Russian Academy of Sciences
Space Research Institute (IKI)

Use of the GlobBiomass GSV product for Russian forests characterisation

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Some limitations of “traditional” data

Limited availability

- The available data at the forest stands level are fragmented (the unified country-wide database do not exist)
- The publically available country-wide forest statistics related to Russian Federation subjects level

Outdating

- Most of the data more than 15-20 years old and do not going to be updated soon

Inconsistency

- Required data accuracy are significantly varying across the country

Some examples of the GlobBiomass product using areas

State institutions (Russian Forest Agency and etc.)

- Forest fire propagation modelling (fuel volume assessment)
- Forest change monitoring
- State forest inventory network design

Public / commercial users

- Forest industry / Investment companies
- VEGA-Pro service users

Scientific users

- GHGs modelling, Forest Ecosystem Dynamics and etc.

Advantages and limitations of the GlobBiomasse product

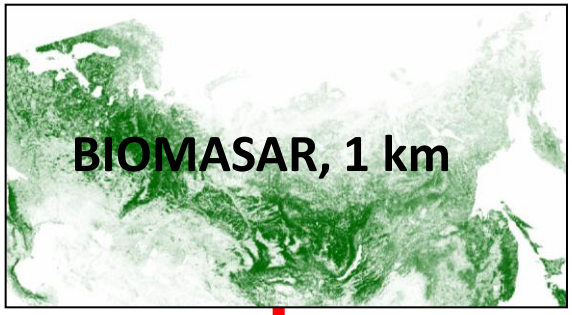
Main advantage

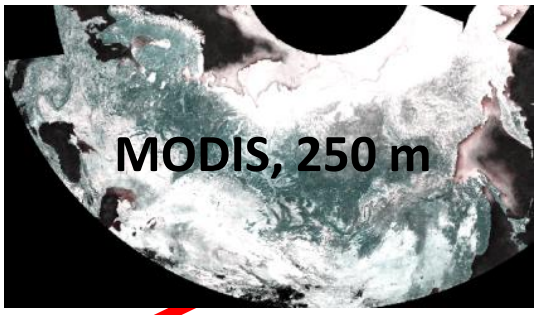
- availability of the country-wide data
- data homogeneity

Limitations

- 1 km spatial resolution is rather course for most “real” applications
- data time series are not available
- saturation effect at relatively low for most of Russian forests GSV values

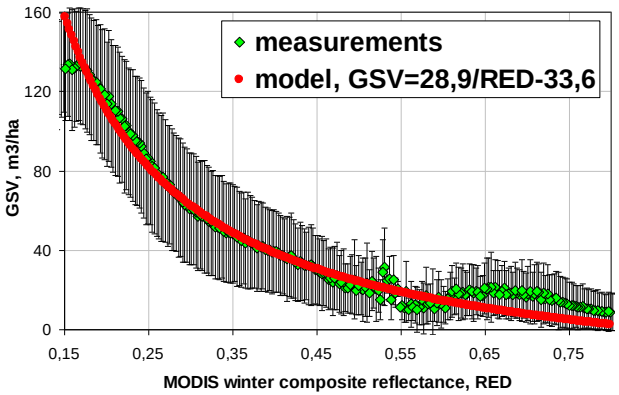
Method of forest GSV retrieval based on GlobBiomass and optical data synergy





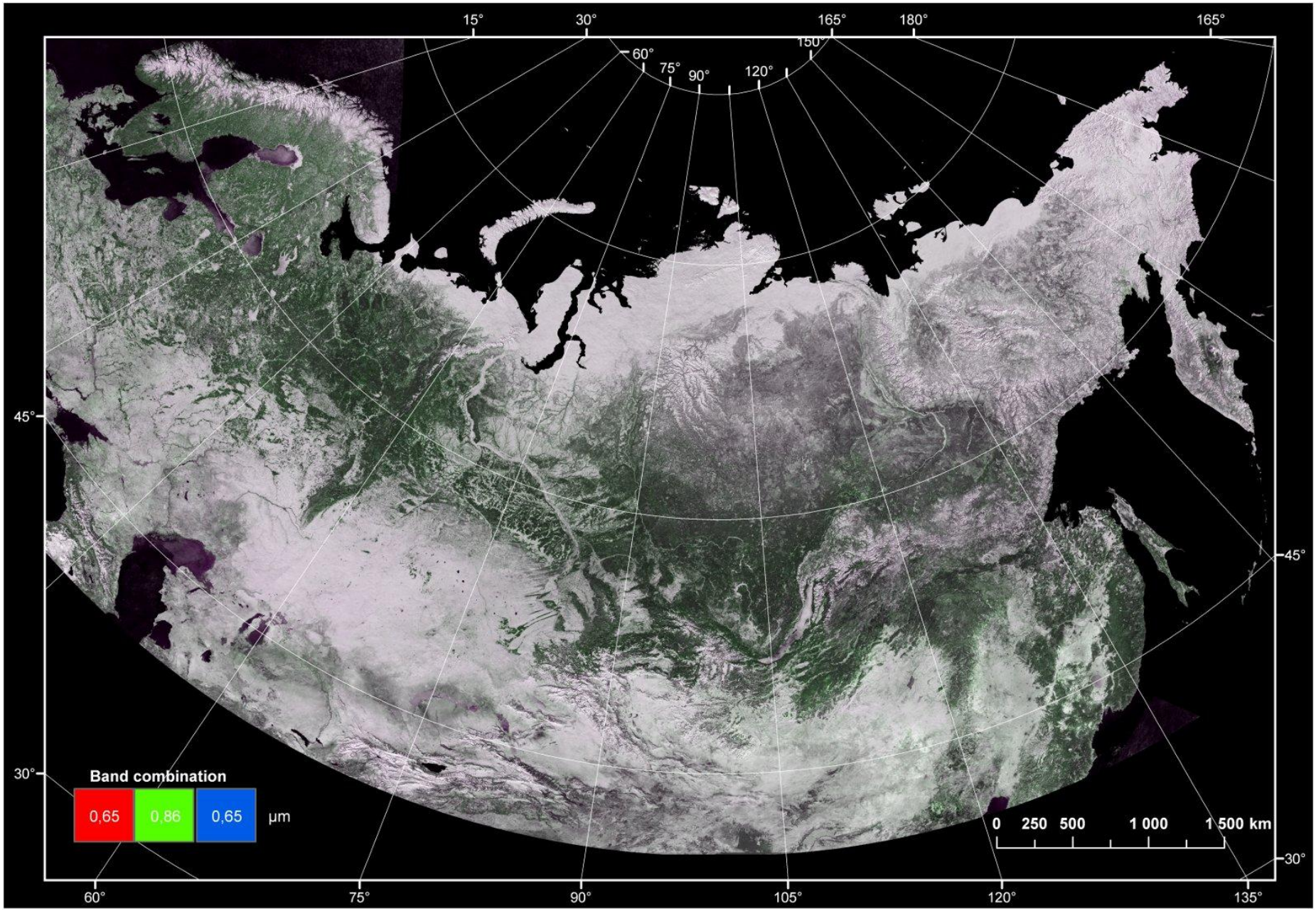
LAGMA

Local classes' signatures of GSV (BIOMASAR) and Surface Reflectance (MODIS Snow Composite)

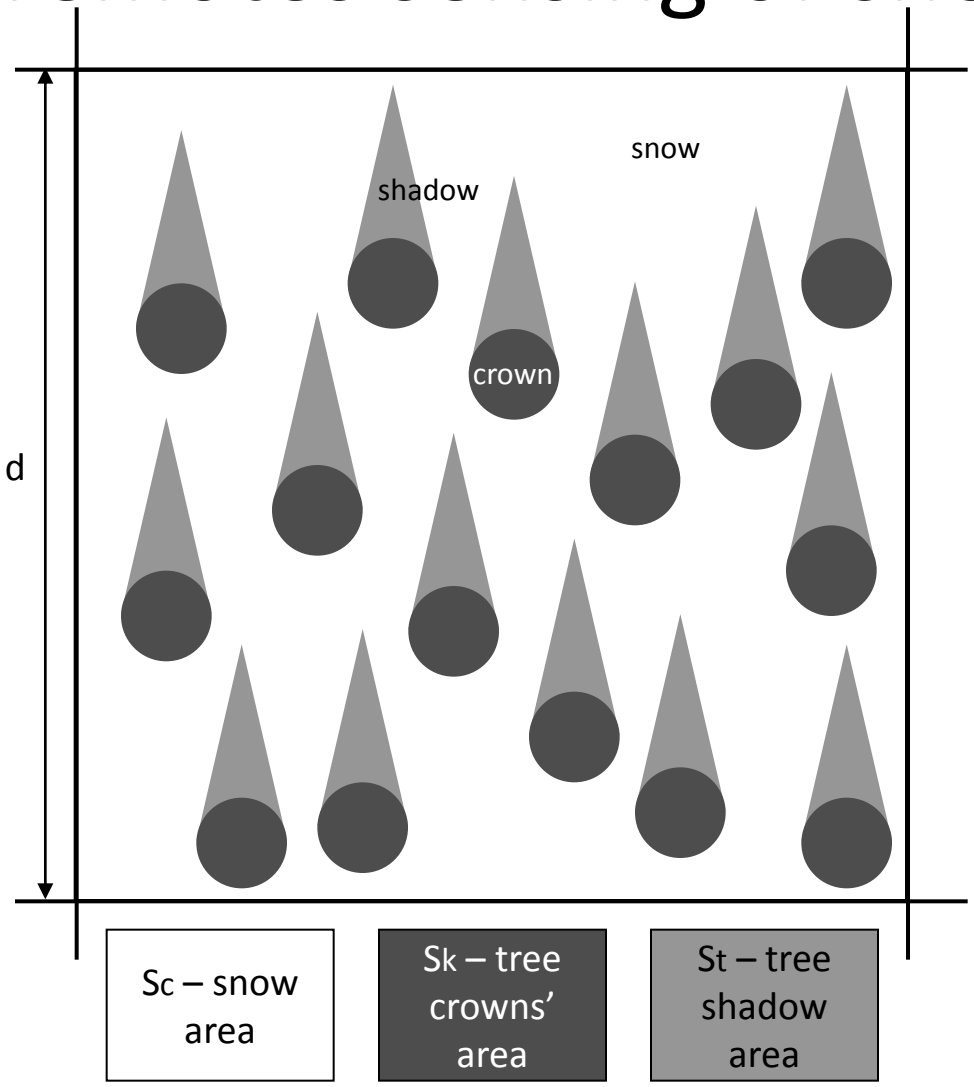


Locally-adaptive regression fitting

Cloud-free winter MODIS composite



Forest GSV assessment with optical remotes sensing of snow covered surface



h – trees' mean height; n – trees number

The forest GSV assessment approach requires remote sensing data acquired at snow covered terrestrial surface condition

$$R^{0,65} = f\left(S_c, S_k, S_t\right);$$

$$S_c = d^2 - S_k - S_t,$$

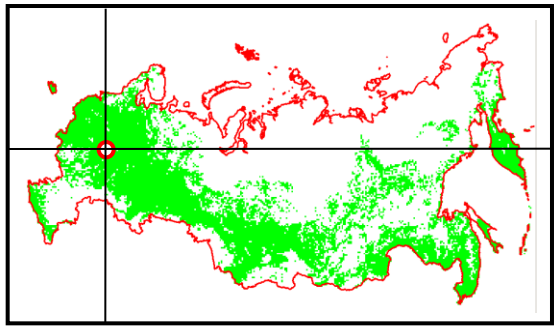
$$S_k = f_1(n), S_t = f_2(n,h),$$

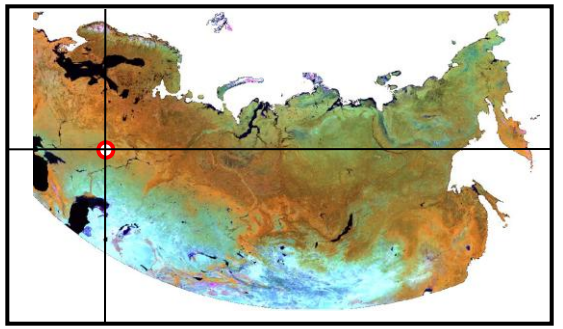
$$R^{0,65} = f_3(n,h);$$

$$GSV\left[m^3/ha\right] = f_4(n,h)$$

$$GSV\left[m^3/ha\right] \sim 1/R^{0,65}$$

LAGMA : Locally Adaptive Global Mapping Algorithm





Local spectral-temporal signatures of classes

Σ_i Covariation of metrics

$\bar{a}_i$ Average of metrics

n_i Number of samples

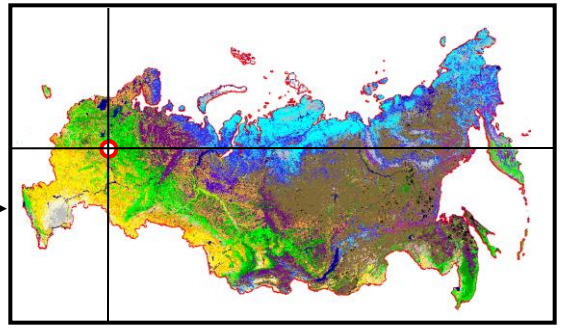
Spectral-temporal MODIS data composites

$\bar{x}$ Metrics for the pixel

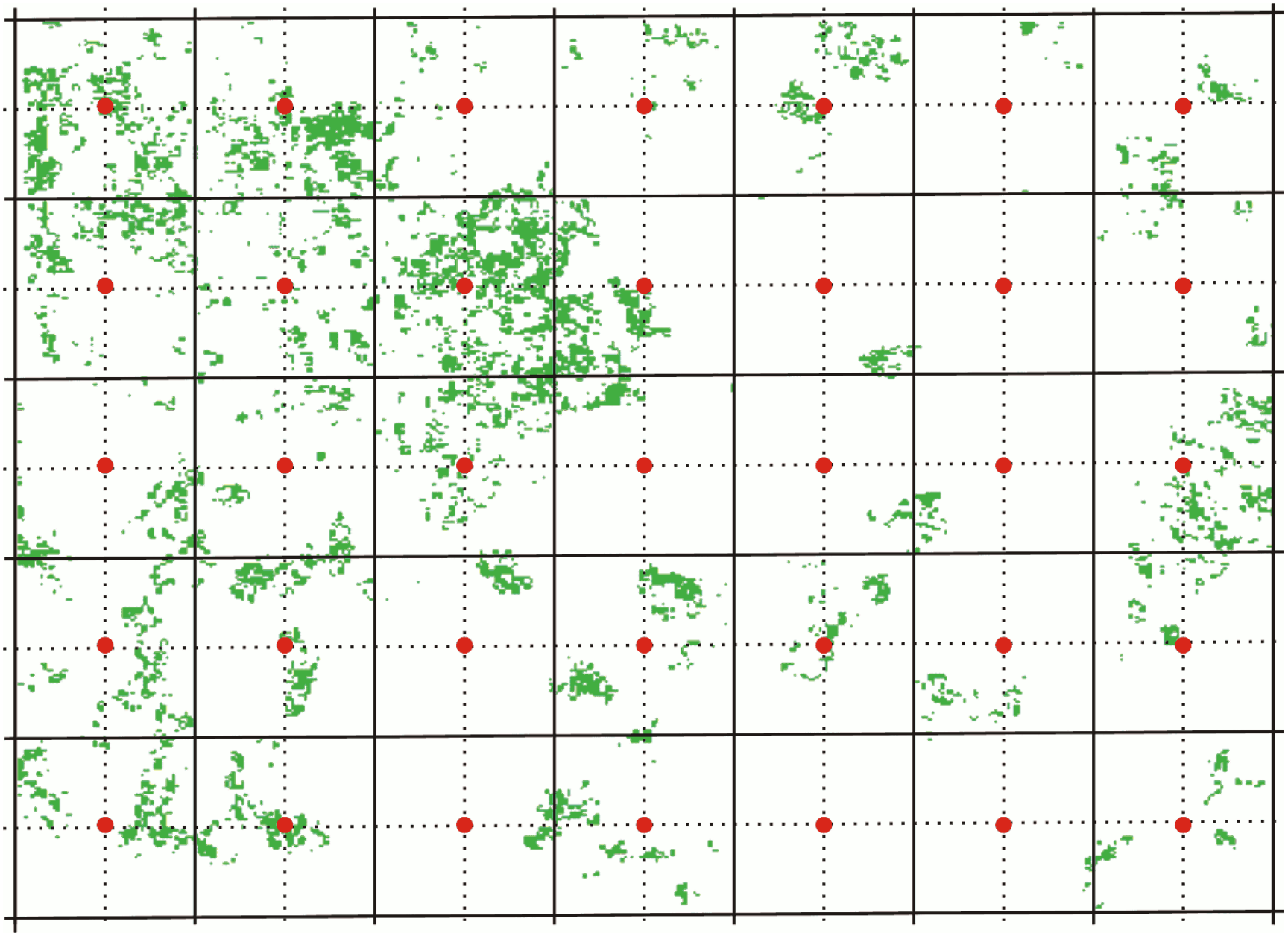
Maximum likelihood classifier

$f_i(\bar{x})$

Probabilities for classes



Locally-adaptive classes' signature retrieval



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A new locally-adaptive classification method LAGMA for large-scale land cover mapping using remote-sensing data

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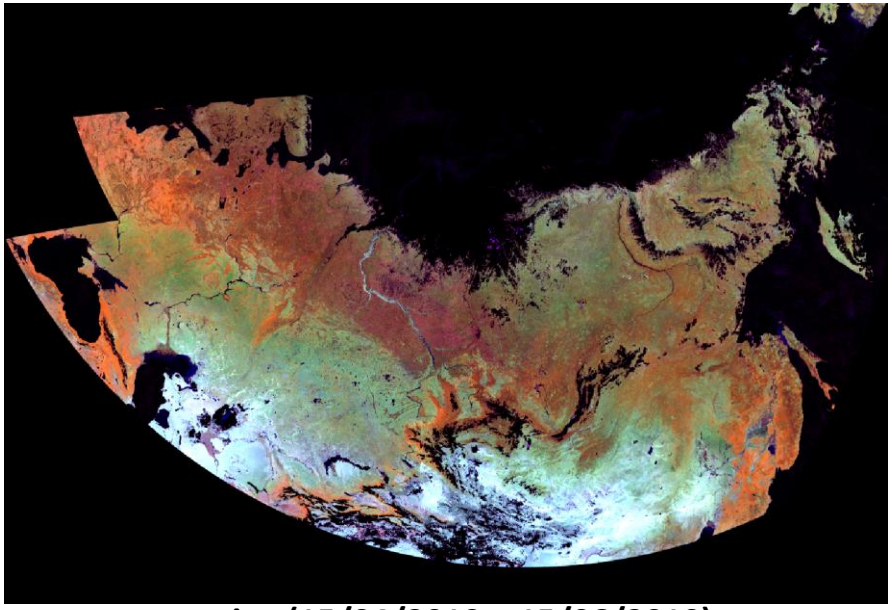
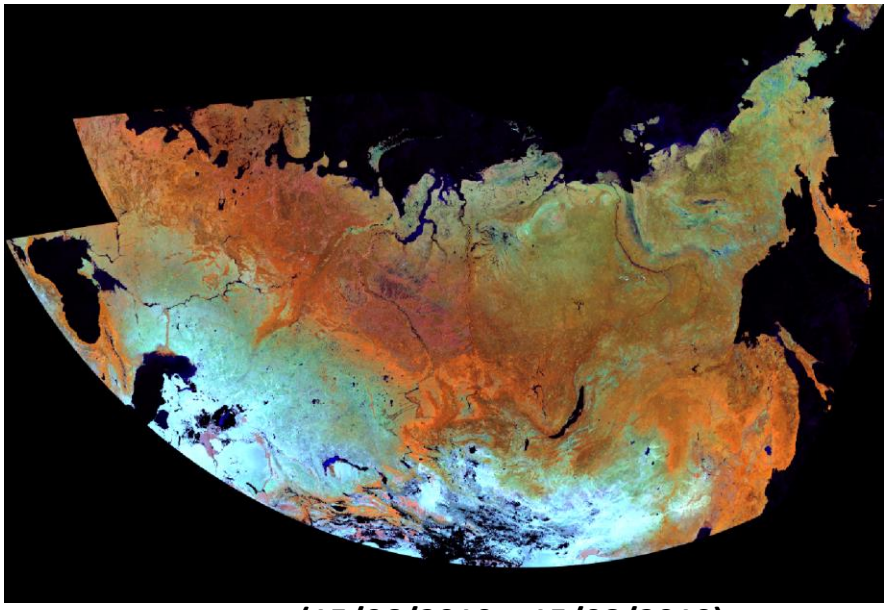
A new locally-adaptive image classification method LAGMA (Locally-Adaptive Global Mapping Algorithm) has been developed to meet requirements of land cover mapping over large areas using remote-sensing data. The LAGMA involves the grid-based supervised image classification using classes' features estimated locally in classified pixels' surrounding from spatially distributed reference data. The LAGMA considers inherently spatial variations of classes' features and is capable of exploiting discriminative properties of local classes' signatures without any preliminary stratification of mapping area. The LAGMA has been applied for country-wide land cover classification over Russian Federation using the Vegetation instrument data on board of the SPOT (Satellite Pour l'Observation de la Terre) satellite and has demonstrated advantages in terms of recognition accuracy.

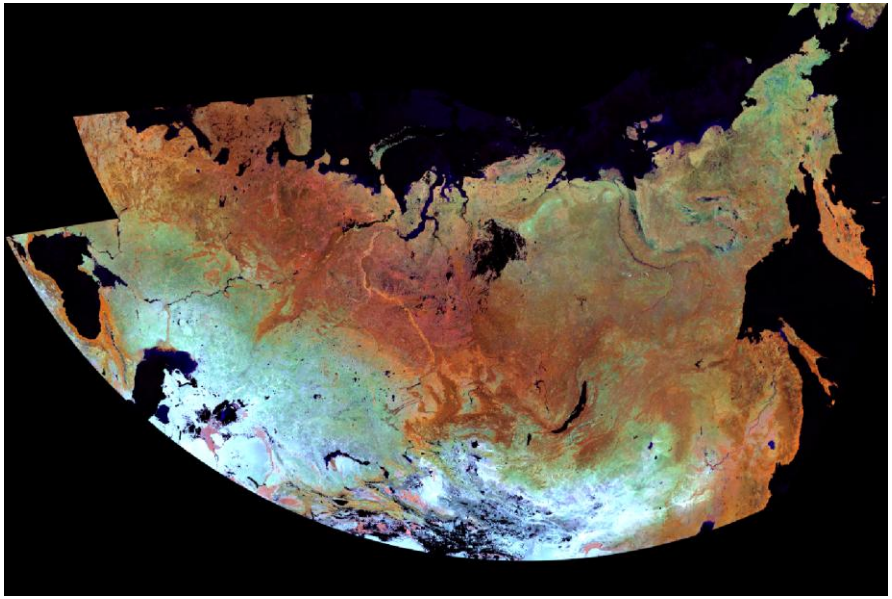
MODIS seasonal composites



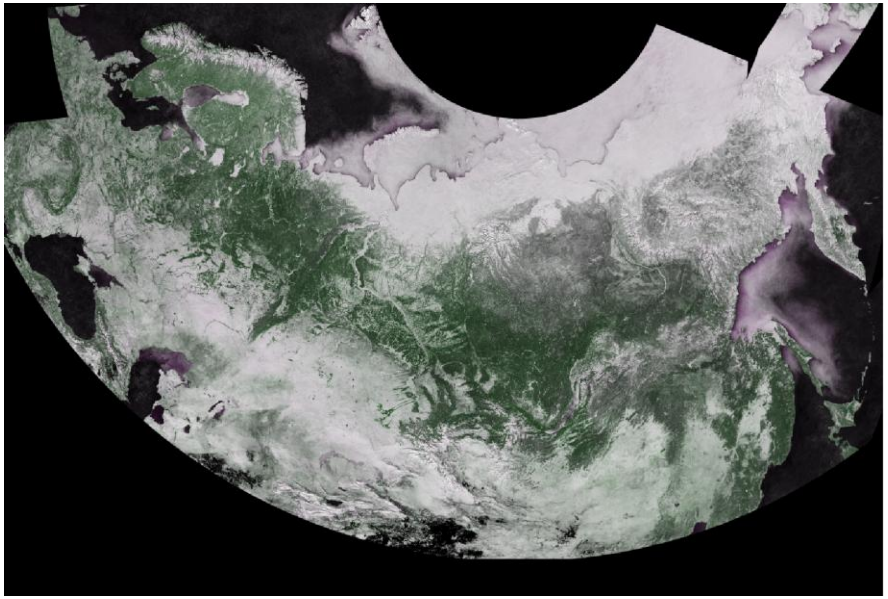
spring (15/04/2010 – 15/06/2010)



summer (15/06/2010 – 15/08/2010)



autumn (15/08/2010 – 15/10/2010)



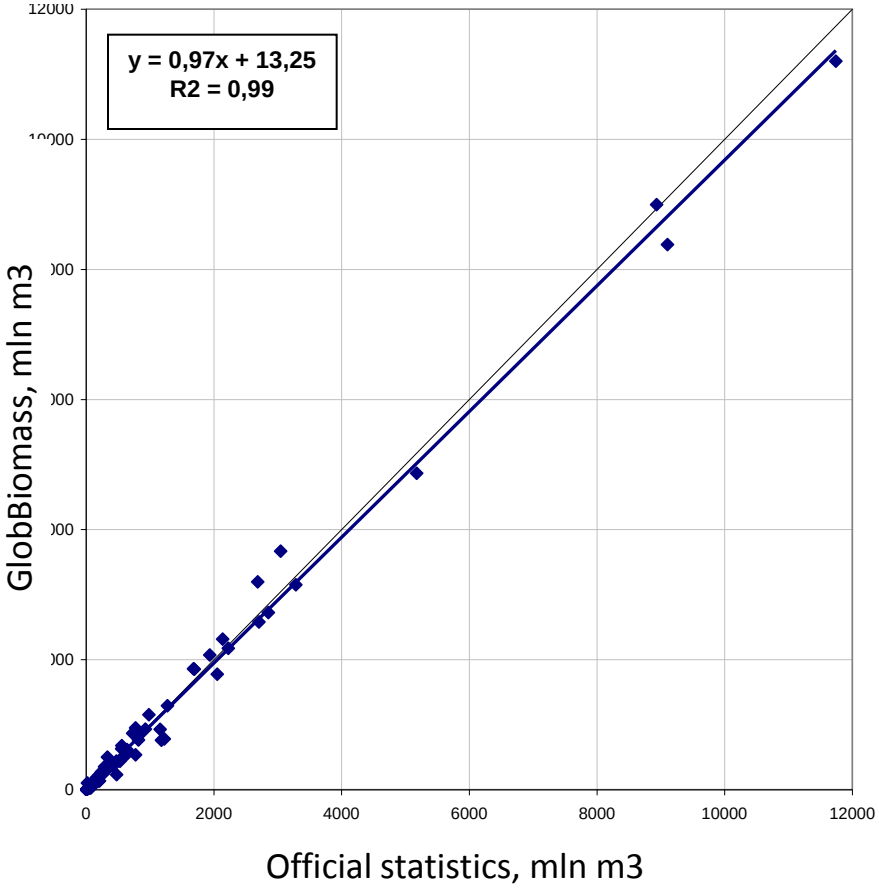
winter (15/11/2009 – 15/03/2010)

TerraNorte RLC Map

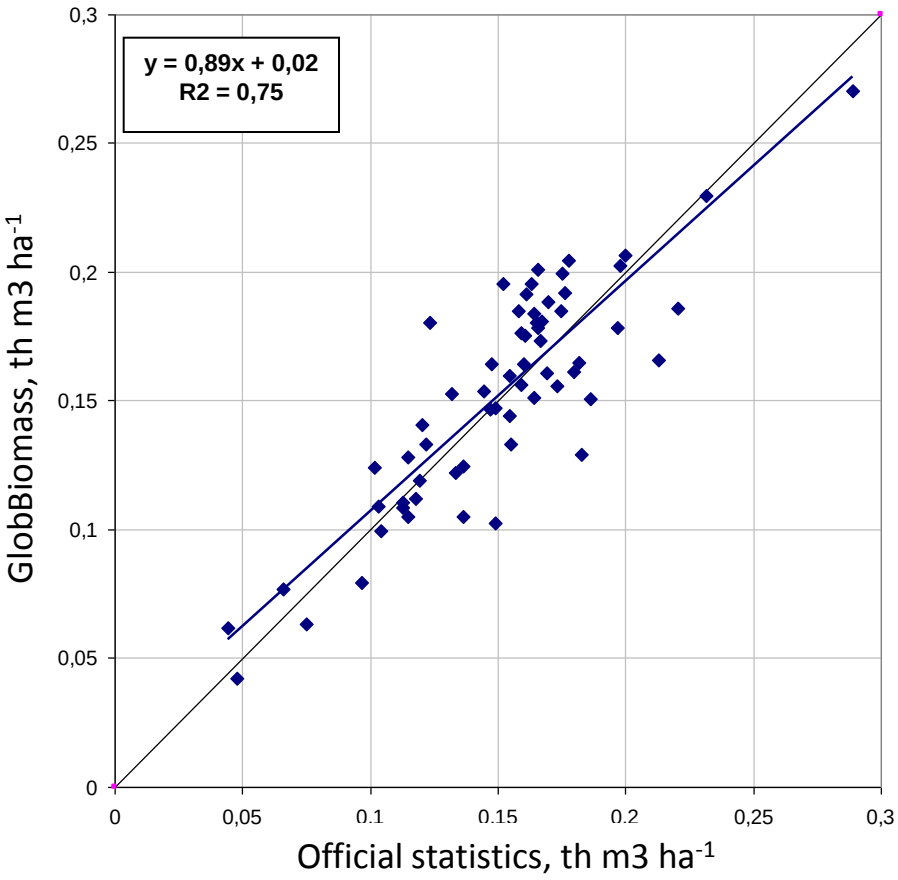
The land cover map for Russia based on MODIS 250 m

Enhanced forest GSV retrieval is based on Envisat-ASAR derived BIOMASSAR product and MODIS data snow composite synergy (250 m, year 2010).

Comparison of the GlobBiomass GSV retrieval vs. official statistics for the subjects of Russian Federation

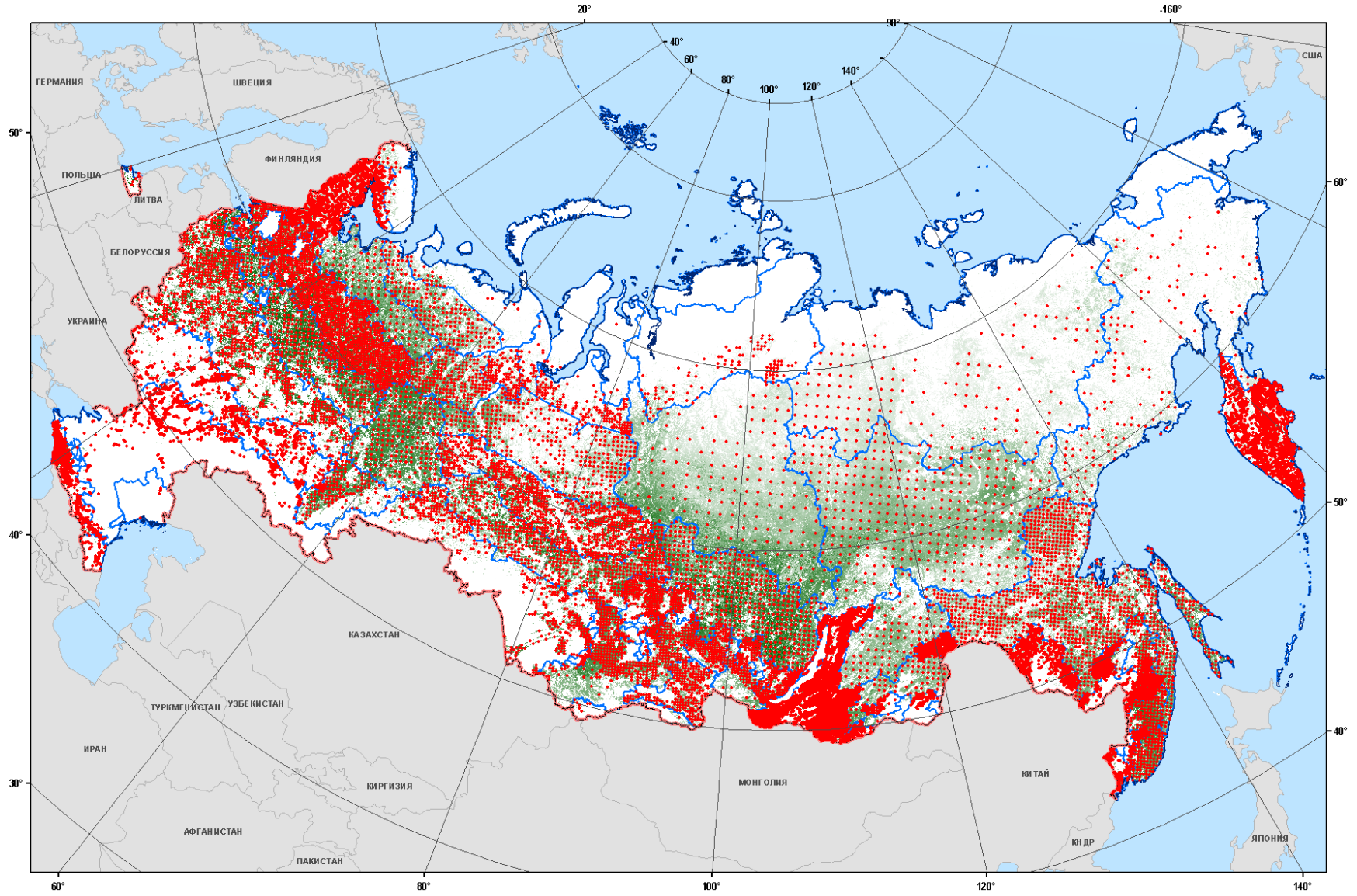


Absolute GSV



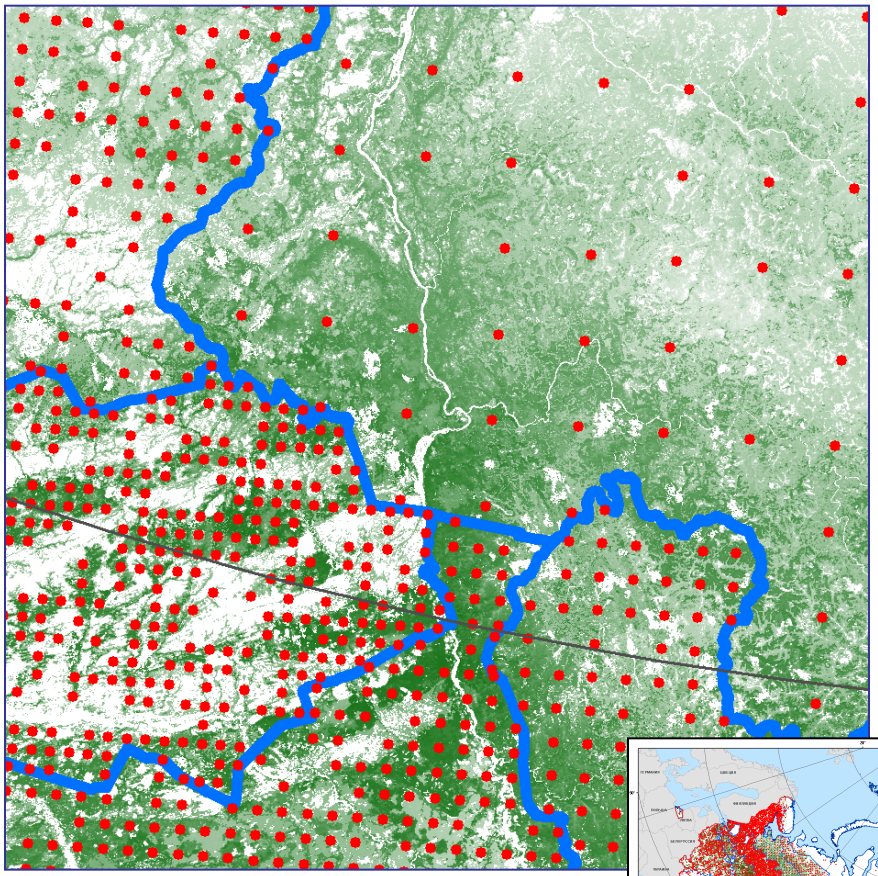
Relative GSV

State Forest Inventory (SFI) sampling scheme designed using MODIS GSV map

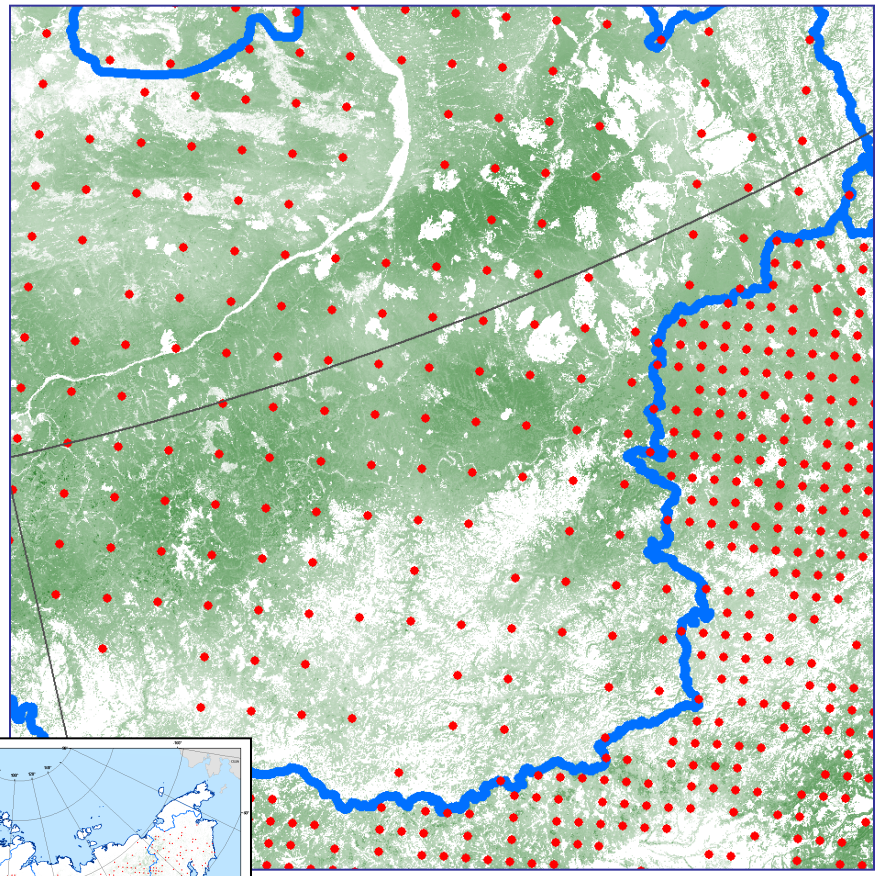


SFI requirements to the GSV assessment accuracy for the forest regions

SFI sampling scheme designed using MODIS GSV map

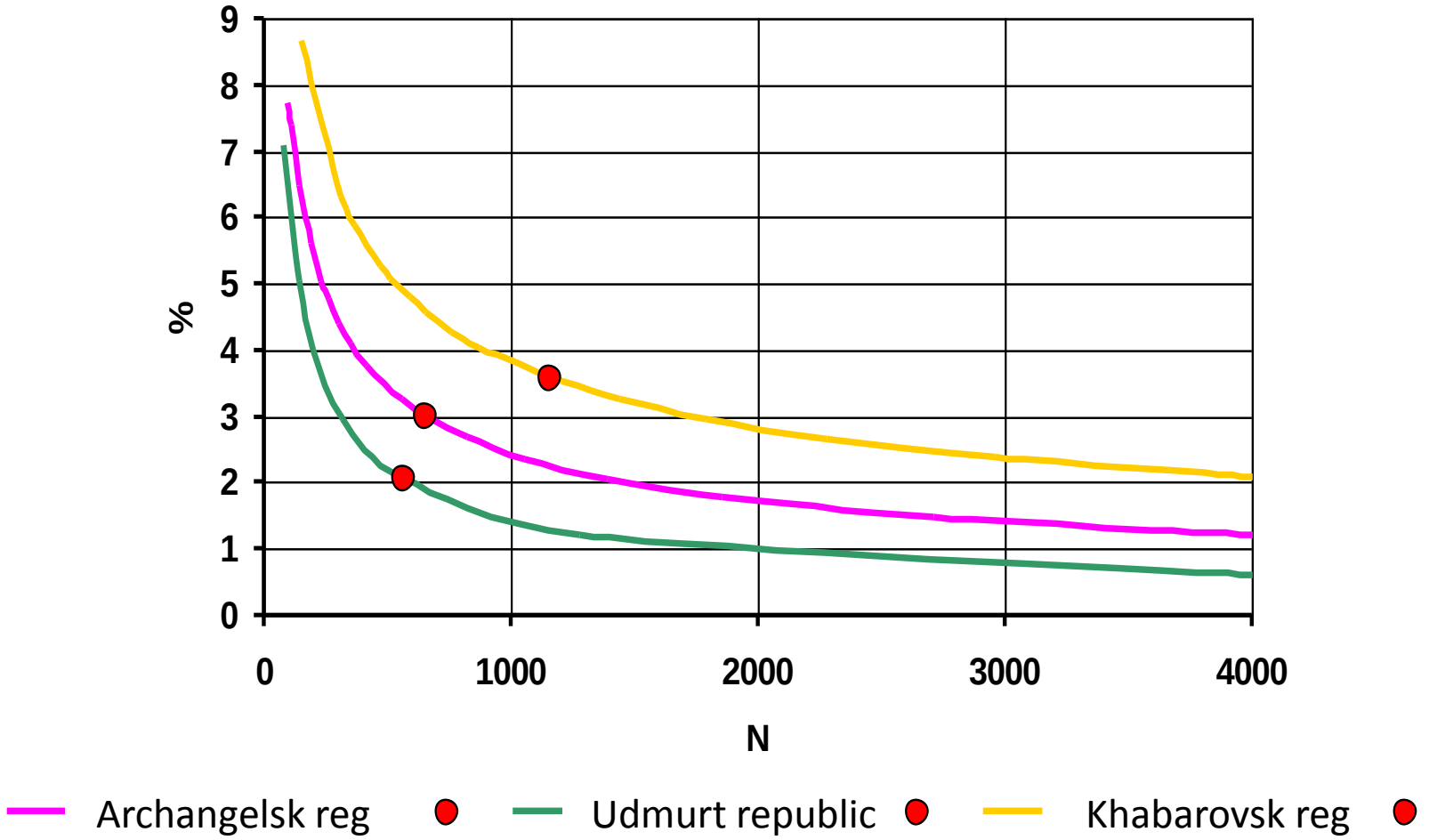


1

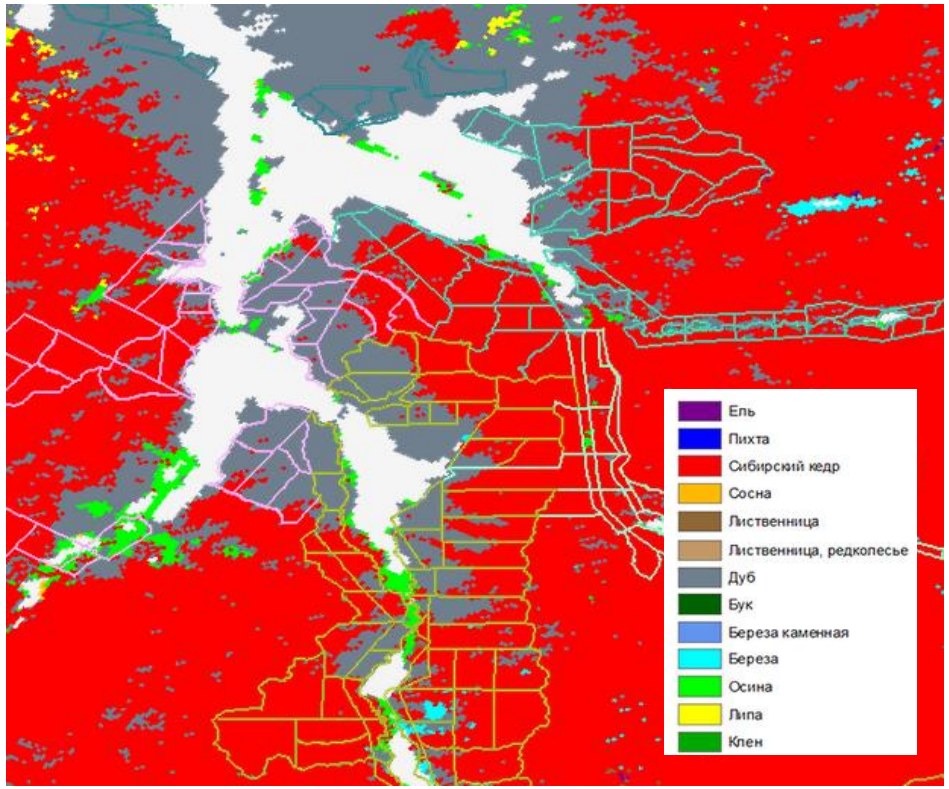


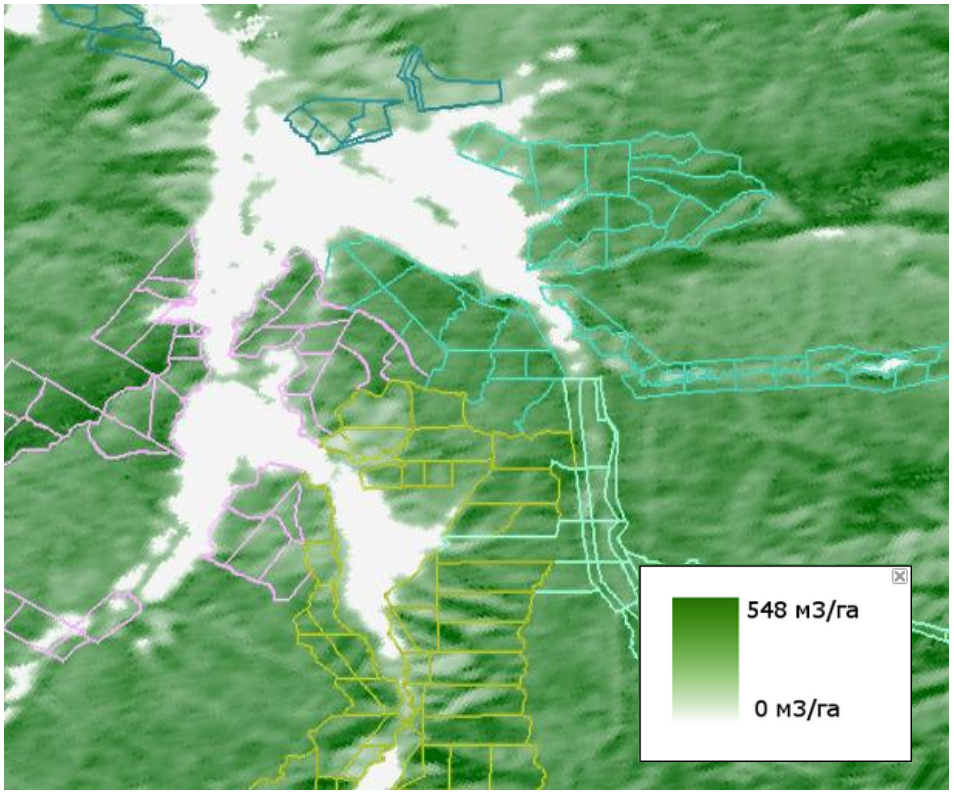
2

Optimum Pareto functions (accuracy – cost space) for SFI in different regions



Forest resources assessment for forest management units



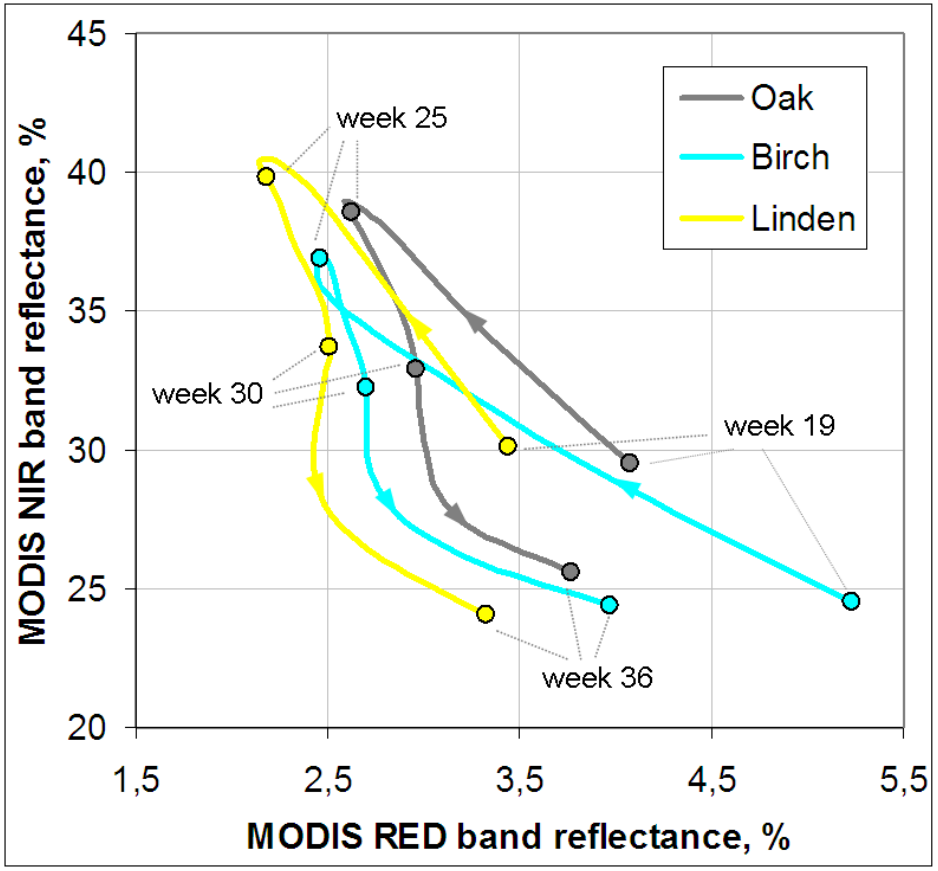


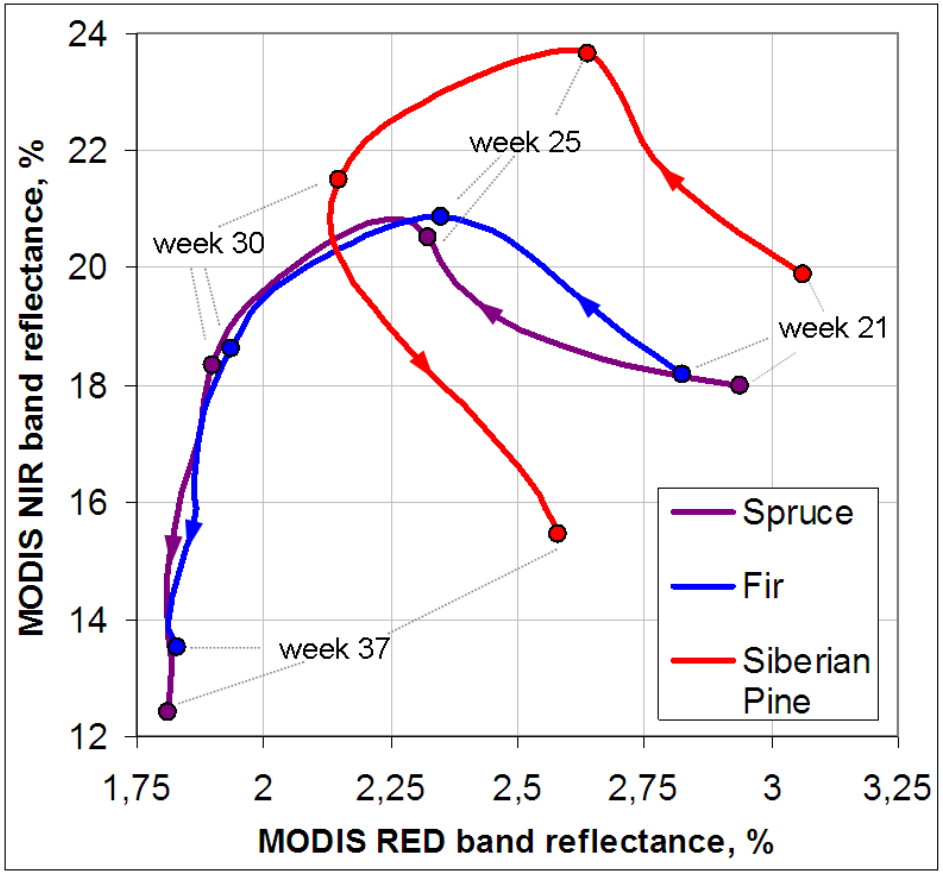
Forest tree dominant species **GSV map**

Forest quarters	Dominant tree species	Area (ha)	GSV (m3)	Relative GSV (m3/ha)
1-57, 65, 72, 73, 75, 76, 81, 88-91, 100, 101, 103, 106, 107, 113	Ceder	28565,2	5960706,9	208,7
	Oak	9664,6	1460321,6	151,1
	Birch	570,1	75560,2	132,5
	Aspen	172,2	21786,1	126,5

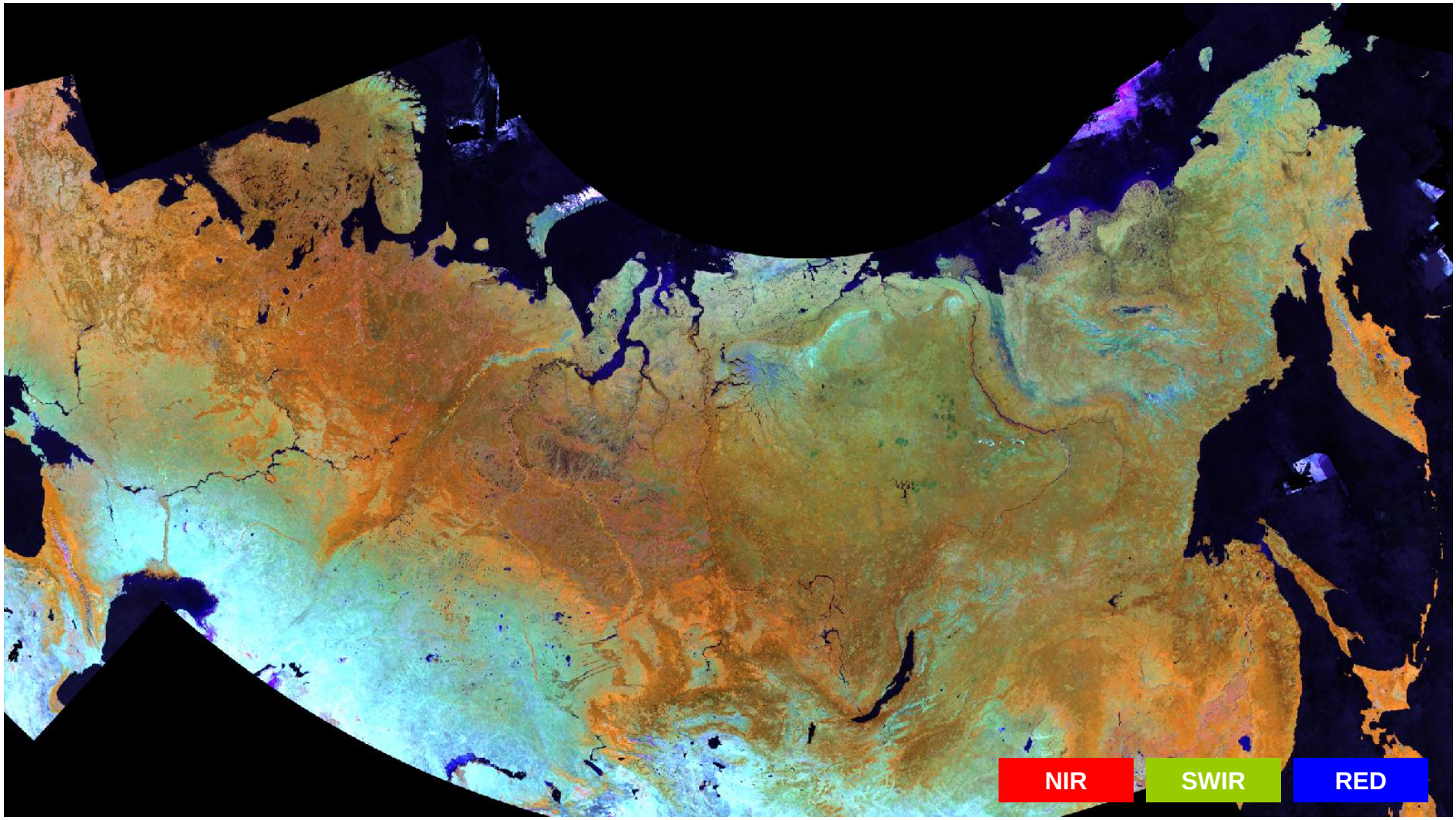
The forest cover is classified considering dominant tree species using seasonal time-series of MODIS data

Tree species trajectories in RED-NIR space during a growing season



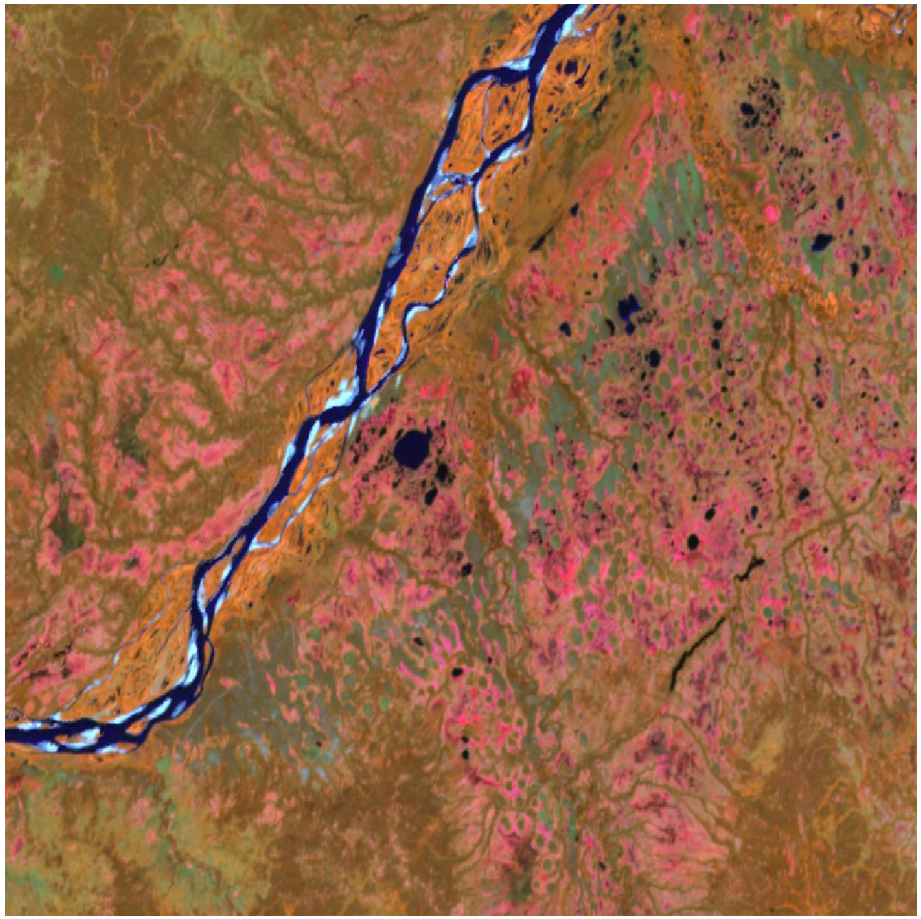


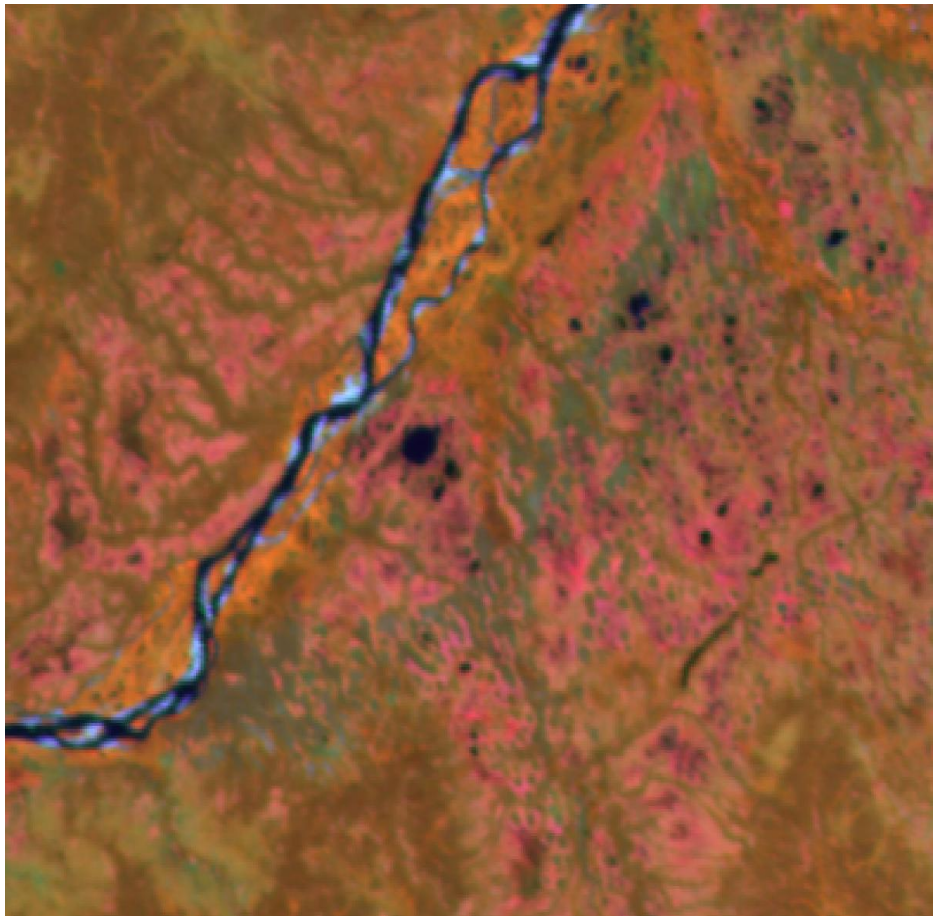
PROBA-V summer composite (100 m)



15 May – 15 September 2014

Summer composites comparison
MODIS (250 м) vs. Proba-V (100 м)





NIR SWIR RED

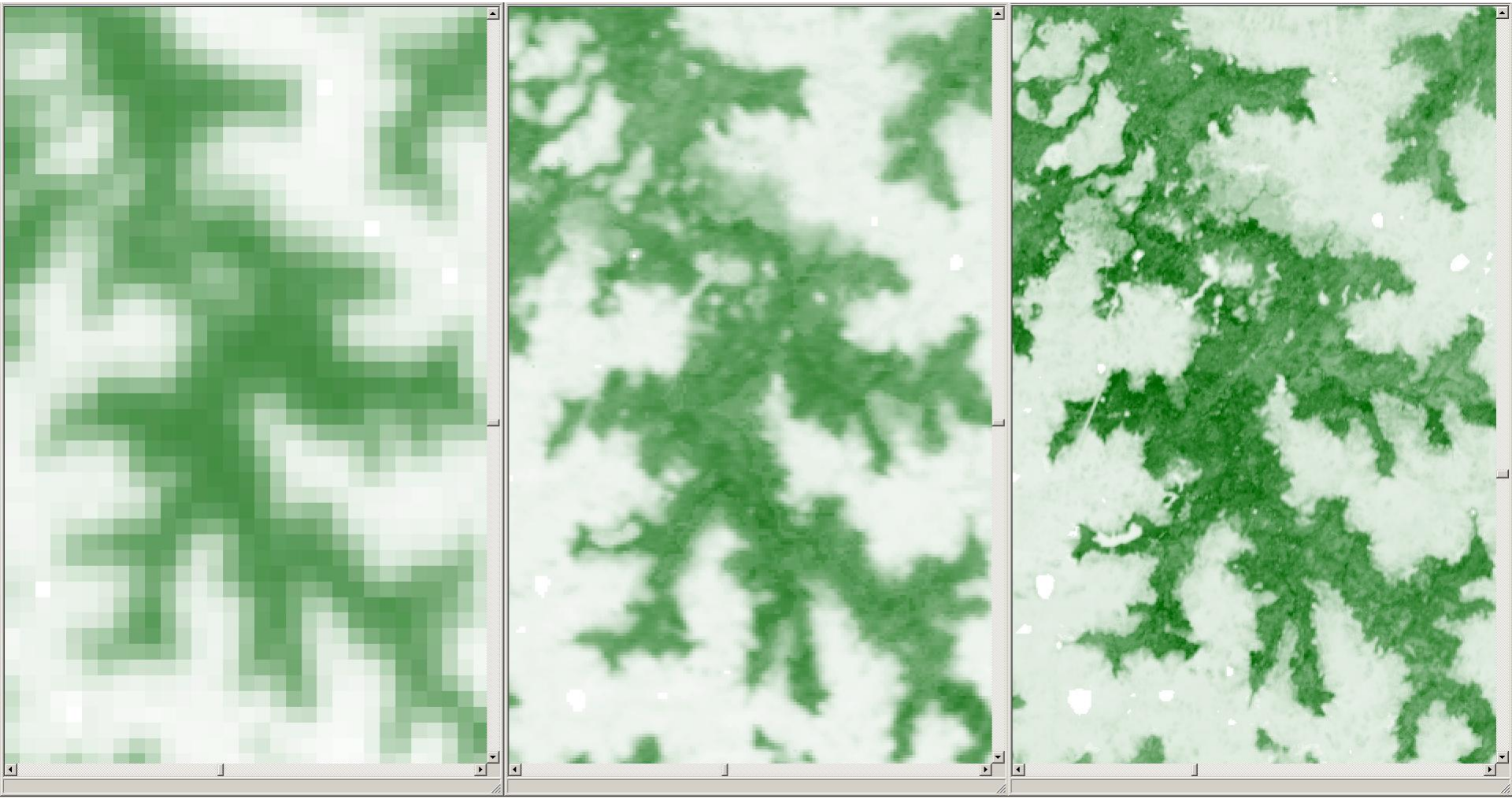
Proba-V

Terra-MODIS

Proba-V data derived prototype of the land cover map at 100 m for year 2014

Towards higher resolution of GSV mapping

BIOMASAR (1km) MODIS (250m) PROBA-V(100m)

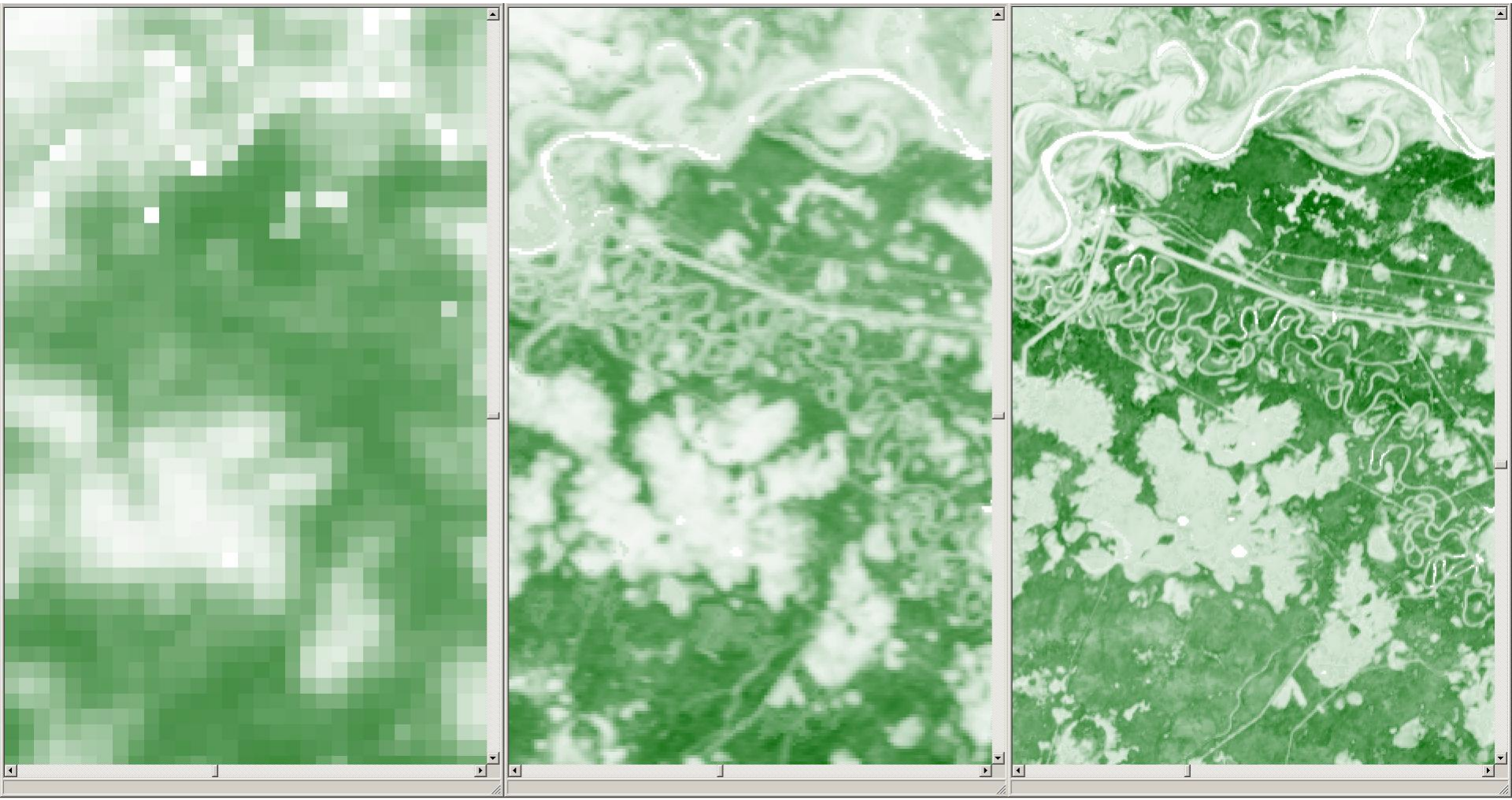


Growing Stock Volume (GSV), m3/ha

0 300/650

Towards higher resolution of GSV mapping

BIOMASAR (1km) MODIS (250m) PROBA-V(100m)



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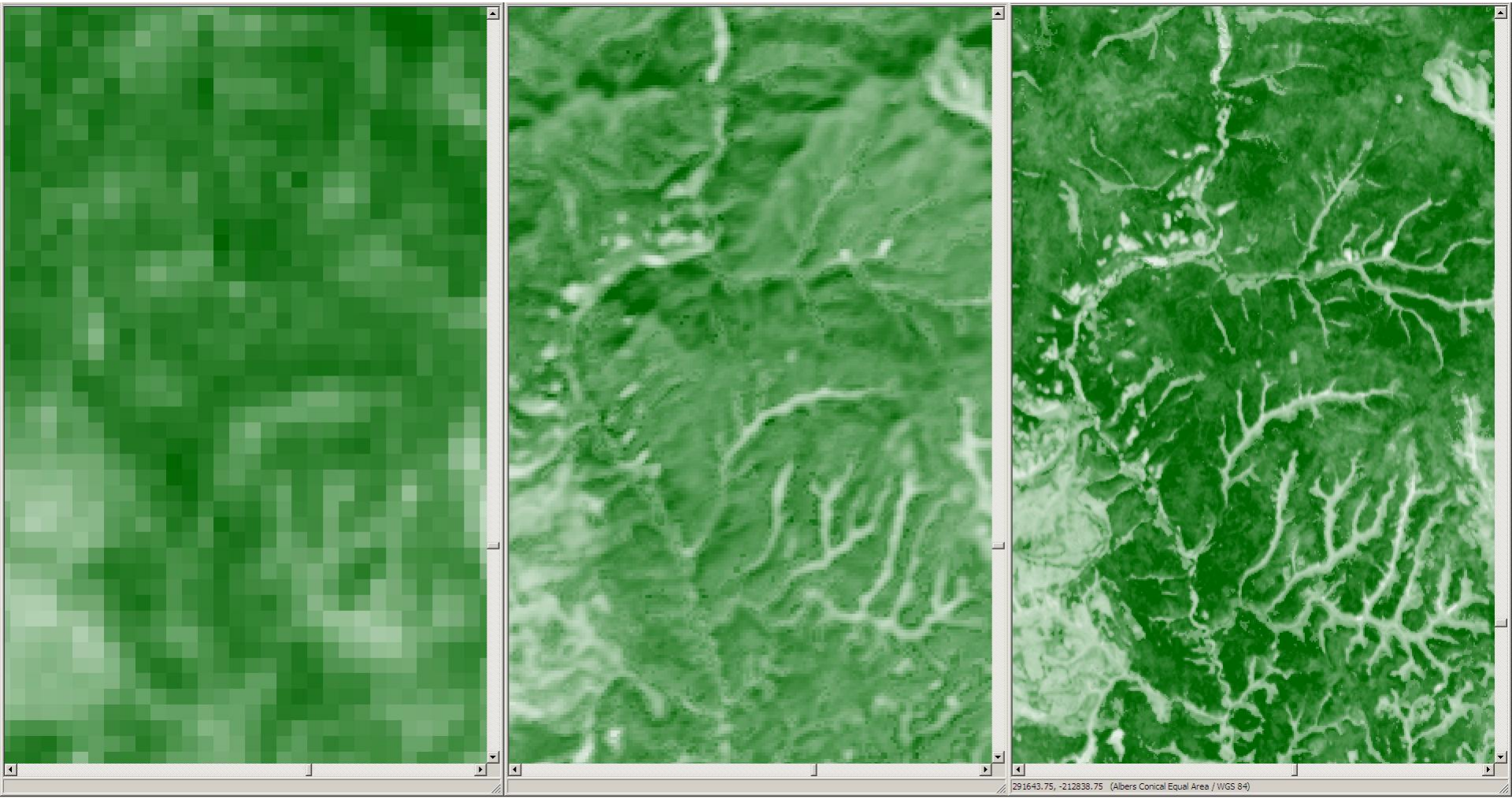

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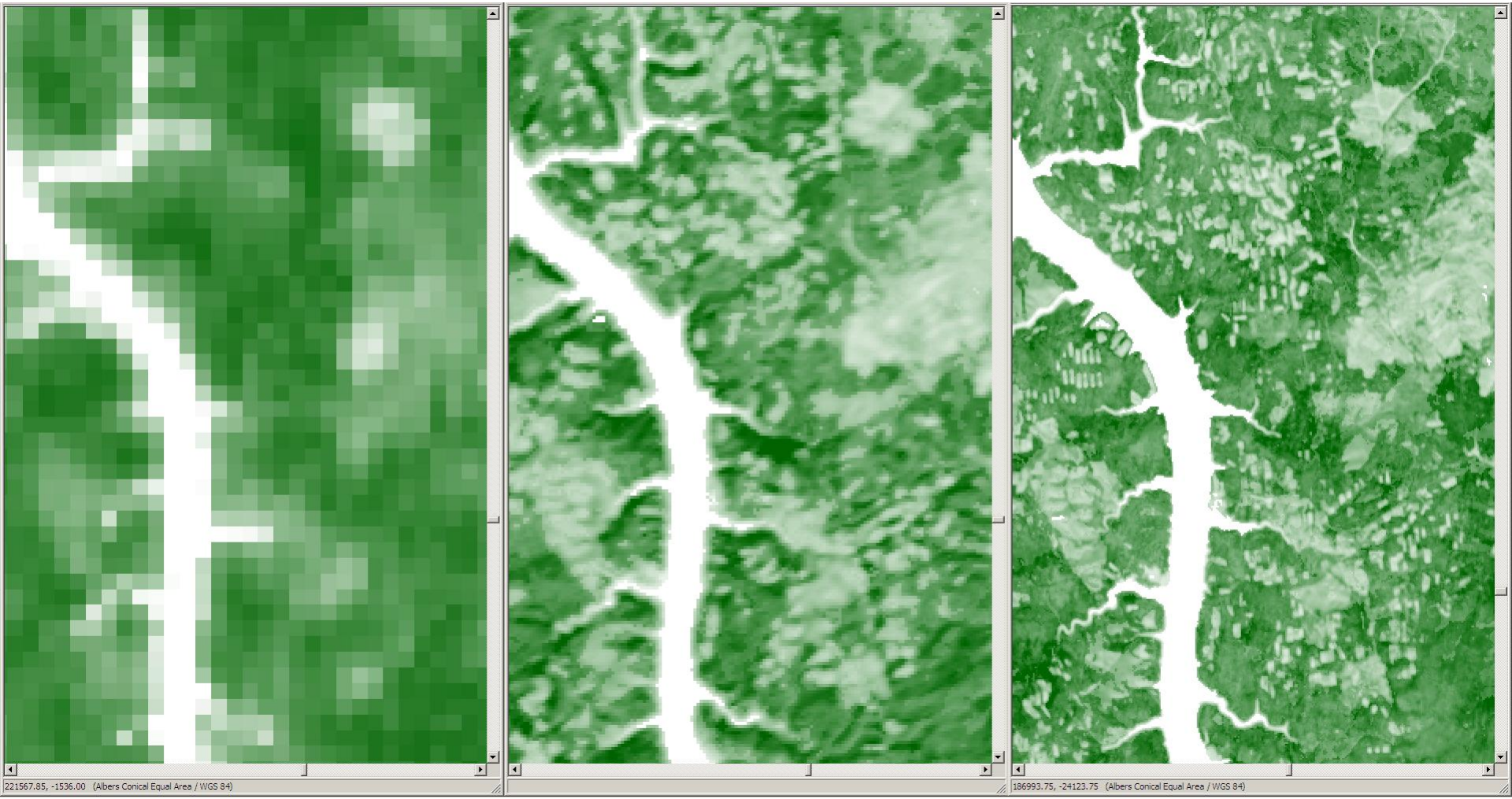
BIOMASAR (1km) MODIS (250m) PROBA-V(100m)



Growing Stock Volume (GSV), m3/ha

0 300/650

Conclusions

- The BIOMASAR 1-km data provided unique (for time being) and timely possibility to initiate developments on the regional forest GSV products;
    - So we are looking forward to new GlobBiomass products !
- The regional forest GSV products still have obvious issues to be solved:
    - The winter MODIS/Proba-V data compositing method requires improvement to filter out of observations related to “snow on tree crowns”
    - The method for radiometric normalisation of topographic effect is under development
- Rigorous validation of the regional forest GSV products is required