Spatial repartition of Central African savannas

Julie ALEMAN[1]*, Charly FAVIER[2], Laurent BREMOND[1] and Valéry GOND[3].

[1]CBAE, Centre de BioArchéologie et d'Ecologie (UMR5059 CNRS), Université Montpellier 2, Institut de Botanique 163 rue Auguste Broussonnet 34090 MONTPELLIER.
[2]ISEM, Institut des Sciences de l'Evolution de Montpellier (UMR 5554 CNRS), Université Montpellier 2, CC 065 34095 MONTPELLIER Cedex 05.
[3]Biens et services des écosystèmes forestiers tropicaux, CIRAD, TA C-105 / D. Campus international de Baillarguet. 34398 Montpellier Cedex 5 - France

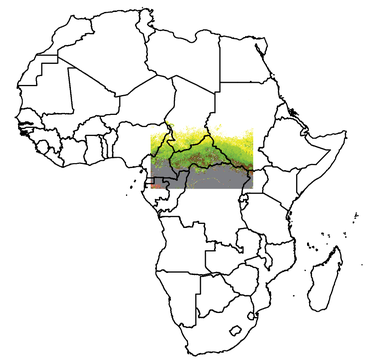
* julie.aleman@univ-montp2.fr

www.coforchange.eu

Introduction

Savannas are ecosystems where trees and grasses co-dominate. A wide range of savanna types exists defined by the density of trees and shrubs.
The factors that determine the relative proportions of trees and grasses across the various savanna types are still under debate (Scholes et al. 1997, Sankaran et al. 2005) and to improve our knowledge, large scale studies are needed. This study is located in Central Africa and hold on two questions:

How to define savanna types using remote sensing products?
How to explain savanna structure repartition?



Material and Methods

Data:
- LAI (Leaf Area Index, cumulative leaf area per unit of soil surface) product of MODIS (8 days, 1 km, from 2003 to 2009).
- Burned Area product of MODIS (1 month, 500 m, from 2001 to 2010).
- Precipitation (mm) of WORLDCLIM (1 month, 1 km, from 1950 to 2000).

To distinguish various savanna types, we used a k-means classification carried out on the average LAI per pixel.
We transformed the Burned Area product to obtain a number of fires in 10 years, and the fire date events.
We performed explanatory statistics on a test area (figure.1.b), to have an overview of the correlation between vegetation, climate and fire.

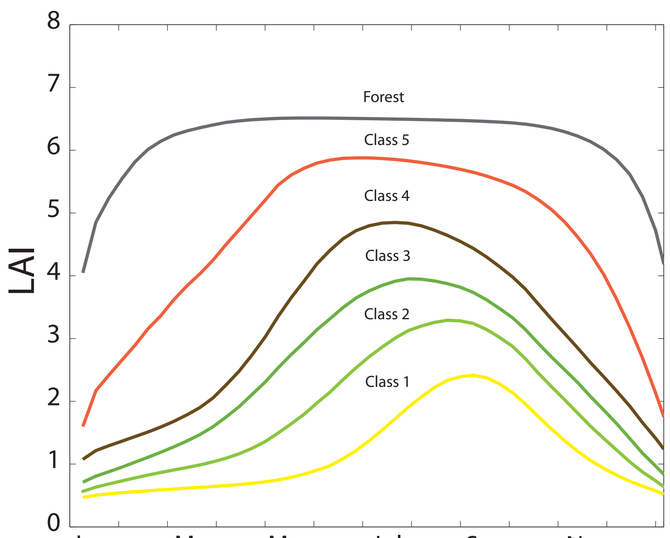


Figure 2: Time series of LAI (averaged between 2003 and 2009) over a year of the 5 classes of Savannas and the Forest.

Figure 1: a) Major vegetation types from White (1983) of the studied zone.

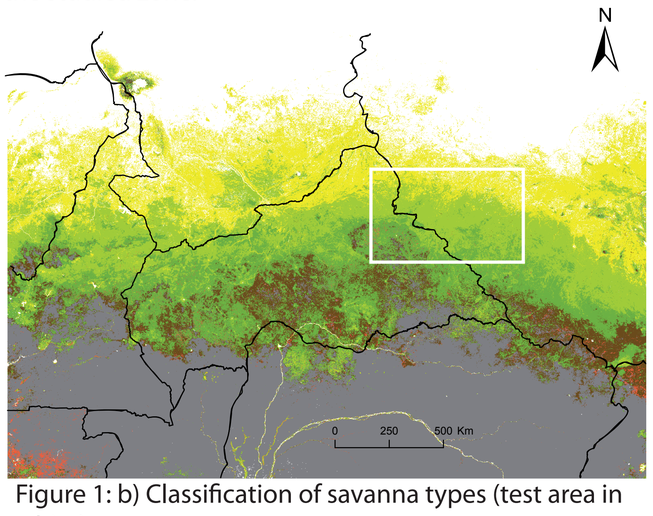


Figure 1: b) Classification of savanna types (test area in white).

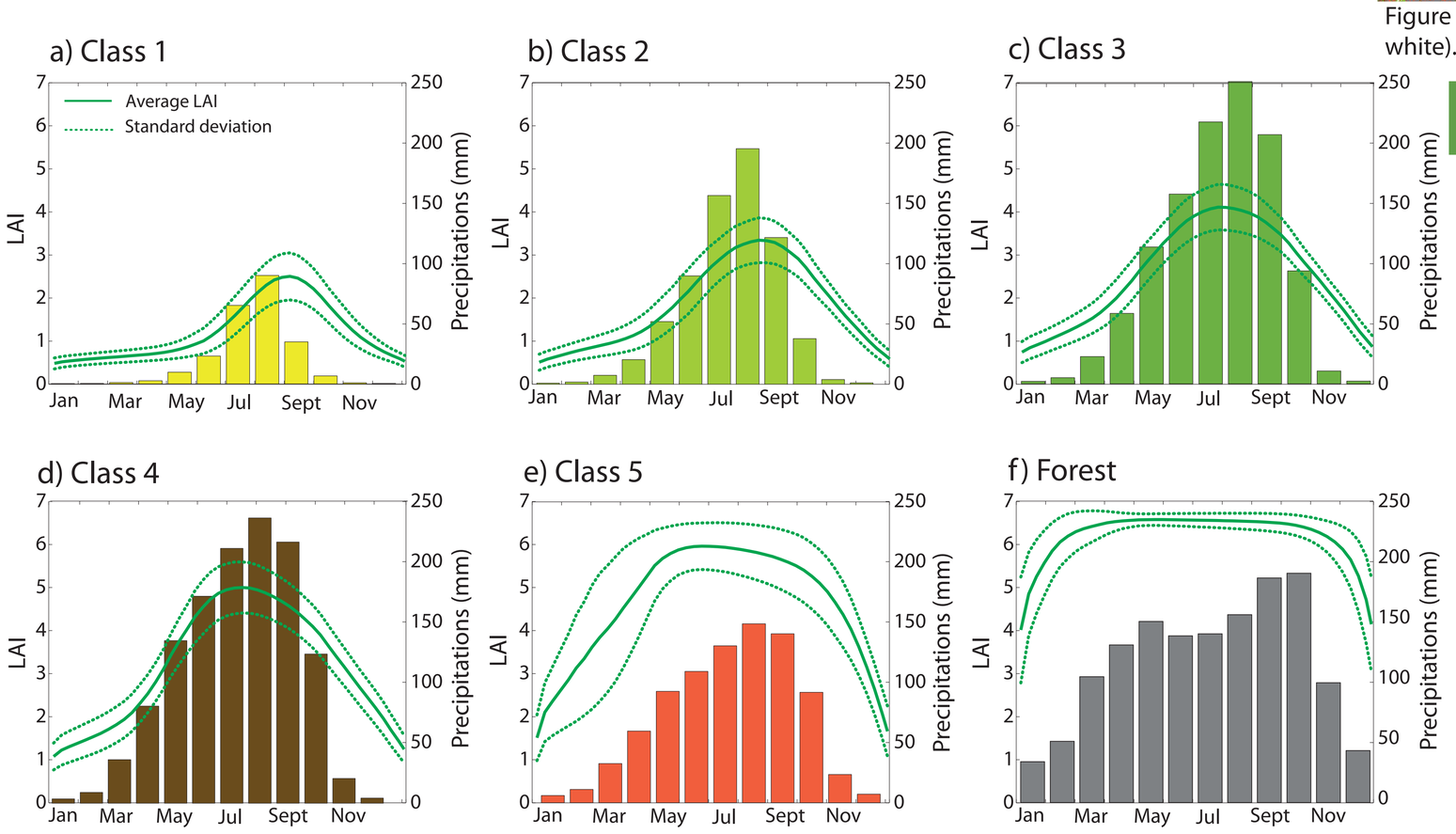


Figure 3: Time series of LAI of the 5 classes of Savannas and the Forest with the corresponding precipitation repartition.

Results

Five different savanna types are defined (figure 1), according to very different temporal behavior (figure 2): beginning of the growth, maximum LAI and beginning of senescence. Class 1 and 2 coresspond to grassland and scrubland of White's classification. Class 3 and 4 correspond to woodland and forest/savanna mosaics. The new classification brings more accuracy in savanna types classification. Those behaviors are related to precipitation repartition (figure 3), but it seems that climate does not explain the whole pattern. Indeed, it appears that the number and the date of fire eventsare very different from one class to another (test area, figure 4). For example, 12 % of class 3 pixels burned 15 times during 10 years.

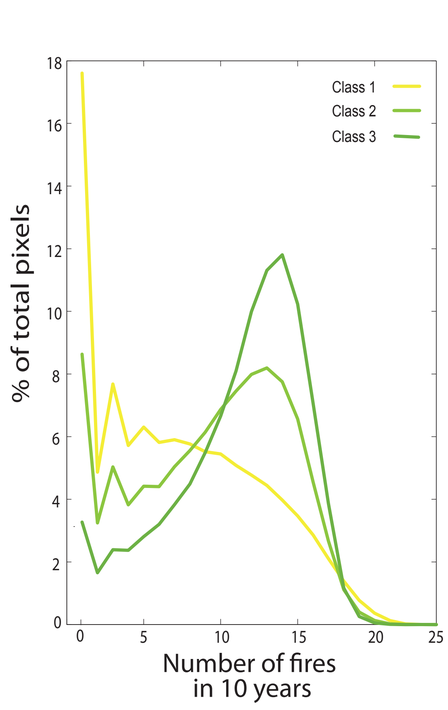


Figure 4: a) Pixels (%) per fire events number for the class 1, 2 & 3 of the test area.

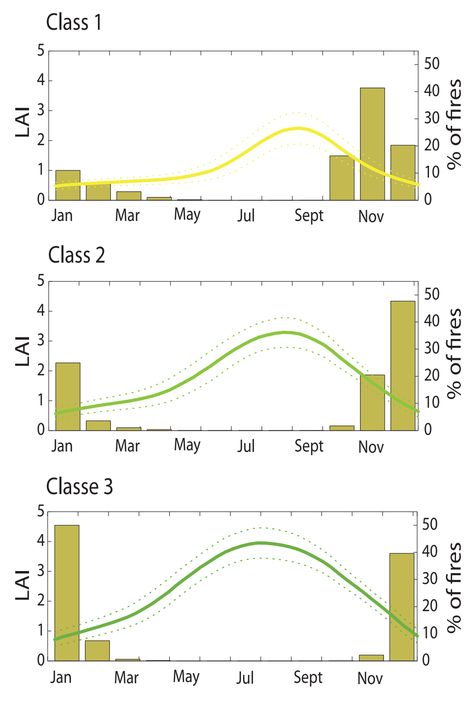


Figure 4: b) Repartition of the fires during the year within each class.

Conclusion and perspectives

This study is the first step of the implementation of a statistical model that will help to determine the functional relationships and the relative importance of several forcing factors (precipitation, fire and soil properties) in the distribution of woody cover in Central African Savannas.
Burned Area products are not easy to interpret and will necessitate a secondary processing, with comparisons with other available products (L3JRC, GLOBCARBON and GFED3).

References

Sankaran, M., Hanan, N.P., Scholes, R.J., Ratnam, J., Augustine, D.J., Cade, B.S., Gignoux, J., Higgins, S.I., Le Roux, X., Ludwig, F., Ardo, J., Banyikwa, F., Bronn, A., Bucini, G., Caylor, K.K., Coughenour, M.B., Diouf, A., Ekaya, W., Feral, C.J., February, E.C., Frost, P.G.H., Hiernaux, P., Hrabar, H., Metzger, K.L., Prins, H.H.T., Ringrose, S., Sea, W., Tews, J., Worden, J. & Zambatis, N. 2005. Determinants of woody cover in African savannas. Nature 438: 846-849.
White, F. 1983. The vegetation of Africa, a descriptive memoir to accompany the UNESCO/AETFAT/UNSO vegetation map of Africa. UNESCO, Paris.
Scholes, R. & Archer, S. 1997. Tree-grass interactions in savannas. Annual Review of Ecology and Systematics 28: 517-544.
wist.echo.nasa.gov/~wist/api/imswelcome
www.worldclim.org