Earth Information Systems/Capacity Building – Geo-Wiki.org: Harnessing the power of volunteers, the internet and Google Earth to collect and validate global spatial information

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Figure 1. Clearcutting in Brazilian Pantanal (© Lanthilda | Dreamstime.com)

Abstract

In recent years the ability to collect spatial information from volunteers has greatly expanded through the combination of Google Earth, geo-tagged photos and the Internet. A Geo-Wiki has been created to aid in both the validation of existing spatial information and the collection

of new information through the powerful resource of crowdsourcing. A case study of a land cover validation Geo-Wiki is described, in which the tool is used to validate existing global land cover products. The potential of such a tool for other applications is also recognized.

Introduction

With an ever increasing dependence on spatial information, and an increasing importance placed on results derived from that information, it becomes crucial to better harmonize and understand the quality of this expanding volume of data. New opportunities exist to collect additional spatial information via the Internet that were non-existent until just a few years ago. Additionally, many international, intergovernmental protocols and conventions rely on this information (e.g. the Kyoto Protocol, the Convention on Biological Diversity, the Convention to Combat Desertification; and others). However, much of the spatial data used to support these important initiatives is conflicting or contains limited validation. New efforts are thus required to improve the quality of spatial information.

In recent years, the exchange of geographic information has increased exponentially [1] and an enormous resource of volunteered geographic information [2] has emerged. In particular, due to major advances in technology development along with the emergence of Web 2.0, it is now possible for ordinary citizens to build large datasets, reversing the traditional top-down flow of information.

One example, a web-validation tool for land cover (geo-wiki.org), is extremely valuable as accurate and up to date information on global land cover plays an important role in a number of different research fields (e.g. climate change, monitoring of tropical deforestation and land use monitoring). Since global land cover datasets contain large areas of disagreement (e.g. a total area of 404 million hectares is identified as croplands in GlobCover but as non-croplands in MODIS), it is beneficial to involve a wider community to validate global land cover datasets and to provide essential information which can help to improve current global land cover. The traditional approaches of data collection and accuracy assessment are still valid and necessary, but can be complemented by such validation exercises.

In addition to land cover, other opportunities exist for such a methodology, including: reporting deforestation (Fig. 1) and illegal logging, property rights infringements, health threats and others. Following the principles of the Global Earth Observation System of Systems (GEOSS), such a tool provides decision-support to a wide variety of users.

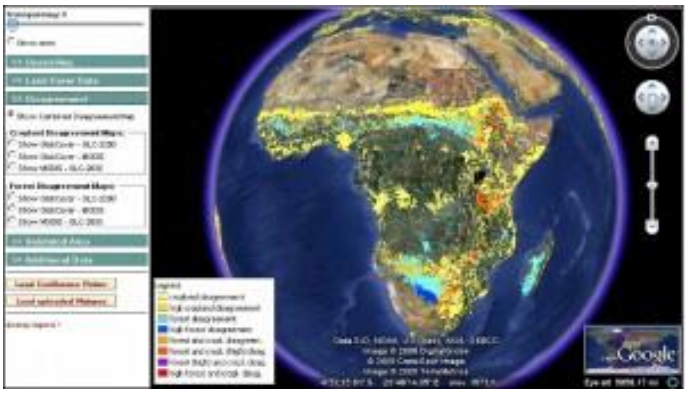

Figure 2. Results of global land cover disagreement in both cropland and forest areas, based on an analysis of three existing land cover products: GLC-2000, MODIS and GlobCover.

Case Study: Land Cover Validation

With an ever increasing amount of very fine spatial resolution images available on Google Earth, it is becoming possible for every Internet user (including non-remote sensing experts) to distinguish land cover features with a high degree of reliability. Such an approach is inexpensive and allows Internet users from any region of the world to get involved in this global validation exercise [3].

Currently in geo-wiki.org, volunteers have the ability to view both cropland and forest Disagreement Maps that were derived from three recent global land cover datasets: GLC-2000, MODIS and GlobCover. Disagreement Maps guide the volunteers to areas of the globe with the highest levels of disagreement – prioritizing the disagreement hotspots in a global cropland/forest Disagreement Map (Fig. 2).

With the help of Google Earth, the next step is to select and visualize available high resolution images as well as to upload or view geo-tagged field pictures (e.g., from Panoramio.com, Confluence.org, or from research projects such as the Global Monitoring for Food security Project (GMFS)), and determine which land cover type is found on the ground (Fig. 3). Volunteers are then asked to decide if the land cover products correctly capture what they see or know to exist on the ground. In addition, it is possible to recommend a new land cover class (i.e. select from a list of possible land cover types, and upload available photos to support the decision). All information entered by volunteers is recorded in a publically available spatial database. This validation database contains a record of the agreement among the datasets, and can be used in the future to create an improved hybrid dataset.

Remaining Challenges

Despite the enormous potential of geo-wiki.org, two main challenges remain. The first challenge is to attract a wide range of volunteers from across the globe. In terms of possible further low cost outreach facilities, one option would be to use social networks and existing user groups, especially those which include people who have some type of experience in geography, visual image analysis and mapping. The second challenge is to guarantee a certain level of quality and to ensure that the tool is not misused. As discussed by a number of authors, the question of credibility of public voluntary contributions is crucial. It can be assumed that if the application is designed in a way similar to Wikipedia and entries are to some extent monitored by volunteers (and are open to additional information by anyone who disagrees with them [4]) – the application has potential to become truly successful.

Future Outlook

Figure 3. Geo-tagged photos uploaded in geo-wiki.org (A) confirming the actual land cover seen in Google Earth high resolution images (B). Using the high resolution images available in Google Earth, in combination with available photos, a volunteer can correct existing land cover products. This combination of information sources, together with user input through the geo-wiki.org interface, creates a very powerful validation source.

IIASA, the International Institute for Applied Systems Analysis, is committed in the next years to maintain geo-wiki.org. Information collected through this tool is continuously recorded in a publicly available spatial database. This application complements previous validation exercises of these products (such as field validation by trained experts) and current efforts of the Earth Observation community to develop an improved global land cover validation database. More importantly, it is intended to lead to a hybrid consolidated land cover map, by combining different maps through geo-statistical methods, incorporating the additional land cover information retrieved by the geo-wiki tool.

Furthermore, efforts are underway to modify the geo-wiki.org to collect and analyze data on many different themes such as mapping indigenous people's territories, locating illegal logging activities, mapping deforestation and more. Additionally, collaboration with various institutes and agencies is being fostered in an effort to obtain more geo-tagged field photos (e.g. Confluence.org, GMFS and classified satellite products e.g. FAO FRA2010). In the near future plans are being formulated to add a temporal aspect to geo-wiki.org, allowing for the monitoring of land use change.

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