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 #23
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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,
  - ➪ Dataset has been co-registered to ALOS-1 mosaic (see presentation of KC22 meeting)
- ALOS-1 PALSAR-1: 4 yearly datasets (2007-2010), HH- and HV-pol.
  - ➪ Base: year 2010. Individual strips presenting clear environmental effects (e.g., acquired at freeze events) have been replaced with other years (2009 and 2008)
- ALOS-2 PALSAR-2: 1 yearly dataset (2015) so far, HH- and HV-pol.
  - ➪ Mosaic obtained and ingested
- Multi-channel filter applied to improve ENL

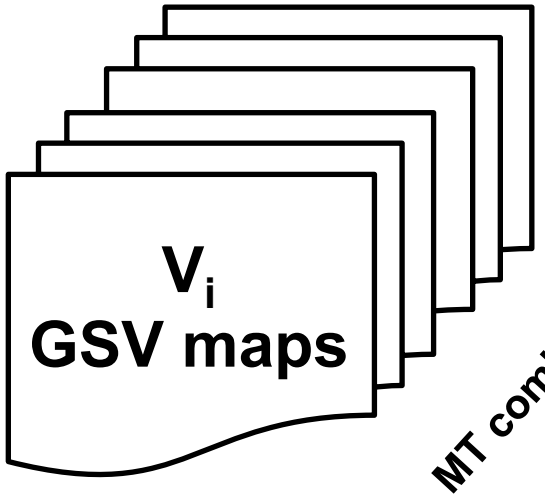
The BIOMASAR approach

Retrieving forest growing stock volume from SAR backscatter

e.g., one year of ASAR data or PALSAR mosaics

Water Cloud Model

Training with:
-MODIS VCF
- CCI land cover
- Dataset of max GSVs



MT combination

GSV map

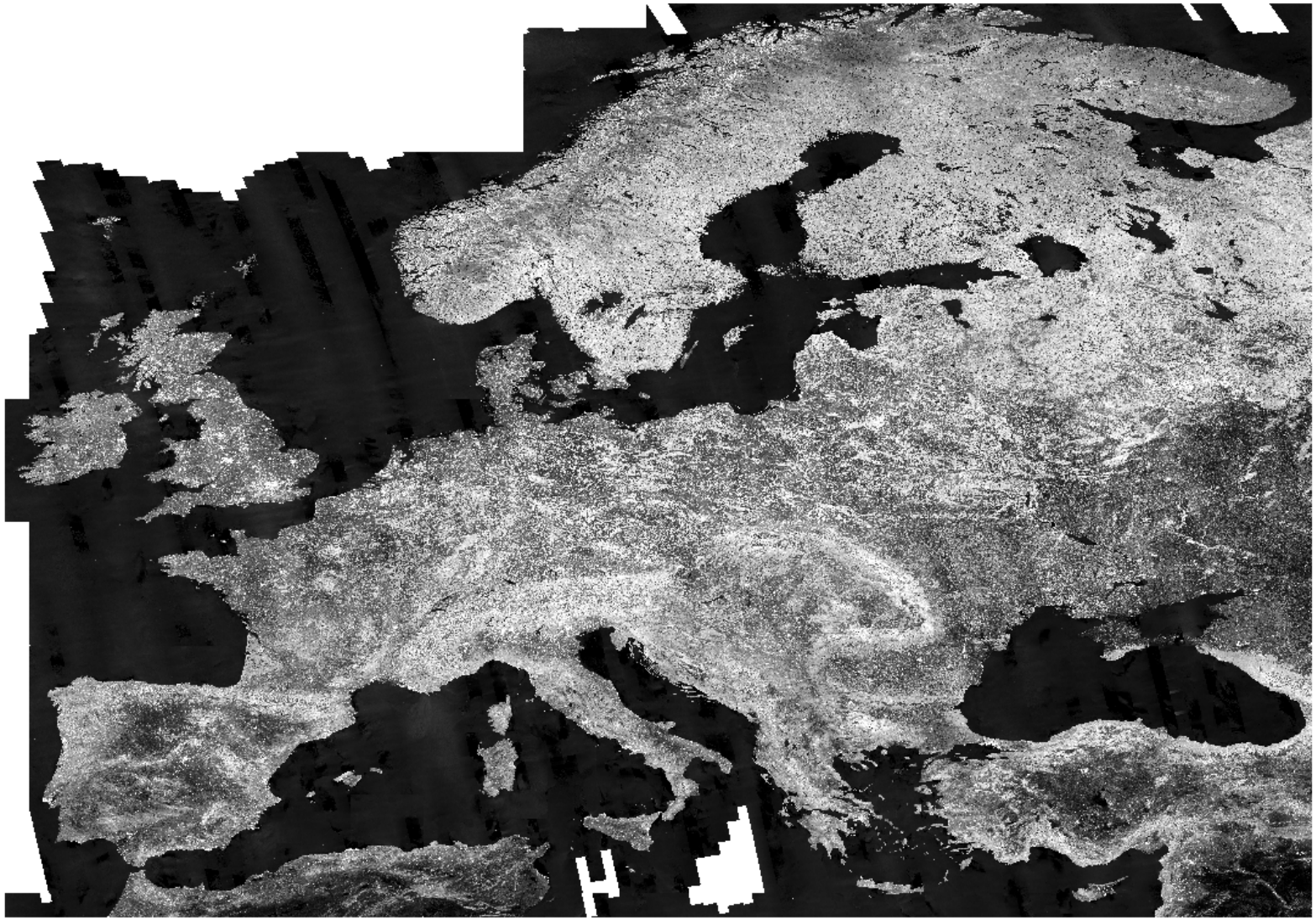
BCEF
(published by IPCC)

AGBmap

-No in situ data required to train the model

- Regional statistics and maps are used to derive global rasters of (1) forest transmissivity (radar parameter) and (2) max retrievable GSV

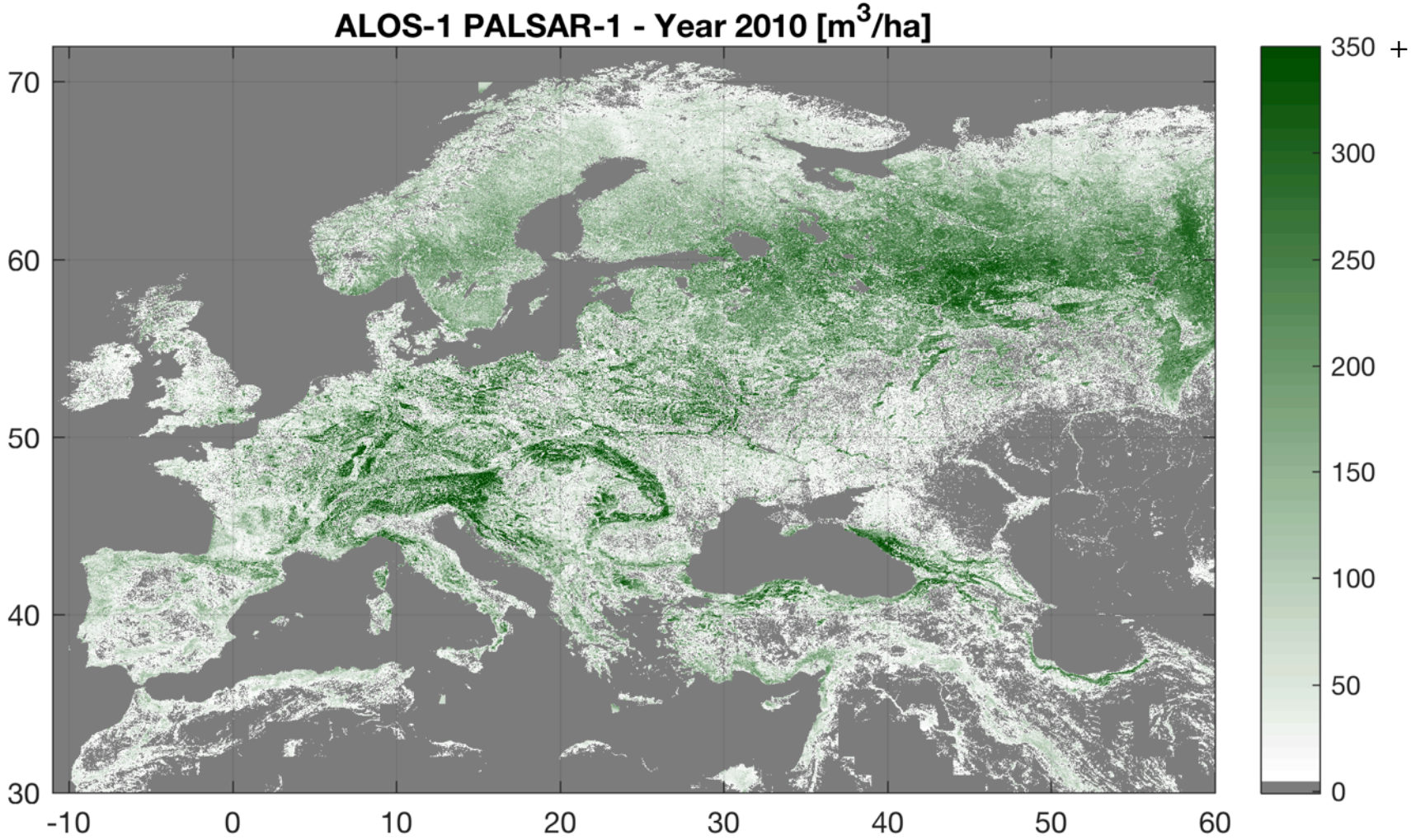
ALOS-1 PALSAR-1 mosaic, HH-pol., 2010



ALOS

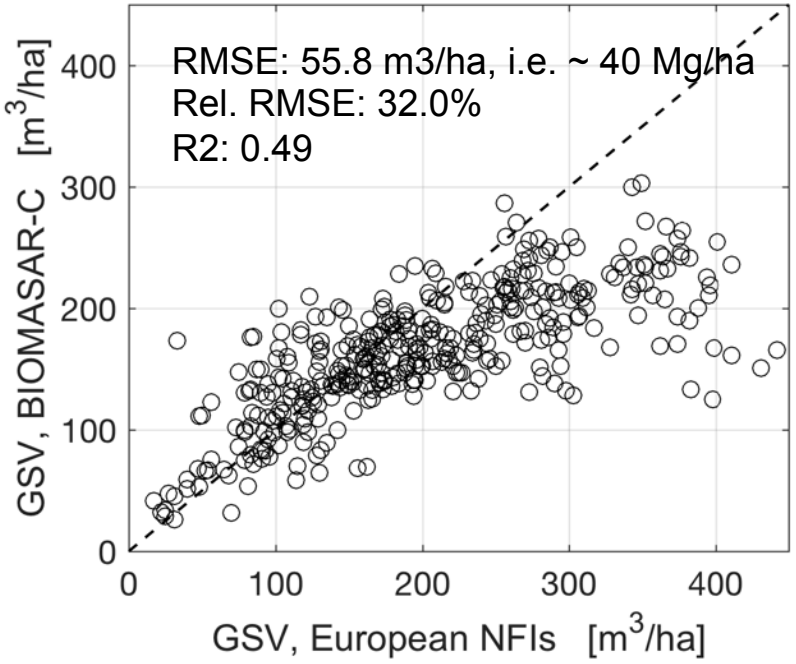
K&C Initiative

An international science collaboration led by JAXA

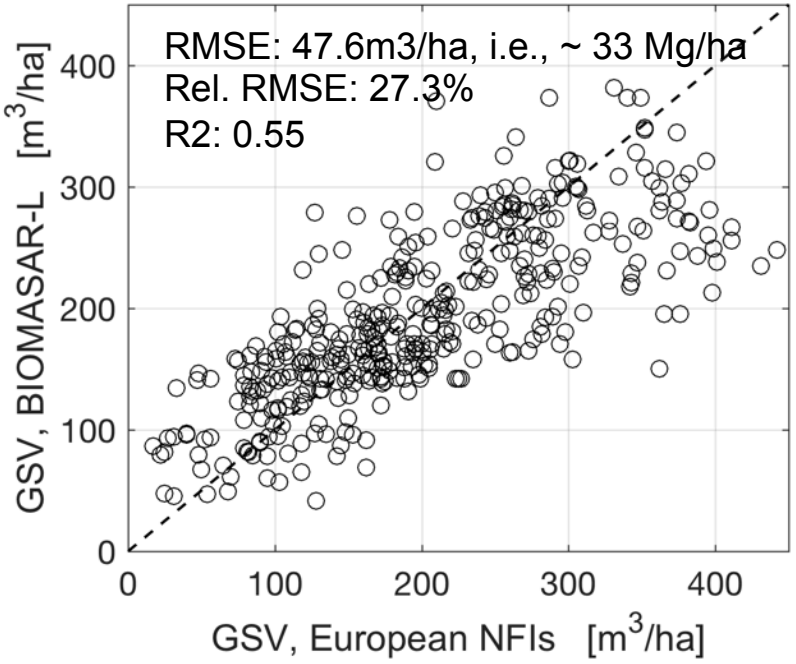


Comparison of regional estimates of GSV

C-band, ASAR, 2010, 1 km
Hyper-temporal observations



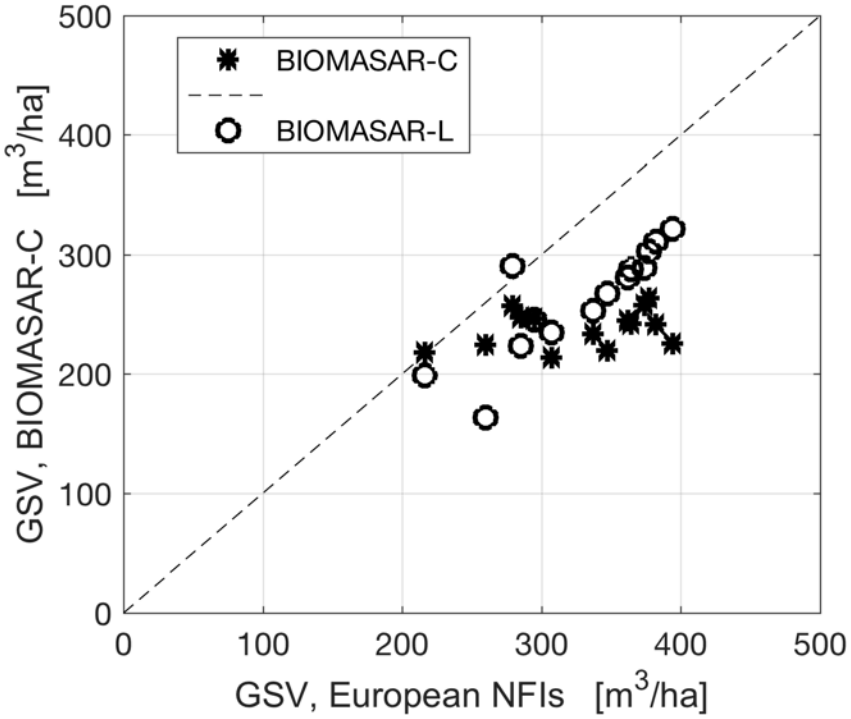
L-band, PALSAR, 2010, 25 m
one HV mosaic

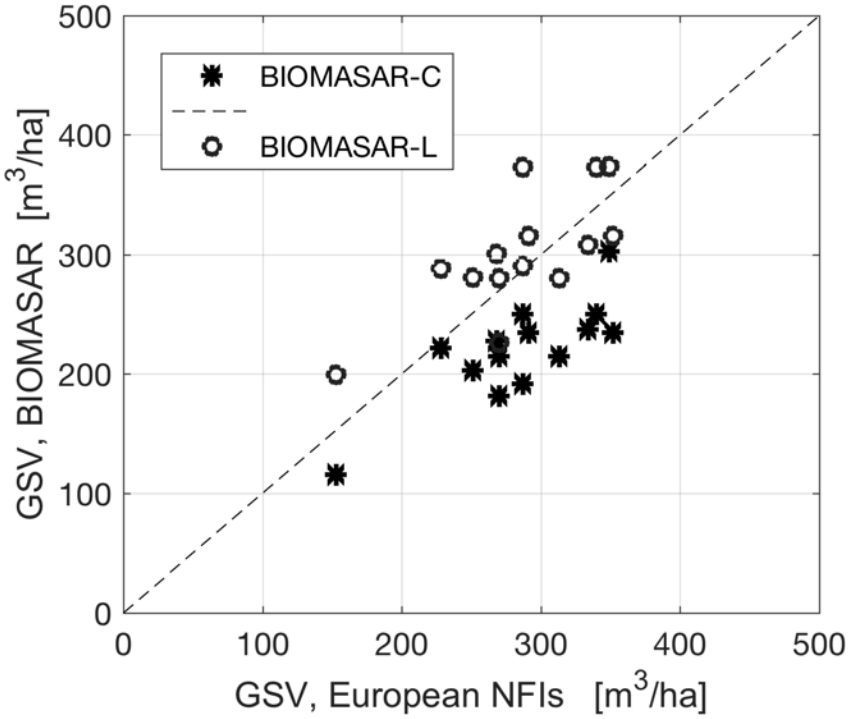


Comparison of estimates of GSV

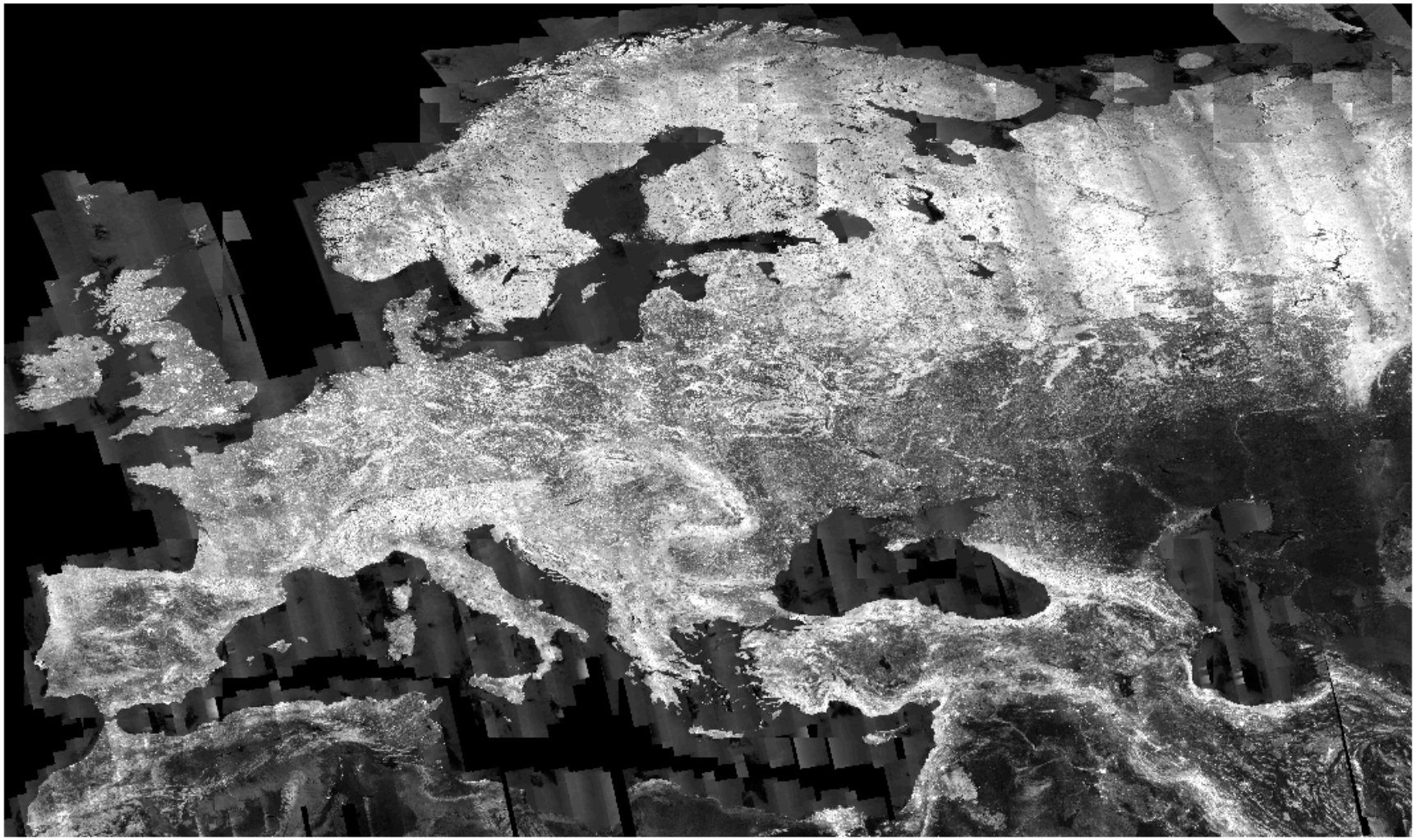
Czech Republic & Slovenia

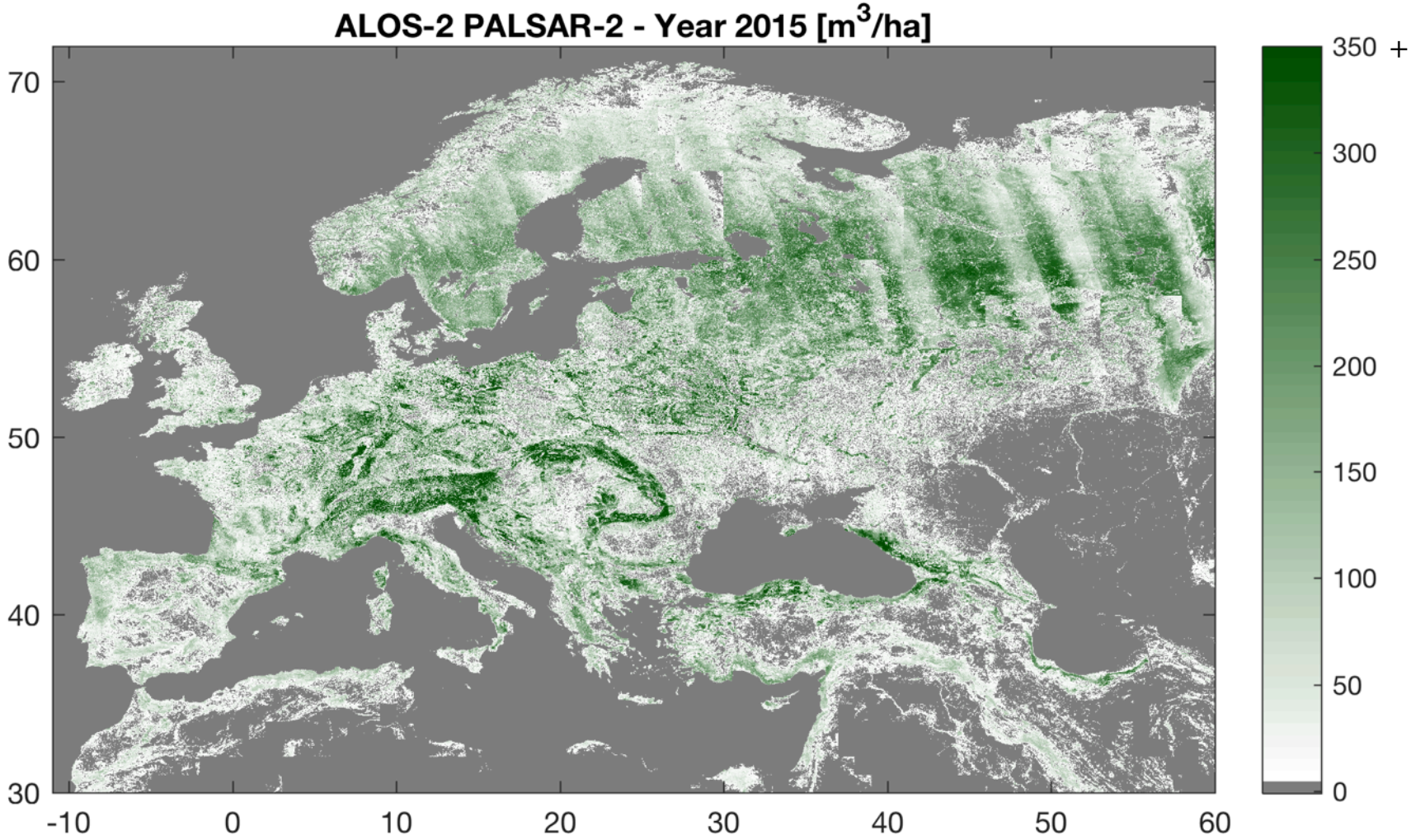
Czech Republic		Slovenia	
C-band	L-band	C-band	L-band
Rel. RMSE: 31.3%	Rel. RMSE: 21.3%	Rel. RMSE: 24.9%	Rel. RMSE: 14.1%

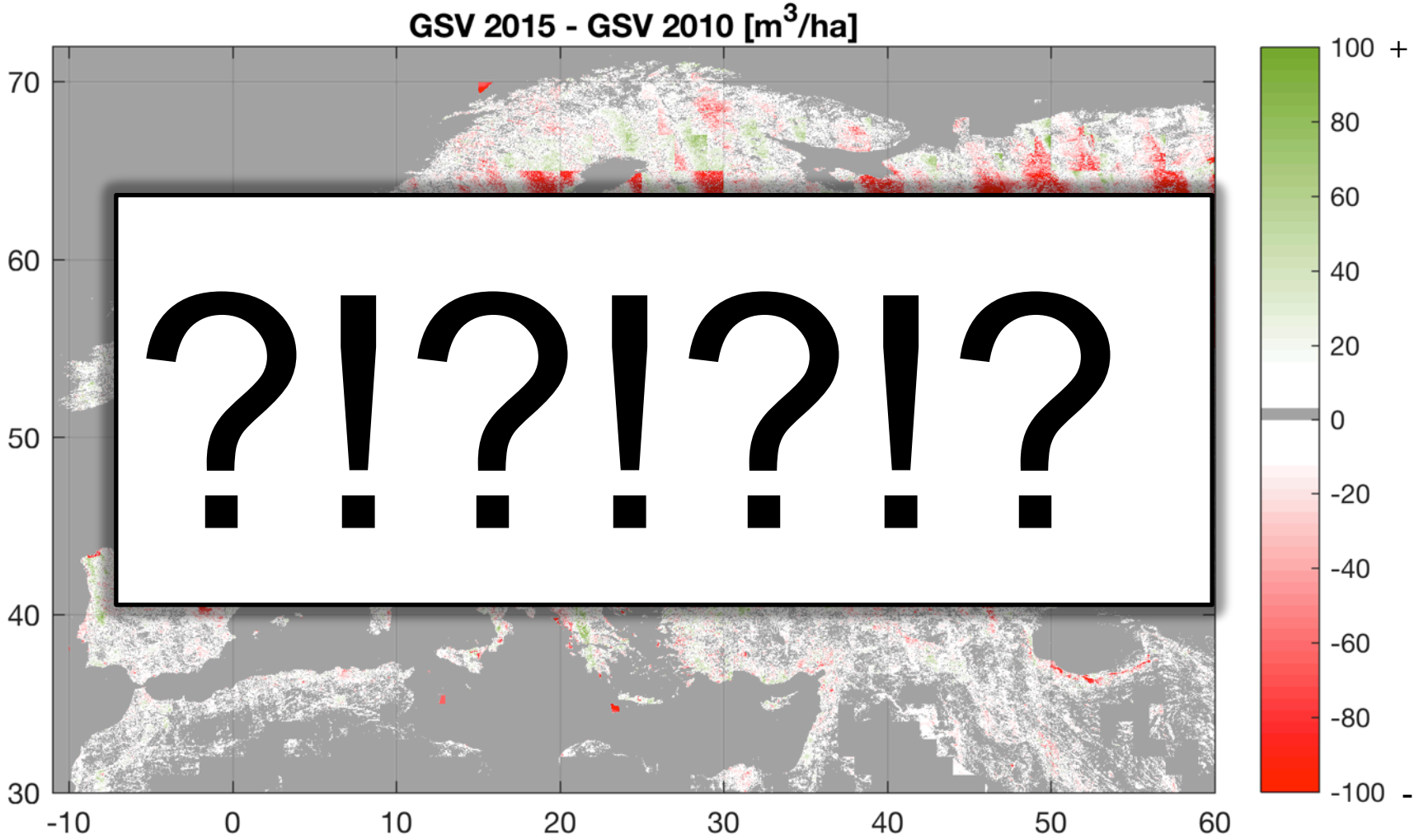




ALOS-2 PALSAR-2 mosaic, HH-pol., 2015




ALOS-2 PALSAR-2 - Year 2015 [m3/ha]
70
60
50
40
30
-10
0
10
20
30
40
50
60
350 +
300
250
200
150
100
50
0


GSV 2015 - GSV 2010 [m3/ha]
?!?!?!?
70
60
50
40
30
-10
0
10
20
30
40
50
60
100 +
80
60
40
20
0
-20
-40
-60
-80
-100 -

Project status-quo

1) Biomass retrieval algorithm for ALOS data in place (BIOMASAR-L algorithm)
2) Retrieval with ALOS-1 mosaic appears to be spatially consistent despite some light striping effects. Retrieval reasonably accurate (at provincial scale)
3) The same cannot be said for the ALOS-2 mosaic of 2015 currently available → question to JAXA: is it seasonal effects? Incidence angle? Calibration? Feathering?
4) First tests on JERS-1 data indicate also substantial artefacts in the retrieval due to poorer quality of backscatter and only co-pol data available (not a surprise though)
5) Implementation of ALOS-1 map in carbon flux accounting currently implemented by carbon modellers at MPI → results at next meeting
6) It is feared that the goal of the project cannot be reached → feedback from JAXA on ALOS-2 mosaic highly desired

Project milestones & Data sharing

1) Final evaluation of biomass estimates from K&C Phase 3 data products (mid of 2015 - completed)
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 – ALOS-1 completed, JERS-1 being revised)
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 – first map generated)
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.

NOTE: the 3 maps will be delivered once all completed and cross-checked

PALSAR/PALSAR-2 data access

Please list the PALSAR/PALSAR-2 data you have

(1) requested and (2) obtained.

JERS mosaic of SAR backscatter, epoch 1995 – obtained

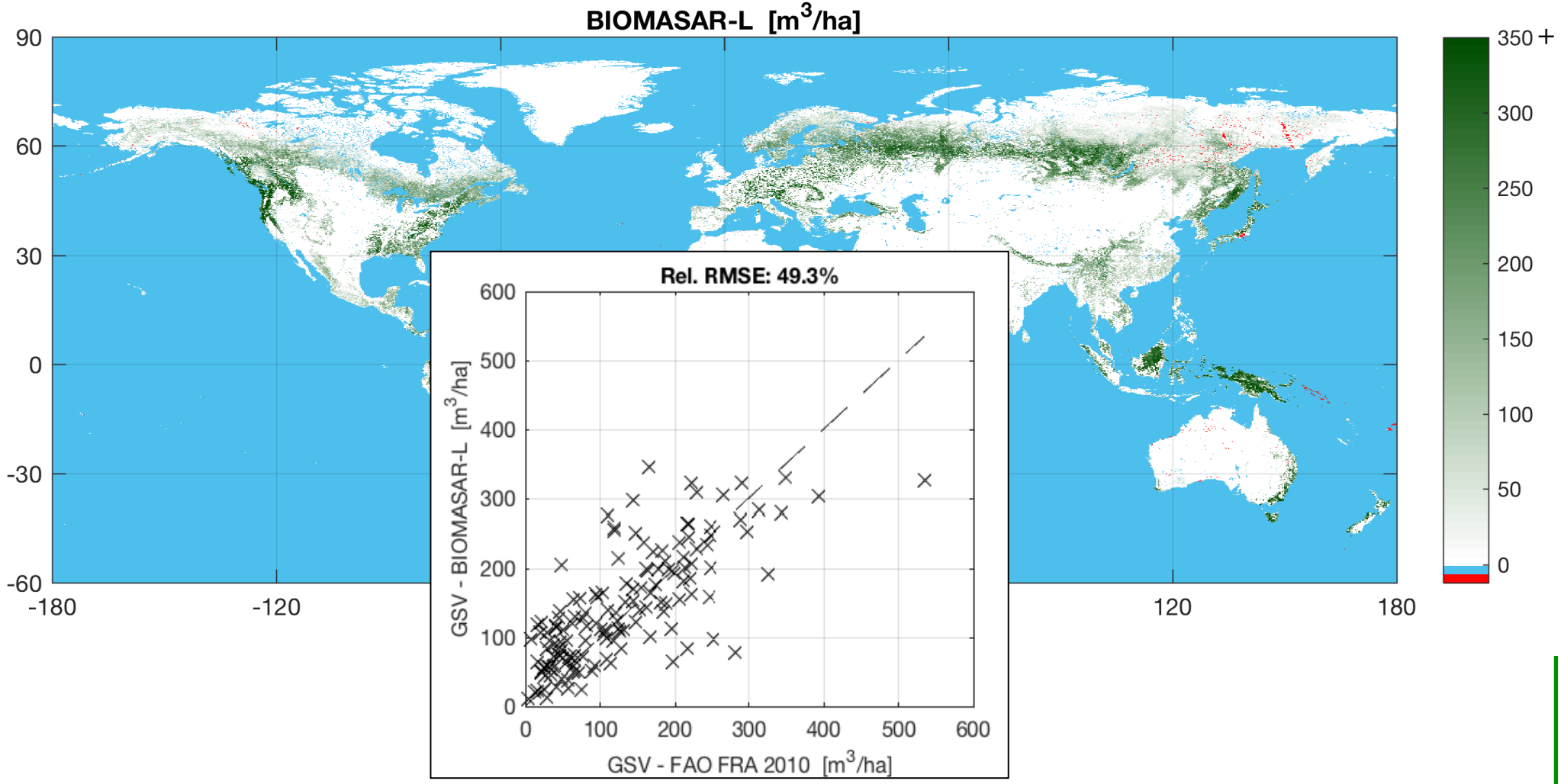
ALOS-1 PALSAR-1 mosaics of SAR backscatter 2007-2010 – obtained

ALOS-2 PALSAR-2 mosaics of SAR backscatter 2015-2017 – obtained 2015

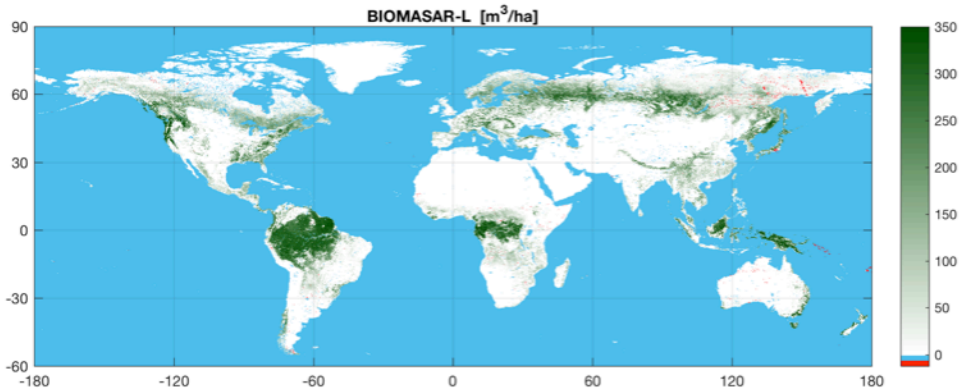
Do you have sufficient data to complete your research (according to your K&C agreement)?

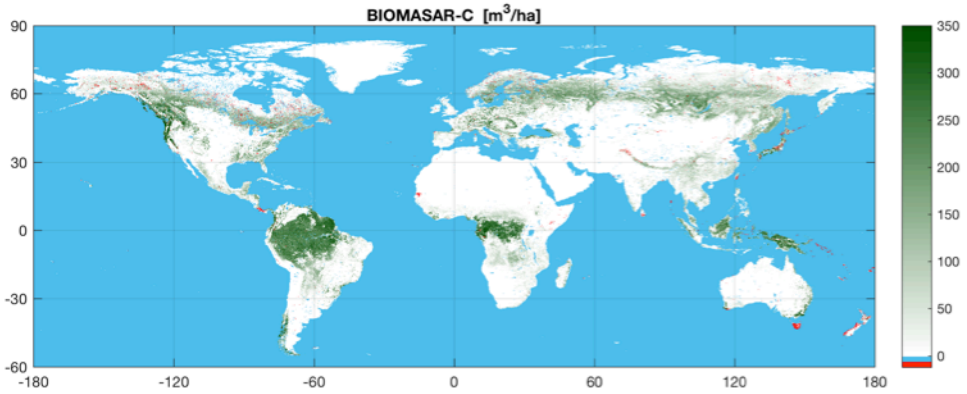
Yes, however striping effects in ALOS-2 are an issue. Individual strips could be more helpful. In addition, multi-temporal observations rather than one year mosaics would be more suitable (see also presentation by Johan Fransson)

Global map of forest GSV from ALOS PALSAR, year 2010



Towards a 2010 global map of forest biomass





- Funded by the ESA DUE GlobBiomass project
- Involved K&C science team members: GAMMA, CESBIO, FSU, SLU, Sheffield
- Release: end of 2017 - Pixel size: 25 m and aggregated versions

- Assessment and conversion to AGB ongoing, integration with C-band estimates foreseen
- **Interested in supporting the assessment? Please contact santoro@gamma-rs.ch**