Finnish Earth Observation Landscape

Jaan Praks remote sensing club of finland **Aalto University**

Community

remote sensing club of finland **The Finnish Society of Photogrammetry and Remote Sensing**

Remote Sensing Club of FinaInd

- The Remote Sensing Club of Finland is an unofficial association, established in 1993 to promote information exchange between Finnish organizations and persons with remote sensing and image processing interests.

- The number of member organizations is about 60 and individuals 230. The members can be contacted with e-mail using an email distribution list.

Steering group 2012

Matti Mõttus (University of Helsinki), matti.mottus@helsinki.fi
Alfred Colpaert (University of Eastern Finland)
Jaan Praks (Aalto University)
Kari Luojus (FMI)
Kirsikka Heinilä (SYKE)
Matias Takala (FMI)
Miia Salminen (SYKE)
Mika Karjalainen (FGI)
Robin Berglund (VTT)
Timo Kumpula (University of Eastern Finland)

www.kaukokartoituskerho.fi

Remote Sensing Days

Annual meeting of Finnish Remote Sensing researchers

Usually a two day confrence

Biggest local EO confer

Sauna

Photo by Jaakko Seppänen

Photo by Jaakko Seppänen

Photo by Jaakko Seppänen


Photo by Jaakko Seppänen

The Finnish Society of Photogrammetry and Remote Sensing

- **The Finnish Society of Photogrammetry and Remote Sensing is devoted to the research and development of photogrammetry and remote sensing in Finland.**
- **The Society has about 150 members.**
- **The most notable part of the work of the Society is to publish The Photogrammetric Journal of Finland.**
- **The Society is member of the International Society for Photogrammetry and Remote Sensing.**

information from imagery

Finnish Earth Observation Programme

TEKES
Academy of Finland

National Space Strategy

Vision: “Finland is a forerunner in selected areas”

- Satellite communication
- Satellite navigation
- Earth observation

- Increasing weight on research that serves industry and on the development of industrial services
- Public EO services already well developed (national forest inventory, ice service, land cover, inland water quality, snow cover, forest fire alert)

- No space agency but distributed structure. Tekes (controlled by the Ministry of Employment and the Economy) has the overall responsibility on space issues.

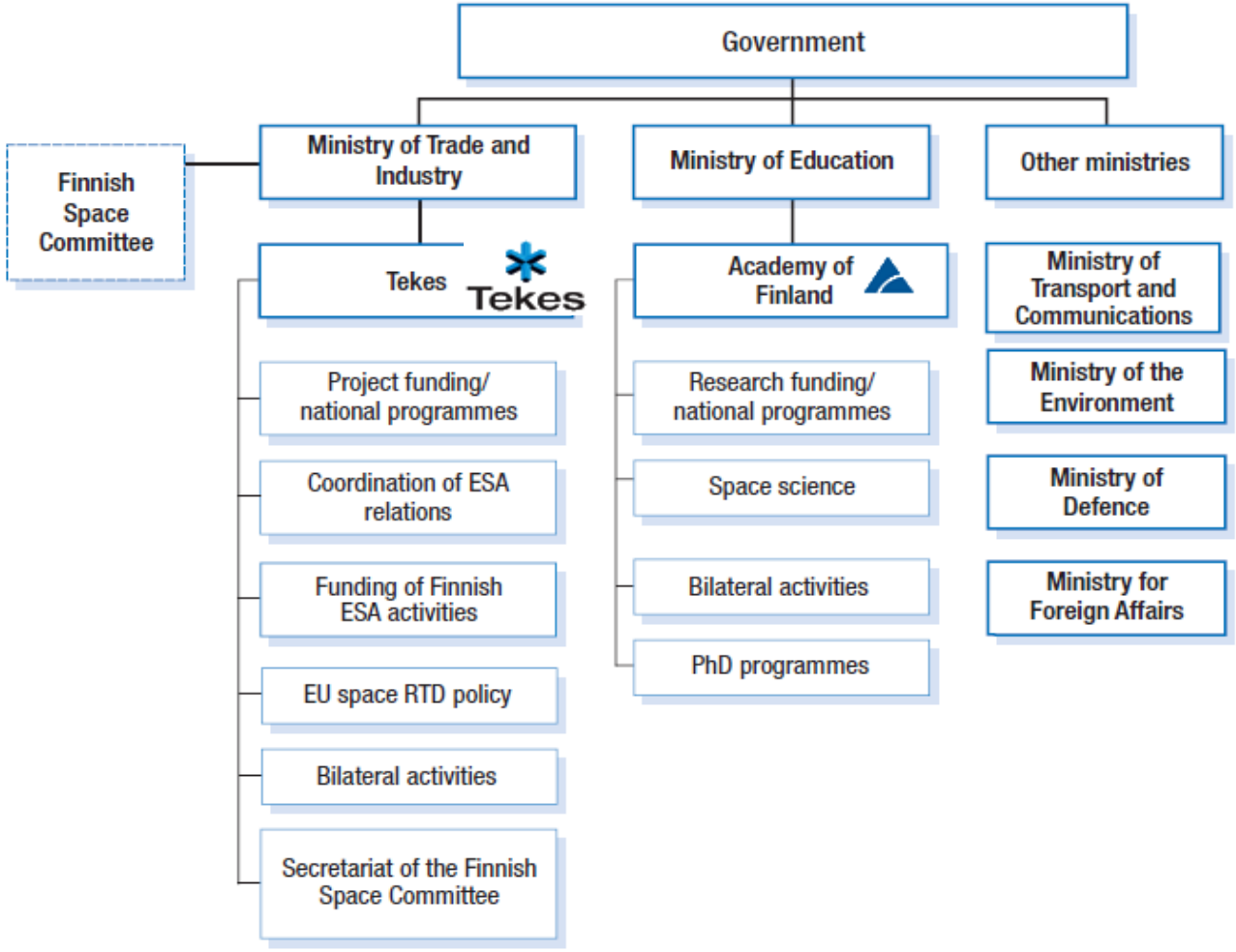
Tekes

Slide by, Pauli Stigell, Tuomas Häme

Earth Observation is part of the Space Strategy

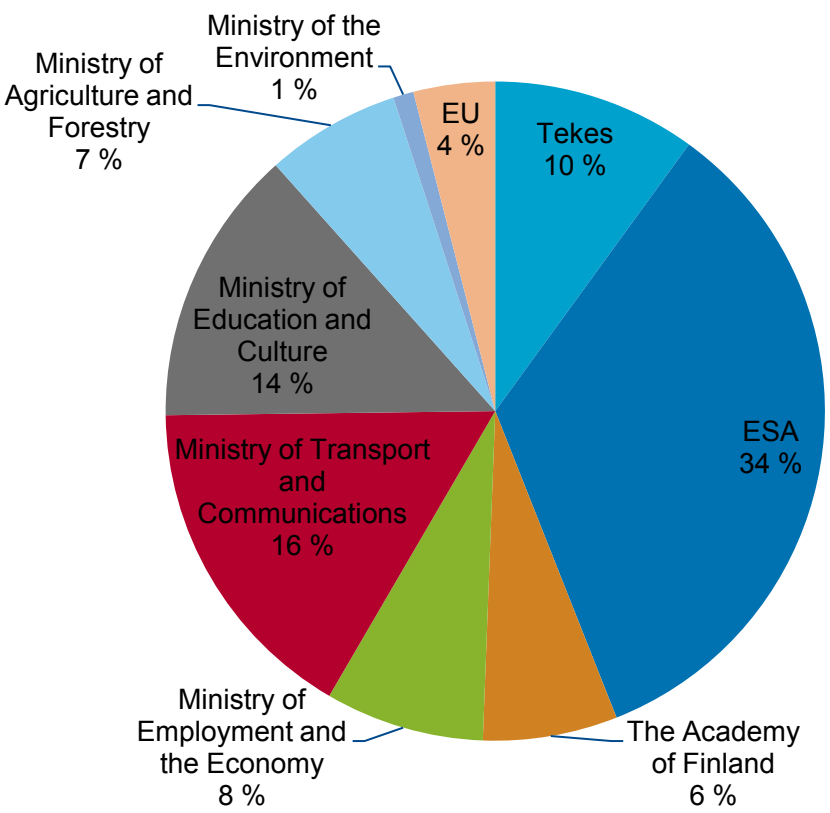
Publicly funded space activities in Finland are administered in decentralised way mainly involving Tekes (Finnish Funding Agency for Technology and Innovation), Academy of Finland and ministries of Employment and the Economy, Education, and Transport and Communications.

Finnish Space Committee (established in 1983) acts as the overall coordinating body for the Finnish space activities.

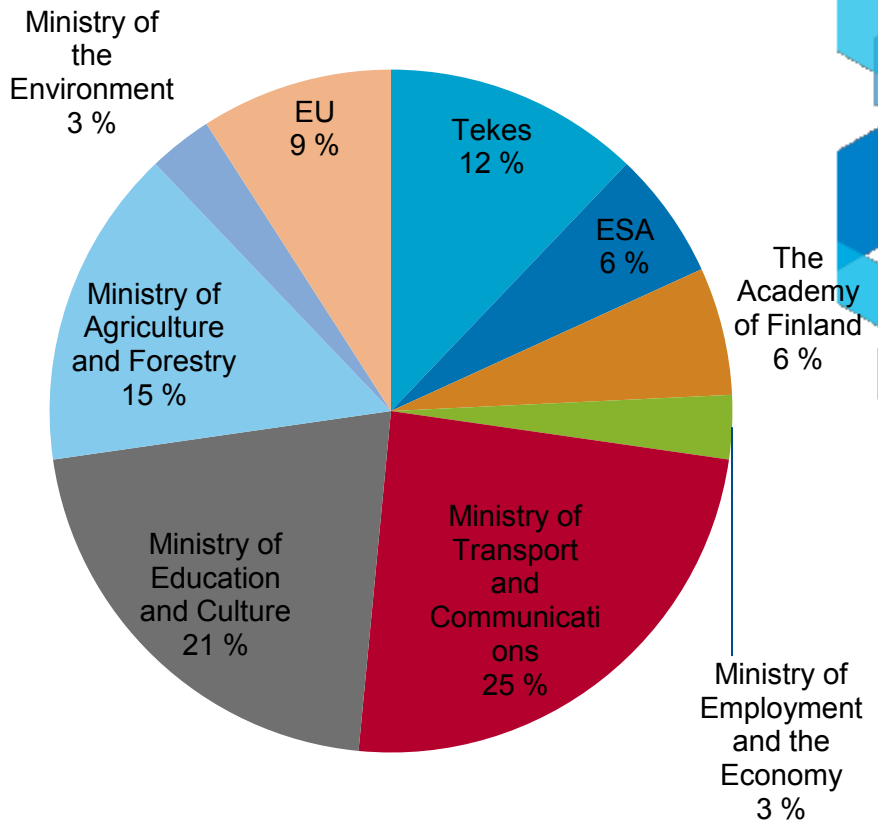


Distribution of public space funding

Overall funding (€50 mill./yr)*



Funding for EO data analysis (€16 mill./yr)**



*Source: National Space Strategy 2009-2011

**Rough estimates, including meteorology and satellite geodesy

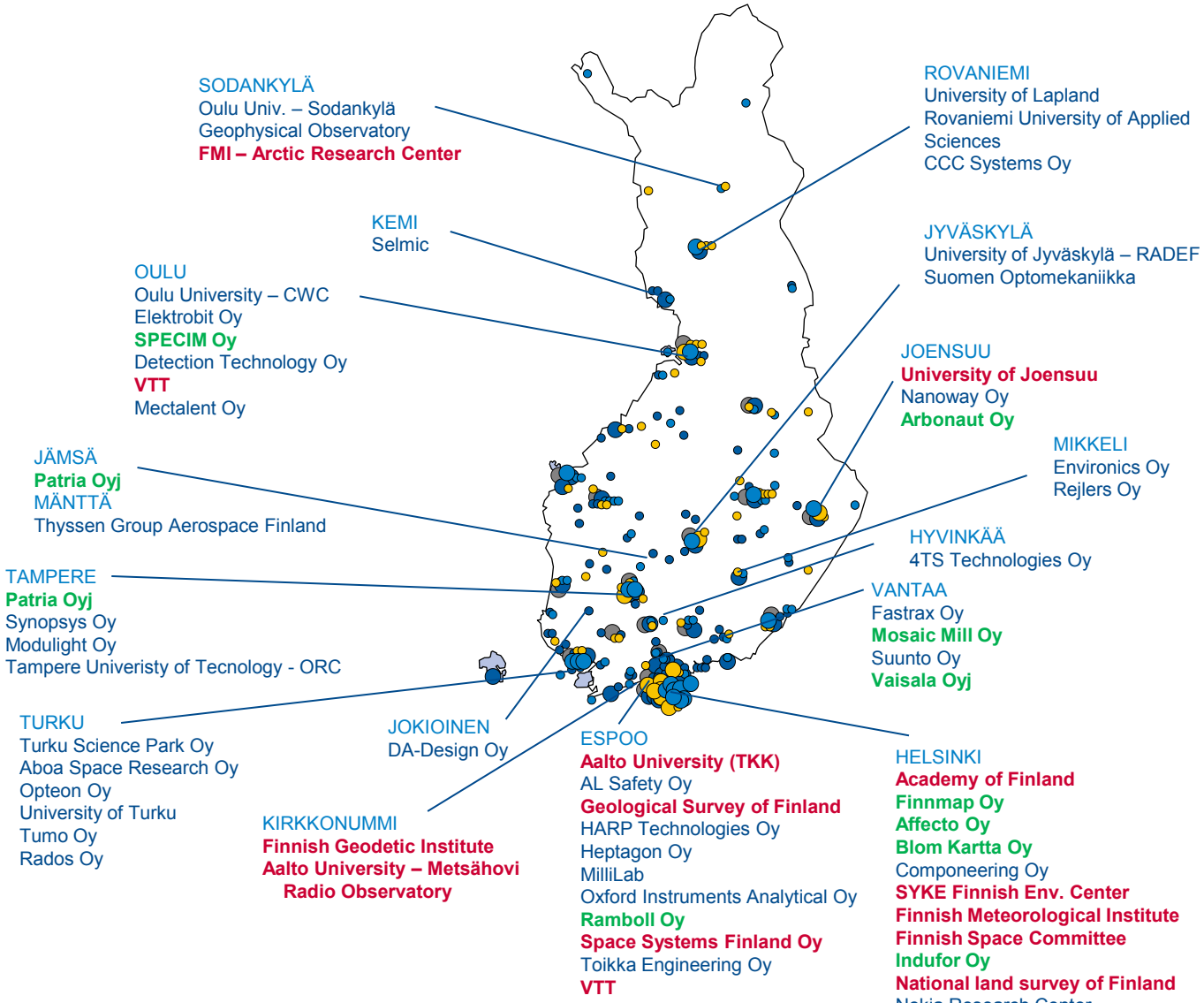
Slide by, Pauli Stigell, Tuomas Häme

Tekes

Finnish space and EO actors

EO actors colored, private shown on green

30 companies
20 research units



SODANKYLÄ
Oulu Univ. – Sodankylä
Geophysical Observatory
FMI – Arctic Research Center

KEMI
Selmic

OULU
Oulu University – CWC
Elektrobit Oy
SPECIM Oy
Detection Technology Oy
VTT
Mectalent Oy

JÄMSÄ
Patria Oyj
MÄNTTÄ
Thyssen Group Aerospace Finland

TAMPERE
Patria Oyj
Synopsys Oy
Modulight Oy
Tampere Univeristy of Tecnology - ORC

TURKU
Turku Science Park Oy
Aboa Space Research Oy
Opteon Oy
University of Turku
Tumo Oy
Rados Oy

KIRKKONUMMI
Finnish Geodetic Institute
Aalto University – Metsähovi Radio Observatory

JOKIOINEN
DA-Design Oy

ESPOO
Aalto University (TKK)
AL Safety Oy
Geological Survey of Finland
HARP Technologies Oy
Heptagon Oy
MilliLab
Oxford Instruments Analytical Oy
Ramboll Oy
Space Systems Finland Oy
Toikka Engineering Oy
VTT

HELSINKI
Academy of Finland
Finnmap Oy
Affecto Oy
Blom Kartta Oy
Componeering Oy
SYKE Finnish Env. Center
Finnish Meteorological Institute
Finnish Space Committee
Indufor Oy
National land survey of Finland
Nokia Research Center
Tekes
University of Helsinki

ROVANIEMI
University of Lapland
Rovaniemi University of Applied Sciences
CCC Systems Oy

JYVÄSKYLÄ
University of Jyväskylä – RADEF
Suomen Optomekaniikka

JOENSUU
University of Joensuu
Nanoway Oy
Arbonaut Oy

MIKKELI
Environics Oy
Rejlers Oy

HYVINKÄÄ
4TS Technologies Oy

VANTAA
Fastrax Oy
Mosaic Mill Oy
Suunto Oy
Vaisala Oyj

Red: Public EO organization, Green: Private EO enterprise

Source: http://www.avaruus.info/en/companies_and_research_groups/universities_and_research_institutes/

Tekes

Research Instutes

Metla **FMI** SYKE

Finnish Geodetic Institute **VTT**

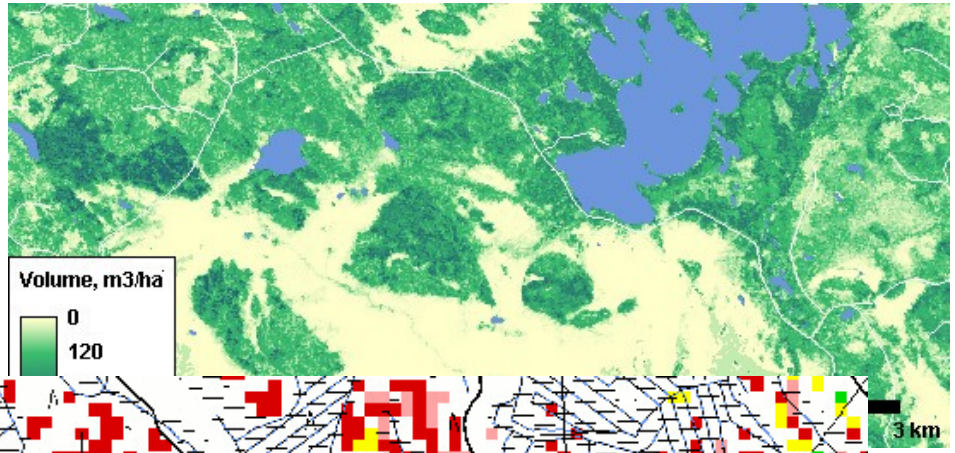
METLA
Finnish Forest Research Institute

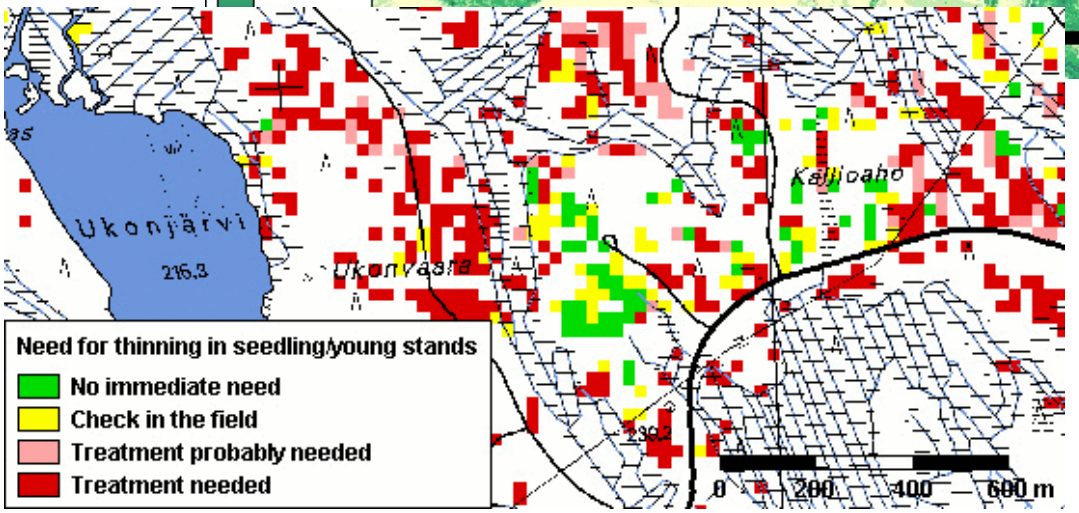
Keywords: forest, forest inventory

Multi-source National Forest Inventory (MS-NFI)

The satellite image based MS-NFI was introduced during the 8th NFI at the end of 1980's. Since then the method has been implemented as a part of the operational NFI, and further developed by the NFI research team.

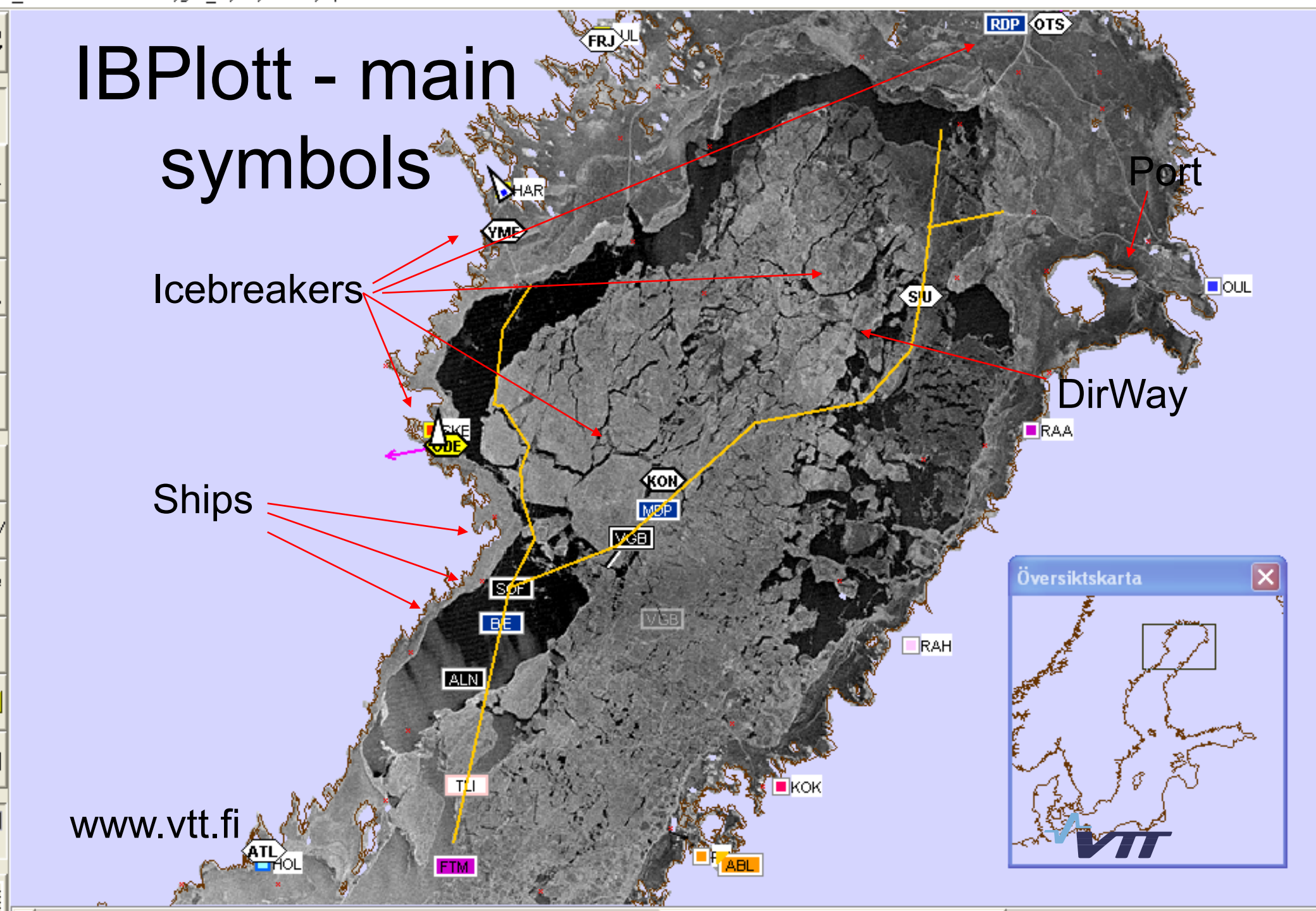
SPOT Landsat TM



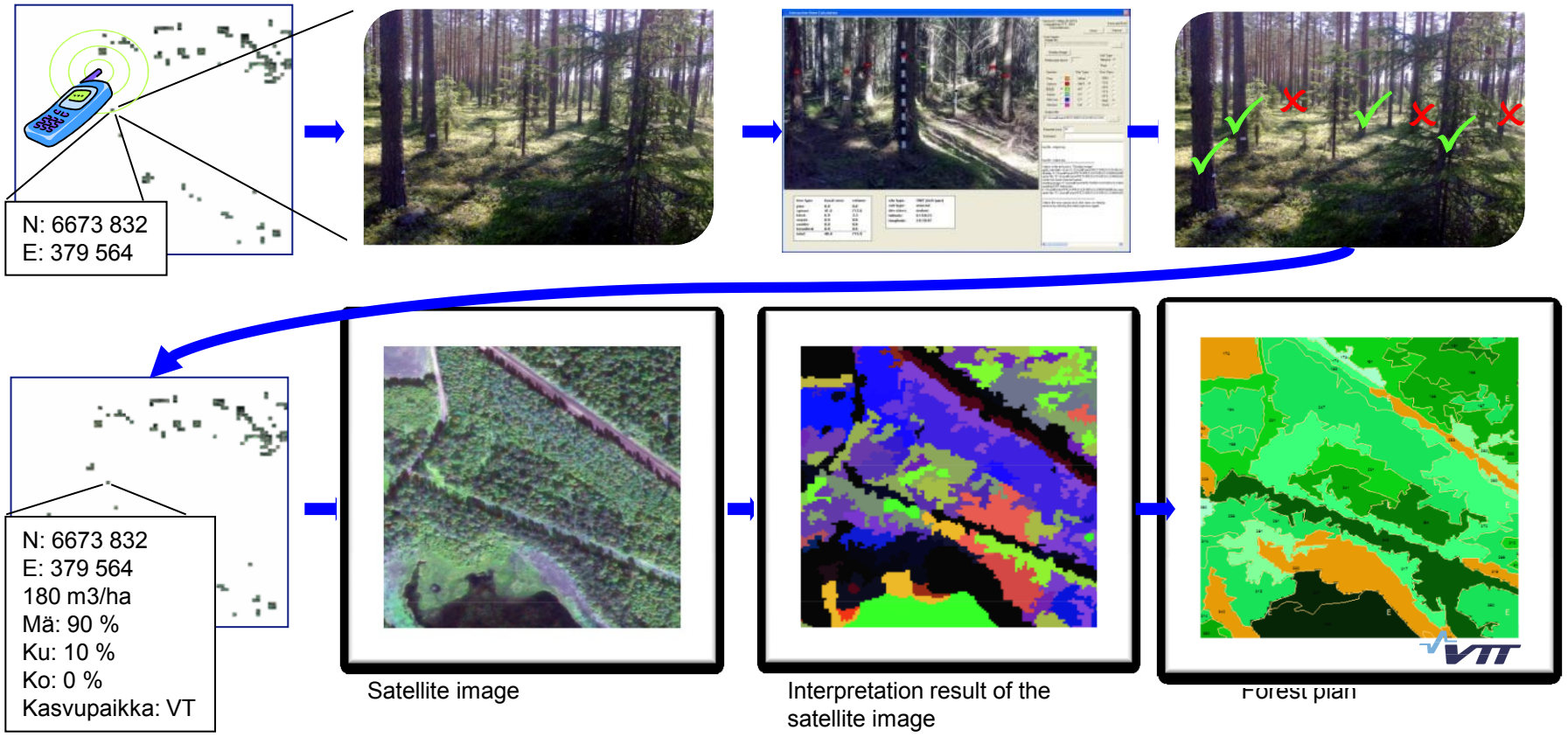


VTT Technical Research Centre of Finland -

Business from technology


IBPlott - main symbols
Icebreakers
Ships
Port
DirWay
www.vtt.fi
FRJ
RDP
OTS
HAR
YME
SIU
OUL
RAA
KON
MOP
VGB
SOF
BE
ALN
RAH
TLI
KOK
ATL
HOL
FTM
ABL
Översiktskarta
VTT

EnviObserver use case - Social forest planning



Overview of the cell phone image processing chain

Reference intensity levels from stems

Euclidian distance

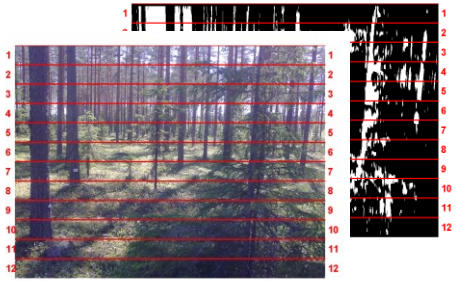
Color angle

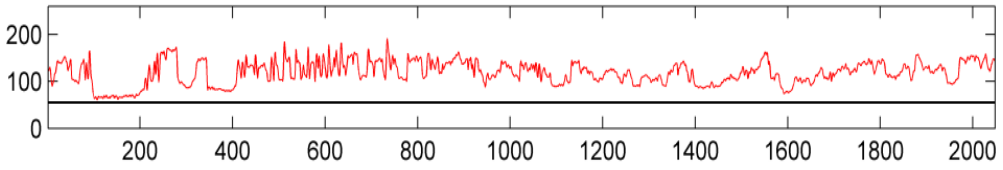
Binary map of candidate trees

Block processing

Intensity profile analysis

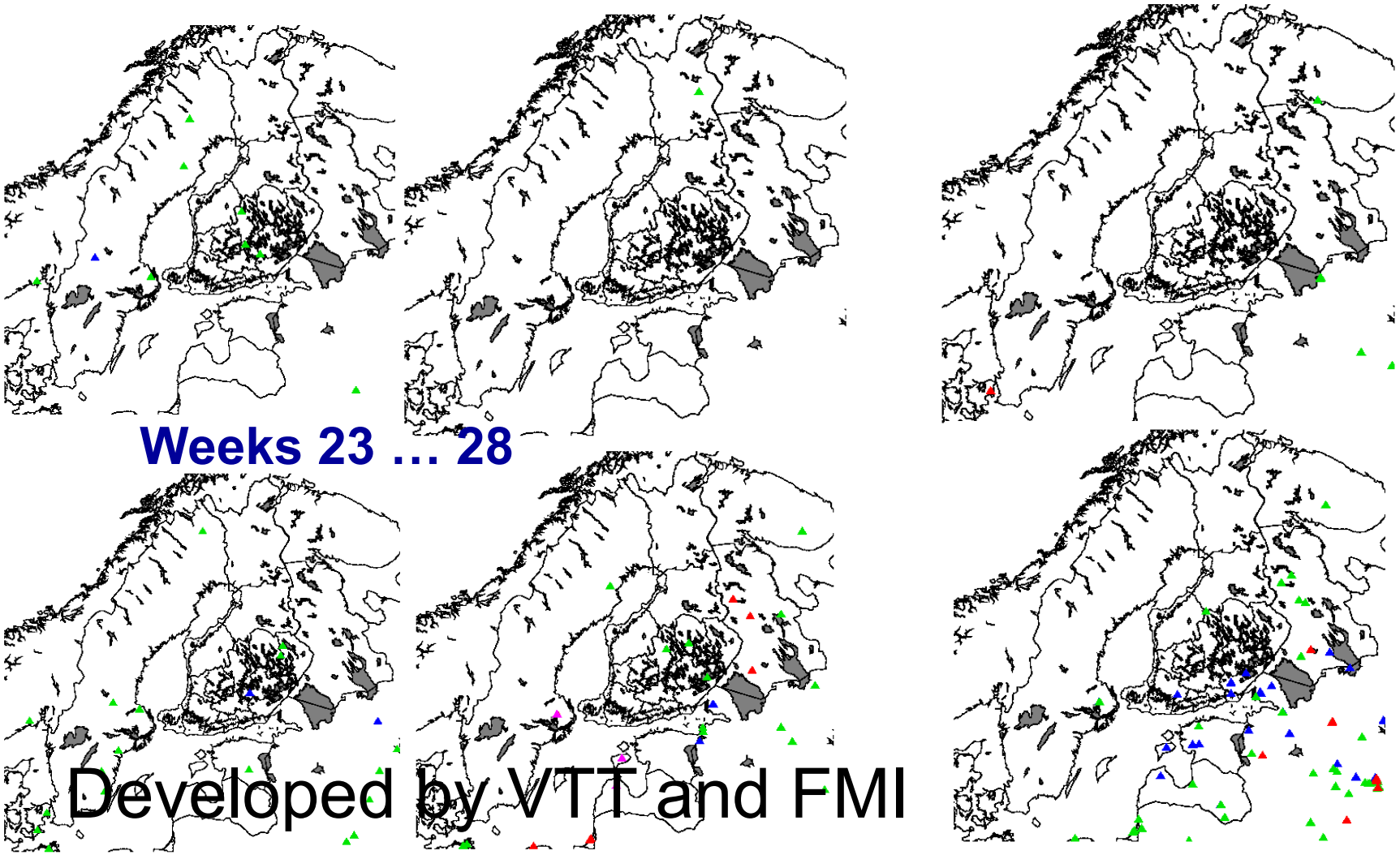
Fine-tuned tree candidates





Slide by Matthew Molinier

Forest fire alert system using AVHRR & Modis



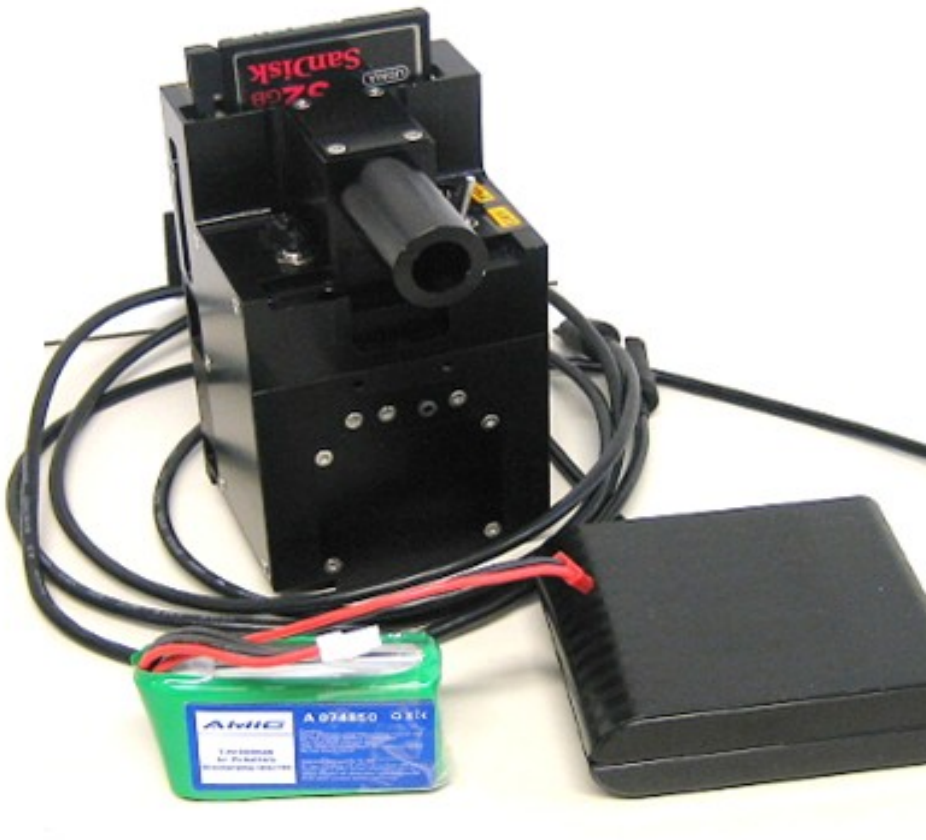
Weeks 23 … 28

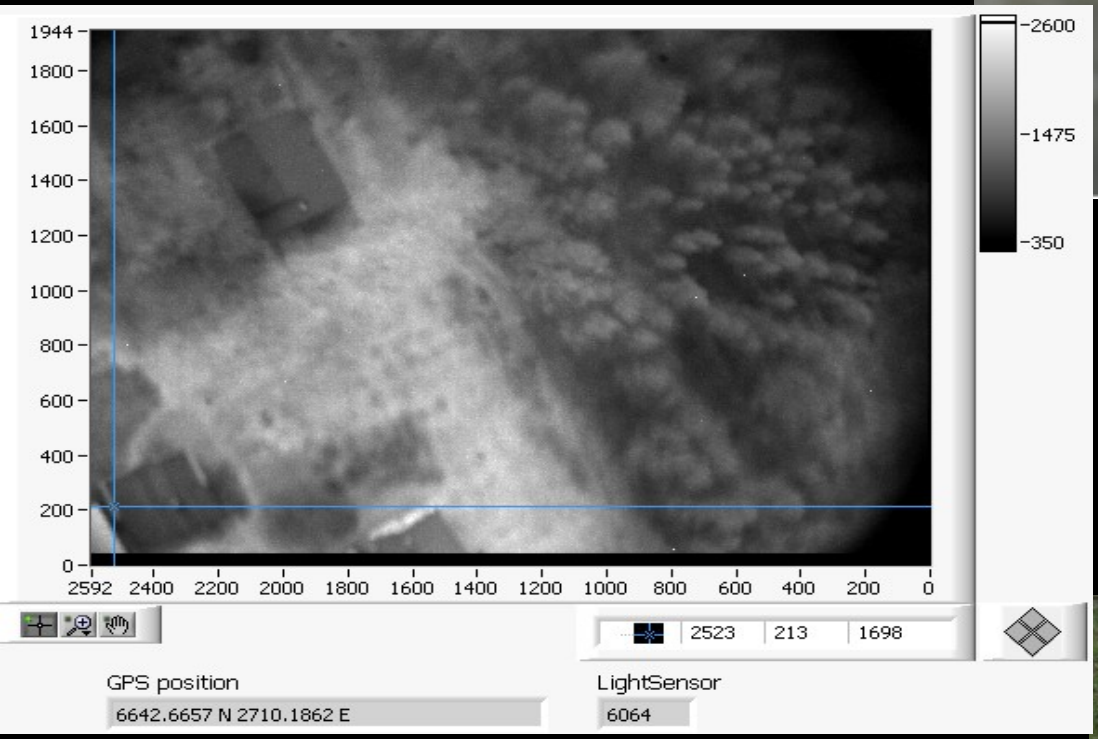
Developed by VTT and FMI

World smallest imaging spectrometer for UAVI

Major specifications of the spectral camera

Spectral range: 500 – 900 nm
Spectral Resolution: 9..45 nm @ FWHM
Focal length: 9.3 mm
F-number: 6.8
Image size: 5.7 mm x 4.3 mm, 5 Mpix
Minimum total exposure time: 30 ms
Field of View: 32° (across the flight direction)
Ground pixel size: 3.5 cm @ 150 m height
Weight: 350 g (without battery)
Size: 62 mm x 61 mm/76mm x 120 mm
Power consumption: 3 W





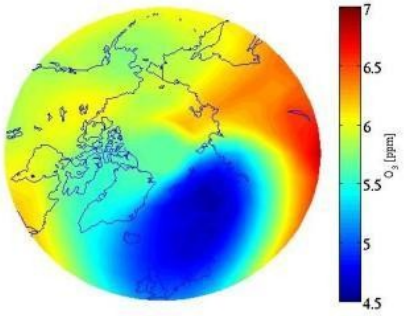
VTT miniature spectrometers UAV test flights

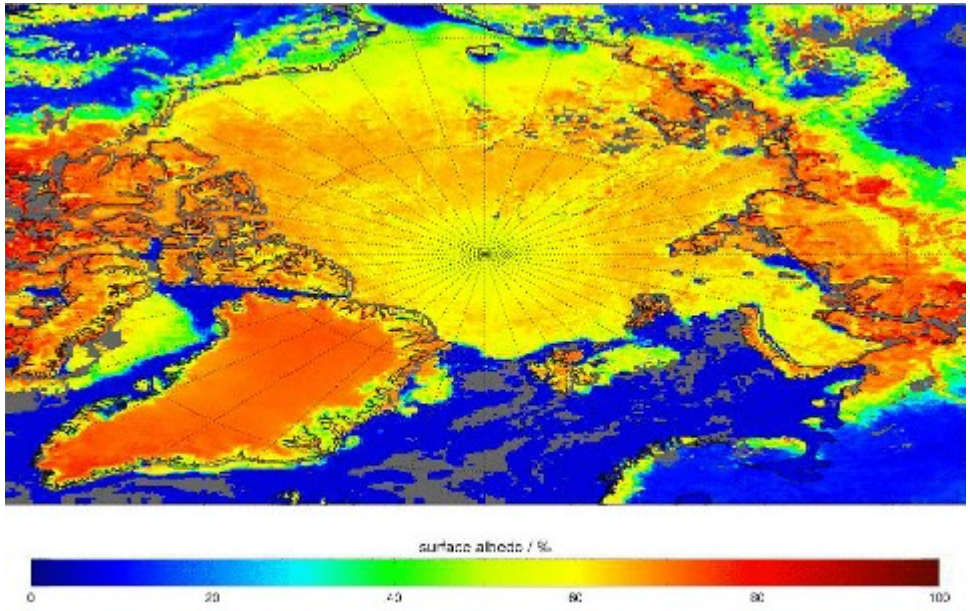
Aalto-1
The Finnish Student Satellite

ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

- **Remote sensing of atmosphere**
- **Earth Observation**
- **Arctic Research Centre**

- **Topics**
  - Snow
  - Forest Cover
  - Albedo





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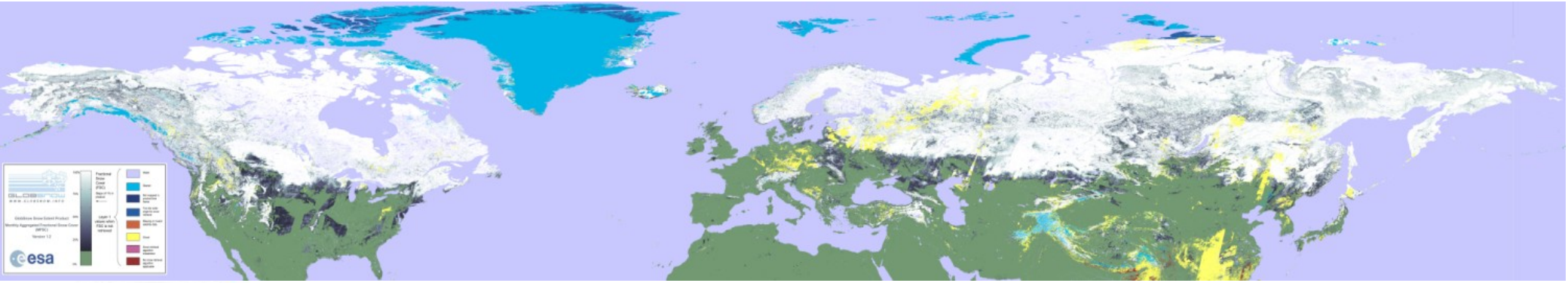
GlobSnow

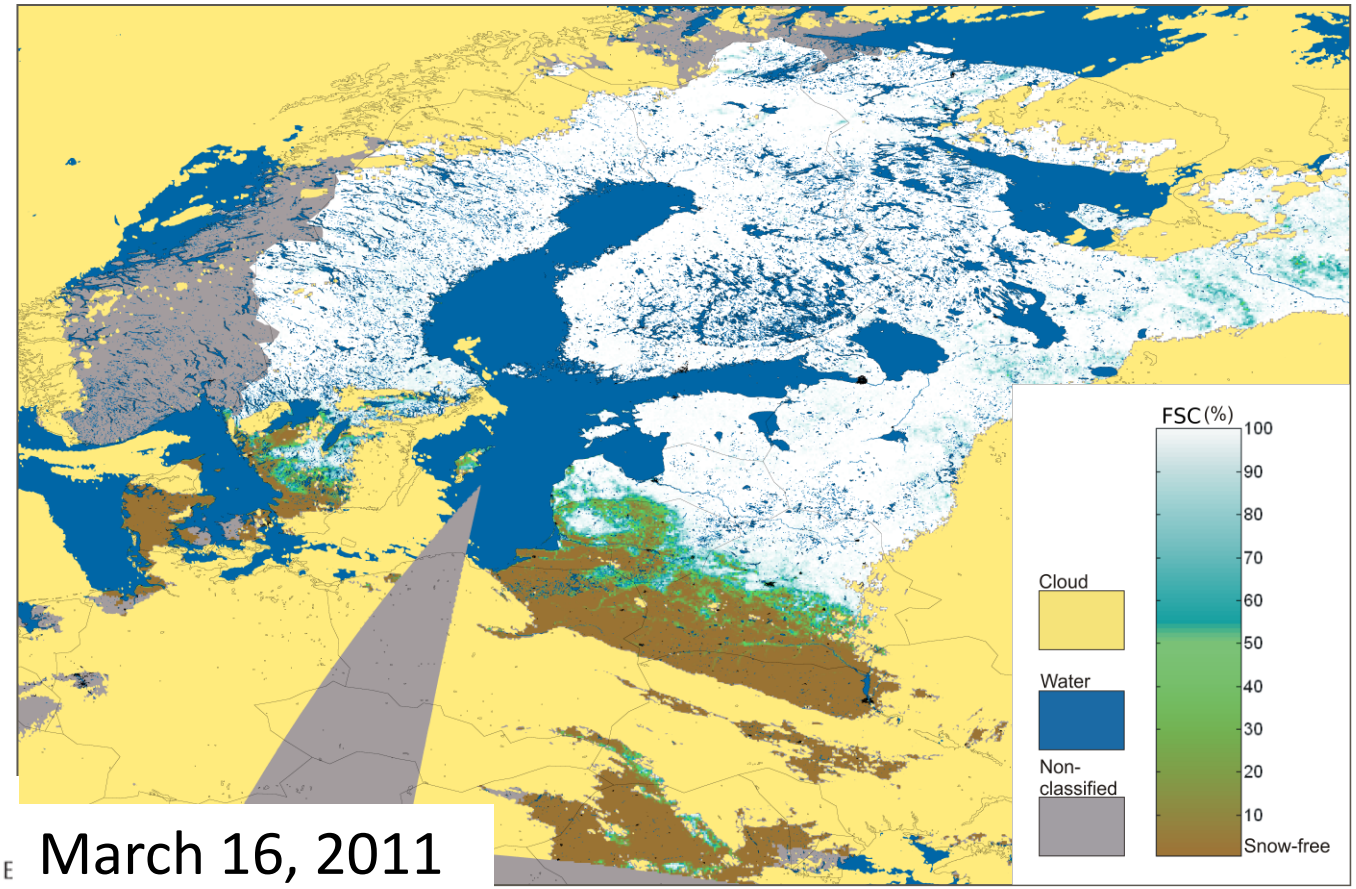
- ESA-funded GlobSnow project: Production of novel Snow Extent (SE) and Snow Water Equivalent (SWE) Climate Data Records (CDR) for the North Hemisphere
- NRT GlobSnow processing system and data archives at FMI-Sodankylä Facility
- Consortium; Finnish Meteorological Institute (FMI) with ENVEO IT (Austria), GAMMA Remote Sensing (Switzerland), Norwegian Computing Center (NR), Finnish Environment Institute (SYKE), and Environment Canada (EC)
- Below: GlobSnow SE-product for fractional snow cover mapping covering a 15-year-long time period using ESA ATSR/AATSR (principal algorithm SYKE's *SCAmod* method)



enveo GAMMA REMOTE SENSING Norsk Regnesentral SYKE Environment Canada Environnement Canada

SCAmod in GMES project PolarView

- Fractional snow cover given in % for 0.005deg / 0.05deg grid cells covering the Baltic Sea drainage area
- Produced with SYKE *SCAmod*-method (for forested and non-forested areas) from Terra/MODIS level1b- data



March 16, 2011

Polar View
Earth Observation for Polar Monitoring

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FINNISH METEOROLOGICAL INSTITUTE

ARCTIC RESEARCH CENTRE OF FINNISH METEOROLOGICAL INSTITUTE

INTERNATIONAL CROSS VALIDATION SATELLITE IMAGE TEST SITE

SNOW RESEARCH

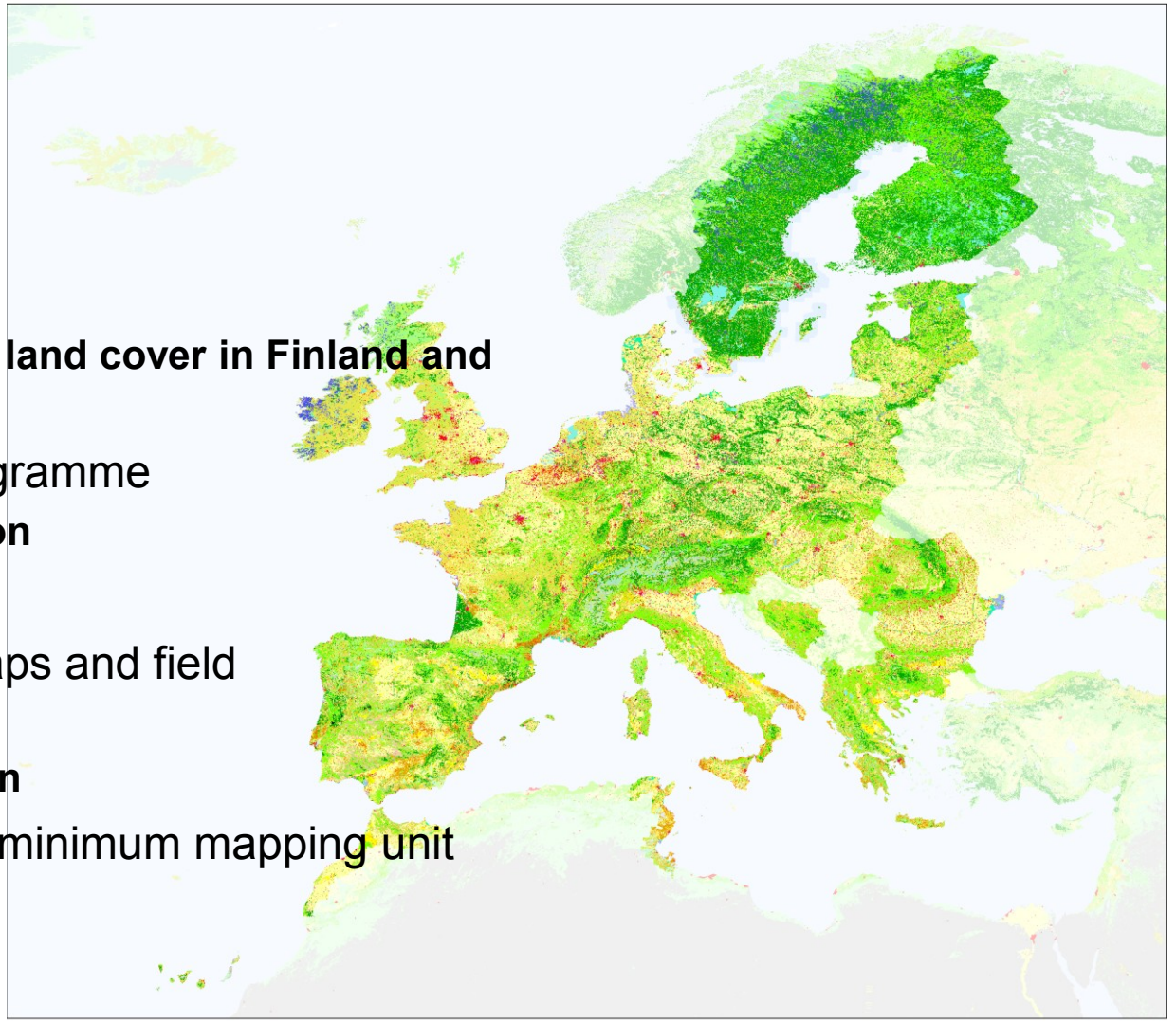
SATELLITE DATA SERVICE

- **ESA MMFI Ground Segment**
- **X-band reception systems:**
  - 7.3 m antenna, data rate 320 (640) Mbps
  - 2.4 m antenna, data rate 20.8 Mbps

FINNISH METEOROLOGICAL INSTITUTE

SYKE

- **Information about land use and land cover in Finland and surrounding areas**
  - pan-European Corine programme
- **National land cover classification**
  - 25 m raster product
  - satellite images, digital maps and field measurements
- **Generalized to European version**
  - Vector product with 25 ha minimum mapping unit



European Environment Agency

Earth observation services SYKE/TK/GEO

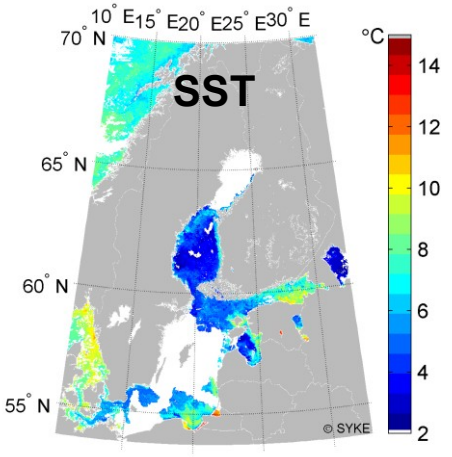
Operative Remote sensing applications, Data processed & published daily by SYKE

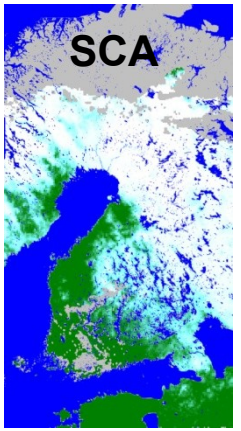
- Snow Covered area (SCA)
  MODIS-Radarsat-Asar
- Sea surface temperature (SST)
  AVHRR
- Turbidity
  MERIS
- Surface Algae
  MERIS
- Snow covered area on Ice
  MODIS
- Chlorophyll a (CHL)
  MERIS

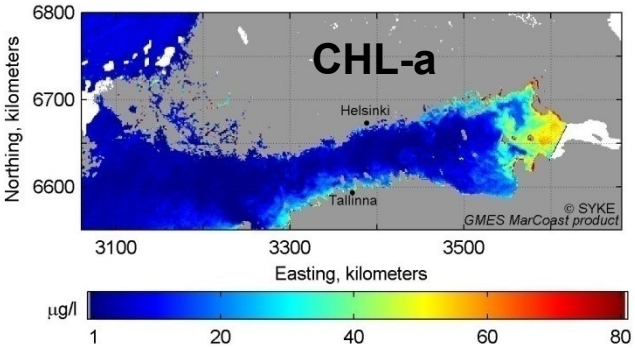
S Y K E

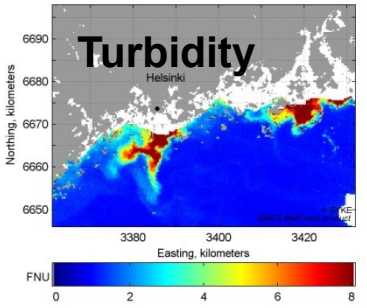
Long term services

- Landcover
- Vegetation





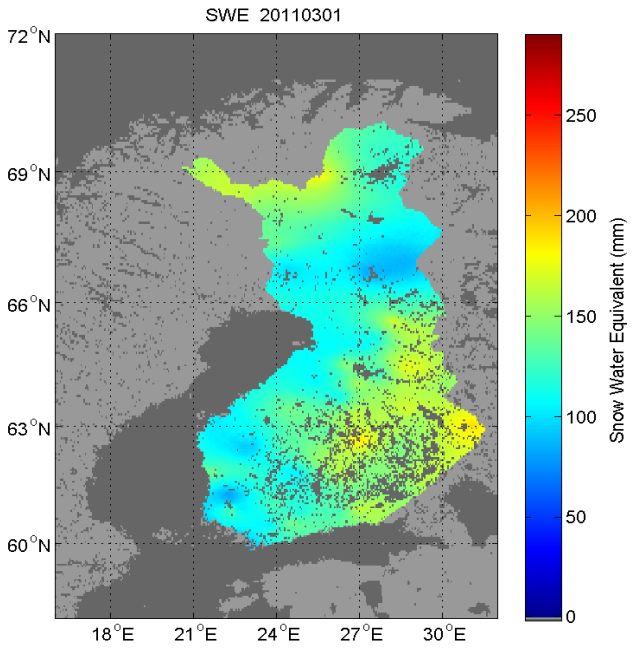


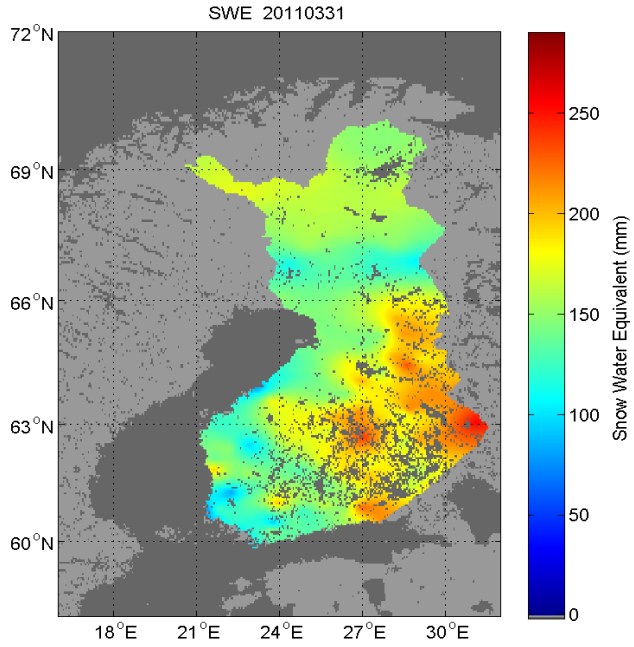


Oil-spill related information systems (EMSA, others)
GIS and map interfaces

Snow water equivalent (SWE)

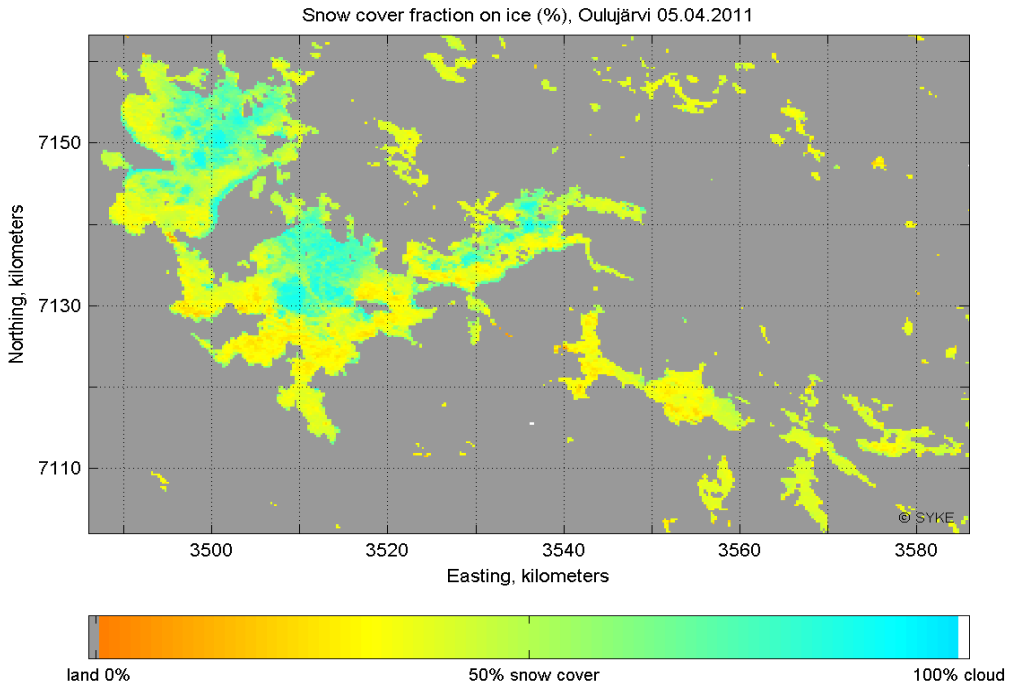
- SWE is the average amount of water existing in snow
- Daily AMSR-E images
  - assimilated with weather station data
  - 10km x 10km grid

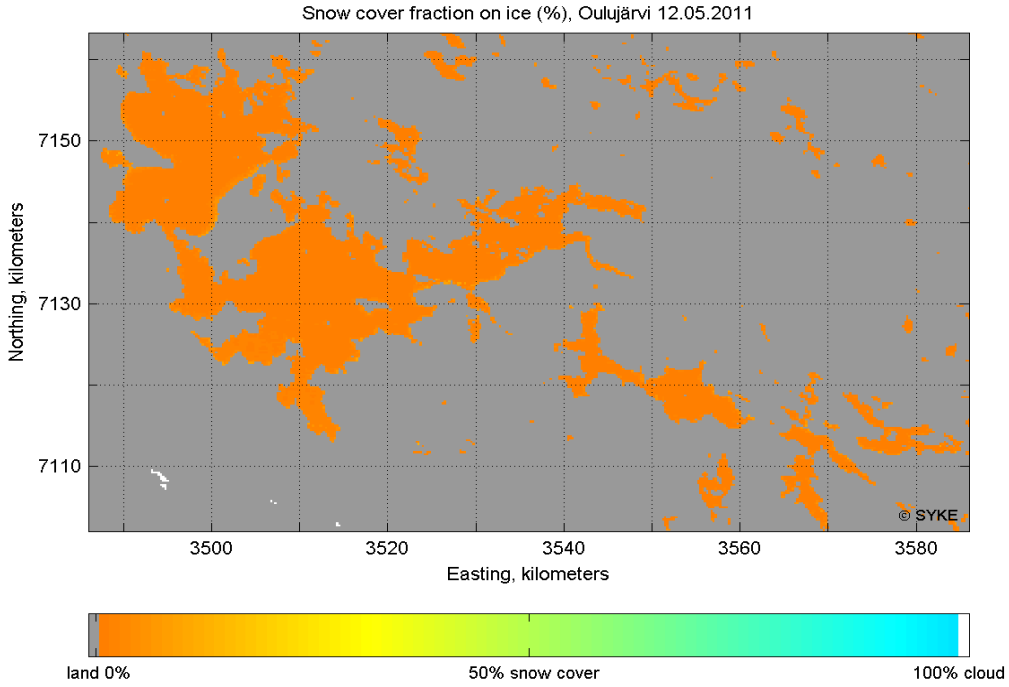


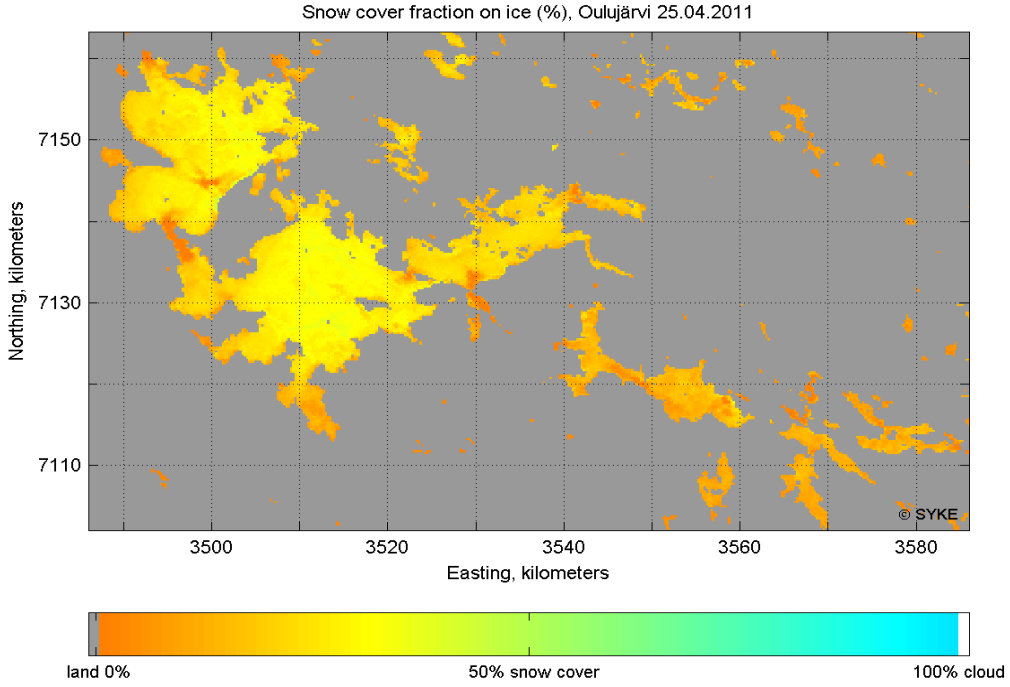


Snow coverage on lakes

- Terra Modis
  - 250 m spatial resolution
- Nine large Finnish lakes
  - March - May

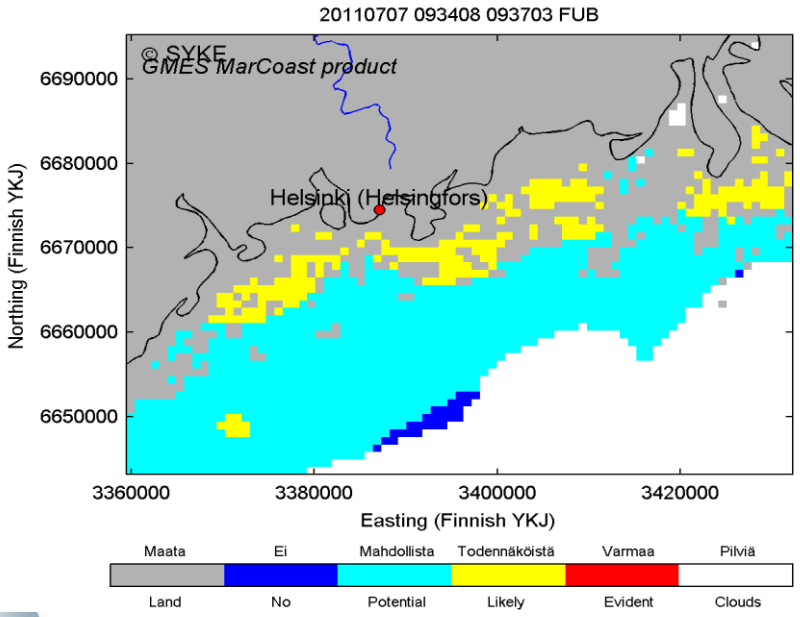


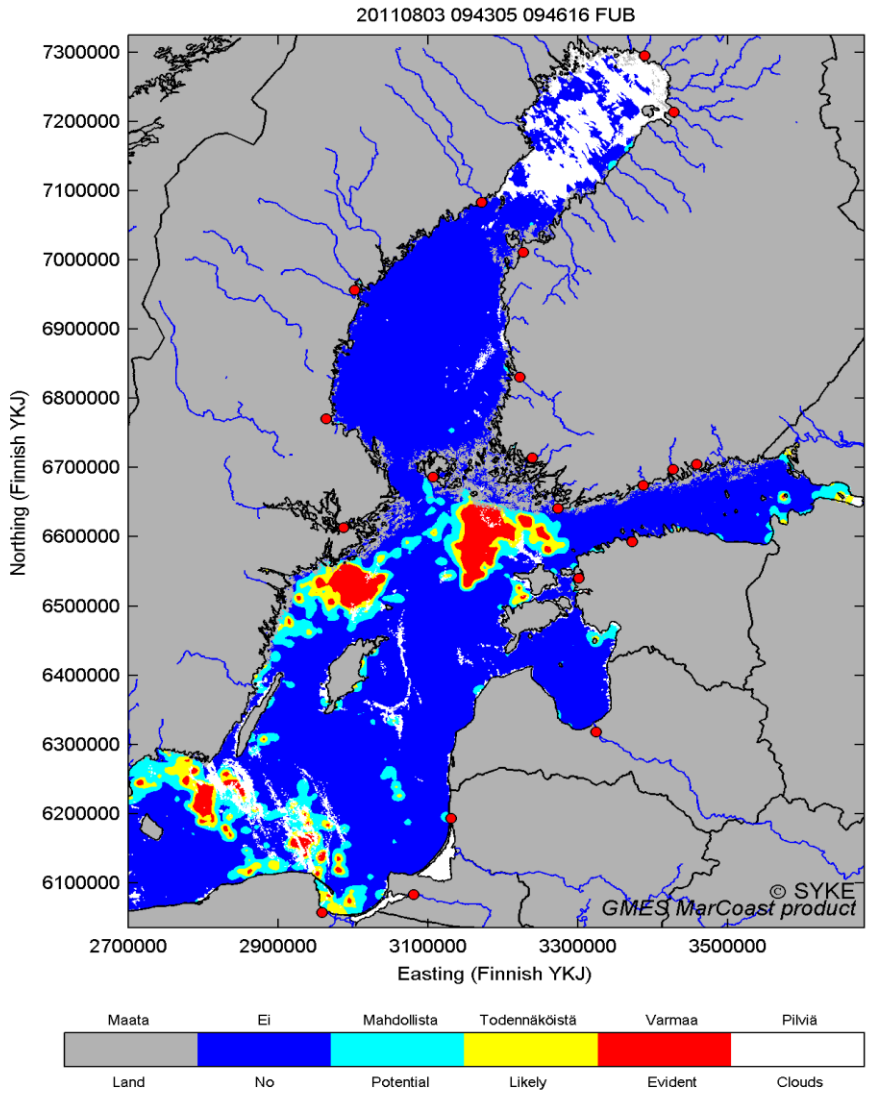




Surface algae intensity

- From late June to August
- Envisat Meris images
  - 300 m spatial resolution
- Weekly composite images are also available
- Archive stars from year 2003





An ice-strengthened research vessel Aranda owned by the Finnish Environmental Institute.

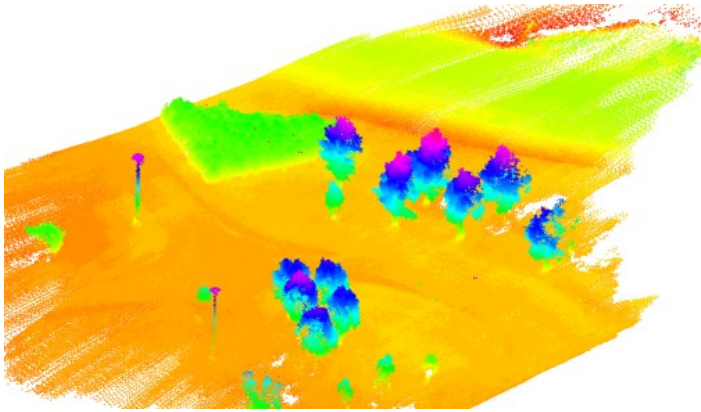
FINNISH GEODETIC INSTITUTE

- **Department of Remote Sensing and Photogrammetry of the FGI**
- **Prof. Juha Hyyppä, Head of the Department**
- **Research groups**
  - Mobile mapping
  - Active sensing
  - Spectrophotogrammetry
- **R&D of modern remote sensing technology, creation of innovative mapping methods, evaluation of new remote sensing data sources and fostering the adaptation of new remote sensing technology in Finland**

FINNISH GEODETIC INSTITUTE

Slide by Mika Karjalainen and Juha Hyyppä

- NovAtel SPAN-CPT
- Ibeo Lux
- AVT Pike F-421C
- Specim V10H



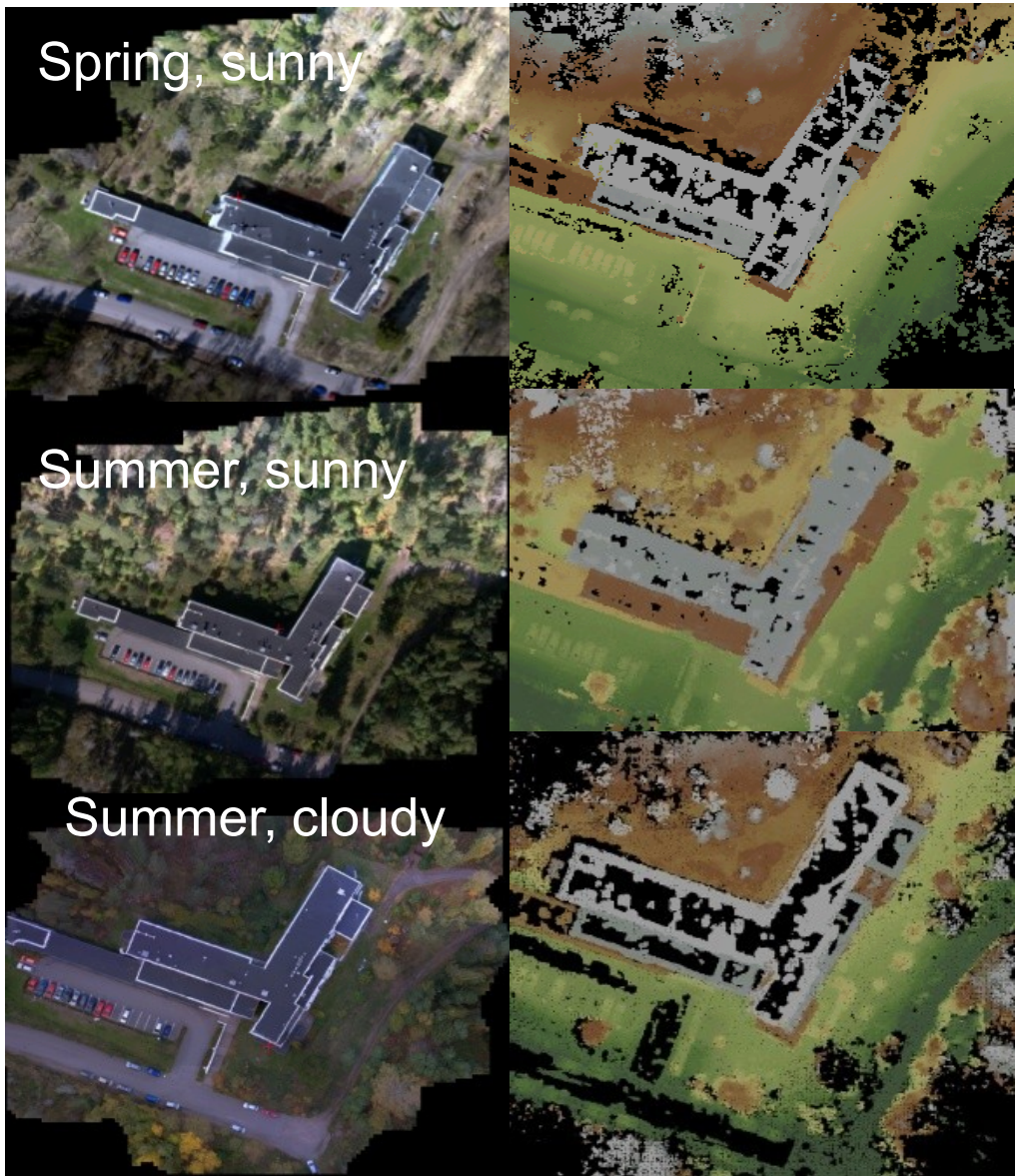
FINNISH GEODETIC INSTITUTE

Slide by Mika Karjalainen and Juha Hyyppä

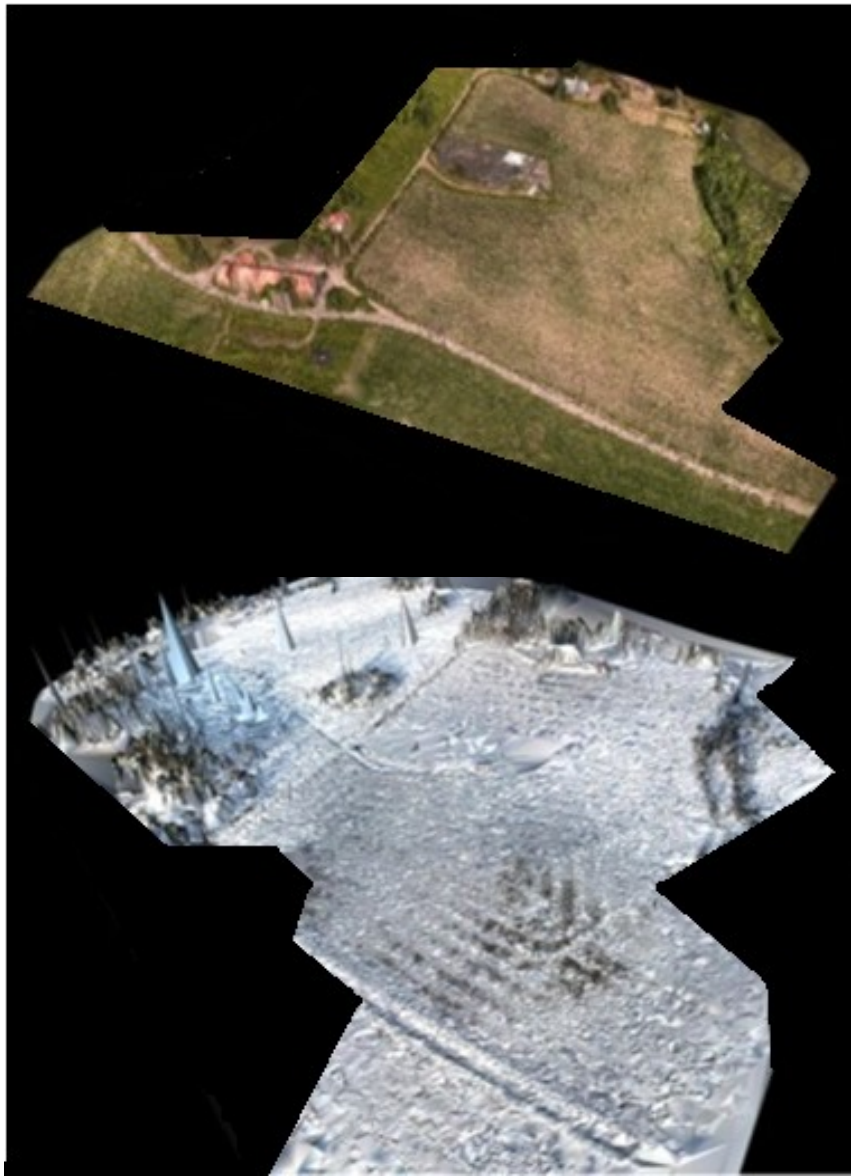
FINNISH GEODETIC INSTITUTE

UAV photogrammetry

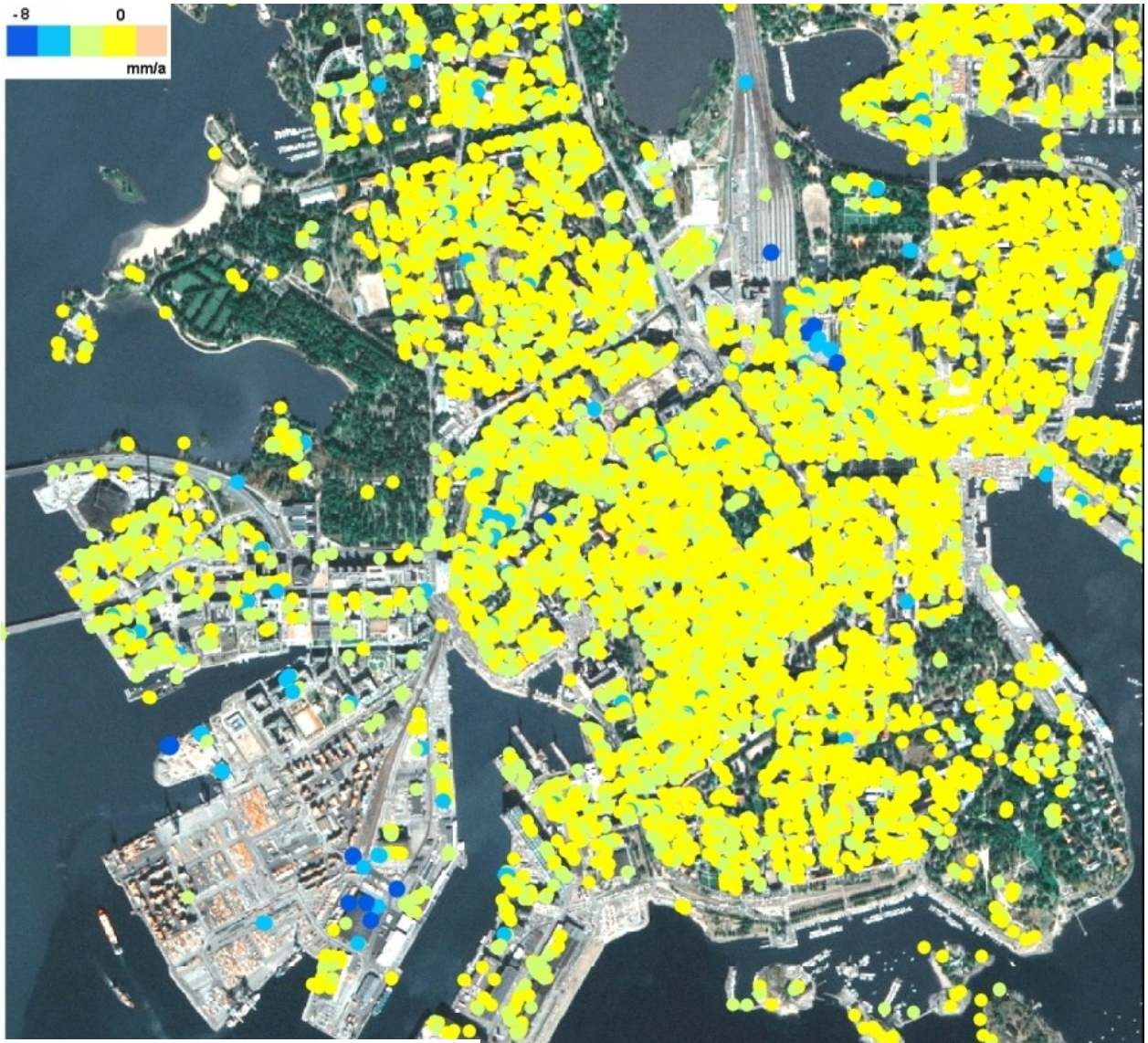
Image and point cloud time series



In all seasons



Land subsidence using SAR interferometry



KAUPUNKI

Satelliitit paljastavat pihojen ja talojen painumisen kortteli korttelilta Helsingissä

Kartassa tuttuja paikkoja, mutta myös yllätyksiä

FINNISH GEODETIC INSTITUTE

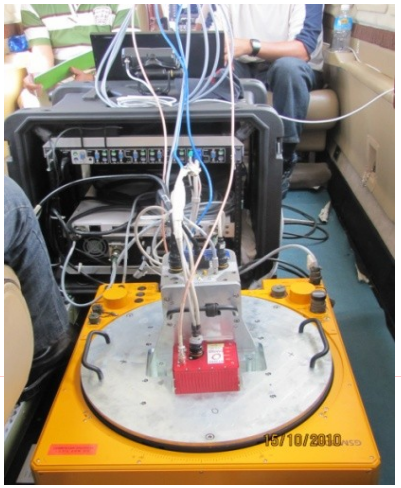
Slide by Mika Karjalainen and Juha Hyyppä

Companies

Arbonaut

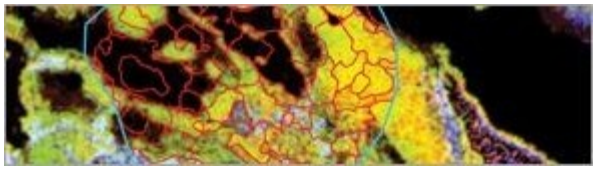
Pieneering Specim

AISA Imaging Spectrometer

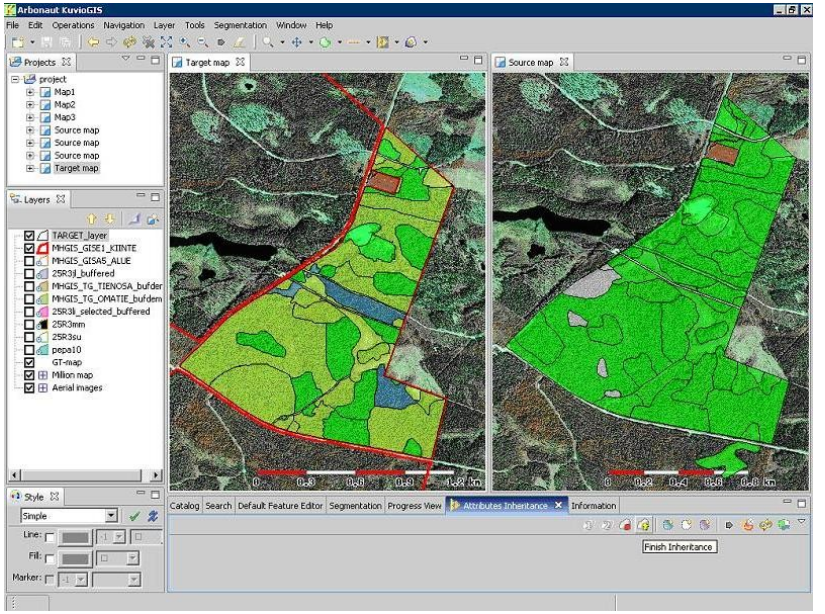


arbonaut
The Single Source for Forest Resource Management

- Arbonaut is a world leader in developing information gathering and GIS solutions for forest inventory and natural resource management. From satellite data collection to computer data analysis.

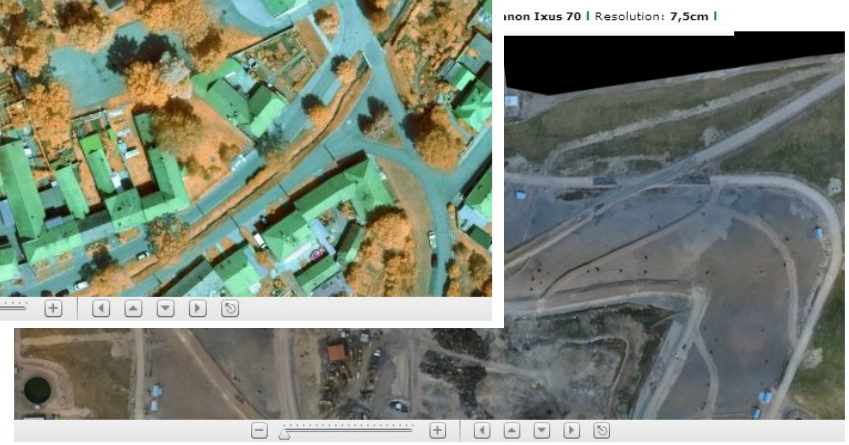


Arbonaut's technological innovations facilitate the collection, analysis and web-based dissemination of forest information in both natural and plantation forests - be they boreal, temperate or tropical.



PIEneering

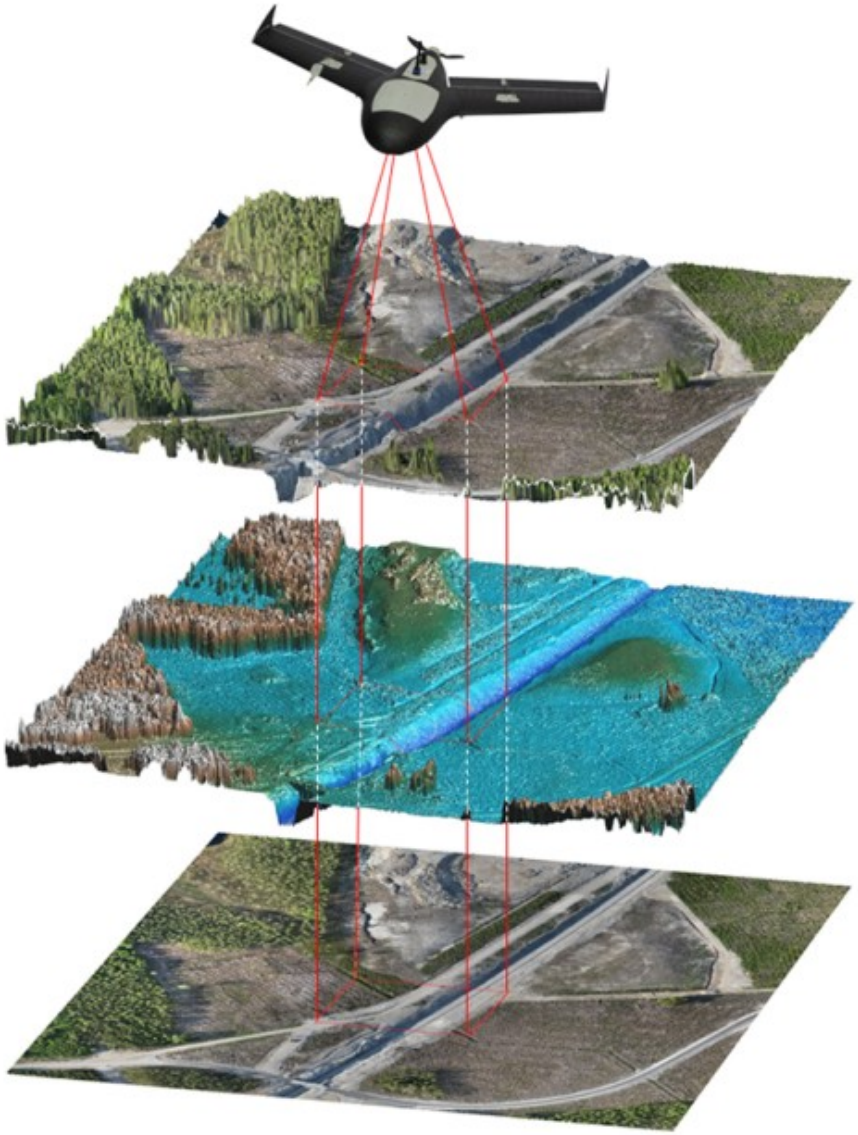
Parallel Image Engineering



SOFTWARE

- RapidProof
- RapidStation
- **RapidTerrain**
- RapidCal
- RapidToolbox

Rapid mapping end products



- 2D image + 3D surface model combined
- 3D surface model
- 2D ortho photos

PIEneering
Parallel Image Engineering

Energy industry: bioenergy depot volume calculation

PIEneering
Parallel Image Engineering

WHAT IS IT?

a. Complete aerial imaging system (software + hardware + support)

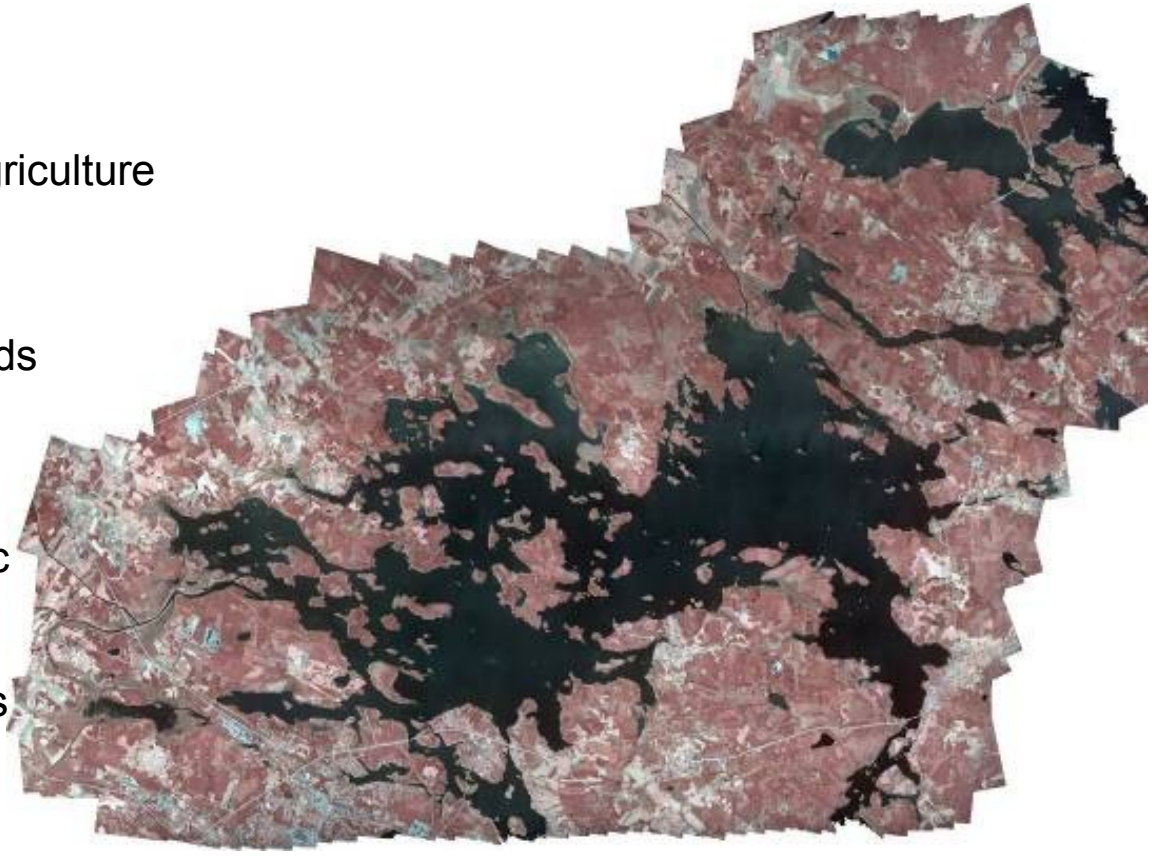
and

b. Software for automatic image processing

TO WHOM?

Companies and organizations in

- Mapping and survey
- Plantations, forestry and agriculture
- Consulting
- Environment
- Mining
- Power lines, pipe lines, roads



WHAT ARE THE OUTPUTS?

- Orthorectified image mosaic
- Digital elevation model
- 3D measurements, volumes

Universities

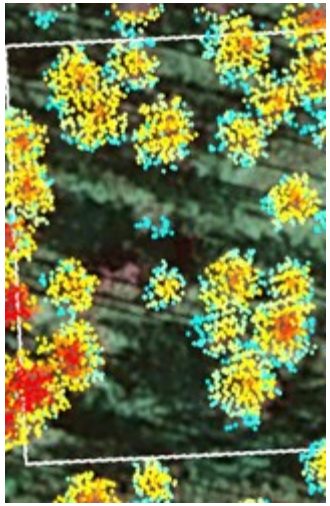
Aalto **university**

of easter finland

University of Helsinki

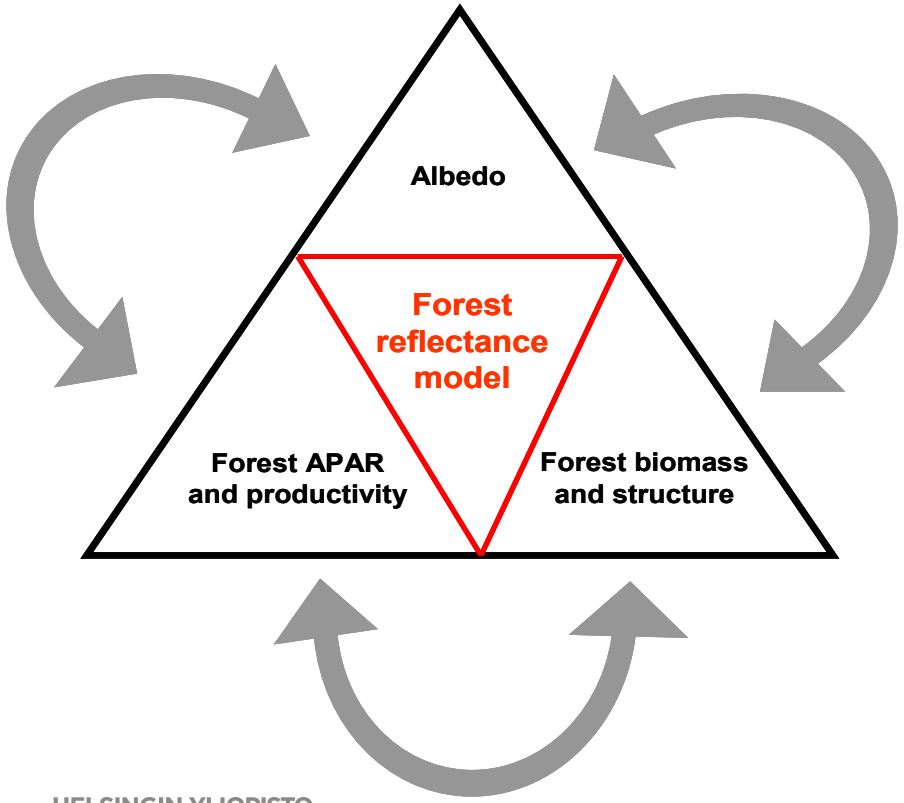
UNIVERSITY OF HELSINKI

- **Department of Forest Sciences**
- **Department of Geography**



University of Helsinki, Department of Forest Sciences
Group leader: Prof. Pauline Stenberg (pauline.stenberg@helsinki.fi)

Main focus area: Structure and radiation regime of boreal forests



- **Examples of on-going projects:**
  - Coupling Northern boreal forest structure and biomass with shortwave albedo
  - Seasonal reflectance changes of boreal forests
  - Remote sensing and physical models for monitoring boreal land cover and forest limits
  - Vegetation structure and functioning from imaging spectroscopy

http://www.mv.helsinki.fi/home/mxrautia/lai/

Land Cover Change Studies in Eastern Africa

Slide by Petri Pellikka, Mika Siljander & Pekka Hurskainen

Aerial Campaign in Taita Hills, January 2012

- Sensors
  - Nikon D3X Digital Camera System, true-colour, 10 cm
  - AISA Eagle hyperspectral sensor, 300 wavebands between green and NIR, 50 cm
- Flown areas:
  - Transect in three blocks
  - Indigeneous forest patches: Ngangao-Irizi, Ronge-Mbololo, Chawia, Kasigau
  - Lowland shrubs, Mwatate sisal plantations (few lines only)
  - Boresight lines for AISA geometric calibration

Slide by Petri Pellikka, Mika Siljander & Pekka Hurskainen

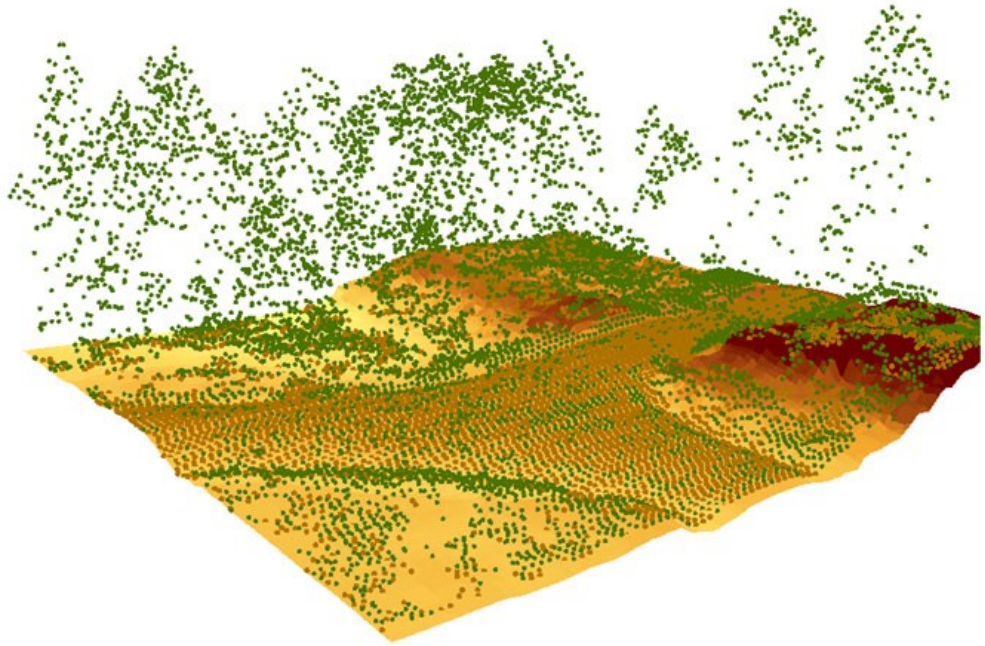
Field mapping of 24 plots from Mwatate to Vuria

Slide by Petri Pellikka, Mika Siljander & Pekka Hurskainen

Leaf area index, chlorophyll and spectra

Slide by Petri Pellikka, Mika Siljander & Pekka Hurskainen

UNIVERSITY OF
EASTERN FINLAND



School of Forest Sciences in Finland

Department of Geography and History

Recent research topics

- **Multi-Scale geospatial analysis of Forest Ecosystems**
- Forest inventory of tropical plantation (Wood Wisdom Era-Net)
- Flexible Wood Supply chain (FP7)
- Multi-scale geospatial analysis of forest ecosystems (UEF strategic funding)
- High Resolution Remote Sensing Potential to Measure Single Trees and Site quality

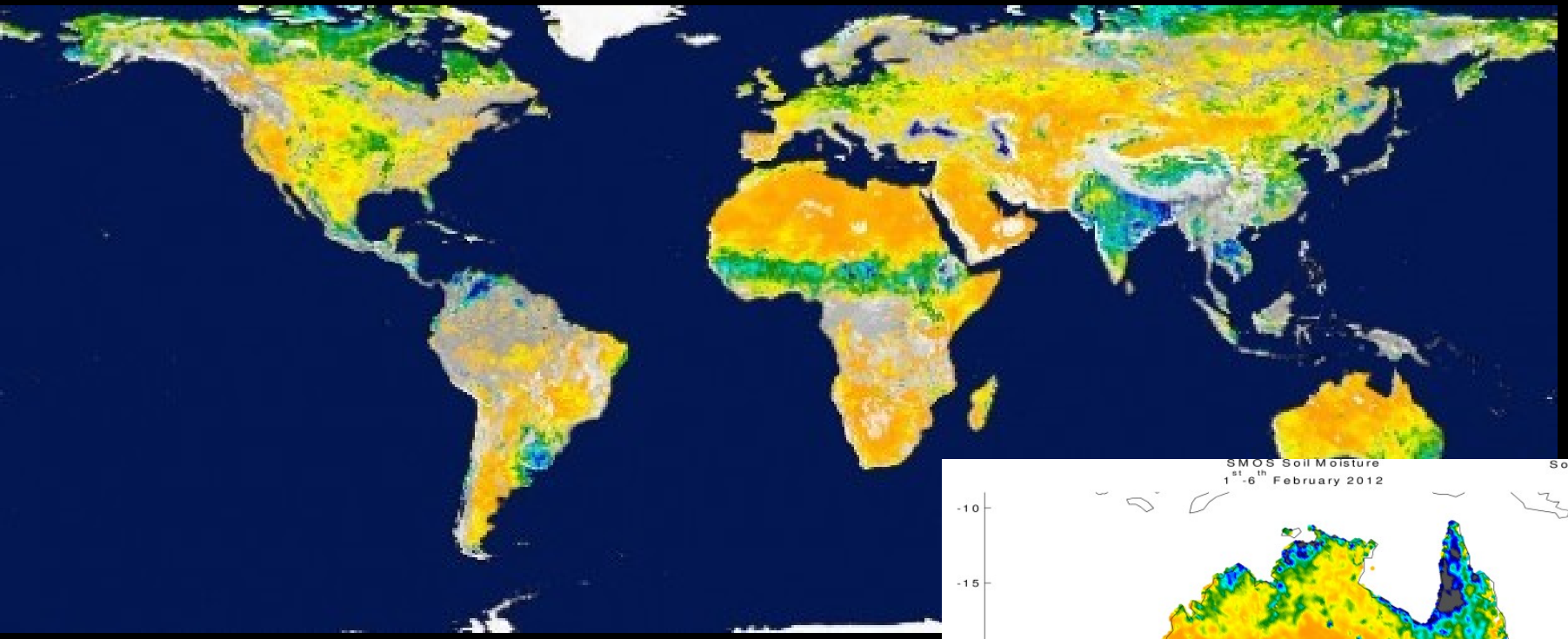
Aalto University

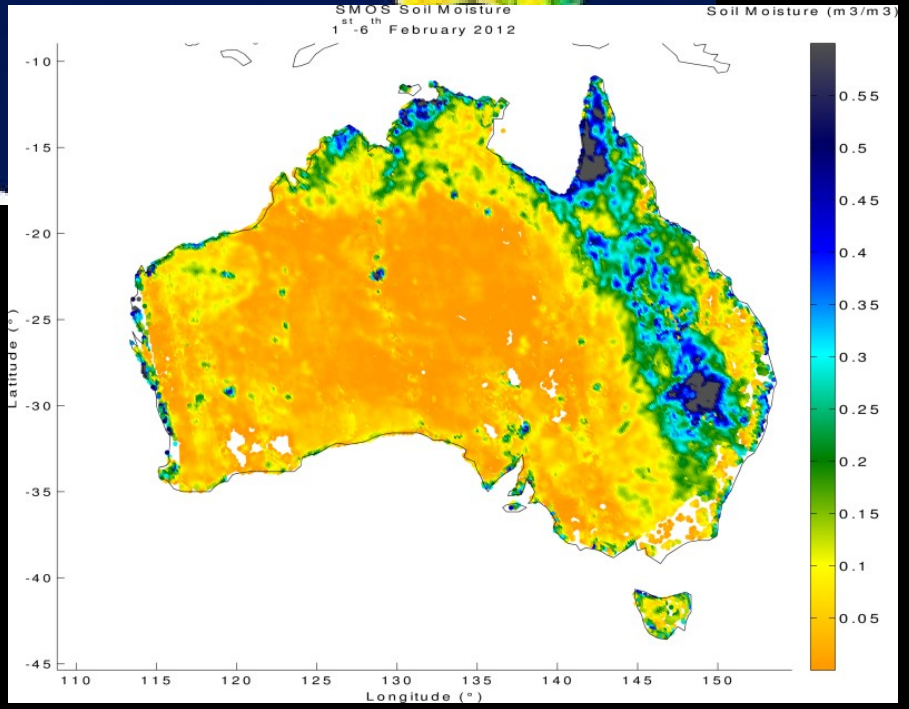
- Department of Surveying (Henrik Haggren)
  - Fotogrammetry
  - GIS
  - Remote Sensing
- Department of Radio Science and Engineering (Martti Hallikainen)
  - Remote Sensing
  - Microwave EO instrumentation
  - Microwave EO methods
  - Research Aircraft

Aalto University
School of Electrical
Engineering

SMOS

Soil Moisture and Ocean Salinity



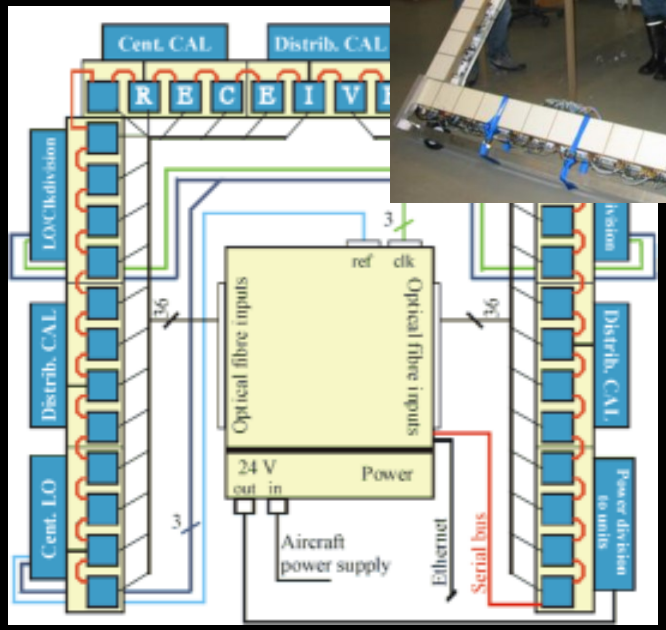


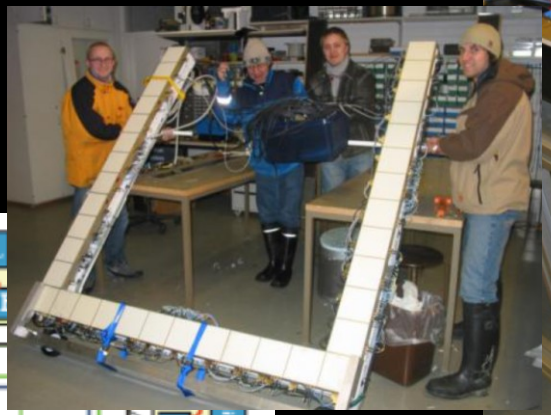
Global Soil Moisture

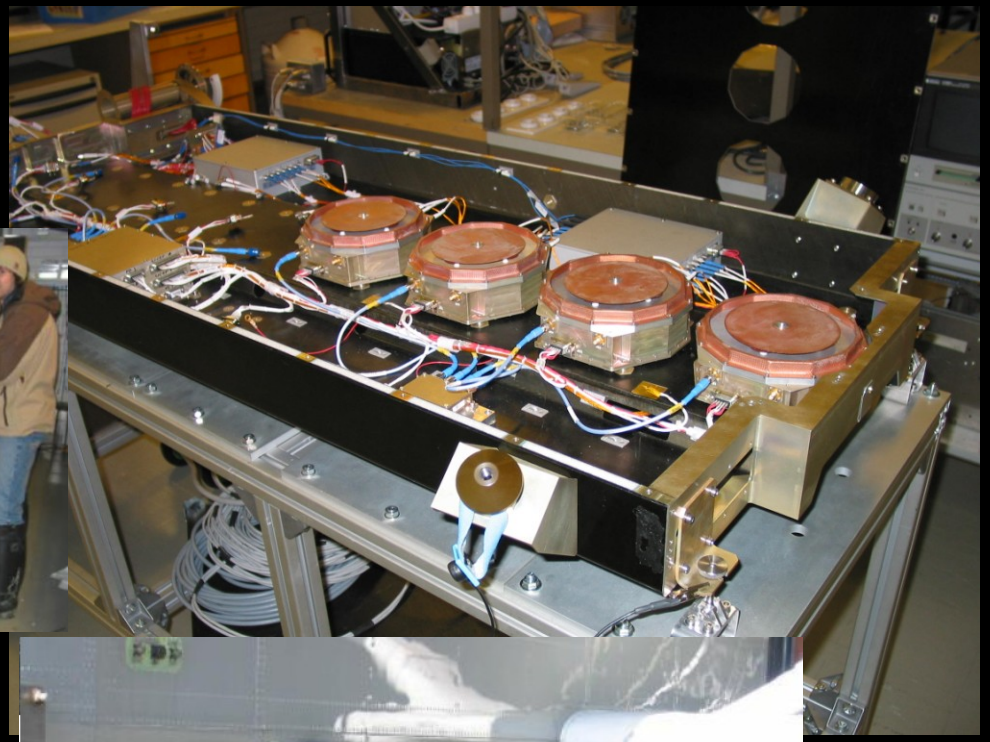
Testing SMOS subsystems

Aalto University

Prototyping







Aalto University

Space Technology Teaching in RAD Aalto

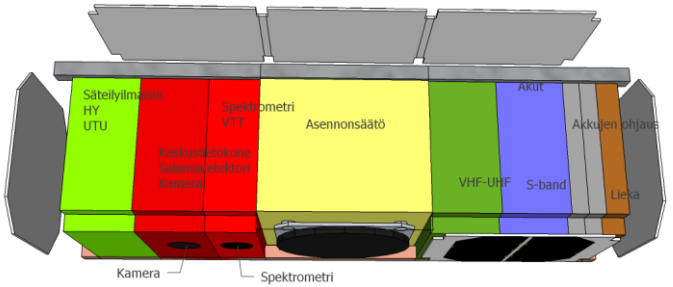
Space Technology as an M.Sc. Main Subject concentrates on remote sensing and space instrumentation

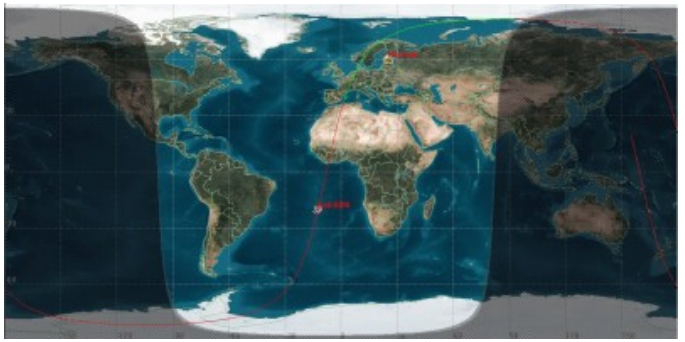
3-4 M.Sc. and 1-2 Ph.D. Graduates per year in Space Technology

Students have participated in instrument development and conducted several satellite feasibility/design studies

The first student satellite project HUTSAT was initiated in 1992, but the satellite was not completed due to lack of funding

Recently we initiated a new student satellite project



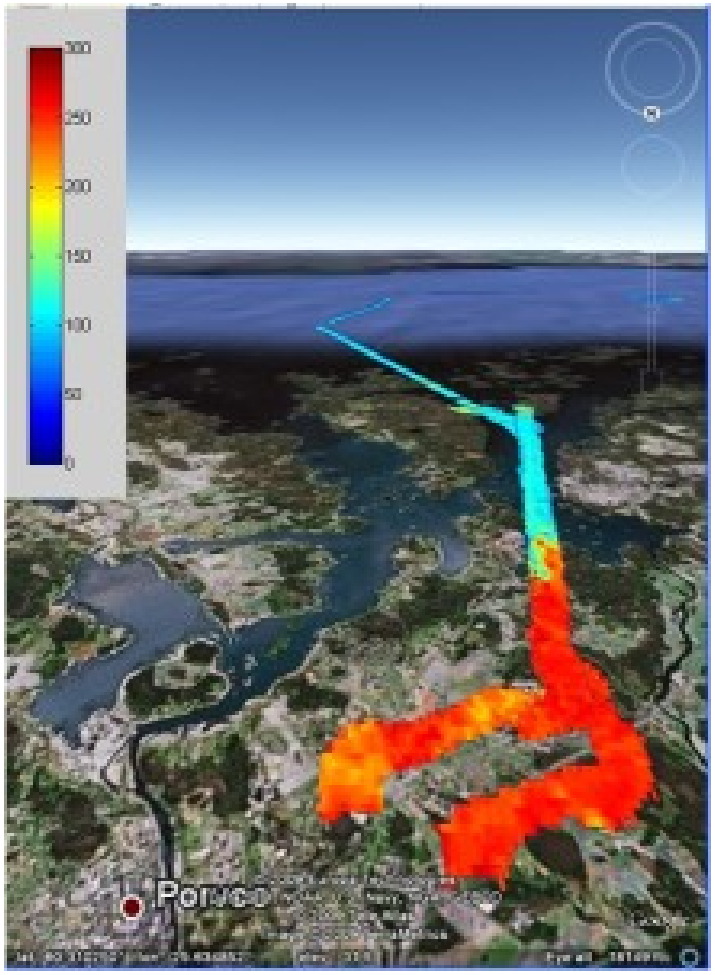


Flying Remote Sensing Laboratory: Skyvan

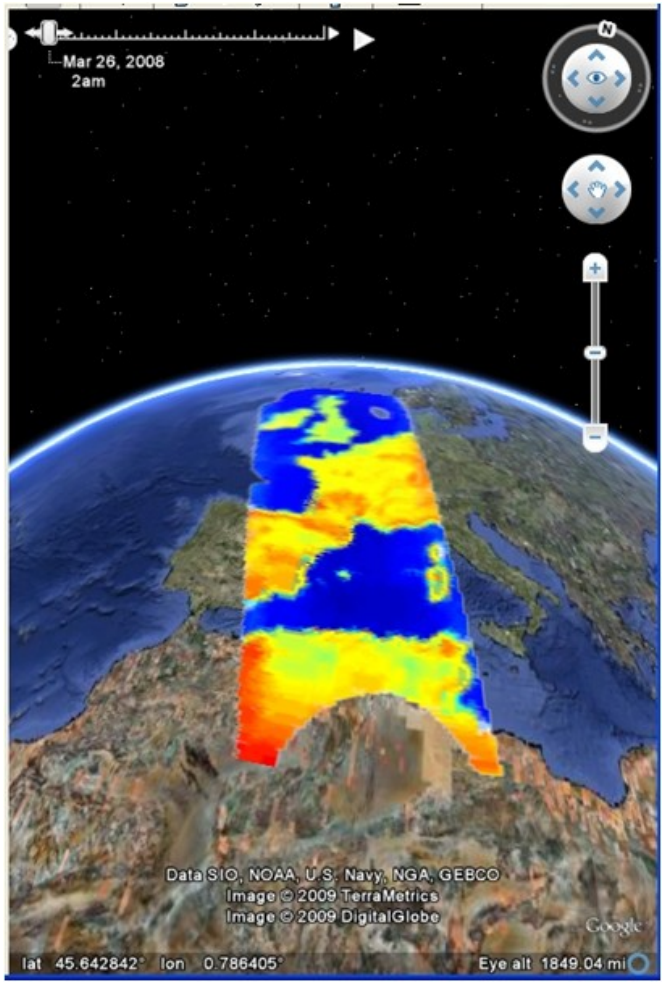
- The only University-owned and operated remote sensing aircraft in Europe
- Most aircraft instruments were built in projects involving graduate and undergraduate students
- Instruments used as satellite sensor demonstrators
- HUT-2D: the world's first airborne interferometric radiometer (1.4 GHz frequency; 36 identical antennas and receivers)
- 6 – 94 GHz microwave radiometer: 14 channels
- 5.3 / 9.8 GHz quad-polarization radar scatterometer
- Imaging spectrometer 400 – 900 nm wavelength
- Infrared, video and conventional cameras
- GPS and attitude data
- Used in numerous national /international campaigns

Research aircraft SkyVan

Our Airborne Data



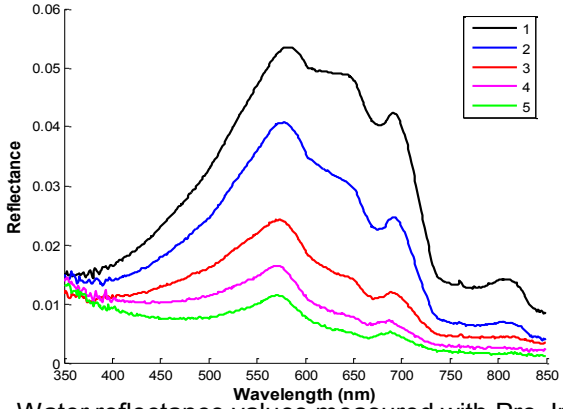
SMOS Satellite Data



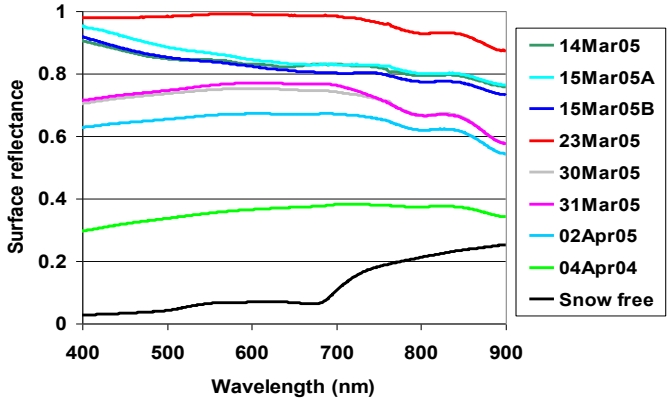
Aalto University

Flood measurements in Lapland

Spectrometer measurements
Applications: snow and water



Water reflectance values measured with Pro Jr on 25 Apr. 2005 near Tvärminne (Gulf of Finland).



Snow reflectance values measured with Pro Jr. during spring 2005.

Aalto University

Turbidity of Gulf of Finland 23.7.2001

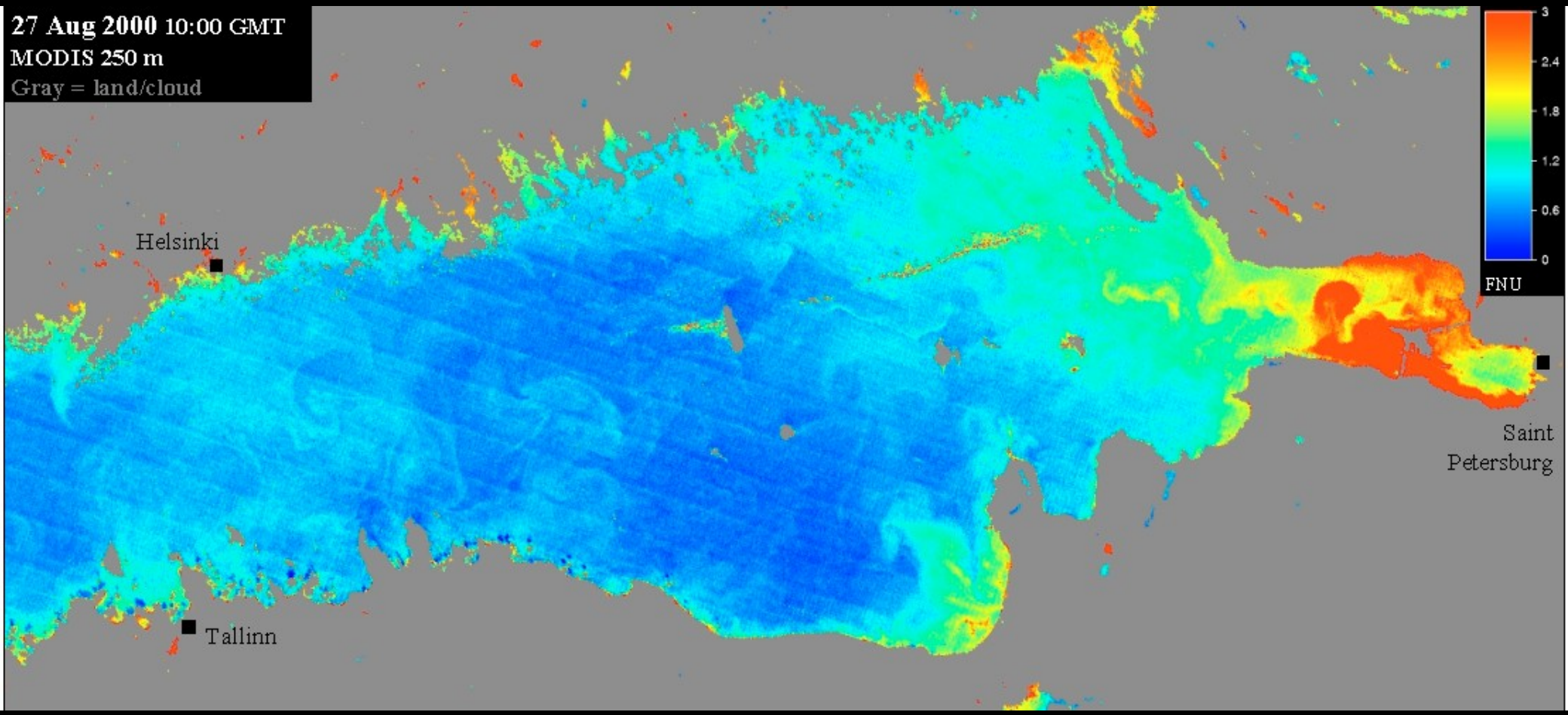


Image by Sampsa Koponen

Ground measurements in Sodankylä

Snow covered area

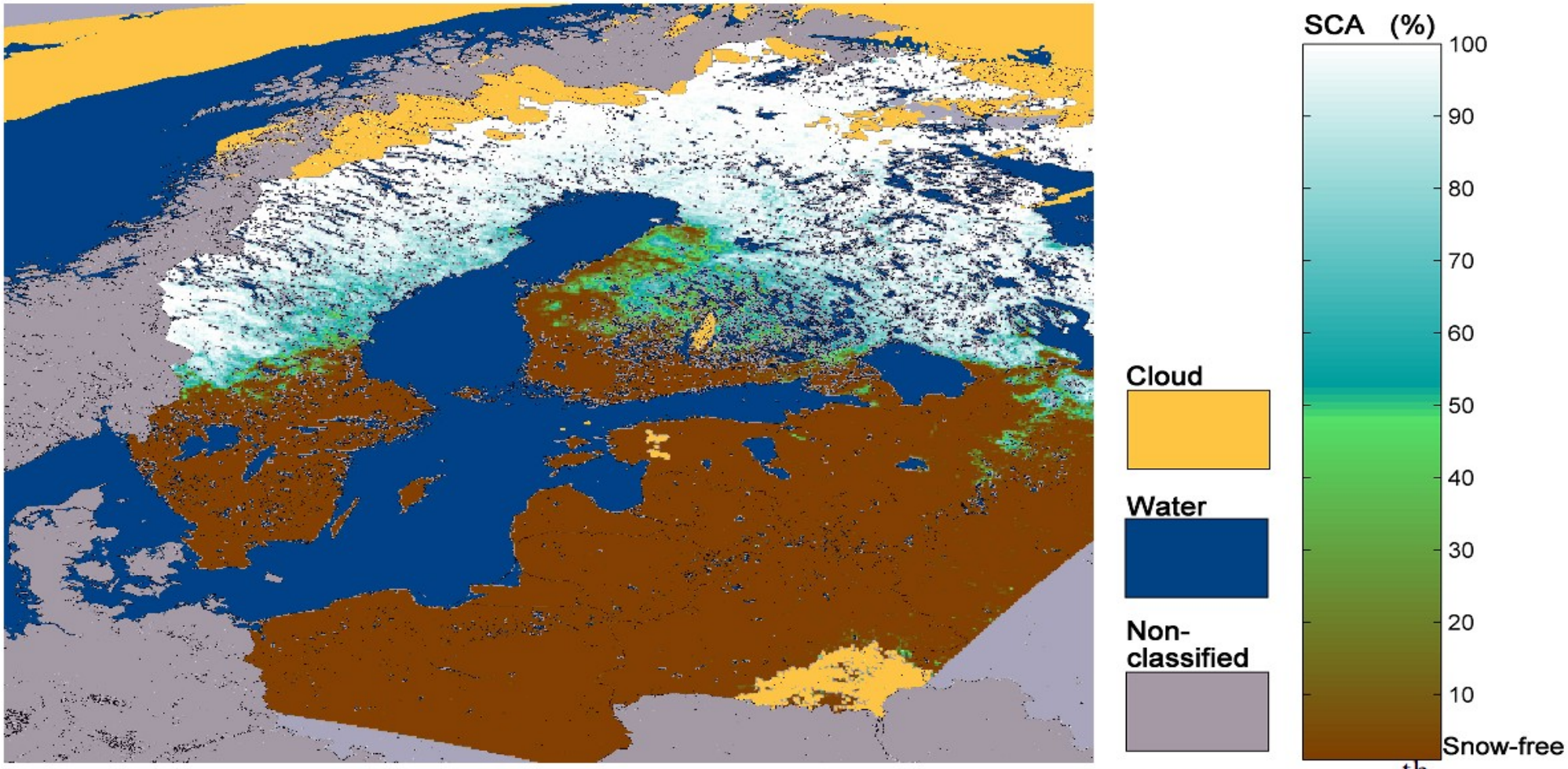


Figure 1. Snow covered area map in the Baltic Sea area on March 27th, 2007.

Snow water equivalent

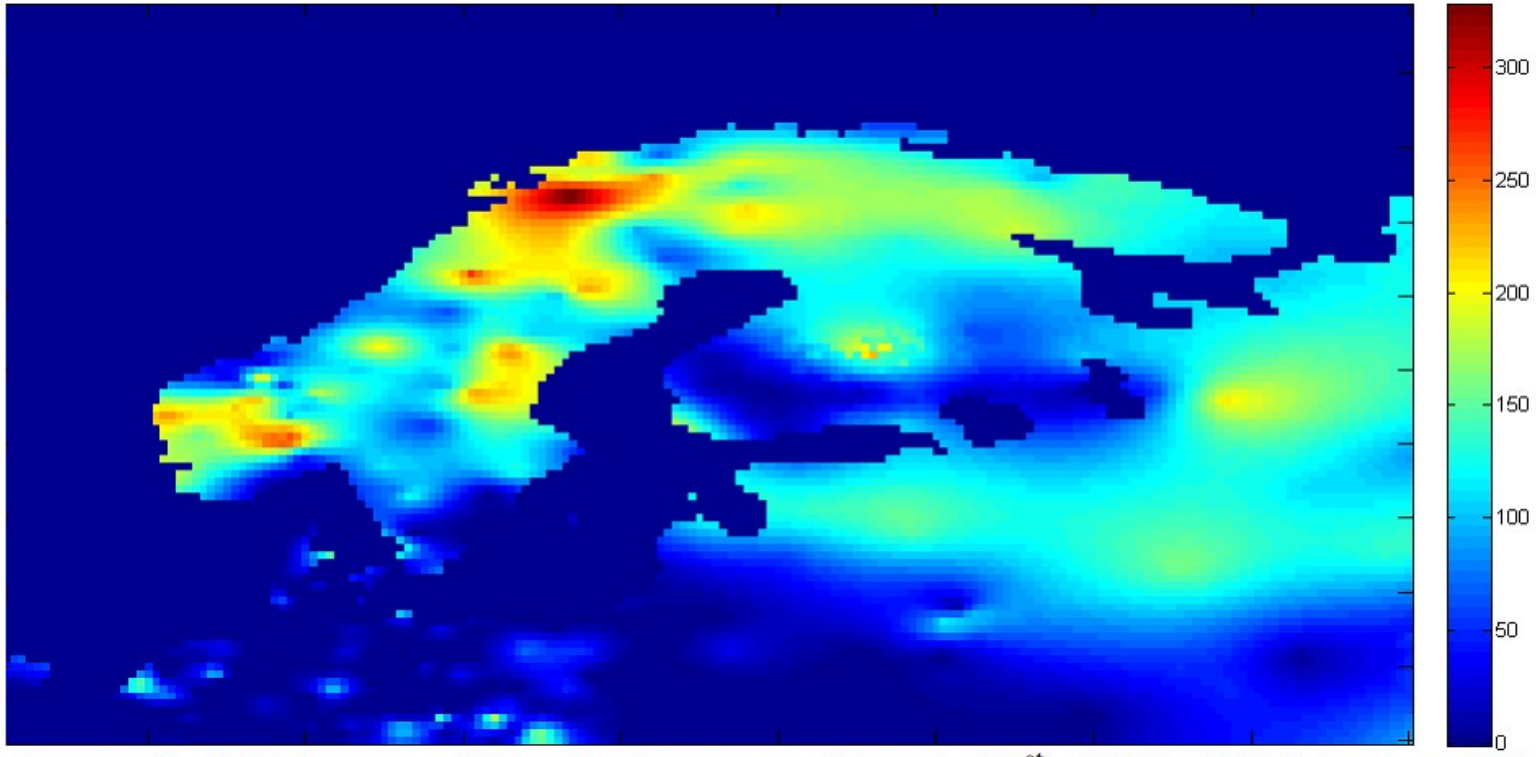
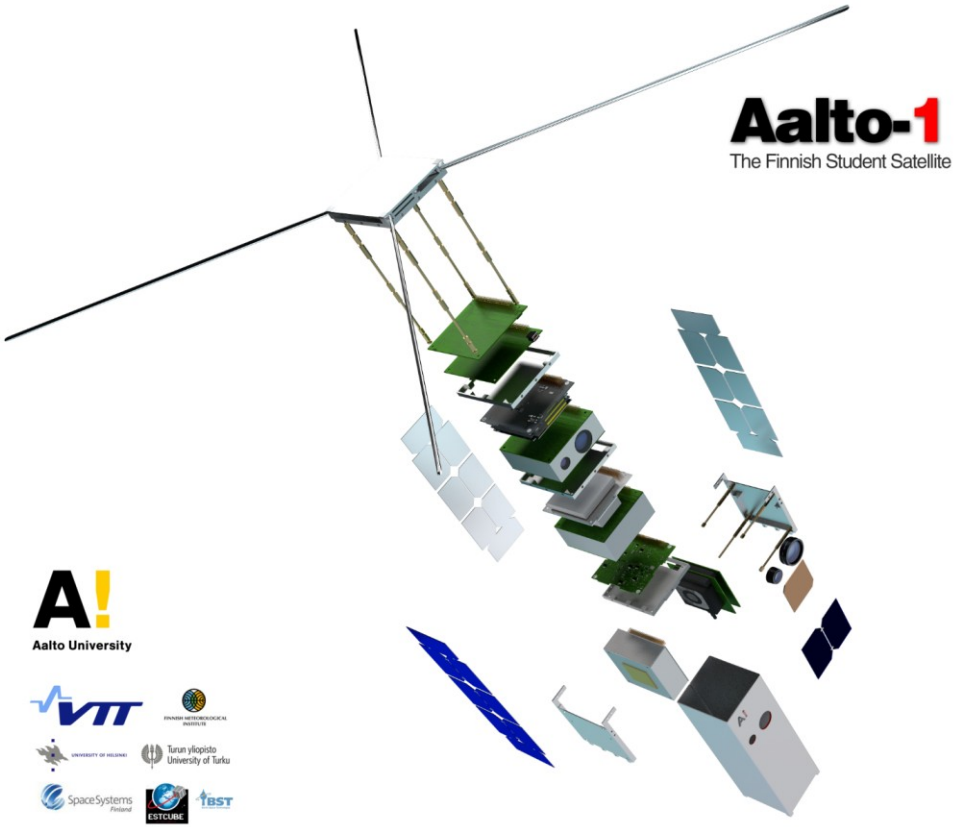


Figure 5. SWE map of Nordkalotten on March 21st, 2007. SWE is in millimeters. The SWE estimate is calculated from AMSR-E radiometer data and synoptic weather station data.

Aalto-1 student satellite project

Based on CubeSat 3U standards
Main payload: imaging spectrometer (VTT)
Weight: 3 kg
Orbit: Sun-synchronous mid-day LEO
Attitude control: 3 axis stabilized
Communication: VHF-UHF housekeeping
S-band data transfer
Solar powered, max power 8 W
Secondary payloads:

- Digital Camera (Aalto, Nokia)
- Radiation detector (HY, UTU)
- Lightning detector (Nokia, Aalto)
- Electrostatic Plasma Brake (FMI)



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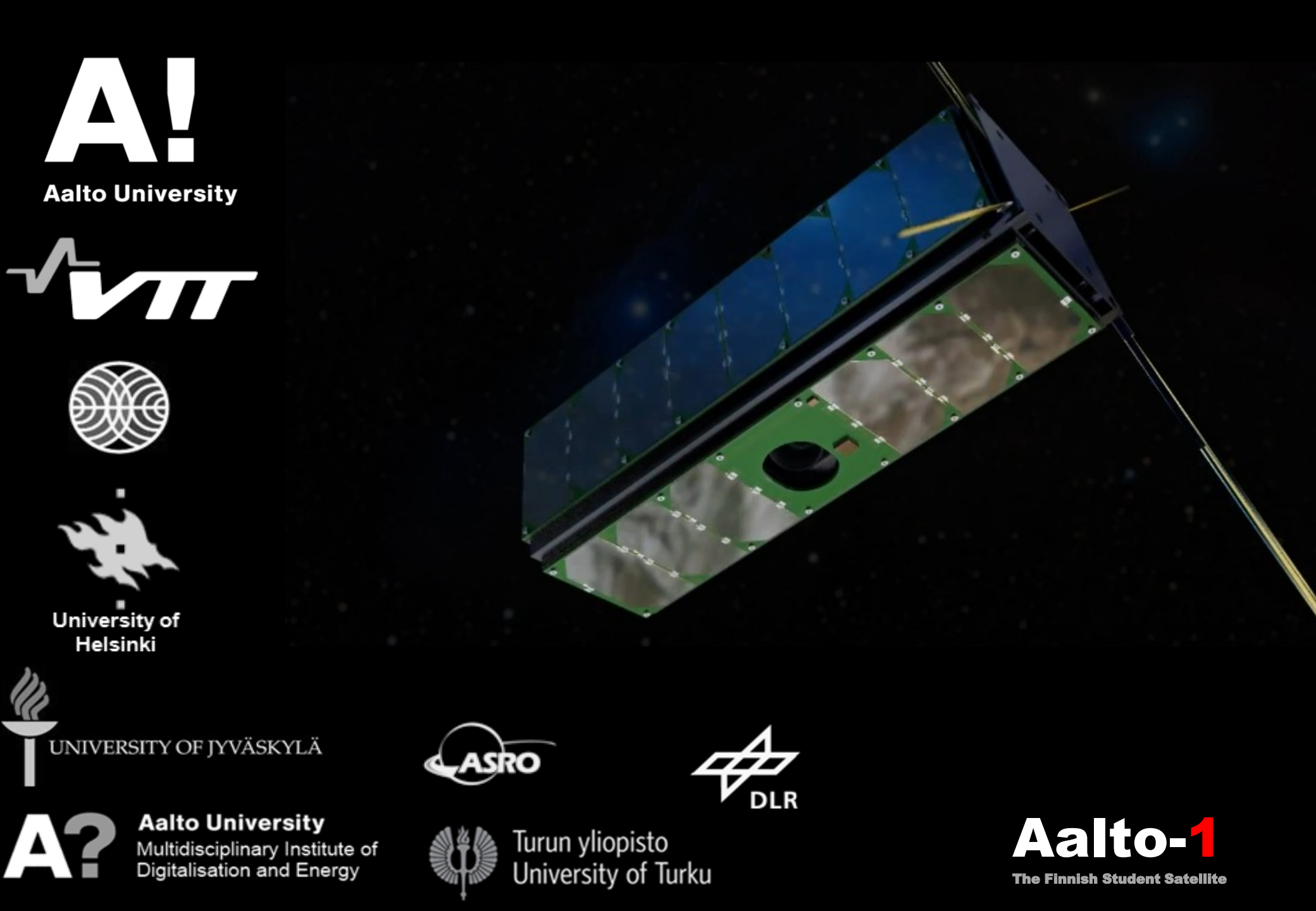
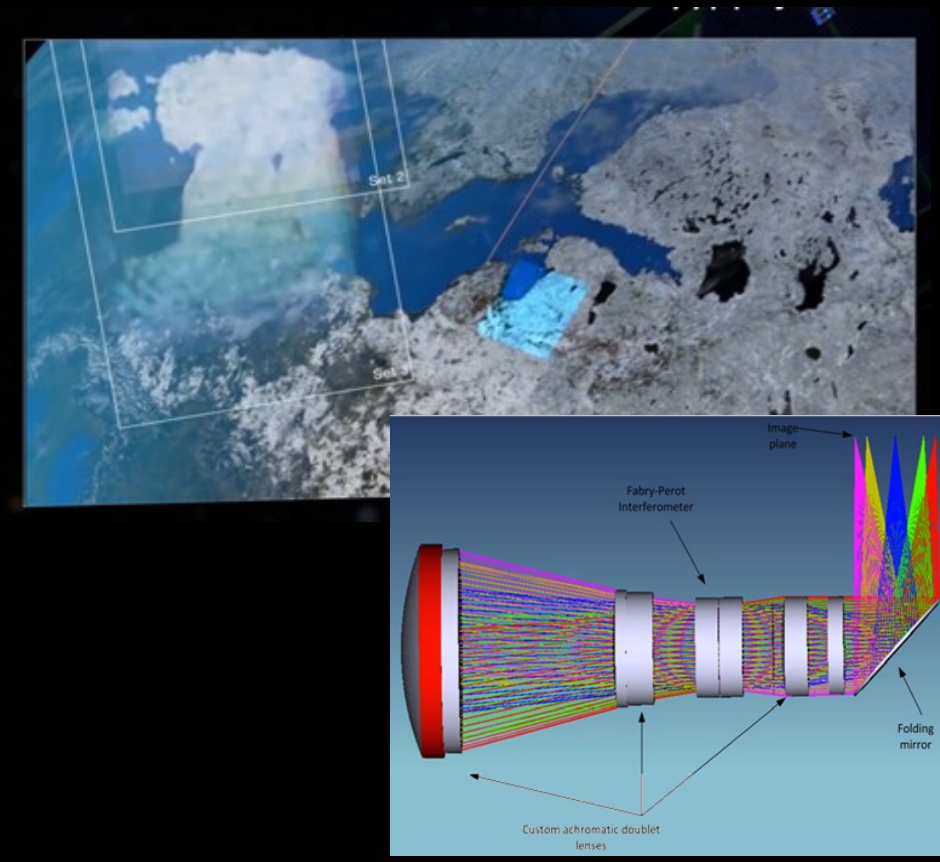

A!
Aalto University
VTT
University of Helsinki
UNIVERSITY OF JYVÄSKYLÄ
ASRO
DLR
A?
Aalto University
Multidisciplinary Institute of Digitalisation and Energy
Turun yliopisto
University of Turku
Aalto-1
The Finnish Student Satellite

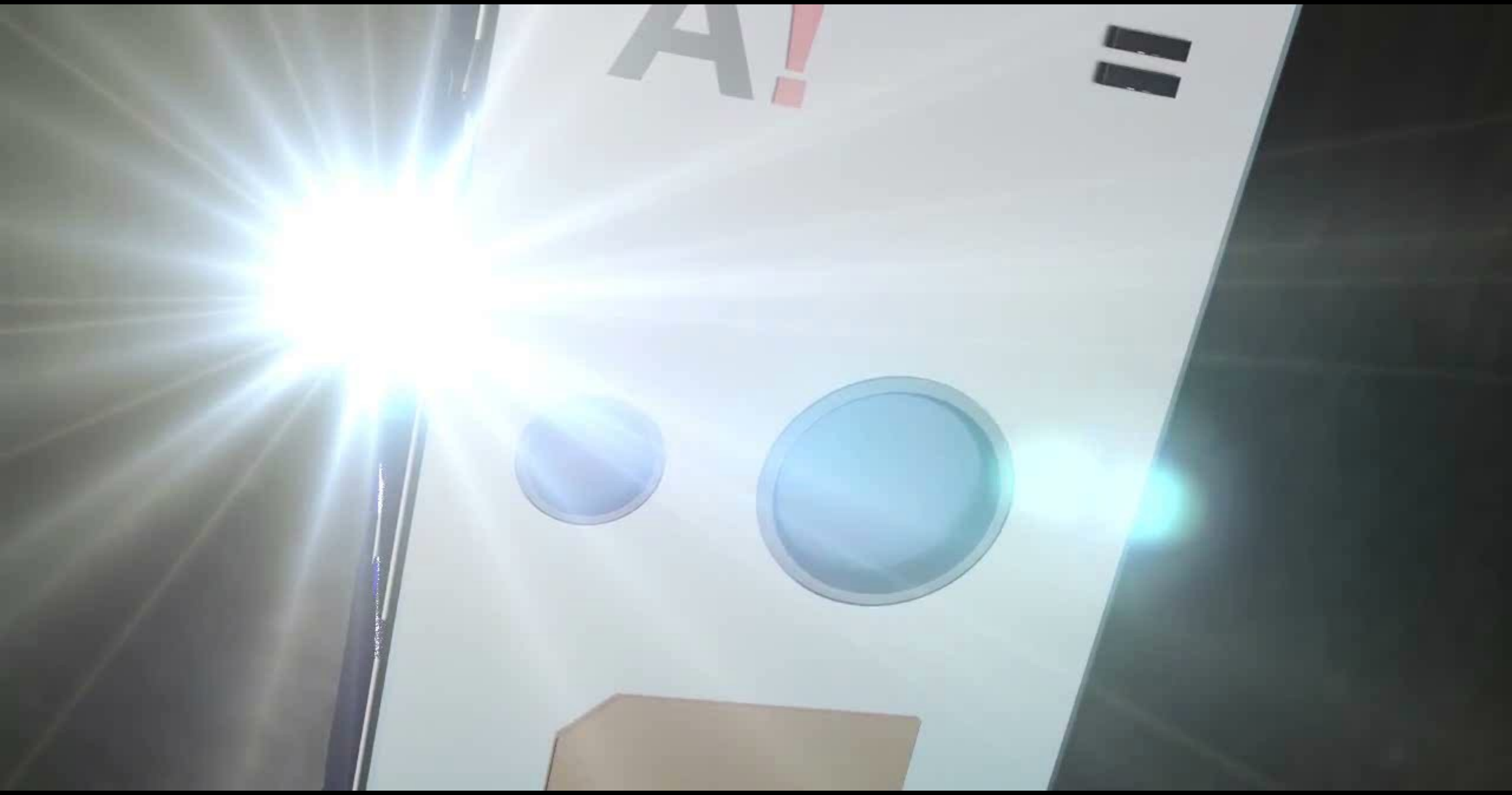
Worlds smallest Imaging space **Spectrometer**

Piezo-actuated Fabry-Perot spectral filter
Sensor: 5 Mpx CMOS
Dimensions: 5x10x10 cm
Mass: ~400 g
Focal lenght: 61 mm
Spectral range: visible
Spectral resolution: 7-10 nm
Field of view: 10 deg
Ground resolution: 250 m
3 channel simultaneous measurement



VTT

Aalto-1
The Finnish Student Satellite



Aalto-1

The Finnish Student Satellite

Thank you

Welcome to Remote Sensing Days next year!