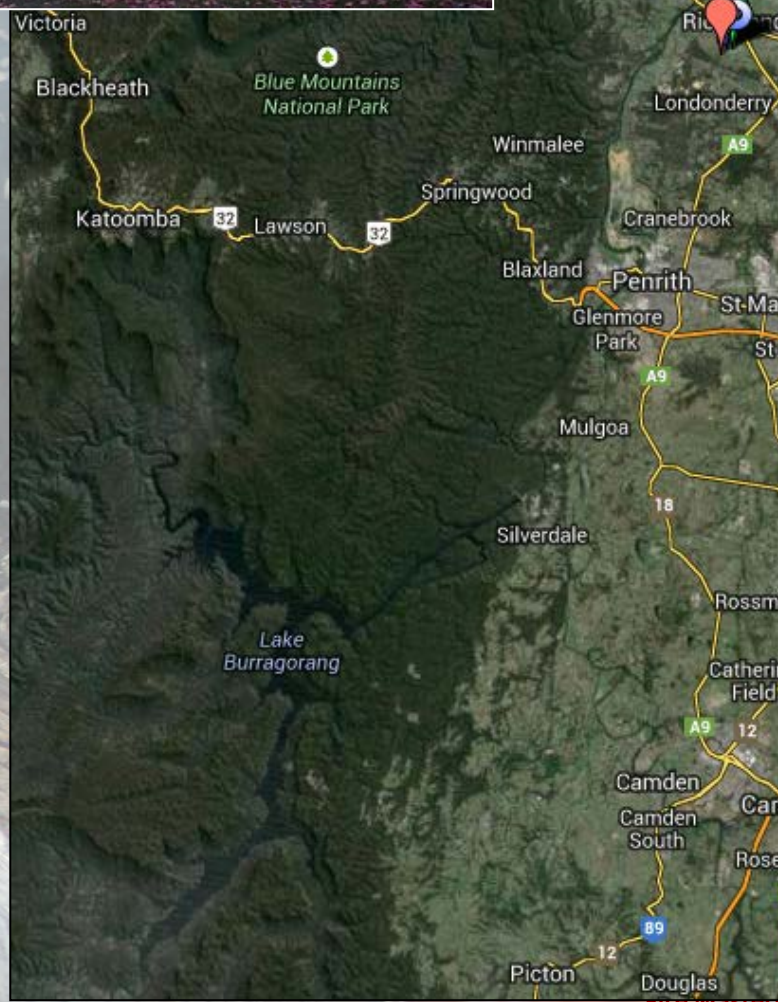




# National Environmental Research Program



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#### Postal Address

Locked Bag 1797  
Penrith NSW 2751

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# What and Why I model...

***What: 'mechanics' of ecological systems we live in and depend on***

***Why: interpret state of the system & make predictions about response***

- *process-pattern relationships (e.g., in ecohydrology, fire ecology)*
- *pattern formation: emergence & self-organization, top-down control*
- *effects of spatiotemporal heterogeneity, scaling issues*
- *minute to decadal & patch to continental scales*
- *focus of climatology-ecology link: identify key biophysical constraints of climate on ecological systems behaviour*



***Interdependence of climate, fuels & fire***



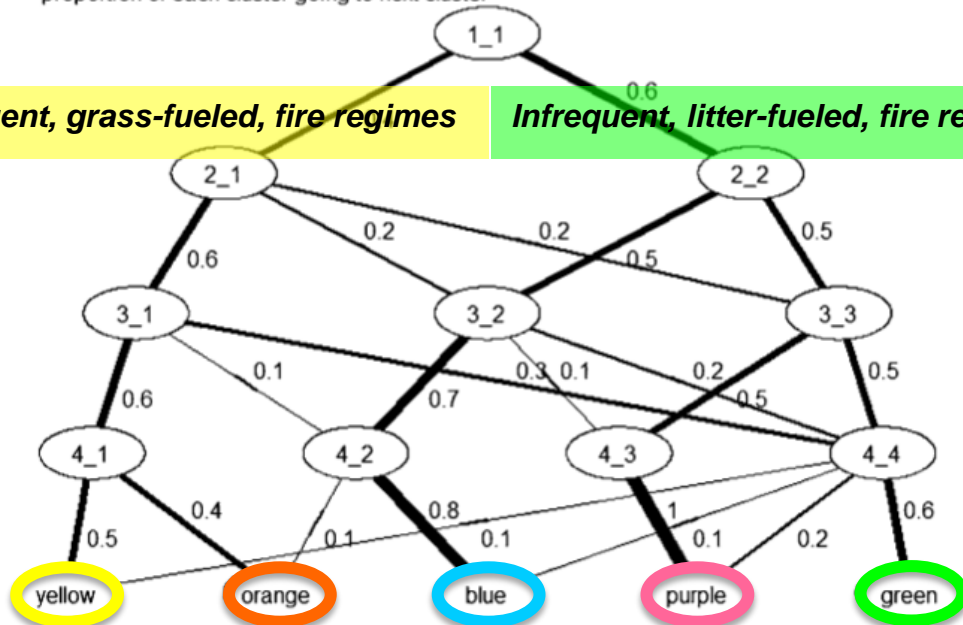


— proportion of each cluster going to next cluster

**Frequent, grass-fueled, fire regimes**

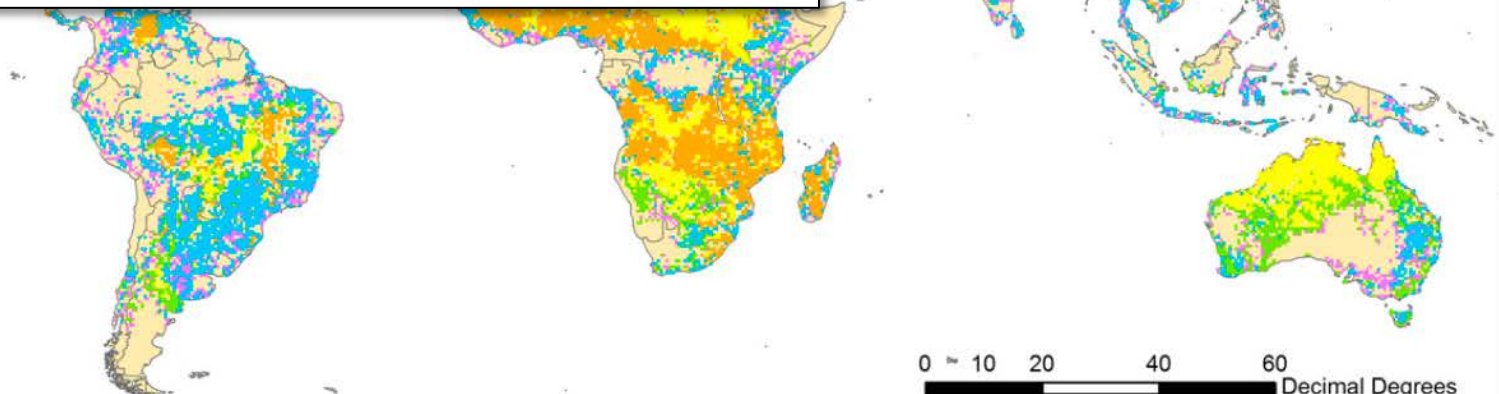
**Infrequent, litter-fueled, fire regimes**

Archibald et al. (2013) *PNAS* 110(16)



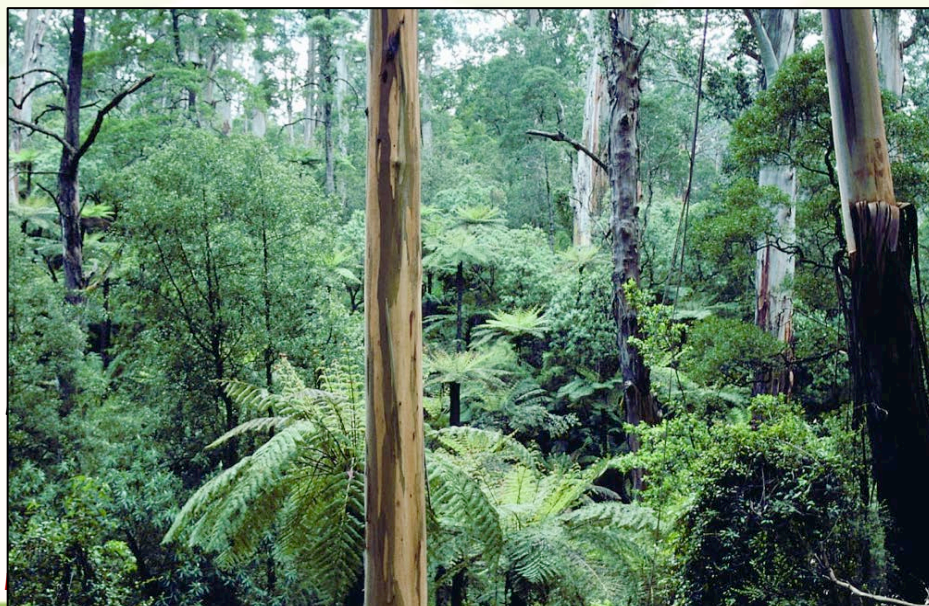
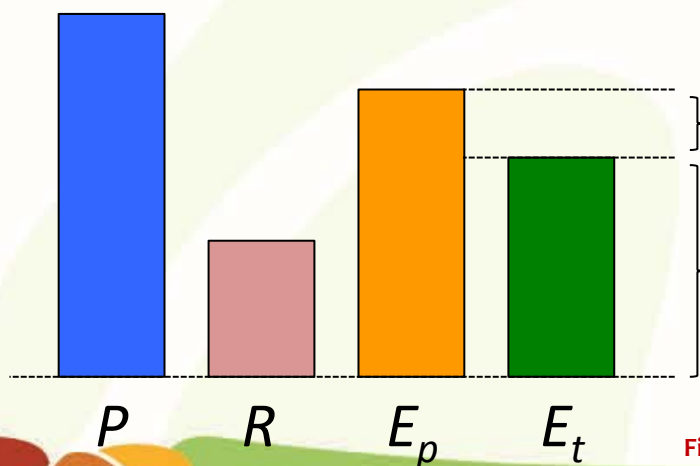
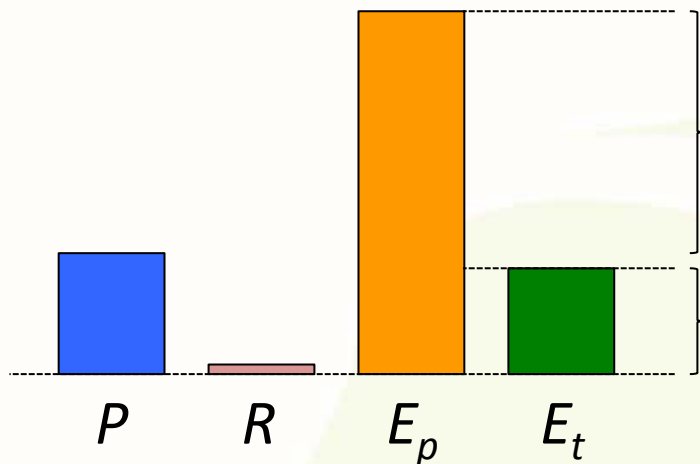
**Pyrome  
Certainty > 60%**

- FIL
- FCS
- RIL
- RCS
- ICS



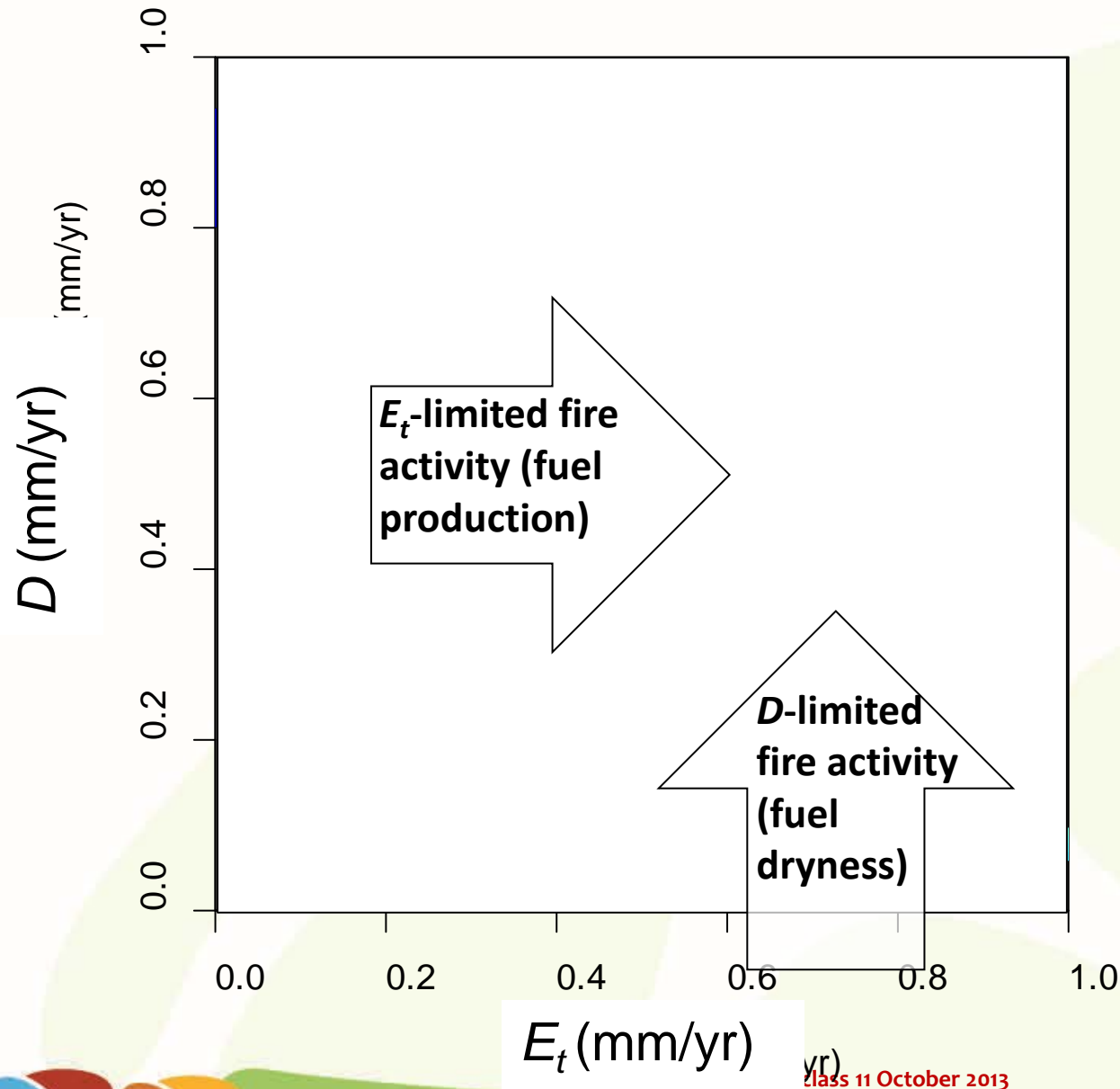
$$\text{Fire} = f(\text{plant growth, desiccation})$$

Climatic water balance

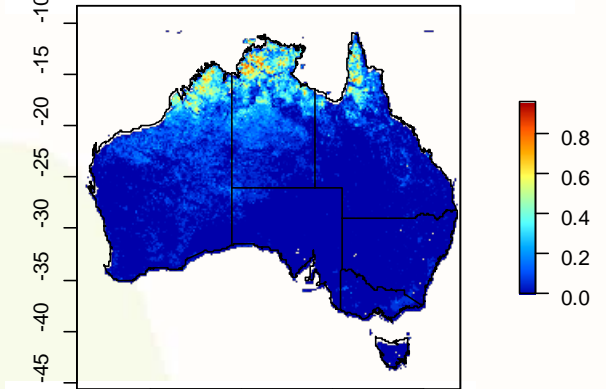


Fire

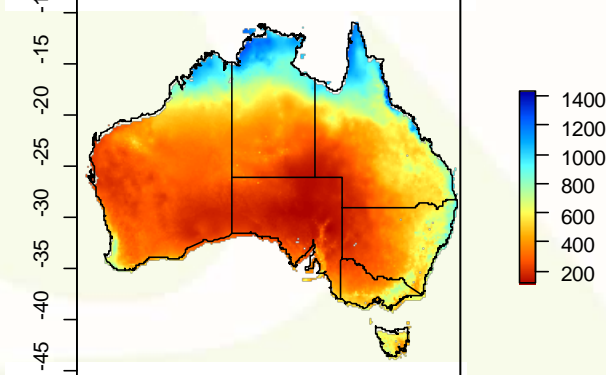
# LANDSCAPES & POLICY HUB Climate-fuel-fire model



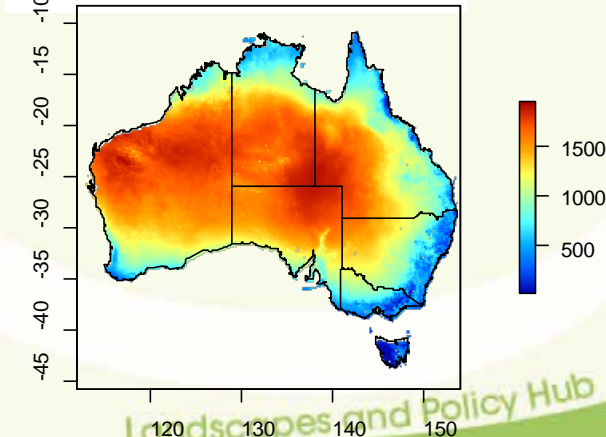
Fire activity index (1997-2010)

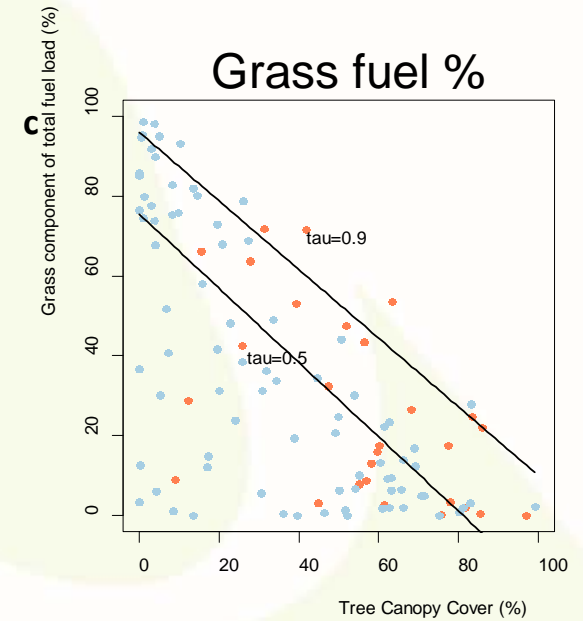
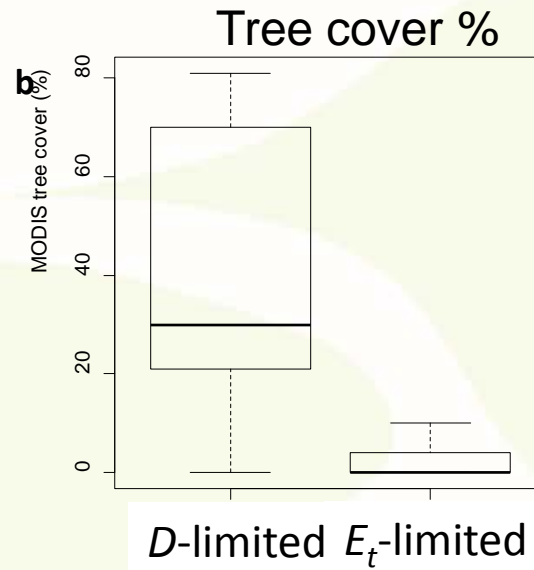
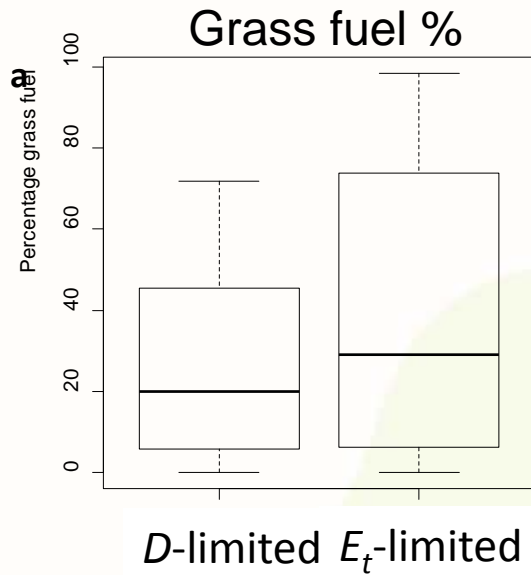


Mean annual  $E_t$  (mm/yr)

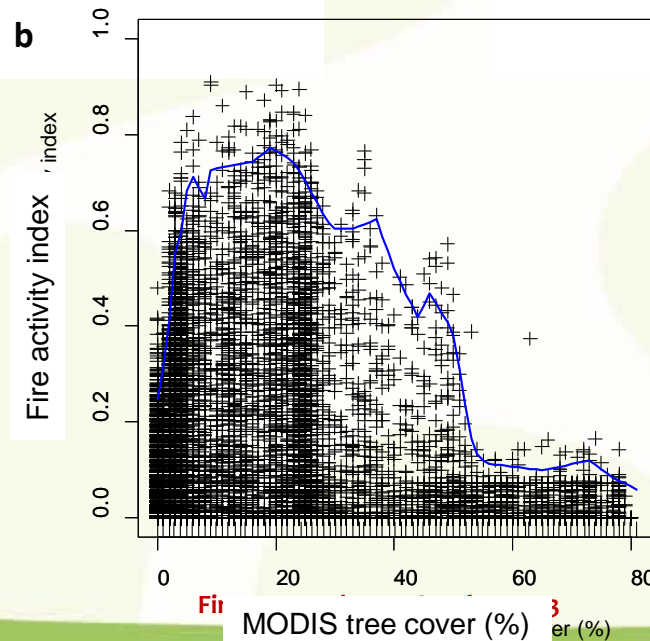
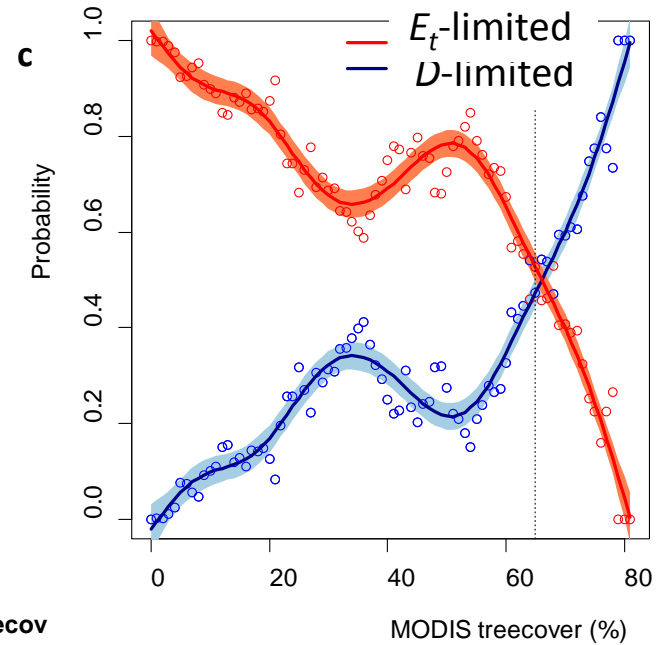
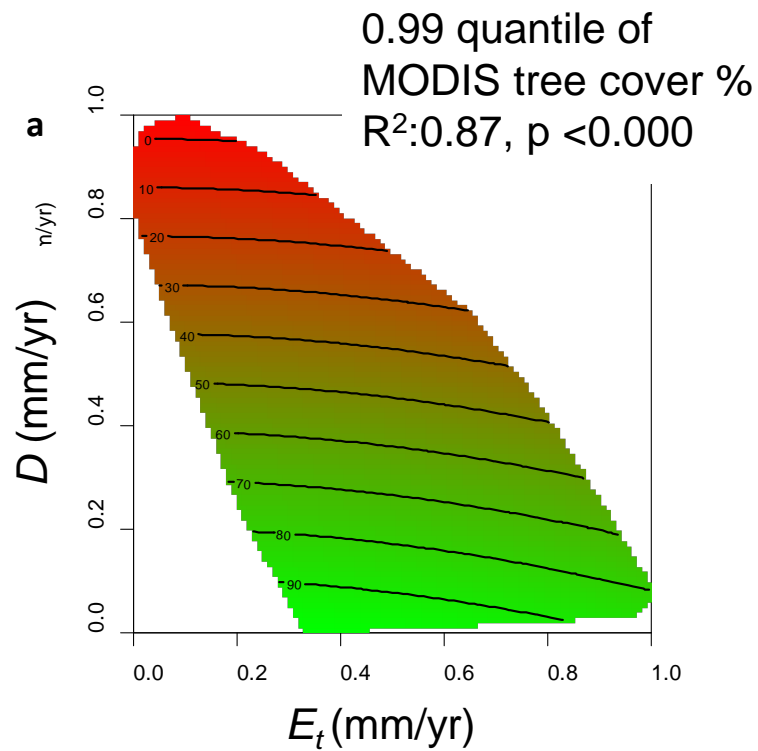


Mean annual  $D$  (mm/yr)

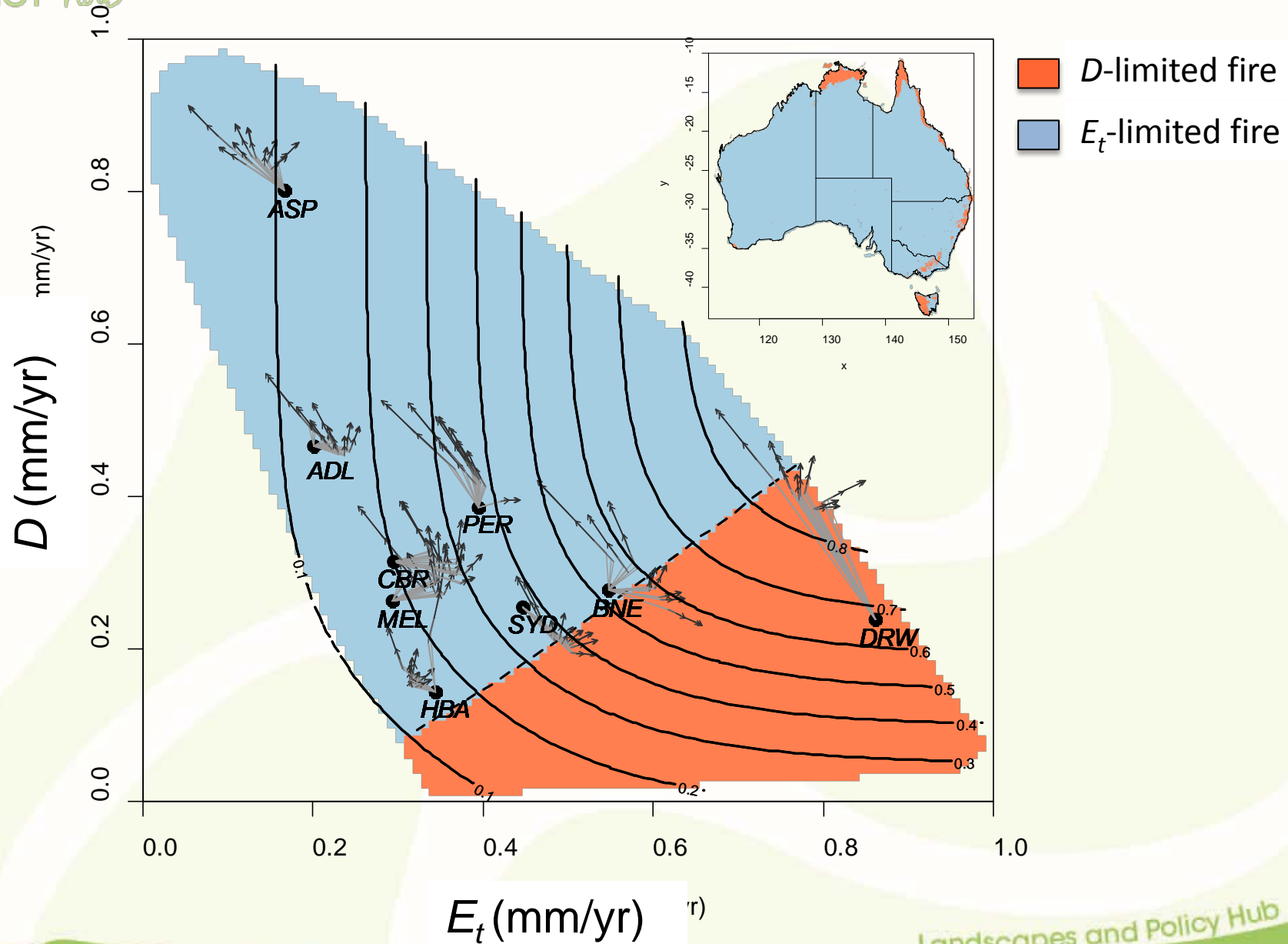












## What does my modelling mean?

- Modelling framework captures both climate-fire & climate-fuel relationships...
- ...therefore should hold (better than existing models?) for future climate conditions and be applicable to predicting change
- Some potential effects of rising atmospheric [CO<sub>2</sub>] (e.g., via WUE) can be accommodated in same water balance framework



## Modelling Caveats

- Coarse spatial scale
- Based on relatively short observation period
- (over)simplifies diversity of fire regimes
- Characterizes climate envelopes of fire regimes – what's the relevance of the change trajectory through climate space?

## My 3 biggest modelling challenges are?

1. How to conceptualise ecosystem structure and function using  $0.05^{\circ} \times 0.05^{\circ}$  grid cells?
2. How to best use uncertainty (or data distributions) in modelling
3. How to best combine top-down approaches (e.g. climate constraints on fuels and fire) and bottom-up approaches (e.g. vegetation modelling)
4. Determine spatiotemporal variation in the relative strengths of climate-fuel-fire interactions