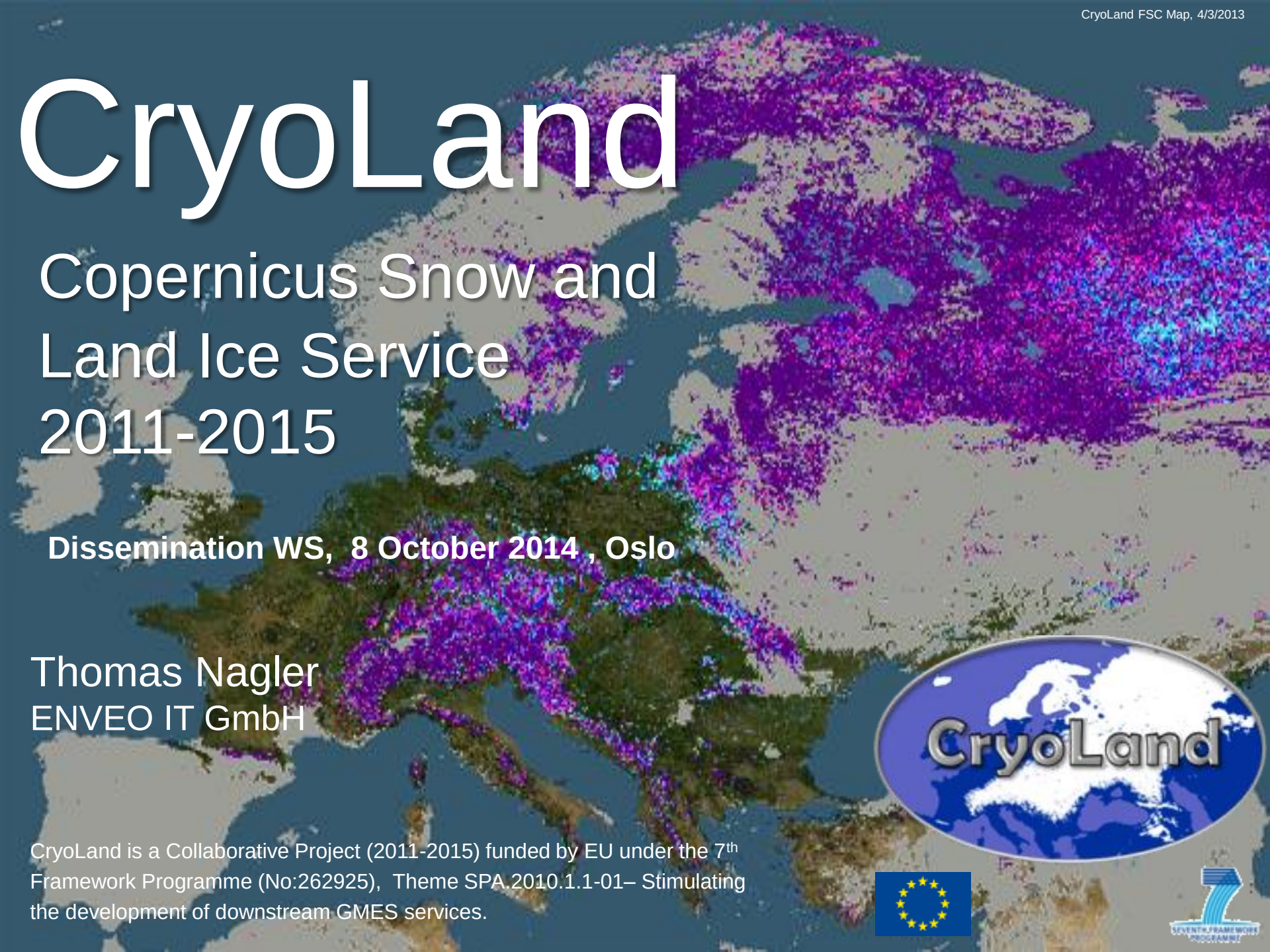


CryoLand

Copernicus Snow and Land Ice Service 2011-2015

Dissemination WS, 8 October 2014 , Oslo

Thomas Nagler
ENVEO IT GmbH

CryoLand is a Collaborative Project (2011-2015) funded by EU under the 7th Framework Programme (No:262925), Theme SPA.2010.1.1-01– Stimulating the development of downstream GMES services.

CryoLand – (FP7 Project 2011-2015)
Copernicus Services Snow and Land Ice

PRIMARY OBJECTIVE

Develop, implement and validate an operational, sustainable service for monitoring snow and land ice as a Downstream Service within Copernicus Initiative of EC and ESA.

The project prepares the basis for a future cryospheric component of the Copernicus Land Monitoring Service.

MAIN SUB-OBJECTIVES

- Integrate and operationalise existing snow and land ice services
- Develop tools to utilize data from the Copernicus Sentinel Satellite Series for snow and land ice applications.
- Products conform to INSPIRE/GEOSS standards
- Perform full verification and real time demonstration of the services
- Prepare the tools for offering snow and land ice services world-wide.
- Make products available via state-of-the-art online services
- Issue guidelines for stakeholders and for service operations

Approach for Product and Service Development Towards User Needs

1. User requirements / dialogue for improved product requirements and specification

User Requirements for Products and Services

2011 Collecting User Requirements for Snow, glacier and lake / River ice products. Workshops in Vienna, Oslo, Bukarest and Web Questionaire

2012 Consolidation of product and service specifications at User Workshop, Stockholm

2013 Interim User Validation Workshop, Copenhagen

2014 Dissemination Workshop – Nordic Countries, Oslo (8.Oct 2014)
Dissemination Workshop – Central Europe, Innsbruck (Dec 2014 TBC)

5. Final algorithms, fully validated products and services

Approved Algorithms, Validated Products and Services

CryoLand Snow Products and Services

Product type	Spatial resolution	Temporal Coverage	Coverage	Latency time	EO sensors
Snow extent, Pan-European	500 m	Daily, full year 2000 -> Today NRT since 2012/13	35N – 72 N 11W – 45E	<1 day	MODIS, Sentinel S3
Snow Water Equivalent	25 km	Daily, dry snow season 2011→ Today	35N – 72 N 11W – 45E	<2 day	SSMI/S, AMSR2
Snow extent, regional	250 m – 500 m	Daily, full year	Alps, Scandinavia Baltic Sea area	<1 day	MODIS Sentinel S1, S3
Melting snow area	100 m	Daily, Spring/Summer/Fall/ Winter	Alps Scandinavia	<1 day	Sentinel S1 Radarsat (ASAR archived),
Snow Surface Wetness	1000 m	Daily	Regional	<1 day	MODIS, Sentinel S3
Snow Surface Temperature	1000 m	Daily	Regional, local	<1 day	MODIS, Sentinel S3

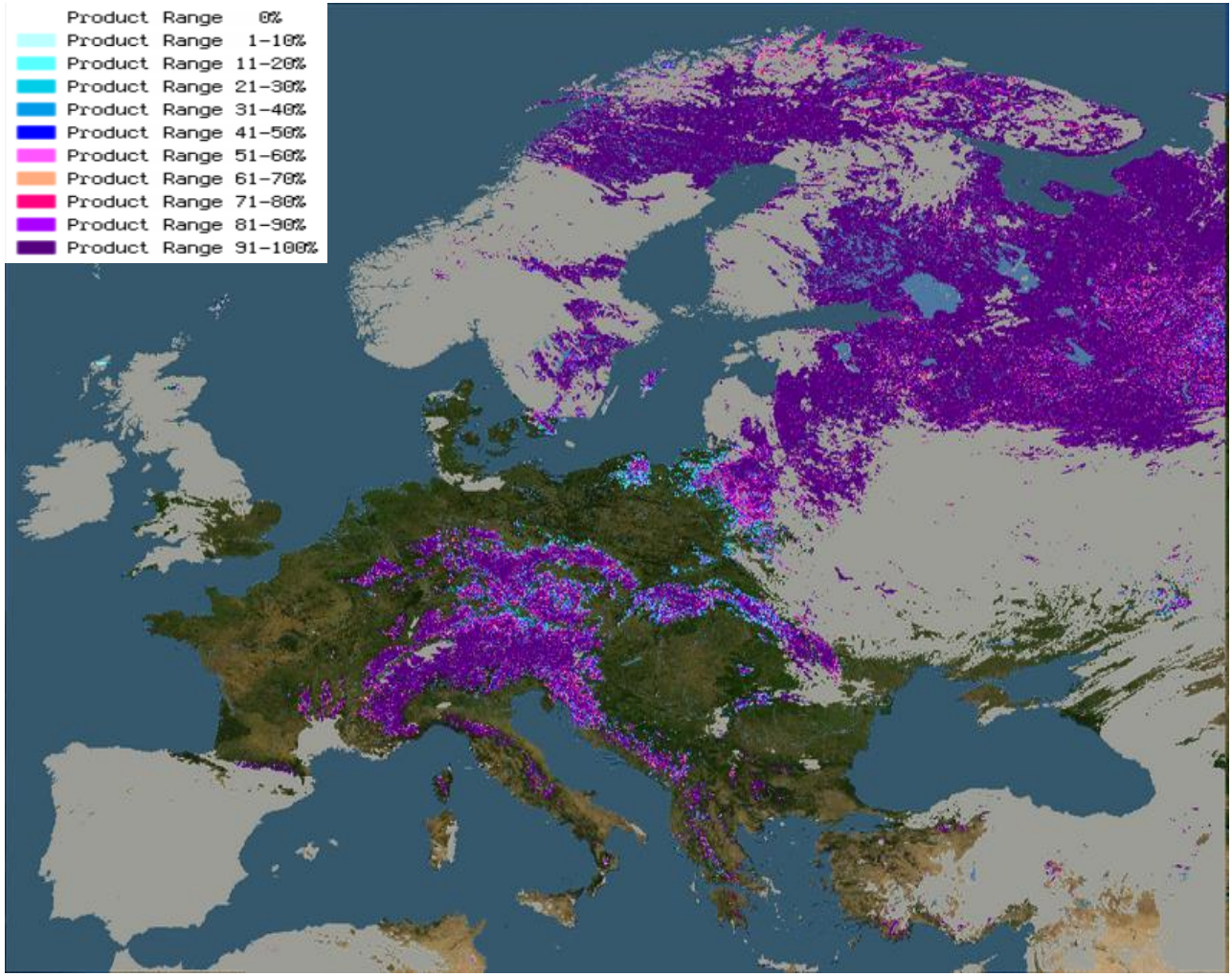
Pan-European Fractional Snow Cover Product

Product Specifications:

- Domain:
  72°N 11°W – 35°N 50°E
- Projection: LatLon/WGS84
- Pixel size: 0.005° (ca 500 m)
- Latency: < 1 day

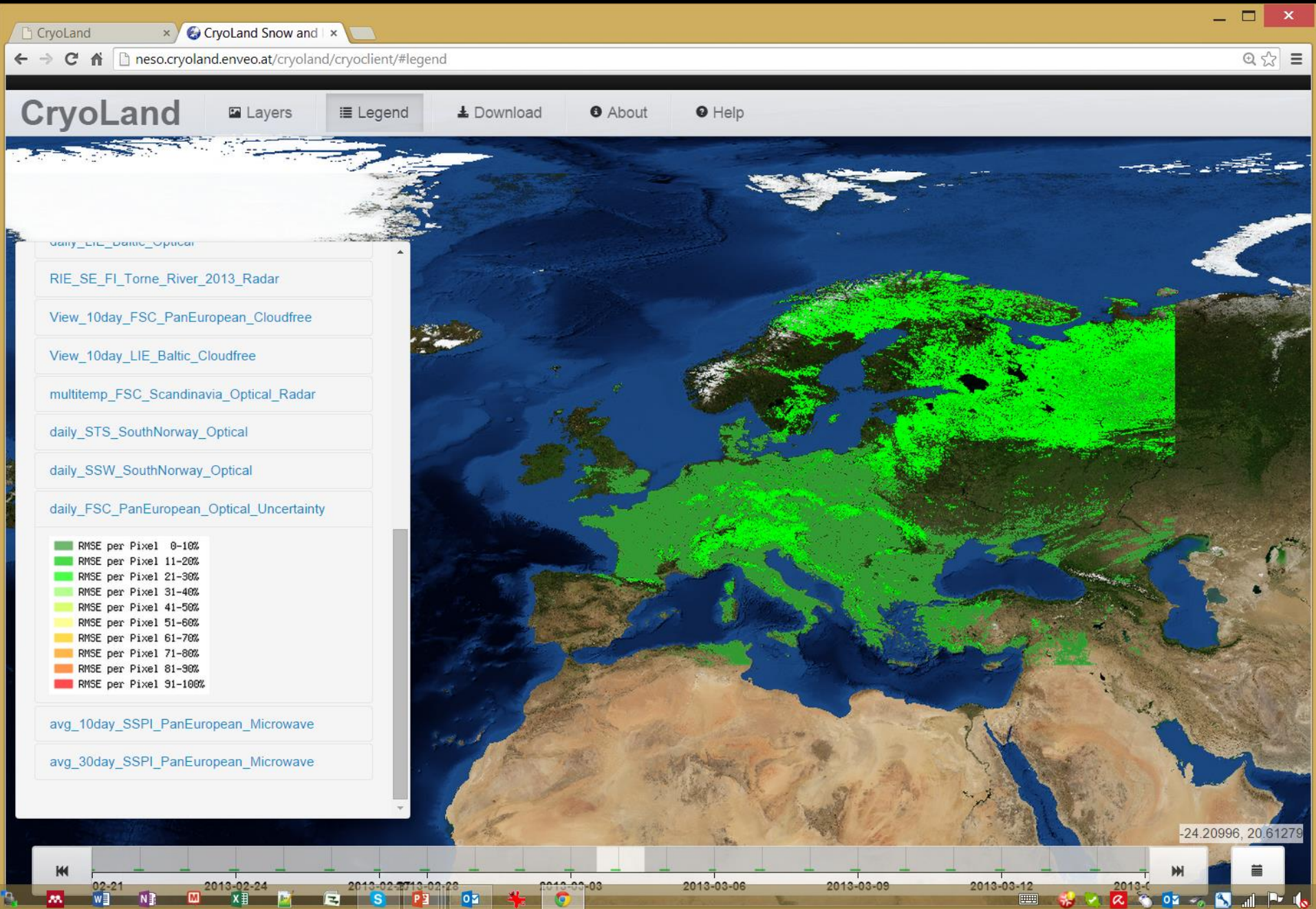
Status:

- Sensor: MODIS
  (Backup VIIRS, Sentinel-3)
- Uncertainty map provided for each daily product
- Archive of Daily Snow product from 2000-Today
- Fully Operational NRT for Winter 2013/14



CryoLand pan-European FSC product, 4/3/2013

Planned for the next seasons – proposed as Core Service to Copernicus Office


CryoLand
CryoLand Snow and
neso.cryoland.enveo.at/cryoland/cryoclient/#legend
CryoLand
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Legend
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RIE_SE_FI_Torne_River_2013_Radar
View_10day_FSC_PanEuropean_Cloudfree
View_10day_LIE_Baltic_Cloudfree
multitemp_FSC_Scandinavia_Optical_Radar
daily_STS_SouthNorway_Optical
daily_SSW_SouthNorway_Optical
daily_FSC_PanEuropean_Optical_Uncertainty
RMSE per Pixel 0-10%
RMSE per Pixel 11-20%
RMSE per Pixel 21-30%
RMSE per Pixel 31-40%
RMSE per Pixel 41-50%
RMSE per Pixel 51-60%
RMSE per Pixel 61-70%
RMSE per Pixel 71-80%
RMSE per Pixel 81-90%
RMSE per Pixel 91-100%
avg_10day_SSPI_PanEuropean_Microwave
avg_30day_SSPI_PanEuropean_Microwave
-24.20996, 20.61279
2013-02-24
2013-03-06
2013-03-09
2013-03-12

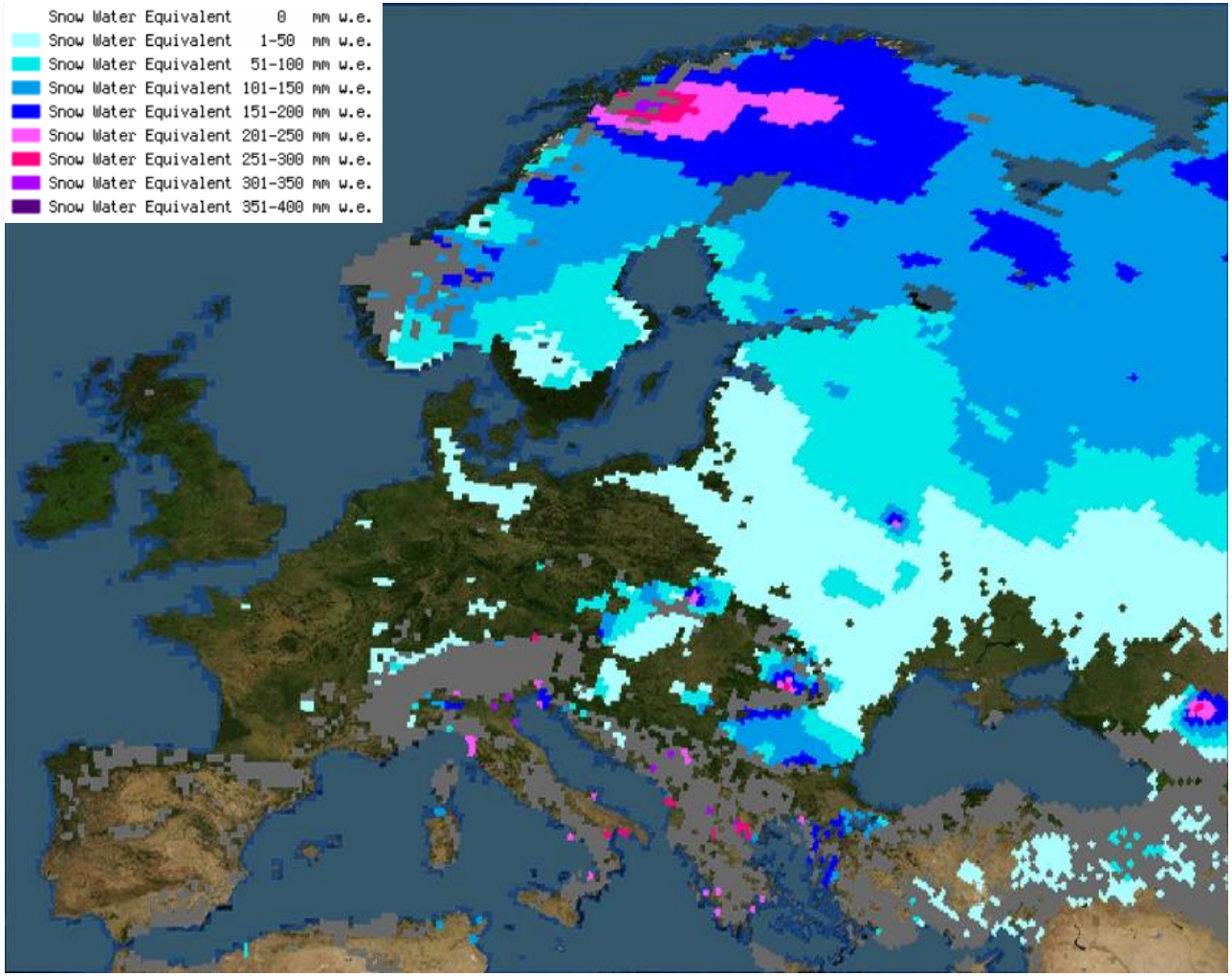
Pan-European SWE Product

Product Specifications:

- Domain:
  72°N 11°W – 35°N 50°E
- Projection: LatLon / WGS84
- Pixel size: 0.1deg; ca 10 km
- Temporal resolution: Daily
- Latency: < 1 day

Status:

- Algorithm based on H-SAF and GlobSnow, new processing and data delivery
- Based on passive microwave observations and ECMWF weather station data



CryoLand pan-European SWE product, 4/3/2013

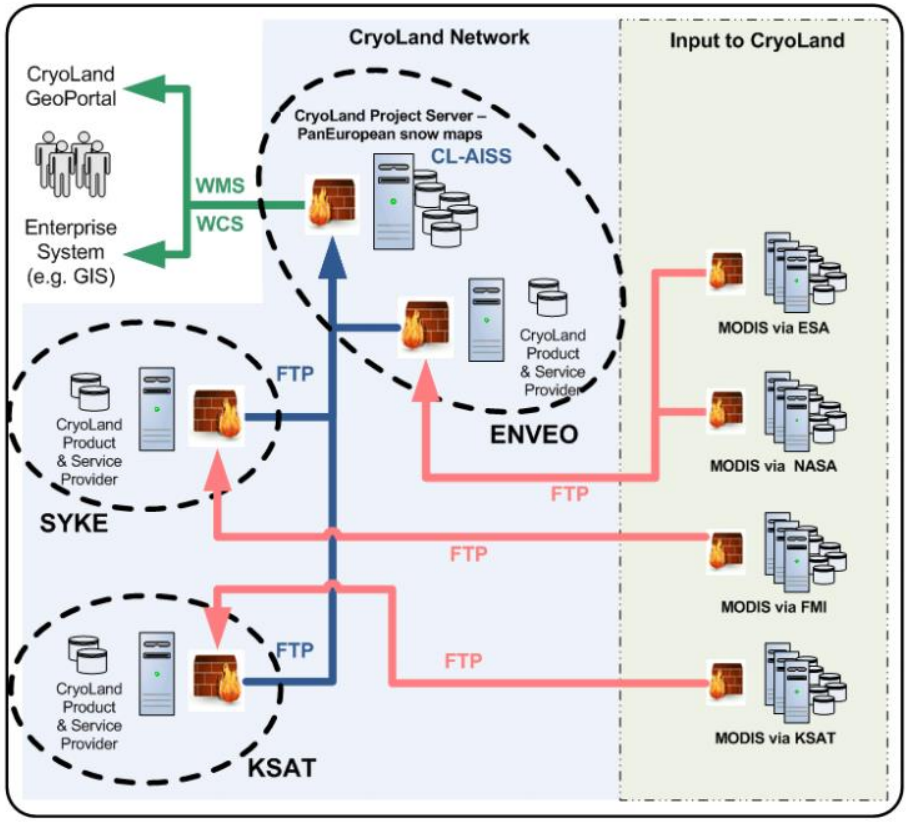
Planned for the next seasons – proposed as Core Service to Copernicus Office

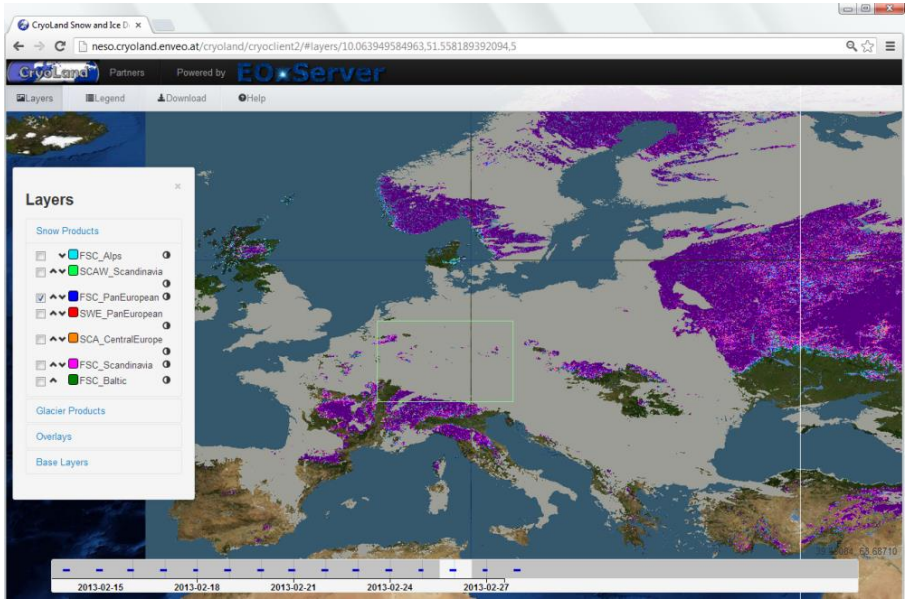
Glacier and Lake / River Ice Products

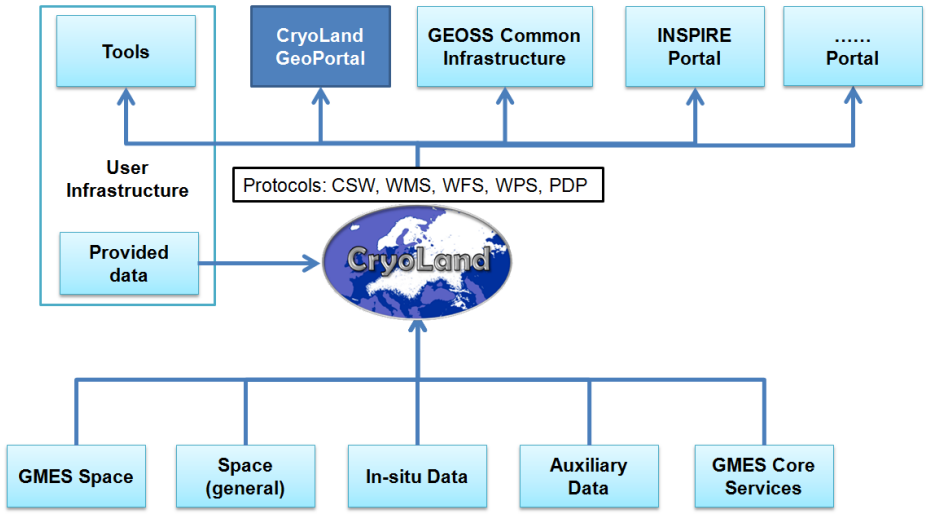
Product type	Coverage	Grid / Projection	Latency time	Sensor
Glacier outlines	Local, regional (on user request)	Lat/Lon / WGS84, UTM / WGS84	3 months	High resolution Optical, SAR
Snow/ice area on glaciers	Local, regional (on user request)	Lat/Lon / WGS84, UTM / WGS84	3 months	High resolution Optical, SAR
Glacier Ice velocity	Local (on user request)	Lat/Lon / WGS84, UTM / WGS84	3 months	SAR
Glacier lakes	Local (on user request)	Lat/Lon / WGS84, UTM / WGS84	3 months, 10 days (quick analysis, hours (emergency)	High resolution Optical, SAR
Lake ice extent (4 classes)	Baltic Sea area (operational)	Lat/Lon / WGS84	3 days	MODIS/Terra, Sentinel-3
River ice jam, flood inundation area	Scandinavia (on user request / emergency)	Lat/Lon / WGS84	3 days	High res. SAR (1-30 m)

CryoLand Geoportal

Implemented Service Network for the operational snow and lake ice/river ice services, utilizing a central data provisioning node







CryoLand Geoporal will be operated by ENVEO at least until 2016 (by best efforts)

Satellite data for CryoLand Services

Sentinel-1 (A/B/C/D) – SAR imaging
All weather, day/night applications, interferometry

Sentinel-2 (A/B/C/D) – Multi-spectral imaging
Land applications: urban, forest, agriculture,…
Continuity of Landsat, SPOT

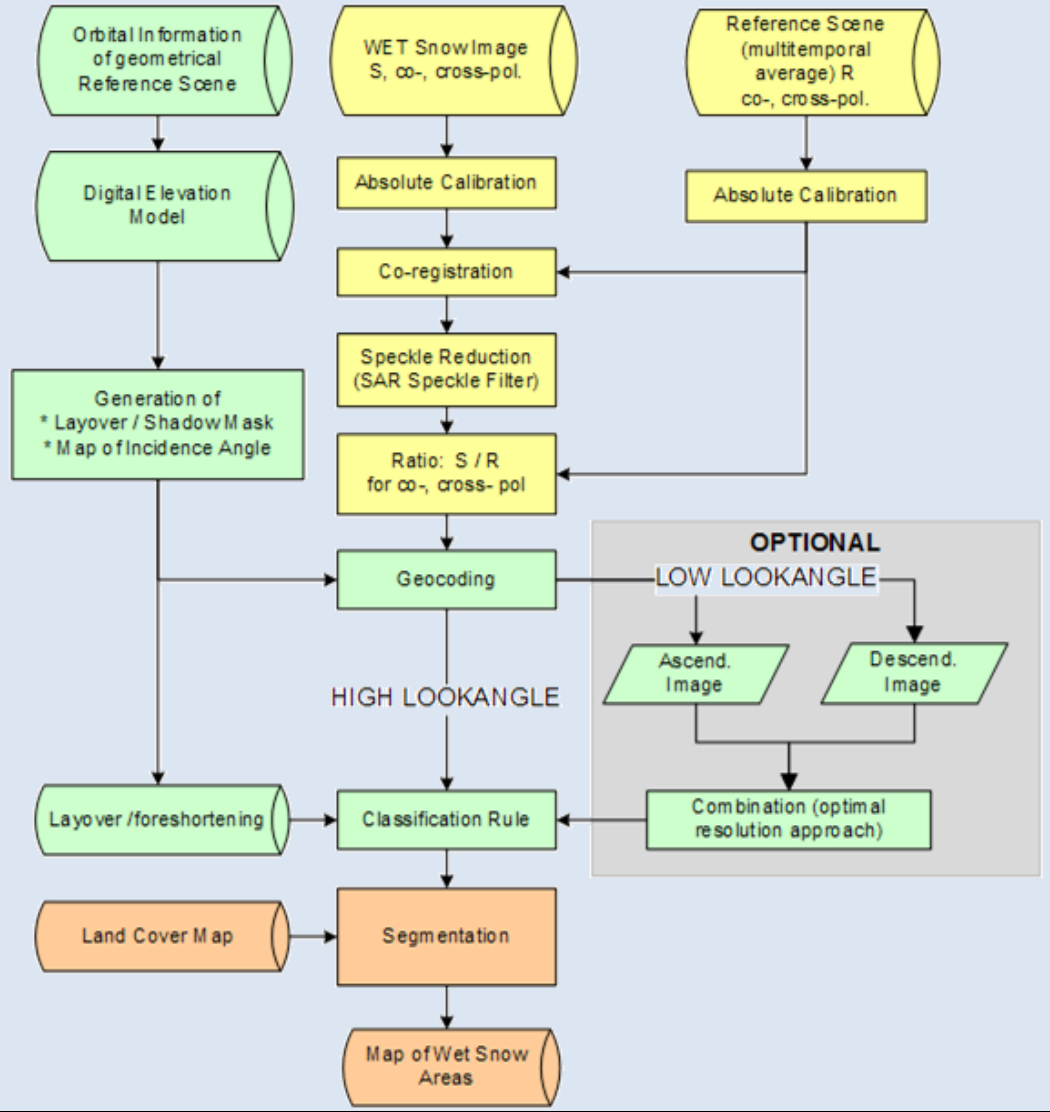
Sentinel-3 (A/B/C/D) – Ocean and land monitoring
Wide-swath ocean color, vegetation, sea/land surface temperature, altimetry

Sentinel-1: Launched 3 April 2014 – Data available for the public since 3 oct. 2014

sentinel-1

5 October 2014

Wet Snow Map Procedure



Main Achievements

- Automated algorithms and processing lines for generating snow, glacier and lake / river ice products developed and implemented taking the needs of users into account.

- Rigorous tests and benchmarking of the products was carried out, in order to achieve full qualification of the products and processing lines.

- *Services are compliant with INSPIRE, GEOSS, Copernicus LMS* implementation rules and interface standards.

- Pan-European snow services and glaciers services are pre-cursors for snow and glacier services within the Copernicus Land Monitoring Service of EC.

- Regional services for Alps, Scandinavia, and Baltic Sea Region and Lake River ice implemented and continued as Downstream services.

- Algorithms and processing lines (wet snow, glacier velocity) are ready for using Sentinel-1 data.

- Demonstration of use of CryoLand Services within various applications like hydrological modelling, snow pack modelling, etc.

CryoLand Server System – Pan European Snow Services

Continuity of CryoLand Server & Geoportal

ENVEO will run the CryoLand Server at least for the coming seasons 2014 – 2016, supporting the services for various products generated by CryoLand partners.

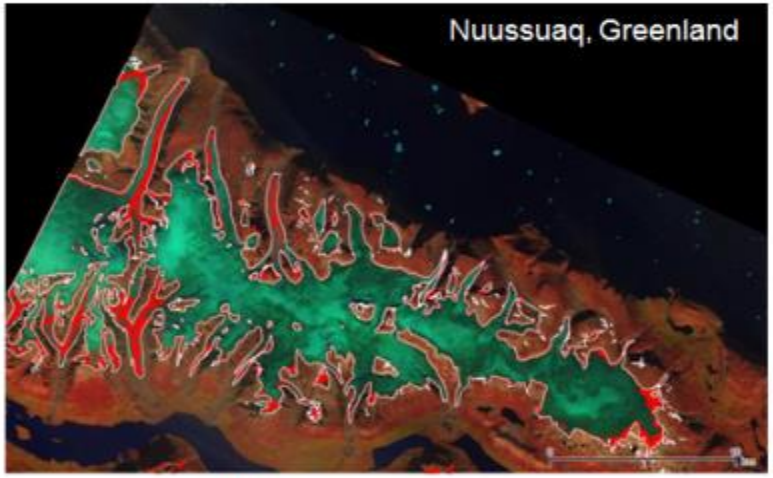
Copernicus Snow and Glacier Services:

PanEuropean Snow Services (FSC, SWE) using Sentinel-3 has been proposed as Copernicus Service to Copernicus Office.

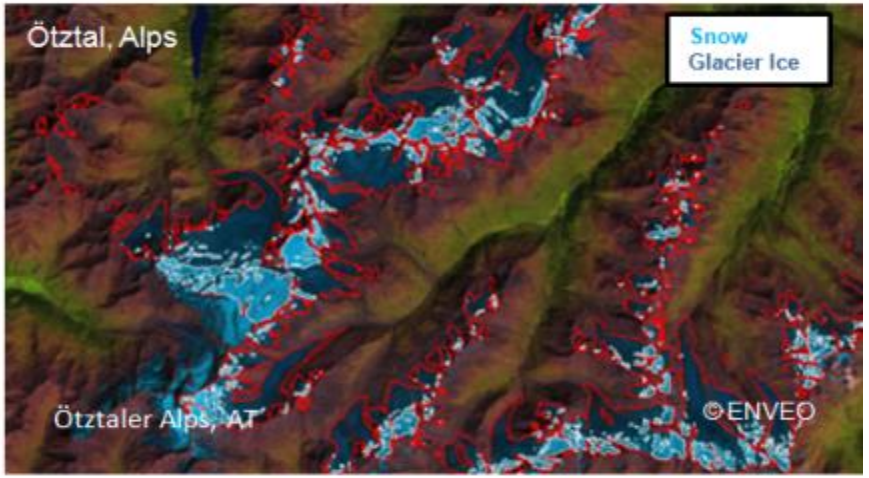
Season 2014/2015: Near Real Time Pan-European Snow Services will be provided (as it is) by ENVEO / SYKE / FMI with best efforts.

Glacier Products

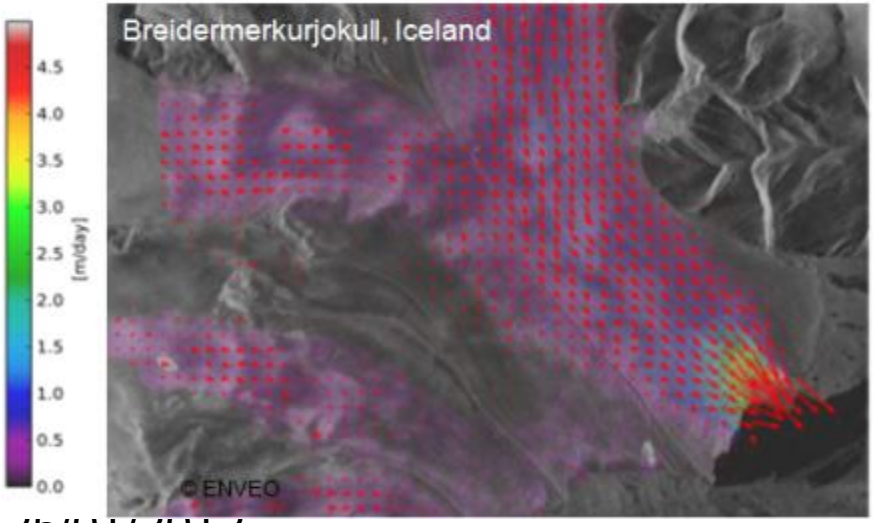
Glacier Outlines



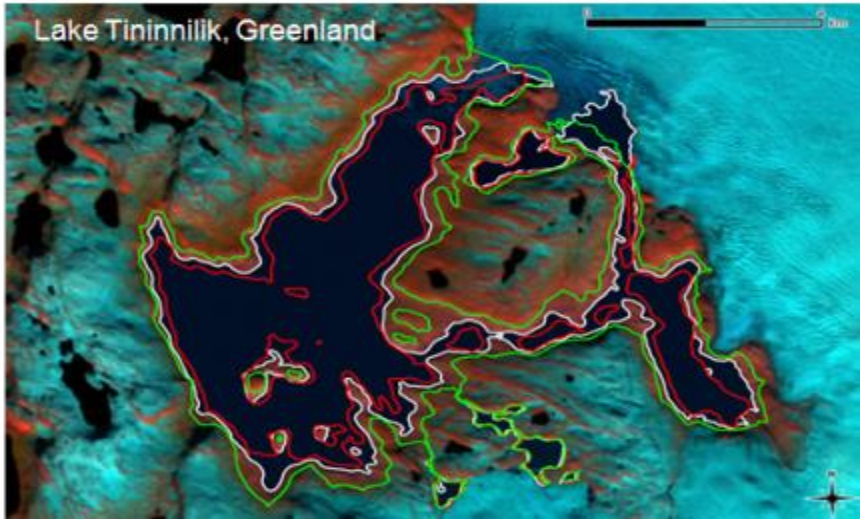
Snow and Glacier Ice areas



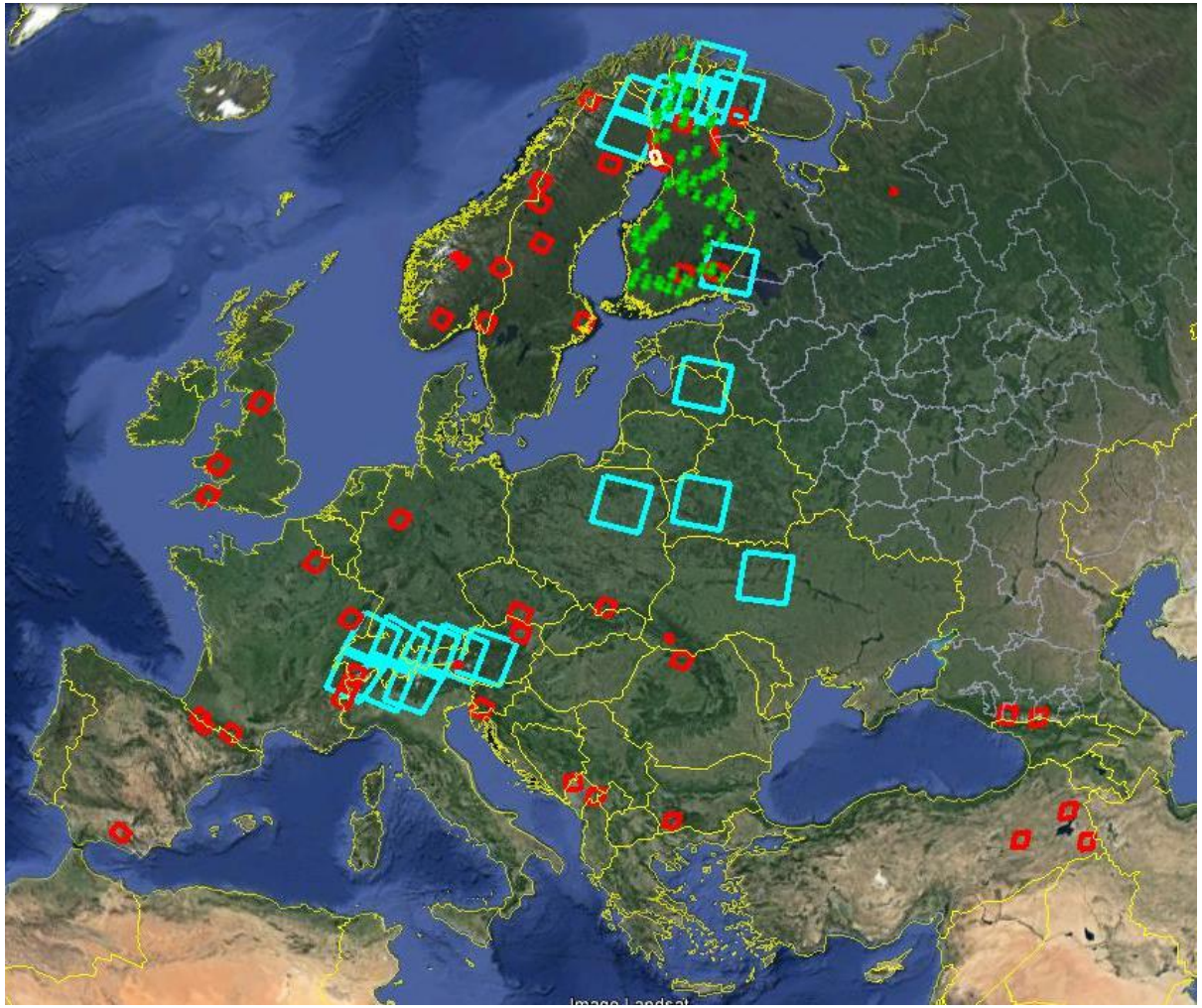
Ice Velocity Fields



Extent of Glacier Lakes



Snow Extent Product Quality Assessment



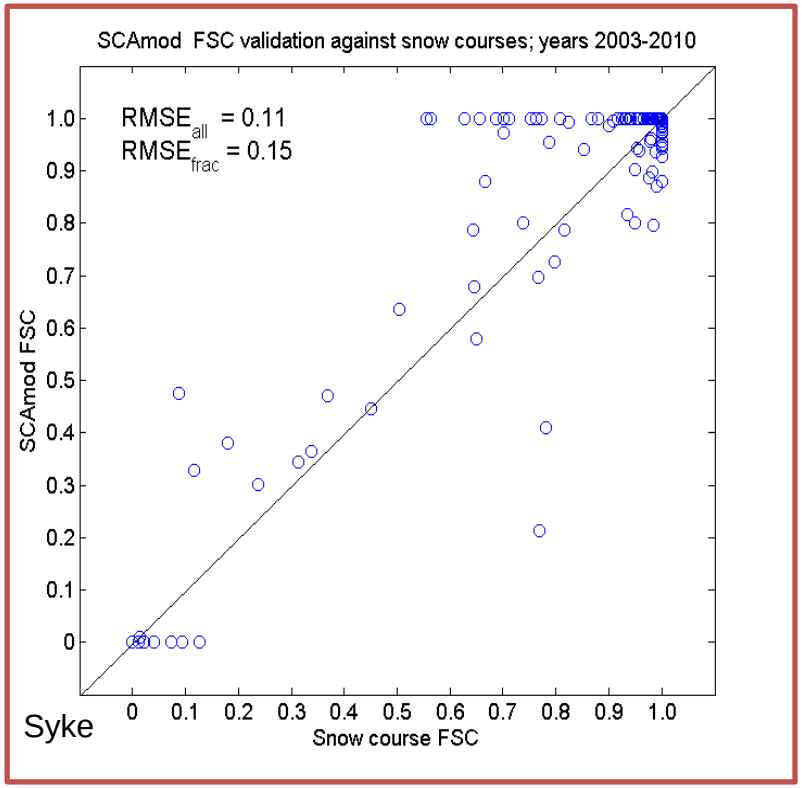
VHR Optical Images - Landsat TM/ETM+ - In-situ snow transects

Quality Assessment of Snow Extent Products is performed in different environments:

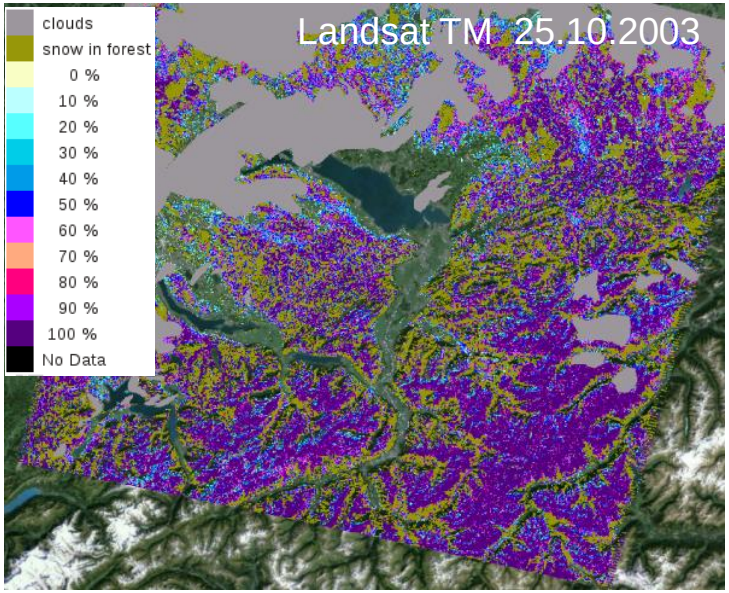
- Fractional SE products from high resolution optical images:
  - Very High resolution images (IKONOS, SPOT5, Quickbird)
  - Landsat TM/ETM+
- In-situ snow transects measured operationally by SYKE in Finland

Accuracy Assessment of SE Products

Pan-European FSC versus In-situ Snow transects Finnland



High and Very High resolution Images provide detailed snow information in mountains and forests (sparse->dense) and enable the quality assessment of CryoLand SE products in these areas.



Pixel (unforested)	RMSD	BIAS	R
106714	17.3	-3.93	0.89