4th Open Science Meeting of the Global Land Programme

April 24-26, 2019 | Bern, Switzerland

Conference Agenda

Overview and details of the sessions of this conference. Please select a date or location to show only sessions at that day or location. Please select a single session for detailed view (with abstracts and downloads if available).

Session Overview

Session

333R: Mapping land system through coupling the biophysical and socioeconomic attributes based on remote sensing and big data approaches - Focus on land rent & markets

Time: **Friday, 26/Apr/2019: 10:30am - 12:00pm**
Session Chair: **Jinwei Dong**
Session Chair: **Daniel Müller**
Session Chair: **Graciela Isabel Metternicht**
Session Chair: **Tobia Lakes**
Session Chair: **Patrick Hostert**
Session Chair: **Le Yu**
Session Topics: How do we support transformation?

Location: **UniS-A -122**
UniS Building, room A -122, basement, 72 seats

Session Abstract

Addressing the social-economic characteristics of land systems, besides biophysical attributes of land cover, is key to understand land system transformations in response to global changes. We have struggled for years to recognize the biophysical change of land systems using the remote sensing technology as well as the mapping algorithms. With the increasing availability of multi-sensor, multi-resolution, multi-temporal remote sensing images, accompanied by the boom of the crowd-sourced photos, social media data, and POI datasets, we can access to more information not only for land cover but also for land use, not only for land use but also for land management, and to understand the continuous process of land use changes instead of

This session will to provide an opportunity for the community to exchange the new progress in picturing the biophysical and social-economic aspects of land systems and tracking the process of land system transformations and changes using remote sensing and big data. We welcome any studies related to the application of remote sensing and big data for the analysis of land system sciences and specific case studies in different regions of the world.

This session is sponsored by the new GLP Working Group on "New Contributions of Remote Sensing to Land System Science in the Big Data Era"

Session Organizers: Jinwei Dong, Patrick Hostert, Graciela Metternicht and Le Yu.

Presentations

Full talk
ID: 586 / 333R: 1
332R Land market dynamics and their effects on land use
Keywords: land prices, land use, urban sprawl, zoning, arable land

Insights into the dynamics of the market for arable land in Brandenburg, Germany

Jens Kolbe, Axel Werwatz
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Prices for arable land are on a rise for over a decade now in Germany. As a consequence, farmers and their respective lobby groups call for stronger regulations on the agricultural land market. Next to the political dimension of the development, there are also economic consequences which have to be considered. Increasing prices will, for instance, have an effect on productivity, farm size and structure and land use intensity.
This study investigates on the process of price formation on the agricultural land market. In order to draw conclusions for policy maker on how to deal with high priced arable land, we focus on the demand side of the market. This means that we analyse the development of prices and potential land use in the study area of Brandenburg, Germany. As a matter of fact, other land use cases like residential, industrial and nature conservation pressurise the available stock of arable land.

The foundation of the analysis is a comprehensive data set of land transactions for the years 2000-2017. Exploiting the adjacency of the growing urban area of Berlin, this study aims to estimate the impact of urban sprawl on land prices. The ability to merge transaction data with spatial data from other sources inhibits a great potential for the analysis. This includes information on soil quality, land use, population density and transportation.

First results show a positive influence of urban sprawl on land prices. But even after controlling for urban sprawl and other price building factors like soil quality, the steep upward price trend remains in the data. This holds in particular for plots sold in areas far away from urban agglomerations. Further investigation seems necessary, in order to reveal the dynamics on this particular market and give advice to planners and policy makers.

Full talk
ID: 620 / 333R: 2
332R Land market dynamics and their effects on land use
Keywords: land prices, land markets, geospatial data systems, data philanthropy

Geospatial land price data: a public good for land system science

Oliver T Coomes, Graham K MacDonald, Yann Le Polain de Waroux
McGill University, Canada

Improved access to data on land prices at the regional and global scale is vital to the land system science community. In many studies of land use and land cover change, land prices are proxied by measures such as market accessibility, or more often, omitted because of a lack of data. Recent studies by members of the GLP community that draw on commercial data or primary data from landowners, however, show the importance of land price data for understanding land-use change. We argue for the creation of an open-access global land price database that would make spatially-explicit land price information available as a public informational good to the international science and policy community. Such a development would be informed by past initiatives to compile and share a wide range of geospatial data, from land cover to population, land tenure and protection status and economic development, and benefit from growing interest in data philanthropy. The initiative would face many challenges in gathering and assembling land price data from a myriad of disparate sources, particularly in data-scare regions, and fusing those data into a consistent database, but the potential for applications in land system science are substantial. The GLP could be both a major beneficiary and contributor to the development of a global land price database.

Full talk
ID: 401 / 333R: 3
333R Mapping land system through coupling the biophysical and socioeconomic attributes based on remote sensing and big data approaches
Keywords: active learning, cubesat, cropland, smallholder, crowdsourcing

Integrating humans and machines to map smallholder-dominated agricultural frontiers

Lyndon Despard Estes[1], Lei Song[1], Su Ye[1], Ryan Avery[2], Dennis McRitchie[3], Stephanie Debats[4], Sitian Xiong[1], Ron Eastman[1], Tammy Woodard[1], Kelly Caylor[2]
[1]Clark University, United States of America; [2]University of California Santa Barbara; [3]Independent Consultant; [4]Uber, Inc.

During the next few decades, agriculture in Sub-Saharan Africa (SSA) will undergo a large-scale expansion to meet the region's rapidly growing food demands. This change will have a significant impact on the trajectory of global change, but understanding that impact is difficult because mapping trends in the region's smallholder-dominated croplands (which is critical to understanding agriculture-environment interactions) is a major Earth Observation challenge. To address this challenge, we present a new method for mapping land cover based on *active learning*. Active learning engages a large number of human mappers via a crowdsourcing platform to iteratively train and test a computer vision/machine learning algorithm that classifies high spatial and temporal resolution imagery collected by cubesats. After initial training on a random sample, the algorithm directs the human mappers to collect new sites in the areas of highest classification uncertainty, whereupon it retrains and re-evaluates performance. This process iterates until accuracy gains saturate. This approach demonstrates the ability to rapidly collect high quality training data, while the classifier is effective in distinguishing cropland from non-cropland across agricultural systems, ranging from complex smallholder landscapes to large-scale, irrigated croplands. When these two components are combined in the active learning framework, high accuracy (True Skill Statistic > 0.65) classifications are produced that require substantially less training data (62% fewer sites) than an alternative approach using a purely randomized approach to sites selection. This method is scaled up on cloud computing infrastructure, and is being deployed to create a next-generation cropland map for sub-Saharan Africa that not only maps agricultural cover, but delineates the boundaries of individual fields or groups of fields, with the ability to update these maps at a seasonal time scale over large areas. Here we demonstrate the capabilities of this system for mapping highly dynamic croplands in Ghana, including information on the size class distribution of fields. We also present a method that accounts for training data error in assessing overall map accuracy.

Full talk
ID: 461 / 333R: 4
333R Mapping land system through coupling the biophysical and socioeconomic attributes based on remote sensing and big data approaches
Keywords: SPAM, crop maps, optimization, household surveys

Generating high-resolution national crop distribution maps: Combining statistics, gridded data and surveys using an optimization approach

Michiel Van Dijk[1], Liangzhi You[2], Petr Havlik[1]
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Detailed information on the location and size of crop area is essential for the assessment of agricultural production, food security and greenhouse gas emissions resulting from land use change. Although, there exist several initiatives to produce spatially-explicit crop distribution maps, these are either limited to a small number of crops (e.g. palm oil, soybeans and maize) or are generally too coarse for detailed country assessments. The aim of this paper is to present a flexible model to create high-resolution crop distribution maps that cover all major crop groups in FAOSTAT and incorporate all relevant information from a wide number of sources, including subnational agricultural statistics, land use maps and household survey data. The model builds on the Spatial Production Allocation Model (SPAM) presented in You et al. (2006, 2014), who use a cross entropy framework to allocate the FAOSTAT crop statistics to a 5 arcmin grid. We improve the model in several ways. First, we combine a Bayesian spatial modelling framework with data from nationally representative household surveys to create crop-specific probability maps, which act as priors in the model. To account for the various drivers of cropland use, we include a range of explanatory factors covering both socio-economic (e.g. distance to roads, population density and farming system) and bio-physical (e.g. soil, topography and climate) variables. Second, the SPAM routine to spatially allocate the FAOSTAT crop statistics is modified to optimize 'around' (potentially) available crop distribution maps based on satellite imagery, citizen science and Open Street Map. This ensures that the most accurate information on the location of crops is incorporated. Finally, we increase the resolution of the crop distribution maps from 5 arc min to 30 arc sec for greater detail. The model is implemented and tested for Malawi and Zambia using data for the year 2010.

Full talk
ID: 860 / 333R: 5
333R Mapping land system through coupling the biophysical and socioeconomic attributes based on remote sensing and big data approaches
Keywords: Land use theories, global land allocation

Classical theories of land use: a model-to-data assessment

Thierry Brunelle[1], David Makowski[2], Patrice Dumas[1]
[1]CIRAD, France; [2]INRA, France

Global economic models relies extensively on classical economic theories of land use - Ricardian rent theory and von Thünen location's theory - to project future dynamics of land expansion over the world. In spite of their influence, the effective capacity of these theories to explain land allocation at global scale has never been thoroughly measured and their validity is still debated. To help settle the debate, this paper aims at evaluating the classical theories of land use against the available spatial datasets regarding actual land use, land suitability and land accessibility. This work is carried out using specific econometric methods to deal with spatial autocorrelation and heteroscedasticity. The explained variable correspond to land uses (pastures, total cropland, main crop types). The Ricardian theory and the von Thunen theory are tested by using respectively an index of land suitability and an index of land accessibility as explicative variable. In addition, we use different sources of data to take into account the uncertainty surrounding them. Our results may be used to assess the relevance of global scales scenarios of land use produced by economic models.

Full talk
ID: 830 / 333R: 6
108R Farming into the future: balancing global competitiveness and localised comparative advantage?
Keywords: comparative advantage, competitive advantage, land rent, land value, suboptimal

How global competitiveness drives comparative disadvantages in farming: a land value and rent explanation.

Anders Wästfelt[1], Qian Zhang[2], Brian Kuns[3]
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The conventional meaning of "comparative advantage" is paradoxical. A comparative advantage in productivity for one place over another does not necessarily mean that these two places are competing on equal conditions concerning labour terms, energy costs, environmental impacts, etc. Unequal competition instead often leads to the production of comparative disadvantages between places, when taking into consideration optimal uses of the land.

For locations which are well-integrated into world markets, land values can be high without a demand for land as an agricultural production resource, which is often also reflected in comparatively low agricultural land rents and in an overall low dependency rate of subsistence production for these places.

This paper shows that high land values in peri-urban locations result in transformations away from resource efficient land use, while low land rent in these same locations make it possible for relatively small scale farms to find a way to become locally competitive. Meanwhile, in rural areas, the combination of low land rents and values with the necessity of

being globally competitive forces farmers to pursue sub-optimal land and resource use. They increase labour productivity to such a level that area productivity decreases. Land rents/values also play a role in inducing unsustainably intensive industrial farming in rural areas.

Differences between land rents for agricultural purposes and land values leads to sub-optimal agricultural land-use, where unequal competitiveness is superseding local comparative advantage, an inequality which produces a devaluation of land as a food producing resource. In turn, this heightens concerns about agricultural productivity and the challenges of feeding a future global population of 10 or more billion. It is important to reconceptualise land value away from the profits that can be generated from land in a global and urban centred economy and more in line with criteria emphasizing self-sufficiency and ecological sustainability.