European Commission

Science for Environment Policy

Multiple datasets combined to make first global cropland and field size maps

A global cropland percentage map and a global field size map have been created for the first time to guide scientists and policymakers interested in global agricultural modelling and assessment. Both maps are for the baseline year 2005 and combined multiple data sets from global, regional and national levels to achieve a high level of accuracy and 1 km^2 resolution.

As the global population continues to rise, the pressure on the agricultural and food industries also increases. Developing countries are particularly vulnerable to food shortages, and mitigating measures such as increased farm efficiency and decreased waste are often not as accurate as they could be. This is because there is a need for a better conceptualisation of what land is currently under cultivation and its distribution across the globe.

Now researchers have aimed to create the largest and most accurate single map of global cropland to date. The map, referred to as the IIASA–IFPRI (International Institute for Applied Systems Analysis-International Food Policy Research Institute) cropland product, combines global land cover maps such as GlobCover 2005 and MODIS v.5, regional maps like AFRICOVER, and national maps from data-sharing exercises. Cropland was defined as arable land, including either temporary or permanent agricultural crops or harvested flowers.

The researchers also developed a second map to illustrate field size across the world. They used map data collected using Geo-Wiki, an online application that involves citizens in environmental monitoring using Google Earth imagery. Participants estimated field size across the globe by looking at 53 000 sample pixels from 36 000 unique locations at a 1 km^2 resolution. The maps and data can be downloaded from http://cropland.geo-wiki.org/.

IIASA–IFPRI utilised Geo-Wiki to test the accuracy of their map by asking individuals to look at images and determine what type of land cover was present there. The accuracy of the map is 82.4%. Both maps were also compared to other datasets like the EarthStat map or validated by experts in the field, who checked the accuracy of the public contributions on Geo-Wiki. The sources were all found to be reliable and the IIASA-IFPRI product was found to be correct twice as often as EarthStat in regions where they disagreed.

Examining the quality of the Geo-Wiki crowdsourced data is a fundamental part of the European Research Council (ERC) CrowdLand project and only data that exceeded a minimum quality threshold were included in the validation of the global cropland map. This work was partly supported by EU-funded GEOCARBON[1], ERC CrowdLand[2], and SIGMA[3] projects.

As cropland is also an important source of greenhouse gas emissions, land cover maps provide important data for IPCC calculations and for the Global Carbon Observing and Analysis System proposed in GEOCARBON.

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The global map will also be input to the IIASA GLOBIOM land use model[4] to examine the future impacts of intensification and extensification scenarios on the environment.

The researchers say their maps present valuable resources for the global modelling and assessment community, particularly those that need baseline cropland information. The maps could also help identify where investment would be most effective, and to study the impact of drought and manmade disasters at a regional level. The cropland map is already being used by organisations such as the Group on Earth Observation Global Agriculture Monitoring Initiative (GEOGLAM)[5] in their crop monitoring activities. Although the field size map is a preliminary attempt at a global product because of its relatively small sample size, it could be helpful in determining the appropriate remote sensing inputs needed for agricultural monitoring, e.g. freely available coarse resolution MODIS imagery can be used to monitor areas with large field sizes, while very small field sizes require costly high resolution imagery.

Combining and validating multiple maps results in a product more reliable than the individual parts, the researchers say. The bottom-up approach taken to create these maps, such as the crowdsourcing and use of high-resolution satellite imagery, could fundamentally change the way large-scale maps are created in the future.

Funding:

1. GEOCARBON (Operational Global Carbon Observing System) was supported under the European Commission under the Seventh Framework Programme. See: http://cordis.europa.eu/result/rcn/168141_en.html

2. CrowdLand is supported by the European Commission under the Seventh Framework Programme.

3. SIGMA (Stimulating Innovation for Global Monitoring of Agriculture) is supported by the European Commission under the Seventh Framework Programme.

4.GLOBIOM (Global Biosphere Management) Model.

5. GEOGLAM (GEO Global Monitoring of Agriculture)