

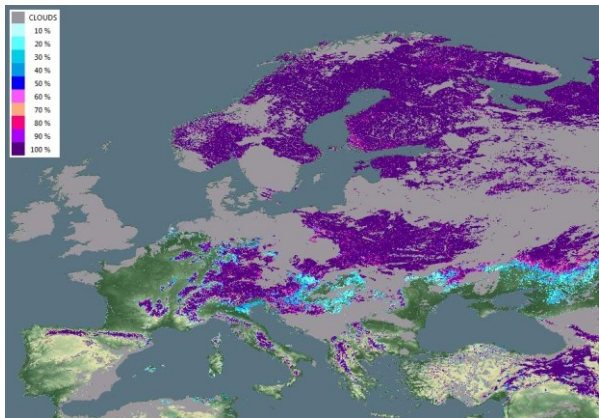
## Satellite Snow Monitoring Activities – Project CRYOLAND

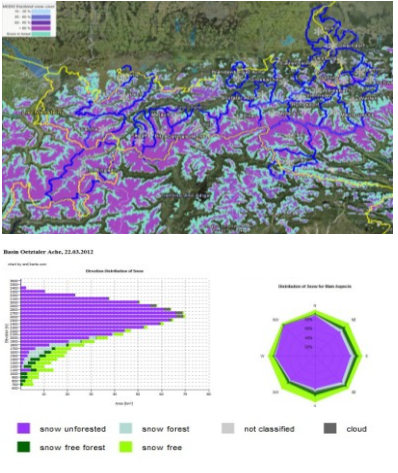
Background material for participants to the Workshop on European Snow Monitoring Perspectives,  
Darmstadt, 4-5 December 2012.

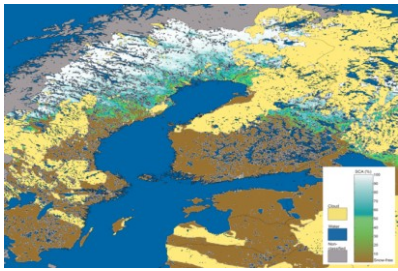
CryoLand provides Snow, Glacier and Lake / River Ice Services. This document gives an overview only on the CryoLand Snow Products and Services.

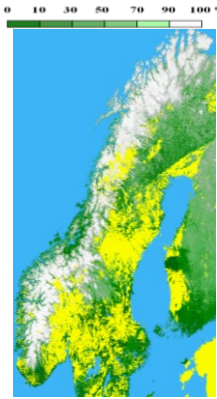
<b>Title</b>	<i>CRYOLAND – GMES Service Snow and Land Ice</i>
<b>Objective</b>	<p>The primary objective of CryoLand is to develop, implement and validate a standardized and sustainable service on snow, glacier and lake/river ice monitoring as a Downstream Service within GMES in a value added chain. CryoLand will exploit the GMES Sentinels and other Earth Observation satellites. The project prepares the basis for a future cryospheric component of the GMES Land Monitoring Service.</p> <p>The project</p> <ul style="list-style-type: none"><li>• develops and validates a pan-European satellite-based snow and land ice service delivering highly needed products to the user community,</li><li>• prepares the tools for offering snow and ice services world-wide,</li><li>• develops processing lines and algorithms to utilize data from the GMES Sentinel Satellite Series for snow and ice application,</li><li>• performs full verification of the products and near real time demonstration of the services,</li><li>• implements services and products conform to INSPIRE/GEOSS standards,</li><li>• makes products available to users via state-of-the-art online services,</li><li>• issues guidelines for stakeholders and for service deployment operations.</li></ul>
<b>Programme</b>	CryoLand is a Collaborative Project (2011-2015) funded by the European Union under the 7th Framework Programme, Theme SPA.2010.1.1-01 – Stimulating the development of downstream GMES services.
<b>Sustainability</b>	Project duration is from Feb 2011 to Jan 2015, with Funding through the EC FP7. The project aims to develop a self-sustained GMES Downstream Service using Sentinel and other EO data as main input.

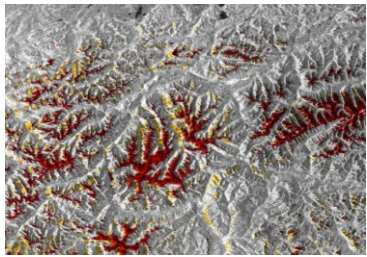


<b>Product Name</b>	<i><b>Pan-European Fractional Snow Extent Service</b></i>	 <p><i>CryoLand Pan-European FSC product, 15/3/2005.</i></p>
<b>Description</b>	<p>This product provides the fractional snow extent per pixel (given in per-cent) calculated from optical satellite data. Automatic cloud screening is applied. Full validation of the snow product in different environments is performed (intercomparison with very high resolution satellite images and in-situ data). Current algorithms use MODIS data. Development of algorithms and processing lines and preparation for using Sentinel-3 as input data is ongoing.</p> <p>Status: Validation of product in different environments and intercomparison of different algorithms.</p>	
<b>Spatial Coverage</b>	<p><i>Pan European Domain: 72N / 11W – 35N / 45E;</i></p> <p>Map Projection: Geographic (Latitude/Longitude, WGS-84);</p> <p>Pixel spacing (depending on sensor): 0.01 deg x 0.01 deg (ca. 1 km x 1 km); 0.005 deg x 0.005 deg (ca. 500 m x 500 m)</p>	
<b>Temporal Coverage</b>	<p>Daily products are generated in near real time.</p> <p>2<sup>nd</sup> Pilot Near Real time service in winter 2012/13, full end-2-end demonstration of service planned for winter period 2013/2014. Processing of time series of archived data planned.</p>	
<b>Producers</b>	ENVEO, FMI/SYKE	
<b>Data Source(s)</b>	MODIS (2000 – onwards) and Suomi NPP VIIRS data (2012 – onwards). Development and adaptation of algorithms to exploit Sentinel-3 SLSTR and OLCI data is ongoing.	
<b>Data Policy</b>	Free access during CryoLand project duration for CryoLand User Group (joining CryoLand User Group is free).	
<b>Source</b>	<p><a href="http://cryoland.eu">http://cryoland.eu</a> → go to CryoLand GEO Portal;</p> <p>contact: <a href="mailto:thomas.nagler@enveo.at">thomas.nagler@enveo.at</a></p>	

<b>Product Name</b>	<b><i>Regional Fractional Snow Extent Service – ALPS</i></b> 
<b>Description</b>	<p>This product provides the fractional snow extent from medium resolution optical data. The procedure is optimized for mountain regions. Reflectance values are topographically corrected, the fractional snow extent is calculated using a multi-spectral spectral unmixing algorithm. Currently MODIS data are used, transition to Suomi NPP VIIRS (as backup sensor) and preparation for Sentinel-3 SLSTR &amp; OLCI is ongoing.</p> <p>Additionally the service includes the calculation of statistical snow information for drainage basins (specified by a shapefile provided by users).</p>
<b>Spatial Coverage</b>	<p>Projection: Geographic (Latitude/Longitude, WGS-84); UTM; Lambert Conformal Conic 2SP</p> <p>Pixel spacing: 250 m x 250 m (500 m x 500 m)</p> <p>Alps</p>
<b>Temporal Coverage</b>	<p>Daily near real time products based on MODIS are currently generated. Archived products are available through the service provider. For status on archived products please contact Thomas Nagler (ENVEO).</p>
<b>Producers</b>	<p>ENVEO (Contact: Thomas Nagler, email: <a href="mailto:thomas.nagler@enveo.at">thomas.nagler@enveo.at</a>)</p>
<b>Data Source(s)</b>	<p>Snow Extent products exploits MODIS (Backup: Suomi NPP VIIRS data; 2012 – onwards)</p> <p>Near Future: Sentinel-3 OLCI / SLSTR</p>
<b>Data Policy</b>	<p><a href="mailto:thomas.nagler@enveo.at">thomas.nagler@enveo.at</a></p>
<b>Source</b>	<p><a href="http://cryoland.eu">http://cryoland.eu</a> → go to CryoLand GEO Portal; contact: <a href="mailto:thomas.nagler@enveo.at">thomas.nagler@enveo.at</a></p> <p>Planned to be provided through CryoLand Server in winter 2013/14.</p>

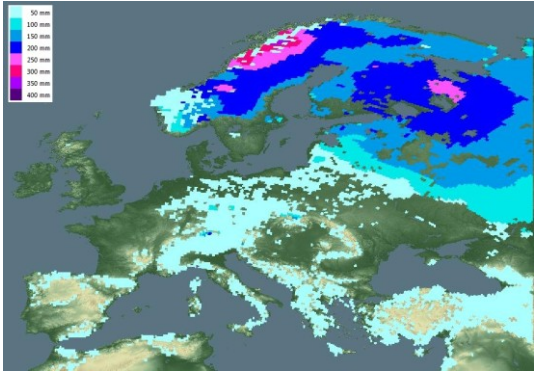
<b>Product Name</b>	<b><i>Regional Fractional Snow Extent Service – BALTIC REGION</i></b>	
<b>Description</b>	<p>This product provides Fractional Snow Coverage (FSC, % from unit-area) during seasonal snow melting period. The product is based on SCAMod-method developed at the Finnish Environment Institute (SYKE). The method is designed to provide Fractional Snow Coverage with good accuracy also in boreal forests. SCAMod is adaptable to any optical sensor operating at visible and near-infrared region, so implementations on Suomi NPP VIIRS and future Sentinel-3/SLSTR are ongoing / foreseeable.</p>	
<b>Spatial Coverage</b>	<p>Projection: Geographic (Latitude/Longitude, WGS-84)</p> <p>Pixel spacing: 0.005 deg × 0.005 deg</p> <p>Baltic Region</p>	
<b>Temporal Coverage</b>	<p>Daily near real time products based on MODIS are currently generated. Archived products are available through the service provider. For status on archived products please contact Sari Metsämäki (SYKE), <a href="mailto:sari.metsamaki@environment.fi">sari.metsamaki@environment.fi</a>.</p>	
<b>Producers</b>	SYKE (Contact: Sari Metsämäki)	
<b>Data Source(s)</b>	<p>Snow Extent products exploits MODIS (Backup: Suomi NPP VIIRS data; 2012 – onwards)</p> <p>Near Future: Sentinel-3 OLCI / SLSTR</p>	
<b>Data Policy</b>	Contact Producers	
<b>Source</b>	<p><a href="http://cryoland.eu">http://cryoland.eu</a> → go to CryoLand GEO Portal; contact: <a href="mailto:thomas.nagler@enveo.at">thomas.nagler@enveo.at</a></p> <p>Planned to be provided as CryoLand Service in winter 2013/14.</p>	

<b>Product Name</b>	<i>Regional Fractional Snow Extent Service – SCANDINAVIA</i>	 <p>24 April 2012.</p>
<b>Description</b>	Multi-sensor multi-temporal algorithm is optimised for FSC monitoring in Scandinavian mountains. The operational FSC product matches the needs of Scandinavian users.	
<b>Spatial Coverage</b>	Projection: Geographic (Latitude/Longitude, WGS-84) Pixel spacing: 0.0025 deg x 0.0025 deg Scandinavia	
<b>Temporal Coverage</b>	Temporal resolution: Daily (for melting period - April 1 <sup>st</sup> to July 31 <sup>st</sup> ) Near real time, Latency: 1 day	
<b>Producers</b>	KSAT (Norwegian Computing center, NORUT)	
<b>Data Source(s)</b>	Sensors: MODIS + Radarsat-2	
<b>Data Policy</b>	Hans E. Larsen (KSAT)	
<b>Source</b>	<a href="http://cryoland.eu">http://cryoland.eu</a> → go to CryoLand GEO Portal; contact: <a href="mailto:thomas.nagler@enveo.at">thomas.nagler@enveo.at</a> Planned to be provided as CryoLand Service in winter 2013/14.	

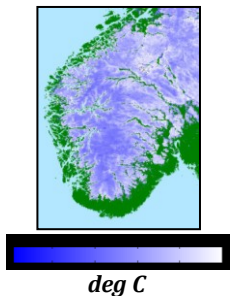
<b>Product Name</b>	<i>High Resolution Melting Snow Area Service – ALPS (from SAR data)</i>	 <p>9 June 2006, ENVISAT ASAR WSM. Red – wet snow extent, Yellow – layover / foreshortening</p>
<b>Description</b>	<p>This product provides information on the extent of melting (wet) snow with high resolution (&lt; 100 m) and is suitable for mountain regions. It uses multi temporal repeat pass SAR data as acquired by ERS, ENVISAT, RadarSAT, and in near future Sentinel-1 SAR. The procedure enables automatic mapping of melting / wet snow in near real time (given near real time access to Sentinel-1 SAR data).</p> <p>Status: Processing lines are ready for near-real time generation of snow maps, but due to ENVISAT Failure no access to NRT SAR data in the project.</p>	
<b>Spatial Coverage</b>	<p>Projection: Geographic (Latitude/Longitude, WGS-84); UTM; Lambert Conformal Conic 2SP</p> <p>Pixel spacing: 75 m x 75 m</p> <p>Eastern Alps</p>	
<b>Temporal Coverage</b>	<p>Near Real Time planned using Sentinel-1.</p> <p>Demonstration products are generated in CryoLand using archived ENVISAT ASAR data. Exploitation of ERS and ENVISAT data archives on request of CryoLand users.</p>	
<b>Producers</b>	ENVEO	
<b>Data Source(s)</b>	<p>In near Future: Sentinel-1 (2014 – onwards).</p> <p>ERS, ENVISAT ASAR Wide Swath data. (Due to the failure of ENVISAT in April 2012, archived data can be processed).</p>	
<b>Data Policy</b>	Free access during project duration for CryoLand Users (joining CryoLand User Group is free).	
<b>Source</b>	<p><a href="http://cryoland.eu">http://cryoland.eu</a> → go to CryoLand GEO Portal; contact: <a href="mailto:thomas.nagler@enveo.at">thomas.nagler@enveo.at</a></p> <p>Demonstration products based on Archived ENVISAT ASAR data, NRT Service is planned with Sentinel-1 data.</p>	

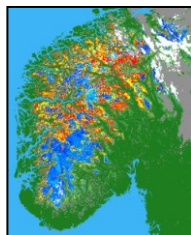
<b>Product Name</b>	<b><i>Regional Nordic Melting Snow Area Service (from SAR)</i></b>
<b>Description</b>	<p>This product (SCAW=Snow cover area wet) provides information on the extent of melting (wet) snow with high resolution (50 m) and is suitable for mountain regions. It uses multi temporal repeat pass SAR data as acquired by Radarsat-2, and in near future Sentinel-1 SAR. The procedure enables automatic mapping of melting / wet snow in near real time (given near real time access to SAR data).</p> <p>Status: Processing lines are ready for near-real time use.</p>
<b>Spatial Coverage</b>	Scandinavia (Norway and partial coverage in Sweden and Finland)
<b>Temporal Coverage</b>	Depending on Radarsat-2 background mode data, on average 2-3 times per week.
<b>Producers</b>	KSAT (Norut)
<b>Data Source(s)</b>	Radarsat-2 (2012-2014) In near Future: Sentinel-1 SAR (2014 – onwards)
<b>Data Policy</b>	Contact: Hans E. Larsen (KSAT)
<b>Source</b>	<a href="http://cryoland.eu">http://cryoland.eu</a> → go to CryoLand GEO Portal; contact: <a href="mailto:thomas.nagler@enveo.at">thomas.nagler@enveo.at</a>



<b>Product Name</b>	<i><b>Pan-European Snow Water Equivalent from PMW radiometer</b></i>	 <p><i>CryoLand SWE product, 15/2/2011.</i></p>
<b>Description</b>	<p>Maps of snow water equivalent, based on passive microwave radiometer measurements, combined in an assimilation scheme with ground-based weather station data.</p> <p>Algorithm is based on the development work carried out in ESA DUE GlobSnow and EUMETSAT H-SAF projects.</p> <p>Difference when compared with EUMETSAT H-SAF is omission of mountains and addition of a new post-processing software to distribute data over WMS/WCS service of CryoLand.</p>	
<b>Spatial Coverage</b>	<p><i>Pan European Domain: 72N / 11W – 35N / 45E;</i></p> <p>Map Projection: Geographic (Latitude/Longitude, WGS-84)</p> <p>Pixel spacing: 0.1 deg x 0.1 deg (ca. 10 km x 10 km)</p>	
<b>Temporal Coverage</b>	Near real time, Daily coverage	
<b>Producers</b>	FMI	
<b>Data Source(s)</b>	SSMIS onboard DMSP satellite	
<b>Data Policy</b>	Free and open, distribution via CryoLand data portal.	
<b>Source</b>	<a href="http://cryoland.eu">http://cryoland.eu</a> → go to CryoLand GEO Portal; contact: <a href="mailto:thomas.nagler@enveo.at">thomas.nagler@enveo.at</a>	



<b>Product Name</b>	<b><i>Regional Snow Surface Temperature Product</i></b>	
<b>Description</b>	<p>The Snow Surface Temperature (SST) product is provided for open areas, including mountains. The product is based on optical instruments (including thermal bands), like data from the MODIS sensor. Automatic cloud detection and fractional snow cover (FSC) mapping is applied. For cloud-free areas with full snow cover, the snow surface skin temperature is retrieved. The product can be used as model input or as an indicator of snowpack development, including updating prognosis for when the snowmelt season will start. The product is available as a raster file and provides the temperature in degree Celsius.</p> <p>Status: Experimental</p>	
<b>Spatial Coverage</b>	<p>Coverage: On demand regionally for mountains and other open areas (non-forested). To be demonstrated winter/spring 2013 &amp; 2014 regularly for South Norway and potentially other regions.</p> <p>Projection: UTM or Geographic (Latitude/Longitude, WGS-84)</p> <p>Pixel spacing: Approximately 1 km x 1 km</p>	
<b>Temporal Coverage</b>	Daily (limited by cloud cover)	
<b>Producers</b>	Norwegian Computing Center (contact: Rune.Solberg@nr.no)	
<b>Data Source(s)</b>	Terra MODIS, NOAA AVHRR, Suomi NPP VIIRS, Sentinel-3 OLCI/SLSTR (when available)	
<b>Data Policy</b>	Free access during project period for CryoLand users (joining the CryoLand User Group is free).	
<b>Source</b>	<p><a href="http://cryoland.eu">http://cryoland.eu</a> → go to CryoLand GEO Portal;  contact: <a href="mailto:thomas.nagler@enveo.at">thomas.nagler@enveo.at</a>  Demonstration products planned for winter/spring 2013/14.</p>	

<b>Product Name</b>	<b><i>Regional Snow Surface Wetness Product</i></b>	 <p>White - dry, cold snow: SST &lt; -2°C  Yellow/orange - moist: -0.5°C &lt; SST &lt; +0.5°C  Red - wet: +0.5°C &lt; +1.0°C  Light/dark blue - dry/moist: -2°C &lt; SST and -0.5°C  Unchanged SCS  Increasing SCS</p>
<b>Description</b>	<p>The Snow Surface Wetness (SSW) product provides an estimate of the snow surface wetness status. The product is based on optical instruments (including thermal bands), like data from the MODIS sensor. Automatic cloud detection and fractional snow cover (FSC) mapping is applied. For cloud-free areas with full snow cover, the snow surface is classified into a set of wetness categories based on a combined temporal monitoring of the development of snow grain size and snow surface temperature. The product can be used to monitor the snow surface state and as an indicator of snowpack development, including updating prognosis for snowpack melting and intensity. The product is available as a raster file.</p> <p>Status: Experimental</p>	
<b>Spatial Coverage</b>	<p>Coverage: On demand regionally for mountains and other open areas (non-forested). To be demonstrated winter/spring 2013 &amp; 2014 regularly for South Norway and potentially other regions.</p> <p>Projection: UTM or Geographic (Latitude/Longitude, WGS-84)</p> <p>Pixel spacing: Approximately 1 km x 1 km</p>	
<b>Temporal Coverage</b>	Daily (limited by cloud cover)	
<b>Producers</b>	Norwegian Computing Center (Contact: Rune.Solberg@nr.no)	
<b>Data Source(s)</b>	Terra MODIS, NOAA AVHRR, Suomi NPP VIIRS, Sentinel-3 OLCI/SLSTR (when available)	
<b>Data Policy</b>	Free access during project period for CryoLand users (joining the CryoLand User Group is free).	
<b>Source</b>	<p><a href="http://cryoland.eu">http://cryoland.eu</a> → go to CryoLand GEO Portal;  contact: <a href="mailto:thomas.nagler@enveo.at">thomas.nagler@enveo.at</a>  Demonstration products planned for winter/spring 2013/14.</p>	