K&C Phase 4 – Status report

Coupling radar-based estimates of forest information with biosphere models for improved carbon flux estimation

Maurizio Santoro & Oliver Cartus
GAMMA Remote Sensing

Science Team meeting #22
Tokyo, Japan, February 16-18, 2016

Collaborators

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Urs Wegmüller

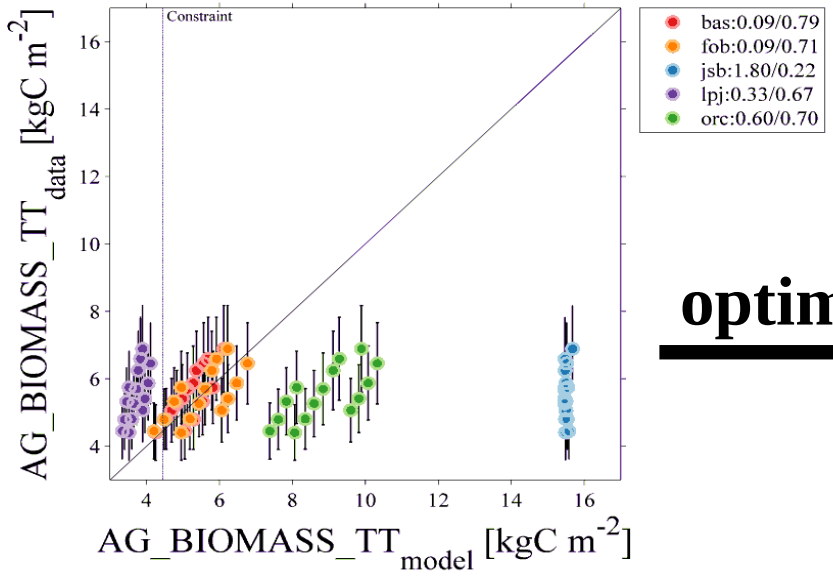
Gamma Remote Sensing AG

Johan Fransson (*)

Swedish University of Agricultural Sciences

(*) PI of another phase 3 KC project, data sharing

Ecosystem models and forest AGB



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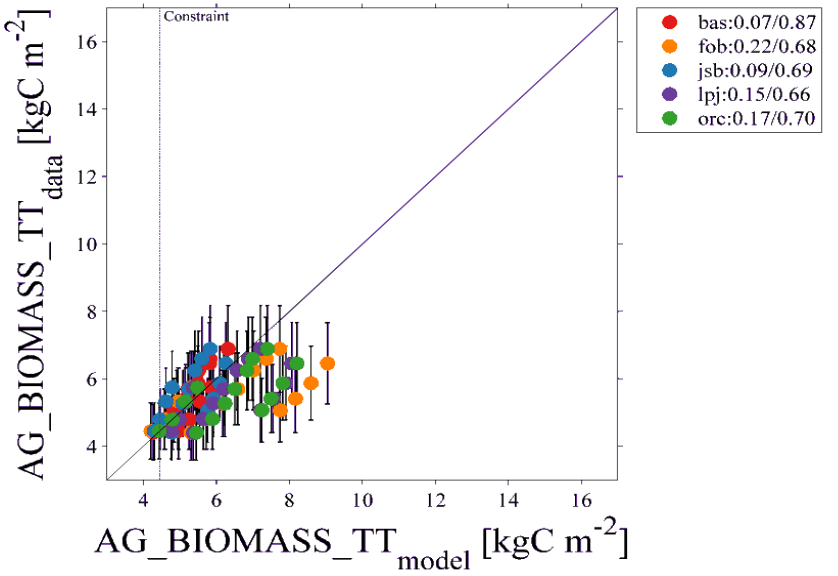

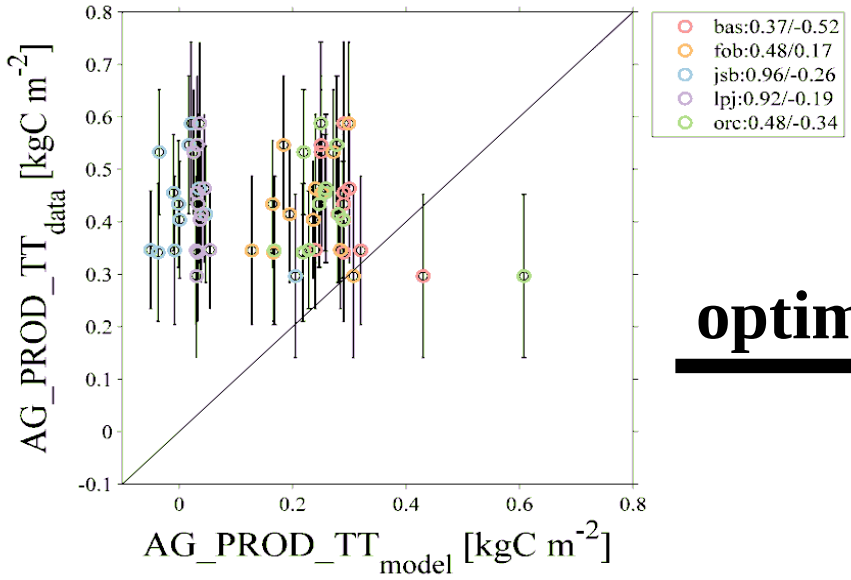

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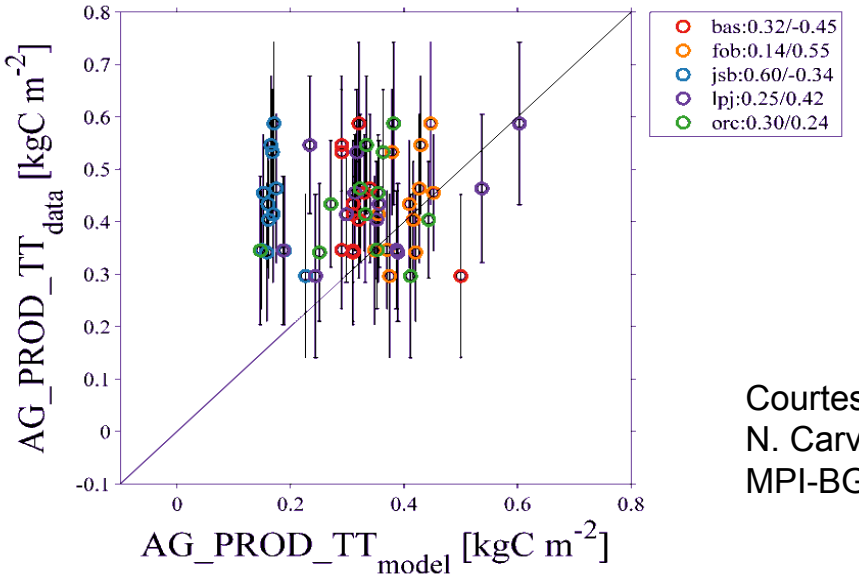
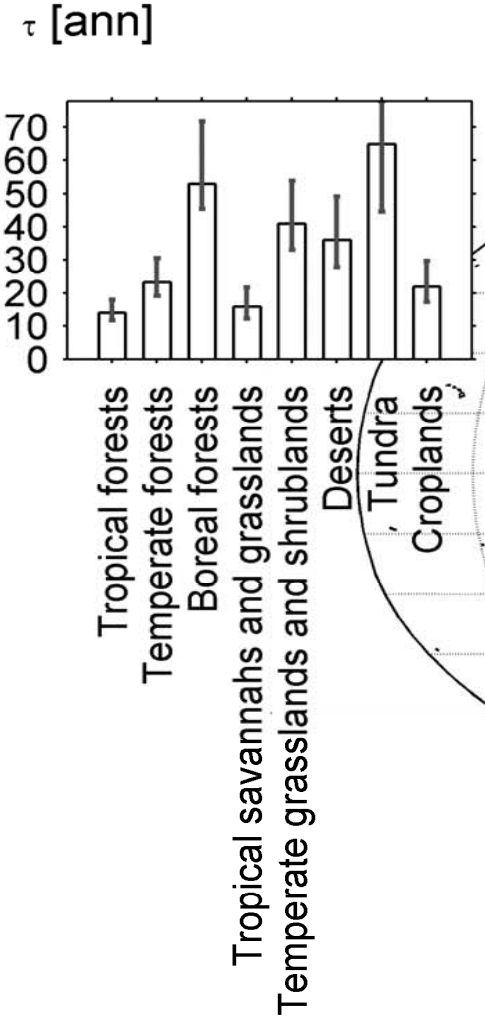
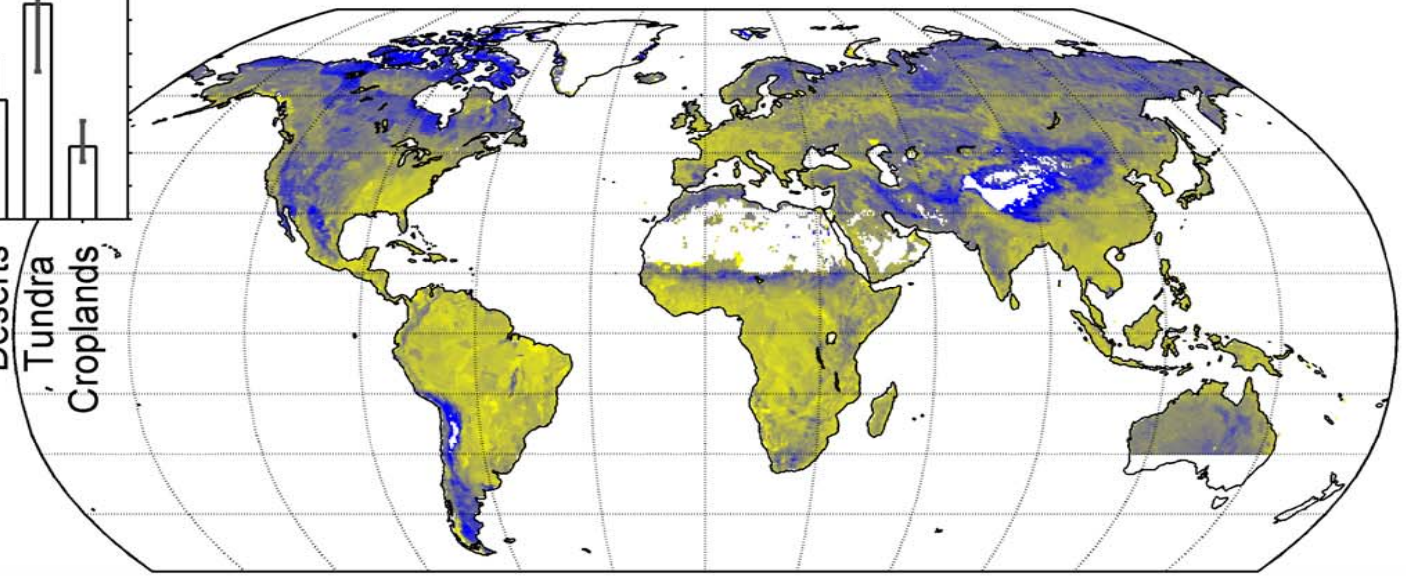


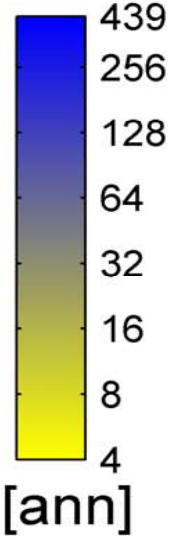
Courtesy
N. Carvalhais,,
MPI-BGC

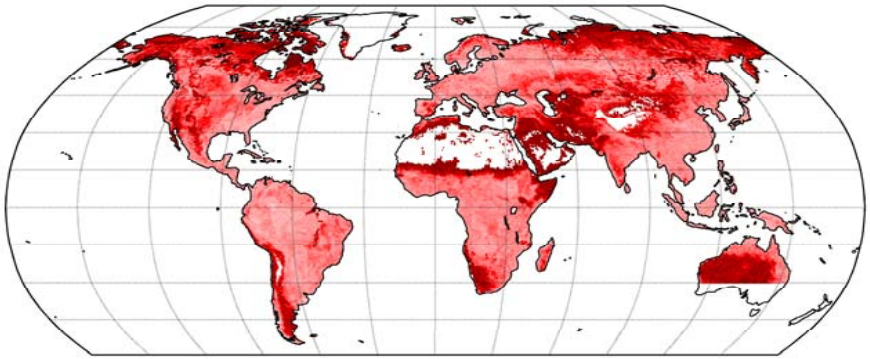
Carbon tunover time, EO data driven

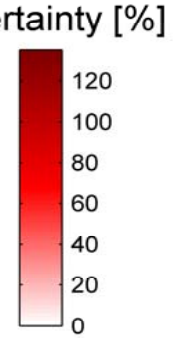
$$\tau = \frac{C_{total}}{GPP} = 23^{+7}_{-4}\, yr$$











Carvalhais et al., Nature, (2014)

Project outline

In the previous phase of the K&C Initiative, regional maps of forest biomass were generated from multi-temporal ALOS PALSAR data with the objective of assessing the usefulness of such estimates for biosphere model parameterization

In this project, we follow on the topic of integration of satellite observations for biomass retrievals into biosphere models to bridge the gap between spatial scales of models (0.1 – 0.5° vs. 25 m).

Project objectives

The objective of this project is twofold

1) Complete the work on the coupling between the PALSAR-derived **biomass** estimates at local scale and the **carbon** fluxes to fully assess the contribution of the former to quantification of **fluxes**.

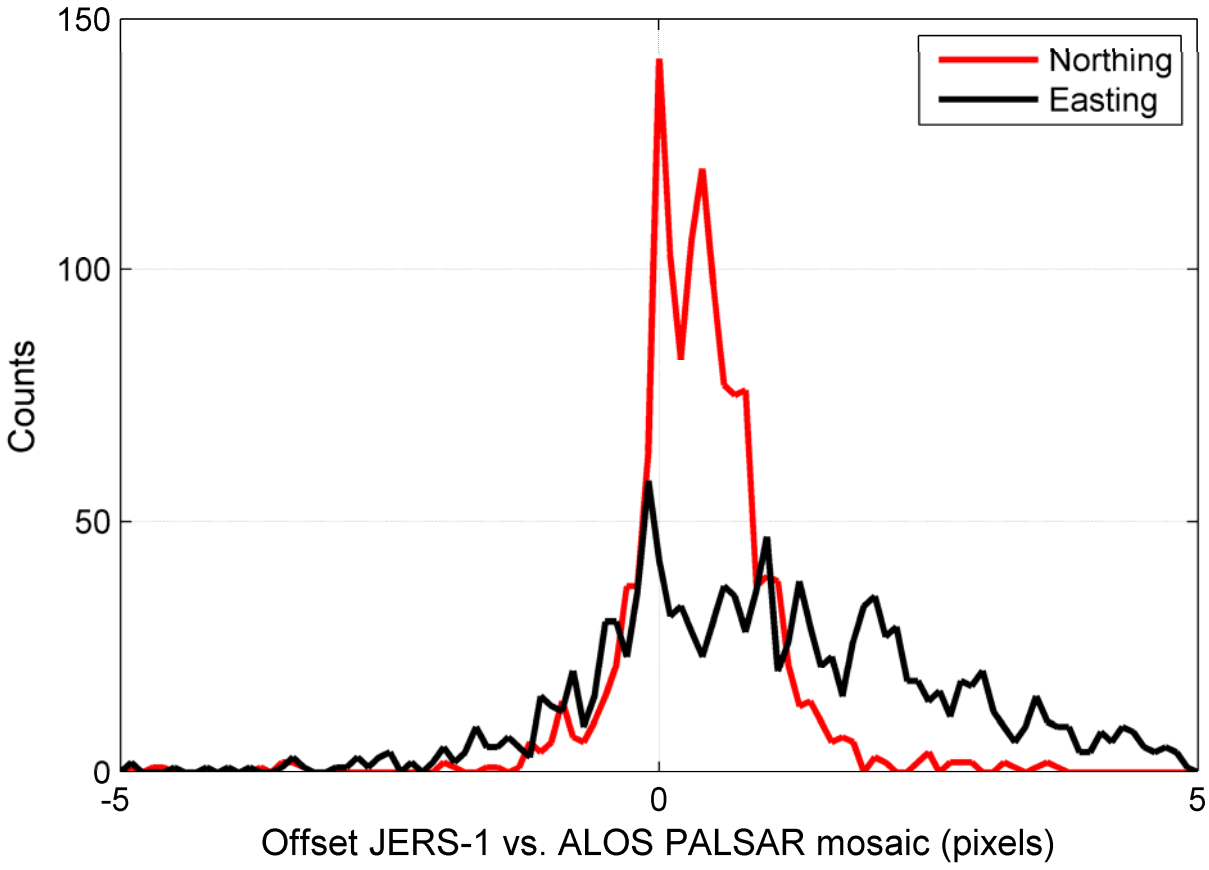
2) Apply the biomass mapping algorithm developed in Phase 3 to PALSAR-2, PALSAR-1 as well as JERS-1 over Europe to derive high-resolution **time series of biomass** estimates (1992-1998; 2007-2010; 2014-onwards). These data will be then used to investigate the spatial patterns of forest biomass and the contribution to modelling ecosystem **carbon cycle** and **fluxes**, including spatial scales effects.

L-band JAXA mosaics – pre-processing

- JERS: single multi-year dataset (epoch 1996), HH-pol
- ALOS-1 PALSAR-1: 4 yearly datasets (2007-2010), HH- and HV-pol.
- ALOS-2 PALSAR-2: 1 yearly dataset (2015) so far, HH- and HV-pol.

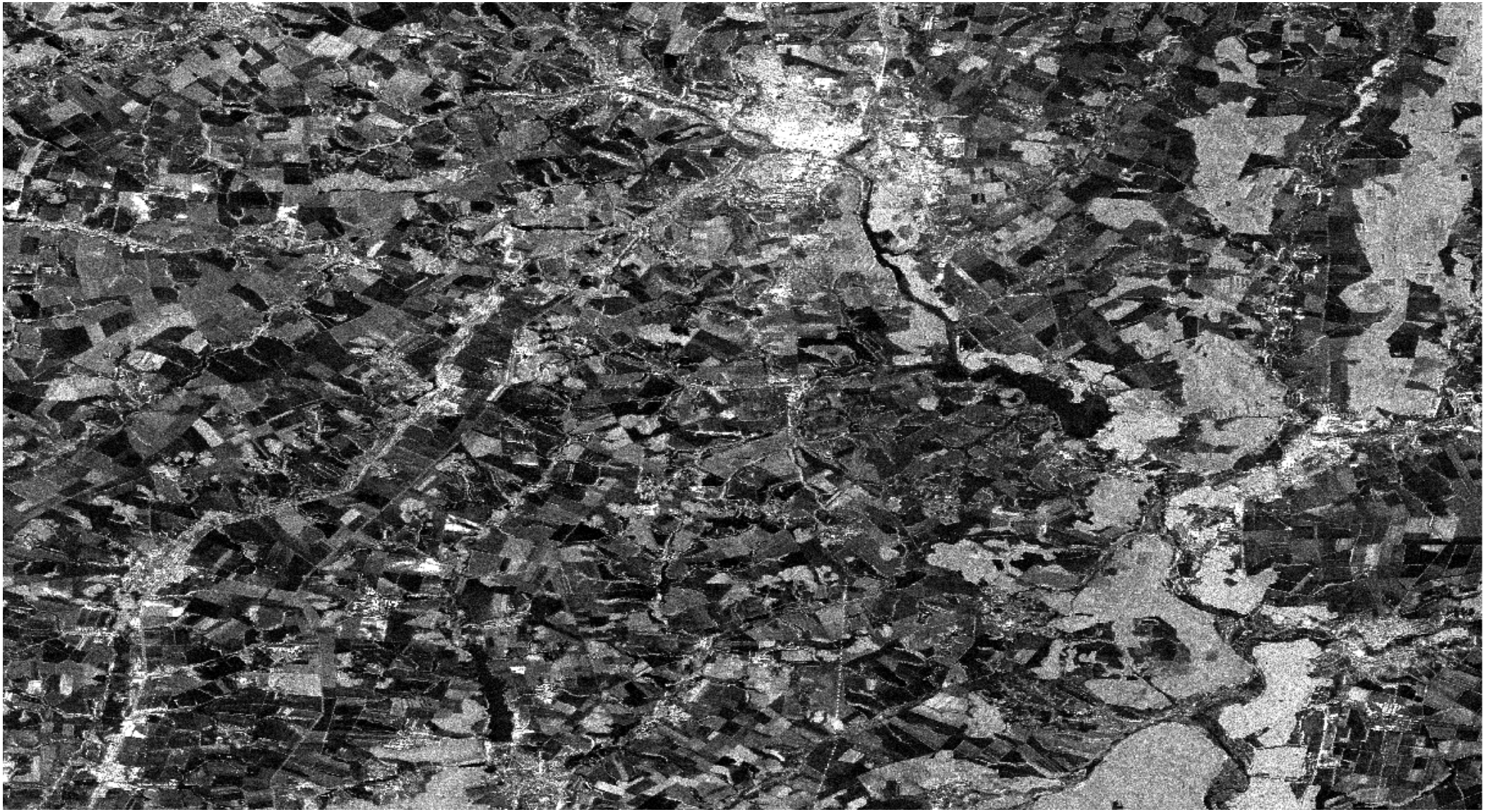
- ALOS PALSAR and JERS-1 data available in form of 1x1 deg tiles of SAR backscattered intensities (pixel size: 25 m)
- JERS and ALOS PALSAR do not match perfectly → need to co-register JERS-1 to ALOS-1
- Reduction of speckle filter implemented with a multi-channel filter (combining all data channels)

JERS-PALSAR co-registration statistics

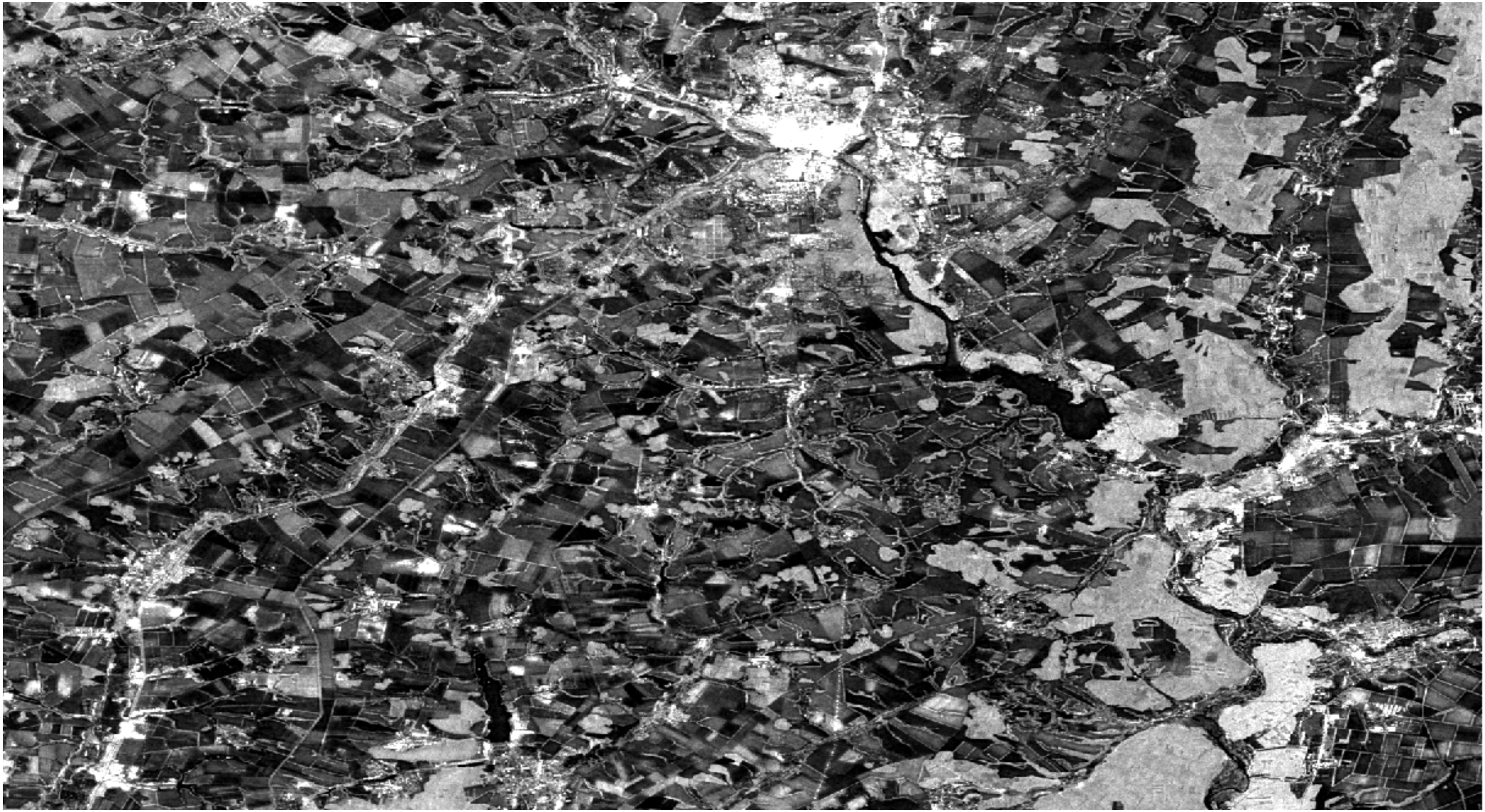


- Significant offsets between mosaic data primarily in longitude

JERS-1, HH-pol., original (N51 E036)



JERS-1, HH-pol., co-registered and multi-channel filtered (N51 E036)



ALOS

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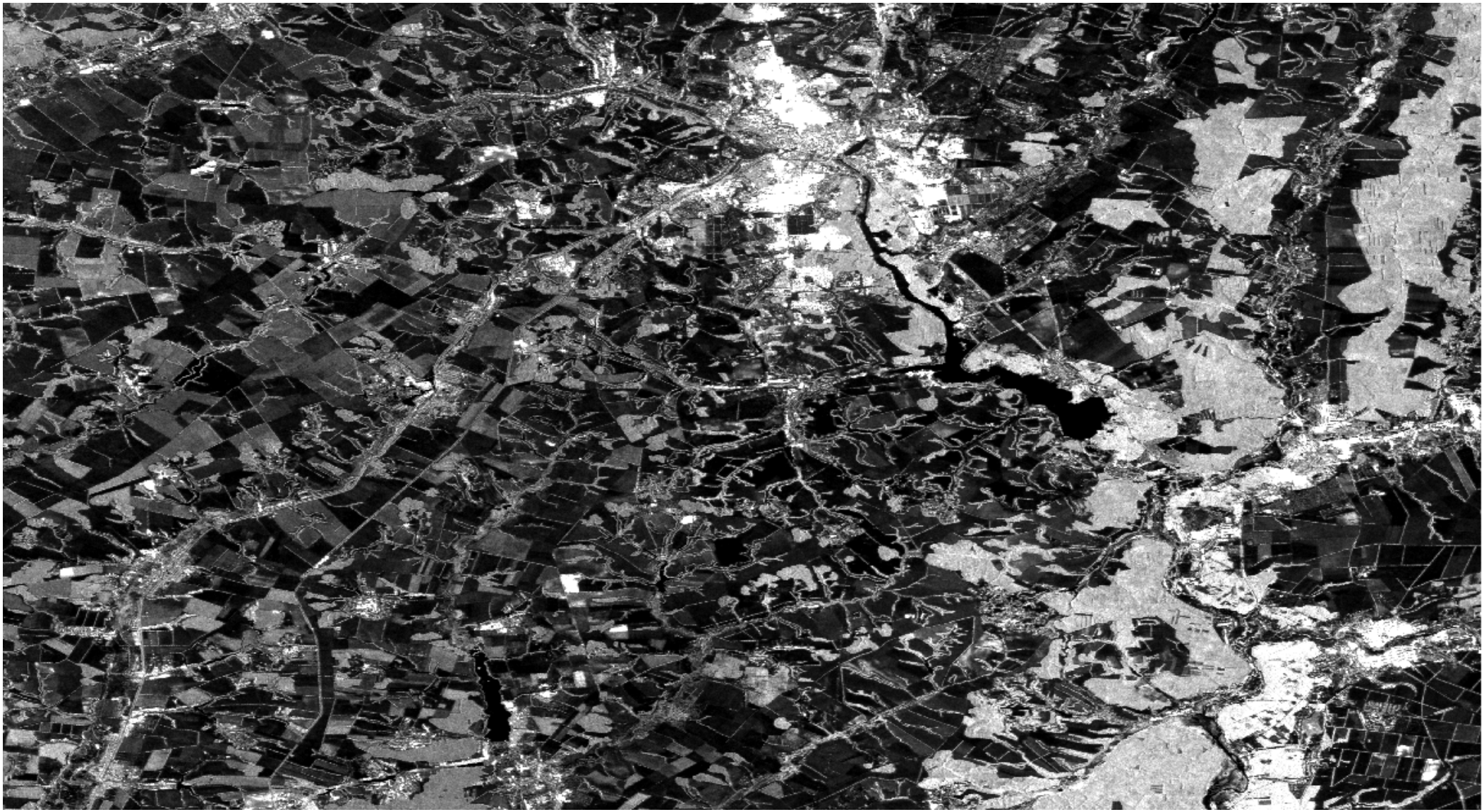
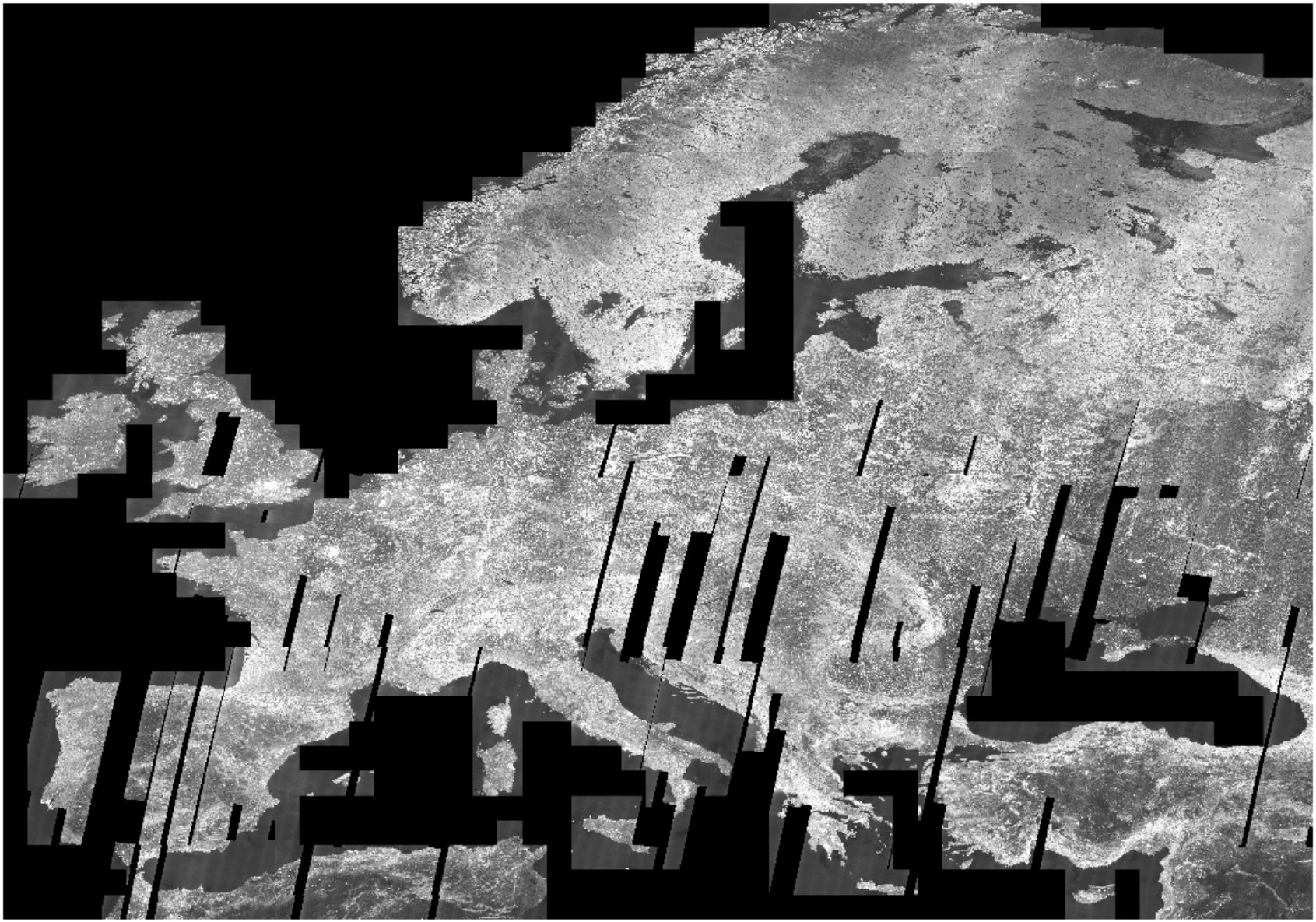
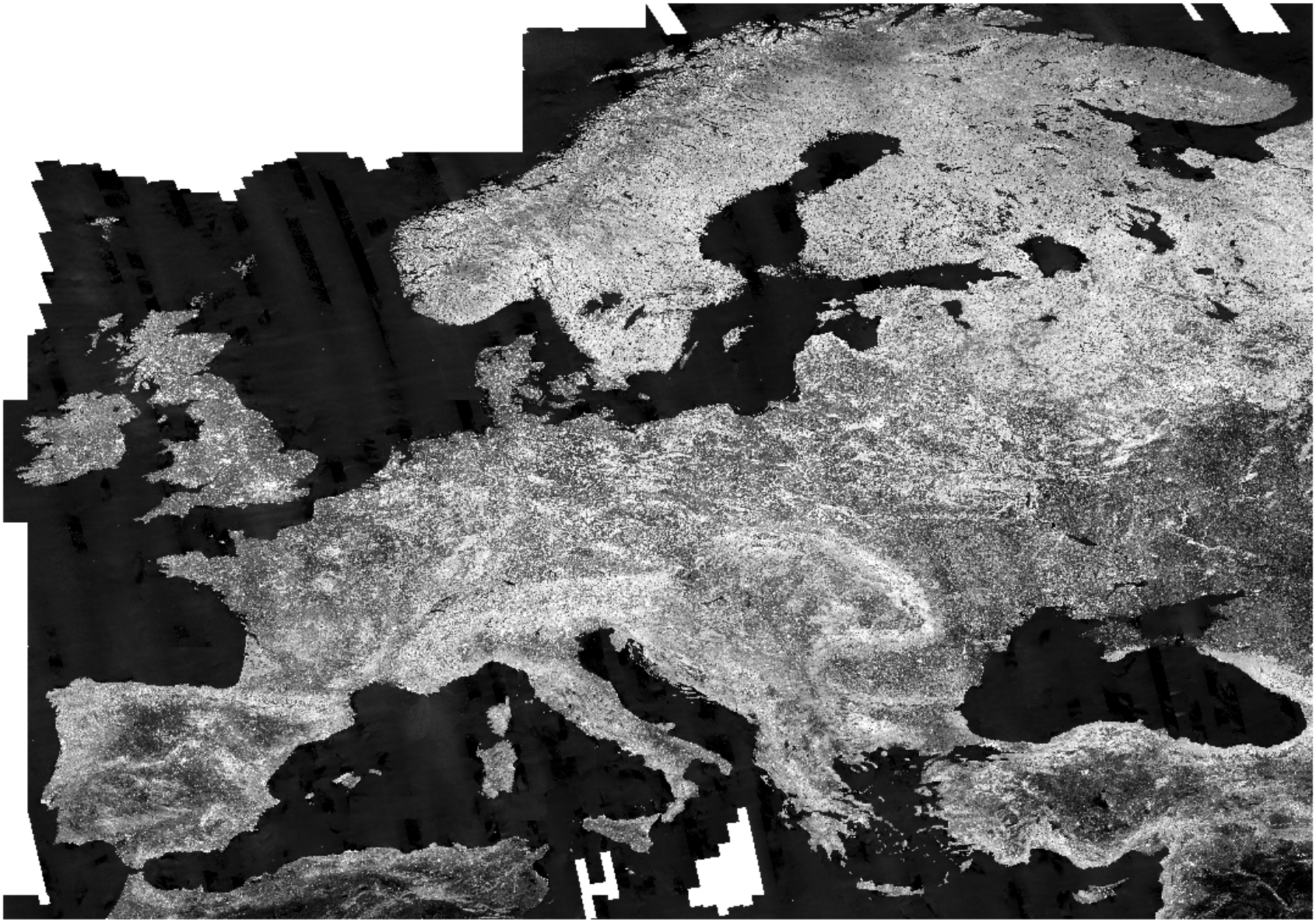
ALOS-1 PALSAR-1, HH-pol, multi-channel filtered (N51 E036)



JERS-1 mosaic (co-registered to PALSAR-1, HH-pol., 1996 epoch



ALOS-1 PALSAR-1 mosaic, HH-pol., 2010



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DUE GlobBiomass

Objective:

Provide the user communities with a better characteristic

of the distribution and changes, and an improved quantification of regional and global biomass

User Consultation in Jena, October 2012:

User Requirements from:

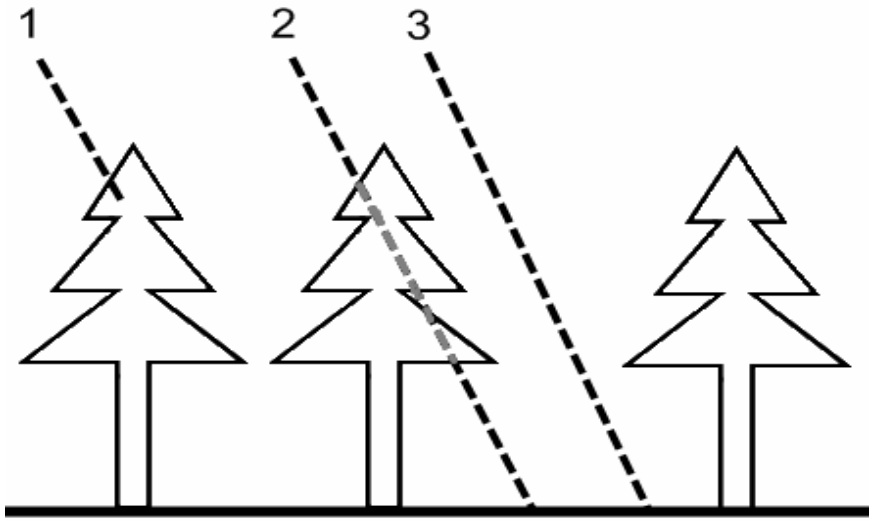
- **Science: Carbon Cycle Science Community**
- **Policy: National Forest Inventory and REDD**
- **Forest Industry: timber production and certification**

GLOBBIOMASS

Project Activities:

1. **Improve above ground biomass maps (stock and changes)**
   - **Better geometric resolution**
   - **Improved accuracy**
   - **Validation (discrepancy map and error statistics)**
2. **Platform for data sharing and validation**
3. **Better stratification of landscape (forest types/species)**
4. **Standardization of maps**

Retrieval method – BIOMASAR-L



1) volume scattering from canopies

2) surface scattering attenuated by canopies

3) scattering from forest floor though canopy gaps

Water Cloud with gaps:

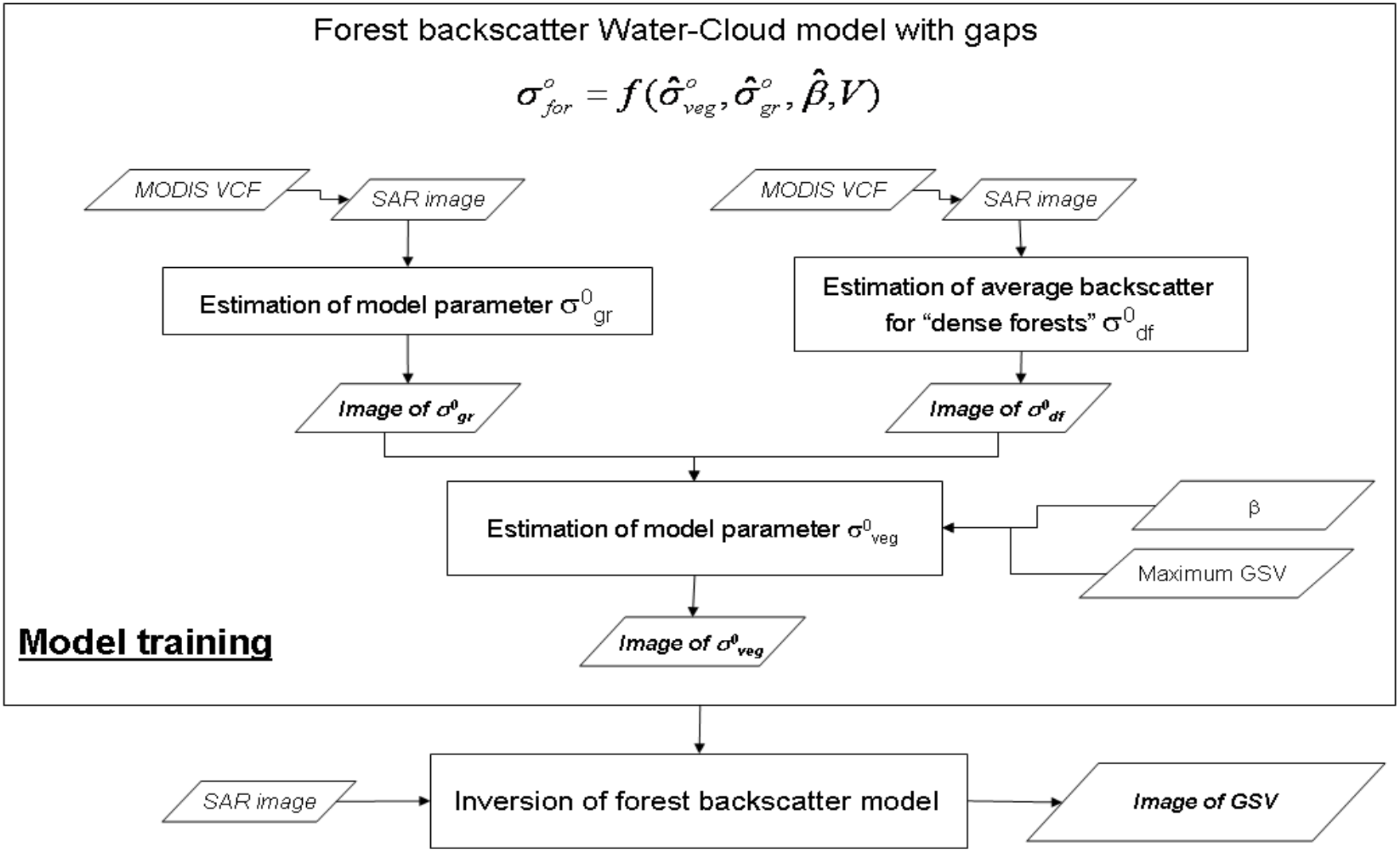
$$\sigma^0_{for} = \sigma^0_{gr} T_{for} + \sigma^0_{veg} (1 - T_{for})$$

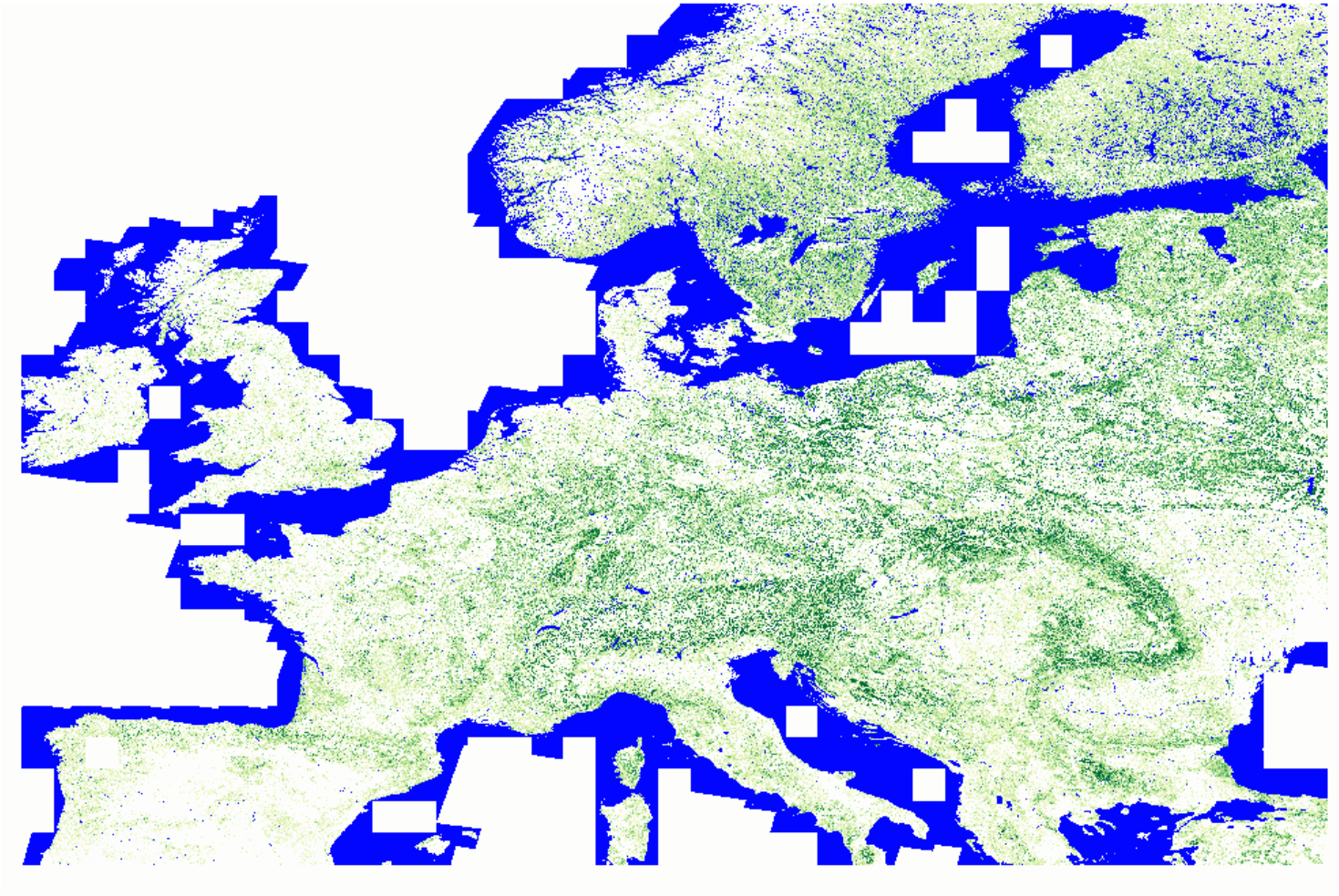
Transmissivity as function of canopy density, η, and height, h, linked to GSV:

$$T_{for} = (1 - \eta) + \eta e^{-\frac{2\kappa_e h}{\cos\theta}} = \exp(-\beta V)$$

β – transmissivity coefficient
κ – extinction coefficient

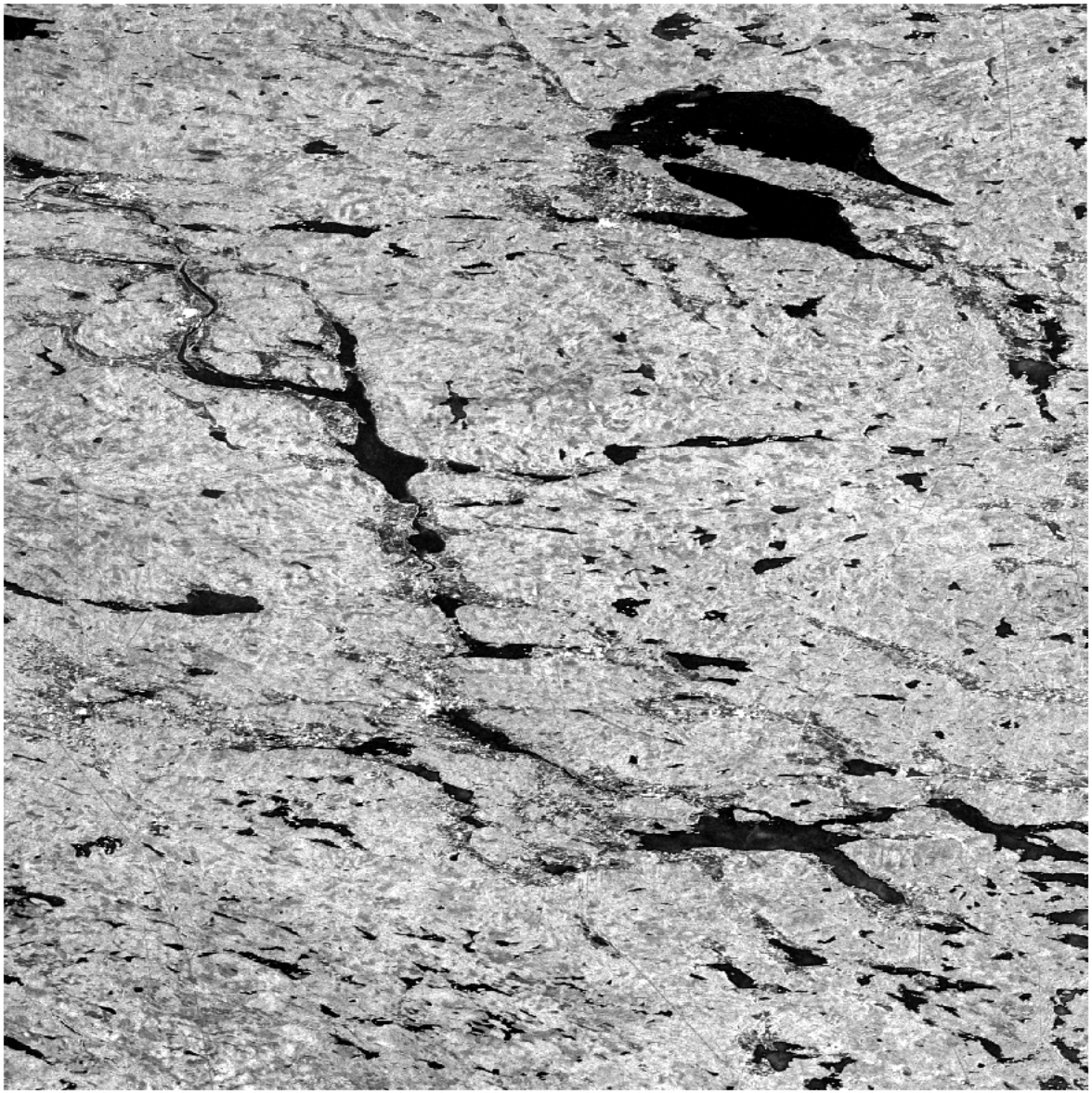
Retrieval method – BIOMASAR-L



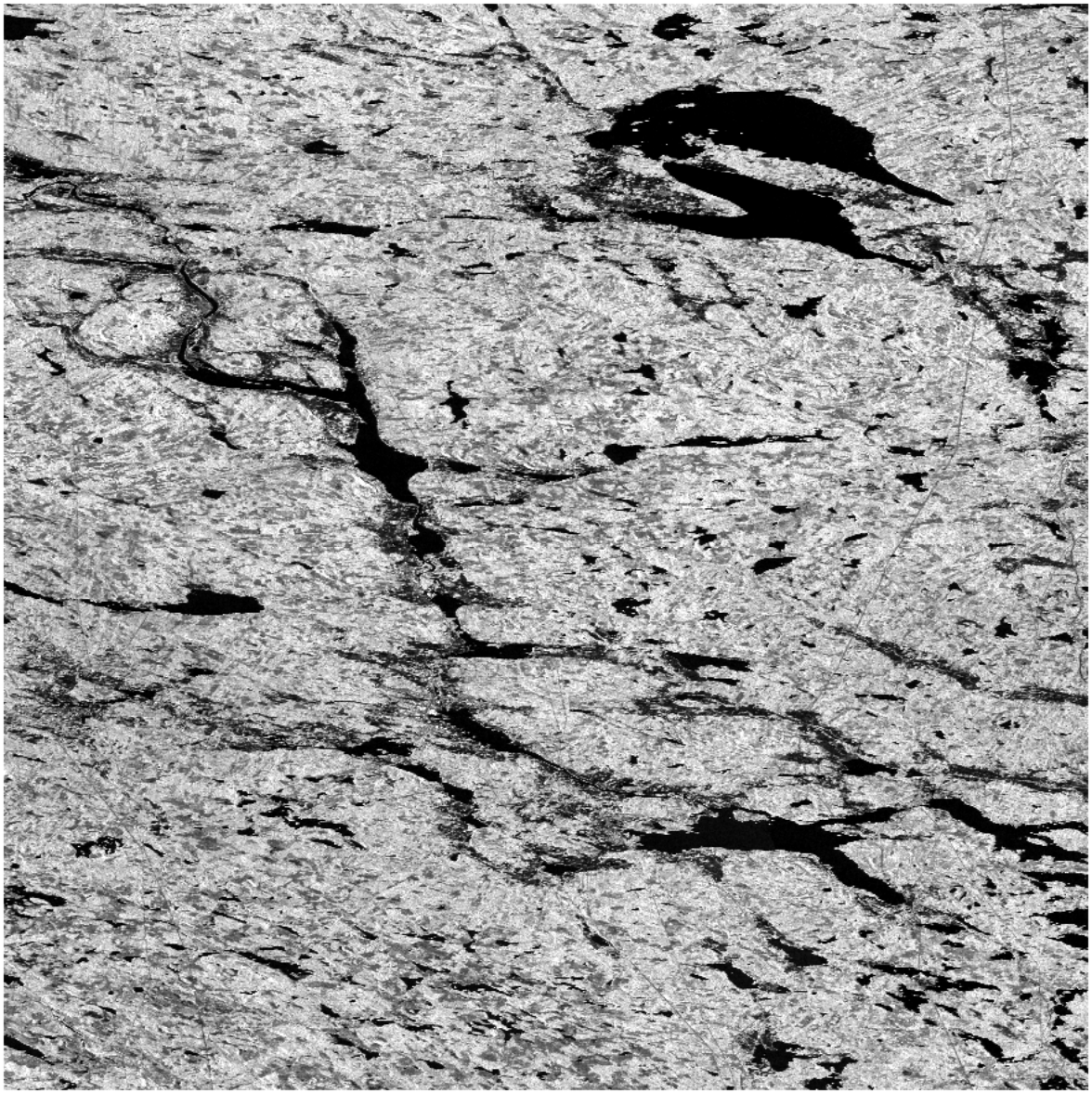


- GSV (m3/ha) estimates from ALOS PALSAR 2010 HV-pol mosaic (preliminary!)
- Approach: BIOMASAR-L (K&C Phase 3 + ESA Globbiomass project)

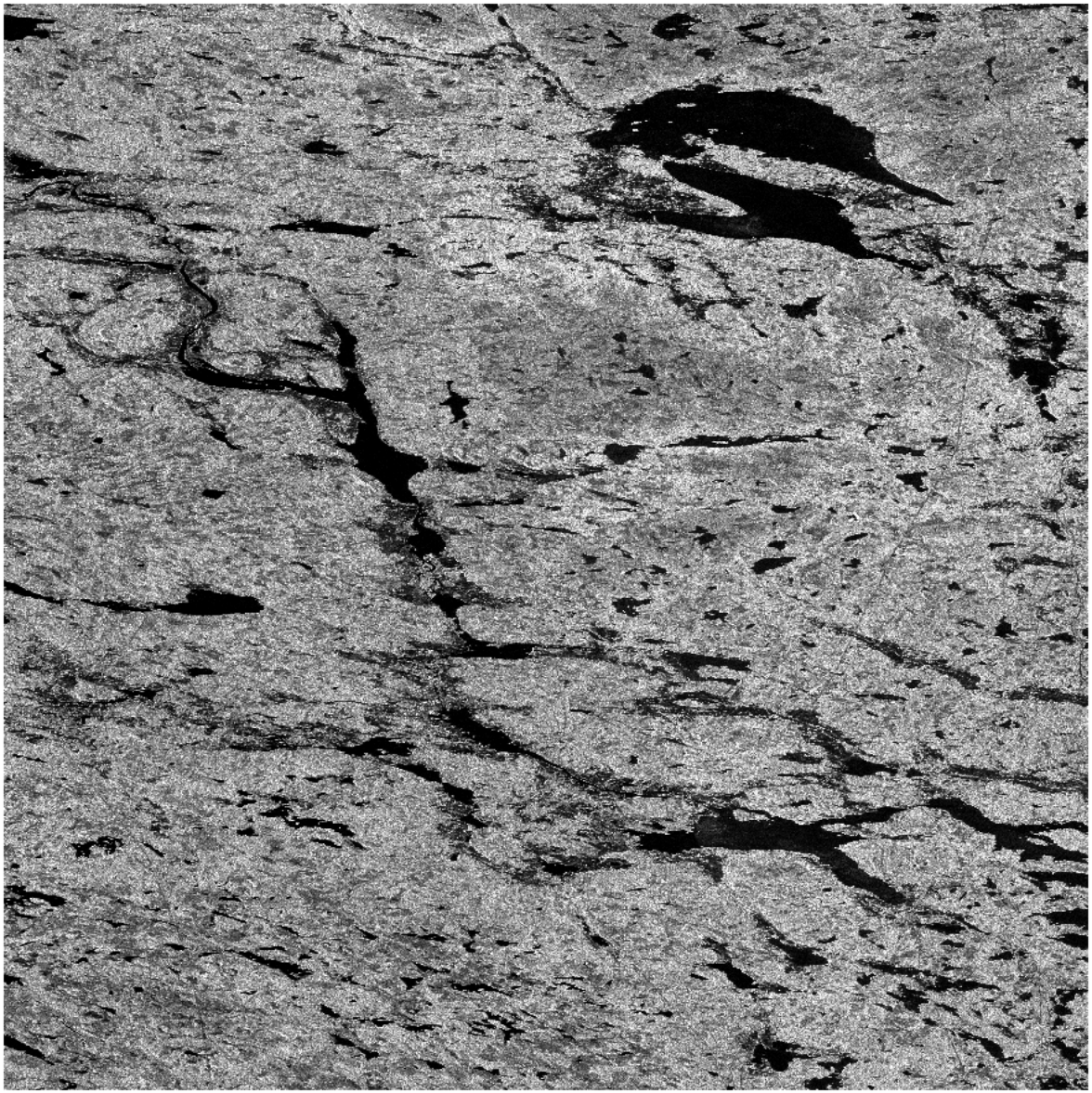
1x1 deg tile, 62 deg N, 16 deg E; JERS-1



1x1 deg tile, 62 deg N, 16 deg E; ALOS-1 PALSAR-1 (HV)

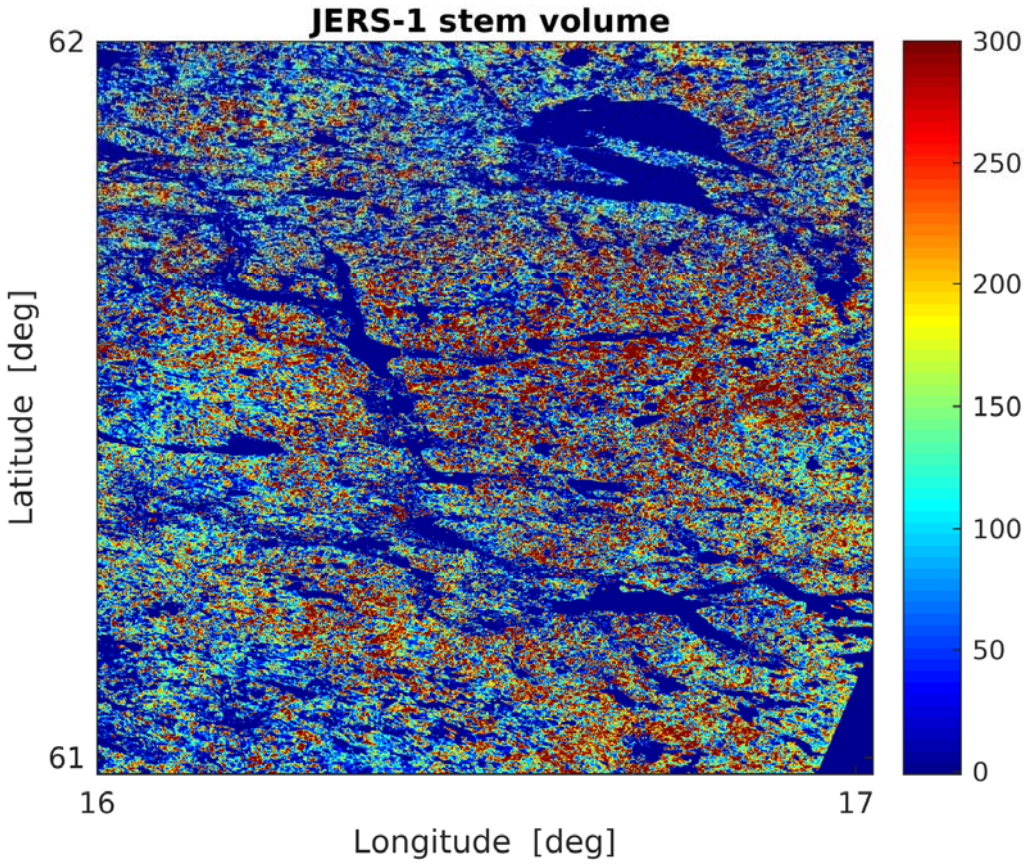


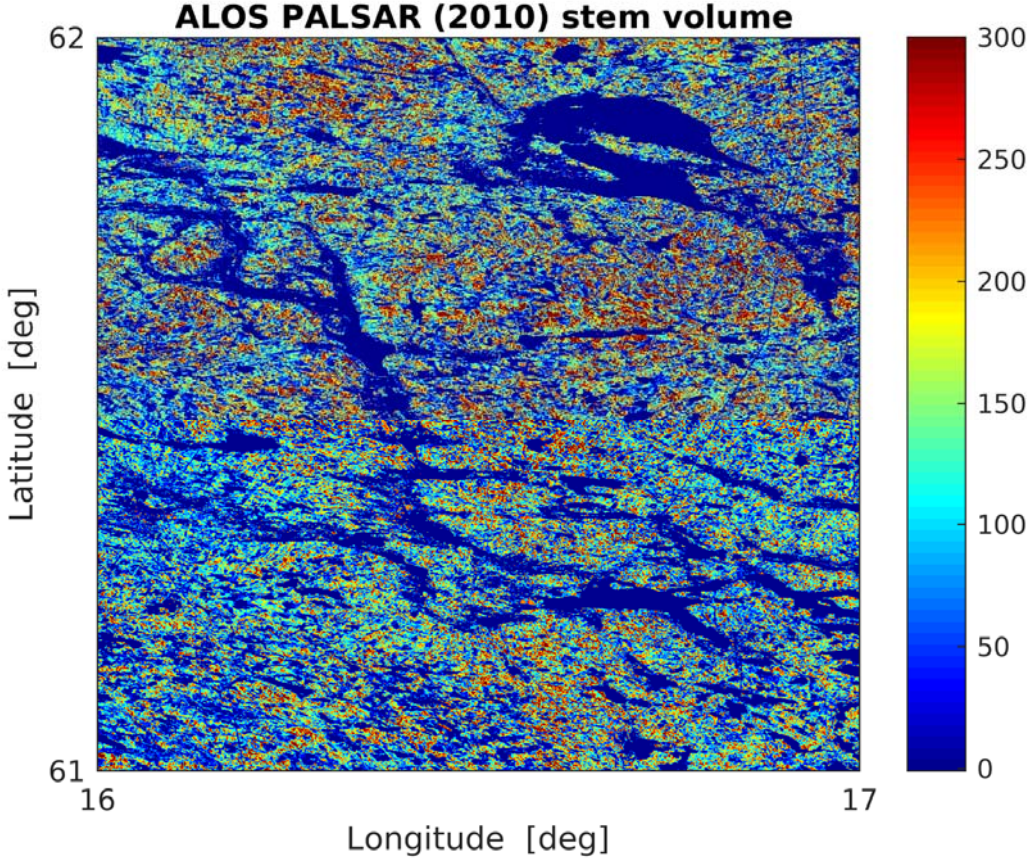
1x1 deg tile, 62 deg N, 16 deg E; ALOS-2 PALSAR-2 (HV)



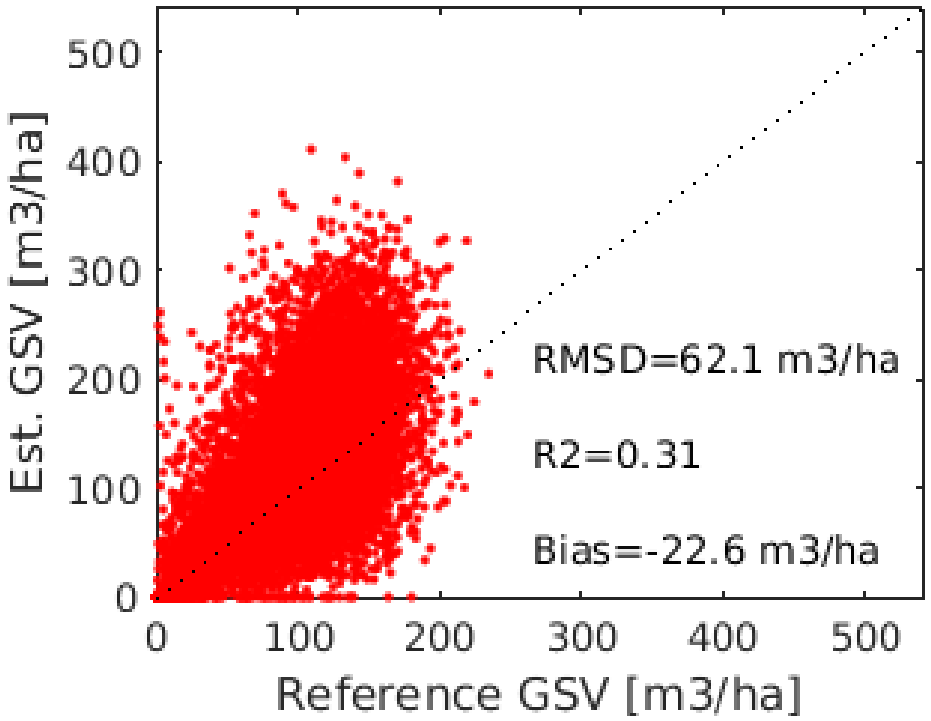
Stem volume estimates (m3/ha)

1x1 deg tile, 62 deg N, 16 deg E

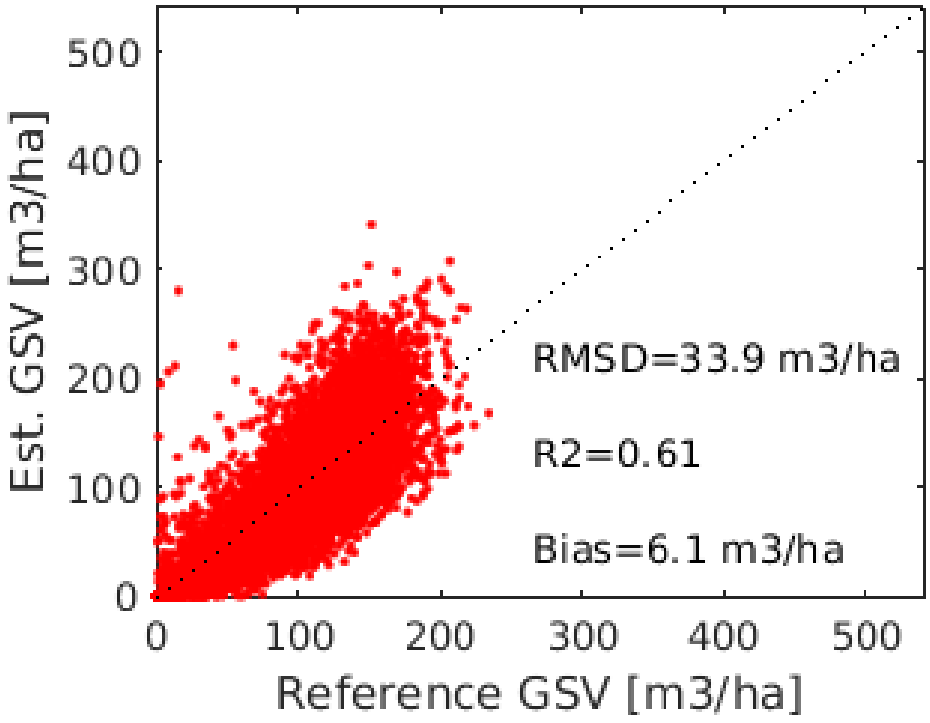




JERS-1



ALOS-1 PALSAR-1 (2010)



1x1 deg tile, 62 deg N, 16 deg E; reference GSV: kNN Sweden 2010

Some research ideas by the ecosystem modelers

- Relate the GSV spatial distribution to forest age
- Assess the impact of an assimilation of GSV data at different resolutions into models on the simulated carbon fluxes
- Use time series of “biomass” estimates together with NPP information and infer and analyze for the first time the "real" outflux (i.e., turnover) from the vegetation carbon pool

Project milestones & Data sharing

1) Final evaluation of biomass estimates from K&C Phase 3 data products (mid of 2015 - ongoing)
2) Completion of database of JERS-1 and ALOS-1 PALSAR images (end of 2015- completed)
3) Completion of database of ALOS-2 images (mid of 2016 for 2014-2015 data - completed)
4) Production of biomass maps until 2010 from JERS-1 and ALOS-1 data (end of 2016 - ongoing)
5) Completion of database of ALOS-2 images (mid of 2017 for 2016 data)
6) Production of biomass maps for 2015 from ALOS-2 data (end of 2017)
7) Yearly feedback to JAXA on quality of their data products.

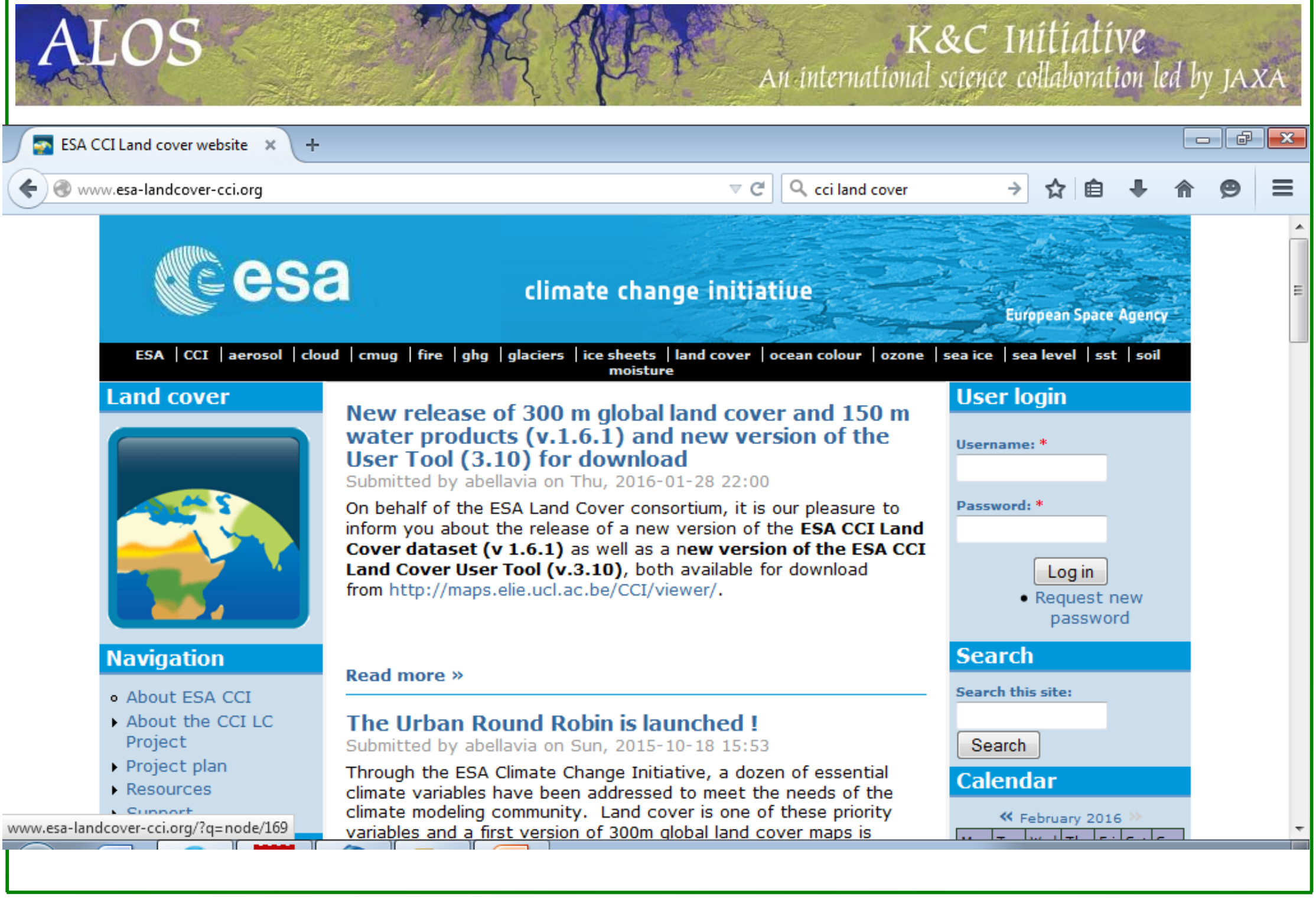
In situ information collected in the Könizberg Wald, south of Bern at ALOS-2 acquisitions

Deliverables

- A forest biomass map of Europe produced with JERS-1 data for the 1995 epoch
- A forest biomass map of Europe produced with ALOS-1 data for 2010 epoch
- A forest biomass map of Europe produced with ALOS-2 data for 2015 epoch
- Report on model-data integration
- Yearly feed-back to JAXA on quality of their data products.

Climate Change Initiative Land Cover (CCI-LC) datasets

Science Team meeting #22
Tokyo, Japan, February 16-18, 2016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ESA | CCI | aerosol | cloud | cmug | fire | ghg | glaciers | ice sheets | land cover | ocean colour | ozone | sea ice | sea level | sst | soil moisture
Land cover
Navigation
About ESA CCI
About the CCI LC Project
Project plan
Resources
New release of 300 m global land cover and 150 m water products (v.1.6.1) and new version of the User Tool (3.10) for download
Submitted by abellavia on Thu, 2016-01-28 22:00
On behalf of the ESA Land Cover consortium, it is our pleasure to inform you about the release of a new version of the ESA CCI Land Cover dataset (v 1.6.1) as well as a new version of the ESA CCI Land Cover User Tool (v.3.10), both available for download from http://maps.elie.ucl.ac.be/CCI/viewer/.
Read more »
The Urban Round Robin is launched !
Submitted by abellavia on Sun, 2015-10-18 15:53
Through the ESA Climate Change Initiative, a dozen of essential climate variables have been addressed to meet the needs of the climate modeling community. Land cover is one of these priority variables and a first version of 300m global land cover maps is
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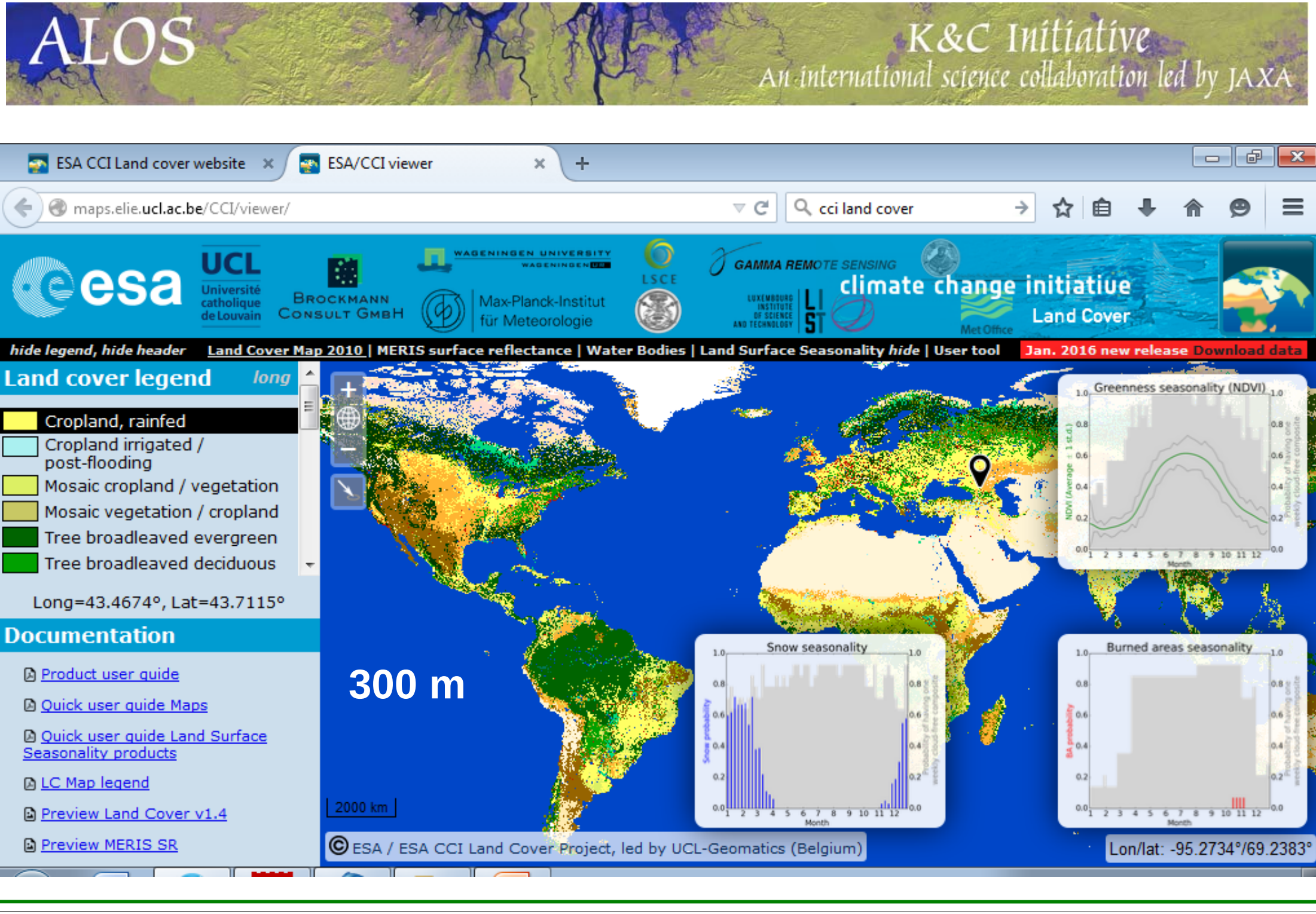
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Land cover legend
long
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Mosaic vegetation / cropland
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Long=43.4674°, Lat=43.7115°
Documentation
Product user guide
Quick user guide Maps
Quick user guide Land Surface Seasonality products
LC Map legend
Preview Land Cover v1.4
Preview MERIS SR
300 m
Greenness seasonality (NDVI)
Snow seasonality
Burned areas seasonality
2000 km
© ESA / ESA CCI Land Cover Project, led by UCL-Geomatics (Belgium)
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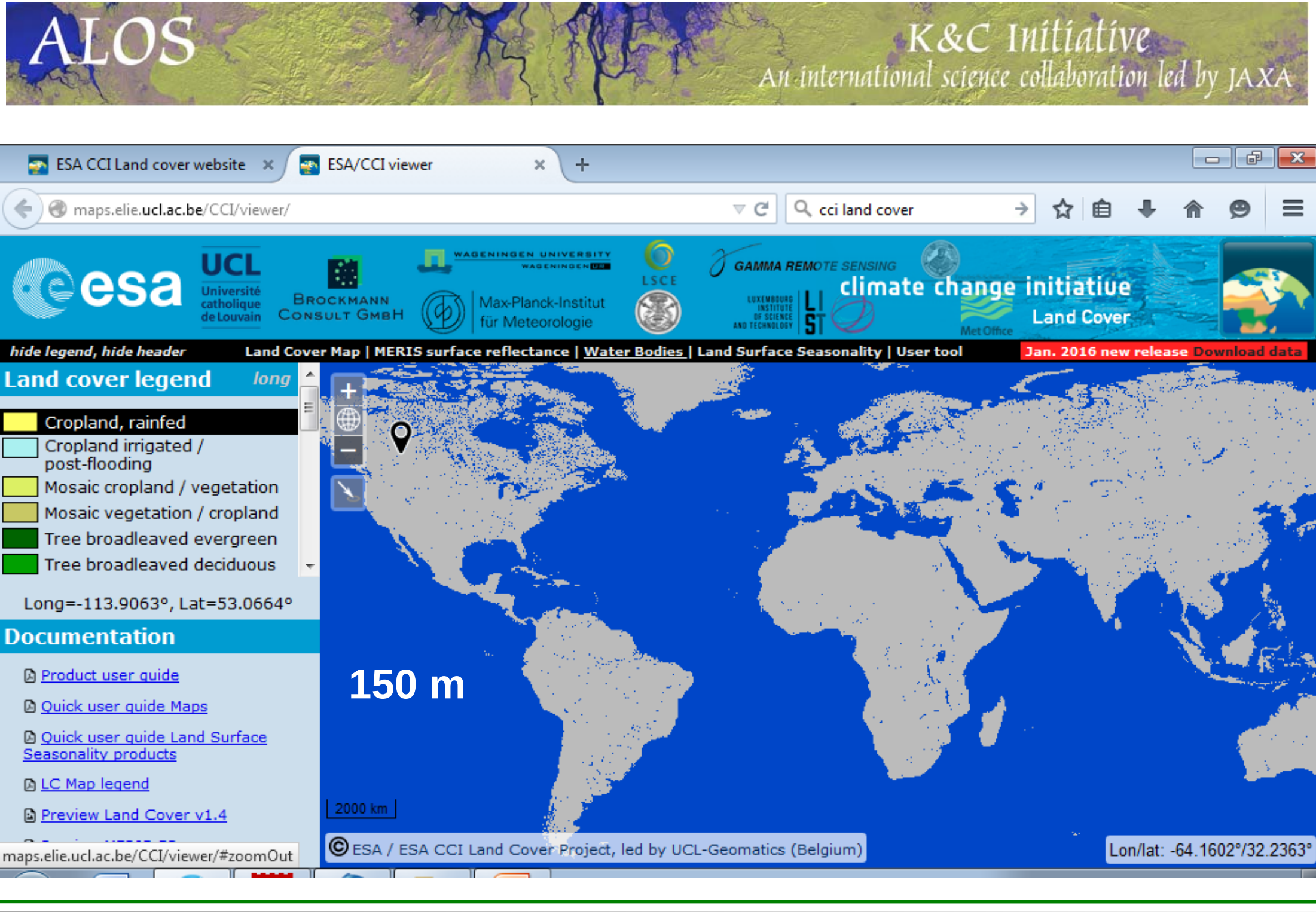
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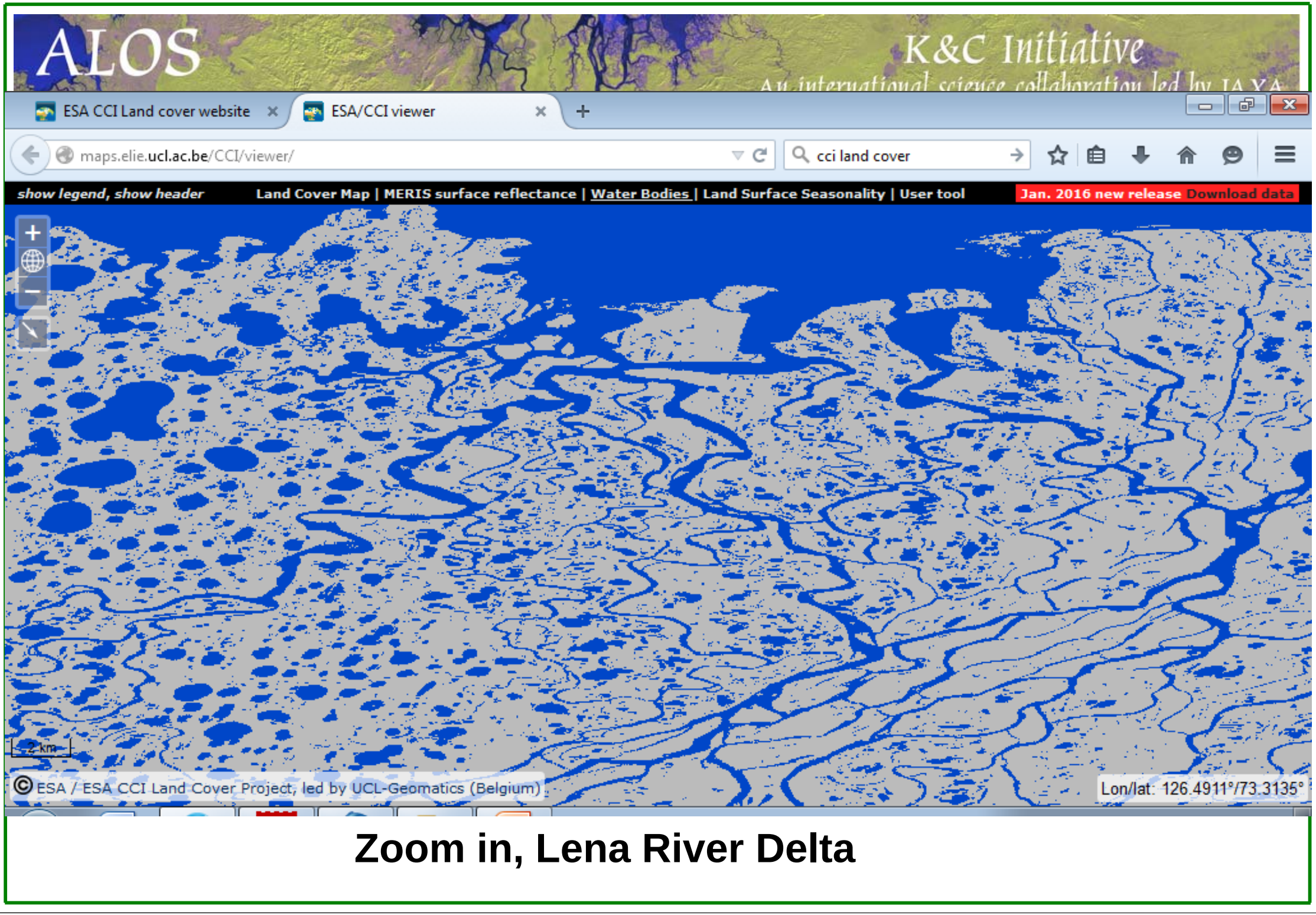

Zoom in, Lena River Delta