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A FUNCTIONAL COMPARISON OF THE DOMINANT SPECIES AT AGOUFOU, INTENSIVE MEASUREMENT SITE IN THE MALIAN GOURMA

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1. Introduction

The proposed work is intended to contribute towards an improvement in the parameterisation of SVAT (Surface-Vegetation-Atmosphere-Transfert) models and in our knowledge of the interspecific variability of the vegetation function in the Malian Gourma. Measurements of leaf gas exchange and of leaf water constraint were made locally and simultaneously at Agoufou, intensive measurement site in the Malian Gourma. Data were collected mainly on the dominant species of the annual cover. The preliminary results from 2004 and 2005 field campaigns are showed.

2. Approaches

Three types of measurements were conducted *in situ* :

- Measurements of the response to light of the carbon assimilation in dominant species of the annual cover,
- Measurement of maximal assimilation within a large range of species composing the annual cover and in some woody shrubs, leading to a "screening" of these species,
- Measurements in natural conditions, either at one time or during the daily course, of leaf gas exchange and water constraints.

A Li-cor 6400 was used for measurement of carbon assimilation and stomatal conductance. An AP4 porometer was used for measurement of stomatal conductance with the aim of comparisons with data from the previous instrument. Finally, a Delta T member press was used to measure leaf water potential.

3. Results

The screening of species showed (figure 1) a large range of maximal assimilation among species with a partition boundary between C_4 and C_3 species at about 30 $\mu mol\ m^{-2}\ s^{-1}$. Woody species show lower maximal assimilation rates than herbaceous plants.

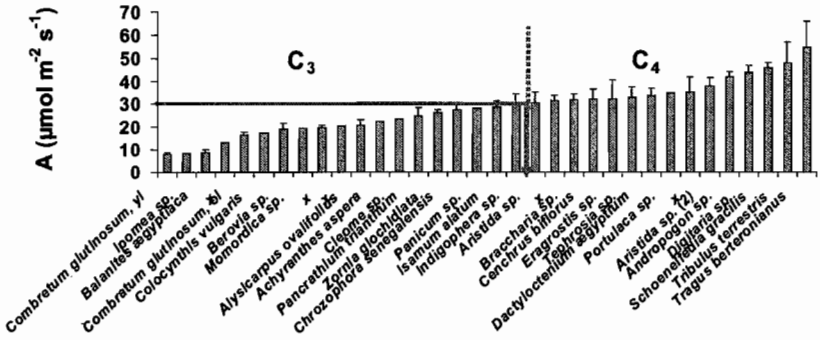

Figure 1 : Species screening - "maximal" assimilation (T = 30 °C, PAR =1800 or 2000 µmol m^{-2} s^{-1})

Leaf water potential is not discriminating among annual species, perhaps due to insufficient accuracy of the member press, leaf water potential of annual species behaving very closely to each other. More obviously, Water Use Efficiency is higher in C_4 than in C_3 annual species. It is clearly due to lower conductance and transpiration, and higher assimilation (figure 2).

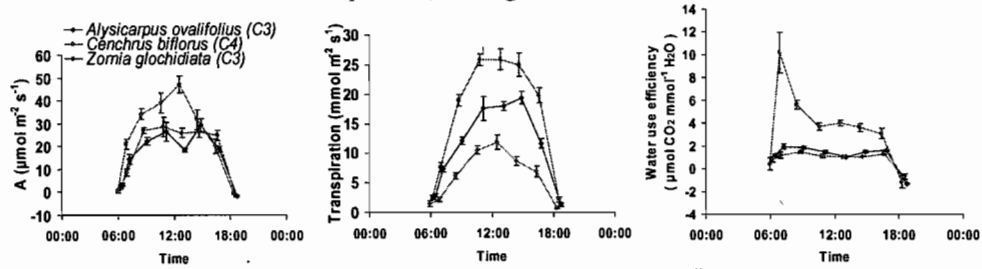

Figure 2 : Comparison between species of some diurnal cycles (14th August 2005) of leaf carbon assimilation, transpiration, and water use efficiency.

Furthermore, we compared measured assimilation and stomatal conductance to a Farquhar's model under the parameterisation from the leaf-level model MOSES (Meteorological Office Surface Exchange Scheme, Cox *et al.* 1998[1]). The model fits the measured data reasonably well for the C_4 species but predicts very low A and Gs for the C_3 species (figure 3). It is probably due to the parameterised temperature response of photosynthesis in C_3 plants. However, it would be useful to compared data to other models to check whether we can generalize this interpretation to most of the vegetation function models.

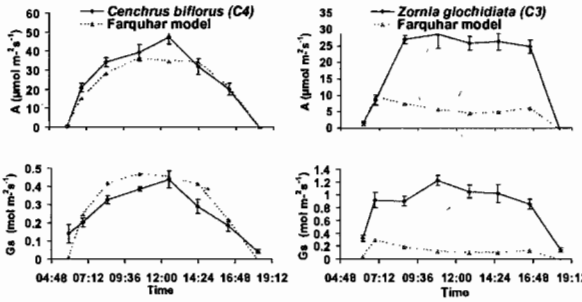

Figure 3 - Comparison of measured assimilation and stomatal conductance to a SVAT model

[1] Cox, P.M., Huntingford, C. Harding, R.J.1998. A canopy conductance and photosynthesis model for use in a GCM land surface scheme. *J. Hydrology*: 212-213, 79-94.

Finally, we compared the CO_2 and light response between a C_3 (*Zornia glochidiata*) and a C_4 species (*Cenchrus biflorus*). CO_2 responses showed that the C_4 plant is saturated at lower ambient CO_2 levels (around 300 µmol mol^{-1} against 500 µmol mol^{-1} in the C_3 plant) which is conform to what is known in the literature. However, curves of light response of C_3 and C_4 plants were similar.

4. Conclusion

In the Sahel, *large variability* in gas exchange rates occurs between woody and herbaceous plants, and between C_3 and C_4 plants within the herbaceous cover. The use of global parameterisations of SVAT models in dry tropical environments leads to significant differences compared to field measurements. *Further field measurements* are crucial to improve model parameterisation in these environments.

FONCTIONNEMENT DE QUELQUES ESPECES DU COUVERT VEGETAL DU SITE DE MESURES INTENSIVES D'AGOUFOU, GOURMA, MALI

Afin de contribuer à améliorer le paramétrage des modèles de transfert Surface-Végétation-Atmosphère, et de documenter la variabilité interspécifique du fonctionnement du couvert végétal dans le Gourma malien, des mesures conjointes de plusieurs paramètres physiologiques ont été réalisées localement sur les espèces herbacées et ligneuses sur le site de mesures intensives d'Agoufou.

Trois types d'approches *in situ* ont été réalisés : 1) mesures de la réponse de l'assimilation à la lumière des espèces dominantes 2) mesures des valeurs d'assimilation maximale d'une large gamme d'espèces présentes 3) mesures en conditions naturelles, ponctuelles ou en suivi journalier, d'échanges gazeux et de contrainte hydrique. Des paramètres structuraux tels que le LMA (leaf mass per area) ont également été mesurés. La teneur en azote et la composition isotopique seront aussi déterminés.

Les premiers résultats permettent d'identifier les « comportements physiologiques » spécifiques et de comparer les stratégies entre espèces face aux variations des conditions ambiantes. Plus globalement, le screening des espèces montre que l'assimilation maximale est comprise entre 8 et 55 µmol m^{-2} s^{-1} avec une transition entre plantes en C3 et C4 vers 30 µmol m^{-2} s^{-1}. L'assimilation par unité de masse présente une relation exponentielle négative avec le LMA. Les plantes ligneuses, bien que minoritairement suivies, présentent une gamme de stratégies apparemment plus large que les plantes herbacées.

Ces résultats sont encore partiels et demandent à être complétés notamment par des courbes de réponse de l'assimilation au CO_2 qui permettront de paramétrer le modèle de Farquhar dans les modèles de fonctionnement de la surface végétale.

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Convective wind system with aerosols, named "haboob", Hombori in Mali, West Africa.