Alice Mulga SuperSite Site and Soil Description

Site Description

The study site is located on Pine Hill cattle station near Ti Tree NT, approximately 200 km north of Alice Springs NT and 180 km north of the Tropic of Capricorn (22.28˚S, 133.25˚E, 549 m asl). The site is located within a tropical arid zone with hot summers and warm winters. Predominant wind direction is from the east, southeast and south (Chen *et al*., 1991). An eddy covariance tower is located on a flat plain between the Hanson and Woodforde Rivers. Potential fetch is 11 km to the east and 16 km to the south. The water table is 49 m deep.

Precipitation

Annual average precipitation at the nearest meteorological station (Territory Grape Farm; Station 015643; 1987–2011 average) is 318.3 mm (since recording began in 1987), ranging from 97.4 mm in 1994 to 750.6 mm in 2010 (http://www.bom.gov.au). Of the annual median rainfall, 72 % falls during the summer months (Dec-Feb) and 86 % falls during monsoon season (Nov–Apr), placing the site just inside the Australian Monsoon Tropics (Bowman *et al*., 2010; Hutley *et al*., 2011).

Temperature

Air temperature at the site can range from a low of -4° C (11 August 1994) to a high of 46° C (5 January 1994) (http://www.bom.gov.au/), although mean minimal and maximal temperatures are in the range of 5° C and 22.6° C in July to 22° C and 37.5° C in January.

Soil Characterisation

The soil is a heavily weathered red kandosol, which is typical of large portions of semi-arid Australia and has a high potential for drainage (Schmidt *et al*., 2010; Morton *et al*., 2011).

The soil is characterised as a red kandosol with a sandy loam soil texture (74:11:15 sand:silt:clay). Soil samples were collected using a slide hammer (AMS Soil Core Sampler, Envco: The Environmental Collective, Auckland, New Zealand) to extract intact cores (38 mm diameter x 10 cm depth to a total depth of 1.4 m) for laboratory analysis.

Soil samples were dried in a 105˚ C oven for 48 h then sub-sampled and placed in a 370˚ C oven for another 48 h to burn off organic matter. Dry bulk density ranged from 1.67 ± 0.01 g cm^{-3} at the surface to 1.86 ± 0.08 g cm^{-3} at a depth of 1.41 ± 0.12 m. Assuming a mineral

density of 2.65 g cm−3, these bulk density measurements resulted in porosity of 0.37 ± 0.01 and 0.30 ± 0.03 at the surface and depth, respectively. Soil organic matter (SOM) at the surface was 1.1 ± 0.1 g/100 g dry soil (i.e. 1.1 %).

Soil organic matter content (g) in 100 g of soil is equal to 1.1 % at the surface and declines to 0.7 ± 0.1 % at 1 m deep. The minimal soil organic matter content (0.5 %) was observed where hardpan was encountered. Bare soil patches are likely surface expressions of the hardpan. Hardpan formation in the top meter, and possibly deeper, is commonly observed with this type of soil (Morton *et al*., 2011). Variability in the depth of the hardpan implies that root development, near-surface storage of soil moisture, and infiltration are spatially heterogeneous in this flat (slope = 0.2 %) landscape.

Vegetation

The Core 1 ha is located in a Mulga savanna woodland at the southern end of the North Australian tropical transect [Hutley *et al*., 2011]. Mulga woodlands are widespread across Australia, covering 20– 25% of the land surface area (Nicholas *et al*., 2011). This site contains two species of Mulga and their hybrids, both of which form symbioses with nitrogen fixing cyanobacteria: *Acacia aneura*, and *A. aptaneura*. The woodland canopy is 6.5 m tall and forms an incomplete cover with a basal area of 8 m^2 ha^{-1}. A patch of Spinifex grass (*Triodia* sp.), which crosses sharp ecotones to form a mosaic with Mulga (*Nicholas et al.,* 2011), is located in a small gap (ca. 150 m2) within the measurement footprint of the eddy covariance system. The dominant understorey forbs and shrubs are distributed sparsely throughout the measurement fetch and include *Psydrax latifolia, Eremophila gilesii*, *E. latrobei* ssp *glabra* (Crimson turkey bush), Sida and *Abutilon* spp., and *Solanum ellipticum* (Potato bush). The dominant grasses form a nearly complete cover when conditions permit and include perennials *Thyridolepis mitchelliana* (Window mulga-grass), *Eragrostis eriopoda* (Naked woolybutt grass), and annual *Eriachne pulchella* ssp *pulchella* (Pretty wanderrie). Below the understorey, cryptobiotic crusts form a widespread ground cover.

References

Bowman, D., *et al*. (2010), Biogeography of the Australian monsoon tropics. J. Biogeogr., 37, 201–216, doi:10.1111/j.1365-2699.2009.02210.x

Chen, X.Y., Bowler, J.M., Magee, J.W., 1991. Aeolian landscapes in central Australia: gypsiferous and quartz dune environments from Lake Amadeus. Sedimentology 38, 519–538.

J. Cleverly, N. Boulain, R. Villalobos-Vega, N. Grant, R. Faux, C. Wood, P. G. Cook, Q. Yu, A. Leigh and D. Eamus. 2013. Dynamics of component carbon fluxes in a semi-arid *Acacia* woodland, central Australia. J. Geophys. Res. Biogeosci., 118, 1168–1185. doi:10.1002/jgrg.20101

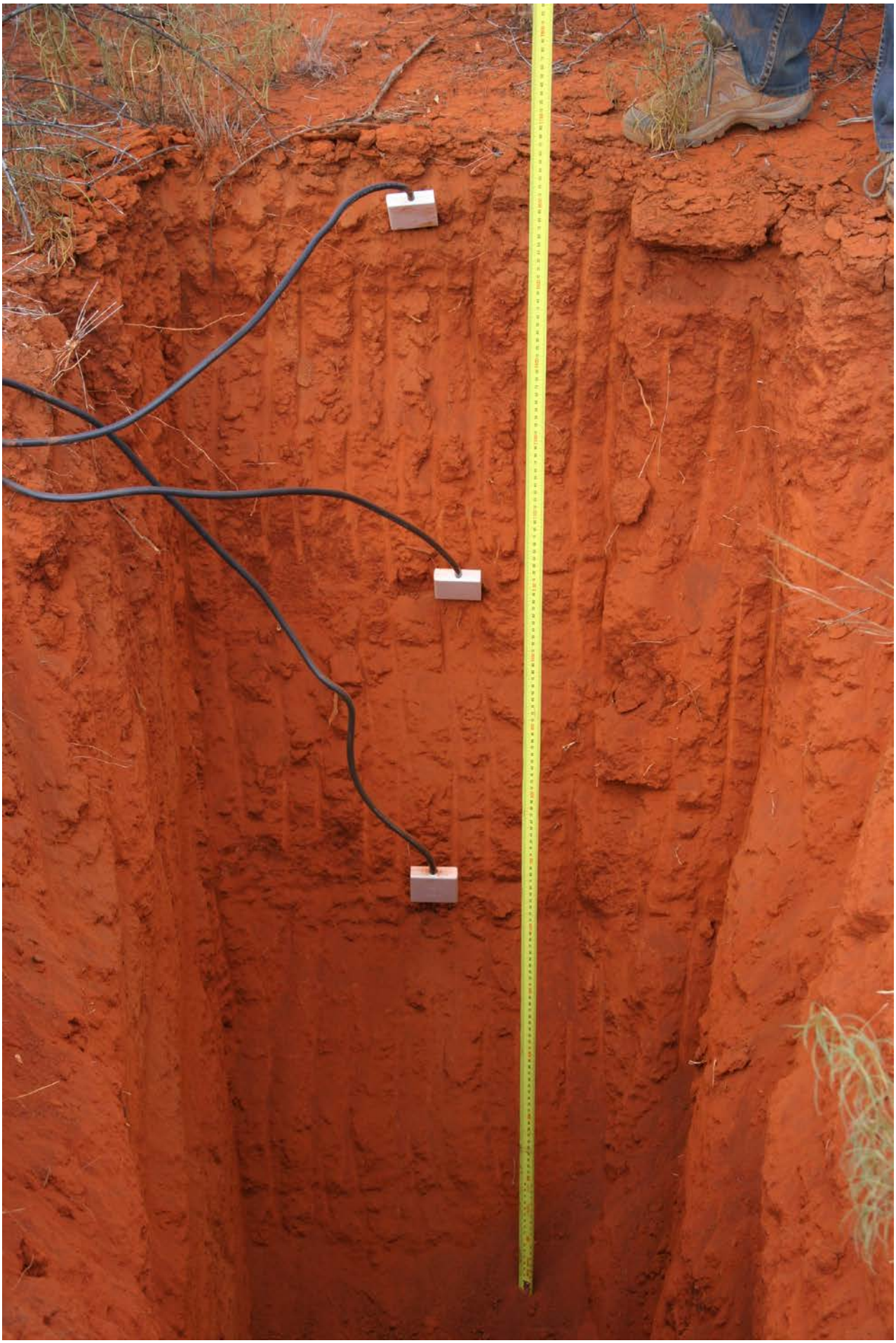
D. Eamus, J. Cleverly, N. Boulain, N. Grant, R. Faux, R. Villalobos-Vega. 2013. Carbon and water fluxes in an arid-zone Acacia savanna woodland: An analyses of seasonal patterns and responses to rainfall events. Agricultural and Forest Meteorology 182-183, 225-238. http://dx.doi.org/10.1016/j.agrformet.2013.04.020

Hutley, L. B., J. Beringer, P. R. Isaac, J. M. Hacker, and L. A. Cernusak (2011), A sub-continental scale living laboratory: Spatial patterns of savanna vegetation over a rainfall gradient in northern Australia, Agric. For. Meteor. 151, 1417–1428. doi:10.1016/j.agrformet.2011.03.002.

Morton, S. R., *et al*. (2011), A fresh framework for the ecology of arid Australia, J. Arid Environ. 75, 313–329. doi:10.1016/j.jaridenv.2010.11.001

Nicholas, A. M. M., D. C. Franklin, and D. M. J. S. Bowman (2011), Floristic uniformity across abrupt boundaries between Triodia hummock grassland and *Acacia* shrubland on an Australian desert sandplain. J. Arid Environ., 75, 1090–1096. doi:10.1016/j.jaridenv.2011.06.016

Schmidt, S., R. E. Lamble, R. J. Fensham, and I. Siddique (2010), Effect of woody vegetation clearing on nutrient and carbon relations of semi-arid dystrophic savanna, Plant Soil, 331, 79–90. doi:10.1007/s11104-009-0233-5



Soil profile and Soil moisture TDR probes installed in the ASM flux tower soil pit.

ASM Flux tower soil pit