GMES products in the Finnish Environment Institute (SYKE)

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Finnish Environment Institute

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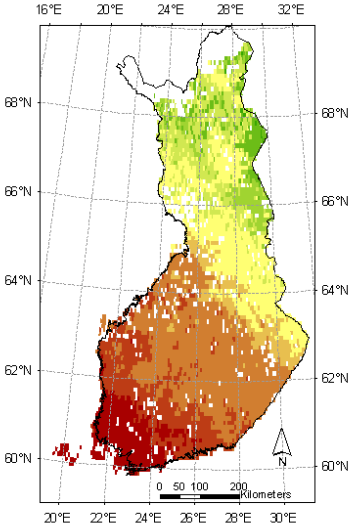
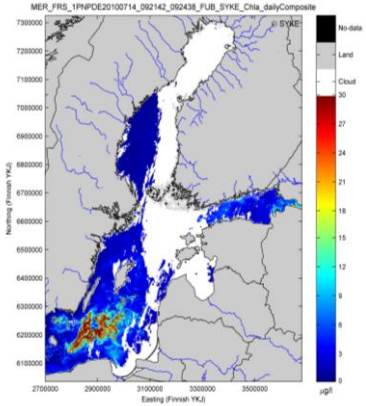
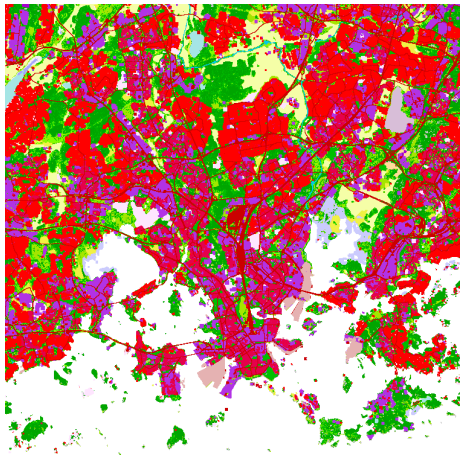
DATA AND INFORMATION CENTRE

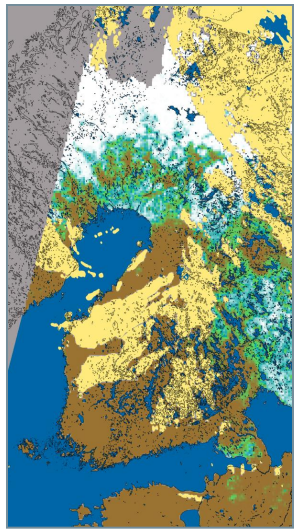
Contents

- Earth observation research at SYKE
- Catalogue of SYKE EO products:
  - Water quality
  - Snow
  - Phenology & Land cover
- How to get our products?
- Summary









SYKE

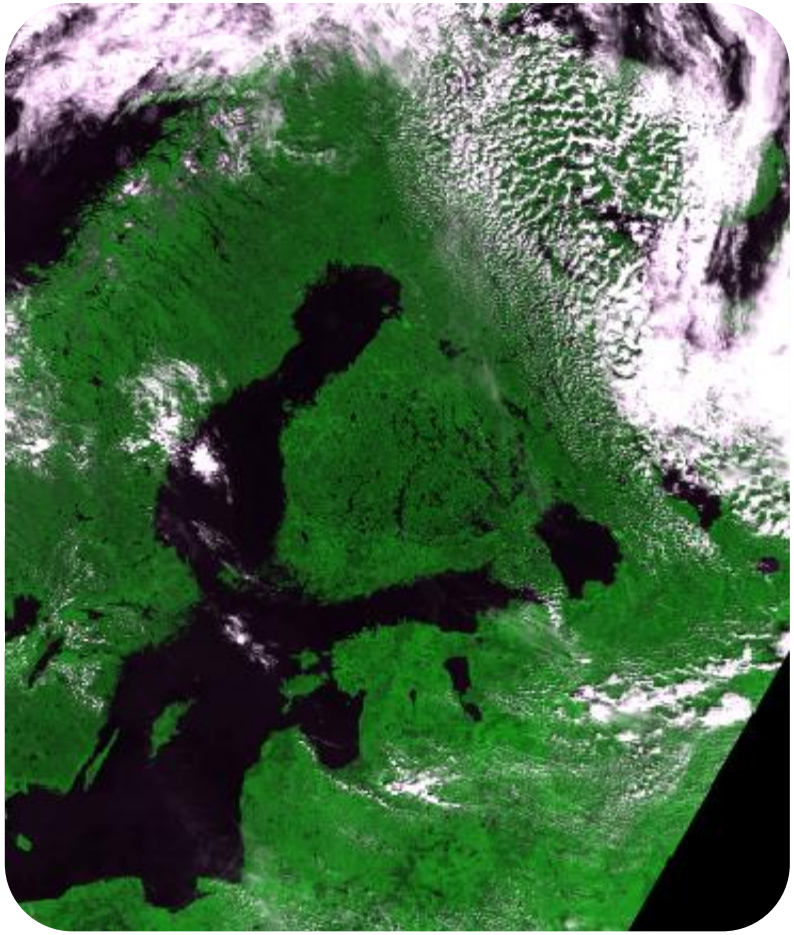
Earth observation at SYKE

- About 15 persons at the Geoinformatics Division
- Algorithm development
  - SYKE's own algorithms
  - Tuning of algorithms made by others
- Data processing
  - Satellite data -> Map products (with manual cloud masking)
  - Map products -> Time series & Information
- Validation
- In situ measurements for validation and algorithm development
  - Reflectances of various targets (water, snow, vegetation, …)
  - Water constituents
  - Snow properties
- Data services (WWW, FTP, WMS, CSW, …)

DATA AND INFORMATION CENTRE

Catalogue of SYKE's EO products

- Near real time (NRT) services
  - Winter and spring:
    - Snow monitoring
  - Spring and summer (Baltic Sea):
    - Water quality (chl-a, algae blooms, turbidity) and temperature
- Long term monitoring services
  - Land cover, land cover change
  - Seasonal vegetation monitoring
- Under development
  - Lake water quality, high resolution water products
- Satellite instruments:
  - MERIS, MODIS, AVHRR, Landsat TM/ETM, SPOT, RapidEye, Radarsat, AMSR-E, SSM/I
  - **Sentinels in the future**



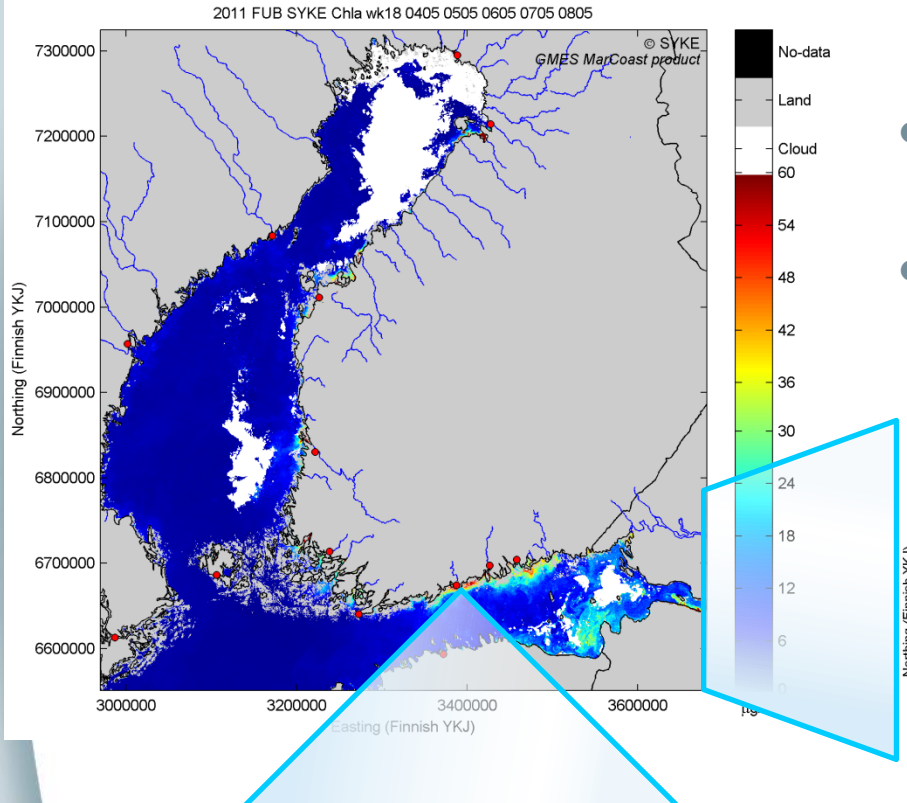
SYKE

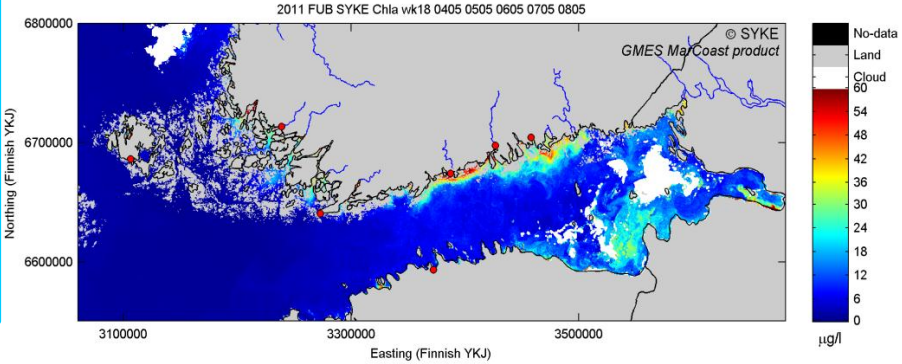
Water quality products

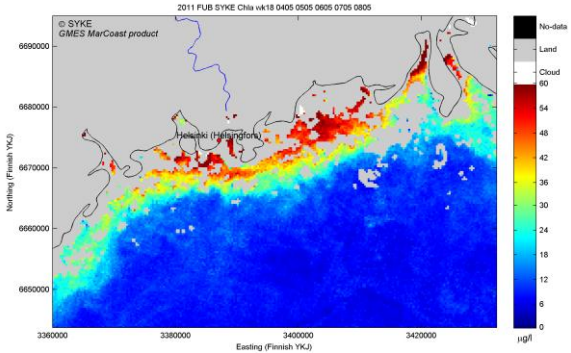
- Operative NRT products (Baltic Sea):
  - Chl-a (MERIS/MODIS)
  - Algal blooms (MERIS/MODIS)
  - Turbidity (MERIS/MODIS)
  - Surface temperature (AVHRR)
- Based mostly on algorithms available in BEAM (MERIS) and SeaDAS (MODIS)
- Demonstration products (under development)
  - Chl-a of various lakes (MERIS)
  - High resolution (Rapid Eye, 5 m) turbidity and water transparency (lakes and coastal areas)
  - High resolution Water Depth and Bottom Type mapping

CHLOROPHYLL-A products

May 4-8, 2011







- Until the end of 2011 estimated from Envisat/MERIS
  - 300m resolution, daily overpass
- Now from MODIS images
  - 500 m resolution, daily overpass
- Composite & daily products
  - Weekly mean (mean of noncloudy pixels)

www.environment.fi/chlorophyll-a

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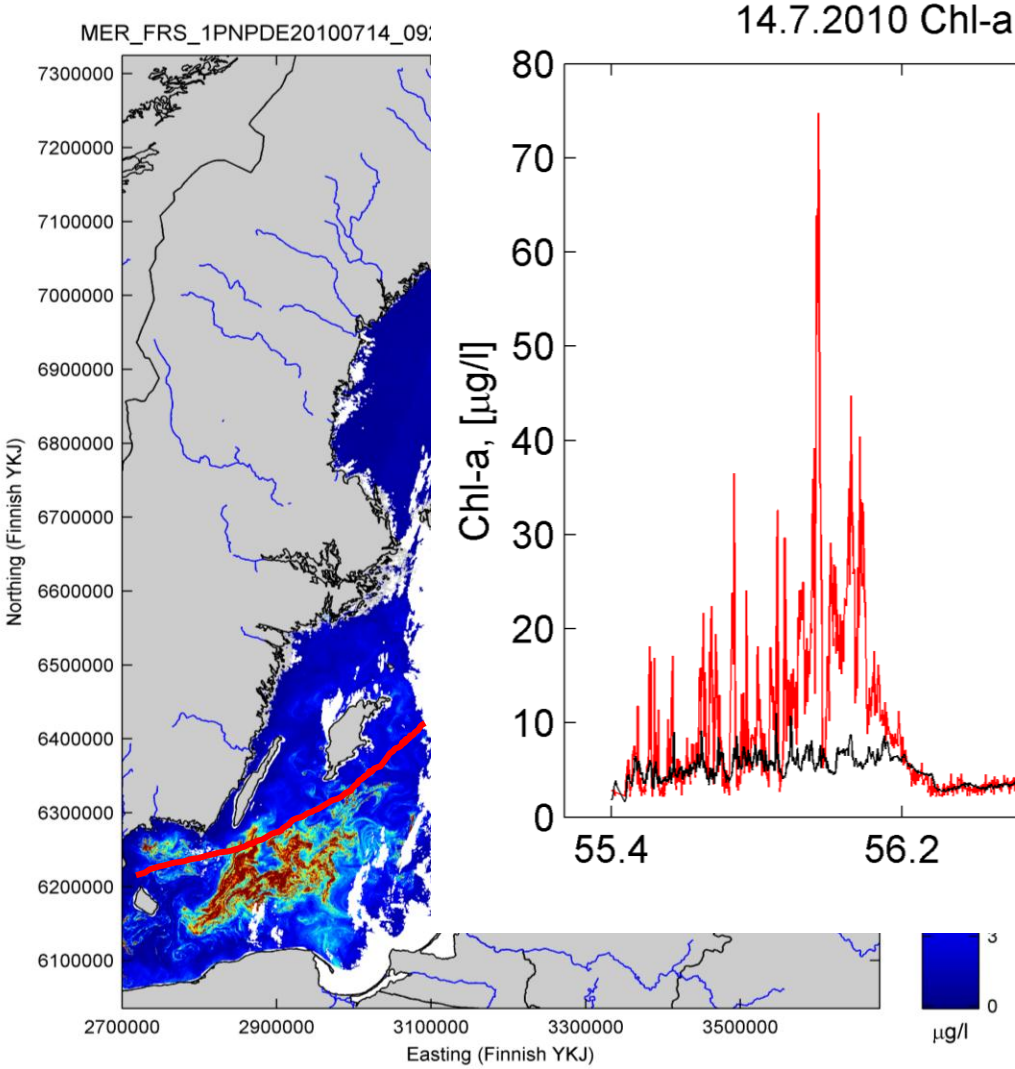
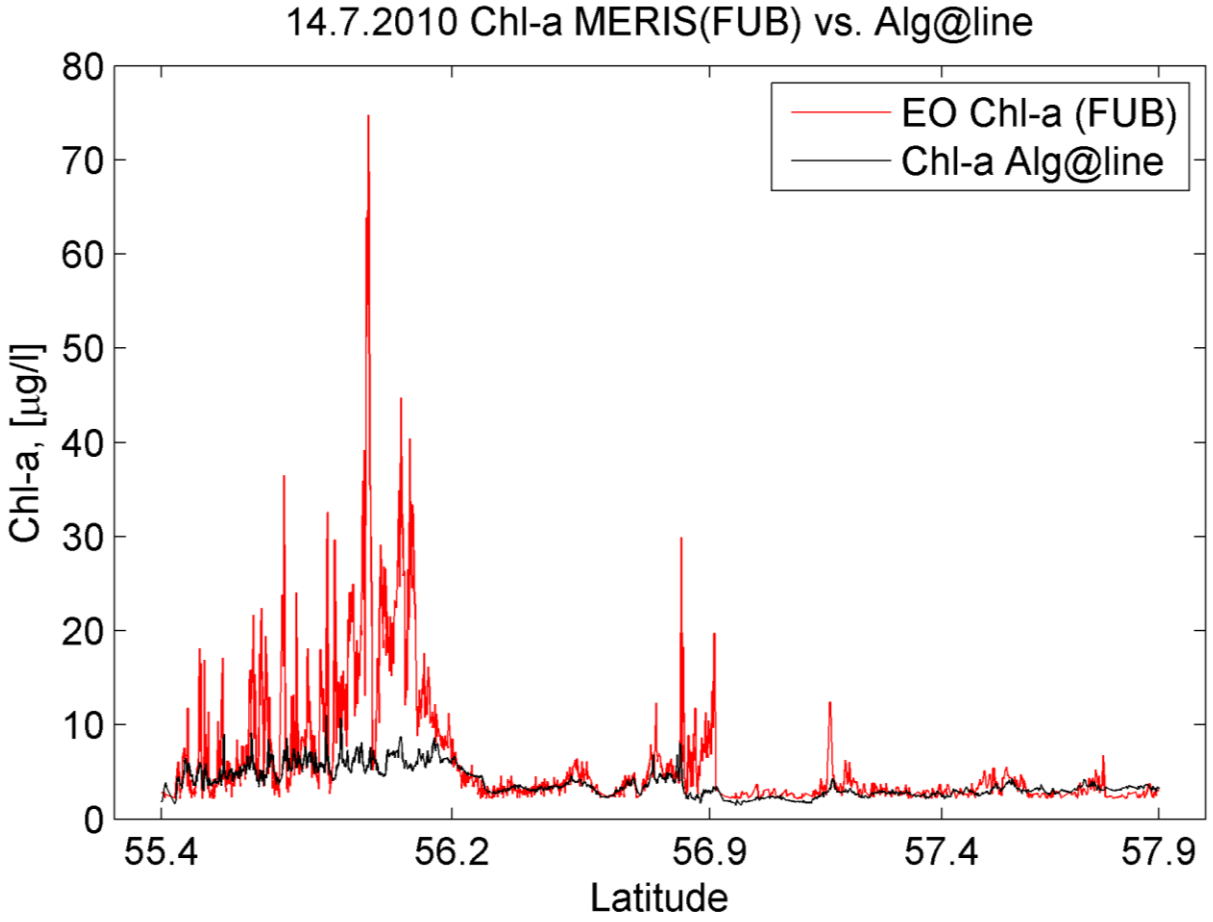
Validation: EO chl-a vs. Algaline chl-a

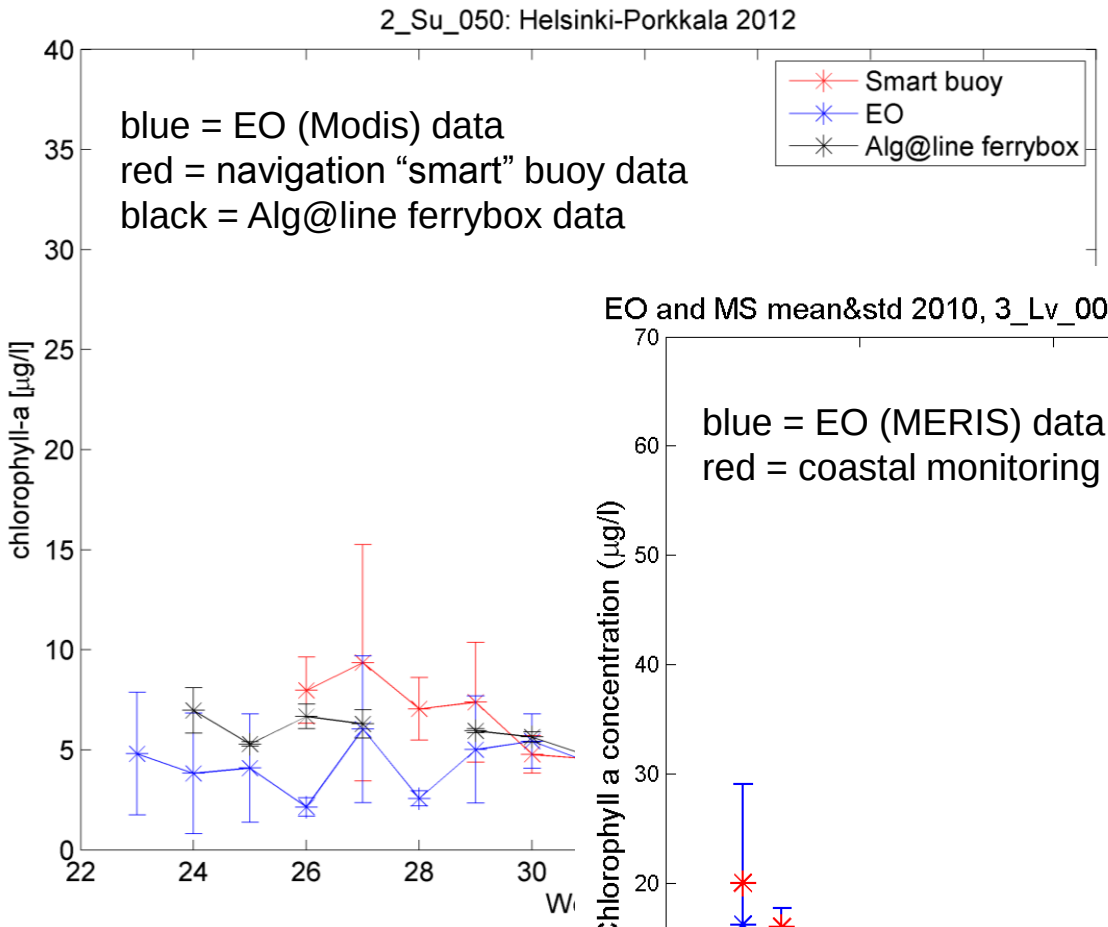


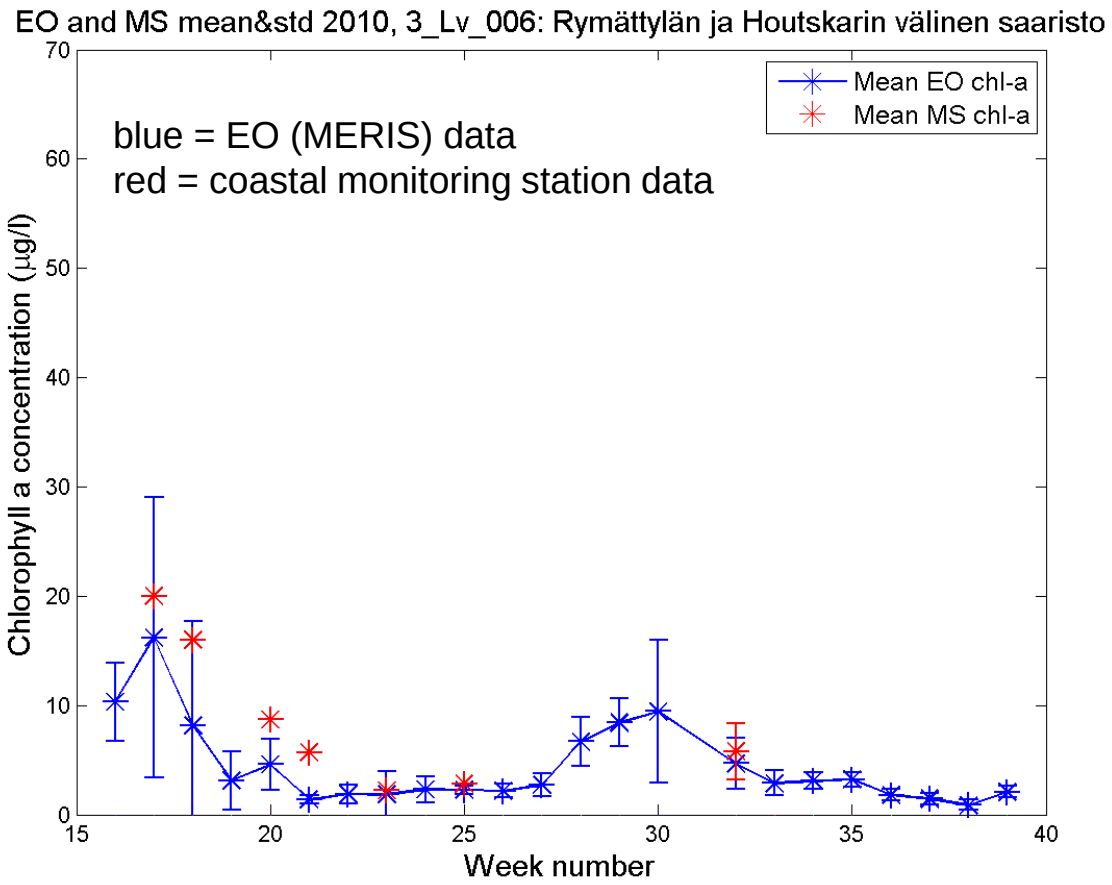


* Attila, Alasalmi, Kaitala

SYKE

Validation: EO chl-a vs. in situ chl-a





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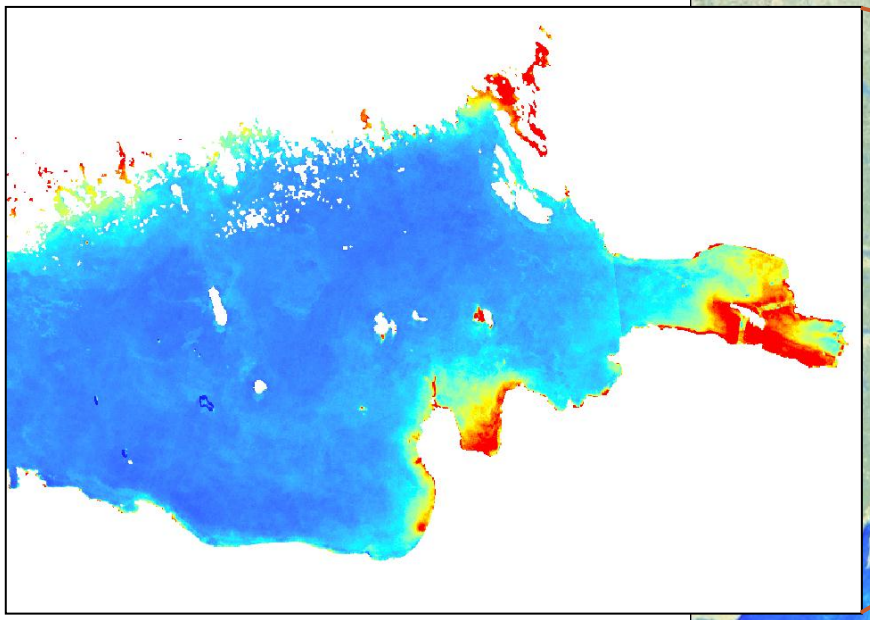
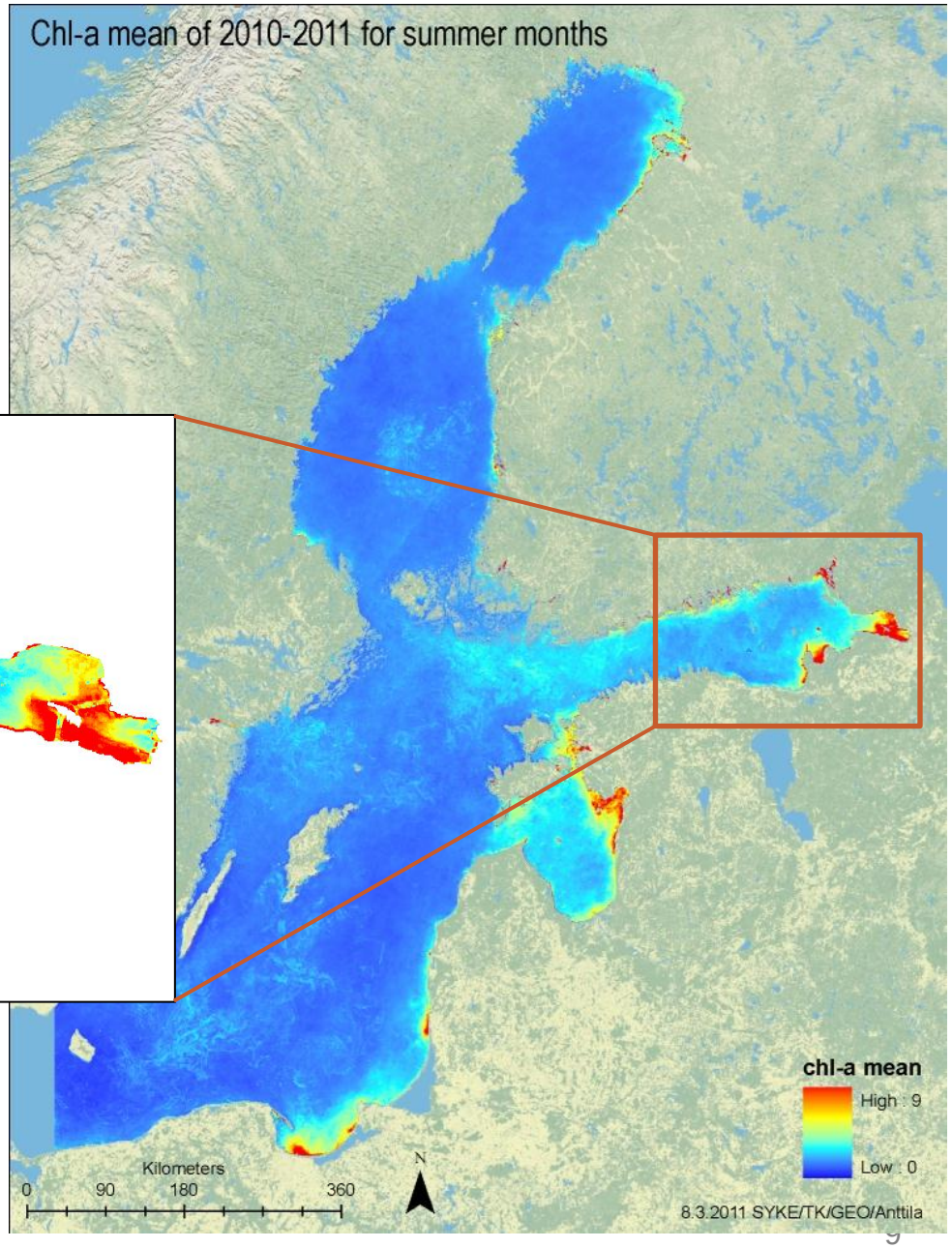
Mean chl-a of summer months of 2010 and 2011





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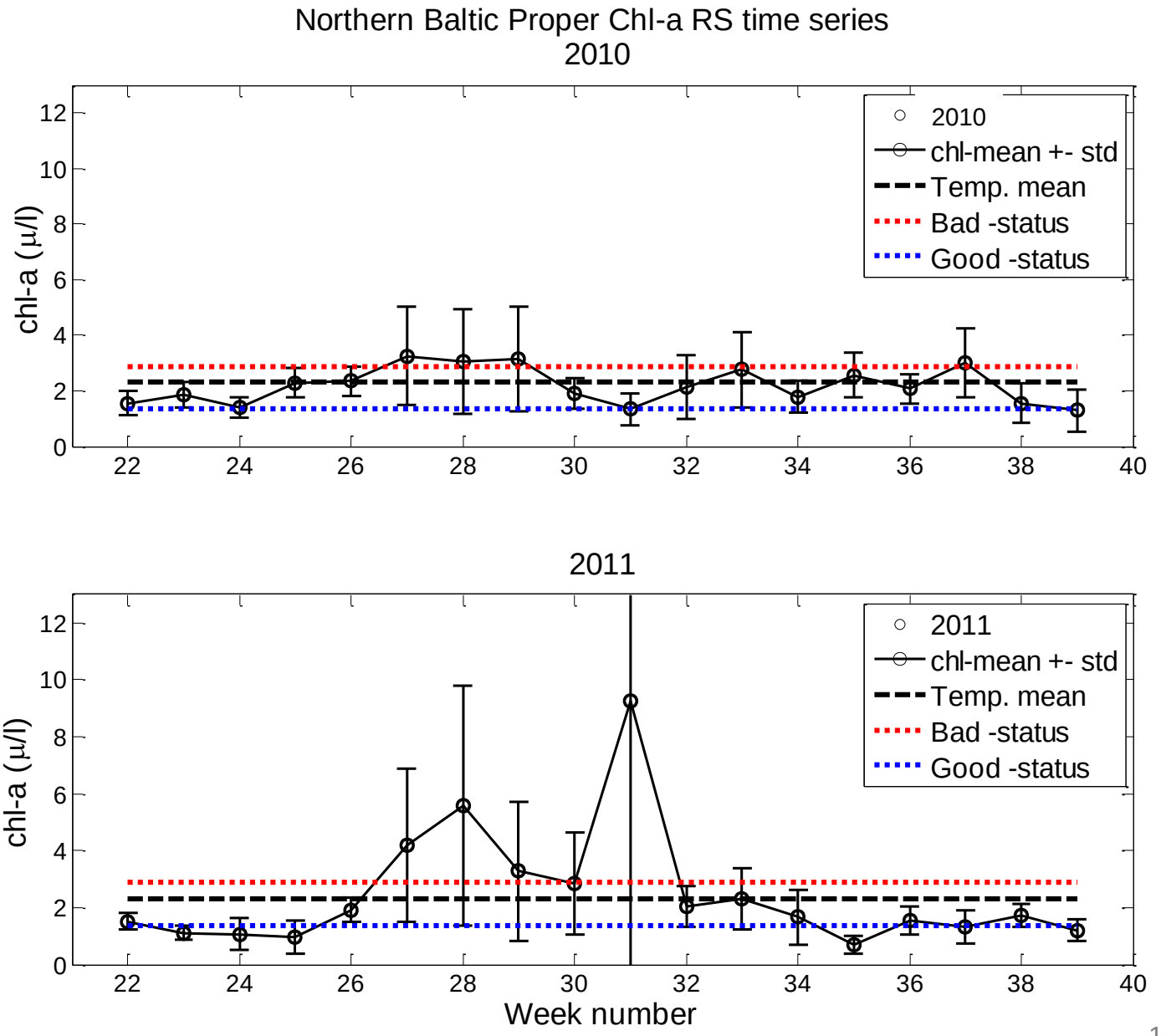
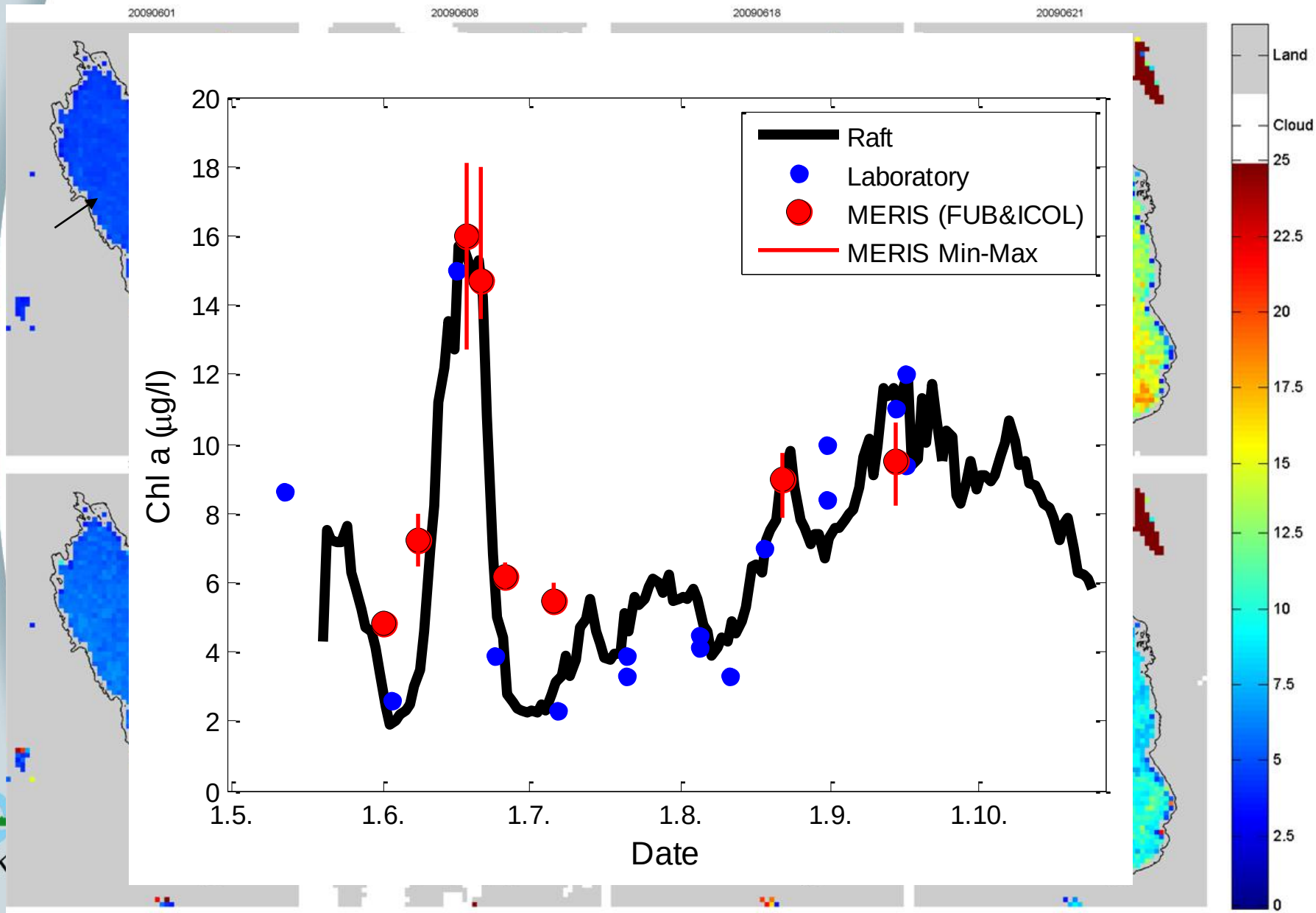
EO chl-a time series and ecological assessment



SYKE

Chl-a maps of Lake Säkylän Pyhäjärvi (MERIS, 2009)



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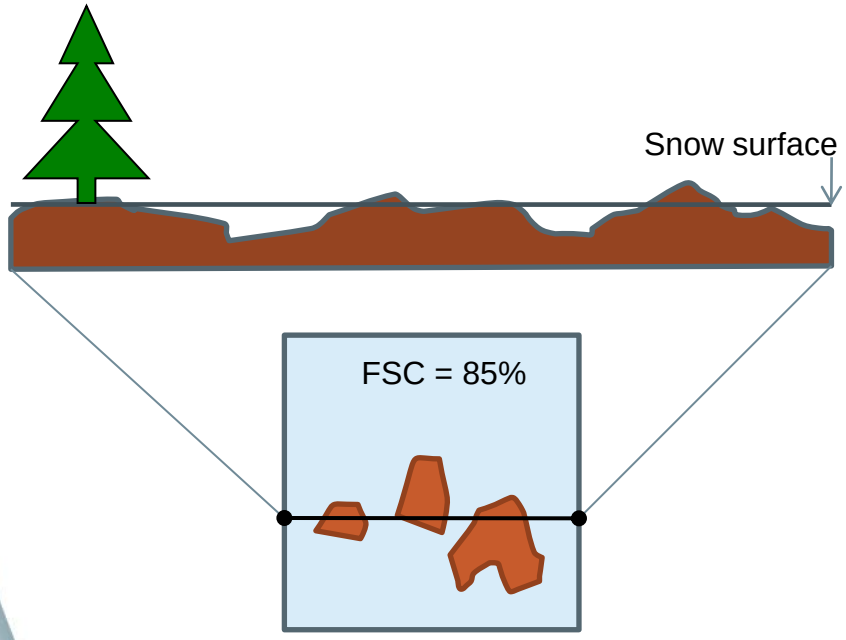
FRESHMON
GMES high resolution freshwater monitoring

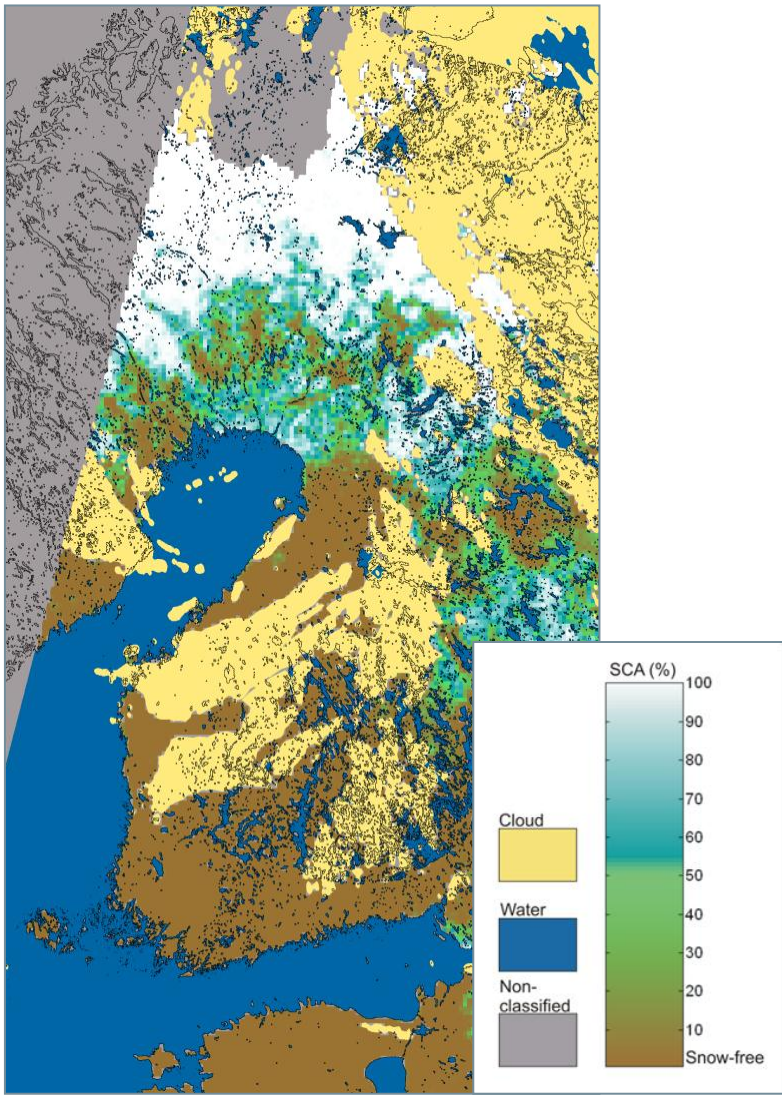
Snow Products

- NRT products
  - Fractional Snow Cover (FSC), method by SYKE
  - Snow Water Equivalent (SWE), method by TKK & FMI
- Lake Ice Data Products (methods by SYKE)
  - Fractional Snow Cover on Lake Ice
  - New prototype Lake Ice Extent

Fractional Snow Cover (FSC) from MODIS

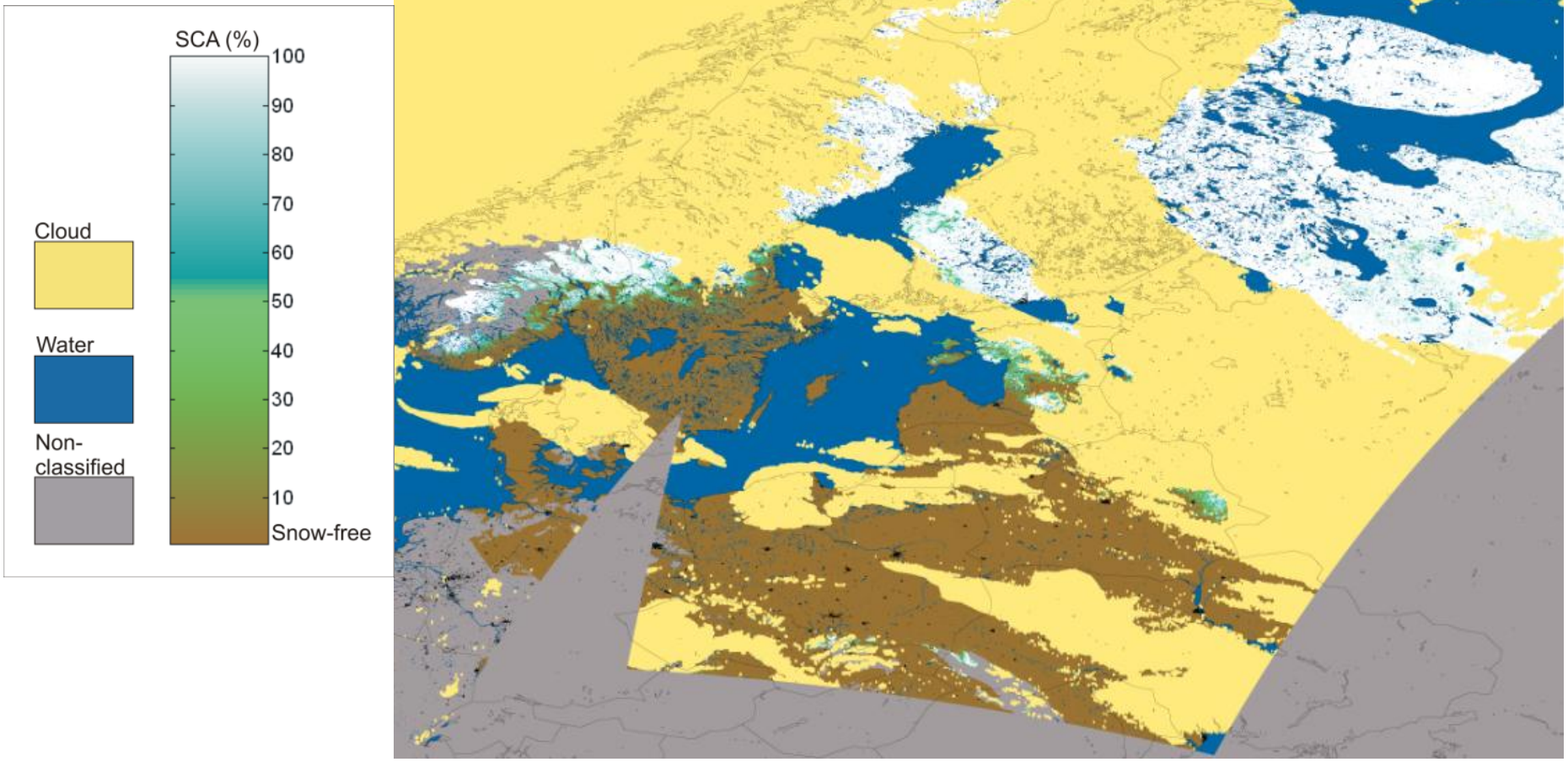
- Nominal Spatial resolution 500 m
- Can be produced daily
  - Restricted by cloud cover
  - Restricted by season (i.e. amount of day light) → only spring season observed
- Possibilities for improvement:
  - Could be calculated also in 250m resolution





SYKE regional FSC product

Fractional Snow Cover by SYKE, 2012, March 23



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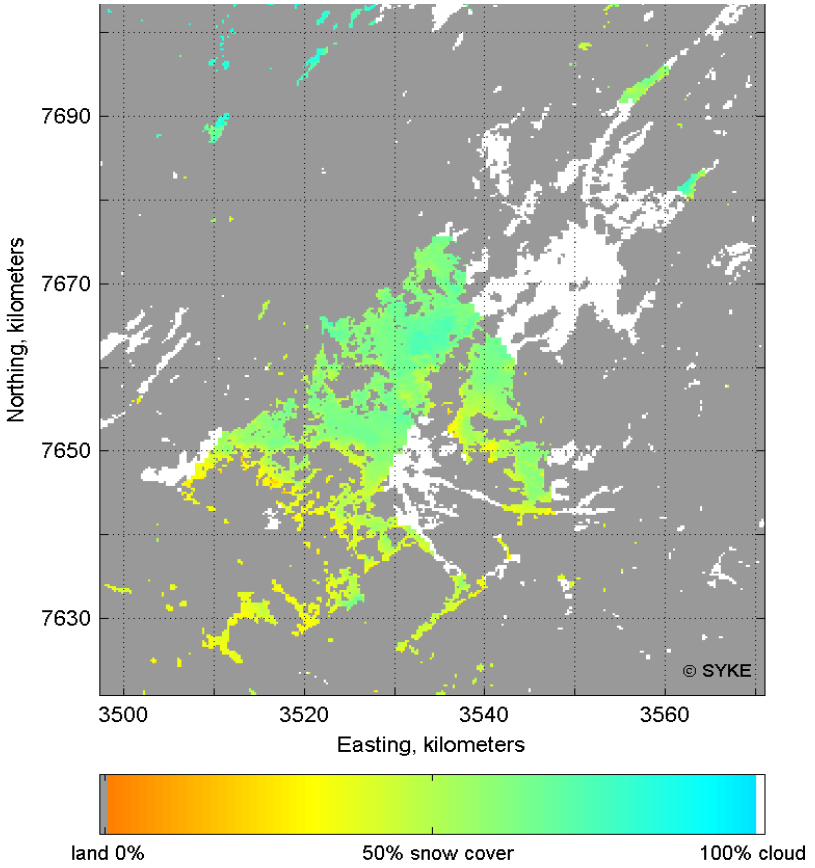
SYKE – Snow On Ice Product (MODIS 250 m)

- Specification:
  - Approximates the snow cover over lake ice (a proxy for ice break off during spring melting)
  - Algorithm: Reflectance thresholds
- Product status:
  - In operational production since 2006
    - For 9 large lakes in Finland
  - Does not strictly distinguish between snow and white ice or ice and open water

→ new product with 3 class classification (snow covered ice, clear ice, open water)



Lake Inari (Finland) April 24, 2011

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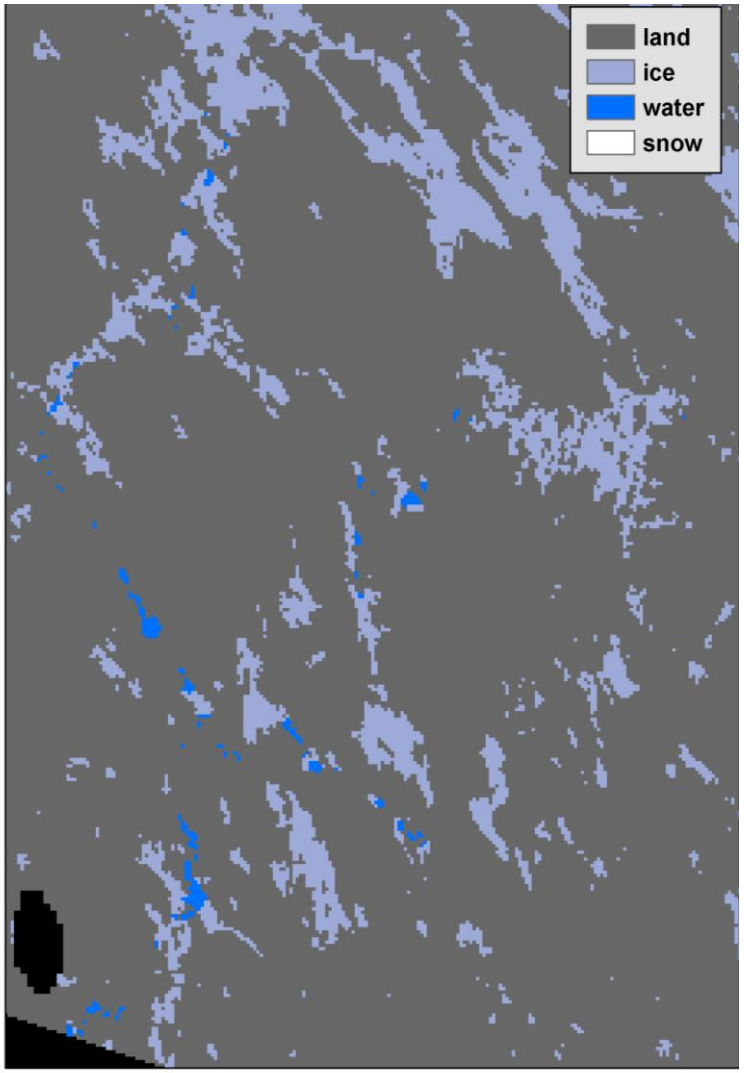
SYKE Ice-Product (MODIS 250m) Under development

- Specification:
  - Algorithm: Reflectance thresholds
  - Three class classification:
    1) Snow/Partial snow cover/ White ice
    2) Clear ice
    3) Open water
  - To be a daily product for melting season covering entire Finland
- Product status:
  - Currently prepared for operational production
  - Under validation



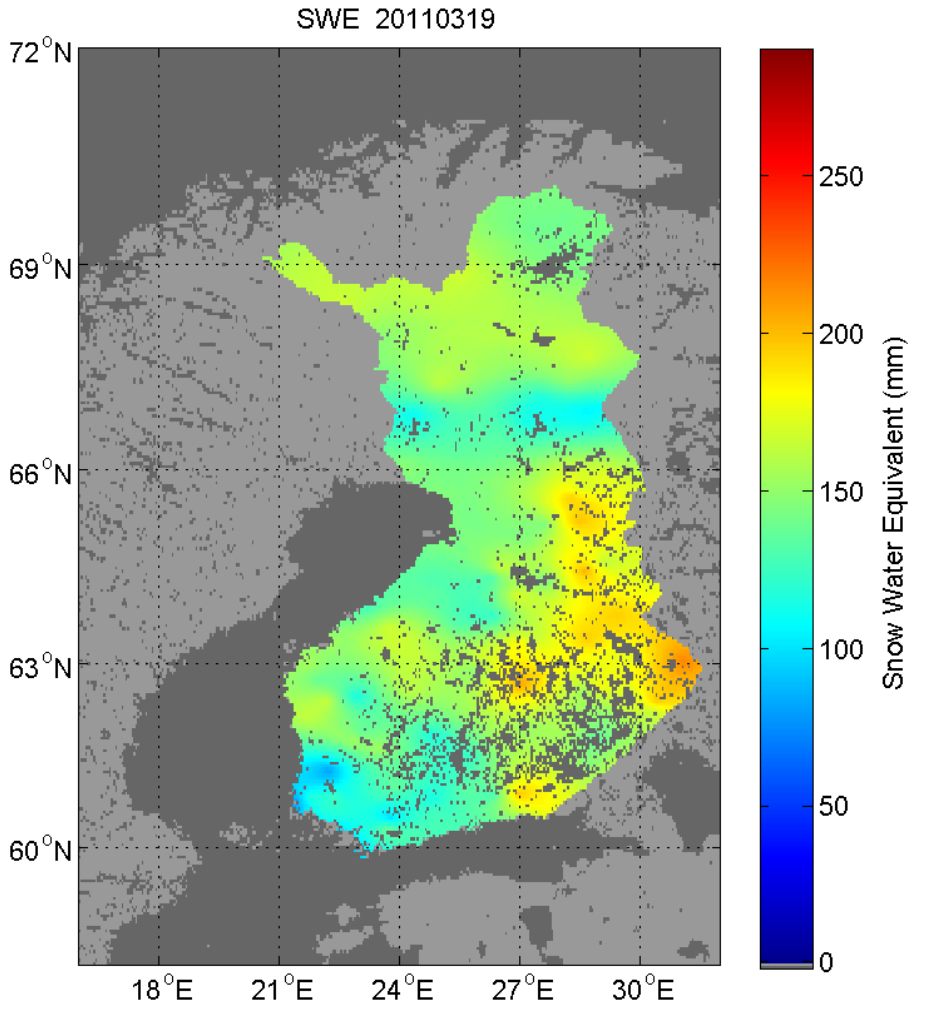
MODIS SYKE Ice- product 30th April 2009.

SYKE

Snow Water Equivalent (SWE)

- SWE = amount of water the snow pack contains

  ≈ thickness (with estimated snow density)
- Daily product from AMSR-E and SSM/I
  - In all weather conditions
  - In night time
- For continuous snow cover (from Nov/Dec – Mar/Apr)
- Calculation unit 0.05° ~ 5km (interpolations of satellite and ground truth data)
- In co-operation with FMI/ARC

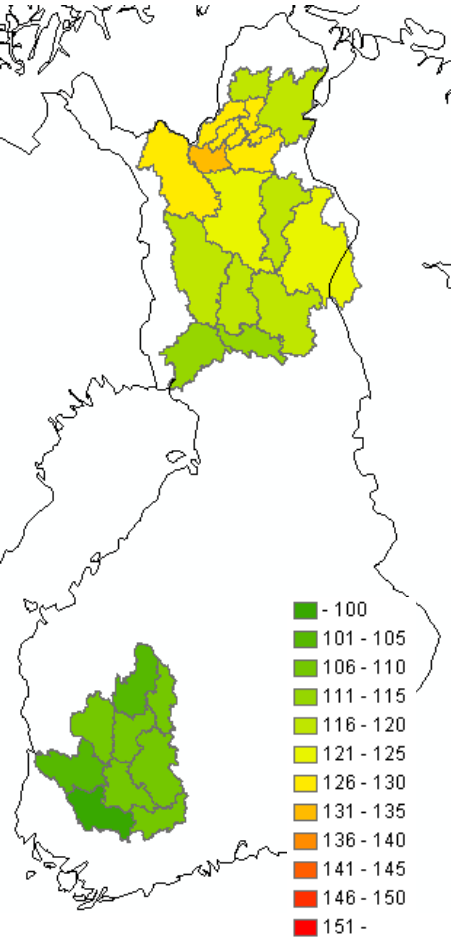


Phenology and land cover products

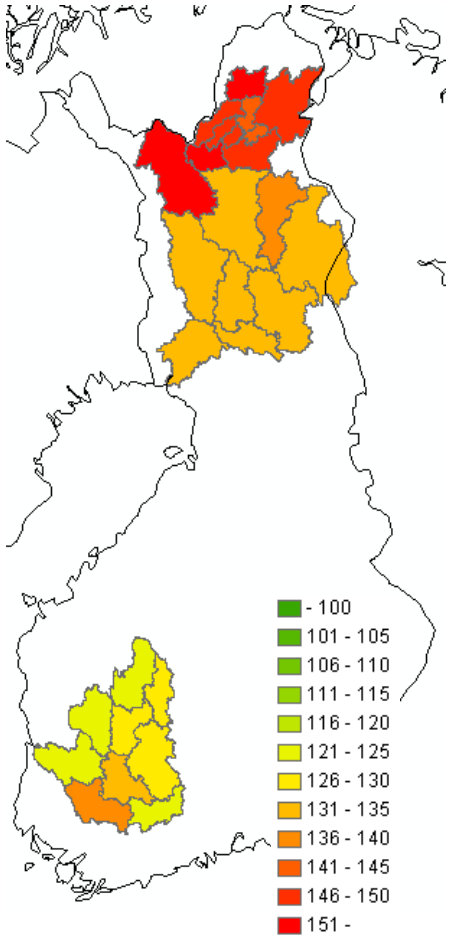
- Beginning, end, and duration of the growing season
  - Algorithms based on FSC and NDVI
- Corine Land Cover (CLC) products
  - National version
  - Standard version

Growing season in different river basins in 2006

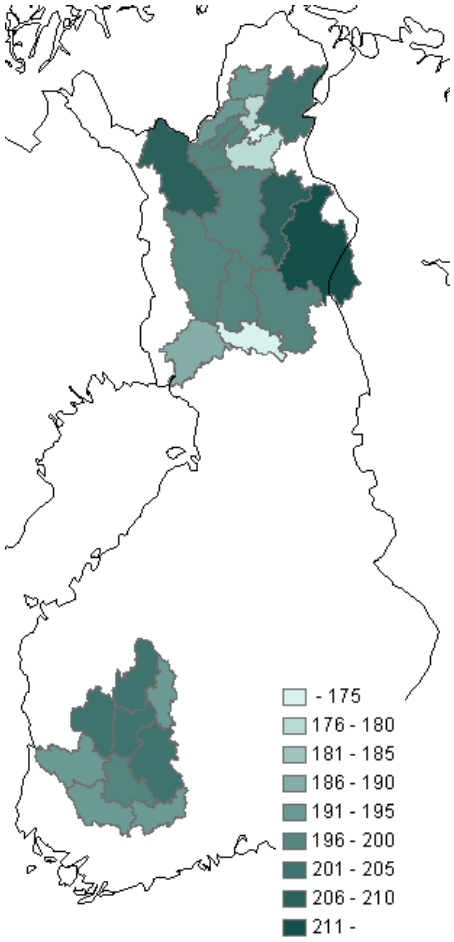
Beginning of growing season 'wake up'



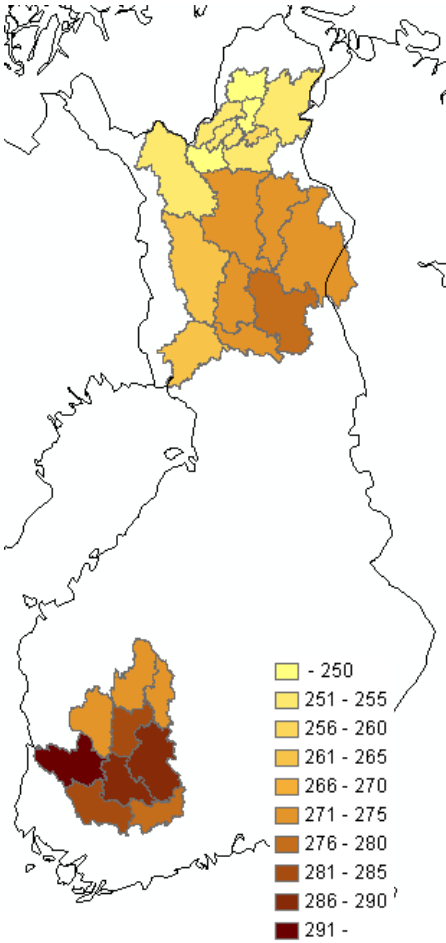
Leaves visible

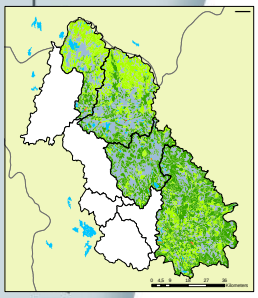


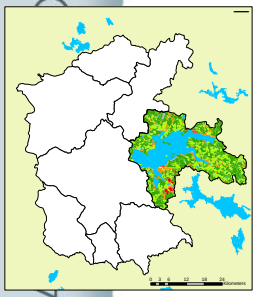
Day of maximum NDVI

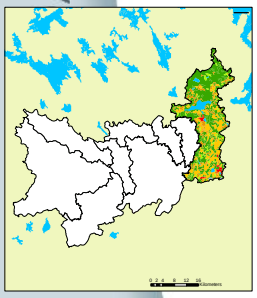


End of growing season

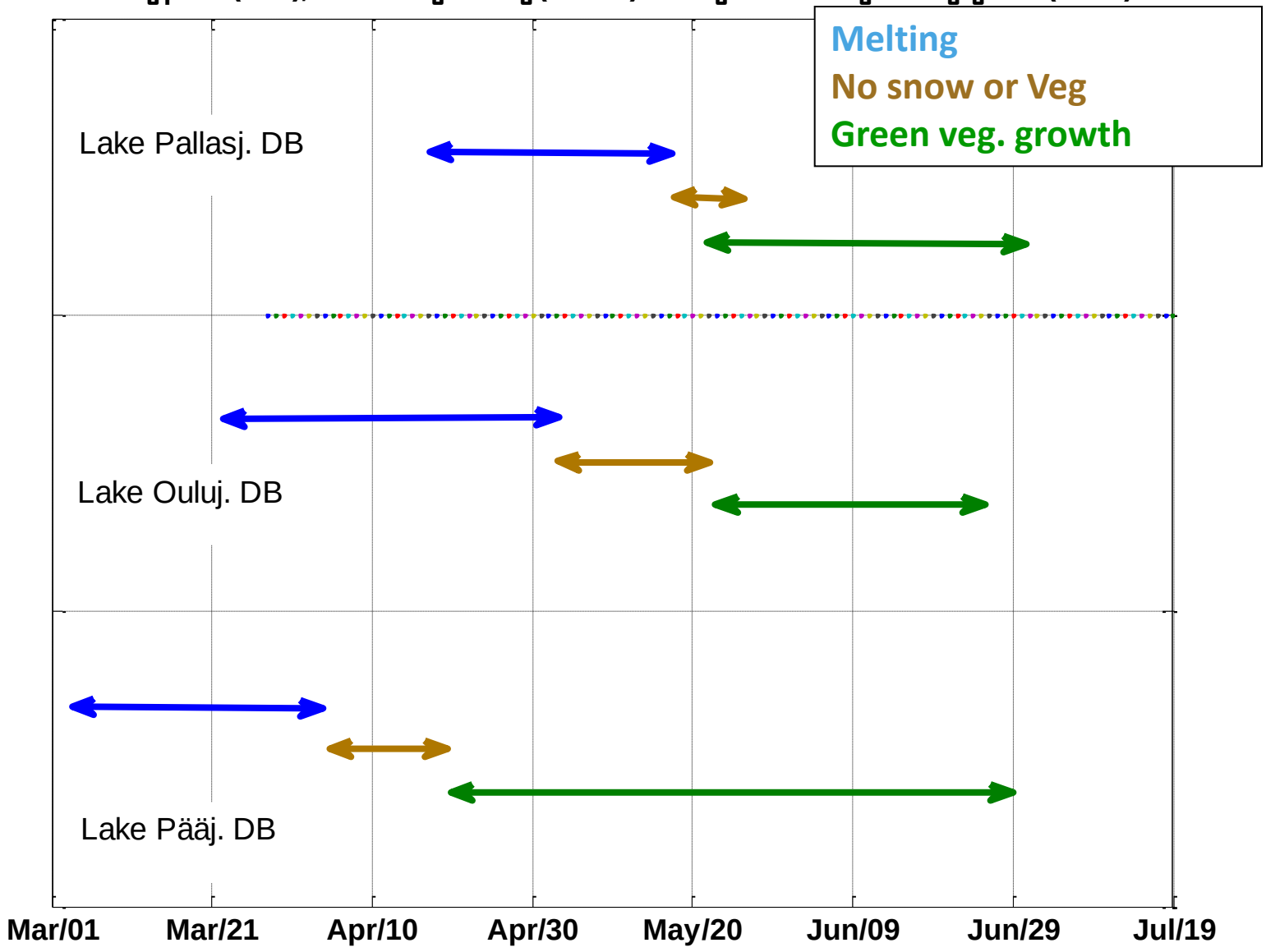








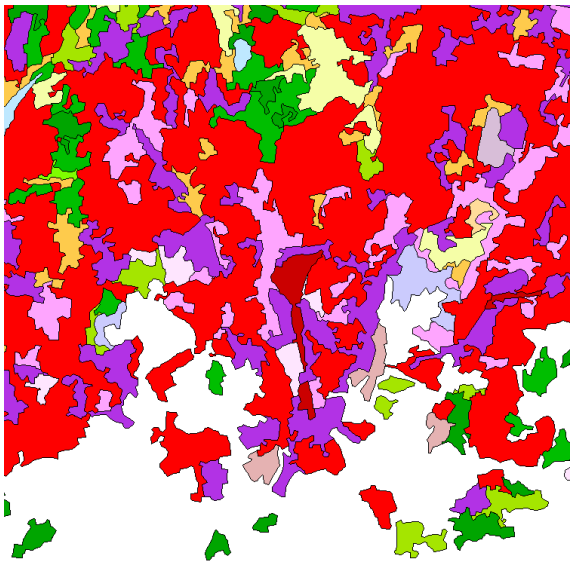
Melting period (BLUE), no snow or green veg (BROWN) and lengt of intensive green veg. growth (GREEN)

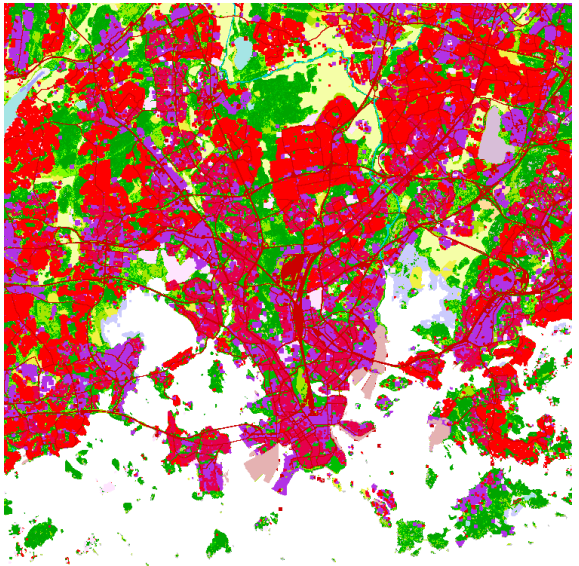


2007

CORINE Land Cover in Finland

- SYKE is responsible for processing the standard version CLC data for Finland
- Standard version does not meet national data needs
- SYKE produces a national version of CLC
  - High spatial resolution (25*25 m raster)
    - Land cover changes (mmu 0.5 – 1 ha)
  - More detailed nomenclature with national land cover categories included
  - In Finland versions 2000 and 2006
  - Land cover changes 2000-2006
  - Next update: CLC 2012, changes 2006-2012
- Standard version is produced from national version
- National cooperation
  - SYKE, Metla, GL
  - MML, VRK, Tike, Mavi
  - Utilization of existing data sources from different organizations





Access to SYKE's EO products

www.ymparisto.fi/syke/kaukokartoitus
www.ymparisto.fi/syke/remotesensing

Summary

- SYKE has a lot of EO products available
- More to come!
- Objective is to create time series for different parameters
- Start from www.ymparisto.fi/syke/remotesensing
- Contact persons at the Geoinformatics division:
  - Land: Pekka Härmä pekka.harma@ymparisto.fi
  - Snow: Sari Metsämäki Sari.metsamaki@ymparisto.fi
  - Water: Jenni Attila jenni.attila@ymparisto.fi
- New access methods coming soon

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Thank you!

SYKE

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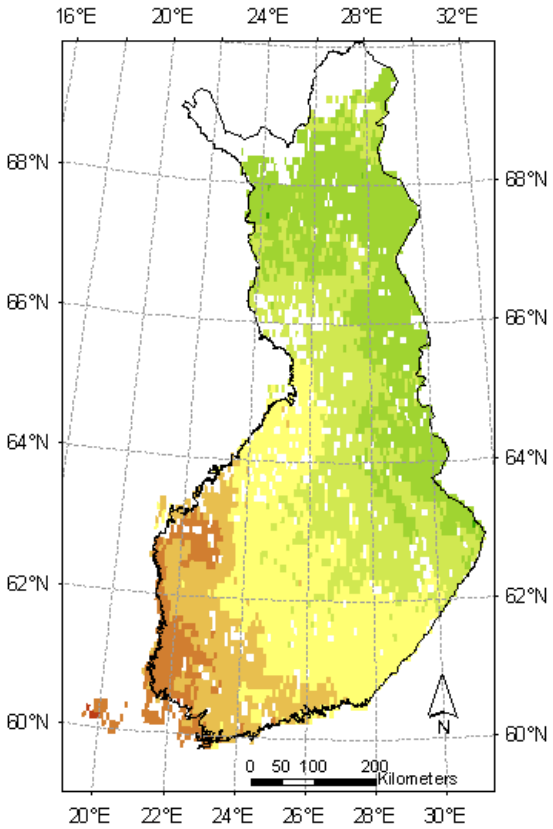
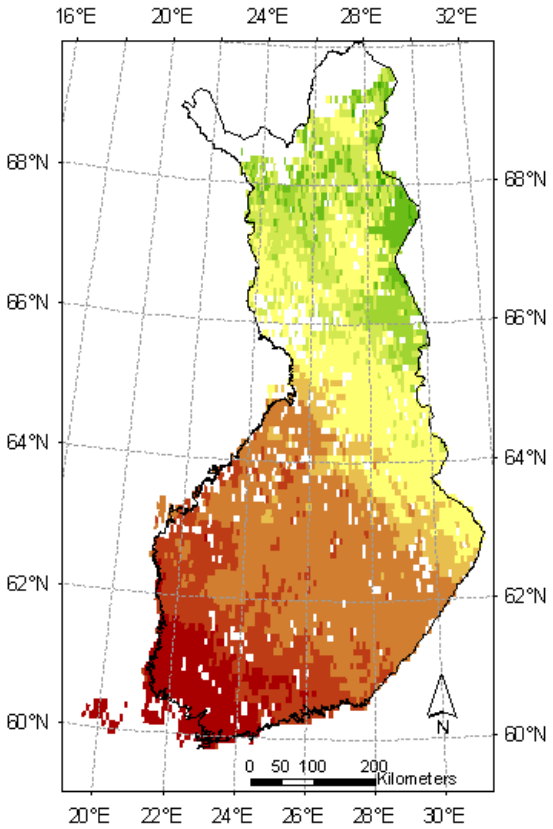
Beginning of the growing season in coniferous forests (from FSC data)



2004



2007

Start of season (day of year)

No data	100 - 110
< 70	110 - 120
70 - 80	120 - 130
80 - 90	130 - 140
90 - 100	140 - 150

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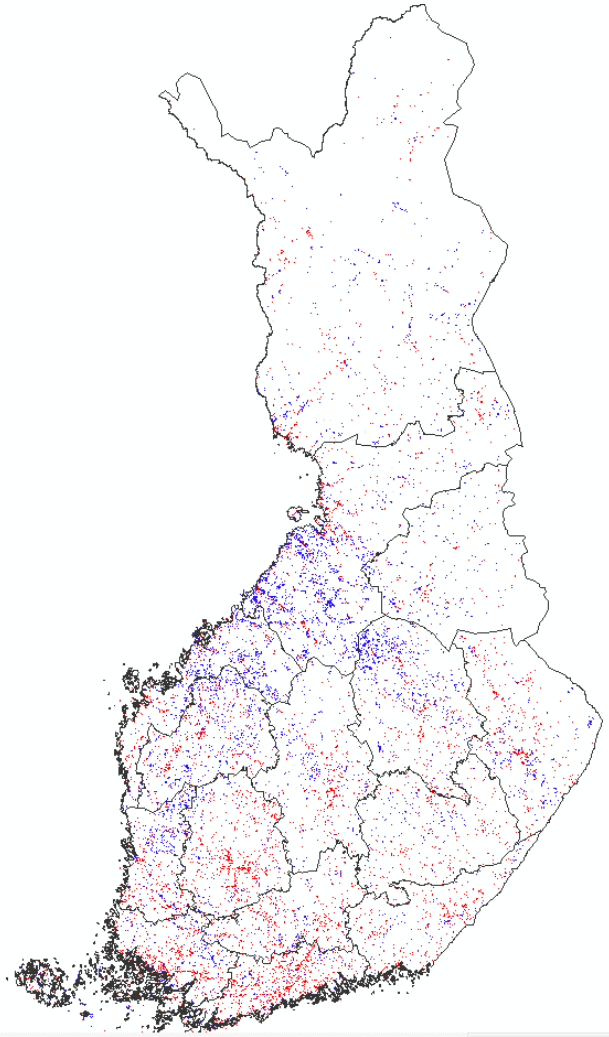
Land Cover changes 2000-2006

Changed areas cover 4.2 % of the total area of Finland

- Forest cuttings and regrowth about 90 %
- build-up sprawl 2 %
- Clearance for agriculture 5 %
- Reforestation of agricultural areas 2 %

As a result

- Area of build-up areas and agricultural areas increases
- Area of forests decreases



New agricultural areas (blue) and build-up areas (red)

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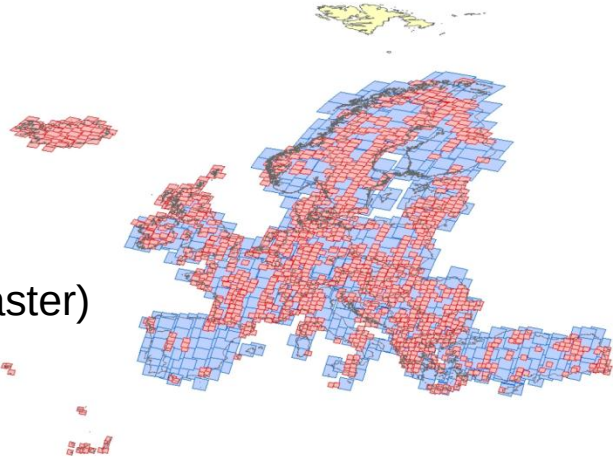
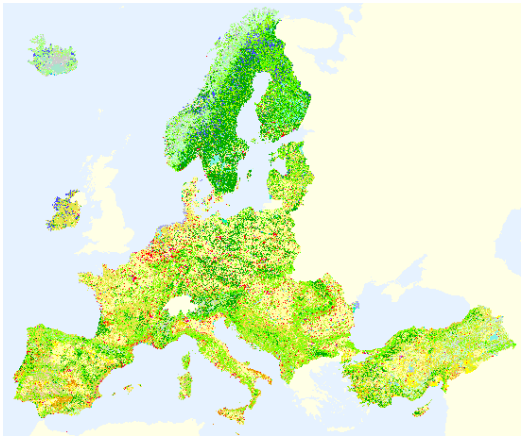
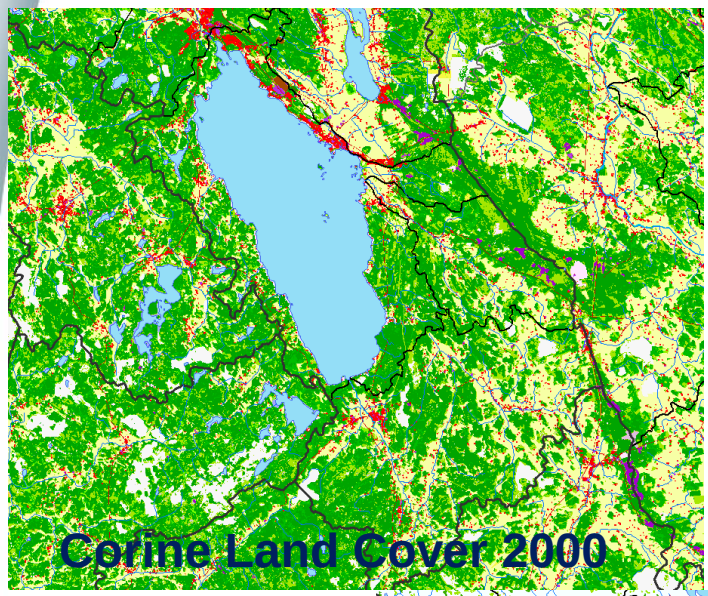
CORINE Land Cover

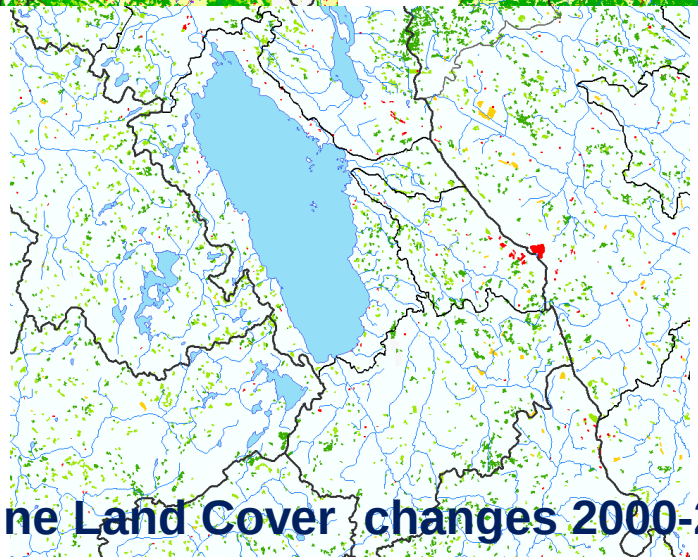
- European Land Cover data
  - Funded by European Environment Agency and MS
  - versions 1990, 2000, 2006
  - Changes 1990-2000; 2000-2006
  - 44 land use and cover classes
  - vector data with MMU of 25 ha (100 m and 250 m raster)
  - Land cover changes mapped with MMU of 5 ha
- Production method
  - Based on high resolution satellite data (20-30 meter resolution)
  - Produced by national teams
  - Coordinated, validated by EEA
  - Visual interpretation in most countries
  - Automated processing chains (Fin, Swe, No, …)
- Continuous program
  - Future updates part of GMES land monitoring
  - Next update 2012





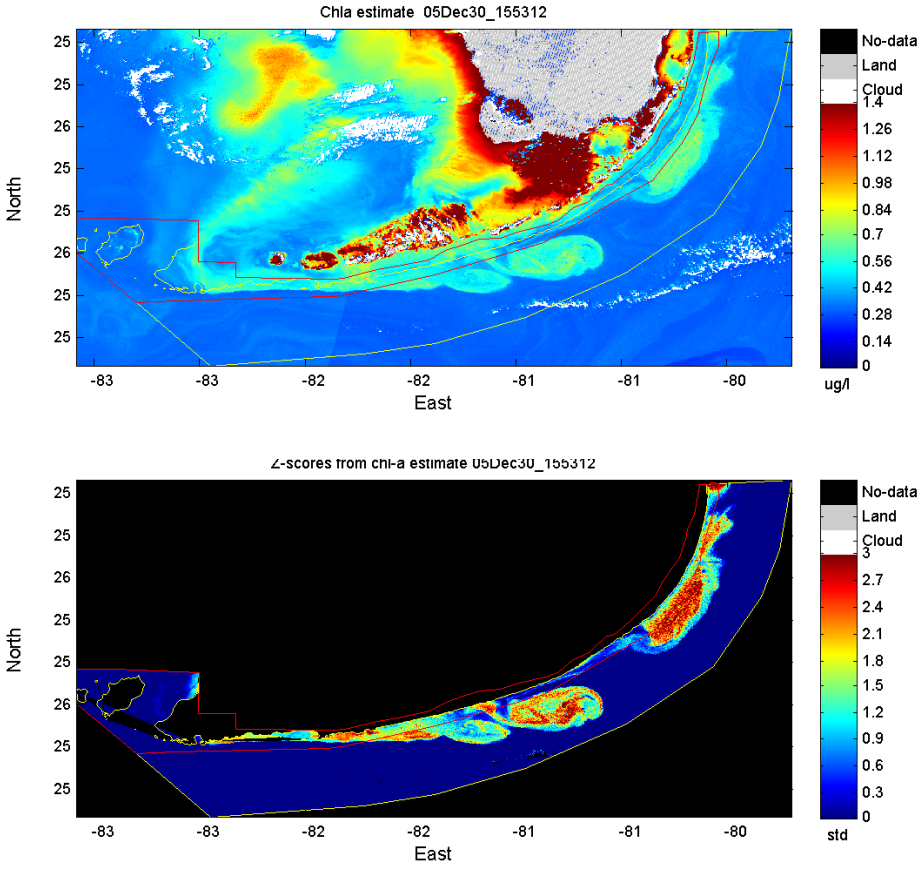
An example

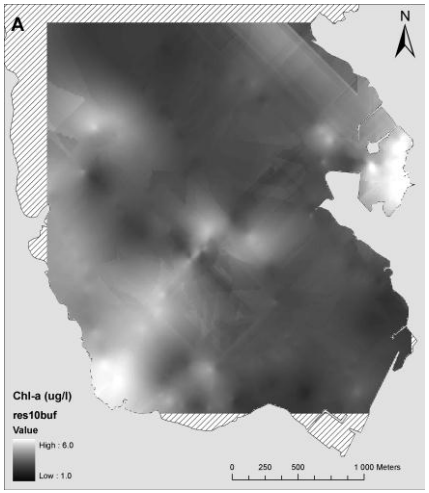


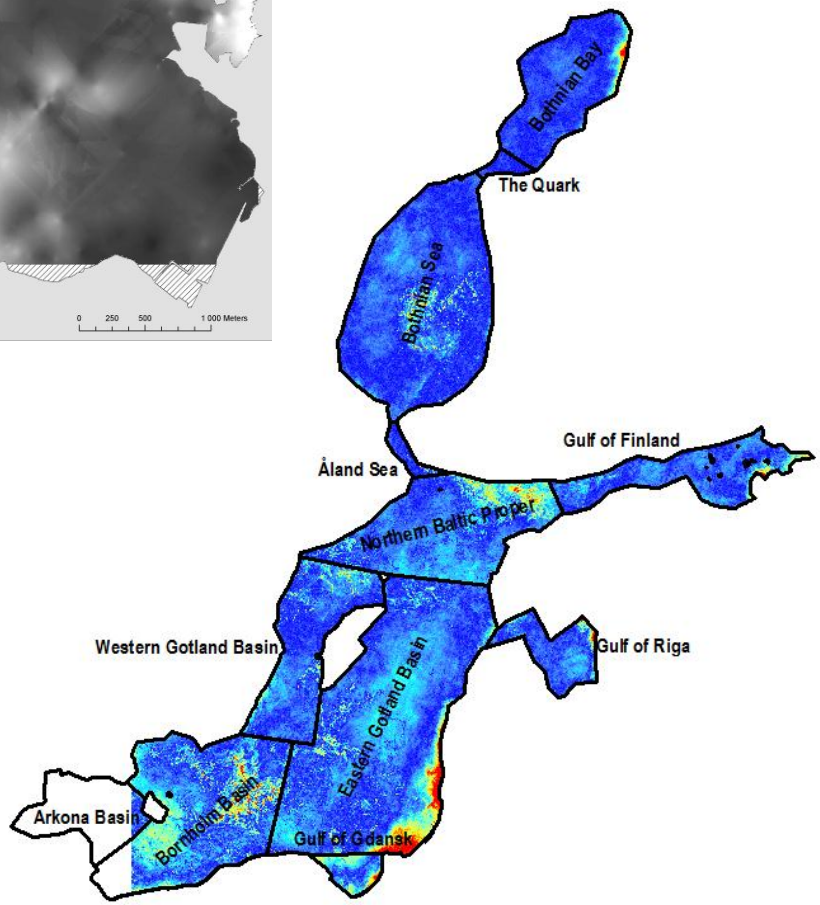


Corine Land Cover changes 2000-2006

Spatial observations in characterizing monitoring regimes

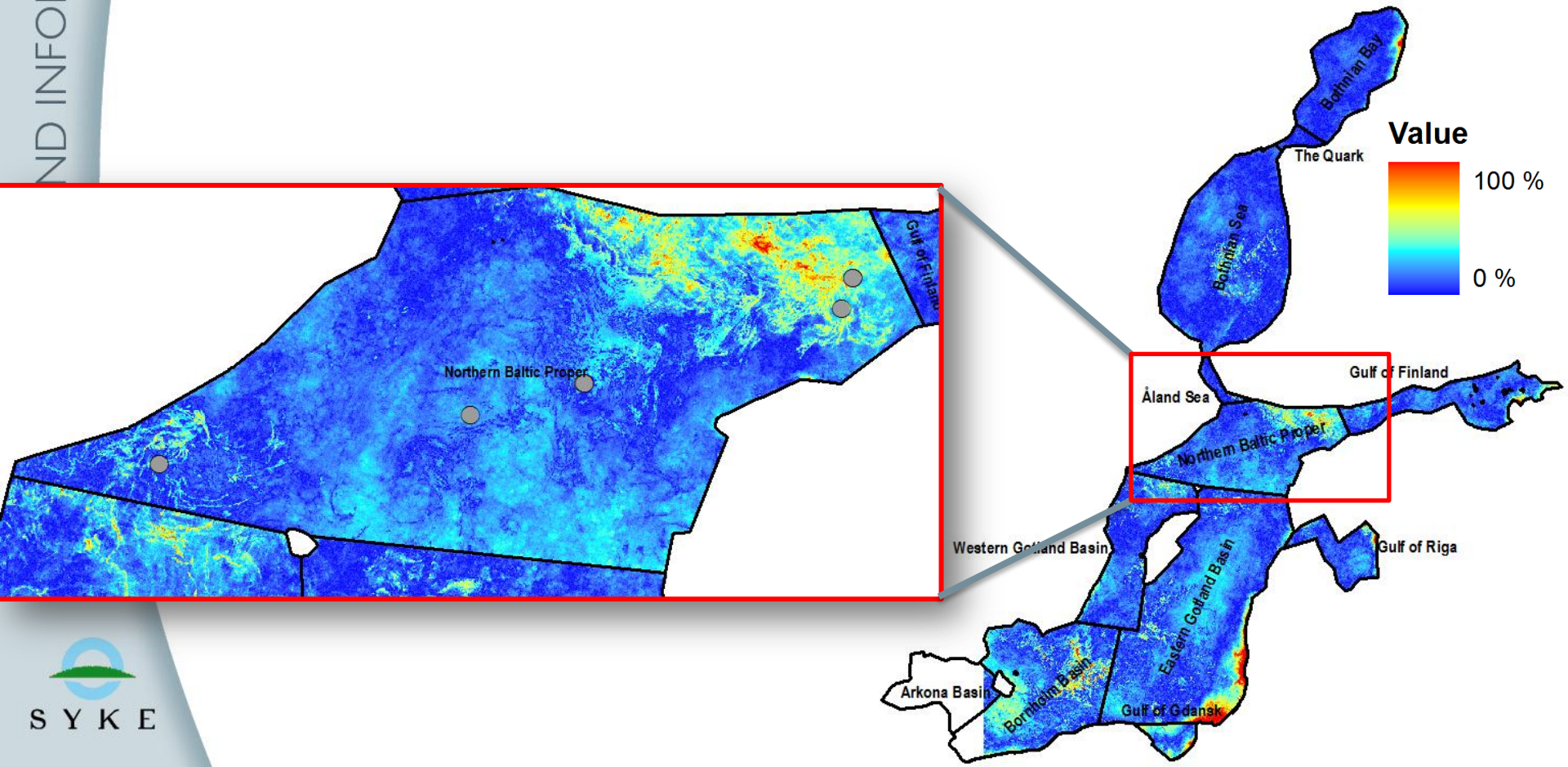




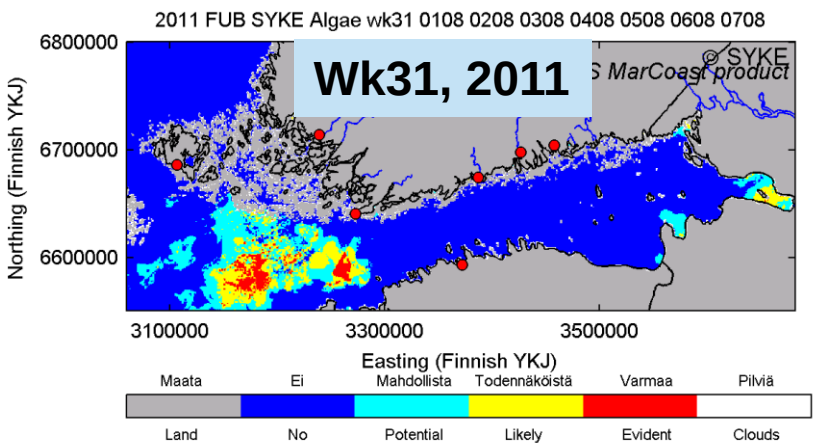


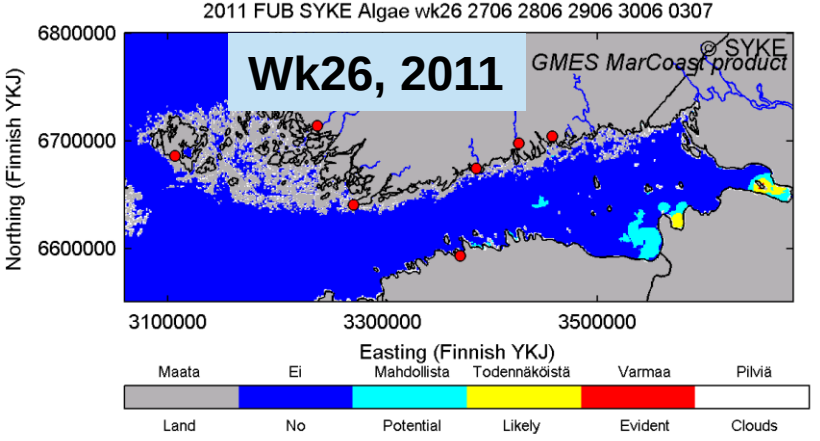
Spatio-temporal considerations

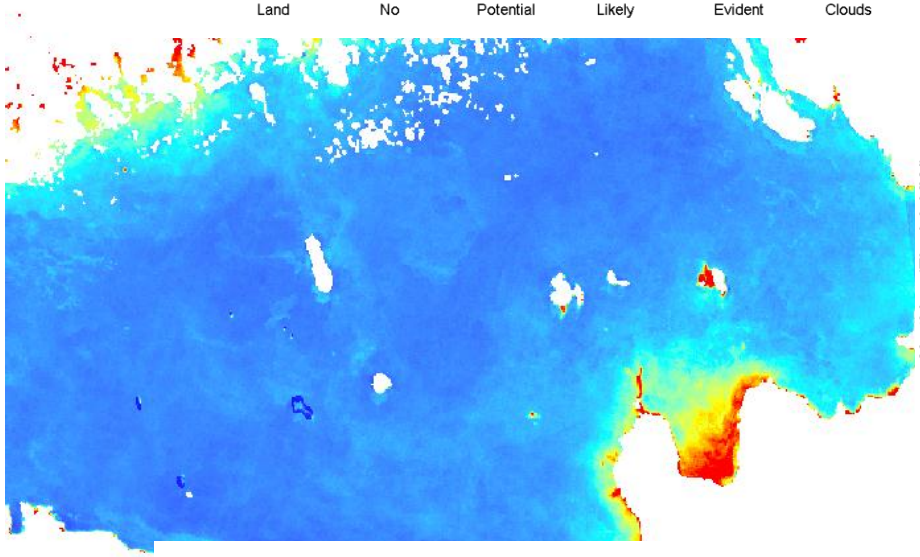
- Difference from the assessment unit spatial chl-a mean for each pixel

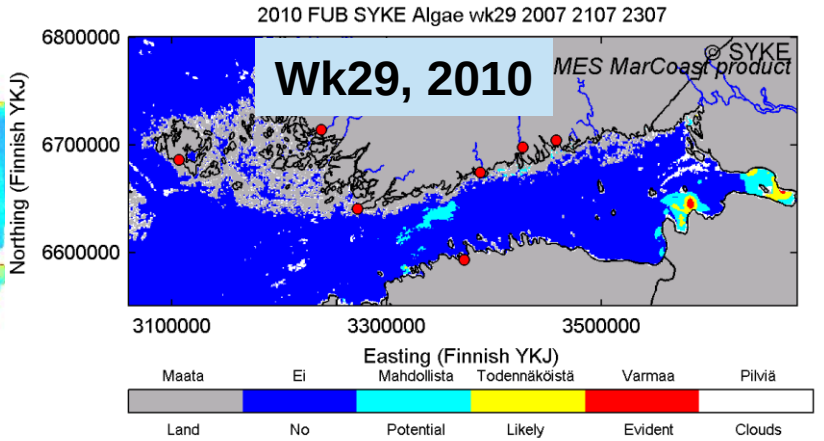


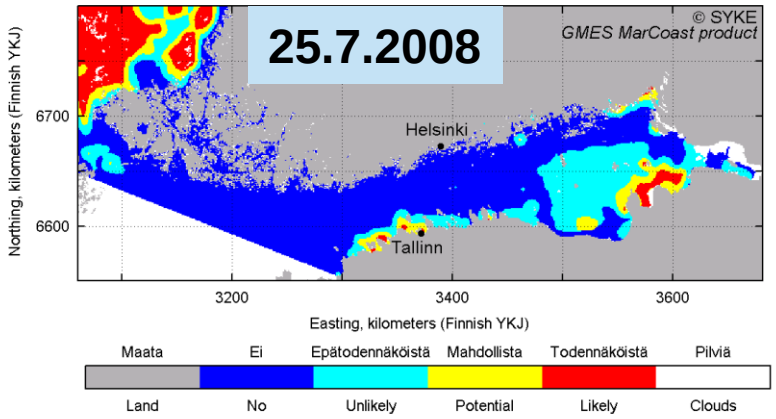
DATA AND INFORMATION CENTRE

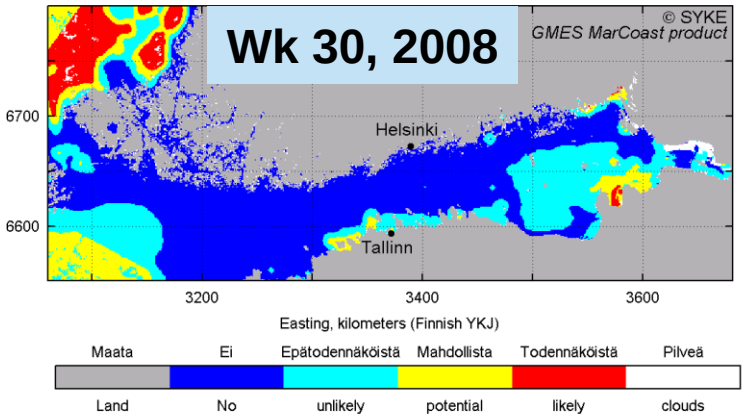










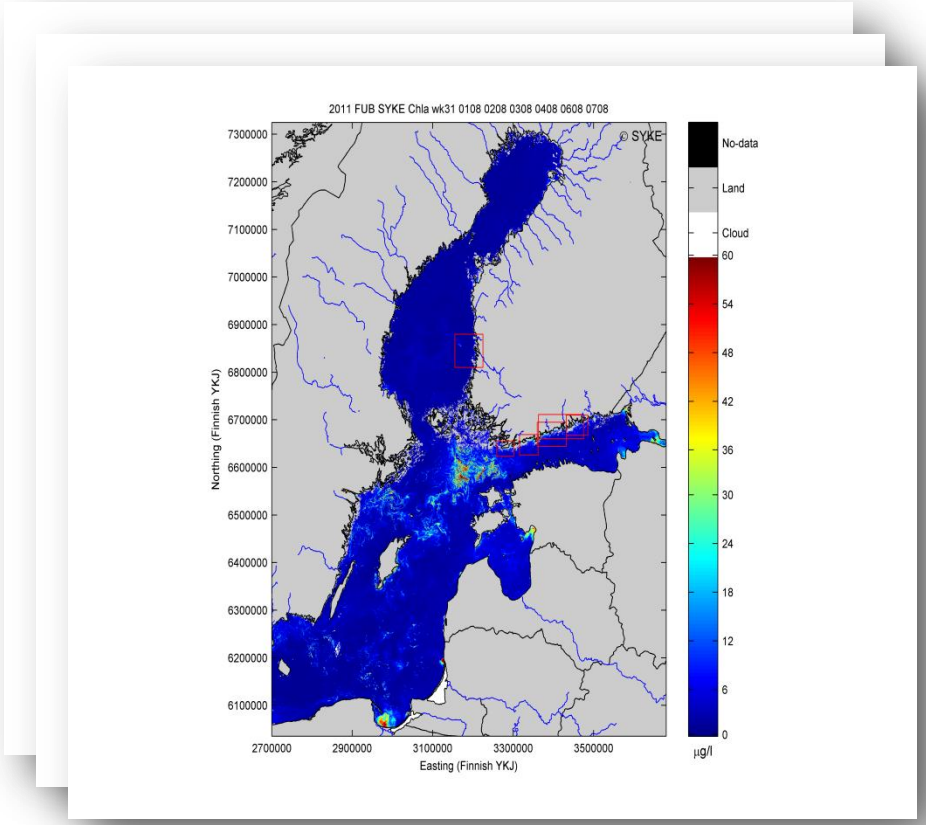


SYKE

Data sets & methods

Chl-a weekly products 2010 & 2011 (Jun – Sep) (Beam/FUB processor)

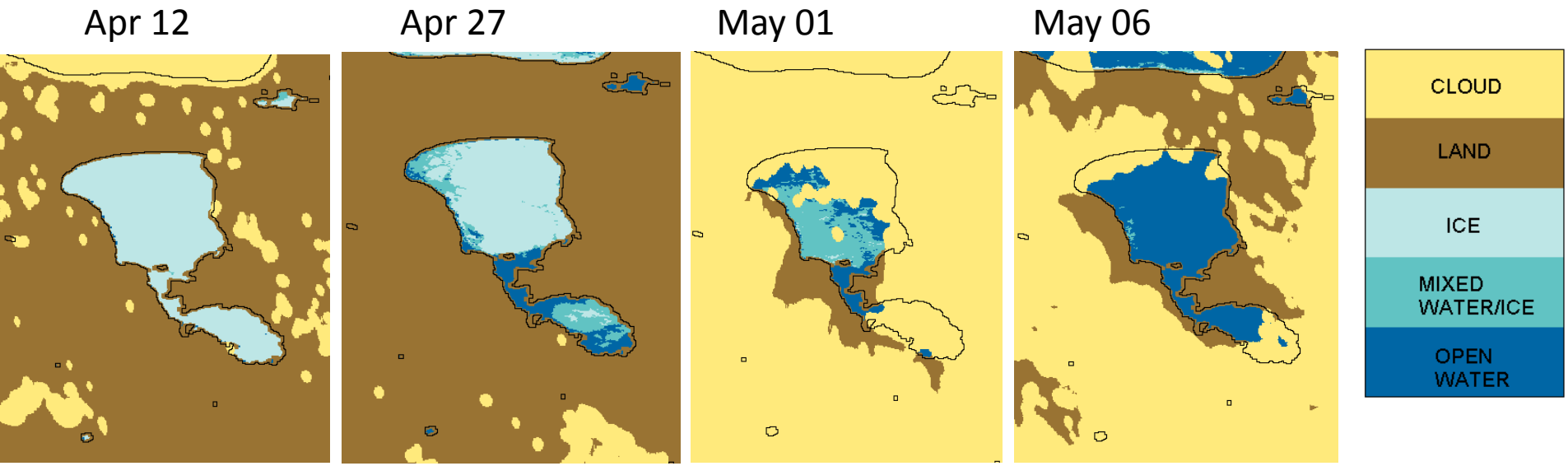
Open Sea areas GIS-data



SYKE

Ice maps for lake Peipsi, Estonia

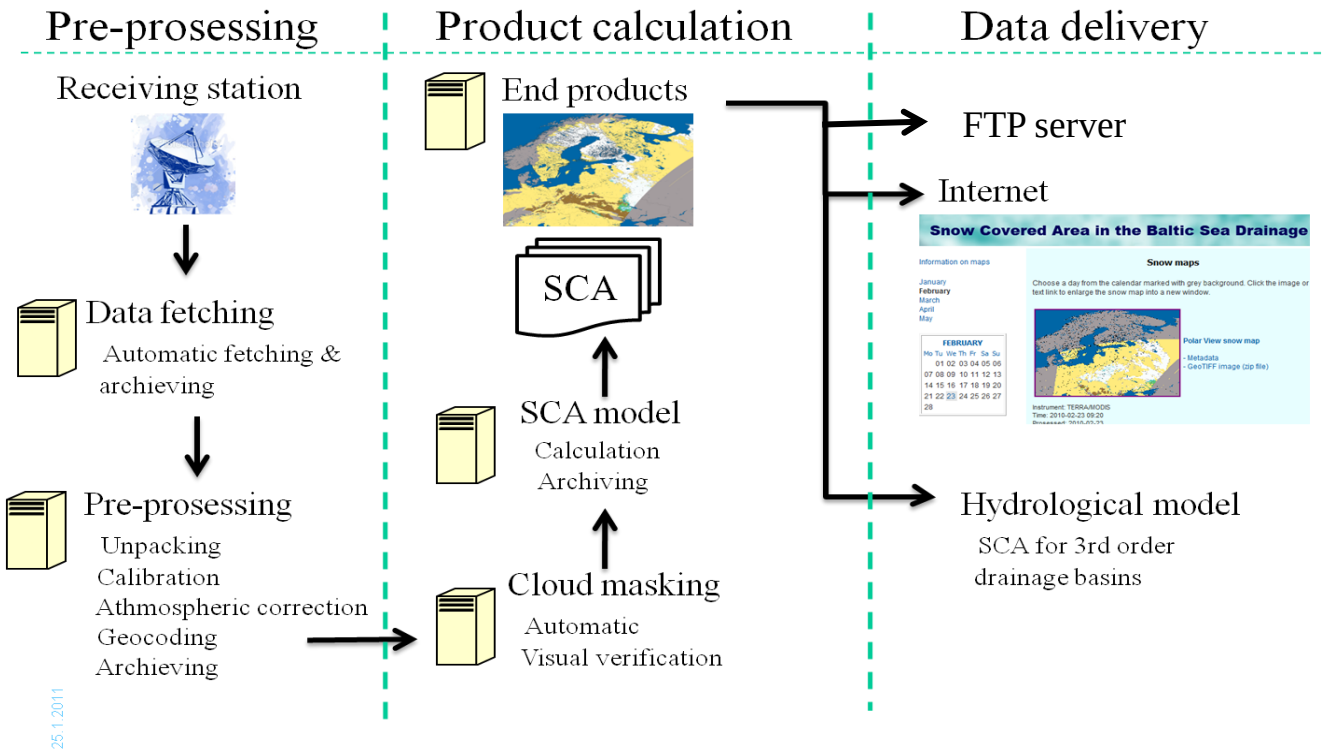
- Algorithm developed at SYKE
  - Based on MODIS 500km (optical and mid-infrared) and 1km (thermal infrared) data
- Operational production as a part of SYKE snow map production chain
- First operational test period: spring 2012
- Data delivered in NRT to Estonian Meteorological and Hydrological Institute EMHI
- EMHI uses GIS-software in utilizing the data → potential for Cryoland data distribution system



Peipsi ice, 2011

SYKE processing line

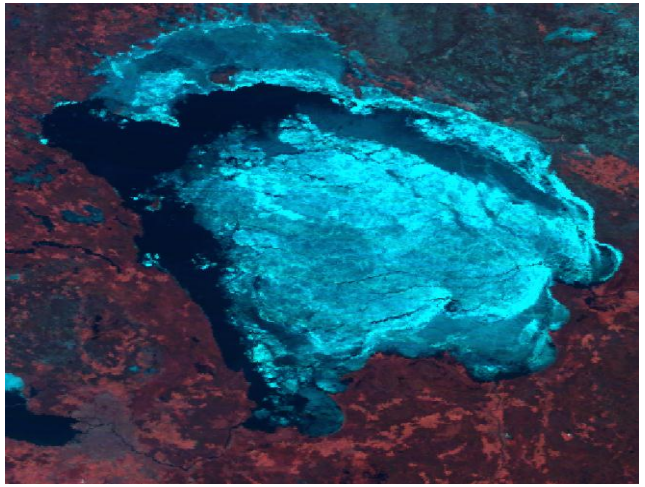
- Processing lines modified to provide Fractional snow cover maps following the CryoLand Specifications
- Metadata-file generated for each product
- Data provision via ftp for Pan-Europe snow map

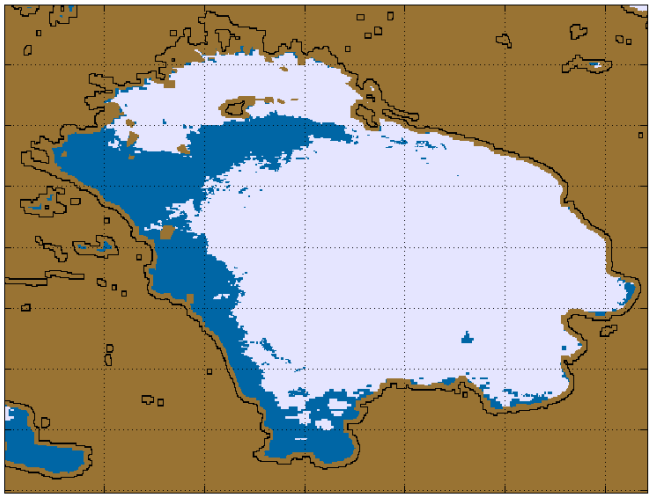


‘New’ prototype Lake Ice Extent product

- Spatial resolution 500 m
  - From MODIS-data
- Currently tested only for Lake Ladoga (Laatokka) and Onega (Ääninen)
- Data delivered to FMI for HIRLAM (High Resolution Local Area Modeling)- weather forecasting system
- Possibilities for improvement
  - Mixed class
  - Could be combined with the prototype product of ice extent

20th April 2011

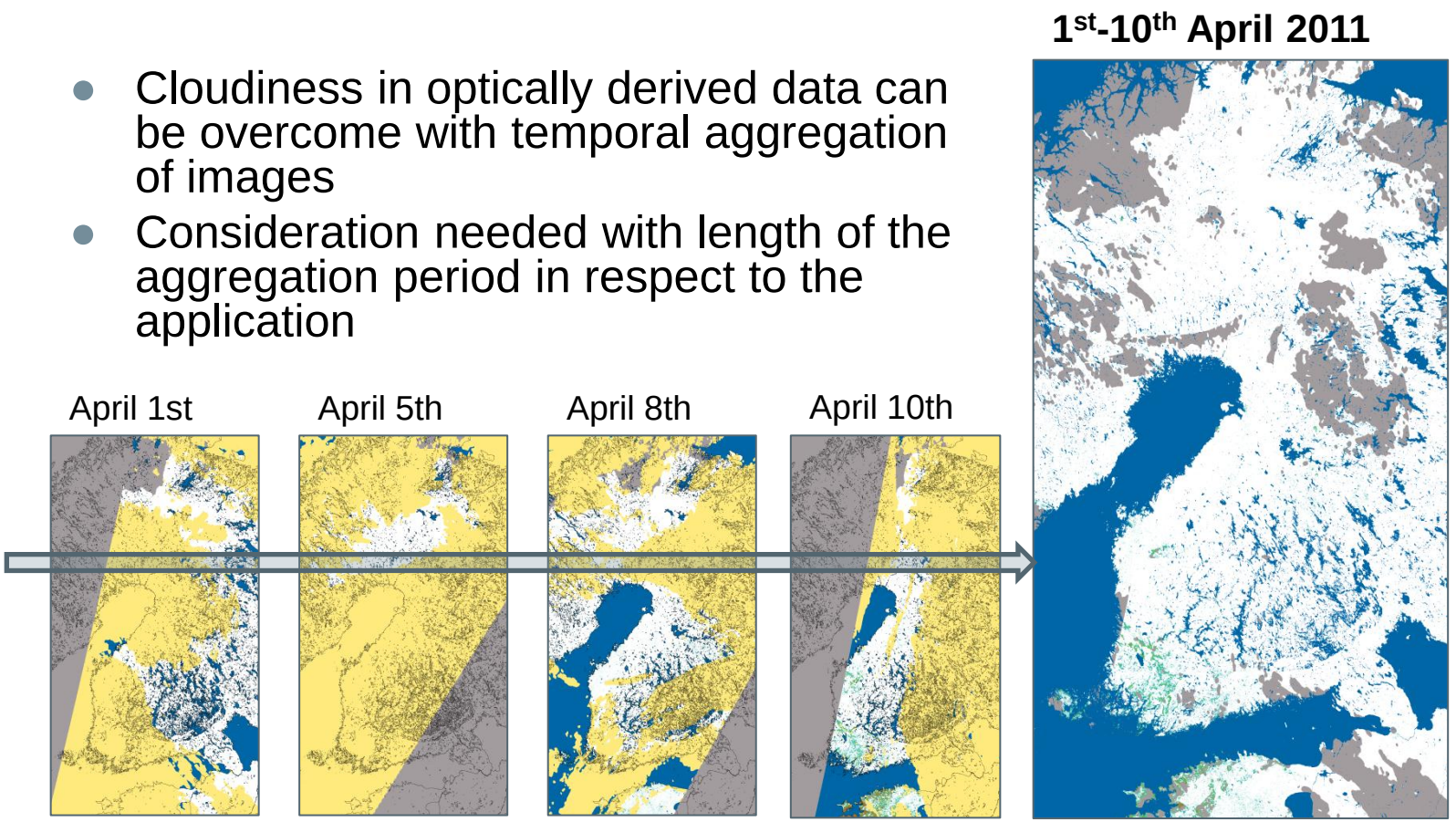




Data post-processing

Temporal aggregation

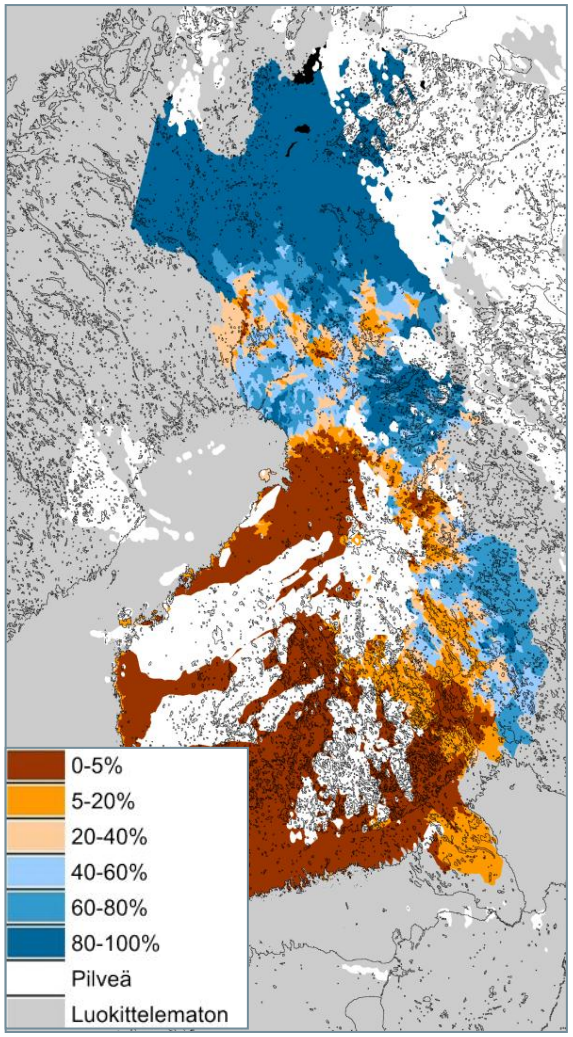
- Cloudiness in optically derived data can be overcome with temporal aggregation of images
- Consideration needed with length of the aggregation period in respect to the application



Examples of Current Use of Satellite Derived Snow and Ice Datasets

Watershed Forecasting System

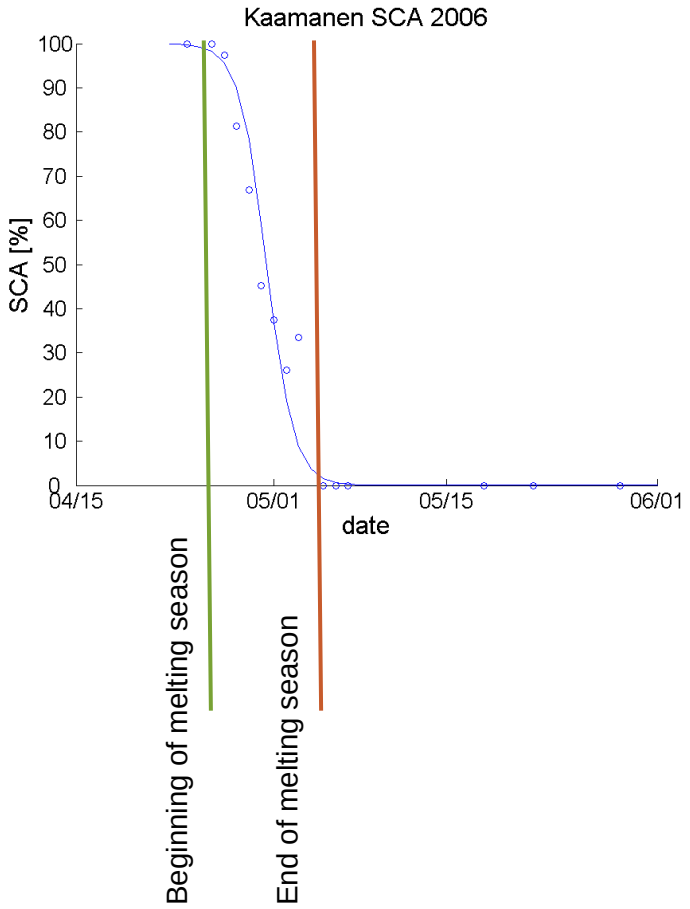
- From grid to basin averages
- Used as ‘input’ to the WSFS-model
  - FSC – assimilated to WSFS model
  - SWE – plotted against model results
- SWE – assimilation has been tested and is under development



Data post-processing

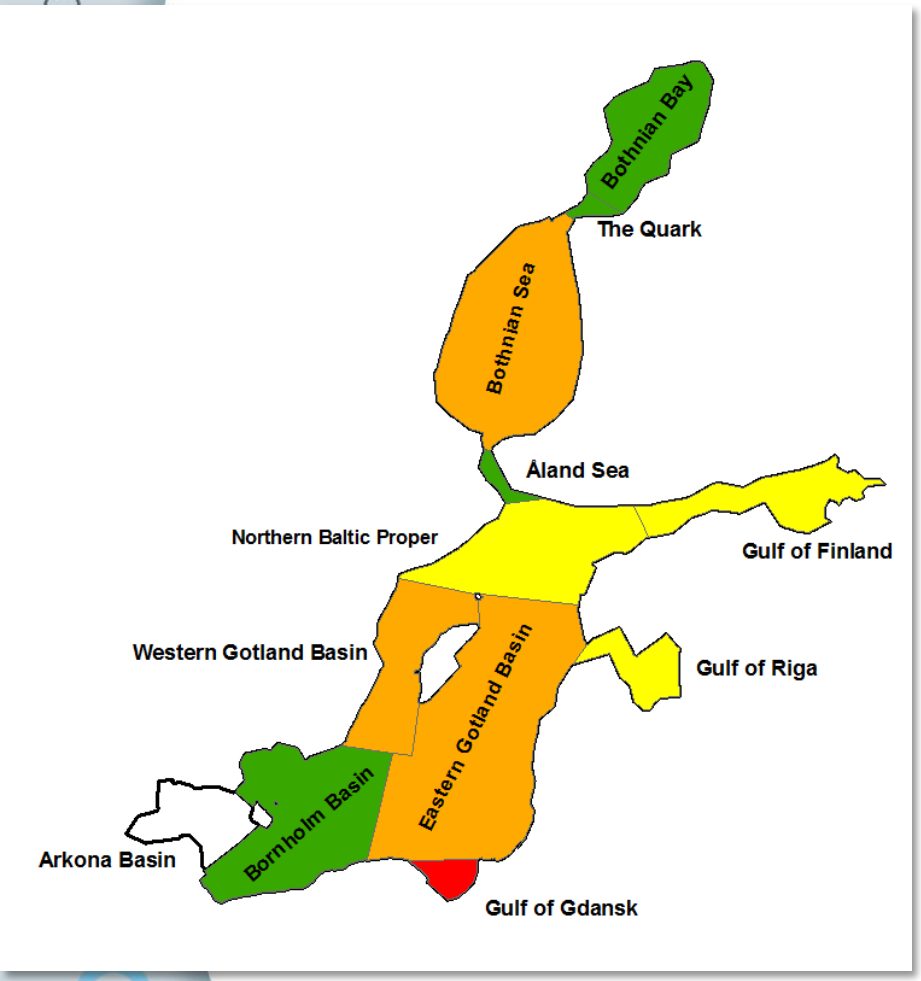
Time Series

- Timing of important events can be extracted from time-series
- For snow:
  - Beginning of melting season
  - End of melting season
  - Length of melting season



Experiences on the use of EO in ecological assessment

EO chl-a 2010-2011



Bad
Poor
Med.
Good
High

HELCOM 2003-2007 (in situ)