Remotely measuring leaf function

Linking leaf-level photosynthetic processes to reflectance in a mature Eucalypt canopy

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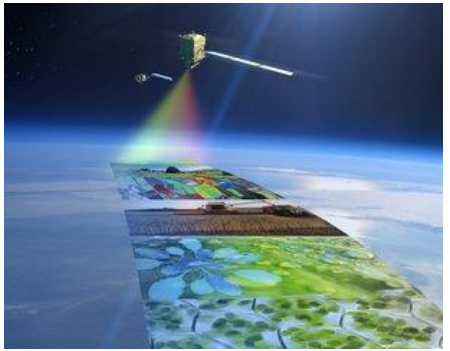
Motivation

Remote sensing  ‘Fast’ diurnal carbon and water fluxes

Objective

Link processed-based measurements across scales



Point & leaf

Tower & site level

Satellite & global level

Tumbarumba (AU-Tum)

Winter 2016 top, Summer 16/17 bottom

Eddy-flux system

Thermal and Hyperspectral Imagery Monitoring System

Fig. 1. Camera system enclosure

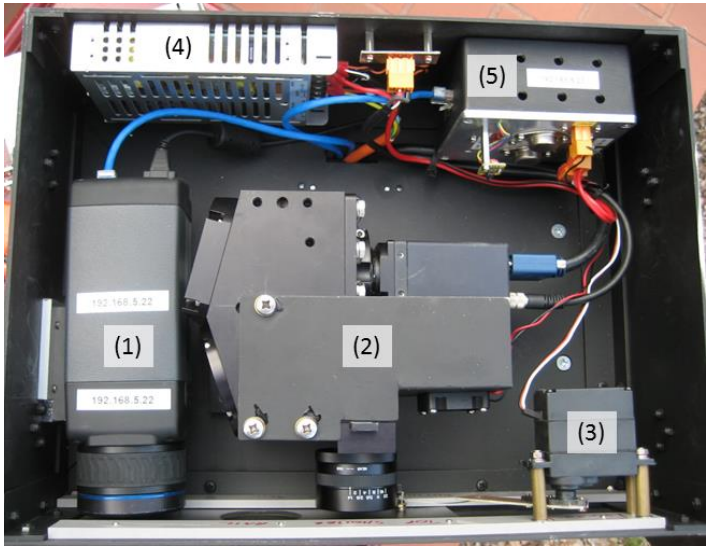
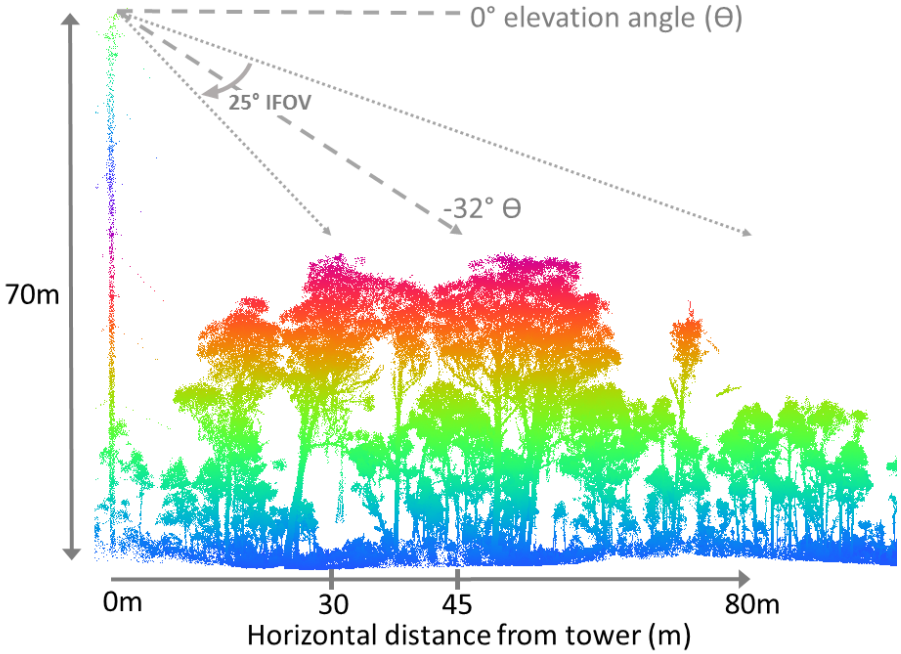
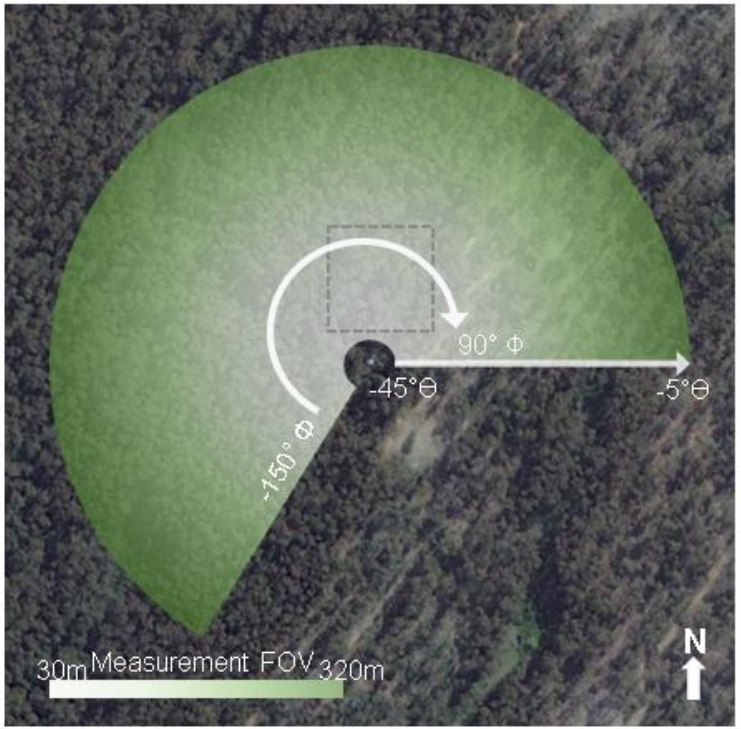


Fig. 2. Internal view

Thermal and Hyperspectral Imagery Monitoring System

- Operational since 2015





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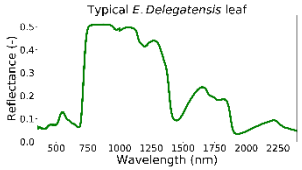
Method: Linking leaf function & pigment content to reflectance

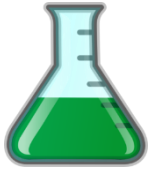
Photosynthetic function

Spectra



Pigment content

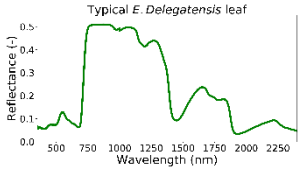
abChl, N ++



Linking leaf pigments to reflectance

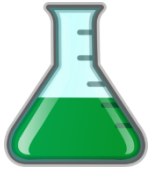
Photosynthetic function

Spectra

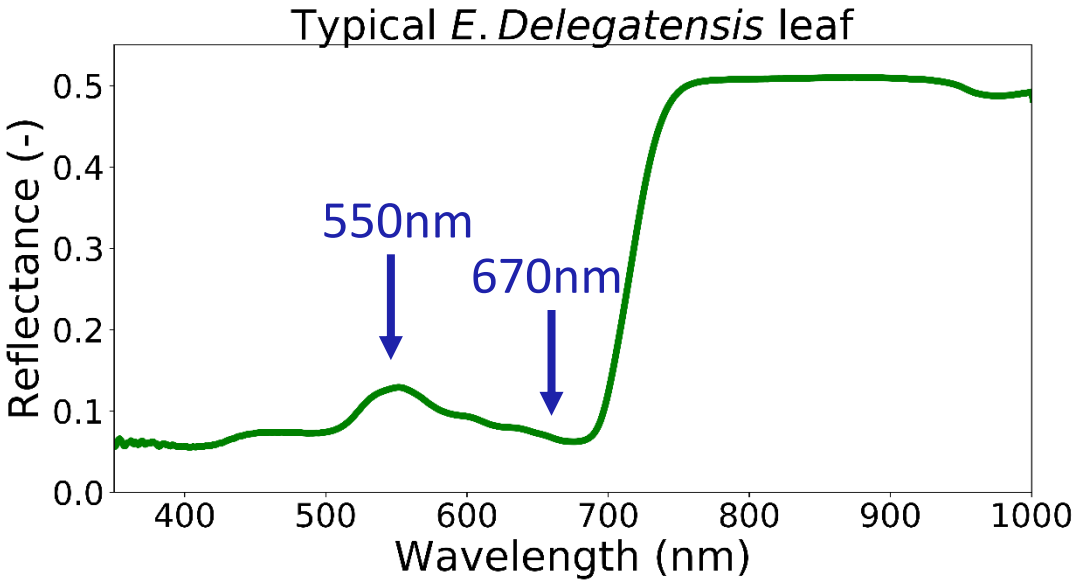


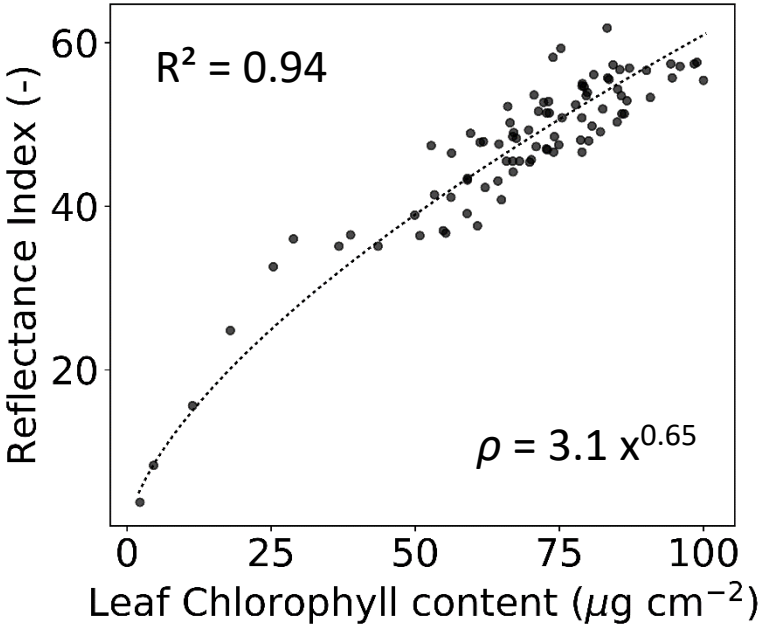
Pigment content

abChl, N ++



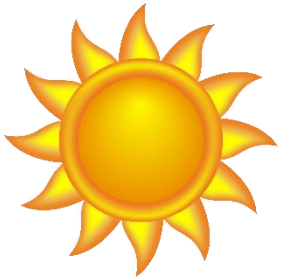
Results: leaf spectra and ‘slow’ pigments

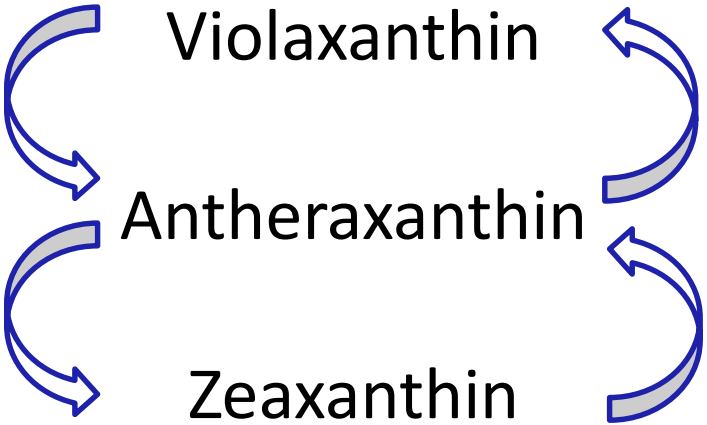


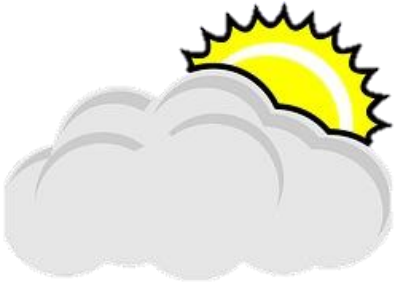


Leaf spectra and ‘fast’ pigments

Xanthophyll pigment cycle



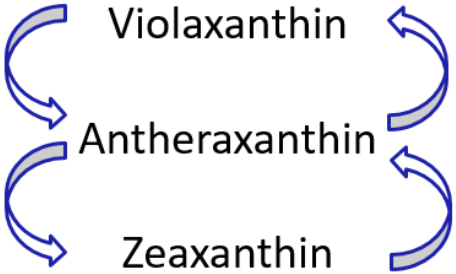


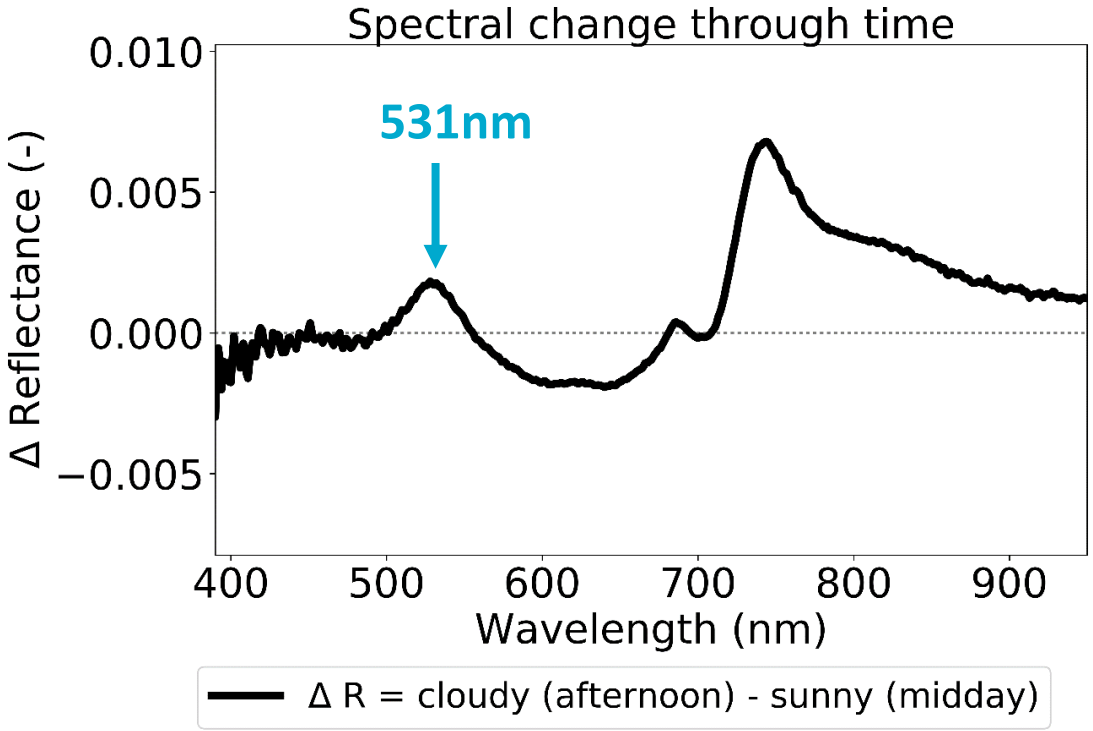


Results 2: leaf spectra and ‘fast’ pigments

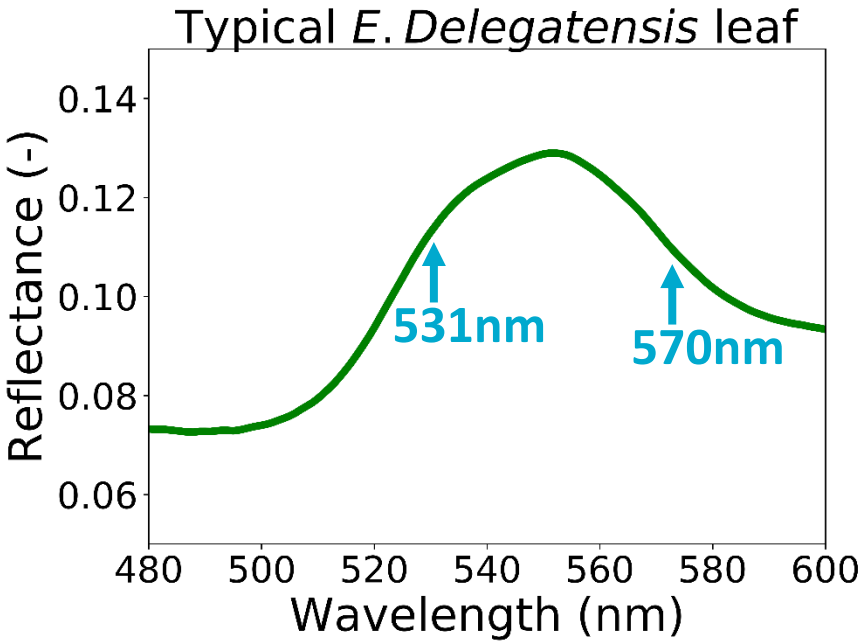
Leaf spectra

Pigment cycle



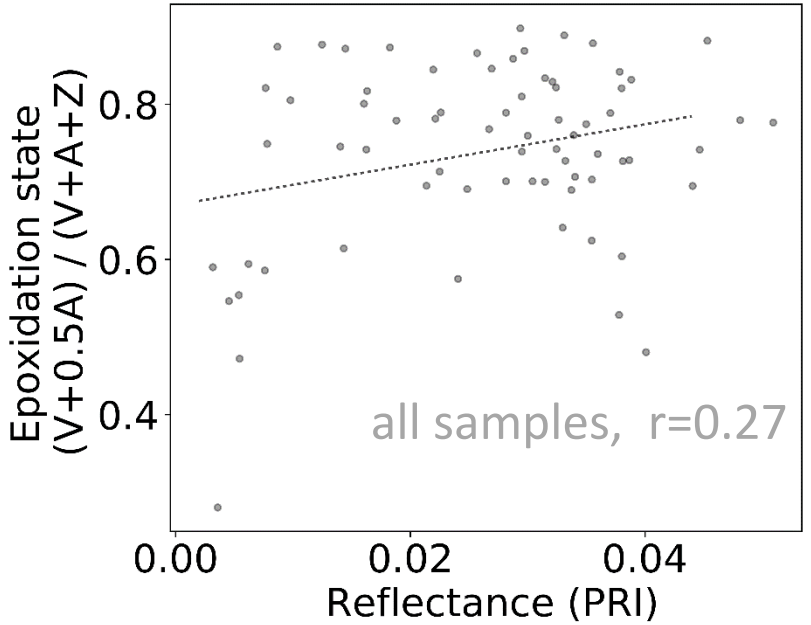


Results: Reflectance and ‘fast’ pigments



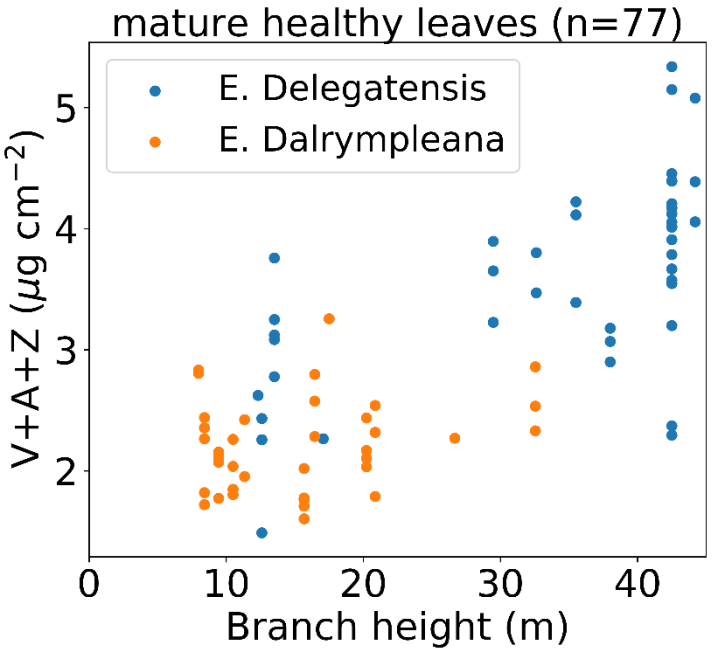
Traditional approach:

PRI = (ρ531-ρ570)/(ρ531+ρ570)



Results: Reflectance and ‘fast’ pigments

Pigment height profile:



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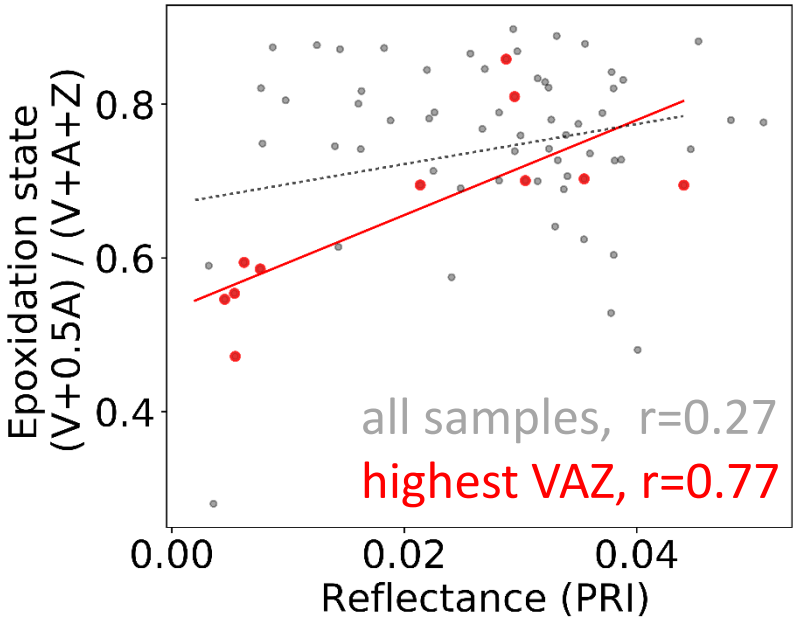
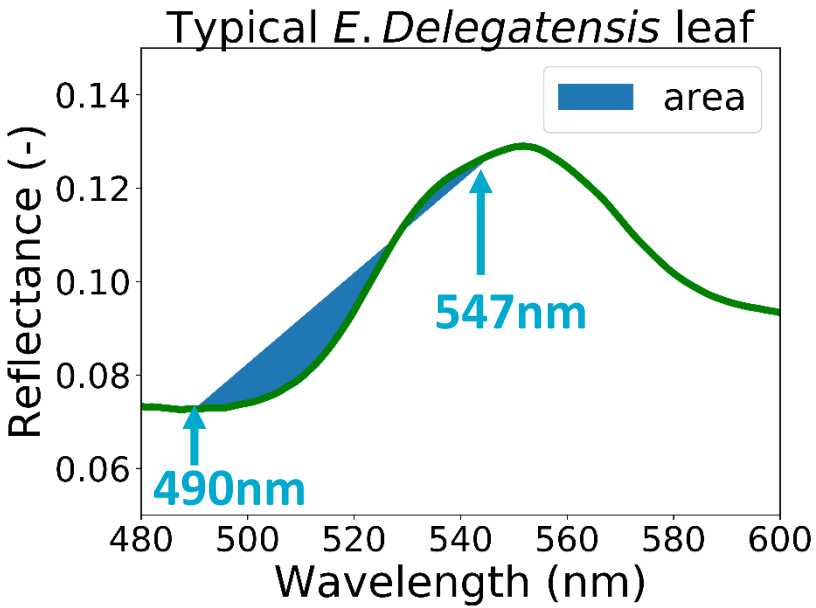
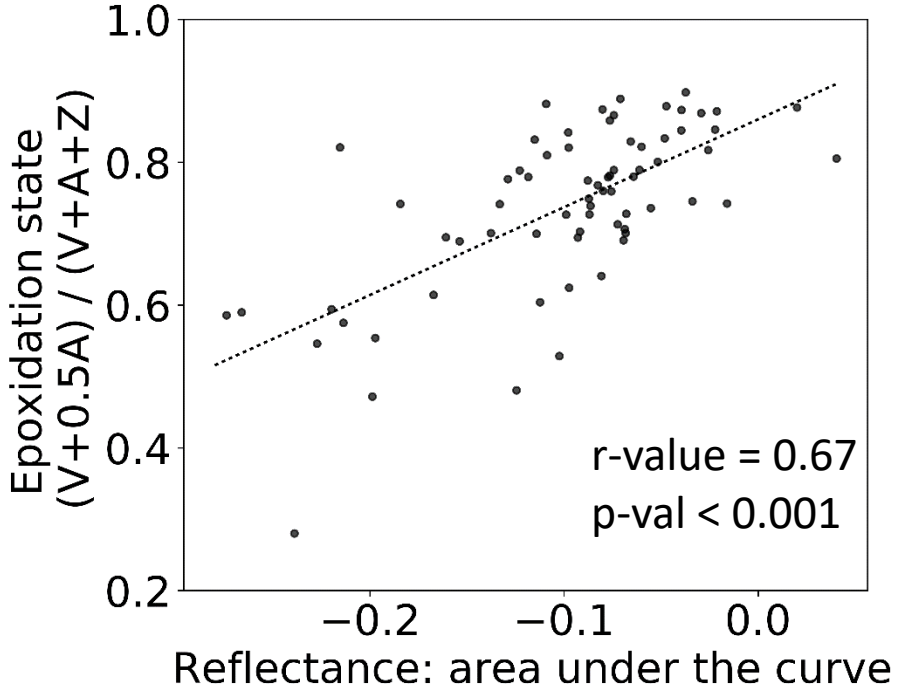


Results: Reflectance and ‘fast’ pigments

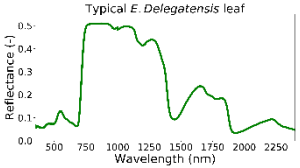




Linking leaf function to reflectance

Photosynthetic function

Spectra

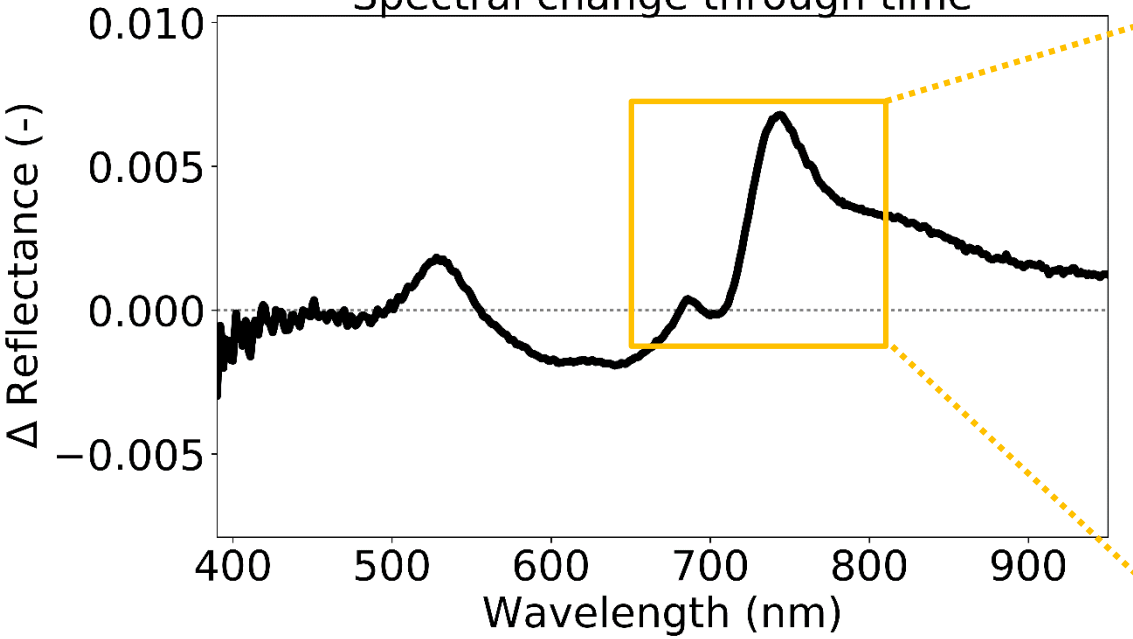


Pigment content

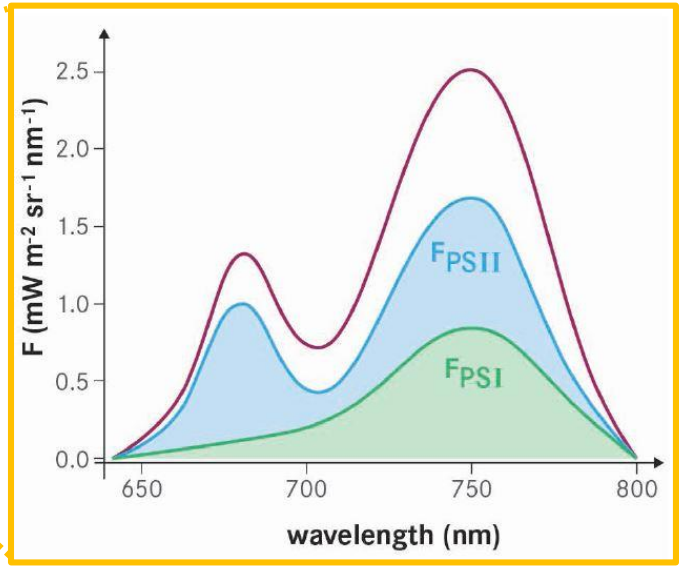
abChl, N ++

Results: leaf spectra and pigments

Spectral change through time

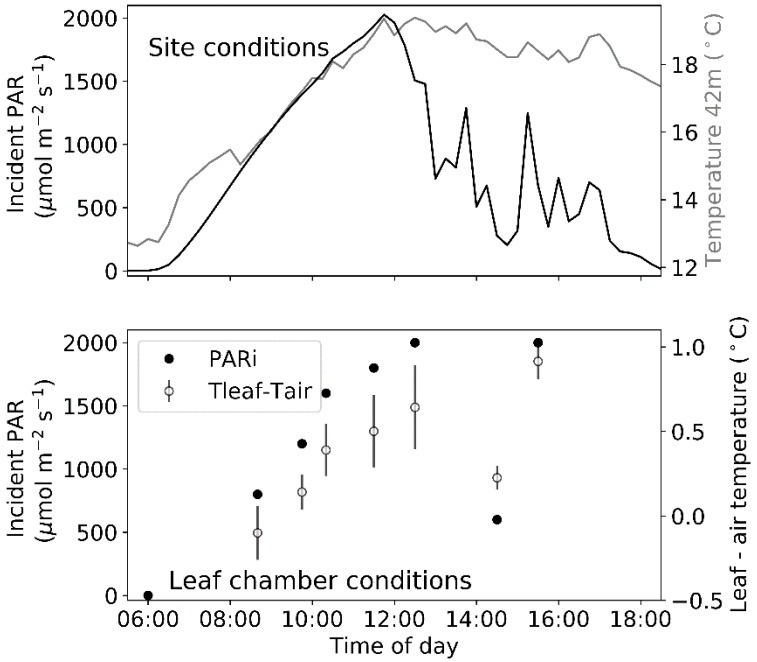


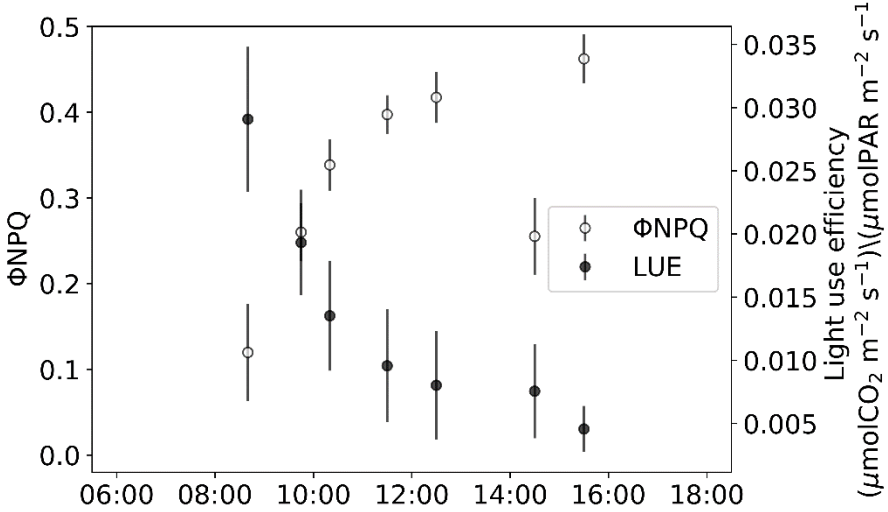
Typical fluorescence spectrum



Δ R = cloudy (afternoon) - sunny (midday)

Results: diurnal observations





Key take home message(s)

1. First time in mature Aus Euc environment we have seen a link between: reflectance and pigments related to near-instantaneous changes in light use efficiency (xanthophyll pool); and fluorescence parameters to other photosynthetic proxies.

2. Flux towers and SuperSites are the key link between satellite and on-the-ground processes. Scaling to link ground, to tower/airborne, to satellite.

3. Many questions remain around verifying fast flux retrievals from remote sensing - most are at the interfaces of scales and platforms.

Future Directions

Thank you

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