SEMI-AUTOMATED CLOUD/SHADOW REMOVAL AND LAND COVER CHANGE DETECTION USING SATELLITE IMAGERY

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ABSTRACT:

Multi-platform/sensor and multi-temporal satellite data facilitates analysis of successive change/monitoring over the longer period and there by forest biomass helping REDD mechanism. The historical archive satellite imagery, specifically Landsat, can play an important role for historical trend analysis of forest cover change at national level. Whereas the fresh high resolution satellite, such as ALOS, imagery can be used for detailed analysis of present forest cover status. ALOS satellite imagery is most suitable as it offers data with optical (AVNIR-2) as well as SAR (PALSAR) sensors. AVNIR-2 providing data in multispectral modes play due role in extracting forest information.

In this study, a semi-automated approach has been devised for cloud/shadow and haze removal and land cover change detection. Cloud/shadow pixels are replaced by free pixels of same image with the help of PALSAR image. The tracking of pixel based land cover change for the 1995-2009 period in combination of Landsat and latest ALOS data from its AVNIR-2 for the tropical rain forest area has been carried out using Decision Tree Classifiers followed by un-supervised classification. As threshold for tree classifier, criteria of NDVI refined by reflectance value has been employed. The result shows all pixels have been successfully registered to the pre-defined 6 categories; in accordance with IPCC definition; of land cover types with an overall accuracy 80 percent.

1. INTRODUCTION

Historical archive satellite imagery together with fresh one gives potentiality classifying time series Land cover (LC) of an area. LC is being used for national land planning since long and time series LC opens new applications, such as Reducing Emissions form Deforestation and forest Degradation (REDD or REDD+). Satellite Remote Sensing is a primary information source for LC and forest assessment as it provides images of wider areas relatively in a faster and cost-efficient manner. After the launch of Landsat 1 Satellite in 1972, several satellites (with both optical and Synthetic Aperture Radar (SAR) sensors) have been launched and trend is continuing at present as well as several planned to be launched in future and in due course spatial resolution has improved to a large extent. High resolution satellite, such as Advanced Land Observing Satellite (ALOS) provides Advanced Visible and Near Infrared Radiometer Type 2 (AVNIR-2) imagery (10m resolution) can be used for analysis of present forest cover status (Nonomura et al., 2010).

However, presence of cloud, shadow, and haze in satellite imagery hamper LC classification and need to be treated. Treatment of all of them (cloud, shadow, and haze) together in different landscape including forest land is the big issue.

There are some programs currently available for cloud, shadow, and haze but these are fragmented and lack of holistic approach that can treat all of them. Experimenting on simulated ALOS data, Hoan and Tateishi, 2008 have used Total Reflectance Radiance Index (TRRI) to separate cloud area. Further for separating thin cloud 'Cloud Soil Index (CSI)' criterion has been mentioned as second step.

Also, satellite based imageries from various platforms and optical sensors have been providing LC information since long, but extracting them correctly is challenging tasks. Employing decision tree classification scheme, Hansen et al., 2000 produced global land cover for which multi-temporal Advanced Very High Resolution Radiometer (AVHRR) metrics were used. Use of multi-temporal satellite data to produce single time land cover becomes complicated for REDD (or REDD+) which needs LC classifications from past, present, and future satellite imagery with minimum human intervention so that it can fulfil the required MRV (Measuring, Reporting and Verification) transparency.

Considering the above issues, in this study we present a semi-automated approach for cloud/shadow and haze removal and LC change detection as a whole. The concept of LC used in this study is equivalent to Land Use (LU) mentioned in IPCC. Most of the image processing steps have been carried out using PASCO Tool™. This has been developed using Erdas Macro Language (EML) and thus works with Erdas Imagine© 1991-2009 ERDAS, Inc., software environment. The processing steps comparatively require less operator inputs and can classify large number of satellite imageries with desired accuracy for pixel based change detection including defined number of LC classes as per IPCC (Bickel et al., 2006).

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