Ancillary ecological measurements I

Fluxnet tables

Allometry, sap flow

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Charles Darwin
UNIVERSITY
Innovation in Education

Talk Outline

- Importance of ancillary ecological / ecophysiological measurements
- Site characteristics – soils, climate
- Vegetation characteristics
  - *LAI – how much canopy driving fluxes ?*
  - *Allometry – how much biomass supporting canopy?*
  - *What are the seasonal dynamics?*

Ancillary ecological measurements

- Provide ecological framework to interpret flux data
  - Tower data are short term quantification of fluxes
  - Ecological properties provide context for long-term appraisal
  - Examine limiting factors on productivity e.g. nutrients, soil moisture, site history
- Required to parameterise dynamic vegetation models
  - Integrating or functionally significant variables
- Independent comparison of fluxes variables
  - GPP, NPP, NEP and ET

Ancillary ecological / ecophysiological measurements

- Fluxnet tables - standardised set of variables
  - Site characteristics
  - Soil descriptors
  - Vegetation descriptors

Ancillary ecological / ecophysiological measurements

Site characterisation	Variable	Role
	Broad soil, climate-vegetation classification	
	Site history, stand age	Representativeness, regional context of study
	Land use, land use change and tenure	
	Topography	Fetch requirements
	Fire regime	

Vegetation descriptors	Variable	Role
	Leaf scale	
	Foliage and root N concentration	
	Specific leaf area	Correlation with gas exchange, growth, phenology
	Amax, WUE, LUE, NUE, Vcmax,	Key DVGM model variables
	Canopy / stand scale	
	Floristics	Vegetation classification
	Stand structure, life forms	
	LAI and phenology	Flux sources and sinks, scaling
	- Overstory LAI	
	- Understory LAI	
	Size-class distribution	Basal area, disturbance regime, site history
	Allometry - AGB, BGB	Carbon stocks, estimation of turnover
	Coarse woody debris	Carbon stock
	Sap flow	Water use of woody components
		Partitioning and validation of ET

Growth descriptors	Variable	Role
	Tree increment	
	Shrub increment	Derive ANPP, GPP - comparison with tower data
	Grass / herb / crop growth	
	Litterfall	
	Fine root turnover	Derive BNPP, GPP
	Coarse root increment	
	Respiration	Validate Re models - comparison with tower data
	Foliar	
	Stem	
	Soil respiration (root, soil microbial respiration)	

Ancillary ecological / ecophysiological measurements

	Variable	**Role**
Vegetation descriptors	*Leaf scale*	
	Foliage and root N concentration	
	Specific leaf area	Correlation with gas exchange, growth, phenology
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→	**LAI and phenology**	Flux sources and sinks, scaling
	- Overstory LAI	
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→	**Allometry - AGB, BGB**	Carbon stocks, estimation of turnover
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→	**Sap flow**	Water use of woody components
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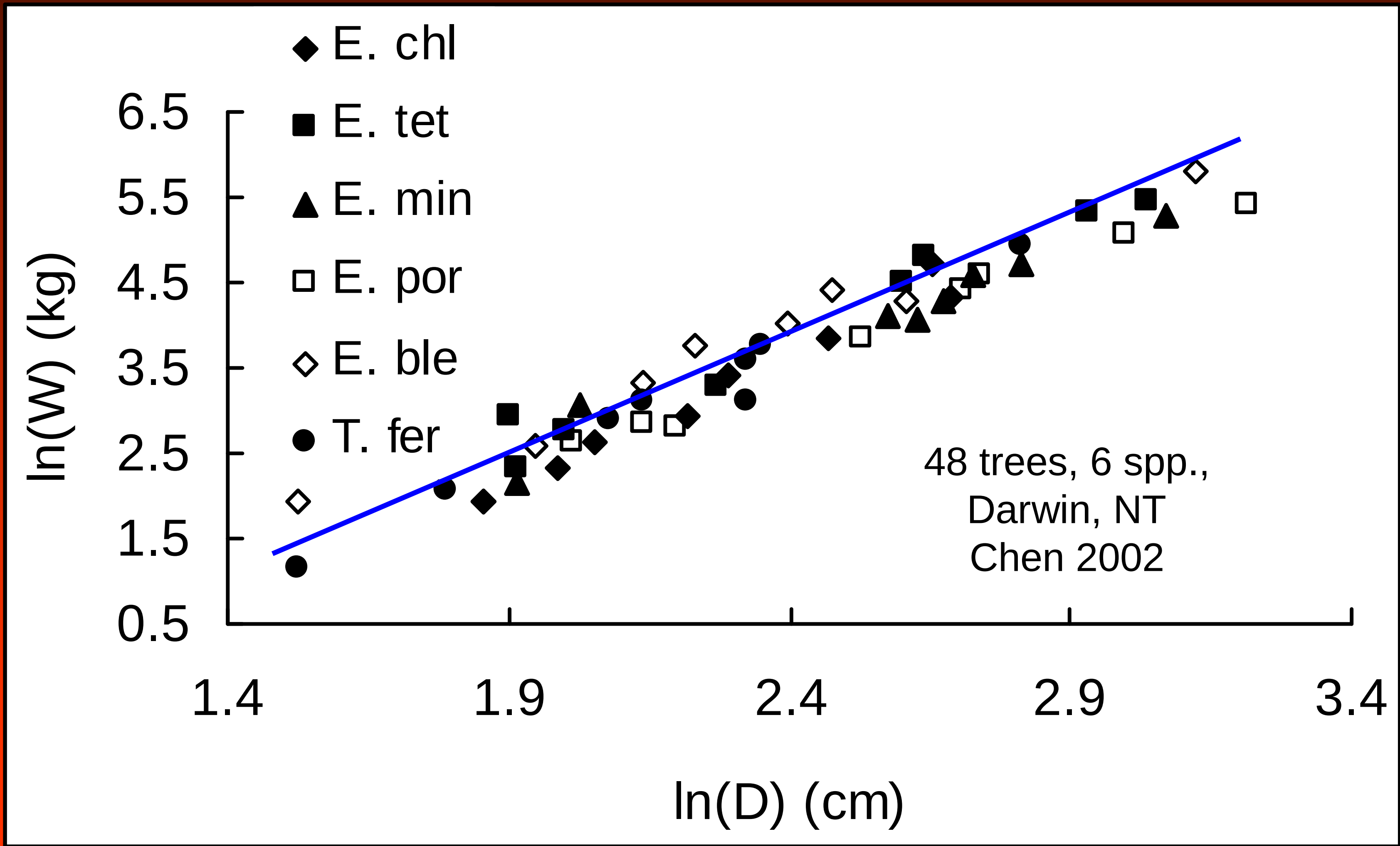
Ancillary ecological / ecophysiological measurements

- Allometry
  - – Convert inventory variables to biomass
  - – Simple measures used to estimate AGB, BGB
    - Ht, DBH and in combination
  - – Calibration essential for differing species
  - – Estimate stocks relative to flux
  - – Carbon accounting

Allometry

- Destructive harvesting
  - Roots, coarse and fine
  - Stem
  - Branch
  - Canopy leaf mass
  - Regressed against tree dimensions
- Species specific relationships developed
- Pool data to look for generic algorithm if possible

Tropical savanna woodlands – AGB allometry



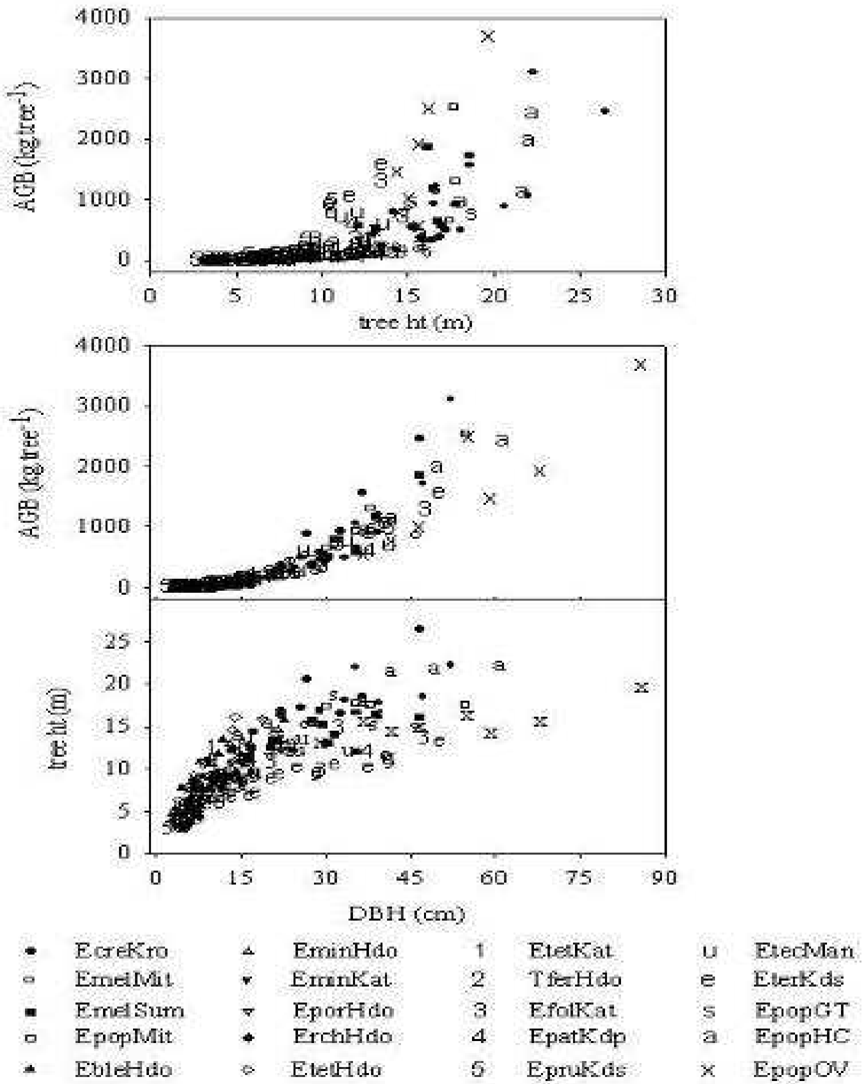
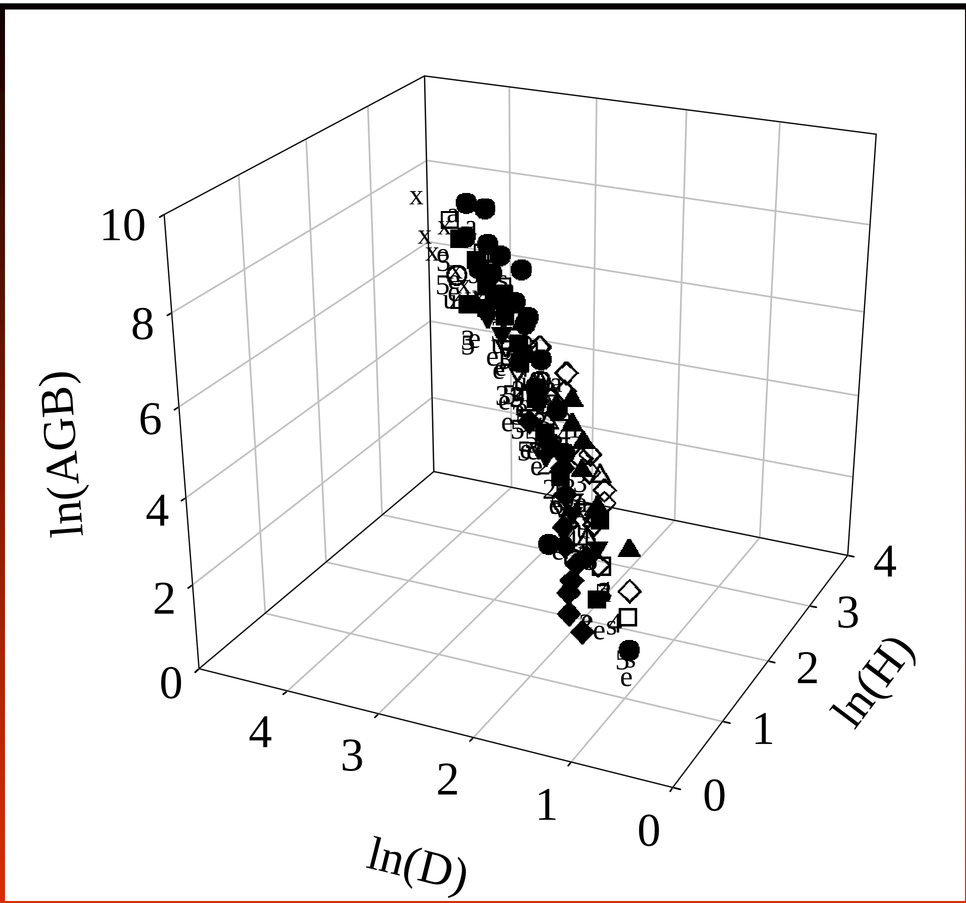


Fig. 1. Height-AGB, ABH-AGB and DBH-height relationships for the various species across sites

220 trees, 14 spp.
NT, Qld, WA
Williams et al. 2004

- Multi-site-species models
- Generic algorithm applicable across woodlands in 3 states
- Combine with remote sensing

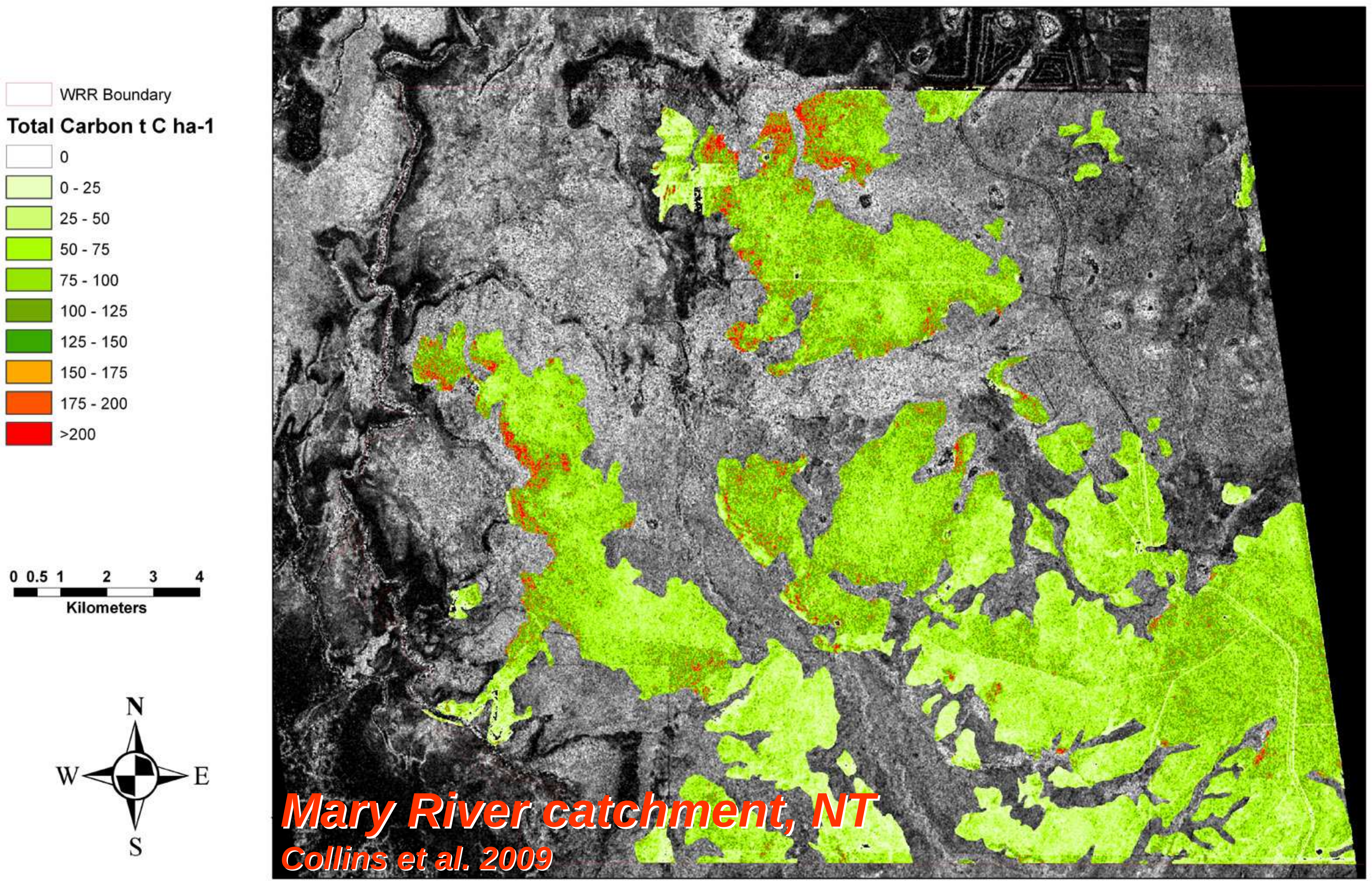


Model development

- Species specific vs pooled

model No.	inputs	intercept	ln(d) (cm)	ln(h) (m)	ln(dh) (m^2)	ln(d^2h) (m^3)	$(lnh)^2$ (m^2)	$(lnd)^2$ (cm^2)	ln(dh^2) (m^3)	RMSE	AIC	BIC	LogLik
1	ln(h)	-3.5413		3.5337						0.8299	548.3	558.5	-271.2
2	ln(dh^2)	1.5812							1.1046	0.4657	294.0	304.2	-144.0
3	ln(dh)	3.9201			1.5588					0.3345	147.1	157.3	-70.5
4	ln(h) + $(lnd)^2$	-0.6266		1.0475				0.3497		0.3109	118.3	131.8	-55.1
5	ln(d)	-2.2077	2.4820							0.2695	53.4	63.6	-23.7
6	ln(d^2h)	5.9812				0.9647				0.2557	30.2	40.4	-12.1
7	ln(d) + ln(h)	-2.6392	2.1735	0.5574						0.2362	-2.6	10.9	5.3
8	ln(d) + $(lnh)^2$	-2.0572	2.1561				0.1359			0.2321	-10.4	3.2	9.2

Application of allometry at landscape scales
Carbon mapping using SAR



Trenching methods – BGB allometry

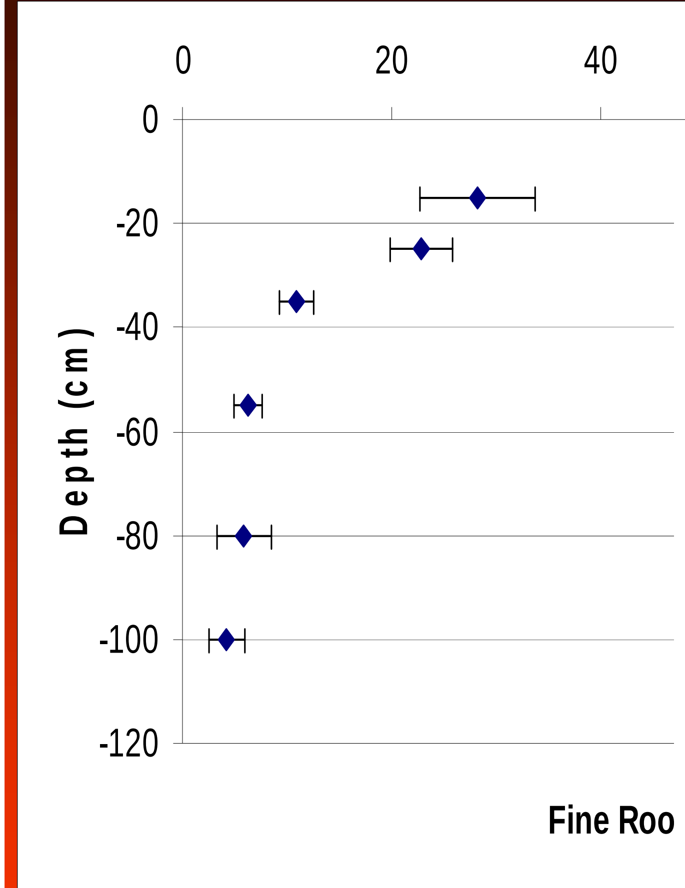
- Link AGB to BGB
- Coarse and fine root distribution
- Fine root biomass
- Soil profile
  - Texture classes
  - SOC
  - Nutrient

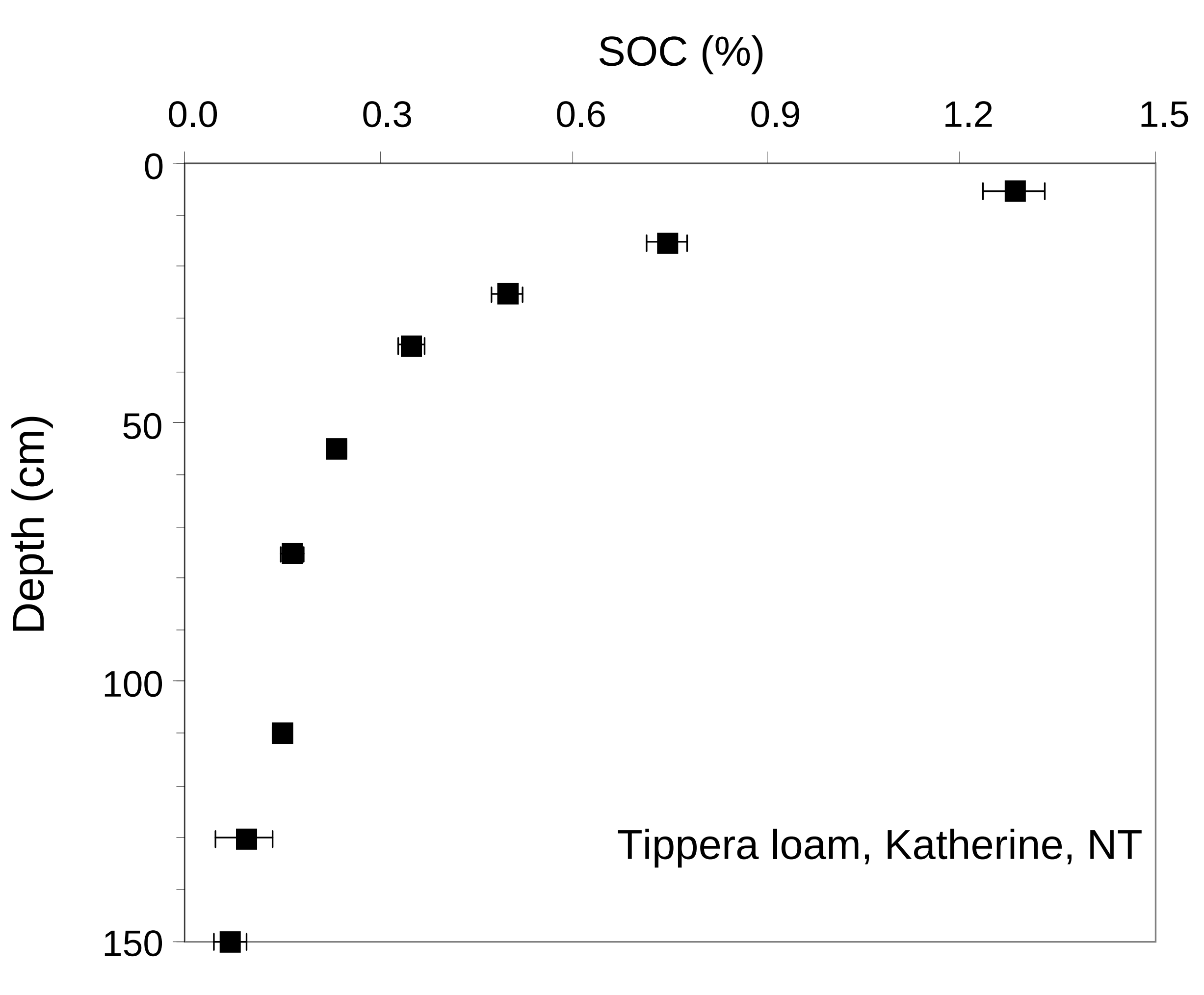
Allometric methods

The hard yards

AGB, BGB

Trenching methods – soils





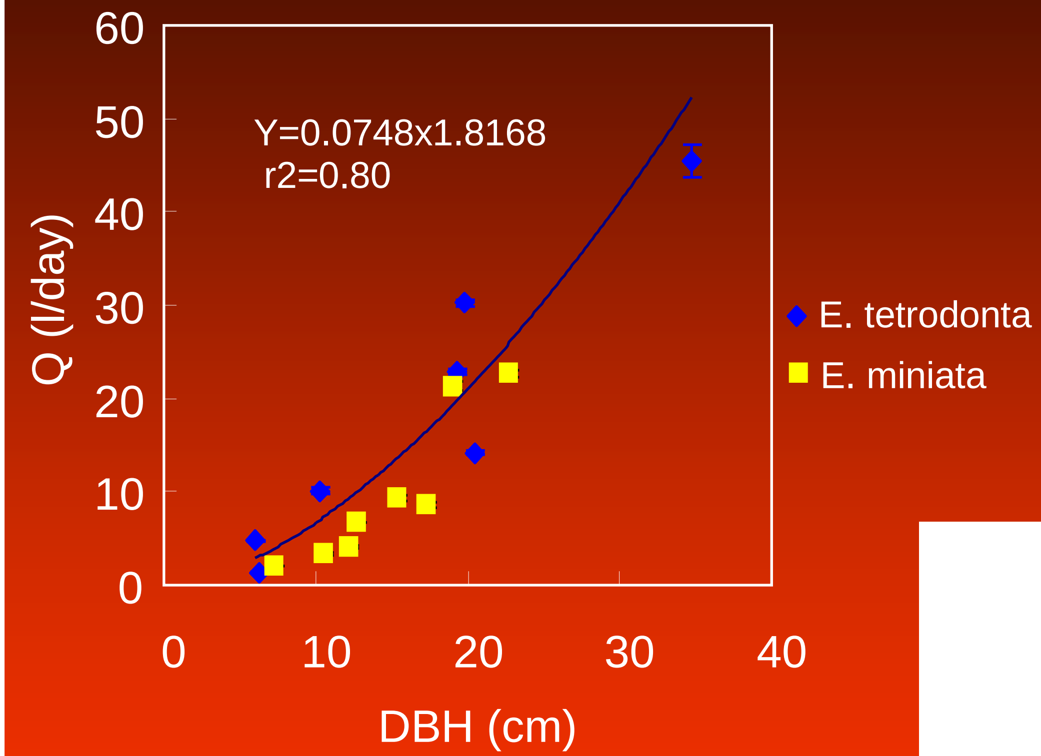
Ancillary ecological / ecophysiological measurements

- Sap flow – whole tree / plant transpiration
  - Dominant term of LE as measured by flux tower
  - Monitor population of trees / plants over a range of size classes
  - Provide stand transpiration estimate
  - Validate flux measurements

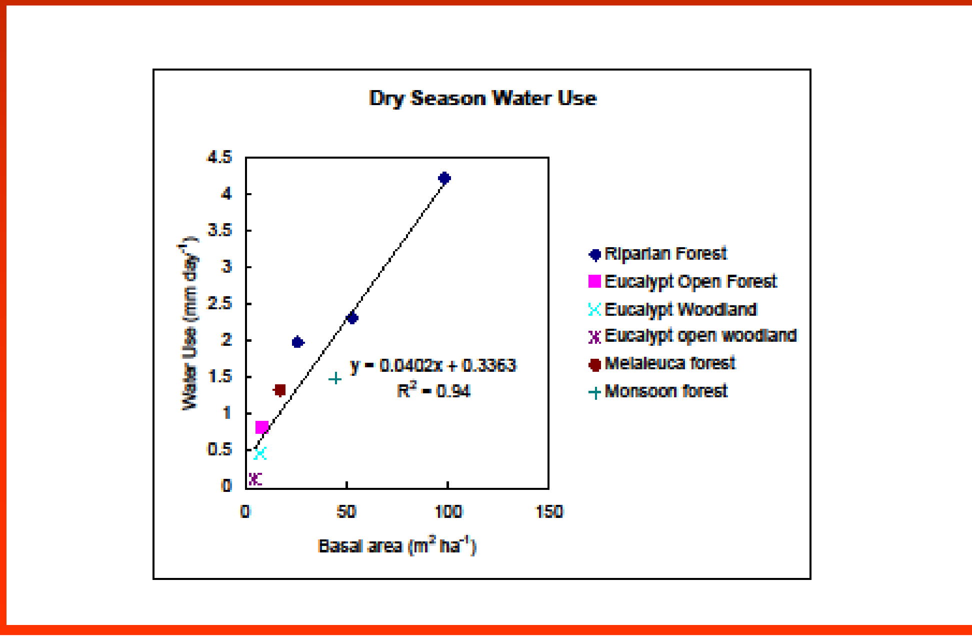
- Me
  - a tracer
  - t constantly app
    tion)
  - (Dynagage sap

Scaling heat pulse measures
Tree water use v size

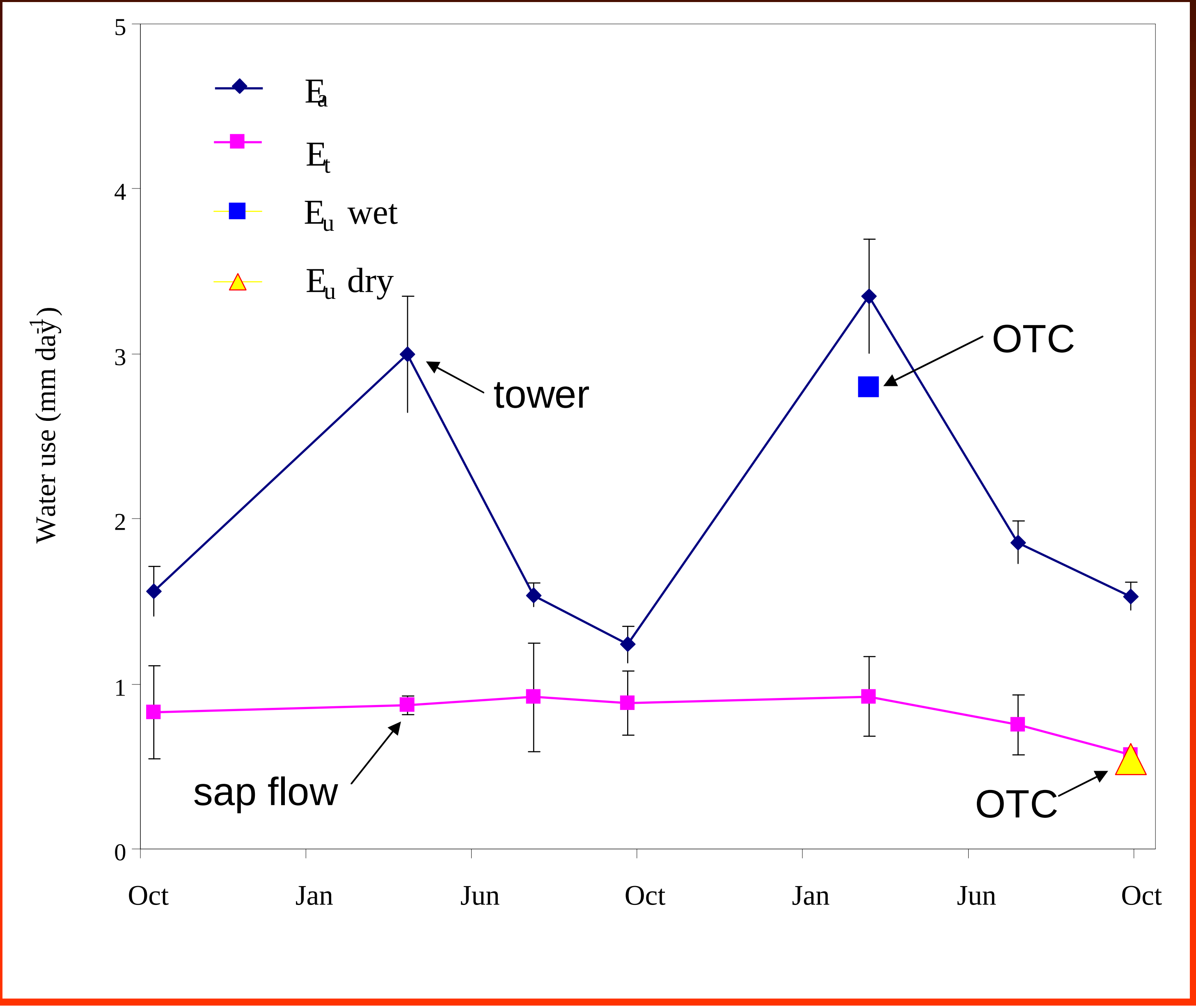
Scaling heat pulse measures
Tree water use v size

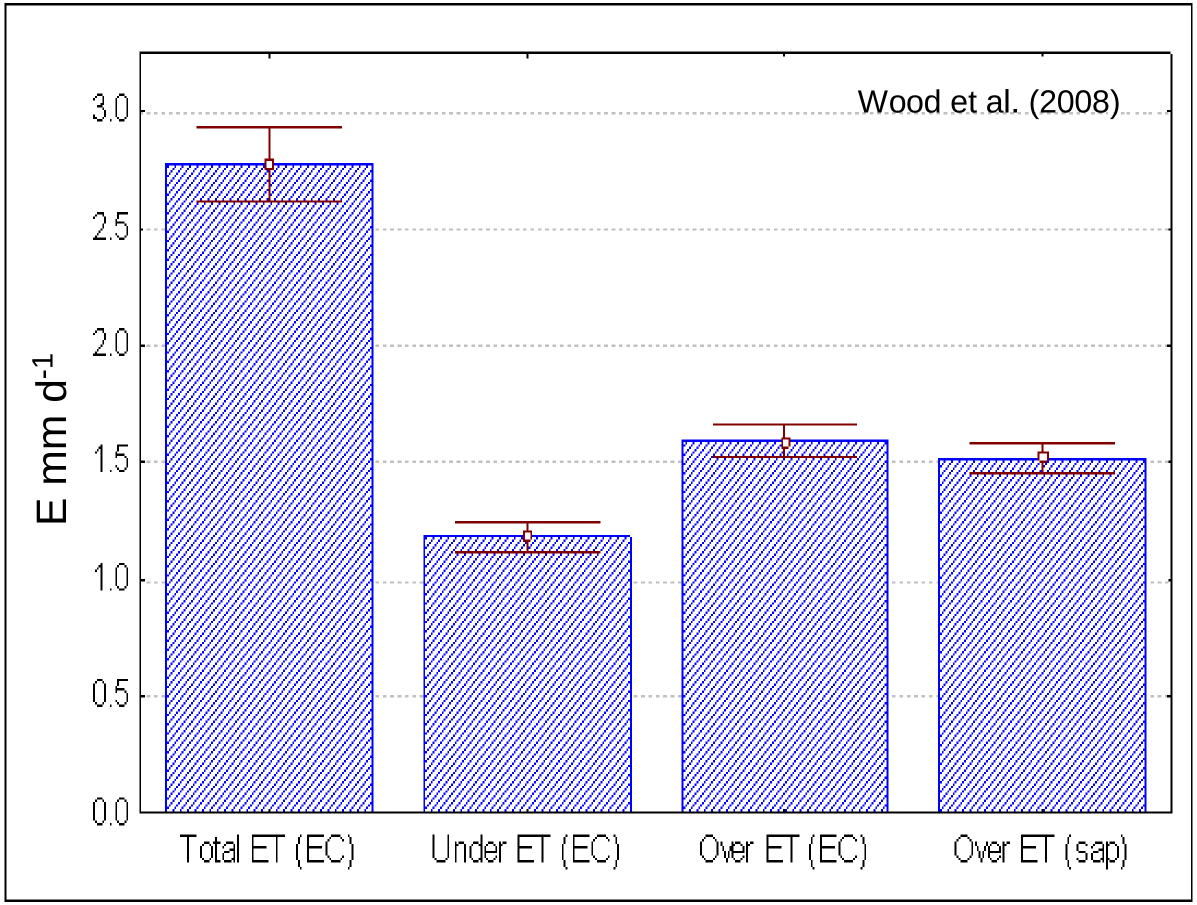


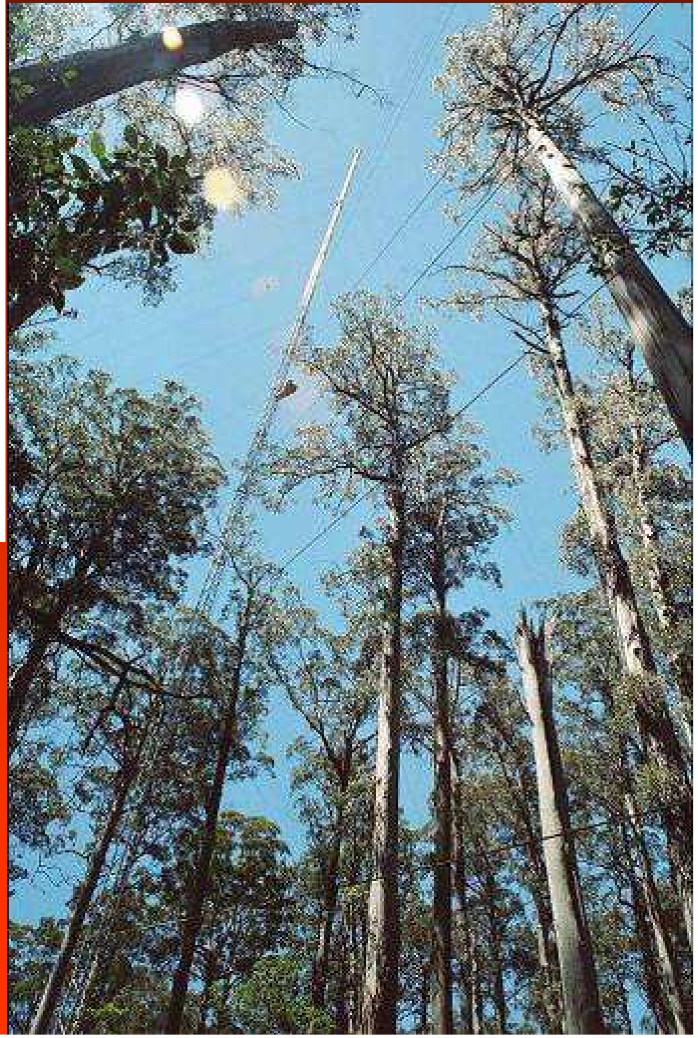
- Combine with plot surveys
- Tree water use in mm d^{-1}



Partitioning LE/ET – OTC and sap flow







Mtn Ash - sap flow and flux validation