



International Institute for  
Applied Systems Analysis  
www.iiasa.ac.at

# IIASA Ecosystem Services and Management Program experience in the field of LCLUC

Dmitry Schepaschenko,  
on behalf of IIASA ESM team



IIASA, International Institute for Applied Systems Analysis

science for global insight

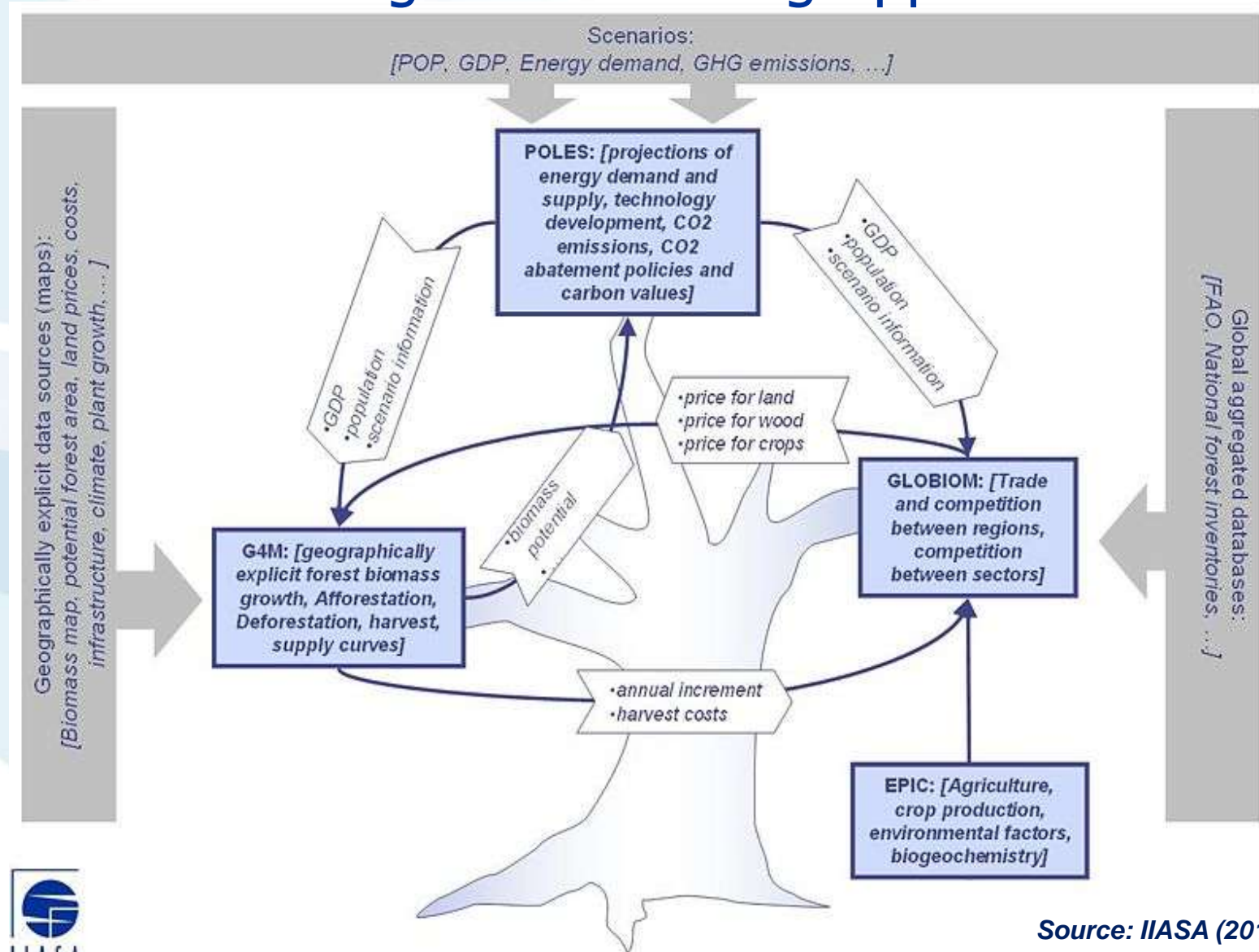
# IIASA - a Global Research Institute



- Est. in 1972 as a scientific bridge between East and West, later extended to North-South collaboration
- 24 member countries from all the continents
- Ecosystems Services and Management program

# Modeling Biomass Supply at Global Scale

## An Integrated Modeling Approach



Visualization  
of Global Land Cover,  
Biomass, Photos, etc.



Crowdsourcing of  
Land Cover  
(Google Earth, Bing Maps)



**Geo-Wiki**

Creation of Hybrid  
Land Cover Maps



Validation of Land  
Cover Maps



In-situ Data via  
Geo-Wiki  
Pictures,  
FotoQuest Go app

Serious Games  
(Cropland  
Capture,  
Picture Pile)



# http://Geo-Wiki.org: Visualization, Crowdsourcing and Validation

**ENGAGING CITIZENS IN ENVIRONMENTAL MONITORING**

**Geo-Wiki**

- » Home
- » News / Outreach
- » Instructions
- » Download Data
- » Mobile Apps
- » Supporting projects
- » Related projects
- » Data source

**Games**

- » Instructions + Videos
- » Cropland Capture
- » FAQ

**Branches**

- » Geo-Wiki branches
- » AusCover Geo-Wiki
- » Livestock Geo-Wiki
- » Risk Geo-Wiki
- » SIGMA Geo-Wiki
- » LACOVAL

**The Geo-Wiki Platform**

Geo-Wiki is a platform that provides citizens with the means to engage in environmental monitoring of the earth by providing feedback on existing spatial information, satellite imagery or by providing entirely new data. Data can be input via the traditional desktop platform or via mobile devices, with campaigns and games used to incentivize input. Resulting data are available without restriction.

**Geo-Wiki.org**

**Land cover**

**Crop-land**

**Biomass**

**Cities**

**Human Impact**

**Risk**

**Forest**

**Livestock**

**Log in**

Email:

Password:

Remember me next time?

[I've lost my password](#)

[Register here!](#)

Try Geo-Wiki

**Administration**

- » Smartphone Legends

**Tweets**

**IIASA** @IIASAVienna 18 Nov

Congratulations to @GrowersNation, for winning the @GEOSEC2025 #GEOappathon! #foodsecurity #earthobservation bit.ly/1v4vaW

Retweeted by Cropland Capture

Tweet to @CropCapture

272

# Land cover disagreement

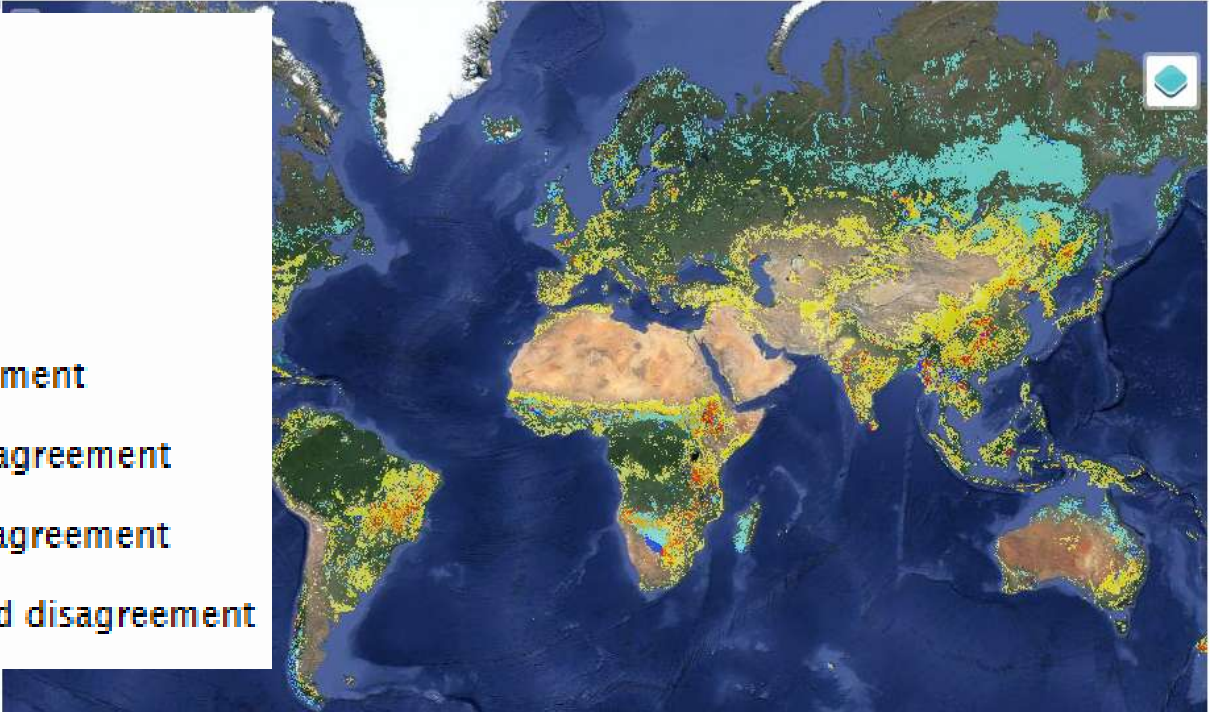
geo-wiki.org/Application/index.php

GEO-Wiki **LAND-COVER**

Land-Cover

Homepage Dmitry Logout

- Cropland disagreement
- High cropland disagreement
- Forest disagreement
- High forest disagreement
- Forest and cropland disagreement
- Forest and high cropland disagreement
- High forest and cropland disagreement
- High forest and high cropland disagreement



The image shows a screenshot of a web application interface for land cover analysis. The main content is a world map where different regions are colored according to the legend. The legend is a white box on the left side of the map. It lists eight categories of land cover disagreement, each with a corresponding colored square. The categories are: Cropland disagreement (yellow), High cropland disagreement (orange), Forest disagreement (light blue), High forest disagreement (dark blue), Forest and cropland disagreement (orange), Forest and high cropland disagreement (red), High forest and cropland disagreement (purple), and High forest and high cropland disagreement (red). The map shows significant areas of disagreement, particularly in the tropical regions of South America, Africa, and Southeast Asia, as well as parts of Europe and Asia. The interface includes a search bar, a home button, and user information (Dmitry) and a logout button.

# Biomass.Geo-Wiki.org

geo-wiki.org/Application/index.php

**GEO-Wiki BIOMASS**

Disagreement

Above Ground Live Biomass

- Global Forest by IIASA [reference](#)
- Pan-Boreal [reference](#)
- European Forest (JRC) [reference](#)
- European Forest (Corine) [reference](#)
- European Forest (GLC2000) [reference](#)
- European Forest (GlobCover) [reference](#)
- Russia, 2009, res.1km [reference](#)
- USA by WHRC [reference](#)
- Tropics by NASA [reference](#)
- Tropics by WHRC [reference](#)
- Tropics by WUR [reference](#)
- Canada [reference](#)
- Global forest by IB-CAS [reference](#)

1 - 10 Mg dm / ha
11 - 20
21 - 40
41 - 70
71 - 100
101 - 150
151 - 200
201 - 300
301 - 715

Europe by JR	- m3/ha
Europe (Corine)	50 Mg dm/ha
Europe (GLC2000)	20 Mg dm/ha
Europe (GlobCover)	110 Mg dm/ha
Europe (JRC)	70 Mg dm/ha
Global by IIASA	70 Mg dm/ha
Global forest by IB-CAS	94 Mg dm/ha
Pan-Boreal	110 Mg dm/ha
Pan-boreal by Gamma	200 m3/ha

Feedback

Download

Google 5000 km

Imagery ©2017 NASA, TerraMetrics Terms of Use

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

**GEO-Wiki Forest Cover Evaluation**

Overview:

Forest cover: Covered area: 55 %

0 % 100 %

Tree cover: Covered area: 90 %

0 % 0 %

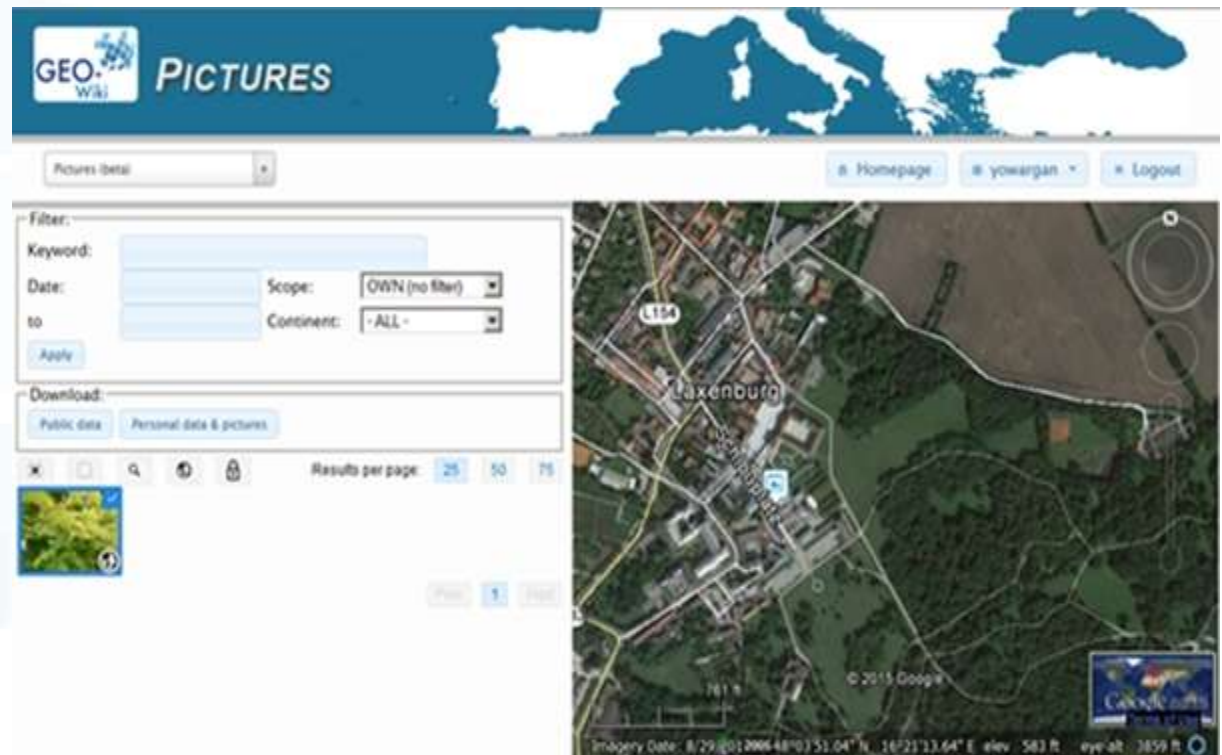
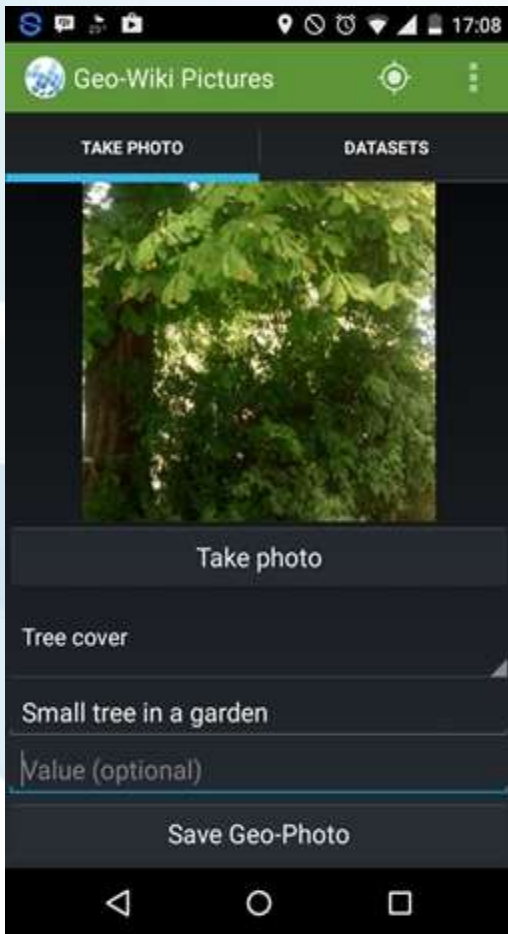
Submit: (click only once)

Imagery Date: 10/13/2012 35°31'58.24" N 78°02'22.24" W elev. 137 ft eye alt 4102 ft

where 55% of 1km pixel area is estimated to be forest cover with tree cover of 90% stocking in this example.

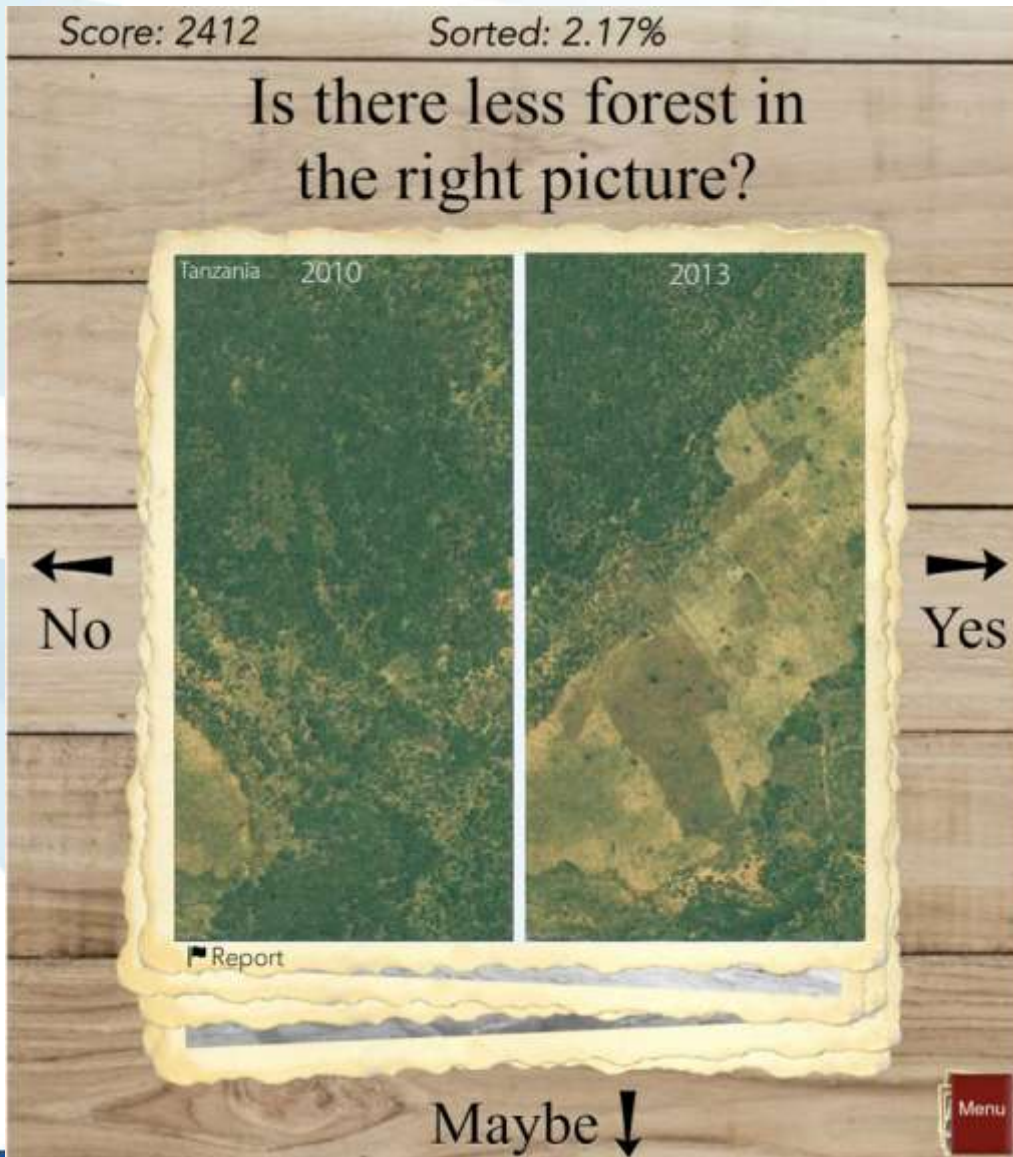


# Mobile App: Geo-Wiki Pictures



Automatically geo-referenced and tagged with information such as compass direction and the angle of tilt

# Serious Game: Picture Pile



914  
Players



2,560,565+  
Classifications



217,331  
Unique images



90%  
< 5 seconds

# fieldsize.geo-wiki.org

## ongoing campaign

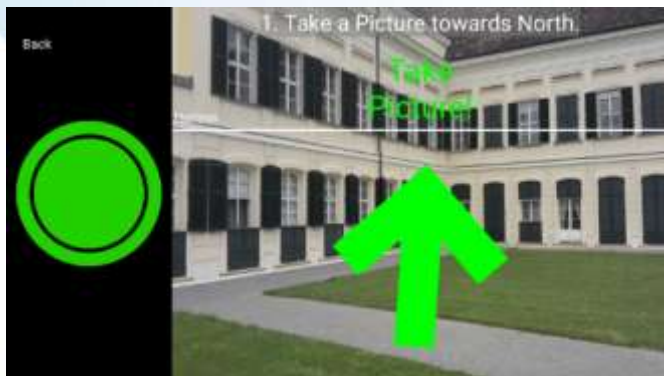
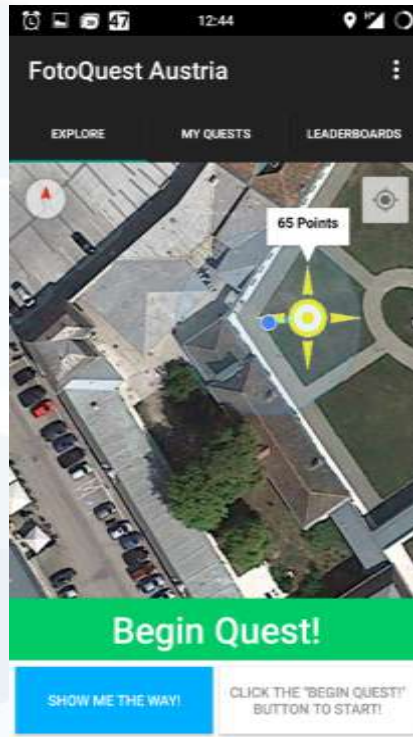
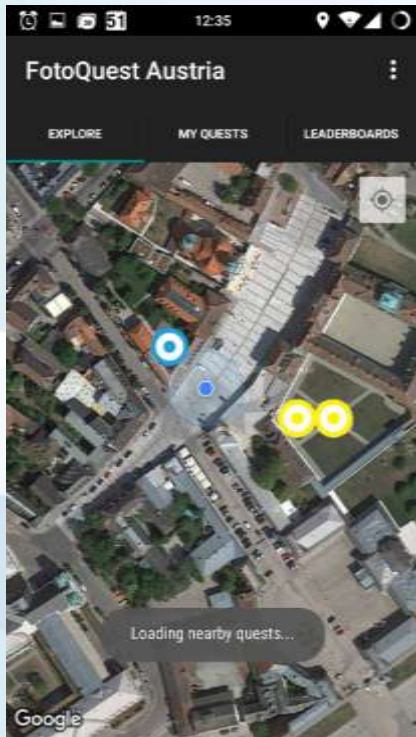


Individual overview **116**

Prizes

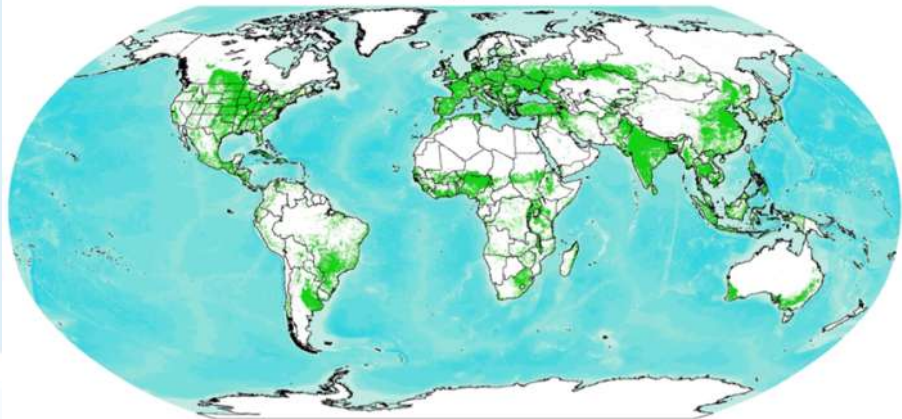
User	Nr of Validations	Quality Score
juncopartner	32,366	48,075
5Mari5M5	22,278	34,090
rubulhazarika	18,755	24,605
paragksaharia	23,295	24,045
dellxrr	15,681	23,365
maryanaviktorivna	7,325	12,675
brigitte.magori	5,582	8,685
ana.perez-hoyos	4,816	8,545
bilous	4,771	8,355
diego.guizzardi	5,871	7,775
sarahgengler	3,818	6,335
GeoCBG	3,327	5,400
narzary.william11	3,632	5,395
chetri.tilok	3,526	5,315
ziga.malek	3,284	5,270
reinhard.prestele	2,742	4,910
pschles	3,172	4,165
sachyn_boro	2,913	4,140
kuleswar08	2,452	3,570
ksmbmei	2,095	3,235
ibrar.space	1,954	3,135
ckpawe	1,905	3,125
saktola	1,891	3,000
kemenen	1,783	2,975
julien.minet	1,782	2,910
moni.molinari	1,638	2,495
forest_biotech	1,450	2,330

# FotoQuest Europe / FotoQuest Go



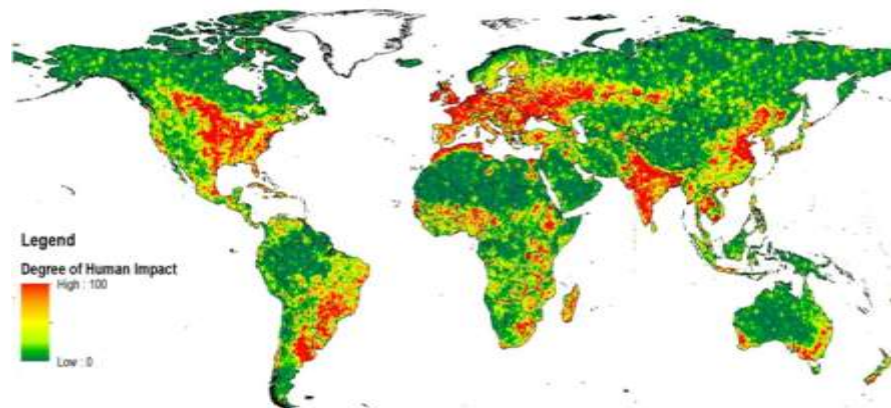
# Geo-Wiki Outputs

**Current Cropland Distribution:**  
best available from existing satellite-derived sources



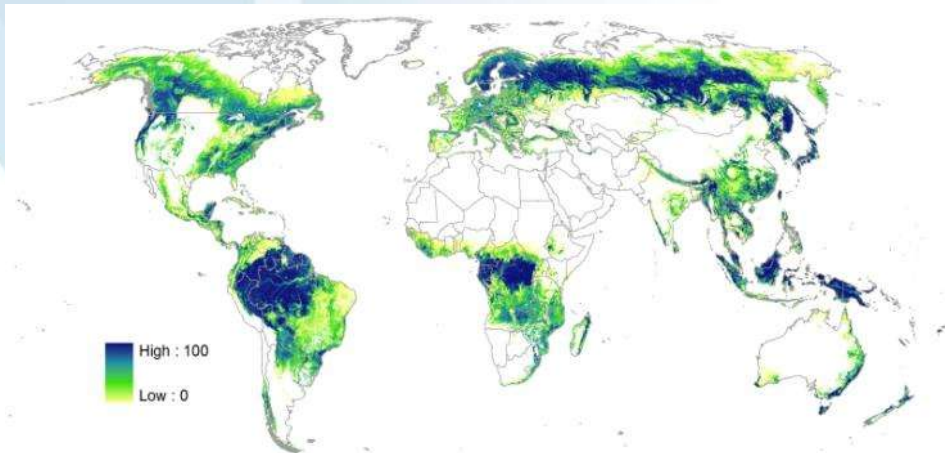
Fritz et al. (2015) in Global Change Biology

**Wilderness**



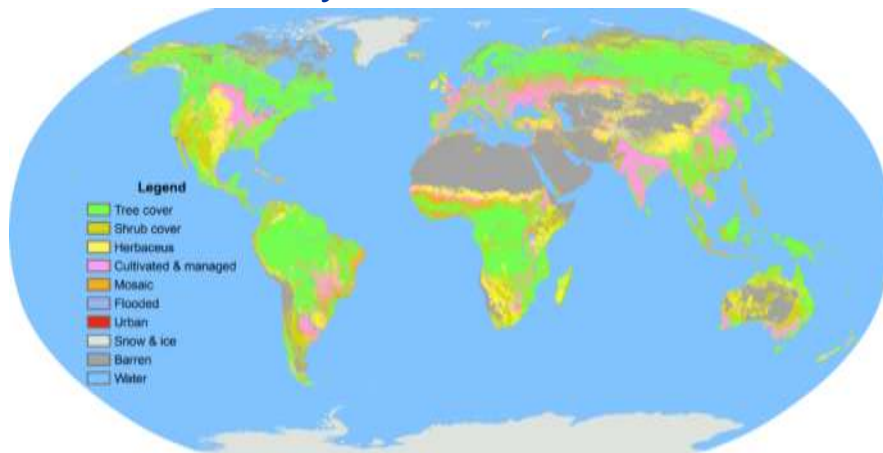
See et al. (2015) in Technological Forecasting and Social Change

**Forest Cover**



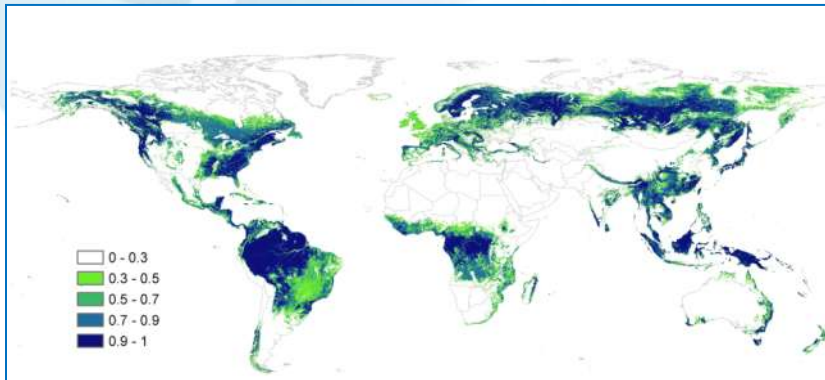
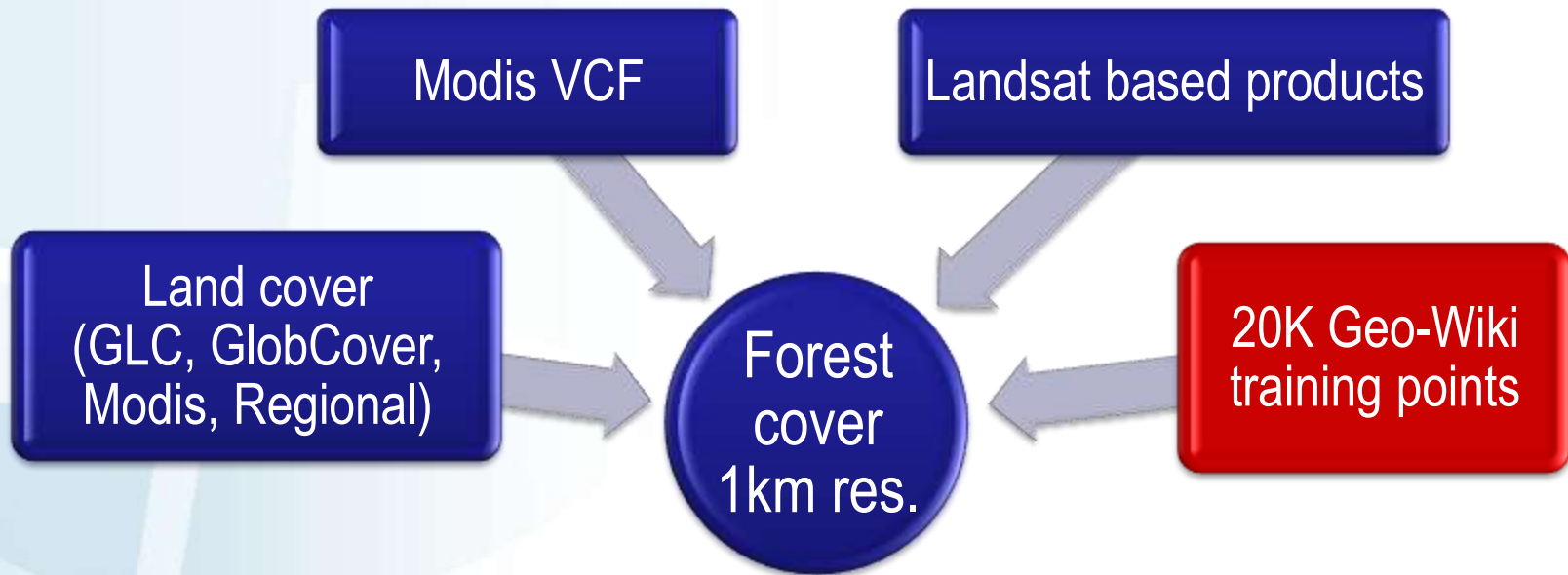
Schepaschenko et al. (2015) in Remote Sensing of Environment

**Hybrid Land Cover**

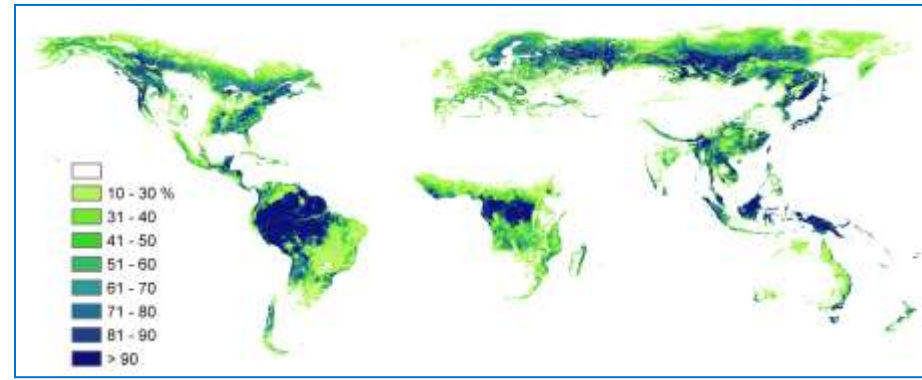


See et al. (2014) in ISPRS Photogrammetry and Remote Sensing

# Global Forest Mask: synergy of remote sensing and crowd-sourcing

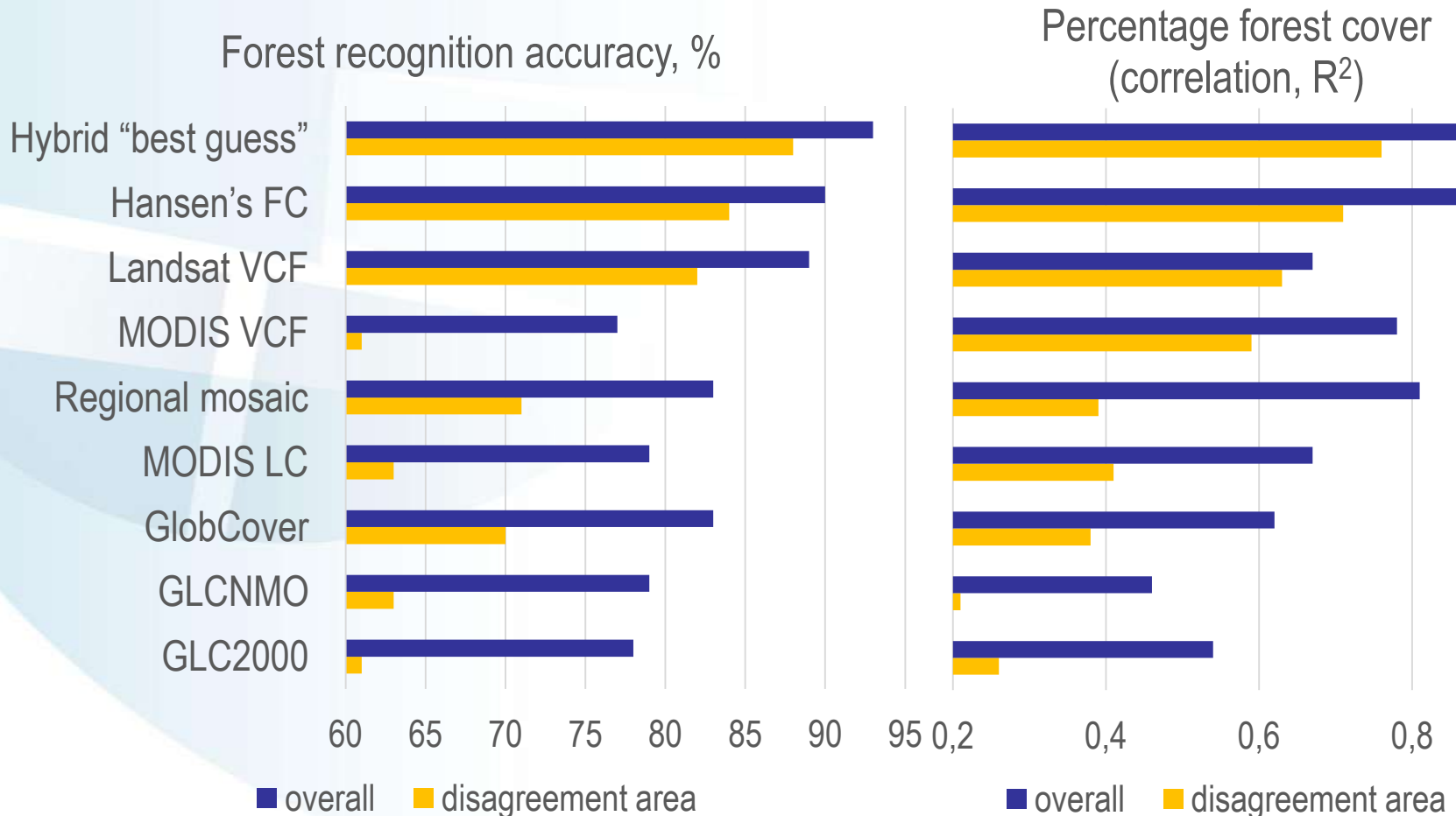


Forest probability



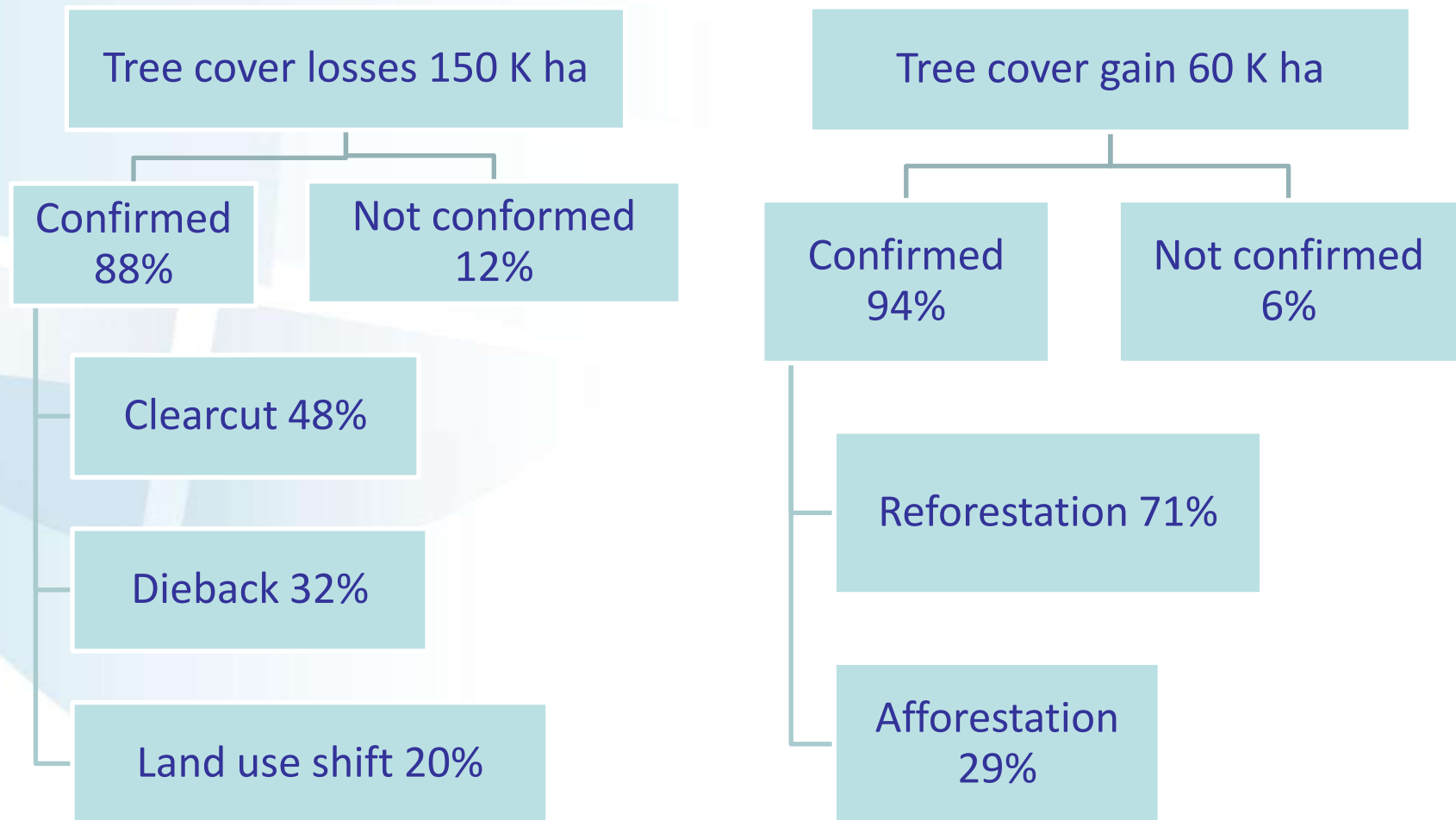
Forest cover, %

# Validation of input datasets and final hybrid product



# Tree cover change in Moscow region 2000-2013

Validation of tree cover change dataset by Hansen et al., 2014





## Laco-Wiki

### The Land Cover Validation Platform



## Welcome to Laco-Wiki

LACO-Wiki is a new web-based solution for validating land cover and land use maps. Using a variety of reference layers including satellite and aerial imagery from Google and Bing as well as OpenStreetMap, validation is a simple four-step process. After uploading your dataset, generate and validate the samples and create a report with the accuracy assessment.

Share your validated samples with us and you will help to build an open database that can be used to improve future land cover and land use maps.



### Upload a dataset

You can upload your own maps for validation in either vector or raster format. Currently accepted formats are shape files and geoTIFFs in a WGS84 projection. Once uploaded you can design a customized legend for display. Additional datasets can also be uploaded to help you in the validation process.



### Generate a validation sample

Once you have uploaded your map, you can create sets of validation samples using random, stratified or systematic sampling. You can specify the size of each sample or be guided by calculations of the minimum sample size needed based on the required confidence levels for your project.



### Validate your map

Using reference information such as satellite imagery, you can validate your sample using your own legend, either by selecting the class, confirming the class or correcting incorrectly classified ones. You can validate the samples by yourself or you can share any validation session to distribute the work.



### Report on the accuracy

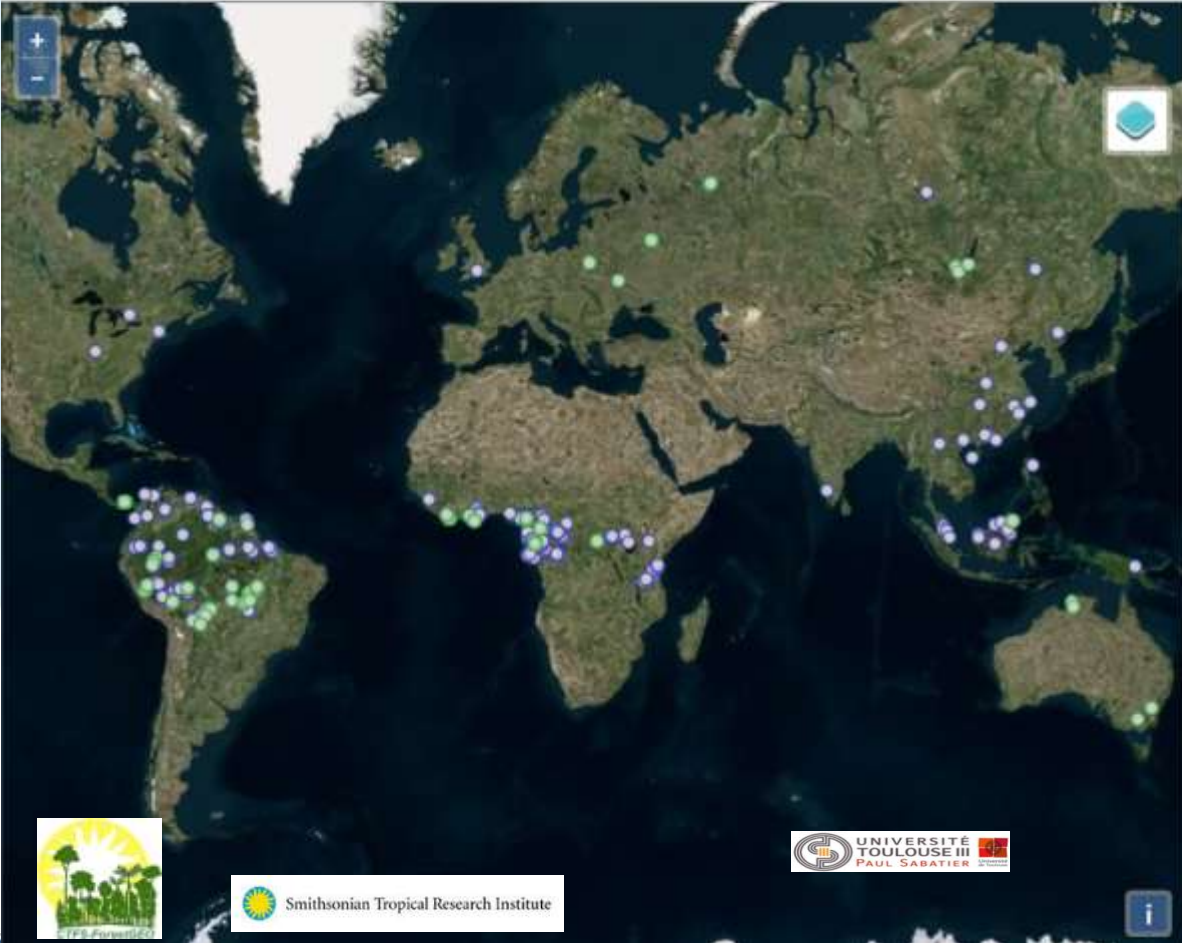
After validation you can download the raw data, the confusion matrix and generate a customized report on accuracy assessment, choosing from a set of different quality indicators including overall accuracy, omission and commission errors, kappa, average mutual information (AMI) and more.

# Forest-Observation-System.net

beta.forest-observation-system.net

FOREST OBSERVATION SYSTEM

MAP ABOUT RESOURCES CONTACTS



**PLOT INFORMATION**

**RKOM (08)**

Russia

Network: IB.KomiSC, IIASA


PIs: K.S. Bobkova, M.A. Kuznetsov, A.F. Osipov

Established: 2014


Census: 2014

Measurements:  
H Average : 16,20 m  
H Max : 20.00 m  
AGB Local HD : 137.91 t/ha

Taxonomic Identifications:  
Picea abies: 88 % (595)  
Betula pendula: 9 % (15)  
Abies sibirica: 2 % (10)  
Pinus sylvestris: 1 % (5)

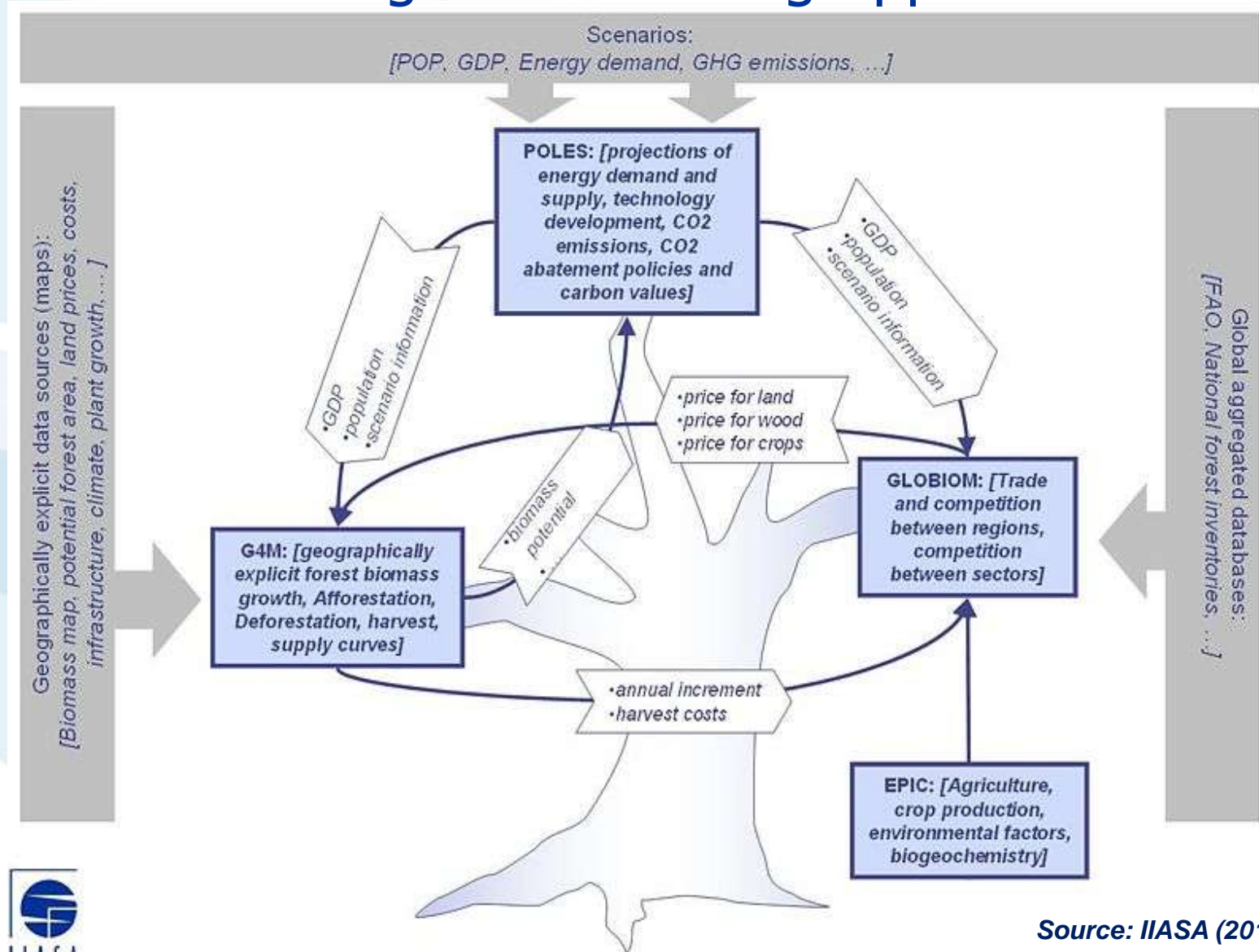


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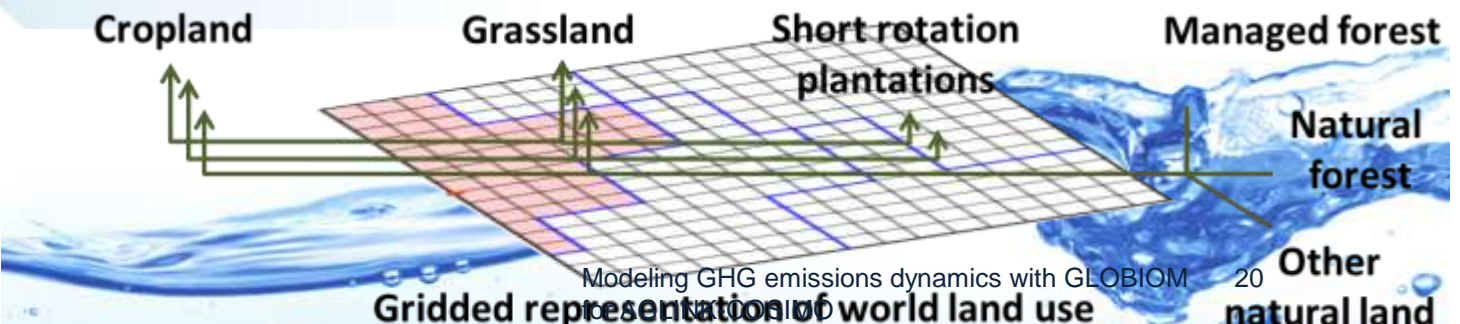
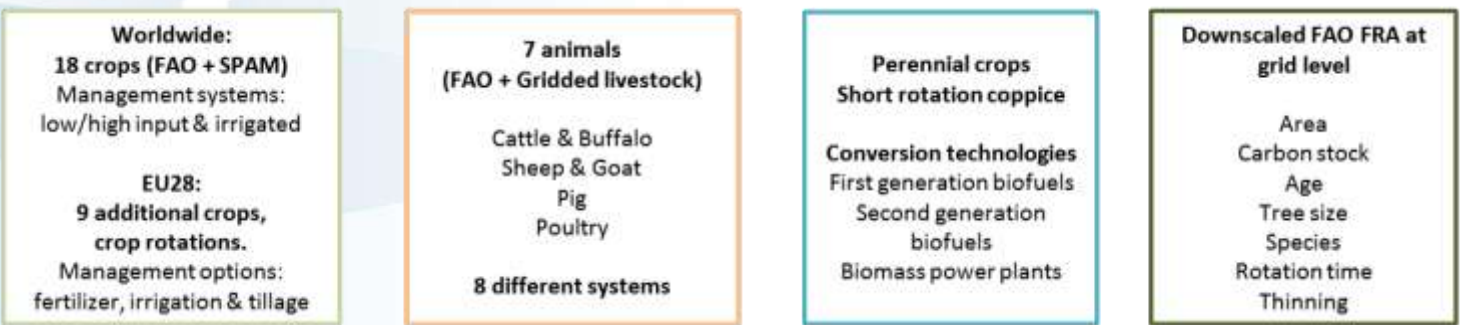
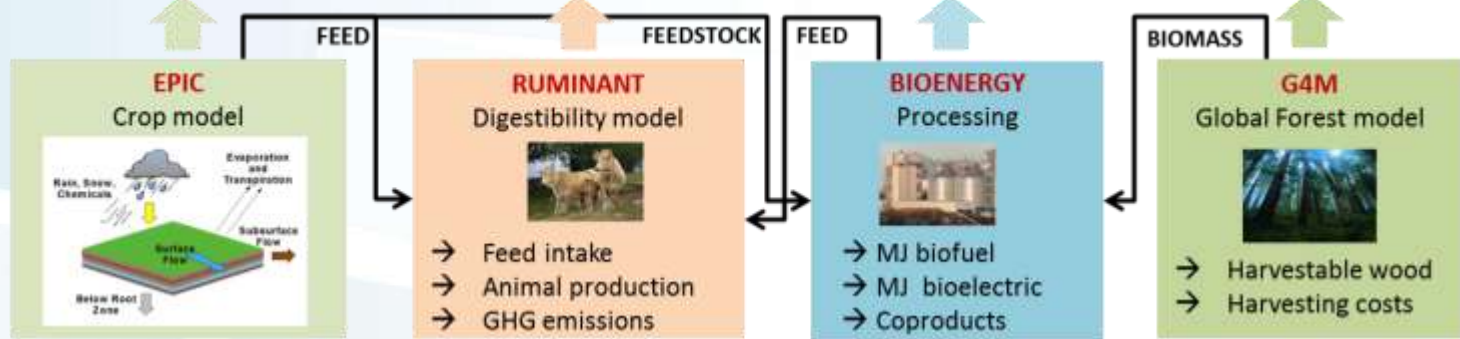
# Modeling Biomass Supply at Global Scale

## An Integrated Modeling Approach



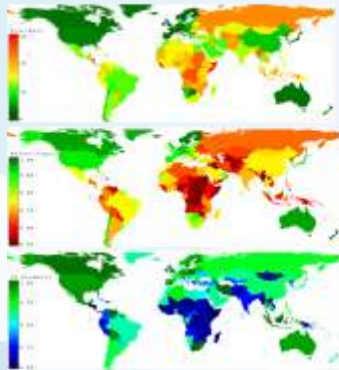
Population, GDP, consumer preferences

Demand  
Markets  
Production  
Land use  
Land cover

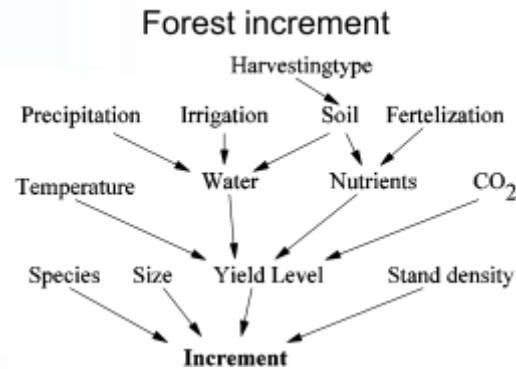


# The global forest model G4M

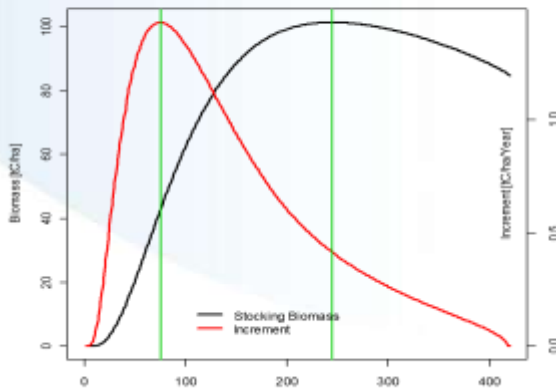
## Datasets



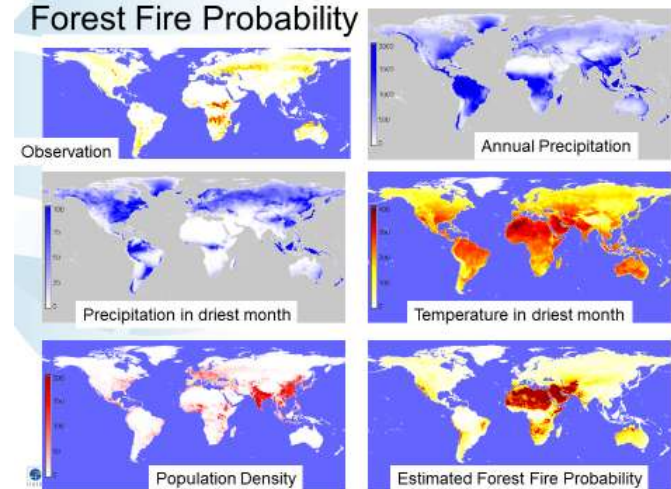
- NPP
- Population Density
- Land cover
- Agricultural suitability
- Forest Biomass
- Price level
- Discount rate
- Money efficiency
- Product use



## Age dependent Increment and Biomass



## Forest Fire Probability



# G4M: what do we estimate

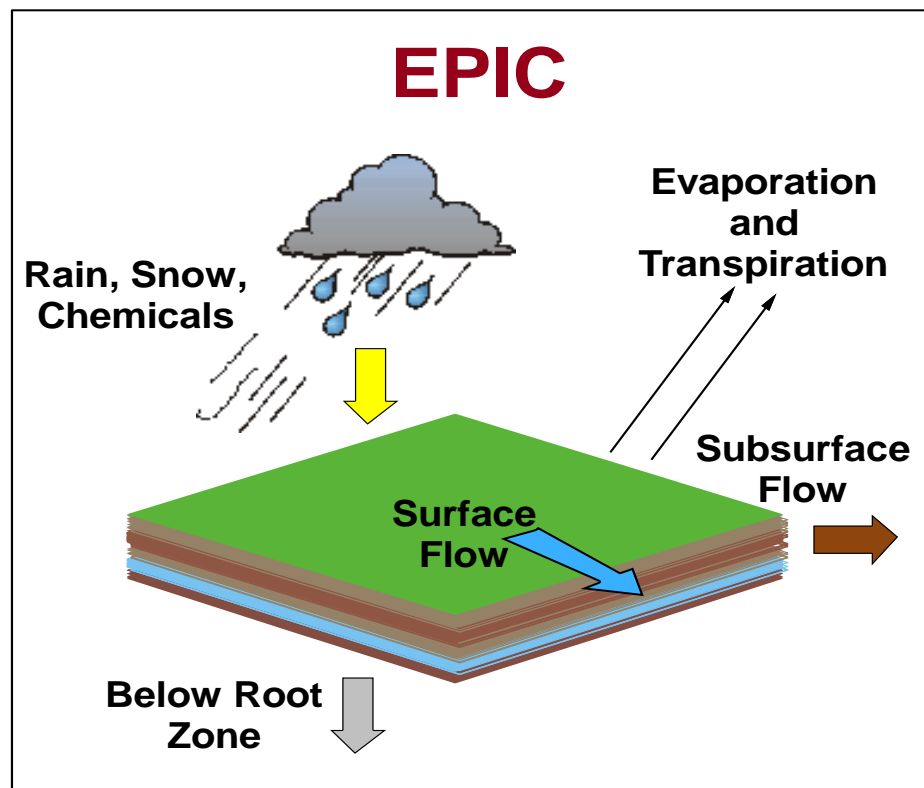


- Afforestation
- Deforestation
- Standing biomass
- Harvested Biomass

# Crops - EPIC

## Processes

- Weather
- Hydrology
- Erosion
- Carbon sequestration
- Crop growth
- Crop rotations
- Fertilization
- Tillage
- Irrigation
- Drainage
- Pesticide
- Grazing
- Manure



## Major outputs:

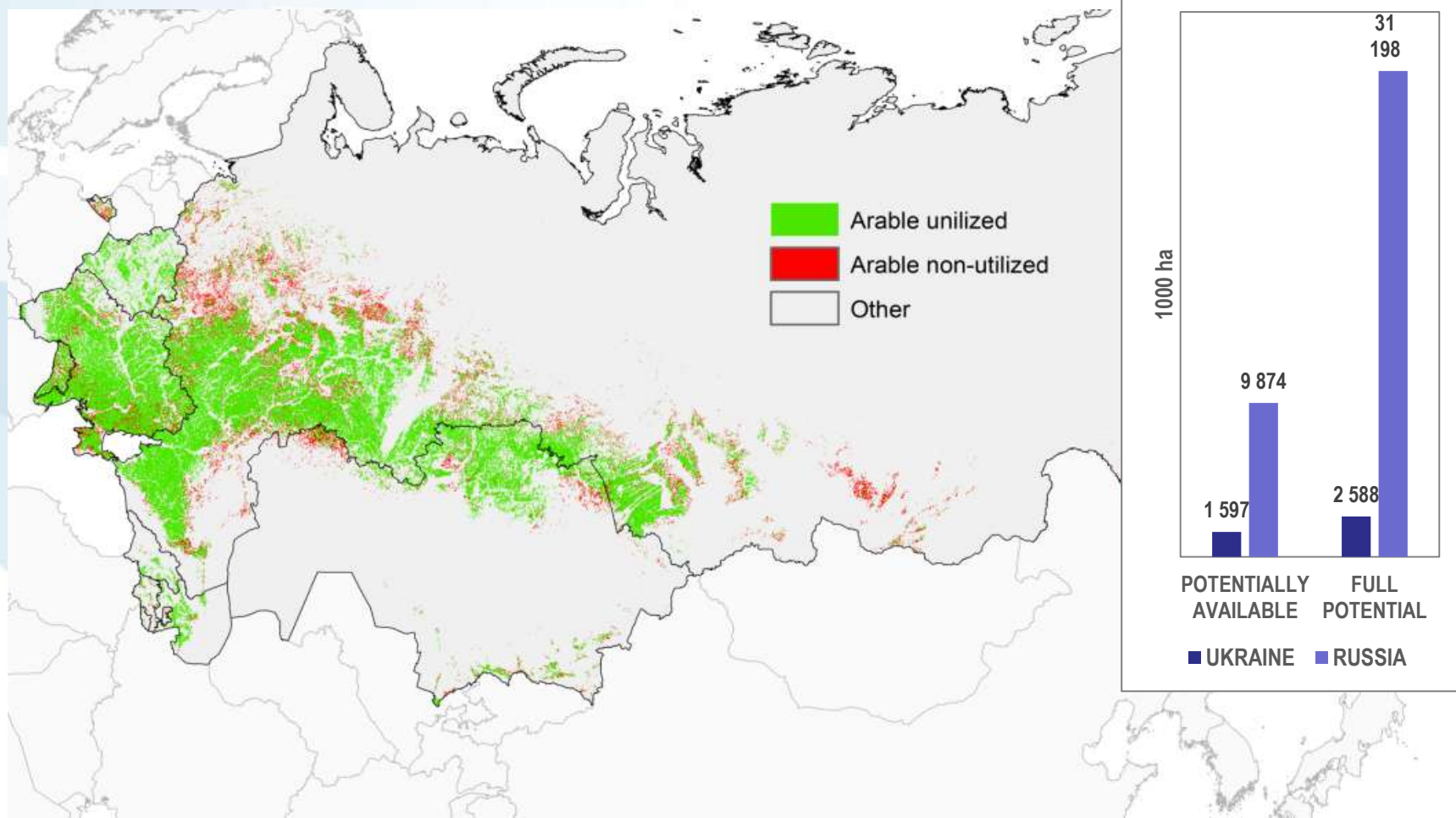
Crop yields, Environmental effects (e.g. soil carbon, nitrogen leaching)

**20 crops** (>75% of harvested area)

**4 management systems:** High input, Low input, Irrigated, Subsistence

# Abandoned agricultural land

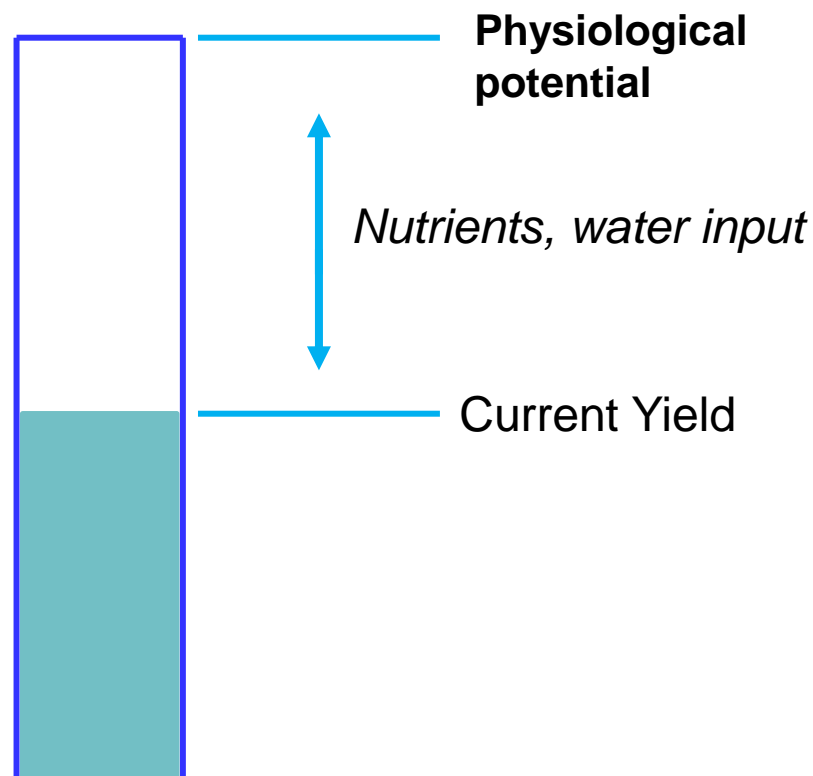
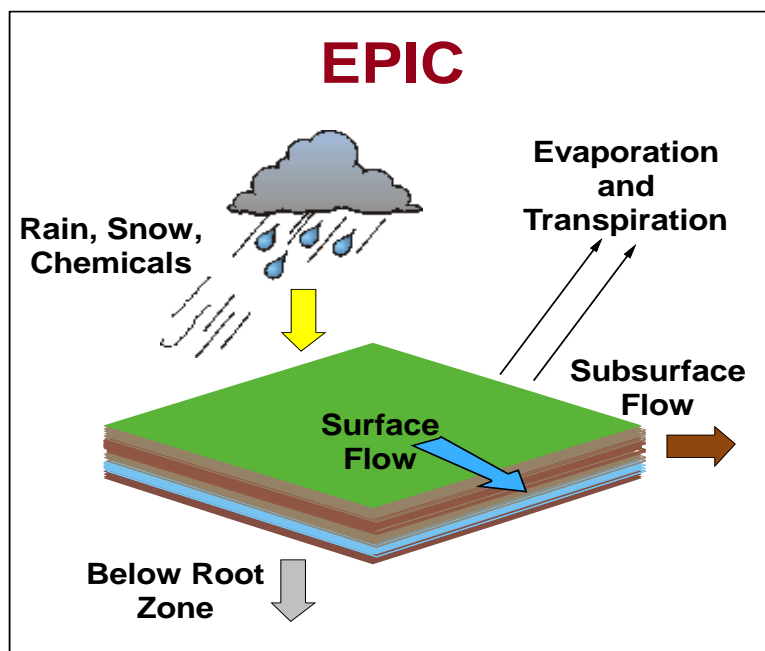
- Merging of existing land cover data with official statistics and “Ground truth” information (verified information) via a Bayesian network approach





# Potential Yields

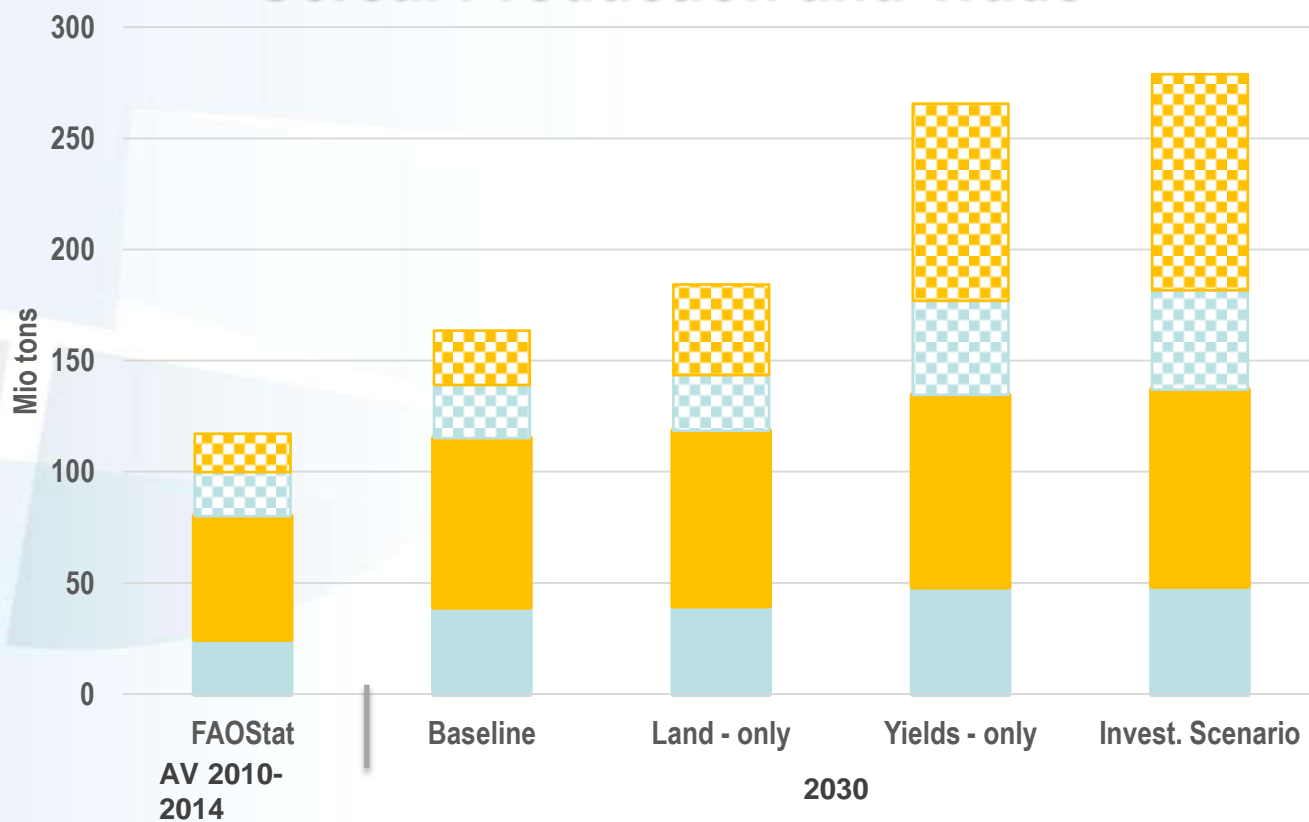
- EPIC: process-based model for crop yields (5 arc min, ca. 10 × 10 km)



# Economic Impacts Assessment



## Cereal Production and Trade



- Russia
- Ukraine
- Net-Exports
- Domestic use

# LandSense



## A Citizen Observatory and Innovation Marketplace for Land Use and Land Cover Monitoring



**Steffen Fritz**

[fritz@iiasa.ac.at](mailto:fritz@iiasa.ac.at)

# LandSense Demonstration Cases

## LANDSENSE DEMONSTRATION CASES



MONITORING URBAN &  
RURAL LANDSCAPE  
CHANGES

### Complementing authoritative data sources

- Reducing costs in professional surveying
- Optimizing workflows of mapping agencies
- Opening up access to land take information



MONITORING  
AGRICULTURAL LAND USE

### EO-driven services for farm management

- Lowering barriers to technology for farmers
- Creating an ecosystem of EO-based services
- Improving agriculture policy compliance



HABITAT & FOREST  
MONITORING

### High-res EO data for biodiversity preservation

- Adding LULC data into biodiversity databases
- Reducing habit degradation and deforestation
- Opening up EO-data for forest monitoring



Thank you for your attention

Geo-Wiki.org  
Forest-Observation-System.net



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International Institute for Applied Systems Analysis



Smithsonian Tropical Research Institute



# GLOBIOM

- ▶ **Global scale model based detailed spatial resolution**
- ▶ **Partial equilibrium**
  - ▶ Agricultural, wood and bioenergy markets
  - ▶ 30 world regions
  - ▶ Bilateral trade flows based on spatial equilibrium approach
- ▶ **Bottom-up approach**
  - ▶ Explicit description of production technologies a la Leontief
  - ▶ Technologies specified by production system and grid cell
- ▶ **Linear programming approach**
  - ▶ Maximization of consumer + producer (incl. trade costs) surplus
  - ▶ Non linear expansion costs
  - ▶ Optimization constraints
- ▶ **Base year: 2000**
- ▶ **Time step: 10 years, time horizon: 2030/2050 but also 2100**