Mapping and monitoring land cover in Acre Sate, Brazilian Amazônia, using multitemporal remote sensing data

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ABSTRACT

This paper discusses the use of multitemporal remote sensing data for mapping and monitoring land cover in Acre State located in the western Brazilian Amazônia. According to IBGE vegetation maps, the study area is primarily covered by moist tropical forests ("Floresta Ombrofila Aberta") that has been partially deforested during the last decades. The climate in Acre is classified as *Am* in the Koppen system. Average monthly temperatures range from 24 to 27 degrees Celsius and yearly rain is about 2,100 mm, with a dry season on June to August. The strong dry season in 2005 affected this region causing numerous forest fires in addition to fires associated with deforestation and land management. The GeoCover orthorectified Landsat Enhanced Thematic Mapper Plus (ETM+) mosaic image centered on 2000, with pixel size of 14.25 m resampled to 100 m, the GeoCover orthorectified Landsat Thematic Mapper (TM) mosaic image centered on 1990, with pixel size of 28.5 m resampled to 100 m, and Landsat Multispectral Scanner (MSS) image centered on 1980, with pixel size of 80 m were used in this study. These remote sensing data were used for analyzing the land use and land cover changes during the 20 years (1980 – 2000) time period. In addition, 2005 and 2007 MODIS images, with 250 m of spatial resolution, were used to map deforestation occurred during the recent years and also to map burned areas occurred in the 2005 dry year in the study site. The Landsat-TM and -MSS and Terra-MODIS images were converted to vegetation, soil, and shade fraction images thus enhancing characteristics of land cover, expressed as different mixtures of these few number of terrain components. Fraction images derived from different remote sensing data have provided consistent results for monitoring deforestation, land cover change, vegetation classification, and mapping burned areas. Fraction images, derived from a linear spectral mixing model [1], constitute synthetic bands with information on end-member proportions. The generation of these images is an alternative approach to reduce the dimensionality of image data and enhancing specific information for digital interpretation [2]. Then land cover maps were obtained by digital classification of these fraction images, following a procedure based on image segmentation, unsupervised classification, and post-classification edition [3]. These products allowed to estimate the interchanges in the land cover classes over the considered period (such as classes of regrowth areas, burned forest, and burned grassland areas), as well as the increment of deforested areas from one period to another. The multitemporal analysis of Landsat datasets corresponding to 1980 (MSS), 1990 (TM) and 2000 (ETM+) showed that the deforestation areas increased 7,114 km^2 from 1980 to 1990, 4,900 km^2 from 1990 to 2000, and 3258 km^2 from 2000 to 2007 time periods. It also showed that about 2,815 km^2 of regrowth was observed in the 2000 ETM+ images. The analysis of MODIS images showed that 6,500 km^2 of land surface

were burned in Acre State in 2005. Of this, 3,700 km^2 corresponded to the previously deforested areas and 2,800 km^2 corresponded to the forested areas [4]. The derived information about deforestation, regrowth and burned areas are critical for regional and global environmental studies and for efforts to control such burning and deforestation in the future. The next step of this research is to apply the proposed method for the entire Amazonia as part of DETER (Detection of Deforested Areas in Real Time, http://www.obt.inpe.br/deter/) and PANAMAZONIA (http://www.dsr.inpe.br/panamazon.htm) operational projects developed at the Brazilian Institute for Space Research (INPE).

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