**Materials and Methods**

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**Dataset summary**

Light and CO2 response curves using a modified Li-6800 were collected on 8 leaves at the Tumbarumba research site in April, 2022. Combined gas exchange, PAM fluorescence, reflectance and transmittance (400-650nm), and spectral fluorescence both forward- and back-scattered (660-850nm) observations were collected for each light and CO2 level.

**Site Description**

The study was conducted at the Tumbarumba flux tower site, New South Wales, Australia (35°39′20″S, 148°09′07″E, 1200 m elevation). The site was established in 2001 and is a member of FLUXNET (Baldocchi et al., 2001), SPECNET (Gamon et al., 2006), and part of the Australian Terrestrial Ecosystem Research Network (TERN; (Beringer et al., 2016; Karan et al., 2016)). The site is characterised by a moderately open wet sclerophyll forest recovering from bushfire. The canopy comprises standing dead fire sensitive Eucalyptus delegatensis, and recovering Eucalyptus dalrympleana (Keith et al., 2012; Leuning et al., 2005). The climate is entails warm summers with mean daily temperatures between 10 °C and 23 °C in January, and cool and moist winters with mean daily temperatures ranging between −1°C to 6 °C. Mean annual precipitation is around 1200 mm. Fieldwork was conducted from April. 5-8, 2022 with a temperature and humidity range between < X°C and Y °C and X%-Y%, respectively>. Data collection, processing, and analysis steps are outlined below.

**Leaf collection**

Tree branches from different heights were excised using the Arborist’s slingshot method (Youngentob et al., 2016). Excised branches were then placed in buckets of water, with their base re-cut underwater to prevent embolism. Mature healthy leaves of epicormic regrowth from Eucalyptus dalrympleana trees similar of ontogeny representative of the canopy conditions were collected from dominant through to suppressed tree classes. These species were the only remaining alive trees after a catastrophic bushfire killed all standing Eucalypt delegatensis. All trees were located within the 1 ha SuperSite plot, with known species, DBH and tree height information.

In total, 9 branches were sampled from 9 trees.

**Instrument description**

A Li-6800 was modified to facilitate observations of reflectance and transmittance (400-650nm), and spectral fluorescence both forward- and back-scattered (660-850nm) – see below:

Diagram

Description automatically generated

**Fig. 1.** Instrument schematic modified with permission from Magney et al. (2017). The first QEP spectrometer is coupled with a halogen light source with a 650nm short pass filter and is inserted in the top chamber to measure backscattered fluxes. A switch is employed to measure any drift from a split halogen light source. The second QEP spectrometer is directed through the bottom of the leaf chamber to measure forward-scattered fluxes. The intensity of the light was < 1 umol m-2 s-1 PAR to minimise any perturbation of photosynthesis at low light levels.

Reflectance and transmittance were calculated using reference measurements of calibration panels of known reflectivity and diffusivity.

**Measurement protocol**

Leaves were first dark adapted for a minimum of 30 minutes before being inserted into a dark LI-6800 chamber with fixed relative humidity (60%) and leaf temperature (25degC). Next, a light response curve was carried out at 16 light levels spaced at 5 minute intervals (0, 10, 20, 40, 80, 150, 300, 450, 600, 750, 900, 1200, 1500, 1800, 2100, 2400, 1500 umol m-2 s-1 PAR). The CO2 level was fixed at 400 ppm. The CO2 response curve proceeded immediately afterwards with a fixed light level of 1500 umol m-2 s-1 PAR for 17 intensities (400, 0, 50, 100, 150, 200, 250, 300, 350, 400, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000, 400 ppm) spaced at 5 minute intervals. Both response curves used the Autoprogram software functionality. Refer to supplementary material for more detailed protocol information.

The spectral observation sequence at each 5 minute increment was as follows: Fs (for PAR >0), Fmax, Fmin, R & T, and can essentially be treated as paired observations for each light or CO2 level.

One leaf had a light response curve measured with no CO2 curve, 8 leaves had both response curves.

**Ancillary measurements**

* Reflectance and transmittance from 400-2500nm were collected for each leaf using an ASD Fieldspec Pro 3 coupled with an ASD integrating sphere.
* Sample height in the canopy, species, branch orientation.
* Mature or juvenile age category

**Data file description**

For each response curve there are 9 files, detailed as follows with a naming convention in brackets:

* LiCOR 6800 file (*leaf ID* “*\_CO2.csv*” or “*\_LRC.csv*”): columns containing all gas exchange and PAM data. With *LRC* and *CO2* in the file name denoting light response and CO2 response curves, respectively.
* QEP fluorescence data (*leaf ID \_ LRC/CO2 \_ fmin/fmax/fs \_ back/forw .csv)*: *Fmin* is minimum fluorescence using only the low intensity halogen light source (no other actinic light), *Fmax* denotes spectra during the PAM saturating pulse, *Fs* denotes spectra at the actinic light level. *Back/forw* in the file name denote back- or forward-scattered fluxes. Columns are wavelengths – recommended to use 670-800nm. All fluorescence spectra are in units <>.
* QEP reflectance data (*leaf ID \_ LRC/CO2 \_ refl/trans .csv)*: *Refl* denotes reflectance and *trans* denotes transmittance (unitless). Columns are wavelengths - recommended to use only 400-640nm.

**Other data:**

* An observation summary table with metadata for each leaf.
* A single dataframe containing the reflectance, transmittance and absorption (350-2500nm) data for each leaf with columns as observations and rows as wavelengths. Column headers can be used to identify each individual leaf (*L1* to *L9*). A 10nm smoothing has been applied to this data to remove noise.