

# **Product Delivery Report for K&C Phase 3**

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GAMMA Remote Sensing

Science Team meeting #21 – Phase 3 Result Presentations  
Kyoto Research Park, Kyoto, Japan, December 3-4, 2014

## Collaborators

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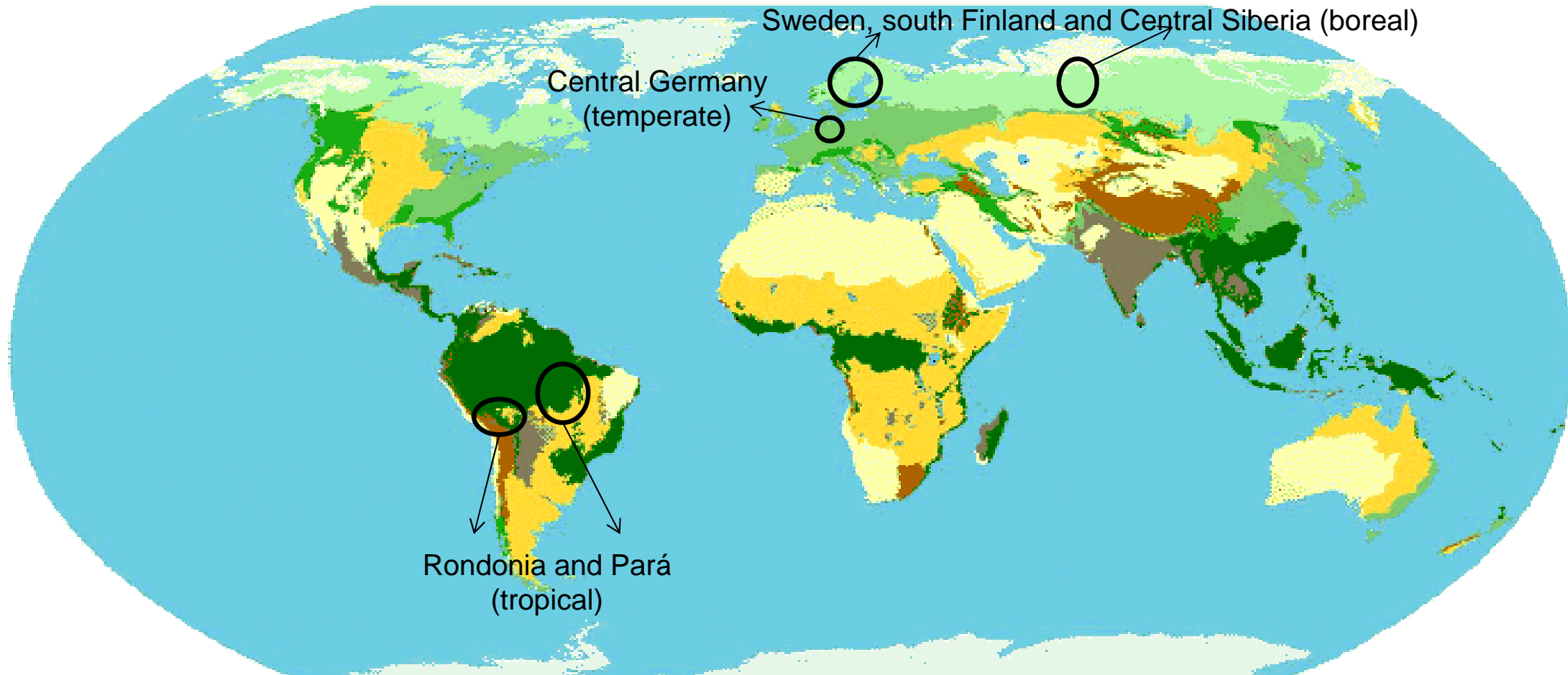
*Friedrich Schiller University*

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

## Project objectives

- Exploit JAXA's yearly mosaics of forest cover and time series of PALSAR image data to obtain high-quality estimates of forest parameters,
- **FULFILLED: multi-temporal data (FBD and WB) were fundamental**
- Provide biomass estimates to be fed into ecosystem models in correspondence of a number of sites with flux measurements to assess improvement in modelling (→ addressing carbon cycle science)
- **PARTLY FULFILLED: the biomass dataset has been investigated but the use a in ecosystem models has been undertaken yet.**
- Support JAXA by evaluating SAR and forest datasets w.r.t internally produced datasets. Product merging (synergy) not excluded..
- **FULFILLED: quality of mosaic and strip data reported (meetings, emails etc.)**

## Study regions



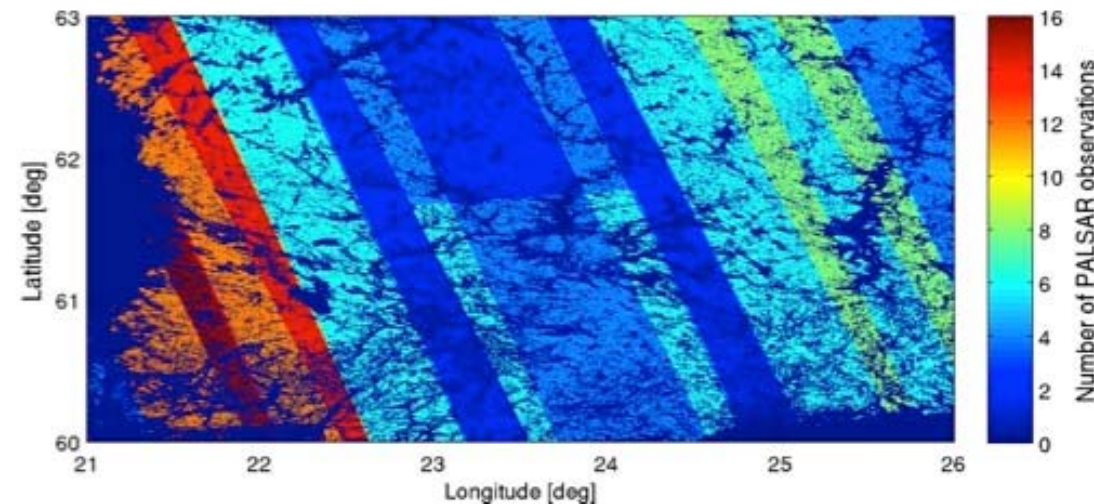
- Availability of in situ and/or other EO datasets to assess GSV retrieval
- Proximity to Fluxnet sites → assess the contribution of SAR-based, high-resolution estimates of biomass to carbon fluxes modeling



## PALSAR dataset

Study area	Area (10 <sup>6</sup> km <sup>2</sup> )	Min, average and max PALSAR observations	
		FBD	WB
Sweden	1.12	0 / 8 / 24	1 / 5 / 11
South Finland	0.23	2 / 6 / 16	1 / 2 / 3
Central Germany	0.25	2 / 6 / 8	1 / 1 / 2
Central Siberia	0.52	0 / 4 / 10	1 / 8 / 15
Pará	0.82	6 / 8 / 16	1 / 12 / 21
Rondonia	0.80	6 / 8 / 16	1 / 15 / 22
TOTAL	3.74	-	-

*Number of images acquired during 2010*



*Number of observations (south Finland)*

- PALSAR achieved indeed global coverage in FBD ...
- ... but not a consistent multi-temporal coverage (see image for south Finland)
- In WB mode, some areas were more often imaged, some areas practically never

## Retrieval algorithm: BIOMASAR adapted to high-res and L-band

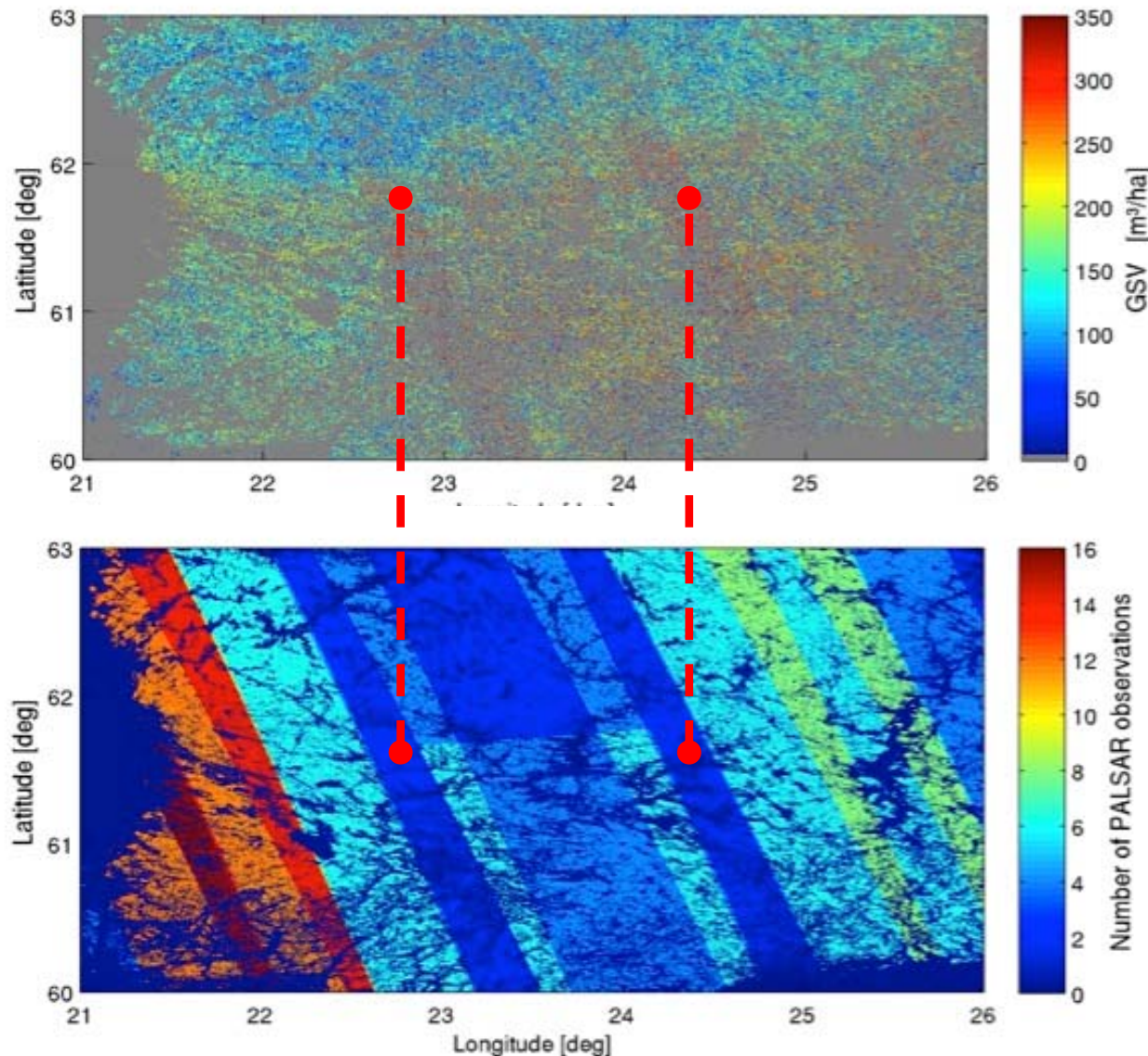
- Implements the Water Cloud Model + multi-temporal combination
- Automated approach; no need of training data

$$\sigma_{for}^o = \sigma_{veg}^o \left(1 - e^{-\beta V}\right) + \sigma_{gr}^o e^{-\beta V}$$

- Requires a dataset of canopy cover (e.g., MODIS VCF) for model training and some knowledge of GSV of dense forest / max possible GSV to calibrate the model.
- Crude assumption (to be revisited): constant transmissivity



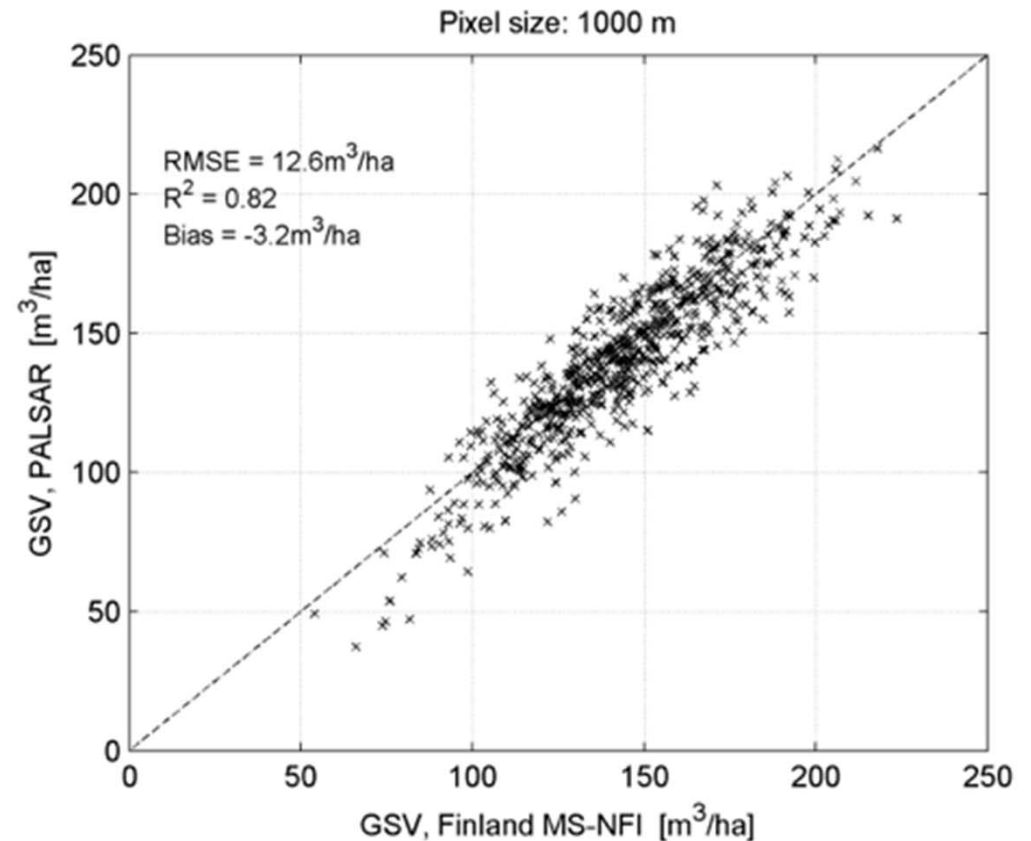
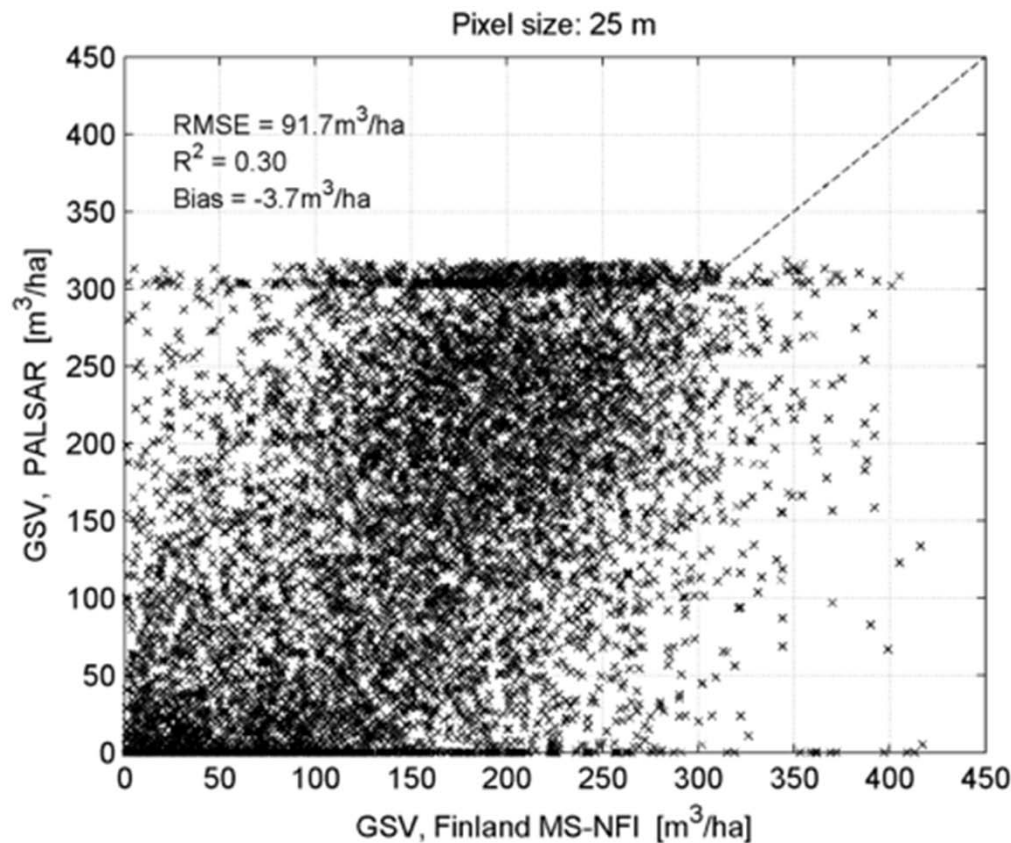
## Importance of number of PALSAR observations (FBD)



Clear artifacts and errors  
when less than 4 PALSAR  
observations (i.e., when only  
2 FBD images available)

This occurred in south  
Finland and central Germany

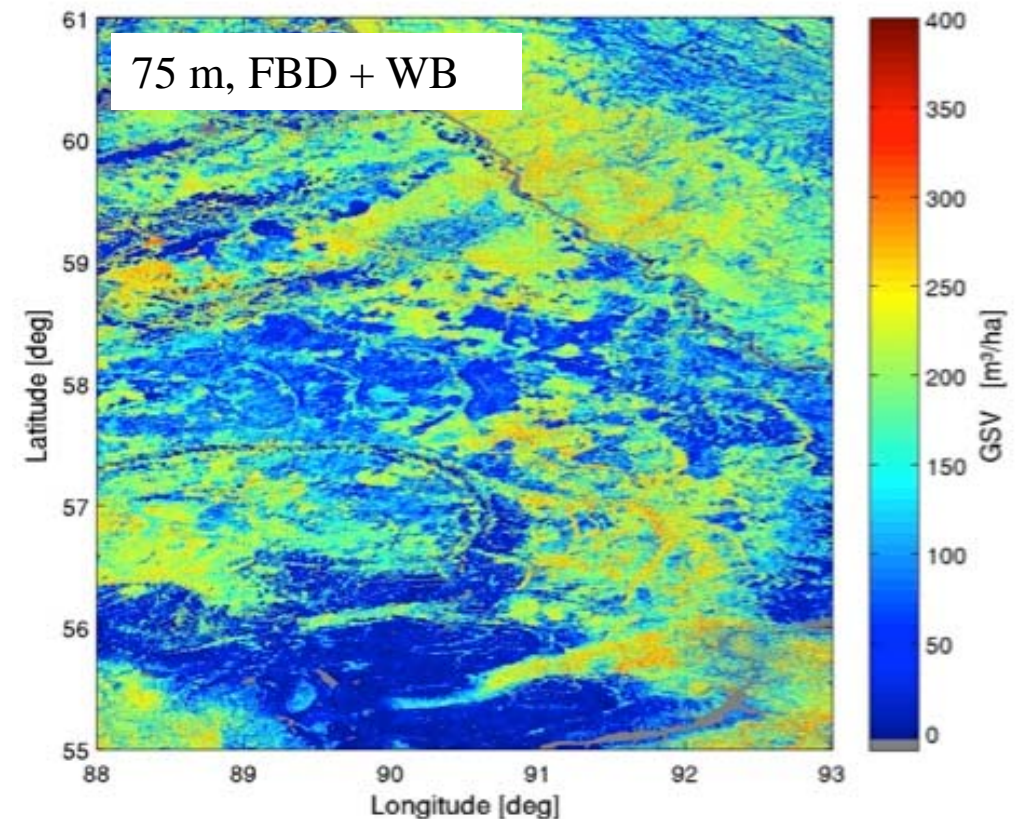
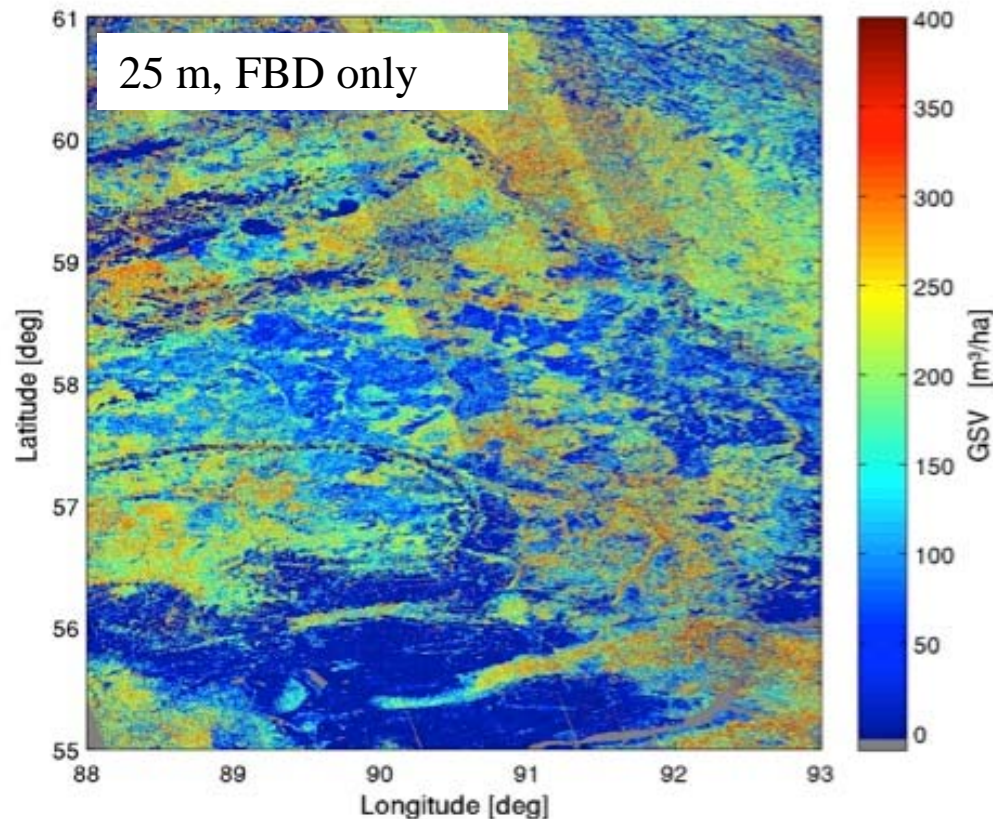
## Assessing the quality of PALSAR-retrieved GSV (example for south Finland)



- Predictions at pixel level rather fuzzy. Aggregated values at km scale very much in agreement with official estimates.



## The value of WB observations: Central Siberia

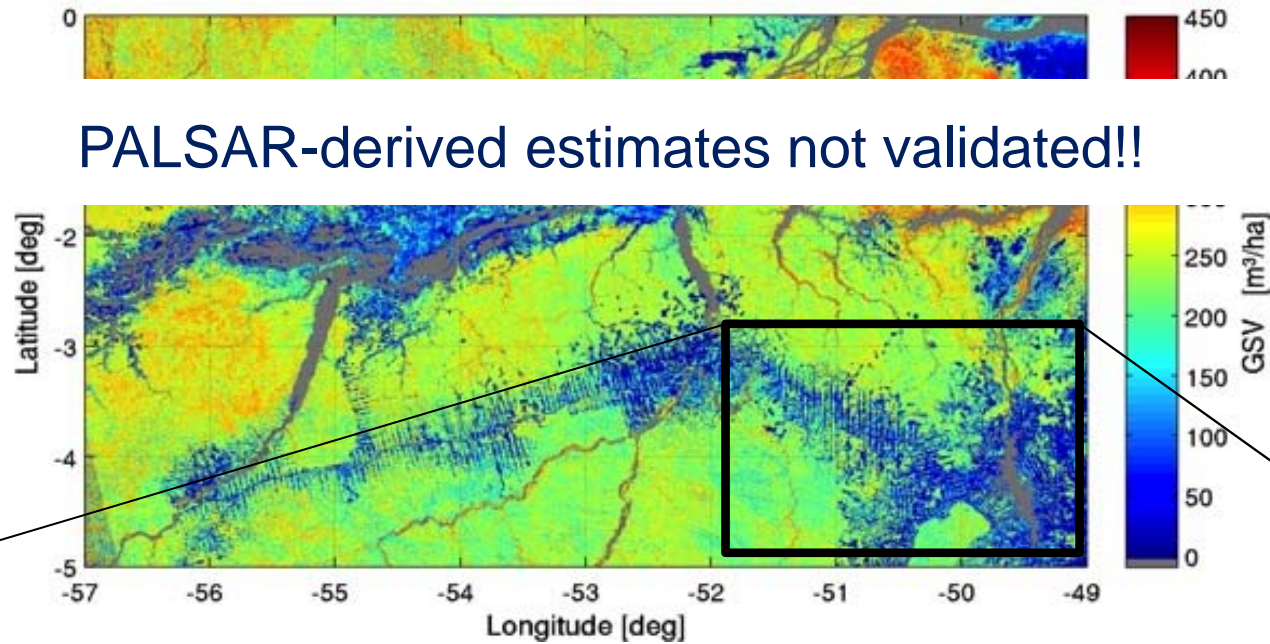


- Striped results in areas of poor FBD coverage (less than 4 images)
- Complementing FBD with WB increases multi-temporal dataset and improves quality of retrieval

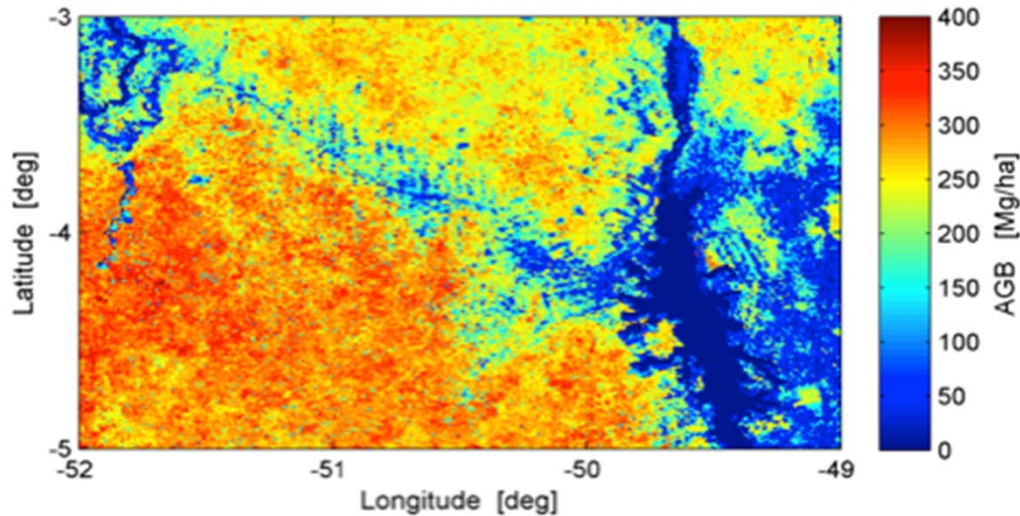


# Pará

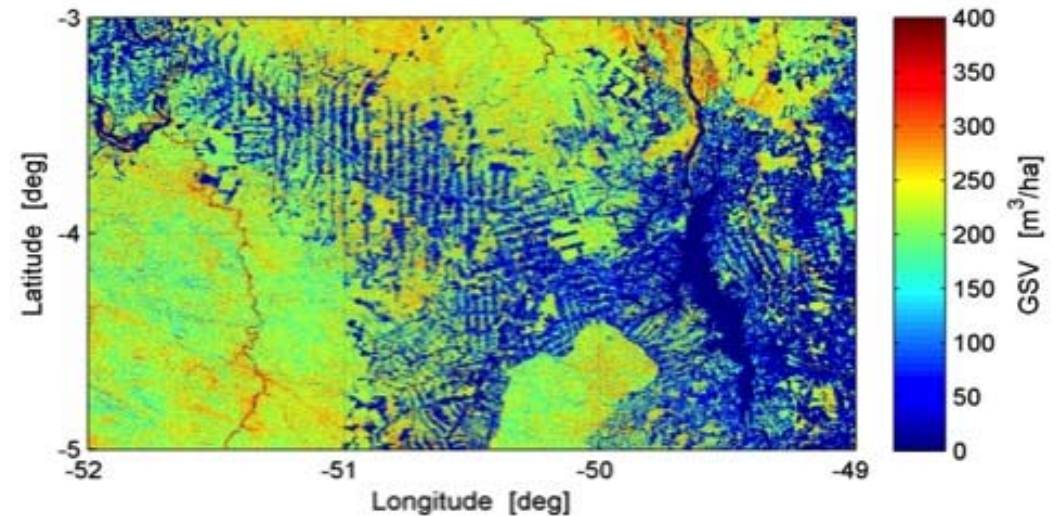
PALSAR-derived estimates not validated!!



Saatchi, pantropical, 1 km, year 2000



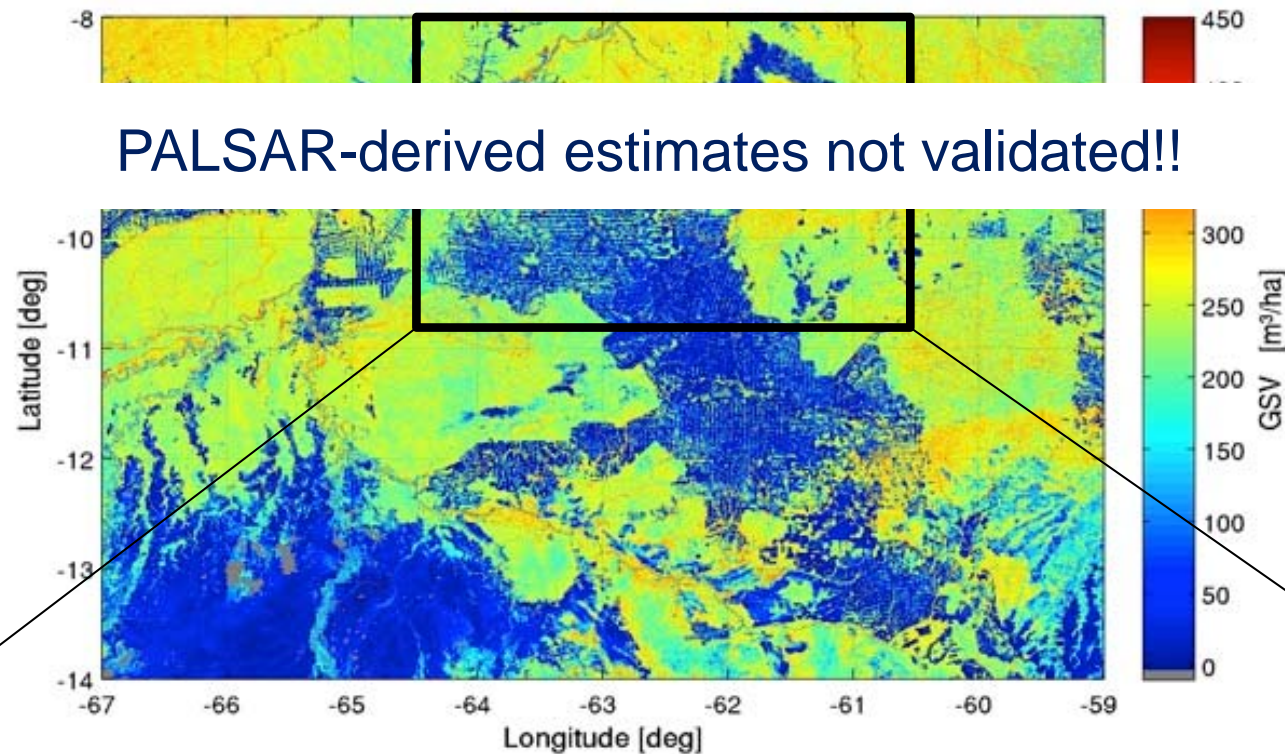
This study, 75 m, year 2010



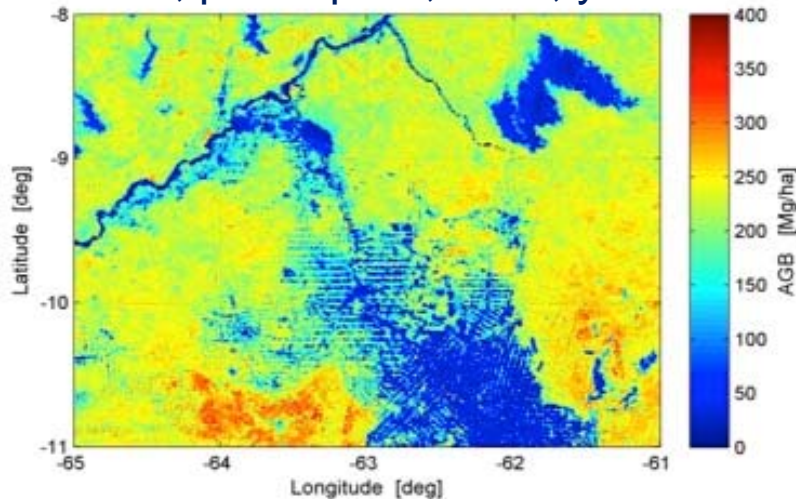


# Rondonia

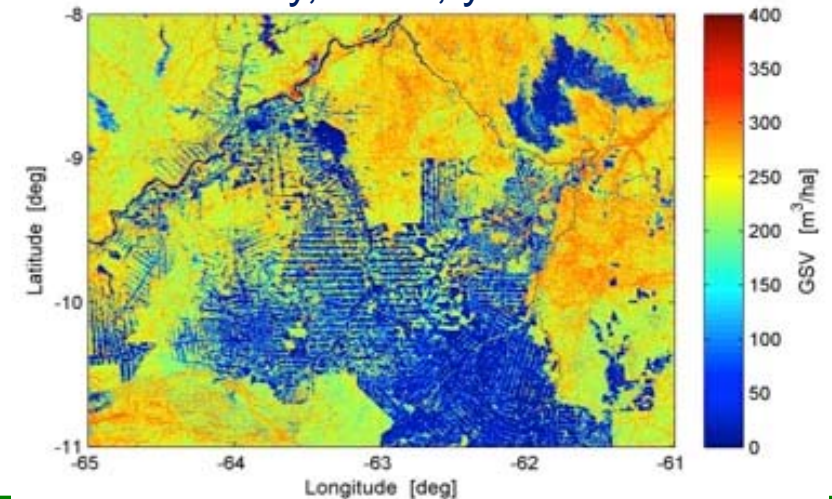
PALSAR-derived estimates not validated!!



Saatchi, pantropical, 1 km, year 2000



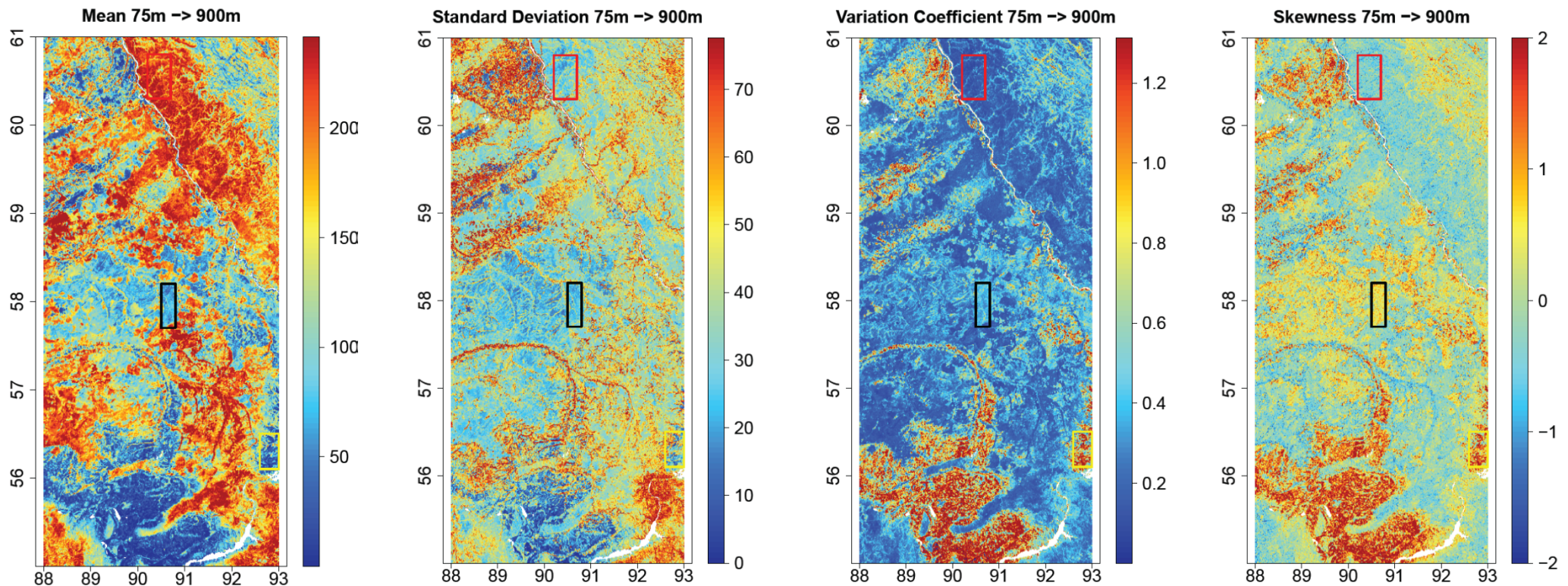
This study, 75 m, year 2010





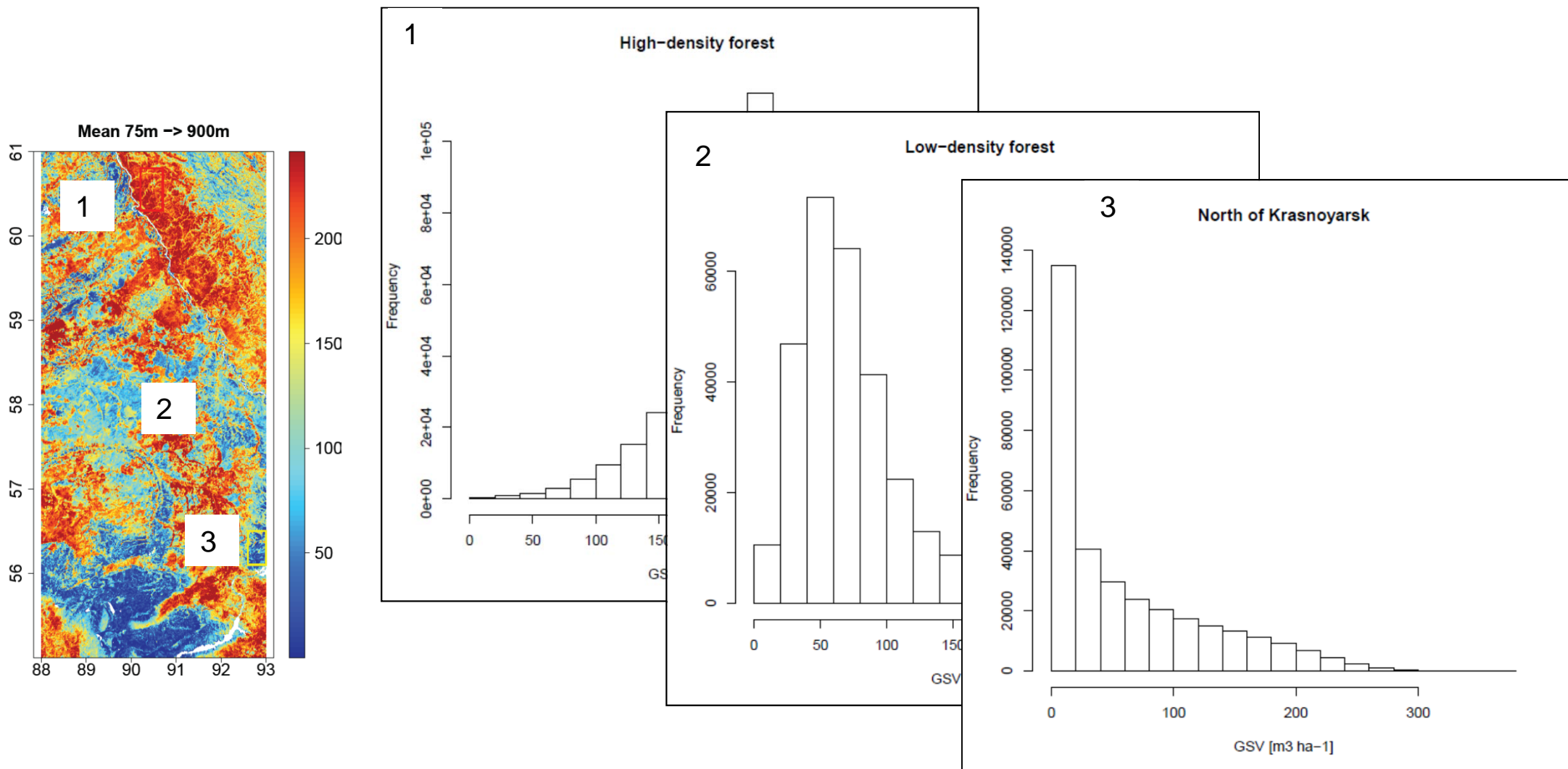
## Coupling PALSAR biomass with ecosystem models: first ideas

- PALSAR estimates are at 25 / 75 m whereas models work at km scale.
- One way to couple estimates and models is to look at statistical parameter of the PALSAR GSV data at the resolution of the models and see if those are of help



# Coupling PALSAR biomass with ecosystem models: first results

- Statistical distribution of GSV in areas of different forest density





## Continuation during Phase 4

- Revise retrieval algorithm and validate results in particular in tropical regions
- Utilize the GSV estimates in a carbon modelling framework (see e.g., Carvalhais et al., Nature, 2014)
- Given the unavailability of truly multi-temporal SAR observations during Phase 4, we shall focus on what can be extracted from mono-temporal yearly mosaics and look at decadal changes (JERS, ALOS series)
- Focus on Europe.
- Support through H2020 COREGAL project and ESA GlobBiomass



## **Deliverables – Papers and reports**

### 1. Published (please provide PDF file)

- Santoro, M., Wegmuller, U., Carvalhais, N., Thurner, M., Beer, C., Fransson, J., Schmullius, C., "K&C Science Report - Phase 3, Coupling radar-based estimates of forest information with biosphere models for improved carbon flux estimation," Scientific reports for K&C Phase 3, 2014.
- Santoro, M., Wegmüller, U., Fransson, J.E.S., Schmullius, C., "Regional mapping of forest growing stock volume with multi-temporal ALOS PALSAR backscatter", Proceedings IGARSS 2014, 14-18 July 2014, Quebec, 2014.

### 2. Submitted/in preparation

- Santoro, M., Fransson, J.E.S., Eriksson, L.E.B., "Reviewing ALOS PALSAR backscatter observations to retrieve stem volume in boreal forest", Transactions on Geoscience and Remote Sensing, submitted Sept. 2014.

## Deliverables – Papers and reports

### 2. Submitted/in preparation

- *Journal Paper 1*
  - *Santoro, M. and KC3 Team, “A model-based approach for regional mapping of forest growing stock volume from ALOS PALSAR backscatter data”, journal to be decided, submission during 2015*
- *Journal Paper 2*
  - *Turner, Beer, Carvalhais, Santoro et al., Paper on contribution of PALSAR biomass to ecosystem modelling“, journal to be decided, submission during 2015*

## **Deliverables – Data sets and Thematic products (mosaics, classification maps etc.)**

### 1. Completed and Delivered to JAXA

- *Ground truth data*
  - *Global DEM tiles based on SRTM, Eurasian digitized topo maps, Canadian CDED; USGS Alaska DEM.*
  - *BIOMASAR Pan-boreal dataset of GSV*
  - *CORINE Land Cover dataset of Europe*

### 2. Completed, but not yet delivered (please deliver ASAP)

- *PALSAR-based estimates of GSV: already delivered?*