Alice Springs Mulga and Ti Tree East

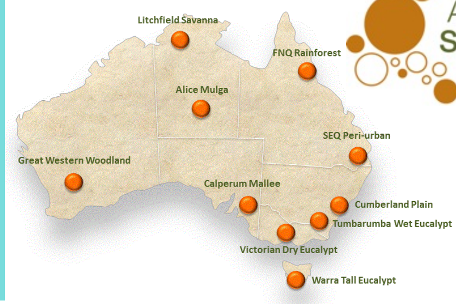
Ti Tree, NT

Terrestrial Ecosystem Research Network (TERN):

Australian and New Zealand Flux Research and Monitoring Network (OzFlux)

Australian Supersite Network (ASN)

National Centre for Groundwater Research and Training (NCGRT)



Australian SuperSiteNetwork

TERN Terrestrial Ecosystem Research Network

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Terrestrial Ecohydrology Research Group (TERG)

School of the Environment (SoE)

Australian Government
National Water Commission
Australian Research Council

NATIONAL CENTRE FOR GROUNDWATER RESEARCH AND TRAINING
sustaining a vital water resource

Personnel

Prof Derek Eamus; director TERG, leader Alice Mulga SuperSite (AMSS)

Current postdocs

- Dr James Cleverly, deputy leader AMSS
- Dr Rachel Nolan (plant hydraulics)
- Dr Nadia Santini (stem anatomy)

Recent postdocs

- Dr Chao Chen (ecohydrological modelling)
- Dr Randol Villalobos-Vega (sapflux)
- Dr Sepideh Zolfagher (plant hydraulics)

PhD students

- Rizwana Rumman (stable isotopes and leaf anatomy)
- Tonantzin Tarin Terrazas (eddy covariance and leaf-level fluxes)

Technical officer

- Ralph Faux

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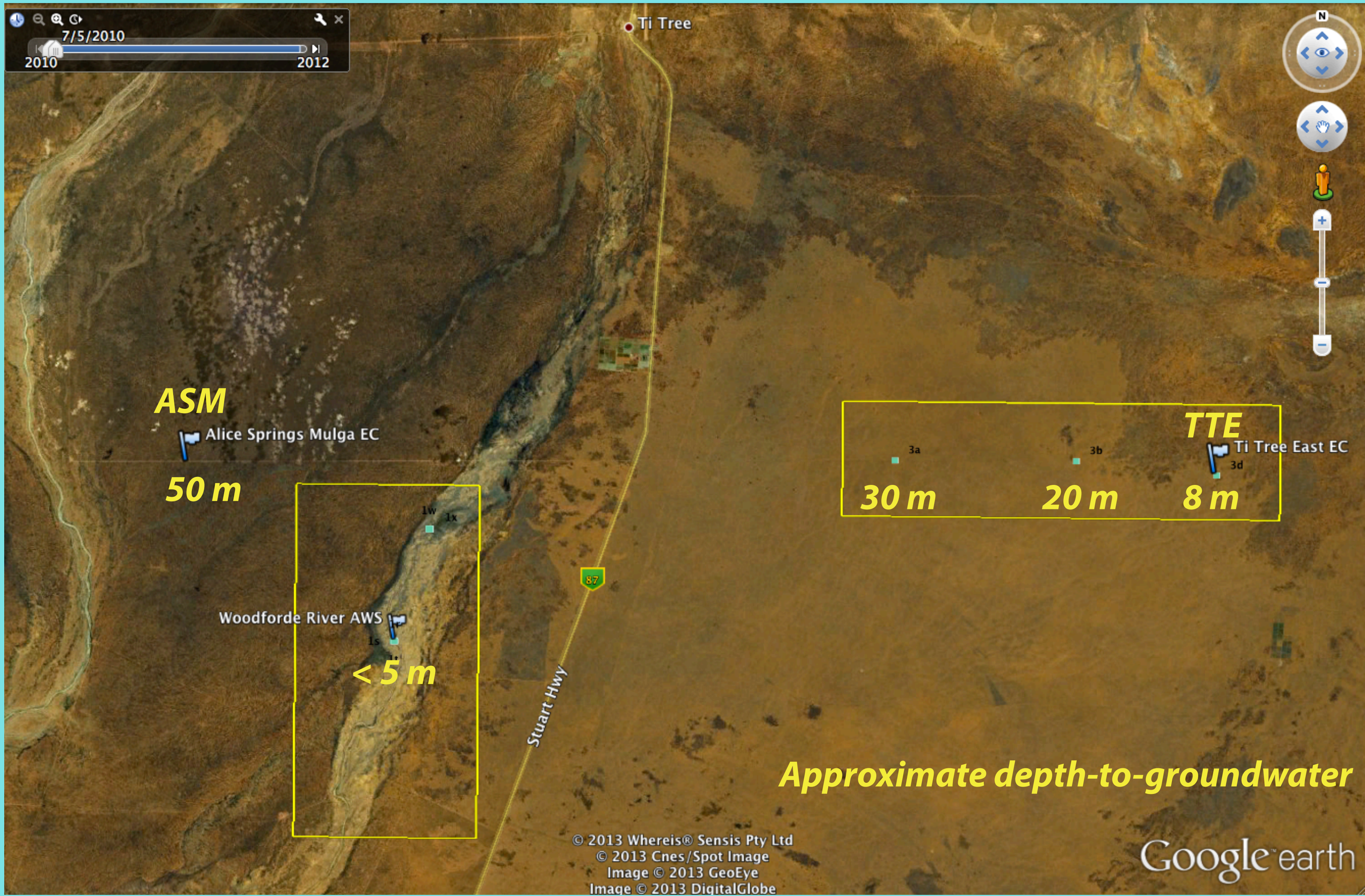
Alice Mulga SuperSite

Mulga, Corymbia open hummock savanna, River Redgum



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Activities
Ecophysiology

Hydrologic niche separation and ecosystem resilience (ARC discovery project, Eamus)
- **hydraulic safety margins**
- **xylem vulnerability to cavitation**
- **stem relative water content**
- **pre-dawn and midday Ψ_x and Ψ_l**
- **leaf-level g_s, A and E**
- **$\delta^{13}C$ (leaves); δD and $\delta^{18}O$ (stems, soil, groundwater and precipitation)**
- **sapflux (NCGRT)**

Atkins/Bloomfield plant thermal tolerance
- **August 2014**

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Activities
Measurements and collections

Ecology

- **DBH, basal diameter & height {ASM, Woodforde River}**
- **litterfall collections {ASM}**
- **leaf area index {ASM, TTE, WR}**
- **basinwide leaf isotope samples**
- **maintain phenological cameras {ASM, TTE}**
- **acoustic monitoring {ASM, TTE}**
- **avifauna survey (volunteers?)**

Airborne laser scanner (LiDAR)

- **flown on 19 September 2014**

Data communications

- **RS232 modem {TTE, WR}; ethernet modem {ASM}**
- **Telstra 3G to Ti Tree tower via +21 dB gain Yagi aerial**
- **10 Hz: binary transfer, same format as on logger and cf card**
- **1 min.: slow sensor averages, sums (except soil measurements); TOA**
- **30 min.: TOA**
- **static IP: Maxon virtual private network, single-client licence**

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Activities

TTE soil moisture calibrations

Ponding to saturate surface
1-minute soil moisture content
Sequential soil sample collections

15 cm intact cores (slide hammer)

Θ_g Θ_v ρ_b

t_0: 0.02 $m^3\ m^{-3}$ (before)
$\Theta_{v\text{-}max}$: 0.15 $m^3\ m^{-3}$

porosity:
0.35 $m^3\ m^{-3}$ (0–10 cm); 0.25 $m^3\ m^{-3}$ (50–100 cm)

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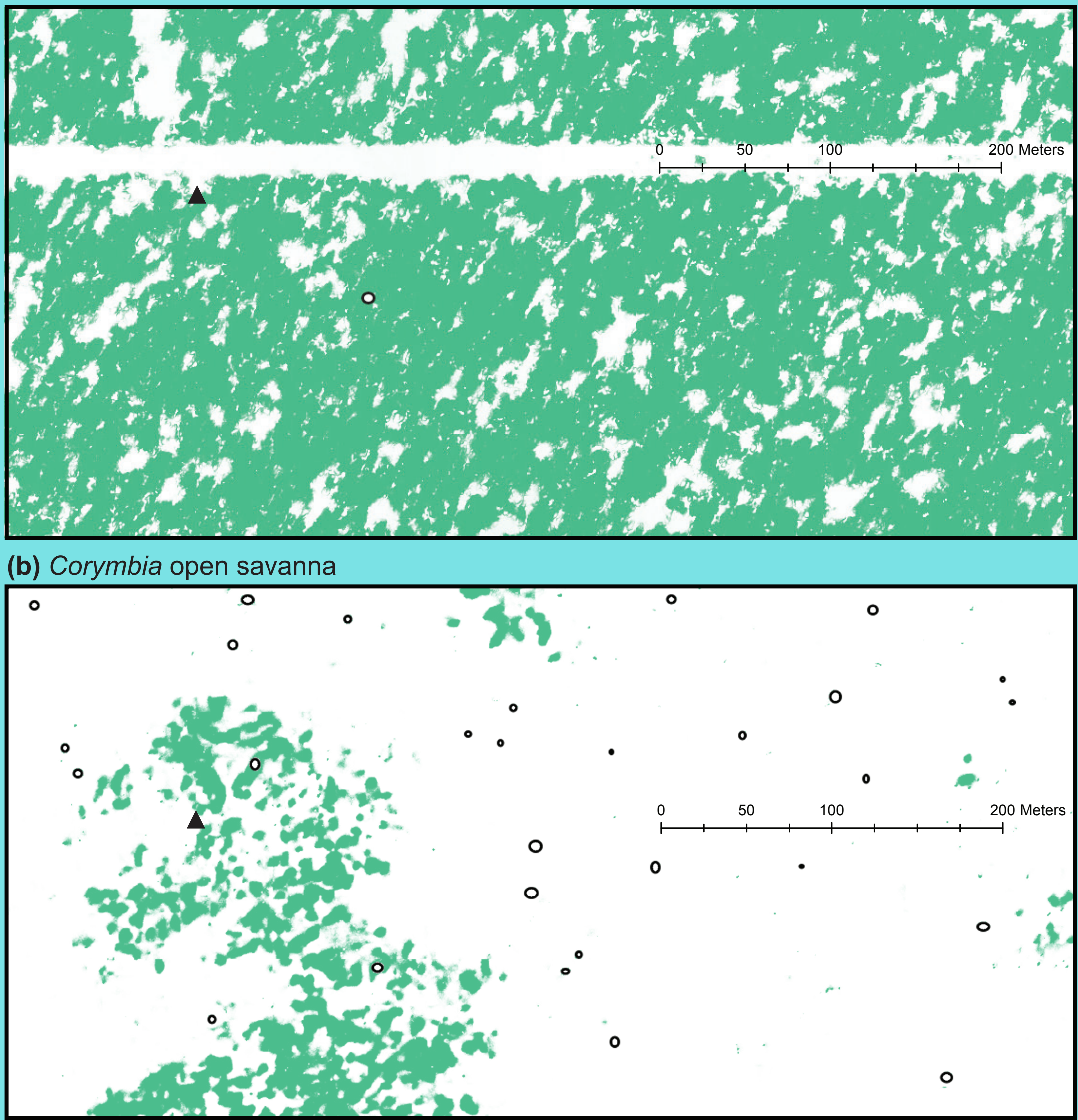
ASM & TTE

Mulga, Corymbia *open savanna—hummock grass*

(a) Mulga woodland



Green shading: Mulga

Open circles: *Corymbia* trees

Triangles: towers

Empty space:

- **Upper panel (ASM): C_3 and C_4 grasses in understorey, conditional on rain**
- **Lower panel (TTE): C_4 grasses**

Both sites:

- **Flat with negligible runoff (some local re-distribution)**
- **Drainage below root zone negligible except in extreme years**

Woody vegetation cover:

- **Mulga: ASM 74%; TTE 6%**
- ***Corymbia*: ASM < 0.1%; TTE 0.4%**

ASM & TTE

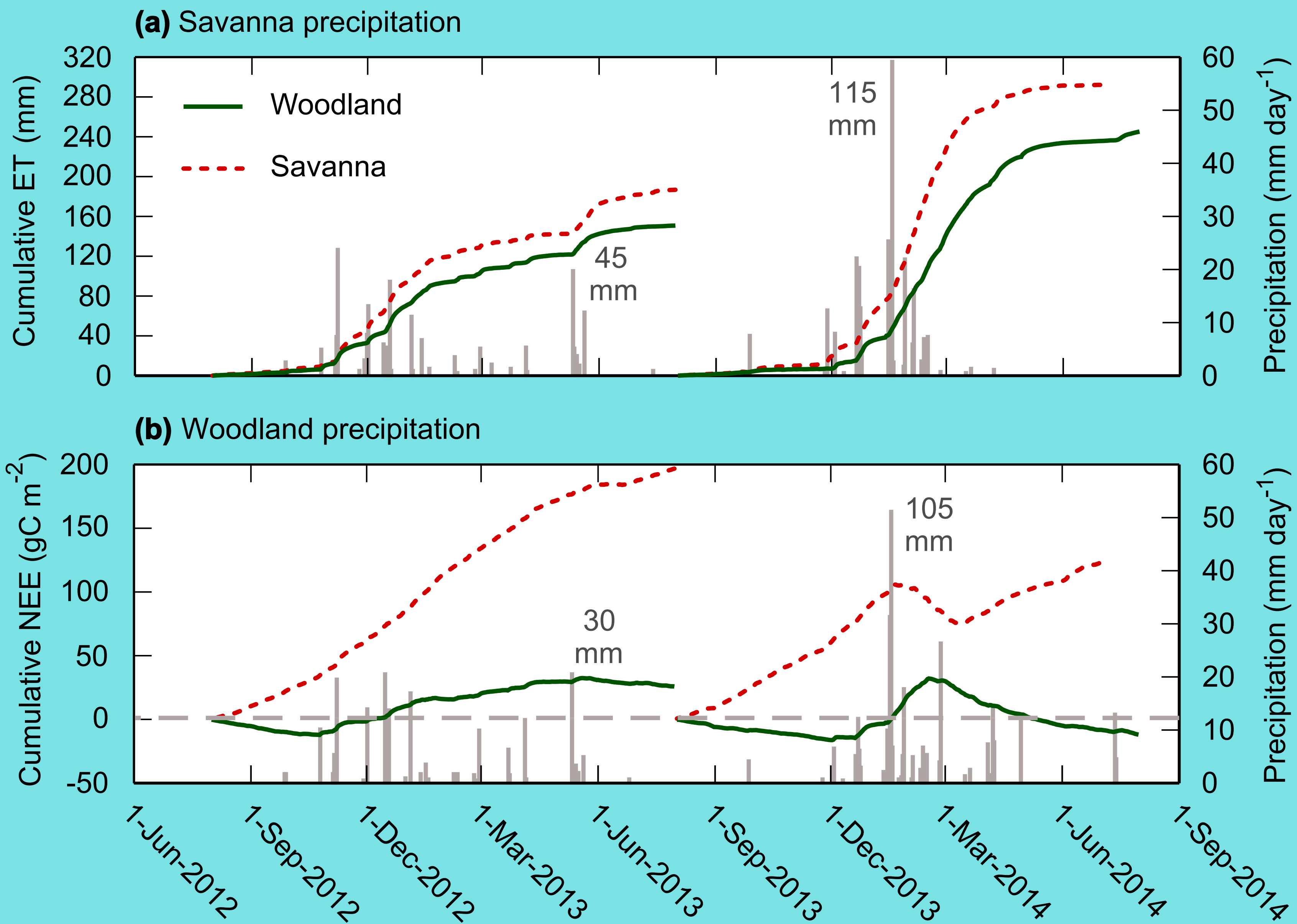
Carbon and water budgets

Savanna:

- **ET = 0.97 × P**
- **strong carbon source**
- **carbon uptake 2013–2014**

Woodland:

- **ET deficit**
- **carbon neutral Jul 2011–Jun 2014**
- **1–2 month time lag in productivity 2013–2014**



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TTE

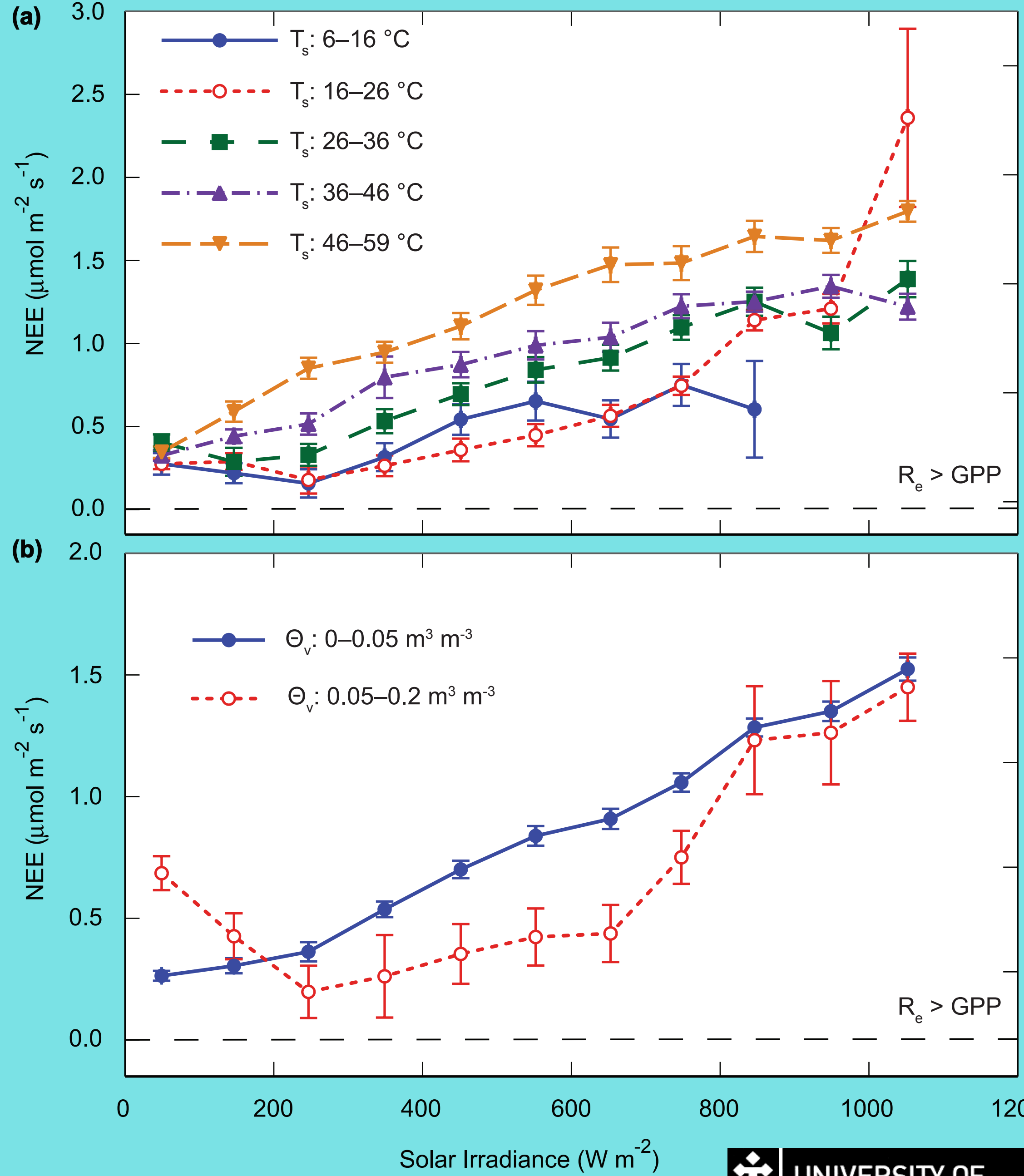
Dominant carbon emission mechanism: photo-degradation

Carbon emissions due to degradation of plant tissue in the:
- **absence of moisture and the presence of heat and light**

Presumes large productivity during previous wet years (2010–2011)

Loss of fuel load:
- **restricts fire risk to a few years following periods of high productivity**

Increased rainfall amounts and variability due to recent climate change results in:
- **high productivity during wet years, and**
- **subsequently large emissions due to fire or photo-degradation**



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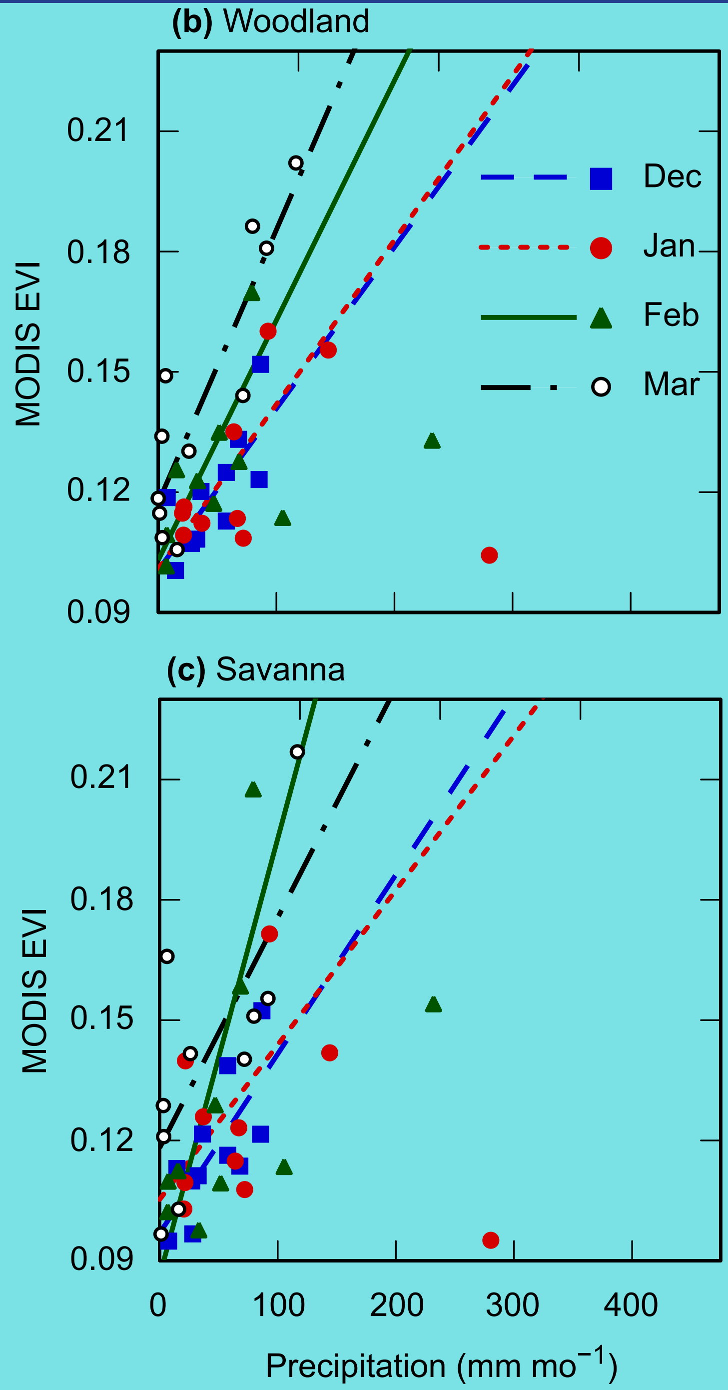
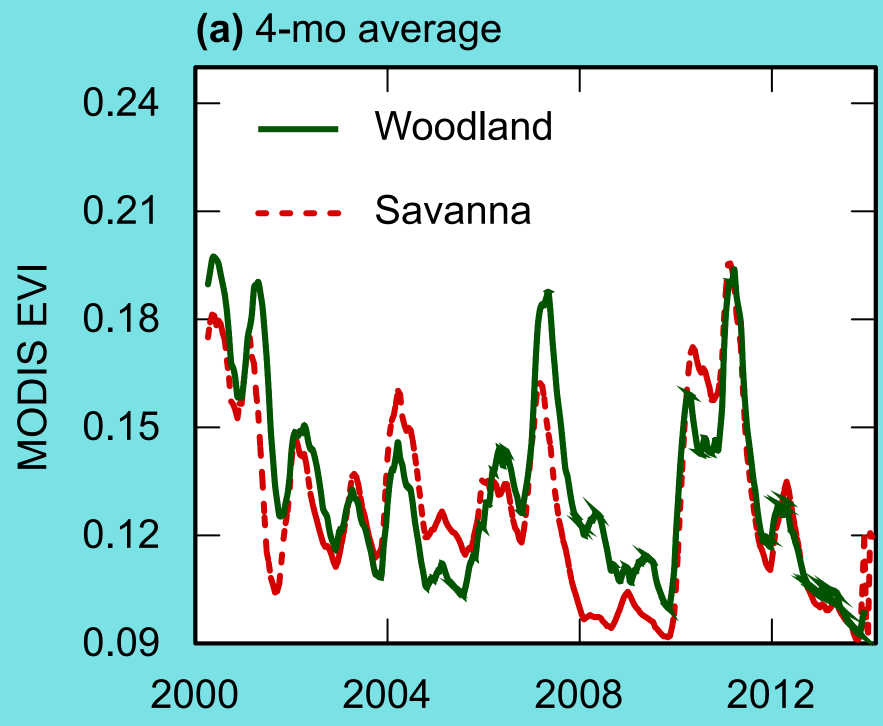
EVI

Responses to rainfall





Large inter-annual variations in EVI

EVI in hummock is very small during dry years

Neither ecosystem consistently exhibits larger responses during wet years

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Local precipitation

Patch point (SILO)

Table 1. Rainfall statistics.

Year	Precipitation (mm yr^{-1})
1900–2012	254*
1900–1969	231*
1970–2012	314*
Five wettest	
1974	955
2010	833
2000	743
1975	676
1904	555
Five driest	
1928	25
1961	70
1964	76
1965	77
1994	97

*median

Large variability in rainfall in the long term (25–955 mm yr^{-1})

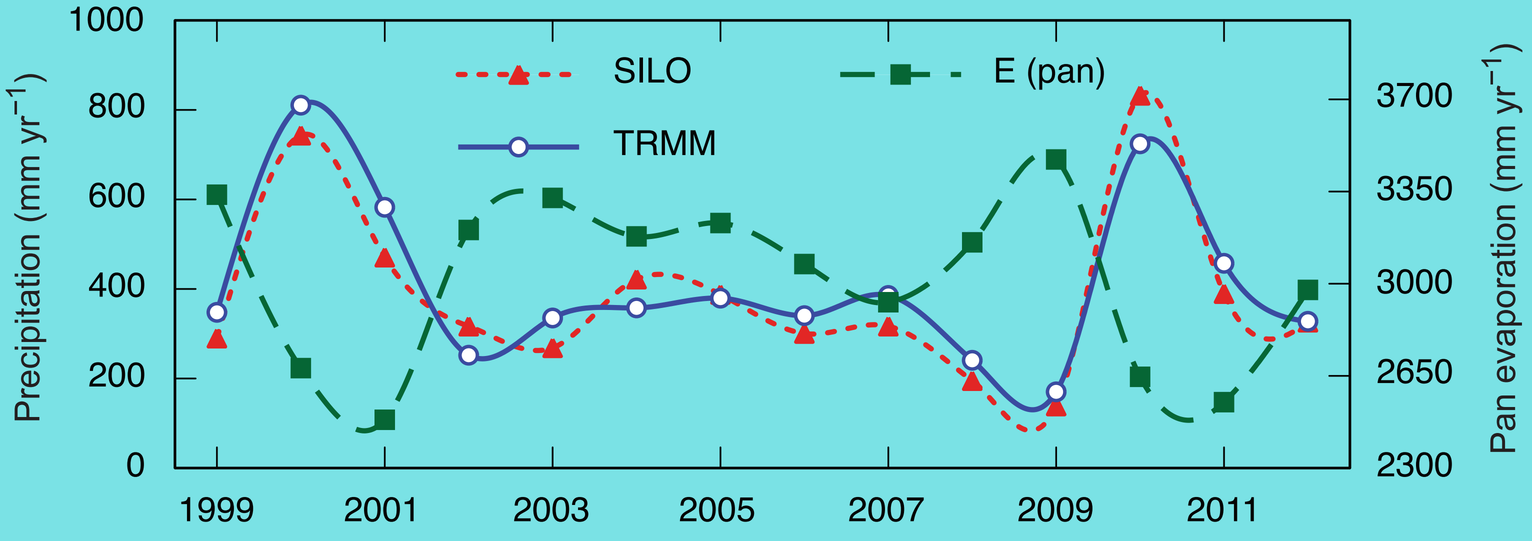
Four of the five driest years occurred before 1970

Four of the five wettest years were after 1970

Long-term increase in rainfall amount

Continued large variability since 1999

Pan evaporation anti-correlated to rainfall



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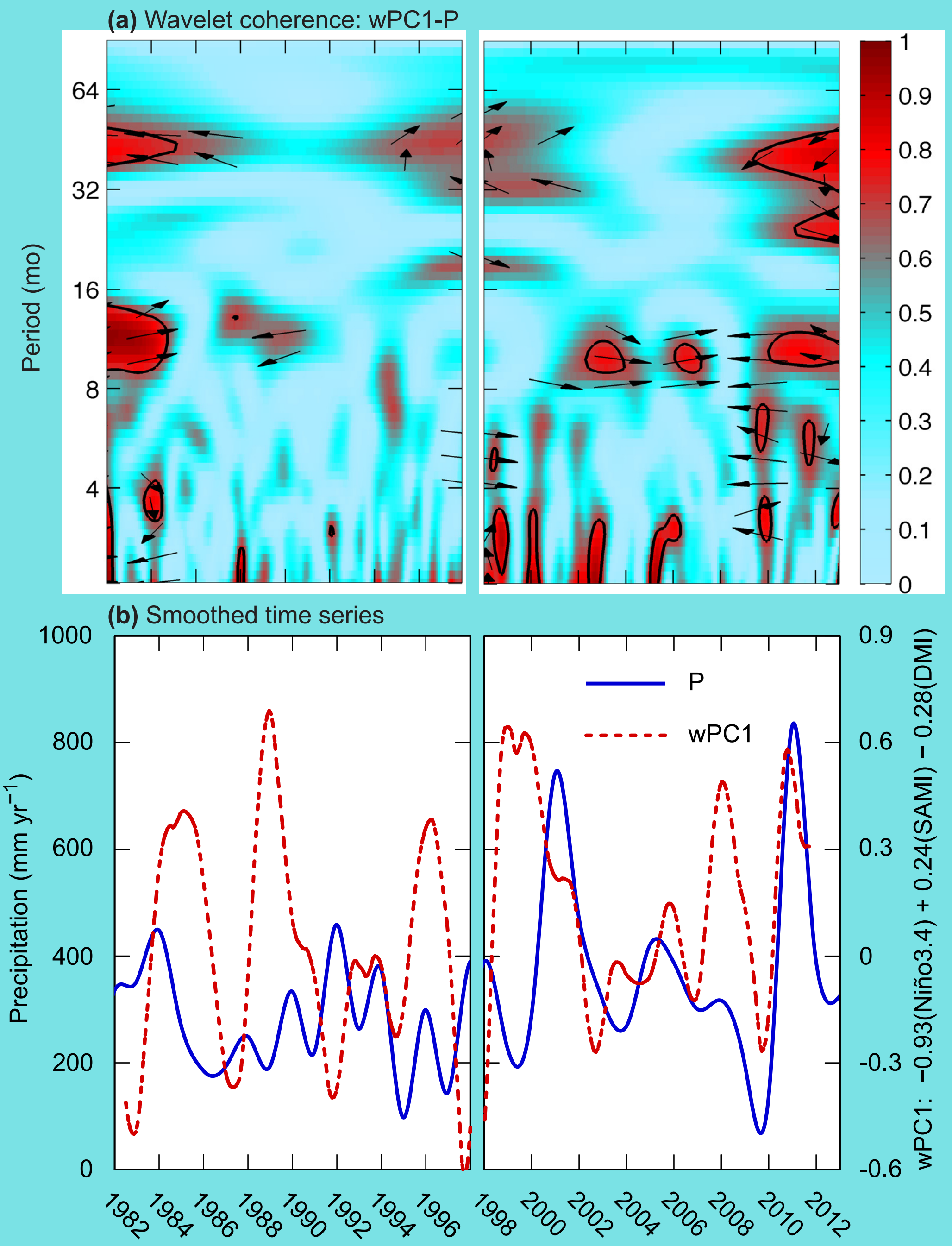
Climate drivers

IOD, ENSO, SAM



IOD: strength of monsoon depression

ENSO: connected to IOD via Walker circulation

SAM: location of landfall via the Mascarene high

wPC1 = −0.93[Niño3.4] + 0.24[SAMI] − 0.28[DMI] (Wavelet PCA)

Correlation between climate drivers and precipitation identified by wavelet coherence (square correlation)

Significant coherence at 2–4 month and annual time scales, 1999–2012

Fluctuations between dry and wet years maintained by sudden phase shift in 2009 (dry) and effects of warming IO (wet)

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2013

Cleverly J, Boulain N, Villalobos-Vega R, Grant N, Faux R, Wood C, Cook PG, Yu Q, Leigh A, Eamus D. 2013. Dynamics of component carbon fluxes in a semi-arid Acacia woodland, central Australia. Journal of Geophysical Research: Biogeosciences 118:1168–1185. DOI: 10.1002/jgrg.20101.

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Ma X, Huete A, Yu Q, Coupe NR, Davies K, Broich M, Ratana P, Beringer J, Hutley LB, Cleverly J, Boulain N, Eamus D. 2013. Spatial patterns and temporal dynamics in savanna vegetation phenology across the North Australian Tropical Transect. Remote Sensing of Environment 139:97-115. DOI: 10.1016/j.rse.2013.07.030.

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Publications
2014

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Ma X, Huete A, Yu Q, Restrepo-Coupe N, Beringer J, Hutley LB, Kanniah KD, Cleverly J, Eamus D. 2014. Parameterization of an ecosystem light-use-efficiency model for predicting savanna GPP using MODIS EVI. Remote Sensing of Environment 154:253-271. DOI: 10.1016/j.rse.2014.08.025.

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