloudfree
daily_LIE_Baltic_Optical

River Ice Extent

RIE_SE_FI_Torne_River_2013_Radar

Glacier

Glacier Outlines

GLO_AT_Hohe_Tauern_2009_Optical

Glacier Images

image_GL_Tininnilik_2012_Optical
image_GL_Tininnilik_2011_Optical
image_GL_Tininnilik_2010_Optical
image_GL_Tininnilik_2007_Optical
image_GL_Tininnilik_2005_Optical
image_GL_Tininnilik_2004_Optical
image_GL_Tininnilik_2001_Optical
image_GL_Tininnilik_2000_Optical
image_AT_Hohe_Tauern_2009_Optical

Glacier Lakes

GLL_GL_Tininnilik_2011_Optical
GLL_GL_Tininnilik_2012_Optical
GLL_GL_Tininnilik_2007_Optical
GLL_GL_Tininnilik_2005_Optical
GLL_GL_Tininnilik_2004_Optical
GLL_GL_Tininnilik_2001_Optical
GLL_GL_Tininnilik_2000_Optical
GLL_GL_Tininnilik_2010_Optical

External Services**Glacier (GLIMS)**

GLIMS_RGI3

Overlays

Forestmask
Watermask
Urbanmask
Glaciermask
Country Borders

Base Layers



Blue Marble (=default selection)
Relief
Open Streetmap

The most recent date for which one or more products are available is shown on the welcome page, using Blue Marble as base layer. Since the "daily_FSC_PanEuropean_Optical" dataset is set as the default layer, this might result in not showing the "daily_FSC_PanEuropean_Optical" dataset at start-up, if another more recent CryoLand product is available. The selection options for each layer group and the default selection of layers are summarized in Table 5.1.

Table 5.1:
Selection options and default selections for the CryoLand products provided in the Layer groups.

Layer Group	Selection Options	Default Selection
Snow	Selection of one or multiple CryoLand snow products is possible.	Fractional Snow Cover over Pan-European area (daily_FSC_PanEuropean_Optical)
Lake / River Ice	Selection of one or multiple CryoLand Lake /River Ice products is possible.	None
Glacier	Selection of one or multiple CryoLand glacier products is possible.	None
External Services	Selection of one or multiple external products is possible.	None
Overlays	Selection of one or multiple CryoLand masks is possible.	None
Base Layers	Selection of one background layer is possible.	Blue Marble

Note:

Optionally, single or multiple products of different layer groups or sub-groups can be selected to be shown at the same time. The opacity of each layer can be adapted by the user: click on the symbol  right hand to each layer. A pop-up window opens showing the opacity. For changing the opacity of the layer, drag the rectangle in the pop-up window to the left or right until the product layer has the opacity you want. For closing the opacity window click again on the symbol  for the selected layer.

5.3.2.1 Snow Products

The convention for snow product names, as for example daily_FSC_PanEuropean_Optical, is based on the following information structure:

Frequency of product generation _ Product abbreviation _ Product Coverage _ Sensor type used for product generation

In Table 5.2 short product descriptions for the snow product layer names are provided. Extended product descriptions are given in Section 3.1, detailed product specifications can be found in the Appendix A.

Table 5.2:
Snow Product Layer abbreviations and associated product descriptions.

Snow Product Layer	Product Description
daily_FSC_PanEuropean_Optical	Daily Fractional Snow Cover over Pan-European Area from Optical satellite data
daily_FSC_PanEuropean_Optical_Uncertainty	Daily uncertainty estimation (root mean square error) for each pixel of the daily_FSC_PanEuropean_Optical product
View_10day_FSC_PanEuropean_Cloudfree	Rolling 10 days aggregated product using the most recent cloud free information per pixel of the daily_FSC_PanEuropean_Optical product, VIEWING Service only.
daily_SWE_PanEuropean_Microwave	Daily Snow Water Equivalent over Pan-European Area from Microwave data
avg_30day_SSPI_PanEuropean_Microwave	Standardized Snow Pack Indicator derived from daily_SWE_PanEuropean_Microwave product on a 30 daily (monthly) basis compared to the reference period 1979 – 2010
avg_10day_SSPI_PanEuropean_Microwave	Standardized Snow Pack Indicator derived from daily_SWE_PanEuropean_Microwave product on a 10 daily basis compared to the reference period 1979 – 2010
daily_FSC_Alps_Optical	Daily Fractional Snow Cover over the European Alps from Optical satellite data
daily_SCAW_Scandinavia_Radar	Daily Wet Snow Covered Area over Scandinavia from Radar data
multitemp_FSC_Scandinavia_Optical_Radar	Daily updated Multi-temporal Fractional Snow Cover over Scandinavia from combined Optical and Radar sensors
multitemp_FSC_Scandinavia_Optical	Aggregated daily Fractional Snow Cover over Scandinavia from Optical satellite data of multiple days using the most recent cloud free pixel information
daily_FSC_Baltic_Optical	Daily Fractional Snow Cover over Baltic Area from Optical satellite data
daily_STS_SouthNorway_Optical	Daily Surface Temperature of Snow over Southern Norway from Optical Satellite data (pre-operational demonstration product)
daily_SSW_SouthNorway_Optical	Daily Snow Surface Wetness over Southern Norway from daily_STS_SouthNorway_Optical product and indicated effective grain sizes (pre-operational demonstration product)
SYKE-Snow Stations	Locations of snow stations hosted by SYKE

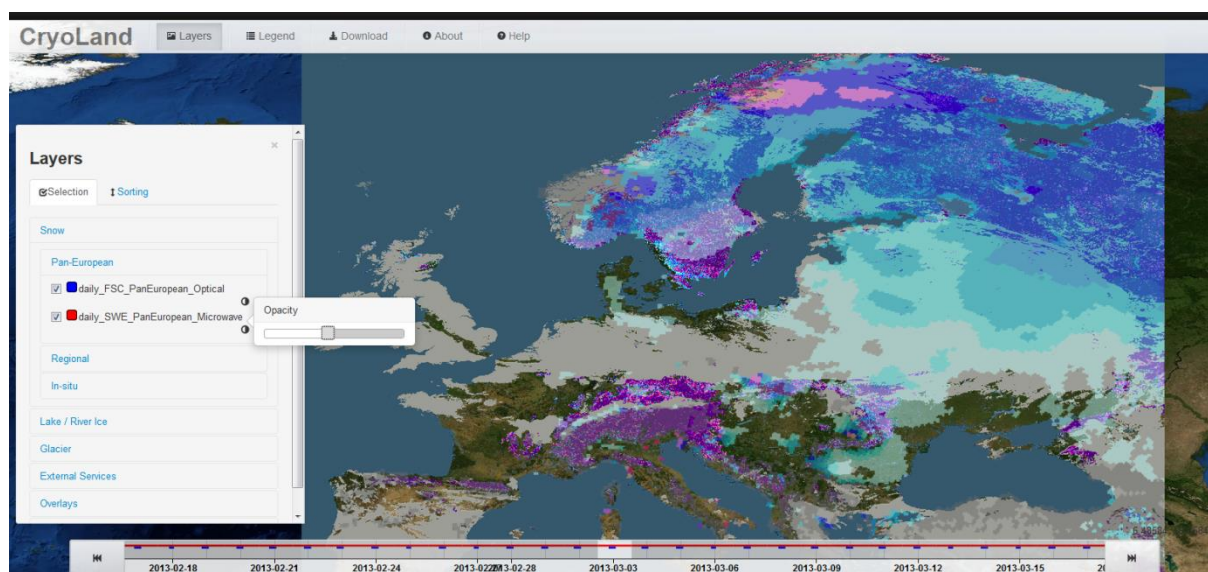


Figure 5.3: CryoLand GeoPortal showing the two layers Snow Water Equivalent and Fractional Snow Cover over the Pan-European Area (daily_SWE_PanEuropean_Microwave, daily_FSC_PanEuropean_Optical). The order of the layers has been changed using the “Sorting” option right of the “Selection” option in the upper part of the Layers widget, showing the Snow Water Equivalent (daily_SWE_PanEuropean_Microwave) product as primary layer. The opacity of the layer Snow Water Equivalent (daily_SWE_PanEuropean_Microwave) is reduced in order to make the Fractional Snow Cover (daily_FSC_PanEuropean_Optical) visible over areas covered by both products.

In Figure 5.3 the Pan-European Snow Water Equivalent (SWE) and the Fractional Snow Cover (FSC) products are shown, using Blue Marble as background. The order of the product layers is changed using the option **↑ Sorting** in the upper part of the Layers widget by dragging and dropping the SWE product on the first rank. The transparency of the SWE product is reduced in order to make the FSC product also visible over areas covered by both products. The opacity can be chosen on a per layer basis using the symbol **ⓘ** right hand to each layer. Clicking again on the symbol closes the opacity window.

5.3.2.2 Lake / River Ice Products

Lake / River Ice Products are by default not activated in the CryoLand GeoPortal, but one or multiple lake / river ice product layers can be optionally loaded. Table 5.3 gives an overview on the lake / river ice product layer names and short product descriptions. More information on lake and river ice products are provided in Section 3.3, and detailed product specifications can be found in Appendix A.

The lake / river ice products are partly generated for irregular time intervals, or only for particular dates. The fast forward and backward signs right and left of the Time-Line (cf. Section 5.4) can be used to find the next date with an available product. Therefore, all other product layers with regularly available products should be deactivated.

An example for the Lake Ice Classification product over the Baltic area is shown in Figure 5.4.

Table 5.3:
Lake / River Ice Product Layer abbreviations and associated product descriptions.

Lake / River Ice Product Layer	Product Description
daily_LIE_Baltic_Optical	Daily Lake Ice Classification over Baltic Area from Optical satellite data
LIE_Analysed_Lakes_Baltic	Outlines of the lakes analysed in the daily_LIE_Baltic_Optical product
View_10day_LIE_Baltic_Cloudfree	Rolling 10 days aggregated product using the most recent cloud free information per pixel of the daily_LIE_Baltic_Optical product, VIEWING Service only.
RIE_SE_FI_Torne_River_2013_Radar	River Ice Extent on Torne River, the border river between Sweden and Finland, in melting season 2013 from Radar data

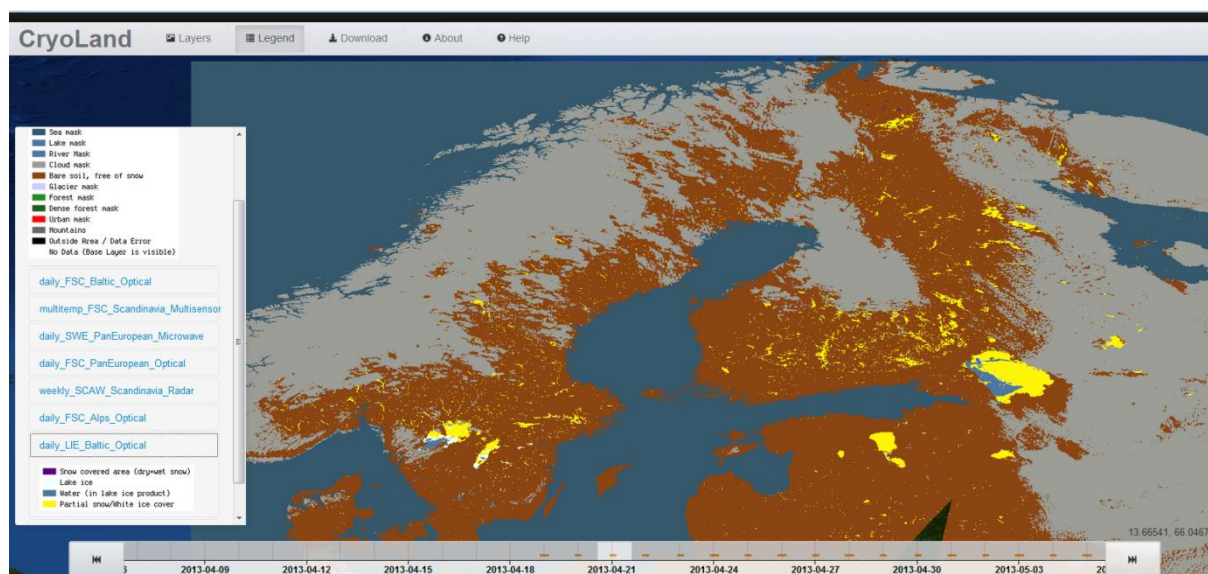


Figure 5.4: Example of the Lake Ice Classification over the Baltic area provided via the GeoPortal. The product legend is shown on the left hand of the figure.

5.3.2.3 Glacier Products

Glacier products are available for particular dates only, which can be far in the past, but activated glacier product layers are shown at any time in the GeoPortal. The naming convention for glacier products, e.g. GLL_GL_Tininnilik_2012_Optical, is based on the following structure:

Product abbreviation _ Country abbreviation _ Region _ Year _ Sensor type used for product generation

For selected regions in Austria and West-Greenland the following glacier products are currently available for viewing in the WebGUI of the GeoPortal (cf. Table 5.4):

- Glacier Outlines – Polygons outlining glaciers, internal rocks, etc.
- Glacier Image – Preview of the high resolution satellite image used for product generation
- Glacier Lakes – Polygons outlining glacier lakes and internal island

Figure 5.5 shows an example of a Glacier Outline Product in Austria.

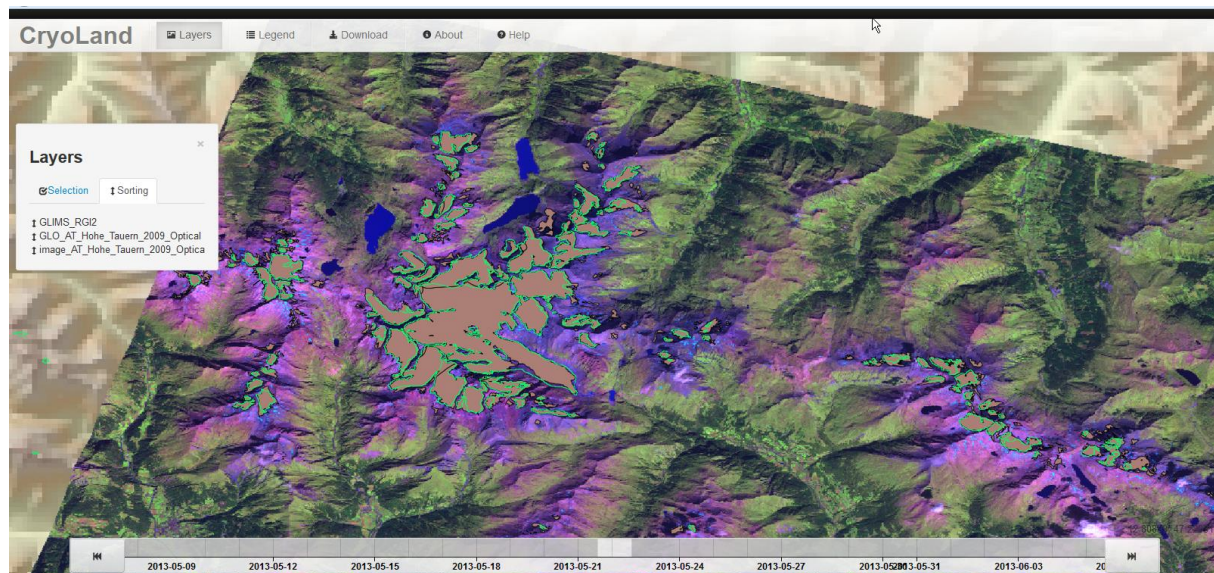


Figure 5.5: CryoLand GeoPortal showing an example of the Glacier Outline Product (brown areas) at Hohe Tauern, Austria. The high resolution satellite image used for product generation is provided as Image Layer, and used as background. Green outlines are the glacier outlines of the External Service GLIMS/RGI. The base layer “Relief” is used as background, and visible outside the Glacier Image Layer. After activating the glacier layers, the layers were re-sorted in order to make all layers visible.

Table 5.4:
Glacier Product Layer abbreviations and associated product descriptions.

<i>Glacier Product Layer</i>	<i>Product Description</i>
GLO_AT_Hohe_Tauern_2009_Optical	Glacier Outlines at Hohe Tauern, Austria, of 1 st September 2009 from Optical satellite data
Image_GL_Tininnilik_2012_Optical	Optical satellite image used for product generation in Greenland, on Lake Tininnilik of 7 th September 2012
Image_GL_Tininnilik_2011_Optical	Optical satellite image used for product generation in Greenland, on Lake Tininnilik of 3 rd July 2011
Image_GL_Tininnilik_2010_Optical	Optical satellite image used for product generation in Greenland, on Lake Tininnilik of 17 th August 2010
Image_GL_Tininnilik_2007_Optical	Optical satellite image used for product generation in Greenland, on Lake Tininnilik of 9 th August 2007
Image_GL_Tininnilik_2005_Optical	Optical satellite image used for product generation in Greenland, on Lake Tininnilik of 4 th September 2005

Glacier Product Layer	Product Description
Image_GL_Tininnilik_2004_Optical	Optical satellite image used for product generation in Greenland, on Lake Tininnilik of 1 st September 2004
Image_GL_Tininnilik_2001_Optical	Optical satellite image used for product generation in Greenland, on Lake Tininnilik of 7 th July 2001
Image_GL_Tininnilik_2000_Optical	Optical satellite image used for product generation in Greenland, on Lake Tininnilik of 22 nd September 2000
Image_AT_Hohe_Tauern_2009_Optical	Optical satellite image used for product generation in Austria, at Hohe Tauern of 1 st September 2009
GLL_GL_Tininnilik_2012_Optical	Glacier Lake Tininnilik, Greenland, on 7 th September 2012 from Optical satellite data
GLL_GL_Tininnilik_2011_Optical	Glacier Lake Tininnilik, Greenland, on 3 rd July 2011 from Optical satellite data
GLL_GL_Tininnilik_2010_Optical	Glacier Lake Tininnilik, Greenland, on 17 th August 2010 from Optical satellite data
GLL_GL_Tininnilik_2007_Optical	Glacier Lake Tininnilik, Greenland, on 9 th August 2007 from Optical satellite data
GLL_GL_Tininnilik_2005_Optical	Glacier Lake Tininnilik, Greenland, on 4 th September 2005 from Optical satellite data
GLL_GL_Tininnilik_2004_Optical	Glacier Lake Tininnilik, Greenland, on 1 st September 2004 from Optical satellite data
GLL_GL_Tininnilik_2001_Optical	Glacier Lake Tininnilik, Greenland, on 7 th July 2001 from Optical satellite data
GLL_GL_Tininnilik_2000_Optical	Glacier Lake Tininnilik, Greenland, on 22 nd September 2000 from Optical satellite data

Note:

The order of the product layers to be shown in the interface can be changed by dragging and dropping the layers in the Sorting menu at the top of the Layers widget.

5.3.2.4 External Services

Currently, the glacier outline data base of GLIMS / RGI (Global Land Ice Measurements from Space / Randolph Glacier Inventory, Version 3.2) is integrated into the CryoLand GeoPortal as WMS Layer. These glacier outlines are shown as green boundary lines.

5.3.2.5 Overlays

Additionally to these product layers, the following Overlays can optionally be selected by the user:

- Forest mask
- Water mask



- Urban mask
- Glacier mask
- Country Borders

These global masks are based on the data sets CORINE Land Cover 2006 (where available) and GLOBCOVER 2009 for the rest of the world. In Figure 5.6 all overlay masks (Forest, Water, Urban, Glacier, Country Borders) provided by CryoLand are presented with the Relief used as background.

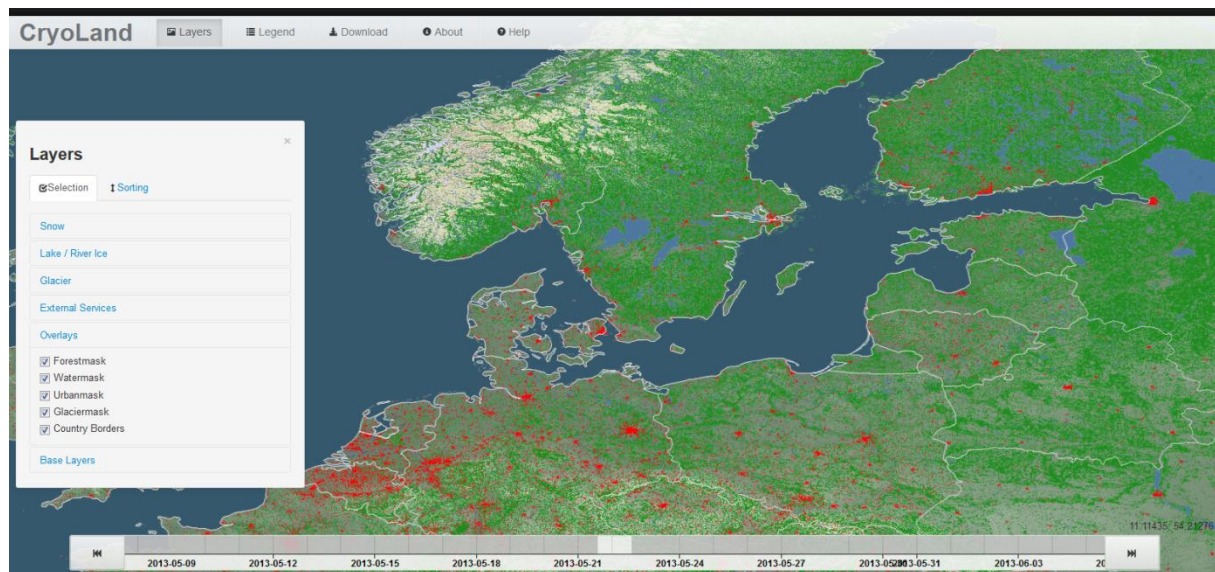


Figure 5.6: CryoLand GeoPortal showing all overlay masks (Forest, Water, Urban, Glacier, Country Borders), using Relief as Base Layer.

5.3.2.6 Base Layers

The design of the GeoPortal WebGUI allows the selection of the provided products (Snow, Glacier, etc.), some Overlay masks, as well as different base layers used as background. Only one of these base layers can be selected as background. The CryoLand Web interface provides currently three different base layers:

- Blue Marble (pixel size: ca. 1 km x 1 km)
- Relief (pixel size: ca. 250 m x 250 m)
- Open Streetmap

5.3.3 Legend

View the legends for the CryoLand products and masks. A common legend used for all CryoLand Products is defined for different surface classes. Additionally, for each snow product the associated legend occurs by clicking on the legend entry.

Figure 5.7 shows the Pan-European Fractional Snow Cover product over central Europe overlaid with the Overlay masks forest, water, urban, glacier and the country borders. Here the *Open Streetmap* has been chosen as Base Layer. Concurrently with the selected products the CryoLand Common Legend together with the Products specific Legend is shown in a separate widget.

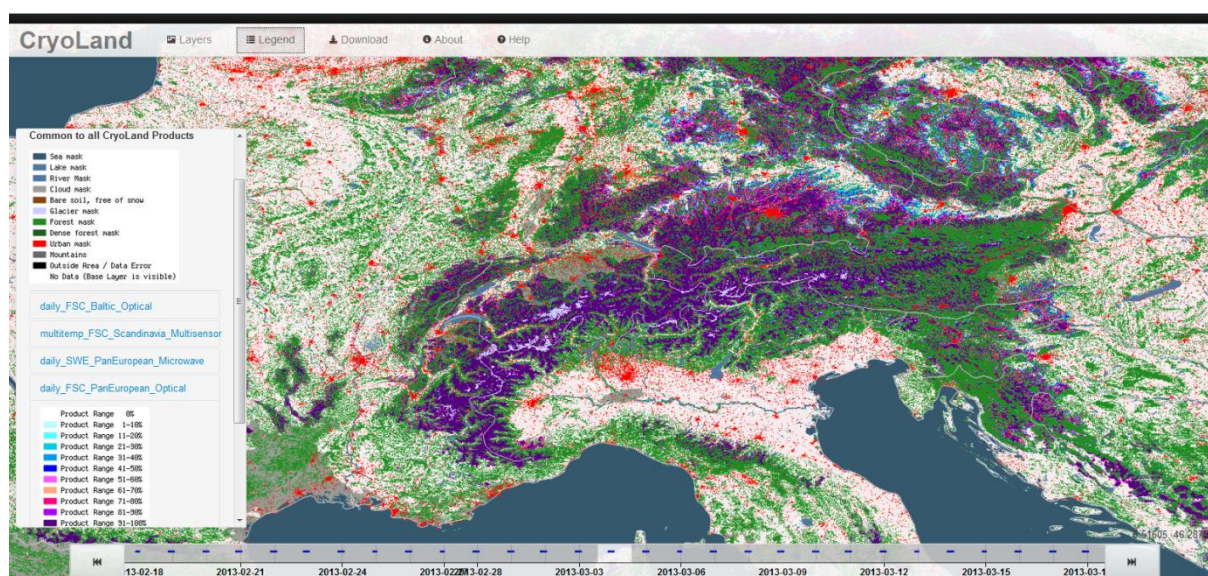


Figure 5.7: CryoLand web interface showing the Pan-European Fractional Snow Cover product (daily_FSC_PanEuropean_Optical) over Central Europe, all overlay masks, the CryoLand Common Legend as well as the Product specific Legend. As background the layer Open Streetmap is used.

5.3.4 Download

For downloading data from the CryoLand GeoPortal via the WebGUI at least one of the snow or lake / river ice product layers has to be activated (see also Section 5.3.1). The following download options are available for one or multiple selected layers:

- Select Area Of Interest (AOI) by Bounding Box – defined by click and drag in the viewing window in the WebGUI or by entering the coordinates into the respective fields (Min X, Min Y, Max X, Max Y).

- Select Area Of Interest (AOI) by Polygon – upload of a shape-file (*.shp and optional *.dbf) to select an AOI defined by a polygon. The shape-file can contain multiple polygons, but only one polygon can be selected as AOI.
- Select Time Of Interest (TOI) – defined by a form for entering start and end dates. Optionally the calendars next to each the start and end date field can be used for selection the dates.
- Selection button to trigger the actual WCS data access request for the selected dataset(s).
- Download the product(s) according to AOI and TOI with a selected projection (Default: geographic coordinates/WGS84) and selected file format (Default: GeoTIFF).

5.3.5 About

Get information about the project partners and the project funding.

5.3.6 Help

Read more in the Help Menu about the CryoLand products, accessing and downloading CryoLand products using the graphical interface of the GeoPortal (WebGUI), and about automated download and data integration into a GIS. Additionally, demonstration scripts written in IDL and Python for getting data automatically from the GeoPortal (using HTTP-KVP requests), and an example for product downloading and further analysis written in IDL are provided. Finally, the most recent version of this document can be downloaded from the Help section.

5.4 Time-Line and Calendar

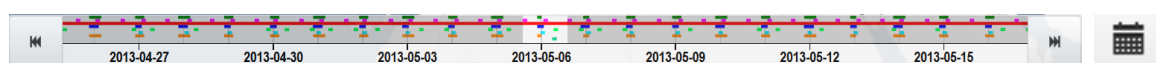




Figure 5.8: Time-line indicating the availability of product layers. On the right side of the time line a calendar widget is provided for faster temporal navigation.

At the bottom of the screen a Time-Line allows the selection of a date (Time Of Interest, TOI) for which the products shall be shown. A “white” box is fixed in the centre of the time line. The time line can be moved by clicking, dragging and dropping along the time axis until the date of interest matches the central box.

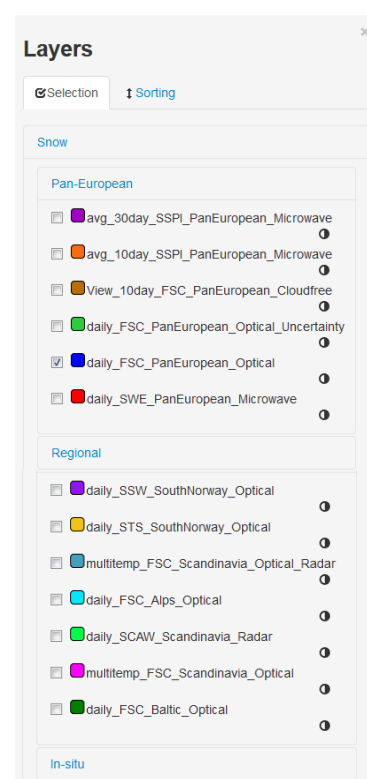
For a faster temporal navigation to specific dates the calendar widget  to the right of the time line can be used to jump to a specific date.

Optionally, a particular date can also be chosen via the Download menu accessible via the main WebGUI menu (cf. Section 5.3). In the Download Menu the “Start” calendar  of the Date Range can be used for selecting a particular date for which layers should be shown in the GeoPortal. The selected date then appears in the white box of the Time-Line.

For pan-European and regional snow products as well as for the lake/river ice products activated in the product layers, the availability of data is indicated by a coloured marker in the time line, as shown in Figure 5.8. The colours of the individual layers correspond with the colours presented in the layers menu for products. An example of the colour coding of the pan-European and regional snow product layers is shown in Figure 5.9.

Snow / Pan-European:

- Purple: Standardized Snow Pack Indicator over Pan-European Area derived from Snow Water Equivalent using 30 days average
- Orange: Standardized Snow Pack Indicator over Pan-European Area derived from Snow Water Equivalent using 10 days average
- Light brown: Rolling aggregated Fractional Snow Cover product over Pan-European Area showing the most recent cloud free information per pixel (VIEWING Service only)
- Green: Daily uncertainty (root mean square error) estimation per pixel for the daily Fractional Snow Cover product over the Pan-European Area
- Blue: Fractional Snow Cover over Pan-European Area
- Red: Snow Water Equivalent over Pan-European Area



Snow / Regional:

- Mauve: Snow Surface Wetness over Southern Norway
- Light Orange: Surface Temperature of Snow over Southern Norway
- Light Blue: Fractional Snow Cover over Scandinavia from Optical and Radar data of multiple dates
- Cyan: Fractional Snow Cover over the Alps
- Light green: Wet Snow Cover over Scandinavia

Figure 5.9: Colour coding used on the timeline after product activation to show the availability of Pan-European and Regional Snow Products.

- Pink: Fractional Snow Cover over Scandinavia
- Dark green: Fractional Snow Cover over Baltic Area

Lake / River Ice:

- Orange: Lake Ice Classification over Baltic Area
- Dark Grey: Rolling aggregated Lake Ice Classification product over Baltic Area showing the most recent cloud free information per pixel (VIEWING Service only)
- Turquoise: River Ice Extent on Torne River on 6 May 2013, southern country border between Sweden and Finland

Glacier products are only provided irregularly for specific dates. Thus, these layers are not indicated by a coloured marker in the time line, but can be overlaid at any date.

5.5 Selecting and downloading data

If you have found a product over an area and for a time you're interested in, you might want to download the data. Here you will learn how to get data in only 4 steps.

Go to the CryoLand GeoPortal: <http://neso.cryoland.enveo.at/cryoland/cryoclient>

Step 1: Select Layer(s)

Go to the Menu "Layers", and activate one or multiple product layers you want to download. These layers are now shown also on the interactive map.

Step 2: Define Area of Interest

Now, go to the Menu "Download". By default, the selection of the area of interest via a "Bounding Box" is provided. Click on the button "Draw Bounding Box" and define your area of interest in the interactive map. Therefore, left click in the map and drag a box keeping the left mouse button pressed. If you want to redraw your area of interest, you have to click again the "Draw Bounding Box" Button, and redo the selection.

Optionally, you can also upload a shapefile outlining an area of interest. Please be aware, that the shapefile must contain a closed polygon, and must be projected in geographic coordinates/WGS84 (EPSG: 4326). Press the Select file button and choose your local Shapefile (.shp) to upload. You may also add the associated Database file (.dbf) concurrently. After the upload press the Select Polygon button to choose the polygon to be used. Thereafter the polygon will be shown in the map.

Step 3: Define Time of Interest

In the next step, select the date or period you're interested in by selecting a start and end date. By providing a date range spanning over multiple days a time series for the selected AOI can easily be downloaded. In such case each product in the date range will be provided as a separate file.

Examples for selecting an area by a bounding box or a locally stored shapefile, and a time of interest in the CryoLand WebGUI are shown in Figure 5.10 and Figure 5.11, respectively. Two layers, the Pan-European Fractional Snow Cover (daily_FSC_PanEuropean_Optical) and the Pan-European Snow Water Equivalent (daily_SWE_PanEuropean_Microwave), are selected for downloading. For the SWE layer a reduced transparency has been applied.

Note:

Please be aware that the Internet Explorer does not allow multiple files to be downloaded but will stop after the first file. It is therefore highly recommended to use Firefox, Chromium or Safari (or similar capable browsers).

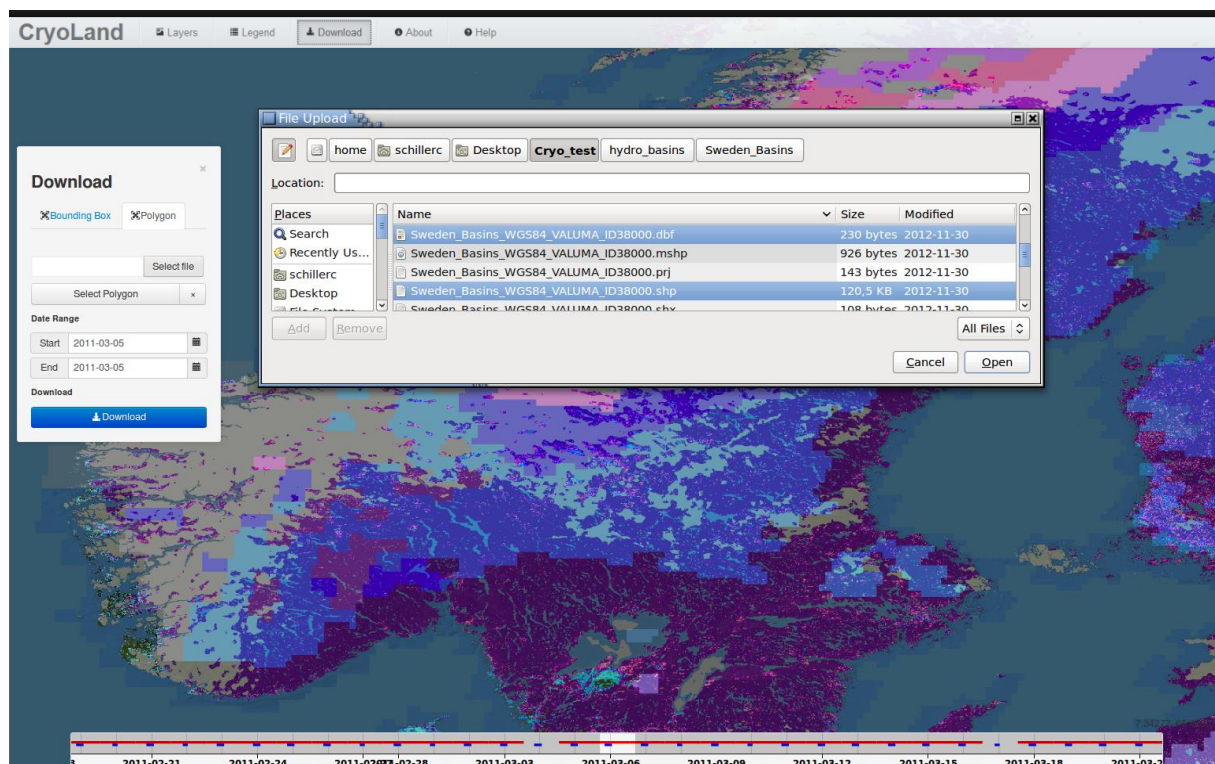


Figure 5.10: CryoLand GeoPortal showing the selection possibilities for the download (AOI, TOI). The upload of a Shapefile is used for the selection of the AOI.

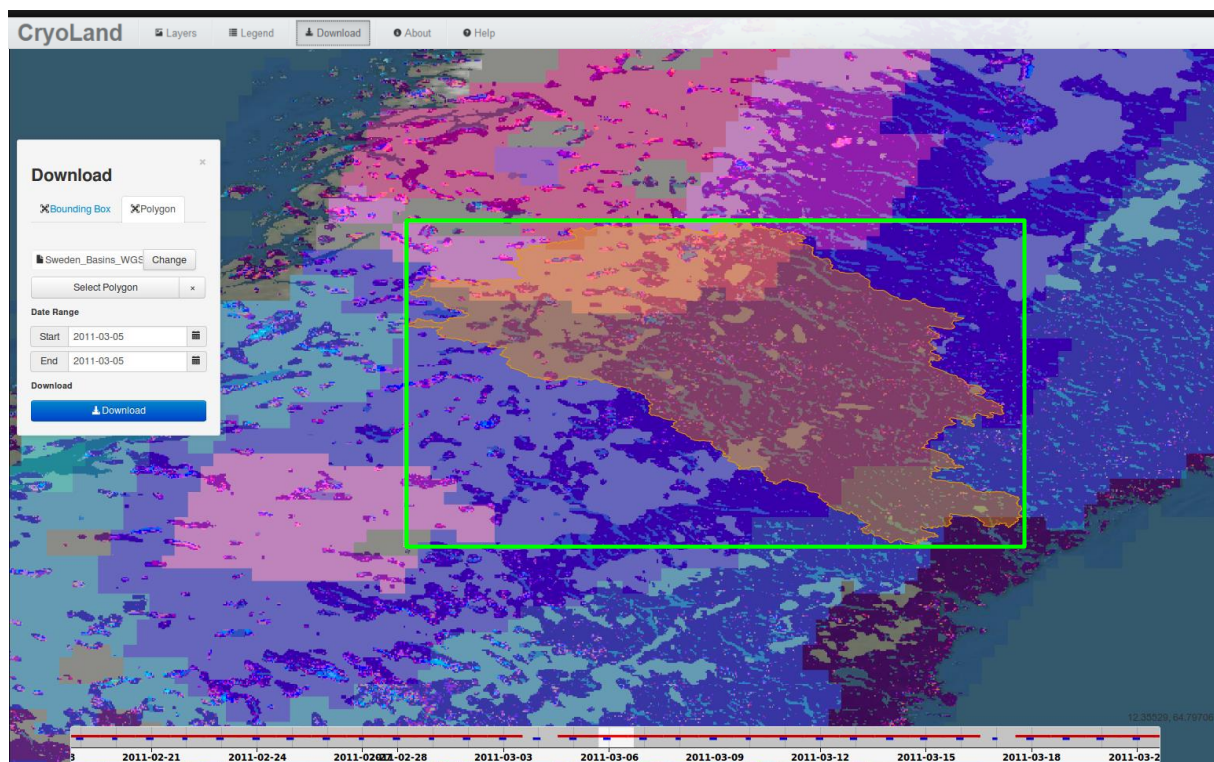



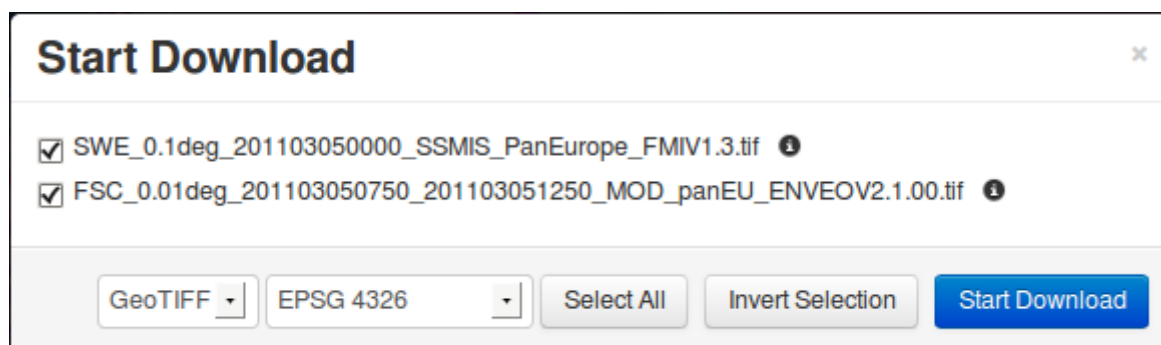
Figure 5.11: The uploaded Shapefile used for the selection of the AOI is shown (orange). Additionally, the bounding box of the area of interest is shown (green).

Step 4: Download the data

If you have selected the area and time of interest, click on the “Download” button. A pop-up window opens (Figure 5.12), where you can either select individual layers, or all listed layers for downloading. The symbol  on the right of each product offers the possibility to view additional information.

Additionally, you have here the option to select a specific file format (currently supported are GeoTIFF, JPEG and PNG) and a projection. By default the products are provided in geographic coordinates/WGS84 (EPSG: 4326). If you have completed your download specifications, press the button “Start Download”, and the individual layers you selected will be downloaded to your local storage.

If you selected a Shapefile for the definition of the area of interest, the polygon will be used as a “masking layer”. All data outside the polygon will be replaced with the “No Data” value (in CryoLand “No Data” = 0).



The screenshot shows a web interface titled "Start Download" with a close button (X) in the top right corner. Below the title, there are two checked checkboxes with file names: "SWE_0.1deg_201103050000_SSMIS_PanEurope_FMIV1.3.tif" and "FSC_0.01deg_201103050750_201103051250_MOD_panEU_ENVEOV2.1.00.tif". Each checkbox has an information icon (i) to its right. Below the file list, there are four buttons: "GeoTIFF" (with a dropdown arrow), "EPSG 4326" (with a dropdown arrow), "Select All", and "Invert Selection". To the right of these buttons is a large blue "Start Download" button.

Figure 5.12: Product download verification with file format and projection selection possibilities.

Figure 5.13 shows the resulting products for the selections shown in Figure 5.11. The resulting data is masked according to the polygon of the uploaded shape-file. Please note that for better visibility in the document a colour schema has been applied to these examples. The actual product downloads will not have a colour schema applied and would appear as greyscale images.

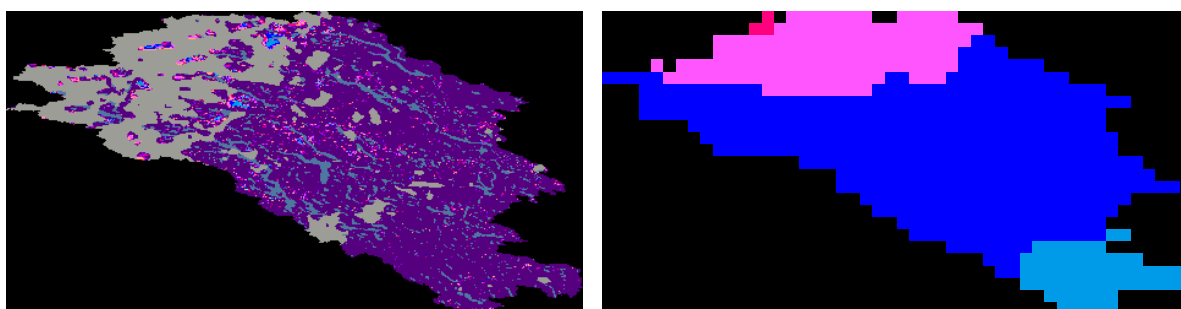


Figure 5.13: Resulting FSC (left) and SWE (right) product layers extracted and masked according to the shape-file provided by the user.

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6. HOW TO ACCESS CRYOLAND PRODUCTS USING A LOCALLY INSTALLED GIS SYSTEM

Using the CryoLand data locally together with other data may be requested by some users.

In this section we show how to load and use CryoLand products as WMS layers directly into your GIS system, locally installed on your computer. For demonstration we use the open source Software Quantum GIS (QGIS), available at www.qgis.org.

6.1 Accessing CryoLand's datasets using WMS (Viewing Service)


The show case, provided below, is based on the QGIS Version 1.8.0 'Lisboa'. With newer versions of QGIS the procedure might be similar but not necessarily equal. Please refer to the user manual of Quantum GIS for any further information how to download and install the Quantum GIS software on your computer, and to get updated information how to add WMS Layers. When you've downloaded and installed the QGIS software, start the Quantum GIS Desktop from your desktop.

Note:

Since the CryoLand GeoPortal supports OGC standards, most commercial and non-commercial GIS systems can access the GeoPortal via the OGC-WMS interface.

Step 1: Connecting to the CryoLand Server

For adding a WMS Layer you have to connect first to a server. In QGIS, you start this with the command "**Add WMS Layer...**". This can be done by one of the following ways:

- Option 1: go to the menu "Layer" and select "Add WMS Layer..."
- Option 2: press Ctrl + Shift + W
- Option 3: press the button  in the graphical interface (you have to activate first the Layer Manager: select the menu "View", go to "Toolbars", and activate the button "Manage Layers")

Adding a WMS layer with either one of these methods opens a pop up window for the selection and connection to an online server.

- If you add a WMS Layer for the first time, there are no servers available for selection. You can change that easily by **pressing the button “Add default servers”** in the upper right part of the window. In the upper left part of the window there is the option to add a user defined server to the list.
- Adding the CryoLand Server: **press the button “New” in the upper left part of the window.** In the now opening pop-up window, type in an optional name for the server connection (e.g. CryoLand), and **add the following line into the URL field:**

<http://neso.cryoland.enveo.at/cryoland/ows>

Finally, **press “OK”**, as indicated by the mouse cursor in the Figure 6.1, and **afterwards the button “Connect”** in the WMS Layer window **for connecting with the CryoLand Server.**

Figure 6.1 shows the described pop-up windows and where to provide the input.

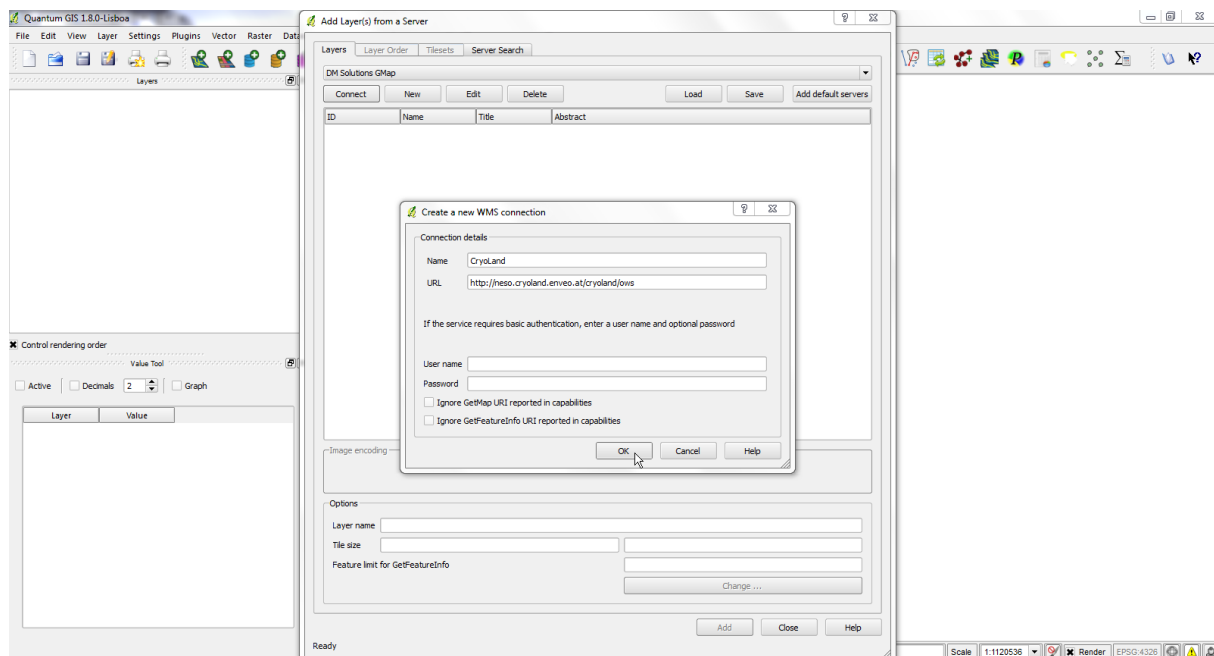


Figure 6.1: Add CryoLand server for loading WMS layers into QGIS.

Note:

All servers you add to the list are saved in the drop down list in this window and can easily be connected by just selecting and connecting with a server the next time.

Step 2: Add WMS Layer(s)

When you have successfully connected to the server, all available WMS Layers are listed in the window. You can order the available layers optionally per ID, Name, Title, or Abstract. In Figure 6.2,

the list of available layers on the CryoLand Server is shown in descending order by Title. The bar on the right hand of the selection window can be used for scrolling downwards.

Select optionally one or multiple layers to be loaded into the main window just by left click on a layer. A layer can be removed from the selection list by left clicking again on the selected layer. All selected layers are listed in the field "Layer name".

If you have selected several layers at the same time these are overlaid and combined in one map. It is not possible to switch between the individual layers. For viewing and switching between multiple layers just repeat the selection and adding of one or multiple WMS Layers as often as you want.

Note:

If you select multiple layers at the same time, these layers will be overlaid and shown as one layer only in the resulting map. Therefore you will not be able to switch between those layers.

For Image encoding two options are available:

- PNG provides the WMS Layer with approximately the same quality as the original raster data, but needs more time for loading, especially if multiple layers are selected.
- JPEG is advisable if the image quality is of less importance, but the data are loaded rather quickly. Also bear in mind that JPEG does not support transparency (transparent areas will be presented in black).

Coordinate Reference System:

If you have selected one layer of the list, you have the option to change the Coordinate Reference System (CRS) for the product to be loaded into the QGIS project. All CryoLand layers are provided by default in geographic coordinates on WGS 84 ellipsoid. If it is necessary, you can change the projection by pressing the button "Change" next to "WGS 84", and select one of a list of further available projections.

Finally, press "Add" to load the selected layers to the main QGIS window. You can now add further WMS layers, or close the selection window.

For further options, as defining "Tile size" or "Feature limit for GetFeatureInfo" please refer to the QGIS User Manual describing these issues in more detail. Online tutorials are available for example via the QGIS homepage, or from the following link:



http://docs.ggis.org/html/en/docs/user_manual/working_with_ogc/ogc_client_support.htm#working-with-ogc-data.

Note:

If you want to overlay layers from your local storage with WMS layers from the CryoLand server it is advisable that you start a project with adding the WMS Layer, and define the project projection based on this layer. Any subsequent vector layers added from your local machine can then be re-projected on-the-fly. Adding a WMS Layer to an existing project with different projection may result in unpredictable errors.

In the example in Figure 6.2, two layers are selected to be shown in one map: a background layer and a Snow Water Equivalent Product layer, using the high quality PNG for image encoding.

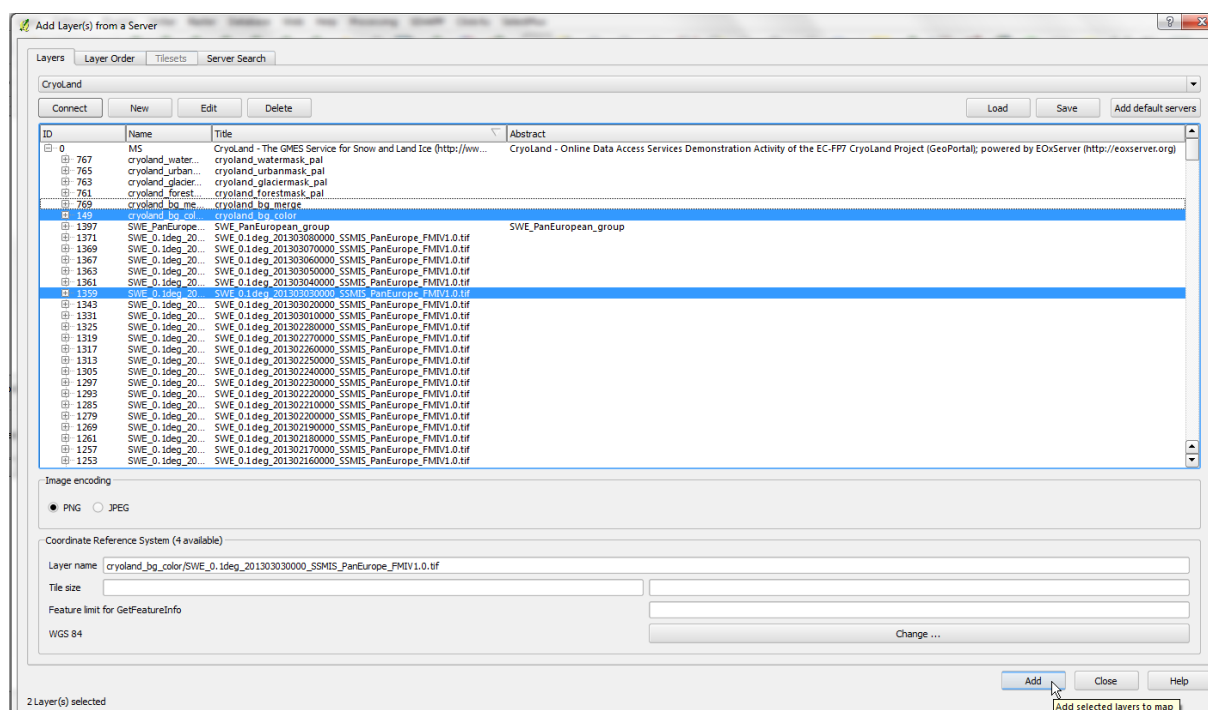


Figure 6.2: List of available WMS layers from the CryoLand server, ordered descending by Title. Two layers, one background layer and one product layer to be overlaid, are selected to be added to the main window. For image encoding PNG is selected.

Congratulations! You've now successfully selected and added one or even multiple WMS layers!

Step 3: Getting more information on the (selected) WMS Layer(s)

If you want to know now **more details on the individual layers** you loaded into the QGIS window, you can either double left click on a layer, or optionally right click on a layer, and then click on **“Properties”**.

A window pops up, which includes three tabs: one for **General** information, another one with the option to change the **Transparency** of the selected layer, and a third one including information about the **Metadata** of the selected or other layers available through the CryoLand server.

An example of multiple WMS Layers loaded into the QGIS main window, and showing the associated metadata information for one of these layers is shown in Figure 6.3.

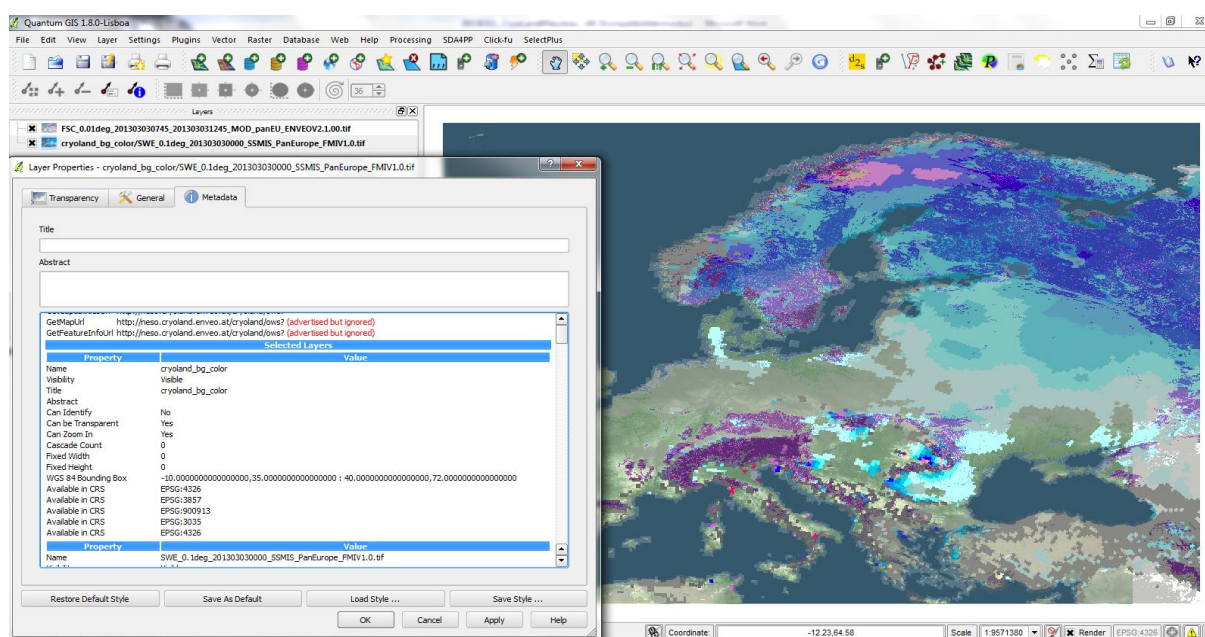


Figure 6.3: QGIS main window showing the a CryoLand background WMS layer “cryoland_bg_color” combined with a SWE product layer of 03 March 2013 for the pan-European area and overlaid with the pan-European FSC product layer of the same date. The transparency of the FSC layer is set to 40 per cent in order to make the combined layers underneath visible. The pop up window on the left side shows the Metadata of the combined WMS layers.

6.2 Accessing CryoLand's datasets using WCS (Download Service)

A QGIS Plugin, which allows to access WCS 2.0 / EO-WCS servers (including the CryoLand GeoPortal) and automatically integrate the downloaded “coverages” into QGIS, has been developed by EOX. This QGIS plugin provides users with a convenient access method and will allow them to easily integrate and analyse the CryoLand provided Snow and Ice maps. In contrast to WMS, which provides

"portraits" (e.g. Jpeg images) of the datasets, WCS allows to actually access the "real" datasets, i.e. to download the data.

This WCS 2.0/EO-WCS client is intended to be used to access/download single Coverages, StitchedMosaics and DatasetSeries (which are offered by OGC WCS 2.0/EO-WCS conformant servers) in a convenient way from within QGIS (>2.0). Downloaded datasets are stored locally and loaded directly into QGIS for further usage.

6.2.1 Download and Installation

The developed QGIS Plugin is available via the official QGIS Plugin repository. The installation can be performed directly within QGIS, like any other QGIS Plugin.

Once installed, you are ready to access the "QgsWcsClient2" plug-in via the QGIS Menu → Plugins → WCSClient2.

6.2.2 Getting Started:

This "WCSClient2" client provides the possibility to send OGC GetCapabilities, DescribeCoverage, DescribeEOCoverageSet, and GetCoverage requests to a selected WCS 2.0/EO-WCS server. The respective request results are received and either shown completely or the relevant information is extracted and provided in the GUI for further usage within the client.

The GUI provides tabs for each request, allowing to select optional parameters (e.g. sub-setting in space and/or time) to be sent with the request. However, not all servers may honour all optional parameters. So if you receive an error message or no answer at all try it with different optional settings. See also the 'How To' section for further details and the 'Hint - Erroneous behaviour' section.

- The first thing which needs to be done is to define at least one server in the "Server/Storage" tab. Press the "New" button, and enter a (personal) "Server Name" and the WCS Access "Server URL". Press "OK" when done. All server entries are stored in the QgsWcsClient2 plugin installation directory
- Make sure the provided WCS Access "Server URL" complies to OGC OWS (e.g. usually OGC-Service Access-URLs end with a "?")
- The supplied server information can be changed anytime utilizing the "Edit" button
- Any server entry can be deleted utilizing the "Delete" button".
- When the server information has been provided, select the desired "Server" entry from the list and press the "Connect to Server" button
- You always need to be connected to a server before you can send requests!

6.2.3 How To:

This section shortly describes a 'typical' usage scenario, starting with a GetCapabilities request to the final download of Coverages utilizing a GetCoverage request.

It also explains the provided options available in the GUI.

6.2.3.1 Server/Storage tab

- The QgsWcsClient2 plugin always starts with the "Server/Storage" tab
- Select the desired "Server" entry from the list and press the "Connect to Server" button. You always need to be connected to a server before you can send requests!
- When the connection is established successfully, the line "Response: Server OK" is printed in the "General Information / Errors / etc." field
- If you want to access/download a coverage, you need to supply a "Local Storage Path". Either type the path into the "Local Storage Path" field or use the "..." button for the path selection
- When the server connection is established click on the "GetCapabilities" tab

6.2.3.2 GetCapabilities tab

- The section parameters allow you to limit the amount and type of information retrieved from the WCS server. The following GetCapabilities section parameters are available:
 - All: Requests full information (equals to no selections)
 - DatasetSeriesSummary: Summary about offered DatasetSeries
 - CoverageSummary: Summary about offered Coverages
 - ServiceIdentification: Information about available Service Profiles
 - ServiceProvider: Information about the Service Provider
 - ServiceMetadata: Information about offered File Formats, offered CRSs, etc.
 - OperationsMetadata: Metadata about available Service Operations (e.g. enabled requests)
 - Contents: Overview of offered Content (i.e. list of CoverageIDs and basic DatasetSeries information)
 - Languages: Offered Languages (if available)
- You may select requesting only sections (subsets) of the full GetCapabilities document. The default settings used have been chosen for fast and efficient usage (some WCS servers may return huge results and therefore take quite some time to respond)

- If you use the same server frequently you are probably not interested in 'older' information. If you want to limit the returned information to 'newer' offers only activate the "Document Update Sequence" check-box and provide a 'Cutoff Date', i.e. only newer information shall be provided
- When the desired options are chosen press the "GetCapabilities" button
- The returned results will be shown in the "Results of GetCapabilities Request" field. There you will see the following columns:

CoverageID/DatasetSeriesID	BeginTime	EndTime	[C]overage/[S]eries
----------------------------	-----------	---------	---------------------

In the first column either a CoverageID or a DatasetSeriesID is provided. The type of ID can be seen in the last column ([C] indicates a Coverage, [S] indicates a DatasetSerie). The two time columns are assumed to be self-explanatory.

- When the GetCapabilities results are listed you have to choose at least one CoverageID or DatasetSeriesID. However, the selection of multiple IDs is possible.
- The selected items will automatically show up in the "DescribeCoverage" tab, in the "DescribeEOCoverageSet" tab, and in the "GetCapabilities" tab (if a Coverage has been selected) or in only the "DescribeEOCoverageSet" tab (if a DatasetSeries has been selected).
- Now continue, changing either to the "DescribeCoverage" tab or to the "DescribeEOCoverageSet" tab. If you have chosen only CoverageIDs you may also switch directly to the "GetCapabilities" tab

6.2.3.3 DescribeCoverage tab

- If one or more CoverageIDs have been selected in the "Results of GetCapabilities Request" field they will be shown in the "Selections from the GetCapabilities Results" field. You need to select a single CoverageID to send a DescribeCoverage request to the server. The full results of this request will be shown in a separate window. No optional parameters are available for a DescribeCoverage request.
- The provided information, however, may later be useful e.g. for specification of the Area of Interest (AOI)

6.2.3.4 DescribeEOCoverageSet tab

- If one or more CoverageIDs and/or DatasetSeriesIDs have been selected in the "Results of GetCapabilities Request" field they will be shown in the "Selections from the GetCapabilities Results" field.

- For the DescribeEOCoverageSet response document the following section restrictions are available:
 - All: Requests full information (equals to no selections)
 - DatasetSeriesSummary: Summary about offered DatasetSeries
 - Coverage Summary: Summary about offered Coverages
- The DescribeEOCoverageSet request can be limited to a user provided Area of Interest (AOI). Here, the AOI always has to be provided in WGS84 coordinates (i.e. long/lat in degrees)! To use an AOI just enter the desired coordinate values
- The DescribeEOCoverageSet request can also be limited to a user provided Time of Interest (TOI). The TOI has to be provided in ISO-Format. To activate the use of TOI click the respective check-box and choose the desired Date-Time values
- Containment: This parameter allows to limit the hits according to:
 - overlaps: Coverages may just touch AOI
 - contains: Coverages must be fully inside AOI
- Hits Count: Limits the number of the returned results
- Coverage IDs only: This setting (non-standard) is not part of the request. It represents a 'convenience' function which extracts the received CoverageIDs to be immediately used in the GetCoverage request. Not checking this check-box will result in the DescribeEOCoverageSet result document to be displayed in a separate window. If it is checked the resulting CoverageIDs will be extracted and listed in the "GetCoverage" tab to which the GUI will automatically change
- You need to select one or more items before sending a DescribeEOCoverageSet request

6.2.3.5 GetCoverage tab

- The CoverageIDs returned by the DescribeEOCoverageSet request or selected in the "Results of GetCapabilities Request" field are shown in the "GetCoverage: download a Coverage" field
- Select one or more CoverageIDs which you want to download and access in QGIS

The following optional parameters, to limit and configure the resulting downloaded Coverages, are provided:

- AOI: At the "GetCoverage" tab the AOI values will subset the delivered Coverages to the limits provided by the AOI. The coordinate values to be supplied depend on the setting provided in the "Type of Subsetting" section. See below.

- **Type of Subsetting:** These settings influence the coordinate values of the AOI. The default setting is "Original", i.e. the coordinate values have to correspond to the CRS of the offered Coverages. The list of server supported CRSs (which is gathered during the "Connect to Server" initialisation process) is provided via the "Output CRS" selection button. However, the "Original" CRS (which corresponds to the CRS of the offered Coverage) is only gathered during a DescribeEOCoverageSet request. Thereafter the "Output CRS" selection button will be set to show the "Original CRS" as an indication. I.e. if you don't issue a DescribeEOCoverageSet request you have to know by yourself (e.g. by other means) the CRS of the offered/selected Coverage ("Original CRS"). If you like to provide the coordinates of the AOI in a different CRS you can select the "CRS" radio button and provide the desired EPSG-Code in the designated "EPSG-No." field (e.g. this method can be used if you don't know the "Original CRS"). If want to provide pixel coordinates you can select the "Pixel" radio button and provide the AOI in pixel coordinates
- **List of Band Numbers:** Here you may provide a comma-separated list of the desired bands (and their order). The delivered Coverages will be subsetting to contain only the provided bands in the provided order
- **Interpolation:** The method of interpolation applied during subsetting and especially for resizing of the delivered Coverages
- **Output Format:** You may choose one of the supported "Output Formats" (file formats) in which the Coverages shall be delivered. The listing of the server side supported "Output Formats" is gathered during the "Connect to Server" initialisation process
- **Output CRS:** Independent of the original CRS, you may choose to reproject the delivered coverages to another CRS offered by the WCS server. The list of offered CRS's is provided as a selection button. The listing of server side offered CRS's is gathered during the "Connect to Server" initialisation process
- **Output Size:** This section allows you to resize/rescale the delivered Coverages, independently of the AOI. You may choose either to provide absolute sizes for the "x-" and the "y-dimension" (pixel/line numbers) of the resulting Coverage, or you provide the desired resolution (dimension of a pixel according to "Output CRS") for each of the axis. In either case you may need to run a DescribeEOCoverageSet request for the desired Coverages first, in order to gather the correct "Axis-Labels" (if you know them already you may skip this step and provide the "Axis-Labels" manually). To return to the original outsize select the respective "Original Outsize" radio button
- Once you have set all desired 'Output Parameters', select the "GetCoverage" button to start the download

- This may take some time (according to the number of selected Coverages and their requested size). Please be patient
- The Coverages will be downloaded and stored in the provided location sequentially and will concurrently be shown in the QGIS Layers list

6.2.4 Hint - Erroneous behaviour

In case you encounter an error (except server errors) or other strange behaviour, please close the QgsWcsClient2 plugin, restart QGIS, activate the 'Python Console' from within QGIS (Menu: Plugins → Python Console), reload the QgsWcsClient2 plugin and repeat your previous actions. You should then get some additional information about the requests sent and error encountered. Please include this output in an error report to us (office@eox.at).

6.2.4.1 Quick How To:

1. Select a WCS server from the "Server" list and press the "Connect to Server" button
2. Provide a "Local Storage Path" where downloaded Coverages shall be stored
3. Switch to the "GetCapabilities" tab and press the "GetCapabilities" button
4. Select one or more CoveragesIDs and/or DataSeriesIDs of interest
5. Switch to the "DescribeEOCoverageSet" tab
6. Provide an AOI and maybe a TOI to which the search for DatasetSeries shall be limited (don't turn off the "Coverage IDs only" check-box!)
7. Select one or more CoveragesIDs and/or DataSeriesIDs of interest
8. Press the "DescribeEOCoverageSet" button
9. The returned results will be automatically shown in the "GetCoverage" tab
10. Optionally: Provide an AOI to which the Coverages shall be subsetting (pay attention to the "Type of Subsetting"; see the 'How To' for details). Select the desired "Output Format" and the "Output CRS". Provide a comma-separated list of "Bands" considering their order
11. Press "GetCoverage" button to start the download
12. The Coverages will be downloaded and stored in the provided location ("Local Storage Path") sequentially and will concurrently be shown in the QGIS Layers list
13. This may take some time (according to the number of selected Coverages and their requested size). Please be patient

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7. HOW TO AUTOMATICALLY SELECT AND DOWNLOAD CRYOLAND PRODUCTS

This section provides some general information about the available service requests and their use for WMS and WCS.

It is mainly targeted to experienced users and developers who want/need to understand/implement HTTP-KVP request. Furthermore, it provides basic examples and some information on how to correctly construct URLs to access the CryoLand offered datasets using such HTTP-KVP requests.

The offered interfaces follow the standards defined by OGC (Open Geospatial Consortium). General information about the applied OGC standards, as well as the standards documents is freely available at [OGC \(http://www.opengeospatial.org\)](http://www.opengeospatial.org).

In particular the following interfaces, provided by the CryoLand GeoPortal, and the corresponding standards plus the applicable versions are provided:

- WMS (1.0, 1.1, 1.3)
- EO-WMS (1.0)
- WCS (1.0, 1.1, 2.0)
- EO-WCS (1.0)

In the following section you find some example requests, and their syntax, to access the various service interfaces available. Such requests may be issued with any Web-Browser or any other tool able to send HTTP GET requests (e.g. wget, curl, etc.) or partly even from within GIS-Tools (e.g. Quantum GIS, etc.).

More examples and further explanations as well as additional parameters and refinement methods available with WCS/EO-WCS can be found in the following links:

- EOxServer Documentation: <http://eoxserver.org/doc/en/users/index.html>
- Demonstration: <http://eoxserver.org/doc/en/users/demonstration.html>
- Parameters: http://eoxserver.org/doc/en/users/EO-WCS_request_parameters.html#eo-wcs-request-parameters).

7.1 *Example requests for scripts*

The CryoLand products can be also accessed and downloaded automatically using simple requests generated by scripts. Example scripts written in IDL and Python, respectively, can be downloaded from the CryoLand Homepage.

7.2 *EO-WMS / WMS Requests*

GetCapabilities:

<http://neso.cryoland.enveo.at/cryoland/ows?Service=WMS&Version=1.3.0&Request=GetCapabilities>

GetFeatureInfo:

http://neso.cryoland.enveo.at/cryoland/ows?SERVICE=WMS&VERSION=1.3.0&REQUEST=GetFeatureInfo&LAYERS=daily_FSC_PanEuropean_Optical_outlines&QUERY_LAYERS=daily_FSC_PanEuropean_Optical_outlines&BBOX=32,-5,61,38&FEATURE_COUNT=10&INFO_FORMAT=text/plain&HEIGHT=650&WIDTH=990&CRS=EPSG:4326&X=321&Y=322

GetMap:

http://neso.cryoland.enveo.at/cryoland/ows?Service=WMS&Version=1.3.0&Request=GetMap&layers=FSC_0.005deg_201203070926_MOD_Baltic_SYKE.tif&CRS=EPSG:4326&Width=450&Height=420&Format=image/png&Transparent=true&BBOX=42.0,15.0,60.0,42.0

GetMap - DatasetSeries:

http://neso.cryoland.enveo.at/cryoland/ows?Service=WMS&Version=1.3.0&Request=GetMap&Layers=daily_FSC_PanEuropean_Optical&CRS=EPSG:4326&Width=450&Height=420&Format=image/png&Transparent=true&BBOX=42.0,15.0,60.0,42.0

GetMap - DatasetSeries and Time:

http://neso.cryoland.enveo.at/cryoland/ows?Service=WMS&Version=1.3.0&Request=GetMap&Layers=daily_FSC_PanEuropean_Optical&CRS=EPSG:4326&Width=450&Height=420&Format=image/png&Transparent=true&BBOX=42.0,15.0,60.0,42.0&TIME=2012-03-31T10:07:00Z/2012-04-01T10:15:00Z

7.3 EO-WCS / WCS Requests

GetCapabilities:

<http://neso.cryoland.enveo.at/cryoland/ows?Service=WCS&Version=2.0.0&Request=GetCapabilities>

DescribeCoverage - Dataset:

http://neso.cryoland.enveo.at/cryoland/ows?service=wcs&version=2.0.1&request=describecoverage&coverageid=FSC_0.005deg_201203190815_201203191145_MOD_panEU_ENVEOV2.1.00.tif

DescribeEOCoverageSet - DatasetSeries (e.g. Time Series):

http://neso.cryoland.enveo.at/cryoland/ows?service=wcs&version=2.0.1&request=describeeocoverage&eoid=daily_FSC_PanEuropean_Optical

DescribeEOCoverageSet - DatasetSeries (e.g. Time Series) - a Slice subset in Time:

[http://neso.cryoland.enveo.at/cryoland/ows?Service=WCS&Version=2.0.0&Request=DescribeEOCoverageSet&Eoid=daily_FSC_PanEuropean_Optical&subset=phenomenonTime\("2012-03-14T11:00:00Z"\)](http://neso.cryoland.enveo.at/cryoland/ows?Service=WCS&Version=2.0.0&Request=DescribeEOCoverageSet&Eoid=daily_FSC_PanEuropean_Optical&subset=phenomenonTime()

DescribeEOCoverageSet - DatasetSeries (e.g. Time Series) - a Trim (Period) subset in Time:

[http://neso.cryoland.enveo.at/cryoland/ows?Service=WCS&Version=2.0.0&Request=DescribeEOCoverageSet&Eoid=daily_FSC_PanEuropean_Optical&subset=phenomenonTime\("2012-03-17","2012-03-19T12:00:00Z"\)](http://neso.cryoland.enveo.at/cryoland/ows?Service=WCS&Version=2.0.0&Request=DescribeEOCoverageSet&Eoid=daily_FSC_PanEuropean_Optical&subset=phenomenonTime()

DescribeEOCoverageSet - DatasetSeries (e.g. Time Series) - a Trim (Period) subset in Time and spatial subset in Lat and Lon:

[http://neso.cryoland.enveo.at/cryoland/ows?Service=WCS&Version=2.0.0&Request=DescribeEOCoverageSet&Eoid=daily_FSC_PanEuropean_Optical&subset=phenomenonTime\("2012-03-17","2012-03-19T12:00:00Z"\)&subset=Lat,http://www.opengis.net/def/crs/EPSSG/0/4326\(32,44\)&subset=Long,http://www.opengis.net/def/crs/EPSSG/0/4326\(11,33\)](http://neso.cryoland.enveo.at/cryoland/ows?Service=WCS&Version=2.0.0&Request=DescribeEOCoverageSet&Eoid=daily_FSC_PanEuropean_Optical&subset=phenomenonTime()

Note:

After such DescribeEOCoverageSet Request an User's Application may parse the results and use the returned CoverageIDs to issue one or more GetCoverage Requests to access the respective datasets.

GetCoverage - Dataset - Full dataset, but resizing the Output - delivery as GeoTIFF:

[http://neso.cryoland.enveo.at/cryoland/ows?service=wcs&version=2.0.1&request=getcoverage&coverageid=FSC_0.005deg_201203190815_201203191145_MOD_panEU_ENVEOV2.1.00.tif&format=image/tiff&size=x\(500\)&size=y\(150\)](http://neso.cryoland.enveo.at/cryoland/ows?service=wcs&version=2.0.1&request=getcoverage&coverageid=FSC_0.005deg_201203190815_201203191145_MOD_panEU_ENVEOV2.1.00.tif&format=image/tiff&size=x(500)&size=y(150))

GetCoverage - Dataset - a subset in Lat and Long - delivery as GeoTIFF:

[http://neso.cryoland.enveo.at/cryoland/ows?service=wcs&version=2.0.1&request=getcoverage&CoverageID=FSC_0.005deg_201203190815_201203191145_MOD_panEU_ENVEOV2.1.00.tif&Format=image/tiff&subset=Lat,http://www.opengis.net/def/crs/EPSSG/0/4326\(32,44\)&subset=Long,http://www.opengis.net/def/crs/EPSSG/0/4326\(11,33\)](http://neso.cryoland.enveo.at/cryoland/ows?service=wcs&version=2.0.1&request=getcoverage&CoverageID=FSC_0.005deg_201203190815_201203191145_MOD_panEU_ENVEOV2.1.00.tif&Format=image/tiff&subset=Lat,http://www.opengis.net/def/crs/EPSSG/0/4326(32,44)&subset=Long,http://www.opengis.net/def/crs/EPSSG/0/4326(11,33))

GetCoverage - Dataset - a subset in Lat and Long - Output CRS EPSG 3035 - delivery as GeoTIFF:

[http://neso.cryoland.enveo.at/cryoland/ows?service=wcs&version=2.0.1&request=getcoverage&CoverageID=FSC_0.005deg_201203190815_201203191145_MOD_panEU_ENVEOV2.1.00.tif&Format=image/tiff&subset=Lat,http://www.opengis.net/def/crs/EPSSG/0/4326\(32,44\)&subset=Long,http://www.opengis.net/def/crs/EPSSG/0/4326\(11,33\)&OutputCRS=http://www.opengis.net/def/crs/EPSSG/0/3035](http://neso.cryoland.enveo.at/cryoland/ows?service=wcs&version=2.0.1&request=getcoverage&CoverageID=FSC_0.005deg_201203190815_201203191145_MOD_panEU_ENVEOV2.1.00.tif&Format=image/tiff&subset=Lat,http://www.opengis.net/def/crs/EPSSG/0/4326(32,44)&subset=Long,http://www.opengis.net/def/crs/EPSSG/0/4326(11,33)&OutputCRS=http://www.opengis.net/def/crs/EPSSG/0/3035)

GetCoverage - Dataset - a subset in Pixels - delivery as GeoTIFF:

[http://neso.cryoland.enveo.at/cryoland/ows?service=wcs&version=2.0.1&request=getcoverage&CoverageID=FSC_0.005deg_201203190815_201203191145_MOD_panEU_ENVEOV2.1.00.tif&Format=image/tiff&subset=x\(1500,2599\)&subset=y\(200,699\)](http://neso.cryoland.enveo.at/cryoland/ows?service=wcs&version=2.0.1&request=getcoverage&CoverageID=FSC_0.005deg_201203190815_201203191145_MOD_panEU_ENVEOV2.1.00.tif&Format=image/tiff&subset=x(1500,2599)&subset=y(200,699))

GetCoverage - Dataset - delivery of GeoTIFF, but embedded inside a GML document (GML + GeoTIFF) - Resizing Output:

[http://neso.cryoland.enveo.at/cryoland/ows?service=wcs&version=2.0.1&request=getcoverage&CoverageID=FSC_0.005deg_201203190815_201203191145_MOD_panEU_ENVEOV2.1.00.tif&format=image/tiff&mediatype=multipart/related&size=x\(500\)&size=y\(150\)](http://neso.cryoland.enveo.at/cryoland/ows?service=wcs&version=2.0.1&request=getcoverage&CoverageID=FSC_0.005deg_201203190815_201203191145_MOD_panEU_ENVEOV2.1.00.tif&format=image/tiff&mediatype=multipart/related&size=x(500)&size=y(150))

A. APPENDIX – PRODUCT SPECIFICATIONS

The CryoLand products were defined in collaboration with the CryoLand user group. In the following tables, the specifications for the Pan-European and regional snow products, the lake / river ice products, and the glacier products are summarized.

Table A.1:
Pan – European Snow Product Specifications.

<i>Product</i>	<i>Fractional Snow Cover, Uncertainty estimation (RMSE) Pan-European</i>	<i>Snow water equivalent, Pan-European, Standardized Snow Pack Indicator (Low res)</i>
Satellite data base	MODIS Future: Sentinel S1, S3	SSMIS, AMSR2
Coverage	72 N / 11 W – 35 N / 50 E Former: 72 N / 11 W – 35 N / 45 E	72 N / 11 W – 35 N / 50 E, Northern hemisphere Former: 72 N / 11 W – 35 N / 45 E
Spatial resolution, m	ca 500 m Former: ca 1 km	ca 10 km (Pan-EU) / ca 25 km (N hem)
Grid / Projection (EPSG Code)	Geographic coordinates / WGS84 (EPSG: 4326)	Geographic coordinates / WGS84 (EPSG: 4326)
Temporal resolution	Daily, full year	Daily, dry snow season
Latency time	<1 day	<1 day

Table A.2:
Regional Snow Product Specifications.

<i>Product</i>	<i>Fractional Snow Cover, regional</i>	<i>Wet Snow Covered Area, Scandinavia</i>	<i>Multi-temporal multi-sensor Fractional Snow Cover, Scandinavia</i>
Satellite data base	MODIS Future: Sentinel S3	Radarsat-2 Future: Sentinel S1	MODIS, Radarsat-2 Future: Sentinel S1, S3
Coverage	Central Europe, Baltic Sea area, Scandinavia	Scandinavia	Scandinavia
Spatial resolution, m	ca 250 m – 500 m	ca 50 m	ca 250 m
Grid / Projection (EPSG Code)	Geographic coordinates / WGS84 (EPSG: 4326), Optional: Grid/Projection defined by user (on request)	Geographic coordinates / WGS84 (EPSG: 4326), Optional: UTM33/WGS84	Geographic coordinates / WGS84 (EPSG: 4326), Optional: UTM33/WGS84
Temporal resolution	Daily, full year	Daily, melting season (1 April – 31 July)	Daily, melting season (1 April – 31 July)
Latency time	<1 day	1 week	<1 day

Table A.3:
Pre-operational Snow Product Specifications.

<i>Product</i>	<i>Surface Temperature of Snow</i>	<i>Snow Surface Wetness</i>
Satellite data base	MODIS Future: Sentinel S3	MODIS Future: Sentinel S3
Coverage	Southern Norway	Southern Norway
Spatial resolution, m	ca 1 km	ca 1 km
Grid / Projection (EPSG Code)	Geographic coordinates / WGS84 (EPSG: 4326), Optional: Grid/Projection defined by user (on request)	Geographic coordinates / WGS84 (EPSG: 4326), Optional: Grid/Projection defined by user (on request)
Temporal resolution	Daily, melting season (March – July)	Daily, melting season (March – July)
Latency time	<1 day	<1 day

Table A.4:
Lake / River Ice Product Specifications.

<i>Product</i>	<i>Lake Ice Classification, Baltic Sea area</i>	<i>River Ice Extent, regional</i>
Satellite data base	MODIS Future: Sentinel S3	Radarsat-2, TerraSAR-X Future: Sentinel S1
Coverage	Baltic Sea area	Regional, focus on Scandinavia, on demand
Spatial resolution, m	ca. 250 m	ca. 1 m – 50 m
Grid / Projection (EPSG Code)	Geographic coordinates / WGS84 (EPSG: 4326)	Geographic coordinates / WGS84 (EPSG: 4326), Optional: Grid/Projection defined by user (on request)
Temporal resolution	Annually, spring season (1 May – 30 June)	Annually, spring season (15 April – 30 June)
Latency time	<1 day	<3 days

The CryoLand snow and lake/river ice products are provided as raster data in GeoTIFF format, projected by default in geographic coordinates / WGS84. Other projections and formats can be selected optionally for downloading data.

Glacier products are provided only on demand. These products meet the internationally accepted standards of GLIMS (<http://www.glims.org>).

Table A.5:
Glacier Product Specifications.

Product	Glacier Outlines, regional	Glacier Lakes, regional	Snow / Ice Areas on Glaciers, regional
Satellite data base	SPOT-5, Ikonos Future: Sentinel S2	SPOT-5, Ikonos, Formosat-2, Radarsat-2, TerraSAR-X Future: Sentinel S1, S2	SPOT-5, Ikonos, Quickbird Future: Sentinel S2
Coverage	Regional, on demand	Regional, on demand	Regional, on demand
Spatial resolution, m	ca. 2.5 m – 10 m	ca. 2 – 30 m	ca. 2.5 m – 10 m
Grid / Projection (EPSG Code)	Geographic coordinates / WGS84 (EPSG: 4326), Optional: Grid/Projection defined by user (on request)	Geographic coordinates / WGS84 (EPSG: 4326), Optional: Grid/Projection defined by user (on request)	Geographic coordinates / WGS84 (EPSG: 4326), Optional: Grid/Projection defined by user (on request)
Temporal resolution	Annually, late summer (1 August – 30 November)	Annually, summer season	Annually, late summer (1 August – 30 November)
Latency time	<3 months	<3 months	<3 months

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B. APPENDIX – PRODUCT CODING

For the coding of the products and specific surface classes, the convention described in Table B.1 is used.

Table B.1:
Product Coding Convention.

Code range	Comment
0	Outside area of interest.
1 – 99	This range is reserved for masks used in all products.
100 – 200	Product coding (Fractional Snow Cover, Snow Water Equivalent, Surface Temperature of Snow).
201 – 249	This range contains certain binary classifications, as for glacier products, wet/dry snow, lake ice etc.
250 – 255	Reserved for error coding.

The following two tables show the coding of the CryoLand snow products. The coding includes masks of surface classes or clouds, product specific coding, as well as the conversion of the code to the product value in defined units.

Table B.2:
Coding of all CryoLand masks.

Code range	Class	Comment
0	Outside area of interest	
20	Sea mask	Water mask available as layer in CryoLand GeoPortal
21	Lake mask	Water mask available as layer in CryoLand GeoPortal
22	River mask	Water mask available as layer in CryoLand GeoPortal
30	Cloud mask	For products from optical sensors only
35	Radar shadow / foreshortening	For products from SAR sensors only
50	Bare Ground, free of snow	
70	Glacier mask	Mask available as layer in CryoLand GeoPortal
80	Forest mask	Mask available as layer in CryoLand GeoPortal
81	Dense forest mask	Not used yet.
82	Snow in forest	Binary snow classification, only used for Central Europe FSC product
90	Urban area mask	Mask available as layer in CryoLand GeoPortal
91	Mountain mask	Used for SWE product
251	Polar night	For products from optical sensors only
254	Input data error	
255	No data	

Table B.3:
Coding of CryoLand Snow Products.

Product	Fractional Snow Cover (Pan-European / Regional), Uncertainty Measure RMSE	Snow Water Equivalent (Pan-European / N-Hemisphere)	Surface Temperature of Snow (Southern Norway)
Product range	0 to 100%	0 to 400 mm	0 to -50 °C
Code range	100 – 200	100 – 200	100 – 200
Unit	Per cent (%)	mm w.e.	°C
Conversion	FSC = CODE – 100	SWE = (CODE – 100) * 4.0	STS = (Code – 200) / 2

Table B.4:
Coding of further CryoLand Snow, Glacier and Lake/River Ice Products.

Code range	Class	Product
Snow Products		
209	Dry snow or bare ground (no SCAW estimate)	Wet Snow Covered Area
210	Snow covered area (dry and wet snow)	Snow Covered Area (Binary), Lake Ice Classification
211	Dry, cold snow (SAR)	Wet Snow Covered Area, Snow Surface Wetness
212	Dry – to – moist snow, stable conditions (SAR)	Snow Surface Wetness
213	Dry – to – moist snow, increasing grain size	Snow Surface Wetness
214	Moist snow, stable conditions	Snow Surface Wetness
215	Moist snow, increasing grain size	Snow Surface Wetness
216	Wet snow	Wet Snow Covered Area, Snow Surface Wetness
217	Fractional snow cover, no product estimate	Snow Surface Wetness, Surface Temperature of Snow
218 – 219	Reserved for further Snow Surface Wetness classes	Snow Surface Wetness
Lake / River Ice Products		
220	Clear Lake Ice	Lake Ice Classification
221	River Ice	River Ice Extent
222	Ice Jam	River Ice Jam
223	Flooded area	Flood Inundation Area
224	Water (in lake ice product)	Lake Ice Classification
225	Partial snow / White ice cover	Lake Ice Classification
Glacier Products		
230	Snow area on glacier	Snow / ice area on glacier
231	Glacier ice	Snow / ice area on glacier
232	Nunataks, internal rocks	Glacier outline, Glacier area, Snow / ice area on glacier

Table B.5:
Coding of Standardized Snow Pack Indicators. Reference period for comparison ("normal") is 1979 – 2010.

<i>SSPI Code</i>	<i>Specification</i>
SSPI < -2.00	Highly less snow than normal
-2.00 <= SSPI < -1.50	Much less snow than normal
-1.50 <= SSPI < -1.00	Less snow than normal
-1.00 <= SSPI < 1.00	Near normal snow conditions
1.00 <= SSPI < 1.50	More snow than normal
1.50 <= SSPI < 2.00	Much more snow than normal
SSPI >= 2.00	Highly much more snow than normal

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C. APPENDIX – SUPPORTED PROJECTIONS FOR DOWNLOADS

Table C.1:
Supported projections optionally selectable for the product download.

<i>ESPG Code</i>	<i>Projection</i>
4326	Geographic Coordinates (Lat, Lon) / WGS84
3034	Lambert Conic Conformal / ETRS89
3035	Lambert Azimuthal Equal Area / ETRS89
900913	Spherical Mercator
32622	UTM 22 / WGS84
32632	UTM 32 / WGS84
32633	UTM33 / WGS84
32643	UTM43 / WGS84
31287	Lambert Conic Conformal SP2 (LCC) / Militär Geographisches Institut (MGI)