Fire distribution in West African Savannas using satellite data

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1. Background

In Africa **fire frequencies** are very high in the dry tropical area (Figure 1). Fires have largely contributed to the bio-complexity in savannas. Fire helps maintain the dynamic balance between savanna and forest and grasslands, and is considered to be the main ecological factor explaining the origin and maintenance of West Africa savannas, and is also a tool for natural resource management in protected areas and farming activities (Figures 2 and 3). They are mostly of anthropogenic origin.
The BIOTA project **study area** in West Africa is experiencing drastic rates of natural habitat loss, exacerbated by human transformation, including changes in fire regime, and climate change. Satellite remote sensing is the only tool that allows a systematic collection of data on a variety of scales, and for long temporal periods.
The **aims** of this study were to analyse fire distributions from 2000 to 2006 using MODIS fire product data at 1 kilometer resolution and to analyse fire patterns as a function of respective vegetation types affected using the GLC2000 (Global Land Cover 2000).
The **result** shows that fire frequencies in the dry season are much larger than in the rainy season. Their frequency increases with the length of the dry season. In general, the fire season is at the beginning of November to the end of April. The earlier fire season from November to the end of January is characterized by fires of low intensity from MODIS temperature scores. The later fire season from February to April is characterized by more intense fires. The highest fire frequency is from December to January.
Superimposed on the GLC2000 vegetation map, Deciduous Shrublands with sparse trees and Deciduous Woodlands are most affected by the bushfires in West Africa (Figure 6 below).

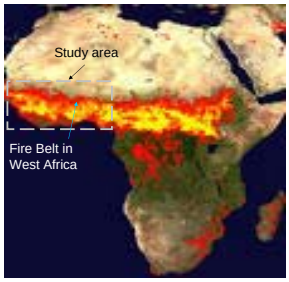

Figure 1: Fire map for period: 12/27/06-01/05/07 from MODIS Rapid Response System

Figure 2: Prescribed burning in the reserve of Lamto (Ivory Coast)

Figure 3: Fire as a tool for farmers

2. Methods used

Figure 4 explains the workflow, from satellite data acquisitions to the analysis and processing of meaningful variables to map active fires per land cover unit

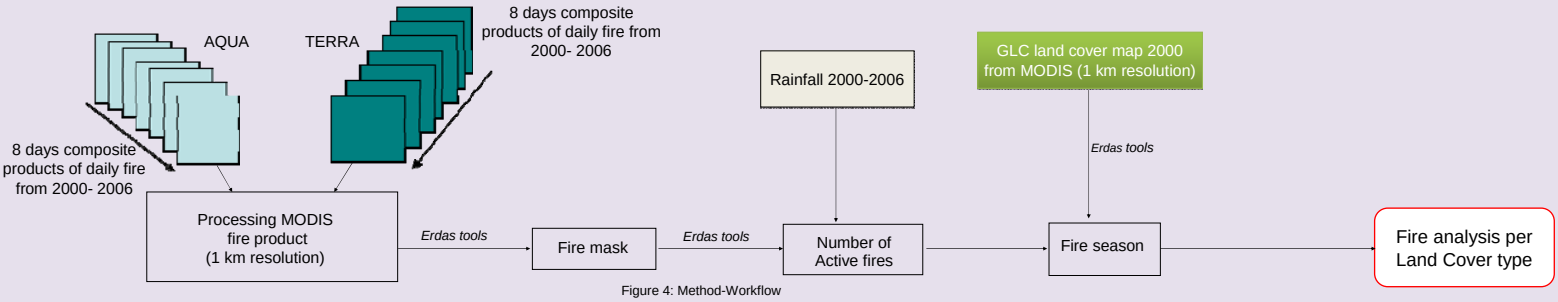

Figure 4: Method-Workflow

3. Results and Conclusion

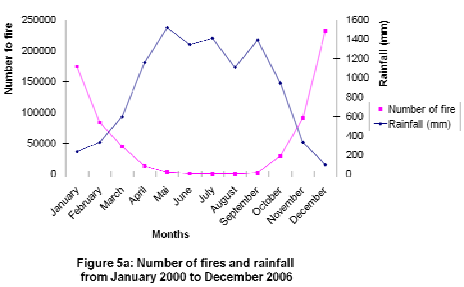

Figure 5a: Number of fires and rainfall from January 2000 to December 2006

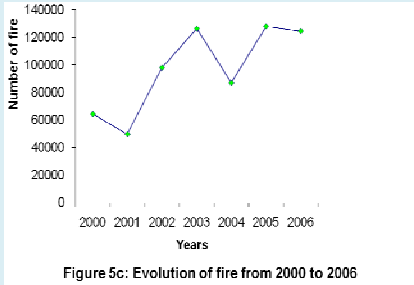

Figure 5c: Evolution of fire from 2000 to 2006

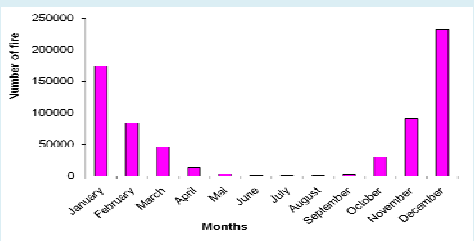

Figure 5b: Fire seasons from January 2000 to December 2006

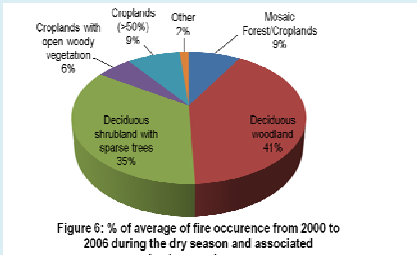

Figure 6: % of average of fire occurence from 2000 to 2006 during the dry season and associated land cover classes

The number of active fires was significantly larger in the dry season than in the wet season with a total of 669749 active fires detected in the dry season against a total of 7663 fires detected in the wet season. The vegetation fuel biomass is very favourable to fire in the dry season, since it contains less moisture. There is also a relationship between rainfall and the amount of fires detected (Figure 5a). The earlier fire season is characterized by fires of low intensity, since the fire pixel energy, measured in Kelvin degrees is considerable lower then. The later fires increased per pixel temperatures and can thus be considered as being more severe. All biomass in this burning period is consumed by the passage of fires because the vegetation has become very dry and therefore ignites easily. Likewise, the fire activity, according to satellite counts is higher during the dry season, with the highest peaks ranging from December to January (Figure 5b). The number of active fires increases with the length of the dry period (Figure 5c). This is because, in this period, after the end of the last rains, farmers apply fire to prepare the fields for tillage, and the shrubs and the cut grasses or harvest residues are very dry. During this period, uncontrolled fires lit in the fields often jump over to adjacent fields, exacerbating fire activities in the peak dry season. In addition, vegetation (bio)diversity is also affected by the activities of stockbreeders and hunters, who use fires to help in the capturing of animals. In the Natural Parks, fire activity is also important at the beginning of the dry season to enhance visibilities and suppress dense vegetation for *"parcours" and "tourists"* Another management practice in protected areas is to utilize fire to conserve the vegetation structure and the production of seedlings for wildlife.
The number of active fires occurred per type of land cover, provides information helping to understand fire spatial distribution patterns and on biomass burning drivers. Deciduous Woodlands and Deciduous Shrublands with sparse trees were more affected by fire than other land cover types, with an average respective of 41% and 35% of active fires detected.