COMPARISON OF GLOBAL LAND COVER PRODUCTS: COMMUNITY REMOTE SENSING TO VALIDATE AREAS OF HIGH DISAGREEMENT

Steffen Fritz[1] Ian McCallum[1], Linda See[2], Florian Kraxner[1], Michael Obersteiner[1]*
[1]FOR Program, International Institute for Applied Systems Analysis, Austria
[2] School of Geography University of Leeds

1. INTRODUCTION

Maps of global land cover derived from satellite-based earth observation have existed for almost two decades and represent one of the most important sources of baseline terrestrial information for a wide variety of users, e.g. the Convention on Biological Diversity. More importantly, land cover maps provide critical input data for global models of land use and land use changes [1]. Urgent questions have arisen that depend upon an accurate global land cover dataset, e.g. how much land is available for agricultural use or how high will competition for land be between food and bioenergy, considering increasing needs in the future. Some of these questions could be answered if a global baseline map of land cover would exist. However, at present, a unified and satisfactory solution has not surfaced, owing in part to large disagreements among existing global land cover datasets.

2. METHODOLOGY

This paper compares the three most recent global land cover products, namely GLC-2000, GlobCover, and MODIS. Moreover, it presents a methodology for comparing global land cover maps that allows for differences in legend definitions as well as different spatial resolution between products to be taken into account. The map legends are first reconciled by creating a legend lookup table that shows how the legends map onto one another. Where there is overlap, the specific definitions for each legend class are used to calculate the degree of overlap between legend classes. In this way, one-to-many mappings are accounted for, unlike in most methods where the legend definitions are often forced into place. Another advantage over previous map comparison methods is that application-specific requirements are captured using expert input, whereby the user rates the importance of disagreement between different legend classes based on the needs of the application. This user-defined matrix in conjunction with the degree of overlap between legend classes is applied on a pixel-by-pixel basis to create maps of spatial disagreement and uncertainty. The user can then highlight the areas of highest thematic uncertainty and disagreement between the different land cover maps allowing for areas that require further detailed examination to be readily identified. Once areas of high disagreement have been identified maps of disagreement are made available to the public via web map services in order to allow every internet user to be able to evaluate those areas of high disagreement and to be able to decide which of the 3 current land cover products has been correctly classified and which areas appear to not reflect the appropriate land cover when compared with google earth high resolution images.

3. RESULTS

Two diverse applications of this methodology are described including the estimation of global forest cover and monitoring of agricultural land. In the case of global forest cover, an example is provided for Columbia which shows that the MODIS land cover map overestimates forest cover in comparison with the GLC-2000. The agricultural example on the other hand, serves to illustrate that for Sudan, MODIS tends to underestimate crop areas while GLC-2000 overestimates them (Fig. 1.). These results are visible in geo-wiki.org, an online tool for global land cover validation [2]. Experts or trained internet users can decide based on google earth high resolution pictures which land cover product has been correctly classified at a specific location. In case the classification does not correspond to the land cover seen on very high resolution image, the appropriate land cover type can be chosen (Fig2).

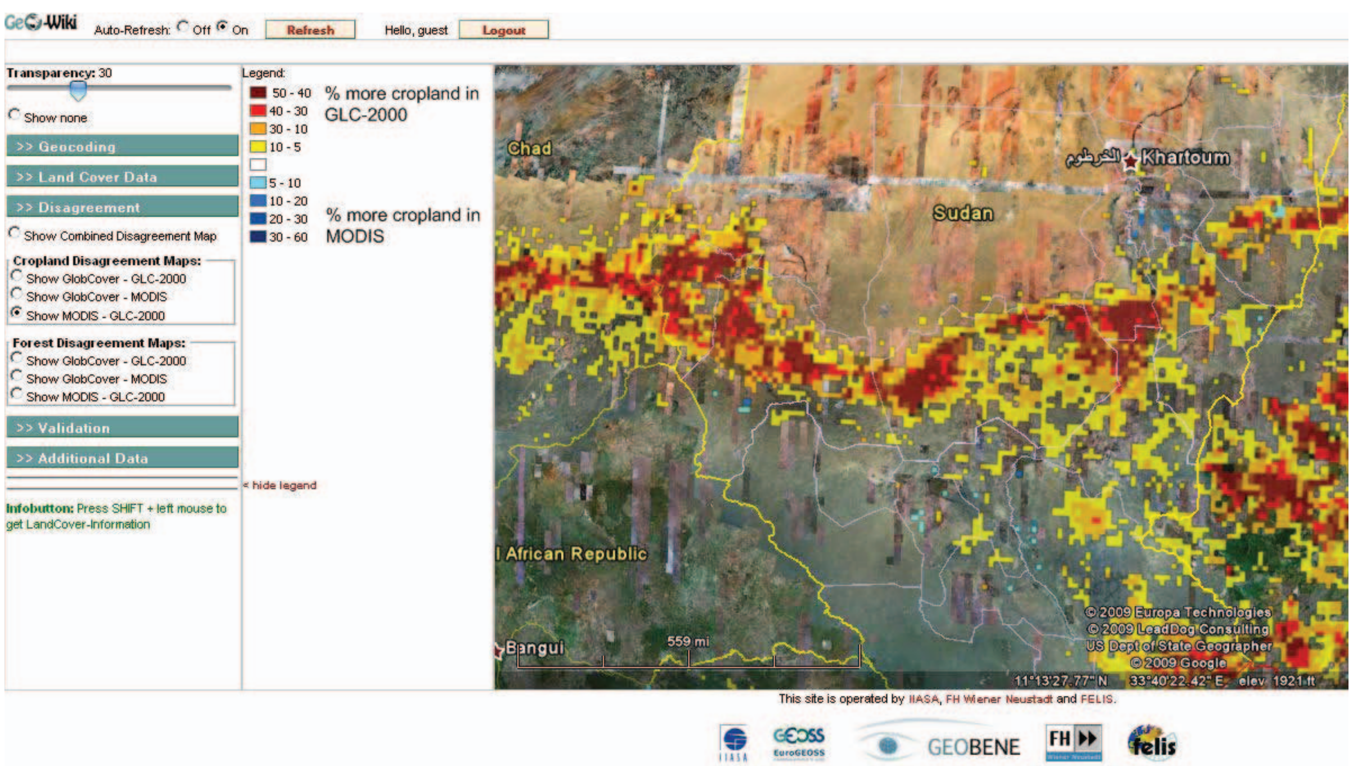

Figure 1. Using geo-wiki.org to display MODIS and GLC-2000 agricultural disagreement areas in Sudan, Africa.

Figure2: cropland in Sudan where GLC-2000 depicts land cover correctly and MODIS and GlobCover has been corrected though community remote sensing.

4. REFERENCES

[1] J. A. Foley et al., Science 309, 570 (Jul, 2005).

[2] Fritz, S.; McCallum, I.; Schill, C.; Perger, C.; Grillmayer, R.; Achard, F.; Kraxner, F.; Obersteiner, M. Geo-Wiki.Org: The Use of Crowdsourcing to Improve Global Land Cover. *Remote Sens.* **2009**, *1*, 345-354.

Bibliography:

Dr. Fritz studied physics and geography at the University of Tübingen and received his master of science degree from the University of Durham in 1996. His thesis was entitled: Mapping and Modeling of Wild Land Areas in Europe and the British Isles, a Multi-Scale Approach. He received his PhD from the University of Leeds in 2001. He has been carrying out a number of consultancy projects in the field of wild land and vegetation mapping. He received a Postdoctoral Fellowship at the Joint Research Centre in 2002. His task was to mosaic, harmonize, and produce the Global Land Cover 2000 database and to carry out the validation of the regional GLC-2000 contributions within the tropics. In 2004 he took up a research post at the Joint Research Centre and got involved in the GEOLAND project. His task was to develop a methodology for acreage estimations of different agricultural crops in South-Western Russia. Since 2007, he has been with the International Institute for Applied Systems Analysis where he has been involved in the EU funded Geo-bene project.

He has published reports, book chapters, and peer reviewed papers in the field of fuzzy logic, remoteness mapping, global and regional vegetation monitoring, crop yield and crop acreage estimations of agricultural crops, and wild land research.