

Global Field Sizes Dataset for Ecosystems Modeling

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Importance of data on field sizes:

Farming and the geography of nutrient production for human use: a transdisciplinary analysis



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Summary

Background Information about the global structure of agriculture and nutrient production and its diversity is essential to improve present understanding of national food production patterns, agricultural livelihoods, and food chains, and their linkages to land use and their associated ecosystems services. Here we provide a plausible breakdown of global agricultural and nutrient production by farm size, and also study the associations between farm size, agricultural diversity, and nutrient production. This analysis is crucial to design interventions that might be appropriately targeted to promote healthy diets and ecosystems in the face of population growth, urbanisation, and climate change.

Methods We used existing spatially-explicit global datasets to estimate the production levels of 41 major crops, seven livestock, and 14 aquaculture and fish products. From overall production estimates, we estimated the production of vitamin A, vitamin B₁₂, folate, iron, zinc, calcium, calories, and protein. We also estimated the relative contribution of farms of different sizes to the production of different agricultural commodities and associated nutrients, as well as how the diversity of food production based on the number of different products grown per geographic pixel and distribution of products within this pixel (Shannon diversity index [*H*]) changes with different farm sizes.

Findings Globally, small and medium farms (≤ 50 ha) produce 51–77% of nearly all commodities and nutrients examined here. However, important regional differences exist. Large farms (> 50 ha) dominate production in North America, South America, and Australia and New Zealand. In these regions, large farms contribute between 75% and 100% of all cereal, livestock, and fruit production, and the pattern is similar for other commodity groups. By contrast, small farms (≤ 20 ha) produce more than 75% of most food commodities in Sub-Saharan Africa, Southeast Asia, South Asia, and China. In Europe, West Asia and North Africa, and Central America, medium-size farms (20–50 ha) also contribute substantially to the production of most food commodities. Very small farms (≤ 2 ha) are important and have local significance in Sub-Saharan Africa, Southeast Asia, and South Asia, where they contribute to about 30% of most food commodities. The majority of vegetables (81%), roots and tubers (72%), pulses (67%), fruits (66%), fish and livestock products (60%), and cereals (56%) are produced in diverse landscapes ($H > 1.5$). Similarly, the majority of global micronutrients (53–81%) and protein (57%) are also produced in more diverse agricultural landscapes ($H > 1.5$). By contrast, the majority of sugar (73%) and oil crops (57%) are produced in less diverse ones ($H \leq 1.5$), which also account for the majority of global calorie production (56%). The diversity of agricultural and nutrient production diminishes as farm size increases. However, areas of the world with higher agricultural diversity produce more nutrients, irrespective of farm size.

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See [Comment](#) page e15
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What has been done up to now?

- First global field size map based crowdsourced data
- Mapping based on Landsat data
- Distribution of average field sizes

Primary Research Article |  Full Access

Mapping global cropland and field size

Steffen Fritz , Linda See, Ian McCallum, Liangzhi You , Andriy Bun, Elena Moltchanova, Martina Duerauer, Fransizka Albrecht, Christian Schill, Christoph Perger, ... [See all authors](#) 

First published: 16 January 2015 | <https://doi.org/10.1111/gcb.12838> | Cited by:103



Remote Sensing of Environment

Volume 172, January 2016, Pages 67-86



LS

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Conterminous United States crop field size quantification from multi-temporal Landsat data

L. Yan , , D.P. Roy 

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Subnational distribution of average farm size and smallholder contributions to global food production

Leah H. Samberg, James S. Gerber, Navin Ramankutty, Mario Herrero, Paul C. West

Institute on the Environment

Research output: Contribution to journal > Article

Objectives of this work:

- to develop a new global field size dataset and to update an existing global field size map
- to estimate area proportions of different field sizes by countries



Global Field Size Campaign

Engagement of participants

- Distribution of Information about the campaign through different networks and by emails
- Prizes: co-authorship and amazon vouchers

Guidelines

- Video and on-hands slides
- Gallery with examples
- First 10 training point with detailed feedback
- Feedback for each control point
- "Hot line" to ask experts for help

Sampling design

- Random stratified
- Strata - maximum cropland extent derived from Globeland30m, ESA CCI LC map at 300m resolution, IIASA cropland hybrid and Unified cropland layer
- Equal area projection
- Size – 130 000 unique locations around the globe

Response design

Questions asked:

- (1) Which field sizes do you see in a box?
- (2) What is a dominant field size?

Tools:

- Geo-Wiki web-application with employed area measurement tool, a few imagery layers(Google and Bing), grids to facilitate detection of fields by eyes, Google Earth historical imagery

Quality assurance

- A set of control points (~4000)
- Distribution of control points: one in random order per every 20 submissions
- 3 submissions per one location by 3 different participants
- Participants' ranking based on a number of submission and quality

Definitions

- Fields are enclosed agricultural areas, including annual and perennial crops, pastures, hayfields and fallow.
- Field size categories:
 - Very large >100 ha
 - Large 16 ha -100 ha
 - Medium 2.56 ha -16 ha
 - Small fields 0.64 ha -2.56 ha
 - Very small < 0.64 ha

Examples of different field size categories

Very small fields in Ethiopia



Small fields in India



Medium fields in France



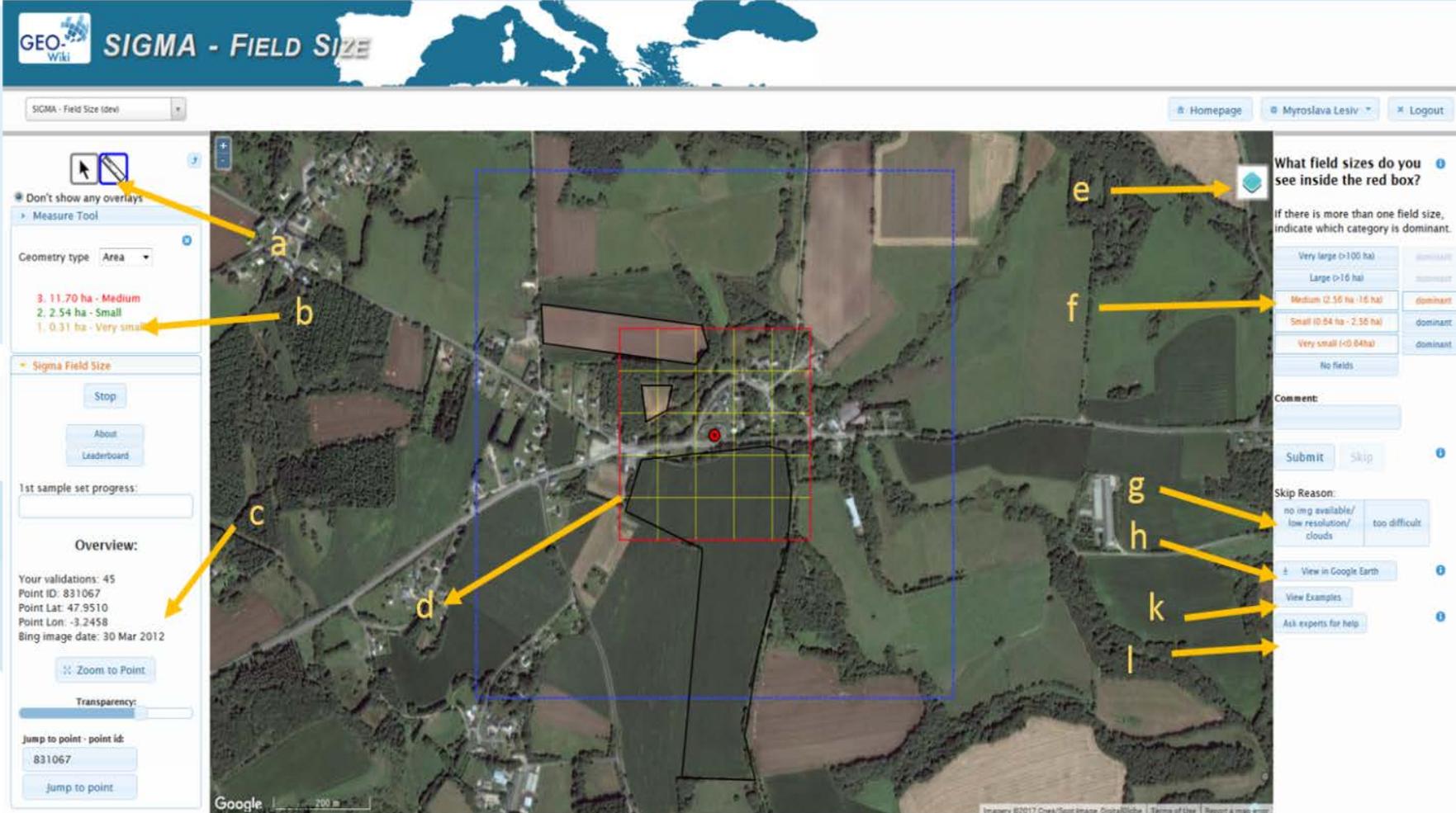
Large fields in the USA



Very large fields in Kazakhstan



Geo-Wiki interface



- a) area measuring tool
- b) fields that has been delineated and measured by a participant
- c) overview board with a work that has been done by a participant
- d) system of grids
- e) access to different open layers, e.g. Google or Bing
- f) buttons to select fields a participant sees in a red box: very large, large, medium, small, and very small, no fields
- g) skip buttons
- h) button to open current location in Google Earth Application
- k) view examples
- l) ask experts for help

Global Field Size Campaign – in June 2017

Participants - 130

Tasks - 390 000

Unique locations – 130 000

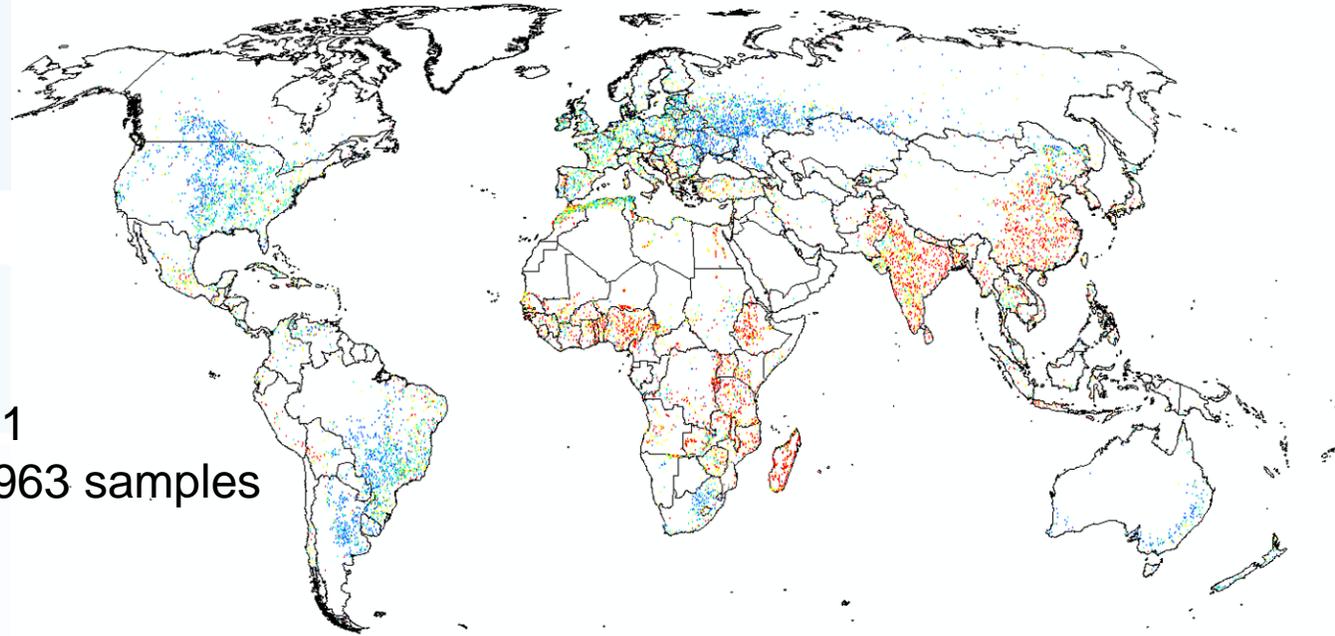
Top 25 participants



Neal Durando
Rubul Hazarika
Parag Kumar Saharian
Mar'yana Vakolyuk
Volodymyr Blyshchyk
Andrii Bilous
Ana Perez-Hoyos
Sarah Gengler
Reinhard Prestele
Svitlana Bilous
Ibrar ul Hassan Akhtar
Sochin Boro Choudhury
Tilok Chetri
Žiga Malek
Khangsembou Bungnamei
Anup Saikia
Dhrubajyoti Sahariah
William Narzary

Spatial distribution of field size data:

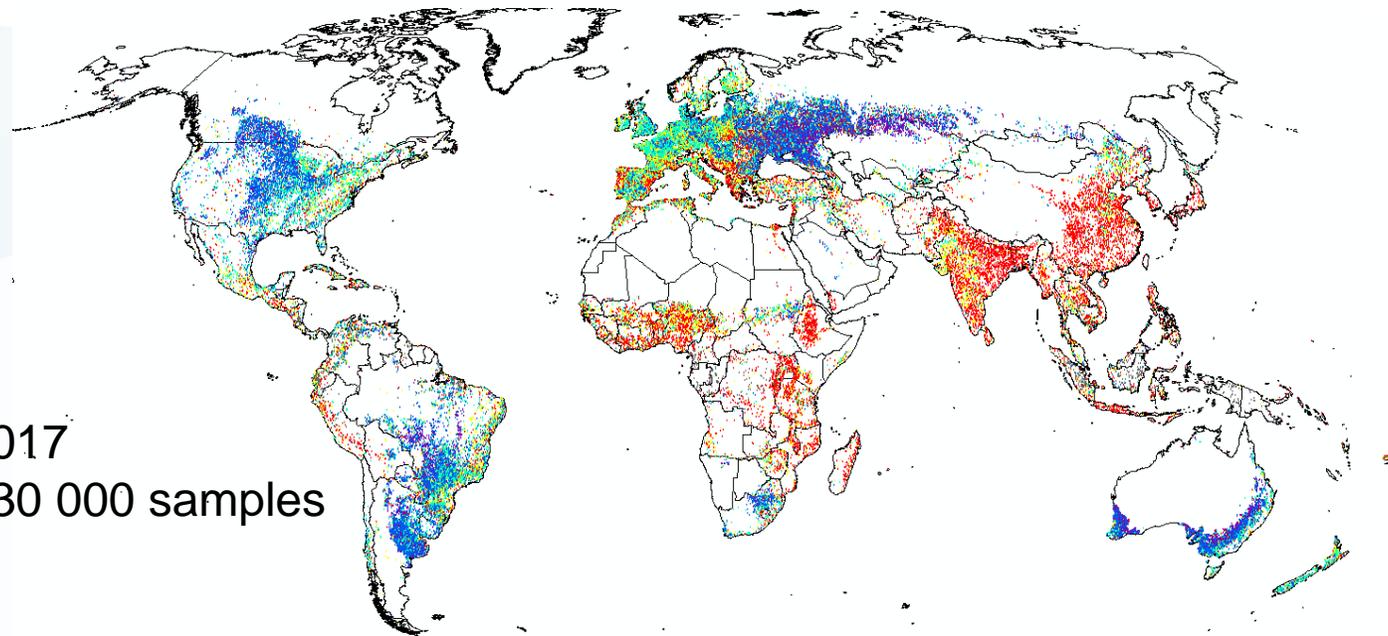
2011
13 963 samples



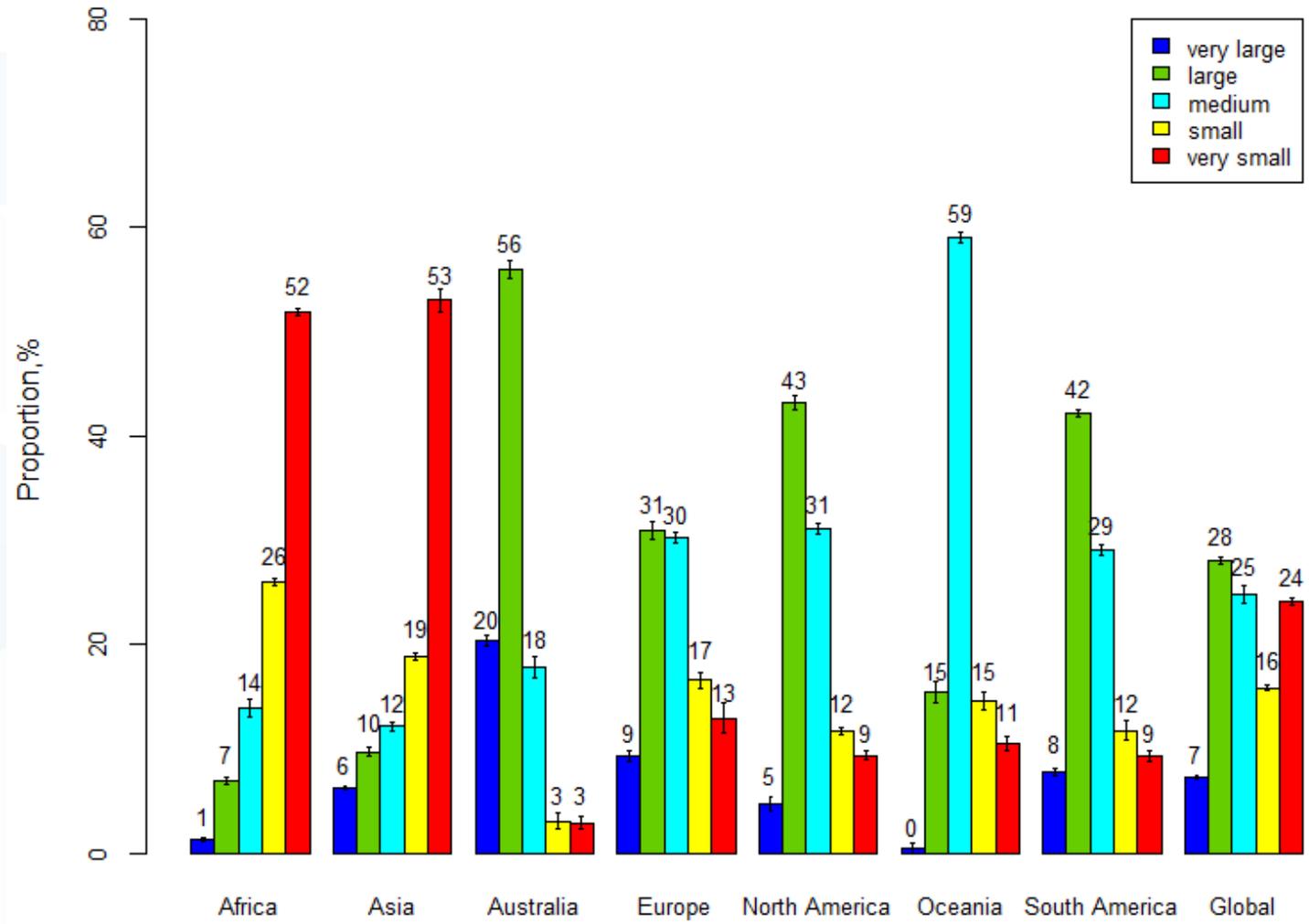
Legend

- low resolution/ no images
- very large
- large
- medium
- small
- very small
- no fields

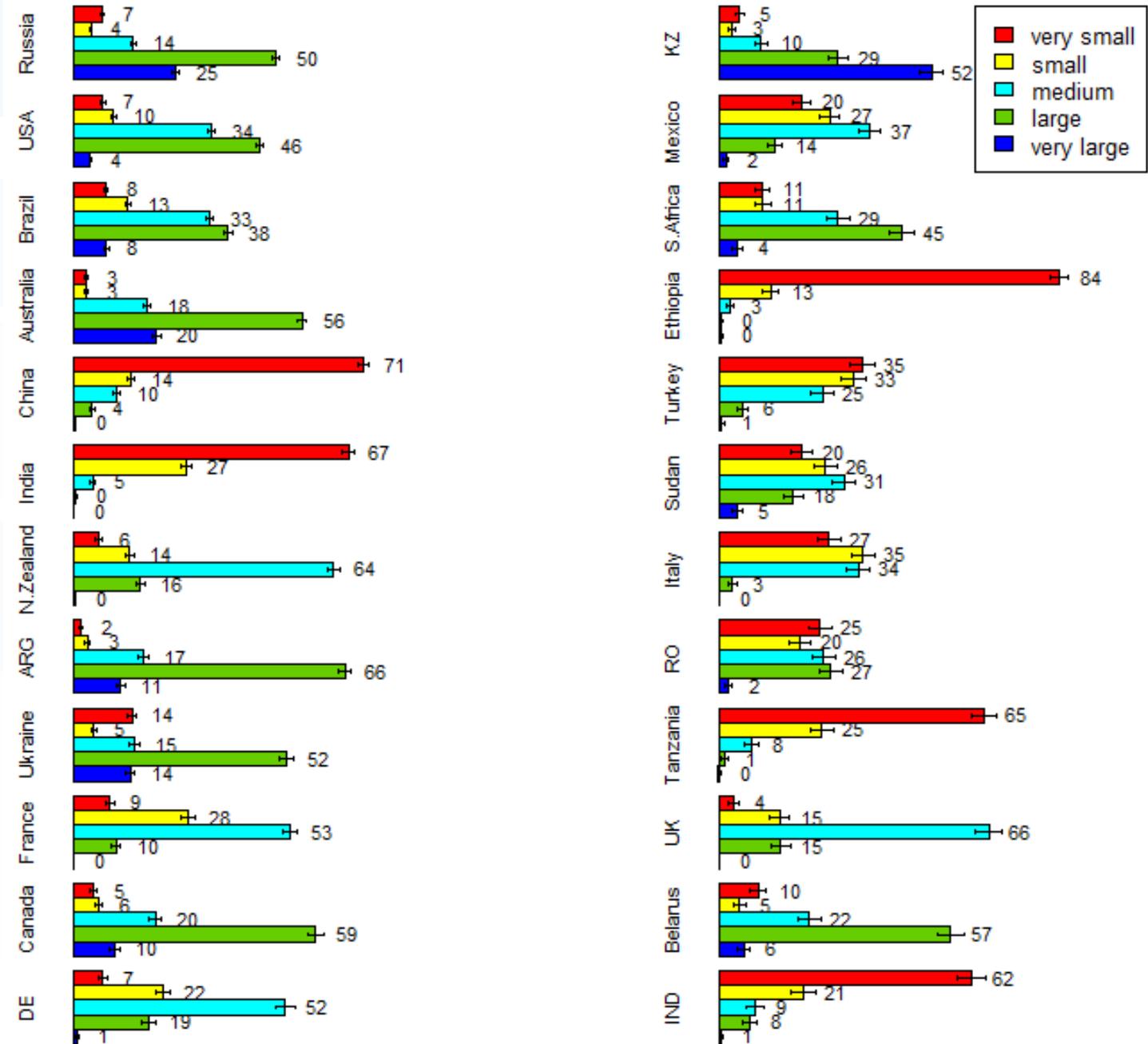
2017
130 000 samples



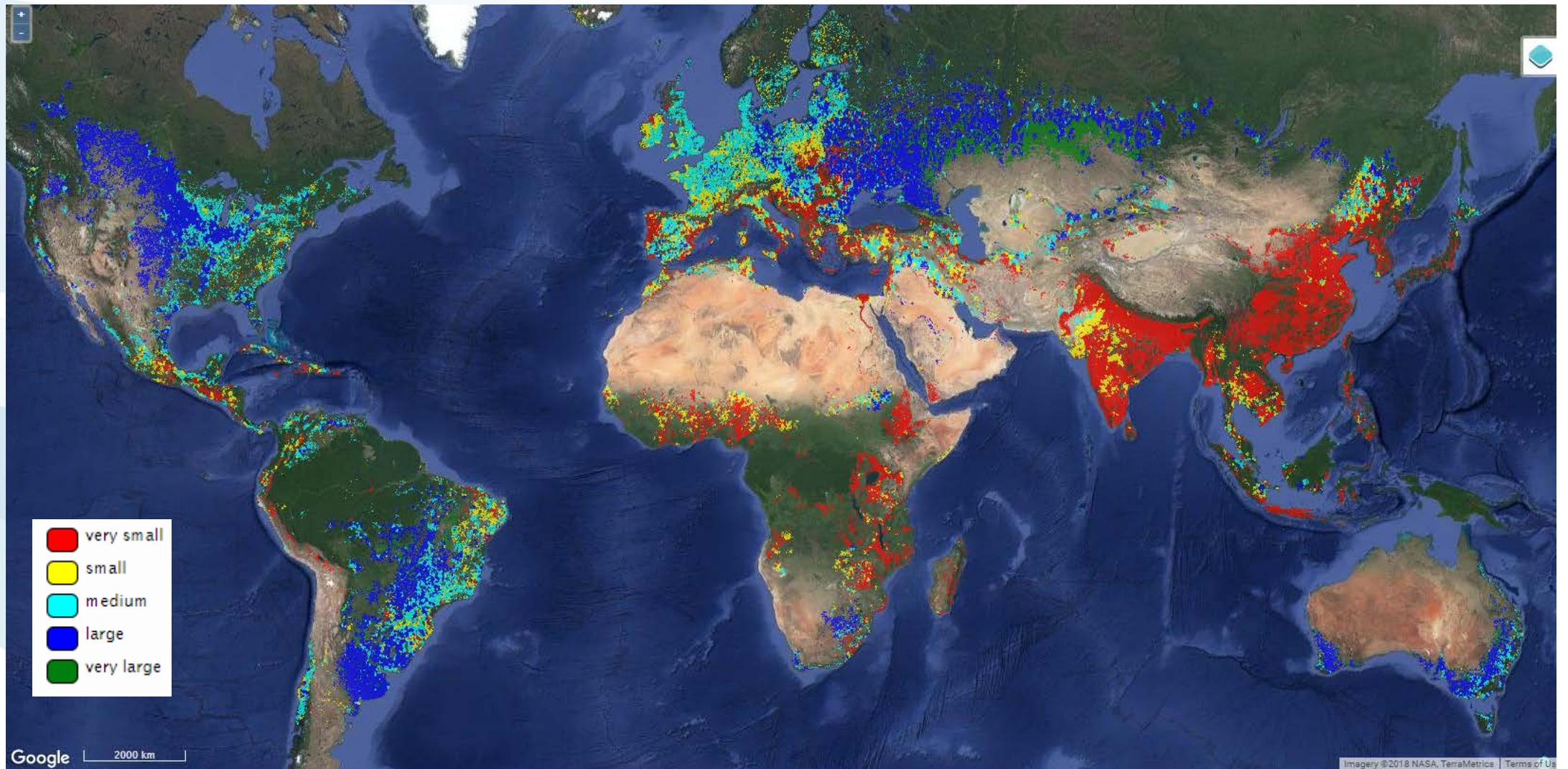
Share of different field size categories by continents:



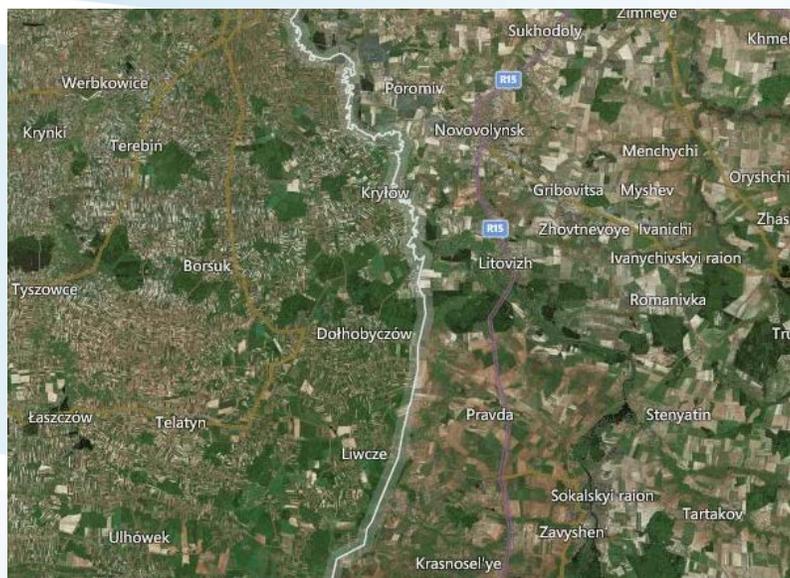
Share of different field size categories by countries:



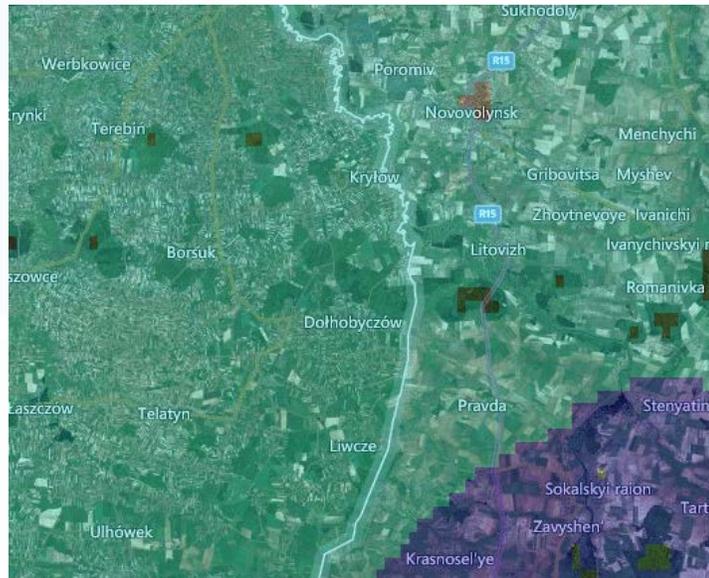
Mapping global field sizes



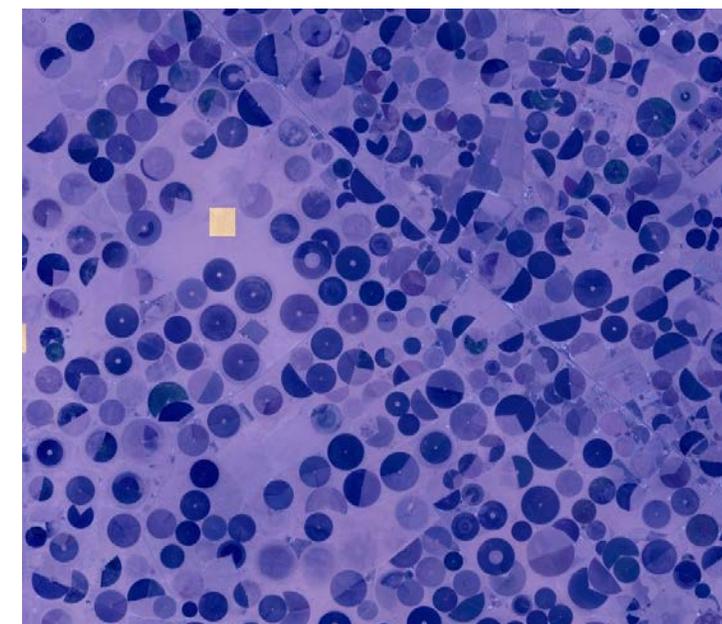
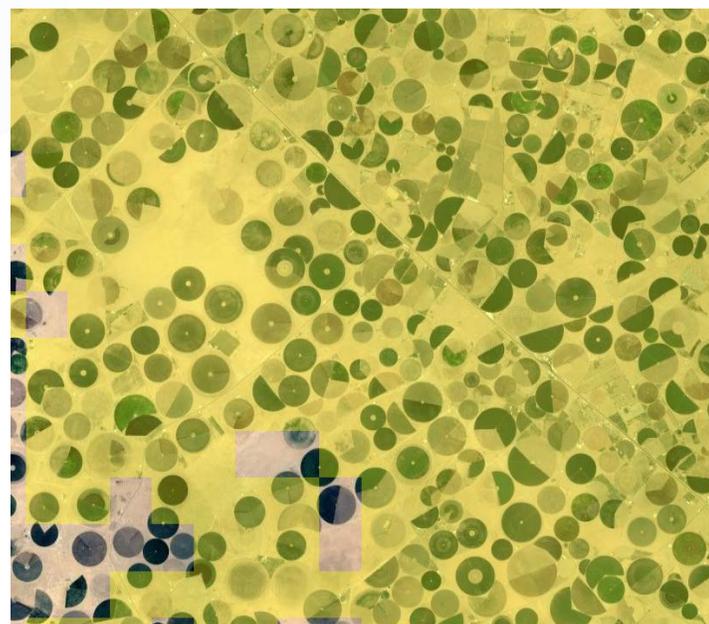
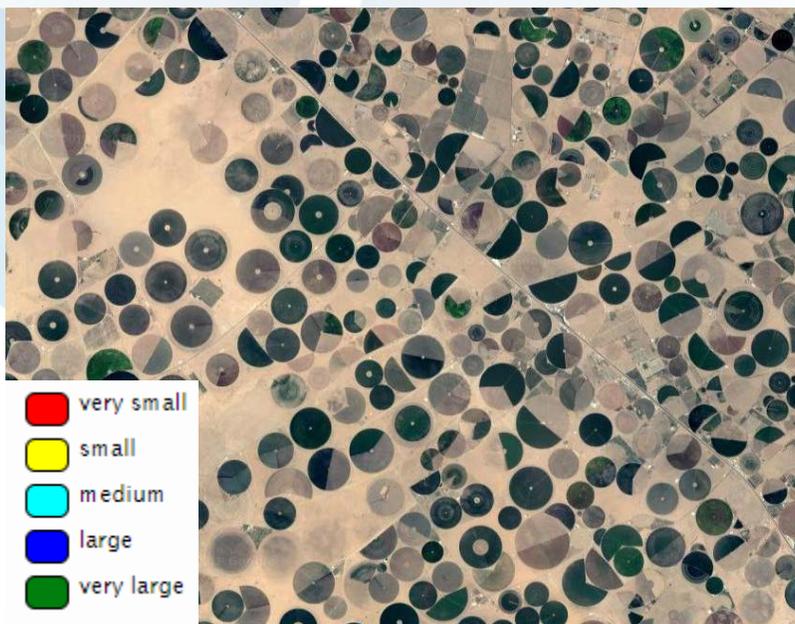
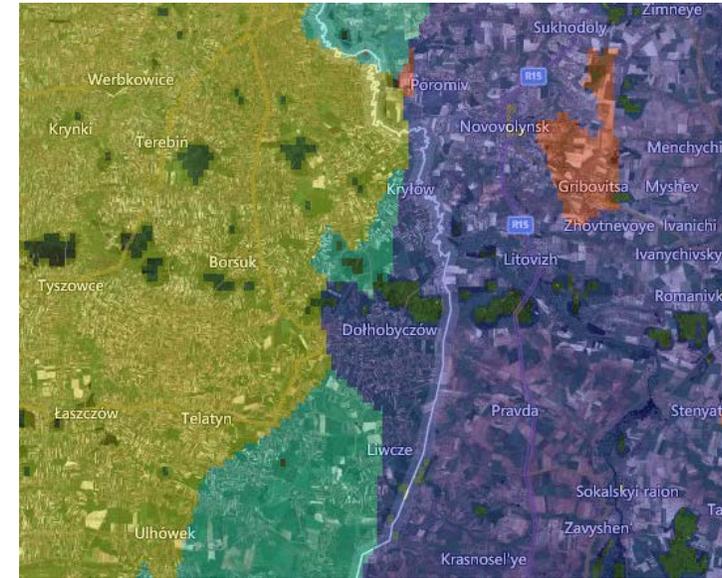
Bing Image



Field size map 2011



Improved - Field size map 2017



Where this dataset can contribute to

- Food security and agricultural dynamics
- Models with land use component, such as
 - Integrated assessment models
 - Biophysical and biochemical models
- Spatially explicit models
- Stratification for selection of satellite data for agricultural monitoring in different parts of the world, with areas dominated by small field sizes requiring satellite imagery of increased precision.
- Etc..

Summary

- A new global field size dataset
 - 130 000 unique locations, 390 000 tasks completed!
- Area proportions of different field sizes by countries
- Area proportions of different field sizes globally:
 - Very small – 24 %
 - Small – 16 %
 - Medium -25 %
 - Large - 28 %
 - Very large - 7 %
- A new global field size map
- Lessons learned during crowdsourcing campaign, including feedback from participants
 - in particular, on quality assurance
- We plan to improve global field size map with a help of remote sensing data



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Thanks!

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