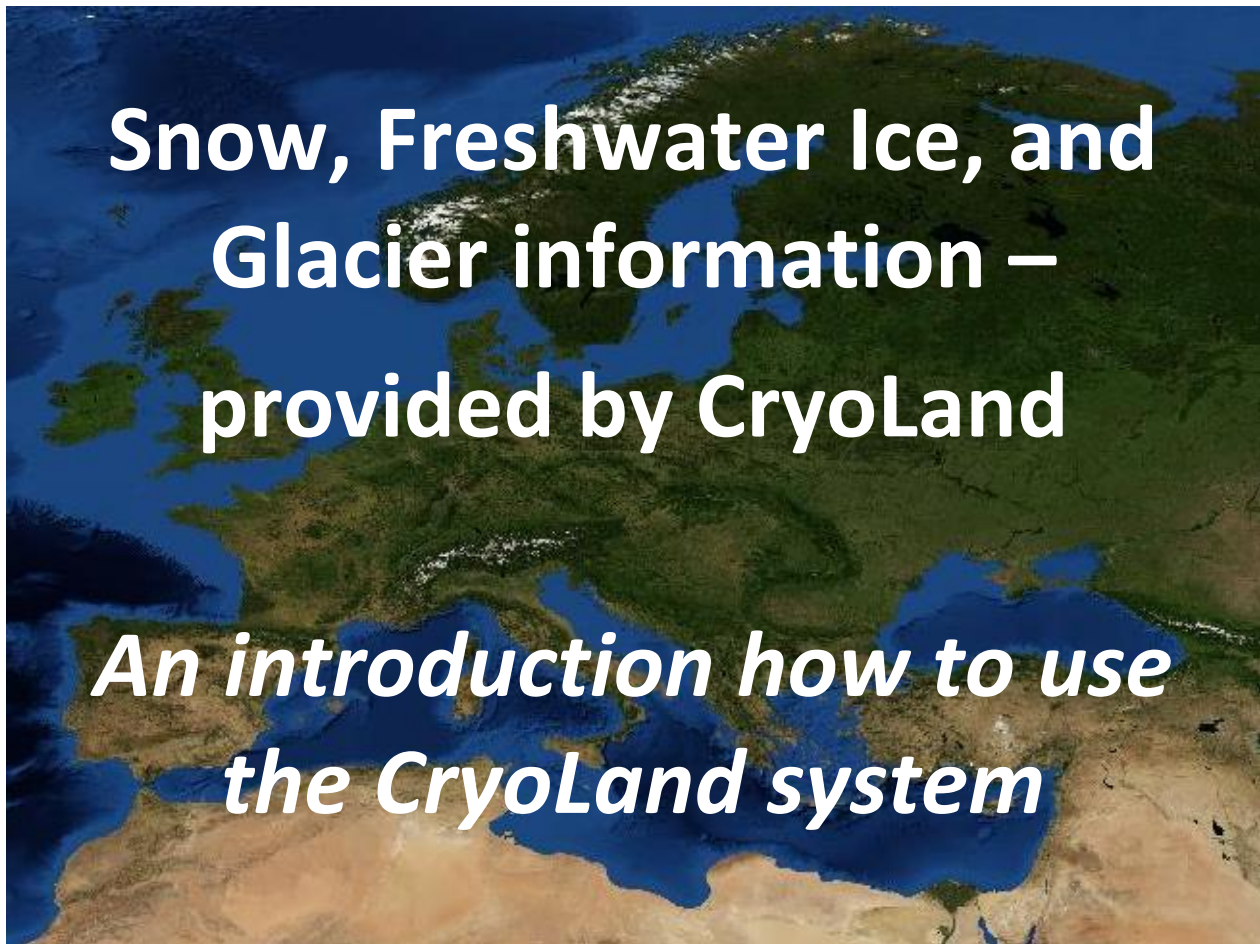


Welcome to the Chills of the Planet



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1. CRYOLAND – THE GMES SERVICE SNOW AND LAND ICE

The FP7 Project CryoLand develops, and implements standardized services on snow and land ice monitoring as a Downstream Service within 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 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)

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

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

After the project end the CryoLand Service will continue with best efforts generating and providing daily snow and lake ice products in Near-Real Time until 2017. The generation of glacier and river ice products after the project end depends on the availability of satellite data, and are on-demand services which can cause costs for the customer. All products generated during the project period, also for former years, are made available free of charge via the CryoLand GeoPortal.

A description of the CryoLand snow, glacier and lake/river ice products are available at the CryoLand Homepage. A brief overview of the products provided by the GeoPortal is given in the next Chapter.

1.1 Recommended Internet Browsers

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

Mozilla Firefox / Google Chrome / Safari

Thus, strongly recommend 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.

1.2 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 3 – 6.

2. PRODUCTS IN THE CRYOLAND SYSTEM

2.1 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 products, new candidates for operational products

Pan-European

daily_FSC_PanEuropean_Optical – Daily Fractional Snow Cover from Optical Satellite Data covering the Pan-European Area

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. A time series of daily products since October 2000 is available via the CryoLand GeoPortal, with a short break from 15 June 2001 – 3 July 2001 due to calibration problems of the used satellite data in this period.

The product is generated daily in near-real time and is updated in the late afternoon at the CryoLand GeoPortal. ENVEO will continue the product generation with best efforts until 2017.

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

For the Pan-European fractional snow cover product derived from optical satellite data the daily unbiased root mean square error (RMSE) per pixel is provided as statistical measure for the product uncertainty. For visualization issues only, the unbiased RMSE in the GeoPortal is shown in discrete classes, using 4 % intervals for RMSE values between 0 and 40 %. All RMSE values larger than 40 % are summarized in one class. The product provided for download includes the exactly retrieved RMSE per pixel, ranging between 0 % and 100 %. The product is available since October 2000, whenever the daily fractional snow cover product for the Pan-European area is available. ENVEO will continue the product generation with best efforts until 2017.

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

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

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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. This viewing service will continue with best efforts until 2017, or as long as the daily pan-European fractional snow cover product is provided.

daily_SWE_PanEuropean_Microwave – Daily Snow Water Equivalent from Microwave Radiometer covering the Pan-European Area

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. A time series since October 2000 is provided via the CryoLand GeoPortal. FMI will continue the product generation with best efforts until 2017.

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

The Standardized Snow Pack Indicator gives snow pack values as standardized values between -3 and 3 (TABLE 2.1) calculated from time series of daily snow water equivalent in mm in water (=kg/m² of snow).

TABLE 2.1:
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%

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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° x 0.01° 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. FMI will continue these two services with best efforts until 2017.

Regional

daily_FSC_Alps_Optical – Daily Fractional Snow Cover from Optical Satellite Data covering the Alps

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. Products are available for the winter seasons 2010/11 and 2011/12 and as a continuous time series since October 2012 via the CryoLand GeoPortal. ENVEO will continue with best efforts providing this product as a downstream service.

daily_FSC_Baltic_Optical – Daily Fractional Snow Cover from Optical Satellite Data covering the Baltic Sea Region

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 for the period February/March – June 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. SYKE will continue with best efforts providing this product as a downstream service.

multitemp_FSC_Scandinavia_Optical – Multi-temporal Fractional Snow Cover from Optical Satellite Data covering Scandinavia

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.

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The product is provided daily from April-July via the CryoLand GeoPortal. KSAT / NR / NORUT will continue with best efforts providing this product as a downstream service.

multitemp_FSC_Scandinavia_Optical_Radar – Multi-temporal Fractional Snow Cover from combined Optical and Radar Sensors covering Scandinavia

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 $0.003^\circ \times 0.003^\circ$, 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. KSAT / NR / NORUT will continue with best efforts providing this product as a downstream service.

daily_SCAW_Scandinavia_Radar – Daily Wet Snow Covered Area from Radar Data over Scandinavia

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 $0.0005^\circ \times 0.0005^\circ$, 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. KSAT / NORUT will continue with best efforts providing this product as a downstream service.

multitemp_SCAW_Alps_Radar – Multi-temporal Wet Snow Covered Area from Radar Data over the Alps



The new Wet Snow Covered Area Product (demonstration products available for melting period 2015, pilot service planned to start in April 2016) is provided during the melting period over the Alps. The product is generated based on Sentinel-1 data and is updated per Sentinel-1 track every 12 days. As the Alps are covered by multiple tracks which are partly overlapping for many pixels updated information are available more frequently, about one to two times per week. With the launch of Sentinel-1B, planned for 2016, the observation frequency per pixel could even be increased. The product provides the binary classification of snow free and wet snow cover for all pixels. The product has a pixel size of $0.001^\circ \times 0.001^\circ$, which is approximately 100 m x 100 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. ENVEO started this downstream service within the EU FP7 project SEN3APP and will continue providing this product with best efforts.



Demonstration Products

daily_SSW_SouthNorway_Optical – Daily Snow Surface Wetness from Optical Satellite Data covering Southern Norway

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. NR will continue with best efforts the product development and provide this product as a downstream service.

daily_STS_SouthNorway_Optical – Daily Snow Surface Temperature from Optical Satellite Data covering Southern Norway

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. NR will continue with best efforts the product development and provide this product as a downstream service.

2.2 Satellite Images

Pan-European

daily_MODIS_RGB651_PanEuropean

Since mid of October 2014, a daily false colour RGB composite of the MODIS reflectances of bands 6 (1628 – 1652 nm), 5 (1230 – 1250 nm) and 1 (620 – 670 nm) is provided as viewing service for the Pan-European area ($72^\circ\text{N}/11^\circ\text{W} - 35^\circ\text{N}/50^\circ\text{E}$) with a pixel size of $0.005^\circ \times 0.005^\circ$, which is approximately 500 m x 500 m. The shown MODIS data are used for the snow products generation from optical satellite data for the Pan-European and the regional areas. Greenish and brownish areas in this viewing layer indicate land cover, such as vegetation, urban areas or bare ground, dark blue areas indicate water bodies, medium blue areas indicate snow areas, and whitish and light bluish areas indicate clouds. This layer will be provided as long as the daily fractional snow cover product for the pan-European area is provided by ENVEO.

2.3 Lake / River Ice Products

Lake Ice Classification

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. This viewing service will continue with best efforts as long as the daily pan-European fractional snow cover product is provided by SYKE.

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

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° x 0.0025°, 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. SYKE will continue with best efforts providing this product as a downstream service.

River Ice Extent

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

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. NORUT will continue with best efforts providing this product as a downstream service.

Note:

Snow and Lake / River Ice and Glacier Ice Velocity 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.



2.4 Glacier Products

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. ENVEO will continue with best efforts providing this product as a downstream service.

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 GMES/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.

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. ENVEO and GAMMA will continue with best efforts providing this product as a downstream service.

Glacier Ice Surface Velocity

Glacier ice surface velocity products are generated on user request for selected glaciers and regions, using high resolution (3 m – 50 m) repeat pass radar satellite data. Ice surface velocities are provided in meters per year (m/yr). Products are provided as raster formats meeting the specified CryoLand standards. ENVEO and GAMMA will continue with best efforts providing this product as a downstream service.

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Note:

Glacier products are available for selected glaciers in the Hohe Tauern, Austria, on Nuussuaq Peninsula, West Greenland, in Norway, Nepal and Bhutan. Glacier 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. HOW TO ACCESS THE CRYOLAND SYSTEM

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

The CryoLand Website is the starting point for informing about CryoLand activities, products and services. It provides:

- 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



3.2 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 4.

2. Access through a Geographic Information System (GIS)

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

Read more in Chapter 5.

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

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interface for decision systems developed by the user.

Read more in Chapter 6.



4. HOW TO USE THE INTERACTIVE WEB INTERFACE

4.1 What you see is what you get (WYSIWYG)

The new version 2.1 of the CryoLand Interactive Map Tool, released in February 2015, 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 4.1).

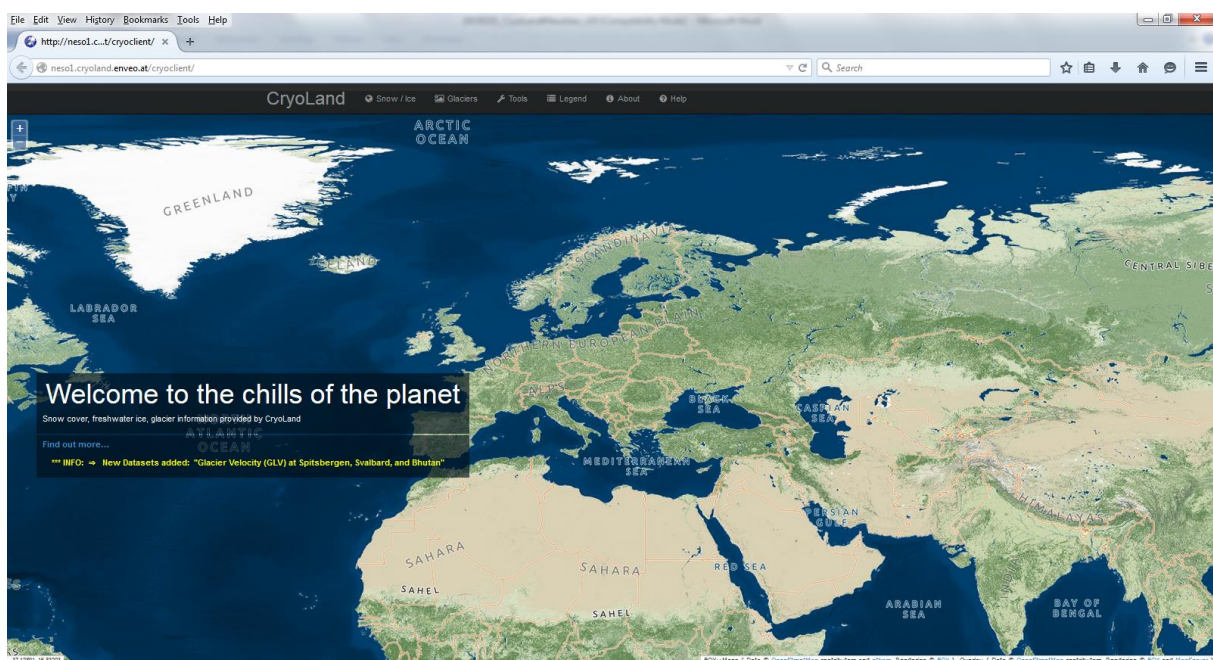


Figure 4.1: Starting page of CryoLand Interactive Map Tool (version 2.1).

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-EO-WMS is used for the previews whereas OGC-EO-WCS 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.

4.2 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 4.2) 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 (appears only when a product is selected) at bottom of map window (zoom in/out, click, drag and drop)
- Coordinates of current cursor position as decimal degrees (small numbers on the lower left corner of the map window)

4.3 WebGUI Menu

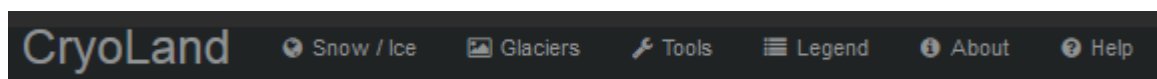


Figure 4.2: WebGUI menu bar.

4.3.1 CryoLand

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

4.3.2 Snow / Ice

The following CryoLand snow and ice products are offered for selection, viewing and download options. Each product can be activated by clicking in the box on the left side of each layer. The user may select one or multiple of the following layers (status: 31 March 2015):

- daily_FSC_PanEuropean_Optical



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- daily_FSC_PanEuropean_Optical_Uncertainty
- daily_FSC_Alps_Optical
- daily_MODIS_RGB651_PanEuropean
- daily_SWE_PanEuropean_Microwave
- avg_10day_SSPI_PanEuropean_Microwave
- avg_30day_SSPI_PanEuropean_Microwave
- daily_FSC_Baltic_Optical
- daily_LIE_Baltic_Optical
- daily_SCAW_Scandinavia_Radar
- daily_SSW_SouthNorway_Optical
- daily_STS_SouthNorway_Optical
- multitemp_FSC_Scandinavia_Optical
- multitemp_FSC_Scandinavia_Optical_Radar
- RIE_SE_FI_Torne_River_2013_Radar
- View_10day_FSC_PanEuropean_Cloudfree
- View_10day_LIE_Baltic_Cloudfree
- multitemp_SCAW_Alps_Radar

As soon as a layer is activated a time line occurs at the bottom of the window, indicating the availability of the selected product by coloured dots or lines, depending on the used zoom. More details about the usage of the time line are provided in Section 4.4.

Note:

Optionally, single or multiple products 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 ① 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 ① for the selected layer.

The symbol ② right hand of each layer can be used for re-sorting the layers by drag and drop.

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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 4.1 short product descriptions for the snow product layer names are provided. Extended product descriptions are given in Section 2.1, detailed product specifications can be found in the Appendix A.

• TABLE 4.1:
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 (unbiased 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)
multitemp_SCAW_Alps_Radar	Multi-temporal Wet Snow Covered Area over the Alps from Radar data

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In Figure 4.3 the Pan-European Snow Water Equivalent (SWE) and the Fractional Snow Cover (FSC) products are shown, using the layer EOX::Maps as background. The transparency of the FSC product is reduced in order to make the SWE 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.

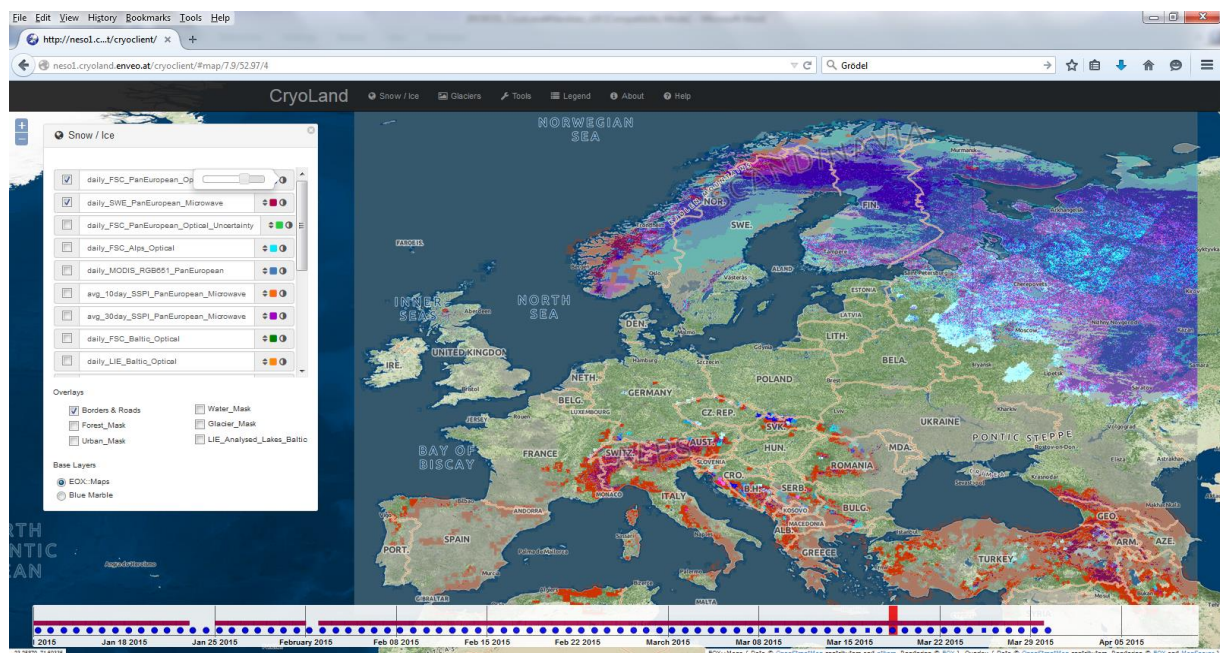


Figure 4.3: CryoLand GeoPortal showing the two layers Snow Water Equivalent and Fractional Snow Cover over the Pan-European Area (daily_SWE_PanEuropean_Microwave, daily_FSC_PanEuropean_Optical). The opacity of the layer Fractional Snow Cover (daily_FSC_PanEuropean_Optical) is reduced in order to make the Snow Water Equivalent (daily_SWE_PanEuropean_Microwave) visible over areas covered by both products.

Satellite Images

The MODIS false colour RGB composite of the reflectances of the visible band 1 and the near-infrared spectral bands 5 and 6 is provided as new viewing service since mid of October 2014. The layer is based on the reflectances of multiple daily swaths of MODIS, merged over the Pan-European area, and shows the data base used for the daily snow and lake ice products generation from optical satellite data for the Pan-European and regional areas. The layer is provided as Viewing Service only. Raw data of MODIS provided in Near-Real-Time (NRT) can be downloaded after registration e.g. from <https://earthdata.nasa.gov/about-eosdis/system-description/lance/modaps/about-modaps/data-products>. TABLE 4.2 provides the layer abbreviation as given in the CryoLand GeoPortal Layer menu,

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as well as a short description. Figure 4.4 shows an example of the MODIS RGB composite over the Pan-European area.

TABLE 4.2:
Satellite images Layer abbreviation and associated layer description.

Snow Product Layer	Product Description
daily_MODIS_RGB651_PanEuropean	Daily RGB composite of MODIS reflectances of bands 6-5-1 over the Pan-European Area, VIEWING Service only.

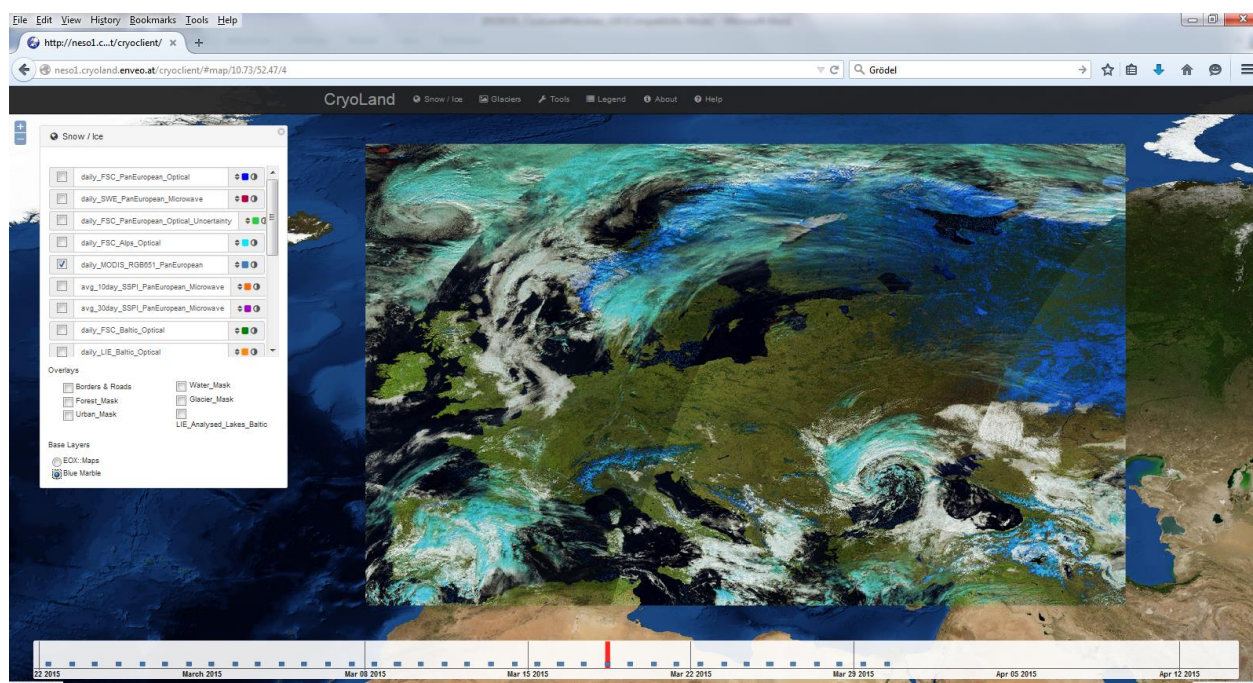


Figure 4.4: Example of the MODIS RGB 6-5-1 reflectances composite merged over the Pan-European area. The layer is provided as viewing service via the GeoPortal. Dark blue areas indicate water bodies, greenish and brownish areas indicate different land cover types, medium blue areas indicate snow, and whitish and light bluish areas indicate cloud cover. As base layer outside the layer extent the Blue Marble is used.

Lake / River Ice Products

Three Lake / River Ice Products are provided in the CryoLand GeoPortal. TABLE 4.3 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 0, 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. An example for the Lake Ice Classification product over the Baltic area is shown in Figure 4.5.



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TABLE 4.3:
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
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

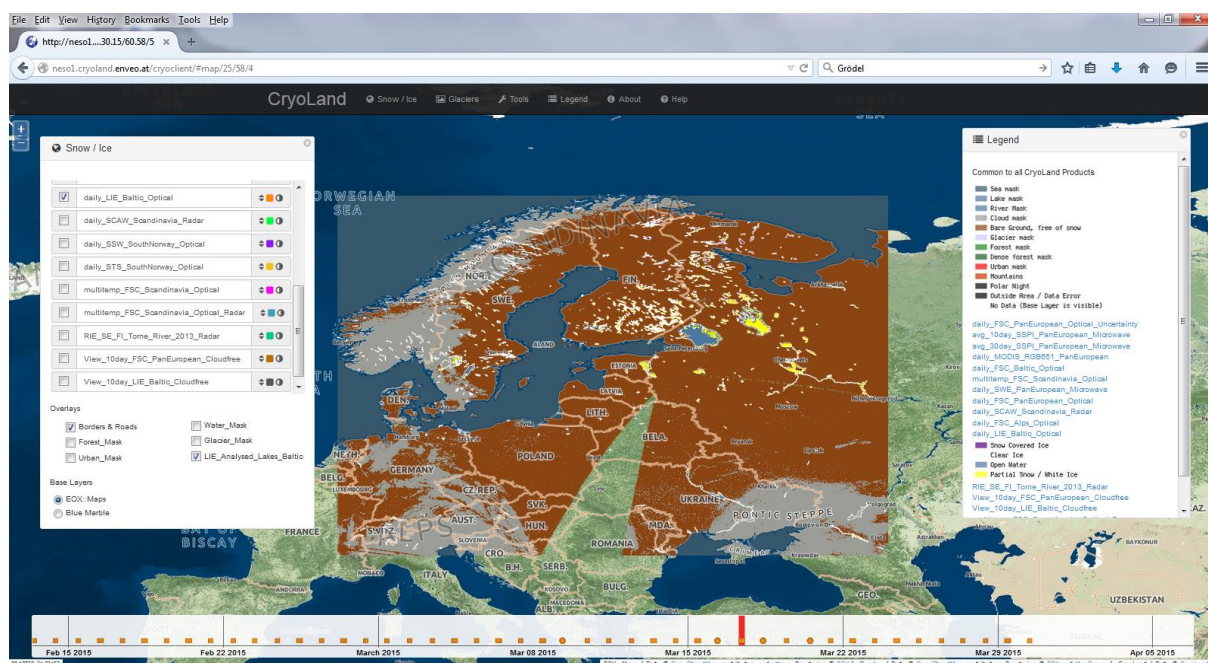


Figure 4.5: Example of the Lake Ice Classification over the Baltic area provided via the GeoPortal. The product legend is shown on the right hand of the figure. Additionally, the overlays analysed lakes of the Baltic region, country borders and names are activated. The EOX Maps is used as base layer.

Overlays

Additionally to the snow and ice product layers, the following Overlays can optionally be selected by the user in this menu:

- Forest mask
- Water mask
- Urban mask
- Glacier mask

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- Country Borders
- LIE_Analysed_Lakes_Baltic

Most of 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 4.6 all overlay masks (Forest, Water, Urban, Glacier, Country Borders) provided by CryoLand are presented with the Relief used as background. The layer LIE_Analysed_Lakes_Baltic includes the outlines of the lakes used for the Lake Ice Extent analysis over the Baltic Sea region.

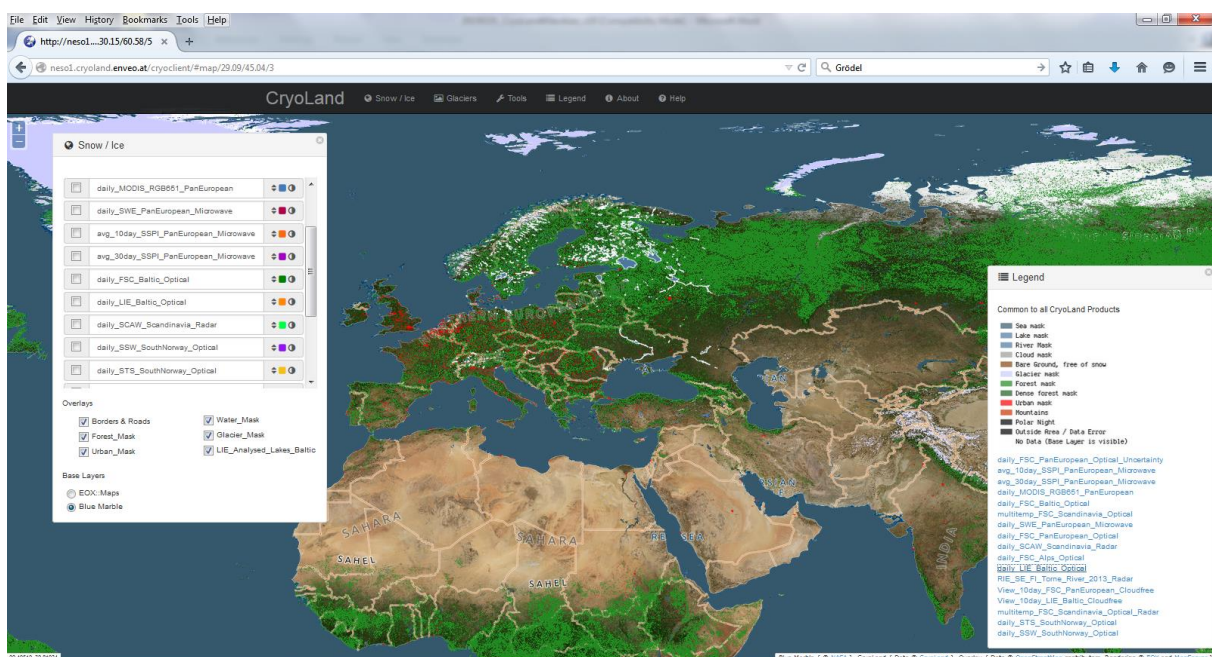


Figure 4.6: CryoLand GeoPortal showing all overlay masks using Blue Marble as Base Layer: Forest, Water, Urban, Glacier, Country Borders, Analysed Lakes of Baltic Region used for LIE product generation.

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.

The CryoLand Web interface provides two different base layers:

- Blue Marble (pixel size: ca. 1 km x 1 km)
- EOX::Map

Only one base layer can be selected as background (default: EOX::Maps).



4.3.3 Glaciers

Glacier products are generated on demand within the CryoLand project, and are directly provided to interested users. In the CryoLand GeoPortal the glacier products are provided as viewing services.

- GL_Tininnilik_lake_20000922
- GL_Tininnilik_lake_20010707
- GL_Tininnilik_lake_20040901
- GL_Tininnilik_lake_20050904
- GL_Tininnilik_lake_20070809
- GL_Tininnilik_lake_20100817
- GL_Tininnilik_lake_20110703
- GL_Tininnilik_lake_20120907
- GL_Tininnilik_images
- AT_Hohe_Tauern_outlines_20090901
- AT_Hohe_Tauern_images
- GLV_glacier_Austfonna
- GLV_glacier_Spitsbergen
- GLV_glacier_Bhutan

Glacier Products

Glacier products are available for particular dates only, which can be far in the past. If you do not know the exact location of the area covered by a glacier product the associated images layer should be activated before activating a glacier product. Use the zoom function of the time line (cf. Section 4.4) to find an available dataset. When you click on the bullet appearing in the time line the map zooms automatically to the region covered by the image. Afterwards, the selection and activation of one or multiple of the available glacier products by just clicking in the boxes left of the layer names is an easy task.

For selected regions in Austria, Norway, Bhutan and West-Greenland the following glacier products are available as viewing services in the WebGUI of the GeoPortal (cf. TABLE 4.4):

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

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- Glacier Lakes – Polygons outlining glacier lakes and internal island
- Glacier Ice Surface Velocity (GLV) – Raster files showing the ice motion (also downloadable)

• TABLE 4.4:

Glacier Product Layer abbreviations and associated product descriptions.

Glacier Product Layer	Product Description
AT_Hohe_Tauern_images	Optical satellite image used for product generation in Austria, at Hohe Tauern of 1 st September 2009
AT_Hohe_Tauern_outlines_20090901	Glacier Outlines at Hohe Tauern, Austria, of 1 st September 2009 from Optical satellite data
GL_Tininnilik_images	Optical satellite image used for product generation in Greenland, on Lake Tininnilik. Currently, images of the following dates are available: 22/09/2000, 07/07/2001, 01/09/2004, 04/09/2005, 09/08/2007, 17/08/2010, 03/07/2011 and 07/09/2012
GL_Tininnilik_lake_20120907	Glacier Lake Tininnilik, Greenland, on 7 th September 2012 from Optical satellite data
GL_Tininnilik_lake_20110703	Glacier Lake Tininnilik, Greenland, on 3 rd July 2011 from Optical satellite data
GL_Tininnilik_lake_20100817	Glacier Lake Tininnilik, Greenland, on 17 th August 2010 from Optical satellite data
GL_Tininnilik_lake_20070809	Glacier Lake Tininnilik, Greenland, on 9 th August 2007 from Optical satellite data
GL_Tininnilik_lake_20050904	Glacier Lake Tininnilik, Greenland, on 4 th September 2005 from Optical satellite data
GL_Tininnilik_lake_20040901	Glacier Lake Tininnilik, Greenland, on 1 st September 2004 from Optical satellite data
GL_Tininnilik_lake_20010707	Glacier Lake Tininnilik, Greenland, on 7 th July 2001 from Optical satellite data
GL_Tininnilik_lake_20000922	Glacier Lake Tininnilik, Greenland, on 22 nd September 2000 from Optical satellite data
GLV_glacier_Austfonna	Glacier Ice surface velocity on Austfonna, from ERS-2 SAR satellite data of March and April 2011
GLV_glacier_Spitsbergen	Glacier Ice surface velocity on Spitsbergen, from TerraSAR-X satellite data of December 2012 and January 2013
GLV_glacier_Bhutan	Glacier Ice surface velocity on glaciers in Bhutan, from TerraSAR-X satellite data of June 2014

Figure 4.7 shows an example of a Glacier Outline Product in Austria.



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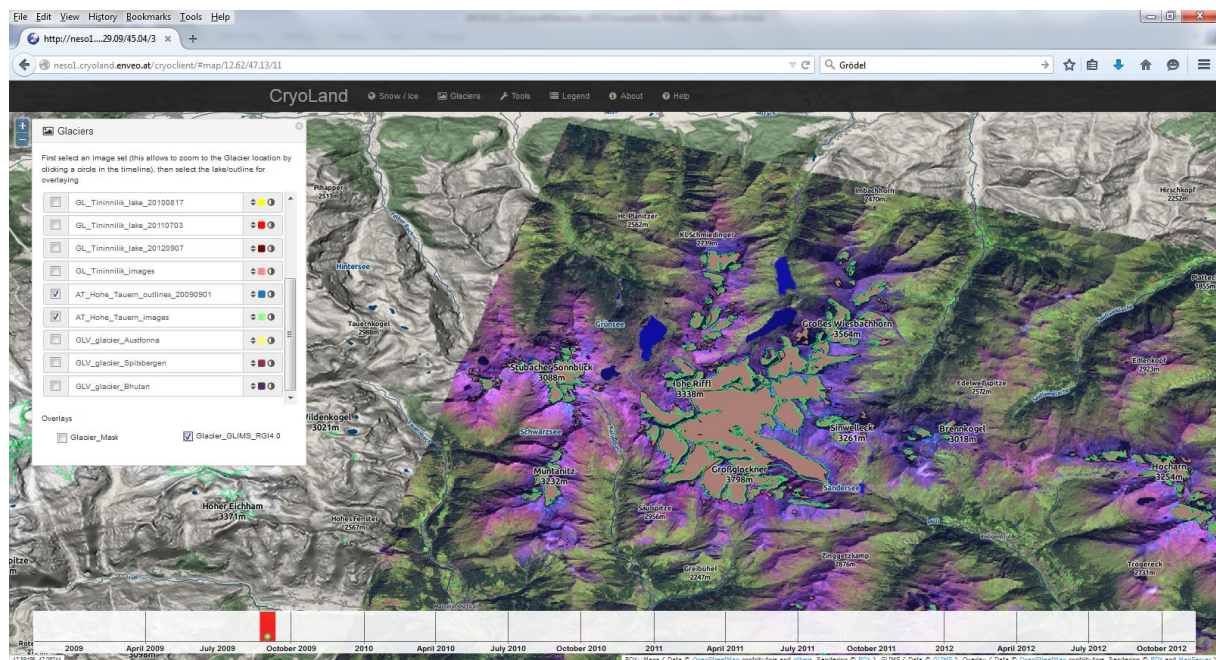


Figure 4.7: CryoLand GeoPortal showing an example of the Glacier Outline Product (brown areas) at Hohe Tauern, Austria. The high resolution satellite image used for product generation is provided as Image Layer, and used as background. Green outlines are the glacier outlines of the External Service GLIMS/RGI. The base layer “EOX::Maps” is used as background, and visible outside the Glacier Image Layer.

External Services

A coarse resolution global glacier mask generated from CORINE Land Cover 2006 (where available) and GLOBCOVER 2009 for the rest of the world is available as overlay layer (same mask as in Overlays of Snow / Ice menu).

Additionally, the glacier outline data base of GLIMS / RGI (Global Land Ice Measurements from Space / Randolph Glacier Inventory, Version 4.0) is integrated into the CryoLand GeoPortal as overlay layer. These glacier outlines are shown as green boundary lines.

4.3.4 Tools

The new tools menu provides four different options, in the following order:

- Selecting an area of interest by a polygon defined by the user in the interactive map
- Selecting an area of interest by a rectangle defined by the user in the interactive map
- Importing, exporting or saving a selection
- Open the download widget



Selecting an area of interest

The selection of an area of interest can be done by a user defined polygon or rectangle.

Click on the polygon symbol to activate the area selection by a polygon. Draw a polygon outlining your area of interest by setting vertices with single left clicks, and complete the area selection by double-clicking the left mouse button. A new click in the map starts a new selection of an Area-Of-Interest. Only one area of interest can be defined at once. Clicking again on the polygon symbol deactivates the polygon selection tool and removes an already outlined area of interest.

Draw a bounding box of your area of interest by holding the left mouse button. For completing the selection of a bounding box, release the left mouse button. A new click in the map starts a new selection of an Area-Of-Interest. Only one area of interest can be defined at once. Clicking again on the rectangle symbol deactivates the bounding box selection tool and removes an already outlined area of interest.

Import, Export, Saving options for selections

The selected areas of interest (by polygon or bounding box) can be exported or saved to GeoJSON (<http://geojson.org/>) files to be stored at your local machine. An already saved area of interest in GeoJSON format can also be imported into the GeoPortal for an area selection.

Download

The download tool only becomes active if at least one snow, lake/river ice or glacier ice surface velocity product, an area of interest and a time of interest are selected. One or multiple selected products can be downloaded for a single date, multiple dates or for a time series.

Once the download tool button is active a click on it will open the pop-up window "Download Manger" providing a list of products available for download, and allows the detailed selection of the products available for the specified area and time of interest by clicking the respective check boxes (on the left of each product name). The widget further provides some additional information on each product (when moving the mouse over the "i-symbol" located to the right of each product name). Select the product(s) you want to download, or use the Select All or the Invert Selection button to make a selection. For downloading the selected products choose the file-format and the output projection as desired.

The following file formats are available for downloading products:

- GDAL/GTIFF, *.tif (GeoTIFF = default format)



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- GDAL/JPEG2000, *.jp2
- GDAL/netCDF, .nc
- GDAL/HDF4Image, .hdf

The selectable output projections, including EPSG code definitions, are provided in Appendix C.

Finally the "Start Download" button will start the download process and a local file manager window will appear asking for the location where the file(s) to be downloaded shall be saved. Unfortunately web Browsers will ask this for each and every file to be saved unless you configure your browser to store files at a predefined location.

In case there are no selected products pressing the "Download" button will perform no action. To close the "Start Download" widget either click on the "x-symbol" (top right) or anywhere on the "Interactive Map" area.

Note:

The download of multiple datasets (e.g. for time-series) does not work using Internet Explorer, since this browser stops its work after the first file is downloaded. This seems to be a design feature. It is, therefore, strongly recommended to use a recent version of one of the following browsers: Chrome/Chromium, Firefox, Safari, especially for the download of multiple files (e.g. time-series).

4.3.5 Legend

The Layer widget provides access to the Legend associated with each CryoLand Product.

The Legend widget presents a "Common to all CryoLand Products" section, and a list of the available products. Each entry can be selected (by clicking it), which will then present the Legend specific for the respective Product. In cases where no Legend is associated with the respective Product a "N/A" (not available) will be displayed.

Figure 4.8 shows the Pan-European Fractional Snow Cover product over central Europe overlaid with the Overlay masks forest, water, urban, and the country borders. Here the *EOX::Maps* 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.

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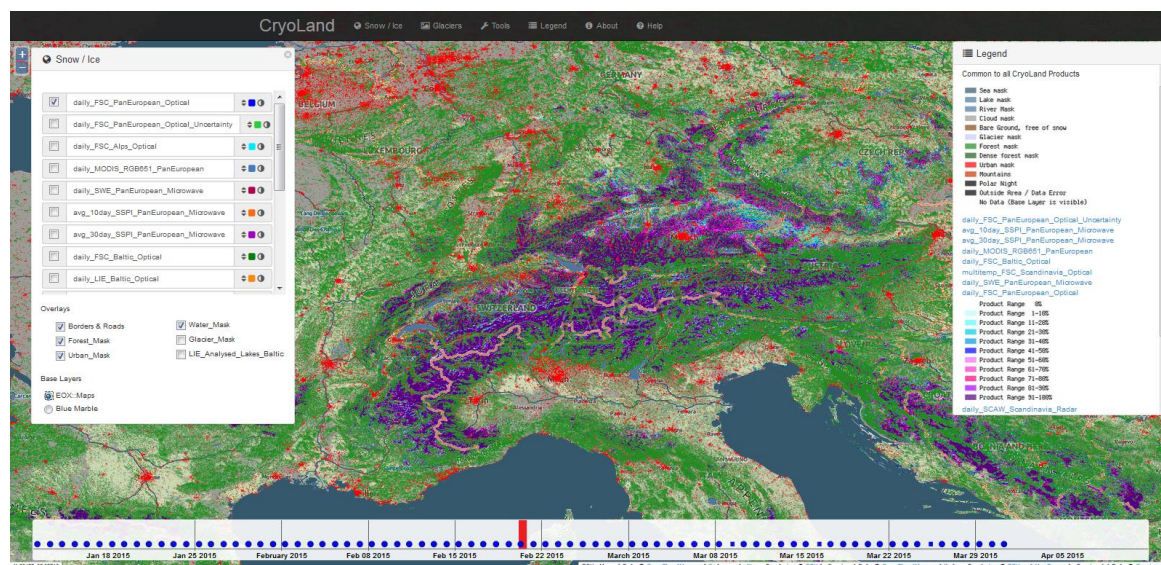


Figure 4.8: CryoLand web interface showing the Pan-European Fractional Snow Cover product (daily_FSC_PanEuropean_Optical) over Central Europe, several overlay masks, the CryoLand Common Legend as well as the Product specific Legend. As background the layer EOX::Maps is used.

4.3.6 About

Get information about the project partners and the project funding.

4.3.7 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 will be provided again soon. Finally, the most recent version of this document can be downloaded from the Help section.

4.4 Time-Line

The new time line in the GeoPortal has been significantly revised, and provides now following functions:

Zoom In/Out:

The new TimeSlider provides a couple of new features to ease the navigation in time as well as the selection of a Time-Of-Interest. The most important one is that you can now Zoom In/Out using the mouse wheel anywhere on the TimeSlider (or by two-finger gestures on the pad or by a combination of mouse+pad).



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Symbols:

The colour code of the products shown right to each product layer is also used in the TimeSlider, showing the availability of datasets. Empty symbols indicate that the respective product is outside the extent of the current view. A full symbol indicates that the product is visible within the extent of the current view. Clicking a symbol (indicated by pointing-finger-icon) will automatically zoom to the extent of the clicked product. Hovering the mouse over a symbol in the TimeSlider shows its product-ID. A change of the symbol when zooming in/out at the Time-Slider (e.g. circle to rectangle) provides an indication of the time-span the products actually covers. A maximum of four products can be shown at once in the time slider.

Select time-period:

In the upper part you can select a time-period (by dragging the mouse, indicated by a cross-icon). A selected time-period is indicated by red-coloured box. You can change the extent of a time-period (at the edge of a previously selected time-period, indicated by a double-arrow-icon), and shift a previously selected period (hovering over a previously selected time-period, indicated by a hand/fist) and then dragging the mouse to the new desired position.

Change shown time-period:

In the lower section of the TimeSlider (Dates area) you can shift the shown time-period (indicated by a double-arrow) by dragging the TimeSlider left or right.

Figure 4.9 shows different zoom factors and functionalities of the new time line.

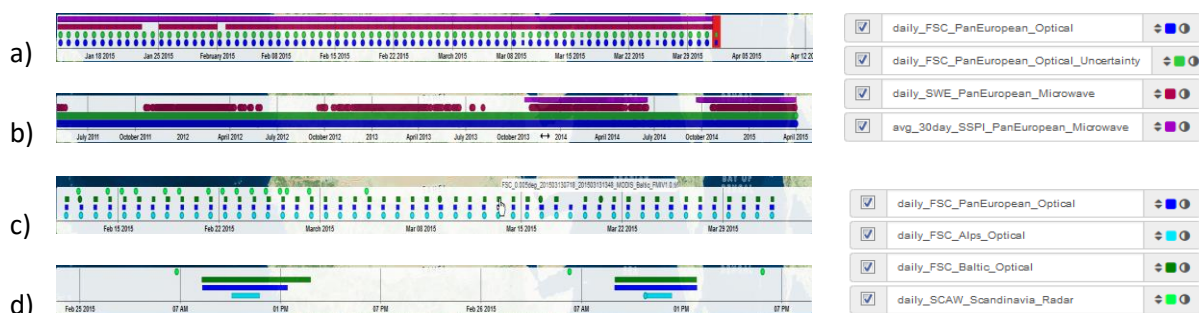


Figure 4.9: Different zoom factors of the time-line (left) indicating the availability of selected product layers (right). The availability of maximum four products can be shown at once. a) Standard zoom, marking the most recent date with available data (red bar). b) Maximum zoom out of the time line, showing several years, and the availability of different products. The left-right arrow in the datum section can be used to move the time line forwards or backwards. c) Zoom to daily availability of products. The pointed finger/fist on one product highlights the name of the selected product data set for this day. d) Zoom to an hourly availability of products, each derived from the acquisition times of the used satellite data base.

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4.5 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 “Snow/Ice” or “Glaciers” (only glacier ice surface velocity products), and activate one or multiple product layers you want to download.

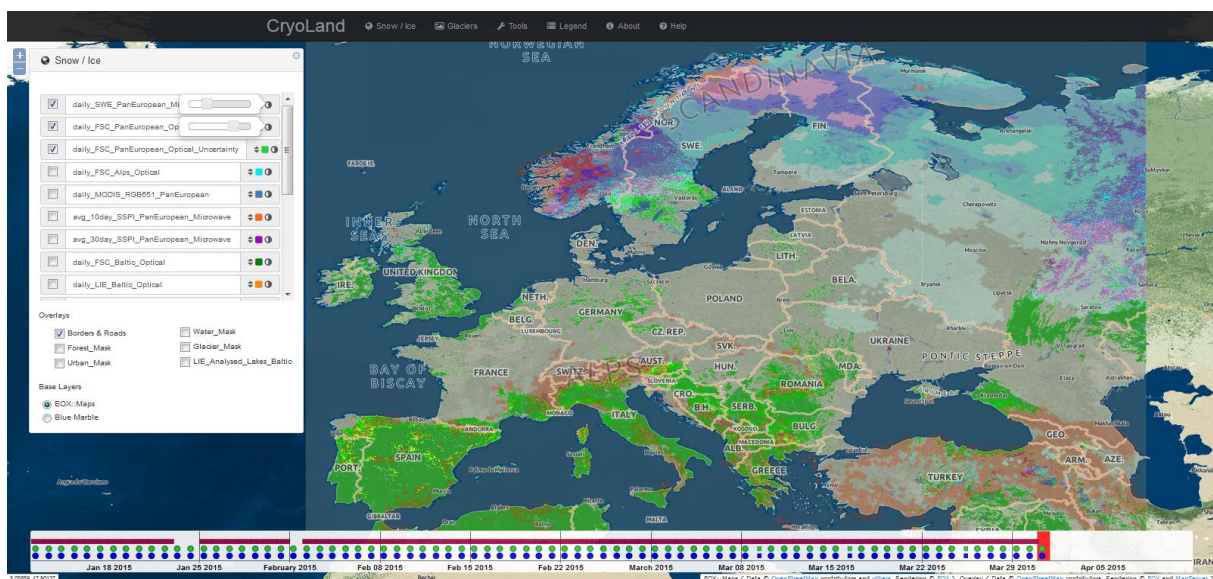


Figure 4.10: Selection of product layers and illustration of selected layers using different opacities in the interactive map. Available products are indicated by bullets or bars in the time line, depending on the zoom factor on the time line and the validity or acquisition time of the used data base. The available data of the most recent date are shown by default, indicated by the red bar in the time line.

Step 2: Define Time of Interest

Use the time line at the bottom of the interactive map to select a particular date or a period you're interested in. For a single date just left click on the desired date in the time line. Make sure that with the left click the hand is shown in the time line, but not a cross. In the latter case no date is selected, and only the selected base layer will be shown, but no product.

For selecting a period hold the left mouse button in the time line and move to the left or to the right until you cover the full period of interest. This time, the cross should be shown in the time line during the period selection.

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A selected time of interest can easily be extended or shortened. When the mouse cursor is moved over the margins of the selected period in the time line a left/right arrow appears. By holding and moving these arrows to the left or right the selected time period can be changed as desired. Optionally, a selected time range can be shifted to another date using the cross arrow appearing when the cursor is inside the selected time period. Don't mix this up with the pointed finger/fist which appears when the cursor is on one particular date, and selects only the data set of this single date.

For long periods zoom out the time line (using the mouse wheel in the time line) before starting the time selection to show several months or even years. By providing a date range spanning over multiple days / months / years a time series for the selected AOI can easily be downloaded. In such case each product in the date range will be provided for each day as a separate file.

Selecting a period longer than two weeks might thus result in long loading times and some effort in downloading the selected products, as layers are downloadable by the interactive map tool only as single files.

We strongly recommend an automated data access using EO-WMS/EO-WCS if you want to download large data amounts.

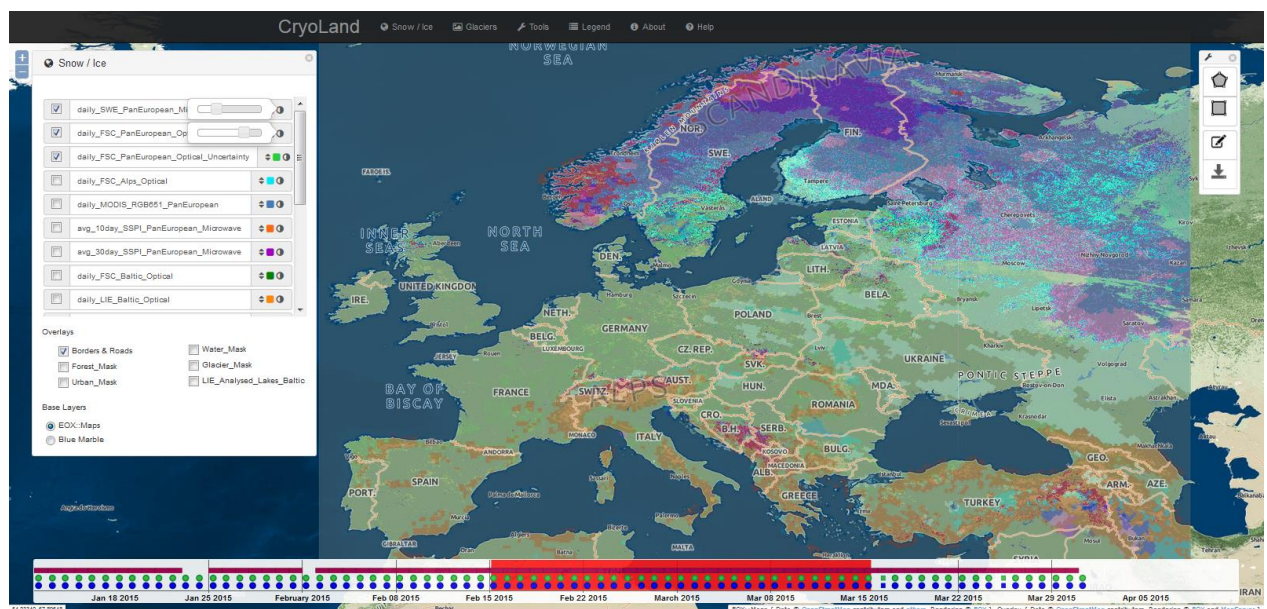


Figure 4.11: Selection of the time period from mid of February 2015 to mid of March 2015, indicated by the red bar in the time line. The most recent clear sky information per pixel is shown in the interactive map. Additionally, clicking on the Tools menu item opened the widget on the right side in the interactive map. Three products from the Snow/Ice menu are activated, as indicated by the bullets in the time line.

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Step 3: Define Area of Interest

Now, go to the Menu “Tools”. An area of interest can be selected by a polygon or by a rectangle. You can also import a previously saved area of interest (GeoJSON format). Click on the button showing the polygon or the rectangle, respectively, and define your area of interest in the interactive map. For a polygon draw the corners of the polygon by left clicks in the interactive map, and complete the area selection by a double left click. The product will always be provided for the rectangular bounding box of the selected polygon. For drawing directly a rectangle left click in the map and drag a box keeping the left mouse button pressed. If you want to redraw your area of interest, just start another selection of an area of interest in the interactive map. You can also click on the polygon or the rectangle button to remove the current area selection and restart another selection.

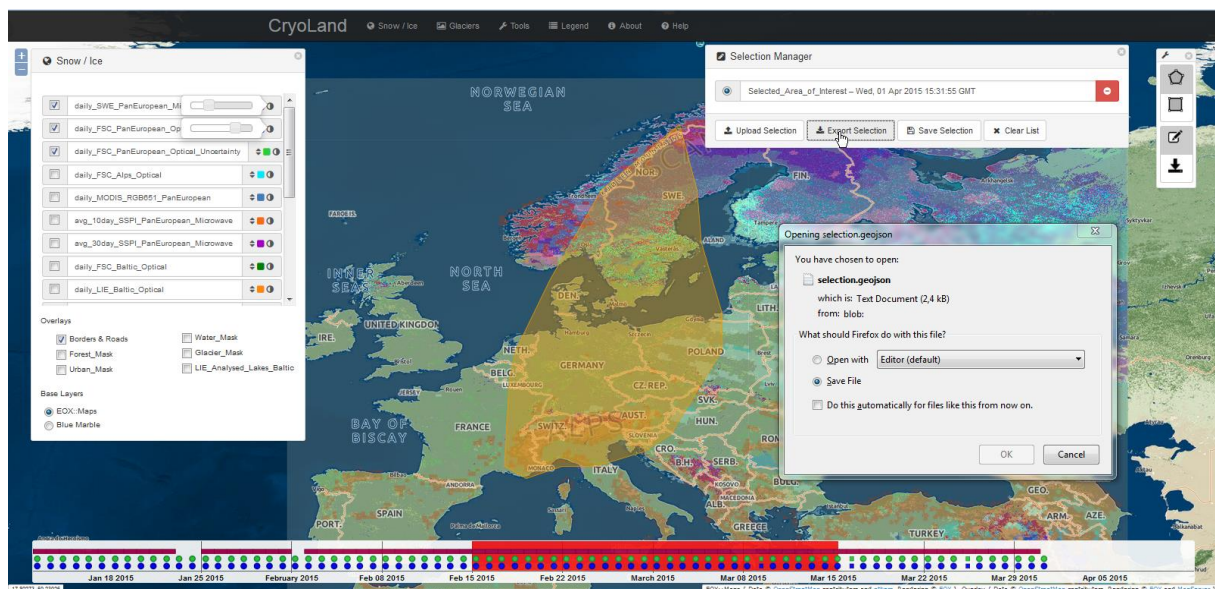



Figure 4.12: Selection of an area of interest using the polygon selection of the Tools menu, and exporting (Tools menu) the selected polygon into a geojson file for storage on the local machine.

Step 4: Download the data

If you have selected the area and time of interest, click on the “WCS Download Tool” button. A pop-up window opens (Figure 4.13), 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 (supported are GeoTIFF, JPEG2000, NetCDF and HDF4) and a projection (cf. Appendix C). By default the products are provided in geographic coordinates/WGS84 (EPSG: 4326).



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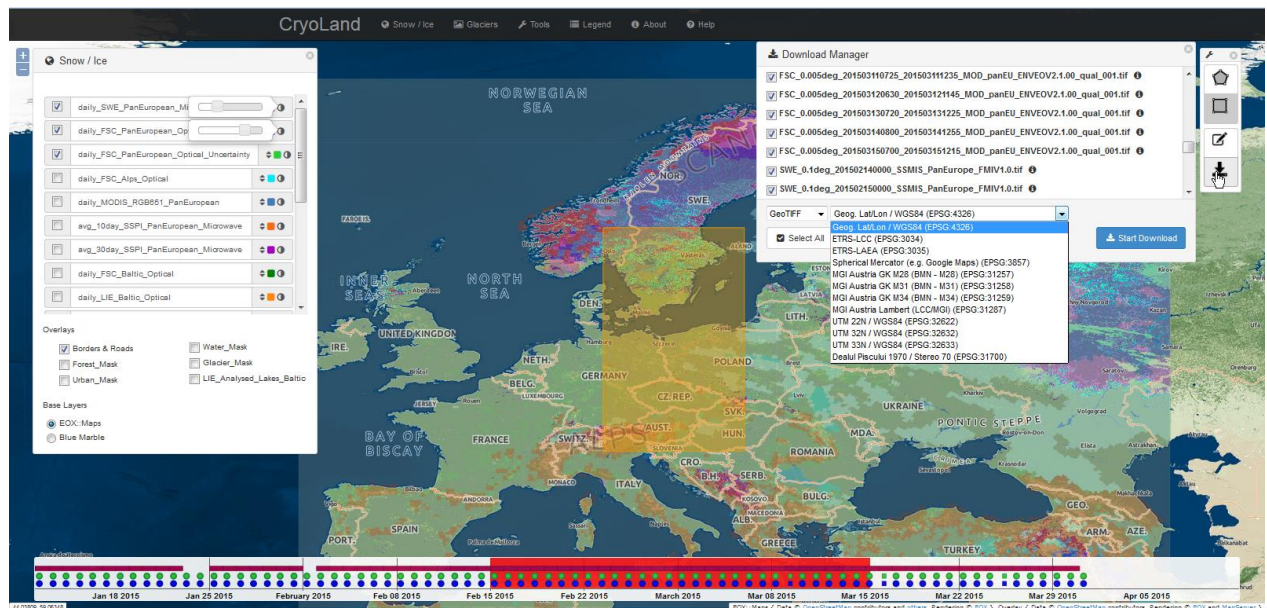


Figure 4.13: Products download verification with file format and projection selection possibilities (drop-down lists). For downloading a product activate the desired layer using the box left of each product layer name or use the “Select All” or “Invert Selection” buttons. Then click on the “Start Download” button.

If you selected a polygon for the definition of the area of interest, the rectangular bounding box of the polygon will be used, as mentioned before in Step 3.

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.

Figure 4.14 shows the resulting products for the selections shown in Figure 4.13. The downloaded products will not have any colour schema as applied in the GeoPortal, but appear as greyscale images. Details about the product coding are provided in Appendix B.

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).

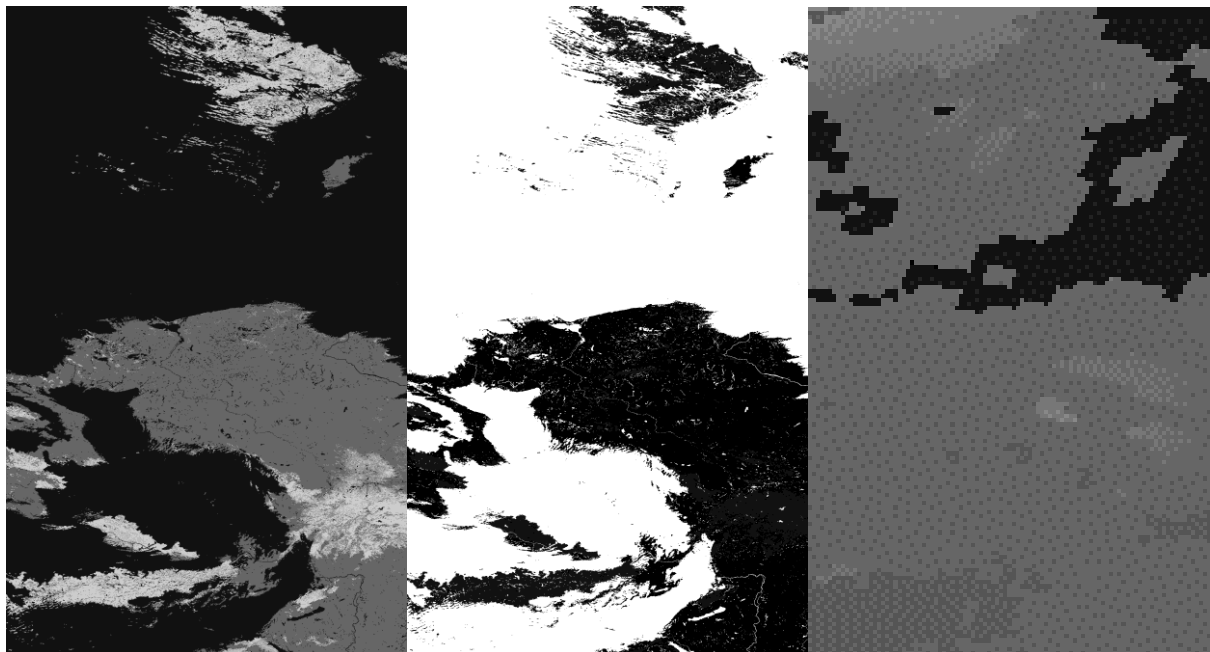


Figure 4.14: Resulting FSC (left), associated uncertainty layer (centre) and SWE (right) product layers for the selected area of interest.

5. CRYOLAND PRODUCTS AND LOCALLY INSTALLED GIS SYSTEMS

Support has changed to EO-WMS and EO-WCS (WCS 2.0) only!

Due to the large number of datasets offered by CryoLand, baseline WMS requests are not supported anymore, since e.g. a WMS-GetCapabilities Response exceeds any reasonable size (>16MB) and creation time (~20min) for the offered products (~20.000 products). This change, to support only EO-WMS & EO-WCS, implies that only DatasetSeries (often called Collections) are now listed in the GetCapabilities response.

5.1 EO-WMS

To the best of our current knowledge there is no GUI-client available to fully utilize EO-WMS, i.e. no client supports submitting time-stamps. A feature-request for the extension of the generic QGIS WMS client has been submitted to QGIS.

However, we therefore recommend to use the CryoLand GeoPortal webGUI to view the products.

5.2 EO-WCS

QGIS offers a WCS 2.0/EO-WCS plugin ("QgsWcsClient2") which is freely available in the official QGIS repository. Unfortunately, "QgsWcsClient2" currently doesn't support the new OGC EO-WCS extensions. However, since the developers of the CryoLand GeoPortal, EOxServer and the QgsWcsClient2 are from the same company, the QgsWcsClient2 will soon receive the corresponding update (status 2015-02-10).

Therefore we recommend to install the QgsWcsClient2 in your QGIS application already now, since you will receive a notification when the update is available.

6. HOW TO AUTOMATICALLY SELECT AND DOWNLOAD CRYOLAND PRODUCTS

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

Due to the large number of datasets offered by CryoLand, baseline WMS requests are not supported anymore, since e.g. a WMS-GetCapabilities Response exceeds any reasonable size (>16MB) and creation time (~20min) for the offered products (~20.000 products). This change, to support only EO-WMS & EO-WCS, implies that only DatasetSeries (often called Collections) are now listed in the GetCapabilities response. In particular the following interfaces, provided by the CryoLand GeoPortal, and the corresponding OGC standards plus the applicable versions are provided:

- EO-WMS (1.0) (Web Map Service + EO Application Profile)
- WCS (1.0.0, 1.1.0, 1.1.1, 1.1.2, 2.0.0, 2.0.1)
- EO-WCS (1.0) (Web Coverage Service + EO Application Profile) including the following standardized WCS_service-extensions:
 - CRS
 - geotiff coverages
 - crs-predefined
 - interpolation
 - range subsetting
 - scaling

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.).

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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.readthedocs.org/en/latest/users/basics.html#eoxserver-documentation>
- Demonstration: <http://eoxserver.readthedocs.org/en/latest/users/demonstration.html>
- Parameters: http://eoxserver.readthedocs.org/en/latest/users/EO-WCS_request_parameters.html

6.1 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.

Note:

Please be aware that these scripts might currently not reflect the latest changes applied at the CryoLand GeoPortal (i.e. the switch to the above described EO-WMS/EO-WCS & extensions might not yet be implemented). However, for the herein targeted experienced users and developers, and with the examples provided below, it should not be a big problem to adapt the request sent to the CryoLand GeoPortal server. We apologize for this inconvenience and will try to update the scripts as soon as our time permits.

The following examples are also provided at <http://neso.cryoland.enveo.at/examples.html> where they can be immediately executed.

6.2 EO-WMS Requests

GetCapabilities:

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

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GetMap - DatasetSeries and Time:

http://neso.cryoland.enveo.at/cryoland/ows?Service=WMS&Version=1.3.0&Request=GetMap&Layers=daily_FSC_Baltic_Optical&CRS=EPSG:4326&Width=540&Height=200&Format=image/png&Transparent=true&BBOX=60.0,15.0,70.0,42.0&TIME=2012-03-31T10:07:00Z/2012-04-01T10:15:00Z

GetMap - you may use a direct request if you already know the exact product name e.g. from a prior WCS DescribeEOCoverageSet request:

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

6.3 EO-WCS / WCS Requests

GetCapabilities:

<http://neso.cryoland.enveo.at/cryoland/ows?Service=WCS&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=DescribeEOCoverageSet&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=2.0.1&Request=DescribeEOCoverageSet&EOID=daily_FSC_PanEuropean_Optical&subset=phenomenonTime\("2012-03-14T09:00","2012-03-14T09:00"\)](http://neso.cryoland.enveo.at/cryoland/ows?Service=WCS&Version=2.0.1&Request=DescribeEOCoverageSet&EOID=daily_FSC_PanEuropean_Optical&subset=phenomenonTime()



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

[http://neso.cryoland.enveo.at/cryoland/ows?Service=WCS&Version=2.0.1&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=2.0.1&Request=DescribeEOCoverageSet&EOID=daily_FSC_PanEuropean_Optical&subset=phenomenonTime()

DescribeEOCoverageSet - DatasetSeries (e.g. Time Series) - a Slice subset in Time → no hit, therefore providing only the DatasetSeries description:

[http://neso.cryoland.enveo.at/cryoland/ows?Service=WCS&Version=2.0.1&Request=DescribeEOCoverageSet&EOID=daily_FSC_PanEuropean_Optical&subset=phenomenonTime\("2012-03-14T05:00","2012-03-14T05:00"\)](http://neso.cryoland.enveo.at/cryoland/ows?Service=WCS&Version=2.0.1&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 Long:

[http://neso.cryoland.enveo.at/cryoland/ows?Service=WCS&Version=2.0.1&Request=DescribeEOCoverageSet&EOID=daily_FSC_PanEuropean_Optical&subset=phenomenonTime\("2012-03-17","2012-03-19T12:00:00Z"\)&subset=lat\(32,44\)&subset=long\(11,33\)](http://neso.cryoland.enveo.at/cryoland/ows?Service=WCS&Version=2.0.1&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 datasets.

GetCoverage – 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

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&scalesize=x\(500\),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&scalesize=x(500),y(150))

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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\(32,44\)&subset=long\(11,33\)&subsettingCRS=http://www.opengis.net/def/crs/EPSG/0/4326](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(32,44)&subset=long(11,33)&subsettingCRS=http://www.opengis.net/def/crs/EPSG/0/4326)

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\(32,44\)&subset=Long\(11,33\)&subsettingCRS=http://www.opengis.net/def/crs/EPSG/0/4326&OutputCRS=http://www.opengis.net/def/crs/EPSG/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(32,44)&subset=Long(11,33)&subsettingCRS=http://www.opengis.net/def/crs/EPSG/0/4326&OutputCRS=http://www.opengis.net/def/crs/EPSG/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\(4000,4499\)](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(4000,4499))

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/mixed&scalesize=x\(500\),y\(350\)](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/mixed&scalesize=x(500),y(350))

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.

Product	Fractional Snow Cover, Uncertainty estimation (RMSE) Pan-European	Snow water equivalent, Pan-European, Standardized Snow Pack Indicator (Low res)
Satellite data base	MODIS Future: Sentinel S1, S3	SSMIS, AMSR2
Coverage	72 N / 11 W – 35 N / 50 E	72 N / 11 W – 35 N / 50 E, Northern hemisphere
Spatial resolution, m	ca 500 m	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.

Product	Fractional Snow Cover, regional	Wet Snow Covered Area, Scandinavia	Multi-temporal multi- sensor Fractional Snow Cover, Scandinavia	Wet Snow Covered Area, Alps (EU FP7 SEN3APP)
Satellite data base	MODIS Future: Sentinel S3	Radarsat-2 Future: Sentinel S1	MODIS, Radarsat-2 Future: Sentinel S1, S3	Sentinel S1
Coverage	Central Europe, Baltic Sea area, Scandinavia	Scandinavia	Scandinavia	Alps
Spatial resolution, m	ca 250 m – 500 m	ca 50 m	ca 250 m	ca 100 m
Grid / Projection (EPSG Code)	Geographic coordinates / WGS84 (EPSG: 4326), Optional: Grid/Projection defined by user (on	Geographic coordinates / WGS84 (EPSG: 4326), Optional: UTM33/WGS84	Geographic coordinates / WGS84 (EPSG: 4326), Optional: UTM33/WGS84	Geographic coordinates / WGS84 (EPSG: 4326), Optional: UTM/WGS84

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	request)			
Temporal resolution	Daily, full year	Daily, melting season (1 April – 31 July)	Daily, melting season (1 April – 31 July)	daily, melting season (1 April – 31 July)
Latency time	<1 day	1 week	<1 day	< 2 days

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

Product	Surface Temperature of Snow	Snow Surface Wetness
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.

Product	Lake Ice Classification, Baltic Sea area	River Ice Extent, regional
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

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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

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	

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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

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

SSPI Code	Specification
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

C. APPENDIX – SUPPORTED PROJECTIONS FOR DOWNLOADS

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

ESPG Code	Projection
4326	Geographic Coordinates (Lat, Lon) / WGS84
3034	Lambert Conic Conformal / ETRS89
3035	Lambert Azimuthal Equal Area / ETRS89
3857	Spherical Mercator (e.g. Google Maps)
32622	UTM 22 / WGS84
32632	UTM 32 / WGS84
32633	UTM 33 / WGS84
31257	MGI Austria GK M28 (BMN – M28)
31258	MGI Austria GK M31 (BMN – M31)
31259	MGI Austria GK M34 (BMN – M34)
31287	Lambert Conic Conformal SP2 (LCC) / Militär Geographisches Institut (MGI)
31700	Dealul Piscului 1970 / Stereo 70