

Carbon and water dynamics in forested catchments



Tarryn Turnbull

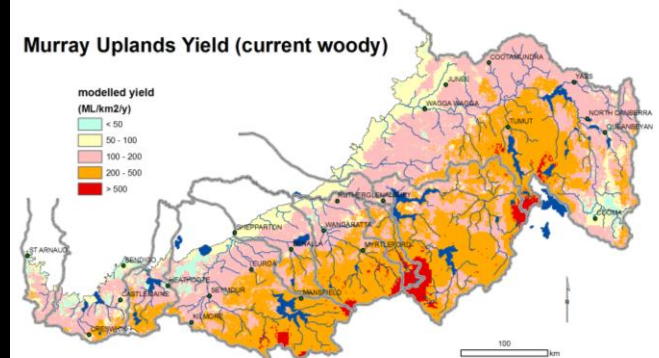
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High-country headwaters

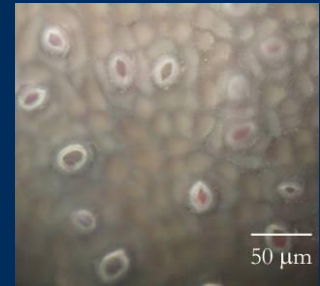


The Murray Uplands

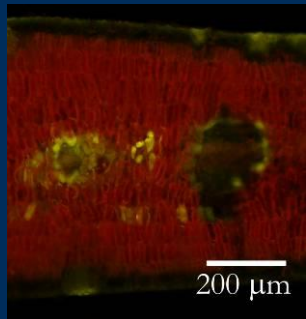
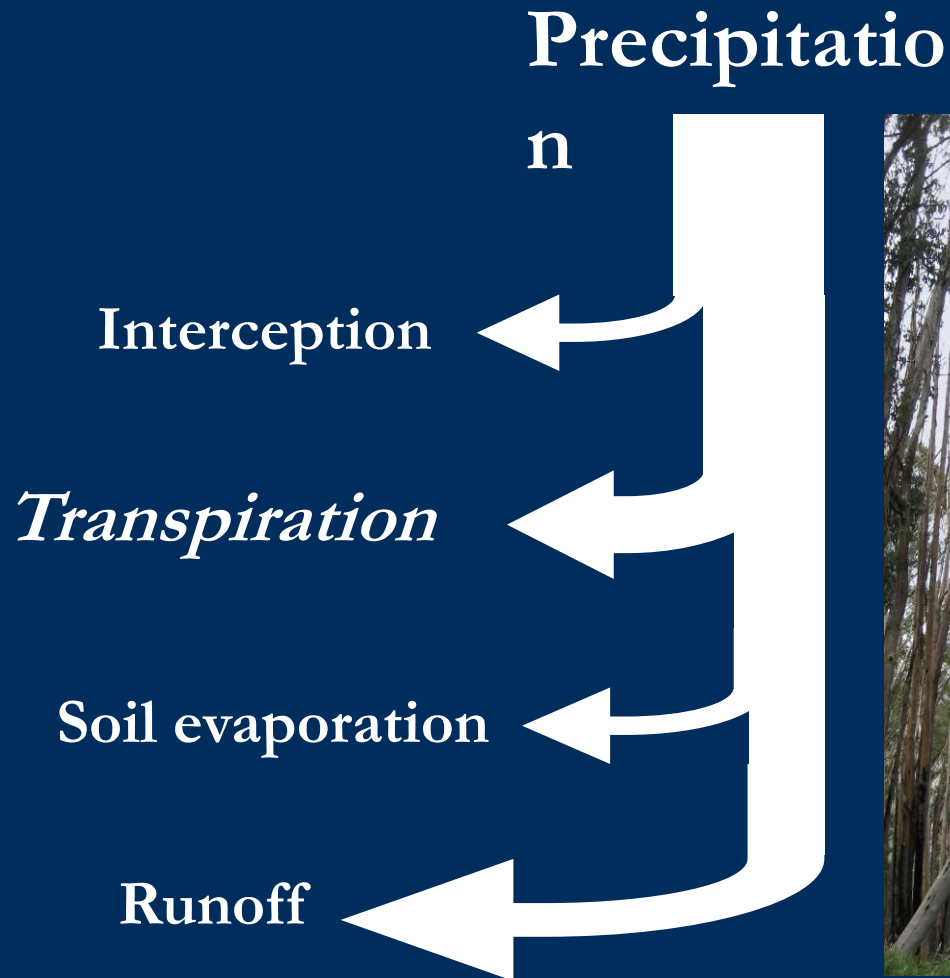
- 3.5 million hectares of forests
- 32,000 GL annual water use
- 8,000 GL annual stream flow



Determinants of water yield

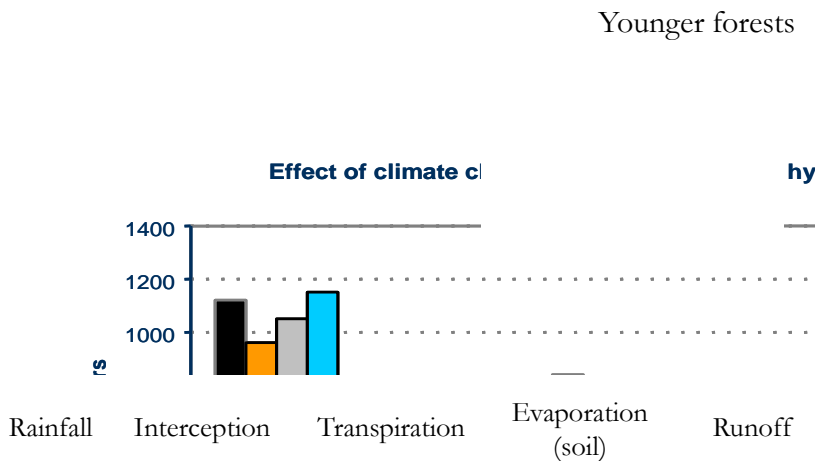
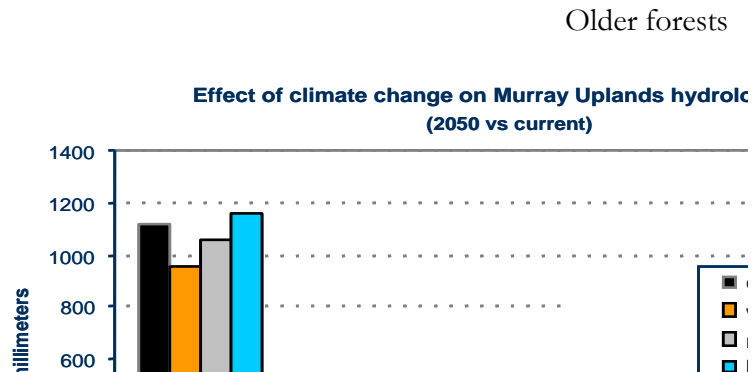


*Leaf
physiology*



Projections of water yield

Millimeters



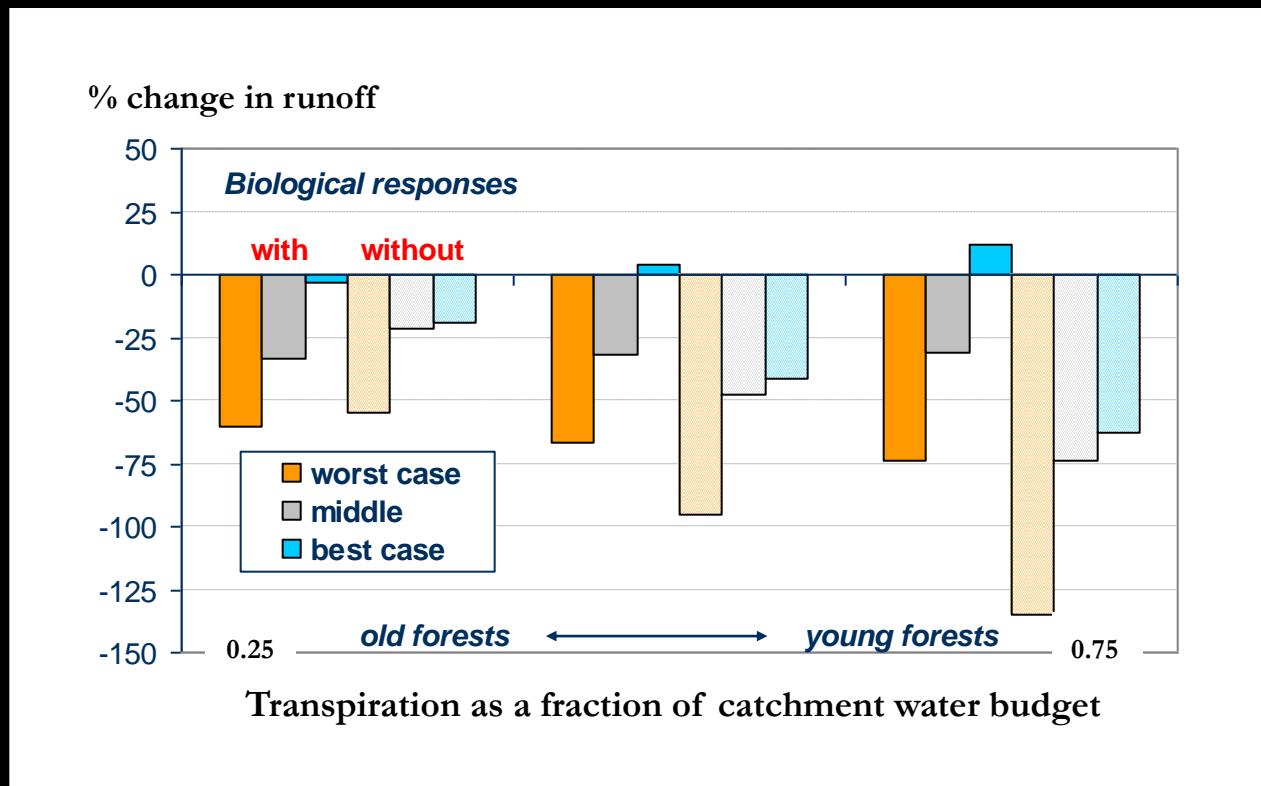
Effect of climate change on Murray uplands hydrology (2050 vs. current)

Based on:

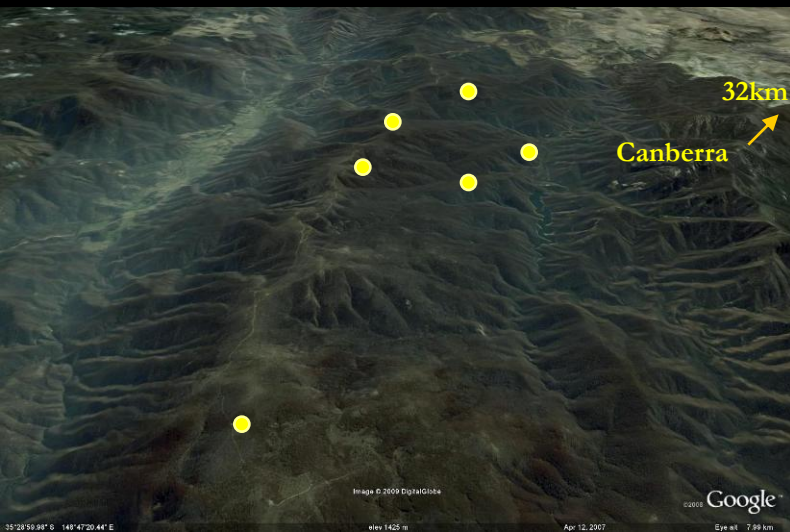
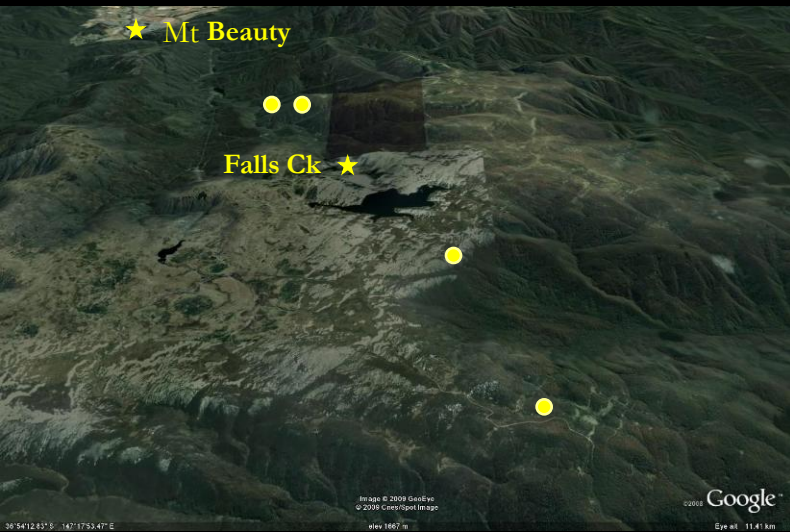
- CSIRO climate models;
- Meta-analysis of CO₂ effects (Ainsworth and Long, 2006);
- Evaporation analysis (Roderick, 2006).

Further projections of water yield

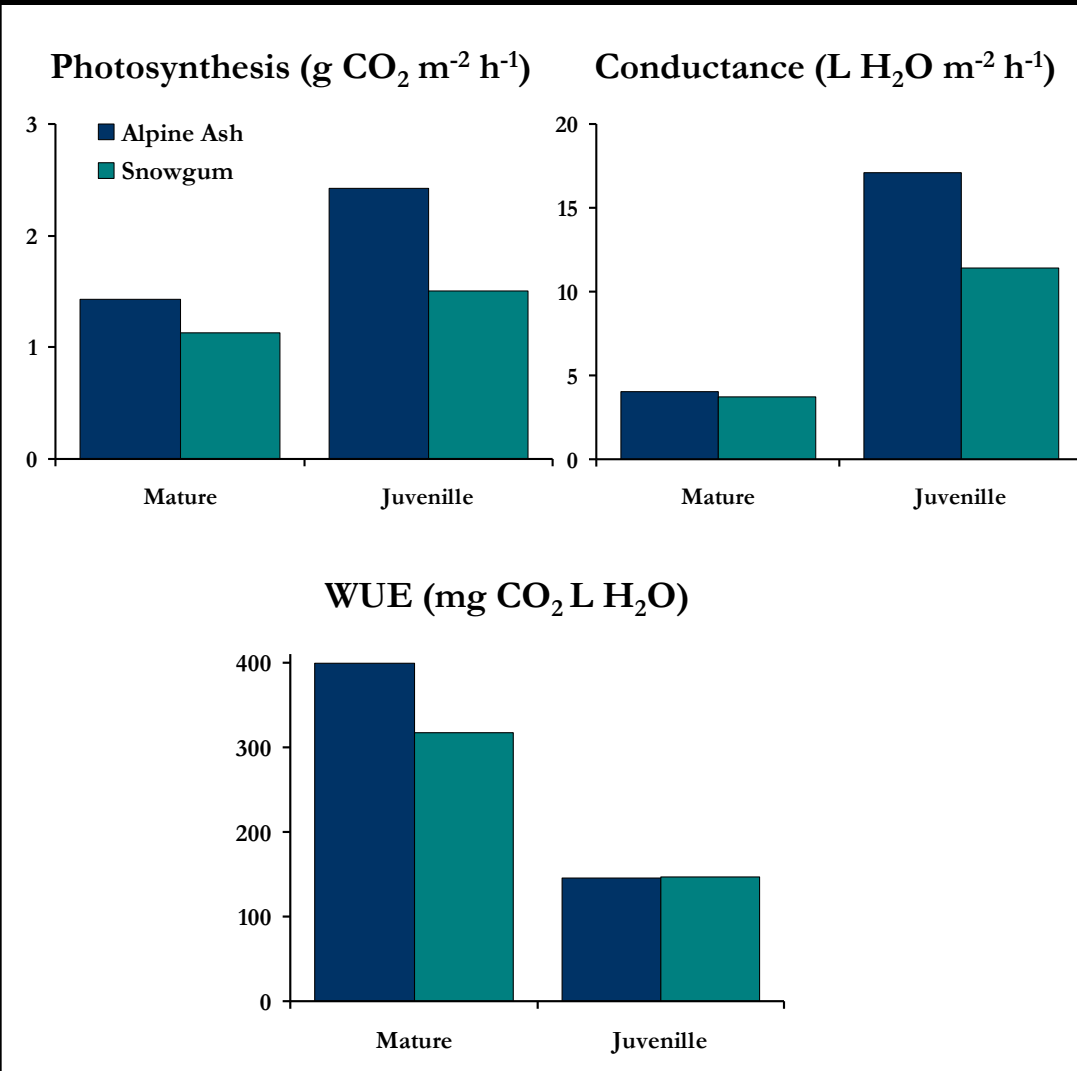
Effect of climate change on Murray uplands hydrology (2050 vs. current)



Validating physiological models of tree water use



Influence of forest age on physiology



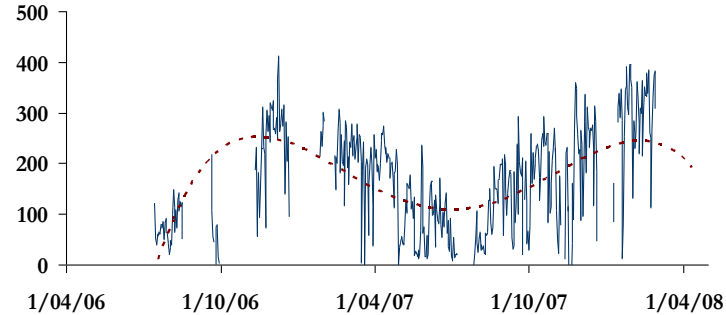
Physiology of leaves and wood

- Influence of ontogeny;
- Stomatal physiology;
- Photosynthetic water-use efficiency;
- Relationships between leaf area and sapwood area.

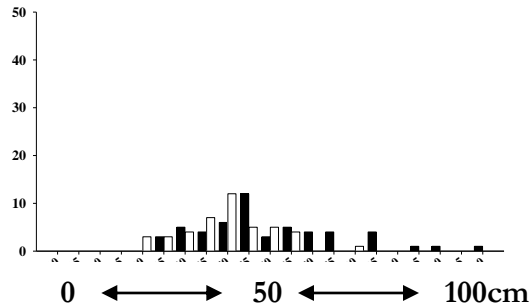
Quantifying sap flow

Alpine Ash

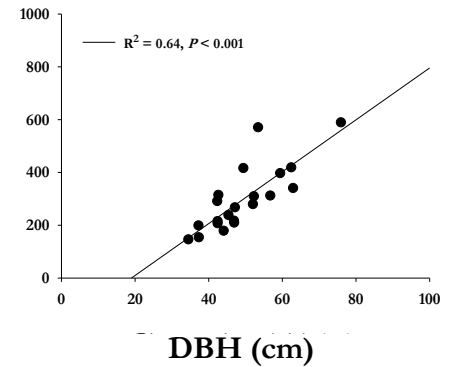
Tree water use (L day⁻¹)



Stems ha⁻¹

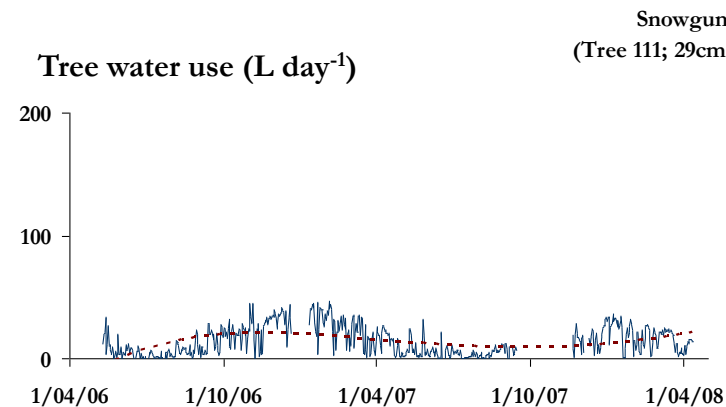


Sapwood area (cm²)

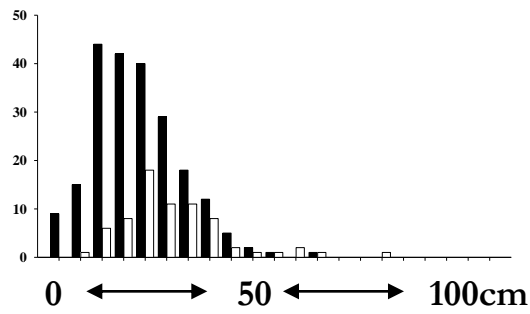


Snowgum

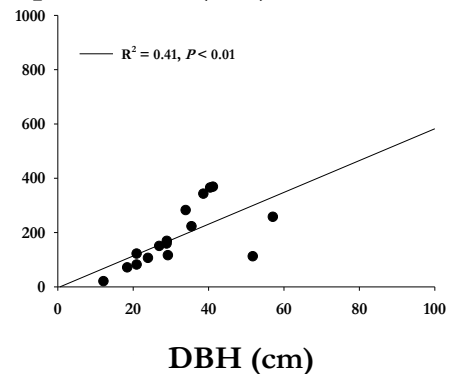
Tree water use (L day⁻¹)



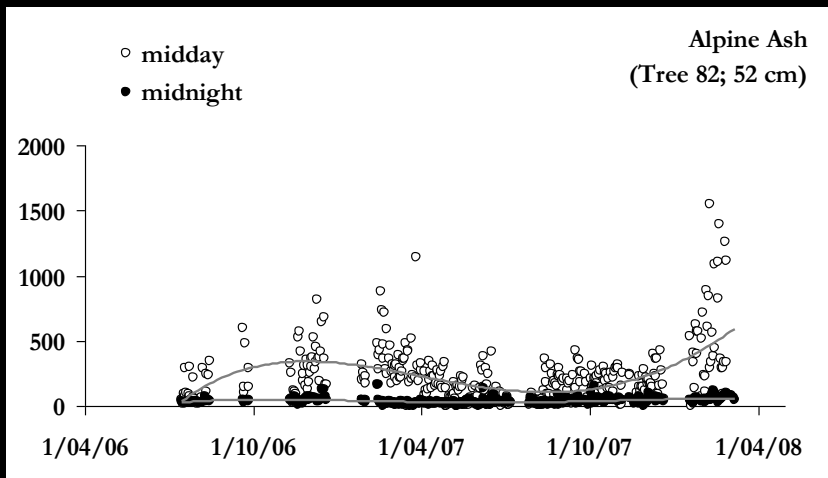
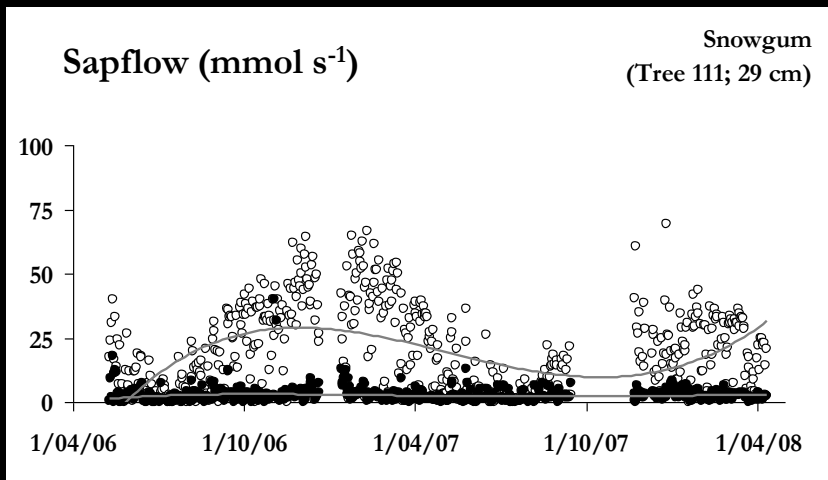
Stems ha⁻¹



Sapwood area (cm²)



Patterns in sap flow – nocturnal



- An assumption of many hydrological models is that nocturnal transpiration is negligible;
- Current models of forest gas exchange, and forest hydrology to not include nocturnal transpiration;
- We have observed significant night-time flow rates:
 - 12 % of daytime sap flow in Snowgum,
 - 24 % of daytime sap flow in Alpine Ash,

Conclusions

- The water balance of our high-country catchments are most sensitive to tree water use;
- As such, runoff is likely to decline with onset of climate change;
- Accurate predictions of water yield depend on knowledge of tree physiology, particularly drivers of water use, and contributions of nocturnal transpiration.

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