EU FP7 SEN3APP Product Description & Data Access

SEN3APP

Processing Lines And Operational Services Combining Sentinel And In-Situ Data For Terrestrial Cryosphere And Boreal Forest Zone

FP7 Grant agreement No 607052

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Acronym:

C-SAR:	C Band Synthetic Apareture Radar
DFSC:	Daily Fractional Snow Cover
DMSP:	Defense Meteorological Satellite Program
ETM+:	Enhanced Thematic Mapper
EU:	European Union
FMI:	Finnish Meteorological Institute
FMIARC:	Arctic Research Centre of Finnish Meteorological Institute
FP7 :	Seventh Framework Programme for Research and Technological Development
FSC:	Fractional Snow Cover
FTP :	File Transfer Protocol
GLO:	Glacier Outlines
GLS:	Snow and Ice Areas on Glacier
GLV:	Glacier Velocity
HR:	High Resolution
HTTP:	Hypertext Transfer Protocol
IMS:	Ice Mapping System
INSPIRE:	Infrastructure for Spatial Information in the European Community
IW:	Interferometric Wide Swath
LIE:	Lake Ice Extent
MODIS:	Moderate Resolution Imaging Spectroradiometer
MSI:	MultiSpectral Instrument
NH:	Northern Hemisphere
NPP:	National Polar-orbiting Partnership
OLCI :	Ocean Land Colour Instrument
OLI:	Operational Land Imager
SCAW:	Wet Covered Snow Area

SE:	Snow Extent
SLC:	Single Look Complex
SLSTR:	Sea and Land Surface Temperature Radiometer
SSMI/S:	Special Sensor Microwave Imager/Sounder
SWE:	Snow Water Equivalent
SYKE:	Suomen Ympäristökeskus (Finnish Environment Institute)
TM:	Thematic Mapper
WCS:	Web Coverage Service
WMS:	Web Map Service
VHR:	Very High Resolution
VIIRS:	Visible Infrared Imaging Radiometer Suite

1. Introduction

In this document, the products generated within the EU FP7 project SEN3APP are described and information on how to access the products is provided. SEN3APP products can be downloaded via the FMIARC GeoPortal (http://saana.nsdc.fmi.fi/fmiarc-geoportal) and the CryoLand GeoPortal (http://neso1.cryoland.enveo.at/cryoclient/). For more information about the FMIARC geoportal and the CryoLand GeoPortal contact Mwaba.Hiltunen@fmi.fi and gabriele.bippus@enveo.at, respectively.

Methods of downloading data:

- WebClient: FMIARC- GeoPortal and CryoLand GeoPortal
- FTP services
- Web Coverage Service (WCS)
- Web Map Service (WMS)
- Drop box
- Http

SEN3APP products are grouped into four categories; Land cover and phenology, Snow, Glacier and Lake ice products.

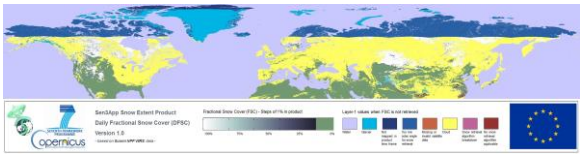
The following section provides details about the products and method to access each product.

2. Products Descriptions

2.1 Snow Products

2.1.1 Fractional Snow Cover Extent for Northern Hemisphere from Optical Data (FMI & SYKE)

Table 2.1.1.: Fractional Snow Cover Extent for Northern Hemisphere from Optical Data (FMI & SYKE) Specifications

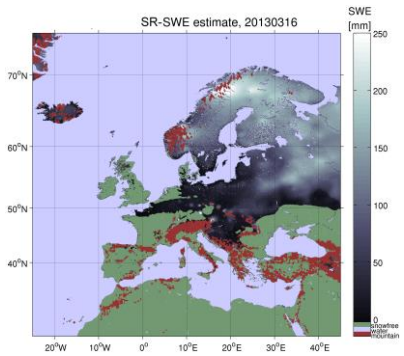
Product Code & Name	***Fractional Snow Cover Extent***	 ***Product example:*** *FSC northern hemisphere 20160225*
Contact	Dr. Kari Luojus, Finnish Meteorological Institute Email: kari.luojus@fmi.fi	

	Dr. Sari Metsämäki, Finnish Environment Institute Email: sari.metsamaki@ymparisto.fi
Overview	The Daily Fractional Snow Cover (DFSC) product provides the fractional snow cover (FSC) in percentage (%) per grid cell for all satellite overpasses of a given day. The product represents the best estimate of today's snow cover. If there are multiple snow observations (only far north within a day), the satellite observations applied are those giving best solar illumination (highest solar elevation). The product is generated for each day based on a 24 hours' time window limited by sunlight. The product is produced and made available for each day in near real time.
Validation Status	The VIIRS based product has not been validated, but the algorithm behind it (applied to nearly corresponding sensors) has undergone extensive validation. We refer here to the description of GlobSnow SE product (Metsämäki et al., 2015) where some validation is presented and to the actual the validation report from GlobSnow product (available on request from Kari Luojus, FMI). Metsämäki, S., Pulliainen, J., Salminen, M., Luojus, K., Wiesmann, A., Solberg, R., Böttcher, K., Hiltunen, M. and Ripper, E., "Introduction to GlobSnow Snow Extent products with considerations for accuracy assessment", Remote Sensing of Environment, Vol. 156, January 2015, pp. 96-108, doi: 10.1016/j.rse.2014.09.018. Bippus, G., Nagler, T., Ripper, E., Hüsler, F., Wunderle, S., Metsämäki, S., Böttcher, K., Foppa, N., Fontana, F., Schöner, W., Unger, R., Malnes, E., Hindberg, H., Solberg, R., Due Trier, O., Luojus, K., Hiltunen, M., Pulliainen, J. and Pinnock, S. (2014): Full Snow Extent Validation and Intercomparison Report. ESA DUE GlobSnow-2, Del. 21. Publication in preparation.
User Guide	The description of the NH FSC product is in preparation. The description to the legacy FSC product, which is applicable for most parts is available here: http://www.globsnow.info/se/GlobSnow2_SE_SWE_Product_User_Guide_v1_r1.pdf
Algorithm Theoretical Basis Document	The algorithm is described in: Metsämäki, S., Pulliainen, J., Salminen, M., Luojus, K., Wiesmann, A., Solberg, R., Böttcher, K., Hiltunen, M. and Ripper, E., "Introduction to GlobSnow Snow Extent products with considerations for accuracy assessment", Remote Sensing of Environment, Vol. 156, January 2015, pp. 96-108, doi: 10.1016/j.rse.2014.09.018. Additional information regarding the algorithm can also be found in the User Guide.
Spatial Coverage & Resolution	Northern Hemisphere Spatial resolution: 1000m, (in future 500m)
Temporal Coverage & Resolution	Daily product, Weekly and Monthly aggregate products

Platform(s)	Suomi NPP
Sensor(s)	VIIRS
Data Format (s)	NetCDF, GeoTIFF
Version	V1.0
Producers	FMI and SYKE
Data Policy	Data are provided free of charge during the project period for non-commercial usage
Access	Products will be provided through the FMIARC GeoPortal. http://saana.nsdc.fmi.fi/fmiarc-geoportal/ Available via http, wms and wcs.

2.1.2 High Resolution (5km) Pan-European SWE Product (Augmented Using Optical FSC Data) (FMI)

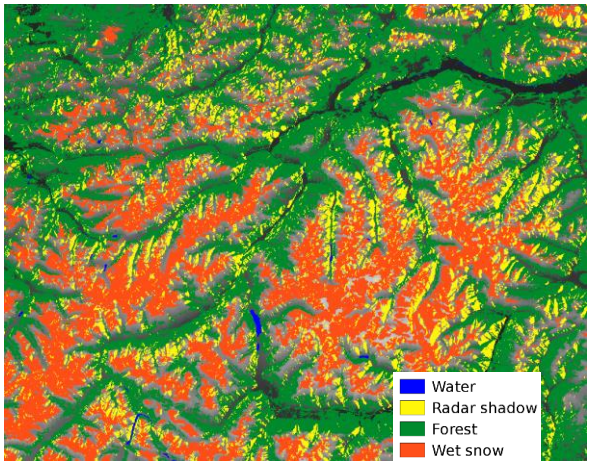
Table 2.1.2.: High Resolution (5km) Pan-European SWE Product (Augmented Using Optical FSC Data) (FMI) Specifications

Product Code & Name	***Pan-European Snow Water Equivalent***	 ***Product example:*** *Pan-European SWE*
Contact	Matias Takala, Finnish Meteorological Institute Email: Matias.Takala@fmi.fi	
Overview	The product estimates Snow Water Equivalent (SWE) in millimeters for Pan European grid in 0.05 degrees spatial resolution. Ground without snow, mountains and water bodies are masked out. Snow line is masked using combination of IMS and VIIRS data.	
Validation Status	Validation is performed one season. Details are in manuscript: Takala, M., Ikonen, J., Luojus, K., Lemmetyinen, J., Metsämäki, S., Cohen,	

	J., Arslan, A. N. and Pulliainen, J., "New Snow Water Equivalent processing system with improved resolution over Europe and its applications in hydrology". *to be submitted*
User Guide	In preparation
Algorithm Theoretical Basis Document	Algorithm is described in manuscript: Takala, M., Ikonen, J., Luojus, K., Lemmetyinen, J., Metsämäki, S., Cohen, J., Arslan, A. N. and Pulliainen, J., "New Snow Water Equivalent processing system with improved resolution over Europe and its applications in hydrology". *to be submitted*
Spatial Coverage & Resolution	Pan European grid, 0.05 degrees pixel
Temporal Coverage & Resolution	Daily product
Platform(s)	DMSP F-series
Sensor(s)	SSMI/S
Data Format (s)	GeoTIFF
Version	V1.0
Producers	SYKE and FMI
Data Policy	Data are provided free of charge during the project period for non-commercial usage.
Access	Products will be provided through the FMIARC GeoPortal. (http://saana.nsdc.fmi.fi/fmiarc-geoportal/) Available via http, wms and wcs.

2.1.3 Regional Wet Snow Cover from Sentinel-1 Data (ENVEO)

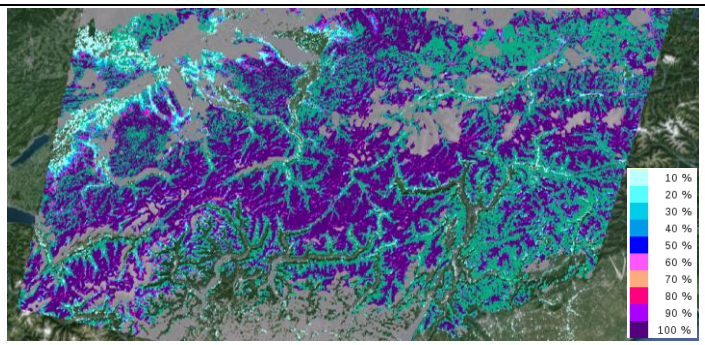
Table 2.1.3: Regional Wet Snow Cover from Sentinel-1 Data (ENVEO) Specifications

Product Code & Name	***SCAW – Wet Snow Covered Area***	 ***Product example:*** *Wet snow covered area from Sentinel-1 (subset of track 168) of 09 May 2015 in the Alps.*
Contact	Dr. Gabriele Bippus, ENVEO IT GmbH, Austria gabriele.bippus@enveo.at	
Overview	The wet snow cover product provides binary information on melting snow for non-forested areas. The product is generated for the European Alps. Water bodies, forested areas, as well as areas affected by radar shadow or fore-shortening are masked. Bare ground and dry snow are identified as one class. Products are provided including metadata meeting INSPIRE standards.	
Validation Status	For a preliminary quality assessment, the product was intercompared with snow maps from Landsat 7 ETM+ and Landsat 8 OLI data. Further validation is on-going in the SEN3APP – project (2014-2016).	
User Guide	The description of the wet snow cover product over the Alps is in preparation. As soon as products are provided through the CryoLand GeoPortal the product description will be included in the CryoLand User Guide, available at http://cryoland.enveo.at/downloads/CryoLand4Newbies/CryoLand4Newbies.pdf	
Algorithm Theoretical Basis Document	Nagler, T., Rott, H., Ripper, E., Bippus, G., Hetzenecker, M. (2016): Advancements for Snowmelt Monitoring by means of Sentinel-1 SAR. Remote Sensing. Submitted.	
Spatial Coverage & Resolution	Coverage of Sentinel-1 tracks over the Alpine area. 4 Sentinel-1A tracks are needed to cover the full alpine area. 100 m pixel size	
Temporal Coverage & Resolution	Melting season, 2015 – present. 12 days repeat time per track. With Sentinel-1B improvement to 6 days repeat time.	

Platform(s)	Sentinel-1
Sensor(s)	C-SAR (Level 1 SLC IW)
Data Format (s)	GeoTIFF, optionally NetCDF
Version	V2.1.0
Producers	ENVEO IT GmbH
Data Policy	Data are provided free of charge during the project period for non-commercial usage
Access	Products will be provided through the CryoLand GeoPortal (http://neso1.cryoland.enveo.at/cryoclient/)

2.1.4 Regional and Pan-European Fractional Snow Cover Product from Synergistic Sentinel-3 SLSTR/OLCI Data (ENVEO)

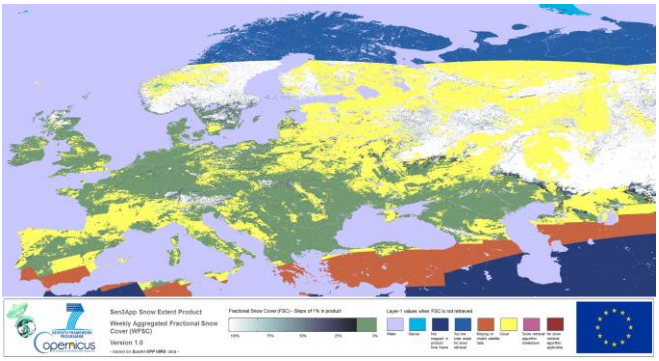
Table 2.1.4.: Regional and Pan-European Fractional Snow Cover Product from Synergistic Sentinel-3 SLSTR/OLCI Data (ENVEO) Specifications

Product Code & Name	***FSC – Fractional Snow Cover for the Pan-European and the Alpine area***	 ***Product example:*** *Fractional snow cover retrieved from synergistic usage of MERIS and AATSR data of 25 October 2003 over alpine area. Semi-transparent grey areas indicate cloud cover. Snow in forest is classified binary.*
Contact	Dr. Gabriele Bippus, ENVEO IT GmbH, Austria gabriele.bippus@enveo.at	
Overview	The daily fractional snow cover products for the Pan-European [72°N/11°W – 35°N/50°E] and Alpine [49.57°N/4.66°E – 43.62°N/17.77°E] area are currently based on Terra MODIS data. The product provides information on fractional snow extent per pixel in percent. Water bodies, cloud covered areas, pixels affected by polar night and invalid input pixels are masked. As soon as Sentinel-3 SLSTR and OLCI data will be continuously available, the	

	service will use these data as input. Products are provided including metadata meeting INSPIRE standards.
Validation Status	Pan-European FSC: daily uncertainty layer providing RMSE per pixel. Additionally, snow maps from multiple VHR and HR optical satellite data were used to validate the product. The product participates also in the ESA project SnowPEx – The Satellite Snow Product Intercomparison and Evaluation Exercise. Validation activities are continuously ongoing. Alpine FSC: the product is evaluated with snow maps from multiple VHR and HR optical satellite data, as well as with in-situ data (snow depth) available for Austria. Validation activities are continuously ongoing.
User Guide	Products are described in the CryoLand User Guide, available at http://cryoland.enveo.at/downloads/CryoLand4Newbies/CryoLand4Newbies.pdf
Algorithm Theoretical Basis Document	EU-FP7-CryoLand project documentation (Deliverable D4-2: Snow products – Algorithms, Processing Lines and Service Description).
Spatial Coverage & Resolution	Pan-European FSC: 72°N/11°W – 35°N/50°E Pixel size: ca 500 m (will be improved to about 300 m with Sentinel-3) Alpine FSC: 49.57°N/4.66°E – 43.62°N/17.77°E Pixel size: ca 250 m
Temporal Coverage & Resolution	Pan-European FSC: 2000 – present, daily Alpine FSC: 2010 – present, daily
Platform(s)	Terra, in future Sentinel-3
Sensor(s)	MODIS, in future synergistic usage of SLSTR / OLCI
Data Format(s)	GeoTIFF, optionally NetCDF
Version	V2.1.0
Producers	ENVEO IT GmbH
Data Policy	Data are provided free of charge during the project period for non-commercial usage
Access	Products are provided through the CryoLand GeoPortal (http://neso1.cryoland.enveo.at/cryoclient/)

2.1.5 Extended Baltic Sea Drainage Basin Direct Broadcast FSC Based on NPP VIIRS/Sentinel-3 SLSTR (SYKE & FMI)

Table 2.1.5.: Extended Baltic Sea Drainage Basin Direct Broadcast FSC Based on NPP VIIRS/Sentinel-3 SLSTR (SYKE & FMI) Specifications

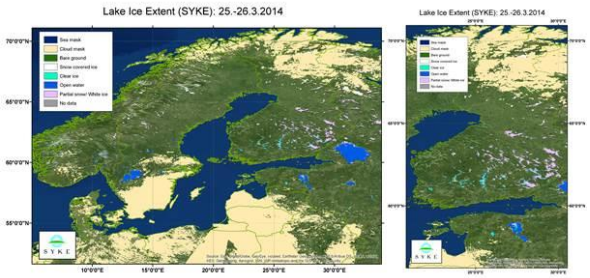
Product Code & Name	***FSC-Fractional Snow Cover Extent***	 ***Product Example:*** *Weekly FSC aggregate 20160228*
Contact	Dr. Sari Metsämäki, Finnish Environment Institute Email: sari.metsamaki@ymparisto.fi Dr. Kari Luojus, Finnish Meteorological Institute Email: kari.luojus@fmi.fi	
Overview	The Daily Fractional Snow Cover (DFSC) product for extended Baltic region provides the fractional snow cover (FSC) in percentage (%) per grid cell for all satellite overpasses of a given day (for the Pan-European domain). The product represents the best estimate of today's snow cover. If there are multiple snow observations (only far north within a day), the satellite observations applied are those giving best solar illumination (highest solar elevation). The product is generated for each day based on a 24 hours' time window limited by sunlight. The product is produced and made available for each day in near real time.	
Validation Status	The VIIRS-based product, being rather new, has not been extensively validated, but the algorithm behind it (applied to the nearly corresponding sensors: Terra/MODIS and Envisat/AATSR) has been validated. The algorithms have been applied in Northern Hemisphere SE production in GlobSnow) and in European-scale SE production in CryoLand-project (Solberg et al., 2013). The validation results reported in these projects are valid and representative so far, until VIIRS (or preferably S-3) based validation is carried out. The existing validations relevant to the Extended Baltic Sea Fractional Snow Cover Extent product are presented in: Solberg, R., Metsämäki, S., Malnes, E., Hindberg, H., Bippus, G., Nagler, T., Luojus, K., Ryyppö, T., Hiltunen, M., and Pulliainen, J. (2013): Implementation of Upgraded Snow Services – V1.0. EU FP7 CryoLand, Internal Deliverable ID4.6, 86 pp. Publication in preparation.	

	Metsämäki, S., Mattila, O.-P., Pulliainen, J., Niemi, K., Luojus, K., Böttcher, K. (2012). An optical reflectance model-based method for fractional snow cover mapping applicable to continental scale. *Remote Sensing of Environment, 123, 508-521.* Metsämäki, S., Pulliainen, J., Salminen, M., Luojus, K., Wiesmann, A., Solberg, R., Böttcher, K., Hiltunen, M. and Ripper, E., "Introduction to GlobSnow Snow Extent products with considerations for accuracy assessment", Remote Sensing of Environment, Vol. 156, January 2015, pp. 96-108, doi: 10.1016/j.rse.2014.09.018.
User Guide	The description of the Extended Baltic Sea FSC product is in preparation. The description to the legacy FSC product, which is for most parts applicable, is available here: http://www.globsnow.info/se/GlobSnow2_SE_SWE_Product_User_Guide_v1_r1.pdf
Algorithm Theoretical Basis Document	The algorithm is described in: Metsämäki, S., Pulliainen, J., Salminen, M., Luojus, K., Wiesmann, A., Solberg, R., Böttcher, K., Hiltunen, M. and Ripper, E., "Introduction to GlobSnow Snow Extent products with considerations for accuracy assessment", Remote Sensing of Environment, Vol. 156, January 2015, pp. 96-108, doi: 10.1016/j.rse.2014.09.018. Metsämäki, S., Mattila, O.-P., Pulliainen, J., Niemi, K., Luojus, K., Böttcher, K. (2012). An optical reflectance model-based method for fractional snow cover mapping applicable to continental scale. *Remote Sensing of Environment, 123, 508-521.* Additional information regarding the algorithm can also be found in the User Guide.
Spatial Coverage & Resolution	Limited Pan-European domain Spatial resolution: 1000m, (in future 500m)
Temporal Coverage & Resolution	Daily product Weekly and Monthly aggregate products
Platform(s)	Suomi NPP
Sensor(s)	VIIRS
Data Format (s)	NetCDF, GeoTIFF
Version	V1.0
Producers	SYKE and FMI
Data Policy	Data are provided free of charge during the project period for non-commercial usage
Access	Products will be provided through the FMIARC geoportal. WMS, WCS

2.2 Lake Ice Product

2.2.1 Lake Ice Extent (SYKE)

Table 2.2.1.: Lake Ice Extent (SYKE) Specifications

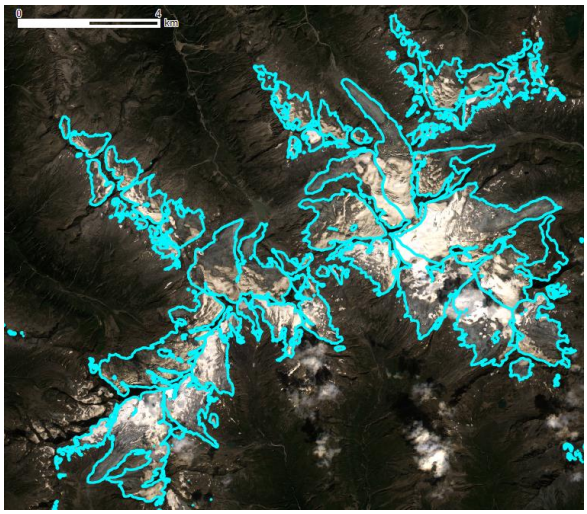
Product Code & Name	***LIE – Lake Ice Extent***	 ***Product example:*** *Lake Ice Extent*
Contact	Olli-Pekka Mattila, Finnish Environment Institute Olli-pekka.mattila@ymparisto.fi	
Overview	The Lake Ice Extent product describes the general lake ice state from optical satellite images. Lake pixels, not obscured by clouds and where polar night is not hindering observations, are classified to three classes: 1) ice with full snow cover 2) ice with variable snow/white ice cover 3) open water	
Validation Status	The product has undergone validation with relatively limited data. Further validation is on-going in SEN3APP –project (2014-2016).	
User Guide	http://cryoland.enveo.at/news-and-events/40-updated-cryoland-4-newbies-online, the guide is for accessing data via the CryoLand GeoPortal, but also describes the data products included.	
Algorithm Theoretical Basis Document	EU-FP7-CryoLand project documentation (Deliverable D5-2: Glacier and Lake/ River Ice products - algorithms, processing line and service description). Available on request.	
Spatial Coverage & Resolution	Northern Europe (Baltic Sea drainage basin) [45 - 71°N, 5 - 45°E] Spatial resolution: Current: 250m; after shift to Sentinels 2/3: 20m and 300m	
Temporal Coverage & Resolution	2011-2015, historical data will be produced along with more extensive validation Temporal resolution: Daily	

Platform(s)	Current: Terra Main: Sentinel-2, Sentinel-3 Auxiliary: Landsat-8, NPP Suomi
Sensor(s)	Current: MODIS Main: MSI (S2), OLCI & SLSTR (S3) Auxiliary: OLI (L8), VIIRS (NPP Suomi)
Data Format (s)	GeoTIFF
Version	V1.0
Producers	Finnish Environment Institute
Data Policy	Creative Commons 4.0-BY
Access	Currently distributed through CryoLand GeoPortal: http://neso1.cryoland.enveo.at/cryoclient/

2.3 Glacier Products

2.3.1 Glacier Outlines (ENVEO)

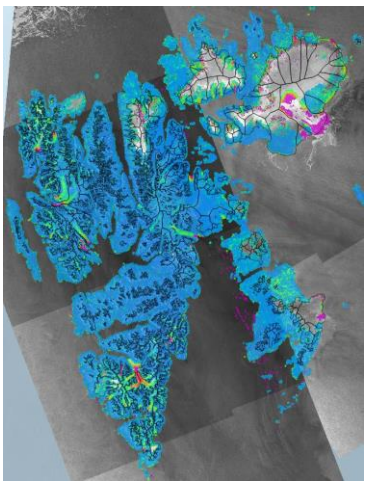
Table 2.3.1.: Glacier Outlines (ENVEO) Specifications

Product Code & Name	***GLO – Glacier outlines***	 ***Product example:*** *Glacier outlines from Sentinel-2 subset (R022) from 13 August 2015, Venedigergruppe, Austria.*
Contact	Dr. Gabriele Bippus, ENVEO IT GmbH, Austria gabriele.bippus@enveo.at	

Overview	Glacier outlines are mapped from very high resolution (VHR) or high resolution (HR) optical satellite data, acquired ideally in late summer, at time of maximum ablation. Glaciers affected fully or partly by clouds or cloud shadows are excluded from the product generation. Glacier outlines and internal rocks on glaciers are mapped as closed polygons, and defined by associated entries in the attribute table. Each glacier has a unique ID following the GLIMS standards, which is also used for all other features associated to the glacier (e.g. internal rock, pre-glacial lake, etc.). The product is generated only on demand for selected regions. Products are prepared following the internationally accepted standards of GLIMS (Global Land Ice Measurements from Space) and the INSPIRE standards.
Validation Status	Limited validation with orthophotos for selected glaciers available, validation activities are ongoing.
User Guide	The product is described in the CryoLand User Guide, available at http://cryoland.enveo.at/downloads/CryoLand4Newbies/CryoLand4Newbies.pdf
Algorithm Theoretical Basis Document	EU-FP7-CryoLand project documentation (Deliverable D5-2: Glacier and Lake/ River Ice products - Algorithms, Processing Line and Service Description). An updated ATBD is in preparation.
Spatial Coverage & Resolution	Selected glaciers. ≤ 10 m – 30 m pixel size (depends on available satellite data)
Temporal Coverage & Resolution	Single date. Temporal resolution depends on availability of usable satellite data.
Platform(s)	Sentinel-2, Landsat 5/7/8, other satellites with VHR or HR optical sensors
Sensor(s)	MSI, TM / ETM+ / OLI, other VHR or HR optical sensors
Data Format (s)	Shapefiles (vector) meeting the internationally accepted standards of GLIMS (Global Land Ice Measurements from Space).
Version	V1.0
Producers	ENVEO IT GmbH
Data Policy	Data are provided free of charge during the project period for non-commercial usage.
Access	Products are provided only on demand via FTP or e-Mail.

2.3.2 Ice Velocity (GAMMA)

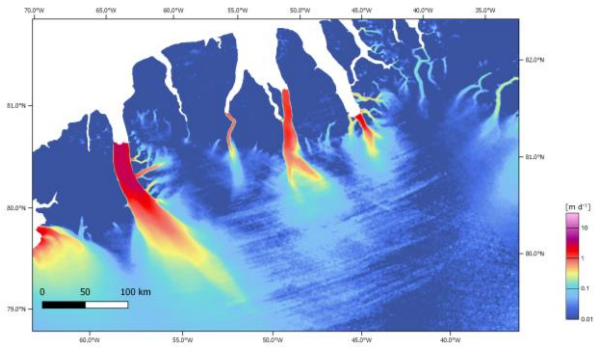
Table 2.3.2.: Ice Velocity (GAMMA) Specifications

Product Code & Name	**Ice Velocity**	  *0 m/year 300* ***Product example:*** Ice surface velocity map of glaciers in the Svalbard Archipelago from Sentinel-1 SLC data acquired between September 30 and October 13, 2015.
Contact	Tazio Strozzi, Gamma Remote Sensing, Worbstrasse 225, 3073 Gümligen (BE), SWITZERLAND, strozzi@gamma-rs.ch	
Overview	Knowledge on glacier ice velocity provides a better understanding of a wide range of processes related to glacier dynamics, for example glacier mass flux, flow modes and flow instabilities (e.g. surges), sub-glacial processes (e.g. erosion), and the development of glacier lakes and associated hazards. In addition, the comparison of the spatio-temporal variations of glacier velocities both within and between regions will improve understanding of climate change impacts. Satellite SAR missions make it possible to operationally map and monitor glacier flow on a nearly global scale using offset-tracking methods. With Sentinel-1 Level 1 SLC data, downloaded from the Scientific Data Hub, the retrieval of ice surface velocity maps over the Svalbard Archipelago is possible since August 2014 every 12 or 24 days. Horizontal surface velocity data in m/day are provided together with a quality measure, a header file describing the input data and validation, and a quick-look image of the product in GeoTIFF format.	
Validation Status	Processor qualified and operational. Verification of selected glaciers.	
User Guide	Product User Guide (PUG), ESA Glacier_CCI Project, Version 1.4 22.02.2016, http://www.esa-glaciers-cci.org/index.php?q=documents#	

Algorithm Theoretical Basis Document	Algorithm Theoretical Basis Document Phase 2 (ATBD), ESA Glacier_CCI Project, Version 2.1 25.11.2014, http://www.esa-glaciers-cci.org/index.php?q=documents# F. Paul, T. Bolch, A. Kääb, T. Nagler, C. Nuth, K. Scharrer, A. Shepherd, T. Strozzi, F. Ticconi, R. Bhambri, E. Berthier, S. Bevan, N. Gourmelen, T. Heid, S. Jeong, M. Kunz, T.R. Lauknes, A. Luckman, J. Merryman, G. Moholdt, A. Muir, J. Neelmeijer, M. Rankl, J. Van Looy and T. Van Niel, The glaciers climate change initiative: Methods for creating glacier area, elevation change and velocity products, Remote Sensing of Environment, 162: 408–426, doi: 10.1016/j.rse.2013.07.043, 2015. Strozzi T., A. Kouraev, A. Wiesmann, U. Wegmüller, A. Sharov and C. Werner, Estimation of Arctic glacier motion with satellite L-band SAR data, Remote Sensing of Environment, 112:636-645, doi:10.1016/j.rse.2007.06.2007, 2008. Strozzi T., A. Luckman, T. Murray, U. Wegmüller, and C. Werner, Glacier motion estimation using SAR offset-tracking procedures, IEEE Transactions on Geoscience and Remote Sensing, Vol. 40, No. 11, pp. 2384-2391, November 2002.
Spatial Coverage & Resolution	Svalbard Archipelago (Norway) at 100 m posting
Temporal Coverage & Resolution	From 2015.08.02 onwards every 12 or 24 days
Platform(s)	Sentinel-1
Sensor(s)	C-SAR
Data Format (s)	ASCII file (csv format) with header file description (xml format) and quick-look image (GeoTIFF format)
Version	Version 04
Producers	Gamma Remote Sensing
Data Policy	Open
Access	Products are provided on demand. Access via unique http link.

2.3.3 Ice Velocity (ENVEO)

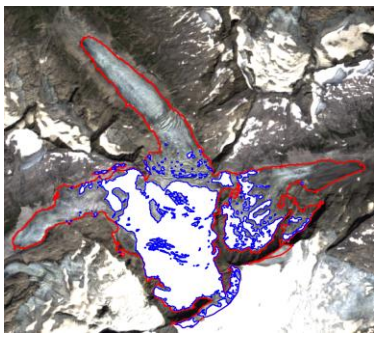
Table 2.1.1.: Fractional Snow Cover Extent for Northern Hemisphere from Optical Data (FMI & SYKE) Specifications

Product Code & Name	***GLV – Glacier ice velocity***	 ***Product example:*** *Ice surface velocity on outlet glaciers of Northern Greenland, mosaic from multiple Sentinel-1 IW data of 2015.*
Contact	Dr. Gabriele Bippus, ENVEO IT GmbH, Austria gabriele.bippus@enveo.at	
Overview	The product provides horizontal ice surface velocity on glaciers in m/day. Ice surface velocity products from Sentinel-1 Level-1 SLC IW, the standard mode of Sentinel-1 for land areas, are generated only for large glaciers with gently inclined surrounding terrain. For small glaciers or glaciers located in very complex terrain with steep surrounding slopes, satellite data with very high resolution are needed for the product generation. The product is generated on demand and can only be prepared if usable satellite imagery is available. Products are provided including metadata meeting INSPIRE standards.	
Validation Status	Intercomparisons of ice velocities from different satellite data for selected glaciers available, validation activities are ongoing.	
User Guide	The product is described in the CryoLand User Guide, available at http://cryoland.enveo.at/downloads/CryoLand4Newbies/CryoLand4Newbies.pdf	
Algorithm Theoretical Basis Document	EU-FP7-CryoLand project documentation (Deliverable D5-2: Glacier and Lake/ River Ice products - Algorithms, Processing Line and Service Description). Algorithm Theoretical Basis Document Phase 2 (ATBD), ESA Glacier_CCI Project, Version 2.1 25.11.2014, http://www.esa-glaciers-cci.org/index.php?q=documents# F. Paul, T. Bolch, A. Kääb, T. Nagler, C. Nuth, K. Scharrer, A. Shepherd, T. Strozzi, F. Ticconi, R. Bhambri, E. Berthier, S. Bevan, N. Gourmelen, T. Heid, S. Jeong, M. Kunz, T.R. Lauknes, A. Luckman, J. Merryman, G. Moholdt, A. Muir, J. Neelmeijer, M. Rankl, J. Van Looy and T. Van Niel (2015): The glaciers climate change initiative: Methods for creating glacier area, elevation change and velocity products, Remote Sensing of Environment, 162: 408–426, doi: 10.1016/j.rse.2013.07.043.	

Spatial Coverage & Resolution	Selected glaciers. Depends on available satellite data
Temporal Coverage & Resolution	Temporal coverage and resolution depend on availability of satellite data.
Platform(s)	Sentinel-1, Sentinel-2
Sensor(s)	C-SAR (IW, SM), MSI
Data Format (s)	GeoTIFF, optionally NetCDF
Version	V1.0
Producers	ENVEO IT GmbH
Data Policy	Data are provided free of charge during the project period for non-commercial usage.
Access	Products are provided only on demand via FTP or e-Mail.

2.3.4 Snow / Ice Areas on Glaciers (ENVEO)

Table 2.3.4.: Snow / Ice Areas on Glaciers (ENVEO) Specifications

Product Code & Name	***GLS – Snow and ice areas on glaciers***	 ***Product example:*** *Snow areas (blue outlines) on selected glaciers (red outlines) in Austria from Sentinel-2 (R022) of 13 August 2015.*
Contact	Dr. Gabriele Bippus, ENVEO IT GmbH, Austria gabriele.bippus@enveo.at	
Overview	Snow and ice areas on glaciers are mapped from very high resolution (VHR) or high resolution (HR) optical satellite data, acquired in late summer, at time of	

	maximum ablation. Glaciers affected fully or partly by clouds or cloud shadows are excluded from the product generation. Snow areas on glaciers are mapped as closed polygons, and linked to the associated glacier with the unique GLIMS ID in the attribute table (cf. description of glacier outlines). The product is generated only on demand for selected glaciers. Products are prepared following the internationally accepted standards of GLIMS (Global Land Ice Measurements from Space) and the INSPIRE standards.
Validation Status	Limited validation with orthophotos for selected glaciers available, validation activities are ongoing.
User Guide	Not yet available
Algorithm Theoretical Basis Document	Bippus, G. (2011): Characteristics of summer snow areas on glaciers observed by means of Landsat data. PhD Thesis, University of Innsbruck: 231 pp. (http://acinn.uibk.ac.at/sites/default/files/PhD_Thesis_Bippus_August2011.pdf) EU-FP7-CryoLand project documentation (Deliverable D5-2: Glacier and Lake/ River Ice products - Algorithms, Processing Line and Service Description).
Spatial Coverage & Resolution	Selected glaciers. ≤ 10 m – 30 m pixel size (depends on available satellite data)
Temporal Coverage & Resolution	Single date. Temporal resolution depends on availability of usable satellite data.
Platform(s)	Sentinel-2, Landsat 5/7/8, other satellites with VHR or HR optical sensors
Sensor(s)	MSI, TM / ETM+ / OLI, other VHR or HR optical sensors
Data Format (s)	Shapefiles (vector) meeting the internationally accepted standards of GLIMS (Global Land Ice Measurements from Space), optionally also provided as raster in GeoTIFF or NetCDF format.
Version	V1.0
Producers	ENVEO IT GmbH
Data Policy	Data are provided free of charge during the project period for non-commercial usage
Access	Products are provided only on demand via FTP or e-Mail.

2.4 Land Cover & Phenology Products

2.4.1 Crop / Vegetation Classification (SYKE)

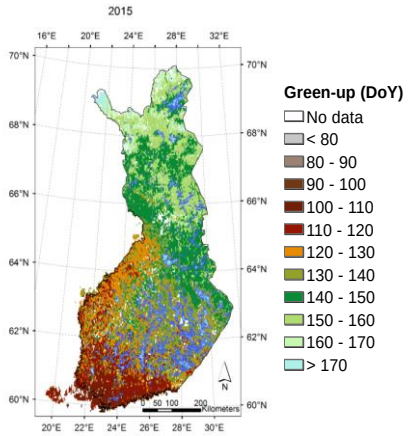
Table 2.4.1.: Crop / Vegetation Classification (SYKE) Specifications

Product Code & Name	***Agricultural monitoring***	***The data is delivered as table (e.g. .csv)***
Contact	Markus Törmä, Finnish Environment Institute Markus.torma@ymparisto.fi	
Overview	The products tailored for the Agency of Rural Affairs Finland (MAVI) for monitoring agricultural areas are simple classifications designed to target specific control requirements for agricultural subsidies. The requirements come both from EC as well as from national authorities. The products are still in development stage; summer 2016 will serve as demonstration phase for assessing the concept. Following test cases are used for demonstration in 2016: • Winter time vegetation • Summer time vegetation • Coarse un-supervised classification based on S1/S2 images	
Validation Status	Currently the validation dataset is used for product development. Validation is achieved during the use of the products. Some field control is unavoidable in the subsidies control process. These field visits will be used to also gather information on the performance of the satellite interpretations. Some dedicated field campaigns are foreseen.	
User Guide	Not available. Please, use the above contact.	
Algorithm Theoretical Basis Document	The product is still in development phase.	
Spatial Coverage & Resolution	Finland Spatial resolution: 20m	
Temporal Coverage & Resolution	The data products are delivered on specific dates, depending on the control requirement. Temporal resolution:	
Platform(s)	Current: Landsat-8, Sentinel-1	

	Main: Sentinel-1, Sentinel-2 Auxiliary: Landsat-8
Sensor(s)	Current: OLI (L8), C-SAR (S1) Main: C-SAR (S1), MSI (S2) Auxiliary: OLI (L8)
Data Format (s)	Data tables (.csv, .xlsx)
Version	V0.8
Producers	Finnish Environment Institute
Data Policy	In the development stage the data is restricted to MAVI only.
Access	Demonstration phase: email Main: Machine readable web-interface

2.4.2 Phenology (SYKE)

Table 2.4.2.: Phenology (SYKE) Specifications

Product Code & Name	***Phenology product of Finnish Environment Institute***	 ***Product example:***
Contact	Kristin Böttcher, Finnish Environment Institute Kristin.bottcher@ymparisto.fi	
Overview	The product is derived from satellite data product time-series. The data products used are FSC (the same algorithm as for SYKE&FMI Extended Baltic Sea drainage basin direct broadcast FSC based on NPP VIIRS/Sentinel-3 SLSTR), NDVI and NDWI indices. Aim: The phenological product will contain four layers:	

	1) The date of the start of the vegetation active season in evergreen coniferous forest. This date corresponds to the start of photosynthetic activity in conifers. 2) The date of the greening-up of deciduous vegetation. This date corresponds to the time of bud break in deciduous trees. 3) The end of season date in evergreen coniferous forest. 4) The end of season date for deciduous vegetation. Currently, the product layers 3) and 4) are under development.
Validation Status	Product layer 1) was calibrated against in situ observation of the start of season in evergreen coniferous forest from CO_2 flux measurements in Finland for the period 2001 to 2010. Validation will be carried out based on in situ observations from 2011 onwards for few sites in Finland. Product layer 2) was validated based on in situ observations on the bud break of birch in Finland for the period from 2001 to 2008. The obtained root mean square error (RMSE) is 7 days. Validation will continue with in situ observations from 2009 to 2014.
User Guide	Not available. Please, use the above contact.
Algorithm Theoretical Basis Document	Böttcher, Kristin, et al. "MODIS time-series-derived indicators for the beginning of the growing season in boreal coniferous forest—A comparison with CO 2 flux measurements and phenological observations in Finland." Remote Sensing of Environment 140 (2014): 625-638. Delbart, N., Kergoat, L., Le Toan, T., L'Hermitte, J., Picard, G., 2005. Determination of phenological dates in boreal regions using normalized difference water index. Remote Sensing of Environment 97, 26-38.
Spatial Coverage & Resolution	Finland Spatial resolution: 0.05°
Temporal Coverage & Resolution	Coverage: 2001-2015 Temporal resolution: Annual maps
Platform(s)	Current: Terra Main: Sentinel-3
Sensor(s)	Current: MODIS (Terra) Main: SLSTR & OLCI (S3)
Data Format (s)	GeoTIFF
Version	V0.5

Producers	Finnish Environment Institute
Data Policy	Creative Commons 4.0-BY
Access	Currently: Upon request Aim: Web-access service (on-going)

3. References

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