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Forest map and its uncertainty as an important input for carbon sink estimation for Poland and Ukraine

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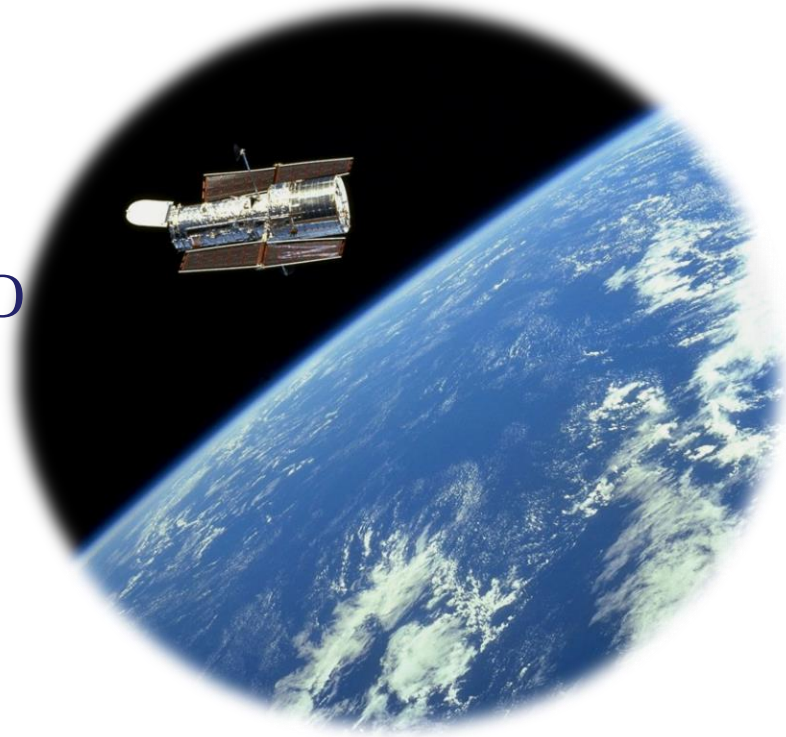
Why do we need to improve forest data ?

- Absence of forest inventory in the territories that do not belong to forest enterprises
- Unavailability of data about private forests
- Obsolete data of forest inventories
- Existence of territories with rapid changes of forest cover, e.g. encroachment of forests in abandoned agricultural land..

One of the ways to complement the in-situ forest data is

involving remote sensing data in the estimation of forest area and forest parameters

Available forest datasets



- Land cover (e.g. MODIS, GlobCover, GLC2000)
- Vegetation Continuous Fields (MODIS VCF, FAO world's forest map)
- Landsat-based forest cover (Sexton et al., 2013; Hansen et al., 2013)
- Radar-based (e.g. Jaxa Palsar forest mask)
- Hybrid (e.g. GLC-SHARE by FAO)

Input datasets used in this study:

- GlobeLand 30m (2010)
- Hansen's tree cover (2010)
- JAXA forest map at 25m resolution (2010)

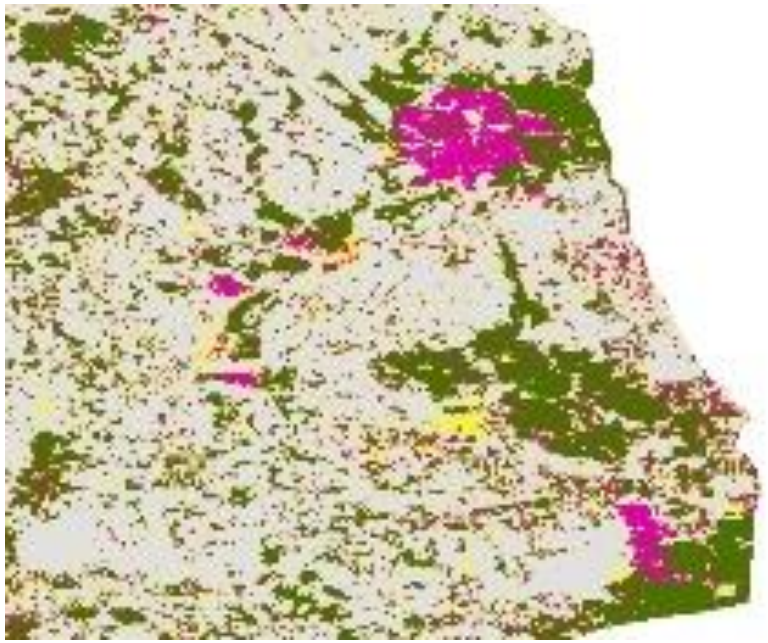
The reasons of the choice of datasets

- The year of reference – 2010
- High resolution – 30m x 30m
- Higher accuracy than of other land cover products (only Hansen's map)
- High fragmentation of Polish and Ukrainian landscapes

Overview of input datasets

- GlobeLand30m
  - global land cover product
  - based on Landsat images with the combination of land resource information and HJ-1 satellite image
- Hansen's tree cover
  - global forest cover change products
  - based on Landsat imagery
  - It is a bit closer to tree cover not forest cover
- JAXA forest map
  - global forest/non-forest map
  - based on Radar (PALSAR)

Spatial comparison of input datasets



Forest score is a number of products identifying forest and varies from 0 to 1

Examples of maps classification errors

Wetlands classified by Hansen as high percent forest

Zoom

Examples of maps classification errors

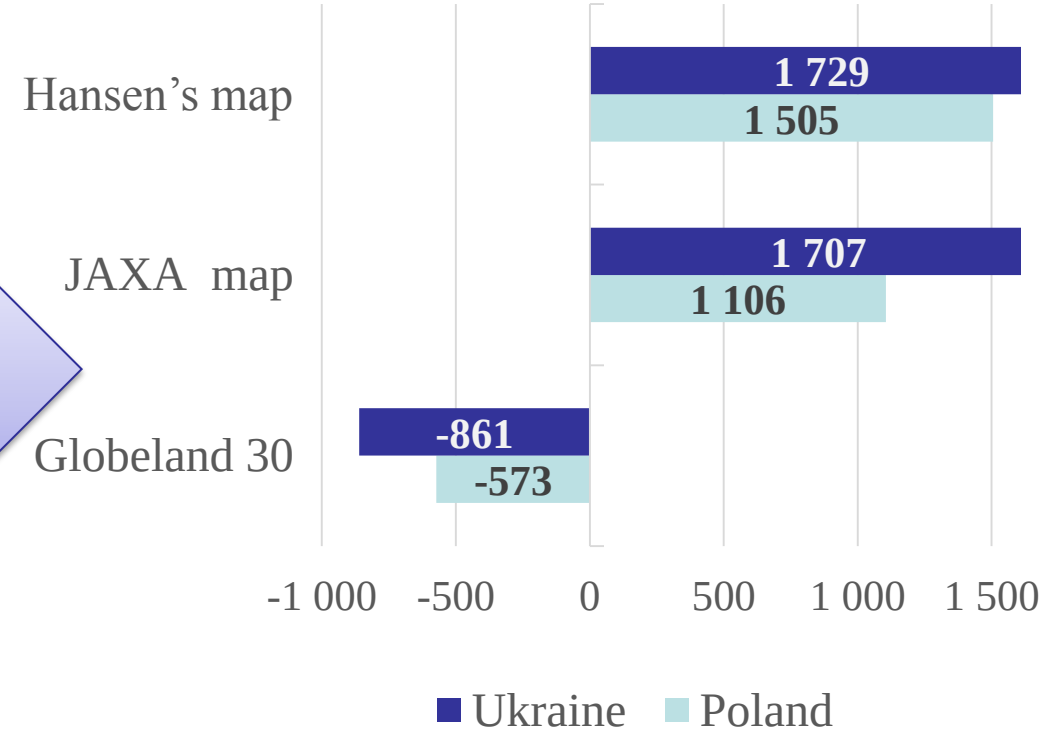
Globeland30m says that it is forest land instead of bare land

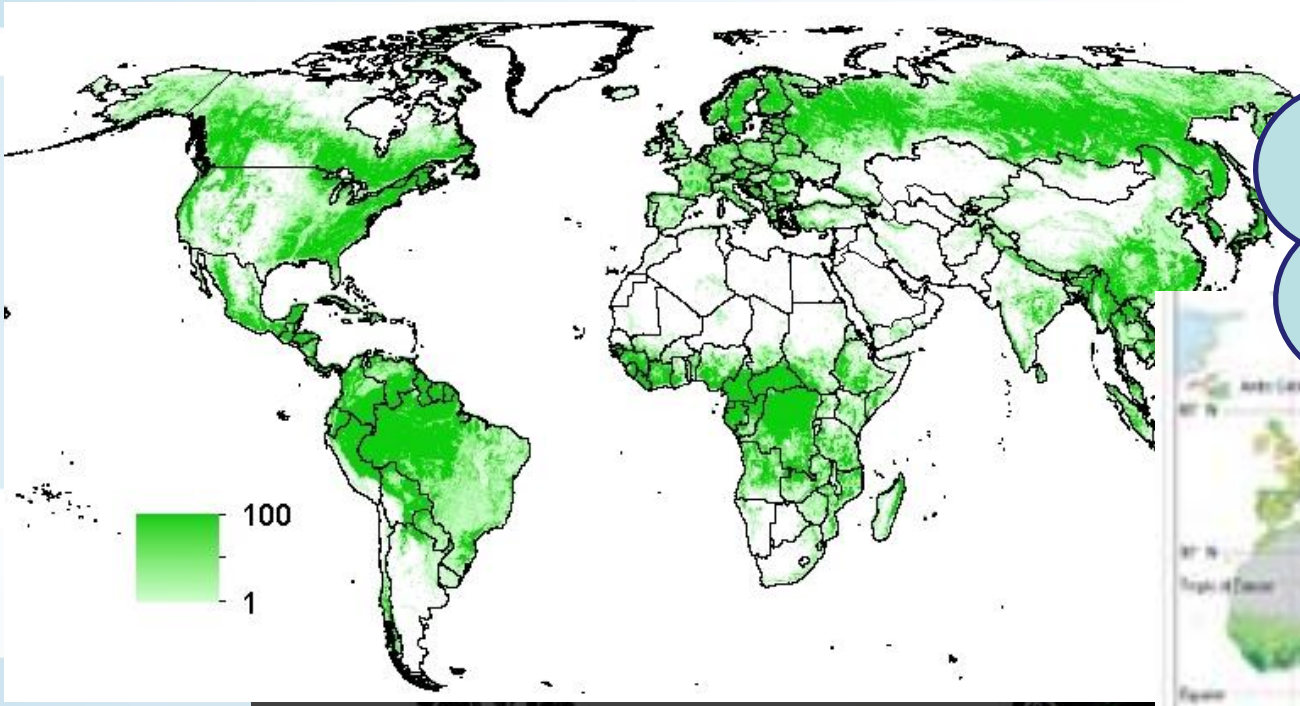
JAXA forest map says that it is forest land instead of urban area

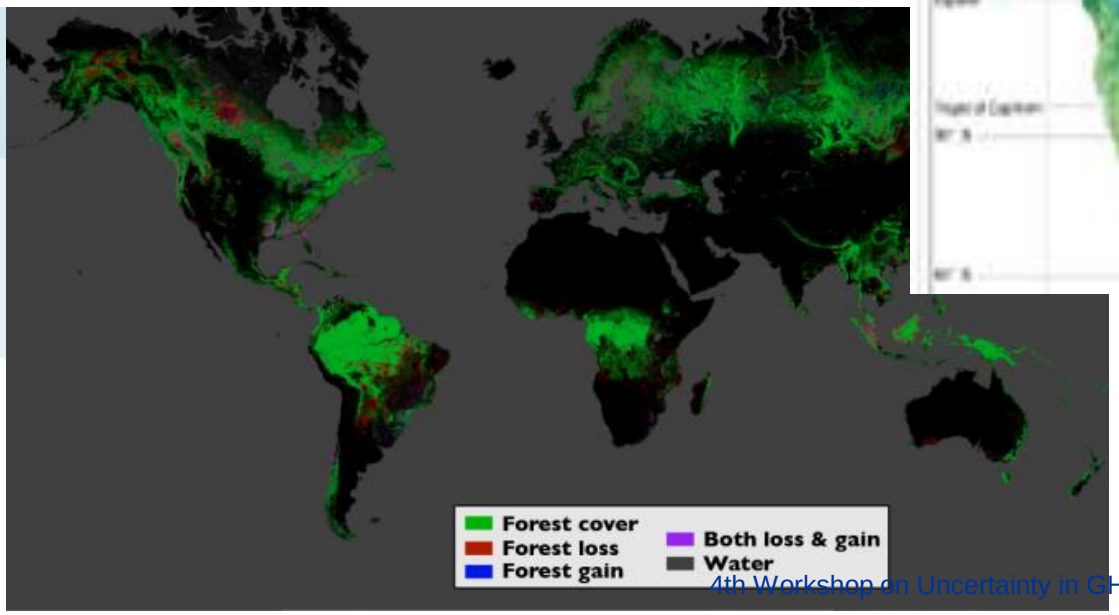
Forest area of Poland and Ukraine, 2010

Forest data	Poland K ha	Ukraine K ha
National Inventory Reports	9.337	9.573
Globeland 30	8.764	8.712
JAXA forest map	10.443	11.280
Hansen's tree cover map	10.842	11.302

Difference, K ha







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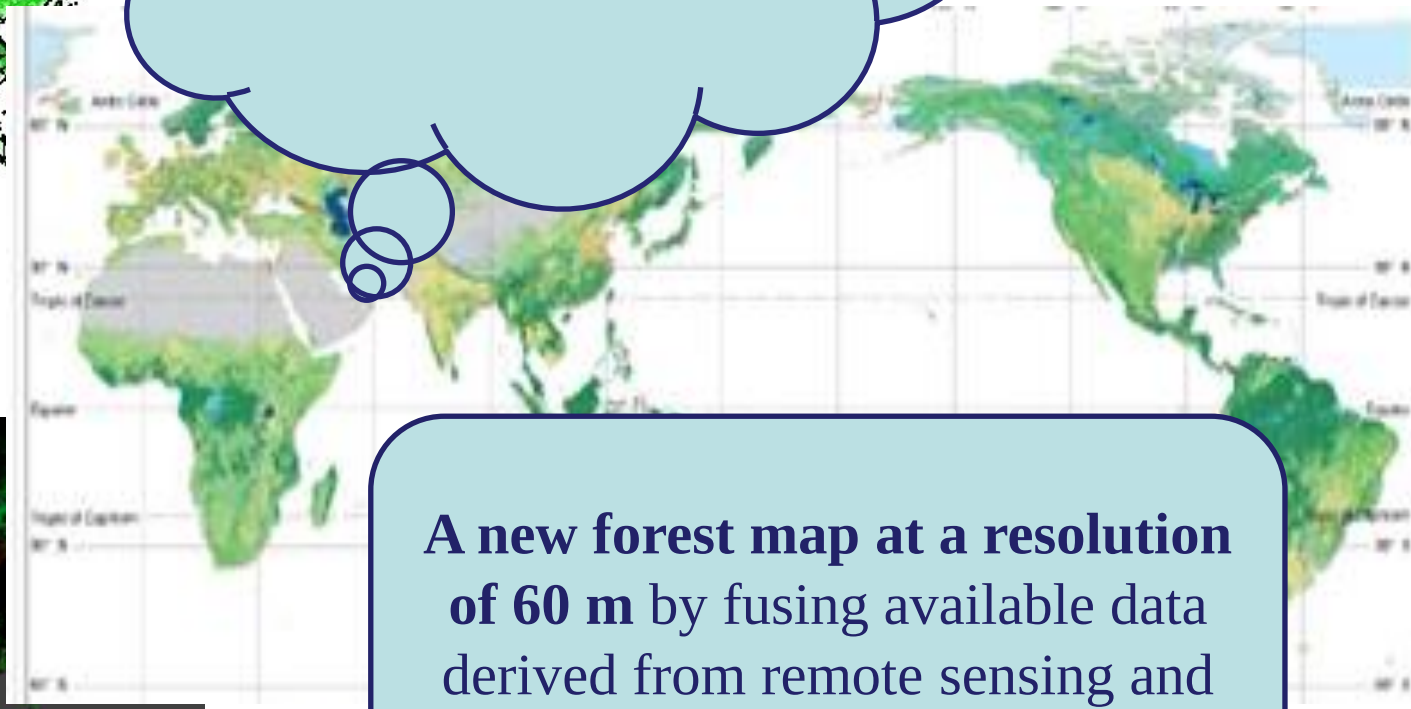
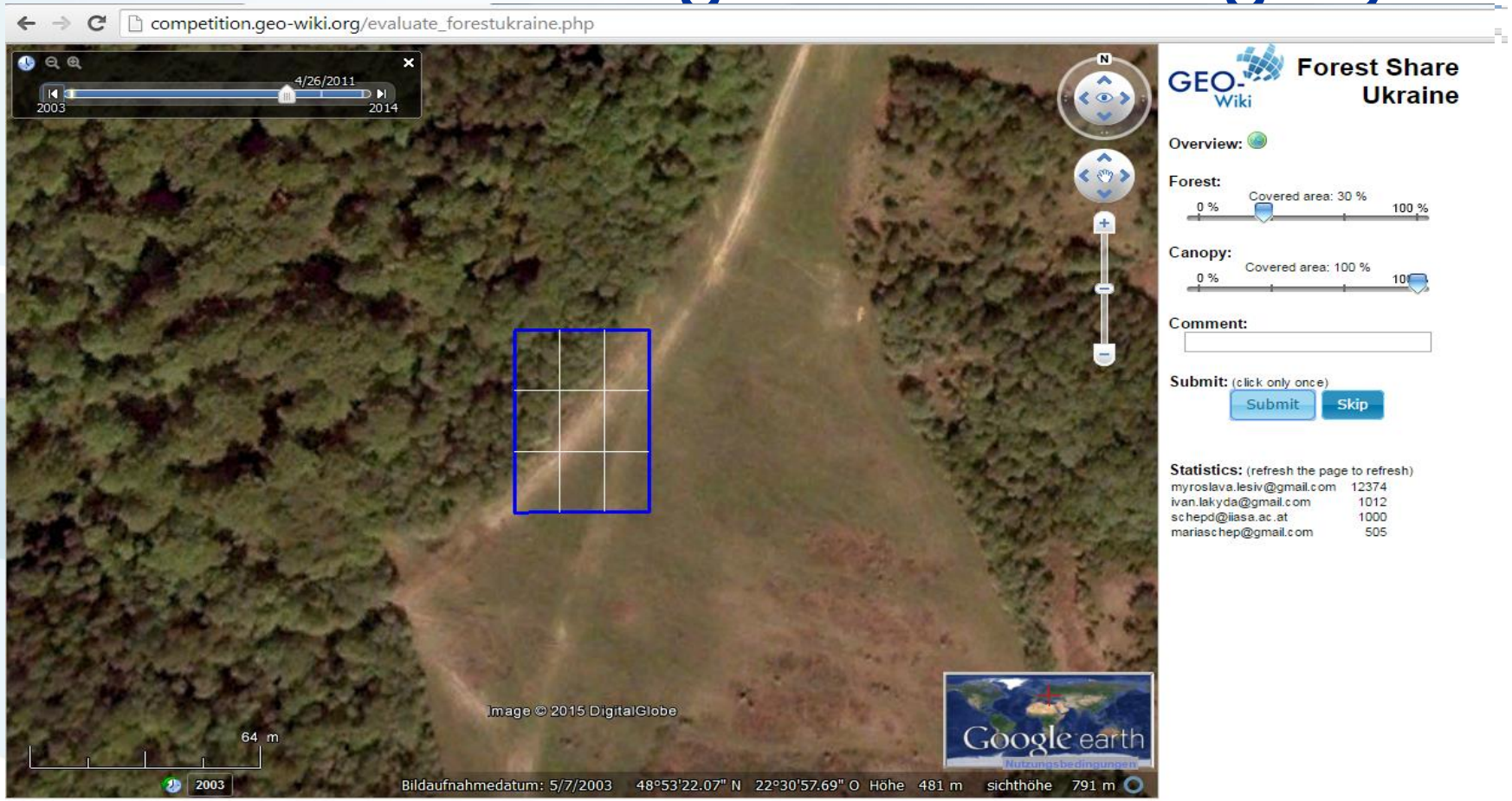


A new forest map at a resolution of 60 m by fusing available data derived from remote sensing and reference data

Estimation of forest cover using Geo-Wiki and high resolution Google Earth imagery



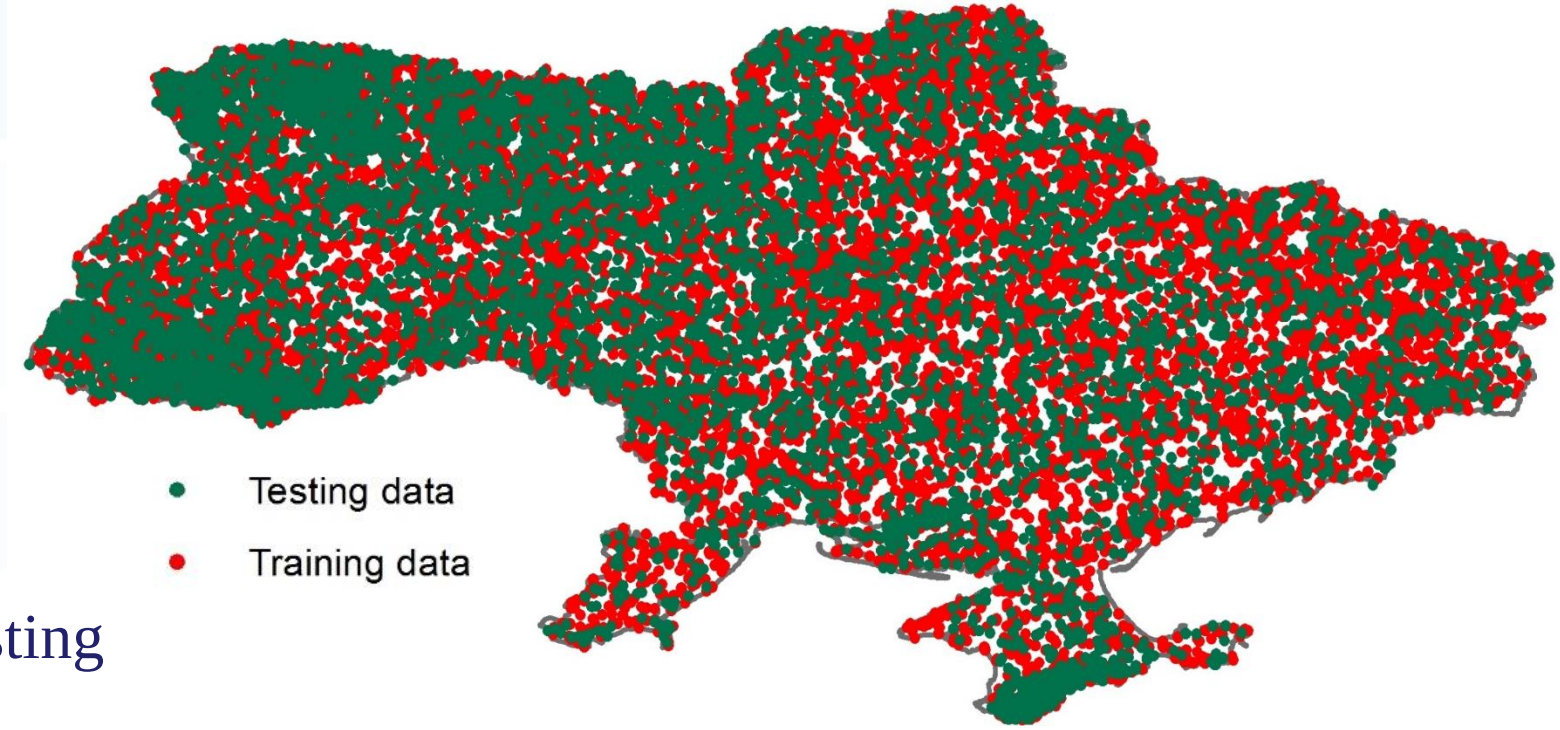
Collected Geo-Wiki data :

Ukraine:

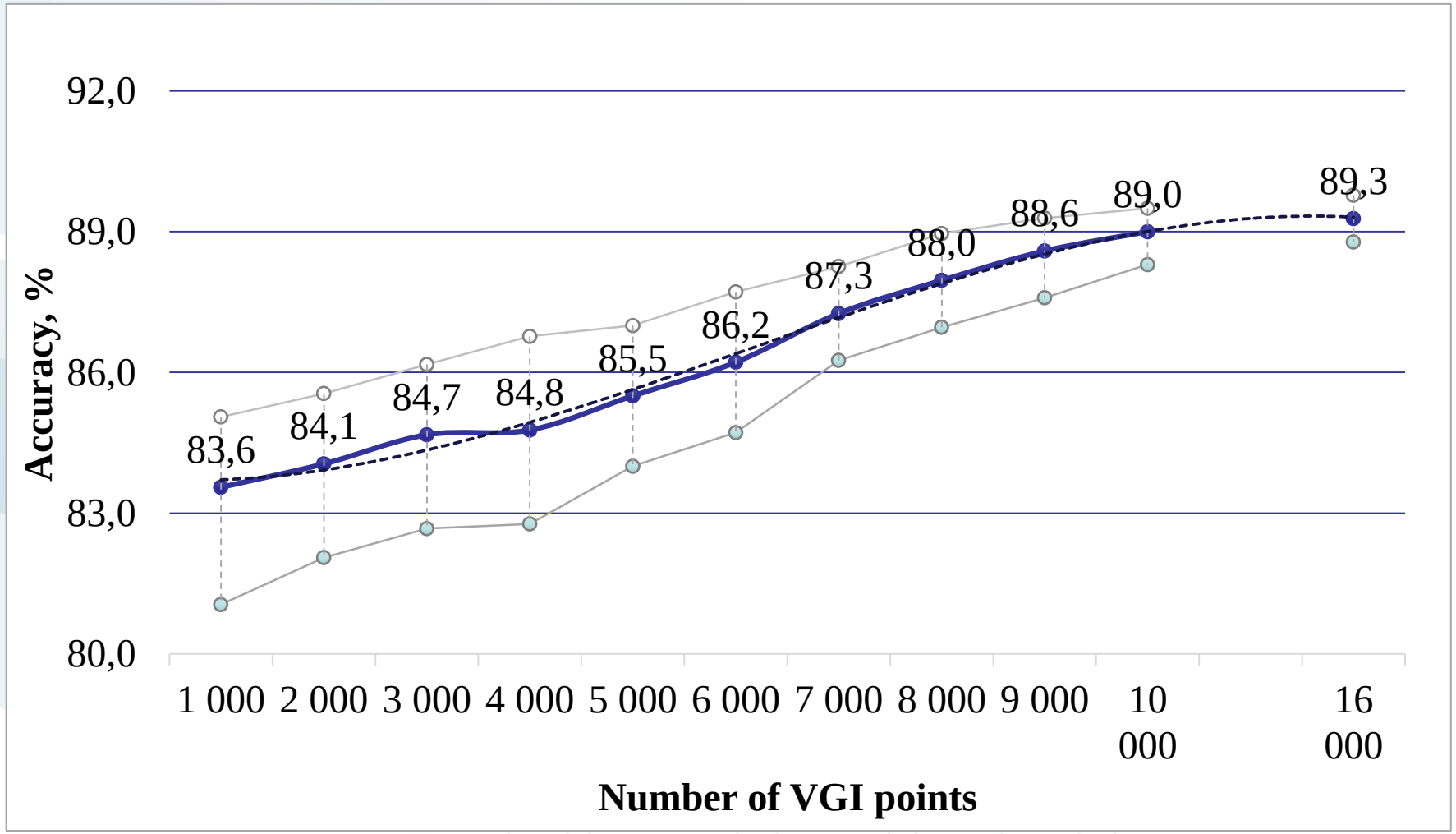
~10 K training points and ~6 K testing points

Poland:

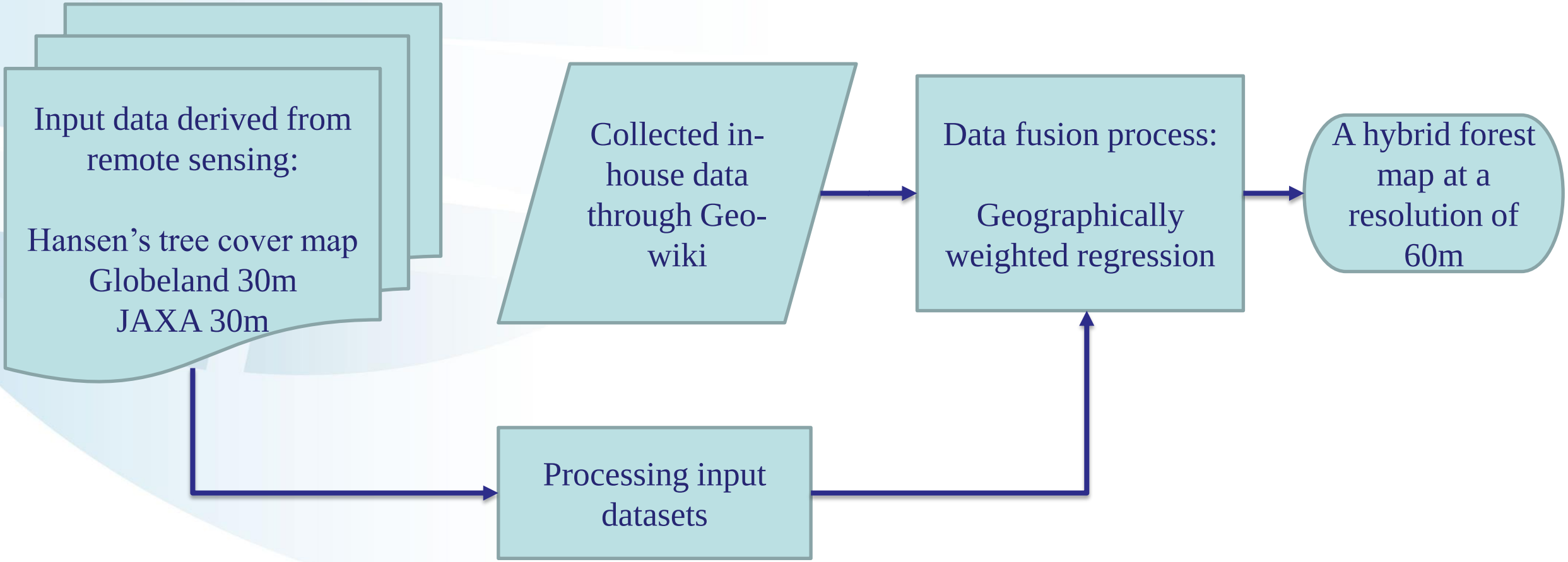
~6 K training points and 2 K testing points



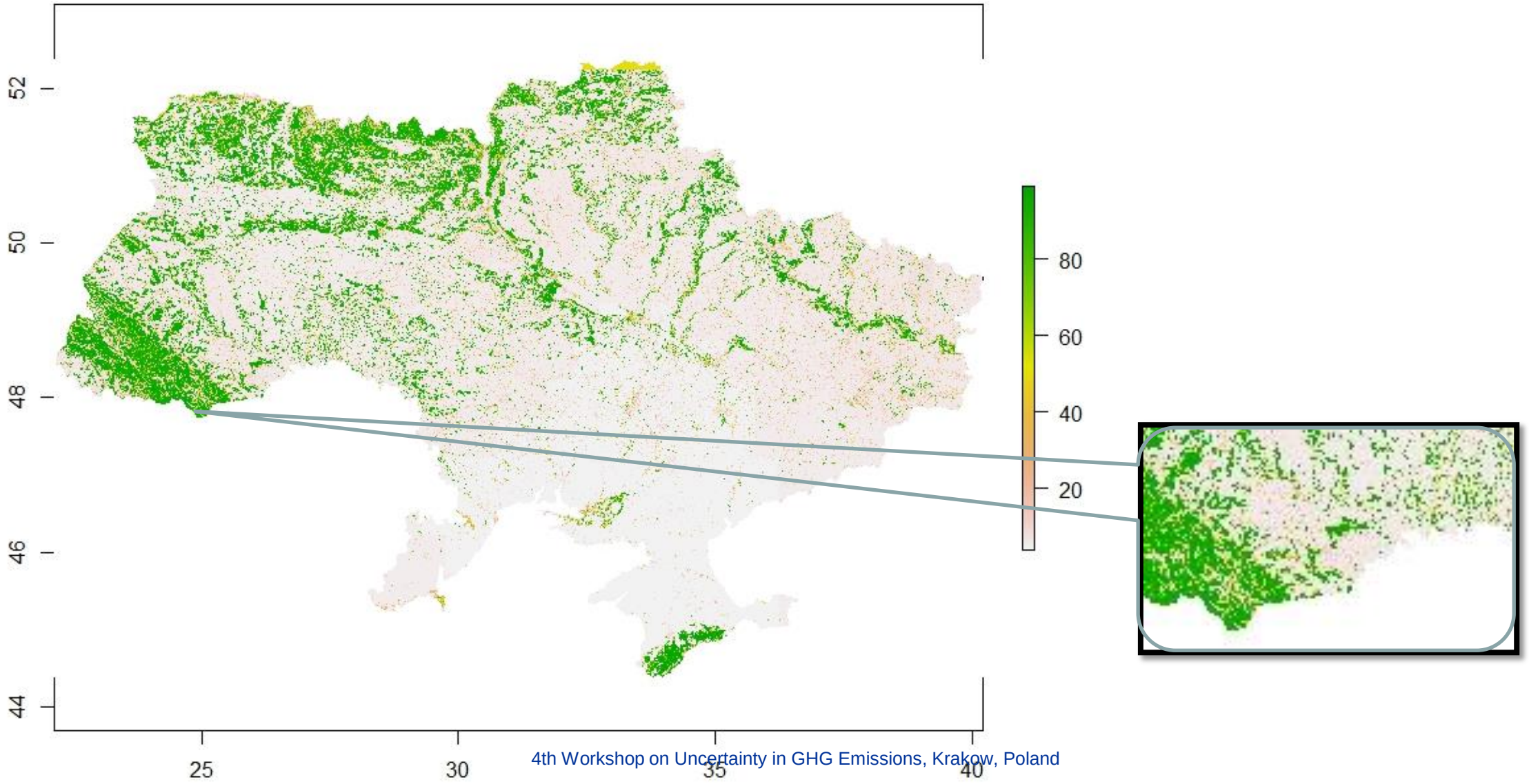
Impact of a number of Geo-Wiki points on a accuracy of a hybrid map



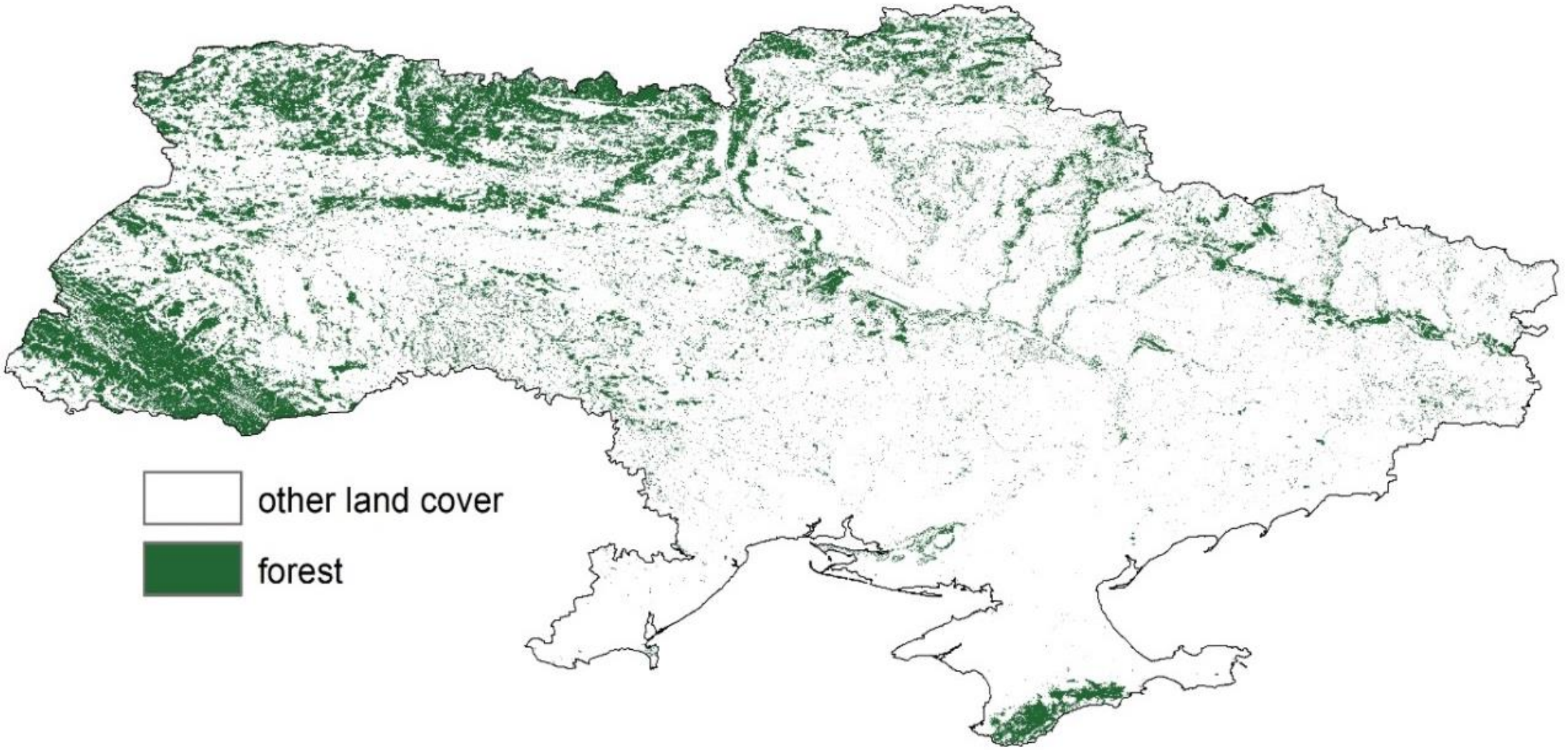
Synergy of remote sensing and Geo-wiki data



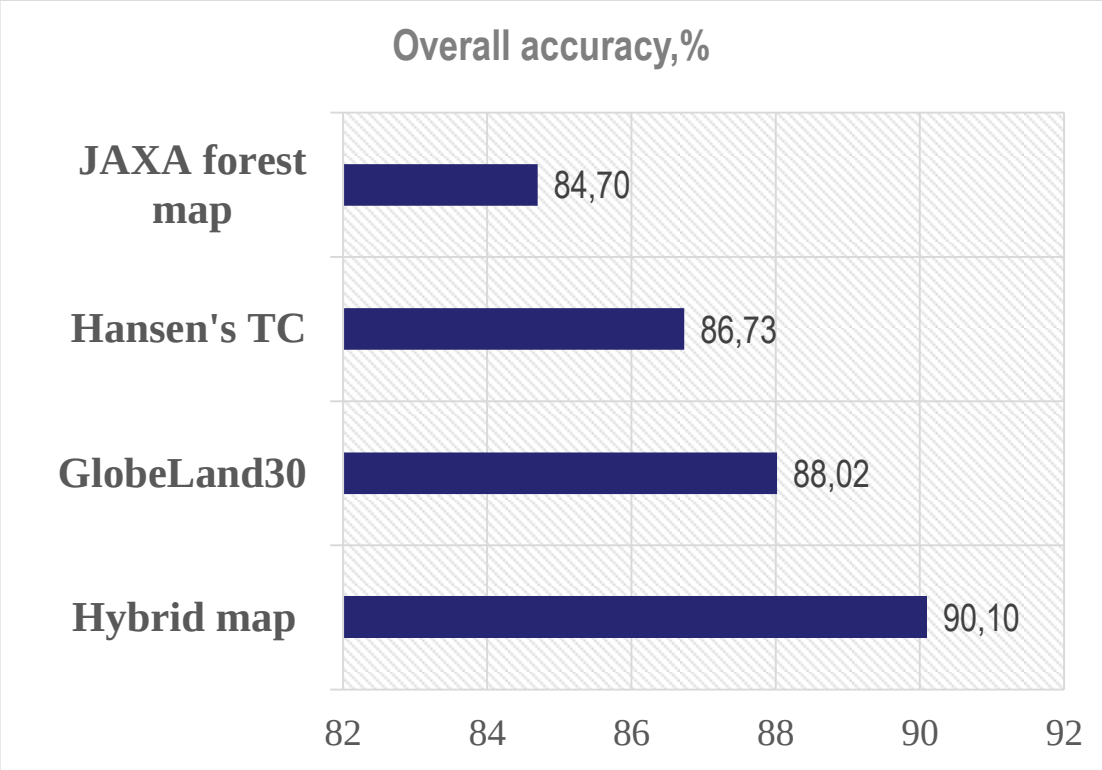
Forest probability map of Ukraine

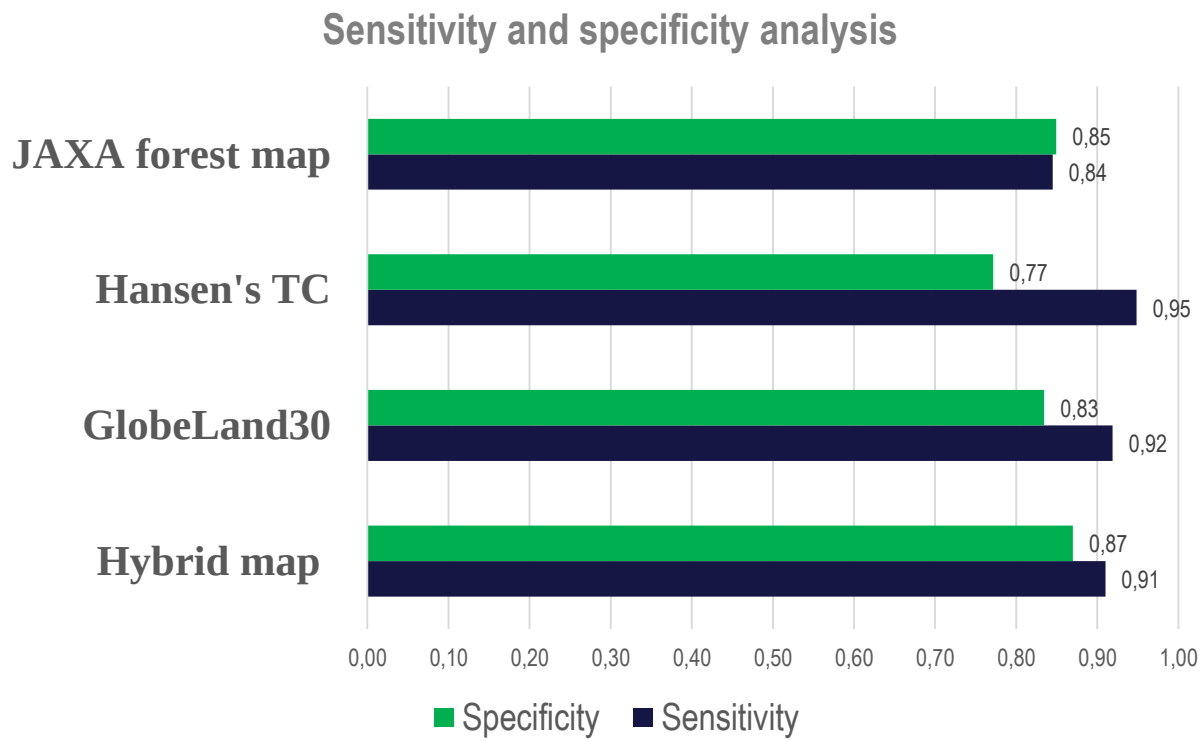


Forest cover map of Ukraine, 2010

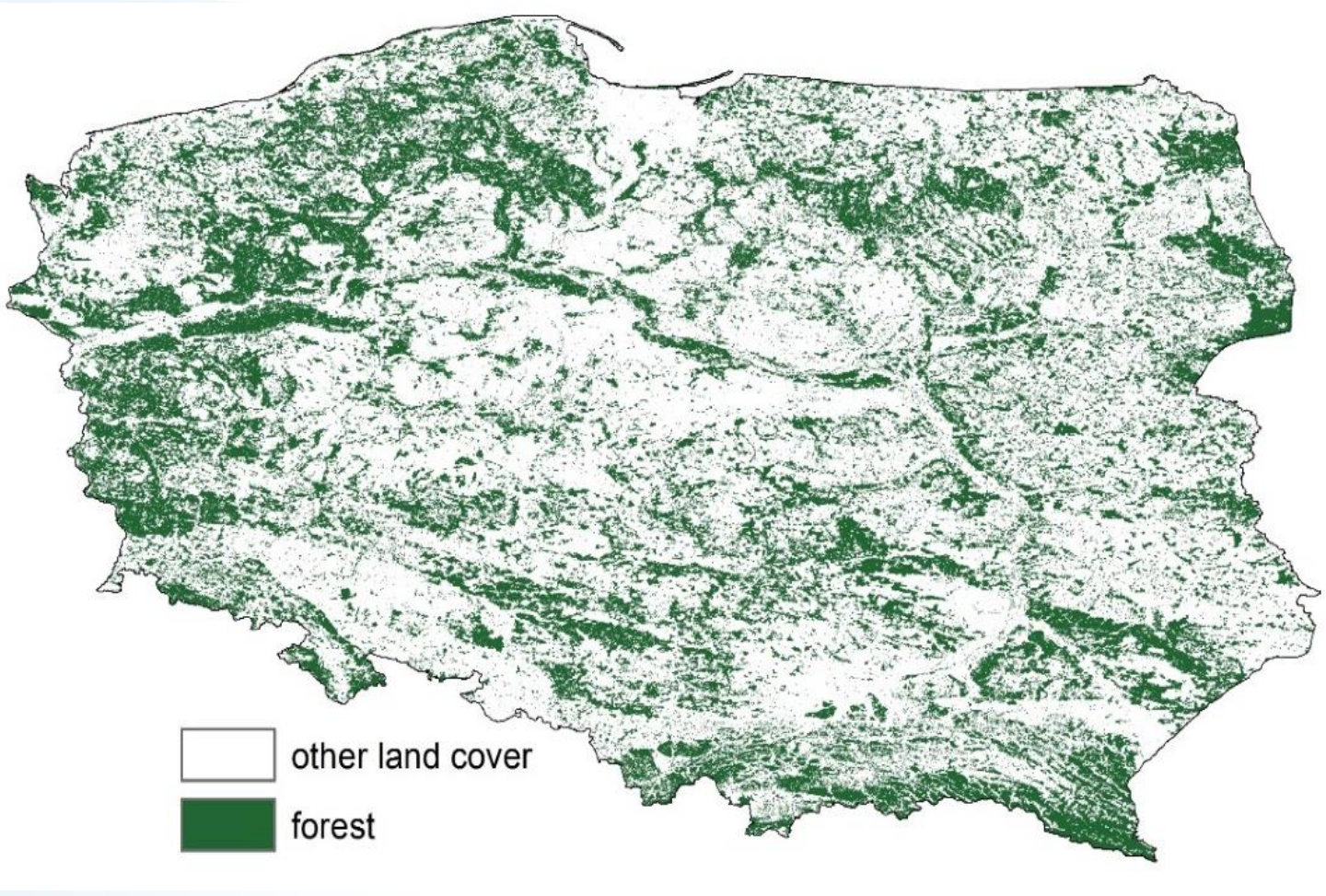


Accuracy, sensitivity and specificity analysis of the Ukrainian map

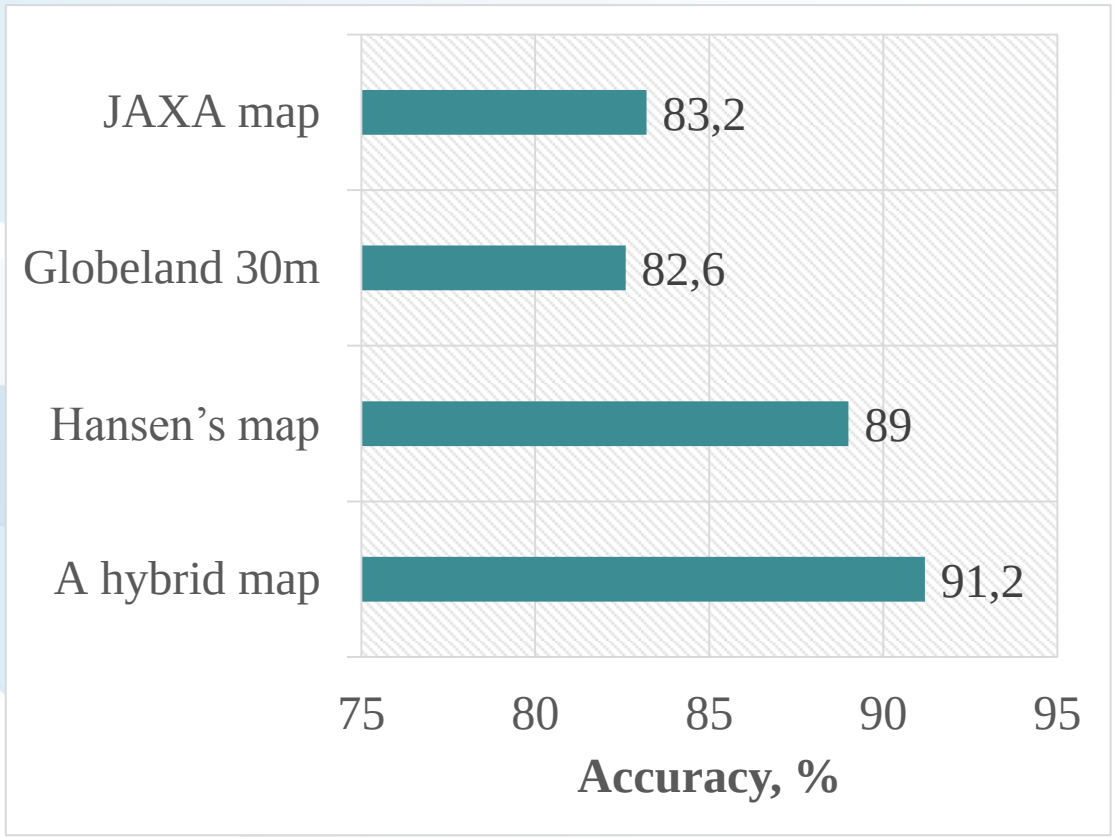


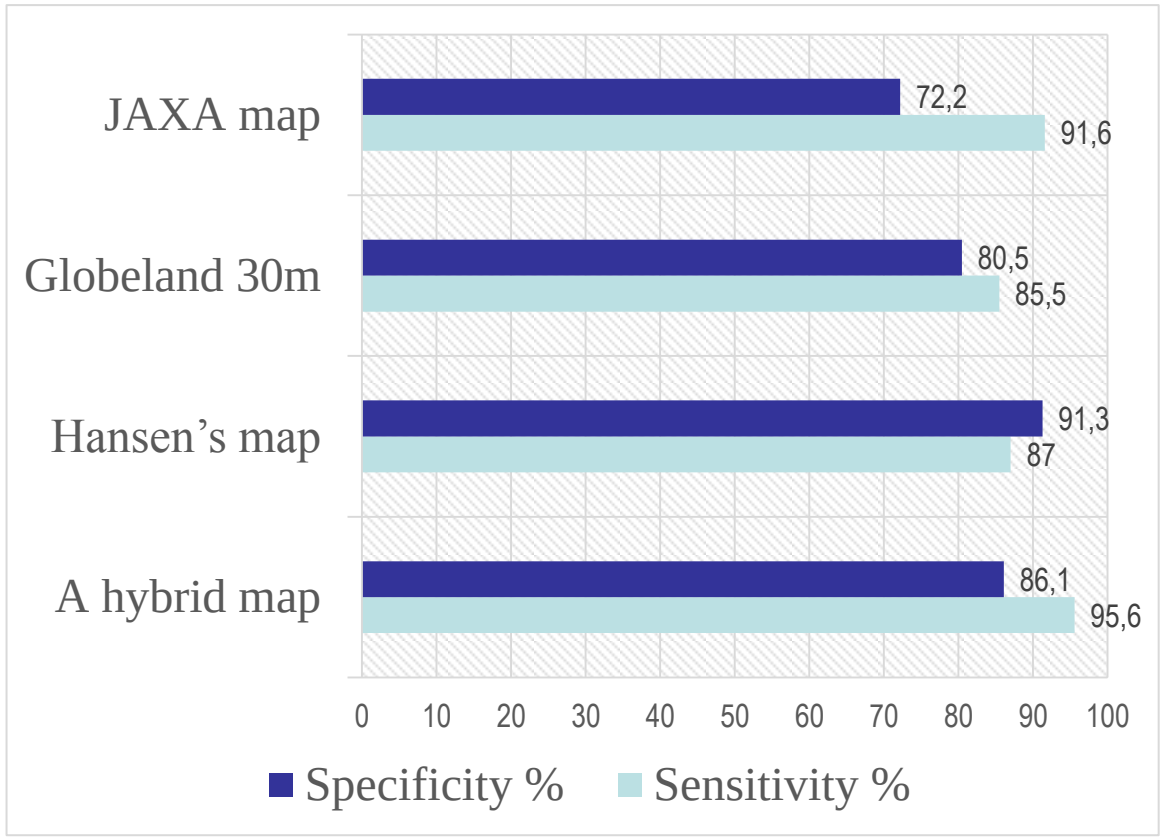


Forest cover map of Poland, 2010



Accuracy, sensitivity and specificity analysis of the Polish map





Comparison of the hybrid forest map with official forest data

Forest data	Poland K ha	Ukraine K ha
Forest inventory data	9,337	9,573
Our forest cover map	9,612	9,561
Difference :	265	12
	~ 3%	~0,1%

However, the differences are much higher at regional level for Ukraine…

Conclusions:

(1) The developed forest map at 60 m resolution is more accurate than the global remote sensing products used.

(2) The accuracy is much higher for the regions with a higher percentage of forest cover (i.e., in northern part of Ukraine, in the Carpathian and Crimean Mountains).

(3) For territories with low percentage of forest cover (<10-15% that is typical for Steppe and southern Forest-Steppe regions), the accuracy is less due to fragmentation of land cover and small areas covered by forests.

(4) The developed algorithm could be used for mapping of different land cover types in other regions of the world.

Ways to improve forest map

- System analysis (definition of land cover classes, classification, etc)
- Methodology for data fusion (generalized mixed models)
- Quality and coverage of collected data through Geo-wiki
- Analysis of a new high resolution remote sensing products, e.g. Sentinel 2
- Quality of national forest data…

Thank you for the attention !!!

Acknowledgement:

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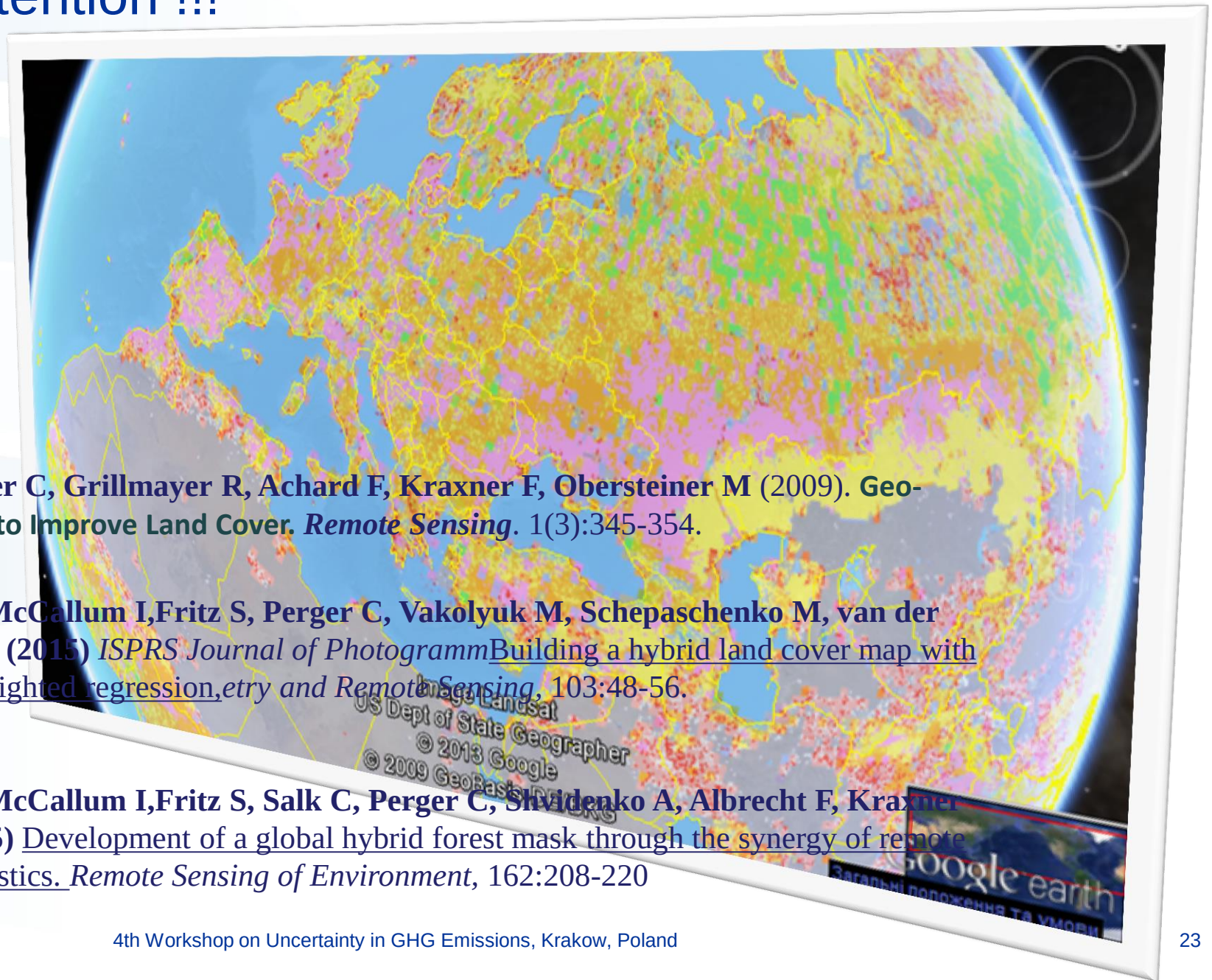

More readings:

Fritz S, McCallum I, Schill C, Perger C, Grillmayer R, Achard F, Kraxner F, Obersteiner M (2009). **Geo-Wiki.Org: The Use of Crowdsourcing to Improve Land Cover.** ***Remote Sensing***. 1(3):345-354.

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