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Interactive comment on “Topo-edaphic controls over woody plant biomass in South African savannas” by M. S. Colgan et al.

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Review of ‘Topo-edaphic controls over woody plant biomass.’ Biogeosciences Discussion 9, 957-987.

This is an excellent and stimulating discussion paper. The correlations between the LIDAR signal and the field plots are remarkably tight, especially given that the LIDAR estimate of biomass was based on an abstract volume calculated from top canopy height and cover! This generates considerable opportunity to further develop LIDAR as a means of generating coverage of structural characteristics of savanna.

Most importantly the manuscript further develops one of the great mysteries of savanna ecology. How soil effects woody structure? The same phenomenon, whereby fine-

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textured fertile substrates have a more open structure than infertile coarse textured soils is evident in Australia. In areas with less than 700 mm rainfall clay soils that crack on drying are treeless yet support productive agriculture by virtue of their excellent moisture relations when moist and their high fertility.

This poorly understood phenomenon is critical for understanding savanna function. Most of the likely reasons are canvassed in the current paper, although the issues are far from being resolved. The issue is deserved of a review paper. I offer a few more notes from the literature.

• Viljoen (1995) documents tree death from Kruger. While it is not explicit, an understanding of tree species or placenames would indicate if death seemed more likely to occur on basalt and related substrates • This is certainly the case in north-east Australia (Fensham and Holman 1999) • One of the first discussion of the ‘inverse texture effect’ was from Noy-Meir (1973) and there are some exceptions in the literature that need to be considered e.g. Galiano et al. (2010).

• Archer (1995) noted that woody plant encroachment was more prevalent on light-textured soils.

• Roots penetrate to greater depths on coarse-textured soils (Hacke et al. 2000, Sperry and Hacke 2002).

• Capillary movement may be disrupted in coarse surface soils as drying progresses with the consequence that deep moisture reserves are diminished less during drought than in fine-textured surface soils (Alizai and Hulbert 1970).

• As soils dry out the small amount of moisture is much more tightly bound in clay soils than sand (Fensham and Fairfax 2007). A clear demonstration of this that I know is in Williams et al. (1983) which collates matric potential curves for a range of soil characteristics. A very instructive paper for ecologists indeed!

Viljoen, A. J. (1995). The influence of the 1991/92 drought on the woody vegetation on

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the Kruger National Park. Koedoe. 38(2): 85-97.

Archer, S (1995). Tree-grass dynamics in a prosopis-thornscrub savanna parkland - reconstructing the past and predicting the future. *Écoscience*) (1195-6860), 2, p. 83.

Fensham R.J. and Fairfax, R.J. (2007) Drought-related death of savanna eucalypts: species susceptibility, soil conditions and root architecture. *Journal of Vegetation Science* 18: 71-80.

Sperry, J. S., and U. G. Hacke. 2002. Desert shrub water relations with respect to soil characteristics and plant functional type. *Functional Ecology* 16:367-378.

Hacke, U. G., J. S. Sperry, B. E. Ewers, D. S. Ellsworth, K. V. R. Schafer, and R. Oren. 2000. Influence of soil porosity on water use in *Pinus taeda*. *Oecologia* 124:495-505.

Fensham, R. J. and Holman, J. E. (1999). Temporal and spatial patterns in drought-related tree dieback in Australian savanna. *Journal of Applied Ecology* 36, 1035-1050.

Williams et al. 1983 The influence of texture, structure and clay mineralogy on the soil moisture characteristic. *Australian Journal of Soil Research* 21, 15-32

Specific comments

p. 958-959 Delete the first three poorly expressed sentences.

p. 959 The word 'drivers' in my opinion is ugly. Usually it is used to refer to 'correlates' ...high clay content can have lower water availability because water is tightly bound. . .the important point here is that it is when soils get dry.

p. 960 Many studies have characterized savanna catenas in hilly granite. . .basaltic savanna catenas on gentle slopes (<10).

Van Langevelde et al. (2003) found on clayey soils. . .did they or did they speculate. This does not sound the subject of intensive effort given the title of the paper.

p. 961 At the regional scale 910-100 km) boundaries between parent materials become

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apparent. Silly

...can be logically challenging..

...due to herbivore-fire interaction. . .you suggested that these results would be outside the scope of the study

p. 966 EAS..define

.p. 968 . . .landscape variable plotted against. . .

p. 969 The AGB gradient is likely the result of high A horizon caly content. . .or perhaps shallow soils on crests?

p. 970 It is different from that found on. . .

p. 971 More soil work on these shales. . .reword

Rod Fensham February 2012

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